**M1.** (a) snail
**or**
shrew

*additional incorrect answer negates correct answer*

**1**

(b) shrew

*additional incorrect answer negates correct answer*

**1**

(c) fewer shrews to eat them

**1**

(d) population

**1**

(e) **C**

**1**

(f) (11 000 × 0.1 =)
1 100 (kJ)

**1**

(g) the snails do not eat the roots of the lettuces

**1**

(h) any **one** from:
- light (intensity)
- temperature
- moisture (levels)
- soil pH
- mineral / ion content (of soil)

- wind intensity / speed

  *ignore wind direction*
- carbon dioxide (levels)
- oxygen (levels)

**1**

**[8]**

**M2.** (a) large area

*allow thin / large / big / flat / light*

*allow adaptations that cannot be seen eg internal air spaces*

**1**

(b) (shape means that) snow falls off

**1**

(c) protect / stop it being eaten

**1**

(d) stores/ absorbs water (from other parts of the plant)

*ignore absorbs water from soil / air*

*ignore nutrients*

**1**

**[4]**

**M3.** (a) *answer to be marked as a whole*

has thorns / prickles / points

*accept sharp points*

**1**

(these) hurt animal

*allow frighten animal*

***only** accept prevent animal eating leaves if qualified by 'hurting' or 'frightening'*

**1**

(b) *answer to be marked as a whole*

camouflaged / looks like twig / disguised

*allow blends in*

*ignore too small to see*

**1**

(animal) cannot **see / detect** / recognise it

*allow animal does not eat twigs*

***only** accept prevents animal eating it if qualified by 'seeing' or 'wrong food'*

**1**

(c) *answer to be marked as a whole*

red / colour

**1**

warns that insect might be poisonous / dangerous

*allow inedible / tastes bad*

**1**

**[6]**

**M4.** any **three** from:

*ignore references to carbon cycle*

*accept digested / decomposed / broken down / rotted for decay throughout*

*ignore eating*

- dead leaves / flowers / bluebells are decayed
- idea that microorganisms do the decaying

  *accept microbes / bacteria / fungi / mould / decomposers for microorganisms*
- minerals / ions / nutrients / named released (by decay / microorganisms)

  ***not** mineral ions unqualified*
- (released) into soil **or** minerals / ions / nutrients taken up / in by (bluebell) roots (next year)

  *look for idea that minerals / ions / nutrients are in soil (eg released into soil or taken up from soil)*

**3**

**[3]**

**M5.** (a) brown (colour)

**1**

(b) (long) ears

**1**

(c) (long) horns

**1**

(d) (white) ring

**1**

**[4]**

**M6.** (a) C

**1**

(b) B

**1**

(c) E

**1**

(d) D

**1**

(e) F

**1**

**[5]**

**M7.**(a) looks like a leaf

**1**

so predator less likely to / won't <u>see it</u>

*allow 'camouflage' as alternative to either point*

**1**

(b) (i) thorns (of acacia tree) hurt (predators)

*allow idea that fewer animals / predators live in trees* ***or*** *ground living animals can't reach them (in the trees)*

**1**

(ii) (giraffe) avoids being bitten by ants

*allow ants are poisonous / have unpleasant taste*

**1**

(c) looks like / mimics a wasp **or** has warning colouration

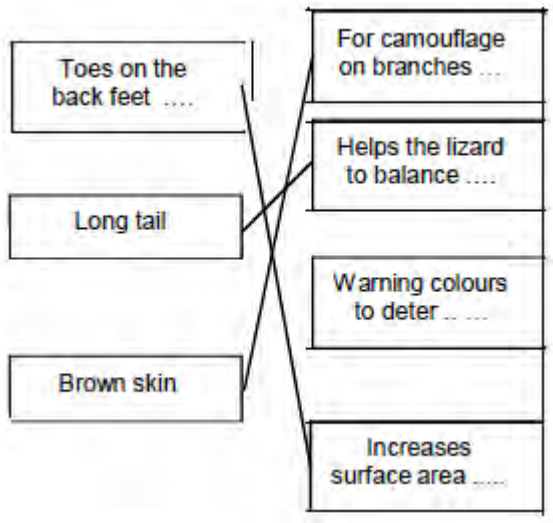
**1**

so predators think it has a sting

**1**

**[6]**

**M8.**(a)




*one mark for each line*

*do **not** award mark for an adaptation if lines are drawn from it to more than one advantage*

**3**

(b) escape (predators)

*accept faster than swimming*

*allow chase prey*

*allow it stops them from drowning*

**1**

(c) food

**1**

territory

**1**

*deduct **one** mark for each tick in excess of two*

**[6]**

**M9.** (a) (i) any **two** from:

*ignore oxygen / food / sun / carbon dioxide*

- light
- water
- space
- nutrients / ions / minerals / named

*accept two named minerals / ions for **2** marks*

**2**

(ii) less competition for water

*ignore space / light / food*

**or**

more water / nutrients / minerals available

**1**

(b) camouflage / same shape as leaf / looks like a leaf

*allow 'blends in'*

*ignore colour*

**1**

**[4]**

**M10.**(a) an extremophile species

**1**

(b) (i) smaller ice area

*allow smaller amount of ice*

*allow less ice*

**1**

(so) less habitat

*allow fewer places to live / nest*

**1**

(ii) **either** increase
as more sea to live in
**or**
as less competition for food

**or** decrease
as less space (ice) to lay eggs
**or**
predators more likely to eat them

*there is no mark for increase / decrease alone. The mark is for an appropriate reason linked to increase / decrease*

*if increase / decrease not ringed the mark may be awarded if it is clear in the explanation which is intended*

**1**

(c) Living organisms show long-term changes.

**1**

**[5]**

**M11.**(a) any **three** from:

- place 30-m tape measure across field / from one wood to the other
- place quadrat(s) next to the tape
- count / record the number / amount of dandelions / plants in the quadrat

  *ignore 'record the results'*

  *ignore measures / estimates dandelions*
- repeat every 2 metres

  *allow every metre / at regular intervals*

**3**

(b) (i) low light / it is shady

*allow no light*

*ignore sun / rays*

**or**

not enough water / ions / nutrients

*accept correct named ion*

*ignore no water / ions / nutrients*

**or**

wrong pH of soil

*accept competition with trees for light / water / ions*

*ignore competition for space and competition unqualified*

*accept soil too acidic / too alkaline*

*ignore temperature*

**1**

(ii) sensible suggestion for a small area, eg chance variation / anomaly / poisoned by animal waste / wrong pH of soil / eaten (by animals) / cut down / footpath

**1**

(c) repeat (transect) / compare with the results of other groups

*allow 'do it in two different locations' for 2 marks*

**1**

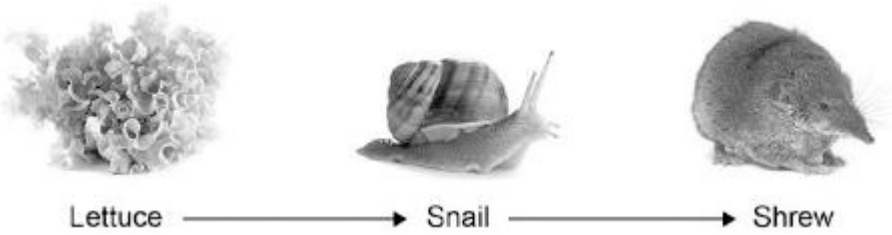
at different / random location(s) / elsewhere (across the field)

*do **not** allow 'in other fields'*

**1**

**[7]**

**Q1.** The diagram below shows a food chain in a garden.






(a) Name **one consumer** shown in the diagram above.

.....

**(1)**

(b) Name **one carnivore** shown in the diagram above.

.....

**(1)**

(c) A disease kills most of the shrews in the garden.

Suggest why the number of snails in the garden may then increase.

.....

.....

**(1)**

(d) What is the name given to all the snails in the garden shown in the diagram above?

Tick **one** box.

Community ☐

Ecosystem ☐

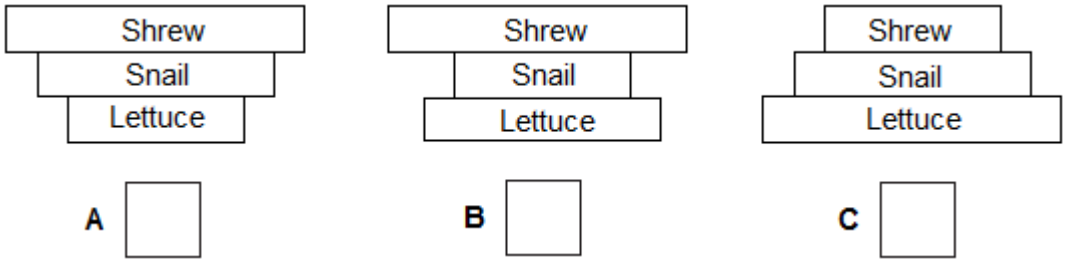
Population ☐

Territory ☐

**(1)**

(e) Which pyramid of biomass is correct for the food chain shown in the diagram above?

Tick **one** box.




**(1)**

(f) Some snails ate some lettuces.

The lettuces contained 11 000 kJ of energy.

Only 10% of this energy was transferred to the snails.

Calculate the energy transferred to the snails from the lettuces.

.....

Energy = ..... kJ

**(1)**

(g) Give **one** reason why only 10% of the energy in the lettuces is transferred to the snails.

Tick **one** box.

The lettuces carry out photosynthesis ☐

The snails do not eat the roots of the lettuces ☐

Not all parts of a snail can be eaten ☐

**(1)**

(h) **Abiotic** factors can affect the food chain.

Wind direction is one abiotic factor.

Name **one other** abiotic factor.

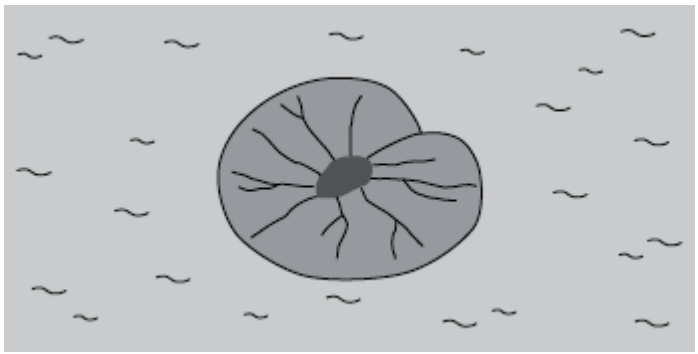
.....

**(1)**
**(Total 8 marks)**

**Q2.** Plants are adapted for survival in many different ways.

Use information from the drawings to answer each question.

(a) This plant lives in ponds. The leaves of the plant float on the surface of the water.



The leaf of this plant is adapted for floating on water.

Suggest how.

.....

.....

**(1)**

(b) This plant lives in areas where a lot of snow falls.

The triangular shape helps the tree to survive in snowy conditions.

Suggest how.

.....

.....

**(1)**

(c) This plant has sharp thorns on the stem.

Thorns help this plant survive.

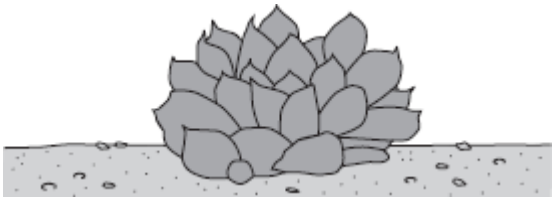
Suggest how.

.....

.....

**(1)**

(d) This plant lives in very dry areas.



The swollen leaves help this plant to survive in very dry places.

Suggest how.

.....

.....

**(1)**
**(Total 4 marks)**

**Q3.** Many animals and plants are adapted to stop other organisms eating them.

(a) The photograph shows part of a plant stem.

By Forest & Kim Starr [CC BY 3.0], via W kimedia Commons

Suggest how this plant is adapted to stop animals eating it.

Adaptation

.....

Describe how the adaptation helps to stop animals eating the plant.

.....

.....

**(2)**

(b) The photograph shows an insect on a plant twig.


By Fir0002 [CC BY-SA 3.0], via Wikimedia Commons

Suggest how this insect is adapted to stop animals eating it.

Adaptation

.....

Describe how the adaptation helps to stop animals eating the insect.

.....

.....

**(2)**

(c) The photograph shows some insects.

These insects are bright red.

By Greg Hume (Greg5030) [CC BY 3.0], via W kimedia Commons

Suggest how these insects are adapted to stop animals eating them.

Adaptation

.....

Describe how the adaptation helps to stop animals eating the insect.

.....

.....

**(2)**
**(Total 6 marks)**

**Q4.** In a woodland, bluebells grow well every year.

**Bluebells growing well in woodland**

Mick Garratt [CC-BY-SA-2.0], via Wikimedia Commons

Each year the dead flowers and leaves of the bluebells and leaves from the trees fall onto the ground.
The bluebells do not run out of mineral ions.

Explain why the bluebells do **not** run out of mineral ions.

The words in the box may help you.

| | | |
|---|---|---|
| **roots** | **dead leaves** | **mineral ions** |
| **microorganisms** | **decay** | |

.....

.....

.....

.....

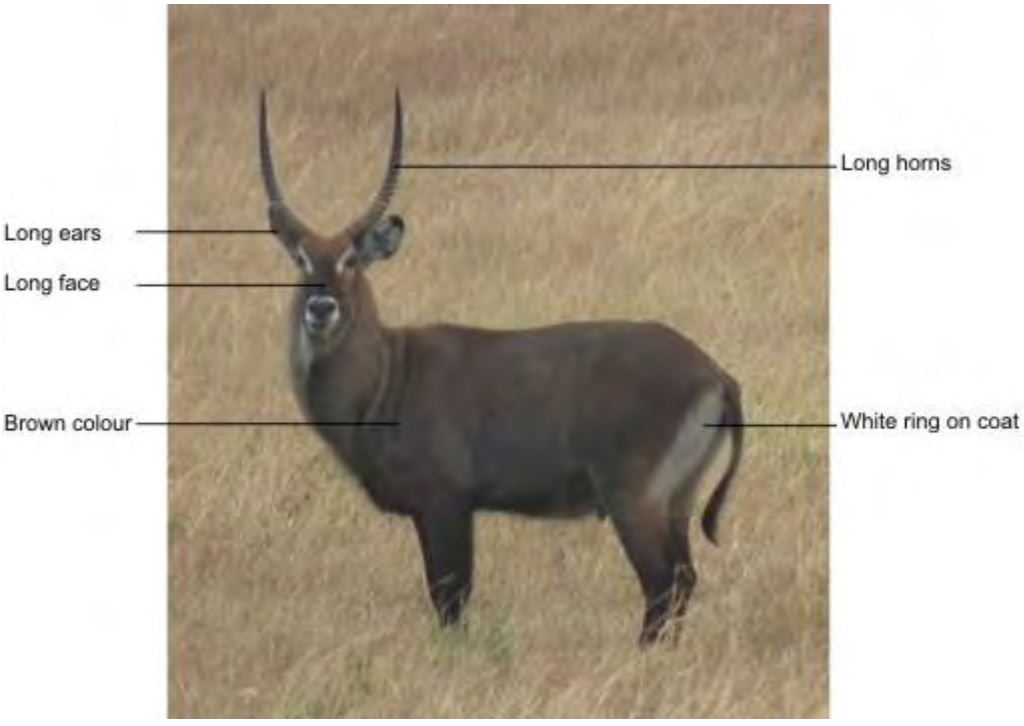
.....

.....

**(3)**
**(Total 3 marks)**

**Q5.** The photograph shows some features of a waterbuck.

Waterbuck live in areas of tall, brown grass.




By Nevit Dilmen (Own work) [CC-BY-SA-3.0], via W kimedia Commons

Choose labels from the photograph to answer these questions.
You should choose a label **once** only.

(a) Which feature helps to camouflage the waterbuck in the grass?

.....

**(1)**

(b) Which feature helps the waterbuck to detect predators?

.....

**(1)**

(c) Which feature helps the waterbuck to fight predators?

.....

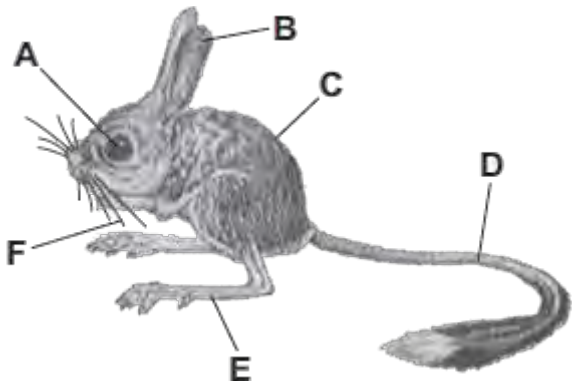
**(1)**

(d) Which feature helps a baby waterbuck to follow a parent through the long grass?

.....

**(1)**
**(Total 4 marks)**

**Q6.**The drawing shows a jerboa. Jerboas live in sandy deserts.




Jerboas sleep in underground holes during the hot day and come out during the cold night.

The jerboa's main food is small insects which run across the surface of the sand.

For each question write the correct letter in the box.

Which structure, **A**, **B**, **C**, **D**, **E** or **F**:

(a) helps to insulate the jerboa ☐

**(1)**

(b) helps the jerboa to detect insects on a dark night ☐

**(1)**

(c) helps the jerboa to hop quickly to catch an insect ☐

**(1)**

(d) helps the jerboa to keep its balance when hopping ☐

**(1)**

(e) helps the jerboa to know the width of its underground hole in the dark? ☐

**(1)**
**(Total 5 marks)**

**Q7.**Many organisms are adapted to avoid being eaten.

(a) The photograph shows a gecko on a leafy branch.




The gecko is adapted to avoid being eaten by predators.

Explain how.

.....

.....

.....

.....

**(2)**

(b) Ants can give a painful bite.

The photograph shows a type of ant living on acacia trees.

Acacia trees have thorns on their branches.

Branch of acacia tree.

By Ryan Somma, cropped by Fama Clamosa,20 January 2010 (UTC)
[CC-BY-SA-2.0], via W kimedia Commons

(i) Predators are less likely to eat ants living on acacia trees than ants living on the ground.

Suggest why.

.....

.....

**(1)**

(ii) Giraffes eat the leaves of acacia trees.

Giraffes do **not** eat the leaves of acacia trees that have ants living on them.

Suggest why.

.....

.....

**(1)**

(c) The photographs show a wasp and a hoverfly.

The wasp and the hoverfly both have black and yellow stripes.

**WaspHoverfly**



Wasps have stings, but hoverflies do **not**.

The stripes on the hoverfly help the hoverfly to avoid being eaten by predators.

Explain why.

.....

.....

.....

.....

**(2)**
**(Total 6 marks)**

**Q8.**The picture shows a basilisk lizard. Some of the adaptations of the lizard are labelled.


Basilisk lizards are often found resting on branches of trees that grow next to water.
Basilisk lizards can run across the surface of the water.

(a) Draw **one** line from each adaptation of the lizard to the advantage of the adaptation.

| **Adaptation** | **Advantage** |
|---|---|
| | For camouflage on branches of trees |
| Toes on the back feet are webbed | |
| | Helps the lizard to balance when running |
| Long tail | |
| | Warning colours to deter predators |
| Brown skin | |
| | Increases surface area in contact with the water |

**(3)**

(b) Suggest **one** advantage to the basilisk lizard of being able to run across the surface of the water.

.....

.....

**(1)**

(c) Animals, such as lizards, compete with each other.

Give **two** factors that animals compete for.

Tick (✓) **two** boxes.

Oxygen ☐

Food ☐

Territory ☐

Light ☐

**(2)**
**(Total 6 marks)**

**Q9.** Animals and plants are adapted in different ways in order to survive.

(a) Plants may have to compete with other plants.

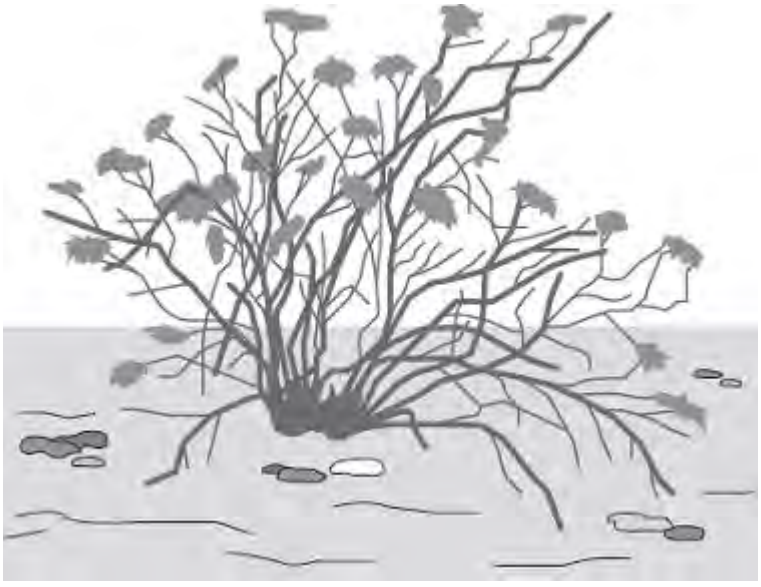
(i) Name **two** things for which plants compete.

1 .....

2 .....

**(2)**

(ii) The drawing shows a creosote bush.



This bush lives in a desert.

The creosote bush produces a poison that kills the roots of other plants.

How does this poison help the creosote bush to survive in the desert?

.....

.....

**(1)**

(b) The photograph shows an insect called a katydid.

By Ltshears (Own work) [Public domain], via Wikimedia Commons

The katydid is preyed on by birds.

How does the appearance of the katydid help it to survive?

.....

.....

.....

.....

**(1)**
**(Total 4 marks)**

**Q10.**(a) Which term describes organisms that can tolerate very hot or very cold places?

Draw a ring around the correct answer.

| | | |
|---|---|---|
| **an environmental species** | **an extremophile species** | **an indicator species** |

**(1)**

(b) **Figure 1** shows photographs of an Adelie penguin and a chinstrap penguin. Adelie penguins and chinstrap penguins live in the Antarctic at temperatures below 0 °C.

**Figure 1**

**Adelie penguin**

© pilipenkoD/iStock/Thinkstock

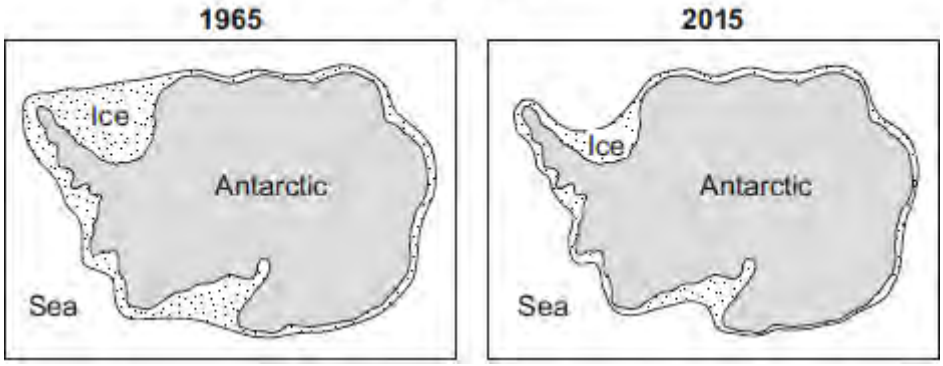
**Chinstrap penguin**

© Jenny Grayson/iStock/Thinkstock

Adelie penguins spend most of their time on the ice around the Antarctic.
Chinstrap penguins live mainly in the sea around the ice.
Since 1965 the number of Adelie penguins has **decreased** by 6 million.

**Figure 2** shows changes to the ice around the Antarctic over the past 50 years.

**Figure 2**




(i) Use information from **Figure 2** to explain why the number of Adelie penguins has decreased since 1965.

.....

.....

.....

.....

.....

.....

**(2)**

(ii) Suggest what has happened to the number of chinstrap penguins since 1965.

Draw a ring around your answer. **increase / decrease**

Give a reason for your answer.

.....

.....

**(1)**

(c) The number of penguins can be used to monitor changes in temperature of the environment.

Temperature readings could also be taken using a thermometer.

What is the advantage of using penguins, instead of a thermometer, to monitor changes in temperature of the environment?

Tick (✓) **one** box.

Living organisms show long-term changes. ☐

Thermometers cannot measure temperatures below 0 °C. ☐

Thermometers do not give accurate readings. ☐

**(1)**
**(Total 5 marks)**

**Q11.** Some students investigated the distribution of dandelion plants in a grassy field. The grassy field was between two areas of woodland.

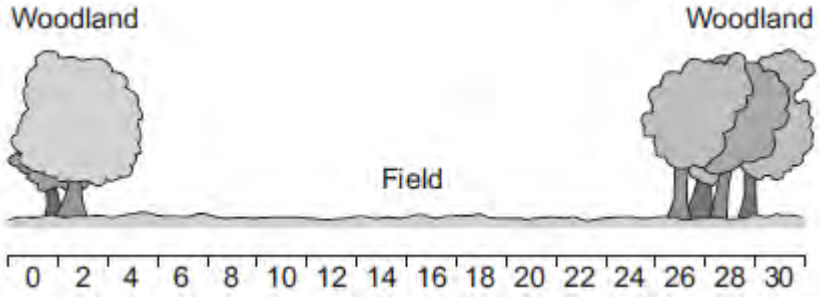
**Figure 1** shows two students recording how many dandelion plants there are in a 1 metre x 1 metre quadrat.

**Figure 1**



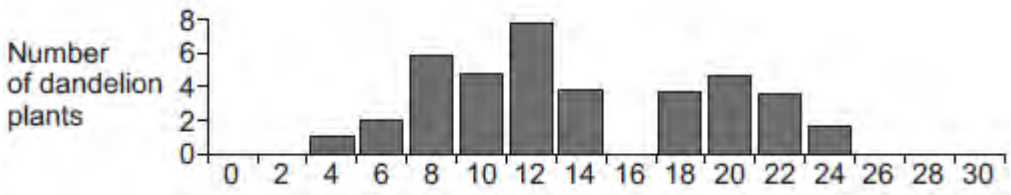

**Figure 2** shows a section across the area studied and **Figure 3** shows a bar chart of the students' results.

**Figure 2**




Distance in m

**Figure 3**




(a) How did the students use the quadrat and the 30-metre tape measure to get the results in **Figure 3**?

Use information from **Figure 1**.

.....

.....

.....

.....

.....

.....

**(3)**

(b) (i) Suggest **one** reason why the students found no dandelion plants under the trees.

.....

.....

**(1)**

(ii) Suggest **one** reason why the students found no dandelion plants at 16 metres.

.....

.....

**(1)**

(c) The teacher suggested that it was **not** possible to make a valid conclusion from these results.

Describe how the students could improve the investigation so that they could make a valid conclusion.

.....

.....

.....

.....

**(2)**
**(Total 7 marks)**

**M1.** (a) (i) counts / 12

**1**

× 120 × 80 / × 9600
**or**
× area of field

**1**

(ii) (more) quadrats / repeats

**1**

placed randomly
*ignore method of achieving randomness*

**1**

(b) (i) any **three** from:
- temperature / warmth / heat
- water / rain
- minerals / ions / salts (in soil)

*allow nutrients / fertiliser / soil fertility*
*ignore food*
- pH (of soil)
- trampling
- herbivores

*ignore predators*
- competition (with other species)
- pollution qualified e.g. $SO_2$ / herbicide
- wind (related to seed dispersal).

*ignore space / oxygen / $CO_2$ / soil unqualified*

**3**

(ii) light needed for photosynthesis

**1**

for making food / sugar / etc.

**1**

effect on buttercup distribution eg more plants in sunny areas / fewer plants in shady areas

**1**

(c) (i) fertiliser / ions / salts cause growth of algae / plants

**1**

(algae / plants) block light

**1**

(low light) causes algae / plants to die

**1**

microorganisms / bacteria feed on / break down / cause decay of organic matter / of dead plants

*do **not** allow germs / viruses*

**1**

(aerobic) respiration (by microbes) uses $O_2$

*do **not** allow anaerobic*

**1**

(ii) sewage / toxic chemicals / correct named example eg metals / bleach / disinfectant / detergent etc

*allow suitable named examples eg metals such as Pb / Zn / Cr / oil / $SO_2$ / acid rain / pesticides / litter*

*ignore chemicals unqualified*

*ignore waste unqualified*

*ignore human waste / domestic waste / industrial waste unqualified*

**1**

(d) (i) 2

**1**

(ii) more food

*allow other sensible suggestion eg more species colonise from tributary streams after forest*

**1**

(iii) number of stonefly species decreases (from **A** to **B** / **B** to **C** / **A** to **C**) as more pollution enters river / less oxygen

*allow fewer species in more polluted water*

*ignore none are found at site C*

**1**

**[19]**

**M2.** (a) (i) chloroplast

**1**

(ii) cell wall

**1**

(b) (i) osmosis

*accept diffusion*

**1**

(ii) cell wall (prevents bursting)

**1**

(c) (i) carbon dioxide

*allow correct formula*

**1**

glucose

*allow sugar / starch*

**1**

(ii) any **two** from:

- light sensitive spot detects light
- tells flagellum to move towards light
- more light = more photosynthesis

**2**

(d) (cell has) larger SA:volume ratio

**1**

short (diffusion) distance

*allow correct description*

1

(diffusion) via cell membrane is sufficient / good enough

**or**

flow of water maintains concentration gradient

1

**[11]**

**M3.** (a) (i) 10

**1**

(ii) any **three** from:

- both increase with distance
- more spp on walls than on trees
- no lichen spp on trees for first 1 km from city
- more steady / less erratic increase on trees than walls (or converse)
- rate of increase increases with distance

**3**

(b) $SO_2$ decreases with distance from centre

*accept converse*

*Ignore pollution*

**1**

high $SO_2$ reduces survival or kills lichen

*accept converse*

**1**

(c) (i) any **three** from:

- (line) transect
- quadrat / reference to specific area
- count number of lichens or coverage on trees
- at regular intervals / set distances

**3**

(ii) (more) Xanthoria nearest road

*allow 'nitrogen-loving' for Xanthoria*

**1**

(more) Usnea further from the road

*allow 'nitrogen-sensitive' for Usnea*

1

because most nitrogen oxide from vehicles (near road)

**or**

because nitrogen oxide levels will be falling / less further away (from road)

*accept converse*

1

**[12]**

**M4.** (a) gets more light (near surface)

*allow warmer (near surface)*

*allow bladders contain (more) carbon dioxide*

**1**

(so) photosynthesises more

**1**

(because) bladders aid floating (when tide is in)

**or**

(so) more biomass / glucose / starch produced

*ref to 'more' needed only once, eg gets more light for photosynthesis gains **two** marks*

*if 'more' not given do not award mark on the first occasion*

**1**

(b) lets angler fish see / attract its prey / mates **or** see predators as it is dark (at 1000m)
**or**
lets angler fish see / attract prey to get food
**or**
lets angler fish see / attract mates to reproduce
**or**
lets angler fish see predators to avoid being eaten

*must be in a correct pair to gain **two** marks*

**2**

**[5]**

**M5.** (a) any **three** from:

- parts of organisms have not decayed
  *accept in amber / resin*
  *allow bones are preserved*
- conditions needed for decay are absent
  *accept appropriate examples, eg acidic in bogs / lack of oxygen*
- parts of the organism are replaced by other materials as they decay
  *accept mineralised*
- or other preserved traces of organisms, eg footprints, burrows and rootlet traces
  *allow imprint or marking of organism*

**3**

(b) (i) teeth for biting (prey)
*must give structure + explanation*

**1**

claws to grip (prey)
*accept sensible uses*

**1**

wing / tail for flight to find (prey)

**1**

(ii) any **two** from:

- new predators
- new diseases
- better competitors
- catastrophe eg volcanic eruption, meteor
- changes to environment over geological time
  *accept climate change*
  *allow change in weather*
- prey dies out **or** lack of food
  *allow hunted to extinction*

**2**

**[8]**

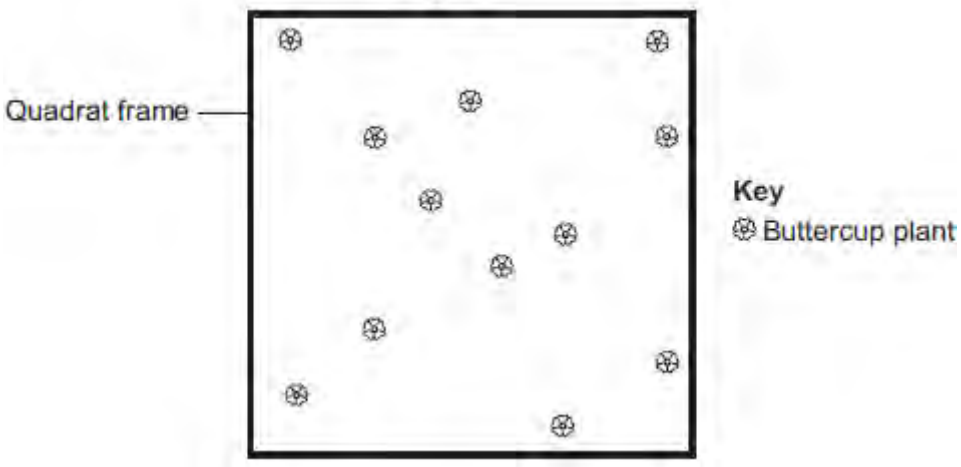
**Q1.**A grassy field on a farm measured 120 metres by 80 metres.

A student wanted to estimate the number of buttercup plants growing in the field.

The student found an area where buttercup plants were growing and placed a 1 m × 1 m quadrat in one position in that area.

**Figure 1** shows the buttercup plants in the quadrat.

**Figure 1**




The student said, 'This result shows that there are 115 200 buttercup plants in the field.'

(a) (i) How did the student calculate that there were 115 200 buttercup plants in the field?

.....

.....

.....

.....

**(2)**

(ii) The student's estimate of the number of buttercup plants in the field is probably not accurate. This is because the buttercup plants are not distributed evenly.

How would you improve the student's method to give a more accurate estimate?

.....

.....

.....

.....

**(2)**

(b) Sunlight is one environmental factor that might affect the distribution of the buttercup plants.

(i) Give **three other** environmental factors that might affect the distribution of the buttercup plants.

1.....

2.....

3.....

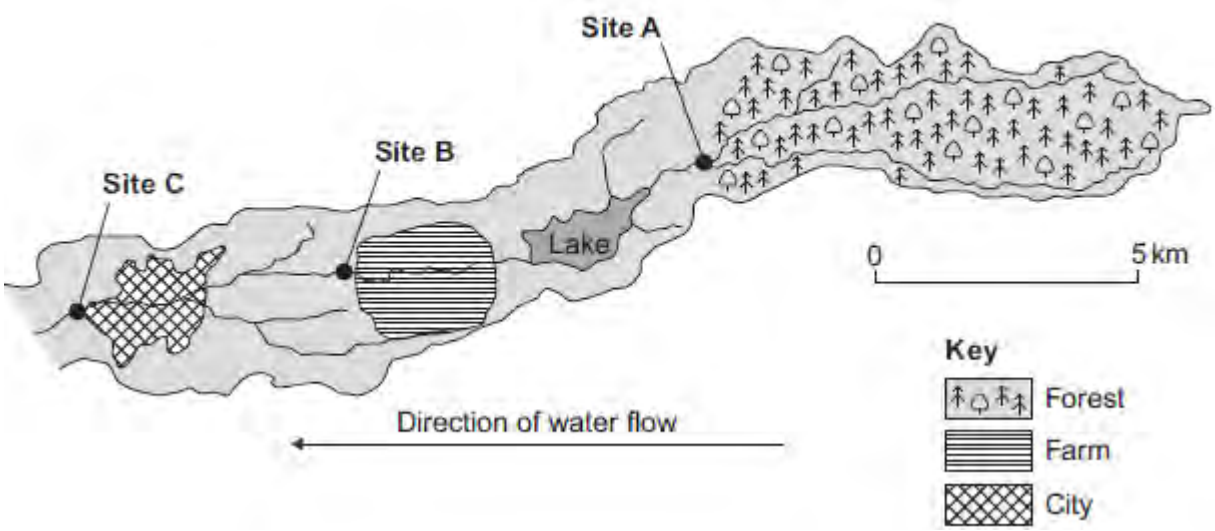
**(3)**

(ii) Explain how the amount of sunlight could affect the distribution of the buttercup plants.

**(3)**

(c) **Figure 2** is a map showing the position of the farm and a river which flows through it.

**Figure 2**




Every year, the farmer puts fertiliser containing mineral ions on some of his fields.When there is a lot of rain, some of the fertiliser is washed into the river.

(i) When fertiliser goes into the river, the concentration of oxygen dissolved in the water decreases.

Explain why the concentration of oxygen decreases.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**(5)**

(ii) There is a city 4 km downstream from the farm.

Apart from fertiliser, give **one** other form of pollution that might go into the river as it flows through the city.

.....

**(1)**

(d) Three sites, **A**, **B** and **C**, are shown in **Figure 2**.

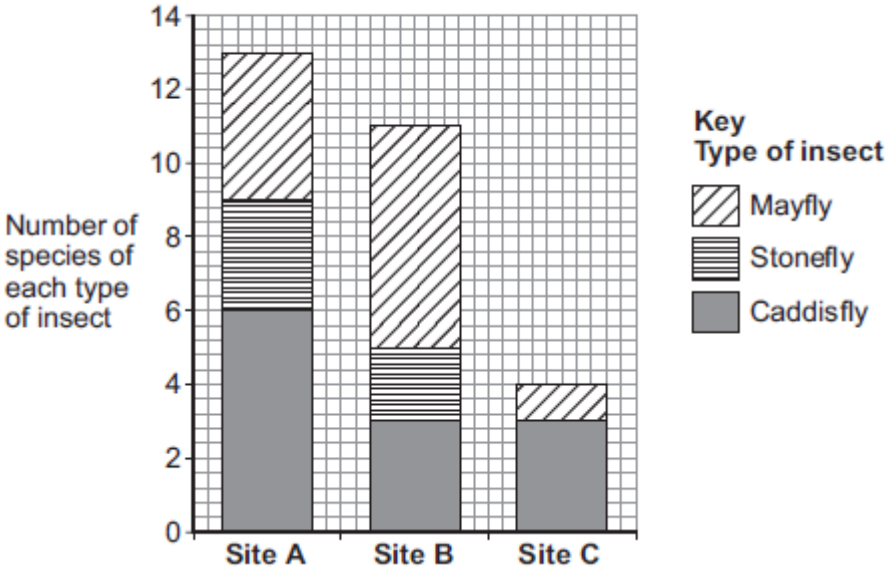
Scientists took many samples of river water from these sites.

The scientists found larvae of three types of insect in the water: mayfly, stonefly and caddisfly. For each type of insect the scientists found several different species.

The scientists counted the number of different species of the larvae of each of the three types of insect.

**Figure 3** shows the scientists' results.

**Figure 3**




(i) How many more species of mayfly were there at Site **B** than at Site **A**?

.....

**(1)**

(ii) Suggest what caused this increase in the number of species of mayfly.

.....

.....

**(1)**

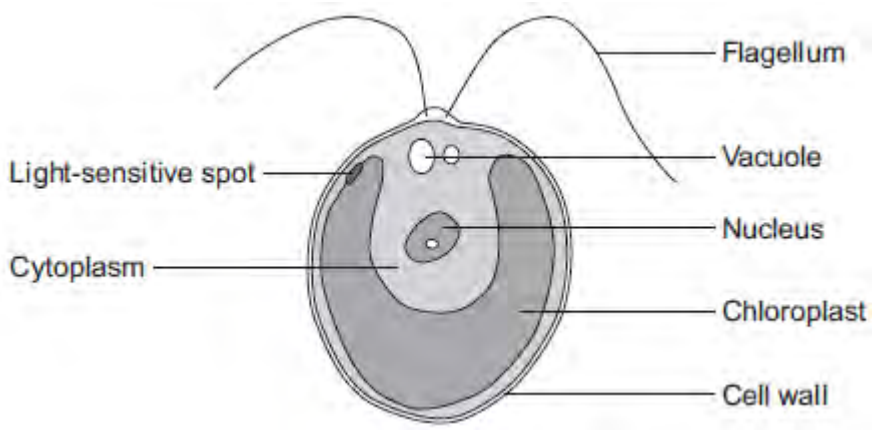
(iii) The scientists stated that the number of species of stonefly was the best indicator of the amount of oxygen dissolved in the water.

Use information from **Figure 3** to suggest why.

**(1)**

**(Total 19 marks)**

**Q2.**The diagram below shows a single-celled alga which lives in fresh water.




(a) Which part of the cell labelled above:

(i) traps light for photosynthesis

.....

**(1)**

(ii) is made of cellulose?

.....

**(1)**

(b) In the freshwater environment water enters the algal cell.

(i) What is the name of the process by which water moves into cells?

.....

**(1)**

(ii) Give the reason why the algal cell does not burst.

.....

.....

**(1)**

(c) (i) The alga can photosynthesise.

Complete the **word** equation for photosynthesis.

water + ..... $\xrightarrow{\text{Light energy}}$ ..... + oxygen

**(2)**

(ii) The flagellum helps the cell to move through water. Scientists think that the flagellum and the light-sensitive spot work together to increase photosynthesis.

Suggest how this might happen.

.....

.....

.....

.....

**(2)**

(d) Multicellular organisms often have complex structures, such as lungs, for gas exchange.

Explain why single-celled organisms, like algae, do **not** need complex structures for gas exchange.

.....

.....

.....

.....

.....

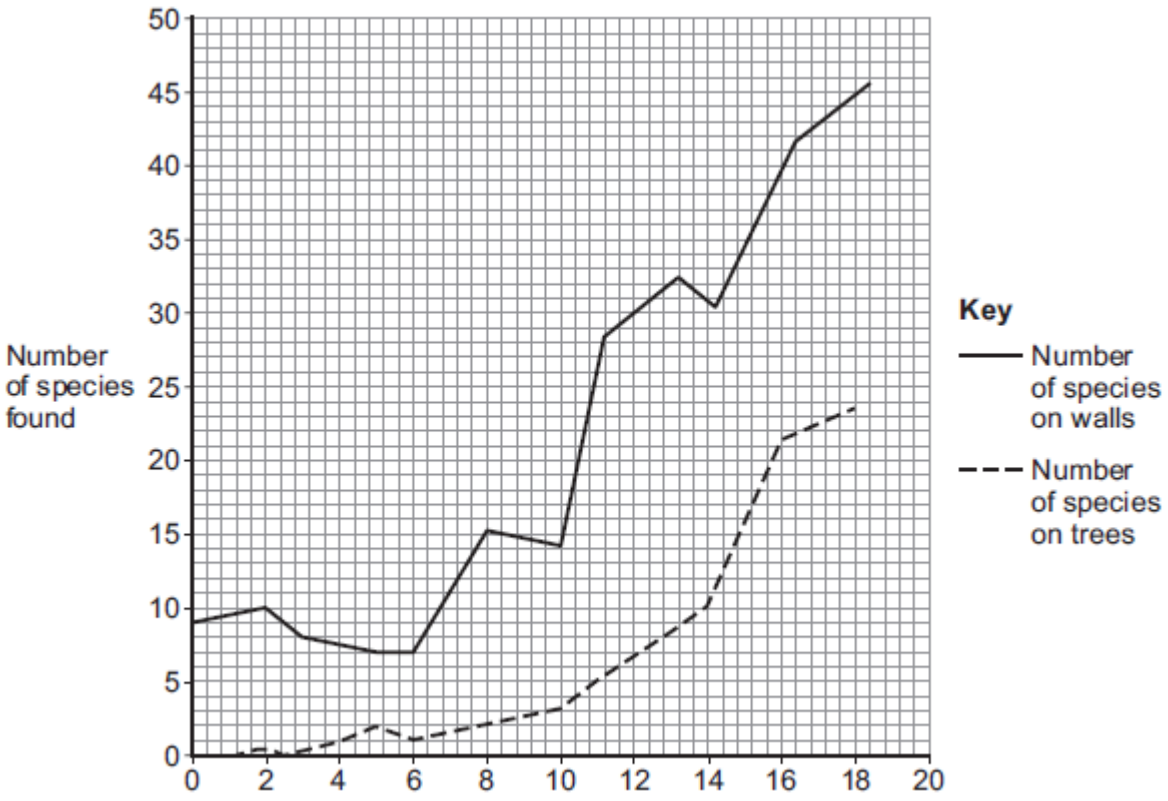
.....

**(3)**

**(Total 11 marks)**

**Q3.**Lichens can be used as air pollution indicators.

The graph below shows the number of lichen species found growing on walls and trees at increasing distances from a city centre.




(a) (i) How many species of lichen are found on walls 2 km from the city centre?

.....

**(1)**

(ii) Describe the patterns in the data.

.....

.....

.....

.....

.....

.....

**(3)**

(b) The table below shows the concentration of sulfur dioxide ($SO_2$) in the air at different distances from the same city centre.

| **Distance from city centre in km** | **$SO_2$ concentration in g per $m^3$** |
|---|---|
| 0 | 200 |
| 3 | 160 |
| 8 | 110 |
| 13 | 85 |
| 18 | 65 |

Suggest how the data in the table could explain the patterns in the graph above.

.....

.....

.....

.....

**(2)**

(c) Nitrogen oxides are also air pollutants.

The main source of nitrogen oxide pollution comes from road vehicles.

Different lichen species vary in their tolerance of the levels of nitrogen oxides in the air.

Some lichens can only grow in very clean air where there are low levels of nitrogen oxides. They are nitrogen-sensitive.

Some lichens grow very well in high levels of nitrogen oxides. They are

nitrogen-loving.

The table below shows one lichen species which is nitrogen-sensitive and one lichen species which is nitrogen-loving.

| **Nitrogen-sensitive** | **Nitrogen-loving** |
|---|---|
| *Usnea*  | *Xanthoria*  |

Usnea © epantha/iStock/Thinkstock; Xanthoria By Zakwitnij!pl Ejdzej + Iric (CC BY-SA.2.0) via wikicommons

(i) Describe how you would investigate the distribution of the two lichens at different distances into a wood from a main road.

.....

.....

.....

.....

.....

.....

.....

**(3)**

(ii) Predict the results from the experiment you described in your answer to part **(c)(i)**. Explain why you made this prediction.

.....

.....

.....

.....

.....

.....

.....

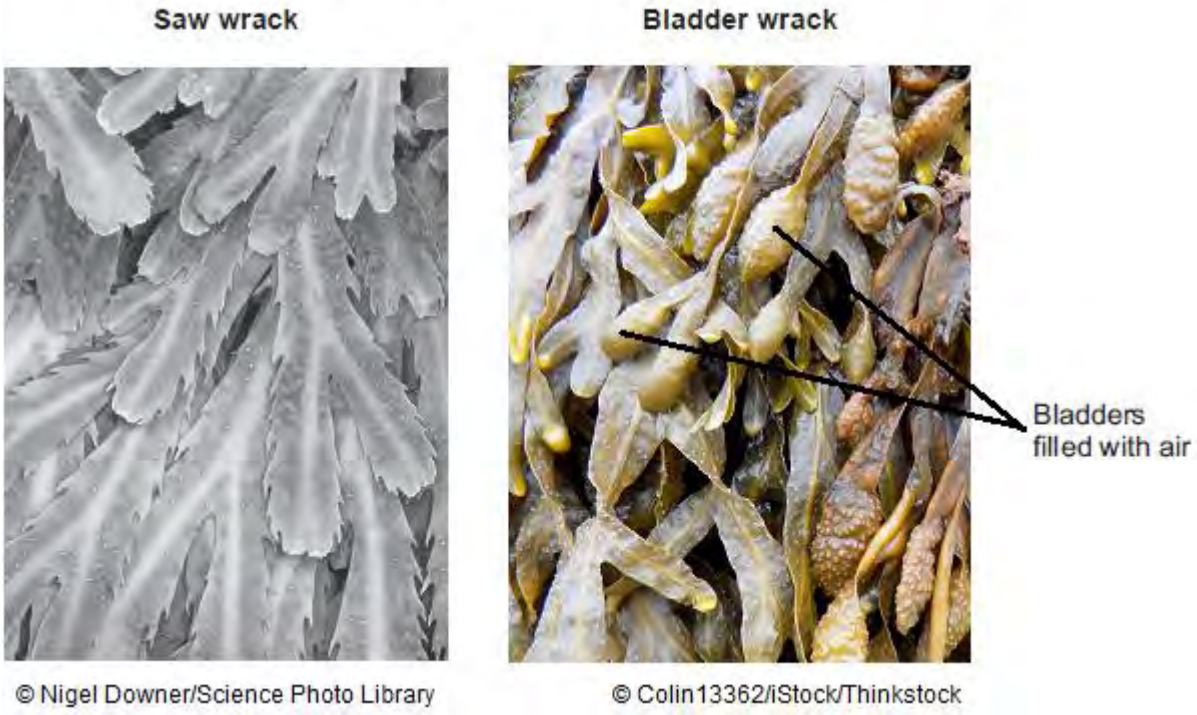
.....

**(3)**
**(Total 12 marks)**

**Q4.** Organisms compete with each other.

(a) **Figure 1** shows two types of seaweed which live in similar seashore habitats.

**Figure 1**




Most of the time the two seaweeds are covered with water.

Bladder wrack has bladders filled with air.

Bladder wrack grows more quickly than saw wrack.
Suggest an explanation why.

.....

.....

.....

.....

.....

.....

.....

**(3)**

(b) **Figure 2** shows an angler fish.

**Figure 2**




Angler fish live at depths of over 1000 m.

In clear water, sunlight does not usually reach more than 100 m deep.
Many angler fish have a transparent 'lure' containing a high concentration of bioluminescent bacteria.
Bioluminescent bacteria produce light.

Suggest an advantage to the angler fish of having a lure containing bioluminescent bacteria.

.....

.....

.....

.....

.....

**(2)**
**(Total 5 marks)**

**Q5.**The photograph shows a fossil of a prehistoric bird called *Archaeopteryx*.

By Ghedoghedo (own work) [CC-BY-SA-3.0 (http://creativecommons.org/licenses/BY-SA-3.0) or GFDL (http://www.gnu.org/copyleft/fdl.html)], via W kimedia Commons; By Steenbergs from Ripon, United Kingdom (Small Fishing Boat In North Sea) [CC-BY-2.0 (http://creativecommons.org/licenses/by/2.0)], via Wikimedia Commons.

(a) Describe **three** ways fossils can be made.

.....

.....

.....

.....

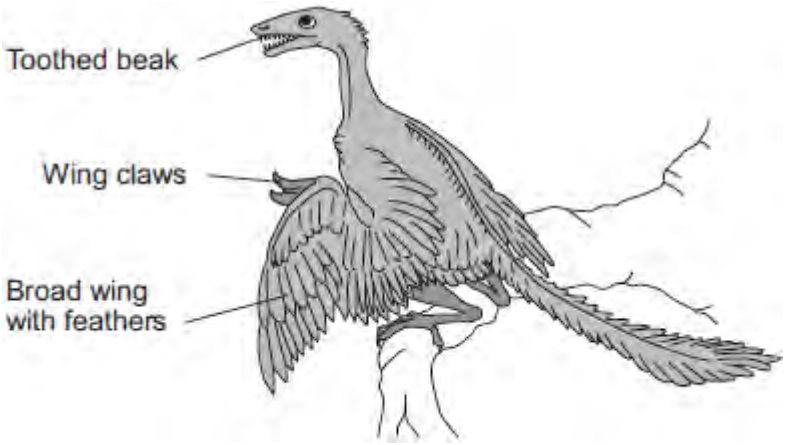
.....

.....

**(3)**

(b) The drawing shows what an *Archaeopteryx* might have looked like when it was alive.

Scientists think that *Archaeopteryx* was a predator.




(i) Look at the drawing.

Write down **three** adaptations that might have helped *Archaeopteryx* to catch prey.

How would **each** adaptation have helped *Archaeopteryx* to catch prey?

Adaptation 1 .....

How it helps .....

.....

Adaptation 2 .....

How it helps .....

.....

Adaptation 3 .....

How it helps .....

.....

**(3)**

(ii) *Archaeopteryx* is now extinct.

Give **two** reasons why animals may become extinct.

1 .....

.....

2 .....

.....

**(2)**
**(Total 8 marks)**

**M1.** (a) (140 + 240 + 380 + 450 = ) 1210

**1**

(b) the local people decided to farm cattle

**1**

a company starts growing plants for biofuels

**1**

(c) carbon dioxide

*in this order only*

**1**

photosynthesis

**1**

(d) animals and birds migrate because there is less food

**1**

more habitats are destroyed

**1**

(e) any **one** from:

- breeding programmes (for endangered species)
- regeneration (programmes)
- reintroduction of field margins / hedgerows
- awareness raising with politicians / public
- recycling

**1**

**[8]**

**M2.** (a) fuel / houses / paper

*allow any object made from wood*

**1**

farming / agriculture / replanting

*allow roads / homes / factories*

**1**

carbon dioxide / greenhouse gas / pollution **or** relative named pollutant

**1**

warming / temperature increase

**1**

(b) (i) none of species left / died out

**1**

(ii) may have products useful to humans / examples

*allow preserve for future generations **or** 'still there to look at'*

*allow affect food chains / cycles **or** extinction of other species*

*allow non human reasons eg loss of habitat*

*ignore environmental effects*

**1**

**[6]**

**M3.** (a) (i) 40

*accept -40 or +40*

**1**

(ii) **Step 1** 92

**1**

**Step 2** 18

**1**

**Step 3** 74

*correct subtraction of answer in **step 2** from answer in **step 1** gains **1** mark*

*correct answer 74 with no working gains **3** marks*

*ignore sign*

**1**

(b) (i) both animals and plants

**1**

(ii) microorganisms

**1**

(iii) carbon dioxide

**1**

**[7]**

**M4.** (a) warmer / dryer

*allow greenhouse effect / global warming*

*ignore wind*

**1**

(b) (i) genes / alleles / chromosomes / DNA / genetic material / genetics

*allow inheritance*

*allow nutrition / food / metabolism / growth <u>rate</u>*

*ignore environment*

**1**

(ii) natural selection / evolution

*allow survival of the fittest*

**1**

**[3]**

**M5.** (a) (i) carbon dioxide

**1**

(ii) sulfur dioxide

**1**

(b) (i) reduces land available for animals and plants

**1**

(ii) metals

**1**

(c) (i) pesticide

**1**

(ii) kill other animals

**1**

**[6]**

**M6.** (a) any **one** from:

- increased pollution
- dumping waste

*allow described consequence e.g. vermin*

*accept (increased) landfill*

*accept (increased) fly tipping.*

**1**

(b) (i) (mass of $SO_2$) decreases

**1**

and then levels off / plateaus

**1**

(ii) 2008

*clear evidence of calculating 700 (000) = 1 mark*

**2**

(iii) any **one** from:

- acid rain
- erosion of statues / buildings
- destruction of habitats
- reduction in biodiversity
- damage to lichen
- breathing problems

*ignore reference to ozone layer*

*allow damage to plants.*

**1**

(c) Carbon dioxide being absorbed in oceans and lakes

**1**

Photosynthesis by trees

**1**

**[8]**

**M7.** (a) 60

*correct answer gains **2** marks*
*if answer incorrect evidence of using 40 gains **1** mark*

**2**

(b) any **two** from

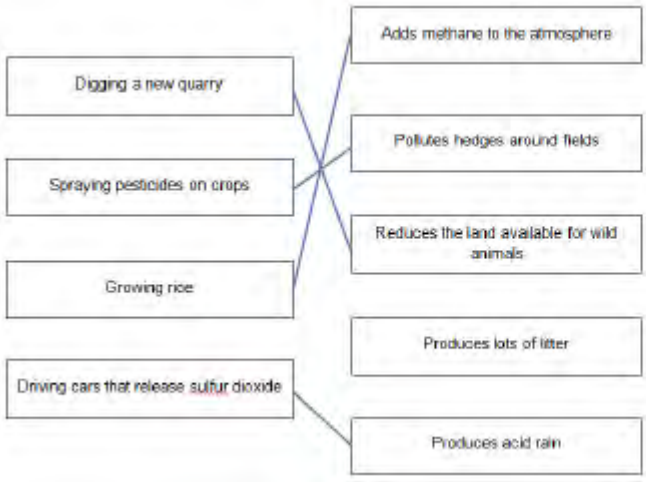
*ignore temperature rise / global warming*

- climate change / described e.g. hotter summers / drought / seasons change
- rise in sea levels / flooding
  *allow other environmental effects*
- glacier melting / ice caps melting
- forest fires
- habitat destruction
- effect on organisms
- eg extinction / migration

**2**

**[4]**

**M8.**(a)




**1** mark for each correct line

extra line from box in left hand column cancels mark

**4**

(b) any **two** from:

- climate change
  *ignore 'Earth warmer'*
- more extreme weather / changes to weather (patterns) / described
- rise in sea level
- melting of ice caps
- reduced biodiversity
- changes to migration patterns
- changes in distribution of species
  *accept faster plant growth / tropical species can be grown in UK*
  *accept tropical diseases / example spread to temperate regions*

**2**

**[6]**

**M9.** (a) genes

**1**

chromosomes

**1**

(b) (i) higher yield

**1**

less use of pesticides

**1**

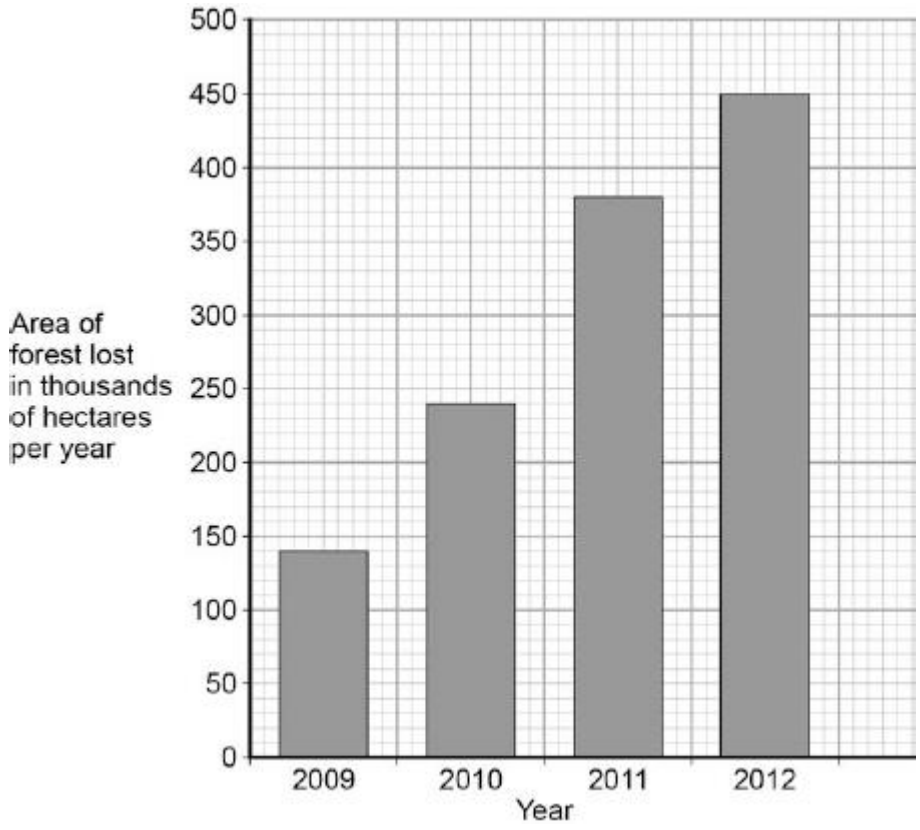
(ii) any **two** from:

- uncertain about effects on health
- fewer bees
- might breed with wild plant
- seeds only from one manufacturer

**2**

**[6]**

**Q1.**The graph below shows the area of forest lost in Madagascar from 2009 to 2012.




(a) The area of forest lost each year in Madagascar increased between 2009 and 2012.

Determine the total area of forest lost from the start of 2009 to the end of 2012.

.....

.....

Total area of forest lost = ..... thousand hectares

**(1)**

(b) What are the possible reasons for the change in the area of forest lost per year between 2009 and 2012?

Tick **two** boxes.

The local people stop growing rice ☐

Fewer new houses are needed for the population ☐

| | |
|---|---|
| The local people decided to farm cattle | ☐ |
| More trees have been planted | ☐ |
| A company starts growing plants for biofuels | ☐ |

**(2)**

(c) More forest was lost in 2012 than in 2009.

Use words from the box to complete the sentences.

| | | |
|---|---|---|
| **carbon dioxide** | **excretion** | **nitrogen** |
| **oxygen** | **photosynthesis** | **respiration** |

The increase in the area of forest lost has caused an increase in the gas .....

The increase of this gas has been caused because less of the gas is being absorbed by plants for the process of ..... .

**(2)**

(d) Deforestation can have negative effects on our ecosystems.

What are the negative effects of deforestation?

Tick **two** boxes.

| | |
|---|---|
| Animals and birds migrate because there is less food | ☐ |
| More habitats are destroyed | ☐ |
| There is less acid rain | ☐ |
| There is more biodiversity | ☐ |
| The global temperature decreases | ☐ |

**(2)**

(e) Scientists try to reduce the negative effects of human activity on our ecosystems.

One way is to protect rare habitats.

Give **one other** way of reducing the negative effects of human activity on our ecosystems.

.....

.....

**(1)**
**(Total 8 marks)**

**Q2.** The photograph shows an area where a tropical forest is being cleared.

(a) Complete the sentences.

People could use timber from the forest for
..... .

The cleared land can be used for
..... .

Clearing forests increases the concentration of
..... in the atmosphere.

This increase causes global ..... .

**(4)**

(b) Clearing forests causes some species to become *extinct*.

(i) What is meant by *extinct*?

.....

.....

**(1)**

(ii) It is important to prevent species from becoming extinct.

Give **one** reason why.

.....

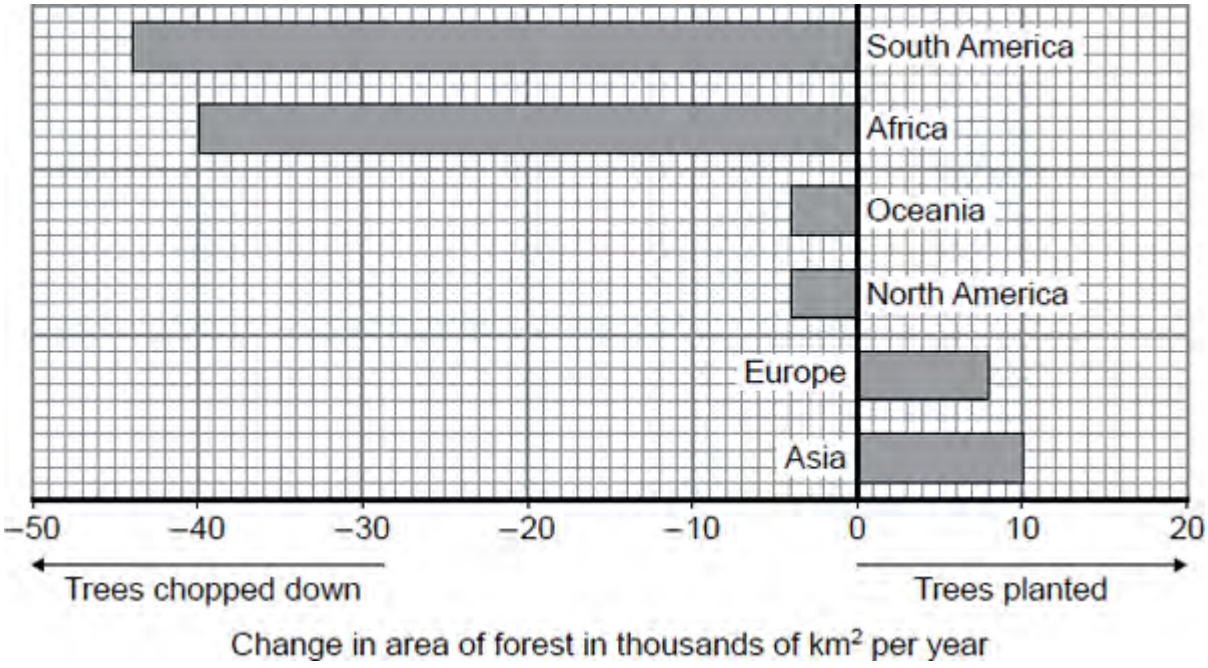
.....

**(1)**

**(Total 6 marks)**

**Q3.** In many parts of the world, forests are being chopped down (deforestation) so that the land can be used to grow food crops. In other parts, trees are planted to produce new forests.

The graph shows how the area of forest in each of the continents is changing each year.




(a) (i) What area of forest is being lost in Africa each year?

Area = ..... thousand km²

**(1)**

(ii) Use **Steps 1**, **2** and **3** to calculate the total change to the area of forest each year.

**Step 1** Calculate the total area of trees chopped down.

.....

Total area chopped down = ..... thousand km²

**Step 2** Calculate the total area of trees planted.

.....

Total area planted = ..... thousand km²

**Step 3** Use your answers from **Steps 1** and **2** to calculate the total change in the area of forest.

.....

Total change in area of forest ..... thousand $km^2$

**(3)**

(b) Draw a ring around the correct answer to complete each sentence.

(i) Large scale deforestation reduces the number of species of

- plants only.
- animals only.
- both animals and plants.

**(1)**

(ii) The remains of the trees are broken down into carbon dioxide by

- lichens.
- microorganisms.
- plants.

**(1)**

(iii) The gas released into the atmosphere when trees are burned is

- carbon dioxide.
- methane.
- oxygen.

**(1)**
**(Total 7 marks)**

**Q4.** Soay sheep live wild on an island off the north coast of Scotland. No people live on the island.

By Owen Jones = Jonesor [CC-BY-SA-2.5], via Wikimedia Commons

Over the last 25 years, the average height and mass of the wild Soay sheep have decreased.

The scientists think that climate change might have affected the size of the sheep.

(a) More Soay sheep are now able to survive winter than 25 years ago.

What change in the climate may have helped more Soay sheep to survive winters?

.....

.....

**(1)**

(b) Complete the sentences.

(i) Soay sheep show variation in size because of differences in their

.....

**(1)**

(ii) The change in the size of the Soay sheep over 25 years can be explained by Darwin's

theory of .....

**(1)**

**(Total 3 marks)**

**Q5.** The photographs show some ways in which humans affect the environment.

(a) Coal-burning power stations give off smoke. The smoke contains many different gases.

By Norbert Kaiser (English: own work.) [CC-BY-SA-3.0], via W kimedia Commons

Draw a ring around the correct answer to complete each sentence.

(i) The gas which causes global warming is

carbon dioxide.

oxygen.

sulfur dioxide.

**(1)**

(ii) The gas which causes acid rain is

methane.

oxygen.

sulfur dioxide.

**(1)**

(b) The photograph shows a quarry.

By Thomas Bjørkan (Own work) [CC-BY-SA-3.0], via W kimedia Commons

Draw a ring around the correct answer to complete each sentence.

(i) Quarrying

releases methane into the atmosphere.

ncreases biodiversity.

reduces land available for animals and plants.

**(1)**

(ii) Quarrying can be reduced by recycling

metals.

paper.

plastic

**(1)**

(c) The photograph shows a farmer spraying fruit trees.

Photograph supplied by Hemera/Thinkstock

Chemicals in the spray kill insects on the trees.

Draw a ring around the correct answer to complete each sentence.

(i) The spray contains

fertiliser.

herbicide.

pesticide.

**(1)**

(ii) The chemical in the spray might also

kill other animals.

kill plants.

ncrease biodiversity.

**(1)**

**(Total 6 marks)**

**Q6.**The human population is increasing and more household waste is being produced.

(a) Give **one** way in which an increase in household waste affects our environment.

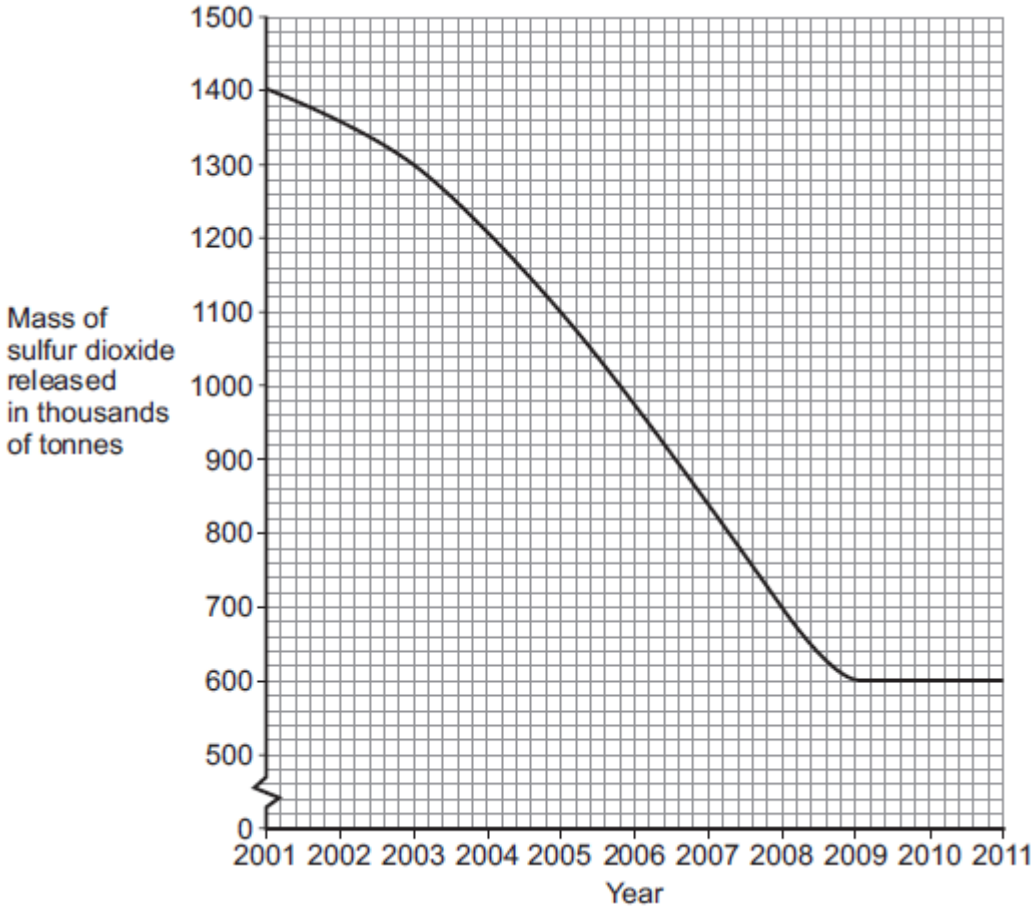
.....

.....

**(1)**

(b) The release of sulfur dioxide affects our environment.

The graph shows how the mass of sulfur dioxide released in the UK has changed from 2001 to 2011.




(i) Describe the pattern shown in the graph.

.....

.....

.....

.....

**(2)**

(ii) In 2001, 1400 thousand tonnes of sulfur dioxide were released.

By which year had the amount of sulfur dioxide released reduced to half of this amount?

.....

.....

.....

Year = .....

**(2)**

(iii) Give **one** problem caused when sulfur dioxide gas is in the air.

.....

.....

**(1)**

(c) Carbon dioxide is another gas that affects the environment.

Which **two** of the following help to reduce the levels of carbon dioxide in the atmosphere by storing carbon dioxide?

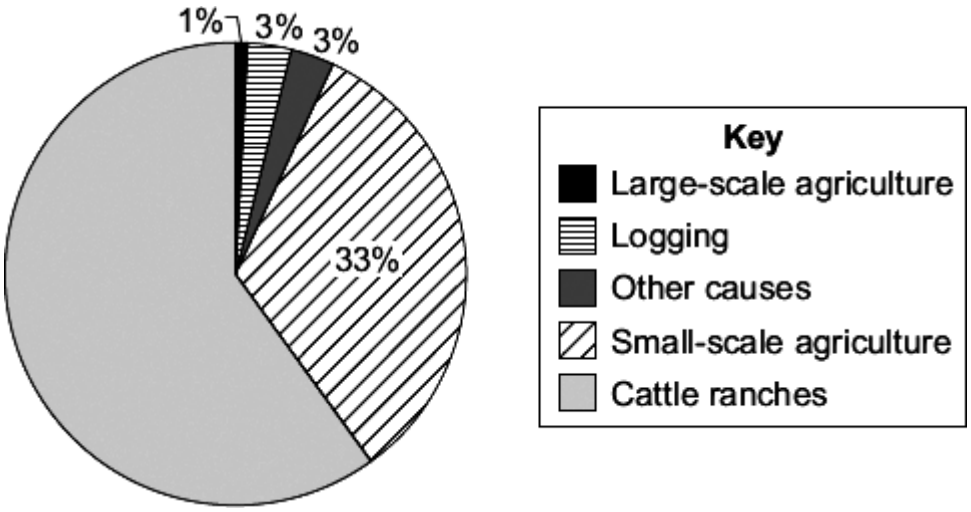
Tick (✓) **two** boxes.

| | |
|---|---|
| Animals respiring | ☐ |
| Carbon dioxide being absorbed in oceans and lakes | ☐ |
| Photosynthesis by trees | ☐ |
| The production of biogas | ☐ |

**(2)**
**(Total 8 marks)**

**Q7.** Large-scale deforestation is taking place in Brazil.

The pie chart shows the causes of deforestation in Brazil.




(a) Calculate the percentage of forest that has been destroyed for cattle ranches.

Show clearly how you work out your answer.

.....

.....

Percentage = .....

**(2)**

(b) Cattle give off large amounts of methane into the atmosphere.

The methane causes the Earth's temperature to increase.

Give **two** effects of the temperature increase on the environment.

1 .....

.....

2 .....

.....

**(2)**
**(Total 4 marks)**

**Q8.**Human activities affect the environment.

(a) **List A** gives four human activities.

**List B** gives the effect of the activities on the environment.

Draw **one** line from each human activity in **List A** to its effect on the environment in **List B**.

| **List A**<br>**Human activity** | **List B**<br>**Effect on the environment** |
|---|---|
| | Adds methane to the atmosphere |
| Digging a new quarry | |
| | Pollutes hedges around fields |
| Spraying pesticides on crops | |
| | Reduces the land available for wild animals |
| Growing rice | |
| | Produces lots of litter |
| Driving cars that release sulfur dioxide | |
| | Produces acid rain |

**(4)**

(b) Human activities are increasing *global warming* .

Give **two** effects of *global warming* on the environment.

1.....

.....

2.....

.....

**(2)**
**(Total 6 marks)**

**Q9.**Scientists have produced many different types of GM (genetically modified) food crops.

(a) Use words from the box to complete the sentence about genetic engineering.

| clones | chromosomes | embryos | genes |
|---|---|---|---|

GM crops are produced by cutting ..... out of the

..... of one plant and inserting them into the cells of a crop plant.

**(2)**

(b) Read the information about GM food crops.

- Herbicide-resistant GM crops produce higher yields.
- Scientists are uncertain about how eating GM food affects our health.
- Insect-resistant GM crops reduce the total use of pesticides.
- GM crops might breed naturally with wild plants.
- Seeds for a GM crop can only be bought from one manufacturer.
- The numbers of bees will fall in areas where GM crops are grown.

Use this information to answer these questions.

(i) Give **two** reasons why some farmers are in favour of growing GM crops.

1 .....

.....

2 .....

.....

**(2)**

(ii) Give **two** reasons why many people are against the growing of GM crops.

1 .....

.....

2 .....

.....

**(2)**
**(Total 6 marks)**

**M1.** (a) methane is produced

*ignore bad smell*

**1**

which is a greenhouse gas / causes global warming

**1**

(b) (9.80 / 0.20 = 49 therefore) 49:1

**1**

(c) horse (manure)

*allow ecf from **11.2***

closest to 25:1 (ratio)

**1**

(d) **Level 3 (5–6 marks):**
A detailed and coherent explanation is given, which logically links how carbon is released from dead leaves and how carbon is taken up by a plant then used in growth.

**Level 2 (3–4 marks):**
A description of how carbon is released from dead leaves and how carbon is taken up
by a plant, with attempts at relevant explanation, but linking is not clear.

**Level 1 (1–2 marks):**
Simple statements are made, but no attempt to link to explanations.

**0 marks:**
No relevant content.

**Indicative content**

**statements:**
- (carbon compounds in) dead leaves are broken down by microorganisms / decomposers / bacteria / fungi
- photosynthesis uses carbon dioxide

**explanations:**

- (microorganisms) respire
- (and) release the carbon from the leaves as carbon dioxide
- plants take in the carbon dioxide released to use in photosynthesis to produce glucose

**use of carbon in growth:**
- glucose produced in photosynthesis is used to make amino acids / proteins / cellulose
- (which are) required for the growth of new leaves

**6**

(e) any **three** from:
(storage conditions)
- (at) higher temperature / hotter
- (had) more oxygen
- (had) more water / moisture
- (contained) more microorganisms (that cause decay)

*allow reference to bacteria / fungi / mould*

**3**

**[13]**

**M2.** (a) (i) counts / 12

**1**

× 120 × 80 / × 9600
**or**
× area of field

**1**

(ii) (more) quadrats / repeats

**1**

placed randomly
*ignore method of achieving randomness*

**1**

(b) (i) any **three** from:
- temperature / warmth / heat
- water / rain
- minerals / ions / salts (in soil)
  *allow nutrients / fertiliser / soil fertility*
  *ignore food*
- pH (of soil)
- trampling
- herbivores
  *ignore predators*
- competition (with other species)
- pollution qualified e.g. $SO_2$ / herbicide
- wind (related to seed dispersal).
  *ignore space / oxygen / $CO_2$ / soil unqualified*

**3**

(ii) light needed for photosynthesis

**1**

for making food / sugar / etc.

**1**

effect on buttercup distribution eg more plants in sunny areas / fewer plants in shady areas

**1**

(c) (i) fertiliser / ions / salts cause growth of algae / plants

**1**

(algae / plants) block light

**1**

(low light) causes algae / plants to die

1

microorganisms / bacteria feed on / break down / cause decay of organic matter / of dead plants

*do **not** allow germs / viruses*

1

(aerobic) <u>respiration</u> (by microbes) uses $O_2$

*do **not** allow anaerobic*

1

(ii) sewage / toxic chemicals / correct named example eg metals / bleach / disinfectant / detergent etc

*allow suitable named examples eg metals such as Pb / Zn / Cr / oil / $SO_2$ / acid rain / pesticides / litter*

*ignore chemicals unqualified*

*ignore waste unqualified*

*ignore human waste / domestic waste / industrial waste unqualified*

1

(d) (i) 2

1

(ii) more food

*allow other sensible suggestion eg more species colonise from tributary streams after forest*

1

(iii) number of stonefly species decreases (from **A** to **B** / **B** to **C** / **A** to **C**) as more pollution enters river / less oxygen

*allow fewer species in more polluted water*

*ignore none are found at site C*

1

**[19]**

**M3.** (a) (rapid) growth in population (size)

**1**

increase in the standard of living

*accept description of increased standard of living, eg more packaging, more food thrown away or overbuying resources*

**1**

(b) (i) 41.5

*allow 1 mark for 9733 ÷ 23454*

***or***

*allow 1 mark for 0.415*

***or***

*allow 1 mark for 41.49* ***or*** *41* ***or*** *41.4*

**2**

(ii) any **four** from

arguments for:

- there has been a reduction in total waste
- there has been an increase in (total mass of) recycling
- there has been an increase in the percentage of waste recycled
- it (may) not be possible to achieve zero waste.

arguments against:

- there is still a lot of waste (not recycled)
- there has only been a small reduction in total waste
- there was one year (2006) where total waste went up
- the rate of increase of percentage recycled is slowing down
- no information on materials reused
- no information on waste from factories / industry

*max 3 marks for a one sided argument*

*allow as reason against if clear*

*allow still more than half or 56.8% of waste (not recycled).*

**4**

(c) (i) any **two** from:

- reduce biodiversity **or** extinction
- change in migration patterns
- change in species distribution
- change in climate

*ignore rise in sea levels*

*ignore temperature change*

*accept correct examples of climate change e.g. storms, flooding, drought*

*references to weather changing is insufficient*
*allow ice caps melting or habitat destruction.*

**2**

(ii) any **one** from:

- absorbed by oceans / ponds / lakes
- peat bogs

*allow used for skeletons / shells of sea creatures*
*allow in fossil fuels / limestone.*

**1**

**[11]**

**M4.** (a) any **two** from:

- (volume of) peat compost has been steady and then declined **or** volume of peat compost has declined since 2005

  *allow 2007 instead of 2005*
- (volume of) peat-free compost has increased (since 1999)
- (volume of) peat is higher than peat-free until 2005, then peat-free compost is higher (than peat)

  *allow 2007*
- total volume of peat and peat-free compost has increased.

**2**

(b) increases carbon dioxide (in the atmosphere)

*ignore methane*

**1**

(c) any **one** from:

- reduces biodiversity
- destruction of habitats
- disruption of food chains.

**1**

**[4]**

**Q1.** A gardener wants to add compost to the soil to increase his yield of strawberries.

The gardener wants to make his own compost.

(a) An airtight compost heap causes anaerobic decay.

Explain why the gardener might be against producing compost using this method.

.....

.....

.....

.....

**(2)**

(b) The gardener finds this research on the Internet:

**'A carbon to nitrogen ratio of 25:1 will produce fertile compost.'**

Look at the table below.

| Type of material to compost | Mass of carbon in sample in g | Mass of nitrogen in sample in g | Carbon:nitrogen ratio |
|---|---|---|---|
| Chicken manure | 8.75 | 1.25 | 7:1 |
| Horse manure | 10.00 | 0.50 | 20:1 |
| Peat moss | 9.80 | 0.20 | **X** |

Determine the ratio **X** in the table above.

.....

Ratio .....

**(1)**

(c) Which type of material in the table above would be **best** for the gardener to use to make his compost?

Justify your answer.

.....

.....

**(1)**

(d) Some of the leaves from the gardener's strawberry plant die.

The dead leaves fall off the strawberry plant onto the ground.

The carbon in the dead leaves is recycled through the carbon cycle.

Explain how the carbon is recycled into the growth of new leaves.

.....

.....

.....

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.....

.....

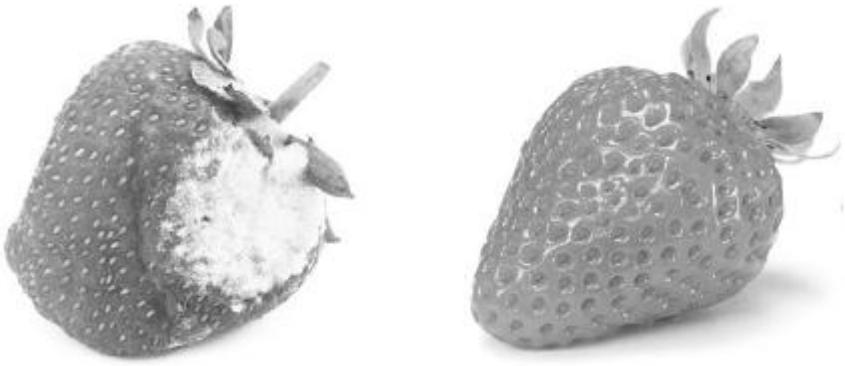
.....

**(6)**

(e) The diagram below shows two strawberries.

- Both strawberries were picked from the same strawberry plant.
- Both strawberries were picked 3 days ago.
- The strawberries were stored in different conditions.

**Strawberry A** **Strawberry B**



A © sarahdoow/iStock/Thinkstock, B © Mariusz Vlack/iStock/Thinkstock

Give **three** possible reasons that may have caused strawberry **A** to decay.

1 .....

.....

2 .....

.....

3 .....

.....

**(3)**
**(Total 13 marks)**

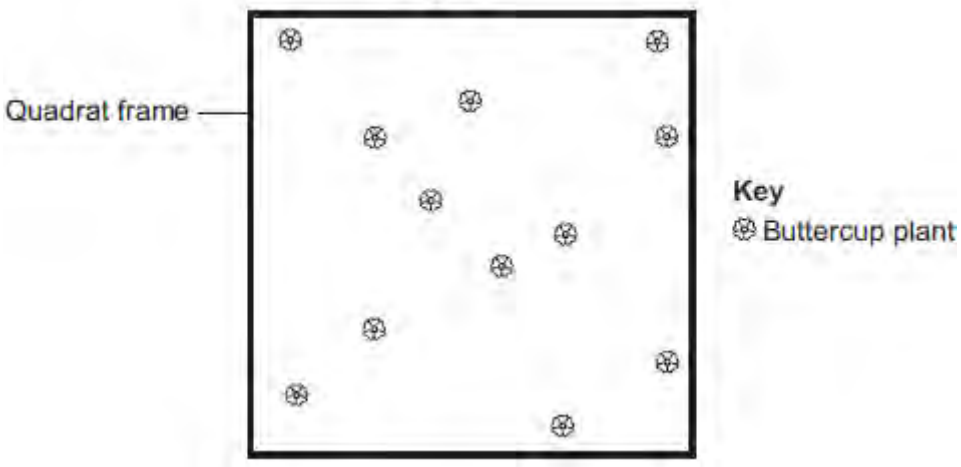
**Q2.**A grassy field on a farm measured 120 metres by 80 metres.

A student wanted to estimate the number of buttercup plants growing in the field.

The student found an area where buttercup plants were growing and placed a 1 m × 1 m quadrat in one position in that area.

**Figure 1** shows the buttercup plants in the quadrat.

**Figure 1**




The student said, 'This result shows that there are 115 200 buttercup plants in the field.'

(a) (i) How did the student calculate that there were 115 200 buttercup plants in the field?

.....

.....

.....

.....

**(2)**

(ii) The student's estimate of the number of buttercup plants in the field is probably not accurate. This is because the buttercup plants are not distributed evenly.

How would you improve the student's method to give a more accurate estimate?

.....

.....

.....

.....

**(2)**

(b) Sunlight is one environmental factor that might affect the distribution of the buttercup plants.

(i) Give **three other** environmental factors that might affect the distribution of the buttercup plants.

1.....

2.....

3.....

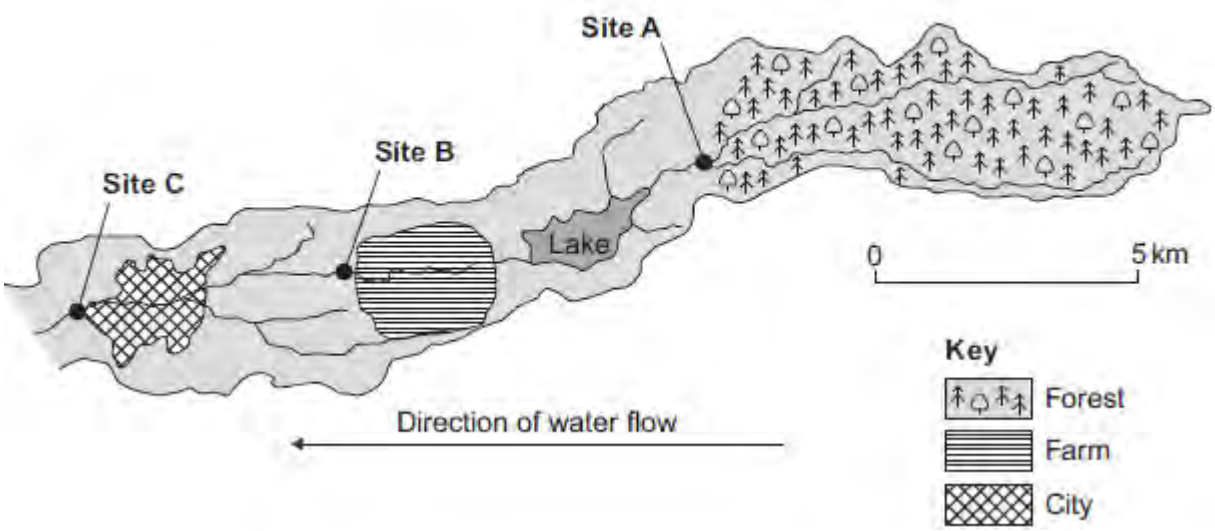
**(3)**

(ii) Explain how the amount of sunlight could affect the distribution of the buttercup plants.

**(3)**

(c) **Figure 2** is a map showing the position of the farm and a river which flows through it.

**Figure 2**




Every year, the farmer puts fertiliser containing mineral ions on some of his fields.When there is a lot of rain, some of the fertiliser is washed into the river.

(i) When fertiliser goes into the river, the concentration of oxygen dissolved in the water decreases.

Explain why the concentration of oxygen decreases.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**(5)**

(ii) There is a city 4 km downstream from the farm.

Apart from fertiliser, give **one** other form of pollution that might go into the river as it flows through the city.

.....

**(1)**

(d) Three sites, **A**, **B** and **C**, are shown in **Figure 2**.

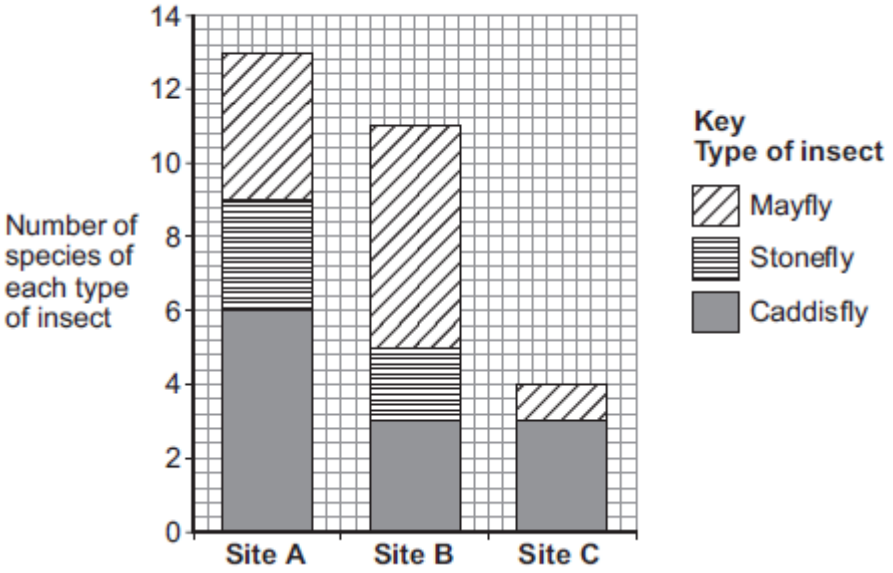
Scientists took many samples of river water from these sites.

The scientists found larvae of three types of insect in the water: mayfly, stonefly and caddisfly. For each type of insect the scientists found several different species.

The scientists counted the number of different species of the larvae of each of the three types of insect.

**Figure 3** shows the scientists' results.

**Figure 3**




(i) How many more species of mayfly were there at Site **B** than at Site **A**?

.....

**(1)**

(ii) Suggest what caused this increase in the number of species of mayfly.

.....

.....

**(1)**

(iii) The scientists stated that the number of species of stonefly was the best indicator of the amount of oxygen dissolved in the water.

Use information from **Figure 3** to suggest why.

**(1)**

**(Total 19 marks)**

**Q3.** In many areas of the world the mass of household waste produced each year is increasing.

(a) Give **two** reasons why the mass of household waste is increasing each year.

1.....

.....

2.....

.....

**(2)**

(b) The table below shows how the mass of household waste in the UK has changed from 2004 to 2012.

| Year | Total mass of household waste in thousands of tonnes (including total household recycling) | Total mass of household recycling in thousands of tonnes | Percentage of household waste recycled |
|---|---|---|---|
| **2004** | 25 658 | 5785 | 22.5 |
| **2006** | 25 775 | 7976 | 30.9 |
| **2008** | 24 334 | 9398 | 38.6 |
| **2010** | 23 454 | 9733 | |
| **2012** | 22 643 | 9782 | 43.2 |

(i) Calculate the percentage of household waste recycled in 2010.

.....

.....

.....

.....

..... %

**(2)**

(ii) The UK government has been encouraging a 'zero waste economy'.

In a ‘zero waste economy’, we reduce, reuse and recycle as much waste as possible.

A newspaper concluded that: **‘The government’s ‘zero waste economy’ has been successful.’**

Use information from the table to describe the reasons for and against the newspaper’s conclusion.

.....

.....

.....

.....

.....

.....

.....

.....

**(4)**

(c) (i) Some waste releases carbon dioxide and methane into the atmosphere. An increase in carbon dioxide and methane contributes to global warming.

Global warming can cause sea levels to rise.

Describe **two** other possible effects of global warming on our environment.

1.....

.....

2.....

.....

**(2)**

(ii) Storing the carbon dioxide helps to prevent more global warming. Carbon dioxide can be stored (sequestered) in trees when they photosynthesise.

Give **one** different way in which carbon dioxide is sequestered in our environment.

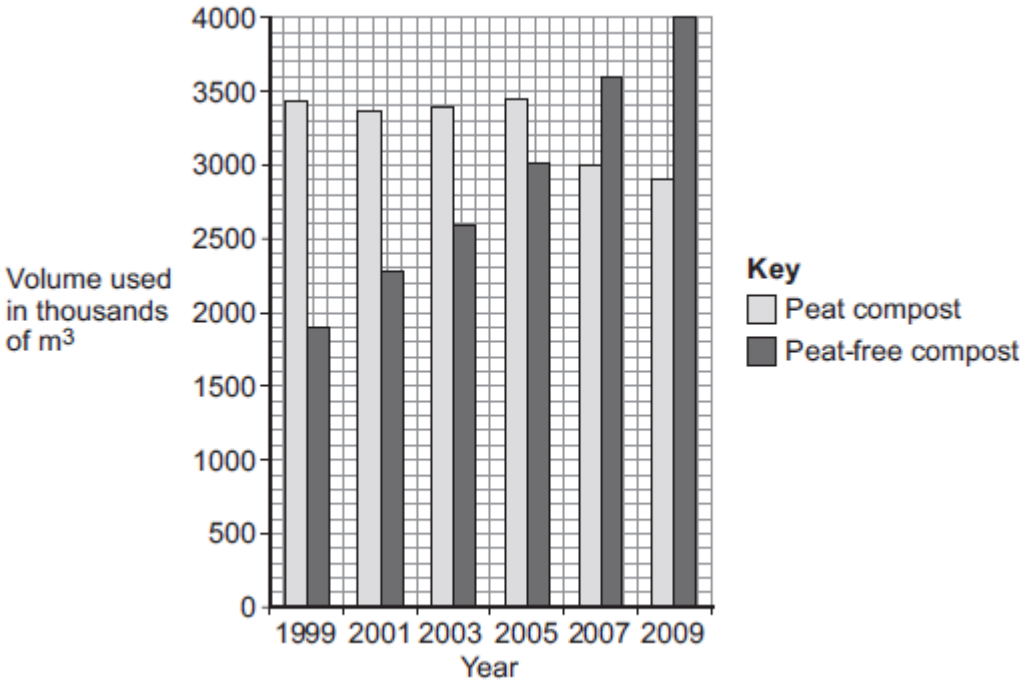
.....

.....

**(1)**
**(Total 11 marks)**

**Q4.**Human activities have many effects on our ecosystem.

The graph shows the volume of peat compost and peat-free compost used in gardening from 1999 to 2009.




(a) Describe the trends shown in the graph.

.....

.....

.....

.....

.....

**(2)**

(b) What effect does the destruction of peat bogs have on the gases in the atmosphere?

.....

.....

**(1)**

(c) Deforestation is also damaging ecosystems.

Describe **one** effect of deforestation on ecosystems.

**(1)**
**(Total 4 marks)**

**M1.** (a) circulating / mixing / described **or** temperature maintenance

**1**

supply oxygen
**or** for <u>aerobic</u> conditions
**or** for <u>faster</u> respiration

*do **not** allow oxygen for anaerobic respiration*

**1**

(b) energy supply / fuel / use in respiration

*do **not** allow just food / growth*
*ignore reference to aerobic / anaerobic*

**or** <u>material</u> for growth / to <u>make</u> mycoprotein

**1**

(c) <u>respiration</u>

*allow exothermic reaction*
*allow catabolism*
*ignore metabolism*
*ignore aerobic / anaerobic*

**1**

(d) (i) any **one** from:

- compete (with *Fusarium*) for food / oxygen **or** reduce yield of *Fusarium*
- make toxic waste products or they might cause disease / pathogenic **or** harmful to people / to *Fusarium*

*do **not** allow harmful unqualified*

**1**

(ii) steam / heat treat / sterilise fermenter (before use)

***not** just clean*

**or**
steam / heat treat / steriliseglucose / minerals / nutrients / water (before

use)
**or**
filter / sterilise air intake
**or**
check there are no leaks
*allow sterilisation unqualified **not** just use pure glucose*

**1**

(e) any **three** from:

- beef is best or beef is better than mycoprotein
- mycoprotein <u>mainly</u> better than wheat
- more phenylalanine in wheat than in mycoprotein
  *allow equivalent numerical statements*
- but no information given on other amino acids / costs / foods

**3**

<u>overall conclusion:</u>

statement is incorrect because
**either**
it would be the best source for vegetarians
**or**
for given amino acids, beef is the best source
**or**
three foods provide insufficient data to draw a valid conclusion

**1**

**[10]**

**M2.** (a) e.g.

timber
agriculture
roads / urban development / buildings
*any two for 1 mark each*

2

(b) *ideas that (accept reverse arguments)*
increased carbon dioxide content since less during photosynthesis and locked-up as wood burning increases carbon dioxide content
increased activity of microbes increases carbon dioxide content
oxygen content reduced water vapour content reduced
*any five for 1 mark each*

5

**[7]**

**M3.** Cogently argued based on biological principles, for **and**

against introduction of caterpillar
maximum of 4 pros e.g.
fewer chemicals used therefore less expense
less chemical damage to other plants
consequent benefits to food chains
fewer farm animals poisoned therefore more economic
countryside more varied therefore more attractive to tourists
tourists bring economic advantages
greater variety of habitats therefore greater variety of species

*any 4 for 1 mark each*

**4**

cons e.g.
danger to livelihoods if crops destroyed by caterpillar
relatively low chance of success since only one third of schemes effective world-wide
unlikely to be natural predators therefore ecological balance affected

*any 2 for 1 mark each*

**2**

cogently argued case **gains up to 2 marks**

**2**

**[8]**

**M4.** (a) increased human population
increased standard of living
*each for 1 mark*

**2**

(b) nutrients absorbed by plants not replaced
*each for 1 mark*

**2**

(c) increased release of carbon dioxide into atmosphere when trees are burned
reduced rate of carbon dioxide removal from atmosphere
increased carbon dioxide absorbs more of energy radiated by Earth
global rise in temperature
*each for 1 mark*

**4**

**[8]**

**M5.** (a) any **one** from:

- increase / give light
- increase temperature / make warmer

award marks if the method by which these could be done is given
eg leave lights on all night **or** use a heater

- increase / give $CO_2$
- add fertiliser / nutrients / minerals / named
  *allow nitrogen*
  *ignore 'food'*

**1**

(b) (i) any **two** from:

- cheaper
  *allow grow faster / more grown*
- better quality / flavour
  *ignore size*
- available all year
  *accept converse if clear that answer refers to use of British tomatoes*
  *allow 'Fair Trade'*

**2**

(ii) any **two** from:

- greater distance **or** more food miles **or** more transport

idea of more needed only once

- transport needs (more) energy / fuel
- reference to eg greenhouse effect / global warming / pollution / $CO_2$ release / carbon footprint
  *ignore ozone*

**2**

**[5]**

**M6.** (a) 860

*correct answer gains **2** marks*
*if answer incorrect evidence of (6100 - 1800) ÷ 5*
***or** 4300 ÷ 5*
***or** (900 + 600 + 1000 + 700 + 1100) ÷ 5 gains **1** mark*
*allow ecf from 1 incorrect graph reading*

**2**

(b) *ignore references to oxygen / sulfur dioxide / nitrogen oxides / acid rain* *ignore global warming*

**Effects of deforestation**

deforestation increases the amount of carbon dioxide in the atmosphere
*award this point only if linked to deforestation*

**1**

any **two** from:

- due to less photosynthesis **or** less carbon dioxide taken in **or** carbon dioxide not locked up in (forest) trees
- due to burning of forest / from machinery
- due to activity of microorganisms / decay

**2**

**Effects of growing palm for fuel**

carbon dioxide released when palm oil used as fuel

**1**

(eventually) $CO_2$ intake and output might balance out **or** burning palm oil carbon neutral
*accept less carbon dioxide than from burning fossil fuels*

**1**

**[7]**

**M7.** (a) (i) kills / gets rid of / reduces methane bacteria

*allow kills / gets rid of / reduces bad bacteria*

*ignore acts like antibiotic*

**1**

(ii) less food converted to methane

*allow can keep more cattle without further environmental damage*

*ignore energy*

**1**

more growth / meat / muscle / milk produced / more profit / fatter animals

*ignore references to bacteria and disease*

**1**

(b) absorbs energy / heat radiated by Earth

*allow absorbs / traps energy / heat / from Earth*

*do **not** allow absorbs energy / heat from Sun*

**1**

some energy / heat reradiated

*ignore reflected*

*do **not** allow reradiates energy / heat from Sun*

**1**

leading to global warming / enhanced greenhouse effect

*accept effects of global warming eg melting ice caps*

*accept methane is a greenhouse gas*

*ignore references to ozone*

**1**

**[6]**

**M8.** (a) any **two** from:

- fewer trees to take in carbon dioxide for photosynthesis
- decomposers / microorganisms respire (as they decay debris) releasing carbon dioxide
- burning of wood releases carbon dioxide

*allow carbon dioxide released by burning fossil fuels in vehicles / factories*

**2**

(b) Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best − fit' approach to the marking.

**0 marks**
No relevant content.

**Level 1 (1 − 2 marks)**
There is a brief description of some steps in the process but the order is not clear with little biological vocabulary used.

**Level 2 (3 − 4 marks)**
There is a reasonably clear description of the process involving many of the steps and using some biological vocabulary.

**Level 3 (5 − 6 marks)**
There is a clear, logical and detailed scientific description of the process using appropriate biological vocabulary.

**examples of biology points made in the response:**

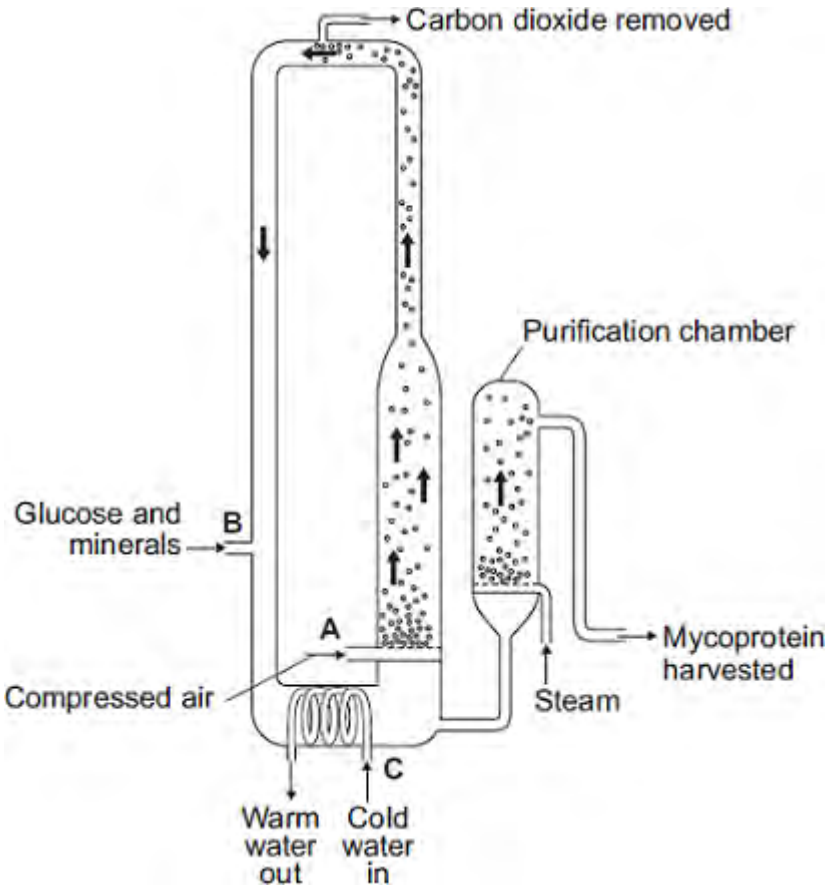
- this contains mineral ions (and organic matter)
- this increases growth of algae / water plants
- the plants / algae (underneath) die
- due to lack of light / photosynthesis / space
- decomposers / microorganisms feed on decaying matter **or** multiply rapidly
- the respiration of decomposers uses up all the oxygen
- so invertebrates die due to lack of oxygen
- this is called eutrophication

**6**

**[8]**

**Q1.** The diagram shows a fermenter. This fermenter is used for growing the fungus *Fusarium*.

*Fusarium* is used to make mycoprotein.




(a) Bubbles of air enter the fermenter at **A**.

Give **two** functions of the air bubbles.

1.....

.....

2.....

.....

**(2)**

(b) Why is glucose added to the fermenter?

.....

.....

**(1)**

(c) The fermenter is prevented from overheating by the cold water flowing in through the heat exchanger coils at **C**.

Name the process that causes the fermenter to heat up.

.....

**(1)**

(d) It is important to prevent microorganisms other than *Fusarium* growing in the fermenter.

(i) Why is this important?

.....

.....

**(1)**

(ii) Suggest **one** way in which contamination of the fermenter by microorganisms could be prevented.

.....

.....

**(1)**

(e) Human cells cannot make some of the amino acids which we need. We must obtain these amino acids from our diet.

The table shows the amounts of four of these amino acids present in mycoprotein, in beef and in wheat.

| **Name of amino acid** | **Amount of amino acid per 100 g in mg** | | | **Daily amount needed by a 70 kg human in mg** |
|---|---|---|---|---|
| | **Mycoprotein** | **Beef** | **Wheat** | |

| | | | | |
|---|---|---|---|---|
| Lysine | 910 | 1600 | 300 | 840 |
| Methionine | 230 | 500 | 220 | 910 |
| Phenylalanine | 540 | 760 | 680 | 980 |
| Threonine | 610 | 840 | 370 | 490 |

A diet book states that mycoprotein is the best source of amino acids for the human diet.

Evaluate this statement.

Remember to include a conclusion in your evaluation.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**(4)**
**(Total 10 marks)**

**Q2.** In tropical areas of the world, forests are being cut down at the rate of 150 hectares every minute of every day.

(a) Give **two** reasons why forests in tropical areas are being cut down at a high rate.

1 .....

.....

2 .....

.....

**(2)**

(b) Explain how this deforestation is affecting the composition of the atmosphere.

.....

.....

.....

.....

.....

.....

**(5)**
**(Total 7 marks)**

**Q3.** Professor John Lawton researches into the problem of controlling the spread of bracken. Bracken is a fern which threatens upland farms, partly because it poses a health risk to people and animals.

Professor Lawton is waiting for government permission to release the Conservular caterpillar which feeds on the bracken.

The Secretary of State has to decide whether the Conservular caterpillar can be released.

The article printed below describes some of the problems faced by the Secretary of State.

**David the caterpillar to bracken's Goliath**

Yorkshire farmer Maurice Cottrill has just forked out £500 to have a helicopter hover over his land and spew out gallons of chemicals aimed at destroying one of the most pervasive and dangerous weeds known to man – bracken. In a little box in a laboratory near Ascot, Berkshire, lies a tiny caterpillar which could have done the job for nothing.

Whether or not that caterpillar and thousand of its chums will ever be let loose on the massive carpet of bracken that is sweeping over Britain at the rate of 53 square kilometres a year has to be decided by the Secretary of State for the Environment.

Weed control through the release of imported insects has never been tried in Britain before. If the Secretary of State permits the experiment, the caterpillar is in for the feast of its life, because five years of painstaking research have proved that bracken is its only food. However, is that the full story? Will the beast stop there, or will it go on, wreaking unforeseen devastation. Can scientists predict what will happen when imported insects are released into the wild?

Bracken is poisonous – more than 20 000 sheep and 1 000 cattle suffer poisoning each year. Its spores are carcinogenic, posing a threat to hill walkers. Bracken costs a depressing £4m a year to control while rendering useless grazing land valued at £5m annually. "Bracken is one factor which is leading to hill farming becoming uneconomic", says the director of the Ramblers Association. "We are worried about that because, the more uneconomic hill farms become, the more prospect there is of the forestry industry taking over."

The National Farmers Union are concerned about the consequences of the caterpillar getting out of control. What if it started consuming garden ferns? What if it loved potatoes? On the other hand, the caterpillar might help to preserve important uplands where wildlife flourishes when bracken is kept at bay. However, the experiment takes the scientists into unknown territory.

World-wide, 94 species of weeds have been controlled by biological releases

involving 215 types of animal in 50 countries. Professor Lawson says that approximately one-third have achieved effective control and the remainder have failed.

Upland farms are artificial ecosystems, created and maintained mainly for the rearing of sheep and cattle. These farms are being threatened by the spread of bracken. Up to now the only treatment for bracken has been to use herbicides.

Use the article to explain, as fully as you can, what advice you would give the Secretary of State.

Explain the arguments for and against that lead to your decision.

You will **not** receive marks for simply copying extracts from the article.

**(Total 8 marks)**

**Q4.** Large areas of rain forest are being cleared and burnt in many parts of the world. The cleared land will often produce crops for only a few years.

(a) Explain why rain forests are being burnt to provide land for crops in many parts of the world.

.....

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**(2)**

(b) Explain why such cleared land will often produce crops for only a few years.

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**(2)**

(c) Explain the effects that large-scale burning of forests may have on the Earth's atmosphere in the short and in the long term.

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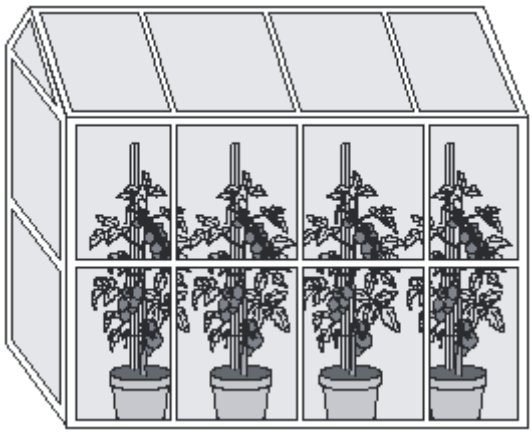
**(4)**

**(Total 8 marks)**

**Q5.** In this country most tomatoes are grown in greenhouses.



(a) Suggest **one** way in which a grower could increase the yield of tomatoes from plants growing in his greenhouse.

.....

.....

**(1)**

(b) Large supermarkets often import tomatoes from overseas.

(i) Suggest **two** reasons why a supermarket might decide to import tomatoes rather than buy them from British growers.

1 .....

.....

2 .....

.....

**(2)**

(ii) Importing tomatoes may be more damaging to the environment than selling tomatoes grown in this country.

Explain why.

.....

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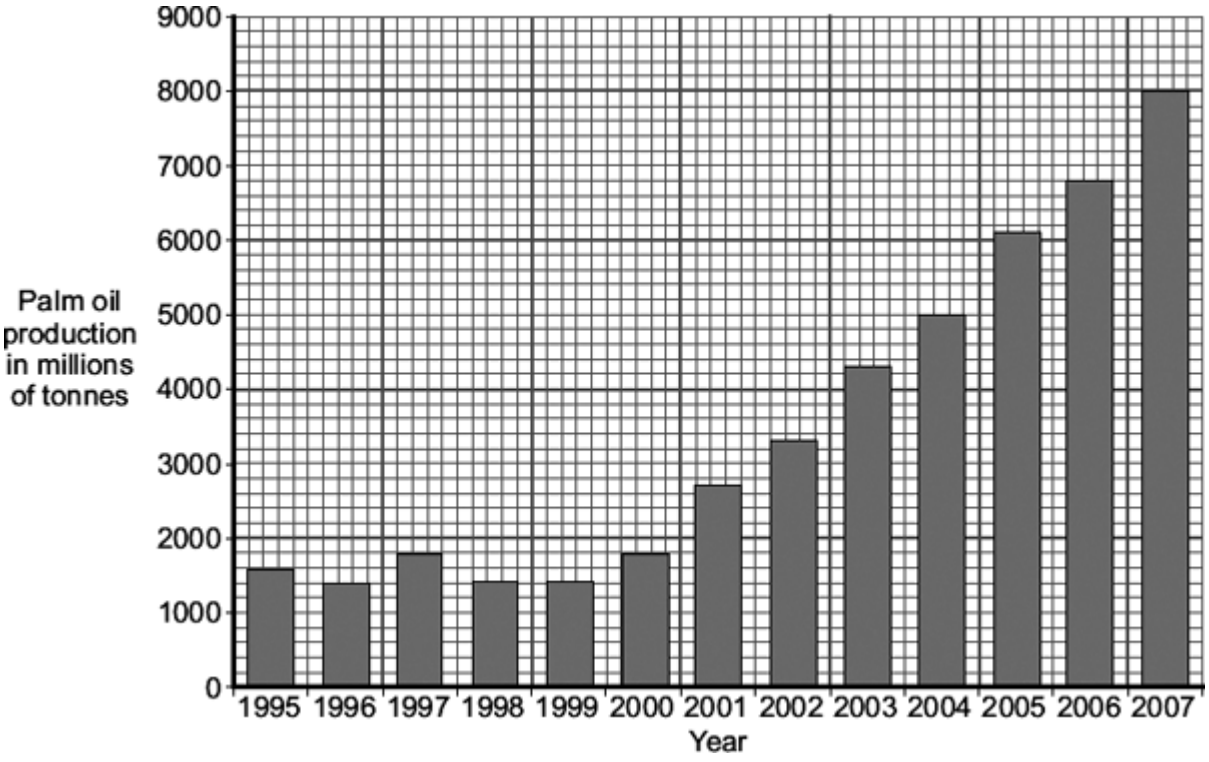
.....

.....

**(2)**
**(Total 5 marks)**

**Q6.** In South Asia, forests are being cleared to grow palm oil trees. The palm oil is mainly used to produce fuel for motor vehicles.

The graph shows the production of palm oil in one South Asian country.




(a) Calculate the mean increase in palm oil production per year for the five year period 2000 to 2005.

Show clearly how you work out your answer.

.....

.....

Mean increase = ..... millions of tonnes per year

**(2)**

(b) Clearing forests and replacing the forests with palm oil trees to produce fuel for motor vehicles will affect the composition of the atmosphere.

Explain how.

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**(5)**
**(Total 7 marks)**

**Q7.** Scientists have discovered that curry spices affect sheep and cattle. Curry spices can reduce the amount of methane that grazing animals give off.

'Bad' bacteria in the animal's stomach produce methane. About 12% of the animal's food is changed into methane.

The curry spice coriander works like an antibiotic. Adding coriander to animal food reduces methane production by about 40%.

(a) (i) Why does adding coriander to an animal's food reduce methane production?

.....

.....

**(1)**

(ii) Explain **one** advantage to a farmer of adding coriander to the animal's food.

.....

.....

.....

.....

**(2)**

(b) Farm animals give off large amounts of methane.

Explain the effects of adding large amounts of methane to the atmosphere.

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**(3)**

**(Total 6 marks)**

**Q8.**Human activities affect the environment.

(a) Deforestation results in an increase in carbon dioxide levels in the atmosphere.

Give **two** reasons why.

.....

.....

.....

.....

**(2)**

(b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

A dairy farmer washes out his cow shed each day. The waste water contains urine and faeces. The waste water overflows into a stream by mistake.

The waste water will have an effect on the plants and invertebrates living in the stream.

Explain why.

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.....

**(6)**
**(Total 8 marks)**

**M1.** (a) (i) tick in box of FIRST pyramid

**1**

(ii) any **one** from:

- less energy / biomass lost / wasted
- greatest biomass / energy for humans
  *ignore human box is bigger*
  *ignore .food. for humans*
- shortest food chain **or** less stages **or** least number of different organisms **or** only one predator **or** only 2 boxes tall **or** least boxes
  *allow only one stage*

**1**

(b) (i) any **two** from:

- quicker / more growth **or** grow fatter
- less* urine **or** less faeces
- less* heat (lost)
- less* movement
  *assume for pigs indoors*
  *allow converse if clear for pigs outdoors*
  *(*) do **not** allow no for less*
  *ignore less space*

**2**

(ii) any **one** from:

- less cruelty **or** more ethical **or** better animal welfare
  *ignore more natural*
  *ignore ideas referring to against God's will*
- better flavour / quality (of meat)
  *ignore pig health **or** free range / organic*

- less pollution / etc / less fossil fuel used for heating

  *ignore quality of life*

  *assume for pigs outdoors*

  *allow converse if clear for pigs indoors*

**1**

**[5]**

**M2.** (a) 30

*award **both** marks for correct answer, irrespective of working*
*100 – (33 + 27 + 10) or equivalent for **1** mark*

**2**

(b) 2 **or** 1.98

*award **both** marks for correct answer, irrespective of working*
*(33 / 100) × 6 or <u>equivalent</u> for **1** mark*

**2**

(c) respiration

**1**

(d) (i) less / no heat loss / movement
*do **not** accept 'energy' / warmth unqualified*

**1**

(ii) any reference to cruelty eg stress to calf / cramped conditions
*ignore references to disease / hygiene*

**1**

**[7]**

**M3.** (a) *idea that*

- so they don't get too hot / cold
  *for high temperatures*
- don't lose condition / weight **or** don't become ill
- don't lose too much water / become dehydrated
  (*allow* don't sweat too much)
  *for low temperatures*
- reduce heat loss from pigs
- less energy wasted in maintaining body temperature
  *for 1 mark each*

**2**

(b)

- reduce energy loss by movement
- so more is available for growth*
  *(*credit this point if given in (a) but only credit once)*
- don't use body mass to provide energy
- easier to handle / monitor
  *for 1 mark each*

**2**

(c) *idea that*

- less humane / not natural / cruel / no room to exercise / stressful
- more intensive labour
- increased risk of disease / (often) in contact with faeces
- antibiotic residues in meat
  *any two for 1 mark each*

**2**

**[6]**

**M4.** (a) (i) bacteria

**1**

(ii) 8

**1**

(iii) 4 tonnes

**1**

(b) (i) mycoprotein contains less fat

**1**

**or**

less circulatory problems

mycoprotein contains (more) fibre

**or**

reduces colon cancer

*it = mycoprotein*
*fat must be comparative*

**1**

(ii) beef contains <u>more</u> protein

*it = beef*
*must be comparative*

**or**

<u>better</u> for growth / making cells /

enzymes / antibodies

**1**

**[6]**

**M5.** (a) (i) cholesterol

**1**

fat

*in this order*

**1**

(ii) mycoprotein has (approx) half amount of protein / has 11.8 (g) protein while chicken has 22.0 (g)

*accept has less protein*

*ignore less fat*

**1**

(b) (i) increased

**1**

(±) constant rate **or** (from 0) to 9.2 / by 9.2(cm) **or** about 1 cm a day **or** increase slower at the beginning and / or at the end

**1**

(ii) species **A** grows faster / more than species **B**
**or**
species **A** has larger diameter **or** is bigger
**or**
the growth of species **B** slows down after 6 weeks

*accept use of approximate figures*

**1**

(c) any **two** from:

- pH / acidity / alkalinity

  *ignore references to carbon dioxide / waste products*

- (speed of) stirring

  *ignore time in the fermenter*

- oxygen (concentration) / aeration

*ignore initial amount of Fusarium*

- ion <u>concentration</u> / named eg -$NH_4^+$
  *allow ammonia*
- pressure

**2**

**[8]**

**M6.** (a) C

**1**

(b) otherwise species may disappear altogether

*allow to avoid extinction*

**1**

(c) any **two** from:

- regulate net size

  *if mesh size specified, must be larger*
- impose fishing quotas
- limit fishing during breeding seasons
- bans on discarding of fish
- bans on fishing in certain areas

**2**

**[4]**

**M7.** (a) 3 (.0)

*correct answer, irrespective of working gains **2** marks.*
*if the answer is incorrect or there is no answer, award **1** mark for use of correct figures (0.5 and 3.5) [and no other figures]*

**2**

(b) as faeces

*if more than two boxes ticked deduct **1** mark for each additional tick*

**1**

as carbon dioxide from respiration

**1**

(c) (i) pigs kept inside are kept in small pens

*if more than two boxes ticked deduct **1** mark for each additional tick*

**1**

pigs kept inside are kept warm in the winter

**1**

(ii) any **one** from:

- faster growth
  *ignore bigger / less flavour / fatty*
- need less food
  *ignore references to movement / energy*
- ready for market sooner
  *ignore ethical arguments*

**1**

**[7]**

**M8.** (a) (i) any **two** from:

- more milk
  *(about) 50 litres milk compared to (up to) 20 litres / 30 litres more*
  *ignore costs / profit*
- electricity produced
- farmers can keep more cows in the space
  *answers must refer to number of cows <u>and</u> space*

**2**

(ii) any **two** from:

- less stress for cow **or** not cruel to cow **or** cows have freedom to move around
  *ignore references to ethical / unnatural without qualification*
- crops fertilised
- less disease **or** disease not as easily spread

**2**

(b) more

**1**

less

*in this order*

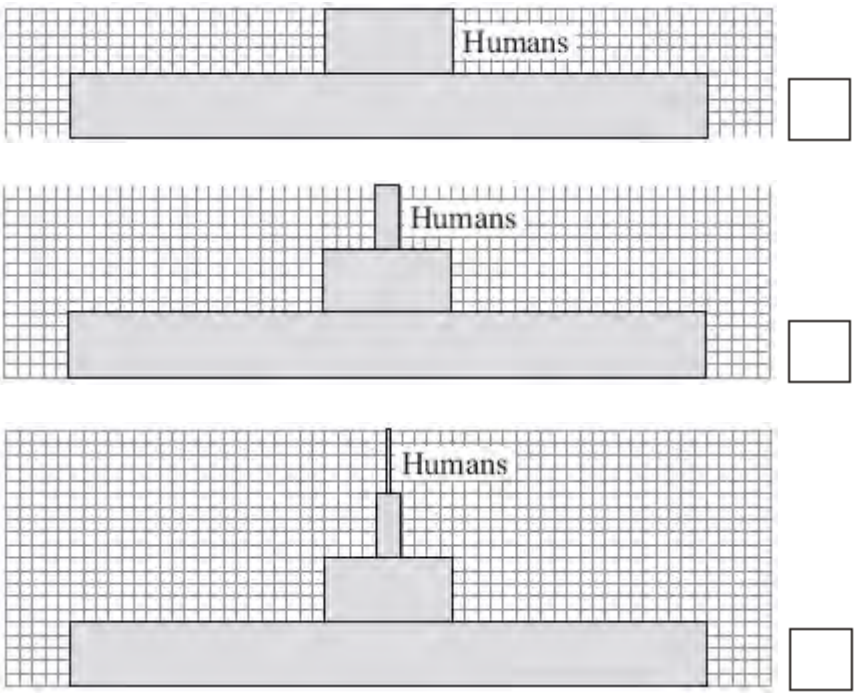
**1**

**[6]**

**Q1.** (a) The diagrams show three pyramids of biomass.

(i) Which pyramid would be the most efficient in providing food for humans?

Tick (✓) **one** box.




**(1)**

(ii) Give **one** reason for your choice.

.....

.....

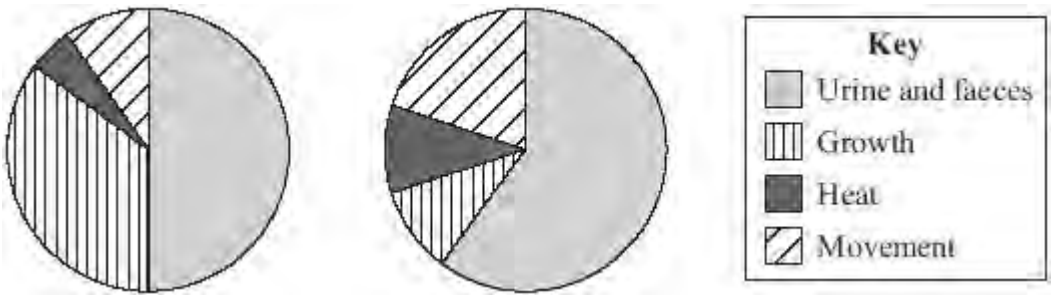
**(1)**

(b) Pigs may be kept indoors or outdoors.

**Pigs kept indoors** **Pigs kept outdoors**

The pie charts show what happens to the energy in the food eaten by pigs kept indoors and pigs kept outdoors.

**Pigs kept indoors** **Pigs kept outdoors**




(i) Farmers make more profit from keeping pigs indoors than from keeping pigs outdoors.

Use information from the pie charts to explain why.

.....

.....

.....

.....

**(2)**

(ii) Meat from pigs kept outdoors may cost more than meat from pigs kept indoors.

Some people prefer to buy meat from animals that have been kept outdoors.

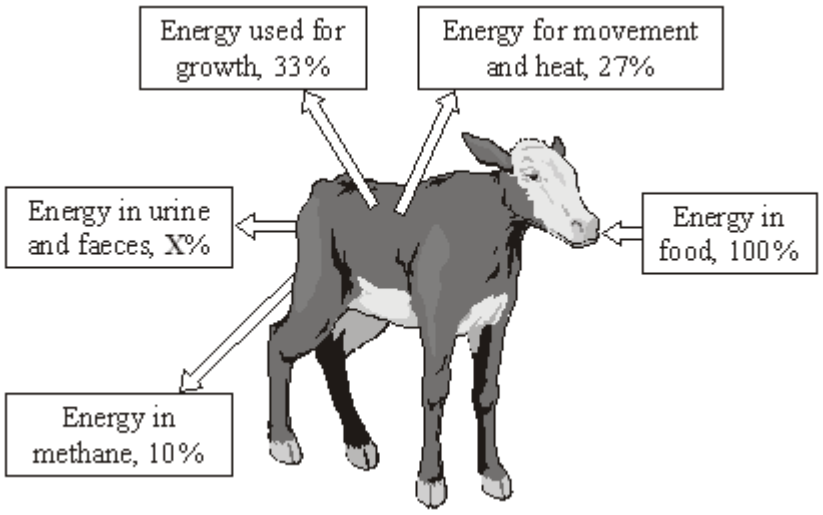
Suggest **one** reason why.

.....

.....

**(1)**
**(Total 5 marks)**

**Q2.** The diagram shows what happens to the energy in the food that a calf eats.




(a) Calculate the % energy lost as urine and faeces (**X**).
Show clearly how you work out your answer.

.....

.....

Energy lost as urine and faeces ..... %

**(2)**

(b) The energy in the food eaten by the calf in one day is 6 megajoules.

Calculate the amount of this energy that would be used for growth.
Show clearly how you work out your answer.

.....

.....

Energy used for growth ..... megajoules.

**(2)**

(c) Which process in the body transforms energy in food into heat?

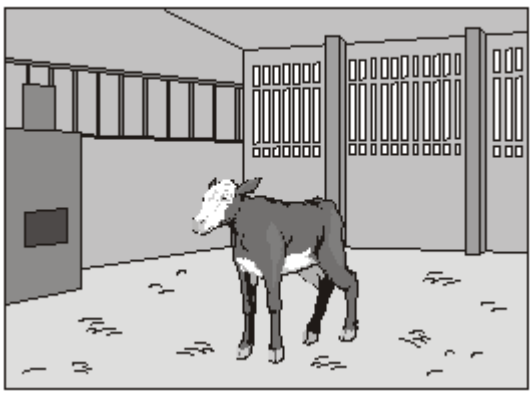
.....

**(1)**

(d) The pictures show two methods of raising calves indoors.

**Method 2** is now banned.

**Method 1**



**Method 2**

(i) Calves raised indoors grow faster than calves raised outdoors.

Suggest **one** reason why.

.....

.....

**(1)**

(ii) **Method 2** was banned after public campaigns.

Suggest **one** reason why people campaigned against this method of rearing calves.

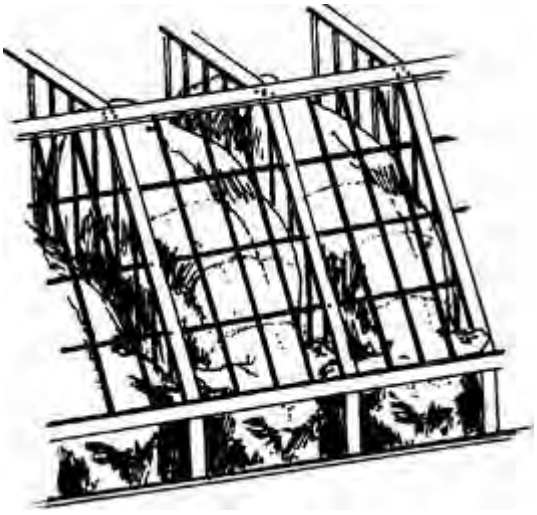
.....

.....

**(1)**

**(Total 7 marks)**

**Q3.** To produce cheap meat, animals must be grown (reared) efficiently. When pigs are reared intensively they are kept indoors. Their surroundings are closely monitored to make sure they have even ventilation and the correct temperature. The risk of infection is high but is reduced by feeding them antibiotics and removing their faeces. The pigs live in cages and cannot move around much.



(a) Explain why farmers control the temperature.

.....

.....

.....

**(2)**

(b) Explain why farmers want to stop the pigs moving about.

.....

.....

.....

**(2)**

(c) Give two arguments **against** rearing pigs indoors instead of rearing them outdoors.

1 .....

2 .....

**(2)**

**(Total 6 marks)**

**Q4.** The table gives information about the growth of different types of organism.
The figures were obtained during the period of fastest growth for each organism.

| **Organism** | **Time taken to double in mass** |
|---|---|
| Bacteria | 40 minutes |
| Yeasts | 2 hours |
| *Fusarium* | 4 hours |
| Algae | 5 hours |
| Soybeans | 1 week |
| Cattle | 8 weeks |

(a) (i) Which type of organism grows the fastest? .....

**(1)**

(ii) How many times faster than cattle do soybeans double in mass?

.....

**(1)**

(iii) *Fusarium* grows at its fastest rate in a fermenter.
Some scientists put **one tonne** of *Fusarium* into a fermenter.

Use data from the table to calculate how much *Fusarium* there would be in the fermenter after 8 hours.

Draw a ring around **one** answer.

**2 tonnes** **4 tonnes** **8 tonnes**

**(1)**

(b) *Fusarium* is used to make mycoprotein.

Read the information about substances found in mycoprotein.

- Protein – can be used for making cells, enzymes and antibodies.

- Fats – are rich in energy but large amounts in the diet can cause circulatory problems.
- Dietary fibre – helps to reduce the risk of colon cancer.

The table compares the composition of mycoprotein and beef.

| Substance | Percentage of dry mass | |
|---|---|---|
| | **Mycoprotein** | **Beef** |
| Protein | 47.2 | 68.3 |
| Fat | 13.5 | 30.1 |
| Dietary fibre | 19.2 | 0.0 |

Use the information above to answer the questions.

(i) Give **two** reasons why it would be better to eat mycoprotein instead of beef.

1 .....

.....

2 .....

.....

**(2)**

(ii) Give **one** reason why it would be better to eat beef instead of mycoprotein.

.....

.....

**(1)**

**(Total 6 marks)**

**Q5.** Mycoprotein is produced from the fungus *Fusarium*. Mycoprotein is sometimes used instead of meat in foods for vegetarians.

(a) The table shows the amounts of some substances in mycoprotein and in chicken.

| Substance | Mass in grams per 100 grams | |
|---|---|---|
| | **Mycoprotein** | **Chicken** |
| Protein | 11.8 | 22.0 |
| Dietary fibre | 4.8 | 0.0 |
| Fat | 3.5 | 6.2 |
| Carbohydrate | 2.0 | 0.0 |
| Cholesterol | 0.0 | 0.1 |

(i) Draw a ring around the correct answers to complete the sentence.

Eating mycoprotein instead of chicken helps to lower the risk of heart disease because

mycoprotein contains no [fat / carbohydrate / cholesterol] and

mycoprotein contains less [dietary fibre. / fat. / carbohydrate.]

**(2)**

(ii) A body-builder ate 4 kilograms of chicken each week to help him build up his muscles.

If he ate mycoprotein instead of chicken, he would need to eat about twice as much to have the same effect.

Use information from the table to give **one** reason why.

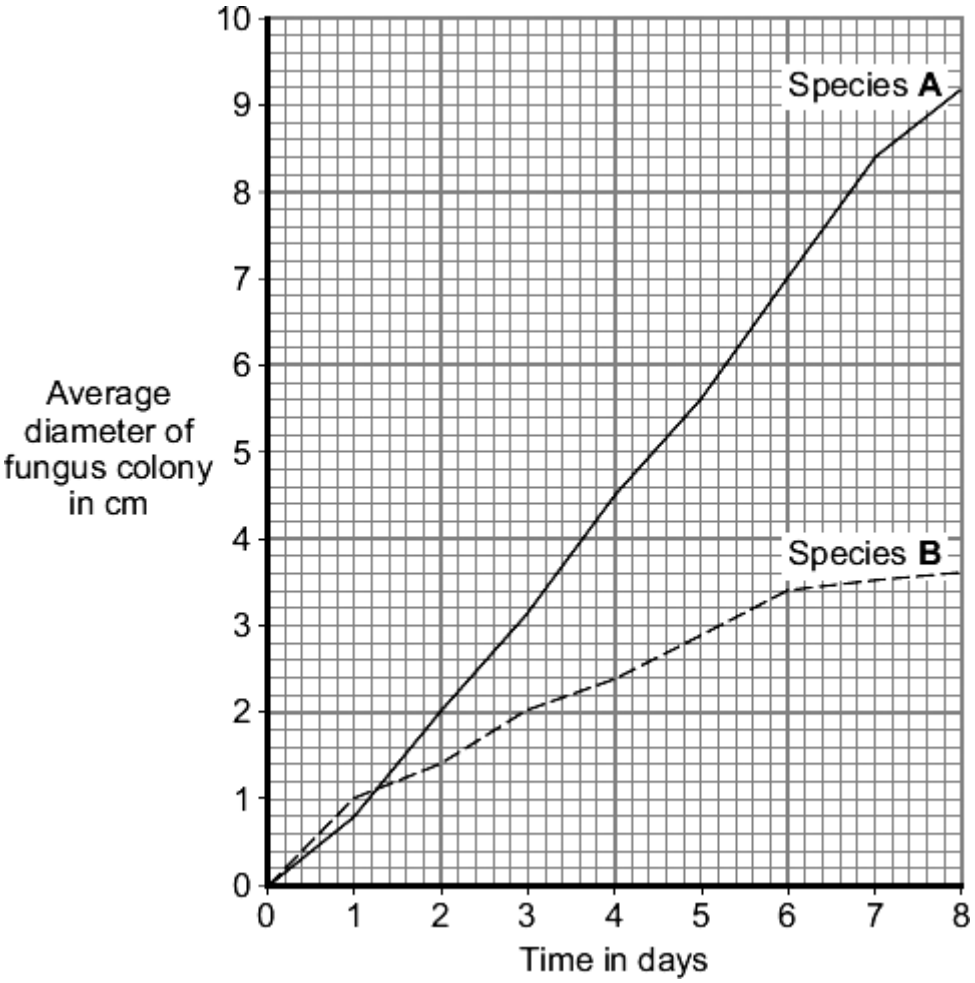
.....

.....

**(1)**

(b) Scientists investigated the growth of two species, **A** and **B**, of the fungus *Fusarium*.
The scientists grew the fungus on agar jelly in Petri dishes.
They measured the diameter of a colony of each fungus every day for 8 days.

The graph shows the results.




(i) Describe how the diameter of the colony of species **A** changed between day 0 and day 8.

.....

.....

.....

.....

**(2)**

(ii) Give **one** difference between the results for species **A** and the results for species **B**.

.....

.....

**(1)**

(c) Both Petri dishes contained the same nutrients.
Both Petri dishes were kept at 25 °C.

When *Fusarium* is grown in an industrial fermenter, other factors also need to be controlled.

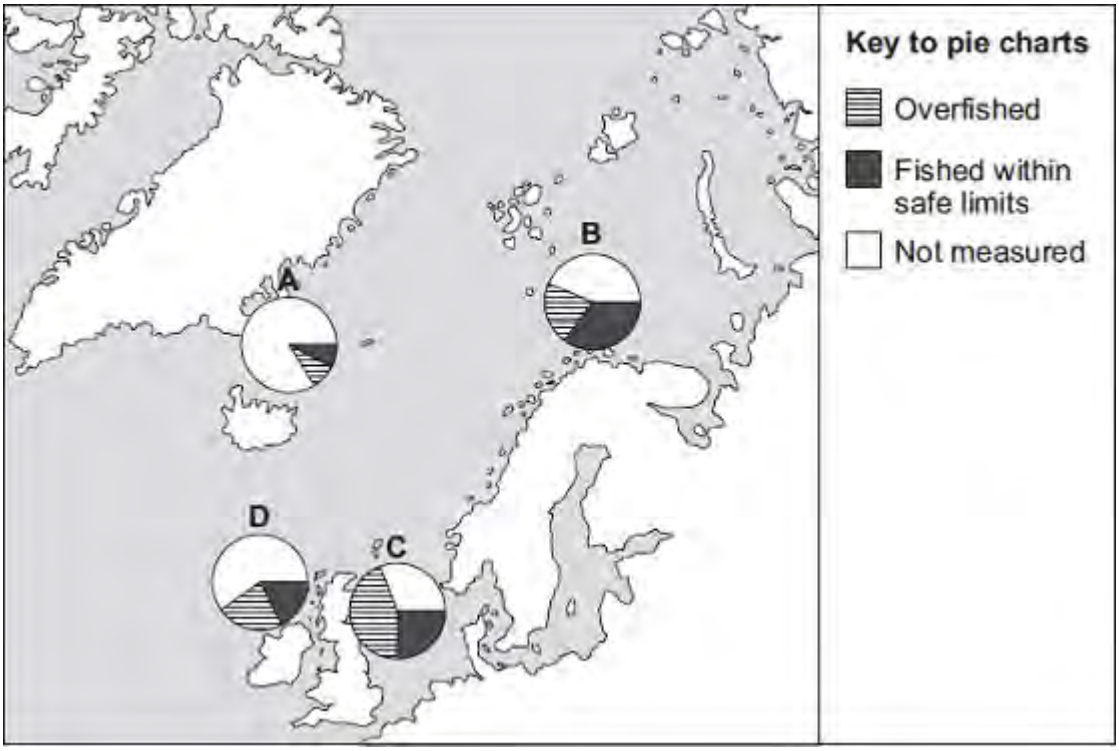
Give **two** of these other factors.

1 .....

2 .....

**(2)**
**(Total 8 marks)**

**Q6.** The map shows pie charts, **A**, **B**, **C** and **D**, that give information about fisheries in some of the seas around Europe.






(a) Which pie chart, **A**, **B**, **C** or **D**, shows the fishery with the largest amount of overfishing? ☐

**(1)**

(b) It is important to maintain fish stocks high enough for breeding to continue.

Give the reason why.

.....

.....

**(1)**

(c) Give **two** ways fish stocks can be conserved.

.....

.....

.....

.....

**(2)**
**(Total 4 marks)**

**Q7.** The photographs show four ways of farming.

**Growing wheat**

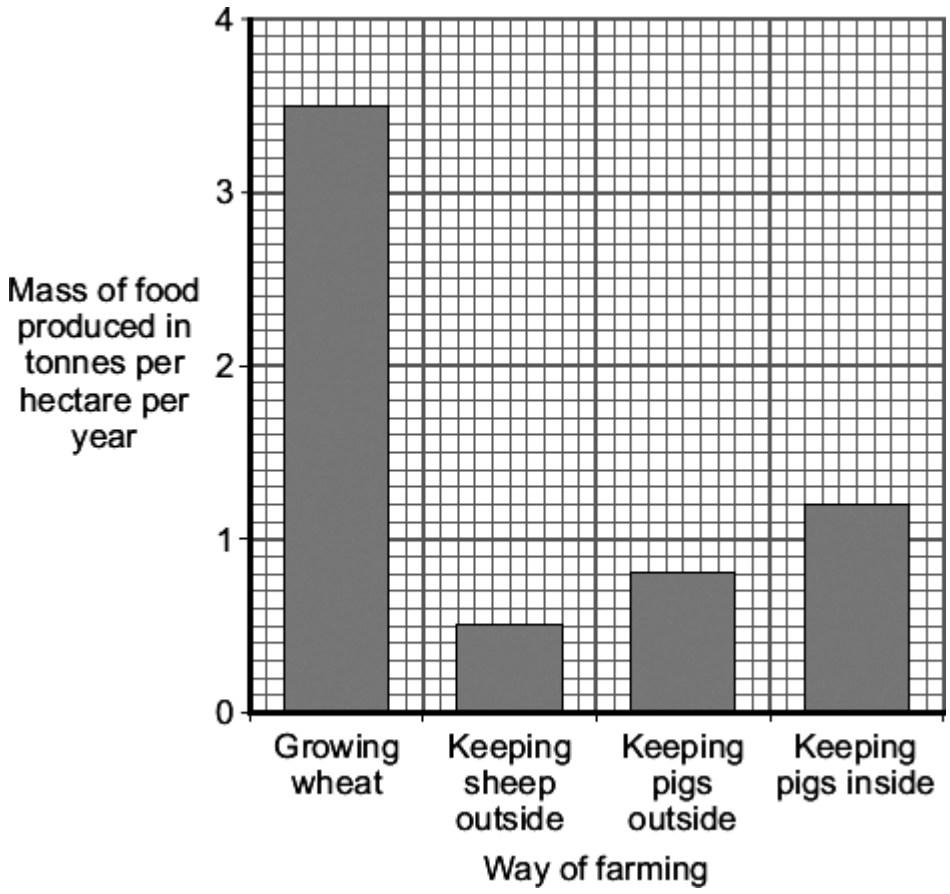
**Keeping sheep outside**

**Keeping pigs outside**

**Keeping pigs inside**

Growing wheat by Eileen Henderson [CC-BY-SA-2.0], via Wikimedia Commons. Keeping Sheep outside by Andrew Smith [CC-BY-SA-2.0], via W kimedia Commons. Keeping Pigs outside by David Williams [CC-BY-SA-2.0], via Wikimedia Commons. Keeping Pigs inside supplied by iStockphoto/ Thinkstock.

The bar chart shows the amount of food produced from these four ways of farming.




(a) How much extra food can be produced when farmers grow wheat, compared with keeping sheep outside?

Show clearly how you work out your answer.

.....

.....

Answer ..... tonnes per hectare per year

**(2)**

(b) Sheep eat grass.
For every 1000 g of grass eaten, a sheep increases in mass by only 50 g.
The other 950 g is lost.

How is the other 950 g lost?

Tick (✓) **two** boxes.

As oxygen from photosynthesis ☐

As faeces ☐

As meat ☐

As carbon dioxide from respiration ☐

**(2)**

(c) (i) Pigs kept inside lose less energy than pigs kept outside.

Why?

Tick (✓) **two** boxes.

Pigs kept inside are fed more. ☐

Pigs kept inside are kept in small pens. ☐

Pigs kept inside are kept warm in the winter. ☐

Pigs kept inside are healthier. ☐

**(2)**

(ii) Meat from pigs kept inside is usually cheaper than meat from pigs kept outside.

Give **one** reason why.

.....

.....

**(1)**
**(Total 7 marks)**

**Q8.** There are plans for a 'cattle factory' to be built in the UK.

Information about the cattle factory and traditional cattle farming in the UK is given below.

Cattle factory

Traditional cattle farming

Cattle factory by Pirhan [CC BY-SA 2.0], via Flickr. Traditional cattle farming by Mat Fascione[CC-BY-SA-2.0], via W kimedia Commons

**Cattle factory**

- There will be over 8 000 cows in three large sheds.
- Each cow will be milked three times a day.
- Each cow will produce about 50 litres of milk every day.
- Waste will be collected and used to produce electricity for 2 000 homes.
- Cows are kept near to each other so disease can spread easily.

**Traditional cattle farming**

- Most farms have between 5 and 500 cows.
- The cows spend most of the time in fields.
- Cows are milked once or twice a day.
- Each cow produces up to 20 litres of milk a day.
- The waste is used as natural fertiliser for crops.

(a) Use the information to answer the questions.

(i) Give **two** reasons why some people think the cattle factory is a good idea.

1 .....

.....

2 .....

.....

**(2)**

(ii) Give **two** reasons why some people think traditional farming is better than the cattle factory.

1 .....

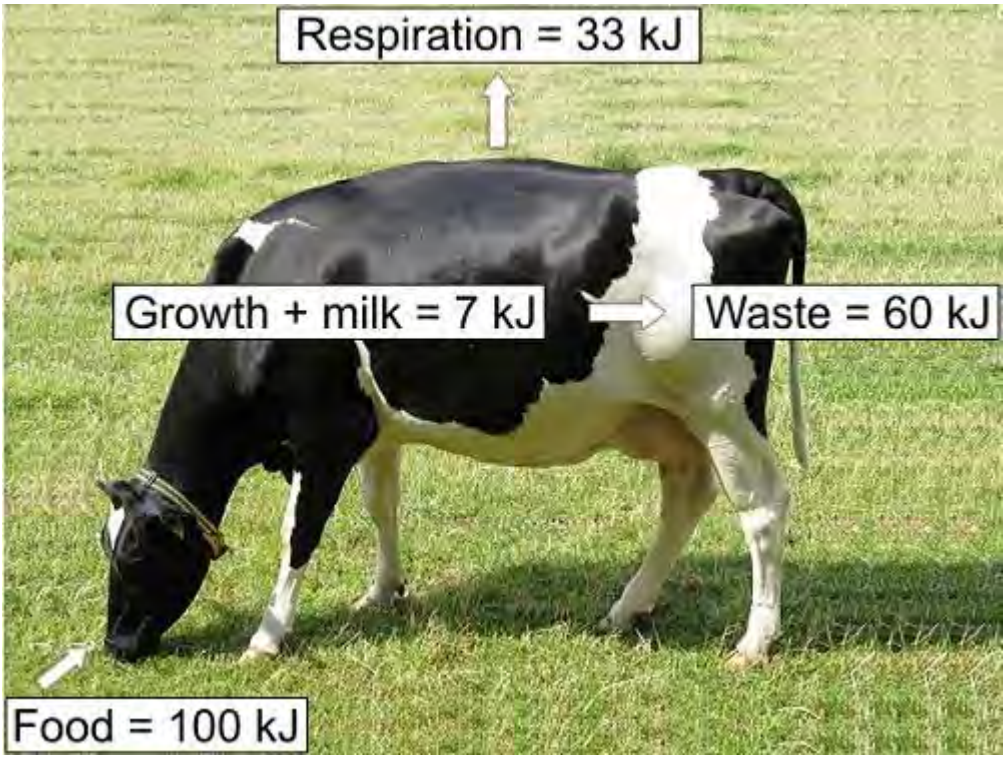
.....

2 .....

.....

**(2)**

(b) The diagram shows what happens to 100 kJ of energy in the food eaten by a cow on a traditional farm.




By Dohduhdah (Own work) [Public domain], via W kimedia Commons

Use your knowledge and the information in the diagram to answer this question.

Compare the transfer of energy from the food eaten by cows in the cattle factory with the energy transferred by cows on a traditional farm.

Use words from the box to complete the table.

| **more** | **less** | **the same** |
|---|---|---|

| **Energy** | **Amount of energy transferred by cows in a cattle factory compared with cows on a traditional farm** |
|---|---|
| transferred for growth and milk | |
| transferred in respiration | |

**(2)**
**(Total 6 marks)**

**M1.** (a) limiting their movement
**or**
controlling the temperature of their surroundings

**1**

reason:
reduces energy transfer

*if no other marks awarded, allow **1** mark for: 'fit more chickens in same space'*

**1**

(b) (i) without oxygen

*ignore 'without air'*

**1**

(ii) any **two** from:
- ethanol

  *allow alcohol*
- carbon dioxide
- lactic acid.

  ***do not accept** energy / ATP (apply list rule)*

**2**

(c) enzymes are denatured / change shape

*ignore microbes are killed*

**1**

(enzyme) shape is vital for function **or** won't work (as efficiently)

**1**

(d) (i) 200

**1**

(ii) 120

*allow ecf from (d)(i)*

*e.g.*

$\frac{60}{100} \times$ *(i)*

**1**

(e) causes global warming

**1**

one predicted consequence of global warming

*eg rising sea levels, climate change, change in migration patterns, change in distribution of species*

**or**
methane is flammable

so might cause fire / damage

*if no other marks awarded, allow methane is a greenhouse gas for **1** mark*

**1**

**[11]**

**M2.** any **three** from:

*maximum **2** marks if only advantages **or** only disadvantages given*

*ignore references to cost unqualified*

advantages: (max 2)

*ignore reference to fresher*

- less transport / example of transport **or** less fuel used

  *accept implication eg less food miles*

  *allow no transport / fuel costs*

- less pollution / example

  *accept eg less carbon dioxide / smaller carbon footprint*

  *allow no pollution / example*

- support of local / UK economy / farmers

disadvantages: (max 2)

- not available all year
- may require use of heat / light
- (production of) heat / light causes pollution

**[3]**

**M3.** (a) (i) wheat → humans chain transfers 10 times more energy than wheat → pigs → humans chain

*allow 10% if given as a comparison e.g. one is 10% of the other*

or

wheat → pigs → humans chain transfers 810 000 (kJ per hectare) less

*ignore less unqualified*

**1**

(ii) any **one** reason for energy loss from pigs e.g :

*ignore respiration, growth*
*ignore heat unqualified*

- movement
- (maintaining) body temperature
- waste materials
  *allow named examples*
- not all parts of pig eaten by human
- because there is an extra stage (pigs) in the food chain and energy is lost at each stage
  *allow longer food chain so more energy lost*

**1**

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance, and apply a 'best-fit' approach to the marking.

**0 marks**No relevant content.

**Level 1 (1-2 marks)**There is a basic description of at least one factory farming method
**or**
identification of an advantage or disadvantage of factory farming.

**Level 2 (3-4 marks)**There is a description of at least one factory farming

method
**and**
an advantage or disadvantage is explained.

**Level 3 (5-6 marks)**There is a description of factory farming methods
**and**
advantage(s) and disadvantage(s) are explained.

**Examples of Biology points made in the response:**

factory farming methods e.g.:

- Kept in cramped conditions / battery hens / calf crates / pig barns / fish tanks
- Controlled temperature / heating
- Controlled feeding / modified food given / growth hormones
- Controlled lighting
- Treated with prophylactic antibiotics

Advantages e.g.:

- Increased efficiency / profit / greater food production / cheaper food / faster growth
- Farmer can have more livestock
- Less energy is lost through movement
- Less energy is used keeping warm
- (Food is high in calories / protein) so animals will grow faster / lay more eggs
- Easier to vaccinate all the animals
- Easier to protect animals from predators
- Antibiotic treatment stops infections in animals

Disadvantages e.g.:

- Stress / cruelty / inhumane / unethical
- Restricted movement / overcrowding
- Faster spread of diseases

- Antibiotics in the food chain / residual chemicals in the food chain
- Wasting fossil fuels / increasing global warming
- Increased pollution from animal waste and from additional transport

**6**

**[8]**

**M4.**(a) (i) fungus

**1**

(ii) oxygen / $O_2$

*accept air*

*accept $O_2$*

*do **not** allow $O^2$ / O / O2*

**1**

(iii) glucose (syrup)

*allow carbohydrate / sugar*

*ignore food / starch*

*allow oxygen if oxygen / air not given in (a)(ii)*

**1**

(b) any **two** from:

- quicker
- suitable for vegetarians
- cheaper
- more efficient **or** less land / methane

*ignore high in protein*

*ignore sustainability unqualified*

*ignore less pollution unqualified*

*allow less animals harmed / killed*

*allow food chain is shorter **or** has less trophic levels*

*allow less energy lost (from the food chain)*

*do **not** allow no energy lost*

*allow low(er) in calories (than some meat)*

*allow low(er) in fat / healthier (than some meat)*

*allow source of fibre / prevent constipation*

**2**

**[5]**

**M5.**(a) (i) 76.0 / 76

*correct answer with or without working gains 2 marks*
*allow 76.04 for 2 marks*
*allow 76.04 with extra decimal places eg 76.042 for 1 mark*
$\frac{465}{611.5}$ *for 1 mark*

**2**

(ii) mass of fish declines (until 2008)

*ignore use of numbers*
*allow number of fish decline (until 2008)*

**1**

(due to an) increase in fishing / overfishing

**1**

and then rises (until 2010)

**1**

(which could be due to) quotas / net restrictions working

*allow any reasonable suggestion, such as countries swapping quotas or restrictions on fishing during breeding seasons*
*ignore less fishing*
*if no other marks awarded allow 1 mark for a decrease in mass **and** an increase in mass if answer relates to sustainable fishing*

**1**

(iii) (this is due to) public awareness / demand

*allow legislation / rules*

**1**

(b) fishing quotas / bans

**1**

(small) net / mesh size

*if size of net is stated then it must be smaller*
*if size of mesh is stated then it must be larger*

**1**

(c) (fish) cannot move freely / as much

1

(therefore) less <u>energy</u> loss from the fish

*do **not** allow 'no energy is lost'*

*ignore references to less heat loss through controlling body temperature*

*ignore references to respiration*

1

(there is) more food available / better quality food / fed more often

*accept 'high-protein food (for making cells)'*

1

(so) there is more energy for growth **or** (more food) is converted to biomass

1

**[13]**

**M6.** (a) it is impossible to weigh all the fish in the sea

**1**

(b) (i) increase / from 50 to 350 / by 300 thousand tonnes

**1**

(ii) due to fishing ban / not allowed

**1**

(c) (i) fishing quotas / limits

**1**

changes to net size

**1**

(ii) yes, biomass increases

**1**

use of figures from graph eg approx 4- times **or** (was effective at first) but numbers decline again after 2004

*must use two comparative figures for 2nd marking point*

**1**

(iii) so that breeding continues

*alllow prevent extinction / limit impact of fishing on food chain / web*

**1**

(iii) 95%

*correct answer gains **2** marks*

*2000-100=1900 award **1** mark*

**2**

(d) any **four** from:

- increase in <u>sea / water</u> temperature

  *accept ref to lower <u>sea / water</u> temp if shift in Gulf Stream is referred to*
- changes in migration patterns / distribution of species

- more eggs may survive (up to 19 °C) and could lead to an increase in herring pop
- reduction in herring pop (because eggs die if >19 °C)

  *accept change in other populations of fish which are alternative prey for cod*
- (appropriate) change in cod population as a result

**4**

**[14]**

**Q1.Figures 1** and **2** show battery chickens and free-range chickens.

**Figure 1**
**Battery chickens**

© studiodr/iStock/Thinkstock

**Figure 2**
**Free-range chickens**

© xlikovec/iStock/Thinkstock

Battery chickens are kept in cages indoors. Free-range chickens can walk around outside.

(a) Give **one** way in which food production might be more efficient from battery chickens than from free-range chickens. Give a reason for your answer.

.....

.....

.....

.....

.....

**(2)**

(b) Some farms use waste from chickens to produce biogas in an anaerobic digester.

Microorganisms in the digester break down the waste by anaerobic respiration.

(i) What does **anaerobic** mean?

.....

.....

**(1)**

(ii) One product of anaerobic respiration is methane.

Name **two** other products of anaerobic respiration.

1.....

2.....

**(2)**

(c) The best temperature for anaerobic digesters is about 35 °C.

Explain why the volume of biogas produced would be **less** at higher temperatures.

.....

.....

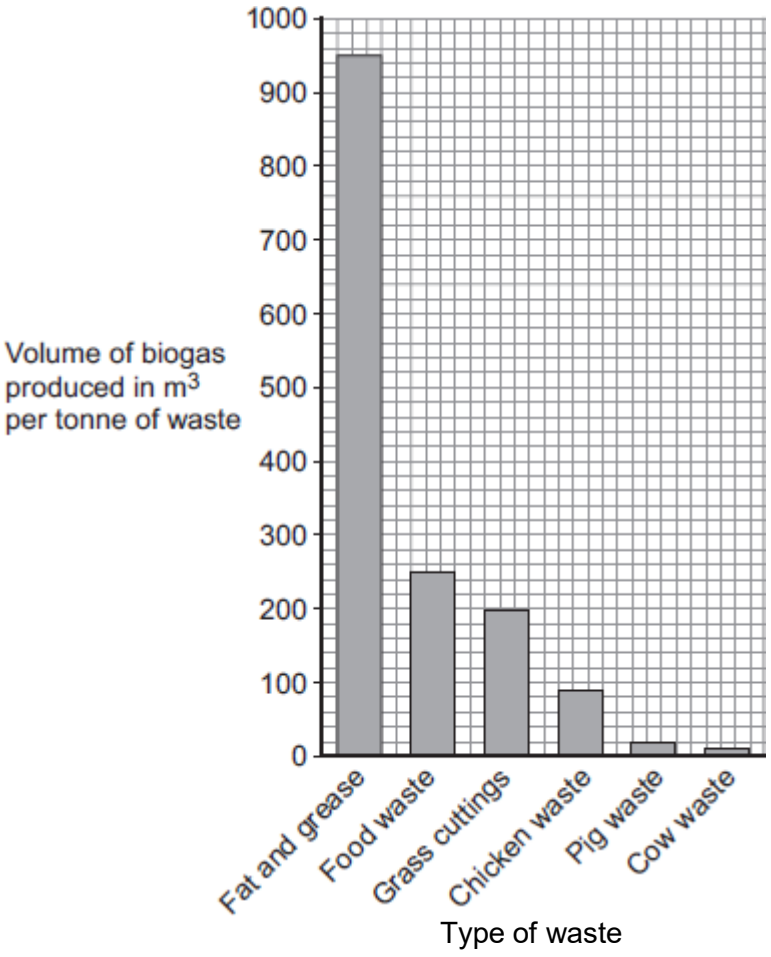
.....

.....

**(2)**

(d) **Figure 3** shows other types of waste that can be used in an anaerobic digester to produce biogas.

**Figure 3**




(i) What is the volume of biogas produced by a tonne of grass cuttings?

..... $m^3$

**(1)**

(ii) Biogas is 60% methane.

Calculate the volume of methane gas produced per tonne of grass cuttings.

..... $m^3$

**(1)**

(e) Why should biogas **not** be allowed to escape into the atmosphere?

.....

.....

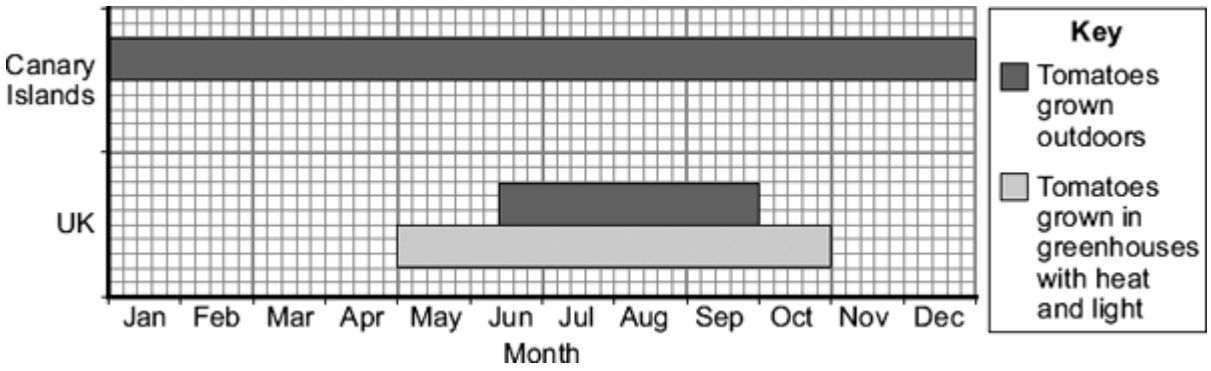
.....

.....

**(2)**
**(Total 11 marks)**

**Q2.** Tomatoes are grown in greenhouses in the UK and outdoors in the UK and the Canary Islands.

The chart shows in which months these tomatoes can be bought in shops in the UK.




The Canary Islands are about 3000 km from the UK.

Some people prefer to buy tomatoes grown in the UK.

What are the **advantages** and **disadvantages** of buying tomatoes grown in the UK, instead of buying tomatoes grown in the Canary Islands?

**Advantages** of buying tomatoes grown in the UK

.....

.....

.....

.....

**Disadvantages** of buying tomatoes grown in the UK

.....

.....

.....

.....

**(Total 3 marks)**

**Q3.**There are many ways to increase the efficiency of food production.

(a) The table shows the energy available to humans from two different food chains.

| Food chain | Energy transferred to humans in kJ per hectare of crop |
|---|---|
| Wheat → humans | 900 000 |
| Wheat → pigs → humans | 90 000 |

(i) Compare the amount of energy the two food chains transfer to humans.

.....

.....

**(1)**

(ii) Give **one** reason for the difference in the amount of energy the two food chains transfer to humans.

.....

.....

**(1)**

(b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Give methods used in the factory farming of animals.
Explain the advantages and disadvantages of these methods.

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**(6)**
**(Total 8 marks)**

**Q4.** The world population is increasing and the need for food is increasing.

Mycoprotein is a high-protein food made in fermenters using the organism *Fusarium*.

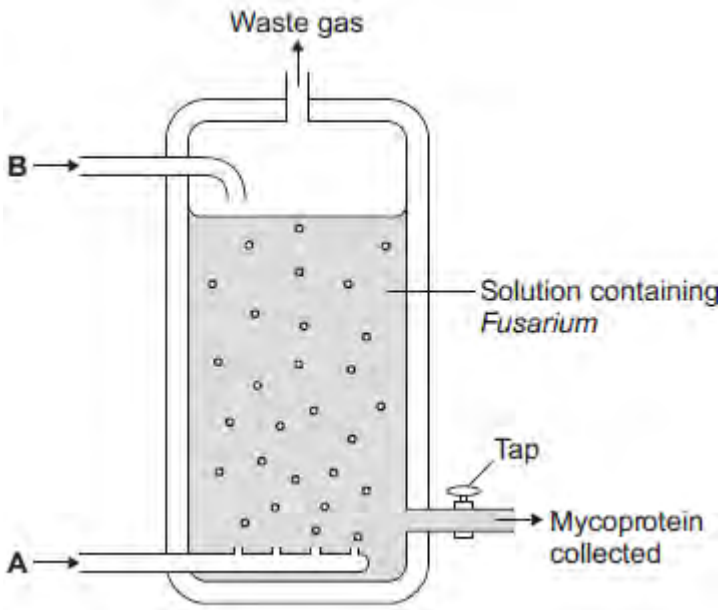
The process takes only a few weeks to produce a large amount of food.

(a) (i) What type of organism is *Fusarium*?

Draw a ring around the correct answer.

**bacterium** **fungus** **virus**

The diagram below shows a fermenter used in mycoprotein production.




**(1)**

(ii) *Fusarium* makes mycoprotein. *Fusarium* respires aerobically.

Suggest which gas is added to the fermenter at point **A**.

.....

**(1)**

(iii) Another substance is added to the fermenter at point **B**. This substance is used in aerobic respiration.

Name this substance.

.....

**(1)**

(b) People need to eat protein to grow and to be healthy.

Some people think that it would be an advantage to get more food from mycoprotein and less from farming animals.

Suggest **two** possible advantages of getting more food from mycoprotein.

1.....

.....

2.....

.....

**(2)**
**(Total 5 marks)**

**Q5.** The number of fish in the oceans is decreasing.

The table below shows information about the mass of fish caught by UK fishermen between 2002 and 2010.

| Year | Mass of fish caught by UK fishermen from ALL SOURCES in thousands of tonnes | Mass of fish caught by UK fishermen from SUSTAINABLE SOURCES in thousands of tonnes | Percentage of fish caught from sustainable sources |
|---|---|---|---|
| **2002** | 690.0 | 427.8 | 62.0 |
| **2004** | 655.0 | 396.6 | 60.5 |
| **2006** | 619.0 | 386.0 | 62.4 |
| **2008** | 589.0 | 436.1 | 74.0 |
| **2010** | 611.5 | 465.0 | |

(a) (i) Calculate the percentage of fish caught from sustainable sources in 2010.

.....

.....

.....

..... %

**(2)**

(ii) Describe the pattern in the table above for the mass of fish caught from all sources.

Suggest reasons for this pattern.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**(4)**

(iii) Suggest why the percentage of fish caught from sustainable sources is increasing.

.....

.....

**(1)**

(b) Give **two** methods of maintaining fish stocks at a sustainable level.

1 .....

2 .....

**(2)**

(c) The image below shows a fish farm.

© debsthelio/iStock/Thinkstock

In a fish farm, large numbers of fish are grown in cages in the sea.

Why do fish in the cages grow faster than fish of the same species that are free in the sea?
You should refer to energy in your answer.

.....

.....

.....

.....

.....

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.....

.....

**(4)**
**(Total 13 marks)**

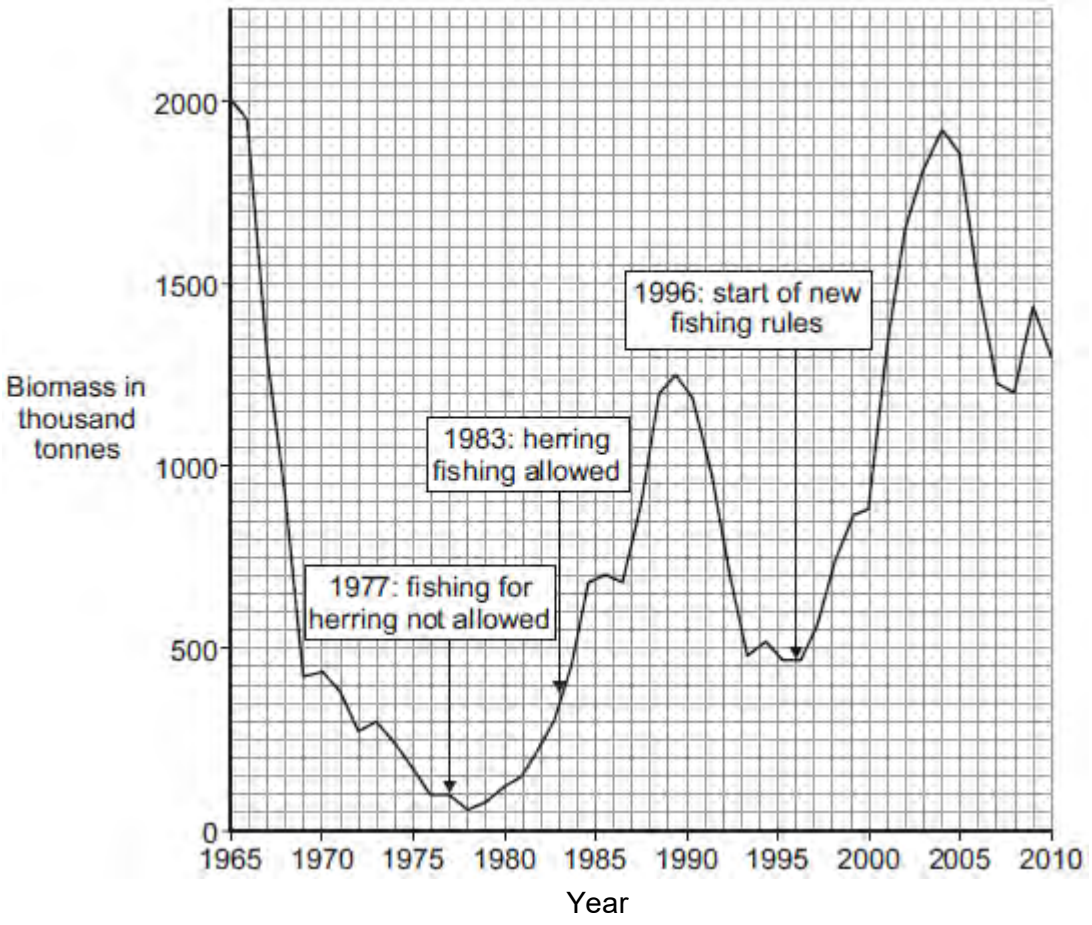
**Q6.** Herring are a type of fish found in the North Sea. Herring are caught using nets which are pulled by large boats.

The photographs show a fishing boat and some herring.

By Atle Grimsby from Utsira, Norway (Herring Catch at Utsira) [CC-BY-2.0 (http://creativecommons.org/licenses/by/2.0)], via Wikimedia Commons.

The herring population in the North Sea has changed a lot in recent years.

The graph shows the estimated biomass of herring in the North Sea between 1965 and 2010.




(a) Suggest why the biomass can only be estimated.

Tick (✓) **one** box.

Scientists are not properly trained. ☐

There are too many different types of fish in the sea. ☐

It is impossible to weigh all the herring in the sea. ☐

**(1)**

(b) (i) Describe the pattern shown in the graph from 1978 to 1983.

.....

.....

**(1)**

(ii) Suggest a reason for the pattern you have described in part **(b) (i)**.

.....

.....

**(1)**

(c) In 1996 the Government brought in strict rules to help to conserve fish stocks.

(i) State **two** rules that would help to conserve fish stocks.

1 .....

.....

2 .....

.....

**(2)**

(ii) Were the Government's rules effective?

Use data from the graph to support your answer.

.....

.....

.....

.....

**(2)**

(iii) Why should fish stocks be kept above a certain minimum level?

.....

.....

**(1)**

(iv) The Government did not introduce rules about the amount of herring caught until 1977.

This was in response to a dramatic decrease in herring stocks.

What was the percentage decrease in herring stocks between 1965 and 1977?

.....

.....

Percentage decrease = .....

**(2)**

(d) Herring migrate to feed and spawn (lay eggs).

The eggs normally take about 3 weeks to hatch at 12 °C.

If the temperature of the water is higher the eggs will hatch more quickly.

But, if the temperature of the water is above 19 °C, the eggs will die.

Other fish, such as cod, feed on herring.

Suggest how climate change could affect North Sea fish.

.....

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.....

.....

.....

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.....

.....

.....

**(4)**
**(Total 14 marks)**

**M1.** (a) (i) 200 kJ

*for 1 mark*

**1**

(ii) 2

*gains 2 marks*
*(if answer incorrect, 20 / 1000 × 100 gains 1 mark)*

**2**

(b) *ideas that*
energy lost by animal (pig / cattle) / extra stage / extra trophic level
in waste materials e.g.
in muscular activity / movement
in keeping body temperature higher than surroundings / lost as heat

*any three for 1 mark each*
*references to respiration regarded as neutral*

**3**

(c) *ideas that*
controlling (high) temperature of surroundings / keeping indoors / insulating
reduces energy transferred from animal as heat / animal uses body heat to maintain temperature restricting movement (e.g. caging or keeping in darkness)
reduces muscular contraction / muscular activity

*each for 1 mark*
*accept respiration as explanation once only if neither explanation point has received credit*
*reject give more food / different food*

**4**

**[10]**

**M2.** to reduce energy ‘lost’ (by movement)

*accept need less energy*

so more energy is available for growth

*accept prevents loss of body mass to provide energy*
*accept so need less food*
*accept get fatter*
*accept so weight gain*
*accept so more growth*

**[2]**

**M3.** (a) circulation / mixing / described

**1**

**or**

temperature maintenance

supply <u>oxygen</u>

*do **not** allow oxygen for anaerobic respiration*

**or**

for <u>aerobic</u> conditions

**or**

for <u>faster</u> respiration

**1**

(b) any **one** from:

- energy supply / fuel
  **or** use in respiration

  *do **not** allow just food / growth*

  *ignore reference to aerobic / anaerobic*

- <u>material</u> for growth
  **or** to <u>make</u> mycoprotein

**1**

(c) (heat / energy) from <u>respiration</u>

*allow <u>exothermic</u> reactions*

*allow description eg <u>breakdown</u> of glucose / catabolism*

*ignore metabolism*

*ignore aerobic / anaerobic*

**1**

(d) (i) any **one** from:

- compete (with Fusarium) for food / oxygen
  **or** reduce yield of Fusarium

- make toxic waste products
  **or** they might cause disease / pathogenic

**or** harmful to people / Fusarium
*do **not** allow harmful unqualified*

**1**

(ii) any **two** from:

- steam / heat treat / sterilise fermenter (before use)
  ***not** just clean*
  *allow sterilisation unqualified for **1** mark*
- steam / heat treat / sterilise glucose / minerals / nutrients / water (before use)
  ***not** just use pure glucose*
- filter / sterilise air intake
- check there are no leaks

**2**

(e) any **three** from:

- beef is best **or** beef is better than mycoprotein(*)
- mycoprotein <u>mainly</u> better than wheat(*)
- more phenylalanine in wheat than in mycoprotein(*)
  *allow equivalent numerical statements(*)*
- but no information given on other amino acids / costs / foods

**3**

<u>overall conclusion</u>:

statement is incorrect

**or**

it would be the best source for vegetarians

**or**

for given amino acids, beef is the best source

**or**

three foods provide insufficient data to draw a valid conclusion

1

**[11]**

**M4.** (a) 4 of:
intensification due to need to improve efficiency of energy transfer;
has led to developing fast growing crop varieties;
native plants cannot compete with these;
for e.g. light/water/minerals;
effect of herbicides;
pesticides killing pollinating insects
*each for 1 mark*

**4**

(b) recommend a variety of measures; (can be implied)
because rotational will allow these species to continue;
permanent will allow others;
leading to conservation of a wide range of species
*each for 1 mark*

**4**

**[8]**

**M5.** (a) any **two** from:

- diseases spread more rapidly
- antibiotics can build up in the food chain
  **or**
  over use of antibiotics
- increased use of fossil fuels (to heat the barn)

**2**

(b) **Level 2 (3–4 marks):**
Clear statements made identifying the farming methods which are linked to relevant explanations of how this increases the efficiency of food production.

**Level 1 (1–2 marks):**
Simple statements made identifying the farming methods used, but no attempt to link to explanations of how this increases the efficiency of food production.

**0 marks:**
No relevant content.

**Indicative content**

**statements:**

- kept inside or in a temperature controlled environment
- kept enclosed or in a restricted environment

**explanations:**

- less energy / heat is lost in controlling body temperature
- less energy required for movement
- so more energy is available for growth
- less energy / heat is transferred to the environment

**4**

(c) (362 − 67 = 295) / 362 × 100

**1**

81 / 81.49 / 81.5

*allow 81 / 81.49 / 81.5 with no working shown for **2** marks*

**1**

(d) aboriginal people can eat other foods (so they may not be in food insecurity)

**1**

we do not know if other (traditional) food sources have declined

1

**[10]**

**M6.** (a) any **one** from:

- increase / give light
- increase temperature / make warmer

award marks if the method by which these could be done is given
eg leave lights on all night **or** use a heater

- increase / give $CO_2$
- add fertiliser / nutrients / minerals / named
  *allow nitrogen*
  *ignore 'food'*

**1**

(b) (i) any **two** from:

- cheaper
  *allow grow faster / more grown*
- better quality / flavour
  *ignore size*
- available all year
  *accept converse if clear that answer refers to use of British tomatoes*
  *allow 'Fair Trade'*

**2**

(ii) any **two** from:

- greater distance **or** more food miles **or** more transport

idea of more needed only once

- transport needs (more) energy / fuel
- reference to eg greenhouse effect / global warming / pollution / $CO_2$ release / carbon footprint
  *ignore ozone*

**2**

**[5]**

**M7.** (a) circulating / mixing / described **or** temperature maintenance

**1**

supply oxygen
**or** for <u>aerobic</u> conditions
**or** for <u>faster</u> respiration

*do **not** allow oxygen for anaerobic respiration*

**1**

(b) energy supply / fuel / use in respiration

*do **not** allow just food / growth*
*ignore reference to aerobic / anaerobic*

**or** <u>material</u> for growth / to <u>make</u> mycoprotein

**1**

(c) <u>respiration</u>

*allow exothermic reaction*
*allow catabolism*
*ignore metabolism*
*ignore aerobic / anaerobic*

**1**

(d) (i) any **one** from:

- compete (with *Fusarium*) for food / oxygen **or** reduce yield of *Fusarium*
- make toxic waste products or they might cause disease / pathogenic **or** harmful to people / to *Fusarium*

*do **not** allow harmful unqualified*

**1**

(ii) steam / heat treat / sterilise fermenter (before use)

***not** just clean*

**or**
steam / heat treat / steriliseglucose / minerals / nutrients / water (before use)
**or**
filter / sterilise air intake
**or**
check there are no leaks
*allow sterilisation unqualified **not** just use pure glucose*

**1**

(e) any **three** from:

- beef is best or beef is better than mycoprotein
- mycoprotein <u>mainly</u> better than wheat
- more phenylalanine in wheat than in mycoprotein
  *allow equivalent numerical statements*
- but no information given on other amino acids / costs / foods

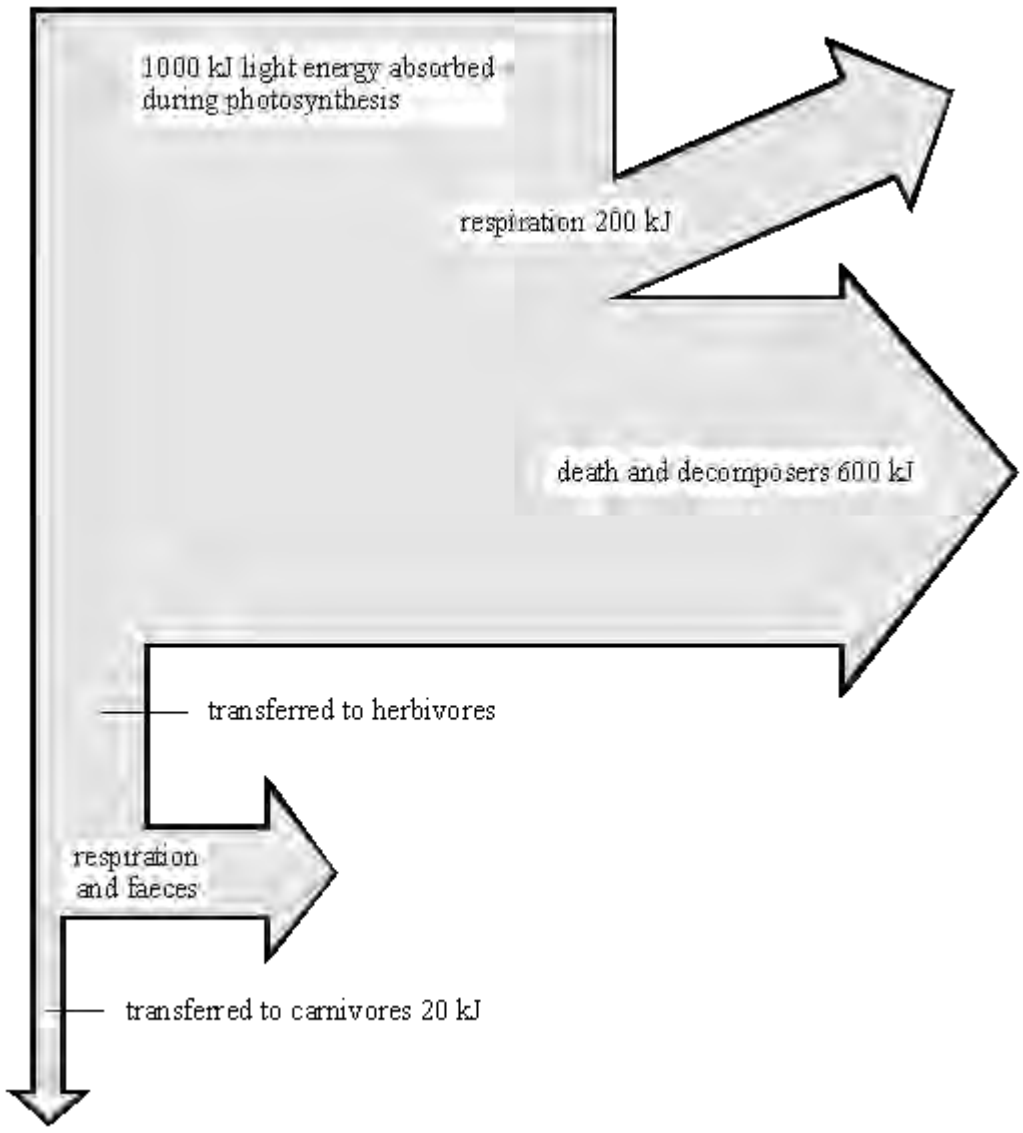
**3**

<u>overall conclusion:</u>

statement is incorrect because
**either**
it would be the best source for vegetarians
**or**
for given amino acids, beef is the best source
**or**
three foods provide insufficient data to draw a valid conclusion

**1**
**[10]**

**Q1.** (a) The diagram shows what happens to each 1000 kJ of light energy absorbed by plants growing in a meadow.




Use the information from the diagram to calculate:

(i) how much energy was transferred to herbivores;

..... kJ

**(1)**

(ii) the percentage of the energy absorbed during photosynthesis that was eventually transferred to carnivores. Show your working.

..... %

**(2)**

(b) The table gives the energy output from some agricultural food chains.

| FOOD CHAIN | ENERGY AVAILABLE TO HUMANS FROM FOOD CHAIN (kJ PER HECTARE OF CROP) |
|---|---|
| cereal crop ⇒ humans | 800 000 |
| cereal crop ⇒ pigs ⇒ humans | 90 000 |
| cereal crop ⇒ cattle ⇒ humans | 30 000 |

Explain why the food chain *cereal crop* ⇒ *humans* gives far more energy than the other two food chains.

.....

.....

.....

.....

.....

.....

.....

.....

**(3)**

(c) The amounts of energy available to humans from the food chain *cereal crop* ⇒ *pigs* ⇒ *humans* can be increased by changing the conditions in which the pigs are kept.

Give **two** changes in conditions which would increase the amount of energy available. In each case explain why changing the condition would increase the available energy.

Change of condition 1 .....

Explanation .....

.....

.....

Change of condition 2 .....

Explanation .....

.....

.....

**(4)**
**(Total 10 marks)**

## Q2. Battery Pigs!

Some countries have battery pigs! Large numbers of pigs are kept indoors and have limited living space which restricts their movement. The temperature of their environment is carefully controlled.

This is a way of producing food efficiently.

These pigs have their movement restricted. Explain why.

.....

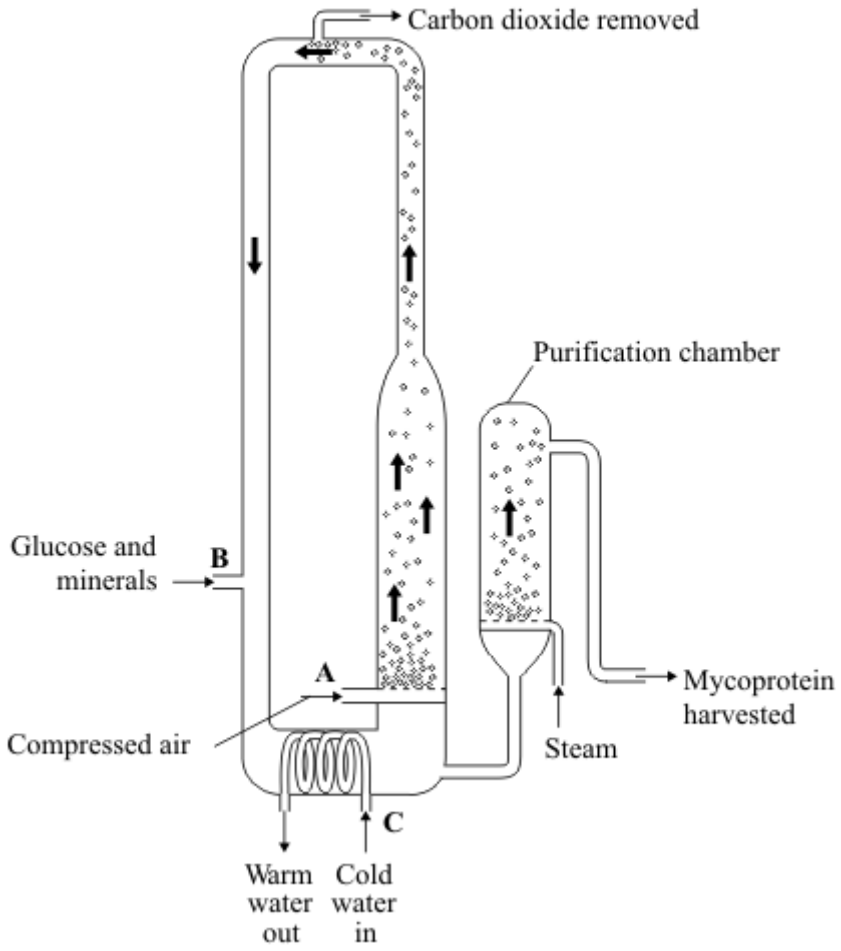
.....

.....

.....

**(Total 2 marks)**

**Q3.** The diagram shows a fermenter. This fermenter is used for growing the fungus *Fusarium* which is used to make mycoprotein.




(a) Bubbles of air enter the fermenter at **A.**

Give **two** functions of the air bubbles.

1 .....

.....

2 .....

.....

**(2)**

(b) Glucose is added to the fermenter at **B.**

Explain why glucose is added.

.....

.....

**(1)**

(c) The fermenter is prevented from overheating by the cold water flowing in through the heat exchanger coils at **C.**

Explain what causes the fermenter to heat up.

.....

.....

**(1)**

(d) It is important to prevent microorganisms other than *Fusarium* from growing in the fermenter.

(i) Why is this important?

.....

.....

**(1)**

(ii) Suggest **two** ways in which contamination of the fermenter by microorganisms could be prevented.

1

.....
.....

.....
.....

2

.....
.....

.....

.....

**(2)**

(e) Human cells cannot make some of the amino acids which we need. We must obtain these amino acids from our diet.

The table shows the amounts of four of these amino acids present in mycoprotein, in beef and in wheat.

| Name of amino acid | Amount of amino acid per 100 g in mg | | | Daily amount needed by a 70 kg human in mg |
|---|---|---|---|---|
| | Mycoprotein | Beef | Wheat | |
| Lysine | 910 | 1600 | 300 | 840 |
| Methionine | 230 | 500 | 220 | 910 |
| Phenylalanine | 540 | 760 | 680 | 980 |
| Threonine | 610 | 840 | 370 | 490 |

A diet book states that mycoprotein is the best source of amino acids for the human diet.

Evaluate this statement.

Remember to include a conclusion in your evaluation.

.....

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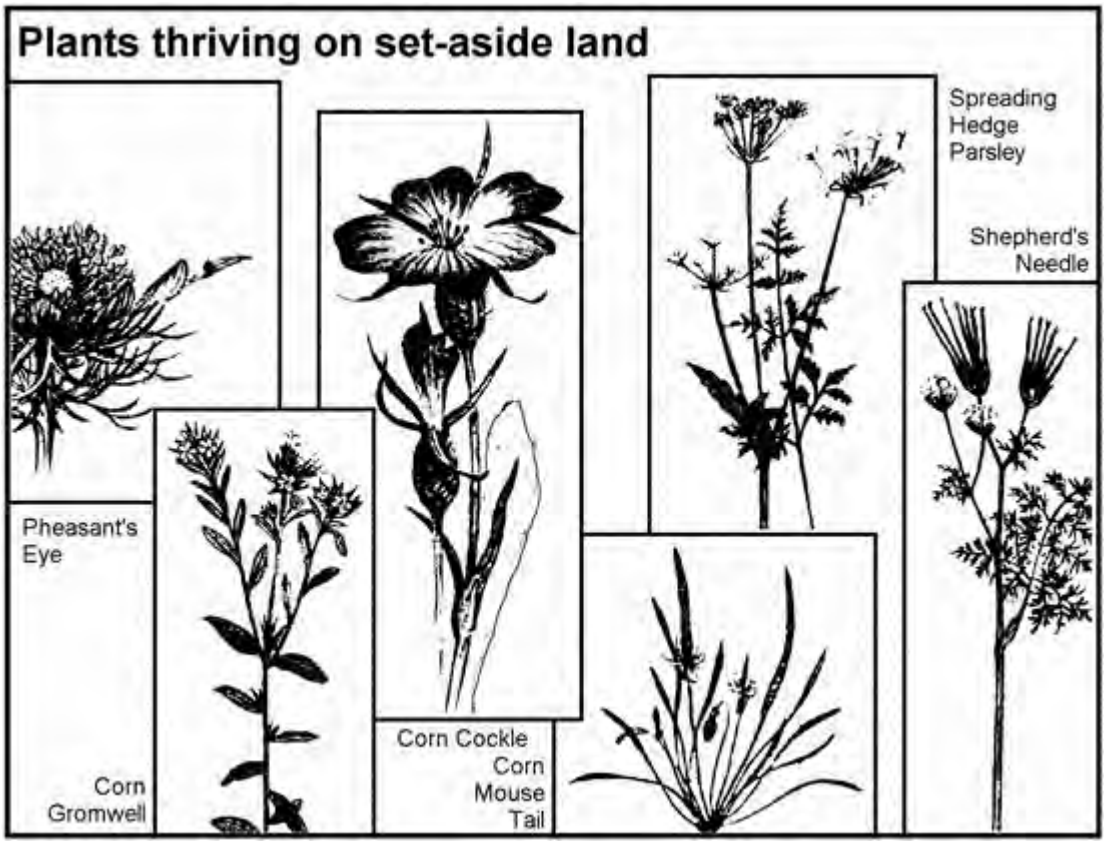
.....

**(4)**

**(Total 11 marks)**

**Q4.**




The drawings and text for this question are based on an article from The Independent newspaper.

Some of Britain's rarest wild flowers are likely to make a come-back thanks to an EC set-aside regime in which 15 per cent of arable land has been taken out of production.

As a result of this set-aside, shepherd's needle, pheasant's eye, corn gromwell, corn cockle, spreading hedge parsley and corn mouse tail are now thriving once again. They were once common in and around cereal fields and were even regarded as weeds, but were swept to near extinction by the intensification of agriculture after the Second World War. Their small, pale flowers are hardly seen. These plants cannot compete in fields where modern cereal crops are cultivated. Nor, however, do they flourish in semi-natural or wild habitats where nature is left to its own devices. They need farmland which is

lightly tilled and cut once a year.

Dr Nick Sotherton, lowland research manager with the Game Conservancy Council, says that these species will flourish under the new rotational set-aside regime, in which farmers are compensated for taking land out of production in an attempt to end crop surpluses.

EC agriculture ministers are meeting to decide how much land should be used for rotational set-aside – in which a field is taken out of production for just one year before being replanted – and how much should be set-aside permanently. The ultimate set-aside is a wood, and Britain is seeking a forestry option.

The Game Conservancy Council says that the rotational scheme can benefit ground nesting birds as well as rare flowers that will not be helped by longer-term set-aside. But Richard Knight of the Wildlife Advisory Group, says "Non-rotational is better because it gives flora and fauna a chance to get well established".

"Intensification of agriculture" has led to the creation of artificial ecosystems.

(a) Explain how the creation of artificial ecosystems may have led to the near-extinction of the plants seen in the picture above.

.....

.....

.....

.....

.....

.....

**(4)**

(b) What would you recommend to ministers meeting to decide a policy involving rotational set-aside and permanent set-aside? Explain the reasons for your answer.

.....

.....

.....

.....

.....

**(4)**
**(Total 8 marks)**

**Q5.**Food security is when a population has enough food to stay healthy.

Lack of food security is a global problem.

One way to maintain food security is to increase the efficiency of food production.

The diagram below shows how some pigs are farmed using intensive methods.



(a) Some people think the farming methods shown in the diagram above are unethical.

Suggest **two** other possible disadvantages of intensive farming methods.

1 .....

.....

2 .....

.....

**(2)**

(b) Explain how the intensive farming of pigs increases the efficiency of food production.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**(4)**

(c) A newspaper reported that:

**'Food security is a serious problem in remote communities in Canada. This is because Aboriginal communities are eating fewer traditional foods.'**

One traditional food eaten by Aboriginal communities in Canada is seal.

Look at the table below

| Year | Number of seals caught in thousands |
|---|---|
| 2004 | 362 |
| 2005 | 316 |
| 2006 | 348 |
| 2007 | 224 |
| 2008 | 215 |
| 2009 | 91 |
| 2010 | 67 |

Calculate the percentage (%) decrease in the number of seals caught from 2004 to 2010.

.....

.....

Decrease in seals = ..... %

**(2)**

(d) The conclusion in the newspaper might **not** be correct.

Suggest **two** reasons why.

1 .....

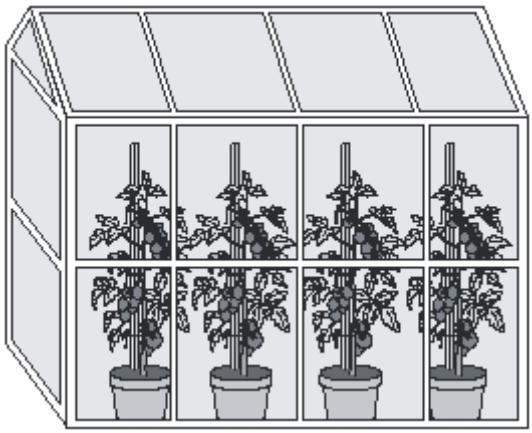
.....

2 .....

.....

**(2)**
**(Total 10 marks)**

**Q6.** In this country most tomatoes are grown in greenhouses.



(a) Suggest **one** way in which a grower could increase the yield of tomatoes from plants growing in his greenhouse.

.....

.....

**(1)**

(b) Large supermarkets often import tomatoes from overseas.

(i) Suggest **two** reasons why a supermarket might decide to import tomatoes rather than buy them from British growers.

1 .....

.....

2 .....

.....

**(2)**

(ii) Importing tomatoes may be more damaging to the environment than selling tomatoes grown in this country.

Explain why.

.....

.....

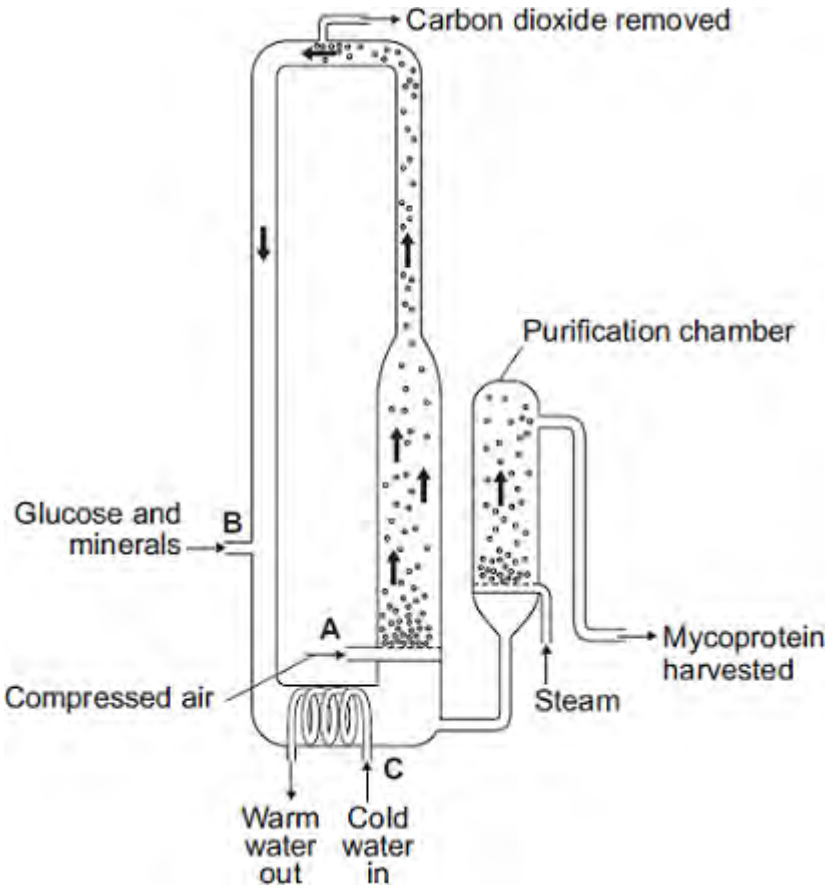
.....

.....

**(2)**
**(Total 5 marks)**

**Q7.** The diagram shows a fermenter. This fermenter is used for growing the fungus *Fusarium*.

*Fusarium* is used to make mycoprotein.




(a) Bubbles of air enter the fermenter at **A**.

Give **two** functions of the air bubbles.

1.....

.....

2.....

.....

**(2)**

(b) Why is glucose added to the fermenter?

.....

.....

**(1)**

(c) The fermenter is prevented from overheating by the cold water flowing in through the heat exchanger coils at **C**.

Name the process that causes the fermenter to heat up.

.....

**(1)**

(d) It is important to prevent microorganisms other than *Fusarium* growing in the fermenter.

(i) Why is this important?

.....

.....

**(1)**

(ii) Suggest **one** way in which contamination of the fermenter by microorganisms could be prevented.

.....

.....

**(1)**

(e) Human cells cannot make some of the amino acids which we need. We must obtain these amino acids from our diet.

The table shows the amounts of four of these amino acids present in mycoprotein, in beef and in wheat.

| **Name of amino acid** | **Amount of amino acid per 100 g in mg** | | | **Daily amount needed by a 70 kg human in mg** |
|---|---|---|---|---|
| | **Mycoprotein** | **Beef** | **Wheat** | |

| | | | | |
|---|---|---|---|---|
| Lysine | 910 | 1600 | 300 | 840 |
| Methionine | 230 | 500 | 220 | 910 |
| Phenylalanine | 540 | 760 | 680 | 980 |
| Threonine | 610 | 840 | 370 | 490 |

A diet book states that mycoprotein is the best source of amino acids for the human diet.

Evaluate this statement.

Remember to include a conclusion in your evaluation.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**(4)**
**(Total 10 marks)**

**M1.**(a) snail

**or**

shrew

*additional incorrect answer negates correct answer*

**1**

(b) shrew

*additional incorrect answer negates correct answer*

**1**

(c) fewer shrews to eat them

**1**

(d) population

**1**

(e) **C**

**1**

(f) (11 000 × 0.1 =)
1 100 (kJ)

**1**

(g) the snails do not eat the roots of the lettuces

**1**

(h) any **one** from:

- light (intensity)
- temperature
- moisture (levels)
- soil pH
- mineral / ion content (of soil)
- wind intensity / speed

*ignore wind direction*

- carbon dioxide (levels)
- oxygen (levels)

**1**

**[8]**

**M2.**(a) 40 – 60 hours

**1**

(b) (i) decrease

**1**

1st slowly then faster / appropriate detail from the graph – e.g. from 7.8 to 0 / faster after 4 – 10h

**1**

(ii) oxygen after glucose

*extra box ticked cancels 1 mark*

**1**

oxygen less than glucose

**1**

(iii) respiration

**1**

**[6]**

**M3.**(a) a higher concentration would be difficult to stir

**1**

(b) (i) methane

**1**

(ii) 60

*100 - (5 + 35) but incorrect answer allow 1 mark*

**2**

(c) (i) aerobic respiration

**1**

(ii) oxygen

**1**

**[6]**

**M4.**(a) place all the quadrats randomly on the lawn

**1**

(b) (i) 1 4

2 2

3 2

4 0

*all 4 counts correct*

**1**

Total = 15

*total correct for their figures*

**1**

(ii) 1.5

*allow ecf from (b)(i)*

**1**

(iii) 180

*correct answer with or without working*

*if answer incorrect, allow **1** mark for* $\frac{15}{10}$ *x 120* ***or*** *15 x 20*

***or*** $\frac{15}{10}$ *x 12 x 10*

***or*** *1.5 x 12 x 10* ***or*** *1.5 x 120*

*allow ecf from (b)(ii)*

*allow **1** mark if only 1 error*

**2**

(c) use a larger sample size / more quadrats

*ignore repeats but allow repeat in different places*

*ignore 'count them all'*

**or**

use bigger quadrats

**1**

**[7]**

**M5.** (a) microorganisms / microbes / bacteria / fungi / decomposers

*allow named example **or** mould*

*ignore germs / worms / other detritivores*

**1**

(b) (weather / it is) warm(er) / hot(ter)

*accept optimum conditions for enzymes*

*allow cold(er) <u>in winter</u>*

*ignore wet(ter) / light(er) / sun*

*do **not** accept heat dries the leaves out*

**1**

(c) oxygen

*no mark if more than one box is ticked*

**1**

**[3]**

**M6.** (a) methane / $CH_4$

*allow $CH_4$*

*do **not** allow $CH^4$ **or** ch4 or CH4*

**1**

(b) any **two** from:

- didn't carry out repeats
- only tested four types of manure
- don't know the mass of manure was the same each time
- inaccuracies in measuring (diameter of) balloon
- bottles might have been different sizes
- temperature of the room may have been different.

**2**

(c) The potato contains a lot of carbohydrate

**1**

**[4]**

**M7.**(a) any **three** from:

- place 30-m tape measure across field / from one wood to the other
- place quadrat(s) next to the tape
- count / record the number / amount of dandelions / plants in the quadrat

  *ignore 'record the results'*

  *ignore measures / estimates dandelions*
- repeat every 2 metres

  *allow every metre / at regular intervals*

**3**

(b) (i) low light / it is shady

*allow no light*

*ignore sun / rays*

**or**

not enough water / ions / nutrients

*accept correct named ion*

*ignore no water / ions / nutrients*

**or**

wrong pH of soil

*accept competition with trees for light / water / ions*

*ignore competition for space and competition unqualified*

*accept soil too acidic / too alkaline*

*ignore temperature*

**1**

(ii) sensible suggestion for a small area, eg chance variation / anomaly / poisoned by animal waste / wrong pH of soil / eaten (by animals) / cut down / footpath

**1**

(c) repeat (transect) / compare with the results of other groups

*allow 'do it in two different locations' for 2 marks*

**1**

at different / random location(s) / elsewhere (across the field)

*do **not** allow 'in other fields'*

**1**

**[7]**

**M8.**(a) measure the length / area of the field

**1**

(b) use (a) random number(s) (generator)
**or**
use coordinates method explained

**1**

(c) compare their results with another student's results

**1**

place more quadrats

**1**

(d) 0.25 × 5 = 1.25

**1**

500 / 1.25 = 400

**1**

(40 × 400 =) 16 000
*allow 16 000 with no working shown for **3** marks*

**1**

(e) 11

**1**

(f) (quadrat) 5
*both quadrat number and correct reason must be given for **1** mark*

**1**

very few or only 2 growing (here)

**[9]**

**M9.**(a) any **two** from:

- amount of waste on each heap

  *allow size of heap*
- (type of) materials on each heap

  *if neither marking points one or two awarded, allow **1** mark for same waste*
- put heaps in same (environmental) conditions.

  *e.g. keep at same (outside) temperature*

  *allow put in same place*

**2**

(b) microorganisms / microbes / bacteria / fungi / decomposers

*ignore detritivores / examples (such as worms, maggots, insects)*

*ignore pathogens / germs*

*do **not** allow viruses*

**1**

(c) (i) oxygen / air added (when turning over)

*allow idea that decay will be aerobic*

*allow bacteria / microorganisms need oxygen / air*

*allow (microorganisms) respire faster*

**1**

(ii) any **two** from:

- dead leaves / fruit / plants (fall off / onto the ground)
- (fallen dead leaves / fruit / plants) decay
- minerals / ions / nutrients are recycled / released.

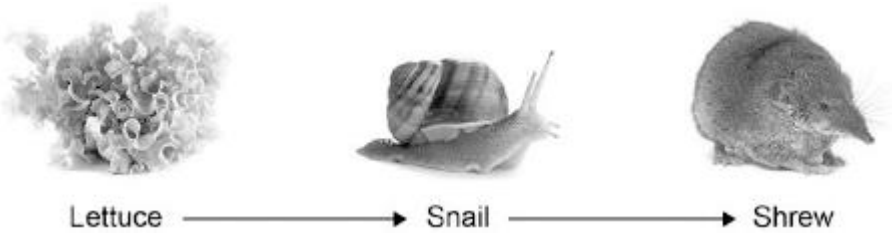
*ignore references to carbon dioxide*

*allow animal waste **or** dead animals*

**2**

**[6]**

**Q1.**The diagram below shows a food chain in a garden.






(a) Name **one consumer** shown in the diagram above.

.....

**(1)**

(b) Name **one carnivore** shown in the diagram above.

.....

**(1)**

(c) A disease kills most of the shrews in the garden.

Suggest why the number of snails in the garden may then increase.

.....

.....

**(1)**

(d) What is the name given to all the snails in the garden shown in the diagram above?

Tick **one** box.

Community ☐

Ecosystem ☐

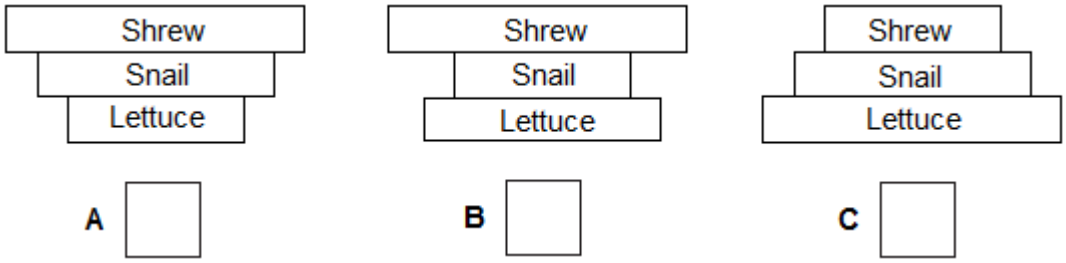
Population ☐

Territory ☐

**(1)**

(e) Which pyramid of biomass is correct for the food chain shown in the diagram above?

Tick **one** box.




**(1)**

(f) Some snails ate some lettuces.

The lettuces contained 11 000 kJ of energy.

Only 10% of this energy was transferred to the snails.

Calculate the energy transferred to the snails from the lettuces.

.....

Energy = ..... kJ

**(1)**

(g) Give **one** reason why only 10% of the energy in the lettuces is transferred to the snails.

Tick **one** box.

The lettuces carry out photosynthesis ☐

The snails do not eat the roots of the lettuces ☐

Not all parts of a snail can be eaten ☐

**(1)**

(h) **Abiotic** factors can affect the food chain.

Wind direction is one abiotic factor.

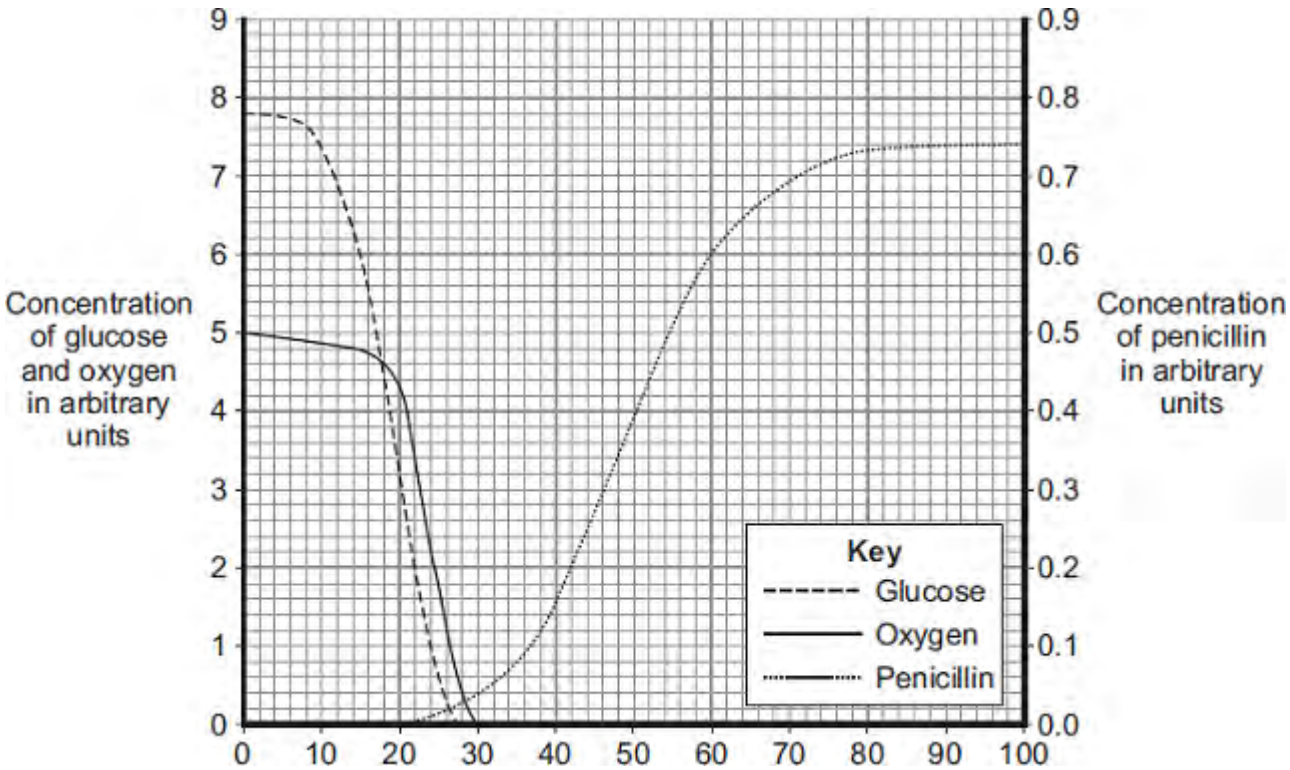
Name **one other** abiotic factor.

.....

**(1)**
**(Total 8 marks)**

**Q2.** The mould *Penicillium* can be grown in a fermenter. *Penicillium* produces the antibiotic penicillin.

The graph shows changes that occurred in a fermenter during the production of penicillin.




(a) During which time period was penicillin produced most quickly?

Draw a ring around **one** answer.

**0 – 20 hours** **40 – 60 hours** **80 – 100 hours**

**(1)**

(b) (i) Describe how the concentration of glucose in the fermenter changes between 0 and 30 hours.

.....

.....

.....

.....

**(2)**

(ii) How does the change in the concentration of oxygen in the fermenter compare with the change in concentration of glucose between 0 and 30 hours?

Tick (✓) **two** boxes.

| | |
|---|---|
| The oxygen concentration changes after the glucose concentration. | ☐ |
| The oxygen concentration changes before the glucose concentration. | ☐ |
| The oxygen concentration changes less than the glucose concentration. | ☐ |
| The oxygen concentration changes more than the glucose concentration. | ☐ |

**(2)**

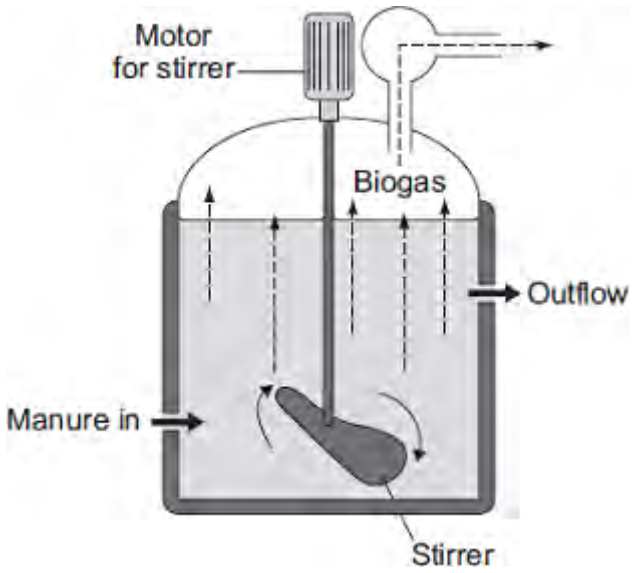
(iii) What is the name of the process that uses glucose?

Draw a ring around **one** answer.

**distillation** **filtration** **respiration**

**(1)**
**(Total 6 marks)**

**Q3.** The diagram shows one type of biogas generator.




(a) With this type of biogas generator, the concentration of solids that are fed into the reactor must be kept very low.

Suggest **one** reason for this.

Tick (✓) **one** box.

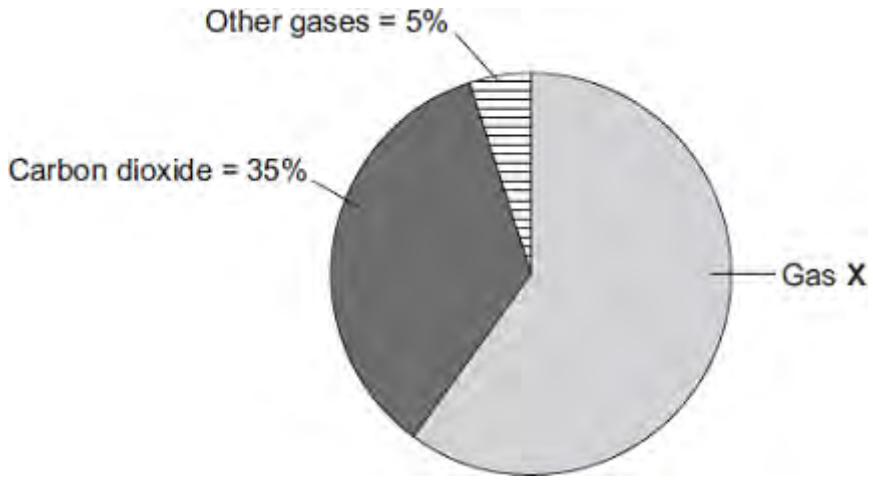
A higher concentration contains too little oxygen. ☐

A higher concentration would be difficult to stir. ☐

A higher concentration contains too much carbon dioxide. ☐

**(1)**

(b) The pie chart shows the percentages of the different gases found in the biogas.




Gas **X** is the main fuel gas found in the biogas.

(i) What is the name of gas **X**?

Draw a ring around **one** answer.

**methane** **nitrogen** **oxygen**

**(1)**

(ii) What is the percentage of gas **X** in the biogas?

Show clearly how you work out your answer.

.....

.....

Percentage of gas **X** = .....

**(2)**

(c) If the biogas generator is not airtight, the biogas contains a much higher percentage of carbon dioxide.

Draw a ring around **one** answer in each part of this question.

(i) The air that leaks in will increase the rate of

| |
|---|
| aerobic respiration. |
| anaerobic respiration. |

| |
|---|
| fermentation. |

**(1)**

(ii) The process in part (c)(i) occurs because the air contains

| |
|---|
| ammonia. |
| nitrogen. |
| oxygen. |

**(1)**
**(Total 6 marks)**

**Q4.** Some students wanted to find the number of thistle plants growing on a lawn.
The students placed 10 quadrats at different positions on the lawn.
Each quadrat measured 1 metre × 1 metre.
The students counted the number of thistle plants in each quadrat.

(a) Which method should the students use to decide where to place the 10 quadrats?

Tick (✓) **one** box.

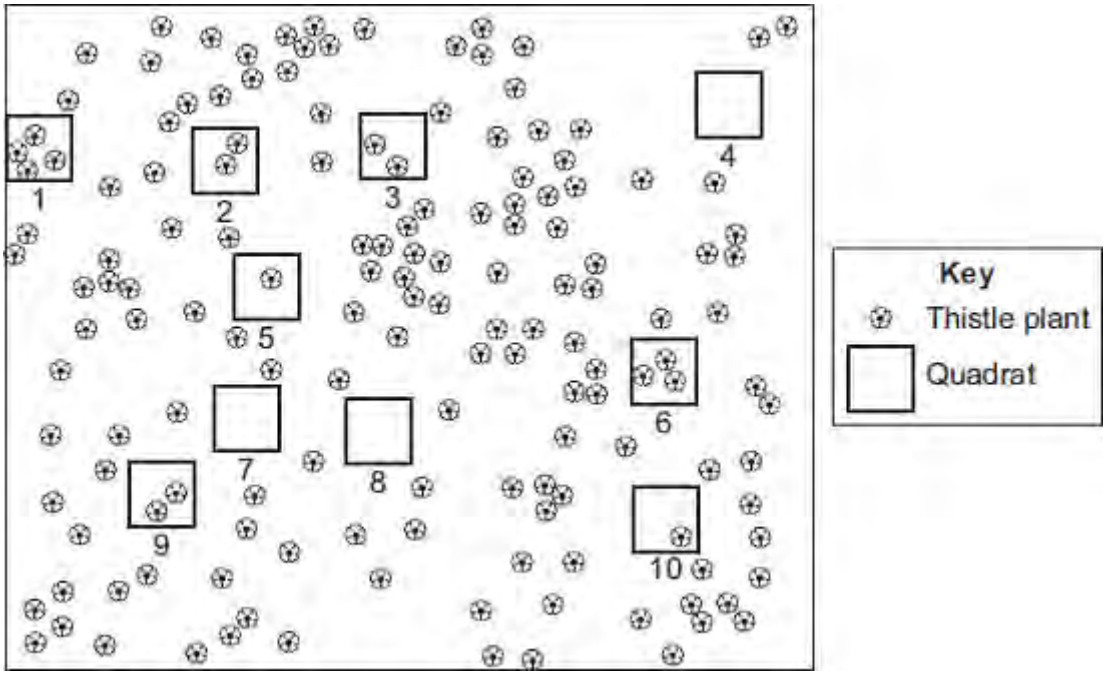
Place the quadrats as evenly as possible around the lawn. ☐

Place 5 quadrats in areas with many thistle plants and 5 quadrats in areas with only a few thistle plants. ☐

Place all the quadrats randomly on the lawn. ☐

**(1)**

(b) The diagram shows the lawn with the positions of the thistle plants and the students' 10 quadrats.




(i) Complete the table to show:

- how many thistle plants the students found in each of the first four quadrats

- the total number of thistle plants found in all 10 quadrats.

| Quadrat number | Number of thistle plants in each quadrat |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | 1 |
| 6 | 3 |
| 7 | 0 |
| 8 | 0 |
| 9 | 2 |
| 10 | 1 |
| Total | |

**(2)**

(ii) Calculate the mean number of thistle plants in one quadrat.

.....

Mean = .....

**(1)**

(iii) The lawn measured 12 metres long and 10 metres wide.

Use your answer from part (b)(ii) to estimate the number of thistle plants on the lawn.

.....

.....

Estimated number of thistle plants = .....

**(2)**

(c) How could the students make their estimate more accurate?

.....

.....

**(1)**

**(Total 7 marks)**

**Q5.**Gardeners often collect fallen leaves in autumn and place them on compost heaps.


(a) Over the next year the leaves decay.

Which living things cause decay?

.....

**(1)**

(b) The leaves decay more quickly in summer than in winter.

Give **one** reason why.

.....

.....

**(1)**

(c) The compost heap has holes in its sides to let gases enter.

Which gas is needed for decay?

Tick (✓) **one** box.

Carbon dioxide ☐

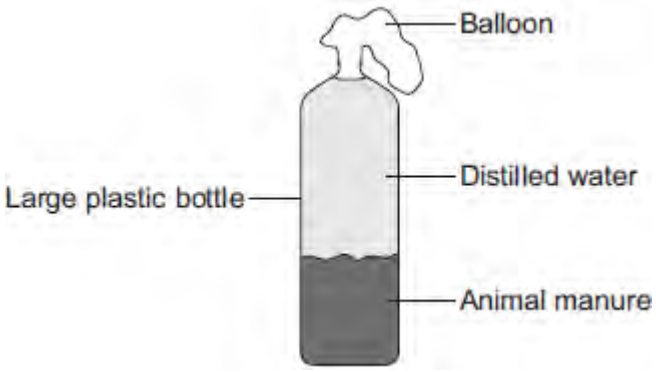
Nitrogen ☐

Oxygen 

**(1)**
**(Total 3 marks)**

**Q6.** Some students set up biogas generators to find out which type of animal manure produced the most biogas.

The diagram shows the apparatus they used.




The students:
Step 1: Put some cow manure into the plastic bottle
Step 2: Filled the bottle with distilled water
Step 3: Attached a balloon over the top of the bottle
Step 4: Put the bottle in a warm room for 10 days
Step 5: Measured the diameter of the balloon on day 10
Step 6: Repeated steps 1 to 5 using each type of animal manure.

The students' results are shown in the table.

| **Type of animal manure** | **Diameter of balloon on day 10 in cm** |
|---|---|
| Cow | 29 |
| Horse | 26 |
| Sheep | 34 |
| Pig | 32 |

(a) What is the main gas found in biogas?

.....

**(1)**

(b) The students concluded that sheep manure is the best type of manure to use in a biogas generator.

A teacher told the students that the design of their investigation meant that their

conclusion might **not** be correct.

Suggest **two** reasons why.

1.....

.....

2.....

.....

**(2)**

(c) Another student suggested that adding potato to the manure would increase the amount of biogas produced.

Why would adding potato increase the amount of biogas produced?

Tick (✓) **one** box.

| | |
|---|---|
| The potato contains a lot of carbohydrate. | ☐ |
| The potato contains a lot of protein. | ☐ |
| The potato contains a lot of water. | ☐ |

**(1)**
**(Total 4 marks)**

**Q7.** Some students investigated the distribution of dandelion plants in a grassy field. The grassy field was between two areas of woodland.

**Figure 1** shows two students recording how many dandelion plants there are in a 1 metre x 1 metre quadrat.

**Figure 1**




**Figure 2** shows a section across the area studied and **Figure 3** shows a bar chart of the students' results.

**Figure 2**

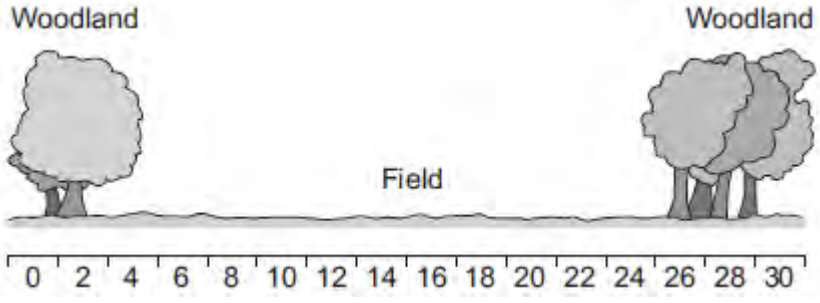
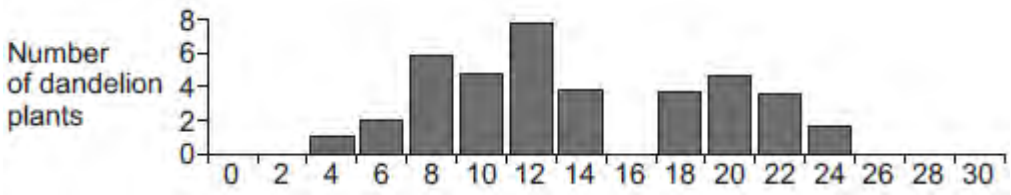



**Figure 3**




(a) How did the students use the quadrat and the 30-metre tape measure to get the results in **Figure 3**?

Use information from **Figure 1**.

.....

.....

.....

.....

.....

.....

**(3)**

(b) (i) Suggest **one** reason why the students found no dandelion plants under the trees.

.....

.....

**(1)**

(ii) Suggest **one** reason why the students found no dandelion plants at 16 metres.

.....

.....

**(1)**

(c) The teacher suggested that it was **not** possible to make a valid conclusion from these results.

Describe how the students could improve the investigation so that they could make a valid conclusion.

.....

.....

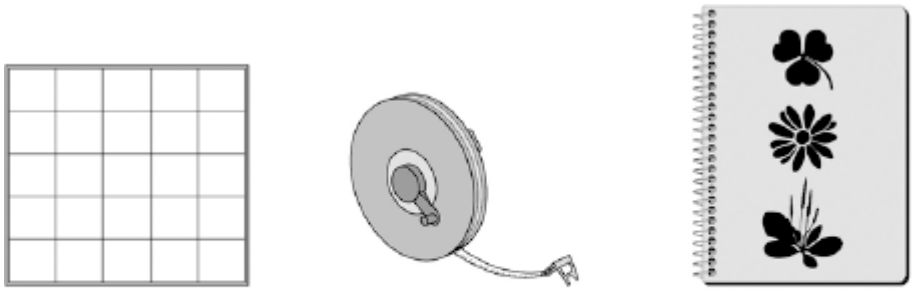
.....

.....

**(2)**
**(Total 7 marks)**

**Q8.**A student was asked to estimate how many clover plants there are in the school field.

The image below shows the equipment used.



Quadrat Tape Identification key

Not drawn to scale

This is the method used.

1. Throw a quadrat over your shoulder.
2. Count the number of clover plants inside the quadrat.
3. Repeat step **1** and step **2** four more times.
4. Estimate the number of clover plants in the whole field.

(a) What is the tape in the image above used for in this investigation?

.....

.....

**(1)**

(b) The teacher told the student that throwing the quadrat over his shoulder was **not** random.

The method could be improved to make sure the quadrats were placed randomly.

Suggest **one** change the student could make to ensure the quadrats were placed randomly.

.....

.....

**(1)**

(c) How could the student improve the investigation so that a valid estimate can be

made?

Tick **two** boxes.

- Weigh the clover plants ☐
- Compare their results with another student's results ☐
- Count the leaves of the clover plants ☐
- Place more quadrats ☐
- Place the quadrats in a line across the field ☐

**(2)**

(d) The table below shows the student's results.

| Quadrat number | Number of clover plants counted |
|---|---|
| 1 | 11 |
| 2 | 8 |
| 3 | 11 |
| 4 | 9 |
| 5 | 1 |
| Total | 40 |

The area of the school field was 500 $m^2$.

The quadrat used in the table above had an area of 0.25 $m^2$.

Calculate the estimated number of clover plants in the school field.

.....

.....

.....

Estimated number of clover plants = .....

**(3)**

(e) What was the mode for the results in the table above?

Tick **one** box.

1 ☐

8 ☐

11 ☐

40 ☐

**(1)**

(f) Suggest which quadrat could have been placed under the shade of a large tree.

Give **one** reason for your answer.

Quadrat number .....

Reason .....

.....

**(1)**

**(Total 9 marks)**

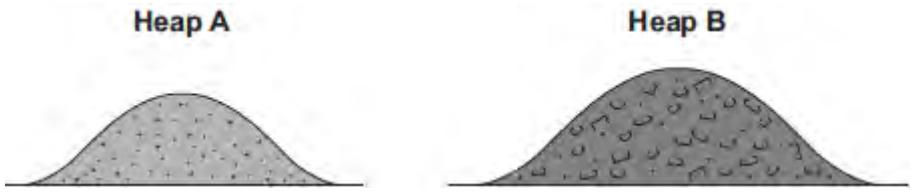
**s**

**Q9.** A gardener investigates if turning over the waste in a compost heap makes the waste decay more quickly.

The gardener:

- makes two separate heaps of garden waste, heap **A** and heap **B**
- turns over the material in heap **A** every 2 weeks
- does **not** turn over the material in heap **B**
- estimates the amount of decay in the two heaps after 6 months.

The diagram shows the two heaps of garden waste at the beginning of the investigation.




(a) Suggest **two** factors, other than time, the gardener should control to make the investigation fair.

1.....

.....

2.....

.....

**(2)**

(b) Name **one** type of living thing that causes decay.

.....

**(1)**

(c) The gardener's results are shown in the table.

| Compost heap | Estimated amount of decay |
|---|---|
| **A** | A lot |
| **B** | Very little |

(i) Why does turning over the material in heap **A** make the material decay more quickly?

.....

.....

**(1)**

(ii) The gardener puts decayed material around his plants to help them grow.

Suggest why the plants in a woodland grow well each year **without** material from compost heaps being added.

.....

.....

.....

.....

**(2)**
**(Total 6 marks)**

**M1.** (a) methane is produced

*ignore bad smell*

**1**

which is a greenhouse gas / causes global warming

**1**

(b) (9.80 / 0.20 = 49 therefore) 49:1

**1**

(c) horse (manure)

*allow ecf from **11.2***

closest to 25:1 (ratio)

**1**

(d) **Level 3 (5–6 marks):**
A detailed and coherent explanation is given, which logically links how carbon is released from dead leaves and how carbon is taken up by a plant then used in growth.

**Level 2 (3–4 marks):**
A description of how carbon is released from dead leaves and how carbon is taken up
by a plant, with attempts at relevant explanation, but linking is not clear.

**Level 1 (1–2 marks):**
Simple statements are made, but no attempt to link to explanations.

**0 marks:**
No relevant content.

**Indicative content**

**statements:**
- (carbon compounds in) dead leaves are broken down by microorganisms / decomposers / bacteria / fungi
- photosynthesis uses carbon dioxide

**explanations:**
- (microorganisms) respire
- (and) release the carbon from the leaves as carbon dioxide
- plants take in the carbon dioxide released to use in photosynthesis to produce glucose

**use of carbon in growth:**
- glucose produced in photosynthesis is used to make amino acids / proteins / cellulose
- (which are) required for the growth of new leaves

**6**

(e) any **three** from:
(storage conditions)
- (at) higher temperature / hotter
- (had) more oxygen
- (had) more water / moisture
- (contained) more microorganisms (that cause decay)

*allow reference to bacteria / fungi / mould*

**3**

**[13]**

**M2.** (a) photosynthesis

**1**

(b) (i) 140

**1**

(ii) (10 billion tonnes) more added (to atmosphere) than removed

*allow ecf from part (b)(i)*

**1**

**[3]**

**M3.** (a) (i) counts / 12

**1**

× 120 × 80 / × 9600
**or**
× area of field

**1**

(ii) (more) quadrats / repeats

**1**

placed randomly
*ignore method of achieving randomness*

**1**

(b) (i) any **three** from:
- temperature / warmth / heat
- water / rain
- minerals / ions / salts (in soil)
  *allow nutrients / fertiliser / soil fertility*
  *ignore food*
- pH (of soil)
- trampling
- herbivores
  *ignore predators*
- competition (with other species)
- pollution qualified e.g. $SO_2$ / herbicide
- wind (related to seed dispersal).
  *ignore space / oxygen / $CO_2$ / soil unqualified*

**3**

(ii) light needed for photosynthesis

**1**

for making food / sugar / etc.

**1**

effect on buttercup distribution eg more plants in sunny areas / fewer plants in shady areas

**1**

(c) (i) fertiliser / ions / salts cause growth of algae / plants

**1**

(algae / plants) block light

**1**

(low light) causes algae / plants to die

**1**

microorganisms / bacteria feed on / break down / cause decay of organic matter / of dead plants

*do **not** allow germs / viruses*

**1**

(aerobic) <u>respiration</u> (by microbes) uses $O_2$

*do **not** allow anaerobic*

**1**

(ii) sewage / toxic chemicals / correct named example eg metals / bleach / disinfectant / detergent etc

*allow suitable named examples eg metals such as Pb / Zn / Cr / oil / $SO_2$ / acid rain / pesticides / litter*

*ignore chemicals unqualified*

*ignore waste unqualified*

*ignore human waste / domestic waste / industrial waste unqualified*

**1**

(d) (i) 2

**1**

(ii) more food

*allow other sensible suggestion eg more species colonise from tributary streams after forest*

**1**

(iii) number of stonefly species decreases (from **A** to **B** / **B** to **C** / **A** to **C**) as more pollution enters river / less oxygen

*allow fewer species in more polluted water*

*ignore none are found at site C*

**1**

**[19]**

**M4.** (a) wear a face mask

*allow wear gloves*

**1**

(b) **Level 2 (3–4 marks):**
A detailed and coherent plan covering all the major steps. It sets out the steps needed in
a logical manner that could be followed by another person to produce an outcome which
will address the hypothesis.

**Level 1 (1–2 marks):**
Simple statements relating to steps are made but they may not be in a logical order. The plan may not allow another person to produce an outcome which will address the hypothesis.

**0 marks:**
No relevant content.

**Indicative content**

**Plan:**
- cut a specified number of pieces of bread to the same size
- place mould spores on the bread
- the number of mould spores needs to be the same quantity of mould spores on
  each piece of bread
- place bread in different sealable plastic bags
- place in different temperatures (minimum of three) eg fridge, room, incubator
- leave each for the same amount of time eg four days
- measure the percentage cover of mould on each piece of bread
- repeat experiment

**additional examiner guidance:**
- good level 2 answer will describe how the growth of mould can be measured and
  will give a range of different temperatures to be used
- allow equivalent levels of credit for alternative methodologies that would clearly produce a measurable outcome in terms of mould growth at various temperatures

**4**

(c) any **one** from:
- type of mould
- amount of mould (put on each piece of bread)
- amount of air in the plastic bags
- size of the pieces of bread
- type of bread

- amount of moisture / water added

**1**

(d) (56 − 4 = 52) / 5

**1**

10.4

*allow 10.4 with no working shown for **2** marks*

**1**

*ecf for incorrectly read figures for **1** mark*

(e) (decomposition occurs at a faster rate when the temperature is higher
**or**
amount of decomposition is higher when temperature is higher

**1**

**[9]**

**M5.** (a) limiting their movement
**or**
controlling the temperature of their surroundings

**1**

reason:
reduces energy transfer

*if no other marks awarded, allow **1** mark for: 'fit more chickens in same space'*

**1**

(b) (i) without oxygen

*ignore 'without air'*

**1**

(ii) any **two** from:
- ethanol

  *allow alcohol*
- carbon dioxide
- lactic acid.

***do not accept** energy / ATP (apply list rule)*

**2**

(c) enzymes are denatured / change shape

*ignore microbes are killed*

**1**

(enzyme) shape is vital for function **or** won't work (as efficiently)

**1**

(d) (i) 200

**1**

(ii) 120

*allow ecf from (d)(i)*

*e.g.*

$\frac{60}{100} \times$ *(i)*

**1**

(e) causes global warming

**1**

one predicted consequence of global warming

*eg rising sea levels, climate change, change in migration patterns, change in distribution of species*

**or**

methane is flammable
so might cause fire / damage

*if no other marks awarded, allow methane is a greenhouse gas for **1** mark*

**1**

**[11]**

**Q1.** A gardener wants to add compost to the soil to increase his yield of strawberries.

The gardener wants to make his own compost.

(a) An airtight compost heap causes anaerobic decay.

Explain why the gardener might be against producing compost using this method.

.....

.....

.....

.....

**(2)**

(b) The gardener finds this research on the Internet:

**'A carbon to nitrogen ratio of 25:1 will produce fertile compost.'**

Look at the table below.

| Type of material to compost | Mass of carbon in sample in g | Mass of nitrogen in sample in g | Carbon:nitrogen ratio |
|---|---|---|---|
| Chicken manure | 8.75 | 1.25 | 7:1 |
| Horse manure | 10.00 | 0.50 | 20:1 |
| Peat moss | 9.80 | 0.20 | **X** |

Determine the ratio **X** in the table above.

.....

Ratio .....

**(1)**

(c) Which type of material in the table above would be **best** for the gardener to use to make his compost?

Justify your answer.

.....

.....

**(1)**

(d) Some of the leaves from the gardener's strawberry plant die.

The dead leaves fall off the strawberry plant onto the ground.

The carbon in the dead leaves is recycled through the carbon cycle.

Explain how the carbon is recycled into the growth of new leaves.

.....

.....

.....

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.....

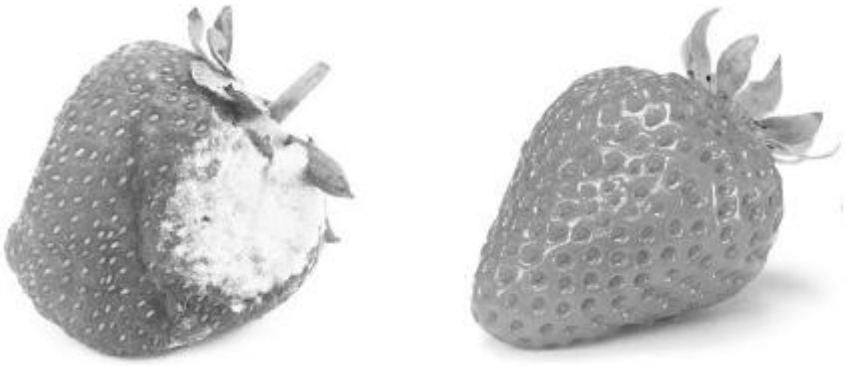
.....

**(6)**

(e) The diagram below shows two strawberries.

- Both strawberries were picked from the same strawberry plant.
- Both strawberries were picked 3 days ago.
- The strawberries were stored in different conditions.

**Strawberry A** **Strawberry B**



A © sarahdoow/iStock/Thinkstock, B © Mariusz Vlack/iStock/Thinkstock

Give **three** possible reasons that may have caused strawberry **A** to decay.

1 .....

.....

2 .....

.....

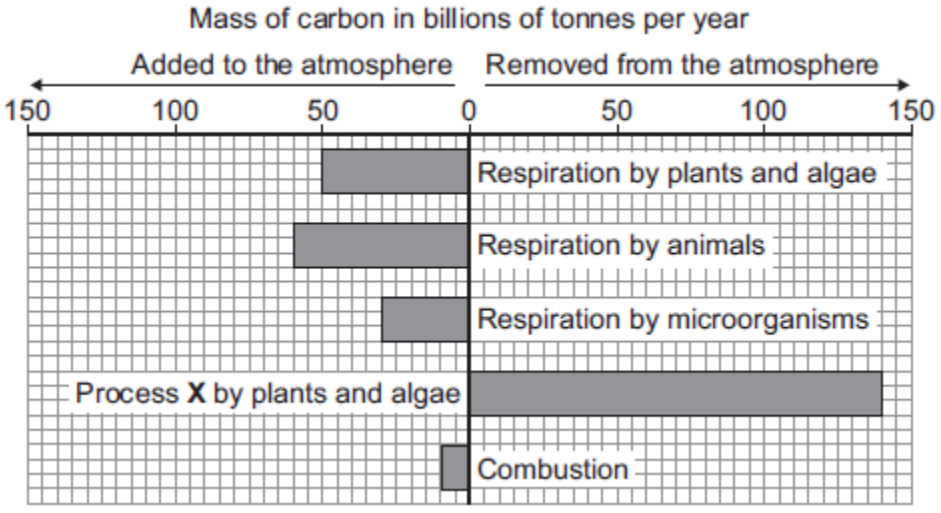
3 .....

.....

**(3)**
**(Total 13 marks)**

**Q2.** This question is about carbon.

The graph shows the mass of carbon added to and removed from the atmosphere each year.




(a) Name process **X**.

.....

**(1)**

(b) (i) Calculate the mass of carbon added to the atmosphere by respiration per year.

Answer = ..... billion tonnes

**(1)**

(ii) Some scientists are concerned that the mass of carbon in the atmosphere is changing.

How does the data in the graph support this idea?

.....

.....

**(1)**

**(Total 3 marks)**

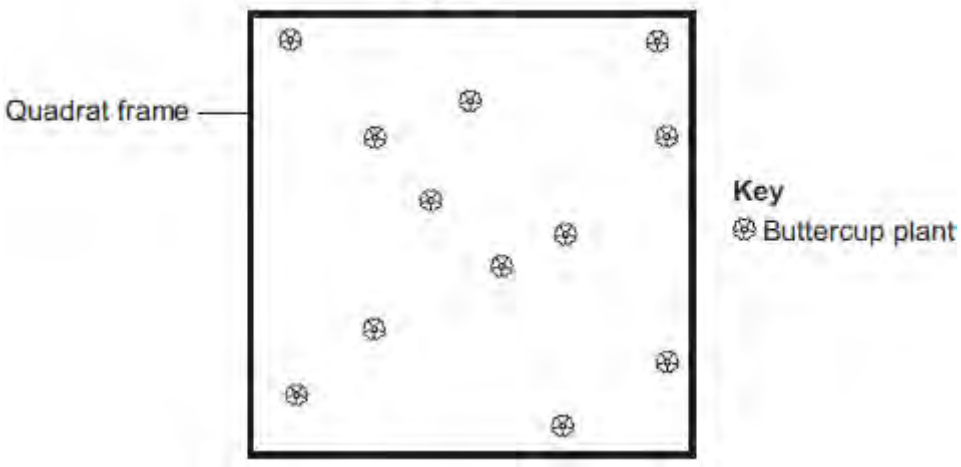
**Q3.**A grassy field on a farm measured 120 metres by 80 metres.

A student wanted to estimate the number of buttercup plants growing in the field.

The student found an area where buttercup plants were growing and placed a 1 m × 1 m quadrat in one position in that area.

**Figure 1** shows the buttercup plants in the quadrat.

**Figure 1**




The student said, 'This result shows that there are 115 200 buttercup plants in the field.'

(a) (i) How did the student calculate that there were 115 200 buttercup plants in the field?

.....

.....

.....

.....

**(2)**

(ii) The student's estimate of the number of buttercup plants in the field is probably not accurate. This is because the buttercup plants are not distributed evenly.

How would you improve the student's method to give a more accurate estimate?

.....

.....

.....

.....

**(2)**

(b) Sunlight is one environmental factor that might affect the distribution of the buttercup plants.

(i) Give **three other** environmental factors that might affect the distribution of the buttercup plants.

1.....

2.....

3.....

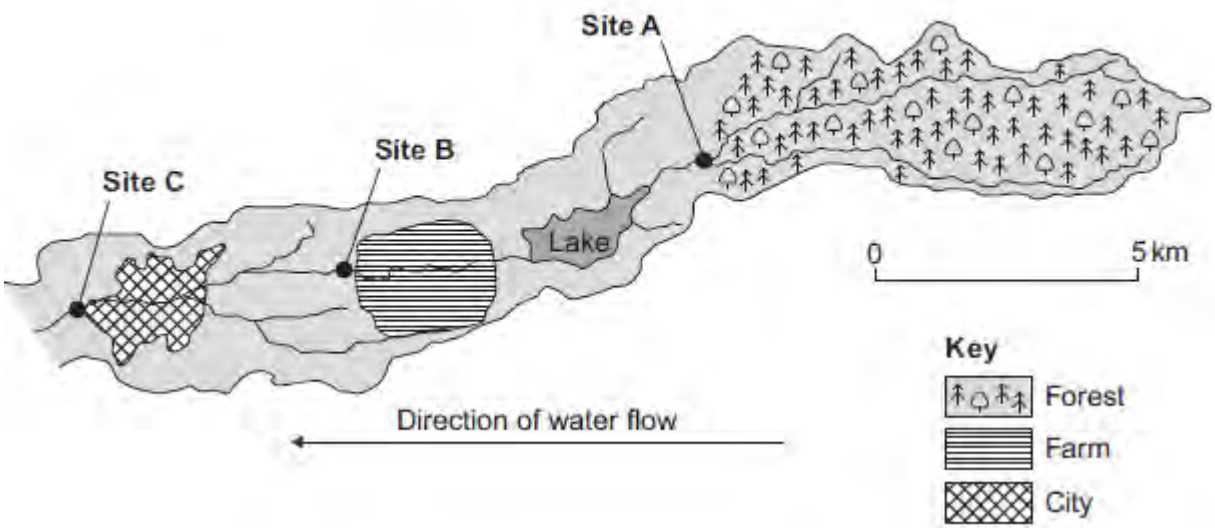
**(3)**

(ii) Explain how the amount of sunlight could affect the distribution of the buttercup plants.

**(3)**

(c) **Figure 2** is a map showing the position of the farm and a river which flows through it.

**Figure 2**




Every year, the farmer puts fertiliser containing mineral ions on some of his fields.When there is a lot of rain, some of the fertiliser is washed into the river.

(i) When fertiliser goes into the river, the concentration of oxygen dissolved in the water decreases.

Explain why the concentration of oxygen decreases.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**(5)**

(ii) There is a city 4 km downstream from the farm.

Apart from fertiliser, give **one** other form of pollution that might go into the river as it flows through the city.

.....

**(1)**

(d) Three sites, **A**, **B** and **C**, are shown in **Figure 2**.

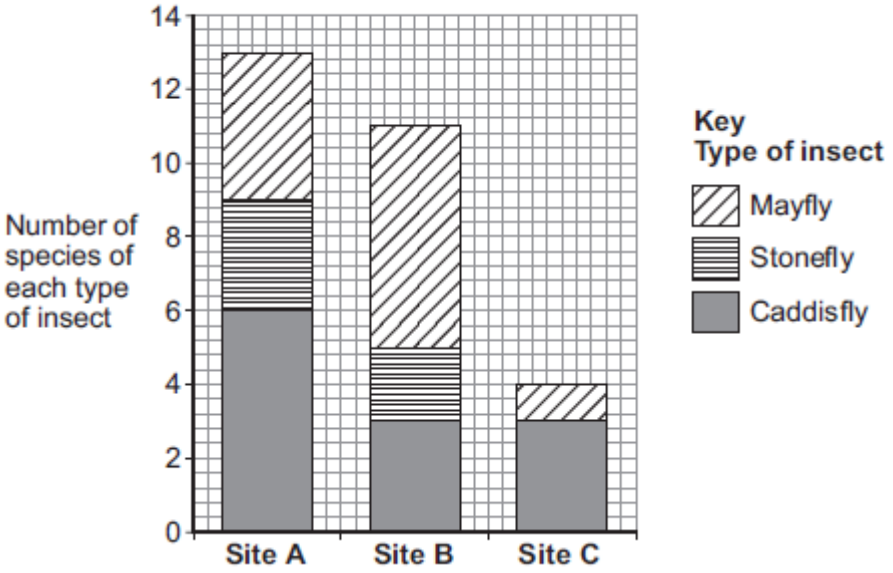
Scientists took many samples of river water from these sites.

The scientists found larvae of three types of insect in the water: mayfly, stonefly and caddisfly. For each type of insect the scientists found several different species.

The scientists counted the number of different species of the larvae of each of the three types of insect.

**Figure 3** shows the scientists' results.

**Figure 3**




(i) How many more species of mayfly were there at Site **B** than at Site **A**?

.....

**(1)**

(ii) Suggest what caused this increase in the number of species of mayfly.

.....

.....

**(1)**

(iii) The scientists stated that the number of species of stonefly was the best indicator of the amount of oxygen dissolved in the water.

Use information from **Figure 3** to suggest why.

**(1)**

**(Total 19 marks)**

**Q4.**A student plans an investigation using mould.

(a) Mould spores are hazardous.

Give **one** safety precaution the student should take when doing this investigation.

.....

.....

**(1)**

(b) A student made the following hypothesis about the growth of mould:

**'The higher the temperature, the faster the growth of mould'.**

The student planned to measure the amount of mould growing on bread.

The student used the following materials and equipment:

- slices of bread
- sealable plastic bags
- a knife
- a chopping board
- mould spores.

Describe how the materials and equipment could be used to test the hypothesis.

.....

.....

.....

.....

.....

.....

.....

.....

**(4)**

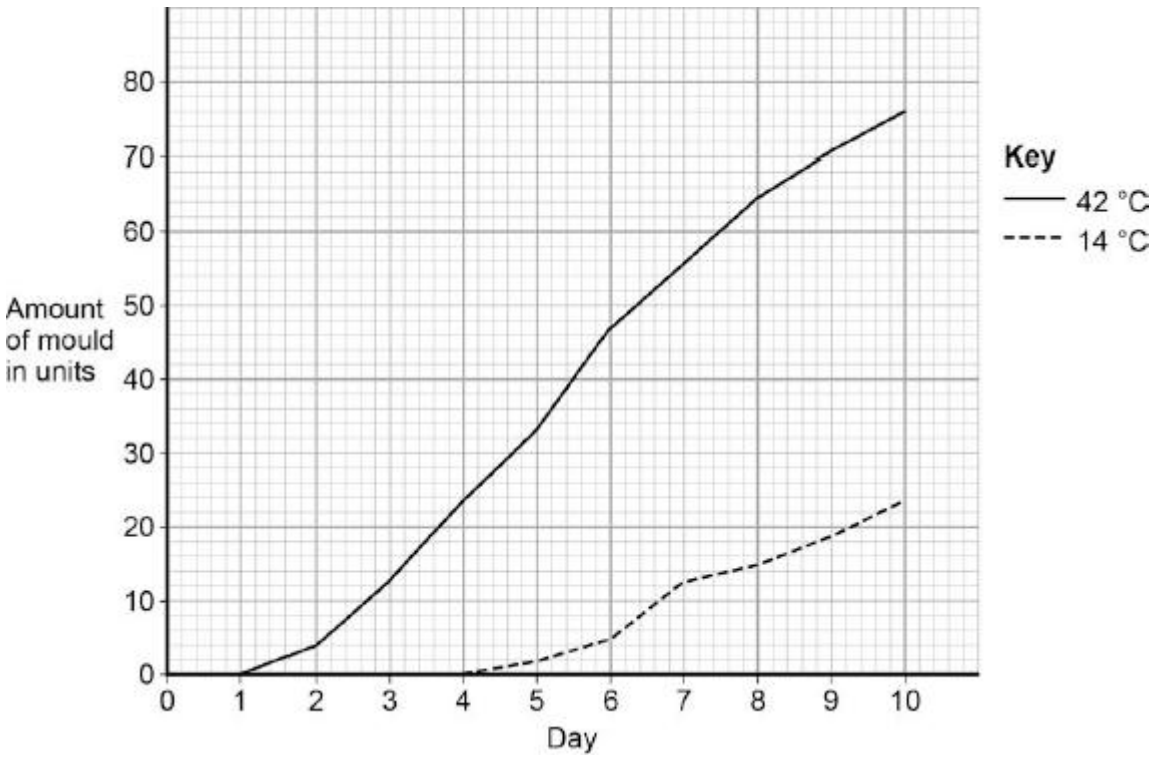
(c) Give **one** variable the student should control in the investigation.

.....

**(1)**

(d) Another student did a similar investigation.

The diagram below shows the results.




Determine the rate of mould growth at 42 °C between day 2 and day 7.

.....

.....

Rate of mould growth = ..... units per day

**(2)**

(e) The growth of mould shows decomposition of the bread.

Give a conclusion about decomposition from the results in the diagram above.

.....

.....

**(1)**

**(Total 9 marks)**

**Q5.Figures 1** and **2** show battery chickens and free-range chickens.

**Figure 1**
**Battery chickens**

© studiodr/iStock/Thinkstock

**Figure 2**
**Free-range chickens**

© xlikovec/iStock/Thinkstock

Battery chickens are kept in cages indoors. Free-range chickens can walk around outside.

(a) Give **one** way in which food production might be more efficient from battery chickens than from free-range chickens. Give a reason for your answer.

.....

.....

.....

.....

.....

**(2)**

(b) Some farms use waste from chickens to produce biogas in an anaerobic digester.

Microorganisms in the digester break down the waste by anaerobic respiration.

(i) What does **anaerobic** mean?

.....

.....

**(1)**

(ii) One product of anaerobic respiration is methane.

Name **two** other products of anaerobic respiration.

1.....

2.....

**(2)**

(c) The best temperature for anaerobic digesters is about 35 °C.

Explain why the volume of biogas produced would be **less** at higher temperatures.

.....

.....

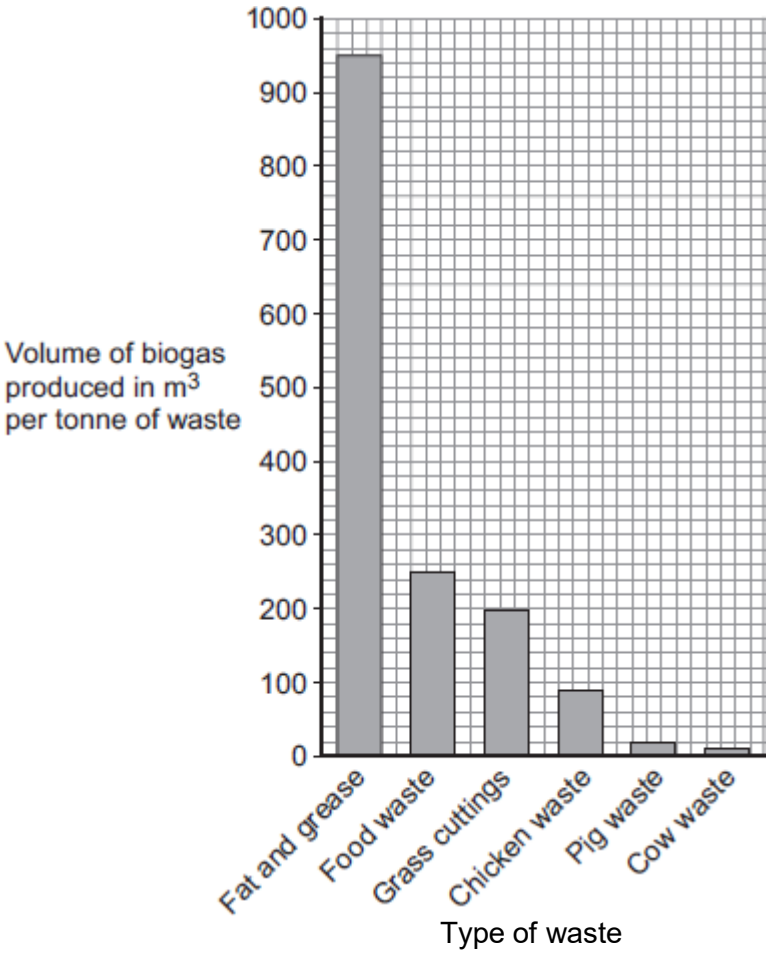
.....

.....

**(2)**

(d) **Figure 3** shows other types of waste that can be used in an anaerobic digester to produce biogas.

**Figure 3**




(i) What is the volume of biogas produced by a tonne of grass cuttings?

..... $m^3$

**(1)**

(ii) Biogas is 60% methane.

Calculate the volume of methane gas produced per tonne of grass cuttings.

..... $m^3$

**(1)**

(e) Why should biogas **not** be allowed to escape into the atmosphere?

.....

.....

.....

.....

**(2)**

**(Total 11 marks)**

**M1.** (a) any **two** from:

- fewer trees to take in carbon dioxide for photosynthesis
- decomposers / microorganisms respire (as they decay debris) releasing carbon dioxide
- burning of wood releases carbon dioxide

*allow carbon dioxide released by burning fossil fuels in vehicles / factories*

**2**

(b) Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best − fit' approach to the marking.

**0 marks**
No relevant content.

**Level 1 (1 − 2 marks)**
There is a brief description of some steps in the process but the order is not clear with little biological vocabulary used.

**Level 2 (3 − 4 marks)**
There is a reasonably clear description of the process involving many of the steps and using some biological vocabulary.

**Level 3 (5 − 6 marks)**
There is a clear, logical and detailed scientific description of the process using appropriate biological vocabulary.

**examples of biology points made in the response:**

- this contains mineral ions (and organic matter)
- this increases growth of algae / water plants
- the plants / algae (underneath) die
- due to lack of light / photosynthesis / space
- decomposers / microorganisms feed on decaying matter **or** multiply rapidly
- the respiration of decomposers uses up all the oxygen
- so invertebrates die due to lack of oxygen
- this is called eutrophication

**6**

**[8]**

**M2.** (a) (i) anaerobic respiration

**or**

fermentation

**1**

(ii) oxygen is present

*accept $O_2$*

*do **not** accept O, $O^2$ or $O^2$*

**1**

aerobic respiration occurs

*ignore anaerobic*

**1**

$CO_2$ from respiration

*allow from fermentation*

**1**

(b) high methane after this time

*ignore $CO_2$*

**1**

(c) organic matter / food / nutrients / named eg used up / reactants

*allow too hot / accumulation of toxins / named*

*do **not** allow products*

*ignore energy*

**1**

**[6]**

**M3.** (a) 0.18

*award both marks for correct answer irrespective of working*
*if no answer or incorrect answer*
*allow **1** mark for 45 × 100 / 25000*

**2**

(b) heat / thermal

*allow heat <u>from</u> respiration*

**1**

(c) energy / mass / biomass lost / not passed on **or** energy / mass / biomass is used **or** not enough energy / mass / biomass left

*ignore reference to losses via eg respiration / excretion / movement / heat*

**1**

a sensible / appropriate use of figures including heron

*eg <u>only</u> **2** from frog / to heron*
*ignore units*

**1**

(d) any **three** from:

*accept marking points if candidate uses other terms for microorganisms*

- (microorganisms) decay / decompose / digest / breakdown / rot
  *ignore eat*
- (breakdown) releases minerals / nutrients / ions / salts / named
  *ignore food*
- (microorganisms) respiration
  *ignore other organisms respiring*
- (microorganisms / respiration) release of carbon dioxide

**3**

**[8]**

**M4.** (a) (i) 5.2

*award **2** marks for correct answer, irrespective of workingor lack of it*

*award **1** mark for 62.4 ÷ 12 only with incorrect or no answer*

**2**

(ii) the smaller the (mass of the) bird the more energy is needed(per gram of body mass)

*allow converse*

*ignore figures*

**1**

(iii) smaller bird has larger surface area : volume / mass ratio

*allow converse*

**1**

so heat / energy lost more quickly

*allow lose more heat / energy*

*if (a)(ii) describes a trend of more energy with increasing body mass allow **one** mark for idea of more energy needed for flight*

**1**

(b) larger birds spend less time feeding

*accept converse*

*allow the less energy they need per day the longer they spend feeding*

**1**

since they need less food per gram of body mass (to satisfy energy needs)

**1**

**[7]**

**M5.** (a) use of quadrat / point frame

*allow description*

**1**

<u>randomly</u> placed / <u>random</u> sampling

*ignore reference to transects*

**1**

(b) (i) 6

**1**

(ii) more <u>light</u> in A / in field / where sunny

*ignore sun*

**1**

more / better / faster photosynthesis in A / with more light

*allow converse*

**1**

(iii) use light meter / measure light <u>intensity</u> in both habitats

**1**

take many measurements at same time of the day

**1**

**or**

laboratory / field investigation with 2 batches high light and low light (1)

count or number of flowers in each (1)

*counting point is dependent on investigation point*

(c) more glucose / energy available

*allow other named product eg protein*

*allow if more energy produced*

**1**

for growth

*dependent on 1st mark*

**1**

**[9]**

**M6.**(a) (i) to get data re position of seaweed / of organism

**1**

in relation to distance from sea / distance down shore / how long each seaweed was exposed

**1**

(ii) repeat several times

*minimum = 2 repeats*

**1**

elsewhere along the shore

**1**

(iii) bladder wrack is further up the shore (than the sea lettuce) / exposed for longer

*ignore found in dry areas / on bare rock*

**1**

sea lettuce (only) in rock pools / in the sea / (only) in water

**1**

(b) gets more light / closer to light

*allow better access to $CO_2$*

**1**

(so) more photosynthesis

*allow 1 mark for light for photosynthesis*
*allow 1 mark for $CO_2$ for photosynthesis*
*ignore reference to oxygen for respiration*
*'more' only needed once for 2 marks*

**1**

**[8]**

**M7.**(a) (i) (initially there is) oxygen

*accept:*
*oxygen hasn't been used up yet (so not anaerobic conditions yet)*

**1**

(so) aerobic respiration (by microorganisms)

*accept (because) methane is produced in anaerobic (fermentation)*

**1**

producing $CO_2$ (which does not burn)

*accept there is no methane*
*ignore inflammable*

**1**

(ii) (peelings had) the most carbohydrate / organic material

*answer must be comparative*

*accept contained more microorganisms / decomposers / bacteria*

*ignore water*

*do **not** allow fat or protein*

**1**

(b) (i) 0.22 / 0.221

*correct answer with or without working gains 2 marks*
*allow 0.2 for 1 mark*
*allow 22.1 for 1 mark*
*allow 0.34 × 65 / 0.65 for 1 mark*

**2**

(ii) (sheep manure) produces a higher volume of biogas / almost double **or** produces 0.27 ($m^3$ per kg) more

*accept 0.408(7) / 0.41 / 0.409 ($m^3$) from sheep for 2 marks*
*accept 0.1877 / 0.188 / 0.19 ($m^3$) more than cow's manure for 2 marks*

**1**

(sheep manure) produces biogas with a higher percentage methane **or** produces 2% more methane

*allow correct difference in volume calculated using 0.408(7) / 0.41 / 0.409 minus answer given in (i) for 2 marks*

1

**[8]**

**M8.** (a) extremophile(s)

1

(b) (i) common (periwinkle) and flat (periwinkle)

*either order, **both** required*

1

(ii) (common and flat) both live in the same habitat / area / named area

*allow habitats overlap the most*

1

(iii) any **two** from:

- would have wrong food
- would otherwise be exposed to (specific) predators
- cannot tolerate extended exposure to air **or** reduced submersion in seawater

  *allow cannot tolerate temperature / dehydration*
- cannot tolerate high salt concentration (in rock pools)

  *allow low salt concentration (in rock pools)*
- cannot compete with small periwinkle

2

**[5]**

**Q1.**Human activities affect the environment.

(a) Deforestation results in an increase in carbon dioxide levels in the atmosphere.

Give **two** reasons why.

.....

.....

.....

.....

**(2)**

(b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

A dairy farmer washes out his cow shed each day. The waste water contains urine and faeces. The waste water overflows into a stream by mistake.

The waste water will have an effect on the plants and invertebrates living in the stream.

Explain why.

.....

.....

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.....

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**(6)**
**(Total 8 marks)**

**Q2.** Some scientists set up a biogas generator.

The table shows how the rate of biogas production and the composition of the biogas changed over the first 30 days.

| Time in days | Rate of biogas production in $cm^3$ per hour | Composition of the biogas | |
|---|---|---|---|
| | | Percentage of methane | Percentage of carbon dioxide |
| 1 | 110 | 27 | 56 |
| 5 | 90 | 20 | 78 |
| 10 | 50 | 30 | 68 |
| 15 | 170 | 68 | 30 |
| 20 | 115 | 72 | 26 |
| 25 | 110 | 71 | 27 |
| 30 | 105 | 70 | 28 |

(a) (i) Name the process that produces the methane in biogas.

.....

**(1)**

(ii) For the first 10 days, the gas released from the generator contained a high concentration of carbon dioxide. This was because there was air in the generator when it was first set up.

Explain why the presence of air results in a high concentration of carbon dioxide in the biogas.

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**(3)**

(b) The scientists concluded that it would not be profitable to collect biogas from the generator until after about 20 days.

Use the data to explain why.

.....

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**(1)**

(c) The rate of biogas production slowed down towards the end of the investigation.

Suggest **one** reason why.

.....

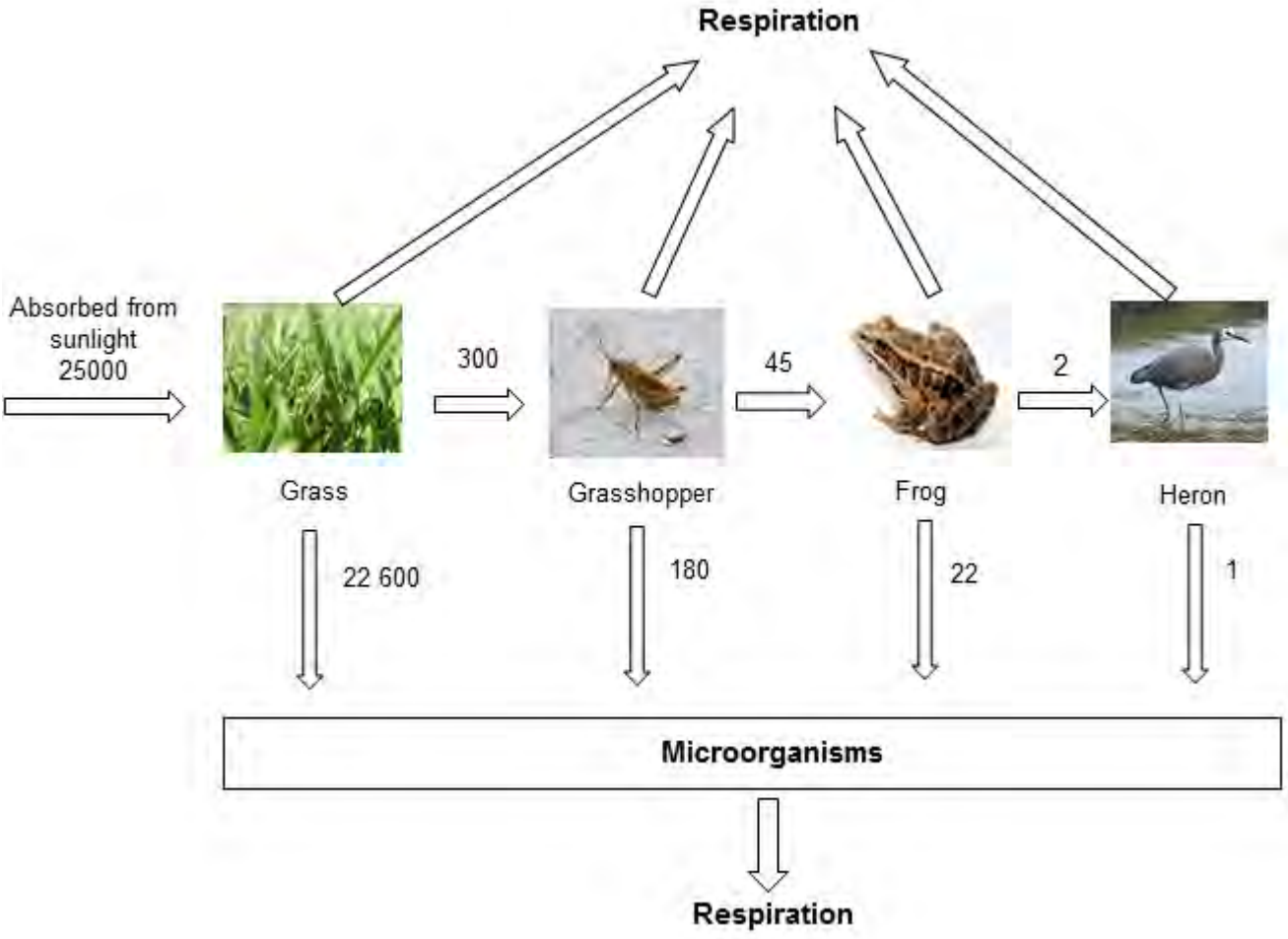
.....

**(1)**

**(Total 6 marks)**

**Q3.** The diagram shows the annual energy flow through 1 $m^2$ of a habitat.

The unit, in each case, is kJ per $m^2$ per year.




(a) Calculate the percentage of the energy absorbed by the grass from sunlight that is transferred to the frog.

Show clearly how you work out your answer.

.....

.....

Answer ..... %

**(2)**

(b) All of the energy the grass absorbs from the sun is eventually lost to the surroundings.

In what form is this energy lost?

.....

**(1)**

(c) Food chains are usually **not** more than five organisms long.

Explain why.

To gain full marks you must use data from the diagram.

.....

.....

.....

.....

**(2)**

(d) In this habitat microorganisms help to recycle materials.

Explain how.

.....

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**(3)**
**(Total 8 marks)**

Grass by By Catarina Carvalho from Lisboa, Portugal (Flickr) [CC-BY-2.0], via Wikimedia Commons. Grasshopper by I, Daniel Schwen [GFDL, CC-BY-SA-3.0], via Wikimedia Commons. Frog by Brian Gratwicke (Pickerel Frog) [CC-BY-2.0], via Wikimedia Commons. Heron by Glen Fergus (Own work, Otago Peninsula, New Zealand) [CC-BY-SA-2.5], via W kimedia Commons.

**Q4.** The photographs show four different species of bird.

Great tit

© JensGade/iStock

Blue tit

© Marcobarone/iStock

Coal tit

© MikeLane45/iStock

Long-tailed tit

© Andrew Howe/iStock

The table gives information about the four species of bird in winter.

| Bird species | Mean body mass in grams | Mean energy needed in kJ per day | Mean percentage of day spent feeding |
|---|---|---|---|
| Great tit | 21 | 84.2 | 75 |
| Blue tit | 12 | 62.4 | 81 |
| Coal tit | 9 | 49.5 | 88 |
| Lond-tailed tit | 7 | 42.0 | 92 |

(a) (i) Calculate the energy needed per day per gram of body mass for the blue tit.

.....

.....

.....

Answer = ..... kJ per day per gram of body mass

**(2)**

(ii) Describe the trend for energy needed per day per gram of body mass for the four species of bird.

.....

.....

.....

**(1)**

(iii) Suggest an explanation for the trend you have described in part (a)(ii).

.....

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**(2)**

(b) Describe and explain the trend shown by the data for the time spent feeding in winter for the birds.

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**(2)**

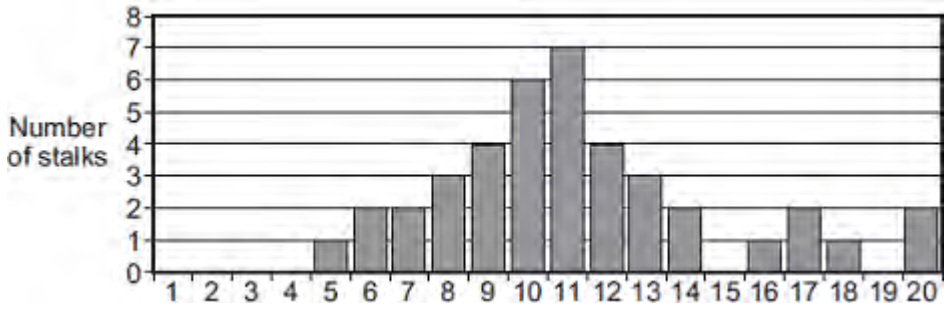
**(Total 7 marks)**

**Q5.** Some students studied bluebell plants growing in two different habitats.

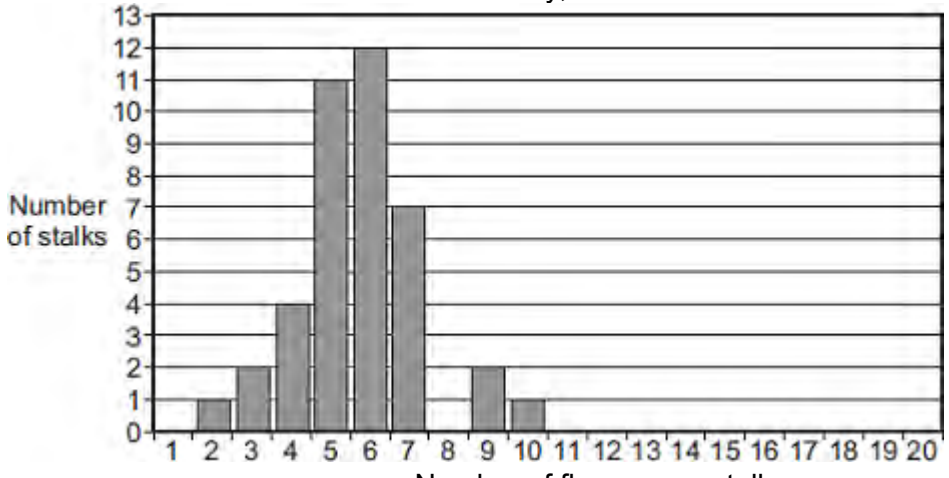
Habitat **A** was a sunny field next to woodland.
Habitat **B** was a shady, moist woodland.

A bluebell plant can have several flowers on one flower stalk. The students counted the number of flowers on each of 40 bluebell flower stalks growing in each habitat.
The bar charts show the results.

Habitat A: Sunny field next to woodland




Habitat B: Shady, moist woodland




(a) The students wanted to collect valid data.
Describe how the students should have sampled the bluebell plants at each habitat to collect valid data.

.....

.....

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.....

**(2)**

(b) (i) The students used the bar charts to find the mode for the number of flowers per stalk in the two habitats.

The mode for the number of flowers per stalk in habitat **A** was 11.

What was the mode for the number of flowers per stalk in habitat **B**?

Mode = .....

**(1)**

(ii) The students suggested the following hypothesis:

'The difference in the modes is due to the plants receiving different amounts of sunlight.'

Suggest why.

.....

.....

.....

.....

**(2)**

(iii) Suggest how the students could test their hypothesis for the two habitats.

.....

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.....

**(2)**

(c) Suggest how receiving more sunlight could result in the plants producing more flowers per stalk.

.....

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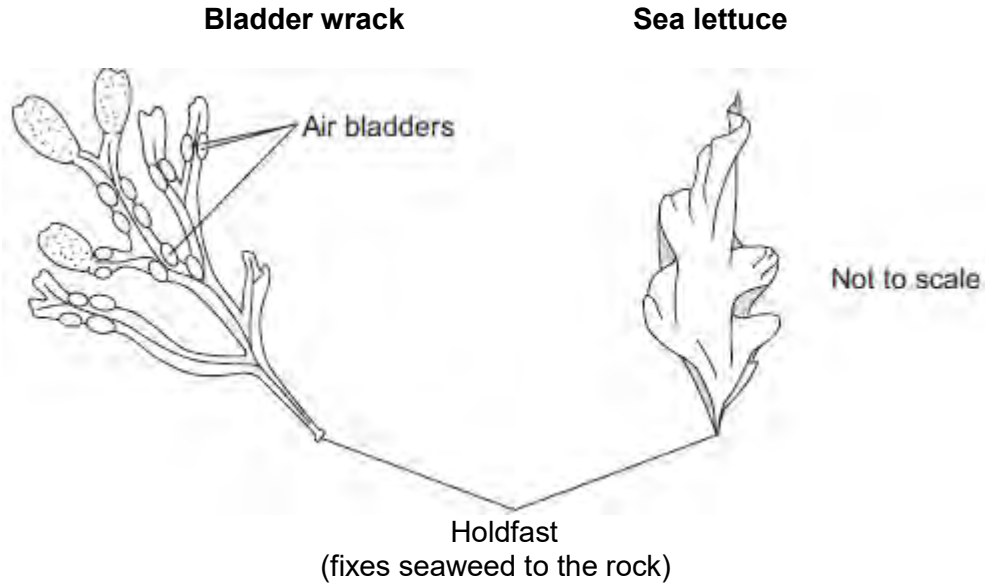
**(2)**
**(Total 9 marks)**

**Q6.**At the seashore, the tide comes in and goes out twice each day.

Some students investigated whether two different species of seaweed could live only at certain positions on a rocky shore.
Seaweeds are plant-like organisms that make their food by photosynthesis.

**Figure 1** shows the two species of seaweed that the students investigated.

**Figure 1**




(a) The students:

1 placed a 50-metre tape measure on the rocks at right angles to the sea

2 placed a quadrat next to the tape measure

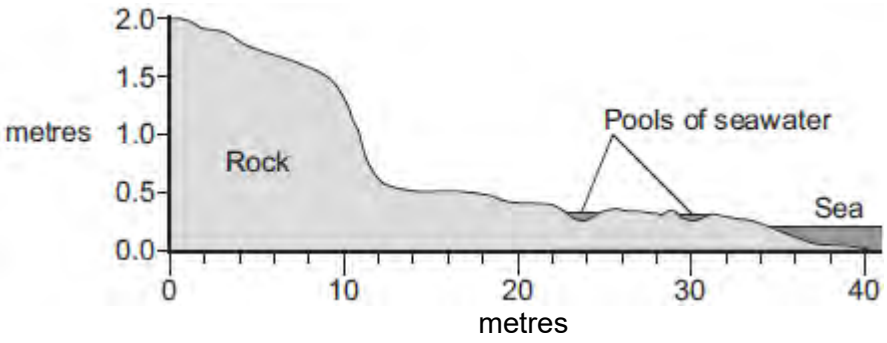
3 recorded whether each species was present or not.

The students repeated steps 2 and 3 every metre down the shore.

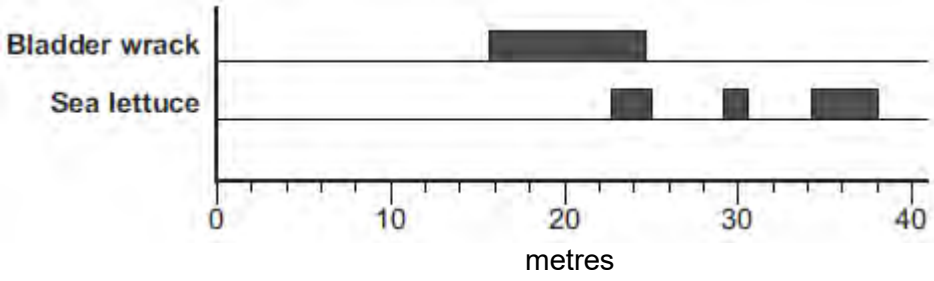
**Figure 2** shows a section of the seashore and the students' results.

**Figure 2**

**Section of the seashore**




**Students' results**




(i) The students placed the quadrat at regular intervals along a transect line rather than placing the quadrat at random positions anywhere on the rocky shore.

Explain why.

.....

.....

.....

.....

**(2)**

(ii) How could the students have improved their investigation to ensure that they produced valid data?

.....

.....

.....

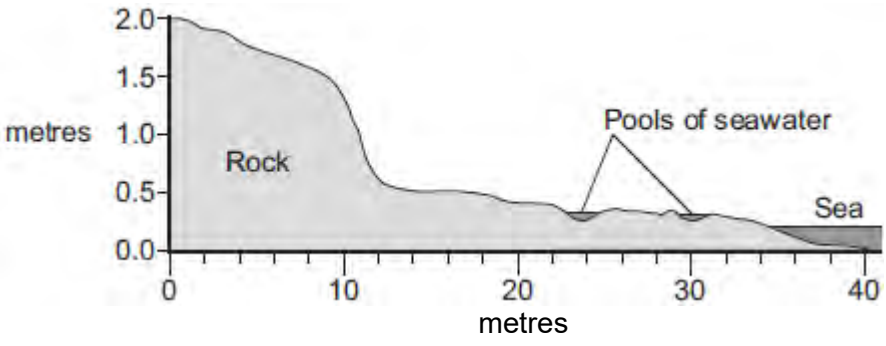
.....

**(2)**

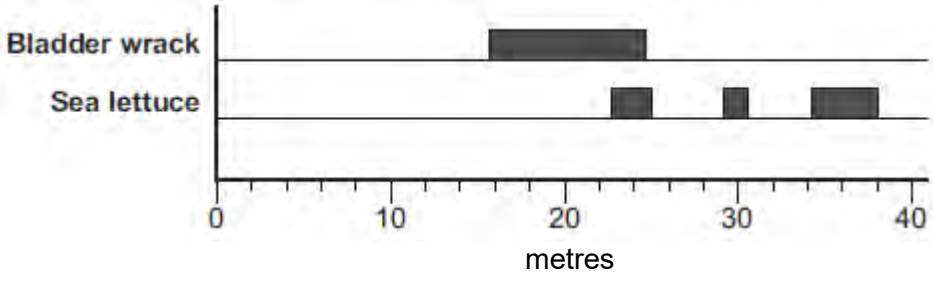
(iii) **Figure 2** is repeated here to help you answer this question.

**Figure 2**

**Section of the seashore**




**Students' results**




The students concluded that bladder wrack is better adapted than sea lettuce to survive in dry conditions.

What is the evidence for this conclusion?

Use information from **Figure 2**.

.....

.....

.....

.....

**(2)**

(b) The bladder wrack has many air bladders.
The air bladders help the bladder wrack to float upwards when the sea covers it.

Suggest how this helps the bladder wrack to survive.

.....

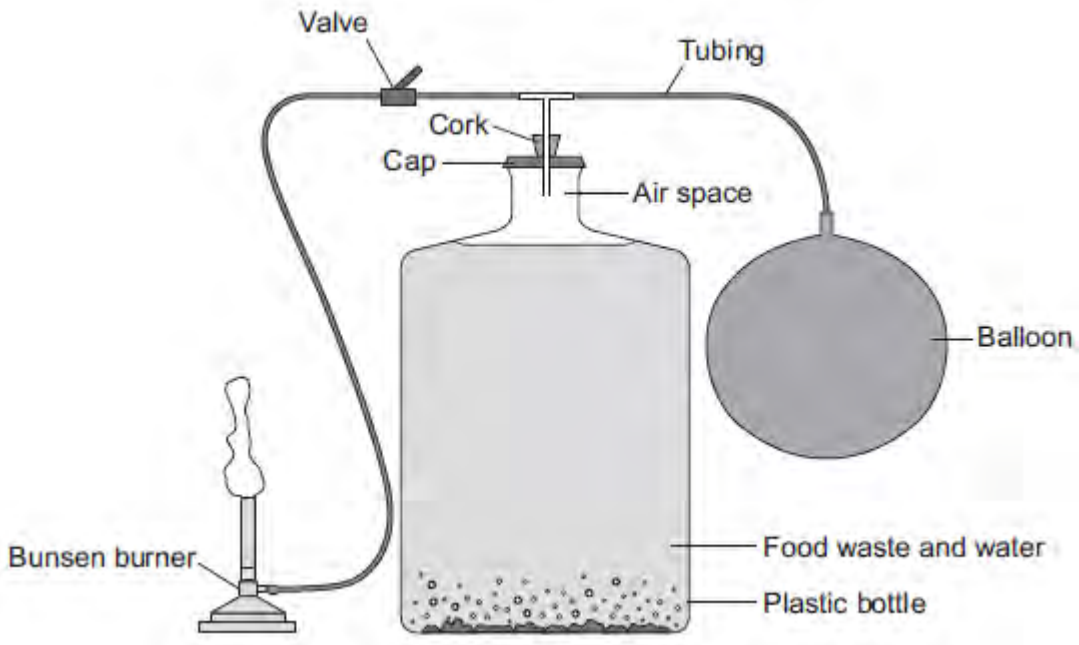
.....

.....

.....

**(2)**
**(Total 8 marks)**

**Q7.**The image below shows a model biogas generator.




Students used the model biogas generator to investigate which type of food waste produces the greatest yield of biogas.

Gas collects in the balloon. The gas is then released through the valve and is burned at the Bunsen burner.

The students:

- put 500 g of potato peelings in the plastic bottle with some water and sealed the apparatus
- released the gas from the balloon after day two and timed how long the gas burned for
- released the gas that had collected in the balloon from day two to day four and timed how long the gas burned for
- repeated the investigation using 500 g of cooked rice, then 500 g of cabbage leaves and then 500 g of cooked pasta.

(a) **Table 1** shows the students' results.

**Table 1**

| Type of food waste | Length of time the gas burned in seconds | |
|---|---|---|
| | After day two | From day two to day four |
| Potato peelings | 0 | 175 |
| Cooked rice | 0 | 100 |
| Cabbage leaves | 0 | 150 |
| Cooked pasta | 0 | 160 |

(i) Suggest why the gas collected in the balloon and released after day two did not burn.

.....

.....

.....

.....

.....

**(3)**

(ii) Suggest why potato peelings produced the most biogas.

.....

.....

**(1)**

(b) Scientists investigated the production of biogas from different types of animal manure.

**Table 2** shows the scientists' results.

**Table 2**

| Type of mannure | Volume of biogas produced in $m^3$ per kg of manure | Methane in the biogas as % of total volume |
|---|---|---|
| Cow | 0.34 | 65 |
| Pig | 0.58 | 68 |
| Hen | 0.62 | 60 |
| Horse | 0.30 | 66 |
| Sheep | 0.61 | 67 |

(i) Calculate the volume of methane produced from 1 kg of cow manure.

.....

.....

Volume of methane = ..... $m^3$

**(2)**

(ii) One scientist concluded that it would be better to use sheep manure in a biogas generator than to use cow manure.

What is the evidence for this conclusion?

Use information from **Table 2** in your answer.

.....

.....

.....

.....

.....

.....

**(2)**

**(Total 8 marks)**

**Q8.** On a rocky shore, when the tide goes in and out, organisms are exposed to the air for different amounts of time.

(a) On hot, windy days when the tide is out the concentration of the salt solution in rock pools may become very high.

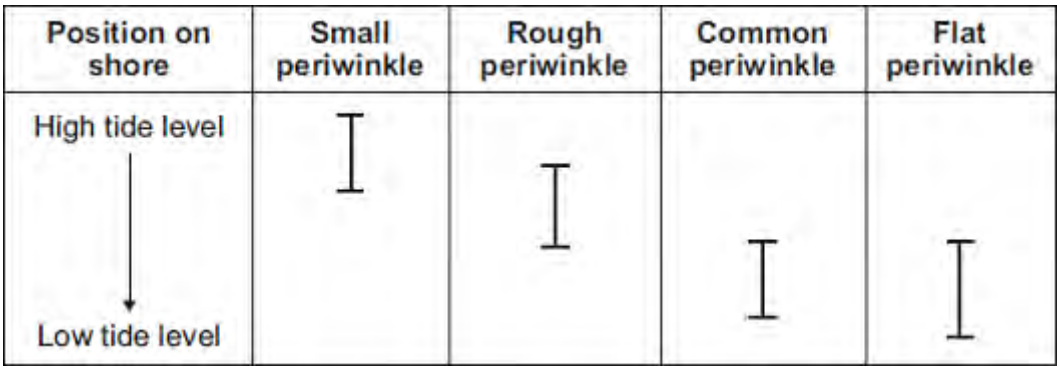
What term is used to describe organisms that can survive in severe conditions such as very high concentrations of salt solution?

.....

**(1)**

(b) Periwinkles are types of snail.
Students surveyed the different types of periwinkle living on a rocky shore.

The diagram shows the results of the students' survey.
The highest position that the sea water reaches on the shore is called the high tide level.
Each bar represents the range of habitats for each type of periwinkle.




(i) Which **two** types of periwinkle are likely to compete with each other to the greatest extent?

.....

**(1)**

(ii) Explain your answer to part (b)(i).

.....

.....

**(1)**

(iii) The small periwinkle can survive much nearer to the high tide level than the

flat periwinkle.

Suggest **two** reasons why the flat periwinkle cannot survive near to the high tide level.

1.....

.....

.....

2.....

.....

.....

**(2)**
**(Total 5 marks)**

**M1.** (a) snail
**or**
shrew

*additional incorrect answer negates correct answer*

**1**

(b) shrew

*additional incorrect answer negates correct answer*

**1**

(c) fewer shrews to eat them

**1**

(d) population

**1**

(e) **C**

**1**

(f) (11 000 × 0.1 =)
1 100 (kJ)

**1**

(g) the snails do not eat the roots of the lettuces

**1**

(h) any **one** from:
- light (intensity)
- temperature
- moisture (levels)
- soil pH
- mineral / ion content (of soil)

- wind intensity / speed

  *ignore wind direction*
- carbon dioxide (levels)
- oxygen (levels)

**1**

**[8]**

**M2.** (a) In sequence:

heron
frog
slug
lettuce

**1**

(b) (i) light / sun

*ignore photosynthesis / respiration*
*cancel mark if water / ions etc given*
*do **not** accept heat*

**1**

(ii) traps / absorbs light

*accept energy for light*
*do **not** accept collects / attracts*
*do **not** accept 'traps sun'*

**1**

(iii) 162

*if correct answer, ignore working / lack of working*

$\frac{10 \times 1620}{100}$ *for **1** mark*

**2**

**[5]**

**M3.** (a) (i) tick in box of FIRST pyramid

**1**

(ii) any **one** from:

- less energy / biomass lost / wasted
- greatest biomass / energy for humans
  *ignore human box is bigger*
  *ignore .food. for humans*
- shortest food chain **or** less stages **or** least number of different organisms **or** only one predator **or** only 2 boxes tall **or** least boxes
  *allow only one stage*

**1**

(b) (i) any **two** from:

- quicker / more growth **or** grow fatter
- less* urine **or** less faeces
- less* heat (lost)
- less* movement
  *assume for pigs indoors*
  *allow converse if clear for pigs outdoors*
  *(*) do **not** allow no for less*
  *ignore less space*

**2**

(ii) any **one** from:

- less cruelty **or** more ethical **or** better animal welfare
  *ignore more natural*
  *ignore ideas referring to against God's will*
- better flavour / quality (of meat)
  *ignore pig health **or** free range / organic*
- less pollution / etc / less fossil fuel used for heating

*ignore quality of life*

*assume for pigs outdoors*
*allow converse if clear for pigs indoors*

**1**

**[5]**

**M4.** (a) bottom / third pyramid ticked

*extra box ticked cancels the mark*

**1**

(b) the sun

*extra ring drawn cancels the mark*

**1**

(c) any **two** from:

- heat

  *ignore keeping warm*

- movement / named example internal or external

  *ignore digestion*

- respiration

  *do **not** allow <u>for</u> respiration*

- faeces / not all digested

  *allow waste for **1** mark if neither faeces nor excretion given*
  *(ie waste + movement = **2** marks waste + faeces = **1** mark*

- excretion/ urine

- not all of animal / all parts eaten

  *do **not** accept growth / reproduction*

**2**

**[4]**

**M5.** (a) (i) any **two** from:

- more milk
  *(about) 50 litres milk compared to (up to) 20 litres / 30 litres more*
  *ignore costs / profit*
- electricity produced
- farmers can keep more cows in the space
  *answers must refer to number of cows <u>and</u> space*

**2**

(ii) any **two** from:

- less stress for cow **or** not cruel to cow **or** cows have freedom to move around
  *ignore references to ethical / unnatural without qualification*
- crops fertilised
- less disease **or** disease not as easily spread

**2**

(b) more

**1**

less

*in this order*

**1**

**[6]**

**M6.** (a) (i) sun

*ignore light*

*apply list principle*

**1**

(ii) photosynthesis

*apply list principle*

*allow approximate spelling*

*do **not** accept phototropism*

**1**

(b) (i) chemical

**1**

(ii) carbon dioxide

**1**

(iii) carbohydrates

**1**

(c) As carbon dioxide from the caterpillar

*if more than 2 boxes ticked deduct one mark for each additional incorrect box*

**1**

As faeces (droppings) from the blue-tit

**1**

**[7]**

**M7.**(a) sulfur dioxide

**1**

(b) (i) mutation

**1**

(ii) pale form now (more) easily seen (by predators) **or** dark form now less easily seen (by predators)

*accept ref to camouflage*

**1**

so pale form (more) likely to be eaten **or** dark form less likely to be eaten

**1**

so dark form (more likely to) breed / pass on genes

**or**

pale form less likely to breed / pass on genes

**1**

(c) (i) pyramid of three layers of diminishing size

*either way up*

**1**

three labels in food chain order

*award 2 marks only if the pyramid is correctly labelled*

*accept trees / birch*

*accept (peppered) moth(s) / larvae*

**1**

(ii) some material is lost in waste from the birds

**1**

peppered moth larvae do not eat all the leaves from the trees

**1**

**[9]**

**M8.** (a) 3 (.0)

*correct answer, irrespective of working gains **2** marks.*
*if the answer is incorrect or there is no answer, award **1** mark for use of correct figures (0.5 and 3.5) [and no other figures]*

**2**

(b) as faeces

*if more than two boxes ticked deduct **1** mark for each additional tick*

**1**

as carbon dioxide from respiration

**1**

(c) (i) pigs kept inside are kept in small pens

*if more than two boxes ticked deduct **1** mark for each additional tick*

**1**

pigs kept inside are kept warm in the winter

**1**

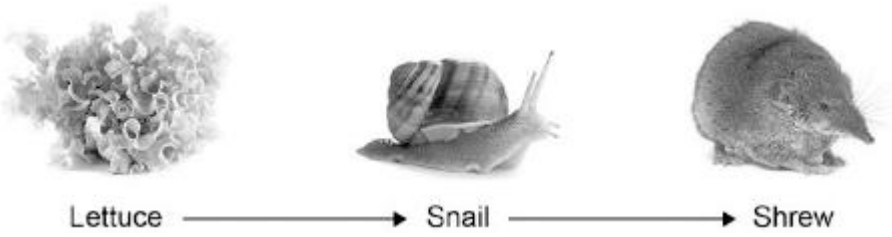
(ii) any **one** from:

- faster growth
  *ignore bigger / less flavour / fatty*
- need less food
  *ignore references to movement / energy*
- ready for market sooner
  *ignore ethical arguments*

**1**

**[7]**

**Q1.** The diagram below shows a food chain in a garden.






(a) Name **one consumer** shown in the diagram above.

.....

**(1)**

(b) Name **one carnivore** shown in the diagram above.

.....

**(1)**

(c) A disease kills most of the shrews in the garden.

Suggest why the number of snails in the garden may then increase.

.....

.....

**(1)**

(d) What is the name given to all the snails in the garden shown in the diagram above?

Tick **one** box.

Community ☐

Ecosystem ☐

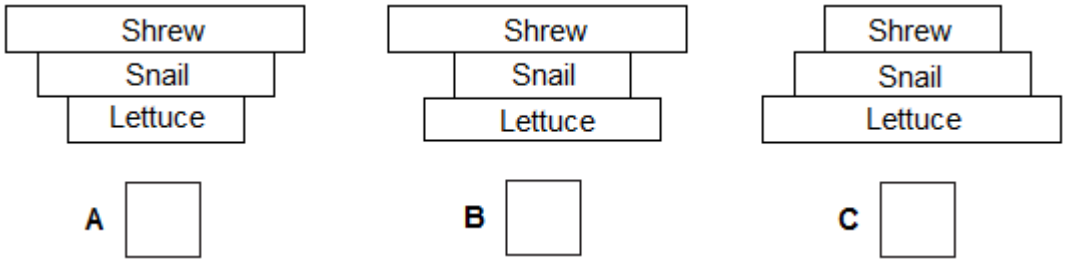
Population ☐

Territory ☐

**(1)**

(e) Which pyramid of biomass is correct for the food chain shown in the diagram above?

Tick **one** box.




**(1)**

(f) Some snails ate some lettuces.

The lettuces contained 11 000 kJ of energy.

Only 10% of this energy was transferred to the snails.

Calculate the energy transferred to the snails from the lettuces.

.....

Energy = ..... kJ

**(1)**

(g) Give **one** reason why only 10% of the energy in the lettuces is transferred to the snails.

Tick **one** box.

The lettuces carry out photosynthesis ☐

The snails do not eat the roots of the lettuces ☐

Not all parts of a snail can be eaten ☐

**(1)**

(h) **Abiotic** factors can affect the food chain.

Wind direction is one abiotic factor.

Name **one other** abiotic factor.

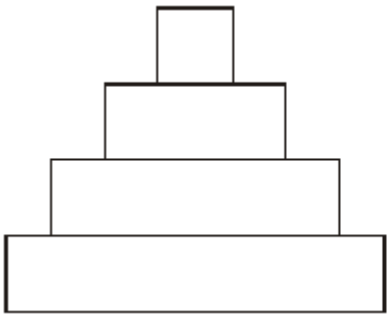
.....

**(1)**
**(Total 8 marks)**

**Q2.** This is a simple food chain.

Lettuce plant → Slug → Frog → Heron

The diagram shows a pyramid of biomass for this food chain.



……

……

……

……

(a) Write the names of the organisms in the food chain on the correct lines next to the pyramid of biomass.

**(1)**

(b) (i) The slug obtains its energy from the lettuce plant. What is the source of energy for the lettuce plant?

.....

**(1)**

(ii) What is the function of chlorophyll in a lettuce plant?

.....

**(1)**

(iii) The slugs ate some lettuce plants which contained 1620 kJ of energy. Only 10 per cent of this energy is used by the slugs for growth. Use the formula to calculate how much energy can be used by the slugs for growth. Show clearly how you work out your final answer.

Amount of energy =

$$\frac{(\text{Percentage of energy used by slugs}) \times (\text{Amount of energy in lettuce})}{100}$$

.....

.....

.....

Amount of energy = ..... kJ

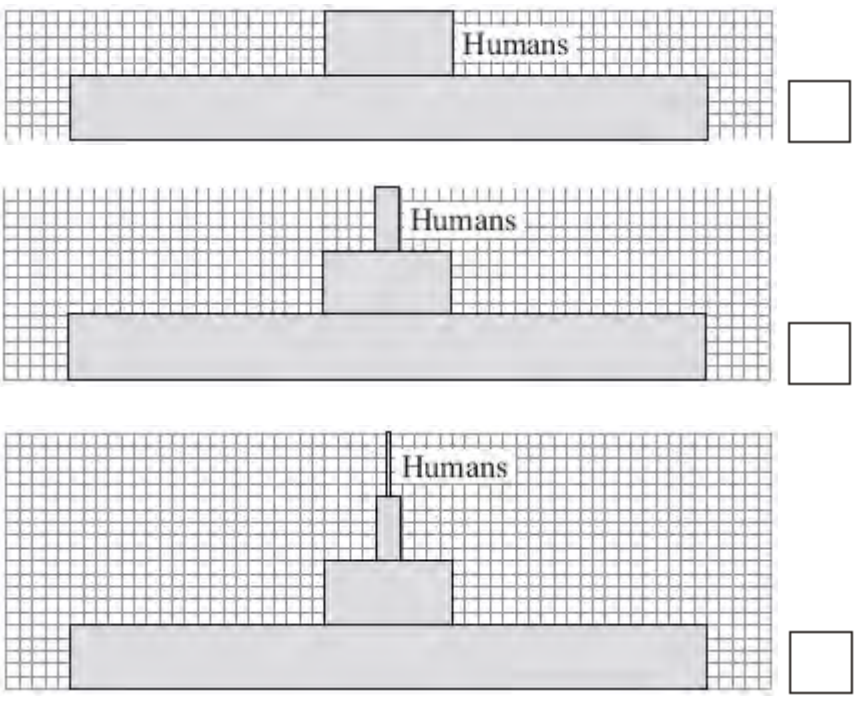
**(2)**

**(Total 5 marks)**

**Q3.** (a) The diagrams show three pyramids of biomass.

(i) Which pyramid would be the most efficient in providing food for humans?

Tick (✓) **one** box.




**(1)**

(ii) Give **one** reason for your choice.

.....

.....

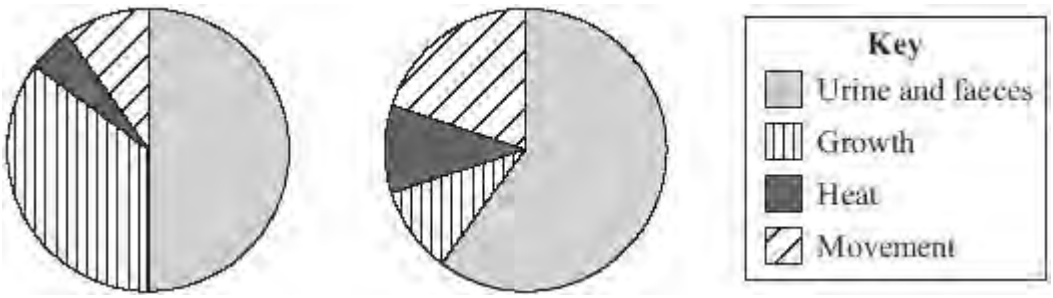
**(1)**

(b) Pigs may be kept indoors or outdoors.

**Pigs kept indoors** **Pigs kept outdoors**

The pie charts show what happens to the energy in the food eaten by pigs kept indoors and pigs kept outdoors.

**Pigs kept indoors** **Pigs kept outdoors**




(i) Farmers make more profit from keeping pigs indoors than from keeping pigs outdoors.

Use information from the pie charts to explain why.

.....

.....

.....

.....

**(2)**

(ii) Meat from pigs kept outdoors may cost more than meat from pigs kept indoors.

Some people prefer to buy meat from animals that have been kept outdoors.

Suggest **one** reason why.

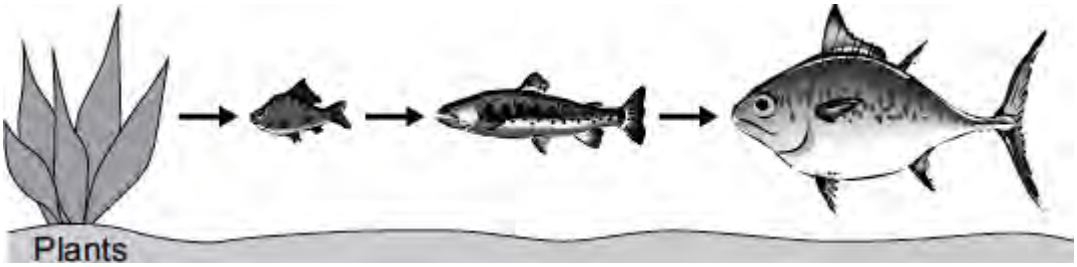
.....

.....

**(1)**

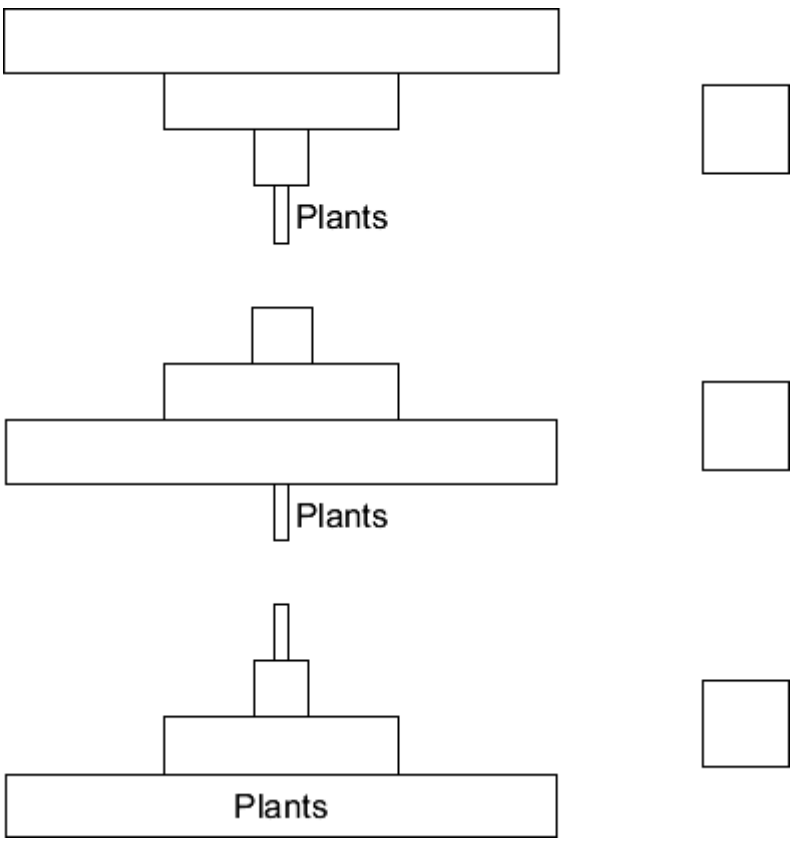
**(Total 5 marks)**

**Q4.** The picture shows a food chain.




(a) Which diagram shows a pyramid of biomass for the food chain in the picture?

Tick (✓) **one** box.




**(1)**

(b) The plants at the start of the food chain absorb energy.

Where does this energy come from?

Draw a ring around **one** answer.

**the water** **the sun** **minerals**

**(1)**

(c) Some energy is lost at each stage of the food chain.

Give **two** ways in which energy may be lost from the food chain.

1 .....

.....

2 .....

.....

**(2)**
**(Total 4 marks)**

**Q5.** There are plans for a 'cattle factory' to be built in the UK.

Information about the cattle factory and traditional cattle farming in the UK is given below.

Cattle factory

Traditional cattle farming

Cattle factory by Pirhan [CC BY-SA 2.0], via Flickr. Traditional cattle farming by Mat Fascione[CC-BY-SA-2.0], via W kimedia Commons

**Cattle factory**

- There will be over 8 000 cows in three large sheds.
- Each cow will be milked three times a day.
- Each cow will produce about 50 litres of milk every day.
- Waste will be collected and used to produce electricity for 2 000 homes.
- Cows are kept near to each other so disease can spread easily.

**Traditional cattle farming**

- Most farms have between 5 and 500 cows.
- The cows spend most of the time in fields.
- Cows are milked once or twice a day.
- Each cow produces up to 20 litres of milk a day.
- The waste is used as natural fertiliser for crops.

(a) Use the information to answer the questions.

(i) Give **two** reasons why some people think the cattle factory is a good idea.

1 .....

.....

2 .....

.....

**(2)**

(ii) Give **two** reasons why some people think traditional farming is better than the cattle factory.

1 .....

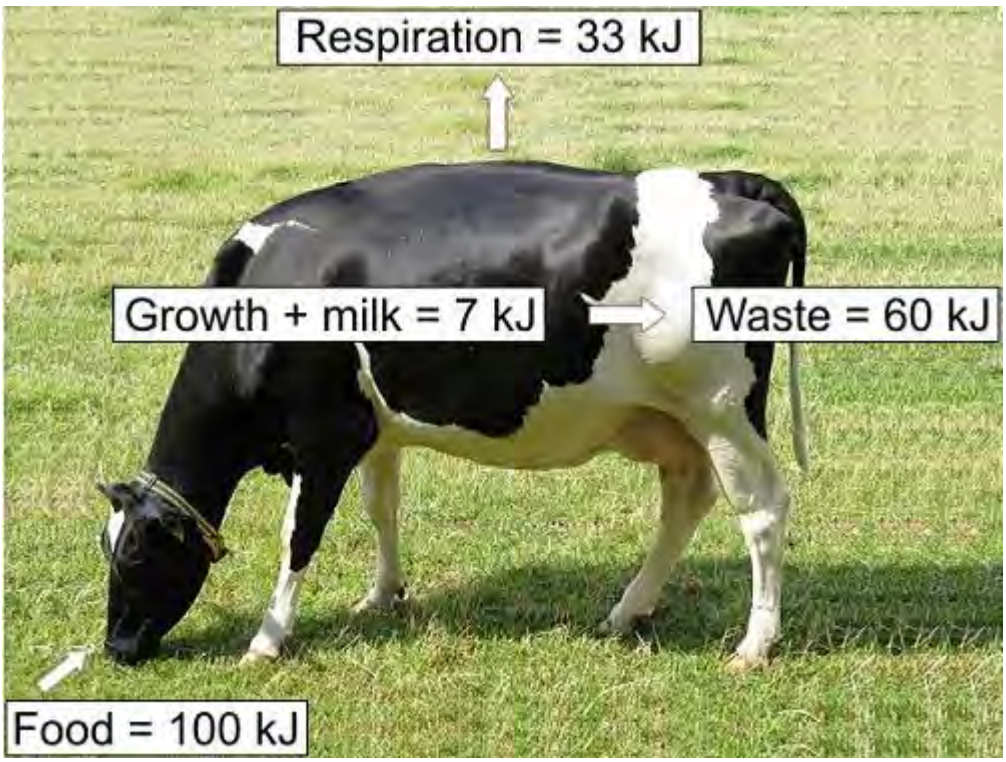
.....

2 .....

.....

**(2)**

(b) The diagram shows what happens to 100 kJ of energy in the food eaten by a cow on a traditional farm.




By Dohduhdah (Own work) [Public domain], via W kimedia Commons

Use your knowledge and the information in the diagram to answer this question.

Compare the transfer of energy from the food eaten by cows in the cattle factory

with the energy transferred by cows on a traditional farm.

Use words from the box to complete the table.

| **more** | **less** | **the same** |
|---|---|---|

| **Energy** | **Amount of energy transferred by cows in a cattle factory compared with cows on a traditional farm** |
|---|---|
| transferred for growth and milk | |
| transferred in respiration | |

**(2)**
**(Total 6 marks)**

**Q6.** Green plants are found at the start of all food chains.

(a) Complete the sentences.

(i) The source of energy for green plants is radiation from the .....

**(1)**

(ii) Green plants absorb some of the light energy that reaches them for a process called .....

**(1)**

(b) Draw a ring around the correct answer to complete each sentence.

(i) This process transfers light energy into

chemical
sound
electrical

energy.

**(1)**

(ii) The process uses the gas

carbon dioxide.
oxygen.
water.

**(1)**

(iii) The process produces carbon-containing compounds called

carbohydrates.
minerals.
salts.

**(1)**

(c) The amount of living material (biomass) at each stage in a food chain is less than at the previous stage.

The diagram shows a food chain.

**oak tree** → **caterpillar** → **blue-tit** → **hawk**

Give **two** ways in which biomass is lost in this food chain.

Tick (✓) **two** boxes.

As carbon dioxide from the caterpillar ☐

As food eaten by the hawk ☐

As oxygen from the oak tree ☐

As faeces (droppings) from the blue-tit ☐

**(2)**
**(Total 7 marks)**

**Q7.** There are two forms of peppered moth, dark and pale.
Birds eat the moths when the moths are resting on tree bark.

Pollution in the atmosphere may:

- kill lichens living on tree bark
- make the bark of trees go black.

(a) Draw a ring around the correct answer to complete the sentence.

Lichens are very sensitive to air pollution caused by

| |
|---|
| carbon dioxide. |
| nitrogen. |
| sulfur dioxide. |

**(1)**

(b) The photographs show the two forms of peppered moth, on tree bark.


Tree bark covered with lichens Tree bark made black by pollution



(i) The dark form of the peppered moth was produced by a change in the genetic material of a pale moth.

Use **one** word from the box to complete the sentence.

| | | |
|---|---|---|
| **characteristic** | **clone** | **mutation** |

A change in genetic material is called a

.....

**(1)**

(ii) In the 19th century, pollution made the bark of many trees go black.

Explain why:

- the population of the pale form of the moth in forests decreased
- the population of the dark form of the moth in forests increased.

.....

.....

.....

.....

.....

.....

.....

.....

**(3)**

(c) (i) The larvae (young) of the peppered moths eat the leaves of birch trees.

The diagram shows the food chain:

birch trees → peppered moth larvae → birds

Draw a pyramid of biomass for this food chain.

Label the pyramid.

**(2)**

(ii) Which **two** reasons explain the shape of the pyramid you drew in part (c)(i)?

Tick (✓) **two** boxes.

| | |
|---|---|
| Some material is lost in waste from the birds | ☐ |
| The trees are much larger than peppered moth larvae | ☐ |
| Peppered moth larvae do not eat all the leaves from the trees | ☐ |
| The trees do not use all of the Sun's energy | ☐ |

**(2)**
**(Total 9 marks)**

**Q8.** The photographs show four ways of farming.

**Growing wheat**

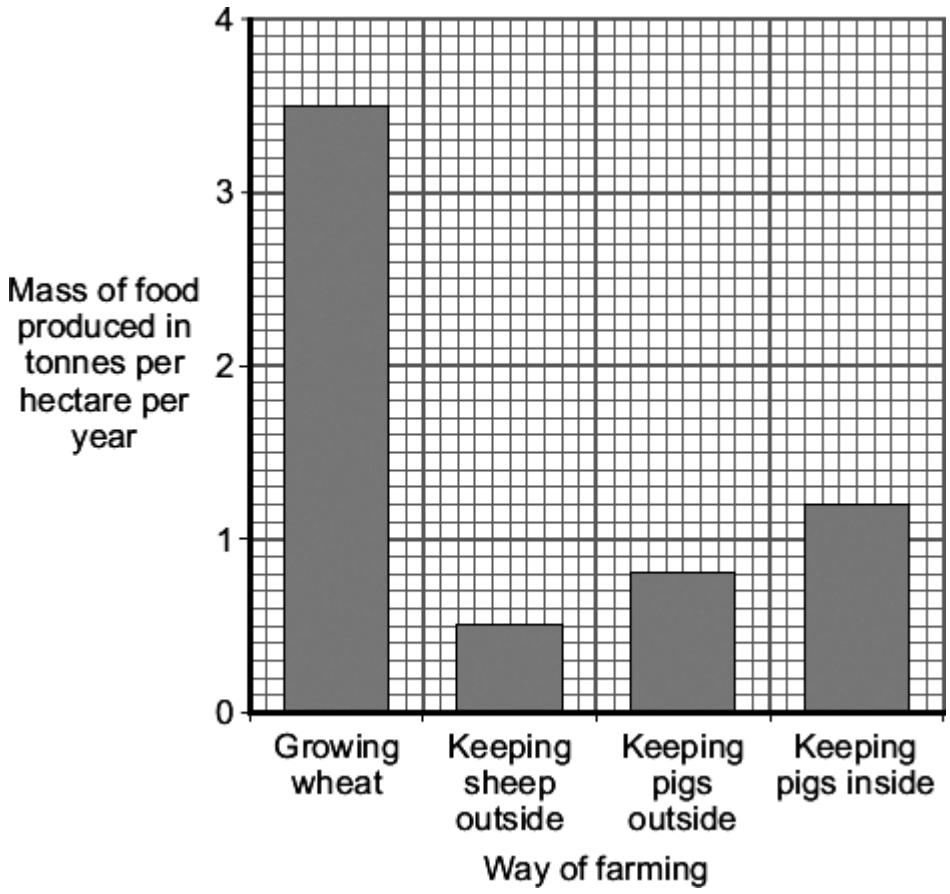
**Keeping sheep outside**

**Keeping pigs outside**

**Keeping pigs inside**

Growing wheat by Eileen Henderson [CC-BY-SA-2.0], via Wikimedia Commons. Keeping Sheep outside by Andrew Smith [CC-BY-SA-2.0], via W kimedia Commons. Keeping Pigs outside by David Williams [CC-BY-SA-2.0], via Wikimedia Commons. Keeping Pigs inside supplied by iStockphoto/ Thinkstock.

The bar chart shows the amount of food produced from these four ways of farming.




(a) How much extra food can be produced when farmers grow wheat, compared with keeping sheep outside?

Show clearly how you work out your answer.

.....

.....

Answer ..... tonnes per hectare per year

**(2)**

(b) Sheep eat grass.
For every 1000 g of grass eaten, a sheep increases in mass by only 50 g.
The other 950 g is lost.

How is the other 950 g lost?

Tick (✓) **two** boxes.

As oxygen from photosynthesis ☐

As faeces ☐

As meat ☐

As carbon dioxide from respiration ☐

**(2)**

(c) (i) Pigs kept inside lose less energy than pigs kept outside.

Why?

Tick (✓) **two** boxes.

Pigs kept inside are fed more. ☐

Pigs kept inside are kept in small pens. ☐

Pigs kept inside are kept warm in the winter. ☐

Pigs kept inside are healthier. ☐

**(2)**

(ii) Meat from pigs kept inside is usually cheaper than meat from pigs kept outside.

Give **one** reason why.

.....

.....

**(1)**
**(Total 7 marks)**

**M1.** (a) 3-layered triangular pyramid

*as blocks or layered triangle, ignore (small) gaps between layers*

**1**

(pyramid) labelled in food chain order

*all three labels are required*

*for **2** marks the pyramid must be fully correct*

**1**

(b) (i) C

**1**

(ii) shortest **or** fewest stages / transfers / (trophic) levels

*allow only if (b)(i) is C or blank*

**1**

less losses in waste / faeces / urine / $CO_2$ / excretion

*allow smaller amount uneaten*

**1**

less loss in respiration / heat / movement

*allow less lost keeping warm*

*do **not** allow energy for respiration*

*do **not** allow respiration makes energy*

*allow less loss (of biomass / energy) **or** less transfer (of biomass / energy) to surroundings if neither 2nd nor 3rd point given, for **1** mark*

**1**

**[6]**

**M2.** (a) (i) 6000

*award **2** marks for correct answer irrespective of working*
*allow **1** mark for 20 x 300 with incorrect or no answer*
*allow answer in table if answer line blank*

**2**

(ii) bar width 6000 **or** to match answer to (a)(i)

*anywhere on scale*
*ignore depth / height of bar*

**1**

drawn below slugs

*label **not** required*

**1**

(b) any **three** from:

*ignore reference to size / mass / number of organisms*
*assume reference is to / of hedgehog unless stated otherwise*

- respiration (by hedgehog)
  *do **not** accept idea that respiration uses / produces energy*
- (results in) loss of $CO_2$
- faeces (of hedgehog) **or** not digested
- excreted / urine / urea (by hedgehog)
  *accept waste for **1** mark if neither faeces nor excretion point made*
  *ignore sweat alone*
- not all slug(s) are eaten (by hedgehogs) **or** some slugs eaten by other things
  *ignore some slugs die*
  *ignore reference to movement / heat / growth*
  *allow references to energy losses by these methods, rather than biomass losses*

**3**

**[7]**

**M3.** (a) (i) wheat → humans chain transfers 10 times more energy than wheat → pigs → humans chain

*allow 10% if given as a comparison e.g. one is 10% of the other*

or

wheat → pigs → humans chain transfers 810 000 (kJ per hectare) less

*ignore less unqualified*

**1**

(ii) any **one** reason for energy loss from pigs e.g :

*ignore respiration, growth*

*ignore heat unqualified*

- movement
- (maintaining) body temperature
- waste materials

  *allow named examples*
- not all parts of pig eaten by human
- because there is an extra stage (pigs) in the food chain and energy is lost at each stage

  *allow longer food chain so more energy lost*

**1**

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance, and apply a 'best-fit' approach to the marking.

**0 marks** No relevant content.

**Level 1 (1-2 marks)** There is a basic description of at least one factory farming method
**or**
identification of an advantage or disadvantage of factory farming.

**Level 2 (3-4 marks)** There is a description of at least one factory farming method

**and**
an advantage or disadvantage is explained.

**Level 3 (5-6 marks)**There is a description of factory farming methods
**and**
advantage(s) and disadvantage(s) are explained.

**Examples of Biology points made in the response:**

factory farming methods e.g.:

- Kept in cramped conditions / battery hens / calf crates / pig barns / fish tanks
- Controlled temperature / heating
- Controlled feeding / modified food given / growth hormones
- Controlled lighting
- Treated with prophylactic antibiotics

Advantages e.g.:

- Increased efficiency / profit / greater food production / cheaper food / faster growth
- Farmer can have more livestock
- Less energy is lost through movement
- Less energy is used keeping warm
- (Food is high in calories / protein) so animals will grow faster / lay more eggs
- Easier to vaccinate all the animals
- Easier to protect animals from predators
- Antibiotic treatment stops infections in animals

Disadvantages e.g.:

- Stress / cruelty / inhumane / unethical
- Restricted movement / overcrowding
- Faster spread of diseases
- Antibiotics in the food chain / residual chemicals in the food chain

- Wasting fossil fuels / increasing global warming
- Increased pollution from animal waste and from additional transport

**6**

**[8]**

**M4.** (a) (i) triangular pyramid with 3 layers

*may be as blocks or as triangle*

*ignore food chains and arrows*

**1**

layers appropriately labelled:

bean / plant

aphid,

ladybird

*labelled in food chain order must **not** contradict correct pyramid*

*allow correctly labelled inverted pyramid for **2** marks*

**1**

(ii) any **two** from:

(for aphid / ladybird)

*ignore energy*

- not all digested / faeces
- loss in urine
- loss of $CO_2$

  *ignore loss of $CO_2$ from bean plant*
- not all eaten

  *if none of first 3 points given then allow waste (materials) / excretion for **1** mark*

**2**

(b) microorganisms / microbes / bacteria / fungi / decomposers / detritivores /named

*do **not** accept germs*

*allow mould*

*ignore aphids*

**1**

decay / breakdown / digest / decompose / rot (bean plant)

*ignore eat*

**1**

respiration (of microorganisms etc / aphids)

*allow burning / combustion*

**1**

carbon dioxide released (from respiration of microorganisms etc / aphids)

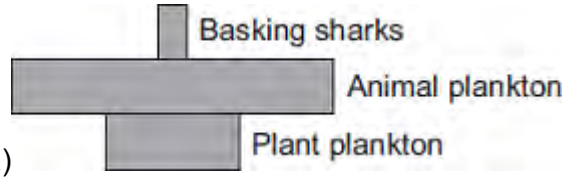
*allow carbon dioxide released / produced (from burning / combustion)*

*ignore other parts of the carbon cycle*
*ignore formation of fossil fuels*

**1**

**[8]**

**M5.** (a)




*if more than one box is ticked award no mark*

**1**

(b) increasing / higher light / temperature

*ignore references to months other than February – April*

*do **not** accept mineral / ions increase*

**1**

more / increased photosynthesis

*for both marks there must be a reference to 'more' at least once (e.g. 'more light for photosynthesis' gains **2** marks)*

*allow **1** mark for reference to light **and** photosynthesis without an idea of 'more'*

**1**

(c) increase due to increase in plant plankton / food

*ignore references to months other than April – July*

**1**

decrease due to fall in plant plankton / food **or** decrease as eaten by (basking) sharks

*allow decrease as eaten by predators / animals / fish*

**1**

(d) fall due to use / intake by <u>plant</u> (plankton)

*ignore ref to no change section of graph*

*for fall allow March / April*

*ignore May / February*

**1**

increase due to decay / decomposition / breakdown

*for increase allow any month in range August to November*

*ignore December*

1

of dead (plant / animal) plankton

*allow of dead organisms / waste*

1

**[8]**

**M6.**(a) Sun / sunlight / light

*accept radiation from the Sun / solar energy*

**1**

(b) (i) 2 (.0)

**1**

8 (.0)

**1**

(ii) 3 layers of decreasing size as they go up

**1**

labelled wheat grains, field mice, red kites <u>in correct order of food chain</u>

**1**

sizes correct (showing half on each side)

*allow ecf from **(b)(i)***

*error ± half square*

**1**

(c) any **two** from:

- not all the field mice are eaten
- not all parts of eaten mice are absorbed / some passed as faeces (of red kite)
- due to respiration (of red kites) / production of $CO_2$

*allow reference to uric acid / urea / urine (of red kite)*

*reference to waste / excretion alone gains **1** mark*

**2**

(d) any **two** from:

- cannot find all wheat grains / too many to count
- field mice hiding / in hedgerows

*allow ref to hibernation / nests / burrows*

- red kites / mice come and go all the time

*allow count an organism more than once*

**2**

**[10]**

**M7.** (a) (i) 1800(g)

**1**

(ii) triangular pyramid with four layers

*accept ecf from (a)(i)*
*allow inverted pyramid*

**1**

correctly labelled in order of food chain

**1**

(b) any **two** from:

- (lost as) crab faeces / not all digested

  *allow waste / excretion for **one** mark if neither faeces nor urine are given*

- (lost as) crab urine / urea

- loss of carbon dioxide by crab

  *accept (lost via) respiration*

- not all the limpet is eaten eg don't eat the shell

- not **all** limpets are eaten (by crabs)

  *allow not enough crabs to eat **all** the limpets / the limpet population*

  *ignore energy losses, such as movement*

**2**

**[5]**

**M8.**(a) (i) 6000

*award **2** marks for correct answer irrespective of working*
*allow **1** mark for 60 × 100 with incorrect or no answer*
*allow answer in table if answer line blank*

**2**

(ii) bar width 6000 **or** to match answer to (a)(i)

*anywhere on scale ignore depth / height of bar*

**1**

drawn below slugs

*label not required*

**1**

(b) any **three** from:

*ignore references to number / size / mass of organisms*
*assume reference is to / of hedgehog unless stated otherwise*

- respiration (by hedgehog)

  *do **not** accept idea that respiration uses / produces energy*

- faeces (of hedgehog) **or** (slug) not absorbed (by hedgehog) **or** (slug) not digested (by hedgehog)

- excreted / urine / urea (by hedgehog)

*accept waste for **1** mark if neither faeces nor excretion point made*

- not all slug (s) eaten (by hedgehogs) **or** some slugs eaten by other things **or** not all parts (of slug) eaten

  *ignore (some) slugs die*

- movement (by hedgehog)
- heat (from hedgehog)

*allow appropriate references to biomass lost by these methods, rather than energy losses*

**3**

**[7]**