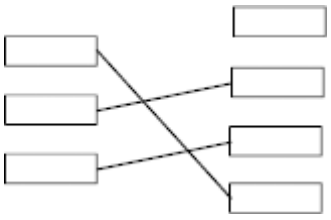
M1. (a) radio

1

(b)



*award **1** mark for each correct line*

if more than one line is drawn from any em wave then none of those lines gain credit

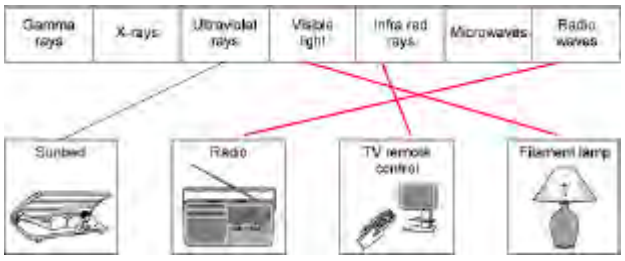
3

(c) ionising

1

[5]

M2. (a) all three lines correct



*allow **1** mark for each correct line*

if more than one line goes from a device then all lines from that device are wrong

3

(b) (i) skin cancer

*do **not** accept cancer*
*do **not** accept sunburn*

correct answer only

1

(ii) other factors may be involved

accept may have been in the Sun too long

accept (over)-use of sunbeds and (over)- exposure to the Sun (both) give the same symptomsaccept any other sensible factor that could lead to doubt

*do **not** accept irrelevant answers eg may be run over by a car*

*do **not** accept killed by exposure to the Sun*

1

(iii) can assess risk

answers should be in terms of assessing our own health risk

or

make your own decision

accept so you limit its use / don't use one

*do **not** accept so you don't get skin cancer*

*do **not** accept so you don't get sunburn*

1

[6]

M3. (a) vibrate / oscillate

accept a correct description

move is insufficient

1

(b) 336

*allow **1** mark for correct substitution, ie 420 × 0.8(0) provided no subsequent step shown*

2

[3]

M4. (a) (i) (visible) light

accept visible

1

(ii) microwaves

1

(b) J

1

(c) (i) B

1

(ii) shorter than

1

(d) (i) To find out if using a mobile phone is harmful to health

1

(ii) any **two** from:

- (X has a) low(er) SAR value

  "it" refers to mobile phone

  accept has a low(er) rate

- (maximum) energy absorbed (by the head) is less

  accept energy emitted (by phone) is less

  accept radiation for energy

- (if mobiles are harmful) less likely to cause harm

  accept will not cause harm

  accept it is safer

2

[8]

M5. (a) C

1

(b) reflection at the mirror of ray from shoe to person's eye

may be drawn freehand

1

angle of incidence = angle of reflection

judged by eye

a ruler must have been used

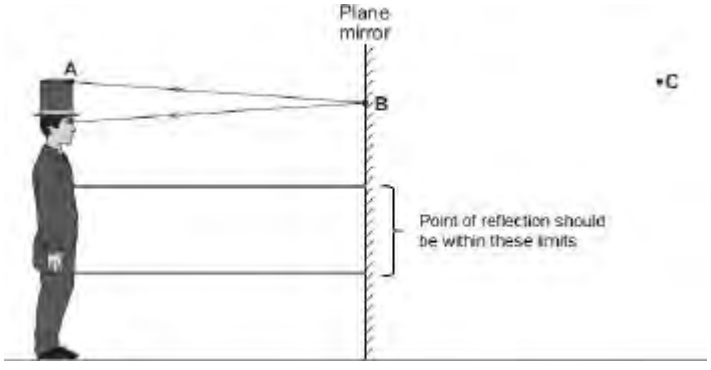
1

arrow to show correct direction on either incident or reflected ray

only one arrow needed but if more drawn must be no contradiction

both incident and reflected ray must be shown

1



(c) virtual

1

[5]

M6. (a) long

1

(b) lens A

1

it is a concave / diverging lens

this mark is only gained if lens A is stated

any reference to lens material or mass of lens negates this mark

allow it will focus light onto the retina

1

(c) The refractive index of the lens material

1

(d) 4

ignore any signs

*allow **1** mark for correct substitution, ie* $\frac{1}{0.25}$ *provided no subsequent step*

2

(e) Cauterising open blood vessels

1

(f) 5

*allow **1** mark for correct substitution, ie* $\frac{70}{14}$ *provided no subsequent step*

2

[9]

M7. (a) transmits

correct order

1

absorbs

1

(b) light

allow ultra violet ***or*** *UV* ***or*** *infrared* ***or*** *IR* ***or*** *gamma*

1

(c) 20

allow ***1*** *mark for correct working, ie* $\frac{60}{3}$ *provided no subsequent step*

2

(d) Killing cancer cells

1

[6]

M8. (a) refraction

1

(b) towards the normal

1

(c) (i) convex

1

(ii) principal focus

accept focal point

1

(d) parallel on left

1

refracted towards the normal at first surface

1

refraction away from normal at second surface

1

passes through or heads towards principal focus

1

(e) refractive index

accept material from which it is made

1

(radius of) curvature (of the sides)

accept shape / radius

*do **not** accept power of lens*
ignore thickness / length

1

[10]

M9. (a) decreases

correct order only

1

increases

1

(b) (i) intensity (of transmitted light) depends on thickness
or
to enable a valid comparison
or
it is a control variable

accept absorption depends on thickness
it would affect the results is insufficient
fair test is insufficient

1

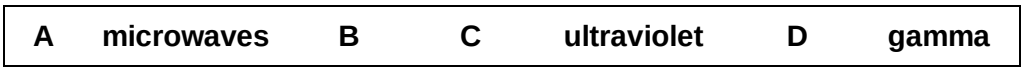
(ii) transmits the least light
or
absorbs the most light

accept very little light is transmitted
*do **not** accept transmits none of the light*
*do **not** accept absorbs all of the light*
any reference to heat negates this mark

1

[4]

Q1. The figure below shows an incomplete electromagnetic spectrum.



(a) What name is given to the group of waves at the position labelled **A** in the figure above?

Tick **one** box.

infrared ☐

radio ☐

visible light ☐

X-ray ☐

(1)

(b) Electromagnetic waves have many practical uses.

Draw **one** line from each type of electromagnetic wave to its use.

Electromagnetic wave	**Use**
Gamma rays	For fibre optic communications
Microwaves	For communicating with a satellite

Ultraviolet	To see security markings
	To sterilise surgical instruments

(3)

(c) Complete the sentence.

Use an answer from the box.

black body	**ionising**	**nuclear**

X-rays can be dangerous to people because X-rays are

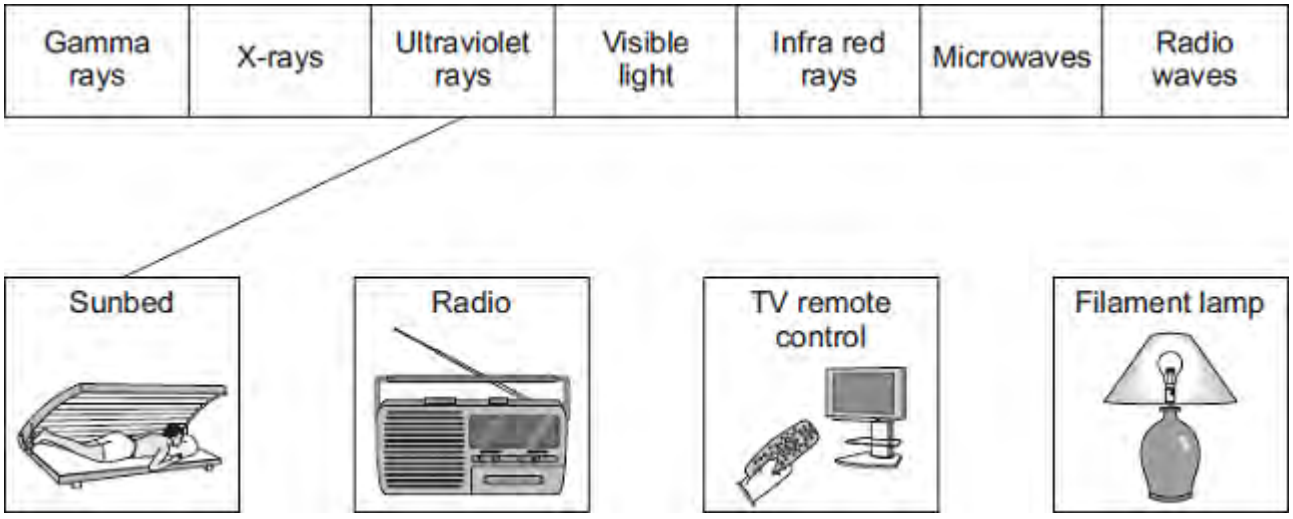
..... radiation.

(1)
(Total 5 marks)

Q2.(a) The diagram shows the electromagnetic spectrum.

The pictures show four devices that use electromagnetic waves. Each device uses a different type of electromagnetic wave.

Draw a line from each device to the type of electromagnetic wave that it uses. One has been done for you.



(3)

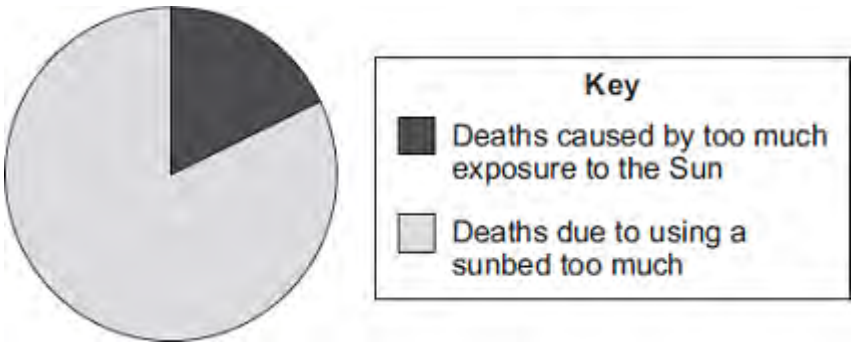
(b) A headline from a recent newspaper article is shown below.

(i) What serious health problem may be caused by using a sunbed too much?

.....

(1)

(ii) The pie chart compares the number of deaths in Britain each year which may have been caused by using sunbeds too much, with those which may have been caused by too much exposure to the Sun.



It is difficult for a doctor to be certain that a person has died because of using a sunbed too much.

Suggest why.

.....

.....

(1)

(iii) A spokesperson for a leading cancer charity said:

> 'We want people, especially young people, to know the possible dangers of using a sunbed.'

Why is it important that you know the possible dangers of using a sunbed?

.....

.....

(1)
(Total 6 marks)

Q3.A lorry has an air horn. The air horn produces sound waves in the air.

(a) Use **one** word to complete the following sentence.

Sound waves cause air particles to ..... .

(1)

(b) The air horn produces sound waves at a constant frequency of 420 Hz.

The wavelength of the sound waves is 0.80 m.

Calculate the speed of the sound waves.

.....

.....

.....

Speed = ... m/s

(2)

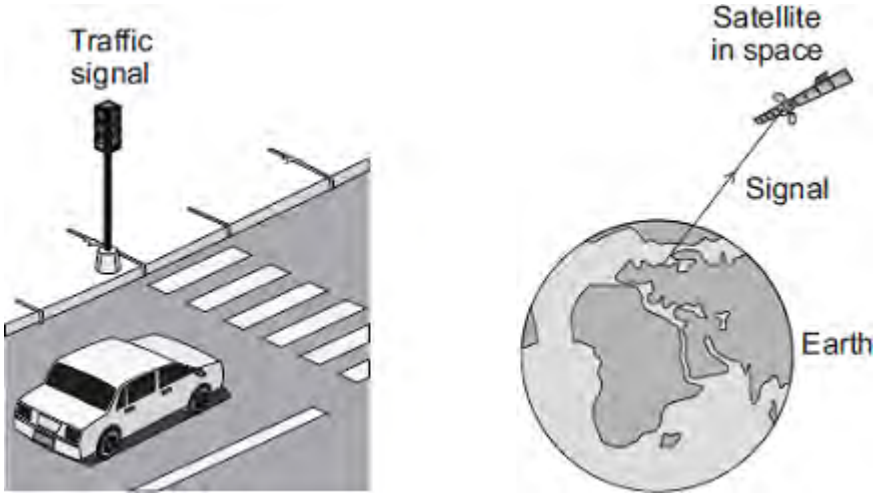
(Total 3 marks)

Q4.Diagram 1 shows four of the seven types of wave in the electromagnetic spectrum.

Diagram 1

J	**K**	**L**	Visible light	Infrared	Microwaves	Radio waves

(a) The **four** types of electromagnetic wave named in **Diagram 1** above are used for communication.



(i) Which type of electromagnetic wave is used when a traffic signal communicates with a car driver?

.....

(1)

(ii) Which type of electromagnetic wave is used to communicate with a satellite in space?

.....

(1)

(b) Gamma rays are part of the electromagnetic spectrum.

Which letter, **J**, **K** or **L**, shows the position of gamma rays in the electromagnetic spectrum?

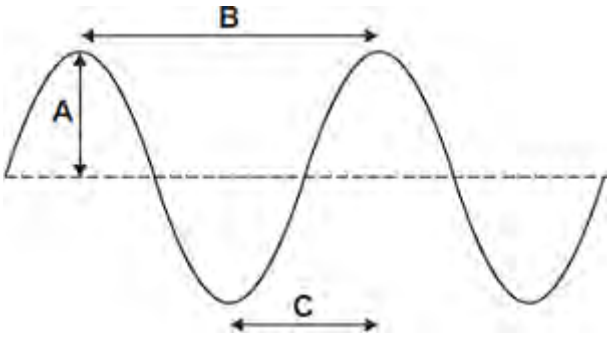
Draw a ring around the correct answer.

J **K** **L**

(1)

(c) **Diagram 2** shows an infrared wave.

Diagram 2



(i) Which **one** of the arrows, labelled **A**, **B** or **C**, shows the wavelength of the wave?

Write the correct answer, **A**, **B** or **C**, in the box. ☐

(1)

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

The wavelength of infrared waves is

shorter than	
the same as	the wavelength of radio waves.
longer than	

(1)

(d) Mobile phone networks send signals using microwaves. Some people think the energy a person's head absorbs when using a mobile phone may be harmful to health.

(i) Scientists have compared the health of people who use mobile phones with the health of people who do not use mobile phones.

Which **one** of the following statements gives a reason why scientists have done this?

Tick (✓) **one** box.

To find out if using a mobile phone is harmful to health. ☐

To find out if mobile phones give out radiation. ☐

To find out why some people are healthy. ☐

(1)

(ii) The table gives the specific absorption rate (SAR) value for two different mobile phones.

The SAR value is a measure of the maximum energy a person's head absorbs when a mobile phone is used.

Mobile Phone	SAR value in W/kg
X	0.28
Y	1.35

A parent buys mobile phone **X** for her daughter.

Using the information in the table, suggest why buying mobile phone **X** was the best choice.

.....

.....

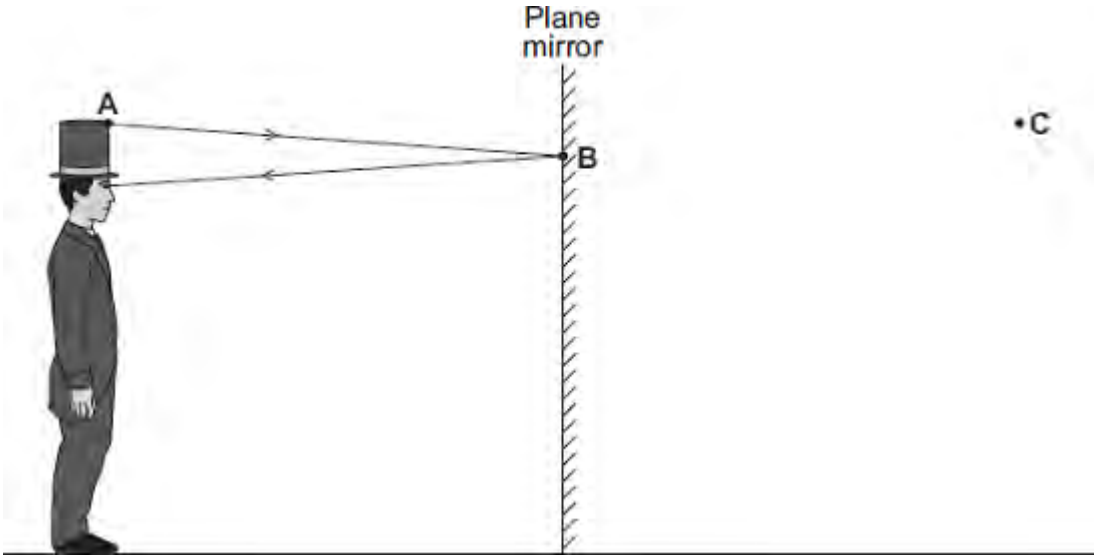
.....

.....

(2)

(Total 8 marks)

Q5.A person can see an image of himself in a tall plane mirror.



The diagram shows how the person can see his hat.

(a) Which point, **A**, **B** or **C**, shows the position of the image of his hat?

Write the correct answer, **A**, **B** or **C**, in the box.

(1)

(b) On the diagram, use a ruler to draw a light ray to show how the person can see his shoe.

(3)

(c) Which **one** of the words in the box is used to describe the image formed by a plane mirror?

Draw a ring around the correct answer.

imaginary	**real**	**virtual**

(1)
(Total 5 marks)

Q6.(a) Some humans are short-sighted.

Complete the following sentence.

Short sight can be caused by the eyeball being too ..... .

(1)

(b) Spectacles can be worn to correct short sight.

The table below gives information about three different lenses that can be used in spectacles.

	Lens feature		
	Material	**Mass in grams**	**Type**
Lens A	Plastic	5.0	Concave (diverging)
Lens B	Glass	6.0	Convex (converging)
Lens C	Glass	5.5	Convex (converging)

Which lens from **Table 2** would be used to correct short sight?

Draw a ring around the correct answer.

Lens A **Lens B** **Lens C**

Give the reason for your answer.

.....

.....

(2)

(c) Every lens has a focal length.

Which factor affects the focal length of a lens?

Tick (✓) **one** box.

The colour of the lens ☐

The refractive index of the lens material ☐

The size of the object being viewed ☐

(1)

(d) A lens has a focal length of 0.25 metres.

Calculate the power of the lens.

.....

.....

.....

Power of lens = ... dioptres

(2)

(e) Laser eye surgery can correct some types of eye defect.

Which of the following is another medical use for a laser?

Tick (✓) **one** box.

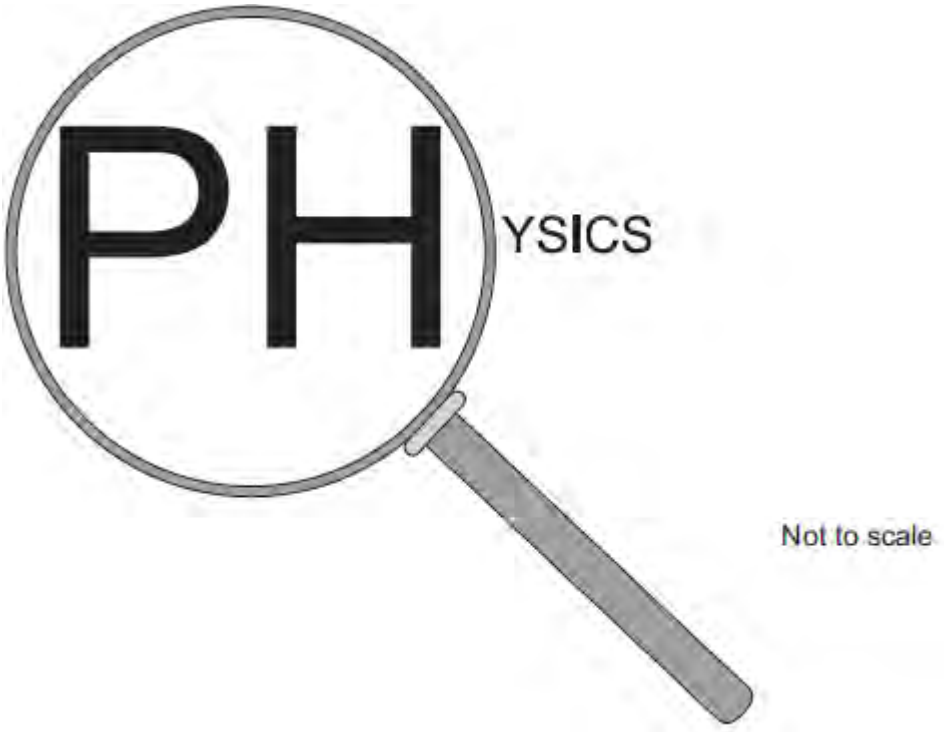
Cauterising open blood vessels ☐

Detecting broken bones ☐

Imaging the lungs ☐

(1)

(f) The figure shows a convex lens being used as a magnifying glass.



An object of height 14 mm is viewed through a magnifying glass.

The image height is 70 mm.

Calculate the magnification produced by the lens in the magnifying glass.

.....

.....

.....

Magnification = ...

(2)
(Total 9 marks)

Q7. The figure below shows an X-ray image of a human skull.

Stockdevil/iStock/Thinkstock

(a) Use the correct answers from the box to complete the sentence.

absorbs	ionises	reflects	transmits

When X-rays enter the human body, soft tissue ..... X-rays

and bone ..... X-rays.

(2)

(b) Complete the following sentence.

The X-rays affect photographic film in the same way that ..... does.

(1)

(c) The table below shows the total dose of X-rays received by the human body when different parts are X-rayed.

Part of body X-rayed	Dose of X-rays received by human body in arbitrary units
Head	3

Chest	4
Pelvis	60

Calculate the number of head X-rays that are equal in dose to one pelvis X-ray.

.....

.....

.....

Number of head X-rays = ...

(2)

(d) Which **one** of the following is another use of X-rays?

Tick (✓) **one** box.

Cleaning stained teeth ☐

Killing cancer cells ☐

Scanning of unborn babies ☐

(1)

(Total 6 marks)

Q8. Light changes direction as it passes from one medium to another.

(a) Use the correct answer from the box to complete the sentence.

diffraction	**reflection**	**refraction**

The change of direction when light passes from one medium to another is called ..... .

(1)

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

When light passes from air into a glass block, it changes

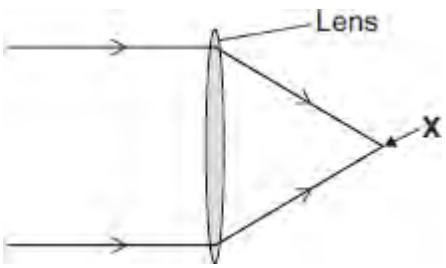
direction

- away from the normal.
- towards the normal.
- to always travel along the normal.

(1)

(c) **Diagram 1** shows light rays entering and passing through a lens.

Diagram 1



(i) Which type of lens is shown in **Diagram 1**?

Draw a ring around the correct answer.

concave **convex** **diverging**

(1)

(ii) In **Diagram 1**, what is the point **X** called?

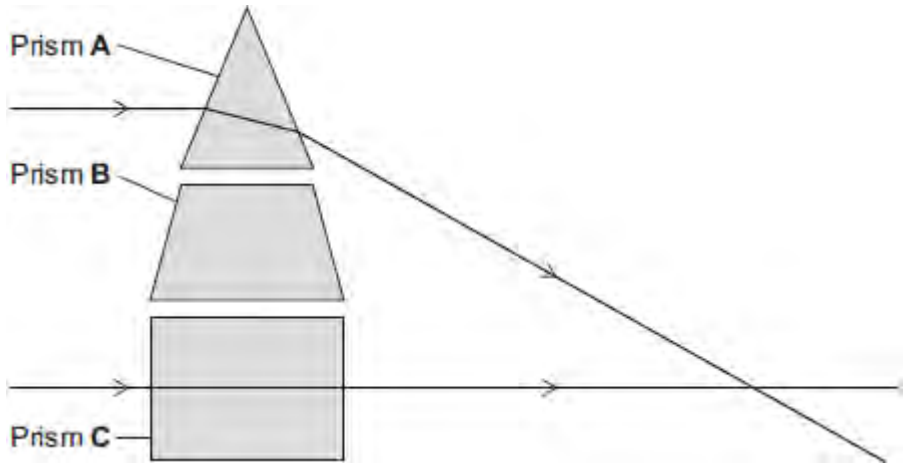
.....

(1)

(d) A lens acts like a number of prisms.

Diagram 2 shows two parallel rays of light entering and passing through prism **A** and prism **C**.

Diagram 2



Draw a third parallel ray entering and passing through prism **B**.

(4)

(e) What **two** factors determine the focal length of a lens?

1 .....

2 .....

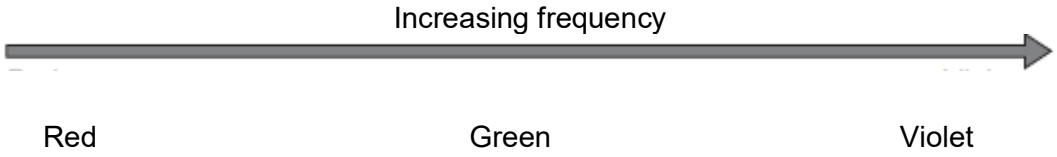
(2)

(Total 10 marks)

Q9.(a) The visible light spectrum has a range of frequencies.

Figure 1 shows that the frequency increases from red light to violet light.

Figure 1



Use the correct answers from the box to complete the sentence.

decreases	**stays the same**	**increases**

As the frequency of the light waves increases, the wavelength

of the light waves ..... and

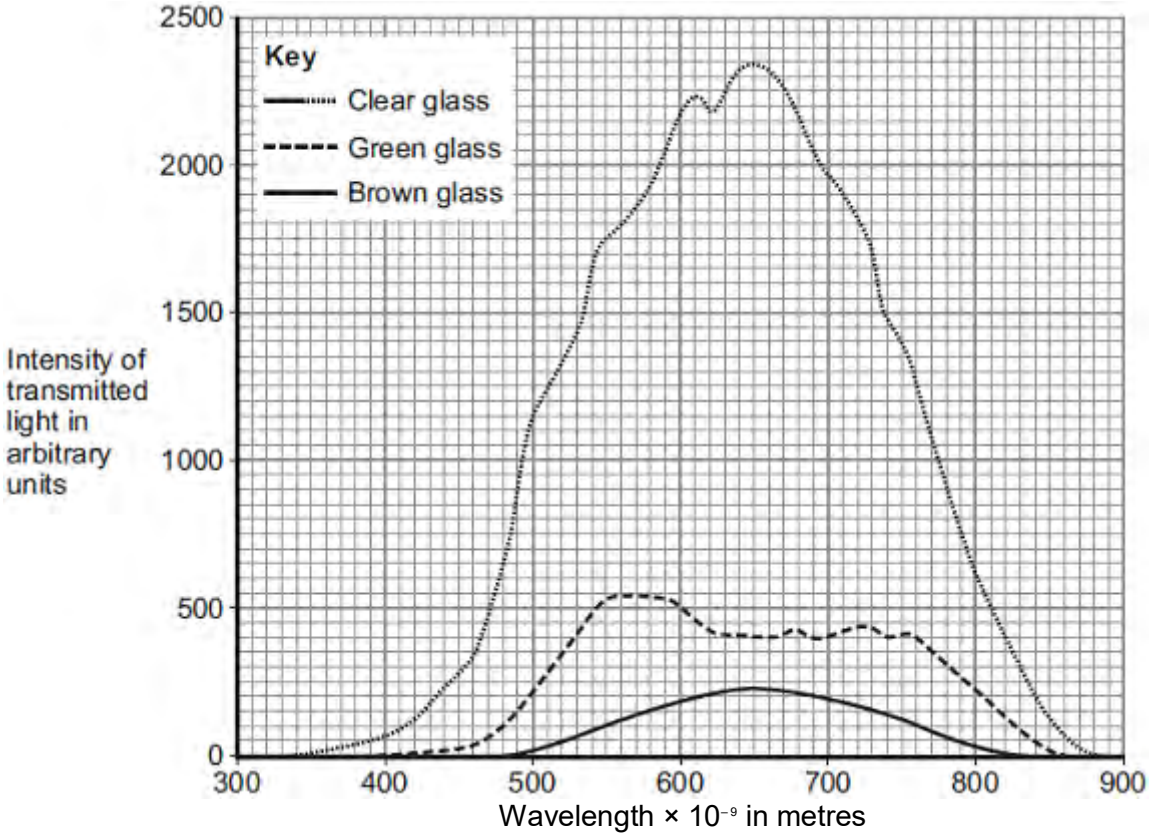
the energy of the light waves ..... .

(2)

(b) Bottled beer will spoil if the intensity of the light passing through the glass bottle into the beer is too high.

Figure 3 shows the intensity of the light that is transmitted through three different pieces of glass.

Figure 3



(i) The pieces of glass all had the same thickness.

Suggest why.

.....

.....

(1)

(ii) Bottles made of brown glass are suitable for storing beer.

Suggest why.

.....

.....

(1)

(Total 4 marks)

M1. (a) (i) short sight

accept myopia

1

(ii) diverging

1

(b) light

1

(c) Marks awarded for this answer will be determined by the quality of communication as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks
No relevant content

Level 1 (1–2 marks)
There is a basic description of one advantage ***or*** disadvantage of using **either** of the methods

Level 2 (3–4 marks)
There is a *description* of some advantages **and / or** disadvantages of using **both** methods
or
a full, detailed description of the advantages and disadvantages of using **either** of the methods.

Level 3 (5–6 marks)
There is a *clear description* of the advantages and disadvantages of using **both** methods.

examples of the points made in the response

extra information

laser surgery

advantages:

- *appearance*
- *permanent effect*

- no glasses which need changing

disadvantages:

- risks associated with surgery
- large cost
- not able to drive etc straightaway
- (still) might need glasses for reading

wearing glasses

advantages:

- able to function straightaway
- any problems easy to sort out

disadvantages:

- *easily broken*
- *easily lost*
- need changing
- overall cost might be greater if several changes in vision
- might eventually need two pairs of glasses

6

(d) move lens

1

closer to film

1

[11]

M2.(a) (sound waves) which have a frequency higher than the upper limit of hearing for humans

or

a (sound) wave (of frequency) above 20 000 Hz

sound waves that cannot be heard is insufficient

a wave of frequency 20 000 Hz is insufficient

1

(b) 640

*an answer of 1280 gains **2** marks*

*allow **2** marks for the correct substitution*

ie 1600 × 0.40 provided no subsequent step

*allow **2** marks for the substitution* $\frac{1600 \times 0.80}{2}$

provided no subsequent step

*allow **1** mark for the substitution 1600 × 0.80 provided no subsequent step*

*allow **1** mark for the identification that time (boat to bed) is 0.4*

3

(c) any **one** from:

- pre-natal scanning / imaging
- imaging of a named organ (that is not surrounded by bone), eg stomach, bladder, testicles

  accept heart

  *do **not** allow brain **or** lungs (either of these negates a correct answer)*
- Doppler scanning blood flow

1

(d) advantage

any **one** from:

- (images are) high quality or detailed or high resolution

  clearer / better image is sufficient
- (scan) produces a slice through the body
- image can be viewed from any direction

  allow images are (always) 3D / 360°
- an image can be made of <u>any</u> part (inside the body)

  allow whole body can be scanned
- easier to diagnose **or** see a problem (on the image)

1

disadvantage

any **one** from:

- (the X-rays used **or** scans) are <u>ionising</u>

  allow a description of what ionising is
- mutate cells **or** cause mutations **or** increase chances of mutations

allow for cells:

DNA / genes / chromosomes / nucleus / tissue

- turn cells cancerous **or** produce abnormal growths **or** produce rapidly growing cells
- kill cells

  damage cells is insufficient
- shielding is needed

  can be dangerous (to human health) unqualified, is insufficient

1

[7]

M3. (a) wavelength correctly shown

1

(b) (i) increased

1

decreased

1

(ii) 17-18 inclusive

1

evidence of measurement divided by 3 or mean of 3 separate measurements

1

mm

accept cm if consistent with answer

1

(c) (i) red shift

1

(ii) moving away

1

(iii) the furthest galaxies show the biggest red shift

1

(meaning that) the furthest galaxies are moving fastest

1

(so the) Universe is expanding

1

(extrapolating backwards this suggests that) the Universe started from an initial point

1

(iv) cosmic microwave background radiation

allow CMBR

1

[13]

M4.Level 3 (5–6 marks):

A detailed and coherent plan covering all the major steps is provided. The steps in the method are logically ordered. The method would lead to the production of valid results.

A source of inaccuracy is provided.

Level 2 (3–4 marks):
The bulk of a method is described with mostly relevant detail. The method may not be in a completely logical sequence and may be missing some detail.

Level 1 (1–2 marks):
Simple statements are made. The response may lack a logical structure and would not lead to the production of valid results.

0 marks:
No relevant content.

Indicative content

place a glass block on a piece of paper

draw around the glass block and then remove from the paper

draw a line at 90° to one side of the block (the normal)

use a protractor to measure and then draw a line at an angle of 20° to the normal

replace the glass block

using a ray box and slit point the ray of light down the drawn line

mark the ray of light emerging from the block

remove the block and draw in the refracted ray

measure the angle of refraction with a protractor

repeat the procedure for a range of values of the angle of incidence

possible source of inaccuracy

the width of the light ray

which makes it difficult to judge where the centre of the ray is

[6]

M5.(a) **Level 3 (5–6 marks):**
A detailed and coherent plan covering all the major steps is provided. The steps in the method are logically ordered. The method would lead to the production of valid results.

A source of inaccuracy is provided.

Level 2 (3–4 marks):
The bulk of a method is described with mostly relevant detail. The method may not be in a completely logical sequence and may be missing some detail.

Level 1 (1–2 marks):
Simple statements are made. The response may lack a logical structure and would not lead to the production of valid results.

0 marks:
No relevant content.

Indicative content

place a glass block on a piece of paper

draw around the glass block and then remove from the paper

draw a line at 90° to one side of the block (the normal)

use a protractor to measure and then draw a line at an angle of 20° to the normal

replace the glass block

using a ray box and slit point the ray of light down the drawn line

mark the ray of light emerging from the block

remove the block and draw in the refracted ray

measure the angle of refraction with a protractor

repeat the procedure for a range of values of the angle of incidence

possible source of inaccuracy

the width of the light ray

which makes it difficult to judge where the centre of the ray is

6

(b) velocity / speed of the light decreases
allow velocity / speed of the light changes

1

[7]

M6.(a) magnification = $\frac{\text{image height}}{\text{object height}}$

1

dividing by an object height of 1 cm gives the same (numerical) value

1

(b) accept anything practical that would work eg:

use a taller object

use a (travelling) microscope

attach a scale to the screen and use a magnifying glass

1

(c) both points plotted correctly

1

correct line of best fit drawn

a curve passing through all points (within ½ square), judge by eye

1

(d) values of 1.4 and 0.6 extracted from the graph

1

2.33 times bigger

accept any number between 2.3 and 2.5 inclusive

1

(e) by dividing the distance between the lens and the image by the distance between the lens and the object

1

at least one correct calculation and comparison eg 100÷25 = 4 which is the same as the measured magnification

1

[9]

Q1. Lenses can be used to correct visual defects.

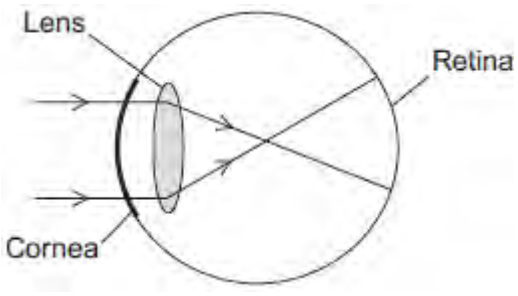
Figure 1 shows a child wearing glasses.
Wearing glasses allows a lens to correct a visual defect.

Figure 1

© monkeybusinessimages/iStock/Thinkstock

(a) **Figure 2** shows rays of light entering a child's eye and being focused at a point.
This point is not on the retina so the child sees a blurred image.

Figure 2



(i) What is the visual defect of this eye?

.....

.....

(1)

(ii) Use the correct answer from the box to complete the sentence.

converging	convex	diverging

The type of lens used to correct this visual defect is a ..... lens.

(1)

(b) Visual defects may be corrected with eye surgery. A laser may be used in eye surgery.

Use the correct answer from the box to complete the sentence.

light	sound	X-rays

A laser is a concentrated source of ..... .

(1)

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

Lasers can be used to correct a visual defect by changing the shape of the cornea.

A knife is used to cut a flap in the cornea. The laser vaporises a portion of the cornea and permanently changes its shape. The flap is then replaced.

Most patients are back at work within a week. Driving may be unsafe for one to two weeks. Tinted glasses with ultraviolet protection are needed when out in the sun for the first three months.

Many people in their mid-40s need reading glasses. This is because the eye lens becomes less flexible with age. Laser surgery cannot cure this.

Laser surgery for both eyes costs £1000. A pair of glasses costs £250.

Describe the advantages and disadvantages of:

- having laser surgery to correct visual defects
- wearing glasses to correct visual defects.

.....

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.....

Extra space .....

.....

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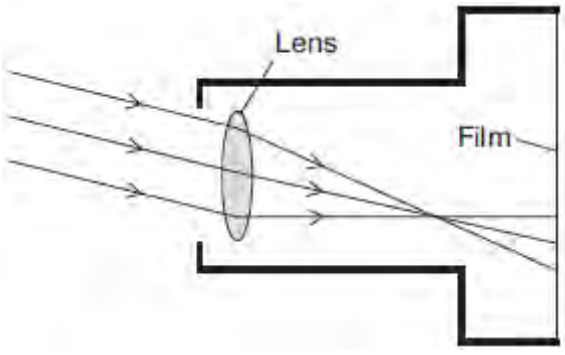
.....

(6)

(d) **Figure 3** shows parallel rays of light, from a point on a distant object, entering a camera.

Figure 3



Describe the adjustment that has to be made to focus the image on the film.

.....

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.....

(2)
(Total 11 marks)

Q2.(a) What is ultrasound?

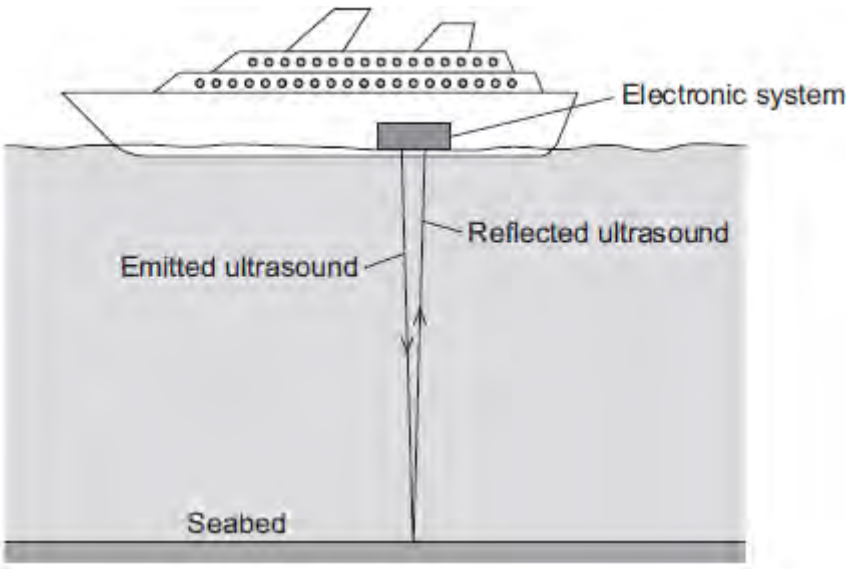
.....

.....

(1)

(b) **Figure 1** shows how ultrasound is used to measure the depth of water below a ship.

Figure 1



A pulse of ultrasound is sent out from an electronic system on-board the ship.

It takes 0.80 seconds for the emitted ultrasound to be received back at the ship.

Calculate the depth of the water.

Speed of ultrasound in water = 1600 m / s

.....

.....

.....

.....

Depth of water = ... metres

(3)

(c) Ultrasound can be used in medicine for scanning.

State **one** medical use of ultrasound scanning.

.....

(1)

(d) Images of the inside of the human body can be made using a Computerised Tomography (CT) scanner. The CT scanner in **Figure 2** uses X-rays to produce these images.

Figure 2

monkeybusinessimages/iStock/Thinkstock

State **one** advantage and **one** disadvantage of using a CT scanner, compared with ultrasound scanning, for forming images of the inside of the human body.

Advantage of CT scanning .....

.....

.....

Disadvantage of CT scanning .....

.....

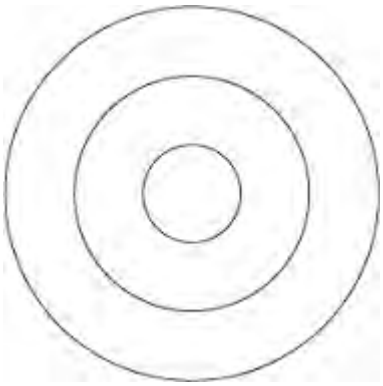
.....

(2)
(Total 7 marks)

Q3.A teacher demonstrates the production of circular waves in a ripple tank.

Diagram 1 shows the waves at an instant in time.

Diagram 1



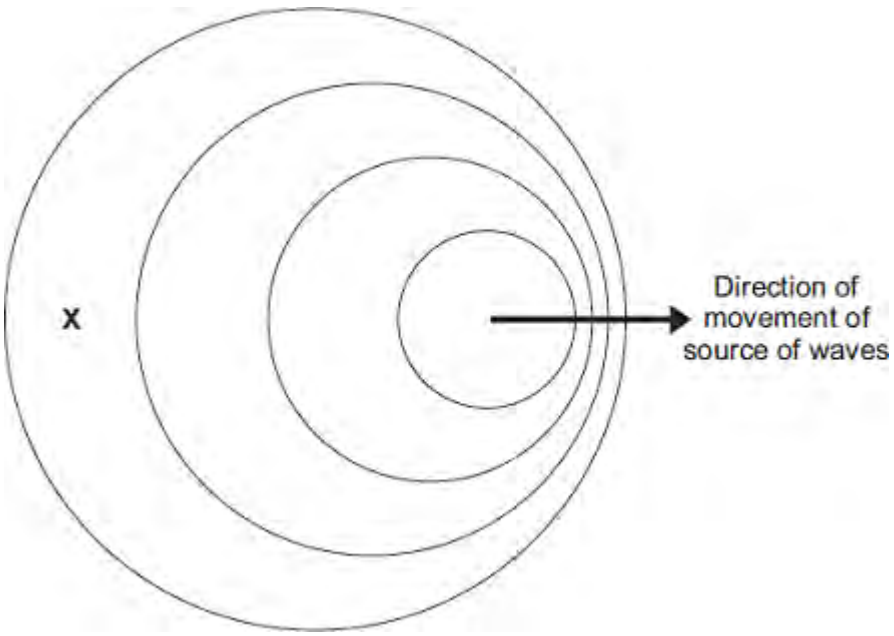
(a) Show on **Diagram 1** the wavelength of the waves.

(1)

(b) The teacher moves the source of the waves across the ripple tank.

Diagram 2 shows the waves at an instant in time.

Diagram 2
(Actual size)



(i) Use the correct answer from the box to complete each sentence.

decreased	**increased**	**stayed the same**

In **Diagram 2**, the observed wavelength of the waves at **X**

has ..... .

In **Diagram 2**, the frequency of the waves at **X**

has ..... .

(2)

(ii) Take measurements from **Diagram 2** to determine the wavelength of the waves received at **X**.

Give the unit.

.....

.....

Wavelength = ...

(3)

(c) The teacher uses the waves in the ripple tank to model the changes in the wavelengths of light observed from distant galaxies.

When observed from the Earth, there is an increase in the wavelength of light from distant galaxies.

(i) State the name of this effect.

.....

(1)

(ii) What does this increase in wavelength tell us about the movement of most galaxies?

.....

.....

(1)

(iii) Explain how this observation supports the Big Bang theory of the formation of the Universe.

.....

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(4)

(iv) State **one** other piece of evidence that supports the Big Bang theory of the formation of the Universe.

.....

.....

(1)
(Total 13 marks)

Q4. The data given in the table below was obtained from an investigation into the refraction of

light at an air to glass boundary.

Angle of incidence	Angle of refraction
20°	13°
30°	19°
40°	25°
50°	30°

Describe an investigation a student could complete in order to obtain similar data to that given in the table above.

Your answer should consider any cause of inaccuracy in the data.

A labelled diagram may be drawn as part of your answer.

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(Total 6 marks)

Q5. The data given in the table below was obtained from an investigation into the refraction of light at an air to glass boundary.

Angle of incidence	Angle of refraction
20°	13°
30°	19°
40°	25°
50°	30°

(a) Describe an investigation a student could complete in order to obtain similar data to that given in the table above.

Your answer should consider any cause of inaccuracy in the data.

A labelled diagram may be drawn as part of your answer.

.....

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.....

(6)

(b) State the reason why light is refracted as it crosses from air into glass.

.....

.....

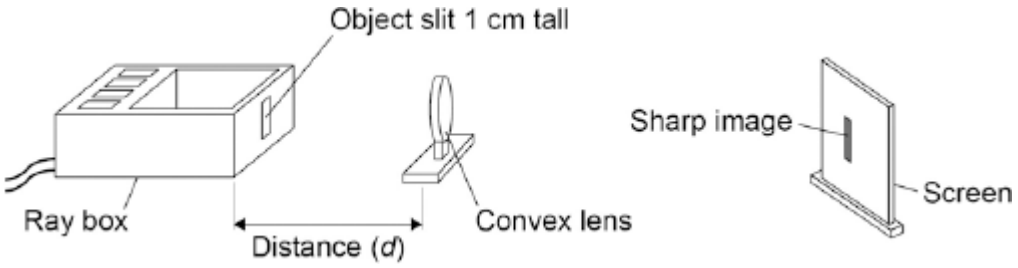
(1)

(Total 7 marks)

Q6. A student investigated how the magnification produced by a convex lens varies with the distance (*d*) between the object and the lens.

The student used the apparatus shown in **Figure 1**.

Figure 1



(a) The student measured the magnification produced by the lens by measuring the image height in centimetres.

Explain why the image height in centimetres was the same as the magnification.

.....

.....

.....

.....

(2)

(b) The data recorded by the student is given in **Table 1**.

Table 1

Distance between the object and the lens in cm	**Magnification**
25	4.0
30	2.0
40	1.0
50	0.7
60	0.5

It would be difficult to obtain accurate magnification values for distances greater than 60 cm.

Suggest **one** change that could be made so that accurate magnification values could be obtained for distances greater than 60 cm.

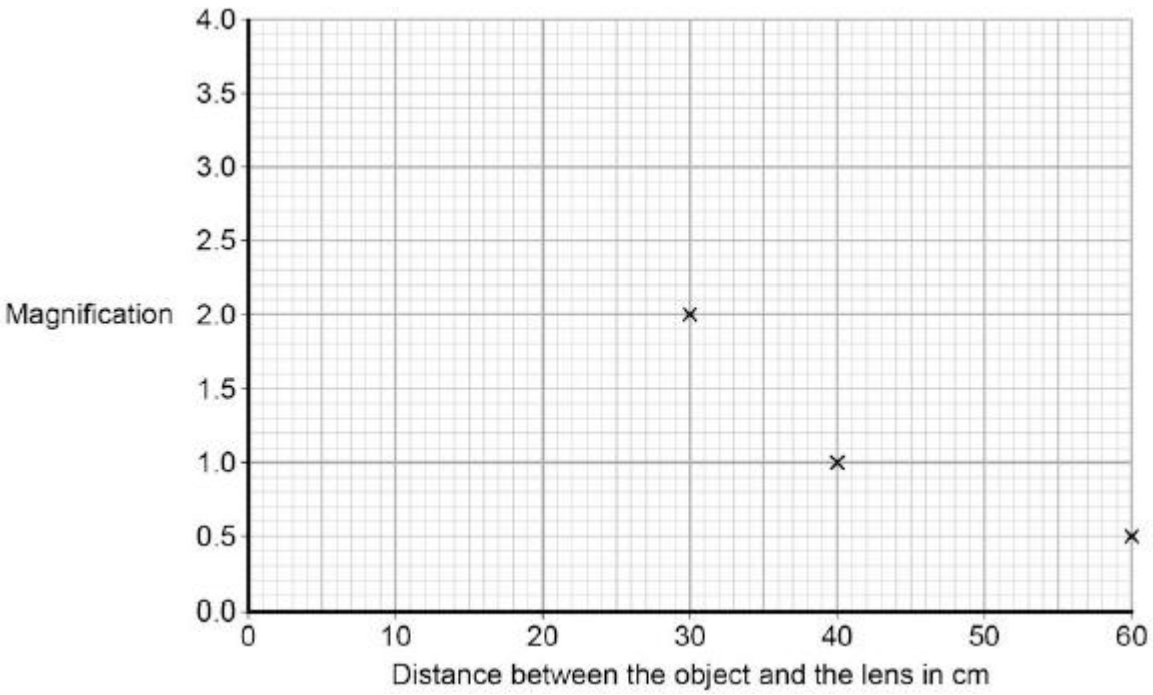
.....

.....

(1)

(c) The graph in **Figure 2** is incomplete.

Figure 2



Complete the graph in **Figure 2** by plotting the missing data and then drawing a line of best fit.

(2)

(d) How many times bigger is the image when the object is 35 cm from the lens compared to when the object is 55 cm from the lens?

.....

.....

.....

(2)

(e) During the investigation the student also measured the distance between the lens and the image.

Table 2 gives both of the distances measured and the magnification.

Table 2

Distance between the lens and the image in cm	Distance between the lens and the object in cm	Magnification
100	25	4.0
60	30	2.0
40	40	1.0
33	50	0.7
30	60	0.5

Consider the data in **Table 2**.

Give a second way that the student could have determined the magnification of the object.

Justify your answer with a calculation.

.....

.....

.....

.....

.....

(2)
(Total 9 marks)

M1. (a) any **two** from:

- travel (at same speed) through a vacuum / space
  *do **not** accept air for vacuum*
- transverse
- transfer energy
- can be reflected
- can be refracted
- can be diffracted
- can be absorbed
- travel in straight lines

2

(b) can pass through the ionosphere
accept atmosphere for ionosphere
*do **not** accept air for ionosphere*
accept travel in straight lines
accept not refracted / reflected / absorbed by the ionosphere

1

(c) $v = f \lambda$

1.2×10^6 / 1200 000
*allow **1** mark for correct substitution*
ie $3.0 \times 10^8 = f \times 2.5 \times 10^2$

2

hertz / Hz
*do **not** accept hz **or** HZ*
*accept kHz **or** MHz*
*answers 1.2 MHz **or** 1200 kHz gain all **3** marks*
for full credit the unit and numerical value must be consistent

1

[6]

M2. (a) (i) gamma

accept correct symbol

1

(ii) any **one** from:

- (ultraviolet has a) higher frequency

  ultraviolet cannot be seen is insufficient

- (ultraviolet has a) greater energy

- (ultraviolet has a) shorter wavelength

  ignore ultraviolet causes cancer etc

1

(b) 1.2×10^7 / 12 000 000

*allow **1** mark for correct substitution, ie $3 \times 10^8 = f \times 25$*

2

hertz / Hz / kHz / MHz

*do **not** accept hz **or** HZ*

*answers 12 000 kHz **or** 12 MHz gain **3** marks*

for full credit the numerical answer and unit must be consistent

1

(c) (i) away (from each other)

accept away (from the Earth)
accept receding

1

(ii) distance (from the Earth)

accept how far away (it is)

1

speed galaxy is moving

1

(iii) (Universe is) expanding

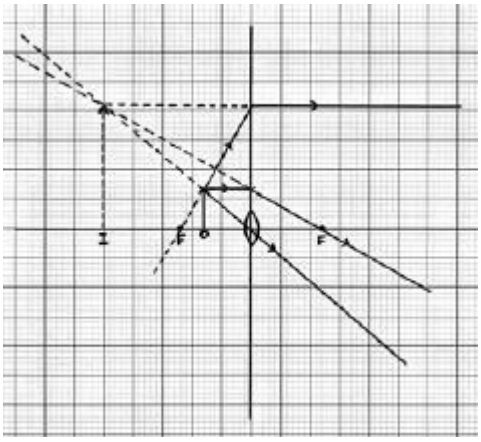
1

[9]

M3. (a) (i) **two** correct rays drawn

1 *mark for each correct ray*

- ray parallel to axis from top of object **and** refracted through focus **and** traced back beyond object
- ray through centre of lens **and** traced back beyond object
- ray joining top of object to focus on left of lens taken to the lens refracted parallel to axis **and** traced back parallel to axis beyond object



2

an arrow showing the position **and** correct orientation of the image for their rays

*to gain this mark, the arrow must go from the intersection of the traced-back rays to the axis **and** the image must be on the same side of the lens as the object and above the axis*

1

(ii) (x) 3.0

accept 3.0 to 3.5 inclusive

or

$$\frac{\text{their image height}}{\text{object height}}$$

correctly calculated

*allow **1** mark for correct substitution into equation using their figures*

ignore any units

2

(b) any **two** from:

in a camera the image is:

- real not virtual
- inverted and not upright

  accept upside down for inverted
- diminished and not magnified

  accept smaller and bigger
  accept converse answers but it must be clear the direction of the comparison
  both parts of each marking point are required

2

[7]

M4. (a) (i) to check rise in temperature (of other thermometers) was due to the (different wavelengths of) light

accept as a control / comparison

to measure room temperature is insufficient

1

(ii) any **two** from three:

- different colours produce different heating effects / (rises in) temperatures
- red light produces the greatest heating effect / (rise in) temperature

or

- violet produces the least heating effect / (rise in) temperature
- all colours produce a greater heating effect than outside the spectrum

an answer

the longer the wavelength the greater the (rise in) temperature

or

the lower the frequency the greater the (rise in) temperature

gains both marks

2

(b) move a thermometer into the infrared region / just beyond the red light

allow use an infrared camera / infrared sensor

1

the temperature increases beyond 24(°C)

accept temperature higher than for the red light

1

(c) $v = f \times \lambda$

9.4×10^{-6}

accept 9.375×10^{-6} or 9.38×10^{-6}

or

0.0000094

accept 0.000009375
***or** 0.00000938*
*allow **1** mark for correct substitution*
ie $3 \times 10^{8} = 3.2 \times 10^{13} \times \lambda$

2

(d) at night the surroundings are cooler

accept at night the air is colder
there is no heat from the Sun is insufficient

or

at night there is a greater temperature difference between people and surroundings

1

(so surroundings) emit less infrared (than in daytime)

accept camera detects a greater contrast

or

gives larger difference in infrared emitted (between people and surroundings)

1

[9]

M5.(a) (i) frequency

1

wavelength

1

(ii) 10^{-15} to 10^{4}

1

(b) 2.0×10^{5}

correct substitution of
*3.0×10^{8} / 1500 gains **1** mark*

2

Hz

1

(c) (i) (skin) burns

1

(ii) skin cancer / blindness

1

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

- (detecting) bone fractures
- (detecting) dental problems
- treating cancer

1

(ii) any **one** from:

- affect photographic film
- absorbed by bone
- transmitted by soft tissue

- kill (cancer) cells

  *answer must link to answer given in **(d)(i)***

1

(iii) 9 / 36 = 0.25
0.5 / 2 = 0.25
4 / 16 = 0.25

accept:

36 / 9 = 4

2 / 0.5 = 4

16 / 4 = 4

2

conclusion based on calculation

*two calculations correct with a valid conclusion scores **2** marks*

*one correct calculation of k scores **1** mark*

1

[13]

M6. (a) C or 0.18 mm

1

(b) 0.6 (m)

*allow **1** mark for correct substitution and/or transformation **or** **1** mark for changing frequency to Hz*
*answer 600 gains **1** mark*

2

(c) creates an alternating current

accept 'ac' for alternating currentaccept alternating voltage

1

with the same frequency as the radio wave

accept signal for radio wave

*accept it gets hotter for **1** mark provided no other marks scored*

1

(d) X-rays cannot penetrate the atmosphere

accept atmosphere stops X-rays

*do **not** accept atmosphere in the way*

or

X-rays are absorbed (by the atmosphere) before reaching Earth

ignore explanations

1

[6]

M7. (for both fibres) increasing the wavelength of light decreases and then increases the percentage / amount of light transmitted

*accept for **1** mark:*
(for both fibres) increasing the wavelength (of light) to 5 (x 10^{-7} metres), decreases the (percentage) transmission

1

(for both fibres) the minimum transmission happens at 5 (x 10^{-7} metres)
or
maximum transmission occurs at 6.5 (x 10^{-7} metres)

*accept for a further **1** mark:*

(for both fibres) increasing the wavelength of the light from 5 (x 10^{-7} metres) increases the amount of light transmitted

increasing wavelength (of light), decreases the percentage transmitted is insufficient on its own

1

the shorter fibre transmits a greater percentage of light (at the same wavelength)

*accept for **1** mark:*
Any statement that correctly processes data to compare the fibres

1

[3]

M8. (a) 10^{-15} metres to 10^{4} metres

1

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

- (TV / video / DVD) remote controls
  mobile phones is insufficient
- (short range) data transmission
  accept specific example, eg linking computer peripherals
- optical fibre (signals)
  *do **not** accept Bluetooth*

1

(ii) 0.17

*an answer 17 cm gains **3** marks*

an answer given to more than 2 significant figures that rounds to

*0.17 gains **2** marks*

*allow **1** mark for correct substitution, ie* $3 \times 10^{8} = 1.8 \times 10^{9} \times \lambda$

3

(c) (maybe) other factors involved

accept a named 'sensible' factor, eg higher stress / sedentary lifestyle / overweight / smoking more / diet / hot office / age

not testing enough people is insufficient

unreliable data is insufficient

1

[6]

Q1. Radio waves and microwaves are two types of electromagnetic wave.

Both waves:

- can be used for communications
- travel at the same speed through air.

(a) Give **two** more properties that are the same for both radio waves and microwaves.

1 .....

.....

2 .....

.....

(2)

(b) Some satellites are used to transmit television programmes. Signals are sent to, and transmitted from, the satellites using microwaves.

What is the property of microwaves that allows them to be used for satellite communications?

.....

.....

(1)

(c) Electromagnetic waves travel at a speed of 3.0×10^8 m/s.

A radio station transmits waves with a wavelength of 2.5×10^2 m.

Calculate the frequency of the radio waves.

Show clearly how you work out your answer and give the unit.

.....

.....

.....

Frequency = ...

(3)

(Total 6 marks)

Q2. Galaxies emit all types of electromagnetic wave.

(a) (i) Which type of electromagnetic wave has the shortest wavelength?

.....

(1)

(ii) State **one** difference between an ultraviolet wave and a visible light wave.

.....

.....

(1)

(b) Electromagnetic waves travel through space at a speed of 3.0×10^8 m/s.

The radio waves emitted from a distant galaxy have a wavelength of 25 metres.

Calculate the frequency of the radio waves emitted from the galaxy and give the unit.

.....

.....

.....

Frequency = ...

(3)

(c) Scientists use a radio telescope to measure the wavelength of the radio waves emitted from the galaxy in part (b) as the waves reach the Earth. The scientists measure the wavelength as 25.2 metres. The effect causing this observed increase in wavelength is called red-shift.

(i) The waves emitted from most galaxies show red-shift.

What does red-shift tell scientists about the direction most galaxies are moving?

.....

.....

(1)

(ii) The size of the red-shift is **not** the same for all galaxies.

What information can scientists find out about a galaxy when they measure the size of the red-shift the galaxy produces?

.....

.....

.....

.....

(2)

(iii) What does the observation of red-shift suggest is happening to the Universe?

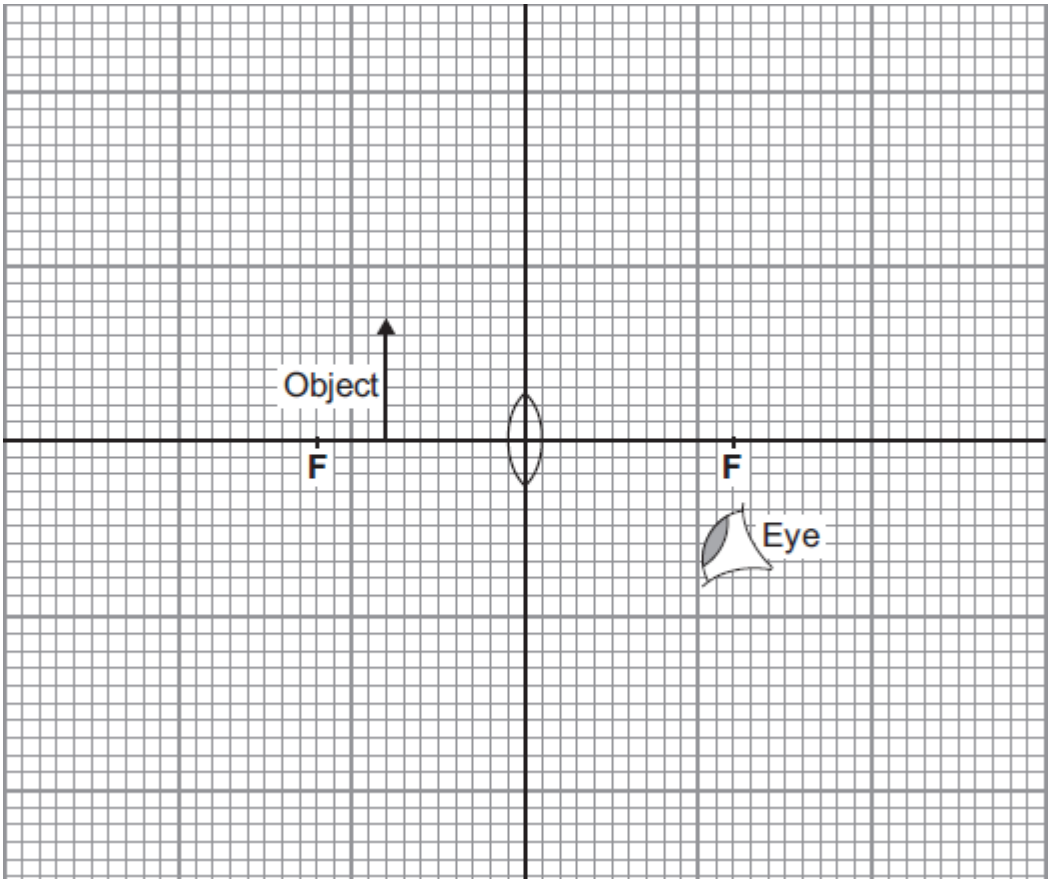
.....

.....

(1)
(Total 9 marks)

Q3. (a) The diagram shows a converging lens being used as a magnifying glass.

(i) On the diagram, use a ruler to draw two rays from the top of the object which show how and where the image is formed. Represent the image by an arrow drawn at the correct position.



(3)

(ii) Use the equation in the box to calculate the magnification produced by the lens.

$$\text{magnification} = \frac{\text{image height}}{\text{object height}}$$

Show clearly how you work out your answer.

.....

.....

Magnification = ...

(2)

(b) A camera also uses a converging lens to form an image.

Describe how the image formed by the lens in a camera is different from the image formed by a lens used as a magnifying glass.

.....

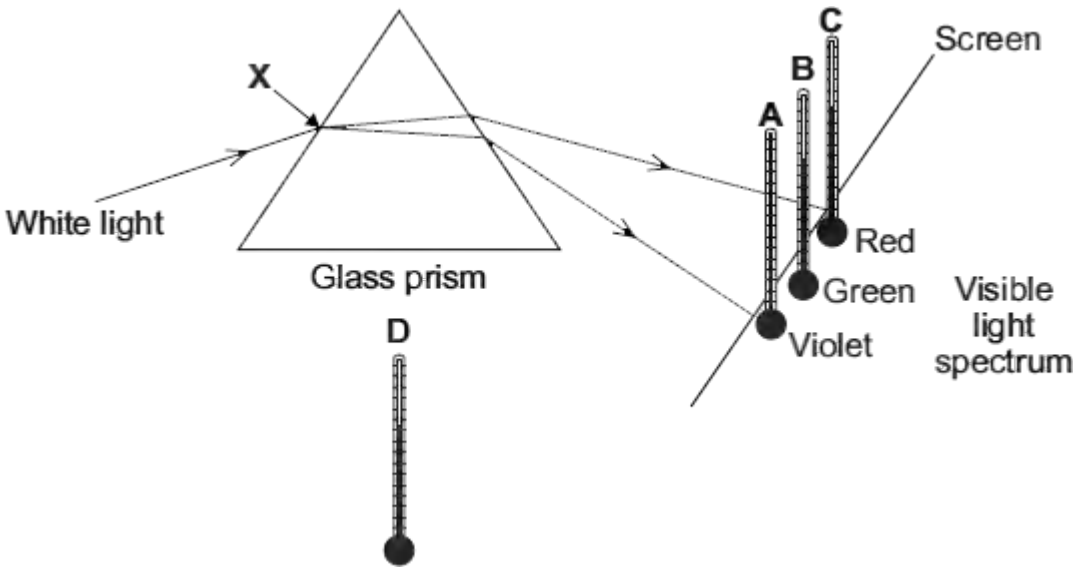
.....

.....

.....

(2)
(Total 7 marks)

Q4. The diagram shows the apparatus that a student used to investigate the heating effect of different wavelengths of light.



(a) (i) The student put thermometer **D** outside of the light spectrum.

Suggest why.

.....

.....

(1)

(ii) The table gives the position and reading of each thermometer 10 minutes after the investigation started.

Thermometer	Position of thermometer	Temperature in °C
A	in violet light	21
B	in green light	22
C	in red light	24
D	outside the spectrum	20

What should the student conclude from the data in the table?

.....

.....

.....

.....

(2)

(b) A similar investigation completed in 1800 by the scientist Sir William Herschel led to the discovery of infrared radiation.

Suggest how the student could show that the spectrum produced by the glass prism has an infrared region.

.....

.....

.....

.....

(2)

(c) A person emits infrared radiation at a frequency of 3.2×10^{13} Hz.

Calculate the wavelength of the infrared radiation that a person emits.

Take the speed of infrared radiation to be 3.0×10^{8} m/s.

Show clearly how you work out your answer.

.....

.....

.....

.....

Wavelength = ... m

(2)

(d) A thermal imaging camera detects infrared radiation. Electronic circuits inside the camera produce a visible image of the object emitting the infrared radiation.

At night, police officers use thermal imaging cameras to track criminals running away from crime scenes.

Thermal imaging cameras work better at night than during the day.

Explain why.

.....

.....

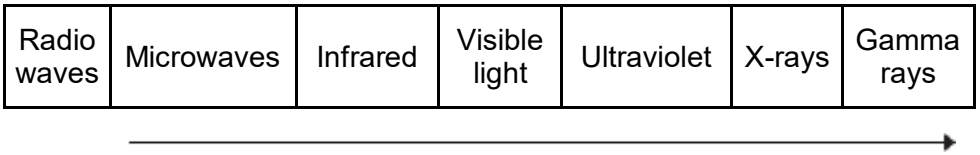
.....

.....

(2)
(Total 9 marks)

Q5. Different parts of the electromagnetic spectrum have different uses.

(a) The diagram shows the electromagnetic spectrum.



(i) Use the correct answers from the box to complete the sentence.

amplitude	**frequency**	**speed**	**wavelength**

The arrow in the diagram is in the direction of increasing .....

and decreasing ..... .

(2)

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

The range of wavelengths for waves in the electromagnetic spectrum is approximately

- 10^{-15} to 10^{4}
- 10^{-4} to 10^{4}
- 10^{4} to 10^{15}

metres.

(1)

(b) The wavelength of a radio wave is 1500 m.
The speed of radio waves is 3.0×10^{8} m / s.

Calculate the frequency of the radio wave.

Give the unit.

.....

.....

.....

Frequency = ...

(3)

(c) (i) State **one** hazard of exposure to infrared radiation.

.....

(1)

(ii) State **one** hazard of exposure to ultraviolet radiation.

.....

(1)

(d) X-rays are used in hospitals for computed tomography (CT) scans.

(i) State **one** other medical use for X-rays.

.....

.....

(1)

(ii) State a property of X-rays that makes them suitable for your answer in part **(d)(i)**.

.....

.....

(1)

(iii) The scientific unit of measurement used to measure the dose received from radiations, such as X-rays or background radiation, is the millisievert (mSv).

The table shows the X-ray dose resulting from CT scans of various parts of the body.

The table also shows the time it would take to get the same dose from background radiation.

Part of the body	X-ray dose in mSv	Time it would take to get the same dose from background radiation
Abdomen	9.0	3 years
Sinuses	0.5	2 months
Spine	4.0	16 months

A student suggests that the X-ray dose and the time it would take to get the same dose from background radiation are directly proportional.

Use calculations to test this suggestion and state your conclusion.

.....

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.....

.....

(3)
(Total 13 marks)

Q6.(a) The wavelengths of four different types of electromagnetic wave, including visible light waves, are given in the table.

Type of wave	Wavelength
Visible light	0.0005 mm
A	1.1 km
B	100 mm
C	0.18 mm

Which of the waves, **A**, **B**, or **C**, is an infra red wave?

.....

(1)

(b) A TV station broadcasts at 500 000 kHz. The waves travel through the air at 300 000 000 m/s.

Calculate the wavelength of the waves broadcast by this station.

Show clearly how you work out your answer.

.....

.....

Wavelength = ... m

(2)

(c) What happens when a metal aerial absorbs radio waves?

.....

.....

.....

.....

(2)

(d) Stars emit all types of electromagnetic waves. Telescopes that monitor X-rays are

mounted on satellites in space.

Why would an X-ray telescope based on Earth **not** be able to detect X-rays emitted from distant stars?

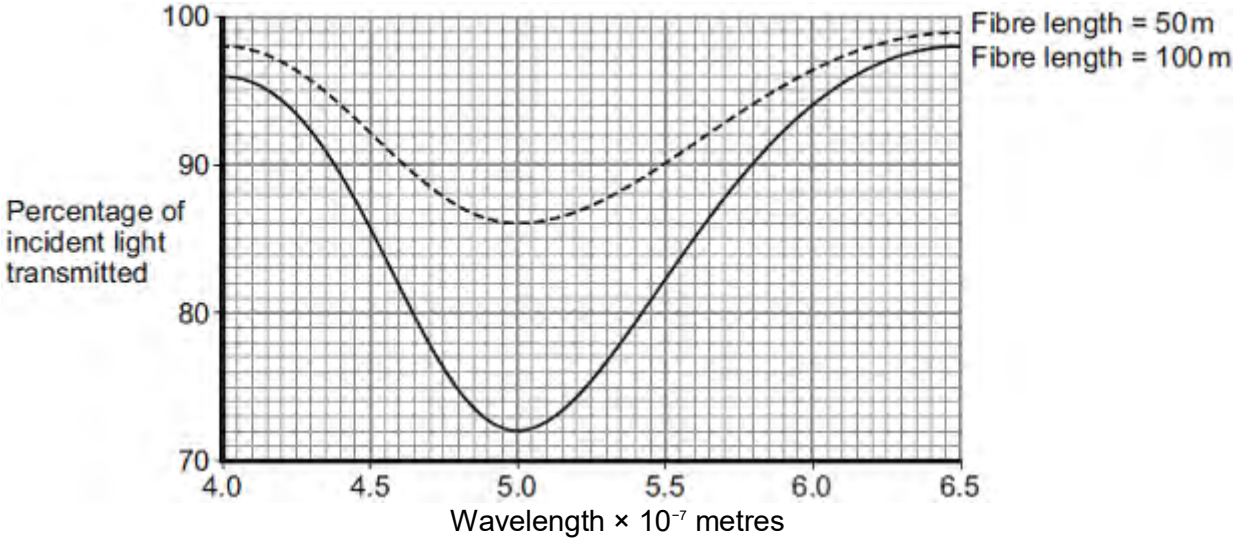
.....

.....

(1)
(Total 6 marks)

Q7. Different wavelengths of light can be used to transmit information along optical fibres.

The graph below shows how the percentage of incident light transmitted through a fibre varies with the wavelength of light and the length of the fibre.



Compare the percentages of incident light transmitted through the two different fibres over the range of wavelengths shown.

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.....

.....

.....

(Total 3 marks)

Q8.(a) Electromagnetic waves form a continuous spectrum with a range of wavelengths.

What is the approximate range of wavelengths of electromagnetic waves?

Tick (✓) **one** box.

10^{-15} metres to 10^{4} metres ☐

10^{-4} metres to 10^{15} metres ☐

10^{-6} metres to 10^{6} metres ☐

(1)

(b) Infrared waves and microwaves are used for communications.

(i) Give **one** example of infrared waves being used for communication.

.....

.....

(1)

(ii) A mobile phone network uses microwaves to transmit signals through the air. The microwaves have a frequency of 1.8×10^{9} Hz and travel at a speed of 3.0×10^{8} m/s.

Calculate the wavelength of the microwaves.

Give your answer to **two** significant figures.

.....

.....

.....

Wavelength = ... m

(3)

(c) Some scientists suggest there is a possible link between using a mobile phone and male fertility.

The results of their study are given in the table.

Mobile phone use in hours per day	**Sperm count in millions of sperm cells per cm^3 of semen**
0	86
less than 2	69
2 – 4	59
more than 4	50

The results show a negative correlation: the more hours a mobile phone is used each day, the lower the sperm count. However, the results do **not** necessarily mean using a mobile phone causes the reduced sperm count.

Suggest **one** reason why.

.....

.....

(1)
(Total 6 marks)

M1. (a) iron

accept any unambiguous correct indication

1

(b) (i) step-down (transformer)

*do **not** accept down step or a description*

1

(ii) less than

accept any unambiguous correct indication

1

(c) (i) 2000

1

(ii) There is no pattern.

1

[5]

M2. (a) (i) iron

1

(ii) step-down (transformer)

1

(b) any **one** from:

- after the power station
- after the generator
- before the power lines
- before the pylons

1

(c) each correct (1)
in its correct place

current

coil

field

core

ends

5

[8]

M3. (a) *there is a* magnetic field *(around the magnet)*

1

(this magnetic field) changes / moves

1

and cuts through coil

accept links with coil

1

so a p.d. *induced* across coil

1

the coil forms *a* complete circuit

1

so a current (*is* induced)

1

(b) ammeter reading does not change

must be in this order

accept ammeter has a small reading / shows a current

1

zero

1

greater than before

accept a large(r) reading

1

same as originally but in the opposite direction

accept a small reading in the opposite direction

1

(c) 0.30

*allow **1** mark for correct substitution, ie 0.05 = Q / 6*

2

C / coulomb

allow A s

1

[13]

M4. (a) step-down (transformer)

1

(b) alternating current

accept minor misspellings but
*do **not** credit 'alternative current'*

1

(c) (i)(ii) magnet

attracts

upwards

correct order essential
accept 'up'

3

[5]

M5. (a) iron

correct positions only

1

primary

1

secondary

1

(b) (it) decreases the p.d.

accept it would increase current
accept voltage for p.d.
the voltage goes from 230(V) to 20(V) is insufficient
*do **not** accept decreases current / energy / power*
*do **not** accept decreases p.d. / voltage and current*

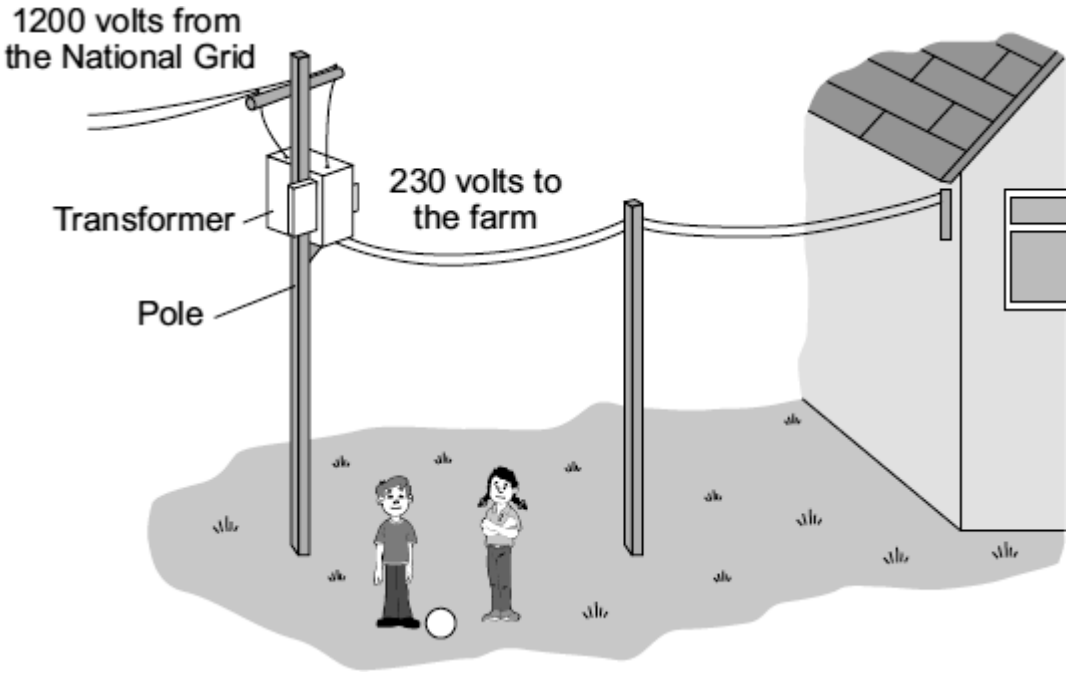
1

(c) an environmental

1

[5]

Q1. The diagram shows part of the system used to supply a farm with electricity.



(a) The core of the transformer is made of metal.

Complete the following sentence by drawing a ring around the correct word in the box.

The metal used for the core of the transformer is

copper.
iron.
steel.

(1)

(b) (i) What sort of transformer is shown in the diagram?

.....

(1)

(ii) Complete the following sentence by drawing a ring around the correct line in the box.

In this transformer, the number of turns on the secondary coil is

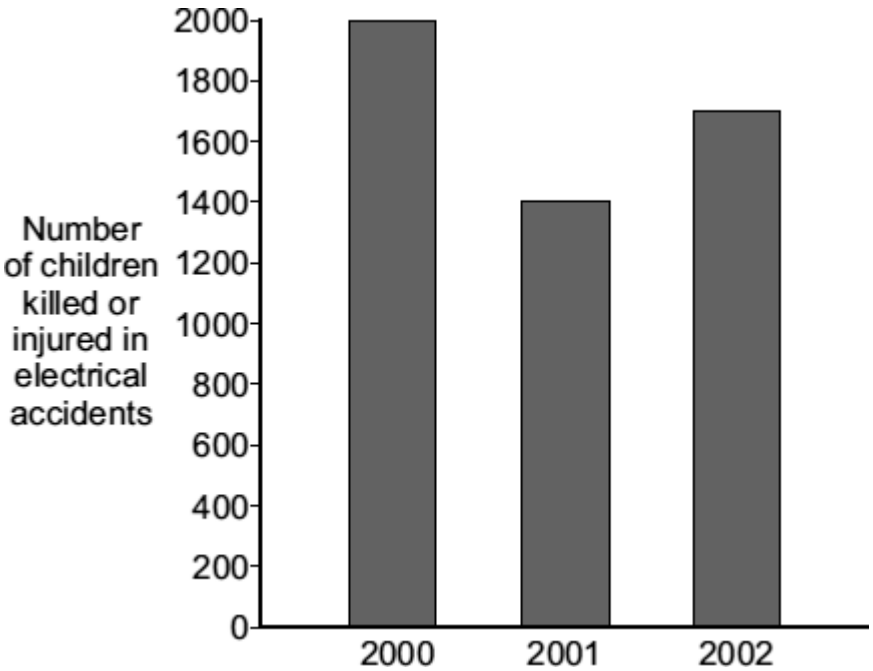
less than

the same as	the number of turns on the primary coil.
greater than	

(1)

(c) Transformers and other electrical equipment can be dangerous.

The following bar chart shows the numbers of children, aged 14 or under, killed or injured in electrical accidents in the UK in 2000, 2001 and 2002.



(i) In which of these years were most children killed or injured in electrical accidents?

.....

(1)

(ii) A newspaper claims that the number of children killed or injured by electrical accidents will increase in 2011.

Which of the following gives a reason why the information given in the graph does not support this claim.

Put a tick (✓) in the box next to your answer.

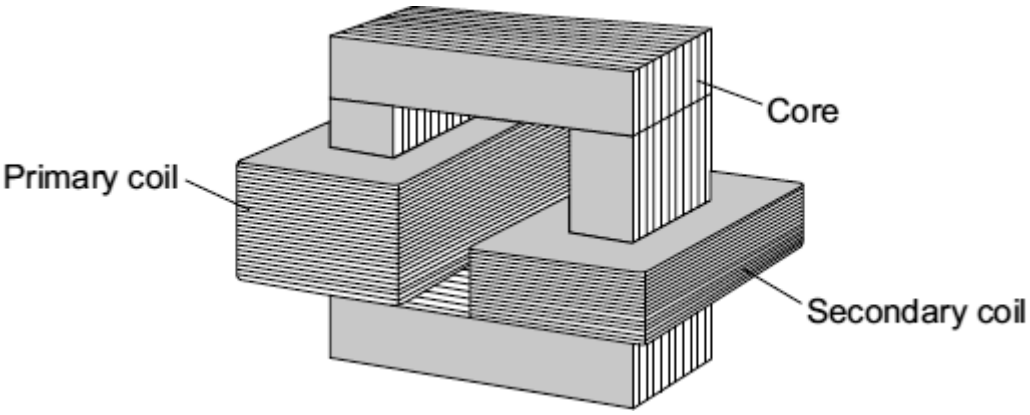
The pattern shows an upward trend. ☐

The pattern shows a downward trend. ☐

There is no pattern. ☐

(1)
(Total 5 marks)

Q2. A teacher demonstrates a small transformer.



(a) (i) What is the core made of?

Draw a ring around the correct word in the box.

aluminium	**copper**	**iron**

(1)

(ii) The potential difference (p.d.) across the secondary coil is less than the p.d. across the primary coil.

What sort of transformer is it?

.....

(1)

(b) Where is a step-up transformer used as part of the National Grid?

.....

(1)

(c) The teacher writes a note about the transformer but leaves **five** spaces.

Use the correct words from the box to complete the spaces.

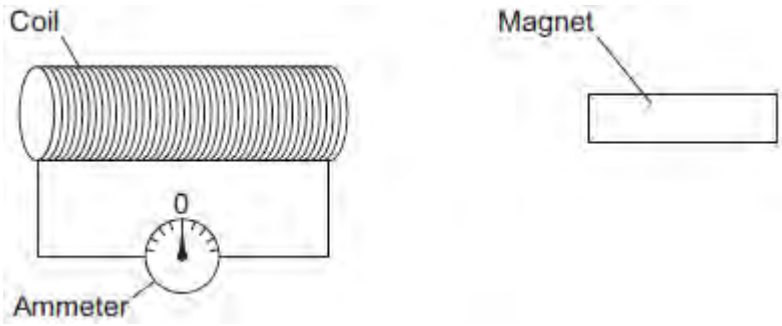
coil	**core**	**current**	**ends**	**field**	**wire**

A transformer works because an alternating ..... in the primary ..... produces a changing magnetic ..... in the ..... and then in the secondary coil.

This induces an alternating potential difference across the ..... of the secondary coil.

(5)
(Total 8 marks)

Q3. The figure below shows a coil and a magnet. An ammeter is connected to the coil.



The ammeter has a centre zero scale, so that values of current going in either direction through the coil can be measured.

(a) A teacher moves the magnet slowly towards the coil.

Explain why there is a reading on the ammeter.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6)

(b) The table below shows some other actions taken by the teacher.

Complete the table to show the effect of each action on the ammeter reading.

Action taken by teacher	**What happens to the ammeter reading?**
Holds the magnet stationary and moves the coil slowly towards the magnet	
Holds the magnet stationary within the coil	
Moves the magnet quickly towards the coil	
Reverses the magnet and moves it slowly towards the coil	

(4)

(c) The magnet moves so that there is a steady reading of 0.05 A on the ammeter for 6 seconds.

Calculate the charge that flows through the coil during the 6 seconds.

Give the unit.

.....

.....

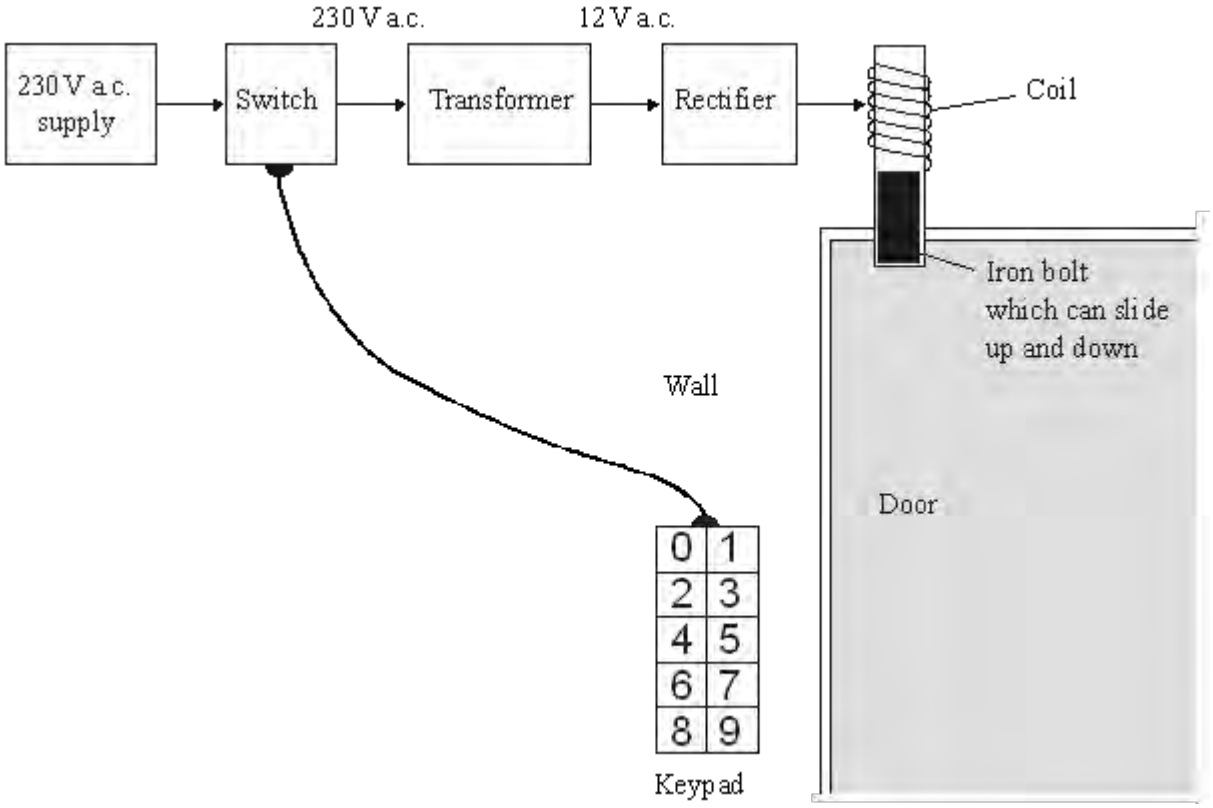
.....

Charge = ...

(3)
(Total 13 marks)

Q4. The diagram shows the design for a remotely controlled door bolt.

When the correct numbers are entered into the keypad the transformer switches on. Then the door can be opened.



(a) What kind of transformer is shown in the diagram?

.....

(1)

(b) What does the abbreviation a.c. stand for?

.....

(1)

(c) Complete the sentences using the correct words from the box.

attracts	**downwards**	**magnet**	**reflects**	**repels**

sideways	**switch**	**transformer**	**upwards**

(i) When a current flows in the coil, the coil becomes a ..... .

(ii) The coil ..... the iron bolt which moves .....

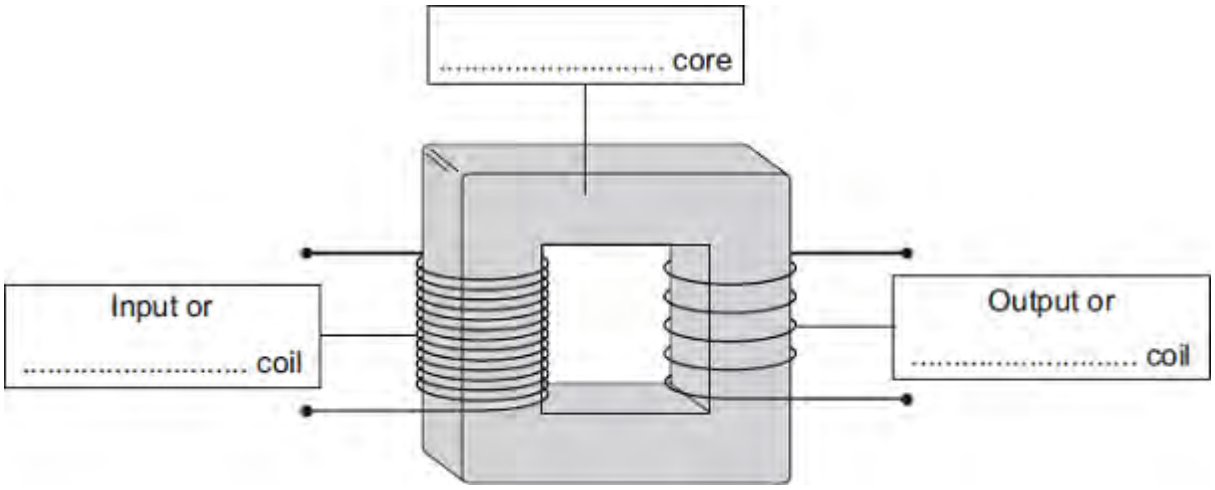
(3)

(Total 5 marks)

Q5.(a) The diagram shows the structure of a traditional transformer.

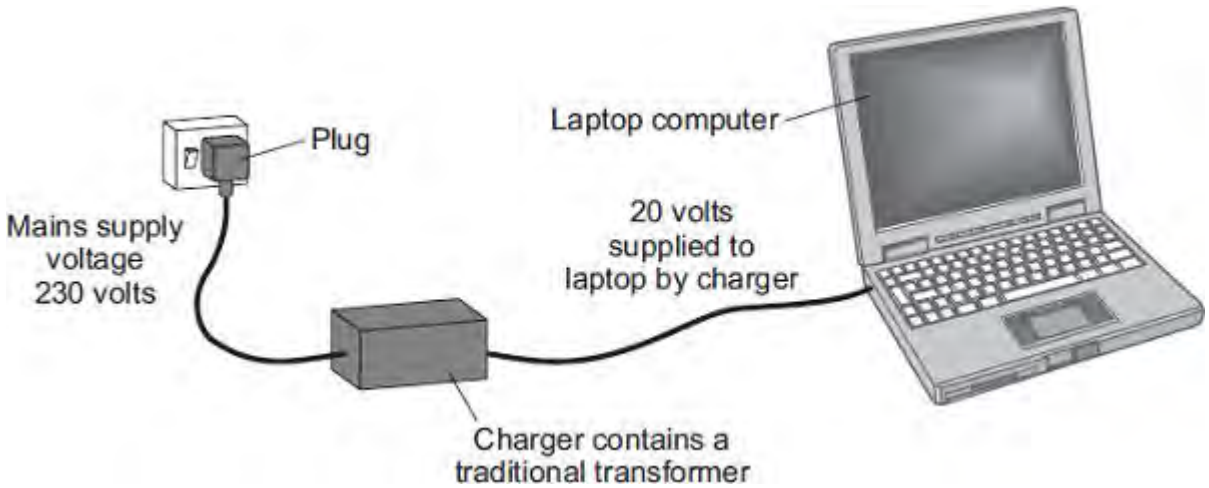
Use words from the box to label the diagram.

aluminium	brass	iron	large	primary	secondary



(3)

(b) Batteries inside laptop computers are charged using laptop chargers. The laptop charger contains a traditional transformer.



The laptop charger contains a step-down transformer.

What does a step-down transformer do?

.....

.....

(1)

(c) Laptop batteries and mobile phone batteries can only be recharged a limited number of times. When a battery cannot be recharged, it is better to recycle the battery than to throw it away.

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

The batteries are recycled mainly due to

an environmental
a political
a social

consideration.

(1)
(Total 5 marks)

M1. (a) (i) secondary(coil) / output (coil)

*do **not** accept just coil*

1

(ii) core

*do **not** accept for either mark it is made out of iron ore*

1

(laminated soft) iron

*allow **1** mark for 'it is made out of iron core'*

1

(iii) magnetic field

accept magnetism / magnetic force

1

(which is) changing / alternating

direction (of field) changes / strength (of field) varies

scoring second mark is dependent on first mark

1

(b) ...step-up .... step-down ...

both in the correct order

1

(c) Do not build new houses ....

1

Build new power lines away ....

*deduct **1** mark for any other(s) to a minimum total of (0)*

1

[8]

M2. (a) (it is) magnetic

or *will carry (an alternating) magnetic field*

or *magnetises and demagnetises (easily)*

reference to conduction negates the mark

1

(b) so the current / electricity does not flow through the iron / core

accept 'so the current / electricity / wires do not short (circuit)'

responses in terms of heat insulation negate the mark

ignore references to safety

1

(c) 5.75 or 5.8 or 6(.0)

*allow for **1** mark **either***

$$\frac{230}{p.d.} = \frac{20\,000}{500}$$

or

p.d. = 230 ÷ 40

2

V / volt(s)

1

[5]

M3. (i) iron

for 1 mark

1

(ii) 20

gains 2 marks

else working

gains 1 mark

2

(iii) reverse input/output

for 1 mark

or increase secondary turns

1

[4]

M4. (a) (i) (quickly) becomes magnetized

or *(quickly) loses its magnetism*

or *'it's (a) magnetic (material)'*

any reference to conduction of electricity/heat nullifies the mark

1

(ii) any **four** from:

- insulation prevents electricity/current flowing through the iron/core

  or *'insulation so electricity/current only flows in the wires/turns/coils'*

- alternating current/a.c. in the primary (coil)
- produces a changing magnetic field (in the iron/core)
- (and hence magnetic) field in the secondary (coil)
- induces/generates/produces an alternating potential difference/p.d./voltage across the secondary (coil)
- (and hence) alternating current/a.c. in the secondary (coil)

4

(b) 80 (turns)

or *credit (1) for any equation which if correctly evaluated would give 80 example*

example

$$\frac{230}{5.75} = \frac{3200}{number\ of\ turns}$$

2

[7]

M5.(a) step-down

1

(b) (i) 1.6

correct order only

1

12.8

1

(ii) values of p.d. are smaller than 230 V

1

(c) (i) a.c. is constantly changing direction

accept a.c. flows in two / both directions

accept a.c. changes direction(s)

a.c. travels in different directions is insufficient

1

d.c. flows in one direction only

1

(ii) an alternating current / p.d. in the primary creates a changing / alternating magnetic field

1

(magnetic field) in the (iron) core

current in the core negates this mark

accept voltage for p.d.

1

(and so) an alternating p.d.

1

(p.d.) is induced across secondary coil

1

[10]

M6. (a) 10

*allow **1** mark for correct substitution ie* $\frac{230}{V_s} = \frac{4600}{200}$

2

(b) any **one** from:

- to prevent short circuiting
- to ensure that the current flows / goes round the coil
- to prevent the current entering the core

*do **not** accept electrocution*
*do **not** accept electricity for current*
answers including heat / energy loss negate mark

1

(c) (i) (soft) iron

*do **not** accept 'steel'*

1

(ii) can be magnetised

because it is magnetic

answers including it's a conductor negate mark

1

[5]

M7. (a) aluminium cannot be magnetised

accept aluminium is not magnetic
"it" refers to aluminium
*do **not** accept aluminium is not easily magnetised*
reference to conduction and aluminium negates mark
iron can be magnetised is insufficient

1

(b) (i) 10 to 50

either order

1

(ii) (data is) anomalous

*accept does **not** fit the pattern*
it is an error is insufficient

1

(iii) 21

accept 22
*do **not** accept any fraction of a turn ie 20.1*

1

secondary p.d. (just) larger than primary p.d.

accept output (just) larger than input/2V

orthere must be more turns on the secondary coil than primary coil

*do **not** accept coil for turns*

1

(c) to reduce/step-down the (input) p.d./voltage

mains p.d. is too high is insufficient
step-down transformer is insufficient
*answers in terms of changing/ stepping-up current **or** fuse blowing **or** not working with 230 volts are insufficient*
any mention of step-up negates mark
*stepping down both voltage/p.d. **and** current negates mark*

1

[6]

M8. (a) (i) live

1

(ii) react faster

1

(iii) live and neutral

1

(b) (i) ammeter

1

to measure current

accept to measure amps

1

plus any **one** from:

- *<u>variable</u> resistor* (1)
  to vary current (1)
  accept variable power supply
  accept change or control
- *switch* (1)
  to stop apparatus getting hot / protect battery
  or
  to reset equipment (1)
- fuse (1)
  to break circuit if current is too big (1)

2

(ii) any **two** from:

- use smaller mass(es)
- move mass closer to pivot
- reduce gap between coil and rocker

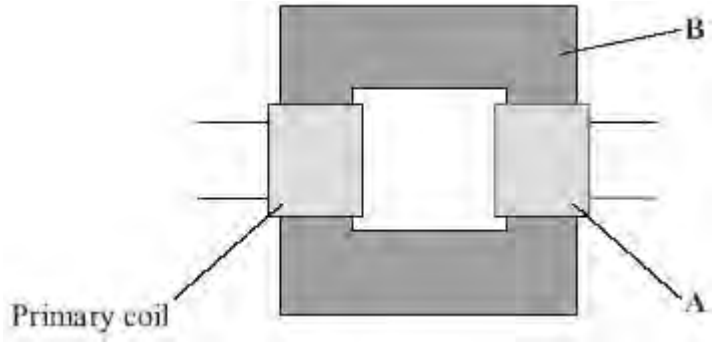
- more turns (on coil)*coil / loop*
- iron core in coil

  accept use smaller weight(s)

2

[9]

Q1. (a) The diagram shows a transformer.



(i) What is part **A**?

.....

(1)

(ii) What is part **B** and what is it made of?

.....

.....

(2)

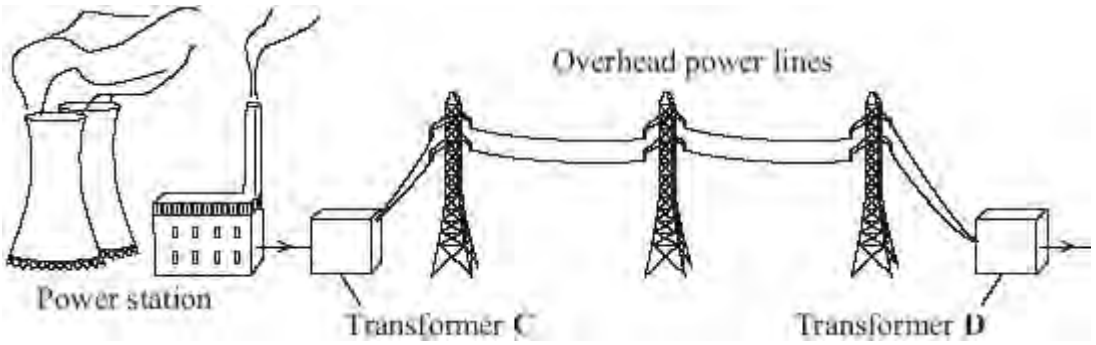
(iii) When there is an alternating current in the primary coil, what is produced in part **B**?

.....

.....

(2)

(b) Transformers are used in the National Grid. The diagram shows part of the National Grid.



Complete the **two** spaces in the sentence.

Transformer **C** is a ..... transformer and transformer **D** is a ..... transformer.

(1)

(c) This is an item from a newspaper.

Health at risk from power lines?

Are high voltage power lines a health risk to people who live near them?

Some scientists think that scientific evidence shows that they are.

Other scientists do not think that the scientific evidence supports this conclusion.

Which **two** suggestions would reduce the possible risk to people's health?
Put a tick (✓) in the box next to your answers.

Do not build new houses near to existing power lines. ☐

Move the power lines so that they take the shortest routes. ☐

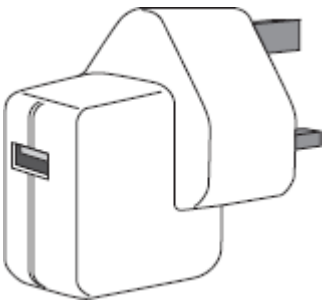
Move each power station to the centre of the nearest city. ☐

Build new power lines away from where people live. ☐

Use more transformers in the National Grid. ☐

(2)
(Total 8 marks)

Q2. The diagram shows a USB power adapter which plugs into a 230 V a.c. mains socket.



The adapter contains a small step-down transformer.

(a) The core of the transformer is made of laminated soft iron.

Why is iron used?

.....

.....

(1)

(b) The coils of the transformers are made of insulated copper wire.

Why is the wire insulated?

.....

.....

(1)

(c) There are 500 turns on one coil of the transformer and 20 000 turns on the other coil.

Use the equation in the box to calculate the p.d. across the secondary coil.

$$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$$

Show clearly how you work out your answer and give the unit.

.....

.....

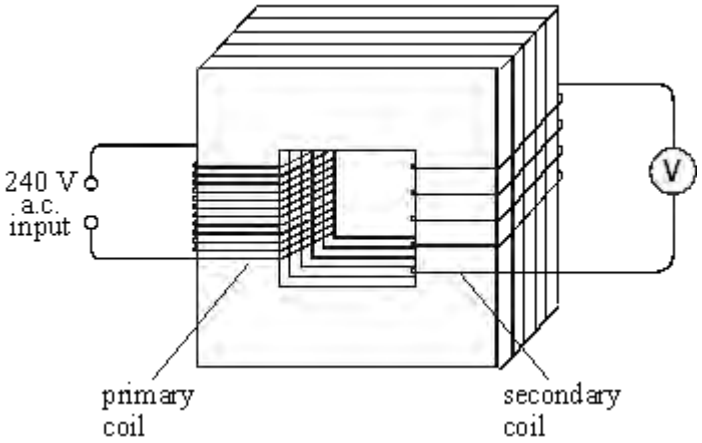
.....

p.d. across the secondary = ...

(3)

(Total 5 marks)

Q3. The diagram below shows a transformer.



(i) Name the material used to make the core of the transformer.

.....

(1)

(ii) The primary coil has 48 000 turns and the secondary coil 4000 turns.

If the input voltage is 240 V a.c., calculate the output voltage.

.....

.....

Answer V

(2)

(iii) Explain how the use of such a transformer could be adapted to transform a low voltage into a higher voltage.

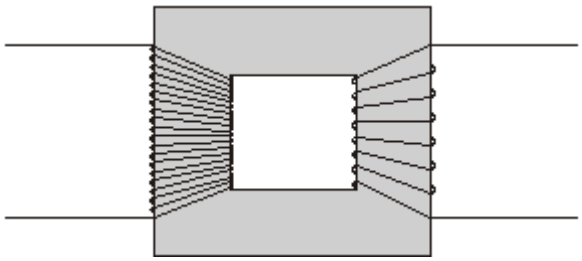
.....

.....

(1)

(Total 4 marks)

Q4. (a) The basic structure of a transformer is a primary coil of insulated wire, an iron core and a secondary coil of insulated wire.



(i) Why is the core made of iron?

.....

.....

(1)

(ii) Explain how a transformer works.

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(b) A small step-down transformer is used in the charger for an electric screwdriver.

The input to the transformer is 230 V a.c. mains supply and the output is 5.75 V a.c. There are 3200 turns on the primary coil.

Use the equation in the box to calculate the number of turns on the transformer's

secondary coil.

$$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$$

Show clearly how you work out your answer.

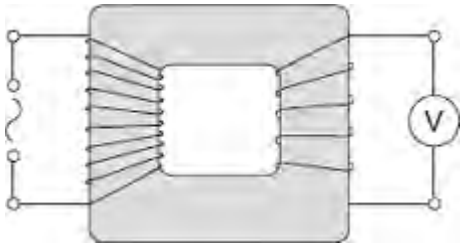
.....

.....

Number of turns = ...

(2)
(Total 7 marks)

Q5. The diagram shows a transformer with a 50 Hz (a.c.) supply connected to 10 turns of insulated wire wrapped around one side of the iron core.
A voltmeter is connected to 5 turns wrapped around the other side of the iron core.



(a) What type of transformer is shown in the diagram?

Draw a ring around the correct answer.

step-down **step-up** **switch mode**

(1)

(b) The table shows values for the potential difference (p.d.) of the supply and the voltmeter reading.

p.d. of the supply in volts	Voltmeter reading in volts
6.4	3.2
3.2	
	6.4

(i) Complete the table.

(2)

(ii) Transformers are used as part of the National Grid.

How are the values of p.d. in the table different to the values produced by the National Grid?

.....

.....

(1)

(c) Transformers will work with an alternating current (a.c.) supply but will **not** work with a direct current (d.c.) supply.

(i) Describe the difference between a.c. and d.c.

.....

.....

.....

.....

(2)

(ii) Explain how a transformer works.

.....

.....

.....

.....

.....

.....

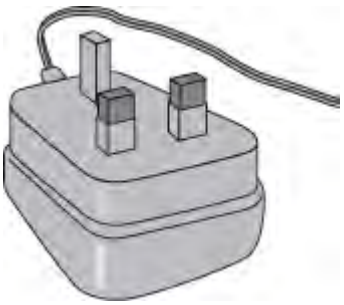
.....

.....

(4)

(Total 10 marks)

Q6. (a) The drawing shows the plug for operating a radio from the mains.



This plug contains a transformer. There are 4600 turns on its primary coil and 200 turns on its secondary coil. The plug is used on the mains supply and has a potential difference (p.d.) of 230 V across its primary coil.

Use the equation in the box to calculate the p.d. across the secondary coil of the transformer.

$$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$$

Show clearly how you work out your answer.

.....

.....

.....

.....

p.d. across secondary = ... V

(2)

(b) The coils of the transformer are made of insulated wire.

Why is the wire insulated?

.....

.....

(1)

(c) (i) What material is the core of a transformer made from?

.....

(1)

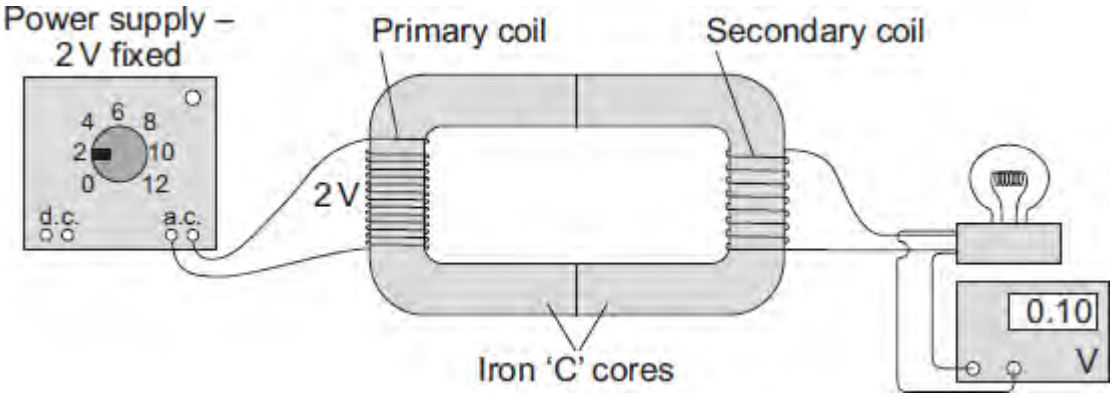
(ii) Why is the core made from this material?

.....

.....

(1)
(Total 5 marks)

Q7. The diagram shows the apparatus used by a student to investigate a transformer.



(a) The transformer made by the student would not have worked if the core had been made from aluminium and not iron.

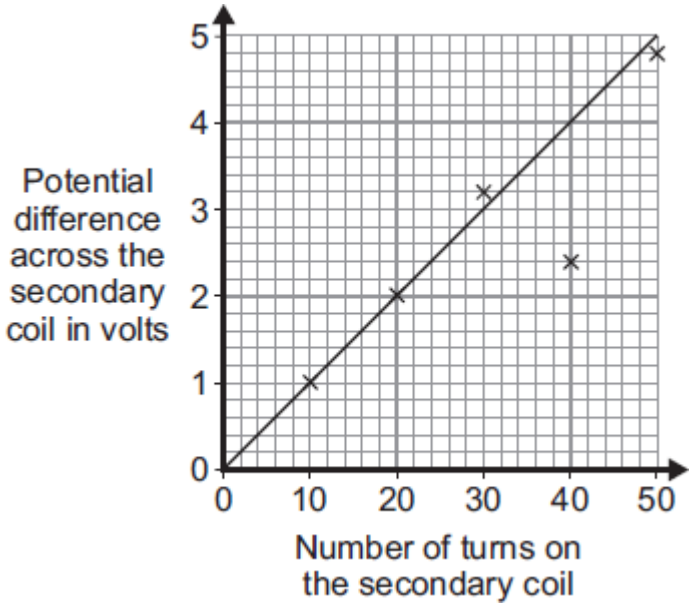
Why?

.....

.....

(1)

(b) The student made changes to the number of turns used to make the secondary coil. He then measured the potential difference across the secondary coil after each change.
The graph shows the student's results.



(i) What range of values was used for the number of turns on the secondary coil?

From ..... to .....

(1)

(ii) When he drew the line of best fit, the student ignored one of the data points.

Why?

.....

.....

(1)

(iii) What is the minimum number of turns needed on the secondary coil for the transformer to act as a step-up transformer?

.....

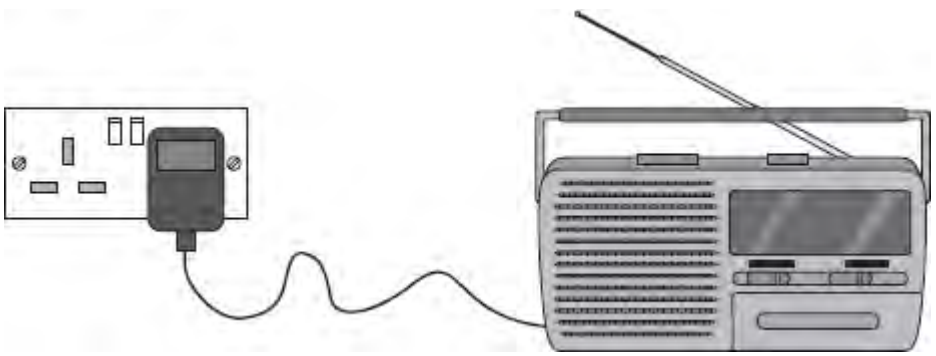
Give a reason for your answer.

.....

.....

(2)

(c) A radio can be used with a 9 V battery or it can be plugged into the 230 V mains electricity supply using an adapter. The mains adapter contains a transformer.



Why must the mains adapter contain a transformer?

.....

.....

(1)

(Total 6 marks)

Q8. If a fault develops in an electrical circuit, the current may become too great. The circuit needs to be protected by being disconnected.

A fuse or a circuit breaker may be used to protect the circuit.
One type of circuit breaker is a Residual Current Circuit Breaker (RCCB).

(a) (i) Use the correct answer from the box to complete the sentence.

earth	live	neutral

A fuse is connected in the ..... wire.

(1)

(ii) Use the correct answer from the box to complete the sentence.

are bigger	are cheaper	react faster

RCCBs are sometimes preferred to fuses because they
..... .

(1)

(iii) RCCBs operate by detecting a difference in the current between two wires.

Use the correct answer from the box to complete the sentence.

earth and live	earth and neutral	live and neutral

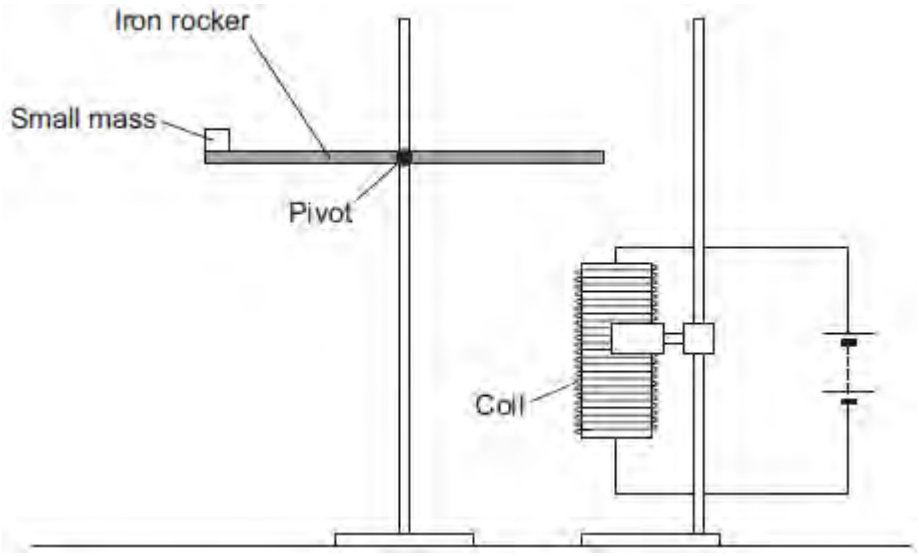
The two wires are the ..... wires.

(1)

(b) An RCCB contains an iron rocker and a coil.

A student investigated how the force of attraction, between a coil and an iron rocker, varies with the current in the coil.

She supported a coil vertically and connected it in an electrical circuit, part of which is shown in the figure below .



She put a small mass on the end of the rocker and increased the current in the coil until the rocker balanced. She repeated the procedure for different masses.

Some of her results are shown in the table below.

Mass in grams	**Current needed for the rocker to balance in amps**
5	0.5
10	1.0
15	1.5
20	2.0

(i) State **two** extra components that must have been included in the circuit in the figure above to allow the data in the above table to be collected.

Give reasons for your answers.

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(ii) A teacher said that the values of current were too high to be safe.

Suggest **two** changes that would allow lower values of current to be used in this investigation.

Change 1 .....

.....

Change 2 .....

.....

(2)

(Total 9 marks)

M1. (a) (i) step-up

both parts required

more turns on the secondary / output (coil)

*do **not** accept coils for turns*

'secondary output is greater than primary input' is insufficient

1

(ii) *(easily) magnetised (and demagnetised)*

accept (it's) magnetic

it's a conductor negates answer

1

(b) 60

*allow **1** mark for correct substitution, ie* $\frac{230}{15} = \frac{720}{N_s}$

2

[4]

M2. *(a) 400 000*

*allow **1** mark for correct substitution ie*

$$\frac{25000}{?} = \frac{800}{12800}$$

or

$$\frac{25}{?} = \frac{800}{12800}$$

2

volt(s) / V

*an answer 400 gains **2** marks*

*an answer 400 kilovolts / kV gains **3** marks*

*although the unit mark is independent to gain **3** marks it must be consistent with the numerical value*

1

(b) *any **one** from:*

*do **not** accept any response in terms of heat insulation, safety or electric shock*

- *(so that there is) no short circuit*
- *(so that the) current goes round the coil*

  *do **not** accept electricity for current*
- *(so that the) current does not enter the core*

1

(c) *(the alternating p.d. in the primary causes) an (alternating) current in the primary*

reference to the current in the core negates this mark

1

(causes an) <u>alternating / changing</u> (magnetic) field in the (iron) core

1

<u>induces</u> (alternating) p.d. across the <u>secondary</u> (coil)

accept in / through or similar for across

accept current for p.d.

accept output (coil) for secondary (coil)

*to gain **3** marks the sequence must be correct*

1

[7]

M3. *(a) which causes the magnet to turn / spin / rotate*

1

(magnetic) field / lines of force / flux rotate(s) / move(s) / through / in / cut(s) the coil

*do **not** credit the idea that movement 'creates' the magnetic field*

1

potential difference / p.d. / voltage <u>induced</u> across the coil

*do **not** credit just 'current induced'*

1

(b) *any **one** from:*

- *more powerful / stronger / lighter magnet*

  *do **not** credit 'a bigger magnet'*
- *larger / more / bigger / lighter cups / with a bigger surface area*
- *longer arms*
- *lubricate the spindle*
- *add more turns to the coil*

1

[4]

M4. *(a)* *It is easily magnetised.*

1

(b) *p.d. across the secondary coil is smaller (than p.d. across the primary coil)*

1

(c) *ratio* $\frac{V_p}{V_s} = \frac{6}{12}$

accept any other correct ratio taken from the graph

1

$\frac{6}{12} = \frac{50}{N_p}$

use of the correct turns ratio and substitution or correct transformation and substitution

1

$N_p = 100$

allow 100 with no working shown for ***3*** *marks*

1

[5]

M5. (a) (i) *generator*

1

(ii) *alternating current*

1

(iii) *voltmeter / CRO / oscilloscope / cathode ray oscilloscope*

1

(b) (i) *time*

1

(ii) *peaks and troughs in opposite directions*

1

amplitude remains constant

dependent on first marking point

1

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

- *increase speed of coil*
- *strengthen magnetic field*
- *increase area of coil*

*do **not** accept larger*

2

[8]

M6. (a) *(the alternating current creates) a <u>changing / alternating magnetic field</u>*

1

(magnetic field) in the (iron) core

accept that links with the secondary coil

current in the core negates this mark

1

(causing a) potential difference (to be) <u>induced</u> in / across secondary coil

accept voltage for p.d.

1

(b) (i) 20

*allow **1** mark for correct substitution, ie* $\frac{230}{V_s} = \frac{575}{50}$

or $\frac{V_s}{230} = \frac{50}{575}$

2

(ii) 0.3

or

correct calculation using 230 × I_p = their (b)(i) × 3.45

*allow **1** mark for correct substitution, ie*

230 × I_p = 20 × 3.45

allow ecf from (b)(i) for 20

OR

substitution into this equation $\frac{I_p}{I_s} = \frac{N_s}{N_p}$

2

*(c) any **one** from:*

- *fewer (waste) batteries have to be sent to / buried in land-fill*
- *the soil is polluted less by batteries in land-fill*
- *fewer (waste) batteries have to be recycled*

- *fewer batteries have to be made*
- *less raw materials are used in making batteries*
- *customers have to replace their batteries less often*
  longer lifetime is insufficient
- *customers have to buy fewer (replacement) batteries*
  it costs less is insufficient

1

[8]

M7.*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 apply a*

'best-fit' approach to the marking.

0 marks
No relevant / correct content.

Level 1 (1–2 marks)
Either *there is an attempt at a description of the construction of a transformer*

or

a correct statement of the effect of one type of transformer on the input p.d.

Level 2 (3–4 marks)
There is a description of the construction of a transformer
and
a correct statement of the effect of one type of transformer on the input p.d.

Level 3 (5–6 marks)
There is a clear description of the construction of a transformer
and
there is a correct description of how transformers affect the input p.d.

details of construction:

extra information

a (laminated) core

core is made from a magnetic material / iron

2 coils

the coils are made from an electrical conductor / copper

the coils are covered in plastic / insulation

the coils are (usually) on opposite sides

step-up transformer has more turns on secondary coil than (its) primary (or vice versa)

step-down transformer has fewer turns on secondary coil than (its) primary (or vice versa)

effect on input p.d. :

step-up transformer, the output p.d. is greater (than the input p.d.)

accept voltage for p.d.

step-down transformer, the output p.d. is lower (than the input p.d.)

6

[6]

M8.*(a) attempt to draw four cells in series*

1

correct circuit symbols

circuit symbol should show a long line and a short line, correctly joined together

example of correct circuit symbol:

1

(b) (i) 6 (V)

*allow **1** mark for correct substitution, ie*

*V = 3 × 2 scores **1** mark*

provided no subsequent step

2

(ii) 12 (V)

ecf from part (b)(i)

18 – 6

or

*18 – their part (b)(i) scores **1** mark*

2

(iii) 9 (Ω)

ecf from part (b)(ii) correctly calculated

3 + their part (b)(ii) / 2

or

*18 / 2 scores **1** mark*

provided no subsequent step

2

(c) (i) need a.c.

1

battery is d.c.

1

(ii) *3 (A)*

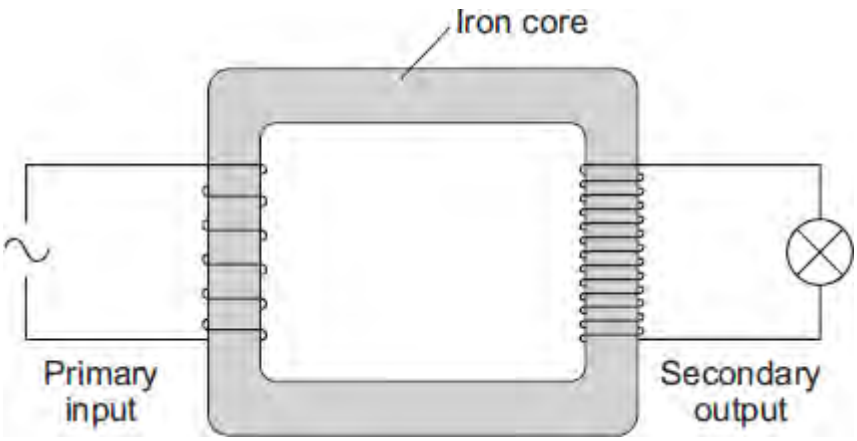
*allow **1** mark for correct substitution, ie*

*18 × 2 = 12 × I_s scores **1** mark*

2

[12]

Q1. The diagram shows a transformer.



(a) (i) Is the transformer in the diagram being used as a step-up transformer or as a step-down transformer?

Put a tick (✓) in the box next to your answer.

a step-up transformer ☐

a step-down transformer ☐

Give a reason for your answer.

.....

.....

(1)

(ii) Why is the core made of iron?

.....

.....

(1)

(b) The power supply to a laptop computer contains a transformer designed to change the 230 V mains input to a 15 V output. The transformer has 920 turns on its primary coil.

Use the equation in the box to calculate the number of turns on the secondary coil.

$$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$$

Show clearly how you work out your answer.

.....

.....

.....

Number of turns on the secondary coil = ...

(2)
(Total 4 marks)

Q2. (a) In the National Grid, very large step-up transformers link power stations to the transmission cables.

A transformer used for this purpose has 800 turns on its primary coil and 12 800 turns on its secondary coil. The p.d. (potential difference) across its primary coil is 25 kV.

Use the equation in the box to calculate the p.d. across its secondary coil.

$$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$$

Show clearly how you work out your answer **and** give the unit.

.....

.....

p.d. across secondary coil = ...

(3)

(b) The primary and secondary coils of a transformer are made of insulated wire.

Why is this insulation necessary?

.....

.....

(1)

(c) Describe what happens when an alternating potential difference is applied across the primary coil of a transformer.

.....

.....

.....

.....

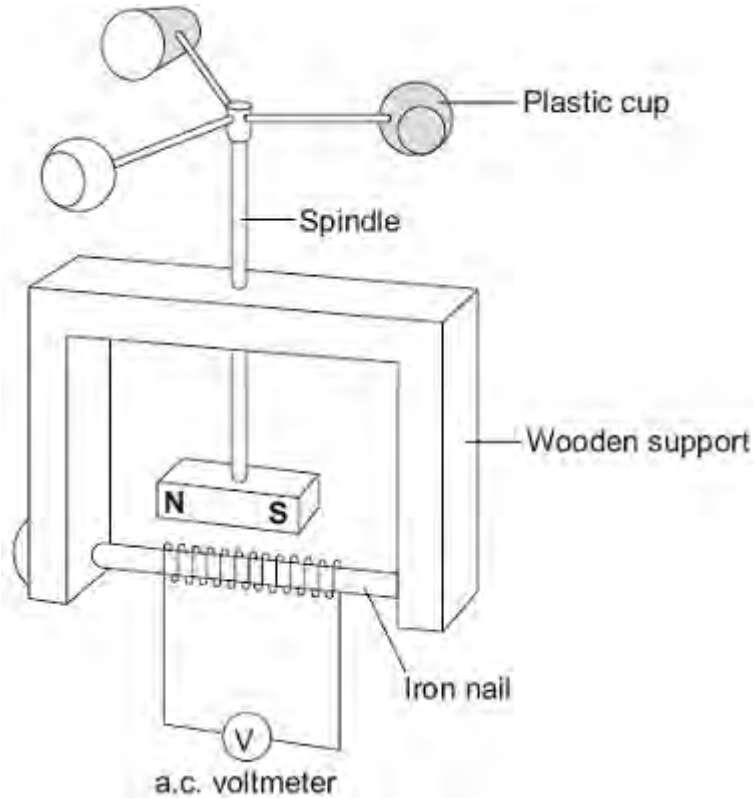
.....

.....

(3)

(Total 7 marks)

Q3. The diagram shows a student's design for a simple wind speed gauge.



(a) Explain why the wind causes the a.c. voltmeter to give a reading. The explanation has been started for you.

The wind causes the plastic cups to turn. .....

.....

.....

.....

.....

.....

.....

(3)

(b) The gauge is not sensitive enough to measure light winds.

Suggest **one** way that the design can be modified to make the gauge more sensitive.

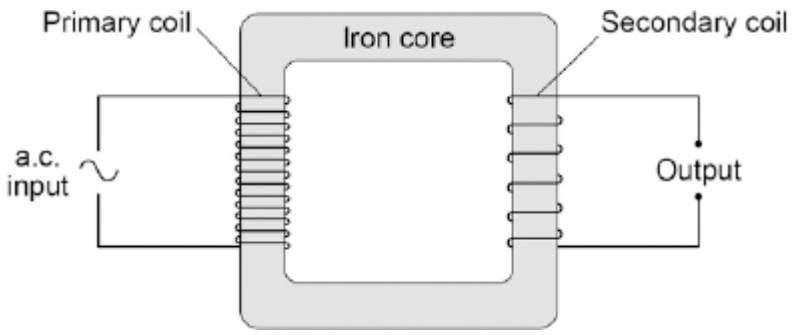
.....

.....

(1)
(Total 4 marks)

Q4.Figure 1 shows the construction of a simple transformer.

Figure 1



(a) Why is iron a suitable material for the core of a transformer?

Tick **one** box.

It is a metal. ☐

It will not get hot. ☐

It is easily magnetised. ☐

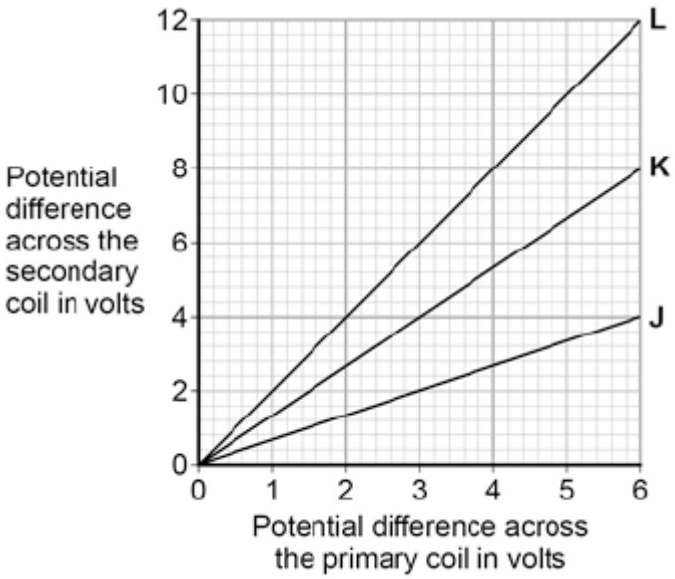
It is an electrical conductor. ☐

(1)

(b) A student makes three simple transformers, **J**, **K** and **L**.

Figure 2 shows how the potential difference across the secondary coil of each transformer varies as the potential difference across the primary coil of each transformer is changed.

Figure 2



How can you tell that transformer **J** is a step-down transformer?

.....

.....

(1)

(c) Each of the transformers has 50 turns on the primary coil.

Calculate the number of turns on the secondary coil of transformer **L**.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

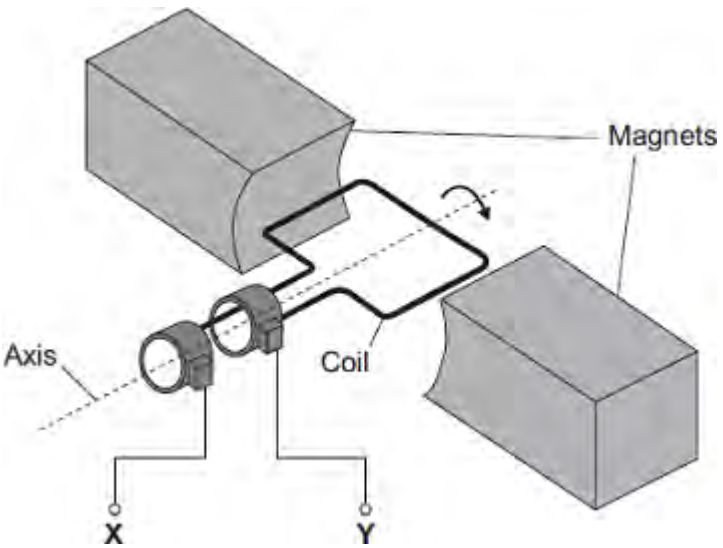
Number of turns on the secondary coil = ...

(3)

(Total 5 marks)

Q5. The diagram shows an a.c. generator.

The coil rotates about the axis shown and cuts through the magnetic field produced by the magnets.



(a) (i) A potential difference is induced between **X** and **Y**.

Use the correct answer from the box to complete the sentence.

electric	**generator**	**motor**	**transformer**

This effect is called the ..... effect.

(1)

(ii) What do the letters a.c. stand for?

.....

(1)

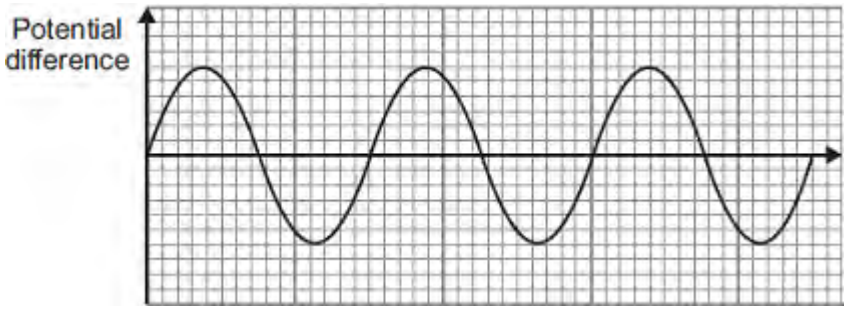
(iii) Name an instrument that could be used to measure the potential difference between **X** and **Y**.

.....

(1)

(b) **Graph 1** shows the output from the a.c. generator.

Graph 1



(i) One of the axes on **Graph 1** has been labelled 'Potential difference'.

What should the other axis be labelled?

.....

(1)

(ii) The direction of the magnetic field is reversed.

On **Graph 1**, draw the output from the a.c. generator if everything else remains the same.

(2)

(c) The number of turns of wire on the coil is increased. This increases the maximum induced potential difference.

State **two** other ways in which the maximum induced potential difference could be increased.

1 .....

.....

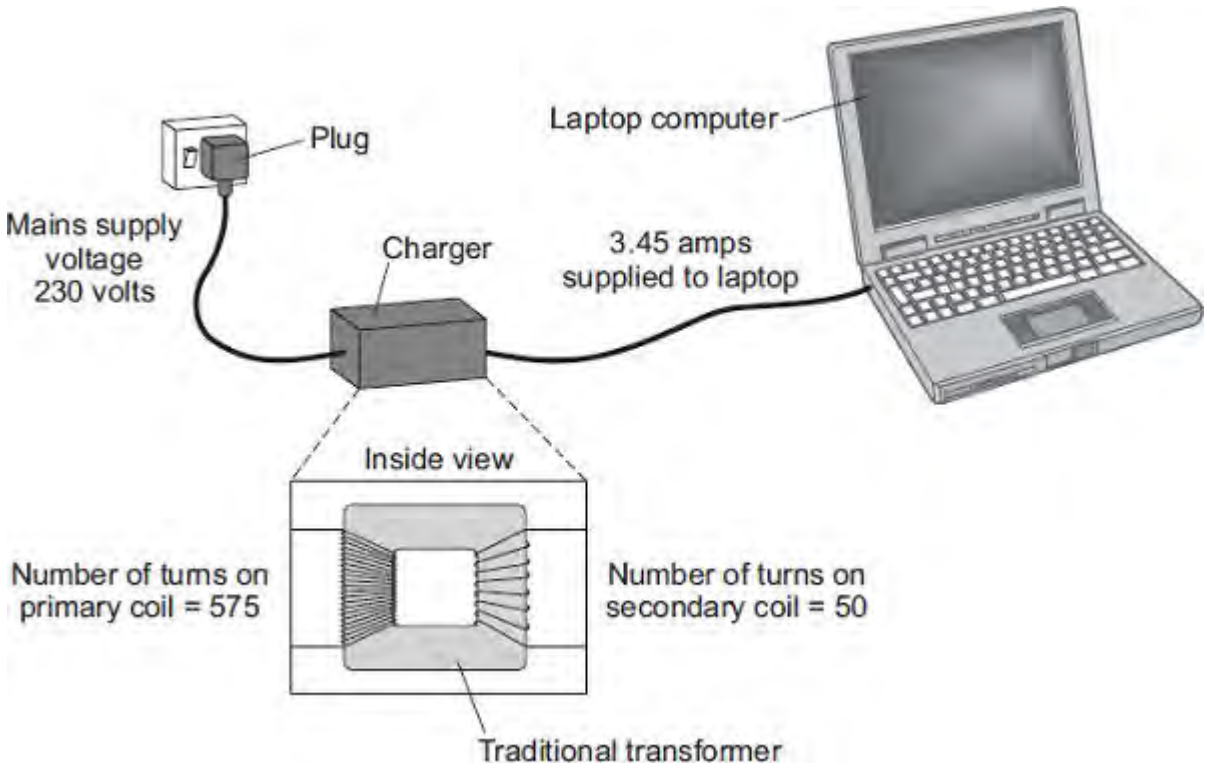
2 .....

.....

(2)

(Total 8 marks)

Q6. Batteries inside laptop computers are charged using laptop chargers. The laptop charger contains a traditional transformer.



(a) The alternating current flowing through the primary coil of the transformer creates an alternating current in the secondary coil.

Explain how.

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(b) (i) Use information from the diagram to calculate the potential difference the charger supplies to the laptop.

.....

.....

.....

.....

Potential difference = ... V

(2)

(ii) Calculate the current in the primary coil of the transformer when the laptop is being charged.

Assume the transformer is 100% efficient.

.....

.....

.....

.....

Current = ... A

(2)

(c) Laptop batteries and mobile phone batteries can only be recharged a limited number of times. After this, the batteries cannot store enough charge to be useful. Scientists are developing new batteries that can be recharged many more times than existing batteries.

Suggest **one** other advantage of developing these new batteries.

.....

.....

.....

(1)

(Total 8 marks)

Q7.In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

There are two types of traditional transformer; step-up and step-down.

Describe the similarities and differences between a step-up transformer and a step-down transformer.

You should include details of:

- construction, including materials used
- the effect the transformer has on the input potential difference (p.d.).

You should **not** draw a diagram.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Extra space .....

.....

.....

.....

.....

.....

(Total 6 marks)

Q8. The current in a circuit depends on the potential difference (p.d.) provided by the cells and the total resistance of the circuit.

(a) Using the correct circuit symbols, draw a diagram to show how you would connect 1.5 V cells together to give a p.d. of 6 V.

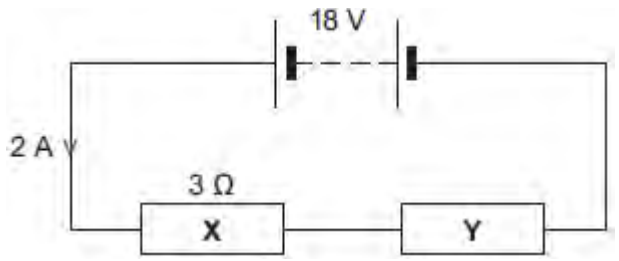
(2)

(b) **Figure 1** shows a circuit containing an 18 V battery.

Two resistors, **X** and **Y**, are connected in series.

- **X** has a resistance of 3 Ω.
- There is a current of 2 A in **X**.

Figure 1



(i) Calculate the p.d. across **X**.

.....

.....

P.d. across **X** = ... V

(2)

(ii) Calculate the p.d. across **Y**.

.....

.....

.....

P.d. across **Y** = ... V

(2)

(iii) Calculate the total resistance of **X** and **Y**.

.....

.....

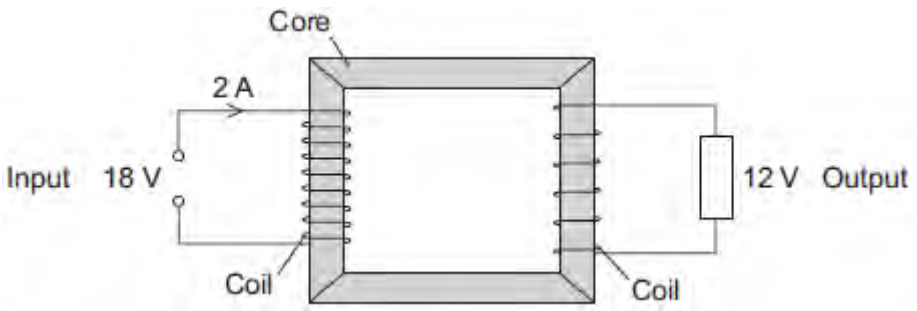
.....

Total resistance of **X** and **Y** = ... Ω

(2)

(c) **Figure 2** shows a transformer.

Figure 2



(i) An 18 V battery could **not** be used as the input of a transformer.

Explain why.

.....

.....

.....

.....

(2)

(ii) The transformer is 100% efficient.

Calculate the output current for the transformer shown in **Figure 2**.

.....

.....

.....

Output current = ... A

(2)

(Total 12 marks)

M1.(a) move a (magnetic / plotting) compass around the wire

1

the changing direction of the compass needle shows a magnetic field has been produced

OR

sprinkle iron filings onto the card (1)

tapping the card will move the filings to show the magnetic field (pattern) (1)

1

(b) **Level 2 (3–4 marks):**
A detailed and coherent explanation is provided. The response makes logical links between clearly identified, relevant points that explain how the ignition circuit works.

Level 1 (1–2 marks):
Simple statements are made. The response may fail to make logical links between the points raised.

0 marks:
No relevant content.

Indicative content

- closing the (ignition) switch causes a current to pass through the electromagnet
- the iron core (of the electromagnet) becomes magnetised
- the electromagnet / iron core attracts the (short side of the) iron arm
- the iron arm pushes the (starter motor) contacts (inside the electromagnetic switch) together
- the starter motor circuit is complete
- a current flows through the starter motor (which then turns)

4

[6]

M2. (a) (i) it moves or experiences a force horizontally to the right

for 1 mark

1

(ii) A – moves in opposite direction or force reversed e.c.f.
B – faster movement or larger force
(**not** move further)

for 1 mark each

2

(b) turns clockwise
oscillates/reverses
comes to rest facing field/at 90° to field/vertically

for 1 mark each

3

(c) number of turns or linear number density of turns current core

for 1 mark each

3

[9]

M3. (a) increase the current (1)

credit increase the p.d./voltage
credit reduce the resistance
credit have thicker wiring
credit add extra / more cells

1

increase the magnetic field (strength) (1)

credit 'have stronger magnet(s)
*do **not** credit 'bigger magnets' either order*

1

(b) **either** reverse polarity

or connect the battery the other way round

1

either reverse direction of the magnetic field

or put the magnet the other way round / reverse the magnet

*do **not** give any credit to a response in which both are done at the same time*

either order

1

(c) **either**

conductor parallel to the magnetic field

or lines of magnetic force and path of electricity do not cross

1

[5]

M4. (a) electric drill, electric fan, electric food mixer and electric screwdriver

all four ticked and no others (2)

***either** all four of these ticked and only one other (1)*

***or** any three of these ticked and none/one/two of the others (1)*

2

(b) (i) reverse (the direction of the) current (1)

***or** reverse the connections (to the battery)*

reverse (the direction of the) magnetic field (1)

***or** reverse the (magnetic) poles /ends*

*do **not** credit 'swap the magnets (around)'*

2

(ii) any **two** from:

- increase the strength of the magnet(s)/(magnetic) field

  *do **not** credit 'use a bigger magnet'*

- increase the current

  allow 'increase the voltage/p.d.'
  allow add cells/batteries
  allow increase the (electrical) energy
  allow increase the power supply
  allow 'decrease the resistance'
  allow 'increase charge'
  allow ' increase the electricity'

  *do **not** credit 'use a bigger battery'*

- reduce the gap (between coil/armature and poles/magnets)

  allow increase the (number of) coils

- increase the turns (on the coil/armature)

  *do **not** credit 'use a bigger coil'*

2

[6]

M5.(a) move a (magnetic / plotting) compass around the wire

1

the changing direction of the compass needle shows a magnetic field has been produced

OR

sprinkle iron filings onto the card (1)

tapping the card will move the filings to show the magnetic field (pattern) (1)

1

(b) **Level 2 (3–4 marks):**
A detailed and coherent explanation is provided. The response makes logical links between clearly identified, relevant points that explain how the ignition circuit works.

Level 1 (1–2 marks):
Simple statements are made. The response may fail to make logical links between the points raised.

0 marks:
No relevant content

Indicative content

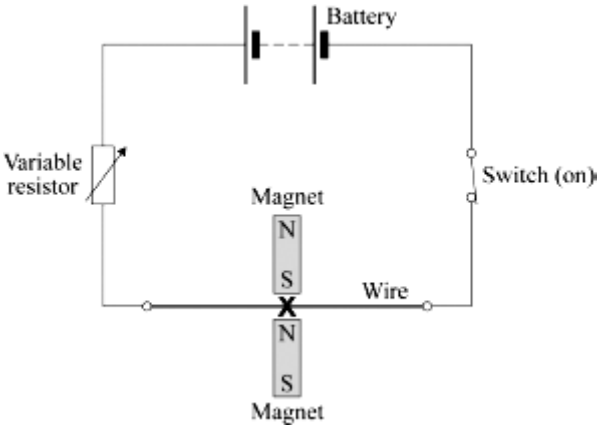
- closing the (ignition) switch causes a current to pass through the electromagnet
- the iron core (of the electromagnet) becomes magnetised
- the electromagnet / iron core attracts the (short side of the) iron arm
- the iron arm pushes the contacts (inside the electromagnetic switch) together
- the starter motor circuit is complete
- a current flows through the starter motor (which then turns)

4

[6]

M6. (a) centre of the **X** midway between the poles

intention correct as judged by eye ***example***



1

(b) move the poles further apart

accept turn for move

accept ends / magnets for poles

accept use weaker magnets

do ***not*** *accept use smaller magnets*

1

(c) (i) add more cells (to the battery)

do ***not*** *accept 'use a bigger battery'*

accept increase the potential difference / voltage

accept increase the current

or*reduce the resistance (of the variable resistor)*

do ***not*** *accept any changes to the magnets, to the wire or to their relative positions*

1

(ii) reverse (the polarity of) the battery

accept turn the battery / cells round

accept swap the connections to the battery

do ***not*** *accept any changes to the magnets, to the wire or to their relative positions*

1

[4]

M7. *(a) (i) an electrical conductor*

1

(ii) increase current

accept increase p.d. / voltage

or*use stronger magnets*

accept move magnets closer

do ***not*** *accept use larger magnets*

1

(iii) reverse the poles / ends (of the magnet)

either order

1

reverse the connections (to the power supply)

1

(b) (i) environmental

1

(ii) ethical

allow political (instability)

allow economic (migration)

1

[6]

M8. *(a) (i) an electric motor*

1

(ii) force

1

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

- *more powerful magnet*
  *do **not** allow 'bigger magnet'*
- *reduce the gap (between magnet and coil)*
- *increase the area of the coil*
- *more powerful cell*
  *do **not** allow 'bigger cell'*
  accept battery for cell
  accept add a cell
  accept increase current / potential difference
- *more turns (on the coil)*
  allow 'more coils on the coil'
  *do **not** allow 'bigger coil'*

2

(c) reverse the (polarity) of the cell
allow 'turn the cell the other way round'
accept battery for cell

1

reverse the (polarity) of the magnet
allow 'turn the magnet the other way up'

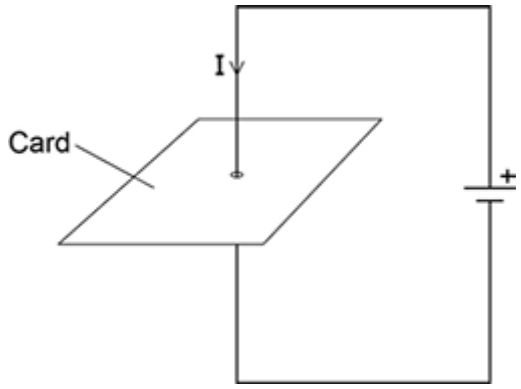
1

[6]

Q1.Figure 1 shows a straight wire passing through a piece of card.

A current (I) is passing down through the wire.

Figure 1



(a) Describe how you could show that a magnetic field has been produced around the wire.

.....

.....

.....

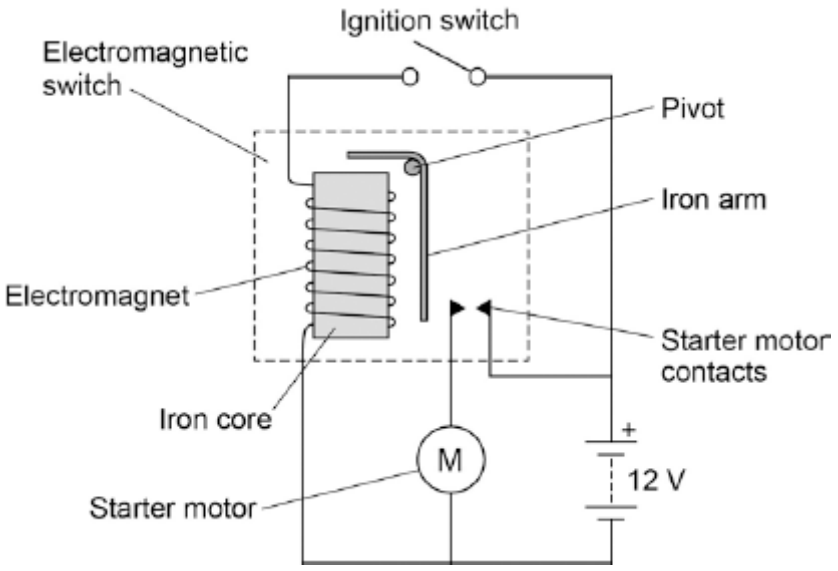
.....

(2)

(b) **Figure 2** shows the ignition circuit used to switch the starter motor in a car on.

The circuit includes an electromagnetic switch.

Figure 2



Explain how the ignition circuit works.

.....

.....

.....

.....

.....

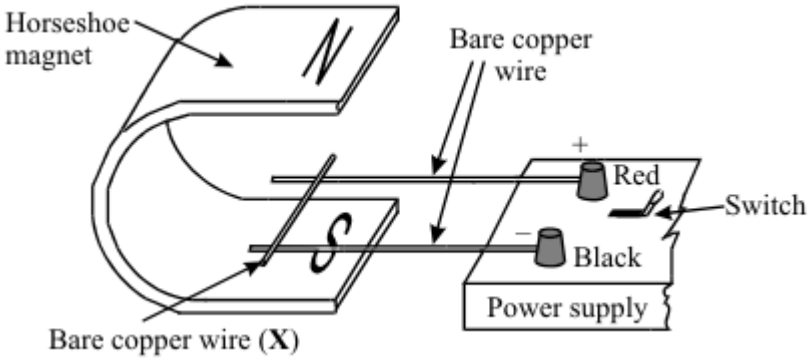
.....

.....

.....

(4)
(Total 6 marks)

Q2. The diagram shows apparatus used to demonstrate the motor effect. **X** is a short length of bare copper wire resting on two other wires.



(a) (i) Describe what happens to wire **X** when the current is switched on.

.....

.....

.....

(ii) What difference do you notice if the following changes are made?

A The magnetic field is reversed.

.....

.....

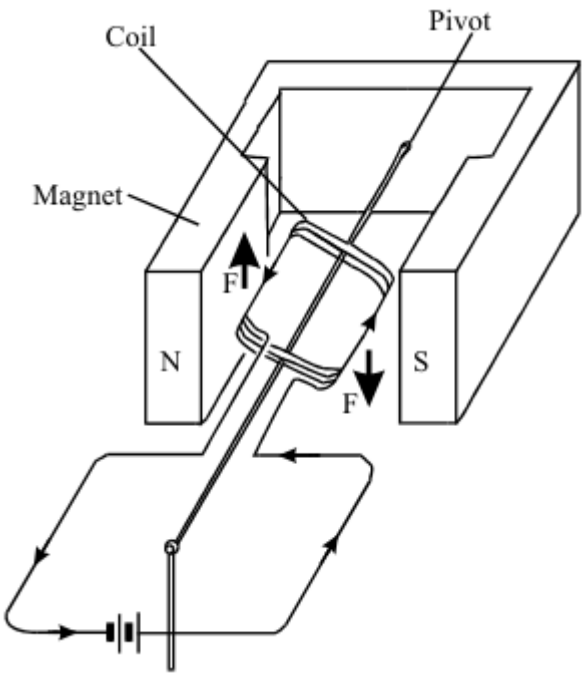
B The current is increased.

.....

.....

(3)

(b) The diagram shows a coil placed between the poles of a magnet. The arrows on the sides of the coil itself show the direction of the conventional current.



The arrows labelled **F** show the direction of the forces acting on the sides of the coil. Describe the motion of the coil until it comes to rest.

.....

.....

.....

.....

.....

(3)

(c) Most electric motors use electromagnets instead of permanent magnets. State three of the features of an electromagnet which control the strength of the magnetic field obtained.

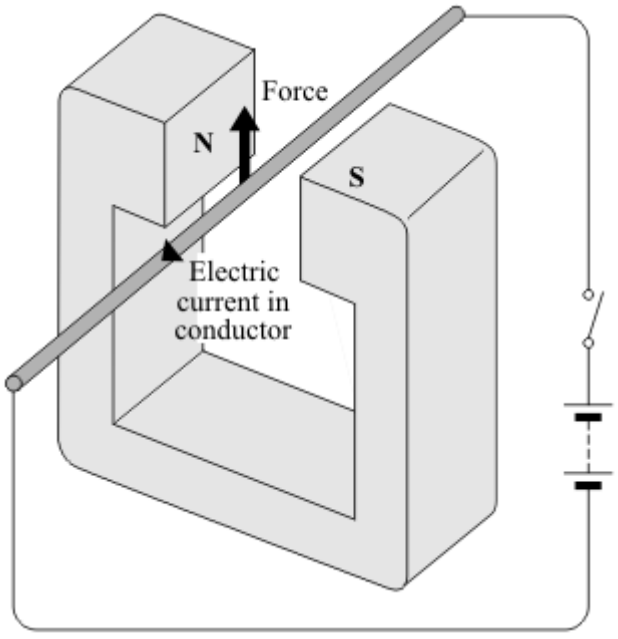
1 .....

2 .....

3 .....

(3)
(Total 9 marks

Q3. When a conductor carrying an electric current is placed in a magnetic field a force may act on it.



(a) State **two** ways in which this force can be increased.

1 .....

2 .....

(2)

(b) State **two** ways in which this force can be made to act in the opposite direction.

1 .....

2 .....

(2)

(c) In what circumstance will **no** force act on a conductor carrying an electric current and in a magnetic field?

.....

.....

(1)

(Total 5 marks)

Show clearly how you work out your answer.

.....

.....

Kinetic energy = ... J

(2)

(Total 7 marks)

Q4. Many electrical appliances use the circular motion produced by their electric motor.

(a) Put ticks (✓) in the boxes next to **all** the appliances in the list which have an electric motor.

electric drill ☐

electric fan ☐

electric food mixer ☐

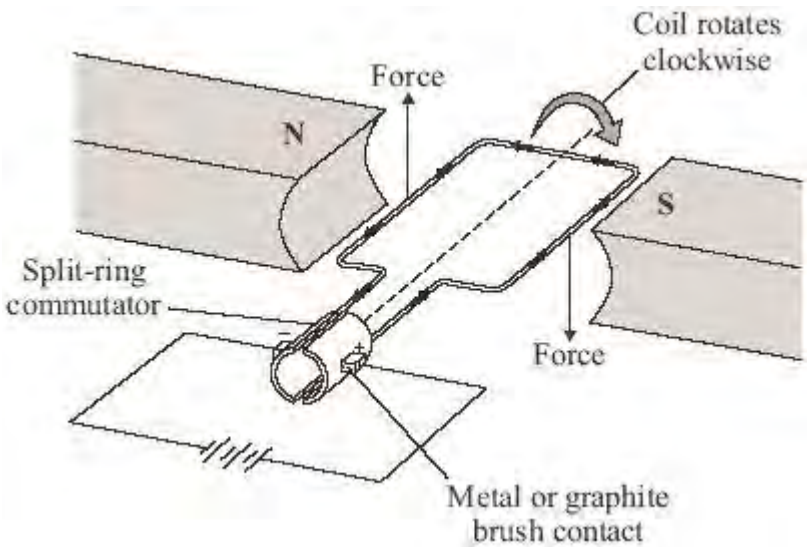
electric iron ☐

electric kettle ☐

electric screwdriver ☐

(2)

(b) One simple design of an electric motor is shown in the diagram. It has a coil which spins between the ends of a magnet.



(i) Give **two** ways of reversing the direction of the forces on the coil in the electric motor.

1 .....

.....

2 .....

.....

(2)

(ii) Give **two** ways of increasing the forces on the coil in the electric motor.

1 .....

.....

2 .....

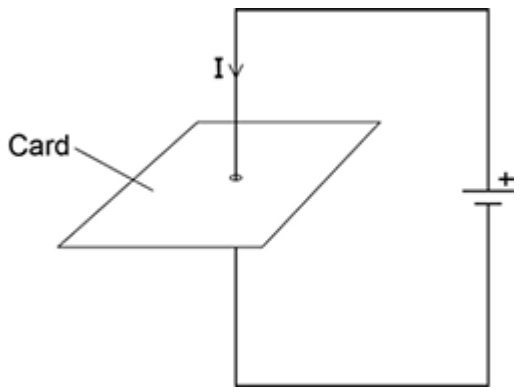
.....

(2)
(Total 6 marks)

Q5.Figure 1 shows a straight wire passing through a piece of card.

A current (I) is passing down through the wire.

Figure 1



(a) Describe how you could show that a magnetic field has been produced around the wire.

.....

.....

.....

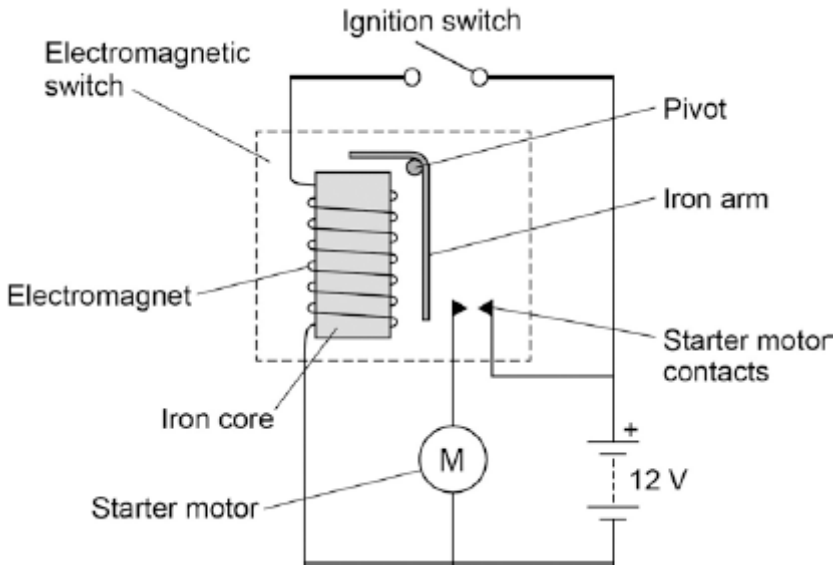
.....

(2)

(b) **Figure 2** shows the ignition circuit used to switch the starter motor in a car on.

The circuit includes an electromagnetic switch.

Figure 2



Explain how the ignition circuit works.

.....

.....

.....

.....

.....

.....

.....

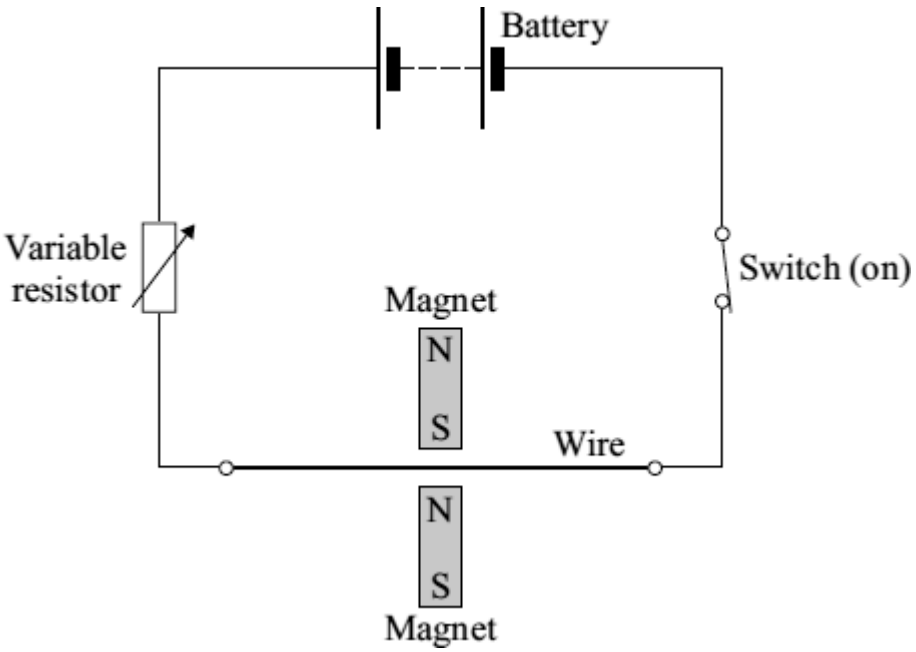
.....

(4)
(Total 6 marks)

Q6. A student investigates the electromagnetic force acting on a wire which carries an electric current. The wire is in a magnetic field.

The diagram shows the circuit which the student uses.

(a) Draw an **X** on the diagram, with the centre of the **X** in the most strongest part of the magnetic field.



(1)

(b) Give **one** change that she can make to the magnets to **decrease** the electromagnetic force on the wire.

.....

.....

(1)

(c) The student wants to change the electromagnetic force on the wire without changing the magnets or moving their position.

(i) Give **one** way in which she can **increase** the electromagnetic force.

.....

.....

(1)

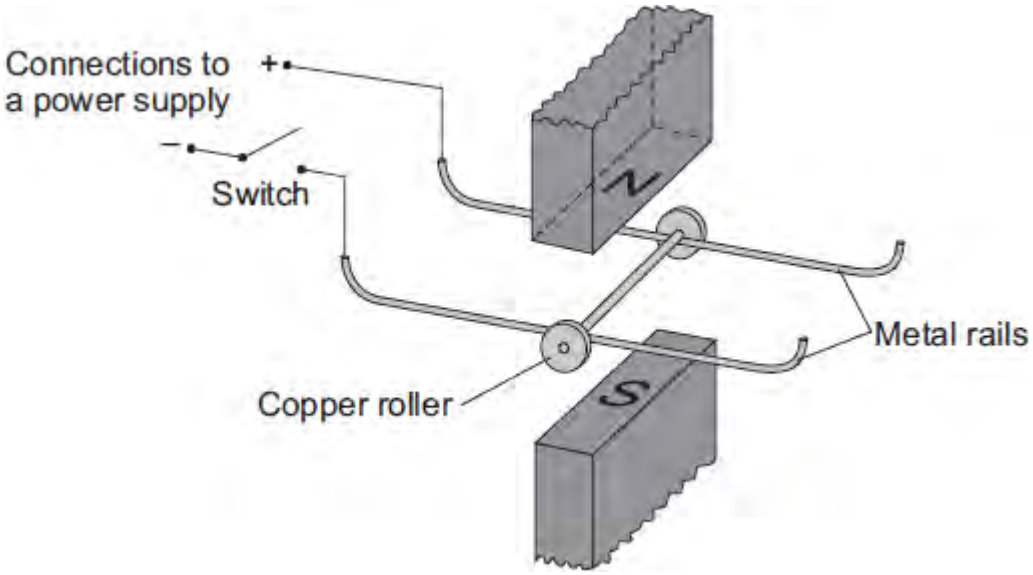
(ii) Give **one** way in which she can **reverse** the direction of the electromagnetic force.

.....

.....

(1)
(Total 4 marks)

Q7. (a) A science technician sets up the apparatus shown below to demonstrate the motor effect. He uses a powerful permanent magnet.



The copper roller is placed across the metal rails. When the switch is closed, the copper roller moves to the right.

(i) Complete the sentence by drawing a ring around the correct line in the box.

This happens because copper is

an electrical conductor.
an electrical insulator.
a magnetic material.

(1)

(ii) Suggest **one** change that the technician can make which will cause the copper roller to move faster.

.....

.....

(1)

(iii) Suggest **two** changes which the technician can make, each of which will separately cause the copper roller to move to the left.

1 .....

.....

2 .....

.....

(2)

(b) Many electrical appliances, such as vacuum cleaners, drills and CD players, contain electric motors. As more electrical appliances are developed, more electricity needs to be generated. Generating electricity often produces pollutant gases.

(i) Complete the sentence by drawing a ring around the correct line in the box.

Generating more electricity to power the increasing number of electrical appliances used

raises

an ethical
an environmental
a political

ssue.

(1)

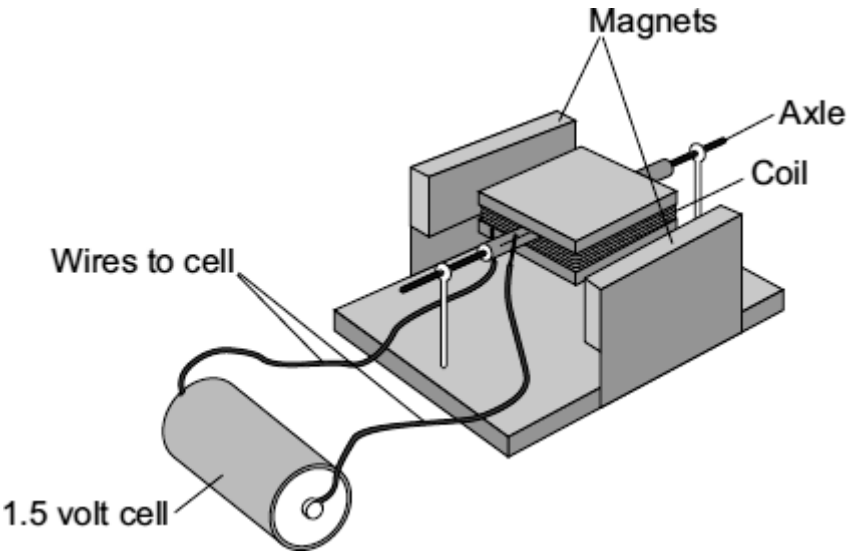
(ii) The number of electrical appliances used in the world's richest countries is increasing yet many people in the world's poorest countries have no access to electricity.

What type of issue does this inequality between people in different countries raise?

.....

(1)
(Total 6 marks)

Q8. (a) Complete the description of the device shown below by drawing a ring around the correct line in each box.



(i) The device is being used as

an electric motor.
a generator.
a transformer.

(1)

(ii) The coil needs a flick to get started. Then one side of the coil is pushed by the

cell
coil
force

and the other side is pulled, so that the coil spins.

(1)

(b) Suggest **two** changes to the device, each one of which would make the coil spin faster.

1 .....

.....

2 .....

.....

(2)

(c) Suggest **two** changes to the device, each one of which would make the coil spin in the opposite direction.

1 .....

.....

2 .....

.....

(2)
(Total 6 marks)

M1. (a) north (pole)

accept N

north (pole)

both needed for mark

1

(b) reverses

accept changes direction

1

(c) (i) first finger:
(direction of) (magnetic) field

1

second finger:
(direction of) (conventional) current

1

(ii) into (plane of the) paper

1

(iii) less current in wire

accept less current / voltage / more resistance / thinner wire

1

weaker field

allow weaker magnets / magnets further apart

*do **not** accept smaller magnets*

1

rotation of magnets (so) field is no longer perpendicular to wire

1

(d) (i) reverse one of the magnets

*do **not** accept there are no numbers on the scale*

1

(ii) systematic or zero error

accept all current values will be too big

accept it does not return to zero

accept it does not start at zero

1

[10]

M2. (a) motor (effect)

1

(b) (i) wire kicks further (forward)

accept moves for kicks

accept moves more

accept 'force (on the wire) increased'

1

(ii) wire kicks back(wards) / into (the space in) the (horseshoe) magnet

accept moves for kicks

accept 'direction of force reversed'

1

[3]

M3. (a) (i) current produces a magnetic field (around XY)

accept current (in XY) is perpendicular to the (permanent)

magnetic field

1

(creating) a force (acting) on XY / wire / upwards

reference to Fleming's left hand rule is insufficient

1

(ii) motor (effect)

1

(iii) vibrate / move up and down

1

5 times a second

only scores if first mark point scores

*allow for **1** mark only an answer 'changes direction 5 times a second'*

1

(b) 0.005

*allow **1** mark for calculating moment of the weight as 0.04 (Ncm)andallow **1** mark for correctly stating principle of moments**or**allow **2** marks for correct substitution*

*ie F × 8 = 2 × 0.02 **or** F × 8 = 0.04*

3

[8]

M4. (a) motor effect

1

(b) increase the strength of the magnet

or

increase the current

1

(c) $4.8 \times 10^{-4} = F \times 8 \times 10^{-2}$

1

$F = 6 \times 10^{-3}$ (N)

1

$6 \times 10^{-3} = B \times 1.5 \times 5 \times 10^{-2}$

1

$B = \frac{6 \times 10^{-3}}{7.5 \times 10^{-2}}$

1

$B = 8 \times 10^{-2}$ or 0.08

1

*allow 8×10^{-2} **or** 0.08 with no working shown for **5** marks*
*a correct method with correct calculation using an incorrect value of F gains **3** marks*

Tesla

accept T

1

do not accept t

[8]

M5. (a) hydraulic (system)

1

(b) 15.40×10^2
or
1540

*allow **1** mark for correct substitution, ie*

$8.75 \times 10^4 = \frac{F}{1.76 \times 10^{-2}}$

or

$87\ 500 = \frac{F}{0.0176}$

or

$F = 8.75 \times 10^4 \times 1.76 \times 10^{-2}$

or

$F = 87\ 500 \times 0.0176$

2

(c) any **one** environmental **advantage**:

stating a converse statement is insufficient, or a disadvantage of the usual oil, ie the usual oil is non-renewable

plant oil is renewable

using plant oil will conserve (limited) supplies **or** extend lifetime of the usual / crude oil.

plant oil releases less carbon dioxide (when it is being produced / processed)

plant oil will add less carbon dioxide to the atmosphere (when it is being produced / processed, than the usual oil)

plant oil removes carbon dioxide from **or** adds oxygen to the air when it is growing

stating that plant oil is carbon neutral is insufficient

1

(d) (the current flowing through the coil) creates a magnetic field (around the coil)

1

(this magnetic field) interacts with the permanent magnetic field
or
current carrying conductor is in a (permanent) magnetic field

it must be clear which magnetic field is which

1

this produces a (resultant) force (and coil / cone moves)

1

when the direction of the current changes, the direction of the force changes to the opposite direction

*accept for **2** marks the magnetic field of the coil interacts with the permanent magnetic field*

1

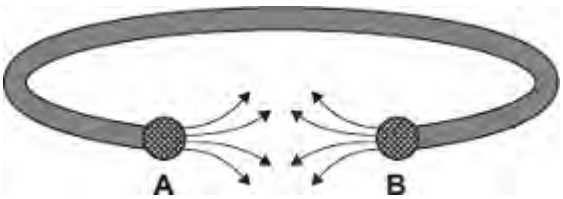
[8]

Q1.(a) Some people wear magnetic bracelets to relieve pain.

Figure 1 shows a magnetic bracelet.

There are magnetic poles at both **A** and **B**.
Part of the magnetic field pattern between **A** and **B** is shown.

Figure 1



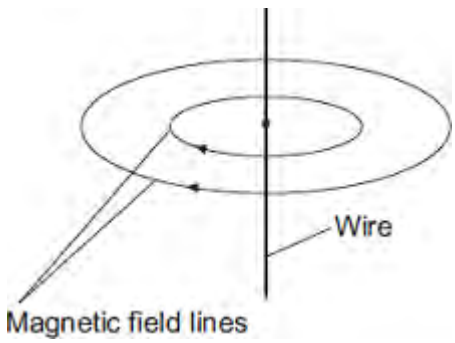
What is the pole at **A**? .....

What is the pole at **B**? .....

(1)

(b) **Figure 2** shows two of the lines of the magnetic field pattern of a current-carrying wire.

Figure 2



The direction of the current is reversed.

What happens to the direction of the lines in the magnetic field pattern?

.....

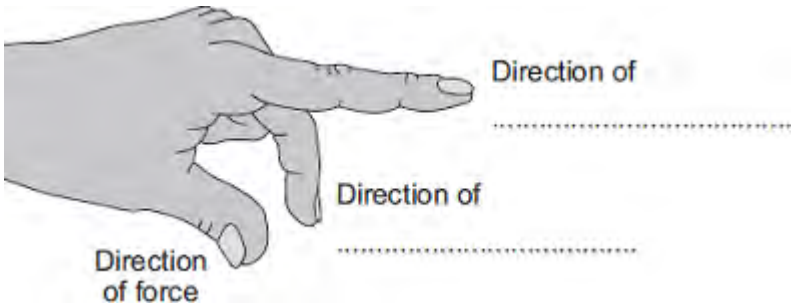
(1)

(c) Fleming's left-hand rule can be used to identify the direction of a force acting on a

current-carrying wire in a magnetic field.

(i) Complete the labels in **Figure 3**.

Figure 3

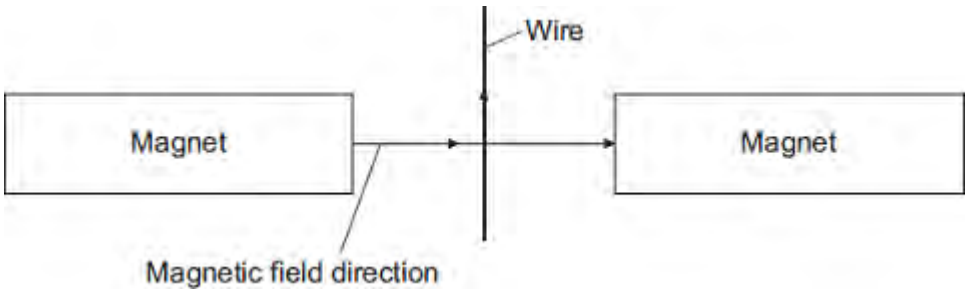


(2)

(ii) **Figure 4** shows:

- the direction of the magnetic field between a pair of magnets
- the direction of the current in a wire in the magnetic field.

Figure 4



In which direction does the force on the wire act?

.....

(1)

(iii) Suggest **three** changes that would **decrease** the force acting on the wire.

1 .....

2 .....

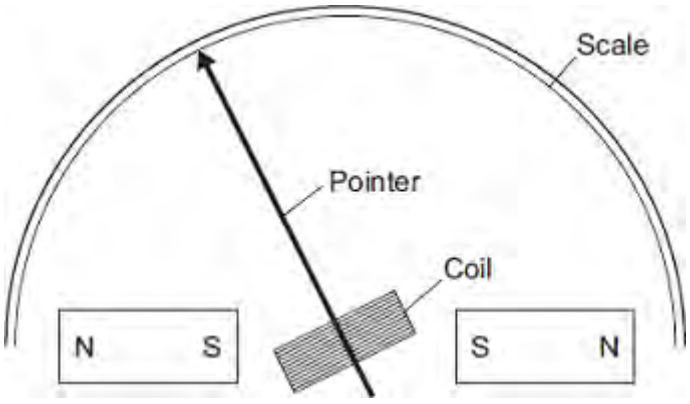
3 .....

(3)

(d) **Figure 5** shows part of a moving-coil ammeter as drawn by a student.

The ammeter consists of a coil placed in a uniform magnetic field.
When there is a current in the coil, the force acting on the coil causes the coil to rotate and the pointer moves across the scale.

Figure 5



(i) The equipment has **not** been set up correctly.

What change would make it work?

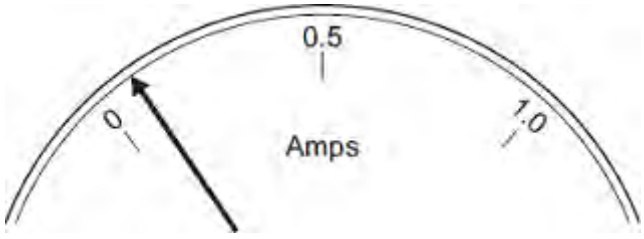
.....

.....

(1)

(ii) **Figure 6** shows the pointer in an ammeter when there is no current.

Figure 6

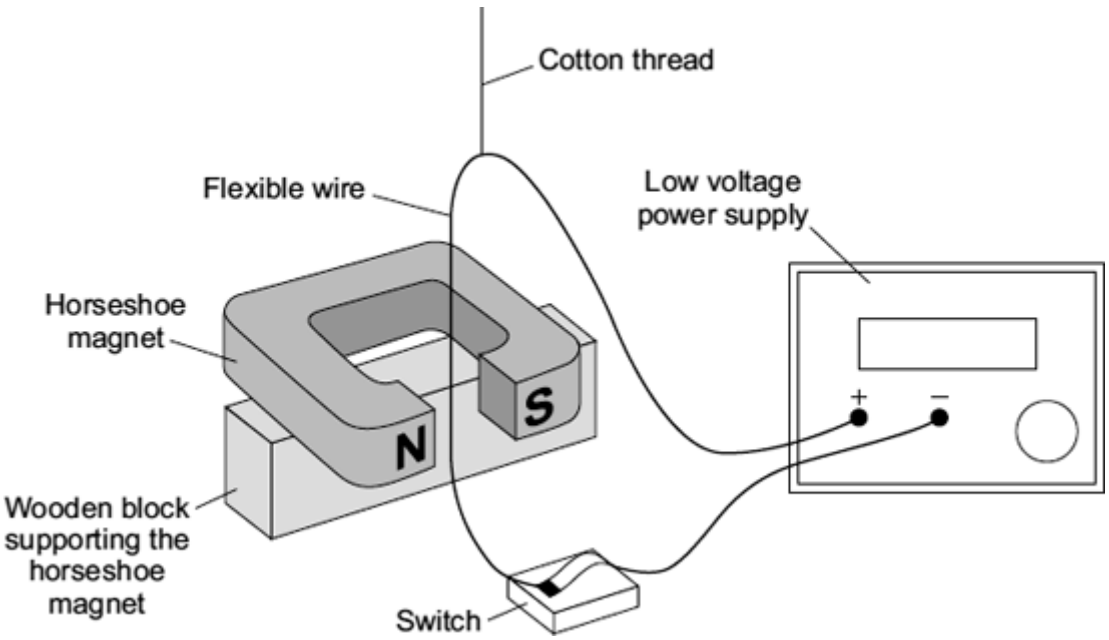


What type of error does the ammeter have?

.....

(1)
(Total 10 marks)

Q2. (a) A laboratory technician sets up a demonstration.



A flexible wire is suspended between the ends of a horseshoe magnet. The flexible wire hangs from a cotton thread. When the switch is closed, the wire kicks forward.

Identify the effect which is being demonstrated.

.....

(1)

(b) A teacher makes some changes to the set-up of the demonstration.

What effect, if any, will each of the following changes have?

(i) more powerful horseshoe magnet is used.

.....

.....

(1)

(ii) The connections to the power supply are reversed.

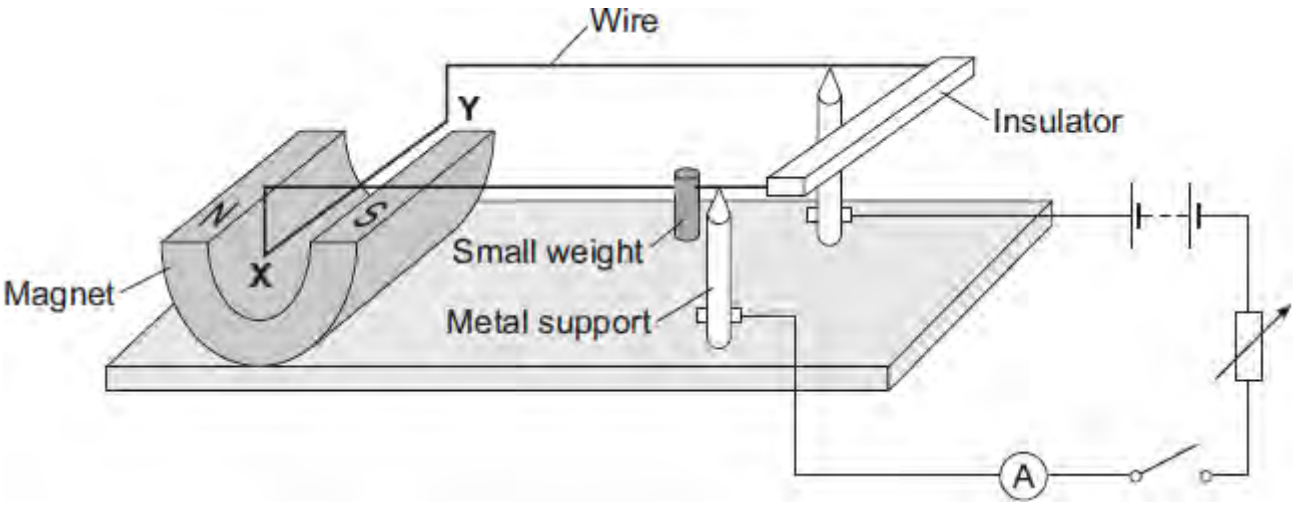
.....

.....

(1)

(Total 3 marks)

Q3. The diagram shows a device called a current balance.



(a) (i) When the switch is closed, the part of the wire labelled **XY** moves upwards.

Explain why.

.....

.....

.....

.....

(2)

(ii) What is the name of the effect that causes the wire **XY** to move?

.....

(1)

(iii) An alternating current (a.c.) is a current which reverses direction. How many times the current reverses direction in one second depends on the frequency of the alternating supply.

Describe the effect on the wire **XY** if the battery is replaced by an a.c. supply having a frequency of 5 hertz.

.....

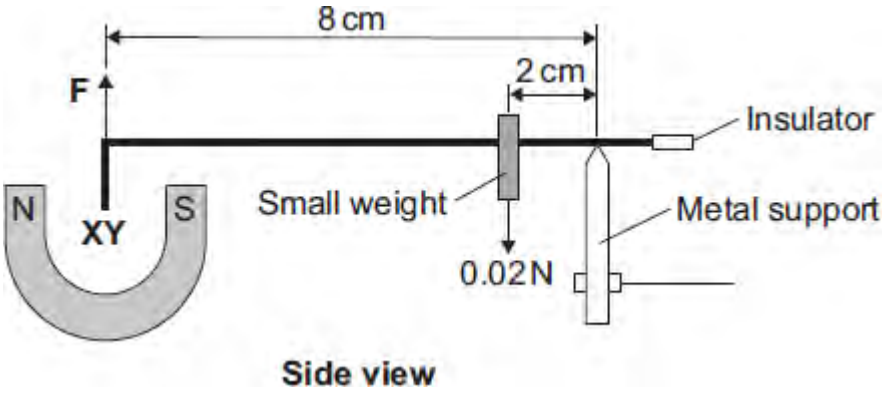
.....

.....

.....

(2)

(b) The diagram shows how a small weight can be used to make the wire **XY** balance horizontally.



Use the data in the diagram and the equation in the box to calculate the force, **F**, acting on the wire **XY**.

moment	=	force	×	perpendicular distance from the line of action of the force to the axis of rotation

Show clearly how you work out your answer.

.....

.....

.....

.....

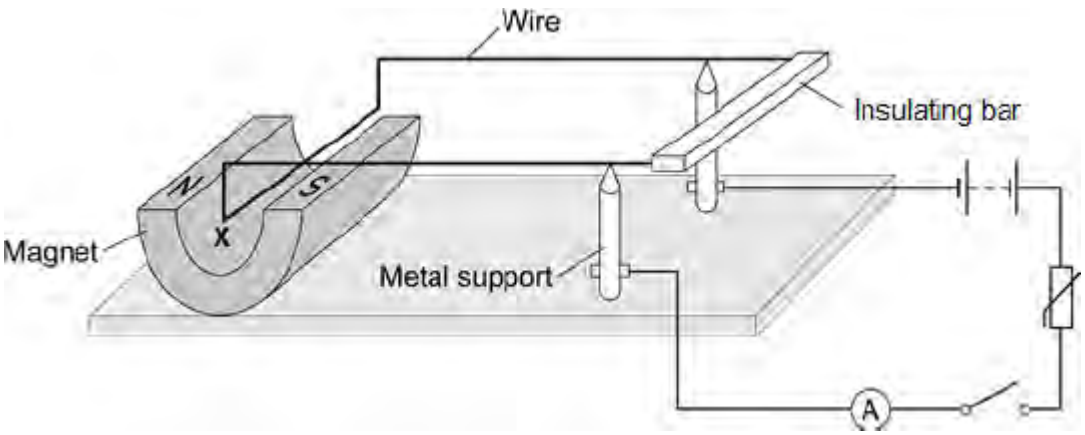
Force = ... N

(3)

(Total 8 marks)

Q4.Figure 1 shows a piece of apparatus called a current balance.

Figure 1



When the switch is closed, the part of the wire labelled **X** experiences a force and moves downwards.

(a) What is the name of the effect that causes the wire **X** to move downwards?

.....

(1)

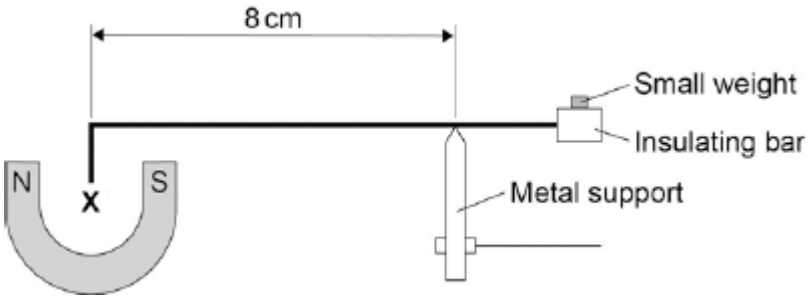
(b) Suggest one change you could make to the apparatus in **Figure 1** that would increase the size of the force that wire **X** experiences.

.....

(1)

(c) **Figure 2** shows how a small weight placed on the insulating bar makes the wire **X** go back and balance in its original position.

Figure 2



The wire **X** is 5 cm long and carries a current of 1.5 A.

The small weight causes a clockwise moment of 4.8×10^{-4} Nm.

Calculate the magnetic flux density where the wire **X** is positioned

Give the unit.

.....

.....

.....

.....

.....

.....

.....

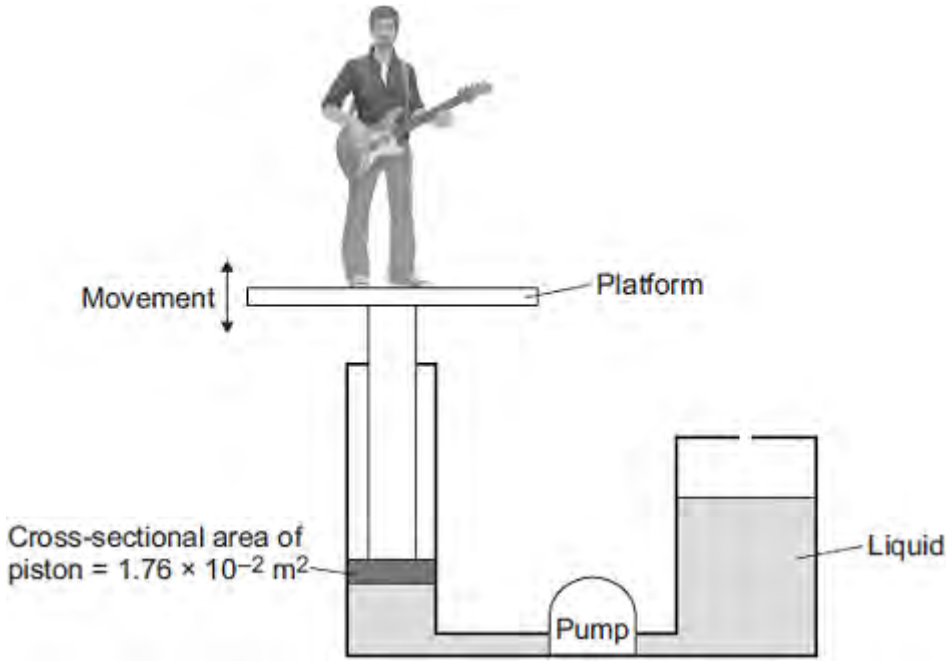
Magnetic flux density = ... Unit .....

(6)
(Total 8 marks)

Q5. Musicians sometimes perform on a moving platform.

Figure 1 shows the parts of the lifting machine used to move the platform up and down.

Figure 1



(a) What type of system uses a liquid to transmit a force?

.....

(1)

(b) The pump creates a pressure in the liquid of 8.75 x 10^4 Pa to move the platform upwards.

Calculate the force that the liquid applies to the piston.

.....

.....

.....

Force = ... N

(2)

(c) The liquid usually used in the machine is made by processing oil from underground wells. A new development is to use plant oil as the liquid.

Extracting plant oil requires less energy than extracting oil from underground wells.

Suggest an environmental advantage of using plant oil.

.....

.....

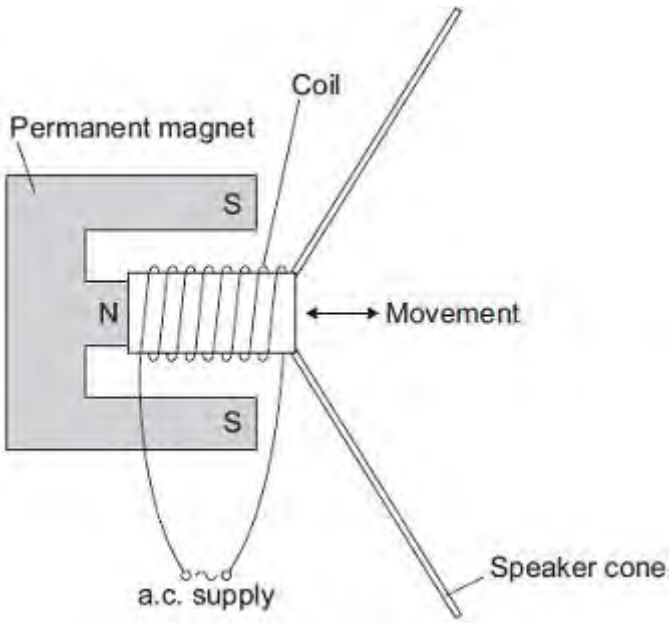
.....

(1)

(d) Musicians often use loudspeakers.

Figure 2 shows how a loudspeaker is constructed.

Figure 2



The loudspeaker cone vibrates when an alternating current flows through the coil.

Explain why.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4)
(Total 8 marks)

M1. (a) induced

1

(b) bar 2

1

(the same end) of bar 1 attracts both ends of bar 2

or

only two magnets can repel so cannot be bar 1 or bar 3

1

(c) so the results for each magnet can be compared

or

so there is only one independent variable

fair test is insufficient

allow different thickness of paper would affect number of sheets each magnet could hold

accept it is a control variable

1

(d) because the magnet with the biggest area was not the strongest

accept any correct reason that confirms the hypothesis is wrong eg smallest magnet holds more sheets than the largest

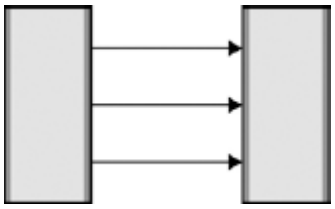
1

[5]

M2. (a) (i) field pattern shows:
some straight lines in the gap

1

direction N to S



1

(ii) north poles repel

1

(so) box will not close

1

(b) (i) as paper increases (rapid) decrease in force needed

1

force levels off (after 50 sheets)

1

(ii) the newtonmeter will show the weight of the top magnet

1

(iii) (top) magnet and newtonmeter separate before magnets separate
accept reverse argument

1

(because) force between magnets is greater than force between magnet and hook of newtonmeter

1

(iv) any **three** from:

- means of reading value of force at instant the magnets are pulled apart
- increase the pulling force gently
  or
  use a mechanical device to apply the pulling force
- clamp the bottom magnet
- use smaller sheets of paper
- fewer sheets of papers between readings (smaller intervals)
- ensure magnets remain vertical
- ensure ends of magnet completely overlap
- repeat the procedure several times for each number of sheets and take a mean
- make sure all sheets of paper are the same thickness

3

(v) 3 (mm)

*30 × 0.1 ecf gains **2** marks*

*2.1 N corresponds to 30 sheets gains **1** mark*

3

[15]

M3. (a) (i) increase

1

(ii) A and B
and
B and C

both required for the mark
either order

1

(iii) any **two** from:

- size of nail
  or
  nail material
  allow (same) nail
- current
  allow (same) cell
  allow p.d.
  same amount of electricity is insufficient
- (size of) paper clip
- length of wire
  accept type / thickness of wire

2

(b) 4

1

B picks up the same number as C, so this electromagnet would pick up the same number as A
or
direction of current does not affect the strength of the electromagnet

allow it has got the same number of turns as A

1

(c) 2

allow 1 or 3

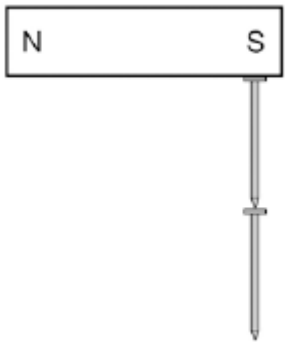
1

[7]

Q1.Figure 1 shows two iron nails hanging from a bar magnet.

The iron nails which were unmagnetised are now magnetised.

Figure 1



(a) Complete the sentence.

Use a word from the box.

forced	**induced**	**permanent**

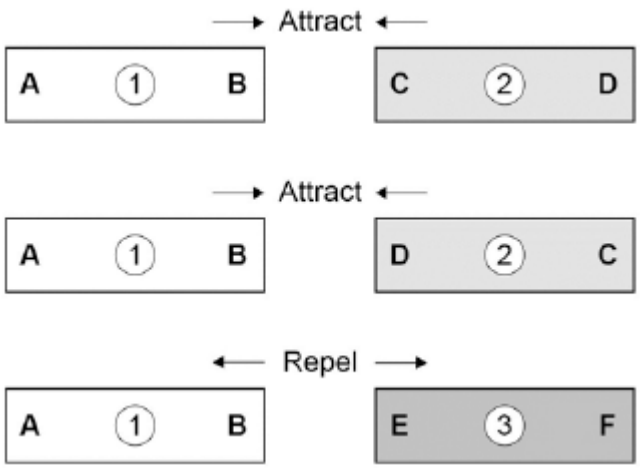
The iron nails have become ..... magnets.

(1)

(b) Each of the three metal bars in **Figure 2** is either a bar magnet or a piece of unmagnetised iron.

The forces that act between the bars when different ends are placed close together are shown by the arrows.

Figure 2



Which **one** of the metal bars is a piece of unmagnetised iron?

Tick **one** box.

Bar 1 ☐

Bar 2 ☐

Bar 3 ☐

Give the reason for your answer.

.....

.....

(2)

(c) A student investigated the strength of different fridge magnets by putting small sheets of paper between each magnet and the fridge door.

The student measured the maximum number of sheets of paper that each magnet was able to hold in place.

Why was it important that each small sheet of paper had the same thickness?

.....

.....

.....

(1)

(d) Before starting the investigation the student wrote the following hypothesis:

'The bigger the area of a fridge magnet the stronger the magnet will be.'

The student's results are given in the table below.

Fridge magnet	**Area of magnet in mm^2**	**Number of sheets of paper held**
A	40	20
B	110	16

C	250	6
D	340	8
E	1350	4

Give **one** reason why the results from the investigation **do not** support the student's hypothesis.

.....

.....

(1)
(Total 5 marks)

Q2.(a) **Diagram 1** shows a magnetic closure box when open and shut. It is a box that stays shut, when it is closed, due to the force between two small magnets.

These boxes are often used for jewellery.

Diagram 1

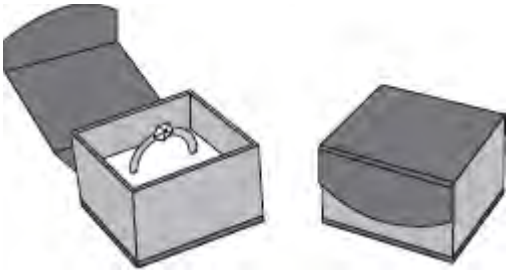
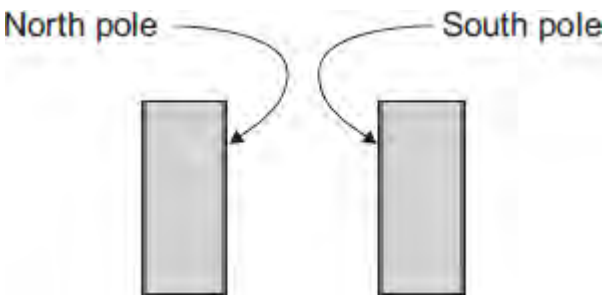


Diagram 2 shows the two magnets. The poles of the magnets are on the longer faces.

Diagram 2



(i) Draw, on **Diagram 2**, the magnetic field pattern between the two facing poles.

(2)

(ii) The magnets in the magnetic closure box must **not** have two North poles facing each other.

Explain why.

.....

.....

.....

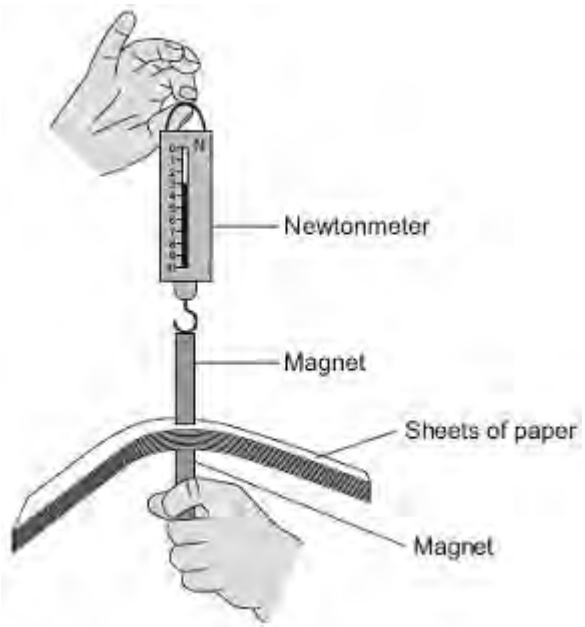
.....

(2)

(b) A student is investigating how the force of attraction between two bar magnets depends on their separation.

She uses the apparatus shown in **Diagram 3**.

Diagram 3



She uses the following procedure:

- ensures that the newtonmeter does not have a zero error
- holds one of the magnets
- puts sheets of paper on top of the magnet
- places the other magnet, with the newtonmeter magnetically attached, close to the first magnet
- pulls the magnets apart
- notes the reading on the newtonmeter as the magnets separate

- repeats with different numbers of sheets of paper between the magnets.

The results are shown in the table.

Number of sheets of paper between the magnets	10	20	30	40	50	60	70	80	120
Newtonmeter reading as the magnets separate	3.1	2.6	2.1	1.5	1.1	1.1	1.1	1.1	1.1

(i) Describe the pattern of her results.

.....

.....

.....

.....

(2)

(ii) No matter how many sheets of paper the student puts between the magnets, the force shown on the newtonmeter never reaches zero.

Why?

.....

.....

(1)

(iii) The student is unable to experiment with fewer than 10 sheets of paper without glueing the magnet to the newtonmeter.

Suggest why.

.....

.....

.....

.....

(2)

(iv) Suggest **three** improvements to the procedure that would allow the student to gain more accurate results.

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(v) The thickness of one sheet of paper is 0.1 mm.

What is the separation of the magnets when the force required to separate them is 2.1 N?

.....

.....

.....

Separation of magnets = ... mm

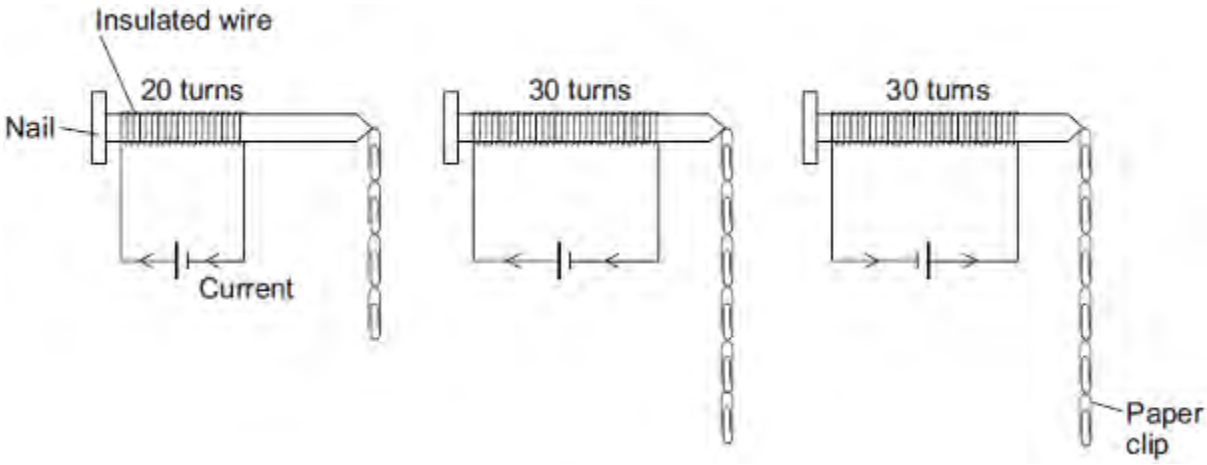
(3)
(Total 15 marks)

Q3.A student is investigating the strength of electromagnets.

Figure 1 shows three electromagnets.

The student hung a line of paper clips from each electromagnet.

Figure 1



Electromagnet **A** Electromagnet **B** Electromagnet **C**

No more paper clips can be hung from the bottom of each line of paper clips.

(a) (i) Complete the conclusion that the student should make from this investigation.

Increasing the number of turns of wire wrapped around the nail will .....

the strength of the electromagnet.

(1)

(ii) Which **two** pairs of electromagnets should be compared to make this conclusion?

Pair 1: Electromagnets ..... and .....

Pair 2: Electromagnets ..... and .....

(1)

(iii) Suggest **two** variables that the student should control in this investigation.

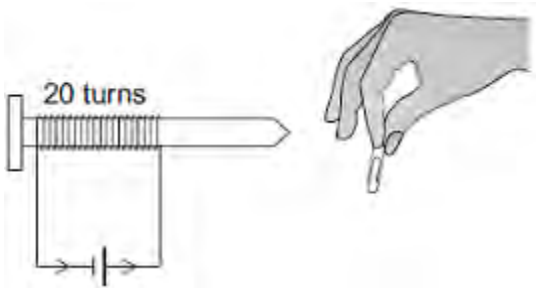
1 .....

2 .....

(2)

(b) The cell in electromagnet **A** is swapped around to make the current flow in the opposite direction. This is shown in **Figure 2**.

Figure 2



What is the maximum number of paper clips that can now be hung in a line from this electromagnet?

Draw a ring around the correct answer.

fewer than 4 **4** **more than 4**

Give **one** reason for your answer.

.....

.....

.....

(2)

(c) Electromagnet **A** is changed to have only 10 turns of wire wrapped around the nail.

Suggest the maximum number of paper clips that could be hung in a line from the end of this electromagnet.

Maximum number of paper clips = ...

(1)

(Total 7 marks)

M1. (a) plastic or rubber

accept any named plastic
*do **not** accept wood*

1

it is a (good) insulator **or** it is a poor conductor

ignore mention of heat if in conjunction with electricity

1

(b) *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*

Maximum of 2 marks if ideas not well expressed.

pulls iron bolt down **or** attracts the iron bolt **or** moves bolt out of plunger

answers in terms of charges attracting
or repelling gain no credit

1

plunger pushed / moved to the right (by spring) **or** plunger released

1

push switch opens / goes to off / goes to right

accept circuit is broken

for maximum credit the points must follow a logical sequence

*3 correct points but incorrect sequence scores **2** marks only*

ignore reset action

1

[5]

M2. Quality of written communication: One mark for correct sequencing.
bolt out → plunger up → switch off / circuit broken

1

any **five** from

- high current flows
- electromagnet is stronger
- the iron bolt is pulled out
- the plastic plunger moves up
- the switch is lifted / open / off
  accept circuit is broken
- no current flowing
- to re-set the plunger must be pushed down

5

[6]

M3. electromagnet becomes <u>stronger</u> (*not* becomes magnetic) iron moves left – implied OK
plunger goes up push switch goes to off or circuit broken unless plunger moves down
for 1 mark each

[4]

M4. (i) relay

accept solenoid

*do **not** accept magnetic switch*

1

(ii) a current flows through the coil (of the electromagnet)
or a current flows through the electromagnet
or a (magnetic) field is produced

accept 'electricity' for 'current'

*accept the electromagnet is activated **or** magnetised **or** turned on*

*do **not** accept answer in terms of magnetic charge*

1

the (iron) arm is attracted to the electromagnet

*accept the arm pivots **or** moves towards the electromagnet*

1

the contacts are pushed together

*do **not** accept contacts attract*

1

[4]

M5. (a) current flows
coil / core magnetised / electromagnet activated / energised / turned on
attracts iron bar causing bolt to be pulled out
each for 1 mark

4

(b) more turns
bigger current / e.m.f
softer iron core
any two for 1 mark each

2

(c) to relock door / return iron bar / to lock door
for 1 mark

1

(d) iron bar would still be attracted / coil still magnetised so still works
for 1 mark each

yes + wrong answer
0 marks

yes + current still flows
1 mark

yes + still magnetised / iron bar still attracted
2 marks

2

[9]

Q1. (a) Name a material that could be used to make the outside case of the plug.

.....

Give a reason for your choice.

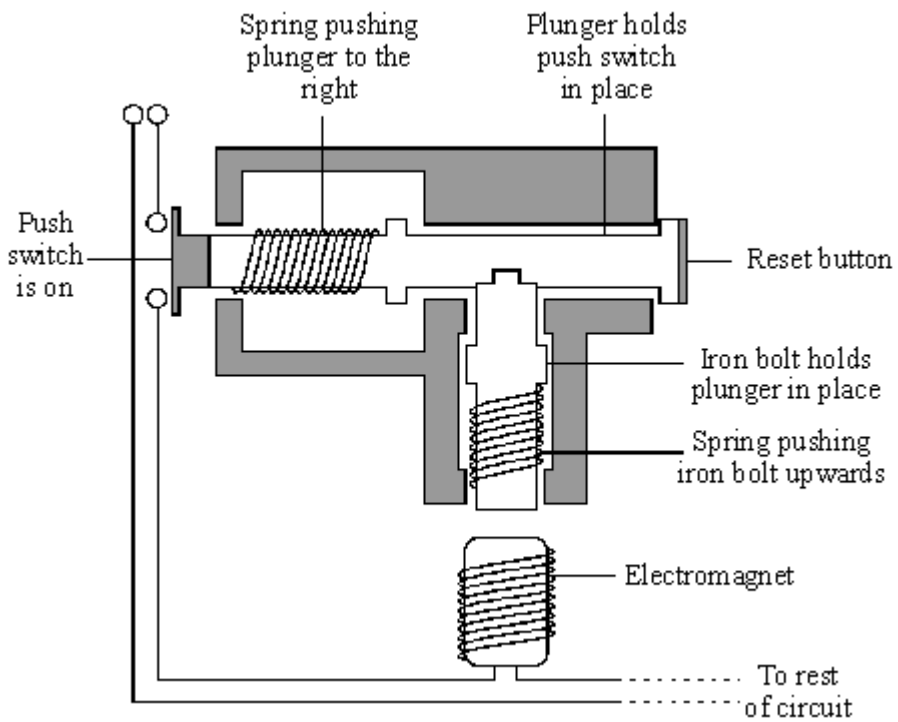
.....

.....

(2)

(b) *To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

Some electrical circuits are protected by a circuit breaker. These switch the circuit off if a fault causes a larger than normal current to flow. The diagram shows one type of circuit breaker. A normal current (15 A) is flowing.



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Explain what happens when a current larger than 15A flows. The answer has been started for you.

When the current goes above 15 A, the electromagnet becomes stronger and

.....

.....

.....

.....

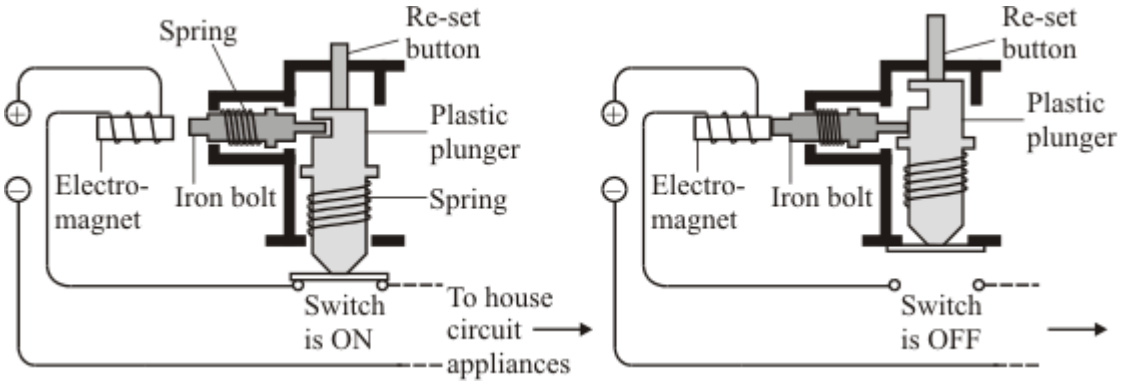
.....

.....

(3)
(Total 5 marks)

Q2. Circuit breakers help to make the electricity supply in homes safer.

A circuit breaker is an automatic safety switch. It cuts off the current if it gets too big.



Describe, in as much detail as you can, how this circuit breaker works.

To gain full marks in this question you should write your ideas in good English. Put them into
a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

.....

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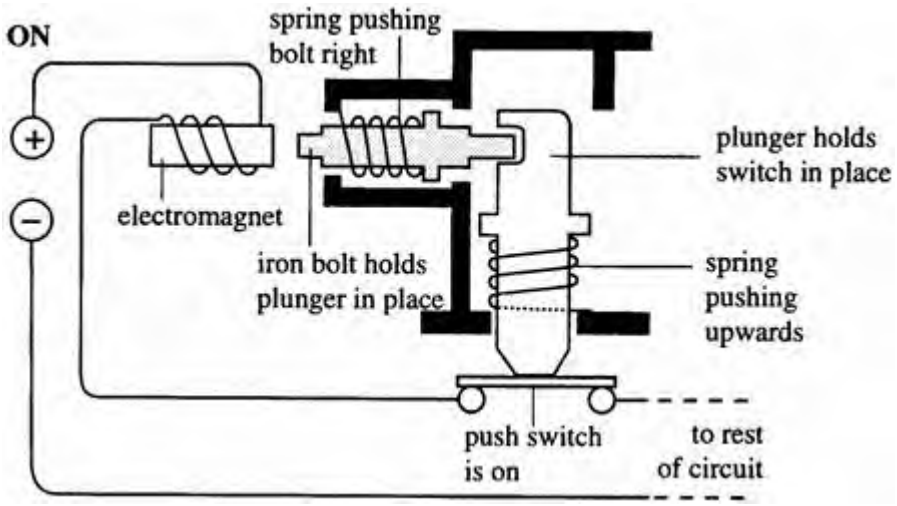
.....

.....

.....

(Total 6 marks)

Q3. A fault in an electrical circuit can cause too great a current to flow.
Some circuits are switched off by a circuit breaker.



One type of circuit breaker is shown above. A normal current is flowing.
Explain, in full detail, what happens when a current which is bigger than normal flows.

.....

.....

.....

.....

.....

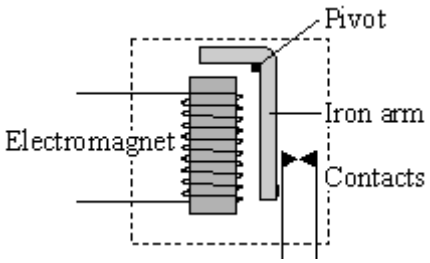
.....

.....

.....

(Total 4 marks)

Q4. The diagram shows a switch that is operated by an electromagnet.

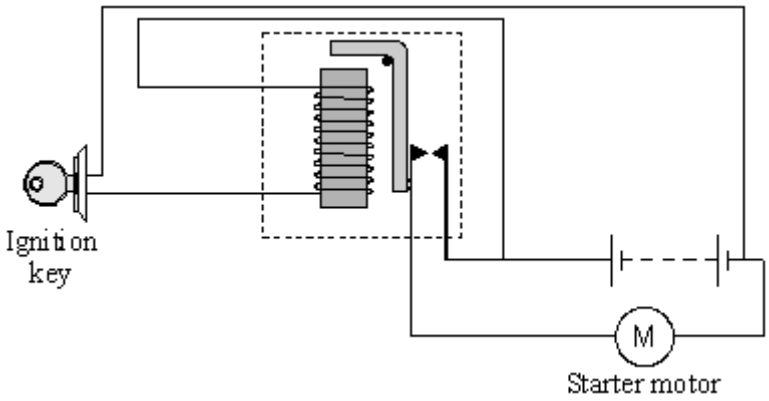


(i) What is this type of switch called?

.....

(1)

(ii) The switch is used in a car starter motor circuit.



Explain how turning the ignition key makes a current flow in the starter motor. The explanation has been started for you.

When the ignition key is turned .....

.....

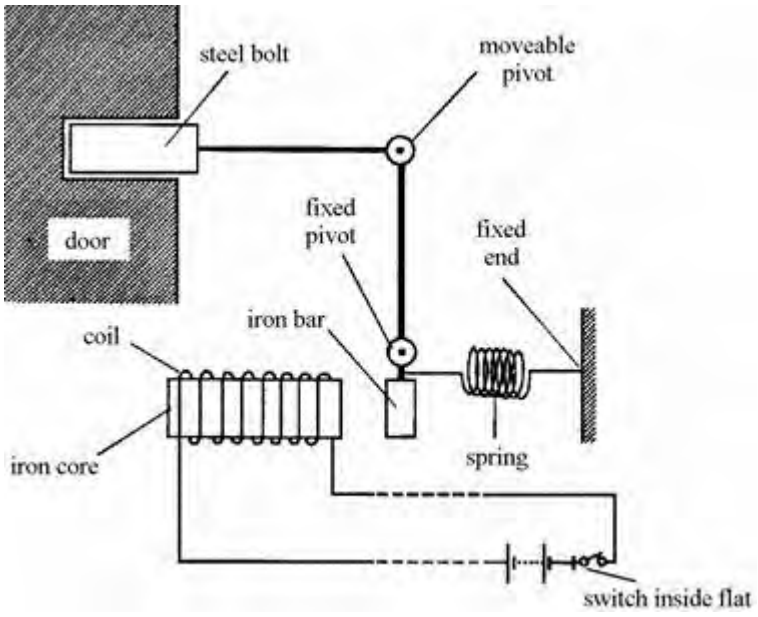
.....

.....

.....

(3)
(Total 4 marks)

Q5. The diagram below shows a door lock which can be opened from a flat inside a building.



(a) Explain how the door is unlocked when the switch is closed.

.....

.....

.....

.....

(4)

(b) State **two** changes which would increase the strength of the electromagnet.

1 .....

2 .....

(2)

(c) Why is the spring needed in the lock?

.....

.....

(1)

(d) The connections to the coil were accidentally reversed. Would the lock still work?

.....

Explain your answer.

.....

.....

(2)
(Total 9 marks)