Exampro GCSE Physics

P1 Foundation - Thermal Transfer Self Study Questions

Name:

Class:

Author:

Date:

Time: 86

Marks: 86

Comments:

Q1. Energy can be transferred through some materials by convection.

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

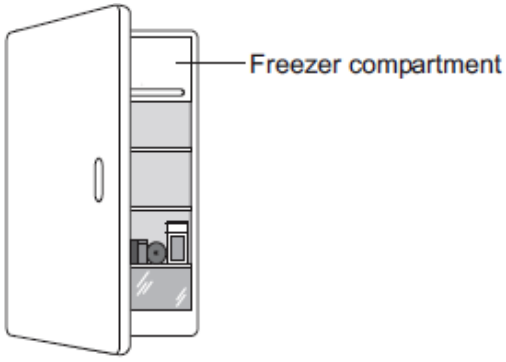
gas	**liquid**	**solid**

Energy **cannot** be transferred by convection through a ..... .

(1)

(b) The figure below shows a fridge with a freezer compartment.

The temperature of the air inside the freezer compartment is –5 °C.



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

Each answer may be used once, more than once or not at all.

decreased	**unchanged**	**increased**

When the air near the freezer compartment is cooled, the energy of the air particles is ..... .

The spaces between the air particles are ..... .

The density of the air is ..... .

(3)

(c) The table below shows some information about three fridges, **A**, **B** and **C**.

The efficiency of each fridge is the same.

Fridge	Volume in litres	Energy used in one year in kWh
A	232	292
B	382	409
C	622	524

(i) Which fridge, **A**, **B** or **C**, would cost the least to use for 1 year? ☐

Give **one** reason for your answer.

.....

.....

(2)

(ii) A householder looks at the data in the table above.

What should she conclude about the pattern linking the volume of the fridge and the energy it uses in one year?

.....

.....

(1)

(iii) The householder could not be certain that her conclusion is correct for all fridges.

Suggest **one** reason why not.

.....

.....

(1)

(Total 8 marks)

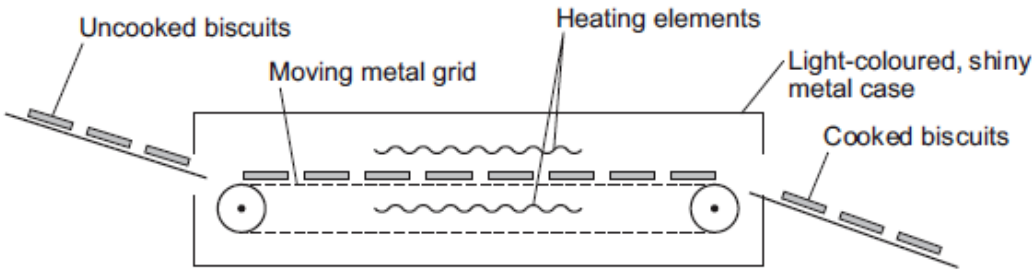
Q2. **Figure 1** shows one way that biscuit manufacturers cook large quantities of biscuits.

The uncooked biscuits are placed on a moving metal grid.

The biscuits pass between two hot electrical heating elements inside an oven.

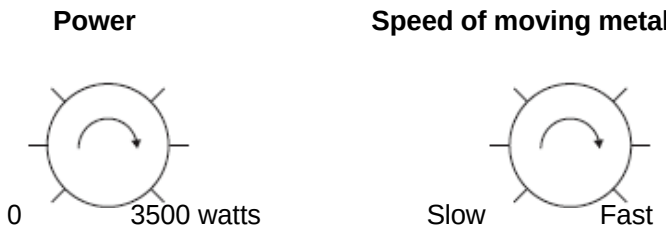
The biscuits turn brown as they cook.

Figure 1



The oven has two control knobs, as shown in **Figure 2**.

Figure 2



(a) Which type of electromagnetic radiation makes the biscuits turn brown?

.....

(1)

(b) Suggest **two** ways of cooking the biscuits in this oven, to make them turn browner.

1 .....

.....

2 .....

.....

(2)

(c) The inside and outside surfaces of the oven are light-coloured and shiny.

Explain why.

.....

.....

.....

.....

.....

.....

(3)
(Total 6 marks)

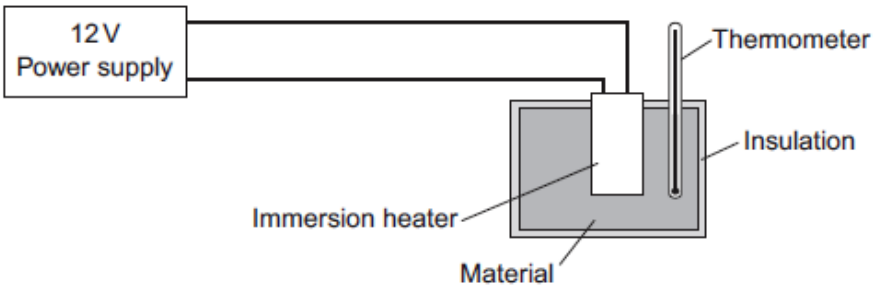
Q3. A student used the apparatus in **Figure 1** to compare the energy needed to heat blocks of different materials.

Each block had the same mass.

Each block had holes for the thermometer and the immersion heater.

Each block had a starting temperature of 20 °C.

Figure 1



The student measured the time taken to increase the temperature of each material by 5 °C.

(a) (i) State **two** variables the student controlled.

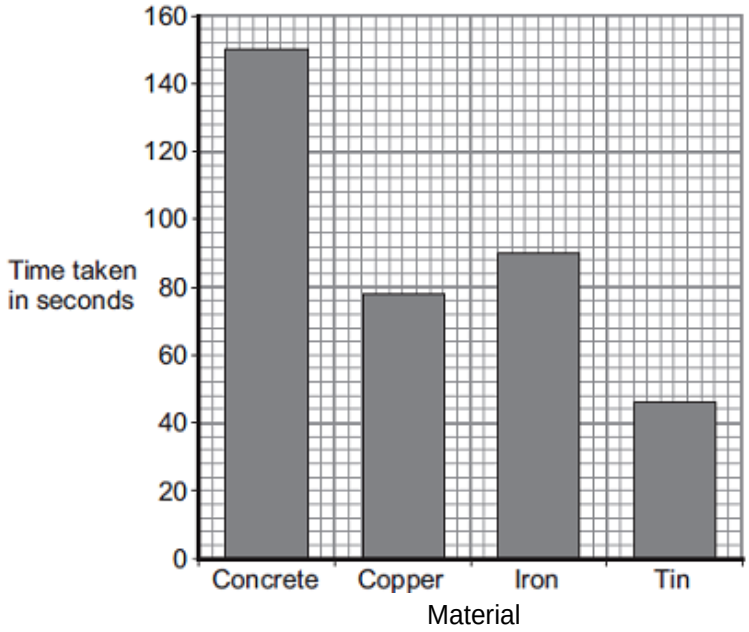
1 .....

2 .....

(2)

Figure 2 shows the student's results.

Figure 2



(ii) Why was a bar chart drawn rather than a line graph?

.....

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(1)

(iii) Which material was supplied with the most energy?

.....

Give the reason for your answer.

.....

.....

(2)

(iv) The iron block had a mass of 2 kg.

Calculate the energy transferred by the heater to increase the temperature of the iron block by 5 °C.

Use the correct equation from the Physics Equations Sheet.

The specific heat capacity of iron is 450 J / kg °C.

.....

.....

.....

Energy transferred = ... J

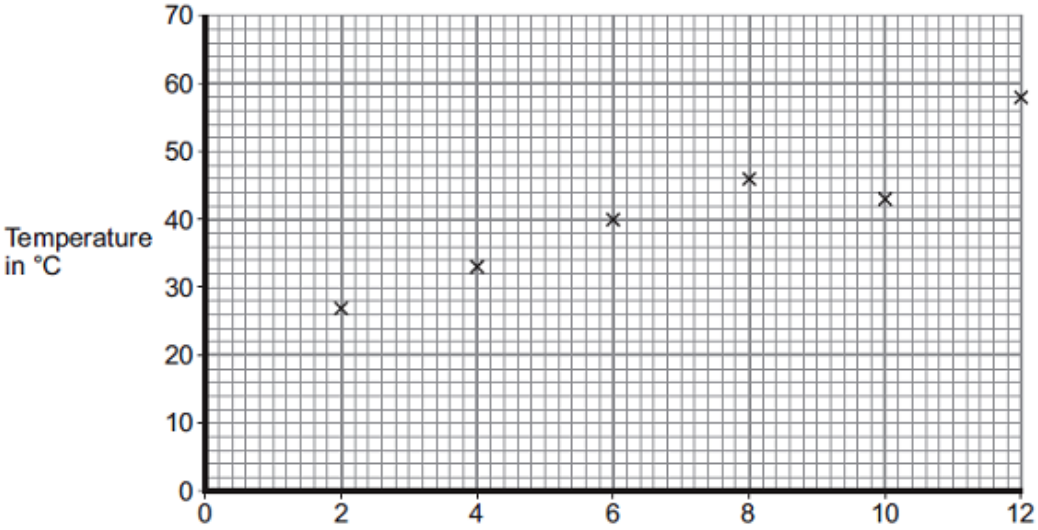
(2)

(b) The student used the same apparatus to heat a 1 kg block of aluminium.

He recorded the temperature of the block as it was heated from room temperature.

The results are shown in **Figure 3**.

Figure 3



(i) One of the student's results is anomalous.

Draw a ring around the anomalous result.

(1)

(ii) Draw the line of best fit for the points plotted in **Figure 3**.

(1)

(iii) What was the temperature of the room?

Temperature = ... °C

(1)

(iv) What was the interval of the time values used by the student?

Interval = ... minutes

(1)

(Total 11 marks)

Q4. In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

The information in the box is about the properties of solids and gases.

Solids:
- have a fixed shape
- are difficult to compress (to squash).

Gases:
- will spread and fill the entire container
- are easy to compress (to squash).

Use your knowledge of kinetic theory to explain the information given in the box.

You should consider:
- the spacing between the particles
- the movement of individual particles
- the forces between the particles.

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Extra space .....

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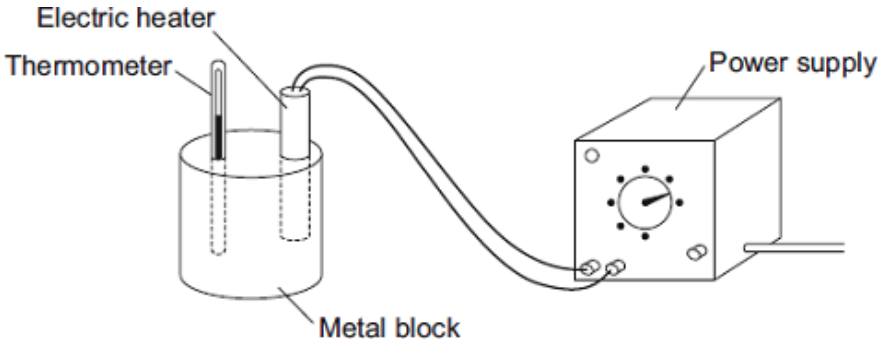
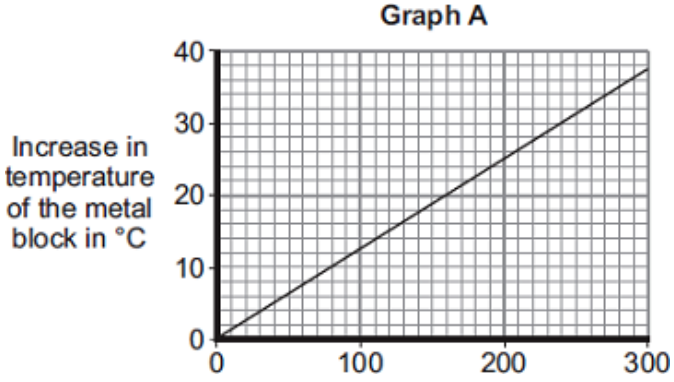
(Total 6 marks)

Q5. (a) A student used the apparatus drawn below to investigate the heating effect of an electric heater.



(i) Before starting the experiment, the student drew **Graph A**.

Graph A shows how the student expected the temperature of the metal block to change after the heater was switched on.



Describe the pattern shown in **Graph A**.

.....

.....

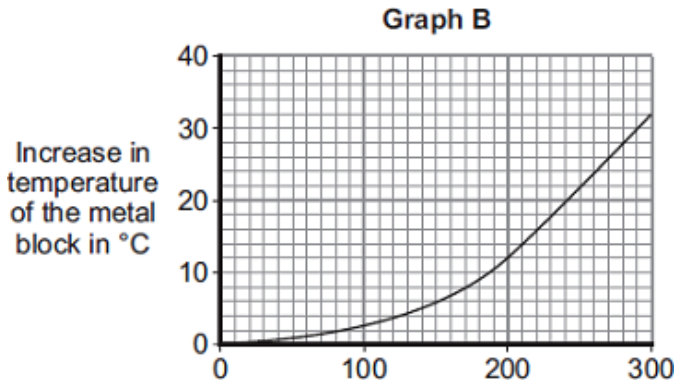
.....

.....

(2)

(ii) The student measured the room temperature. He then switched the heater on and measured the temperature of the metal block every 50 seconds.

The student calculated the increase in temperature of the metal block and plotted **Graph B**.



After 300 seconds, **Graph B** shows the increase in temperature of the metal block is lower than the increase in temperature expected from **Graph A**.

Suggest **one** reason why.

.....

.....

(1)

(iii) The power of the electric heater is 50 watts.

Calculate the energy transferred to the heater from the electricity supply in 300 seconds.

Use the correct equation from the Physics Equations Sheet.

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.....

Energy transferred = ... J

(2)

(b) The student uses the same heater to heat blocks of different metals. Each time the heater is switched on for 300 seconds.

Each block of metal has the same mass but a different specific heat capacity.

Metal	Specific heat capacity in J/kg°C
Aluminium	900
Iron	450
Lead	130

Which **one** of the metals will heat up the most?

Draw a ring around the correct answer.

aluminium **iron** **lead**

Give, in terms of the amount of energy needed to heat the metal blocks, a reason for your answer.

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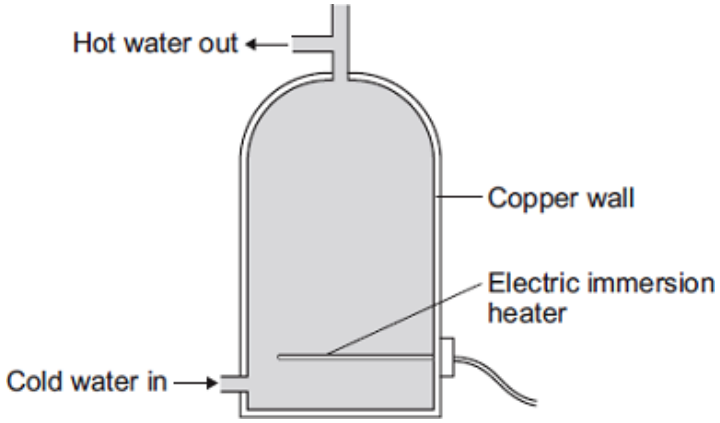
(2)

(c) A homeowner uses an electric immersion heater to heat the water in his hot water tank. The hot water tank has no insulation.



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

Energy is transferred through the water by

conduction.
convection.
evaporation.

Energy is transferred through the copper wall of the hot water tank by

conduction.
convection.
evaporation.

(2)

(ii) To keep the water in the tank hot for longer, the homeowner fits an insulating jacket around the tank. The insulating jacket costs £12 to buy.

The homeowner expects to save £16 each year from reduced energy bills.

Calculate the pay-back time for the insulating jacket.

.....

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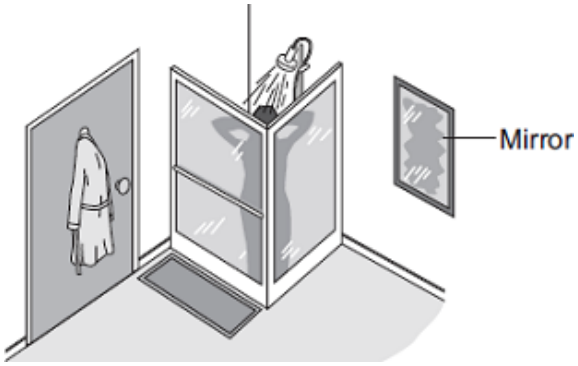
Pay-back time = ... years

(2)

(Total 11 marks)

Q6. The picture shows a person taking a hot shower.



(a) When a person uses the shower the mirror gets misty.

Why?

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(3)

(b) The homeowner installs an electrically heated mirror into the shower room.

When a person has a shower, the heated mirror does **not** become misty but stays clear.

Why does the mirror stay clear?

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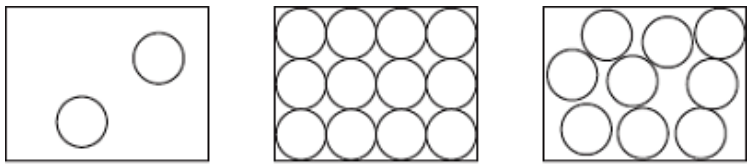
(2)
(Total 5 marks)

Q7. (a) The diagrams, **X**, **Y** and **Z**, show how the particles are arranged in the three states of matter.



X **Y** **Z**

(i) Which **one** of the diagrams, **X**, **Y** or **Z**, shows the arrangement of particles in a liquid?

Write the correct answer in the box. ☐

(1)

(ii) Which **one** of the diagrams, **X**, **Y** or **Z**, shows the arrangement of particles in a gas?

Write the correct answer in the box. ☐

(1)

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

(i) In a gas, the particles are

vibrating in fixed positions.
moving randomly.
not moving.

(1)

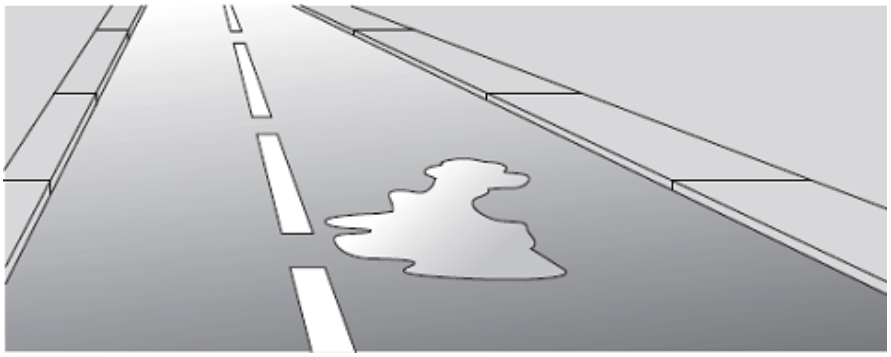
(ii) In a solid, the forces between the particles are

stronger than
equal to
weaker than

the forces between the particles in a liquid.

(1)

(c) The picture shows a puddle of water in a road, after a rain shower.



(i) During the day, the puddle of water dries up and disappears. This happens because the water particles move from the puddle into the air.

What process causes water particles to move from the puddle into the air?

Draw a ring around the correct answer.

condensation **evaporation** **radiation**

(1)

(ii) Describe **one** change in the weather which would cause the puddle of water to dry up faster.

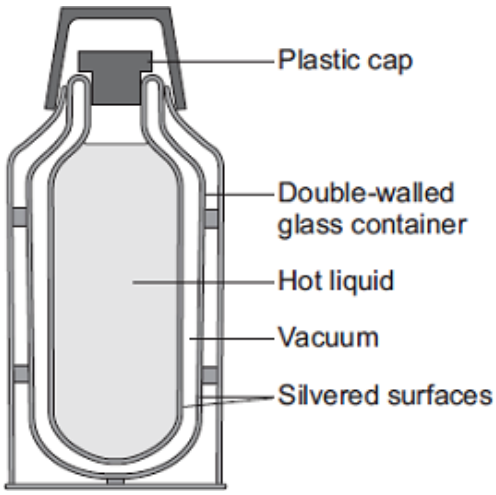
.....

.....

(1)
(Total 6 marks)

Q8. (a) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The diagram shows the structure of a vacuum flask.



A vacuum flask is designed to reduce the rate of energy transfer by heating processes.

Describe how the design of a vacuum flask keeps the liquid inside hot.

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(6)

(b) Arctic foxes live in a very cold environment.

© Purestock/Thinkstock

Arctic foxes have small ears.

How does the size of the ears help to keep the fox warm in a cold environment?

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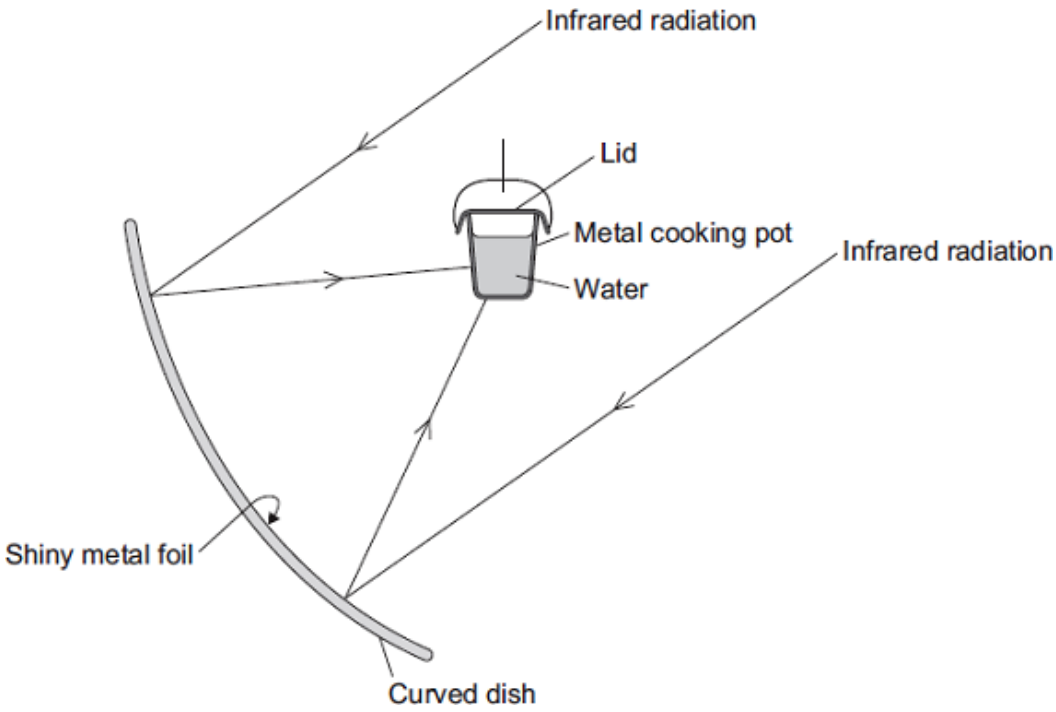
.....

(2)
(Total 8 marks)

Q9. The diagram shows the design of a solar cooker. The cooker heats water using infrared radiation from the Sun.



(a) Why is the inside of the large curved dish covered with shiny metal foil?

.....

.....

(1)

(b) Which would be the best colour to paint the outside of the metal cooking pot?

Draw a ring around the correct answer.

black **silver** **white**

Give a reason for your answer.

.....

.....

.....

(2)

(c) Why does the cooking pot have a lid?

.....

.....

(1)

(d) Calculate how much energy is needed to increase the temperature of 2 kg of water by 80 °C.

The specific heat capacity of water = 4200 J/kg °C.

Use the correct equation from the Physics Equations Sheet.

.....

.....

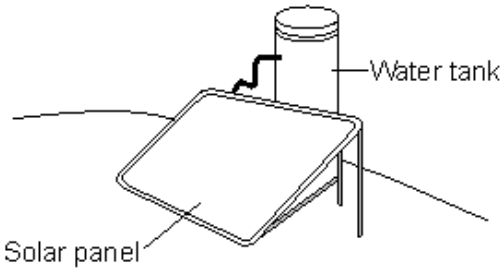
.....

Energy = ... J

(2)

(Total 6 marks)

Q10. The picture shows one type of solar water heater. Water from the tank is slowly pumped through copper pipes inside the solar panel where the water is heated by energy from the Sun.



(a) Explain why the copper pipes inside the solar panel are painted black.

.....

.....

.....

.....

(2)

(b) Each day the average European family uses 100 kg of hot water.
To kill bacteria, the water going into the tank at 20 °C must be heated to 60 °C.

Calculate the energy needed to increase the temperature of 100 kg of water by 40 °C.

Specific heat capacity of water = 4200 J/kg °C.

Write down the equation you use, and then show clearly how you work out your answer.

.....

.....

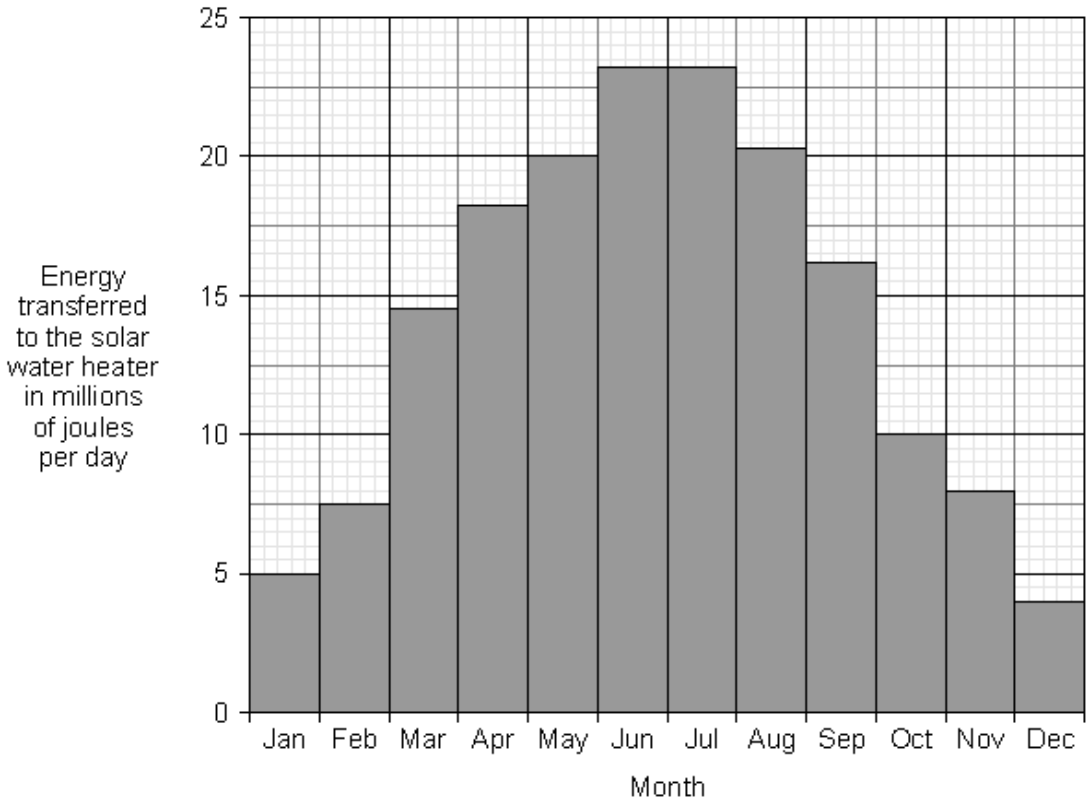
.....

.....

Energy transferred = ... J

(2)

(c) The bar chart shows how the amount of solar energy transferred to the water heater varies throughout the year.



How many months each year will there **not** be enough solar energy to provide the hot water used by an average European family?

..... months

(1)

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

The water in the tank could be heated by using an electric immersion heater.

Outline the advantages and disadvantages of using solar energy to heat the water rather than using an electric immersion heater.

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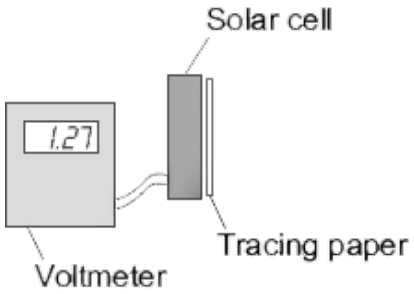
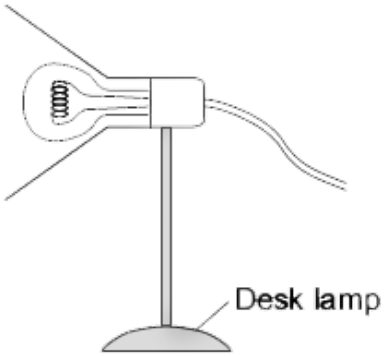
(6)
(Total 11 marks)

Q11. A student has read that a solar cell with a dirty surface will not work as well as a solar cell with a clean surface.

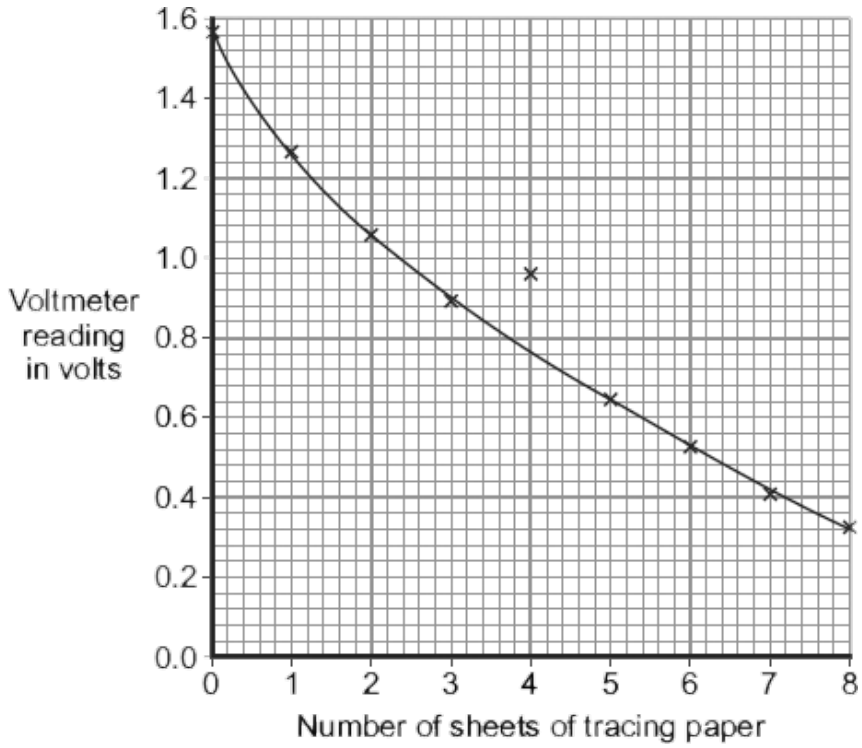
To test the effect of a dirty surface on a solar cell, the student set up the following equipment.





The student put the desk lamp a fixed distance from the solar cell. To represent the effect of a dirty surface, the student covered the surface of the solar cell with pieces of tracing paper. Each time the student added a piece of paper, she measured the output voltage of the solar cell.

(a) The results taken by the student have been used to draw the graph below.



(i) One of the results seems to be anomalous.

Draw a ring around the anomalous data point on the graph.

(1)

(ii) The larger the number of sheets of tracing paper used, the lower the intensity of the light reaching the solar cell.

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

A decrease in the intensity of the light reaching the solar cell causes

a decrease in
no change to
an increase in

(1)

the output voltage from the solar cell.

(b) People can buy panels of solar cells to generate electricity for their homes.
Any surplus electricity can be sold to the electricity supply company.

(i) Give **one** environmental advantage of generating electricity using solar cells rather than generating electricity in a coal-burning power station.

.....

.....

(1)

(ii) A homeowner pays £7600 to have solar panels fitted on the roof of their house.
The homeowner expects to save £950 each year from reduced energy bills and from selling the electricity.

Assuming these figures to be correct, calculate the pay-back time for the solar panels.

Show clearly how you work out your answer.

.....

.....

.....

Pay-back time = ... years

(2)

(iii) Draw a ring around the correct answer in the box to complete the sentence.

Allowing the surface of the solar panels to become very dirty will

decrease
not change
increase

the pay-back time.

(1)

(iv) Explain your answer to part (b)(iii).

.....

.....

.....

.....

(2)

(Total 8 marks)

M1. (a) solid

1

(b) decreased

correct order only

1

decreased

1

increased

1

(c) (i) A

reason only scores if A chosen

1

uses least / less energy (in 1 year)

a comparison is required

accept uses least power

accept uses least kWh

1

(ii) greater the volume the greater the energy it uses (in 1 year)

1

(iii) a very small number sampled

accept only tested 3

accept insufficient evidence / data

*allow not all fridges have the same efficiency **or** a correct description implying different efficiencies*

only tested each fridge once is insufficient

there are lots of different makes is insufficient

1

[8]

M2. (a) infrared / IR

correct answer only

1

(b) any **two** from:

- increase the power / watts

  allow increase the temperature of the oven or make the oven hotter
- decrease the speed

  allow leave the biscuits in for longer
- put biscuits through again

  increase radiation is insufficient

  ignore changes to the design of the oven

2

(c) (inside) surface is a (good) reflector or poor absorber (of IR)

Ignore bounce for reflect

surface is a (good) reflector of light does not score

surface is a (good) reflector of light and infrared / heat does score

1

(and) <u>outside</u> surface is poor emitter (of IR)

1

(so) increases the energy reaching the biscuits

allow reduces energy loss or makes oven more efficient

*do **not** accept no energy losses*

keeps oven hotter is insufficient

1

[6]

M3. (a) (i) any **two** from:

- mass (of block)

  accept weight for mass
- starting temperature
- final / increase in temperature

  temperature is insufficient
- voltage / p.d.

  same power supply insufficient
- power (supplied to each block)
- type / thickness of insulation

  same insulation insufficient

2

(ii) one of variables is categoric

or

(type of) material is categoric

accept the data is categoric

accept a description of categoric

*do **not** accept temp rise is categoric*

1

(iii) concrete

reason only scores if concrete chosen

1

(heater on for) longest / longer time

a long time or quoting a time is insufficient

*do **not** accept it is the highest bar*

1

(iv) 4500 (J)

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

2 × 450 × 5 provided no subsequent step shown

2

(b) (i) point at 10 minutes identified

1

(ii) line through all points except anomalous

line must go from at least first to last point

1

(iii) 20 (°C)

if 20°C is given, award the mark.

If an answer other than 20°C is given, look at the graph. If the graph shows a correct extrapolation of the candidate's best-fit line and the intercept value has been correctly stated, allow 1 mark.

1

(iv) 2 (minutes)

1

[11]

M4. 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 content.

Level 1 (1–2 marks)
Considers either solid or gas and describes at least one aspect of the particles.

or

Considers both solids and gases and describes an aspect of each.

Level 2 (3–4 marks)
Considers both solids and gases and describes aspects of the particles.

or

Considers one state and describes aspects of the particles and explains at least one of the properties.

or

Considers both states and describes an aspect of the particles for both and explains a property for solids or gases.

Level 3 (5–6 marks)
Considers both states of matter and describes the spacing and movement / forces between the particles. Explains a property of both solids and gases.

examples of the points made in the response

extra information

Solids

- (particles) close together
- (so) no room for particles to move closer (so hard to compress)
- vibrate about fixed point
- strong forces of attraction (at a distance)
- the forces become repulsive if the particles get closer
- particles strongly held together / not free to move around (shape is fixed)

any explanation of a property must match with the given aspect(s) of the particles.

Gases

- (particles) far apart
- space between particles (so easy to compress)
- move randomly
- negligible / no forces of attraction
- spread out in all directions (to fill the container)

[6]

M5. (a) (i) temperature (increase) and time switched on are directly proportional

accept the idea of equal increases in time giving equal increases in temperature

answers such as:

- *as time increases, temperature increases*
- *positive correlation*
- *linear relationship*
- *temperature and time are proportional*

*score **1** mark*

2

(ii) any **one** from:

"it" refers to the metal block

- energy transfer (from the block) to the surroundings

accept lost for transfer

accept air for surroundings

- (some) energy used to warm the heater / thermometer (itself)

accept takes time for heater to warm up

- (metal) block is not insulated

1

(iii) 15 000

*allow **1** mark for correct substitution, ie 50 × 300 provided no subsequent step shown*

2

(b) lead

reason only scores if lead is chosen

1

needs least energy to raise temperature by 1°C

accept needs less energy to heat it (by the same amount)
lowest specific heat capacity is insufficient

1

(c) (i) convection

correct order only

1

conduction

1

(ii) 3 / 4 (year)

or

*allow **1** mark for correct method, ie* $\frac{12}{16}$ *shown*

0.75

or

9 months

or

274 days

2

[11]

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

- water evaporates
  accept steam / water vapour for water molecules
  accept water turns to steam
- water molecules / particles go into the air
- mirror (surface) is cooler than (damp) air
  accept the mirror / surface / glass is cold
- water molecules / particles that hit the mirror lose energy
  accept water molecules / particles that hit the mirror cool down
- cooler air cannot hold as many water molecules / particles

2

(causes) condensation (on the mirror)
accept steam changes back to water (on the mirror)

or
particles move closer together

1

(b) mirror (surface) is warm
mirror is heated is insufficient

1

(rate of) condensation reduced
accept no condensation (happens)

1

[5]

M7. (a) (i) Z

1

(ii) X

1

(b) (i) moving randomly

1

(ii) stronger than

1

(c) (i) evaporation

1

(ii) any **one** from:

- becomes windy
- temperature increases
  accept (becomes) sunny
  "the sun" alone is insufficient
- less humid

1

[6]

M8. (a) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance.

0 marks
No relevant content.

Level 1(1-2 marks)
There is a basic explanation of **one** feature
or
a simple statement relating reduction in energy transfer to **one** feature.

Level 2(3-4 marks)
There is a clear explanation of **one** feature
or
a simple statement relating reduction in energy transfer to **two** features.

Level 3(5-6 marks)
There is a detailed explanation of at least **two** features
or
a simple statement relating reduction in energy transfer to all **four** features.

Examples of the points made in response

extra information

accept throughout:
heat for energy
loss for transfer

plastic cap:

- plastic is a poor conductor
  accept insulator for poor conductor
- stops convection currents forming at the top of the flask so stopping energy transfer by convection
- molecules / particles evaporating from the (hot) liquid cannot move into the (surrounding) air so stops energy transfer by evaporation
- plastic cap reduces / stops energy transfer by conduction / convection / evaporation

glass container:

- glass is a poor conductor so reducing energy transfer by conduction
- glass reduces / stops energy transfer by conduction

vacuum:

- both conduction and convection require a medium / particles
- so stops energy transfer between the two walls by conduction and convection
- vacuum stops energy transfer by conduction / convection

silvered surfaces:

- silvered surfaces reflect infrared radiation
  accept heat for infrared
- silvered surfaces are poor emitters of infrared radiation
- infrared radiation (partly) reflected back (towards hot liquid)
- silvered surfaces reduce / stop energy transfer by radiation

6

(b) (the ears have a) small surface area
ears are small is insufficient

1

so reducing energy radiated / transferred (from the fox)
accept heat lost for energy radiated
*do **not** accept stops heat loss*

1

[8]

M9. (a) to reflect (the infrared)

accept (shiny surfaces) are good reflectors
ignore reference to incorrect type of wave

1

(b) black

1

best absorber (of infrared)

answer should be comparative
black absorbs (infrared) is insufficient
accept good absorber (of infrared)
ignore reference to emitter
ignore attracts heat
ignore reference to conduction

1

(c) to reduce energy loss

accept to stop energy loss
accept heat for energy
accept to stop / reduce convection

or
so temperature of water increases faster

accept to heat water faster
accept cooks food faster

or
reduces loss of water (by evaporation)

1

(d) 672 000

*allow **1** mark for correct substitution, ie 2 × 4200 × 80 provided no subsequent step shown*

2

[6]

M10. (a) because black is a good absorber of radiation

1

there will be a faster transfer of energy

allow the temperature of the water rises faster

1

(b) 16 800 000

*allow **1** mark for substitution into correct equation*
ie 100 × 4200 × 40

2

(c) 7 allow

ecf from part (b)

1

(d) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response.

No relevant content.

0 marks

There is a brief description of the advantages and disadvantages of using solar energy to heat the water rather than using an electric immersion heater, including either advantages or disadvantages from the **examples** below.

Level 1 (1-2 marks)

There is a description of some of the advantages **and** disadvantages of using solar energy to heat the water rather than using an electric immersion heater, with at least **one** advantage and **one** disadvantage from the **examples** below.

Level 2 (3-4 marks)

There is a clear, balanced and detailed description of the advantages **and** disadvantages of using solar energy to heat the water rather than using an electric immersion heater, with a minimum of **two** advantages and **two** disadvantages from the **examples** below.

Level 3 (5-6 marks)

examples of the points made in the response

advantages

accept specific examples of polluting gases

- a renewable energy source
- energy is free
- does not pollute the atmosphere
- no fuel is burnt
- energy can be stored (in the water)

disadvantages

accept unreliable energy source

- only available in daylight hours
- availability fluctuates
- insufficient hours of sunlight in some countries
- average low intensity in some countries

[11]

M11. (a) (i) correct data point identified (4, 0.96)

1

(ii) a decrease in

1

(b) (i) no / less atmospheric pollution

accept specific examples eg no CO_2 / greenhouse gases produced

accept no harmful gases / fumes
accept reduced pollution from transportation (of coal)
accept does not contribute to global warming
it / they refers to solar cells
*do **not** accept no / less pollution*
does not harm the environment is insufficient
it is a renewable energy source is insufficient

1

(ii) 8

*allow **1** mark for showing correct method ie* $\frac{7600}{950}$ *provided that no subsequent step is shown*

2

(iii) increase

1

(iv) ***these marks can score even if (b)(iii) is wrong***

less / no electricity generated

accept energy for electricity
accept reduced power / voltage output

1

(because) lower light intensity (hitting solar panel / cell)
or
so decreases money paid / gained (from selling electricity)

allow less light / sun (hitting solar panel / cell)

1

[8]