

AQA GCSE PHYSICS (HIGHER) • 8463

PHYSICS



EXAM QUESTION PACK

4.1.1.3 ENERGY CHANGES IN SYSTEMS (PACK 1)

SCORE

/167

PERCENTAGE

%

STEMUP

These questions belong to AQA, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by AQA. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with AQA and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. AQA has not endorsed, approved or been involved in the production of it. AQA and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

AQA publishes its past papers, mark schemes and examiner reports. Always check the current specification at aqa.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

There are many different energy resources.

- (a) Which **two** energy resources are renewable?

Tick **two** boxes.

Biofuel	☐
Coal	☐
Gas	☐
Geothermal	☐
Nuclear fuel	☐

(2)

- (b) Some non-renewable energy resources are more reliable than others.

Which statement correctly describes a reliable resource?

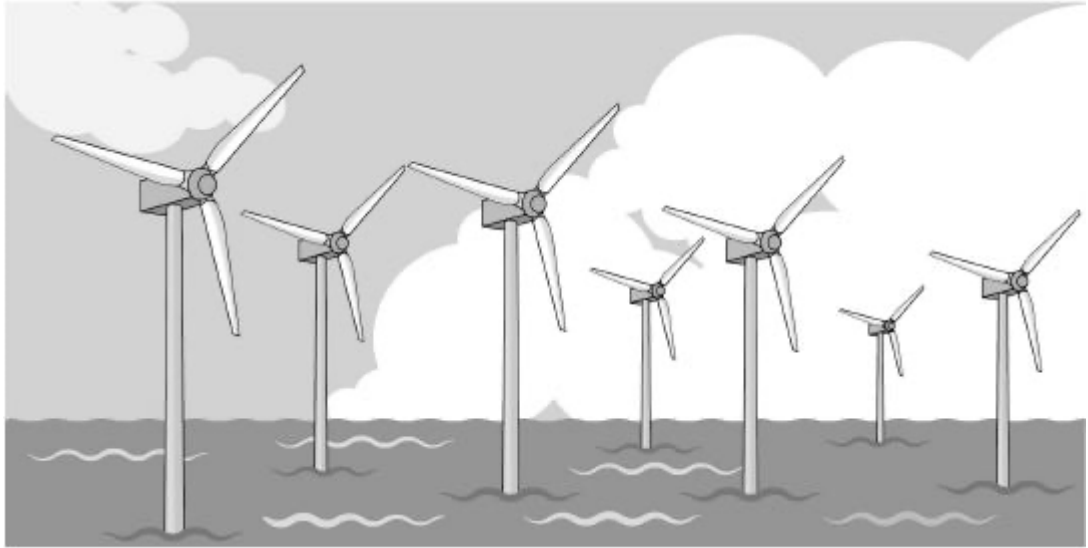
Tick **one** box.

It does not burn fuel.	☐
It is predictable.	☐
It will never run out.	☐
It is cheap to use.	☐

(1)

- (c) **Figure 1** shows a wind farm.

Figure 1



The total power output of the wind farm is 19.6 MW

All of the wind turbines have the same power output.

What is the power output of **one** wind turbine?

Tick **one** box.

2.7 MW

☐

2.8 MW

☐

2.9 MW

☐

3.2 MW

☐

3.3 MW

☐

(1)

(d) Give **two** reasons why people might **not** like having wind turbines near their homes.

1. _____

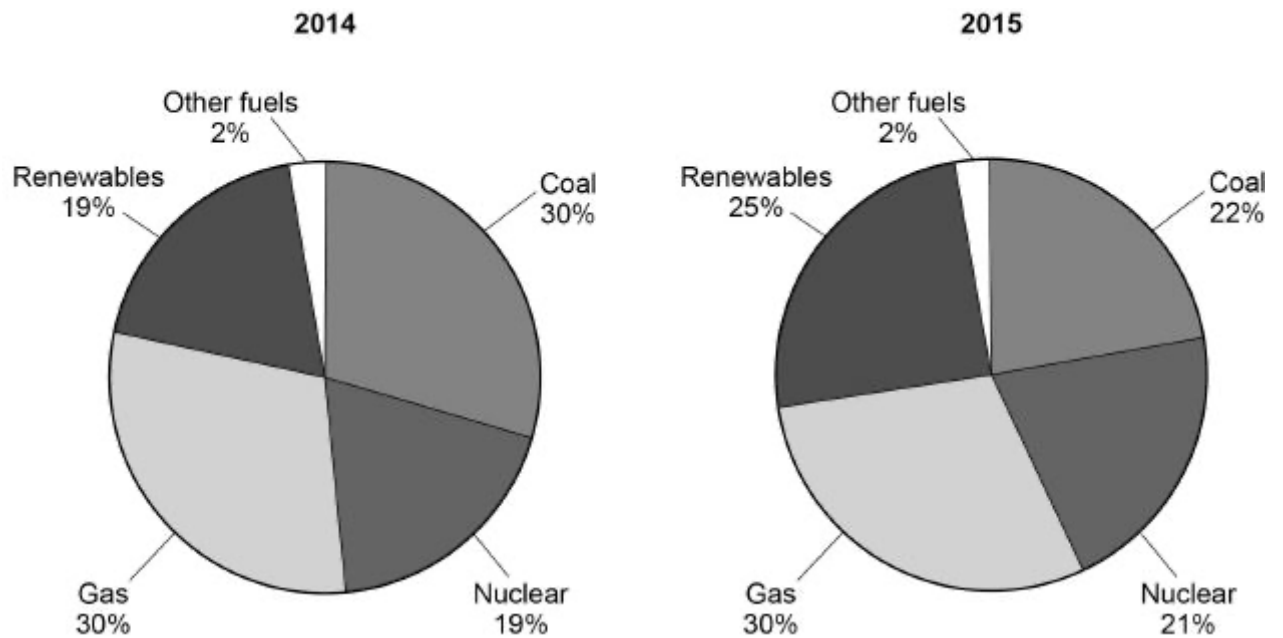
2. _____

(2)

(e) **Figure 2** shows the electricity generated by different energy resources in the UK.

The total amount of electricity generated was the same in 2014 and in 2015

Figure 2



There are changes in the amounts of different energy resources used between 2014 and 2015

Explain the environmental impacts of the changes.

(4)
(Total 10 marks)

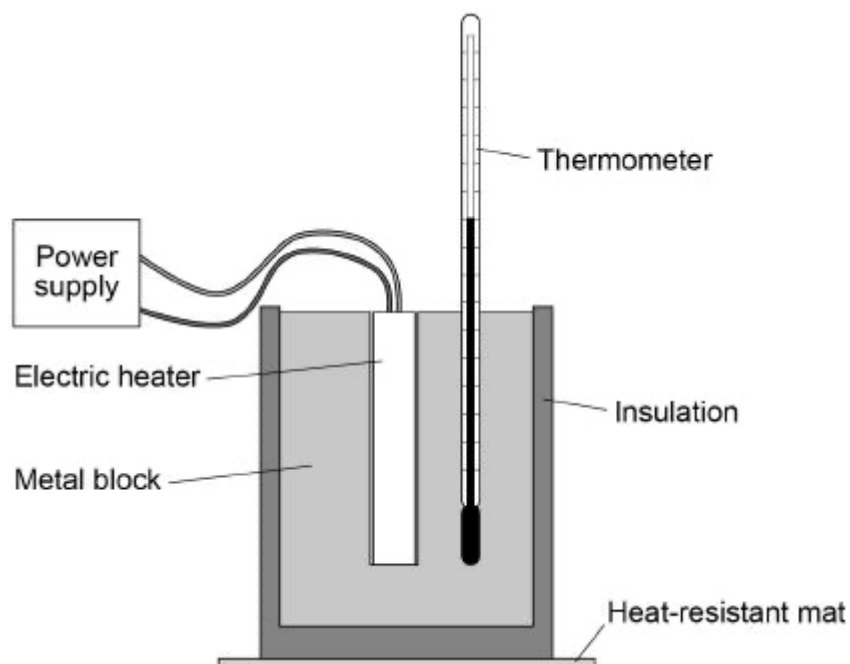
Q2.

A student investigated how the temperature of a metal block changed with time.

An electric heater was used to increase the temperature of the block.

The heater was placed in a hole drilled in the block as shown in **Figure 1**.

Figure 1



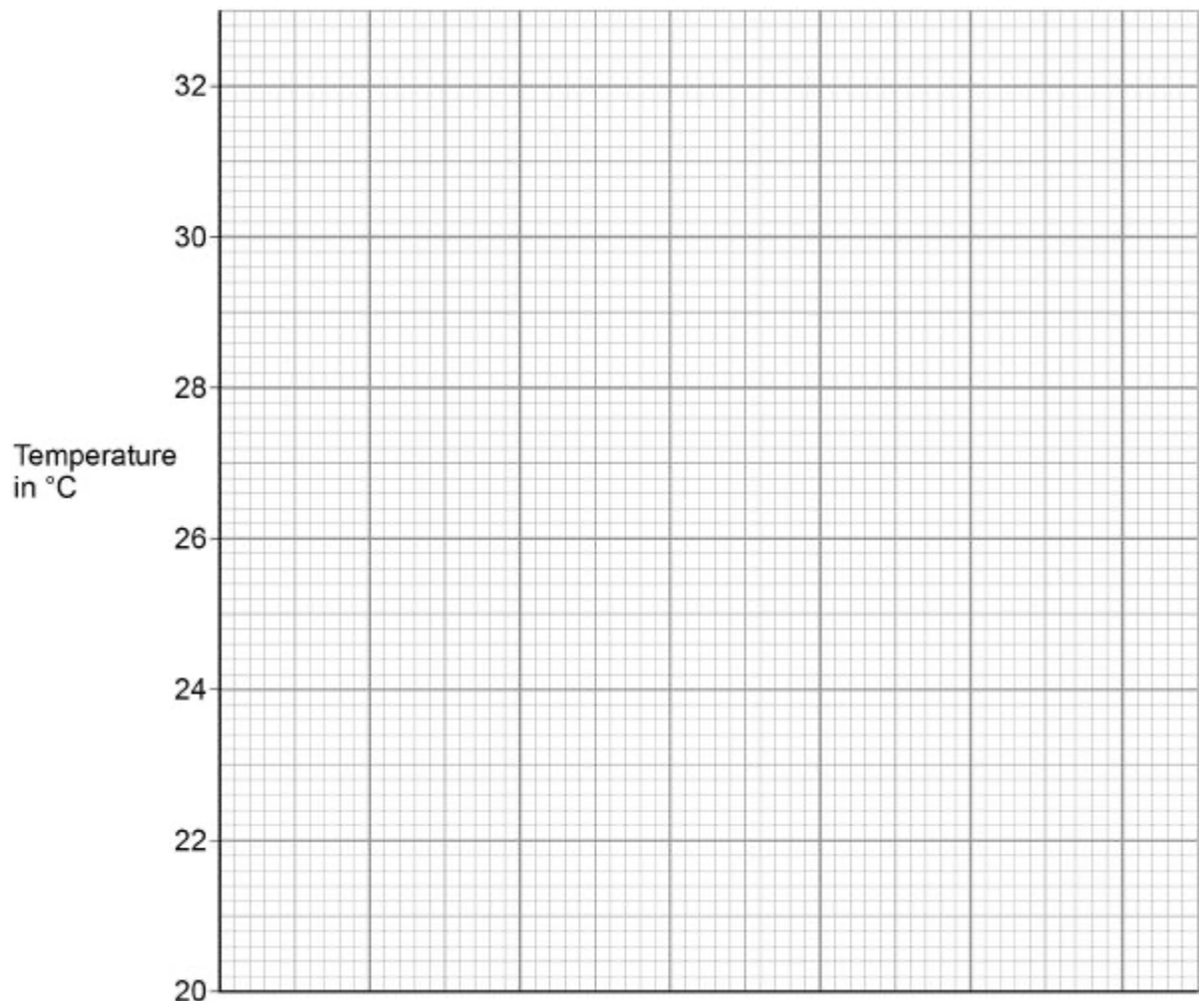
The student measured the temperature of the metal block every 60 seconds. The table below shows the student's results.

Time in s	Temperature in °C
0	20.0
60	24.5
120	29.0
180	31.0
240	31.5

(a) Complete the graph of the data from the table above on the graph below.

- Choose a suitable scale for the x-axis.
- Label the x-axis.
- Plot the student's results.
- Draw a line of best fit.

Figure 2



(4)

- (b) The rate of change of temperature of the block is given by the gradient of the graph.
Determine the gradient of the graph over the first 60 seconds.

Gradient = _____

(2)

- (c) The metal block had a mass of 1.50 kg
The specific heat capacity of the metal was 900 J/kg °C
Calculate the change in thermal energy of the metal during 240 seconds.
Use the Physics Equations Sheet.
Give your answer in kilojoules.

Change in thermal energy = _____ kJ

(4)

- (d) Another student repeated the investigation.

Give **two** variables this student would need to control to be able to compare their results with the results in the table above.

1. _____

2. _____

(2)

(Total 12 marks)

Q3.

Astronauts have landed on the Moon on six separate occasions.

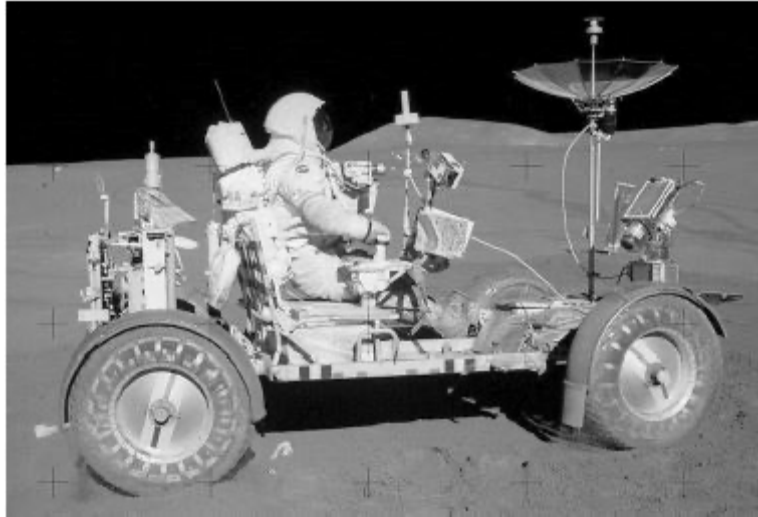
- (a) The Moon is in a circular orbit around the Earth. The speed of the Moon is constant.

Explain why the Moon is accelerating.

(3)

The astronauts moved around the surface of the Moon in a lunar rover.

The photograph below shows a lunar rover.



- (b) At one point, the lunar rover accelerated from 1.4 m/s to 2.6 m/s

The acceleration of the lunar rover was 0.31 m/s²

Which calculation could be used to calculate the distance travelled s during this acceleration?

Tick **one** box.

$$s = \sqrt{2.6^2 - 1.4^2 - 2 \times 0.31}$$

☐

$$s = \frac{1.4^2 - 2.6^2}{2 \times 0.31}$$

☐

$$s = \frac{2.6^2 - 1.4^2}{2 \times 0.31}$$

☐

$$s = \frac{2 \times (2.6^2 - 1.4^2)}{0.31}$$

☐

(1)

- (c) The lunar rover used four electric motors connected in parallel to a 36 V battery.

The maximum output power of one motor was 190 W

The efficiency of each motor was 72%

Calculate the current drawn from the battery when all four motors were operating at maximum power.

Current = _____ A

(6)

- (d) Scientists once thought that the Moon formed elsewhere in the solar system and later came to orbit the Earth.

Studies of Moon rocks brought back by the astronauts showed that the rocks were extremely similar to those found on Earth.

This led to a new theory about how the Moon formed called the 'Giant Impact Hypothesis'.

According to the Giant Impact Hypothesis, a small planet collided with the Earth. Molten rock thrown up by the collision then formed the Moon.

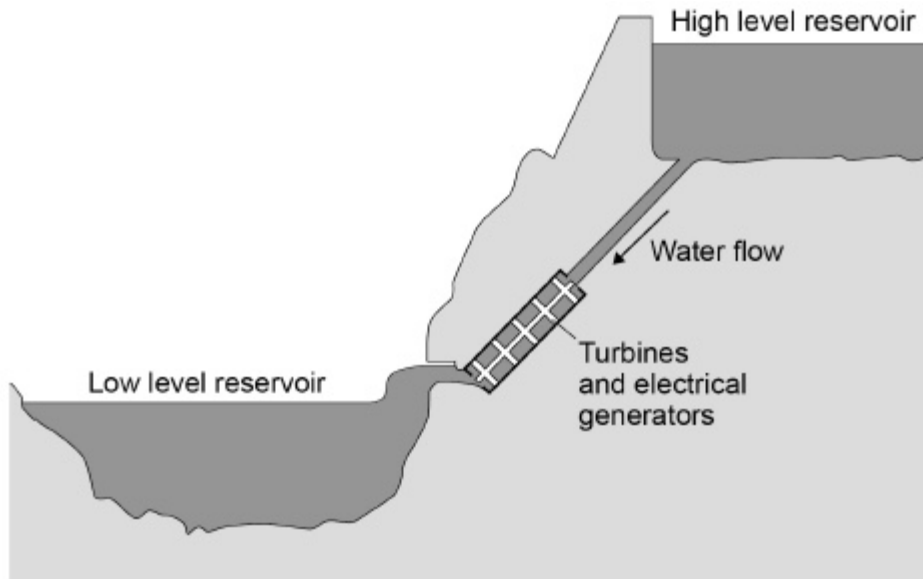
Suggest why a new theory was developed.

(2)

(Total 12 marks)

Q4.

The diagram shows the flow of water through a hydroelectric power station.



The falling water turns the turbines.

The movement of the turbines causes the electrical generators to generate electricity.

- (a) Write the equation which links kinetic energy, mass and speed.

(1)

- (b) In 1 minute, a mass of 9 000 kg of water flows through the turbines.

The speed of the water is 30 m/s

Calculate the total kinetic energy of the water passing through the turbines in 1 minute.

Give your answer in kilojoules (kJ).

Kinetic energy = _____ kJ
(3)

- (c) Write the equation which links efficiency, total input energy transfer and useful output energy transfer.

(1)

- (d) The efficiency of the turbines and generators is 80%

Use your answer to part (b).

(3)

- The people plan to buy an electricity generating system that uses either the wind or the flowing water in a nearby river.

- Compare the advantages and disadvantages of the two methods of generating electricity.

Use your knowledge of energy resources and information given.

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

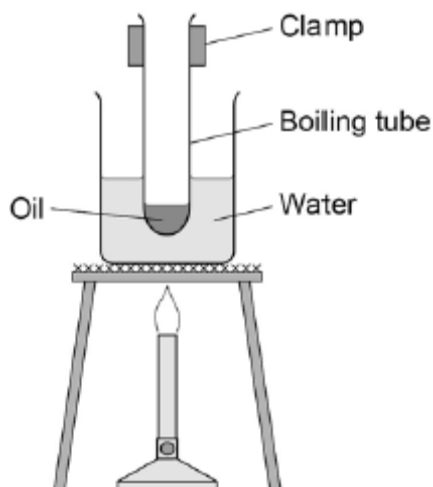
(4)

Page 11 of 56

Q5.

A student investigated the change in temperature when oils of different specific heat capacities were heated.

She set up the apparatus shown in the figure below.



This is the method used.

1. Put 25 g of oil into a boiling tube.
2. Pour 100 ml of water into a beaker and heat it with a Bunsen burner.
3. When the water is boiling, put the boiling tube into the beaker.
4. When the temperature of the oil reaches 30 °C, heat for a further 30 seconds and record the rise in temperature.
5. Repeat with different oils.
6. Repeat the whole investigation.

- (a) Name **two** pieces of apparatus the student used that are **not** shown in the figure above.

1. _____
2. _____

(2)

- (b) What are the independent and dependent variables in the student's investigation?

Independent _____

Dependent _____

(2)

- (c) Give **two** safety precautions the student should have taken.

1. _____
2. _____

(2)

- (d) Suggest **one** improvement to the student's method.

(2)

- (e) The table below shows the student's results.

Type of oil	Temperature rise in °C			
	1	2	3	Mean
Castor oil	20	19	21	20
Linseed oil	19	18	19	19
Mineral oil	21	21	21	21
Olive oil	17	17	18	
Sesame oil	23	23	20	22

Calculate the mean temperature rise for olive oil.

Give your answer to two significant figures.

Mean temperature rise = _____ °C

(2)

- (f) The mean change in temperature of the castor oil is 20 °C

The specific heat capacity of castor oil is 1 800 J / kg °C

The mass of oil used is 0.025 kg

Calculate the change in thermal energy of the castor oil the student used.

Use the correct equation from the Physics Equations Sheet.

Select the correct unit from the box.

joule	newton	volt
-------	--------	------

Change in thermal energy = _____

Unit = _____

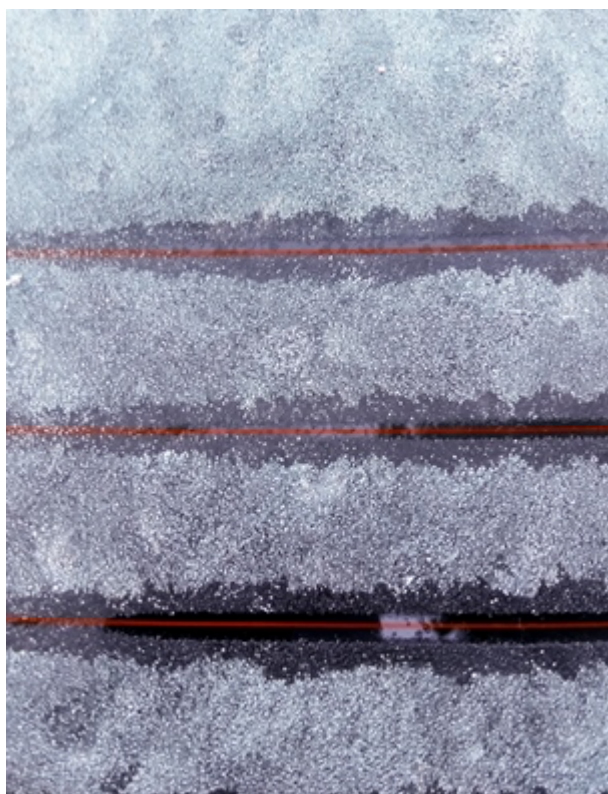
(3)

(Total 13 marks)

Q6.

Figure 1 shows solid ice on a car's rear window.

Figure 1

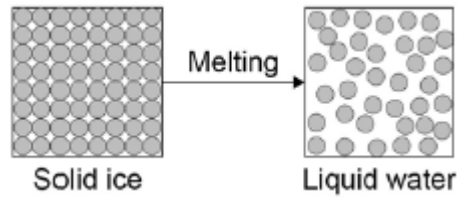


© Captive cookies/iStock/Thinkstock

The glass window contains an electrical heating element.

- (a) Use the particle model in **Figure 2** to describe how the heating element causes the arrangement of the ice particles to change as the ice melts.

Figure 2



You should include a description of how the particles are arranged in the solid ice and in the water.

(6)

- (b) A car manufacturer tests different heating elements by measuring how long it takes ice to melt.

During the test some variables must be controlled.

Identify **two** control variables in the car manufacturer's test.

Tick **two** boxes.

The colour of the car

☐

The current in the heating element

☐

The mass of ice

☐

The size of the car

☐

The time taken for the ice to melt

☐

(2)

- (c) Some of the energy supplied by the heater causes the ice to melt without the temperature of the ice increasing.

What is the name given to this energy supplied by the heater?

Tick **one** box.

Latent heat of freezing

☐

Latent heat of fusion

☐

Latent heat of vaporisation

☐

(1)

- (d) When the heater is supplied with 120 J of energy each second, the internal energy of the ice increases by 45 J each second.

Use the following equation to calculate the efficiency of the heater.

$$\text{Efficiency} = \frac{\text{Output energy transfer}}{\text{input energy transfer}}$$

Give your answer to two decimal places.

Efficiency = _____

(2)

(Total 11 marks)

Q7.

Figure 1 shows a battery operated remote control car.

Figure 1



© Brandon Bolin/iStock/Thinkstock

- (a) The car's battery contains a store of energy.

As the car moves, energy from one store is transferred to another store.

Describe how different stores of energy change as the car moves.

(2)

- (b) The car has a top speed of 12 m/s and a mass of 800 g .

Write down the equation that links kinetic energy, mass and speed.

Equation _____

(1)

- (c) Calculate the maximum kinetic energy of the car.

Maximum kinetic energy = _____ J

(2)

- (d) Explain why having a more efficient motor increases the top speed of the car.

- (e) **Figure 2** shows an electric car being charged.

Figure 2



By Alan Trotter Electric Car Charging [CC-BY-2.0]via Flickr

A driver wishes to buy a new car.

The table below gives some data about an electric car and one with a petrol engine.

	Electric car	Petrol engine car
Cost (£)	27 000	15 000
Running cost per year (£)	250	2 000
Average lifetime (years)	12	12

Which car would be the most economic over its 12 year lifetime?

Use data from the table above to support your answer.

You should include the difference in cost in your answer.

(4)
(Total 11 marks)

Q8.

Figure 1 shows a kettle a student used to determine the specific heat capacity of water.

Figure 1



© vladimirkim3722/iStock/Thinkstock

The student placed different masses of water into the kettle and timed how long it took for the water to reach boiling point.

The student carried out the experiment three times.

The student's results are shown in the table below.

Mass of water in kg	Time for water to boil in seconds				Mass × change in temperature in kg°C	Energy supplied in kJ
	1	2	3	Mean		
0.25	55	60	63	59	20	131
0.50	105	110	116	110	40	243
0.75	140	148	141	143	60	314
1.00	184	190	183	182	80	401
1.25	216	215	211	214	100	471
1.50	272	263	266	267	120	587

1.75	298	300	302		140	
------	-----	-----	-----	--	-----	--

- (a) Suggest how the student was able to ensure that the change in temperature was the same for each mass of water.

(2)

- (b) Calculate the uncertainty in the student's measurements of time to boil when the mass of water was 1.75 kg.

Uncertainty = _____ s

(2)

- (c) The power rating of the kettle is 2.20 kW.

Calculate the average electrical energy used by the kettle, in kJ, for 1.75 kg of water to reach boiling point.

Average energy = _____ kJ

(2)

- (d) Use information from the table above to calculate the change in temperature of the water during the investigation.

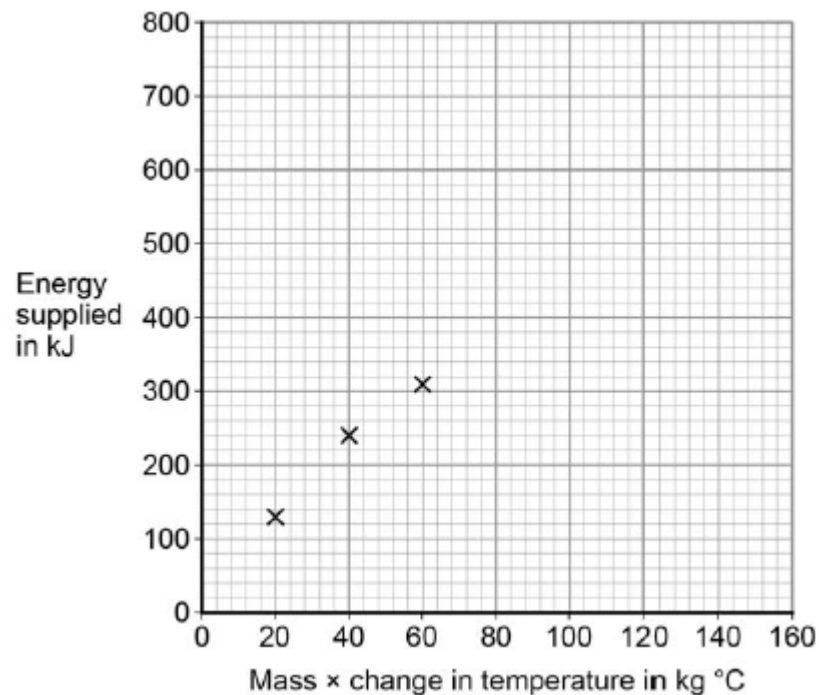
Change in temperature = _____ °C

(2)

- (e) The student plotted a graph of energy supplied in kJ against mass $\times$ change in temperature in kg °C.

Figure 2 shows the graph the student plotted.

Figure 2



Use data from the table above to plot the four missing points.

Draw a line of best fit on the graph.

(3)

- (f) Use the graph to determine the mean value of the specific heat capacity of water, for the student's investigation.

Specific heat capacity of water = _____ J / kg °C

(4)

- (g) The student's value for the specific heat capacity of water was greater than the accepted value.

Suggest why.

(1)

- (h) The kettle used in the experiment had a label stating that the power rating of the kettle was 2.2 kW.

The student did not measure the power of the kettle.

Suggest why measuring the power of the kettle may improve the student's investigation.

(1)

(Total 17 marks)

Q9.

A student investigated the specific heat capacity of metals.

- (a) Describe an experiment the student could do to measure the specific heat capacity of a metal.

(6)

- (b) The student calculated the specific heat capacity of four metals.

The table below shows the student's results.

Metal	Mass of material in kg	Time in minutes	Temperature in °C	Change in thermal energy in J	Calculated specific heat capacity of material in J / kg °C
Aluminium	1	10	2	4 780	2 390
Brass	1	10	4	4 660	1 165
Copper	1	10		4 600	657
Steel	1	10	5	4 690	938

Use data from the table above to calculate the temperature change for copper.

Use the correct equation from the Physics Equation Sheet.

Temperature change = _____ °C

(3)

- (c) What is the independent variable in the student's investigation?

Tick **one** box.

Mass of material

☐

Power used

☐

Time in minutes

☐

Type of material

☐

(1)

- (d) The student calculated the specific heat capacity of aluminium to be 2390 J / kg °C.

The 'true' specific heat capacity of aluminium is 900 J / kg °C.

Suggest why the student's result for aluminium is different from the 'true' value.

(2)

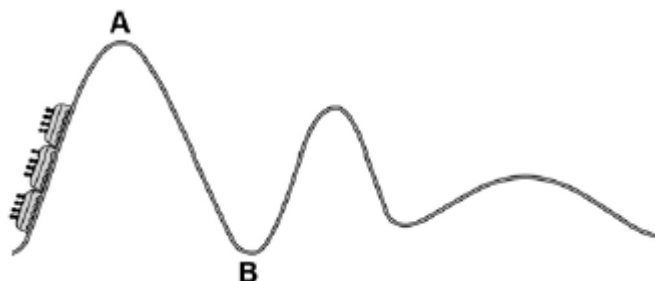
- (e) The teacher suggested that putting bubble wrap round the metal block would change the results.

How would using bubble wrap change the results?

Give a reason for your answer.

Q10.

The figure below shows a rollercoaster.



The rollercoaster car is raised a vertical distance of 35 m to point **A** by a motor in 45 seconds.

The mass of the rollercoaster is 600 kg.

The motor has a power rating of 8 000 W.

- (a) Calculate the percentage efficiency of the motor.

Gravitational field strength = 9.8 N / kg.

Efficiency = _____ %

(5)

- (b) The rollercoaster rolls from point **A** to point **B**, a drop of 35 m.

Calculate the speed of the roller coaster at point **B**.

Assume that the decrease in potential energy store is equal to the increase in kinetic energy store.

Speed at point **B** = _____ m / s

(6)

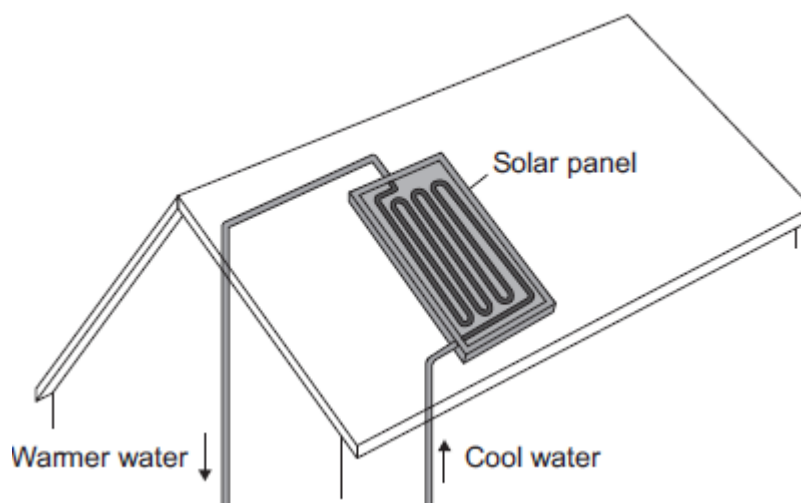
(Total 11 marks)

Q21.

Solar panels can heat water for use in a home.

Figure 1 shows a solar panel on the roof of a house.

Figure 1



(a) The solar panel is designed to transfer as much energy to the water as possible.

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

The solar panel is black to increase energy transferred to the water by

conduction. **infrared radiation.**

(1)

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

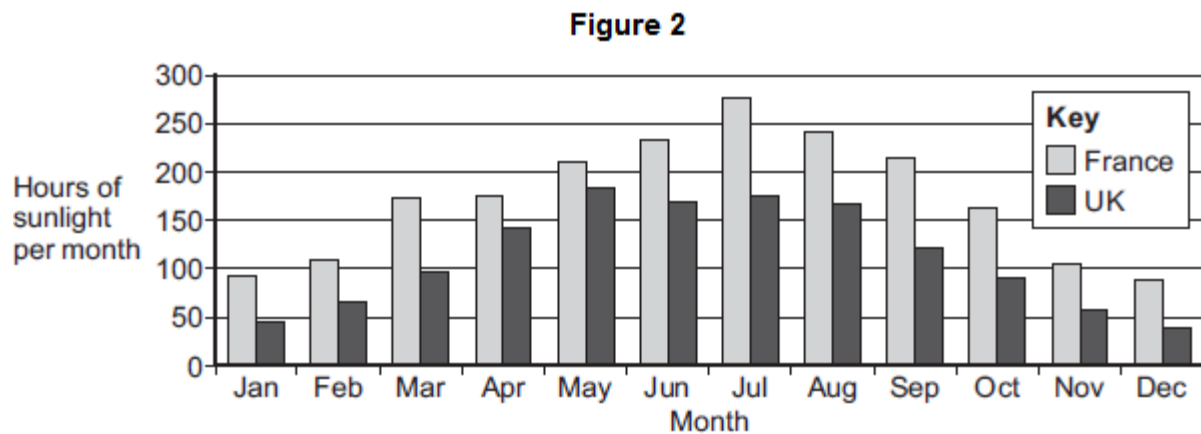
Solar panels usually have a large surface area so that more energy can be

absorbed. **emitted.** **reflected.**

(1)

(b) **Figure 2** shows the hours of sunlight each month for one year in France and in the

UK.



Solar panels are used more in France than in the UK.

Use **Figure 2** to explain why.

(2)

- (c) The solar panel heats 200 kg of water each day. On one day it increases the temperature of the water by 50 °C.

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

Calculate the energy needed to increase the temperature of 200 kg of water by 50 °C.

Use the correct equation from the Physics Equations Sheet.

Tick (✓) the correct unit.

Energy = _____

	Tick (✓)
joules	
seconds	

watts	
-------	--

(3)
(Total 7 marks)

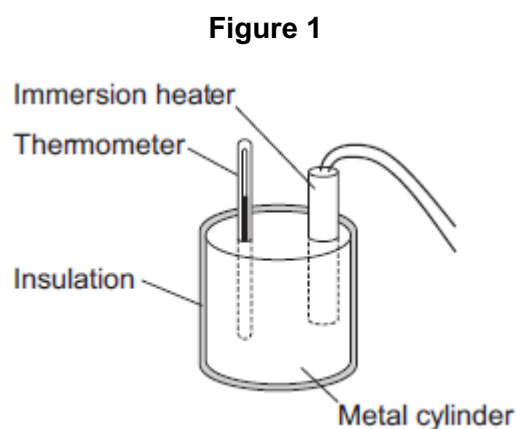
Q22.

A student investigated the specific heat capacity of five different metal cylinders.

Each metal cylinder had a mass of 2 kg.

He used an immersion heater to transfer 18 000 J of energy to each different metal cylinder.

Figure 1 shows the apparatus he used.

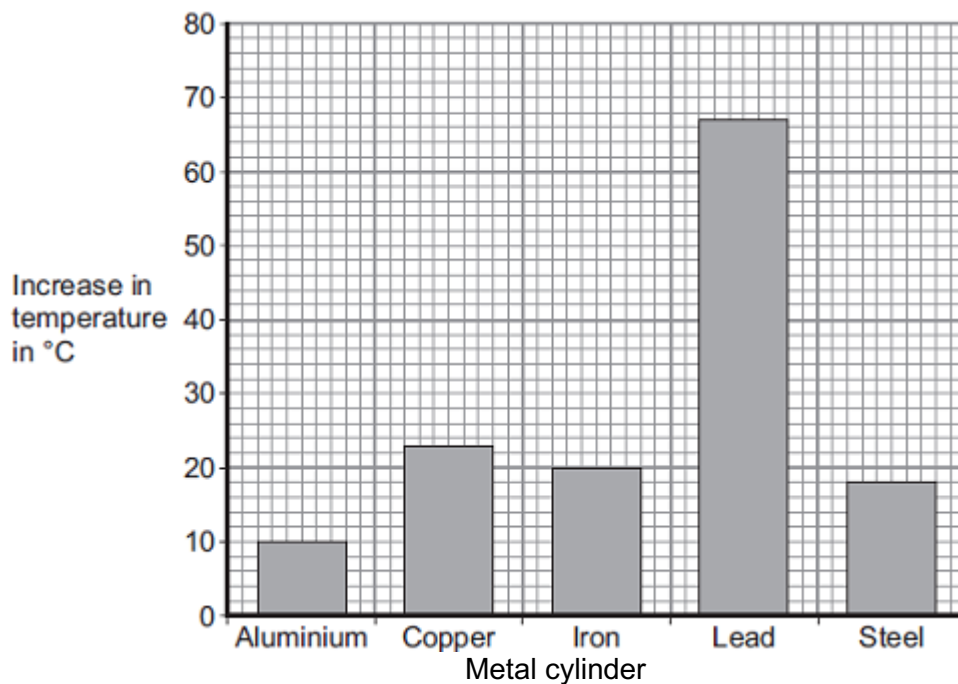


He measured the temperature of the metal cylinder at the start and at the end of each experiment, using a thermometer.

He calculated the temperature rise of each metal cylinder.

The results are shown in **Figure 2**.

Figure 2



- (a) Suggest an appropriate resolution for the thermometer used in the investigation.

Resolution = _____ °C

Give a reason for your answer.

(2)

- (b) The mass of metal and the energy transferred to each metal were control variables in the investigation.

Suggest another variable that should have been controlled.

(1)

- (c) Which metal has the highest specific heat capacity? _____

Give a reason for your answer.

(2)

- (d) In this investigation, 18 000 J of energy was supplied to a 2 kg cylinder of steel.

Calculate the specific heat capacity of steel.

Use the correct equation from the Physics Equations Sheet.

Specific heat capacity = _____ J / kg °C

(3)

(Total 8 marks)

Q23.

During the day, the Sun transfers energy to an outdoor swimming pool.



© Volodymyr Burdiak/iStock

- (a) By which method of energy transfer does the pool receive energy from the Sun?

(1)

- (b) (i) The mass of water in the pool is 5000 kg. The specific heat capacity of water is 4200 J/kg°C.

Calculate how much energy needs to be supplied to increase the water temperature by 5°C and state the correct unit.

Use the correct equation from the Physics Equations Sheet.

Give the unit.

Energy = _____

(3)

- (ii) The Sun supplies energy to the water in the pool at a rate of 16 kJ every second.

Calculate how much time it would take for energy from the Sun to raise the water temperature by 5 °C.

You will need to use your answer to **(b)(i)** and the correct equation from the Physics Equations Sheet.

Time = _____ seconds

(3)

- (iii) On one day, the temperature of the pool is 7 °C lower than the air temperature.

The time it takes for the pool temperature to rise by 5 °C is less than the answer to part **(b)(ii)**.

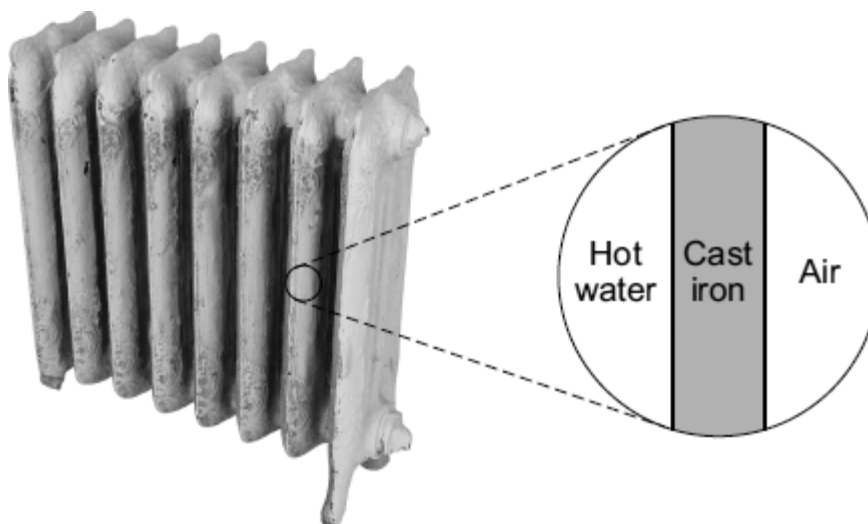
Suggest a reason why.

(1)

(Total 8 marks)

Q24.

An old house has a cast iron radiator. The radiator has hot water inside it.



Photograph supplied by PhotoObjects.net/Thinkstock

- (a) The table shows how the power output of the radiator varies with the temperature difference between the hot water and the air temperature of the room.

Temperature difference in °C	10	20	30	40	50	60
Power output in W	400	900	1480	2200	3050	4000

- (i) Describe fully the relationship between temperature difference and power output.

(1)

- (ii) The house owner wants to reduce their heating bills.

Use the data in the table to advise the house owner.

(1)

- (b) The air in a room is at a temperature of 12 °C.

The house owner switches the heating on until the temperature reaches 22 °C. The amount of energy needed to raise the temperature of the air to 22 °C is 580 000 J.

The mass of air in the room is 58 kg.

Calculate the specific heat capacity of air and give the unit.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

Specific heat capacity = _____

(3)

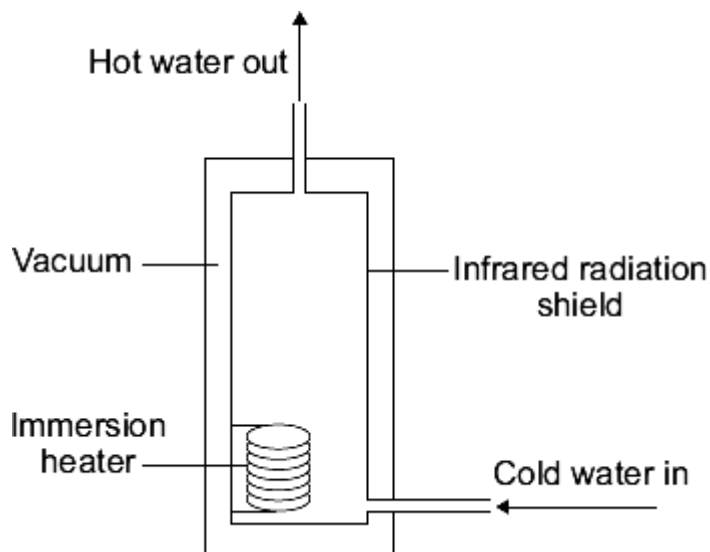
(Total 5 marks)

Q25.

Modern kitchens can be fitted with a device that immediately supplies water at a temperature of 93 °C.

A tank that stores very hot water is fitted under the sink so that hot water is always available.

The infrared radiation shield and the vacuum reduce the energy transfer to the surroundings.



- (a) The infrared radiation shield is made of shiny metal.

Why does the shiny metal reduce energy transfer?

(1)

- (b) When the hot water tank is filled with water, the immersion heater can heat the water from a temperature of 15°C to 93°C in 10 minutes.
The energy transferred to the water is 982 800 joules.
The specific heat capacity of water is $4200 \text{ J/kg}^{\circ}\text{C}$.

Calculate the mass of water needed to fill the hot water tank.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

Mass = _____ kg

(3)

- (c) When hot water is **not** needed the immersion heater has a power input of 10 W.
The energy is used to maintain the 93°C temperature in the hot water tank.

How much energy, in joules, does the immersion heater transfer in 30 minutes when the power input is 10 W?

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

Energy = _____ J

(2)

- (d) The manufacturer of the device made the following claim:
'When people use conventional electric kettles, they always boil more water than they actually need. This system makes sure you only heat the water you need.'

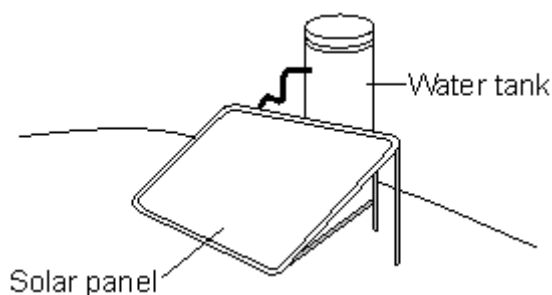
Suggest **one** other advantage of using the device compared to using a conventional electric kettle.

(1)

(Total 7 marks)

Q26.

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) 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.

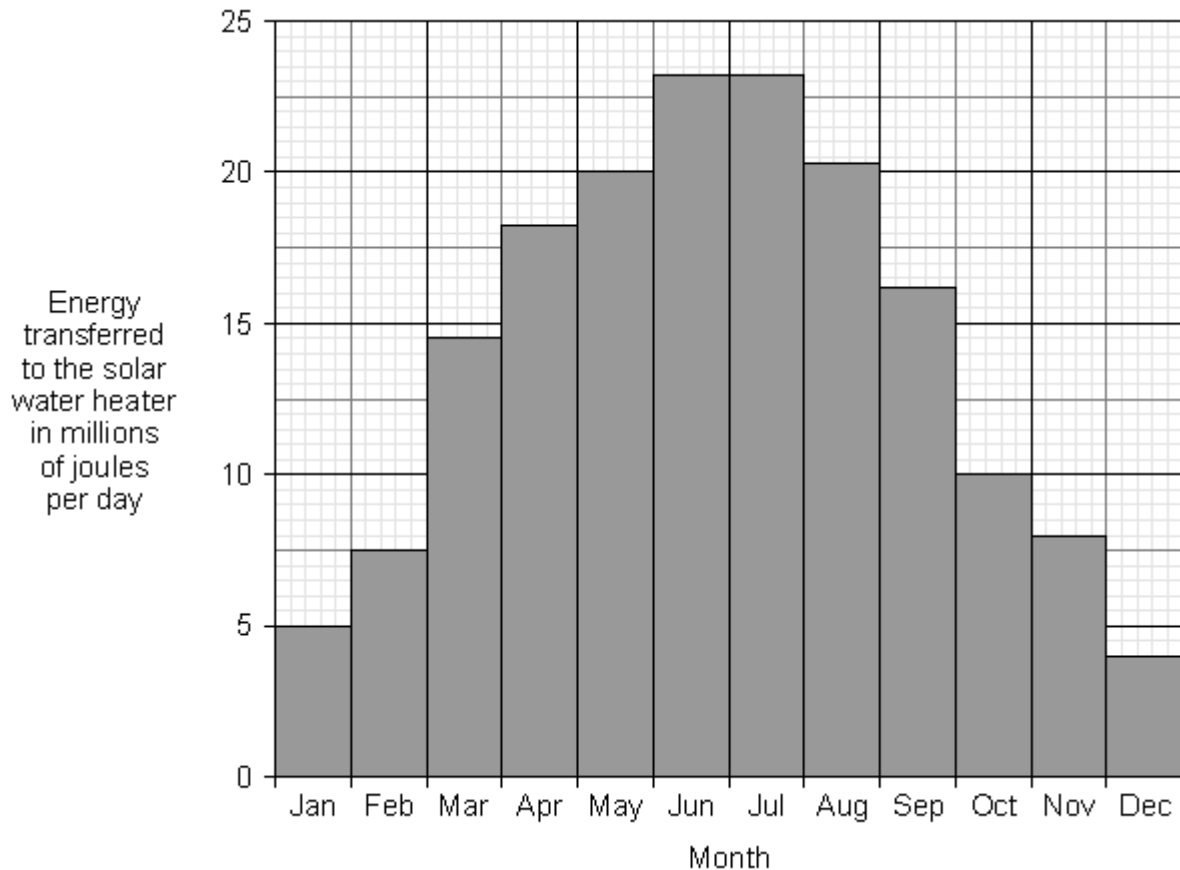
Specific heat capacity of water = 4200 J/kg °C.

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

Energy transferred = _____ J

(2)

- (b) 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)

- (c) *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.

(6)

(Total 9 marks)

Mark schemes

Q1.

- | | |
|---|-----|
| (a) biofuel | 1 |
| geothermal | 1 |
| (b) it is predictable | 1 |
| (c) 2.8 MW | 1 |
| (d) any two from: | |
| • visual pollution | |
| • noise pollution | |
| • dangerous to birds | |
| • may lower house prices | 2 |
| (e) Level 2: Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account. | 3–4 |
| Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking. | 1–2 |
| No relevant content | 0 |

Indicative content

- less fossil fuel burnt
- more nuclear fuel used
- more renewables used
- gas remained the same
- less carbon dioxide released
- less greenhouse gases
- less global warming
- less acid rain
- less environmental pollution
- more hazardous waste produced (nuclear)
- the percentage generated by coal has decreased 8%
- the percentage generated by renewables has increased by 6%
- the percentage generated by nuclear has increased by 2%

[10]

Q2.

- | | |
|---|---|
| (a) x-axis labelled and suitable scale | 1 |
| points plotted correctly | |

allow 5 correctly plotted for **2** marks, 3–4
correctly plotted for **1** mark
allow $\pm \frac{1}{2}$ square

2

line of best fit

1

(b) $\frac{4.5}{60}$

allow ecf from line of best fit in part (a)

1

0.075 (°C/s)

1

an answer of 0.075 (°C/s) scores **2** marks

(c) $\Delta\theta = 11.5$ (°C)

a calculation using an incorrect temperature
scores max 3 marks

1

$$\Delta E = 1.50 \times 900 \times 11.5$$

1

$$\Delta E = 15\,525 \text{ (J)}$$

1

$$\Delta E = 15.525 \text{ (kJ)}$$

1

an answer of 15.525 (kJ) **or** 15.53 (kJ) **or** 15.5
(kJ) scores **4** marks

an answer of 15 525 (kJ) scores **3** marks

(d) any **two** from:

- mass of block*
- size / dimensions of block*
- material of block*

*allow same block for **1** mark

- current through heater
allow power of heater

- thickness of insulation*
 - material of insulation*
- *allow same insulation for **1** mark

- time interval
- starting temperature (of block / heater)

2

[12]

Q3.

(a) (in circular motion) the direction is (constantly) changing

1

(so) velocity is (constantly) changing

1

(and) acceleration is rate of change of velocity

allow

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

1

(b) $s = \frac{2.6^2 - 1.4^2}{2 \times 0.31}$

1

(c) $0.72 = \frac{190}{P_{\text{input}}}$

allow $\frac{72}{100} = \frac{190}{P_{\text{input}}}$

1

$$P_{\text{input}} = \frac{190}{0.72}$$

1

$$P_{\text{input}} = 264 \text{ (W)}$$

allow an answer that rounds to 264 (W)

1

$$264 = 36 \times I$$

allow their calculated

$$P_{\text{input}} = 36 \times I$$

1

$$I = 7.33 \text{ (A)}$$

1

$$I = 29 \text{ (A)}$$

allow an answer that rounds to 29 (A)

allow their value for $I \times 4$ correctly calculated

1

an answer of 29 (A) scores 6 marks

(d) old theory suggests Moon rocks would be different from Earth rocks

1

(but) new evidence shows they are similar

this mark is dependent on scoring the first mark

1

allow 1 mark for new evidence (from studying Moon rocks) could not be explained by the old theory

[12]

Q4.

- (a) kinetic energy = $0.5 \times \text{mass} \times (\text{speed})^2$

$$\text{allow } E = \frac{1}{2}mv^2$$

1

- (b) $0.5 \times 9000 \times 30^2$

1

4 050 000

1

4050 (kJ)

an answer of 4050 (kJ) scores 3 marks

an answer of 4 050 000 scores 2 marks

1

- (c) efficiency =

$$\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$

1

- (d) $0.80 = \frac{\text{useful output energy transfer}}{4050}$

allow ecf from (b)

1

(useful output energy transfer =) $0.80 \times 4\,050$

1

= 3240 (kJ)

an answer of 3240 (kJ) scores 3 marks

1

- (e)

Level 2: Scientifically relevant features are identified; the way(s) in which they are similar/different is made clear and (where appropriate) the magnitude of the similarity/difference is noted.	3-4
Level 1: Relevant features are identified and differences noted.	1-2
No relevant content	0
Indicative content advantages of both methods: - both renewable sources of energy - both have no fuel (cost) - no carbon dioxide produced advantages of wind - higher average power output	

advantages of hydroelectric • constant / reliable power (output) • lower (installation) cost disadvantages of wind • higher (installation) cost • variable / unreliable power output disadvantages of hydroelectric • lower power output disadvantages of both methods • (may be) noisy • visual pollution	
---	--

4

[12]

Q5.

- (a) thermometer

1

stopclock / stopwatch

accept measuring cylinder

accept top pan balance

1

- (b) independent: type of oil

1

dependent: temperature rise in °C

1

- (c) wear safety goggles

1

oil not heated directly

accept any reasonable comment about not handling hot apparatus.

1

- (d) repeat the experiment

1

and calculate the mean temperature rise

OR

heat the oil for a longer period of time (1)

to get a wider range of temperatures (1)

1

(e)	$(17 + 17 + 18) / 3 (= 17.33)$	1
	temperature rise = 17 (°C)	1
	<i>accept 17 (°C) with no working shown for 2 marks</i>	
	<i>allow 17.33 with no working shown for 1 mark</i>	
(f)	$E = 0.025 \times 1800 \times 20 \text{ (J)}$	1
	$E = 900 \text{ (J)}$	1
	<i>allow 900 without working shown for the 2 calculation marks</i>	
	Joule	1
		[13]

Q6.

- (a) **Level 3 (5–6 marks):**
A clear, logical explanation containing accurate ideas presented in the correct order with links between ideas.

Level 2 (3–4 marks):
Key ideas presented with some linked together to form a partial explanation.

Level 1 (1–2 marks):
Fragmented ideas, some may be relevant, insufficient links to form an explanation.

0 marks:
No relevant content.

Indicative content

- current in the wire causes heating
- increases temperature of the metal wires / ice

Solid

- arrangement of particles is regular
- particles vibrate about a fixed position

Melting

- internal energy of the ice increases, increasing the temperature to melting point
- so (as the temperature increases) particles vibrate faster
- eventually particles vibrate fast enough to break free from the (strong) bonds
- therefore the arrangement of particles becomes irregular

Liquid

- arrangement of particles is irregular
- particles movement (translational) is random

- (b) The current in the heating element
- 1

The mass of ice	1
(c) latent heat of fusion	1
$45 / 120 = 0.375$	1
0.38	
<i>allow 0.38 with no working shown for 2 marks</i>	
<i>allow 0.375 with no working shown for 1 mark</i>	1
	[11]

Q7.

(a) the store of chemical energy (in the battery) decreases	1
the internal energy of the surrounding air increases.	1
<i>accept description of energy becoming less usefully stored for 2 marks</i>	
(b) kinetic energy = $\frac{1}{2}$ mass $\times$ velocity ²	1
(c) $E_k = \frac{1}{2} \times 0.8 \times 12^2$	1
$E_k = 57.6$ (J)	1
<i>allow 57.6 (J) without working shown for 2 marks</i>	
(d) lower proportion of wasted energy	
<i>accept less energy is wasted</i>	1
higher proportion of energy is converted into <u>kinetic</u> energy	
<i>accept more kinetic energy</i>	1
(e) Level 2 (3–4 marks): A relevant and coherent argument which demonstrates processing and numerical analysis of the information presented and draw a conclusion which is logically consistent with the reasoning and refers to payback time for the vehicles.	
Level 1 (1–2 marks): Simple comparisons are made which demonstrate a basic ability to numerically analyse the information presented. The conclusion, if present, may not be consistent with the calculations.	
0 marks: No relevant content	
Indicative content	

- The electric car costs £12 000 more to buy
- Running cost of electric car = £3 000
- Running cost of petrol engine car = £24 000
- Total cost of electric car = £30 000
- Total cost of petrol engine car = £39 000
- The electric car cost £1 750 less to run each year
- The electric car will save £9 000
- Additional cost is covered in 6.9 years
- So the electric car will be cheaper over the 12 year lifetime

or

Electric

$$27000 / 12 = 2250$$

$$\text{Annual cost} = 2250 + 250 = 2500$$

Petrol

$$15000 / 12 = 1250$$

$$\text{Annual cost} = 1250 + 2000 = 3250$$

So electric is £750 cheaper per year

4

[11]

Q8.

- (a) water boils at the same temperature each time

1

control starting temp by allowing enough time for water and kettle to reach room temperature

1

- (b) uncertainty = $(302 - 298) / 2$

1

$$\text{uncertainty} = \pm 2 \text{ (s)}$$

ignore missing $\pm$

1

- (c) (Energy transferred = Power $\times$ time)

$$E = 2.20 \times 300$$

1

$$E = 660 \text{ (kJ)}$$

1

allow 660 (kJ) without working shown for 2 marks

allow answer calculated using incorrect value for t (298 or 302) for 1 mark

- (d) (mass $\times$ change in temperature) / mass

allow 1 mark for any correct pair of values from the table

1

eg $20 / 0.25$

80 ($^{\circ}\text{C}$)

1

allow 80 (°C) without working shown for 2 marks

- (e) four points plotted correctly
allow 1 mark for three correctly plotted points 2
ecf their 5.3
allow $\pm 1\text{mm}$
accurate line drawn
line should be straight and drawn with a ruler 1
line must not go through the origin
(f) values read correctly from graph 1
correct conversion into J 1
correct use of $\Delta y / \Delta x$ 1
value in range 4200 – 4800 1
allow value in range 4200 – 4800 without working shown for 4 marks
(g) some of the energy supplied does not raise the temperature of the water
some of the energy is wasted is insufficient 1
(h) (the power of the kettle may not be 2.2kW)
(by measuring the power) the student can accurately calculate the amount of energy supplied to each mass of water 1

[17]

Q9.

- (a) **Level 3 (5–6 marks):**
A full, detailed and coherent plan covering all the major steps is provided, which outlines what needs to be measured to calculate specific heat capacity. The steps are set out in a logical manner that could be followed by another person to calculate the specific heat capacity.
- Level 2 (3–4 marks):**
The substantive content of a plan is present but may be missing some steps. The plan may not be in a completely logical sequence but leads towards the calculation of the specific heat capacity.
- Level 1 (1–2 marks):**
Simple statements relating to relevant apparatus or steps are made but they may not be in a logical order. The plan would not allow another person to calculate specific heat

capacity.

0 marks:

No relevant content.

Indicative content

- measure the mass of metal
- correct use of balance
- description of how work is done or energy transferred to metal
eg electrical work, mechanical work (eg dropping lead shot)
- how energy transfer or work done is measured
eg electrical using joulemeter, mechanical decrease in potential energy store of falling lead shot
- equate work done / energy transferred = increase in thermal energy store of the metal
- calculate specific heat capacity

6

(b) $4\,600 = 1 \times 657 \times \text{temperature change}$

1

$\text{temperature change} = 4\,600 / 657$

1

$= 7\ (^{\circ}\text{C})$

allow 7 with no working shown for 3 marks

1

(c) Type of material

1

(d) heat loss

1

then any **one** from:

- turned off the power supply too early
- incorrectly measured mass of material
- incorrectly measured temperature
- incorrectly read the change in thermal energy

1

(e) would give a more accurate value **or** the calculated specific heat capacity will be smaller

1

because the bubble wrap insulates the material **or** prevents heat loss

1

[14]

Q10.

(a) $600\text{ kg} = 5880\text{ N}$

1

$$\text{power} = \frac{5880 \times 35}{45}$$

$$= 4573.3 \text{ (W)}$$

this step without the previous steps stated gains 3 marks

$$\% \text{ Eff.} = \frac{4573.3 \times 100}{8000}$$

$$= 57.17 \text{ (\%)}$$

allow 57.17 with no working shown for 5 marks

(b) $\text{gpe} = 600 \times 9.8 \times 35$

$$= 205\,800$$

$$\text{gpe} = \text{KE} = \frac{1}{2} m v^2$$

$$v = \sqrt{\frac{2 \times \text{KE}}{m}}$$

$$= \sqrt{\frac{411\,600}{600}}$$

$$= 26.2 \text{ (m / s)}$$

allow 26.2 with no working shown for 6 marks

[11]

Q21.

- (a) (i) infrared radiation

- (ii) absorbed

- (b) France has more hours of sunlight (all year round)

or

France has more hours of sunlight in every month of the year

accept the converse

allow France is sunnier

(so) there will be more energy to heat the water

or

(so) more energy can be absorbed / transferred

allow (so) more water can be heated

allow 'heat' for energy

- (c) 42 000 000
allow 4.2×10^7
allow for 1 mark correct substitution
 $200 \times 4200 \times 50$ provided no subsequent step shown
or
 42 000

2

joules

42 000 kJ = **3** marks

1

[7]

Q22.

- (a) a value of 1°C or less
reason only scores if a correct value for the resolution is given
*do **not** allow 0 / zero*

1

temperatures in investigation are recorded to the nearest degree (Celsius)

or

differences between temperature rises for different materials is greater than 1°C

1

- (b) any **one** from:
- room temperature / start temperature (of material)
 - type of insulation
 - thickness of insulation
 - time that cylinder was heated for
 - the power output of the immersion heater
- allow amount*

1

- (c) aluminium
reason only scores if 'aluminium' is given

1

smallest temperature rise

allow smaller temperature rise (than the other metals)
accept justification by calculation

1

- (d) 500(J / kg °C)
allow temperature increase = 18 °C for 1 mark
correct substitution $18000 = 2 \times c \times 18$ gains 2 marks
provided no subsequent step
or
correct substitution and rearrangement

$c = 18000 / (2 \times 18)$ gains **2** marks provided no subsequent step

allow **2** marks for 474 (J / kg °C) (a SHC calculated using a temperature of 19 °C)

allow **1** mark for substitution $18000 = 2 \times c \times 19$ provided no subsequent step

or

substitution and rearrangement

$c = 18000 / (2 \times 19)$ provided no subsequent step

allow **2** marks for a SHC calculated using a temperature increase of an incorrect metal, ie

900 (J / kg °C for aluminium)

391 (J / kg °C for copper)

450 (J / kg °C for iron)

134 (J / kg °C for lead)

3

[8]

Q23.

(a) radiation

ignore infra red, IR, or heat

1

(b) (i) 105 000 000

($E = mc\theta$)

accept answers in standard form eg. 1.05×10^8

$E = 5000 \times 4200 \times 5$ gains **1** mark

Unit mark is independent, but must match value given for full marks

if no other marks gained 1 mark for any correct unit of energy

2

J / joules

not lower case j

allow Joules

allow units in words eg kilojoules

allow 105 000 kJ or 105 MJ for **3** marks. These figures must have units.

allow units written as words Eg. kilojoules

not KJ, kj, mJ, Mj

1

(ii) 6600(s) / 6560(s) / 6563(s) / 6562.5(s)

($E = Pt$)

allow ecf from (b)(ii)

allow answers in minutes and hours provided correct and unit changed on answer line

eg. 109 / 110 minutes or 1.8 hours

if correct answer given with incorrect unit, maximum mark of **2** eg 6600 minutes

$105\,000\,000 = 16\,000 \times t$ gains **1** mark
 $t = 105\,000\,000 / 16\,000$ gains **2** marks
 $t = 105\,000\,000 / 16$ gains **1** mark
or
 $6\,562\,500(\text{s})$ gains **2** marks

3

- (iii) energy gained from surroundings / air
 allow heat
 ignore air is warmer or pool is colder

1

[8]

Q24.

- (a) (i) as temperature difference increases, power output increases
 at an increasing rate / as temperature difference doubles,
 power output more than doubles

1

- (ii) reduce the temperature difference (between air and water)
 ignore turn power / heating down
 ignore insulation

1

- (b) $E = m \times c \times \theta$

1000 J/kg °C

allow **2** marks for 1000

allow **1** mark for correct substitution and correct
 rearrangement of correct equation,

$$\text{eg } c = \frac{580000}{58 \times 10}$$

give **1** mark for unit (allow J/kgK)

3

[5]

Q25.

- (a) reflector of infrared radiation
 allow reflector of infrared / IR / radiation / heat / energy
 ignore bounces off

or

poor emitter of (infrared) radiation

do **not** accept **no** radiation emitted

1

- (b) 3(kg)

allow **1** mark for evidence of correct calculation of
 temperature change (78 °C)

allow **1** mark for correct substitution and rearrangement
 $982\,800 / (4200 \times 78)$

if temperature change is incorrect but used correctly in calculation allow maximum of 2 marks

3

(c) 18000 (joules)

allow 1 mark for correct substitution (10×1800)

or ($10 \times 30 \times 60$)

allow 1 mark for an answer of 300

an answer 10×0.5 or 5 gains 1 mark

ignore incorrect units for compensation marks

if answer given is 0.005 kWh award 2 marks

2

(d) any **one** from:

- uses less electricity / energy

allow saves energy or wastes less energy

ignore power

- reduced cost

- instant availability of hot water

allow it's quicker

allow you don't have to wait

1

[7]

Q26.

(a) 16 800 000

allow 1 mark for substitution into correct equation

ie $100 \times 4200 \times 40$

2

(b) 7

allow ecf from part (a)

1

(c) 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 explanation 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 some explanation 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 explanation 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

- a renewable energy source
- energy is free
- does not pollute the atmosphere
accept specific examples of polluting gases
- no fuel is burnt
- energy can be stored (in the water)

disadvantages

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

[9]

Examiner reports

Q1.

- (a) 90% of students gained at least 1 mark and nearly 60% gained both marks for correctly choosing two renewable resources.
- (b) Fewer students showed an understanding of reliability with over 70% gaining no marks on this question. The majority of students ticked the box that gave the meaning of renewable.
- (c) Over three-quarters of students correctly determined the power of one turbine.
- (d) More than three-quarters of students gained at least one mark for describing or stating visual or noise pollution. 35% of students gained both marks. Some students made vague statements such as “they are big”. Some students thought that the wind turbines acted as fans and would make the surrounding area windier.
- (e) This levels of response question produced a wide variety of responses. Fewer than 20% of students gained more than two marks; a similar number scored no marks with a significant number making no attempt at all. Most commented on the percentages supplied, but many students failed to expand their answer to give environmental impacts. For some students their written English impaired their ability to answer this question.

Students must read the question carefully and tailor their responses accordingly. Limiting the answer to comparing the two pie charts does not answer the question sufficiently but some credit was given for doing this – particularly if numerical comparisons were made. To access the higher marks, examiners were looking for explanations of the environmental impacts and clear logical linking between the changes and their effects.

There were frequent incorrect references to ozone layer depletion. Misconceptions about nuclear power were seen, such as carbon dioxide and toxic gases were emitted. The best answers made clear that decreasing use of coal and increasing use of renewables would decrease the amount of carbon dioxide and link this to the greenhouse effect and global warming.

Q2.

Foundation

- (a) Most students made a good attempt at selecting a linear scale and labelling the x-axis. The label should include the unit.

Plotting was generally correct on major gridlines, but many plotting mistakes were seen. The line of best fit was a smooth curve in this instance. Straight lines of best fit and dot-to-dot did not gain the fourth marking point.

This question discriminated well with 82% of students achieving some credit, and 42% achieving three or four marks.

- (b) 2% of students could calculate the gradient of the graph. Students need to ensure they bring a calculator to the exam so as not to be disadvantaged in these calculation questions. When attempted, a single value was often read from each axis, and then divided.

Students did not appear to notice that the y-axis does not begin at zero, requiring a difference between two points on each axis to be determined before dividing.

- (c) Many students used the final temperature, rather than calculating the temperature change. Three out of four marks were still available for subsequent stages if the correct method was used. Answers frequently used the time in seconds, rather than the temperature change. Again, subsequent marks were available.

Most students did not attempt the unit conversion from joules to kilojoules. Of those who attempted the unit conversion, as many multiplied by 1000, as divided by 1000.

- (d) Students could generally give one control variable (29% of students), but few (11%) gave two correctly. Many incorrect answers of 'temperature' unqualified were seen. At this level, simple statements to keep it a fair test, or to use the same equipment, with no detail given, are insufficient.

Higher

- (a) Most students could choose a sensible linear scale and label the x-axis. Some errors in plotting were seen. The line of best fit was a smooth curve in this instance. Straight lines of best fit and dot-to-dot did not gain the fourth marking point. 75% of students achieved three or four marks.
- (b) 79% of students could not calculate the gradient. Some students attempted to count the squares of the graph paper to calculate the gradient, rather than use the appropriate scale.

Students were expected to calculate the gradient in '°C/second' because seconds were the unit of time provided, however, some students calculated the gradient in '°C/minute'. This could achieve full marks if the method was clear. Just calculating the change in temperature was insufficient.

- (c) 53% of students could calculate the change in thermal energy using the equation on the Physics Equations Sheet, although some did attempt to use an incorrect equation. Errors in calculating the temperature change were frequent. Unit conversion from joules to kilojoules was generally correct when attempted.
- (d) 32% of students could state two control variables. however students should be aware that general statements regarding keeping equipment the same are insufficient. The answer should apply to the investigation given in the question.

Q3.

- (a) Over 11% of students made no attempt to answer this question and more than three quarters scored no marks.

Few students realised that this question was linked to the vector nature of velocity and acceleration. Indeed, several students stated that the question was incorrect because the moon could not be accelerating because it was moving at constant speed.

Students who attempted an incorrect explanation attributed the acceleration to a variety of causes – global warming, astronauts landing on the moon and the earth's changing magnetic field were fairly common answers.

Students who scored marks for this question usually cited the constant change in direction of the moon, linking this to a change in velocity, but omitting the link

between velocity and acceleration.

- (b) Around half of students chose the correct response to the calculation. The next most popular choice was the final box, which was similar to the correct one, but with '2' as a multiplier. The other two responses were equally chosen.
- (c) Around 3% of students performed this complex calculation correctly to gain all six marks. Some students attempted calculations, but it was often difficult to follow the line of reasoning. Strings of figures, apparently randomly multiplied or divided, were often seen, with no attempt to explain what was being worked out. It would benefit students to explain, just with a word or two, what they think they are working out. Some students attempted to deal with all stages of this multi-stage calculation in one equation – such answers seldom scored any marks.

Of those whose working was clear enough to follow, the most frequent mistake was working out the input power as 72% of the output power, ending up with a smaller value for the input power than the output. However, such answers could go on to gain up to three of the marks by using the $P = IV$ equation and/or multiplying by four.

- (d) In order to gain marks, students needed to refer to the old theory and what it would suggest about the composition of Moon rocks compared to Earth rocks. Very few answers made reference to the old theory, so very few students gained marks.

Many answers stated that if the Moon rocks had a similar composition to Earth rocks, it was likely that they originated from the same place – this is what was stated in the question so there was no credit for repeating it.

There was evidence that a number of students had mis-read or failed to understand the question, as they referred to the Giant Impact Hypothesis as being incorrect because the Earth would have been destroyed in a collision.

Q21.

- (a)
 - (i) Less than half the students correctly said that the solar panel is black to increase energy transfer to the water by infrared radiation. Almost as many thought it was to reduce energy transfer by conduction.
 - (ii) The majority of students correctly said that the solar panels have a large surface area to absorb more energy.
- (b) Most students gained the first marking point for saying that there are more hours of sunlight in France. This was phrased in a variety of ways. Few students gained the second marking point due to poor use of language. Some reference to more energy being absorbed was required. 'More sun' or 'more light' were ignored.
- (c) Most students gained at least 1 mark for either substituting correctly into the equation, or for selecting the correct unit. There were quite a lot who did not attempt the question, and did not select a unit, which might have been worth a guess. Those who gained two marks were able to correctly calculate the energy needed but then gave an incorrect unit, or they gave the correct unit and substituted into the equation correctly, but then made a mistake in the calculation. This was often by omitting a 0 from a correctly calculated value on the answer line.

Q22.

- (a) Most students did not understand the term "resolution". Students who did give a value of 1 °C or lower frequently wrote "accuracy" as their reason. The reason

should have related to the results, but many linked it to the graph scale. Answers of around 67 °C to 70 °C were common as this was the highest value, or it would include all the values shown for all the metals. "10 °C" was less commonly seen, but their reason for this choice was that it was the lowest result. Values of 18 °C to 23 °C were often given because they were the most common or average values for the results. "20 °C" was also seen because that is room temperature.

- (b) Less than half of the students could give a control variable. Students who gained the mark often said the type or amount of insulation used. Some said the mass or amount of metal, or the amount of energy transferred, both of which were given in the question. Other responses that were ignored included the surface area, volume or colour of the metals, various pieces of apparatus used, such as the thermometer; and some thought that there was water in the cylinder so gave volume of water as a variable.
- (c) Just under two thirds of the students gained no marks. The most common answer was lead, with the reason that it had the highest temperature rise. Some students correctly identified aluminium as having the highest specific heat capacity but then said it was due to increasing in temperature by only 10 °C, when a comparative statement was needed. Other students demonstrated a good understanding by going on to explain that, since the rise in temperature was the lowest, this meant the amount of energy required to raise the temperature of 1kg by 1 °C was the highest. A few justified their response by calculating the specific heat capacity of aluminium.
- (d) Students should be told that the first mark in a calculation is for the substitution, not for the rearrangement. Many students scored no marks because they did not show their working. In this calculation, 1 mark was given for reading the bar chart, 18°C, and 2 marks for the substitution into the equation, i.e. $18000 = 2 \times c \times 18$. This substitution would gain two thirds of the total marks. There were no further marks for the rearrangement, but 3 marks for the final answer of 500 (J / kg°C). Students who calculated the specific heat capacity for a different metal were awarded 2 marks. Students who misread the increase in temperature as 19°C and used this to calculate the specific heat capacity as 474 (J / kg°C) were also awarded 2 marks.

Q23.

- (a) The question asked for a method of energy transfer, but many students gave infrared radiation as the answer. In this instance, infrared was ignored, so they gained the mark.
- (b)
 - (i) Most students gained at least 1 mark for $5000 \times 4200 \times 5$, however they often then wrote down an incorrect answer. It is always good to check the answer. Some made avoidable errors when writing down the number of noughts. A variety of units was given.

Any unit of energy could gain a mark, if no other marks had been given, as long as it was written correctly. Many wrote j instead of J, or KJ instead of kJ.
 - (ii) Most students managed to substitute into the correct equation and many also reorganised the equation to find the time. However, a lot of students forgot to convert the kJ to J, so could only gain 2 marks.
 - (iii) Many responses referred to the air being warmer than the pool, but did not go on to explain that the water would absorb energy from the air or surroundings. Some talked about the Sun being hotter or cooler, or the use of heaters.

Q24.

- (a)
 - (i) Few students realised that there was more to the question than both temperature and power increased, omitting reference to increasing rate.
 - (ii) Most students simply advised the homeowners to turn the temperature down, not considering the data about temperature difference. The temperature on a thermostat is controllable but the temperature difference to the air proved to be a difficult concept.
- (b) The calculation was often correctly performed but relatively few gave a fully correct unit ($\text{J/kg}^{\circ}\text{C}$). A number of students could not use a calculator correctly to work out $58\,000 / (58 \times 10)$.

Q25.

- (a) The majority of correct responses were for reflection of radiation, with most students stating heat rather than infrared radiation, which was allowed. A few answers gained the mark for stating the shiny metal was a poor emitter of radiation, but those that stated no radiation was emitted were not credited. Incorrect responses included reference to absorption and conduction of radiation.
- (b) Many students selected the wrong equation from the sheet and tried to calculate efficiency. A mark was picked up by the majority of students for calculating the temperature change but then made errors in the rearrangement of the equation. Even where a correct substitution and rearrangement of the equation was shown, students often came up with the wrong answer, probably due to misuse of their calculator and not realising 4200×78 had to be calculated first. A third of students scored full marks.
- (c) By far the most common answer was 300 J as students forgot to convert the time to seconds. Several students tried to use the wrong equation. An answer of 930 was often given, from multiplying power by temperature. Only a few students gained two marks for this question.
- (d) Many creditworthy responses were in terms of saving energy or saving money. Some students said it wasted less water which did not gain the mark as this was too similar to the information given in the stem of the question, and a different advantage was asked for.