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EDEXCEL GCSE PHYSICS: QUESTIONS BY TOPIC

Conservation of Energy (3)

GCSE Physics (Foundation) Topic 3

11 questions · 114 marks · Mark schemes included

Pearson Edexcel GCSE (9-1) Physics 1PH0, Foundation Tier, June 2018 - June 2025

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 Piccadilly Business Centre, Unit C, Aldow Enterprise Park
Blackett Street, Manchester, M12 6AE

HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.

Click any row below to jump straight to that question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

QUESTION	SOURCE	MARKS	PAGE
1. Q3	Paper 1 June 2018	8	4
2. Q4 <i>also Topic 5</i>	Paper 1 November 2020	9	7
3. Q6	Paper 1 June 2023	9	10
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5. Q4	Paper 1 November 2021	10	17
6. Q4	Paper 1 June 2022	10	20
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11. Q9	Paper 1 June 2023	13	39



QUESTIONS

11 questions · 114 marks · lowest tariff first



8-MARK QUESTIONS

1 question in this booklet



- 3 (a) A copper can, painted black, contains boiling water at 100°C .

The can is left to cool and a measurement of the water temperature is taken every 5 minutes.

Figure 3 shows the measurements.

time in minutes	temperature in $^{\circ}\text{C}$
0	100
5	74
10	60
15	56
20	37
25	30
30	25

Figure 3

- (i) Two points, shaded in the table, have not been plotted.

Plot these two points on the graph, in Figure 4.

(2)

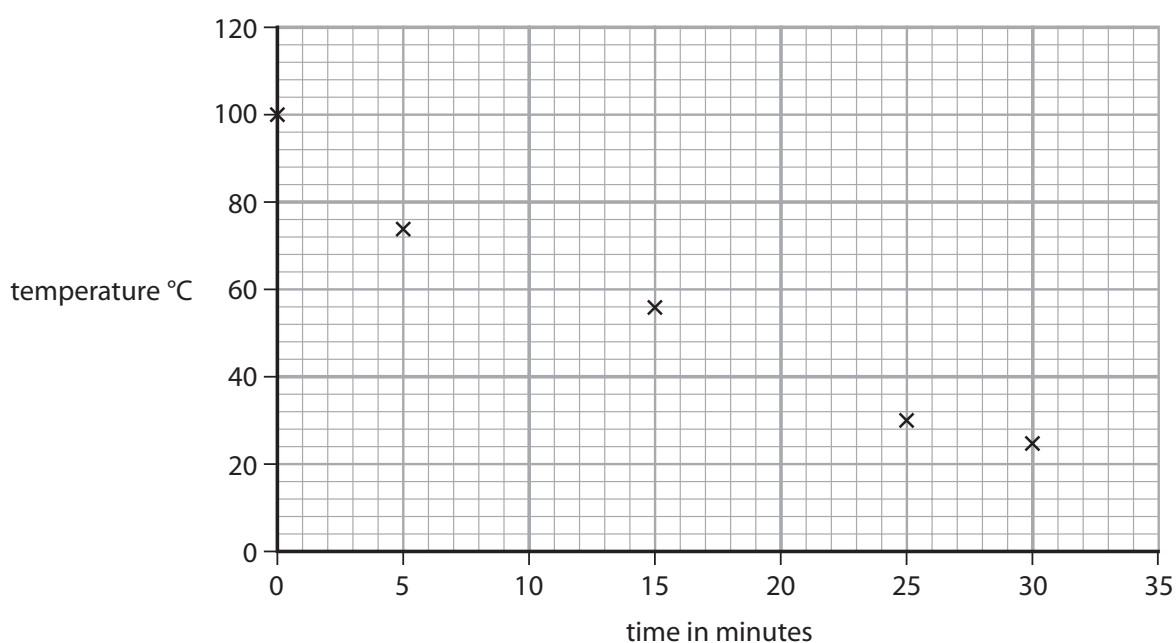


Figure 4

- (ii) One of the points on the graph in Figure 4 is anomalous.

Circle the anomalous point.

(1)

- (iii) Draw the best fit curve on the graph in Figure 4.

(1)



(iv) An identical can contains the same amount of boiling water.

This can has a shiny silver surface.

The measurements are repeated with this can and a new curve is drawn.

State how the cooling curve would be different from the curve in the graph in Figure 4.

(1)

(b) Figure 5 is a graph showing the intensity–wavelength curves for two hot objects, L and M.

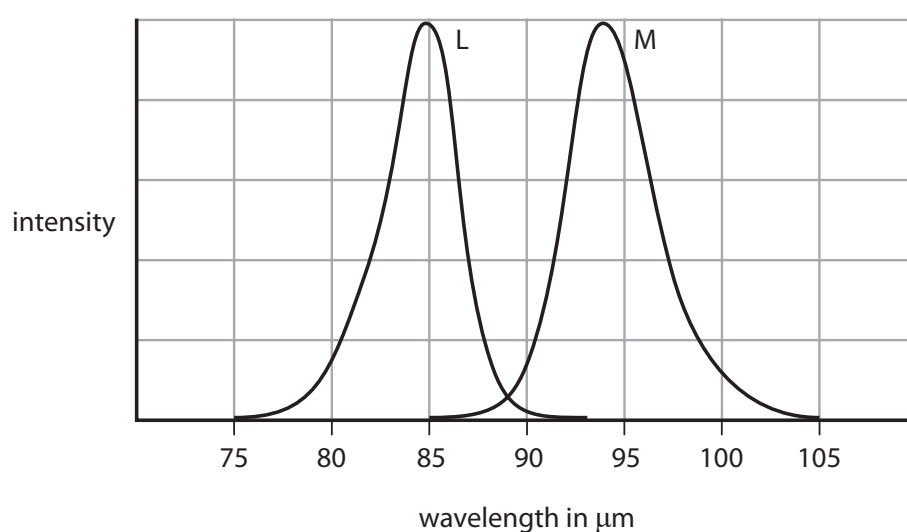


Figure 5

(i) Estimate the wavelength where the intensity is at a maximum for each of the objects.

(2)

wavelength at maximum intensity for object L = ... μm

wavelength at maximum intensity for object M = ... μm

(ii) State, with a reason, which object is the hotter object.

(1)

Object

Reason

(Total for Question 3 = 8 marks)

9-MARK QUESTIONS

2 questions in this booklet



- 4 (a) (i) Figure 4 shows two light rays hitting a glass lens.

On Figure 4, draw the two light rays after they leave this lens.

(1)

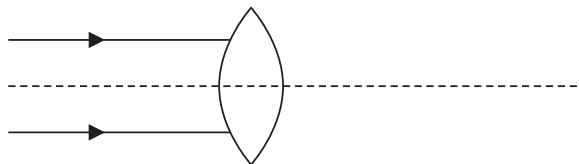


Figure 4

- (ii) Figure 5 shows two light rays hitting a different glass lens.

On Figure 5, draw the two light rays after they leave this lens.

(1)

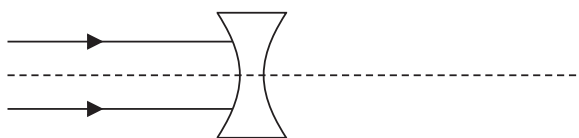


Figure 5

- (iii) A lens has a focal length of 25 cm.

Calculate the power of the lens.

Use the equation

$$\text{power in dioptres} = \frac{1}{\text{focal length in metres}}$$

(2)

power of the lens = ... dioptres

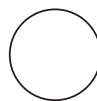
(b) Figure 6 shows two solid metal balls, **P** and **Q**.

ball painted black

ball painted white



P



Q

Figure 6

P and **Q** are made from the same metal and have the same radius.

P is painted black and **Q** is painted white.

Each ball is heated to a different temperature.

The balls then cool in the same room.

The graph in Figure 7 shows how the temperature of each ball changes with time.

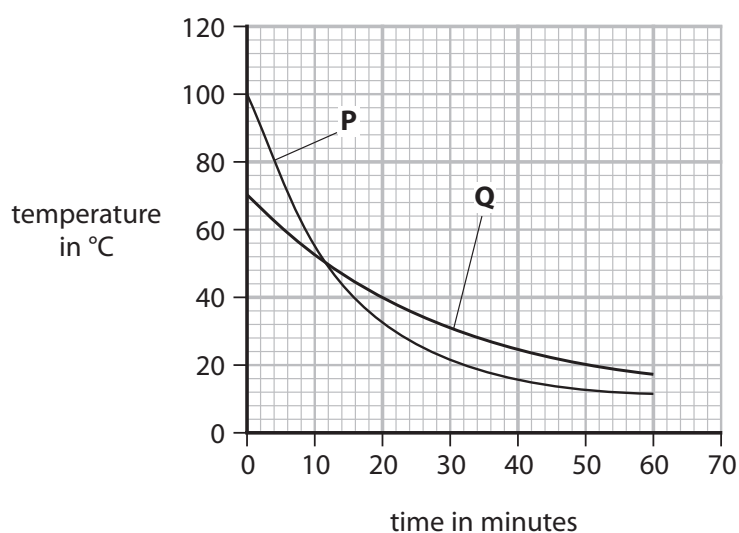


Figure 7

- (i) Use the graph in Figure 7 to determine the time when **P** and **Q** were at the same temperature.

Show your working on the graph.

(2)

time = ... minutes

(ii) Which of these temperatures is most likely to be room temperature, as shown by the graph in Figure 7?

(1)

☐ **A** 100°C

☐ **B** 70°C

☐ **C** 10°C

☐ **D** 0°C

(iii) Explain why the curve for **P** is different from the curve of **Q**. Use information from Figure 6 and Figure 7 to help your answer.

(2)

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(Total for Question 4 = 9 marks)



6 (a) Figure 9 shows a metal cube filled with hot water.

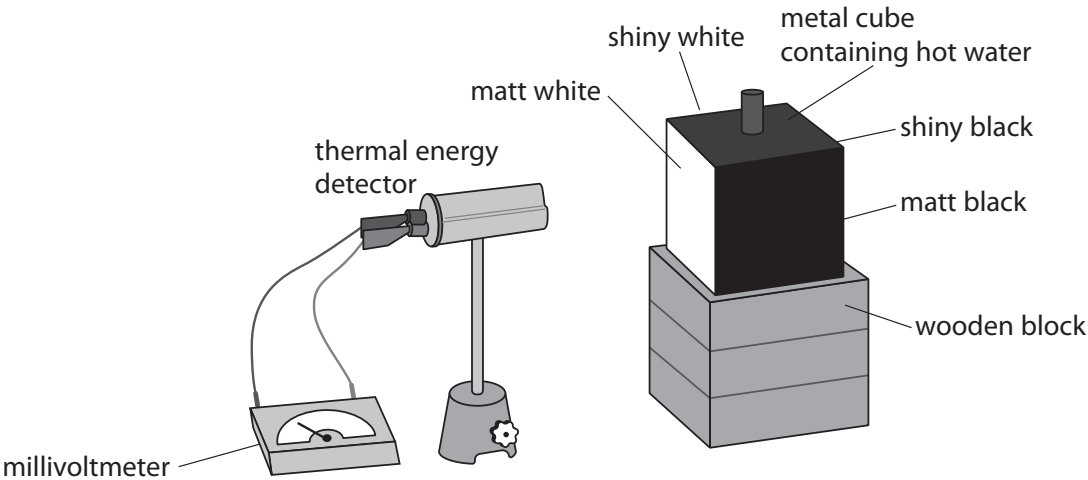


Figure 9

Four sides of the cube have different surfaces, as shown in Figure 9.

The four surfaces are at the same temperature.

The thermal energy radiated by each side of the box is measured using a thermal energy detector connected to a millivoltmeter.

The detector is moved to get a reading of the thermal energy emitted from each side of the box.

Figure 10 shows the table of results.

type of surface	millivoltmeter reading in mV
matt white	32
shiny white	20
shiny black	
matt black	55

Figure 10

(i) Suggest a possible millivoltmeter reading for the shiny black surface.

(1)

..... mV

(ii) State what must be kept the same to take the measurement for each surface.

(1)

(iii) Suggest why the cube is placed on a block of wood.

(1)

(b) A hot surface emits radiation of different wavelengths.

The graph in Figure 11 shows how the intensity of the radiation emitted changes with the wavelength.

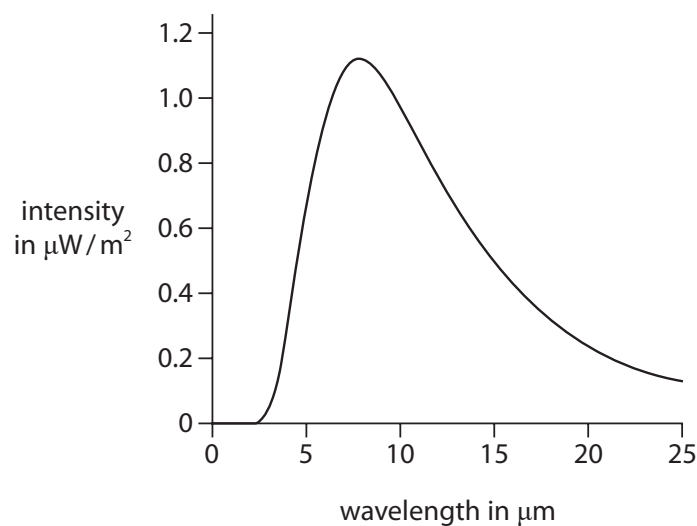


Figure 11

Describe how intensity changes with wavelength in Figure 11.

(2)

(c) Figure 12 shows two cans, a radiant heater and some other apparatus.

The cans absorb thermal radiation from the heater.

One can has a matt black surface and the other can has a shiny silver surface.

Both cans contain water at the same temperature.

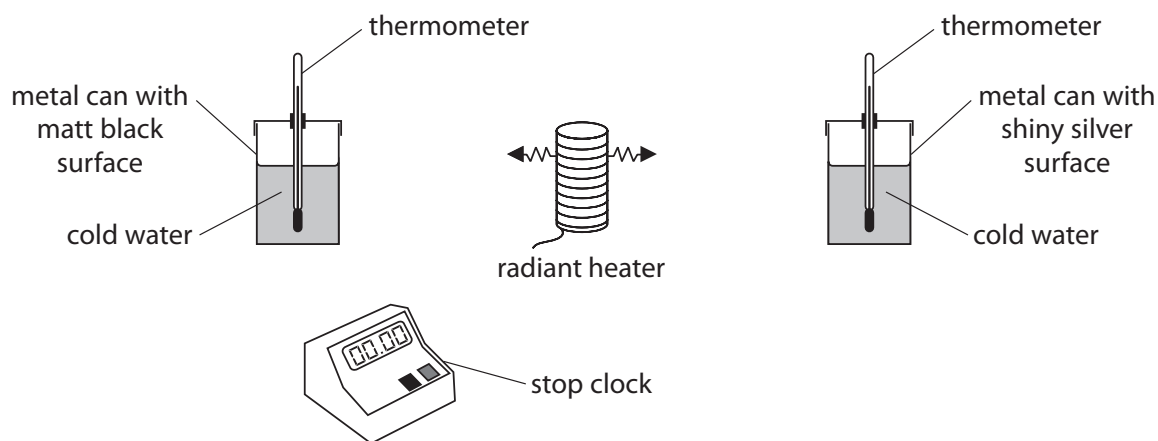


Figure 12

Describe how a student could use the apparatus in Figure 12 to determine which can is the better absorber of thermal radiation.

(4)

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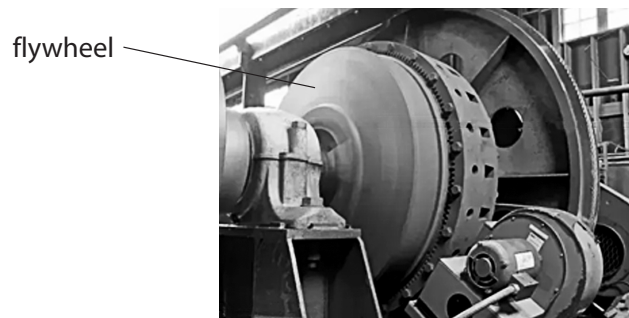
(Total for Question 6 = 9 marks)

10-MARK QUESTIONS

3 questions in this booklet



- 4 (a) Figure 6 shows a spinning flywheel.



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Figure 6

- (i) State how energy is stored in a spinning flywheel.

(1)

- (ii) State **one** way to increase the amount of energy stored in the flywheel.

(1)

(b) Figure 7 shows a skier going down a hill.

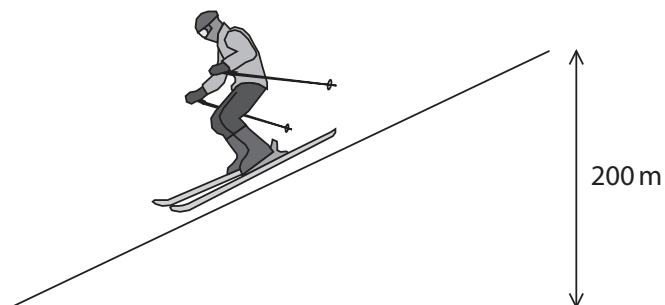


Figure 7

She descends through a vertical height of 200 m.

The skier's mass is 65 kg.

(i) Calculate the change in gravitational potential energy.

Use the equation

$$\Delta GPE = m \times g \times \Delta h$$

Take the gravitational field strength, g , as 10 N/kg.

(2)

change in gravitational potential energy = ... J

(ii) At the bottom of the slope her speed was 36 m/s.

Calculate her kinetic energy at the bottom of the slope.

Use the equation

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

(3)

kinetic energy = ... J



(c) Describe how her speed at the bottom of the slope could be determined.

(3)

(Total for Question 4 = 10 marks)



4 (a) A cyclist has a mass of 64 kg.

(i) The cyclist rides from a flat road to the top of a hill.

The top of the hill is 24 m above the flat road.

Calculate the gain in gravitational potential energy, ΔGPE , of the cyclist.

Use $g = 10\text{ N/kg}$

Use the equation

$$\Delta\text{GPE} = m \times g \times \Delta h \quad (2)$$

gain in gravitational potential energy = ... J

(ii) The cyclist returns to the flat road.

The mass of the cyclist is 64 kg.

Calculate the kinetic energy of the cyclist when the cyclist is travelling at 6.0 m/s.

Use the equation

$$\text{KE} = \frac{1}{2} \times m \times v^2 \quad (3)$$

kinetic energy = ... J



(iii) The cyclist then uses the brakes on the bicycle to stop.

Explain what happens to the kinetic energy of the cyclist.

(2)

.....

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.....

.....

(b) A different cyclist uses a motorised bicycle.

The motorised bicycle is powered by an electric motor.

Figure 3 is an energy diagram for the motor.

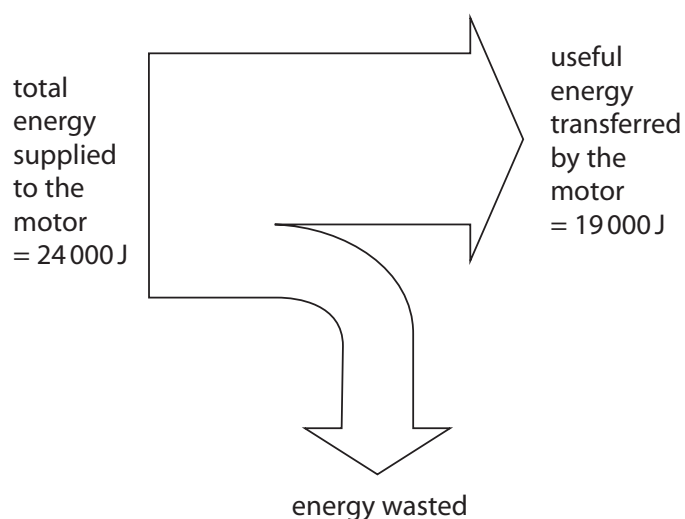


Figure 3

(i) Calculate how much energy is wasted.

(1)

energy wasted = ... J

(ii) Calculate the efficiency of the electric motor.

(2)

Use the equation:

$$\text{efficiency} = \frac{\text{(useful energy transferred by the device)}}{\text{(total energy supplied to the device)}}$$

efficiency of electric motor = ...

(Total for Question 4 = 10 marks)



- 4 (a) Figure 7 shows a truck lifting a box.

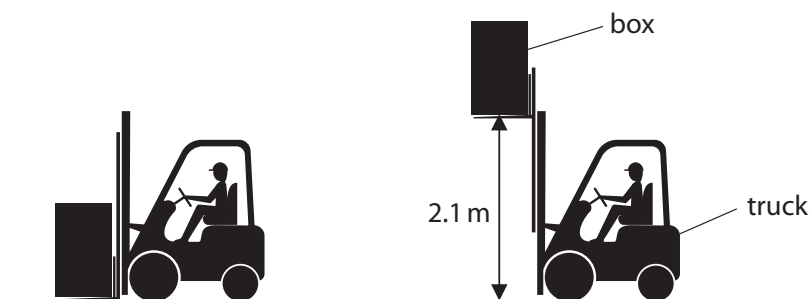


Figure 7

The box has a mass of 57 kg.

The truck lifts the box through a vertical height of 2.1 m.

The gravitational field strength, $g = 10 \text{ N/kg}$

Calculate the change in the gravitational potential energy of the box.

Use the equation

$$\Delta GPE = m \times g \times \Delta h$$

(2)

change in gravitational potential energy = ... J

- (b) A cyclist of mass 70 kg travels at a constant velocity of 8 m/s.

Calculate the kinetic energy of the cyclist.

(3)

kinetic energy of the cyclist = ... J

- (c) Figure 8 shows a trolley at the top of a slope.

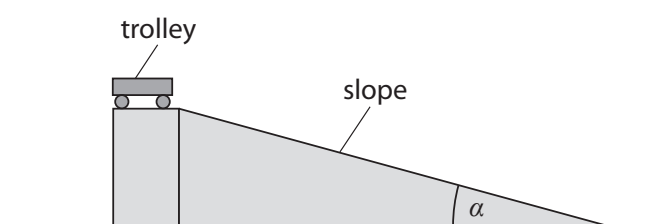


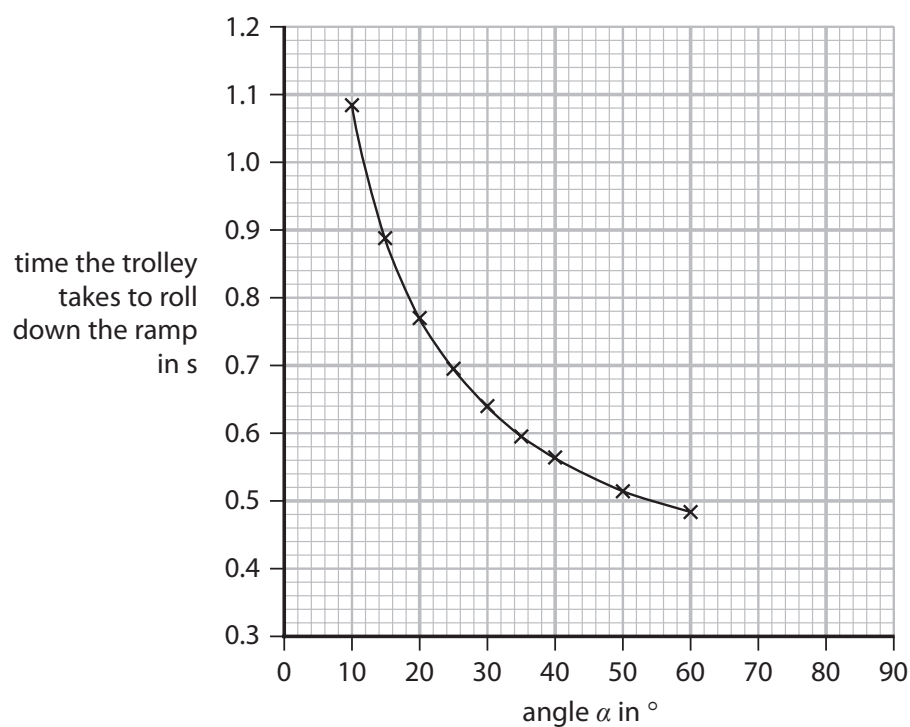
Figure 8

A student gently pushes the trolley until it just starts to roll down the slope.

The student measures the time it takes for the trolley to roll down the slope.

The student repeats this for different values of the angle α .

Figure 9 is a graph of the student's results.

**Figure 9**

- (i) Use the graph in Figure 9 to find the time the trolley takes to roll down the ramp when the angle $\alpha = 45^\circ$.

(1)

time = ... s

- (ii) Use the graph in Figure 9 to estimate the time the trolley takes to roll down the ramp when the angle $\alpha = 80^\circ$.

Show your working on the graph.

(2)

time = ... s



(iii) The student had a choice of how to measure the time the trolley takes to roll down the ramp.

1. Use a hand-held stopwatch.
2. Use light gates at the top and bottom of the slope.

The student chose to use the light gates.

Explain why this was the correct choice.

You should refer to the data on the time axis of Figure 9 in your answer.

(2)

(Total for Question 4 = 10 marks)



11-MARK QUESTIONS

3 questions in this booklet



6 (a) State **two** non-renewable energy sources.

(2)

1.....

2.....

(b) Figure 9 shows the renewable energy sources used in the UK in 2015.

Figure 9 is to scale.

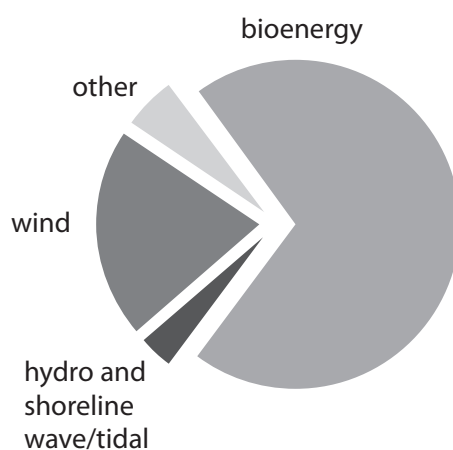


Figure 9

(i) State the energy source that gave the greatest amount of renewable energy for the UK in 2015.

(1)

.....

(ii) Justify your choice of energy source in part (i).

(1)

.....

.....

(iii) State which of these energy sources gave about 20% of the energy from renewable sources for the UK in 2015.

(1)

.....

(c) Figure 10 shows all the energy sources used in Canada in 2014 and a prediction for 2040.

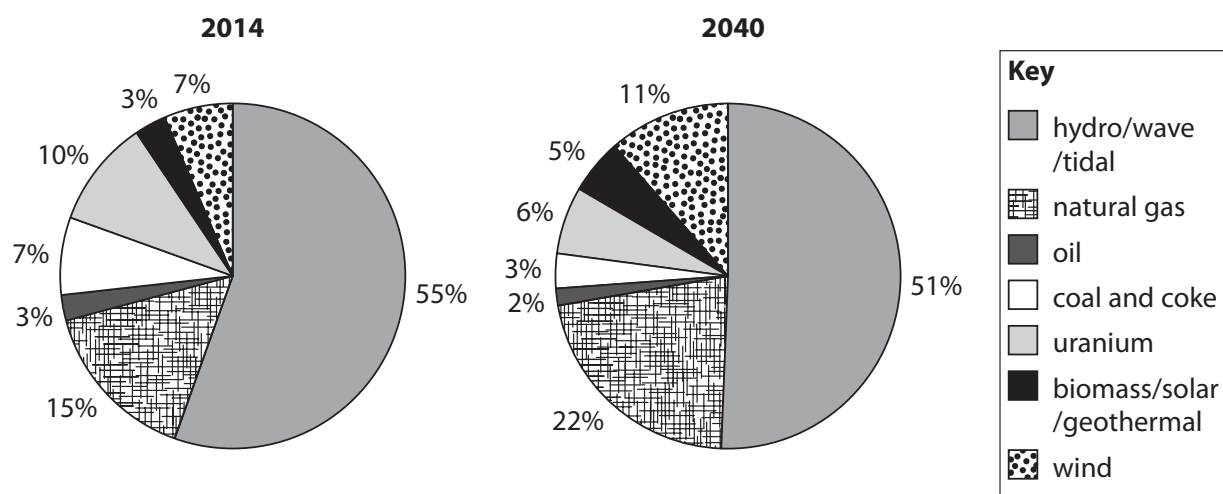


Figure 10

Discuss the effects on the environment of **two** predicted changes between 2014 and 2040.

(4)

change 1

effect on the environment

change 2

effect on the environment

(d) Figure 11 shows a wind turbine.

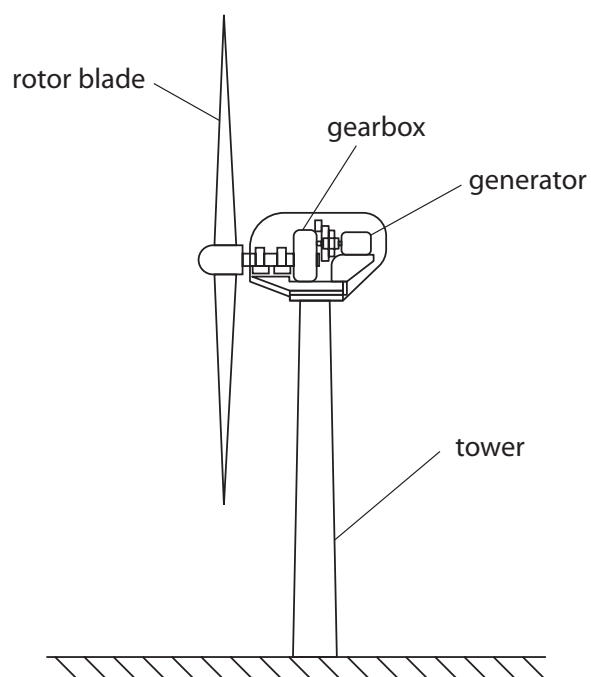


Figure 11

Explain how unwanted energy transfers could be reduced in the gear box.

(2)

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(Total for Question 6 = 11 marks)

- 8 A student lifts a toy car from a bench and places the toy car at the top of a slope as shown in Figure 16.

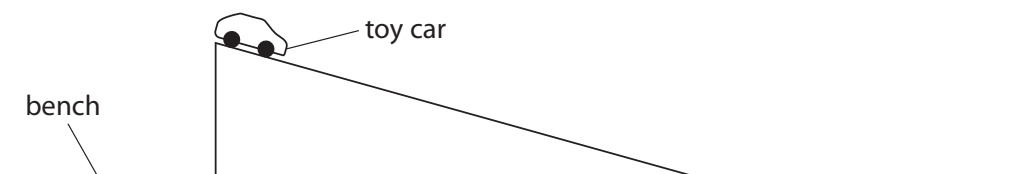


Figure 16

- (a) Describe an energy transfer that occurs when the student lifts the toy car from the bench and places the toy car at the top of the slope.

(2)

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- (b) The student lets the toy car roll down the slope.

Describe how the student could find, by experiment, the speed of the toy car at the bottom of the slope.

(4)

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- (c) The student needs to develop the experiment to determine the loss in potential energy and the gain in kinetic energy as the toy car is rolling down the slope.

State the other measurements the student must make.

(2)

- (d) When the toy car rolls down the slope, some energy is transferred to the surroundings as thermal energy.

State how the student could calculate the amount of energy transferred to the surroundings.

(1)

- (e) Explain **one** way the student could reduce the amount of thermal energy transferred to the surroundings as the toy car rolls down the slope.

(2)

(Total for Question 8 = 11 marks)



8 Figure 18 shows a person on a skateboard at the top of a ramp.

At P, the person is not moving.

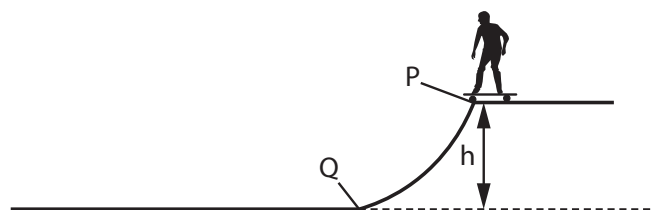


Figure 18

(a) The person rides the skateboard down the ramp from P to Q.

The gravitational potential energy of the person decreases by 980 J.

The mass of the person is 35 kg.

Calculate h , the height of the ramp.

Use $g = 10 \text{ N/kg}$.

Use the equation

$$\text{change in gravitational potential energy} = m \times g \times h$$

(2)

$h = \dots\dots\dots \text{ m}$

(b) The kinetic energy, KE, of the person at Q is 950 J.

The mass of the person is 35 kg.

Calculate the velocity of the person at Q.

Use the equation

$$v^2 = \frac{2 \times KE}{m} \quad (3)$$

velocity = ... m/s



(c) Figure 19 is a diagram that represents energy changes from P to Q.

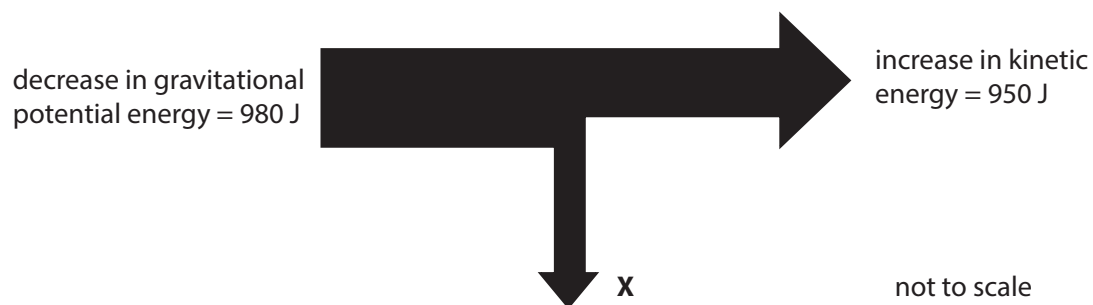


Figure 19

(i) State what is represented by **X**.

(1)

(ii) Calculate the value of **X**.

(1)

value of **X** = ... J

(iii) Calculate the efficiency of the system represented in Figure 19.

(2)

efficiency = ...

(d) The person would like to start from P again but have a greater velocity at Q.

Suggest **two** ways that this can be achieved.

(2)

1

2

(Total for Question 8 = 11 marks)



12-MARK QUESTIONS

1 question in this booklet



8 (a) Which statement describes conservation of energy in a closed system?

(1)

- ☐ **A** when there are energy transfers, the total energy reduces
- ☐ **B** when there are energy transfers, the total energy does not change
- ☐ **C** when there are no energy transfers, the total energy reduces
- ☐ **D** when there are no energy transfers, the total energy increases

(b) A student uses the apparatus in Figure 12 to find out which of two materials, sand or sawdust, is the better insulator.

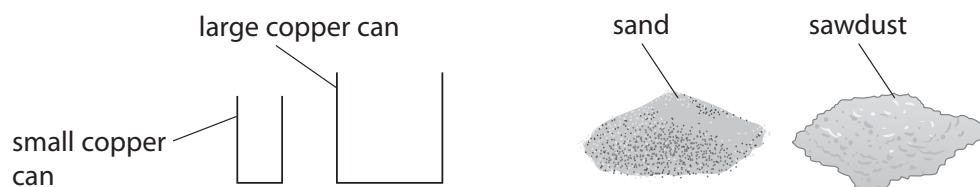


Figure 12

The student also has a kettle to boil water, a thermometer and a stop clock.

- (i) Draw a labelled diagram to show how the student should set up the equipment to investigate which material is the better insulator.

(3)

(ii) Give **three** factors that the student must control in this investigation.

(3)

1.....

2.....

3.....

(c) Expanded polystyrene, used to insulate buildings, has different densities.

Figure 13 shows how the thermal conductivity of expanded polystyrene changes with the density of expanded polystyrene.

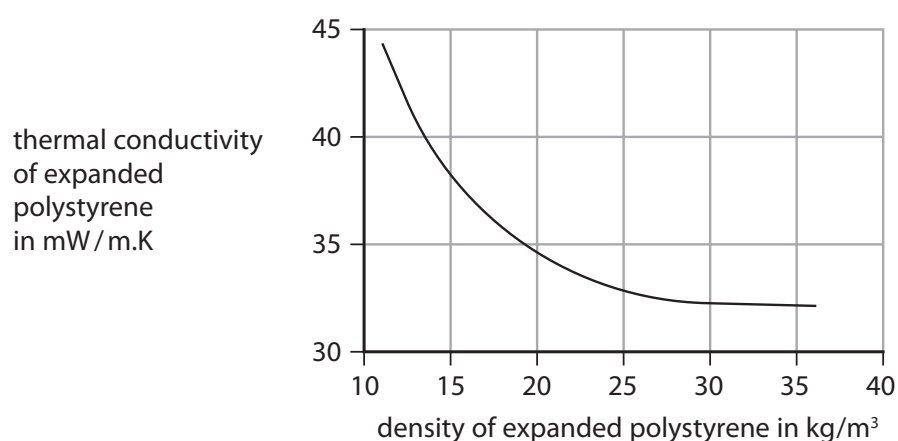


Figure 13

Using the graph in Figure 13, describe how the thermal conductivity of expanded polystyrene changes with the density of expanded polystyrene.

(2)

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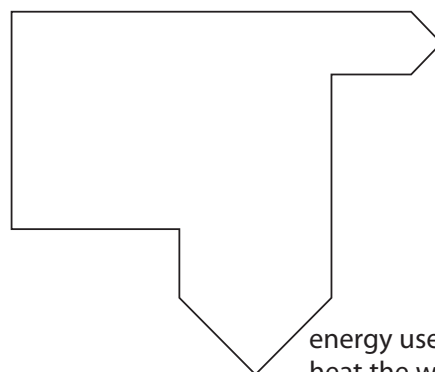
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(d) Figure 14 is an energy diagram for an electric kettle, used to heat water.

energy supplied
to the kettle in
one second = 3000 J



energy lost to the
surroundings in
one second

energy used to
heat the water in
one second = 2400 J

Figure 14

(i) Calculate the amount of energy lost to the surroundings in one second.

(1)

energy lost to the surroundings in one second = ... J

(ii) Calculate the efficiency of the kettle.

Use the equation

$$\text{efficiency} = \frac{\text{useful energy transferred by the kettle in one second}}{\text{total energy supplied to the kettle in one second}}$$

(2)

efficiency = ...

(Total for Question 8 = 12 marks)

13-MARK QUESTIONS

1 question in this booklet



- 9 (a) Figure 17 shows a football kicked against a wall.

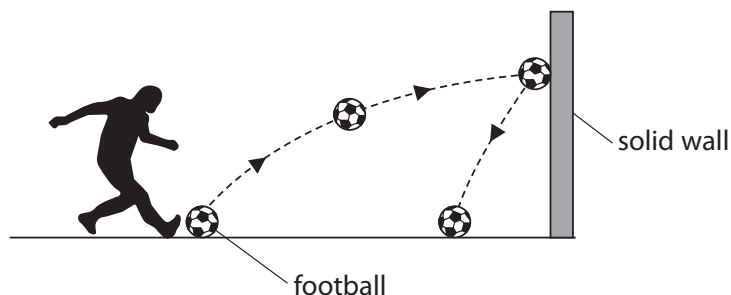


Figure 17

The football has a mass of 0.42 kg.

- (i) The football gains 11 J of gravitational potential energy as it moves from the ground to the wall.

Calculate the height at which the ball hits the wall.

(3)

Gravitational field strength = 10 N/kg

Use the equation

$$\Delta GPE = m \times g \times \Delta h$$

height = ... m

- (ii) Calculate the kinetic energy of the football when it is moving at a velocity of 12 m/s.

(2)

Use the equation

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

kinetic energy = ... J

(iii) Describe the energy transfers that happen when the ball hits the wall.

(2)

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*(b) In the UK, electricity is generated using non-renewable and renewable energy resources.

The graph in Figure 18 shows how the amount of electricity generated by these resources changed from 2012 to 2020.

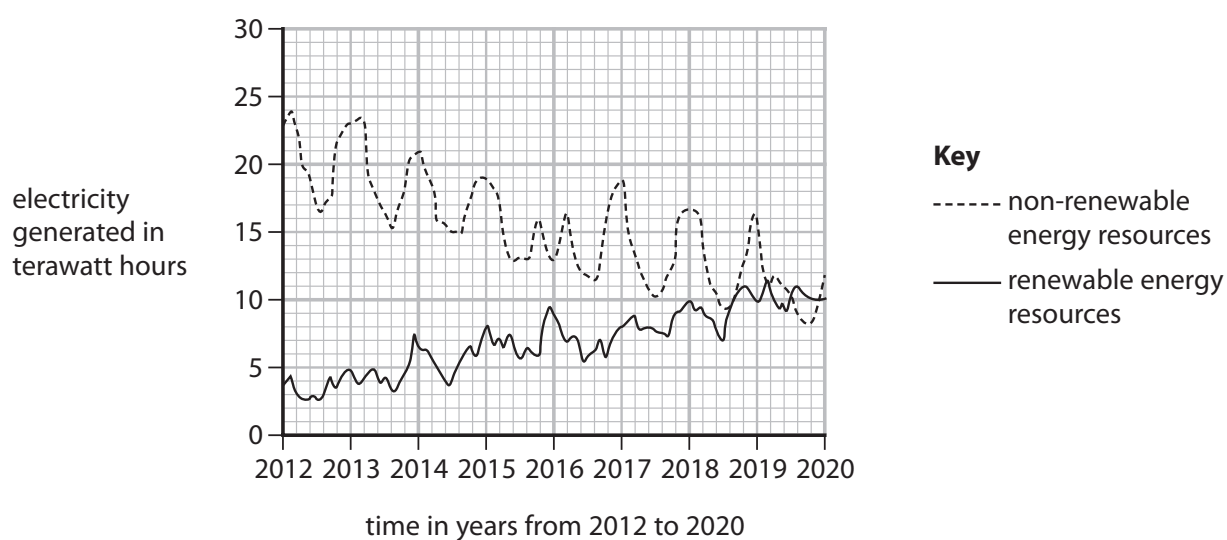


Figure 18



Explain how and why the amount of electricity generated by renewable and non-renewable energy resources has changed from 2012 to 2020.

Your answer should include

- the trends shown in Figure 18
- the change in the amount of electricity generated by at least one renewable resource
- the change in the amount of electricity generated by at least one non-renewable resource.

(Total for Question 9 = 13 marks)



MARK SCHEMES

official Pearson Edexcel mark schemes



Question Number	Answer	Additional guidance	Mark
3(a)(i)	points plotted to within ± 1 small square (10, 60) (1) (20, 37) (1)		(2) AO 2 1

Question Number	Answer	Additional guidance	Mark
3(a)(ii)	point at 15,55 circled (1)		(1) AO 2 1

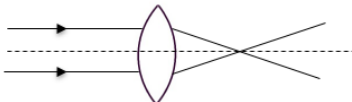
Question Number	Answer	Additional guidance	Mark
3(a)(iii)	best fit curve passing through most of the points seen, apart from 15,55 (1)	reject tramlining (multiple lines/curves) ignore slight shakiness in drawing	(1) AO 3 2a

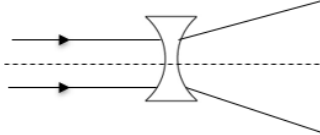
Question Number	Answer	Additional guidance	Mark
3(a)(iv)	the curve will be above the first one (starting at the same point) / it will take longer to cool down / cools more slowly (1)	less steep ignore all comments about heat / the process; the question is about the curve	(1) AO 2 1

Question Number	Answer	Additional guidance	Mark
3(b)(i)	wavelength for object L = 84.(0) to 85.(0) (μm) (1) wavelength for object M = 93.(0) to 95.(0)(μm) (1)	estimates, so we are being generous with this	(2) AO 3 2a

Question Number	Answer	Additional guidance	Mark
3(b)(ii)	object L and shorter wavelength (1)		(1) AO 3 1a

(Total for Question 3 = 8 marks)

Question number	Answer	Additional guidance	Mark
4(a)(i)	rays converging	 arrows not needed	(1)

Question number	Answer	Additional guidance	Mark
4(a)(ii)	rays diverging	 arrows not needed award 1 mark if convergence and divergence are shown but with the wrong lenses	(1)

Question number	Answer	Additional guidance	Mark
4(a)(iii)	substitution (1) $\frac{1}{25(\times 10^{-2})}$ evaluation (1) 4(.0)	or 0.04 seen ignore powers of ten until evaluation award full marks for the correct answer without working	(2)

Question number	Answer	Additional guidance	Mark
4(b)(i)	line shown on graph from intersection of two curves (1) answer in range 11 – 13 (minutes) inclusive (1)	award full marks for the correct answer without working	(2)

Question number	Answer	Mark
4(b)(ii)	☒ C 10 °C	(1)

Question number	Answer	Additional guidance	Mark
4(b)(iii)	an explanation linking: the gradient for P is greater/steeper than the gradient for Q (1) (because) P/black is a better emitter (of radiation) (than Q/white) (1)	P cools quicker than Q P loses thermal energy/heat quicker than Q allow reverse arguments credit answers in terms of absorption in this context	(2)

(Total for Question 4 = 9 marks)

6 (a)(i)	any value between 21 and 54 inclusive		(1) AO3
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Question Number	Answer	Additional guidance	Mark
6 (b)	a description including any two from (at low wavelength) intensity increases (as wavelength increases) (1) after peak/at long wavelengths intensity decreases (as the wavelength increase)(1) intensity peaks between 7 and 10(μm) or between 1.0 and 1.2 ($\mu\text{W}/\text{m}^2$) (1)	allow use of data from the graph to indicate the peak	(2) AO3

Question Number	Answer	Additional guidance	Mark
6 (c)	a description including any four from one method Using temperature change method: any one control (1) start the stopclock and switch on the heater (at the same time) (1) measure over a certain time (1) measure final temperature of each (1) largest temperature difference/rise gives better absorbing surface (1) Using time change method: any one control (1) switch on the heater and start the stopclock (at the same time) (1) measure time taken (1) to reach a certain temperature (1) quickest time to reach a certain temperature gives better absorbing surface (1)	allow testing each can separately (two experiments) same distance from heater same volume/mass of water allow same volume/surface area of cans lids on both cans start the stopclock and measure initial temperature (at the same time) Accept 'highest temperature is better' same distance from heater same volume/mass of water allow same volume/surface area of cans lids on both cans accept 'fastest (to reach temperature) is better'	(4) AO1

Total for Question 6 =9 marks

	Answer	Mark
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Question Number	Answer	Additional guidance	Mark
4(a)(i)	kinetic (1)	only (adding another incorrect alternative negates)	(1) AO 2 1

Question Number	Answer	Additional guidance	Mark
4(a)(ii)	any one of increase the speed (of spinning) (1) increase the mass / weight (of the flywheel) (1)	accept (idea of) faster ignore make it bigger	(1) AO 2 1

Question Number	Answer	Additional guidance	Mark
4(b)(i)	substitution (1) ($\Delta GPE =$) $65 \times 10 \times 200$ evaluation (1) 1.3×10^5 / 130 000 (J)	allow substitution mark with 65000 (g) allow 1 mark for answers that round to 1.3 with any other power of ten do not allow 13000 award full marks for the correct answer without working	(2) AO 2 1

Question Number	Answer	Additional guidance	Mark
4(b)(ii)	substitution (1) (KE) $\frac{1}{2} \times 65 \times 36^2$ squaring (1) 36^2 (=1296) (completing) evaluation (1) $42\,120$ / $4.2(1) \times 10^4$ (J)	using $36 \rightarrow 1170$ (J) OR $36 \times 2 \rightarrow 2340$ (J) scores 2 marks (apply power of ten error as well if occurring e.g. 117000 (J) gets 1 mark) award full marks for the correct answer without working allow 2 marks for answers that round to 4.2 with any other power of ten omitting $\frac{1}{2}$ gives 84240(J) scores 2 marks	(3) AO 2 1

Question Number	Answer	Additional guidance	Mark
4(c)	a description to include 3 points from: • measure a distance (at the bottom) / use mark(er)s (certain distance apart) (1) • starting timer (at first mark(er)) (1) • stopping timer (at 2nd mark(er)) OR measures a time (interval) (1) • (use speed) = distance/time (1)	use a light gate (or equivalent sensors idea) not over whole slope for this mark point use of video / (speed) camera /interrupts the light beam accept any time measured for this mp including data logger OR timer / stopwatch	(3) AO 2 2

(Total for Question 4 = 10 marks)



Question number	Answer	Additional guidance	Mark
4 (a)(i)	substitution (1) $(\Delta GPE \Rightarrow) 64 \times 10 \times 24$ evaluation (1) 15 000 (J)	accept 15 360(J) or 15 400(J) award full marks for correct answer without working.	(2) AO2

Question number	Answer	Additional guidance	Mark
4 (a)(ii)	substitution (1) $(KE =) \frac{1}{2} \times 64 \times 6^{(2)}$ calculation of 6^2 (1) evaluation (1) 1200 (J)	accept 1152(J) award full marks for correct answer without working. 192 (J) scores 2 marks	(3) AO2

Question number	Answer	Additional guidance	Mark
4(a)(iii)	an explanation linking any two from: the kinetic energy (store)/it decreases (to zero) (1) (the energy) has dissipated (1) to the surroundings (1) thermal energy (store) increases (1)	transferred to ground/brake(s) pads make the brakes hot	(2) AO2

Question number	Answer	Additional guidance	Mark
4 (b)(i)	5000(J)	24 000 – 19 000	(1) AO2

Question number	Answer	Additional guidance	Mark
4 (b)(ii)	substitution (1) (efficiency =) $\frac{19000}{24000} (\times 100\%)$ evaluation(1) 0.79 or 79%	allow 0.8 do not award 79 without percentage award full marks for correct answer without working.	(2) AO2

Total marks for Question 4 = 10

Question number	Answer	Additional guidance	Mark
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4(a)	substitution (1) $(\Delta GPE =) 57 \times 10 \times 2.1$ evaluation (1) $(\Delta GPE =) 1200 (J)$	ignore attempts to convert kg to g for this MP only 1197 allow numbers that round to 1200 no ecf from MP1 award full marks for the correct answer without working.	(2) AO2
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	Answer	Additional guidance	Mark
4(b)	select correct equation (1) $KE = \frac{1}{2} \times m \times v^2$ substitution (1) $(KE =) \frac{1}{2} \times 70 \times 8(.0)^{(2)}$ evaluation (1) $(KE =) 2200 (J)$	ignore attempts to convert kg to g for this MP only allow numbers that round to 2200 e.g. 2240 280 or 35×8 seen scores 2 marks award full marks for the correct answer without working.	(3) AO2

	Answer	Additional guidance	Mark
4(c)(i)	0.54 (s)	allow any value from 0.53 and 0.55 inclusive	(1) AO3

	Answer	Additional guidance	Mark
4(c)(ii)	curve extended to $\alpha = 80^\circ$ (1) 0.45 (s) (1)	judge generously allow range 0.42 to 0.48 award full marks for the correct answer without working.	(2) AO3

	Answer	Additional guidance	Mark
4(c)(iii)	mention/idea of reaction time (1) (reaction time) about the same as the times on the graph (1)	human reaction time is about 0.2 seconds (compared with) 0.4 seconds on the graph ignore accuracy ignore "human error"	(2) AO3

(Total for Question 4 = 10 marks)

Question Number	Answer	Additional guidance	Mark
6(a)	any two sources from: • oil • (natural) gas • coal • nuclear/uranium	accept petrol /diesel for oil accept fossil fuel(s) for any of the first three i.e. fossil fuel and oil or coal or gas scores 1 mark but fossil fuel and nuclear scores 2 marks	(2) AO 1 1

Question Number	Answer	Additional guidance	Mark
6(b)(i)	bioenergy	biofuel / biomass	(1) AO 3 1b

Question Number	Answer	Additional guidance	Mark
6(b)(ii)	largest area / fraction / percentage (idea)	must be referring to the chart , not just repeating 4bi stem- can't have greatest/ largest amount by itself	(1) AO 3 1b

Question Number	Answer	Additional guidance	Mark
6(b)(iii)	wind		(1) AO 3 1b

Question Number	Answer	Additional guidance	Mark
6(c)	discussion to involve two points each giving change and effect (max 4 marks) some examples: change: biomass-solar-geothermal (fraction) increases (1) effect: e.g. reduces greenhouse gas / CO₂ emissions (1) change: 'wind' (fraction) increases (1) effect: e.g. visual/noise pollution arguments (1) change: 'natural gas' (fraction) increases (1) effect: e.g. contributes to global warming (1) change: 'uranium' (fraction) decreases (1) effect: e.g. less radioactive waste (1)	ignore vague responses such as 'environmentally friendly', less pollution etc. candidates may give positive or negative effects for this change (and for oil) allow decreases (with a correct accompanying effect for 2 marks) accept conserves non-renewables but not just 'more renewable'	(4) AO 3 2a AO 3 2b

Question Number	Answer	Additional guidance	Mark
6(d)	an explanation linking use of lubrication / oil (1) to reduce friction (between parts) (1)		(2) AO 2 1

(Total for Question 6 = 11 marks)



Question number	Answer	Additional guidance	Mark
8 (a)	A description to include: mention relevant energy store such as GPE or chemical (1) 'correct' transfer in context (1)	allow KE or mechanical or thermal or heat chemical to (G)PE or chemical to KE (in lifting) allow misread GPE to KE/thermal on <u>slope</u> Allow KE to GPE in lifting	(2)

Question number	Answer	Additional guidance	Mark
8 (b)	A description to include: measurement of (relevant) distance (1) measurement of (relevant) time (1) use of speed = $\frac{\text{distance}}{\text{time}}$ (1) detail (1)	one of distance down slope or distance along bench or length of toy car/card 'record the distance the car travels and time it' scores 2 marks for example: speed down slope $\times 2$ <u>mark</u> distance along bench use a light gate speed gun at the bottom of the slope repeating AND averaging	(4)

Question number	Answer	Additional guidance	Mark
8 (c)	(vertical) height of slope (1) mass (of the toy car) (1)	allow (in this context) weight if no other mark scored allow 1 mark for quoting either equation (Δ)GPE = mgh OR KE = $\frac{1}{2} mv^2$	(2)

Question number	Answer	Additional guidance	Mark
8 (d)	(original) GPE – KE (at bottom) (1)	allow (idea of) input – output allow wrong way round (eg output-input)	(1)

Question number	Answer	Additional guidance	Mark
8(e)	An explanation linking: lubricate/oil the wheels (1) (to) reduce friction (1)	make the toy car more streamlined / different surface / lubricate slope reduce air resistance / drag accept start from lower down the slope (1) (to) reduce the total amount of energy (transfer) (1)	(2)

(Total for Question 8 = 11 marks)



Question number	Answer	Additional guidance	Mark
8 (a)	Substitution or rearrangement (1) $980 = 35 \times 10 \times h$ evaluation (1) $(h =) 2.8 \text{ (m)}$	$(\Delta h =) \frac{\Delta \text{GPE}}{m \times g}$ or $(\Delta h =) \frac{980}{35 \times 10}$ allow use of 9.8 N/kg or 9.81 N/kg allow substitution into visible incorrectly rearranged algebraic expression allow 2.85/2.86/2.9 for use of $g = 9.8 \text{ N/kg}$ or 9.81 N/kg ignore use of negative for decrease in GPE award full marks for the correct answer without working	2 AO2.1

Question number	Answer	Additional guidance	Mark
8 (b)	substitution (1) $(v^2) = \frac{950 \times 2}{35}$ evaluation of v^2 (1) 54(.29) evaluation of v (1) ($v =$) 7.4 (m/s)	accept values that round to 7.3(m/s) or 7.4(m/s) accept answer of 7 (one sig. fig.) award 2 marks for an answer that rounds to 54 (m/s) if no other mark scored allow 1 mark for an answer that rounds to 0.23 (m/s) (use of mass in g) award full marks for correct answer without working	3 A02.1

Question number	Answer	Additional guidance	Mark
8(c)(i)	thermal (energy/store) (1)	energy dissipated energy wasted energy lost energy transferred to surroundings energy transferred due to friction energy transferred due to air resistance allow heat (energy) ignore sound/not useful energy	1 AO2.1

Question number	Answer	Additional guidance	Mark
8 (c)(ii)	30 (J) (1)	accept -30	1 AO2.1

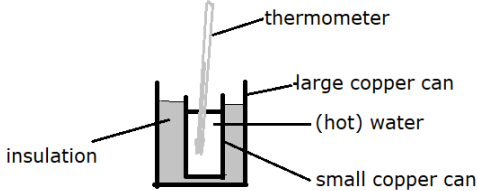
Question number	Answer	Additional guidance	Mark
8 (c)(iii)	substitution (1) $\frac{950}{980} (\times 100)$ evaluation (1) 0.97 OR 97%	 allow answers that round to 0.97 or 97% for 2 marks allow 1 mark for answers that round to 97 or 0.97% allow 1 mark for answers of 0.96 or 96% (truncated) award full marks for correct answer without working	2 AO2.1

Question number	Answer	Additional guidance	Mark
8 (d)	any two from reduce air resistance (1) lubricate (wheels) (1) push off (1)	be more aerodynamic crouch down	2 AO1.1

Total for question 8 = 11 marks



Question Number	Answer	Mark
8(a)	B. when there are energy transfers, the total energy does not change <i>A is not correct because the total energy does not reduce</i> <i>C is not correct because the total energy does not increase</i> <i>D is not correct because there must be no net change in the total energy</i>	(1) AO1

Question Number	Answer	Additional guidance	Mark
8(b)(i)	A diagram showing: apparatus labelled to include three from • thermometer • water • insulator / sand / sawdust/ material • (copper) can (1) thermometer in the water (1) arrangement for water and insulator in and between copper cans (e.g. as in diagram below) (1) 	independent of arrangement ignore kettle and stop clock accept reverse positions for water and insulator	(3) AO2

Question Number	Answer	Additional guidance	Mark
8(b)(ii)	any three factors from: {mass / volume} of water (1) {volume / thickness / mass} of insulators / materials (1) {starting / initial} temperature of water (1) time interval / temperature change (1)	accept amount / specified values / "how much" accept amount / specified values / "how much" accept temperature of hot / boiling water / specified values accept specified values of interval or change unqualified "same time" is insufficient	(3) AO3

	Answer	Additional guidance	Mark
8(c)	a description giving as the density (of expanded polystyrene) increases the (thermal) conductivity decreases (1) non-linear / gradient decreases / at a decreasing rate / levels off / plateaus / becomes (almost) constant (1)	ORA allow inversely proportional / exponential for non-linear in this context ignore negative correlation unqualified quoted values are insufficient	(2) AO3

	Answer	Additional guidance	Mark
8(d)(i)	600 (J)	accept 3000 – 2400 accept -600	(1) AO3

	Answer	Additional guidance	Mark
8(d)(ii)	substitution (1) (efficiency =) $\frac{2400}{3000}$ evaluation (1) 0.8(0)	allow $\frac{4}{5}$ accept 80 (%) award full marks for the correct answer without working allow 1.25 for 1 mark for selecting and evaluating from the correct pair of values	(2) AO3

(Total for Question 8 = 12 marks)

	Answer	Additional guidance	Mark
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Question number	Answer	Additional guidance	Mark
9 (a)(i)	substitution (1) $11 = 0.42 \times 10 \times \Delta h$ rearrangement (1) $(\Delta h =) \frac{11}{0.42 \times 10}$ evaluation (1) 2.6 (m)	accept substitution and rearrangement in either order $(\Delta h =) \frac{\Delta GPE}{m \times g}$ accept any value which rounds to 2.6 (m) award 2 marks for 2.6 to any other power of 10 allow 1 mark for 0.38 allow 1 mark for 46(.2) award full marks for the correct answer with no working give full credit for use of $g=9.8$ or 9.81 N/kg (gives 2.7 (m))	(3) AO2

Question number	Answer	Additional guidance	Mark
9 (a)(ii)	substitution(1) $(KE =) \frac{1}{2} \times 0.42 \times 12^2$ evaluation (1) 30 (J)	allow 30.2(4) (J) award 1 mark for 30 240 (J) award 1 mark for 2.52 (J) award 1 mark for 60.5 (J) award full marks for the correct answer with no working	(2) AO2

Question number	Answer	Additional guidance	Mark
9 (a)(iii)	A description including: KE/kinetic (energy store) (1) (transfers to) and one of: elastic (potential energy store) (1) OR thermal (energy of ball/wall/surroundings) (1) OR <u>dissipates</u> (to surroundings) (1)	allow mechanically / mechanical transfer ignore reference to gravitational potential energy allow heat for thermal allow sound in this context ignore reference to the ground	(2) AO2

Question number	Indicative content	Mark
9*(b)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO2,AO3 Non-renewable sources of energy trend: less used/decrease in use (between 2012 and 2019) fossil fuels coal, gas, oil are running out / finite resource / sustainability argument produce carbon dioxide/ sulphur dioxide/ greenhouse gases (when burned) in power stations cause pollution/ smoke particles /damage to the environment causes climate change / global warming production of greenhouse gases needs to be reduced (for Britain to become carbon neutral) nuclear fuels no carbon dioxide produced radioactive waste produced safety concerns Renewable sources of energy trend: more used /increase in use (between 2012 and 2019) renewable and non-renewable about equally used from 2019 solar, wind, hydroelectric, tidal, geothermal, wave and biomass never run out / are sustainable do not produce carbon dioxide/ greenhouse gases (except biomass) slow down climate change / global warming	(6) AO2, AO3



Level	Mark	Descriptor
	0	No awardable content
Level 1	1–2	- Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3) - The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
Level 2	3–4	- Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (AO3) - The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)
Level 3	5–6	- Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3) - The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)

Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> isolated facts about the resources, non-renewable or renewable OR the trend(s) in usage	<u>Possible candidate responses</u> coal is non-renewable and solar is renewable non-renewables are decreasing and renewables are increasing non-renewable resources are higher on (most of) the graph
Level 2	3–4	<u>Additional guidance</u> trend(s) AND limited explanation of the renewable trend OR limited explanation of the non-renewable trend	<u>Possible candidate responses</u> use of renewable resources is increasing because renewables are sustainable OR use of non-renewable resources are decreasing because they cause global warming
Level 3	5–6	<u>Additional guidance</u> both trends AND detailed explanation of one trend AND some explanation of the other trend	<u>Possible candidate responses</u> use of renewable resources are increasing and the use of non-renewable resources are decreasing because non-renewable resources are running out and wind turbines do not produce carbon dioxide

Total for question 9 =13 marks

	Answer	Additional guidance	Mark
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