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EDEXCEL COMBINED SCIENCE PHYSICS: QUESTIONS BY TOPIC

Conservation of Energy (3)

Combined Science Physics (Foundation) Topic 3

6 questions · 64 marks · Mark schemes included

Pearson Edexcel Combined Science (9-1) Physics 1SC0, Foundation Tier, June 2018 - June 2025

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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
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QUESTIONS

6 questions · 64 marks · lowest tariff first

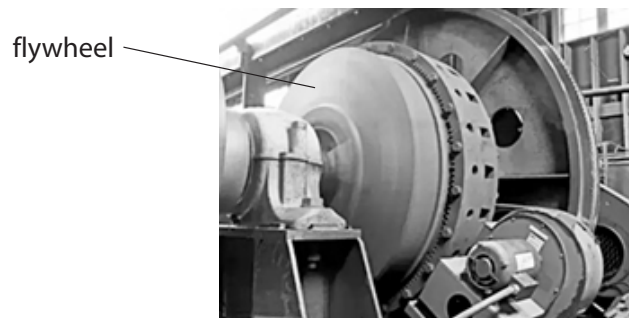


10-MARK QUESTIONS

3 questions in this booklet



- 3 (a) Figure 3 shows a spinning flywheel.



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Figure 3

- (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 4 shows a skier going down a hill.

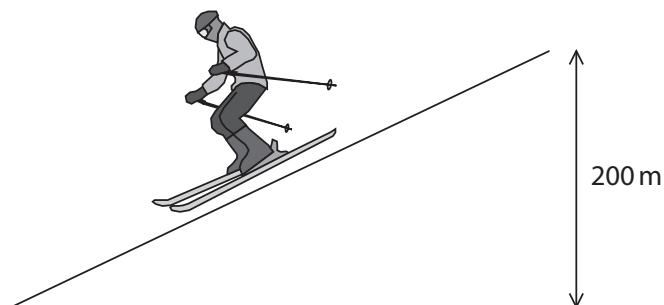


Figure 4

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 3 = 10 marks)



2 (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)

.....

.....

.....

.....

(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.

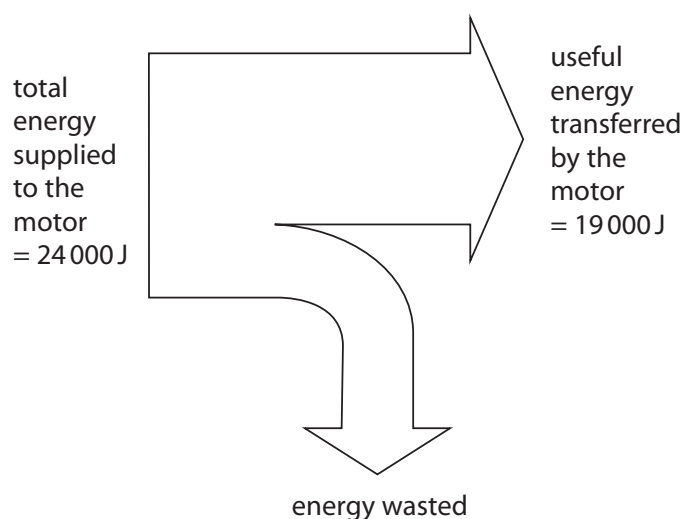


Figure 3

(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 2 = 10 marks)



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

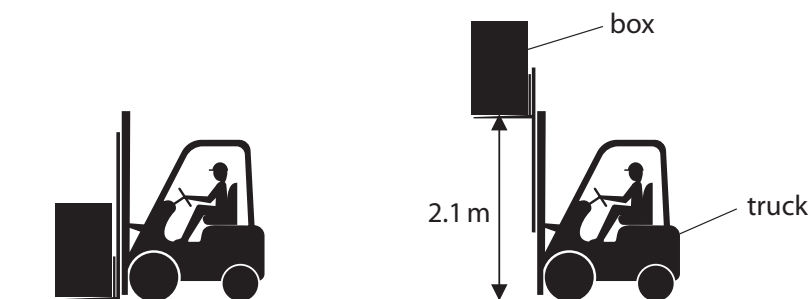


Figure 4

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 5 shows a trolley at the top of a slope.

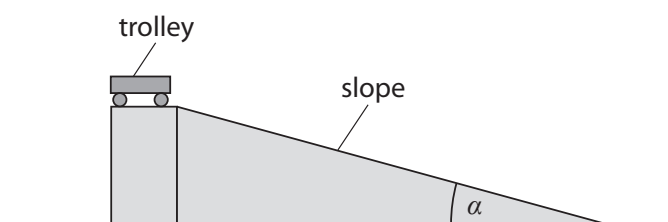


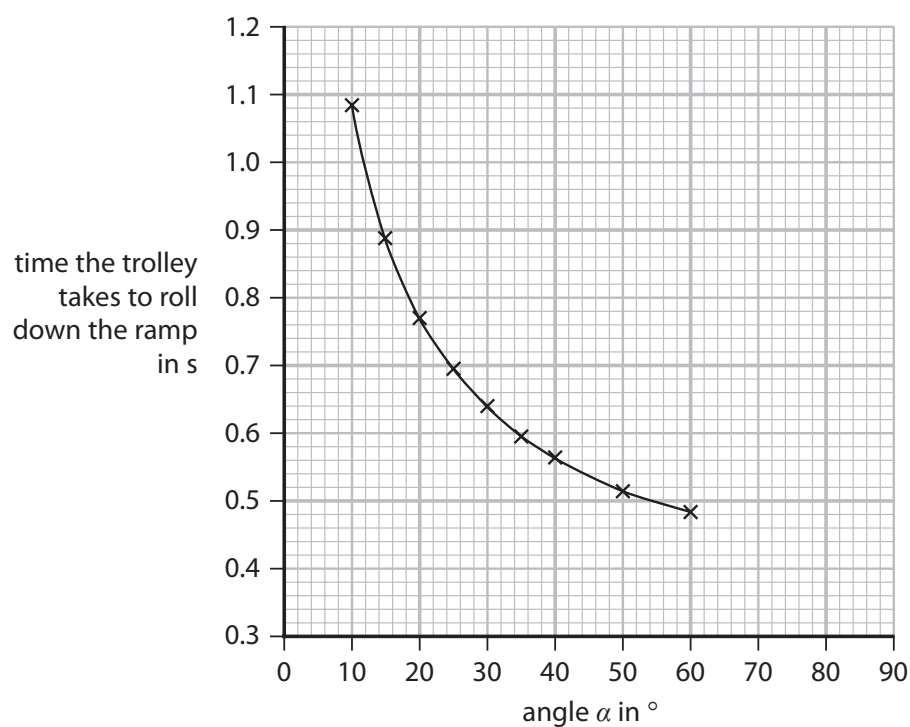
Figure 5

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 6 is a graph of the student's results.

**Figure 6**

- (i) Use the graph in Figure 6 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 6 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 6 in your answer.

(2)

(Total for Question 3 = 10 marks)



11-MARK QUESTIONS

2 questions in this booklet



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

(2)

1.....

2.....

(b) Figure 5 shows the renewable energy sources used in the UK in 2015.

Figure 5 is to scale.

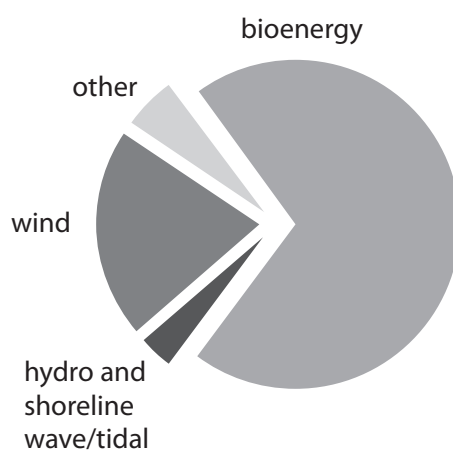


Figure 5

(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 6 shows all the energy sources used in Canada in 2014 and a prediction for 2040.

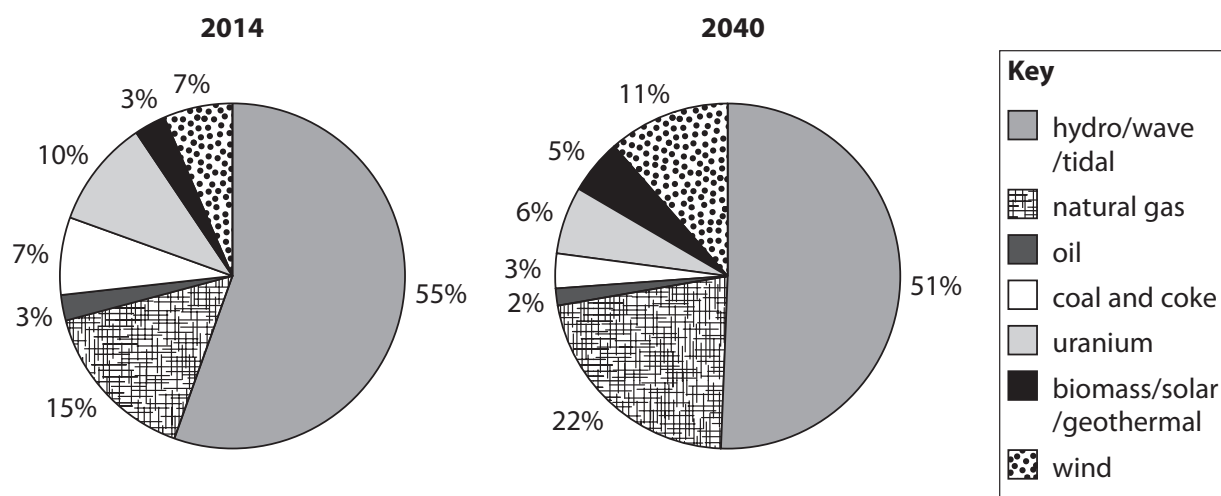


Figure 6

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 7 shows a wind turbine.

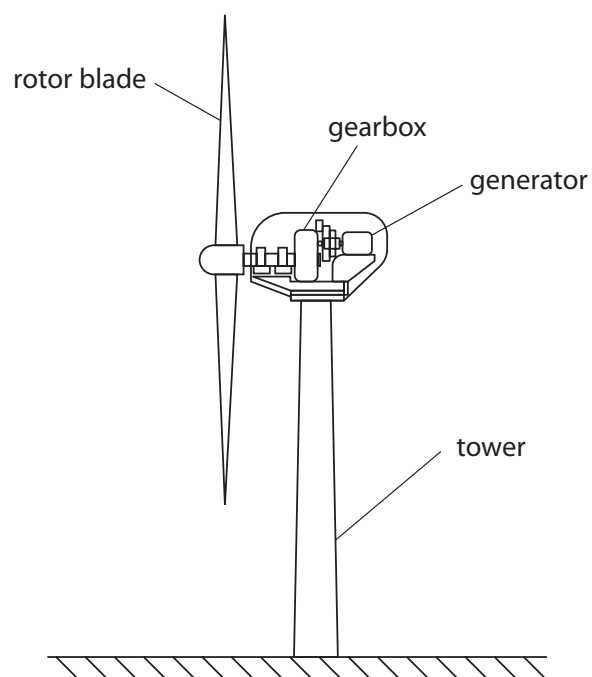


Figure 7

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

(2)

.....

.....

.....

.....

(Total for Question 4 = 11 marks)

5 Figure 9 shows a person on a skateboard at the top of a ramp.

At P, the person is not moving.

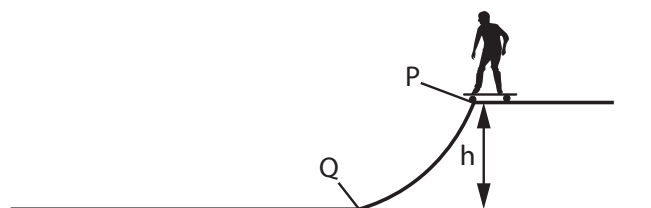


Figure 9

(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 10 is a diagram that represents energy changes from P to Q.

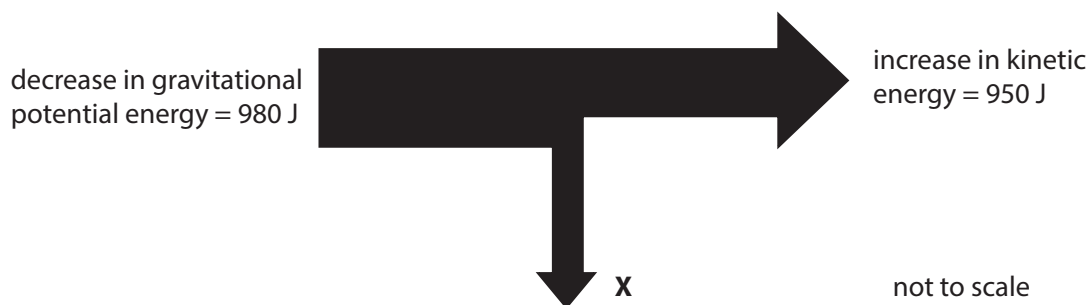


Figure 10

(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 10.

(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 5 = 11 marks)



12-MARK QUESTIONS

1 question in this booklet



5 (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 9 to find out which of two materials, sand or sawdust, is the better insulator.



Figure 9

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

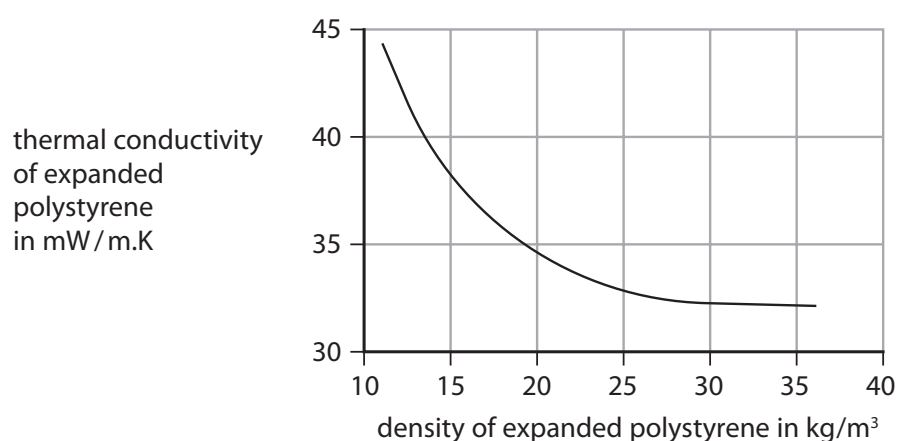


Figure 10

Using the graph in Figure 10, describe how the thermal conductivity of expanded polystyrene changes with the density of expanded polystyrene.

(2)

.....

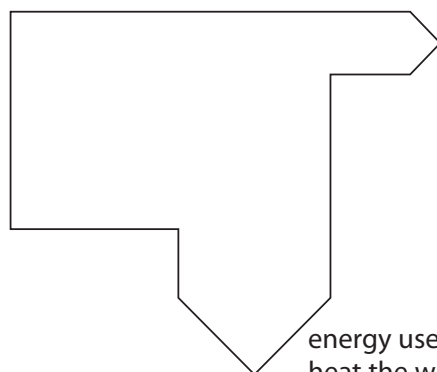
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(d) Figure 11 is an energy diagram for an electric kettle, used to heat water.

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 11

(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 5 = 12 marks)

MARK SCHEMES

official Pearson Edexcel mark schemes



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

Question Number	Answer	Additional guidance	Mark
3(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
3(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
3(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
3(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 3 = 10 marks)

Question number	Answer	Additional guidance	Mark
2 (a)(i)	substitution (1) ($\Delta GPE =$) $64 \times 10 \times 24$ 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
2 (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
2(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
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Question number	Answer	Additional guidance	Mark
2 (b)(ii)	substitution (1) $(\text{efficiency} =) \frac{19000}{24000} (\times 100\%)$ 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 2 = 10



3(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
3(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
3(c)(i)	0.54 (s)	allow any value from 0.53 and 0.55 inclusive	(1) AO3

	Answer	Additional guidance	Mark
3(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
3(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 3 = 10 marks)

	Answer	Additional guidance	Mark
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Question Number	Answer	Additional guidance	Mark
4(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
4(b)(i)	bioenergy	biofuel / biomass	(1) AO 3 1b

Question Number	Answer	Additional guidance	Mark
4(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
4(b)(iii)	wind		(1) AO 3 1b

Question Number	Answer	Additional guidance	Mark
4(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
4(d)	an explanation linking use of lubrication / oil (1) to reduce friction (between parts) (1)		(2) AO 2 1

(Total for Question 4 = 11 marks)



Question number	Answer	Additional guidance	Mark
5 (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
5(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

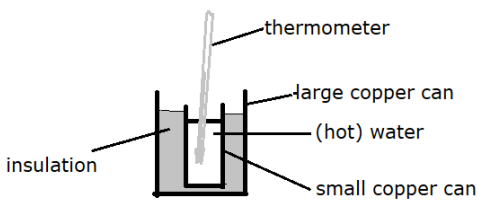
Question number	Answer	Additional guidance	Mark
5 (c)(ii)	30 (J) (1)	accept -30	1 AO2.1

Question number	Answer	Additional guidance	Mark
5 (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
5 (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 5 = 11 marks

Question Number	Answer	Mark
5(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
5(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
5(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
5(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
5(d)(i)	600 (J)	accept 3000 – 2400 accept -600	(1) A03

	Answer	Additional guidance	Mark
5(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) A03

(Total for Question 5 = 12 marks)

	Answer	Additional guidance	Mark
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