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EDEXCEL COMBINED SCIENCE PHYSICS: QUESTIONS BY TOPIC

Energy - Forces Doing Work (8)

Combined Science Physics (Foundation) Topic 8

6 questions · 62 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
1.	**Q4**	Paper 2 November 2021	9	**4**
2.	**Q4**	Paper 2 June 2023	9	**7**
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QUESTIONS

6 questions · 62 marks · lowest tariff first

9-MARK QUESTIONS

2 questions in this booklet

4 This question is about energy changes.

(a) Figure 8 shows a water slide.
A person travels from the top to the bottom of the water slide.

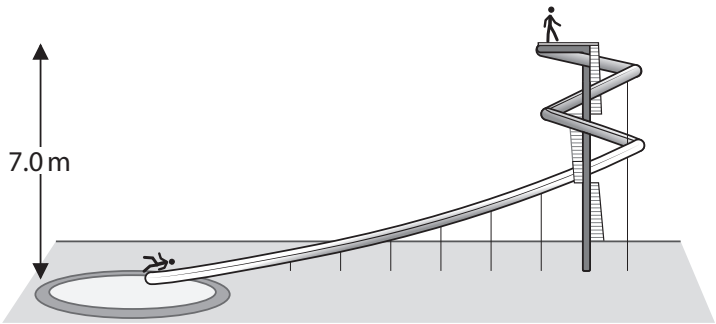

Figure 8

(i) The mass of the person, $m = 72$ kg.
The change in vertical height, $h = 7.0$ m
Gravitational field strength, $g = 10$ N / kg

Calculate the change in gravitational potential energy for the person.

Use the equation

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

(2)

change in gravitational potential energy = ... J

(ii) The person comes to rest after the end of the water slide.

Explain what happens to the energy as the person comes to rest after the end of the water slide.

(2)

.....

.....

(b) Figure 9 shows a person pushing a box from the bottom of a slope to the top of the slope.

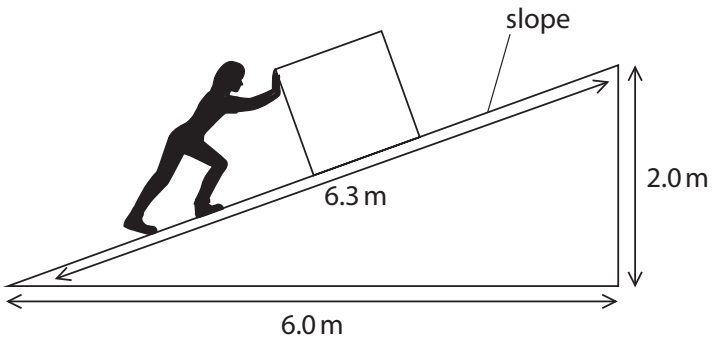

Figure 9

Explain which one of the three distances shown in Figure 9 should be used to calculate the work done against the force of friction between the box and the slope.

(2)

.....

.....

.....

.....

(c) Calculate the kinetic energy of a tennis ball travelling at 28 m/s.
The mass of the tennis ball = 58 g.

Use the equation

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

(3)

kinetic energy = ... J

(Total for Question 4 = 9 marks)

4 This question is about energy transfers.

Figure 8 shows the apparatus used for investigating the transfer between gravitational potential energy and kinetic energy.

A metal ball is attached to a thread.

The ball is released from a starting position and swings on the thread.

The ball cuts a light beam at the bottom of its swing.

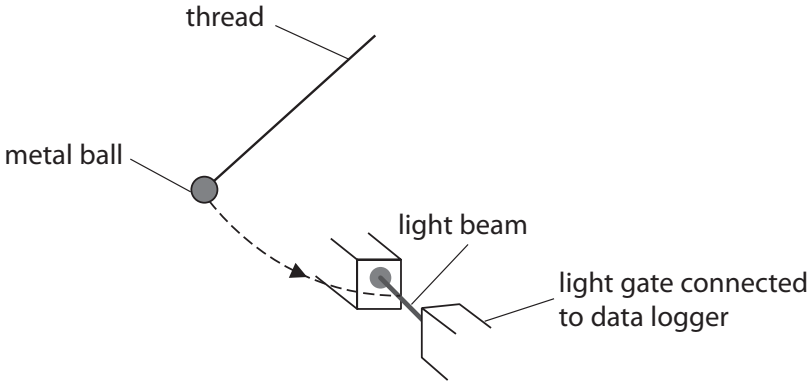

Figure 8

When the ball cuts the light beam, the speed of the ball is recorded by the data logger.

The ball was released 3 times from the same height and the speed measured each time.

The measurements of speed are given in Figure 9.

speed in m/s	1.31	1.27	1.16

Figure 9

(a) Calculate the mean speed.

(2)

mean speed = ... m/s

(b) Suggest **one** reason why the measurements of speed were repeated.

(1)

.....

.....

(c) The mass of the ball is 0.052 kg.

The ball falls through a vertical height (Δh) of 5.0 cm as it swings.

The gravitational field strength, g, is 10 N/kg.

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

Use the equation

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

(3)

change in gravitational potential energy = ... J

(d) Figure 10 shows an end-on view of the ball's swing from its starting position.

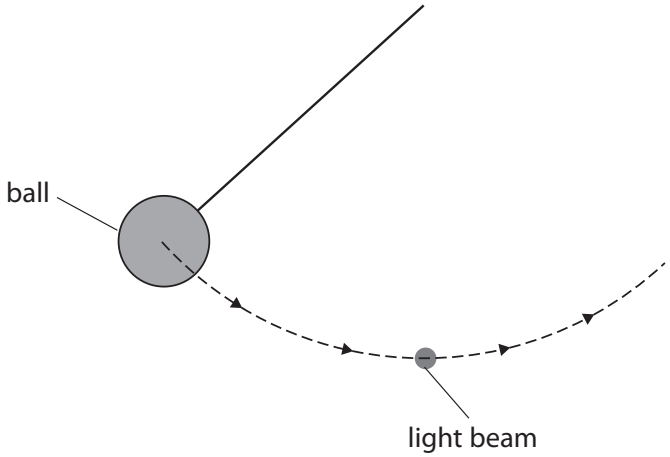

Figure 10

(i) To measure the change in vertical height, Δh, through which the ball moves, a ruler could be used.

Draw a ruler on Figure 10, placed in a position to measure the change in vertical height Δh.

(1)

(ii) Figure 11 shows a set square.

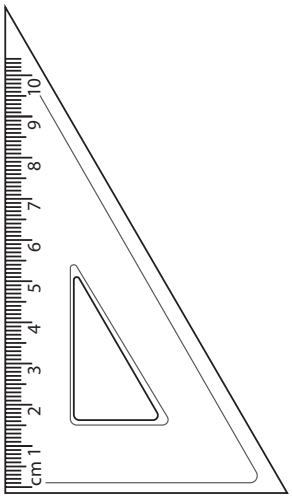

Figure 11

Describe how the measurement of the change in vertical height, Δh, could be improved using the set square.

You may add to Figure 10 or Figure 11 to help your description.

(2)

.....

.....

.....

.....

(Total for Question 4 = 9 marks)

10-MARK QUESTIONS

2 questions in this booklet

4 Three students carry out an investigation to determine their powers when running up stairs.

(a) Figure 7 shows a diagram of the stairs with four distances, A, B, C and D, marked.

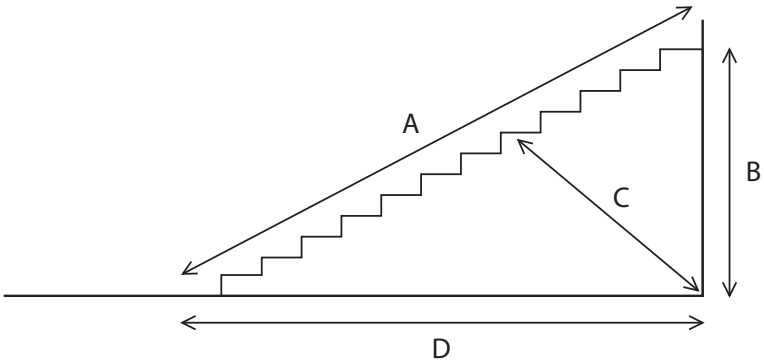

Figure 7

The students need to calculate the work done against gravity.

Which distance should be used in the calculation?

(1)

☒ **A** A

☒ **B** B

☒ **C** C

☒ **D** D

(b) They take turns to run up the stairs and use a stopwatch to measure the time taken.

The students estimate their own weight.

Figure 8 shows a table of their results.

The table is not complete.

student	student estimate of weight in N	distance in m	work done	time taken in s	power in W
A	550	4.0	2200	5.0	440
B		4.0	1960	4.5	436
C	510	4.0	2040		425

Figure 8

(i) State the unit for work done.

(1)

unit for work done is .....

(ii) Use the data for student B to calculate his estimated weight.

(2)

weight = ... N

(iii) Use the data for student C to calculate the time she takes.

(2)

time taken = ... s

(iv) Use the data for all three students to calculate the average power of the students.

(2)

average power = ... W

(c) Identify a significant source of error in the investigation and state how this error can be reduced.

(2)

source of error

.....

.....

can be reduced by

.....

.....

(Total for Question 4 = 10 marks)

3 (a) Figure 5 shows a truck on a horizontal road.

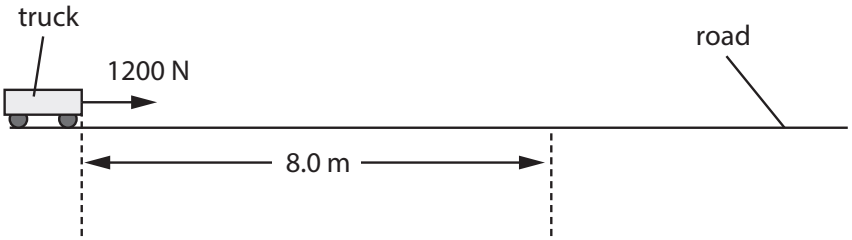

Figure 5

(i) A force of 1200 N pulls the truck along the road for a distance of 8.0 m.

Calculate the work done by the 1200 N force.

Use the equation

work done = force × distance moved in the direction of the force

State the unit of work done.

(3)

work done = ...

unit .....

(ii) At 8.0 m the force is removed and the truck slows down until it stops.

Describe the energy transfers as the truck slows down.

(2)

.....

.....

.....

.....

(b) A box has a mass of 90 kg.

Which of these is the weight of the box?

(1)

☒ **A** 9 N

☒ **B** 90 N

☒ **C** 900 N

☒ **D** 9000 N

(c) Figure 6 shows a truck lifting a different box.

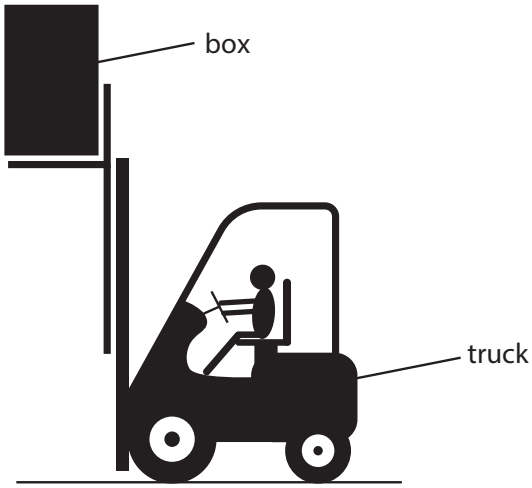

Figure 6

A student calculates the change in gravitational potential energy, ΔGPE, for the box at different heights.

Figure 7 shows the results of the student's calculations.

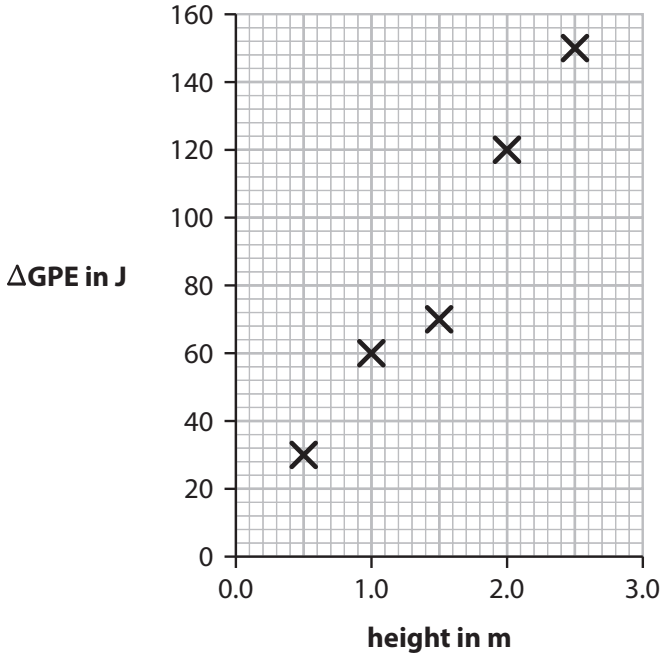

Figure 7

(i) The student has made one incorrect calculation.

On Figure 7, draw a circle round the ✕ for this incorrect calculation.

(1)

(ii) The truck lifts the box from the ground to a height of 2.0 m.

This takes a time of 5.0 s.

Using data from the graph in Figure 7, calculate the power needed to lift the box.

(3)

Use the equation

$$\text{power} = \frac{\Delta GPE}{\text{time}}$$

power = ... W

(Total for Question 3 = 10 marks)

11-MARK QUESTIONS

1 question in this booklet

5 (a) A student places a trolley at the top of a runway, as shown in Figure 9.

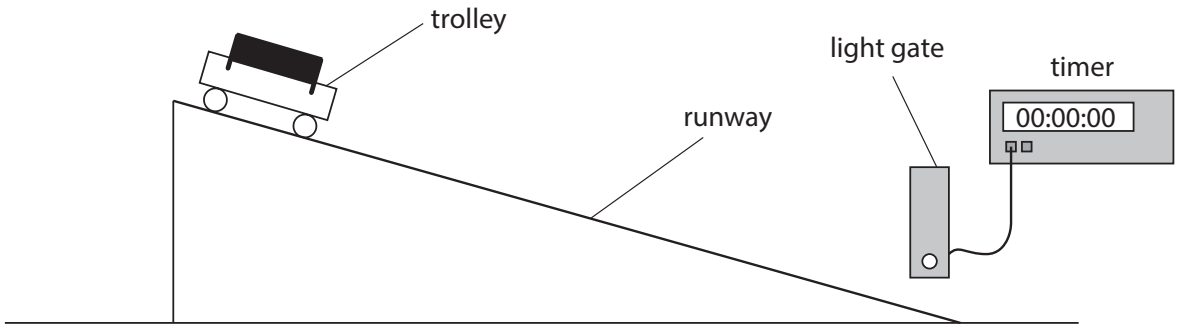

Figure 9

The student had to lift the trolley through a height of 26 cm to put it at the top of the runway.

The gravitational potential energy, ΔGPE, of the trolley increases by 4.1 J when lifted to the top of the runway.

The gravitational field strength, g, = 10 N / kg.

(i) Show that the mass of the trolley is about 1.6 kg.

Use the equation

$$m = \frac{\Delta GPE}{g \times \Delta h}$$

(2)

(ii) The student releases the trolley and the trolley moves down the runway.

The student assumes that all the extra gravitational potential energy, ΔGPE, stored at the top of the runway is transferred to kinetic energy at the end of the runway.

Calculate the expected value of the velocity of the trolley at the end of the runway.

Use the equation

$$v^2 = \frac{2 \times \Delta GPE}{m}$$

(3)

expected velocity = ... m / s

(iii) The light gate, shown in Figure 9, is used to determine the actual velocity of the trolley at the end of the runway.

The actual velocity at the end of the runway is less than the expected velocity as calculated in part (ii).

Suggest **one** way to reduce the difference between the actual velocity and the expected velocity.

(1)

.....

.....

(b) (i) A different student finds out how much power can be generated by running up some stairs in a measured amount of time.

The following quantities are measured:

mass of student = 48 kg

total height of stairs = 2.9 m

time to run up stairs = 3.4 s

Calculate the power the student generated.

Give the answer to 2 significant figures (2 s.f.).

Use the equation

$$\text{power} = \frac{\text{weight of student} \times \text{height of stairs}}{\text{time to run up stairs}}$$

(3)

power = ... W

(ii) Explain how the total height of the stairs can be found using a 50 cm ruler.

(2)

.....

.....

.....

.....

(Total for Question 5 = 11 marks)

13-MARK QUESTIONS

1 question in this booklet

6 A cyclist is riding a bicycle at a steady velocity of 12 m/s.

The cyclist and bicycle have a total mass of 68 kg.

(a) Calculate the kinetic energy of the cyclist and bicycle.

Use the equation

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

(2)

kinetic energy = ... J

(b) Describe the energy transfers that happen when the cyclist uses the brakes to stop.

(2)

.....

.....

.....

.....

(c) The cyclist starts to cycle again.

The cyclist does 1600 J of useful work to travel 28 m.

Calculate the average force the cyclist exerts.

(3)

average force = ... N

*(d) A class of students investigate the power output of each student in the class.

The class must decide whether they use a method using steps or a method using weights. The whole class must use the same method.

Plan what measurements the students should take and how these can be used to calculate and compare the power output of each student.

You may draw a diagram to help with your plan.

(6)

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(Total for Question 6 = 13 marks)

MARK SCHEMES

official Pearson Edexcel mark schemes

Question number	Answer	Additional guidance	Mark
4(a)i	substitution (1) $(\Delta GPE) = 72 \times 10 \times 7.0$ evaluation (1) 5040 (J)	do not penalise any power of ten error (p.o.t.e.) at this stage do not accept an answer without value for g (10) being used) award full marks for correct answer without working	(2) AO2

Question number	Answer	Additional guidance	Mark
4aii	an explanation to include (potential / kinetic) energy is transferred / dissipated (1) to surroundings / water / air / slide (1)	 accept lost / deceases accept friction / air resistance acts accept to **thermal** (store)	(2) AO3

Question number	Answer	Additional guidance	Mark
4b	Explanation linking **two** from: choice of distance (1) 6.3 m (calculations of work done need) the distance moved in the direction of the force (1) (friction acts) along the slope / hypotenuse (1)	 accept pushed up the slope	(2) AO3

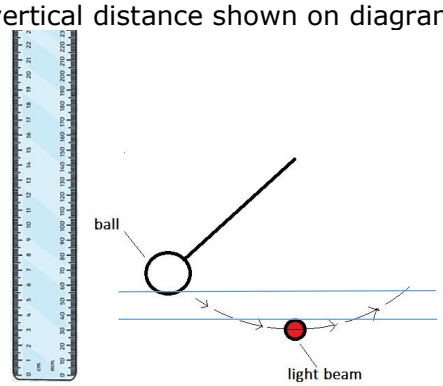
Question number	Answer	Additional guidance	Mark
4 (c)	substitution (1) $KE = ½ \times 58\left(\times 10^{-3}\right) \times 28^2$ conversion (1) uses 58×10^{-3} or 0.058 evaluation (1) 23 (J)	do not penalise p.o.t.e. at this stage award full marks for any answer that rounds to 23 (e.g. 22.736) (J) award max two marks for any answer that rounds to 2.3 to any other power of 10 consolation mark for not squaring 28 (8.1(2) to any p.o.t.) (maximum 1 mark)	**(3)** **AO2**

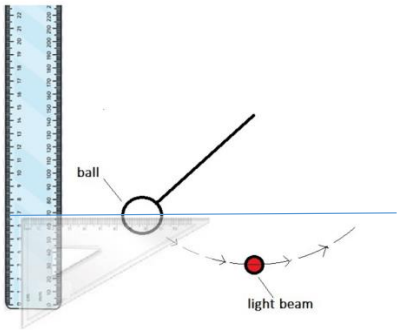
(Total for Question 4 = 9 marks)

Question number	Answer	Additional guidance	Mark
4 (a)	substitution (1) (mean speed) $= \frac{1.31 + 1.27 + 1.16}{3}$ evaluation (1) speed = 1.25 (m/s)	 $\frac{3.74}{3}$ any number that rounds to 1.25 (m/s) e.g. 1.247 accept 1.2 or 1.3 allow 1.24 award full marks for the correct answer without working	(**2**) AO2

Question number	Answer	Additional guidance	Mark
4 (b)	any one idea from • identifying anomalous results (1) • improve reliability (1) • uncertainty in starting point (1)	ignore accuracy check if results are precise allow more precise	(**1**) AO1

Question number	Answer	Additional guidance	Mark
4 (c)	substitutions (2) $(\Delta GPE = m \times g \times \Delta h)$ = 0.052 x 10 x (0.0)5 (1) converts 5 cm to 0.05 m (1) evaluation (1) = 0.026 (J)	 0.05 seen award full marks for the correct answer without working 0.026 to any other power of ten scores 2 marks	(**3**) AO2

Question number	Answer	Additional guidance	Mark
4 (d) i	ruler / line / rectangle shown vertically, must include minimum vertical distance shown on diagram (1)  	judge by eye accept any vertical line covering the minimum vertical distance	(**1**) AO3

Question number	Answer	Additional guidance	Mark
4 (d) ii	description to include set square placed against ruler (to measure vertical position) (1) (one edge of set square placed at) right angles / perpendicular / 90° (to ruler) (1) (set square used to) make ruler vertical (1)	accept reasonable alternatives on a diagram or explained in writing accept one edge of the set square shown as vertical in diagram full marks may be awarded from additions to Figure 10 or 11 e.g.  allow 2 marks for any horizontal line (set square use) on the diagram drawn through / touching a vertical ruler if no other mark scored allow 1 mark for improving accuracy	(**2**) AO3

Total for Q4 = 9 marks

Question number	Answer	Additional guidance	Mark
4 (a)	B A, C and D are incorrect because these do not measure the vertical change in height above the earth's surface.		**(1)** **AO1**

Question number	Answer	Additional guidance	Mark
4 (b)(i)	joule(s)	J j Nm newton metre(s) kg m^2 s^{-2} kg m^2/s^2 Ignore SI prefixes do not accept nm	**(1)** **AO1**

Question number	Answer	Additional guidance	Mark
4 (b)(ii)	selection of and substitution into E = F x d (1) 1960 = weight x 4.0 rearrangement and evaluation (1) (weight =) 490 (N)	accept P x t = F x d 436 x 4.5 = weight x 4.0 490.5 or 491 award full marks for the correct answer without working 530 scores 1 mark (used data to calculate median value)	**(2)** **AO2**

Question number	Answer	Additional guidance	Mark
4 (b)(iii)	selection of and substitution into P = E÷t (1) 425 = 2040 ÷ t rearrangement and evaluation (1) (time =) 4.8 (s)	 0.208 scores 1 mark 867000 scores 1 mark award full marks for the correct answer without working	**(2)** **AO2**

Question number	Answer	Additional guidance	Mark
4 (b)(iv)	values for power selected and added (1) 440 + 436 + 425 (3) evaluation (1) 434 (W)	 1301 (3) accept values that round to 434 e.g. 433.667 accept 436 (median average) for 2 marks 1301 scores 1 mark 1017(.666) scores 1 mark award full marks for the correct answer without working	**(2)** **AO2**

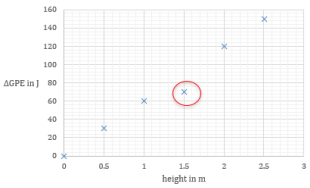
Question number	Answer	Additional guidance	Mark
4 (c)	estimate of weight (1) measure (actual) weight (1)	ignore reaction time use scales ignore repeating measurements	**(2)** **A03**

Total 10 marks

Question	Answer	Additional guidance	Mark
3(a)(i)	substitution (1) (work done =) 1200 × 8(.0) evaluation (1) (work done =) 9600 unit (1) J	 award 2 marks for the correct answer without working independent mark accept j OR joule(s) OR N m ignore n m (lower case n) accept 9.6 kJ (kilojoules) for three marks	**(3)** **AO2.1**

Question	Answer	Additional guidance	Mark
3(a)(ii)	A description to include **two** from: kinetic (energy store) (1) (kinetic energy store is) transferred to thermal (energy store) (1) energy of the	ignore references to GPE KE accept heat for thermal thermal (energy store) increases accept arrow for 'transferred to'	**(2)** **AO2.1**

Question	Answer	Mark
3(b)	**C** 900 N ***A, B and D*** *do not give the weight of the box.*	**(1)** **AO1.1**

Question	Answer	Additional guidance	Mark
3(c)(i)	circle around (1.5, 70) (1)		**(1)** **AO3.1**

Question	Answer	Additional guidance	Mark
3(c)(ii)	correct value of ΔGPE from the graph (1) 120 substitution (1) (120) 5	(power =) their value of energy 5 their energy value must be a number between 0 and 160	**(3)** **AO3.2**
	evaluation (1) 24 (W)	evaluation of their value of energy 5 award full marks for the correct answer without working	

(Total for question 3 = 10 marks)

Question	Answer	Additional guidance	Mark

Question Number	Answer	Additional guidance	Mark
5(a)(i)	substitution with conversion (2) (m =) $\frac{4.1}{10 \times 0.26}$ (=1.58)	accept 9.8(1) instead of 10 for g throughout alternative method substitution and rearrangement with conversion (2) e.g. Δgpe = 10 x 0.26 x 1.6 (=4.1) Allow for 1 mark: (m =) $\frac{4.1}{10 \times 26}$ allow 26 to any power of 10 for this mark OR Δgpe = 10 x 26 x 1.6 allow 26 to any power of 10 for this mark OR height converted to m 0.26 (m) or 26 x 10^{-2} (m)	**(2)** **AO 2.1**

Question Number	Answer	Additional guidance	Mark
5(a)(ii)	substitution (1) (v^2=) $\frac{2 \times 4.1}{1.6}$ evaluation of v^2 (1) 5.1(25) evaluation of v (1) 2.3 (m/s)	ecf from part a(i) throughout accept use of 1.58 accept 5.2 (use of 1.58) accept values that round to 2.3 e.g. 2.264 award full marks for the correct answer without working	**(3)** **AO2.1**

Question Number	Answer	Additional guidance	Mark
5(a)(iii)	addition of any lubricant / oil / grease	make runway steep(er) use an air track instead streamline trolley	(1) AO 3.3b

Question Number	Answer	Additional guidance	Mark
5(b)(i)	substitution (1) (P =) $\frac{48 \times 10 \times 2.9}{3.4}$ evaluation (1) 409 (W) to 2 s.f. (1) 410 (W)	accept 9.8(1) instead of 10 for g throughout $\frac{480 \times 2.9}{3.4}$ OR $\frac{1392}{3.4}$ accept values that round to 409 accept values that round to 402 (used g = 9.81) accept the result of any **calculation** to 2s.f. for this mark accept 400 (W) if 402 seen (used g = 9.81) award full marks for the correct answer without working	(3) AO 2.1

Question Number	Answer	Additional guidance	Mark
5(b)(ii)	an answer linking: measure the height of a step (1) multiply by number of steps (1)	 accept add all step heights together	(2) AO2.2

Total for Question 5 = 11 marks

Question Number:	Answer	Additional guidance	Mark
6(a)	substitution (1) (KE =) ½ x 68 x 12^2 evaluation (1) 4900 (J)	 ½ x 68000 x 12^2 scores 1 mark accept values that round to 4900(J) e.g. 4896(J) award full marks for correct answer without working	**(2)** AO 2 1

Question Number:	Answer	Additional guidance	Mark
6(b)	a description to include: kinetic energy (store) (of cyclist and /or bicycle) decreases / is transferred into(1) thermal energy (store) (of brakes / surroundings) increases (1)	 KE for kinetic energy allow heat for thermal allow brakes get hotter ignore sound energy accept kinetic (energy) to heat (energy) for 2 marks in this context	**(2)** AO 1 1

Question Number:	Answer	Additional guidance	Mark
6(c)	recall and substitution (1) 1600 = force x 28 rearrangement (1) (force) = $\frac{1600}{28}$ evaluation (1) 57 (N)	substitution and rearrangement in either order accept f, F or ? for force accept values that round down to 57 e.g. 57.14 award full marks for correct answer without working award 1 mark for answers of 44800 or 0.0175 **and** a correct expression relating work, force and distance	**(3)** AO 2 1

Question Number:	Answer	Mark
6(d)	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 (example) 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. Indicative content • Description of an experiment which will allow work done over a given time to be measured. • E.g. running upstairs, step-ups, lifting weights • Apparatus to be used, weighing scales, known weights ruler, stop clock • Measurements to be made • E.g. weight of person/weights lifted, vertical distance moved, time taken. • Calculation of work done for each student using work done =force x distance moved in direction of force • Calculation of power for each student using power=work done/time taken Comparison of powers by lifting same weights, in a constant time and comparing the distance moved	**(6)** AO 2 2

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1–2	• The plan attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (AO2) • Analyses the scientific information but understanding and connections are flawed. An incomplete plan that provides limited synthesis of understanding. (AO3)
Level 2	3–4	• The plan is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (AO2) • Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)
Level 3	5–6	• The plan is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (AO2) • Analyses the scientific information and provide logical connections between scientific concepts throughout. A well-developed plan that synthesises relevant understanding coherently. (AO3)

(Total for Question 6 = 13 marks)