PEARSON EDEXCEL GCSE COMBINED SCIENCE (HIGHER) · 1SC0

PHYSICS



MARK SCHEME

TOPIC 8: ENERGY – FORCES DOING WORK (PAPER 2)

SCORE	PERCENTAGE
/164	%

STEMUP

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Mark Scheme

Q1.

Question Number:	Answer	Mark
	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)

(**Q23 1SC0/2PF, June 2018**)

Q2.

Question Number:	Answer	Additional Guidance	Mark
	an explanation linking: over the **same time / in 300s**, more work done / energy transferred in session 1 than in session 2 (1) (therefore) more power (developed) in session 1 (1)	allow reverse argument power in session 1 = $\frac{45.2}{300}$ = 0.15 (kW) or 150(W) allow statement that power = work / time or power = energy(transferred) / time for MP1 power in session 2 = $\frac{37.9}{300}$ = 0.13 (kW) or 126(W)	**(2)** AO 3 2a AO 3 2b

(**Q07 1SC0/2PH, June 2018**)

Q3.

Question Number	Answer	Additional guidance	Mark
(i)	substitution (1) (ΔQ =) 0.96 x 920 x 17 evaluation (1) 15000 (J)	0.96 x 920 x (35-18) accept 15014 (.4) 15000 to any other power of ten scores 1 mark award full marks for the correct answer without working	**(2)** **AO2.1**

Question Number	Answer	Additional guidance	Mark
(ii)	add insulation (around aluminium block) (1)	accept any named insulator allow polish aluminium block allow wrap in foil or put in a box ignore 'lids' unless with a (named) insulator	**(1)** **AO3b**

Question Number	Answer	Additional guidance	Mark
(iii)	any **one** from: energy needs (time) to transfer (through the aluminium) (1) heater and thermometer are not close together (1) there is a gap between the thermometer and the block (1)	 accept heat for energy accept travel/conduct/spread for transfer	**(1)** **AO1.1**

(**QU02c 1SC0/2PF, June 2025**)

Q4.

Question number	Answer	Additional guidance	Mark
(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
(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
(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
(iv)	values for power selected and added (1) $\frac{440 + 436 + 425}{(3)}$ evaluation (1) 434 (W)	 $\frac{1301}{(3)}$ 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**

(**QU04b 1SC0/2PF, June 2022**)

Q5.

Question Number:	Answer	Additional guidance	Mark
	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

(**Q22 1SC0/2PF, June 2018**)

Q6.

Question Number:	Answer	Additional Guidance	Mark
	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

(**Q06 1SC0/2PH, June 2018**)

Q7.

	Answer	Acceptable answers	Mark	
	C when the bungee cord is stretched the most		**(1)**	

(**Q14 1SC0/2PF, June 2013**)

Q8.

	Answer	Acceptable answers	Mark	
(a)	**C** when the bungee cord is stretched the most		**(1)**	
(b)	**A** 600 kg m/s		**(1)**	
(c)(i)	Substitution: (1)		**(3)**	

	60 × 10 × 50 or 600 × 50 Evaluation: (1) 30 000 Unit: (1) J / Nm	give two marks for correct answer no working j / joule 30 kJ for full marks		
(c)(ii)	After falling 50 m / when the cord becomes straight/when cord starts to stretch	tension starting to increase at terminal velocity ignore maximum velocity/speed	**(1)**	
(c)(iii)	An explanation linking any two of not all GPE is transferred to KE (1) some {of the GPE transfers to thermal energy /work is done} (1) due to drag (1)	not all GPE goes to KE maximum energy is same (value) as GPE before falling /speed does not reach the speed at which he should fall some lost as heat/sound (of rope or movement through air) (air) resistance / friction ignore wind	**(2)**	

(**Q12 1SC0/2PF, June 2013**)

Q9.

Question number	Answer	Additional guidance	Mark
i	rearrangement **and** substitution (1) $(\Delta\theta =) \frac{210 (x10^3)}{5.8 \times 860}$ evaluation (1) 42 (°C)	$(\Delta\theta =) \frac{210 (x10^3)}{4988}$ accept any value which rounds to 42 e.g. 42.10 award full marks for the correct answer without working 4.2 to any other power of 10 scores 1 mark	**(2) AO2.1**

Question number	Answer	Additional guidance	Mark
ii	an explanation linking any **two** from not **all** the energy supplied goes to the <u>brick</u> (1) not all the energy supplied stays in the <u>brick</u> (1) energy transferred to the storage heater parts (1)	ignore: • energy is lost / wasted, unqualified • not 100% efficient • arguments about sound energy accept heat for energy throughout less (thermal) energy given to <u>brick</u> energy transfers from the <u>brick</u>	**(2) AO2.1**

	energy transferred to the surroundings (1) argument linking $\Delta\theta$ to ΔQ **using** $\Delta\theta = \frac{\Delta Q}{m \times c}$ (1)	energy dissipated from the equation, if energy supplied to the block is smaller the change of temperature will be smaller 'brick transfers (thermal) energy to the surroundings' scores 2 marks	

(**QU06c 1SC0/2PH, June 2024**)

Q10.

Question number	Answer	Additional guidance	Mark
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
ii	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**

(**Q04a 1SC0/2PF, Nov 2021**)

Q11.

Question number	Answer	Additional guidance	Mark
(i)	rearrangement of work = force × distance (1) d = W ÷ F substitution and evaluation (1) 18 (m)	 d = 2700 ÷ 150 Award full marks for correct answer without working	(2)

Question number	Answer	Mark
(ii)	2700 (J)	(1)

Question number	Answer	Additional guidance	Mark
(iii)	rearrangement of KE = ½ mv^2 (1) $v = \sqrt{(2 \times KE \div m)}$ substitution and evaluation (1) 19 (m/s)	 $v = \sqrt{(2 \times 2700 \div 15)}$ $v^2 = (2 \times 2700 \div 15)$ allow answers that round to 19 award full marks for correct answer without working allow alternative route using $v^2 - u^2 = 2ax$ for full marks	(2)

(**Q05b 1SC0/2PF/S2, SAM**)

Q12.

Question number	Answer	Additional guidance	Mark
(i)	rearrangement of work = force × distance to give distance = work ÷ force (1) substitution and evaluation (1) 18 (m)	 seeing 2700 ÷ 150 Award full marks for correct answer without working	(2)

Question number	Answer	Mark
(ii)	2700 (J)	(1)

Question number	Answer	Additional guidance	Mark
(iii)	rearrangement of $KE = ½ mv^2$ $v = \sqrt{(2 \times KE \div m)}$ (1) substitution and evaluation (1) 19 (m/s)	 $v = \sqrt{(2 \times 2700 \div 15)}$ $v^2 = (2 \times 2700 \div 15)$ allow answers that round to 19 award full marks for correct answer without working allow alternative route using $v^2 - u^2 = 2ax$ for full marks	(2)

(**Q01b 1SC0/2PH/S2, SAM**)

Q13.

Question Number	Answer	Additional guidance	Mark
(i)	substitution (1) (ΔGPE =) (0.0)46 x 10 x 2.05 evaluation (1) 0.94(3) (J)	allow $g=9.8(1)$ m/s^2 0.9 (J) values that round to 0.92 or 0.93 (from using g = 9.8 or 9.81) do not award for 1(J) no POT error in evaluation award full marks for the correct answer without working.	(2)

Question Number	Answer	Additional guidance	Mark
(ii)	recall (1) (KE =) ½ x m x v^2 substitution (1) (KE =) ½ x (0.0)46 x 3.5^2 evaluation (1) 0.28 (J)	 allow answers that round to 0.28 e.g. 0.28175 (J) allow max 2 marks for POT error e.g. 0.00028 award full marks for the correct answer without working	**(3)**

Question Number	Answer	Additional guidance	Mark
(iii)	Any value between 0.8 (m) and 0.95 (m) inclusive		**(1)**

Question Number	Answer	Additional guidance	Mark
(iv)	An explanation linking (the ball) has lost energy (1) identification of what has happened to that energy (1)	 accept (energy) dissipated **or** (transferred to) surroundings / ground **or** thermal energy **or** heat / sound **or** system is not 100% efficient **or** bounce is not (100%) elastic **or** squashing (the ball or the ground)	**(2)**

Q14.

Question Number	Answer	Additional guidance	Mark
(i)	substitution (1) (ΔGPE=) (0.0)46×10×2.05 evaluation (1) 0.94(3) (J)	allow g=9.8(1) m/s^2 0.9 (J) values that round to 0.92 or 0.93 (from using g = 9.8 or 9.81) do not award for 1(J) no POT error in evaluation award full marks for the correct answer without working.	**(2)**

Question Number	Answer	Additional guidance	Mark
(ii)	recall (1) (KE=) $\frac{1}{2} \times m \times v^2$ substitution (1) (KE=) $\frac{1}{2} \times$ (0.0)46 $\times 3.5^2$ evaluation (1) 0.28 (J)	 allow answers that round to 0.28 e.g. 0.28175 (J) allow max 2 marks for POT error e.g. 0.00028 award full marks for the correct answer without working	**(3)**

Question Number	Answer	Additional guidance	Mark
(iii)	Any value between 0.8 (m) and 0.95 (m) inclusive		**(1)**

Question Number	Answer	Additional guidance	Mark
(iv)	An explanation linking (the ball) has lost energy (1) identification of what has happened to that energy (1)	 accept (energy) dissipated **or** (transferred to) surroundings / ground **or** thermal energy **or** heat / sound **or** system is not 100% efficient **or** bounce is not (100%) elastic **or** squashing (the ball or the ground)	**(2)**

(**Q01b 1SC0/2PH, June 2019**)

Q15.

Question Number	Answer	Additional guidance	Mark
(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
(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**

(**QU05b 1SC0/2PF, June 2025**)

Q16.

Question Number	Answer	Additional guidance	Mark
	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**

(**QU01b 1SC0/2PH, June 2025**)

Q17.

Question number	Answer	Additional guidance	Mark
(i)	select and substitute (1) ($\Delta GPE = m \times g \times \Delta h$) $= 1100 \times 3.7 \times 1.8 (\times 10^3)$ evaluation (1) 7 326 000 (J) evaluation to 2 s.f. (1) 7 300 000 (J)	 any number rounding to 7 300 000 7326 scores 1 mark **independent mark** -any final answer stated to 2 s.f.	**(3) AO2.1**

Question number	Answer	Additional guidance	Mark
(ii)	select and substitute (1) ($\Delta KE = \frac{1}{2} m \times v^2$) $= \frac{1}{2}\ 1100 \times 88^2$ evaluation (1) 4 300 000 (J)	ignore minus signs accept numbers that round to 4 300 000 (J) e.g. 4 259 200 (J) award full marks for the correct answer without working	**(2) AO2.1**

Question number	Answer	Additional guidance	Mark
iii	A description linking **three** from: 1. work is done against / by gravity (1) 2. **idea of** work done by the thrusters / jets (on the rover) (1) 3. (work done) by air/atmospheric resistance on the parachute (and rover) (1) 4. this reduces the kinetic energy (store) (1) 5. (there is a) decrease in the gravitational potential energy (store) of the rover (1) 6. (there is a) transfer of chemical energy from the thrusters (1) 7. energy transferred to thermal energy (store) (1) 8. (transfer) mechanically (to the thermal store) (1)	**KEY: attempt to explain <u>how work done</u> contributes towards the energy changes / conservation of energy** if no other mark scored allow one mark for work = force x distance	**(3) AO2.1**

(**QU04a 1SC0/2PH, June 2022**)

Q18.

Question number	Answer	Additional guidance	Mark
(i)	recall and substitution into (1) gpe = m x g x h (gpe) = 4.5 x 10 x 20 evaluation (1) 900(J)	 allow 90(J) for 1 mark award full marks for the correct answer without working	**(2)**

Question number	Answer	Additional guidance	Mark
ii	900(J)	allow ecf from bi	(1)

Question number	Answer	Additional guidance	Mark
iii	recall and substitution (1) power = work done / time taken (power =) 900 / 4 evaluation (1) 200 (W)	allow ecf from bi or bii 230(W) 225(W) award full marks for the correct answer without working	(2)

(**Q06b 1SC0/2PF, Nov 2020**)

Q19.

Question number	Answer	Additional guidance	Mark
(i)	recall and substitution into (1) gpe = m x g x h (gpe) = 4.5 x 10 x 20 evaluation (1) 900(J)	 allow 90(J) for 1 mark award full marks for the correct answer without working	(2)

Question number	Answer	Additional guidance	Mark
ii	900(J)	allow ecf from bi	(1)

Question number	Answer	Additional guidance	Mark
iii	recall and substitution (1) power = work done / time taken (power =) 900 / 4 evaluation (1) 200 (W)	allow ecf from bi or bii accept 230(W), 225(W) award full marks for the correct answer without working	**(2)**

(**Q02b 1SC0/2PH, Nov 2020**)

Q20.

Question number	Answer	Additional guidance	Mark
	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**

(**QU04c 1SC0/2PF, June 2023**)

Q21.

Question number	Answer	Additional guidance	Mark
i	substitution (1) $(I = \frac{P}{V})$ = $\frac{1.9\ (\times 10^3)}{230}$ (1) evaluation (1) 8.3 (A)	 8.3 / 8.26 (A) award full marks for correct answer without working award one mark for 8.26×10^{-3} / 0.0083	**(2)** **AO2**

Question number	Answer	Additional guidance	Mark
ii	choice and substitution (1) $E = I \times V \times t$ = 7.4 x 230 x 120 evaluation (1) 200000 (J)	 accept 204000 / 204240 award full marks for correct answer without working award 1 mark for 3400 / 3404 (J) (using 2 minutes as time)	**(2)** **AO2**

(**Q03a 1SC0/2PF, Nov 2021**)

Q22.

Question number	Answer	Additional guidance	Mark
	substitution (1) 7440 = 645 x distance rearrangement (1) (distance =) $\frac{7440}{645}$ evaluation and rounding to 3sf (1) 11.5 (m)	rearrangement and substitution in either order allow substitution of correct values into a visible, incorrectly rearranged algebraic equation for this mark only (distance =) $\frac{\text{work done}}{\text{force}}$ 11.53 (m) scores 2 marks only award full marks for the correct answer without working	(3) **AO2.1**

(**QU04a 1SC0/2PH, June 2024**)

Q23.

Question number	Answer	Additional guidance	Mark
	substitution (1) $KE = ½ \times 58(\times 10^{-3}) \times 28^2$ 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**

(**Q04c 1SC0/2PF, Nov 2021**)

Q24.

Question number	Answer	Additional guidance	Mark
(i)	selection and substitution (1) (KE =) ½ x 1200 x 16(.0)^2 evaluation in kJ (1) (KE =) 150 (kJ)	 (KE =) ½ x 1200 x 16(.0)^2 x 10^{-3} accept any value that rounds to 150 e.g. 153.6 award full marks for correct answer without working. award 1 mark for 153.6 or 150 to any other power of ten	**(2)** **AO2**

Question number	Answer	Additional guidance	Mark
(ii)	 selection and substitution (1) 17.5 (x 10^3) = $\frac{126\ (x10^6)}{t}$ re-arrangement and evaluation (1) (t=) 2(.0) (h)	alternative method selection and rearrangement (1) (t =) $\frac{E(nergy)}{P(ower)}$ or (t=) $\frac{126\ (x10^6)}{17.5\ (x\ 10^3)}$ (substitution and) evaluation (1) (t=) 2(.0) (h) award full marks for correct answer without working. allow 1 mark for 7(.2) to any power of ten (incorrect time conversion) allow 1 mark for 2(.0) to any power of 10 (POT error)	**(2)** **AO2**

Question number	Answer	Additional guidance	Mark
(iii)	an explanation linking (energy transfers when the car is decelerating) (from) kinetic energy (store) (1) (to) chemical energy (store) (1)	idea of energy that would be otherwise wasted uses an electrical pathway {electric current / electricity / emf} produced allow mechanical for kinetic in this context recharges battery increases available energy store of battery more useful energy available	**(2)** **AO2**

(**QU05a 1SC0/2PH, June 2023**)

Q25.

Question number	Answer	Additional guidance	Mark
	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**

(**QU04a 1SC0/2PF, June 2023**)

Q26.

Question	Answer	Additional guidance	Mark
(i)	substitution (1) (P =) $\frac{130\,000}{87}$ evaluation (1) (P =) 1494 (W) value to 2sf (1) 1500 (W)	 award two marks for the correct answer without working independent mark for **any** number to 2sf	**(3)** **AO2.1**

Question	Answer	Additional guidance	Mark
(ii)	substitution (1) (efficiency =) $\frac{96\,000}{130\,000}$ evaluation (1) (efficiency =) 0.74	 accept values that round to 0.74 e.g. 0.7385 accept 74 % for 2 marks allow 74 without % sign for 1 mark only allow 0.73 or 73% for 1 mark award full marks for the correct answer without working	**(2)** **AO2.1**

(QU04b 1SC0/2PF, June 2024)

Q27.

Question Number	Answer	Additional guidance	Mark
(i)	recall (1) (P =) $\frac{E}{t}$ substitution and evaluation (1) (P=) 75 (W)	P = work done ÷ time P = $\frac{45}{0.6}$ award full marks for the correct answer without working	**(2)**

Question Number	Answer	Additional guidance	Mark
(ii)	substitution into $E = \frac{1}{2} \times k \times x^2$ (1) $45 = \frac{1}{2} \times 140 \times x^2$ rearrangement (1) $(x =) \sqrt{\frac{2 \times 45}{140}}$ evaluation (1) 0.8(0) (m)	allow substitution and rearrangement in either order $x^2 = (\frac{E}{0.5k} =) \frac{2 \times 45}{140}$ $x^2 = 0.64(28571)$ accept values that round to 0.80 e.g. 0.80178 award full marks for the correct answer without working	**(3)**

(**Q05a 1SC0/2PH, June 2019**)

Q28.

Question number	Answer	Additional guidance	Mark
	substitution (1) $2{,}800 = ½ \times 85 \times v^2$ rearrangement (1) $(v^2 =) \frac{2800 \times 2}{85}$ evaluation (1) v = 8.1 (m/s)	allow substitution and rearrangement in either order 66 or 65.88 seen allow values that round to 8.1 e.g 8.1168 award full marks for the correct answer without working	**(3)** **AO2**

(**Q04b 1SC0/2PH, Nov 2021**)

Q29.

Question	Answer	Additional guidance	Mark
(i)	substitution (1) (work done =) 1200 × 8(.0) evaluation (1) (work done =) 9600 unit (1) J	 award two 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
(ii)	A description to include **two** from: kinetic (energy store) (1) (kinetic energy store is) transferred to thermal (energy store) (1) energy of the surroundings increases (1) OR energy is dissipated (to surroundings) (1)	ignore references to GPE KE accept heat for thermal thermal (energy store) increases accept arrow for 'transferred to' energy is transferred to the air/ground/surroundings	**(2)** **AO2.1**

(**QU03a 1SC0/2PF, June 2024**)

Q30.

Question number	Answer	Additional guidance	Mark
i	substitution (1) (E =) ½ X 20 x $0.09^{(2)}$ evaluation (1) 0.08(1) (J)	 allow 1 mark for ½ x 20 x 9^2 or answer of 810 (J) or answer of 90 (J) award full marks for the correct answer without working	**(2)**

Question number	Answer	Additional guidance	Mark
ii	a description including mention of one relevant energy store (1) correct transfer in context (1)	 potential/ PE/ kinetic/ KE/ thermal/ heat/ elastic potential energy stored in the spring transferred to kinetic energy of the ball/rod scores 2 marks kinetic energy of rod is transferred to kinetic energy of ball scores 2 marks idea of energy transferred to the surroundings/ thermal scores 2 marks	**(2)**

Question number	Answer	Additional guidance	Mark
iii	an explanation linking two from (controls the maximum) extension (1) idea of keeping below the elastic limit (1) (which would result in) spring being permanently stretched (1)	ignore <u>damaging</u> the spring (given in stem) stretch prevents spring being over-stretched / extended too far scores 2 marks allow distorted/ break	**(2)**

(**Q02b 1SC0/2PF, Nov 2020**)

Q31.

Question number	Answer	Additional guidance	Mark
(i)	substitution into work done = force x distance (1) 1800 = force x 1.2 rearrangement and evaluation (1) (force =) 1500 (N)	alternative method rearrangement (1) $\text{(force =)} \frac{\text{work (done)}}{\text{d(istance moved)}}$ **or** (force =) $\frac{1800}{1.2}$ (substitution and) evaluation (1) (force =) 1500 (N) if no other marks scored allow one mark for answer of 500 (N) or 4500 (N) award full marks for correct answer without working.	**(2)** **AO2**

Question number	Answer	Additional guidance	Mark
(ii)	substitution (1) $64 = \frac{1800 \times 100}{\text{total work done}}$ **or** $0.64 = \frac{1800}{\text{total work done}}$ rearrangement and evaluation (1) (work done =) 2800 (J)	alternative method re-arrangement (1) (total work done =) $\frac{\text{work done on barrel} \times 100}{\text{efficiency}}$ **or** (work done=) $\frac{1800 \times 100}{64}$ **or** (work done=) $\frac{1800}{0.64}$ (substitution and) evaluation (1) (work done =) 2800 (J) allow values that round to 2800; e.g. 2812.5 award full marks for correct answer without working.	**(2)** **AO2**

Question number	Answer	Additional guidance	Mark
(iii)	any **one** of additional mass in the system (1) rope stretches (1)	 (bottom) pulley / rope has {mass / weight} ignore references to the mass / weight of barrel tension in rope ignore references to consequences of friction such as air resistance, heat or sound. ignore pulling at an angle ignore references to person	**(1)** **AO1**

(**QU06a 1SC0/2PH, June 2023**)

Q32.

Question number	Answer	Additional guidance	Mark
(a)(i)	substitution (1) $(KE =) \frac{1}{2} \times 85 \times 1.5^2$ answer (1) 96 (J)	award full marks for correct numerical answer without working allow 95.625 (J)	**(2)**

Question number	Answer	Additional guidance	Mark
(a)(ii)	rearrange (1) force = work done ÷ distance answer (1) (force) = 15 (N)	accept rearrangement with values subst., i.e. (force) = 1200 ÷ 80 award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Additional guidance	Mark
(b)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • the work done is the same for walking and running (1) • because work done depends on force and distance only, not time (1)	allow energy for work done because work done ÷ time is power	(2)

Question number	Answer	Additional guidance	Mark
(c)	rearrangement (1) (height) = change in GPE ÷ (mass × g) answer (1) 2.2 (m)	accept rearrangement with values, i.e. (h) = 264 ÷ (12 × 10) or = 264 ÷ 120 award full marks for correct numerical answer without working	(2)

(**Q03bcd 1SC0/2PF, SAM 2016**)

Q33.

Question number	Answer	Mark
(a)	C	(1)

Question number	Answer	Mark
(b)(i)	change in GPE = mass × gravitational field strength × change in vertical height	(1)

Question number	Answer	Additional guidance	Mark
(b) (ii)	transformation (1) $h = \Delta E \div mg$ substitution (1) $h = 39\,000 \div (580 \times 10)$ evaluation (1) 6.7 (m)	accept use of $g = 9.81$ accept 6.72 accept 6.85 (from $g = 9.81$)	(3)

(**Q01ab 1SC0/2PH, SAM 2016**)

Q34.

Question Number:	Answer	Additional guidance	Mark
	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

(**Q20 1SC0/2PF, June 2018**)

Q35.

Question Number:	Answer	Additional Guidance	Mark
	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

(**Q04 1SC0/2PH, June 2018**)

Q36.

	Answer	Acceptable answers	Mark
	substitution: 0.6 × 20 (1) evaluation 12 (1) J (1)	 give 2 marks for correct answer no working unit is an independent mark joules, Nm, kgm^2/s^2 , Ws	**(3)**

(**Q05 1SC0/2PF, June 2013**)

Q37.

Question number	Answer		Mark
(i)	An answer that combines the following points of understanding to provide a logical description: • when steam condenses, its molecules move closer together, so the internal energy decreases (1) • when the water from the condensed steam cools, its molecules move more slowly, therefore storing less kinetic energy (1)	allow as water cools, the distance between the particles decreases which increases the intermolecular forces	(2)

Question number	Answer	Additional guidance	Mark
(ii)	equating the variables in the three equations/principle of conservation of energy (1) $(m_w \times l_w) + (m_w \times c_w \times \Delta\theta_w) = (m_m \times c_m \times \Delta\theta_m)$ rearrangement (1) $m_m = \frac{(m_w \times l_w) + (m_w \times c_w \times \Delta\theta_w)}{(c_m \times \Delta\theta_m)}$ substitution of correctly calculated quantities (1) $= \left(\frac{\left(\left(\frac{25}{1000}\right) \times 2260000\right) + \left(\left(\frac{25}{1000}\right) \times 4200 \times 35\right)}{3840 \times 60} \right)$ evaluation (1) 0.26 (kg)	allow in words or with suitable alternative subscripts temperature changes and l_w must be correct allow maximum of 3 marks for calculations that omit the energy from cooling of water	(4)

Question number	Answer	Mark
(iii)	Any two of the following reasons: • more steam must condense and transfer the energy that is dissipated to the jug during the process (1) • more steam must condense and transfer the energy that is dissipated to the surroundings during the process (1) • more steam must condense and transfer the energy needed to cause the milk to froth (1) • more steam must condense to replace any steam that might leave the milk without condensing (1)	(2)

(**Q10b 1SC0/2PH, SAM 2016**)

Q38.

		Indicative Content	
QWC	*	A discussion including some of the following points • improved lighting levels for LEDs • energy savings per year for LEDs or calculatio time • calculation of energy savings over lifetime of L calculation of monetary savings by using LEDs • link to savings in fossil fuels for LEDs or link to LEDs and reduced global warming • comparison of lifetimes and maintenance cost	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited discussion of benefits using some pieces of the information provided, e.g. LEDs last 40 000 hours longer and the lighting levels are 200% brighter. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple discussion of benefits using some pieces of the information and processing one of them OR 2 processed pieces of information. e.g. LEDs save 3000 kW h of energy each year and are much brighter. The money they save each year compared to fluorescents is £420. OR The payback time for the LEDs is about 5 years and in that time they would have to pay for the fluorescent lights to be replaced 5 times. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed discussion of benefits using processed information covering more than half of the data points in the table e.g. LEDs use less energy each year and this means that fossil fuel reserves are not used up as quickly. The LEDs save £420 each year and have a payback time of about 5 years. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(**Q25 1SC0/2PF, June 2013**)

Q39.

Question number	Answer	Additional guidance	Mark
(i)	Recall GPE = m x g x Δh (1) Substitution = 400 x 9.8 x 1.5 (1) Evaluation = 5900 (J) (1) (which is nearly 6000 J)	 accept 5880 (J)	**(3)**

Question number	Answer	Additional guidance	Mark
(ii)	An explanation that combines identification – knowledge (1 mark) and reasoning (1 mark) • energy is dissipated/scattered (1) • into the surroundings (1)	 energy from a loss of ball's PE / its gain in KE ends up as (kinetic) energy of molecules (of ball / wall / air)	**(2)**

Question number	Answer	Mark
(iii)	B velocity	**(1)**

(**Q06a 1SC0/2PH/S2, SAM**)

Q40.

Question number	Answer	Additional guidance	Mark
	An answer that combines points of interpretation/evaluation to provide a logical description: efficiency increases (at first) (1) to maximum efficiency (for mass of about 25 kg) (1)	 e.g. decreases for larger masses	**(2)**

(**Q05c 1SC0/2PF/S2, SAM**)