AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.1.1.1

Energy stores and systems

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**19**
Available paper years	**2018–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

6.1.1.1 Energy stores and systems

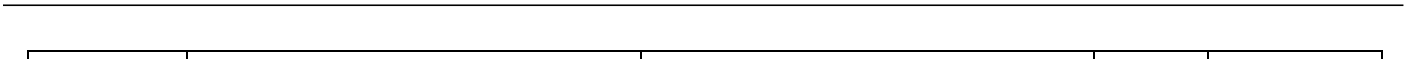
Answer 01 · Mark scheme June 2018 | 8464/P/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	the wall has two / three layers	allow the wall is thick	1	AO1 6.1.2.1
	cavity wall insulation / brick / block has a low thermal conductivity		1	
	so less energy is transferred by conduction	allow rate of energy transfer is lower ignore any reference to convection and / or radiation	1	
05.2	$T = 17.4 + \left(\frac{(20.8 - 17.4)}{2}\right)$ **or** $T = 20.8 + \left(\frac{(20.8 - 17.4)}{2}\right)$	an answer in the range 18.5–19.1 scores **2** marks	1	AO3 6.1.2.1
	T = 19.1 (°C)		1	
05.3	chemical energy store of the fuel decreases		1	AO1 6.1.2.1
	thermal energy store of the water increases	allow kinetic energy store of the water particles increases	1	
	thermal energy store of the air / atmosphere increases	allow kinetic energy store of the air particles increases	1	
05.4	E = 15 000 000 (J)	an answer of 25 000 scores **4** marks	1	AO2 6.1.1.4
	t = 600 (s)		1	
	$p = \frac{15\ 000\ 000}{600}$	allow a correct substitution of incorrectly / not converted values of E and / or t	1	
	P = 25 000 (W)	allow a correct calculation using incorrectly / not converted values of E and / or t	1	
Total			**12**	

6.1.1.1 Energy stores and systems

Answer 01 · Mark scheme

June 2018 | 8464/P/1H | Original Q5



6.1.1.1 Energy stores and systems

Answer 02 · Mark scheme June 2019 | 8464/P/1H | Original Q5

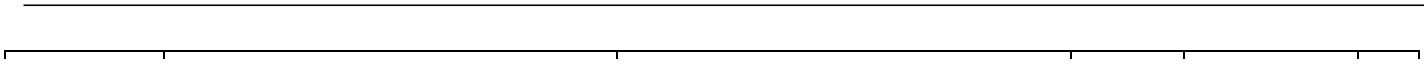
Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	electrons collide with particles in the heating element which increases the (kinetic) energy of the particles (in the heating element)	allow there is a current in the heating element allow internal store of energy increases allow the particles (in the heating element) vibrate more rapidly	1 1	AO1.1 6.2.4.2 6.3.2.1 WS 1.2	E
05.2	the starting temperature of the water	allow the starting temperature of the kettle	1	AO3.3a 6.2.4.2 WS 2.2	E
05.3	(the heating element of) the kettle took time to heat up		1	AO3.1a 6.2.4.2 WS 3.7	E
05.4	the (rate of) energy transfer (per kg of water) to the surroundings decreases as the mass of water increases **or** the efficiency of the kettle increases as the mass of water increases	allow the (rate of) energy transfer (per kg of water) to the surroundings changes as the mass of water changes allow the efficiency of the kettle changes as the mass of water changes	1	AO3.1b 6.2.4.2 WS 3.7	E

05.5	E = 2600 × 120 E = 312 000 (J) 312 000 = 0.80 × c × (100-18) **or** 312 000 = 0.80 × c × (82) $c = \frac{312\,000}{0.80 \times 82}$ c = 4 756 c = 4 800 (J/kg °C) (2 s.f.)	an answer of 4800 (J/kg °C) scores **6** marks a correct answer given to more than 2 s.f. scores **5** marks allow a correct substitution of an incorrectly/not converted value of P and/or t. this answer only the equation E=Pt must have been used to score subsequent marks. allow use of their value of E calculated using E =Pt for this and subsequent steps this mark can only be scored for a correct rounding of a value of c calculated using correct equations	1 1 1 1 1	AO2.1 6.3.2.2 6.1.1.3 6.1.1.4 WS 3.3	E
Total			**11**		

6.1.1.1 Energy stores and systems

Answer 02 · Mark scheme

June 2019 | 8464/P/1H | Original Q5



6.1.1.1 Energy stores and systems

Answer 03 · Mark scheme

November 2020 | 8464/P/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	the (maximum tendon) extension increases (as speed increases)	allow the tendons stretch more (as speed increases)	1	AO3 6.1.2.2
	so the elastic potential energy increases	allow so the (elastic) force increases	1	
	which is transferred to gravitational potential energy		1	
07.2	E = 770 × 0.14	allow E = 107.8 (J)	1	AO2 6.1.1.2
	extension = 0.070m		1	
	$107.8 = 0.5 \times k \times 0.070^2$	this mark may be awarded if extension is incorrectly/not converted and/or if the efficiency equation has not been applied	1	
	$k = 2 \times \frac{107.8}{0.070^2}$	this mark may be awarded if extension is incorrectly/not converted and/or if the efficiency equation has not been applied	1	
	k = 44 000 (N/m)	this mark may be awarded if extension is incorrectly/not converted this mark may not be awarded if the efficiency equation has not been applied	1	
Total			8	

6.1.1.1 Energy stores and systems

Answer 04 · Mark scheme

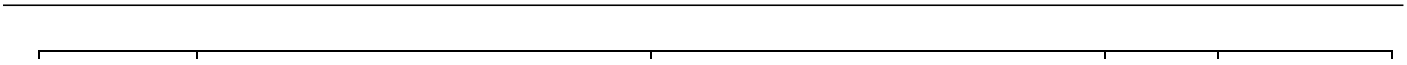
November 2021 | 8464/P/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	$V = I R$		1	AO1 6.2.1.3
01.2	$3.9 = 0.12 \times R$ $R = \frac{3.9}{0.12}$ $R = 32.5\ (\Omega)$	 allow R = 33 (Ω)	1 1 1	AO2 6.2.1.3
01.3	energy = power × time **or** E = P t		1	AO1 6.2.4.2
01.4	time = 150 000s energy = 0.46 × 150 000 energy = 69 000 (J)	 allow a substitution using an incorrectly/not converted value of time allow a correct calculation using an incorrectly/not converted value of time	1 1 1	AO2 6.2.4.2
01.5	thermistor		1	AO1 6.2.1.1
01.6	the current will increase (because) the resistance decreases		1 1	AO1 6.2.1.4
Total			**11**	

6.1.1.1 Energy stores and systems

Answer 04 · Mark scheme

November 2021 | 8464/P/1H | Original Q1



6.1.1.1 Energy stores and systems

Answer 05 · Mark scheme

November 2021 | 8464/P/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	solar	allow biofuel / biodiesel allow wave power	1	AO1 6.1.3
03.2	sometimes there is no wind (but the battery can still be charged using the generator) when there is wind less fuel is burned	allow if the generator breaks then the turbine can still generate electricity allow a disadvantage of burning fossil fuel	1 1	AO1 6.1.3
03.3	carbon dioxide increases global warming **OR** sulfur dioxide or NOx emissions (1) increases acid rain (1) **OR** particulates or NOx emissions (1) can harm living organisms (1)	 allow increases the greenhouse effect	1 1	AO1 6.1.3

6.1.1.1 Energy stores and systems

Answer 05 · Mark scheme

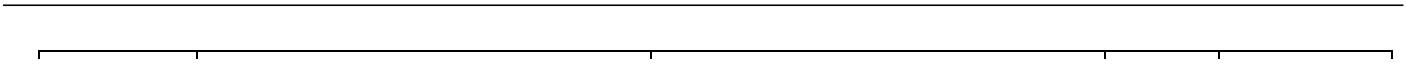
November 2021 | 8464/P/1H | Original Q3

03.4	81 kJ = 81 000 J $81000 = 0.5 \times 8000 \times v^2$ $v = \sqrt{\frac{81\,000}{0.5 \times 8000}}$ v = 4.5 (m/s)	 allow a correct substitution using an incorrectly/not converted value of energy allow a correct re-arrangement using an incorrectly/not converted value of energy allow a correct calculation using an incorrectly/not converted value of energy	1 1 1 1	AO2 6.1.1.2
03.5	$19600 = 8000 \times 9.8 \times \Delta h$ $\Delta h = \frac{19\,600}{8000 \times 9.8}$ Δh = 0.25 m		1 1 1	AO2 6.1.1.2
Total			**12**	

6.1.1.1 Energy stores and systems

Answer 05 · Mark scheme

November 2021 | 8464/P/1H | Original Q3



6.1.1.1 Energy stores and systems

Answer 06 · Mark scheme

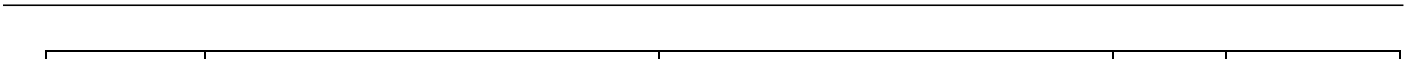
November 2021 | 8464/P/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	the spring will return to its original length when the force is removed		1	6.5.3 AO1
01.2	measure the original length of the spring **and** the extended length of the spring (with the metre rule) extension = extended length – original length		1 1	6.5.3 AO1
01.3	e = 0.080 m $E_e = 0.5 \times 40 \times (0.080)^2$ $E_e = 0.128$ (J)	 allow a correct substitution using an incorrectly / not converted value of e allow a correct calculation using an incorrectly / not converted value of e	1 1 1	6.5.3 AO2
01.4	force = spring constant × extension **or** F = k e		1	6.5.3 AO1
01.5	300 = k × 0.40 $k = \frac{300}{0.40}$ k = 750 (N/m)		1 1 1	6.5.3 AO2
Total			10	

6.1.1.1 Energy stores and systems

Answer 06 · Mark scheme

November 2021 | 8464/P/2H | Original Q1



6.1.1.1 Energy stores and systems

Answer 07 · Mark scheme

November 2021 | 8464/P/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	different temperatures emit different intensities of infrared which are represented (on the infrared camera) as different shades / colours	 allow wavelength / frequency / amount for intensity throughout	1 1	AO1 AO3 6.6.2.4
05.2	visible light		1	AO3 6.6.2.1
05.3	both ionising radiation so some risk of cancer the whole body is irradiated by gamma rays when an X-ray is taken only part of the body is exposed exposure time for gamma rays is longer		1 1 1 1	AO1 AO3 AO3 AO3 6.6.2.3
05.4	$1.2 \times 10^{-13} = F \times 0.015$ $F = \frac{1.2 \times 10^{-13}}{0.015}$ $F = 8.0 \times 10^{-12}$ N	 allow a correct rearrangement using an incorrectly / not converted value of s allow 8×10^{-12} allow a correct calculation using an incorrectly / not converted value of s	1 1 1	AO2 6.5.2

6.1.1.1 Energy stores and systems

Answer 07 · Mark scheme

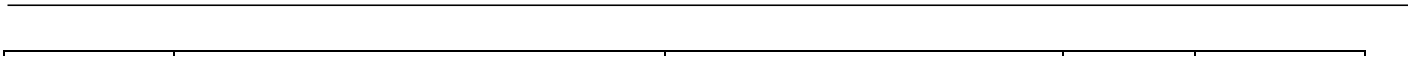
November 2021 | 8464/P/2H | Original Q5

05.5	some of the energy of the electrons causes heating (therefore) increasing the temperature (so using tungsten) allows more electrons to be collided per second than using any other metal	 allow (so using tungsten) enables more energy per second to be transferred than using any other metal	1 1 1	AO1 AO3 AO3 6.5.2
Total			**13**	

6.1.1.1 Energy stores and systems

Answer 07 · Mark scheme

November 2021 | 8464/P/2H | Original Q5



Answer 08 · Mark scheme

Question 2

Question	Answers	Mark	AO / Spec. Ref.
02.1	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 6.1.1.3 6.3.2.2 RPA14
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content • measure mass of oil using the top pan balance • measure start temperature of oil using the thermometer • place beaker of oil on heater • switch on heater to heat oil • measure final temperature of oil using the thermometer • measure energy transferred using joulemeter • calculate increase in temperature ($\Delta\theta$) • use the equation $E = mc\Delta\theta$ to determine c		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	burns / scalds	allow cuts from broken glass ignore the heater / oil is hot	1	AO1 6.1.1.3 RPA14

6.1.1.1 Energy stores and systems

Answer 08 · Mark scheme

June 2022 | 8464/P/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	power = $\frac{\text{energy transferred}}{\text{time}}$ **or** $P = \frac{E}{t}$		1	AO1 6.1.1.4 6.2.4.2 RPA14

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	$50 = \frac{4750}{t}$ **or** $4750 = 50 \times t$ $t = \frac{4750}{50}$ t = 95 (s)		1 1 1	AO2 6.1.1.4 6.2.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	thermistor		1	AO1 6.2.1.4

6.1.1.1 Energy stores and systems

Answer 08 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	250 (Ω)	allow an answer in the range 240 (Ω) to 260 (Ω) allow **1** mark for temperature = 160 (°C)	2	AO3 6.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	the water will recover its original properties if the steam is cooled		1	AO1 6.3.1.2

Total Question 2		**15**

6.1.1.1 Energy stores and systems

Answer 09 · Mark scheme

June 2022 | 8464/P/1H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	**Child** gravitational potential energy decreases kinetic energy increases **and** then decreases (to zero) **Springs** elastic potential energy increases **Surroundings** internal / thermal store of energy increases	ignore descriptions of energy transfers before the child reaches position A ignore references to kinetic energy of the springs allow energy is dissipated allow (average) kinetic energy of the particles increases	1 1 1 1	AO1 6.1.1.1 6.1.2.1

Answer 09 · Mark scheme

June 2022 | 8464/P/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	**At position A** $4.9 = 0.5 \times k \times 0.056^2$ $k = \frac{2 \times 4.9}{0.056^2} = 3125$ (N/m) **At position B** $8.1 = 0.5 \times 3125 \times e^2$ $e = \sqrt{\left(\frac{2 \times 8.1}{3125}\right)}$ $e = 0.072$ (m)	 allow a correct substitution of an incorrectly calculated value of k using 0.056 m **and** 4.9 J allow $e^2 = 0.005184$ allow a correct re-arrangement using an incorrectly calculated value of k allow an answer consistent with their calculated value of k	1 1 1 1 1	AO2 6.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	the total energy transferred by the child		1	AO1 6.1.1.4

Total Question 3		10

6.1.1.1 Energy stores and systems

Answer 10 · Mark scheme

June 2023 | 8464/P/1H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	geothermal		1	AO1 6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	36×10^9 J		1	AO2 6.1.3

Question	Answers	Mark	AO / Spec. Ref.
01.3	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO3
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO1
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO2
	No relevant content	0	
	Indicative content **Figure 1** • the power output from wind increased • because more wind turbines were built • the power output from solar increased • because more solar panels were built • power output from wind and solar may have increased due to climate change For 2015 and 2016 • wind power was lower in 2016 than in 2015 • because 2016 was less windy than 2015 **Figure 2** • for most of the year the electricity generated from wind is greater than from solar. • the electricity generated from wind is greater in winter than in summer • because winter is windier than summer • the electricity generated from solar is greater in summer than in winter • because hours of sunlight are longer in summer • because the intensity of sunlight is greater in summer to access Level 3, the answer should describe trends in both graphs, and in solar power and wind power, and give some explanation for changes.		6.1.3

Total Question 1	8

Answer 11 · Mark scheme

June 2023 | 8464/P/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	the measurement will be more accurate	allow parallax error is reduced	1	AO3
	because (in position B) the eye is level with (the maximum height of) the toy		1	AO1 6.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	64 cm = 0.64 m		1	AO2 6.1.1.2
	$0.049 = m \times 9.8 \times 0.64$	allow a correct substitution using an incorrectly / not converted height	1	
	$m = \frac{0.049}{9.8 \times 0.64}$	allow a correct rearrangement using their incorrectly / not converted height	1	
	$m = 0.0078125$ (kg)	allow an answer consistent with their incorrectly / not converted height	1	
	$m = 0.0078$ (kg)	this mark can only be scored if the equation $E_p = m\ g\ h$ has been used	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	energy from the toy is dissipated (to the surroundings / air)	allow energy from the toy is transferred to the surroundings / air	1	AO1 6.1.2.1 6.1.1.1
	(but) in a closed system the total energy remains constant		1	

Total Question 5	9

Answer 12 · Mark scheme

June 2023 | 8464/P/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$W \propto e$		1	AO1 6.5.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	750 = k × 0.060		1	AO2 6.5.3
	$k = \frac{750}{0.060}$	allow a correct rearrangement using an incorrectly / not converted value of *e*	1	
	k = 12 500 N/m	allow a correct calculation using incorrectly / not converted value of *e*	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	(an object that is inelastically deformed) will not go back to its original length	allow shape for length	1	AO1 6.5.3
	when the force is removed		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	$1800 = ½ \times 225 \times e^2$		1	AO2 6.5.3
	$e = \sqrt{\frac{2\times1800}{225}}$	allow $e^2 = \frac{2\times1800}{225}$	1	
	e = 4 (m)	allow *e* = 4.0 (m)	1	

6.1.1.1 Energy stores and systems

Answer 12 · Mark scheme

June 2023 | 8464/P/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	$e = \frac{750}{225}$ e = 3.3… (m) the extension will be too great so not suitable for use in the chair **OR** F = 225 x 0.3 (1) F = 67.5 (N) (1) the weight of a person will be too great so (spring is) not suitable for use in the chair (1)	 allow a conclusion consistent with their calculated extension allow the chair would rest on the ground allow the spring will not stretch beyond its elastic limit	1 1 1	AO3 6.5.3

Total Question 5	12

6.1.1.1 Energy stores and systems

Answer 13 · Mark scheme

June 2024 | 8464/P/1H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	kinetic energy (of the beater / food) internal / thermal energy (of the surroundings / whisk / food)	ignore sound	1 1	AO1 6.2.4.2 6.1.2.1 6.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	power = $\frac{\text{work done}}{\text{time}}$ or $P = \frac{W}{t}$		1	AO1 6.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	$92 = \frac{23\,000}{\text{time}}$ $\text{time} = \frac{23\,000}{92}$ 250 (s)		1 1 1	AO2 6.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	$P = I^2 R$		1	AO1 6.2.4.1

6.1.1.1 Energy stores and systems

Answer 13 · Mark scheme

June 2024 | 8464/P/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	I = 0.500 A		1	AO2 6.2.4.1
	$P = 0.500^2 \times 640$	allow a correct substitution of an incorrectly / not converted current	1	
	P = 160 (W)	allow a correct calculation using an incorrectly / not converted current	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	230 (V)		1	AO1 6.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	decreases		1	AO1 6.2.4.1

Total Question 1	**12**

6.1.1.1 Energy stores and systems

Answer 14 · Mark scheme

June 2024 | 8464/P/1H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	chemical store of energy decreases gravitational potential energy of the drone increases		1 1	AO2 6.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	$3920 = 2.5 \times 9.8 \times \Delta h$ $\Delta h = \frac{3920}{2.5 \times 9.8}$ $\Delta h = 160$ (m) $(840 - 160) = 680$ (m) **OR** Initial $E_p = 2.5 \times 9.8 \times 840$ (1) Final $E_p (= 20580 - 3920) = 16660$ (1) $h = \frac{16660}{2.5 \times 9.8}$ (1) = 680 (m) (1)	 allow an answer consistent with their calculated value of Δh using the correct equation allow initial $E_p = 20580$ allow correct use of an incorrectly calculated value of E_p using the gravitational potential energy equation allow a correct substitution and rearrangement using their calculated value of E_p using the gravitational potential energy equation allow an answer consistent with their calculated value of E_p using the gravitational potential energy equation	1 1 1 1	AO2 6.1.1.2

6.1.1.1 Energy stores and systems

Answer 14 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	max E_k = 3920 + 150 (= 4070 J)	allow max E_k = 4070 J	1	AO2 6.1.1.2
	$4070 = 0.5 \times 2.5 \times v^2$	allow a substitution using their value for kinetic energy	1	
	$v = \sqrt{\frac{4070}{0.5 \times 2.5}}$	allow a correct re-arrangement using their value for kinetic energy allow $v^2 = \frac{4070}{0.5 \times 2.5}$	1	
	v = 57.06… (m/s)	allow v = 57 (m/s)	1	
	v = 0.057… (km/s)	allow an answer consistent with their calculated value for v using the kinetic energy equation	1	

Total Question 4	**11**

6.1.1.1 Energy stores and systems

Answer 15 · Mark scheme

June 2024 | 8464/P/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	efficiency = 0.72 × 0.86	allow use of percentages if % is seen	1	AO2 6.1.2.2
	efficiency = 0.61(92)		1	
	0.62		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	(at higher temperatures) the (average) speed of the particles is greater	allow the (average) kinetic energy of the particles is greater do **not** accept vibrations	1	AO3 6.1.1.1 6.1.1.4 6.3.2.1 6.3.3.1
	so the frequency of collisions (between particles and the turbine) increases		1	
	and the force of each collision (between a particle and the turbine) is greater		1	
	so more energy transferred (each second)	dependent on MP2 or MP3 ignore increases the power	1	

Answer 15 · Mark scheme

June 2024 | 8464/P/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	$48 = \frac{\text{mass}}{5.0 \times 10^5}$		1	AO2 6.3.1.1 6.3.2.2 6.1.1.3
	mass = $48 \times 5.0 \times 10^5$		1	
	mass = 24 000 000		1	
		the equation density = $\frac{\text{mass}}{\text{volume}}$ must have been used to score subsequent marks		
	E = 24 000 000 × 1100 × 15	allow a correct substitution using their calculated value for mass	1	
	E = 396 000 000 000	allow an answer consistent with their calculated value for mass	1	
	$E = 3.96 \times 10^{11}$(J)	allow a correctly converted answer consistent with their calculated value for energy using the equation $\Delta E = m\, c\, \Delta\theta$	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(efficient energy storage means) less energy is wasted		1	AO1 6.1.3
	(to reduce carbon dioxide emissions) less fossil fuel used / burned	allow named fossil fuel	1	
	the amount of energy generated from renewable resources will need to increase **or** (most) renewable resources do not generate electricity all the time	allow named renewable resources allow renewable resources are unreliable	1	
	(so) efficient energy storage will help to meet the demand for energy / electricity		1	

Total Question 6	17

6.1.1.1 Energy stores and systems

Answer 16 · Mark scheme

June 2024 | 8464/P/2H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(as a spring decompresses) the elastic potential energy of the spring decreases		1	AO1 6.5.3
	(as the gymnast leaves the floor) the kinetic energy of the gymnast increases **or** the gravitational potential energy of the gymnast increases		1	
	OR			
	(as a spring decompresses) the spring exerts a force on the gymnast (1)			
	(so) work is done on the gymnast (1)			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	e = 0.012 m		1	AO2
	E_e= 0.5 × 8500 × 0.012^2	allow a correct substitution using an incorrectly / not converted value of e	1	AO2
	E_e = 0.612	allow 0.61 allow a correct calculation using an incorrectly / not converted value of e	1	AO2
	J **or** joule		1	AO1 6.5.3

6.1.1.1 Energy stores and systems

Answer 16 · Mark scheme

June 2024 | 8464/P/2H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	measure the original length of the spring **and** the compressed length of the spring (using a metre rule) compression = original length − compressed length **OR** calculate / measure the weight of the mass on the spring (1) use the equation $e = \frac{F}{k}$ (1)		1 1	AO3 6.5.3 RPA18

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	masses could fall (off the spring) (so) less likely to cause injury / damage (if done on the floor)	 allow less hazardous allow lower risk (of injury) allow specific cause of injury eg landing on foot	1 1	AO1 6.5.3 RPA18

Answer 16 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	Δy = (330 – 80 =) 250 (N)		1	AO3 6.5.3 RPA18

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	Δx = (0.052 – 0.010) = 0.042 (m)		1	AO3 6.5.3 RPA18

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7		allow ecf from question **02.5 and** question **02.6**		AO3 6.5.3 RPA18
	$k = \frac{250}{0.042}$	allow k = 5952.38	1	
	5950 (N/m)	allow their calculated gradient to 3 significant figures	1	

Total Question 2	14

6.1.1.1 Energy stores and systems

Answer 17 · Mark scheme

June 2025 | 8464/P/1H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	any **two** from • chemical store (of the fuel) decreases • thermal store (of engine / gases / surroundings) increases • kinetic energy (of the engine / car) increases		2	AO2 6.1.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	biofuel	allow a named biofuel allow biogas allow wood ignore fossil fuels	1	AO1 6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	(by a) battery **or** (by) electricity	allow (by an) electric motor	1	AO3 6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	the amount of fossil fuel that is burned to generate electricity each year has decreased		1	AO3 6.1.3

6.1.1.1 Energy stores and systems

Answer 17 · Mark scheme

June 2025 | 8464/P/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	many generators are required **or** lots of resources are required	allow named device such as wind turbines for generators ignore unreliable	1	AO3 6.1.3
	so it is expensive	if no other mark awarded allow **1** mark for lack of political will	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	*hydro-electric power* loss of habitat *wind power* negative visual impact	 allow dangerous for birds allow noise pollution	 1 1	AO1 6.1.3

Total Question 1	9

6.1.1.1 Energy stores and systems

Answer 18 · Mark scheme

June 2025 | 8464/P/1H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	$13\,800 = 0.75 \times c \times 20$		1	AO2 6.1.1.3 RPA14
	$c = \frac{13\,800}{0.75 \times 20}$		1	
	$c = 920$ (J/kg °C)		1	

6.1.1.1 Energy stores and systems

Answer 18 · Mark scheme

June 2025 | 8464/P/1H | Original Q2

Question	Answers	Mark	AO / Spec. Ref.
02.2	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 6.1.1.3 RPA14
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content **Mass** • use a top pan balance to measure mass of block **Energy transfer** • use a joulemeter to measure energy • connect heater to a joulemeter • measure initial energy and switch on • switch off and measure final energy • calculate the difference between initial and final energy • use an ammeter, voltmeter and stopwatch • calculate energy transferred **Temperature change** • use a thermometer to measure temperature • measure the initial temperature • measure the final temperature • calculate the difference between initial and final temperature for **Level 3** answers must describe all three measurements		

6.1.1.1 Energy stores and systems

Answer 18 · Mark scheme

June 2025 | 8464/P/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	the amount of wasted energy is less the temperature increase of the aluminium block is greater		1 1	AO3 6.1.1.3 6.1.2.1 RPA14

Total Question 2	11

6.1.1.1 Energy stores and systems

Answer 19 · Mark scheme

June 2025 | 8464/P/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	V (= 5 × 5 × 5) = 125 (m^3)	do **not** allow subsequent marks unless volume is used subsequent marks may be awarded if volume is incorrectly calculated	1	AO2 6.3.1.1
	$4200 = \frac{m}{125}$		1	
	m = 4200 × 125		1	
	m = 525 000 (kg)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	(the greater the density) the greater the mass (for a given volume)		1	AO1
	(so) a greater amount of energy can be stored		1	AO3
	OR			6.1.1.2
	(the greater the density) the smaller the volume (for a given mass) (1)			
	(so) the same amount of energy can be stored (for a smaller volume) (1)			

6.1.1.1 Energy stores and systems

Answer 19 · Mark scheme

June 2025 | 8464/P/1H | Original Q6

Question	Answers		Mark	AO / Spec. Ref.
06.3	measure the energy input from the National Grid **and** measure the energy output to the National Grid	allow measure the energy input to the motor **and** measure the energy output from the generator	1	AO3
	(then) use the equation: efficiency = $\frac{\text{energy output}}{\text{energy input}}$	MP2 dependent on MP1	1	AO1 6.1.2.2
	if no other mark awarded, allow **1** mark for: efficiency = $\frac{\text{energy released when lowering the block}}{\text{energy stored when raising block}}$			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	use a motor with a greater power	allow increase the power of the motor	1	AO1 6.1.1.4
	(so) the cube / weight / mass is lifted more quickly	MP2 dependent on MP1	1	

Total Question 6	10

Question 5 (Standard/high and High demand)

05.1 Very few students gained more than one mark on this question. This is a new specification point this year but the answer to the question is straight recall from the specification.
Most students wrote vague answers about heat being contained inside and the cold not being allowed to enter. The starting point about the thickness of the wall was rarely mentioned and nor was the low thermal conductivity of the material.

05.2 72% of students calculated this correctly, either using the method in the mark scheme, or by calculating the midpoint using (20.8 + 17.4) /2. Of the incorrect responses, some students attempted to adjust the result to take into account the decreasing rate at which the temperature decreased, but were not always successful. Some students calculated the differences between the given temperatures, then the differences between the differences in order to determine the trend and then estimated the temperature at 30 minutes. Some students attempted to find an average temperature over a range of time, using various ranges.

05.3 49% of students scored no marks. Only 17% of students scored more than one mark and fewer than 2% scored three marks. Many students appeared confused by the reference to energy stores, rather than being asked to simply identify a chain of energy changes. Most commonly, one mark was scored for referring to thermal energy being added to the water. There were very few who considered the thermal store of the air.

A fairly common misconception was that, despite clearly shown exiting the boiler as hot water, the water would be heated enough to boil and leave the boiler as steam – the implication being that the hot exhaust gas was formed in this way.

05.4 75% of students gained at least one mark. Just over a tenth of students correctly carried out both conversions and achieved four marks. The most common mistake was in the conversion of 15 MJ into J but most students knew the equation and could substitute their sometimes incorrect conversions into the equation and calculate it correctly. A very simple answer saw 15 / 10 = 1.5 often written down and this gave the student two marks. Unfortunately a few students calculated energy × time and could only obtain the conversion marks if done correctly.

6.1.1.1 Energy stores and systems

Answer 02 · Examiner comments — June 2019 | 8464/P/1H | Original Q5

Question 5 (High demand)

05.1 Just over 40% of students scored at least 1 mark on this question and just below 5% of students gained both marks. Of those gaining no marks, some stated that the hot water in the kettle increased the temperature of the heating element. Many students wrote about friction in the circuit causing heating, although some of these answers gained one mark by also mentioning that a current was involved.

05.2 Slightly more than 15% of students identified that the starting temperature of the kettle, water, or heating element needed to be controlled. A small proportion of students suggested that the kettle itself was a control variable, but this was not allowed as if this had been changed, the investigation would not then have been about a particular electric kettle.

05.3 Around 1 in 10 students gained this mark for either suggesting that the kettle or element took time to heat up, or for suggesting that the kettle took time to detect that there was no

Answer 02 · Examiner comments — June 2019 | 8464/P/1H | Original Q5

water in the kettle. The data for this question was taken from a real kettle. Many students stated that the kettle took time to switch off when it was empty, which is effectively saying the same as the line does not go through the origin, so and gained no credit. A large number of students stated that it is not possible to put no water in a kettle, and again this scored no marks.

05.4 Only a very small proportion of students gained this mark. Most students did not appear to realise that they had to suggest what caused the curve to be non-linear, and instead described what was meant by a non-linear trend or pointed out that the graph was not directly proportional.

05.5 Just over 60% of students scored 0 marks on this level 8-9 calculation question. However, the students who did manage to access the question generally scored rather well, with more than 25% of all students gaining 5 or 6 marks.

6.1.1.1 Energy stores and systems

Answer 04 · Examiner comments — November 2021 | 8464/P/1H | Original Q1

Question 01 (Standard demand)

01.1 Slightly over two thirds of students selected the correct equation.

01.2 Full marks were gained by over 60% of the students, with about 35% failing to gain any credit.

01.3 This equation was correctly recalled by around 70% of students.

01.4 Most students did not attempt to convert 2500 minutes into seconds. Nearly a quarter of students gained all 3 marks, with just over half of students gaining 2 marks.

01.5 Slightly less than 40% of higher tier students were able to correctly identify the symbol for a thermistor.

Answer 04 · Examiner comments — November 2021 | 8464/P/1H | Original Q1

01.6 Most students failed to recognise that the resistance of the thermistor would decrease as temperature increased, with many students stating that because the potential different across the thermistor was constant, the current in the thermistor must also be constant. Another misconception demonstrated in a number of responses was that the current would increase because the increased temperature gives the current more energy. Roughly one in ten students gained 2 marks, with just over a third gaining 1 mark.

6.1.1.1 Energy stores and systems

Answer 05 · Examiner comments — November 2021 | 8464/P/1H | Original Q3

Question 03 (Standard/high demand)

03.1 Slightly over half of students answered correctly. The most common incorrect answer was to suggest that the boat could utilise tidal power.

03.2 It appeared that some students did not assimilate all of the information in the question, with answers stating that the boat can move using the generator. It was also fairly common for students to describe why using wind power is beneficial, but not to give reasons why it is useful to have both a wind turbine and a generator. Approximately 15% of students gained both marks, with nearly 60% gaining at least 1 mark.

03.3 This question proved to be accessible to all students, and differentiated well between them. Approximately a third of students gained both marks, a third gained one mark, and a third of students gained no marks.

03.4 Many students did not convert 81 kJ into J. Re-arranging the kinetic energy equation to give *v* also caused problems for a fair proportion of students. Roughly one in four students gained at least 3 marks. Over half the students gained no marks at all.

Answer 05 · Examiner comments — November 2021 | 8464/P/1H | Original Q3

03.5 This calculation was carried out correctly by just over a third of students, with about 50% of students gaining no marks.

6.1.1.1 Energy stores and systems

Answer 06 · Examiner comments

November 2021 | 8464/P/2H | Original Q1

Question 1 (Standard demand)

01.1 30% of students correctly selected the meaning of elastically deformed.

01.2 Approximately 25% of students scored at least 1 mark on this question for suggesting that the length of the spring should be measured with a ruler. Nearly 15% correct suggested that the initial and final length should be measured, then subtracted.

01.3 85% of students were able to select the correct equation from the physics equations sheet, and substitute the values into the equation. Nearly all these students correctly evaluated the answer and were awarded 2 marks. Around 15% of these students converted 80 mm to metres and scored full marks.

01.4 Approximately 65% of students correctly recalled the equation.

01.5 Approximately 65% of students were able to substitute the numbers into the correctly rearranged equation and evaluate the answer to score full marks.

Answer 07 · Examiner comments

November 2021 | 8464/P/2H | Original Q5

Question 5 (standard/high demand and high demand)

05.1 Only 10% of students scored marks on this question. At high demand it is expected that where a question follows a figure, students should use information from the figure. Very few students linked the amount of infra-red radiation to temperature, or stated that different temperatures are displayed at different colours, despite that information being given in Figure 8.

05.2 This was a demanding question - students had to compare wavelengths given in nm and mm and in standard form. They then had to use their understanding of the electromagnetic spectrum. Less than 30% of students answered this question correctly.

05.3 The vast majority of the 40% of students that scored marks on this question only scored 1 mark, and that was mostly for saying that there is some risk of cancer with both.

05.4 This question performed as expected with 30% of students scoring 2 marks. Only 8% of students included the conversion to gain full marks.

6.1.1.1 Energy stores and systems

Answer 07 · Examiner comments November 2021 | 8464/P/2H | Original Q5

05.5 20% of students gained at least 1 mark. Most of those stated that the energy from the electrons would cause heating and increase the temperature. Some went on to say that tungsten could be heated to a higher temperature than any other metal. No student scored full marks for explaining this meant that more electrons could be collided.

Answer 08 · Examiner comments

June 2022 | 8464/P/1H | Original Q2

Question 02 (Standard demand)

02.1 Almost all students gained some marks on this question, with about half of students accessing level 2 of the mark scheme and gaining 3 or 4 marks. Just over 15% of students gave answers which scored in level 3.

It was clear that a lot of students were not aware of what a top pan balance is, with many thinking that it is a device to help prevent things from falling over, or that the pan of the top pan balance was to be used for heating the oil. As a consequence of this misunderstanding, many students placed the top pan balance on the heater. Of the students who did know what a top pan balance is, a sizeable minority thought that it is used to find the weight of oil, rather than the mass of oil.

While most students realised that the thermometer should be used to measure temperature, some students measured the heat with the thermometer, which was worth no credit.

The joulemeter was often confused with a voltmeter, or students did not appreciate the function of a joulemeter. Common suggestions included setting the joulemeter to 10 and leaving it for a fixed time, for example.

A lot of students did not mention the measuring equipment at all, and simply stated that they would weigh the oil and measure its temperature. Students who did this were unable to access level 3 on the mark scheme, but could gain some credit for these statements.

Some students described the use of a voltmeter, ammeter, and stopclock to determine the energy supplied to the heater. Although a method determining specific heat capacity of oil using this equipment would lead to a valid outcome, this did not use the equipment given in the question, so would not be able to score all 6 marks.

Many students described the wrong experiment, either finding the boiling point of the oil, carrying out a cooling-curve experiment, or describing how to use an immersion heater to find the specific heat capacity of a block of metal. These responses could still gain some credit, for example by correctly stating how to use the thermometer.

02.2 Approximately 60% of students could identify the risk when using the given equipment.

It was clear that many students were unable to distinguish between risks, hazards, and precautions. Some students did not talk about safety at all, instead suggesting that a risk might be inaccurate results, for example.

02.3 As students were given an equation sheet for this exam, almost 100% of students gave the correct equation.

02.4 Nearly 90% of students gained full marks on this question, with just over 5% of students scoring 0 marks.

6.1.1.1 Energy stores and systems

Answer 08 · Examiner comments

02.5 Only about a fifth of students recognised that the electrical component whose resistance decreases as temperature increases is a thermistor.

02.6 Just over 40% of students gained both marks, with around a quarter gaining one mark on this question.

Some students misread the temperature scale, deciding that the maximum temperature reached was 152 °C or 170 °C, for example. Some students thought that the relevant temperature was the change in temperature of 140 °C. Of those students who correctly read 160 °C from figure 4, but did not then use figure 3, many decided to divide the temperature by a time read from the graph, or tried to use the equation $R = V / I$ or $P = I^2 R$. Some students used their temperature with the maximum resistance of 1000 Ω shown on figure 3.

Students who read 160 °C on figure 3 and decided that this was the resistance of the resistor by writing 160 on the answer line gained no marks.

02.7 Just under 40% of students chose the correct answer to why this was a physical change.

6.1.1.1 Energy stores and systems

Answer 09 · Examiner comments

June 2022 | 8464/P/1H | Original Q3

Question 03 (Standard and standard/high demand)

03.1 Many students struggled with this question, which revealed a number of misconceptions held by students. Around 70% of students gained at least one mark, but very few managed to score all 4 marks.

Many students began by describing energy changes as the child moved from the trampoline to the maximum height. This was ignored, and most of these responses went on to describe what happened as the child then fell downwards.

A lot of students described the forces acting on the child, which did not answer the question, and it was reasonably common to see descriptions of gravitational potential energy being a force which acts on the child. The concept of energy stores continues to be widely misunderstood by students, with some students making statements suggesting that there is a gravitational potential energy store when the child is in the air, for example. Lots of responses to the question described a transfer of gravitational potential energy to kinetic energy as the child descended, which gained the first marking point. Very few students realised that the kinetic energy of the child would decrease after landing on the trampoline.

For the springs, it was common to read descriptions of the springs stretching, rather than descriptions of changes to energy stores. Some students identified that the elastic potential energy of the springs would increase, but added that the chemical energy of the springs would decrease, and therefore did not gain the mark. A fair number of students made statements that elastic energy was used to stretch the springs, which was not credit-worthy.

For the surroundings, a lot of students stated that there was no change to the energy stores, and a lot of students described an increase in sound energy. This is not a store of energy, and was ignored. A fair proportion of students did identify that energy would be dissipated to the surroundings, thus gaining the mark.

6.1.1.1 Energy stores and systems

Answer 09 · Examiner comments June 2022 | 8464/P/1H | Original Q3

03.2 This calculation proved to be very challenging, with nearly three quarters of all students failing to gain any marks.

A lot of students calculated the difference between the energies at positions A and B, which is incorrect physics so was unable to gain credit. A lot of students substituted 0.056 m in for the spring constant in position A, and some students forgot to square the extension when using the elastic energy equation.

Students who realised that they needed to use the value of elastic potential energy at position A to calculate the spring constant, tended to do very well in this question, with nearly two thirds of those who gained any credit scoring all 5 marks. A few students arrived at the correct final answer, but then subtracted the original extension to find the change in extension, an approach which scored a maximum of 4 marks.

03.3 Over 60% of students selected the correct definition of work done.

Answer 10 · Examiner comments June 2023 | 8464/P/1H | Original Q1

Question 01 (Standard demand)

01.1 Approximately 85% of students identified geothermal as the renewable energy resource.

01.2 About a third of students knew that giga means 10^9.

01.3 Students found this question to be quite accessible, and wrote a fair amount in their answers, with only about 1% omitting any attempt at an answer. Over 40% of students gave answers which included explanations for trends shown in the graphs, which placed their response into level 3.

Many students were not clear in their use of English. A fair proportion of students stated that there was more wind than sun to explain why power output from wind turbines often exceeds power output from solar panels, which was ignored. Many students also wrote about the demand for electricity over time increasing because more electronic devices were used so more electricity was needed. Statements such as this were also ignored when marking this question.

Some students attempted to explain the increase in power output from solar panels in the middle of the year by referring to temperature or to hotter months, rather than attributing this increase to greater light intensity or more daylight hours.

6.1.1.1 Energy stores and systems

Answer 11 · Examiner comments — June 2023 | 8464/P/1H | Original Q5

Question 05 (Standard/high and high demand)

05.1 Around half of students gained at least 1 mark on this question. There were many acceptable ways to describe the toy being at eye level in position B. A fair number of students suggested that in position B the student could push down harder on the toy so that it would reach a greater height, which missed the point of the question and tended to score no marks.

05.2 About 85% of students gained at least 1 mark for this calculation, with about 20% scoring full marks, about 25% on 4 marks and about 15% on 3 marks. Most students did not attempt to convert the height into metres. Many students struggled to give the answer to 2 significant figures, perhaps caused by students not understanding how their calculators were giving the answer in standard form. So, for example, 7.8125×10^{-3} as an answer might have been rounded to 7.8 without any power of 10 shown.

Answer 11 · Examiner comments — June 2023 | 8464/P/1H | Original Q5

05.3 Approximately a quarter of students scored at least 1 mark, with many not knowing how the specification defines a closed system.

Answer 12 · Examiner comments — June 2023 | 8464/P/2H | Original Q5

Question 5 (standard/high demand and high demand)

05.1 Approximately 70% of students selected the correct relationship.

05.2 90% of students correctly substituted and calculated a spring constant. However, only 35% of students converted the extension to metres and scored three marks. 55% of students did not do the conversion or did it incorrectly and scored two marks.

05.3 Approximately 60% of students knew that an object that is inelastically deformed will not go back to its original length but did not refer to when the force is removed. Only 2% of students were awarded both marks for this question. Many students who scored zero marks wrote vague statements such as the object will not go back to its original form.

05.4 50% of students scored full marks. Many students who scored zero used an incorrect equation despite having the equation sheet. Many students tried to substitute into the correct equation but omitted the squared symbol.

05.5 Many students find evaluate questions challenging, particularly when they have to do a calculation. 30% of students did score at least two marks for a calculation, and 12% went on to draw a sensible conclusion and were awarded all three marks.

Answer 13 · Examiner comments

June 2024 | 8464/P/1H | Original Q1

Question 1 (standard demand)

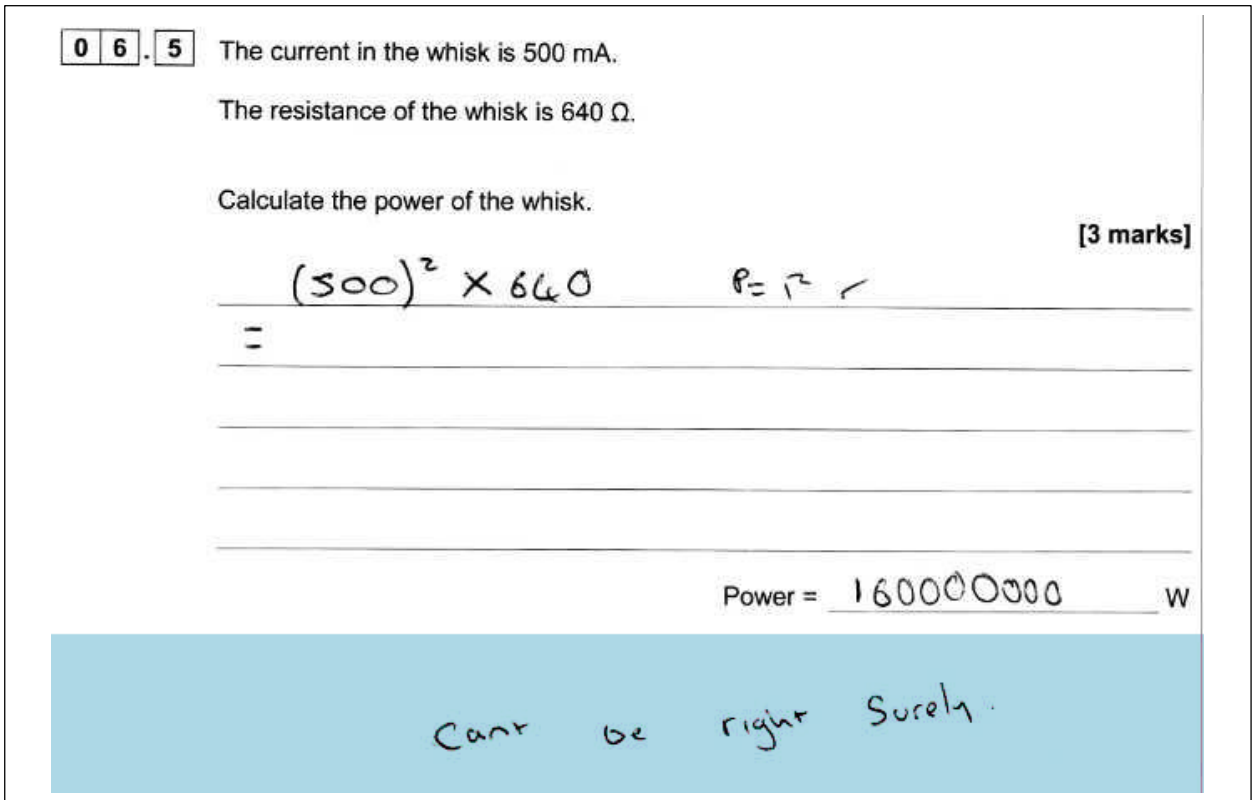
01.1 Almost all students scored at least 1 mark on this question, with nearly two-thirds scoring both marks. The most common incorrect answers were an increase in electrical energy and an increase in chemical energy.

01.2 A very low proportion of students answered this incorrectly.

01.3 Nearly 90% of students arrived at the correct final answer for this calculation, gaining 3 marks.

01.4 Most students selected the correct equation, with about 1% of students not gaining this mark.

01.5 For this calculation, many students did not correctly convert the current into amps. Some students forgot to show that the current should be squared in their substitution. Others showed a valid substitution but forgot to square the current when they entered it in their calculator. About 40% scored all 3 marks, but about 50% gained 2 marks, and over 95% scored at least 1 mark.



This student did not realise that the current was given in milliamps, so only scored marking points 2 and 3. However, the comment 'Can't be right, surely' indicates that they realise that the power of an electric whisk ought to be a lot lower. Students who think about how realistic their answer is may give themselves a much better chance of spotting their mistakes and doing something to rectify them.

01.6 Slightly more than one in two students could recall the potential difference between the live and neutral wires.

01.7 Over 80% of students identified that an increase in current would be caused by a decrease in resistance.

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Answer 14 · Examiner comments

Question 4 (standard/high & high demand)

04.1 Many students just named energy stores and did not describe how the stores changed. A fair proportion of students stated that the kinetic energy of the drone would remain constant, which is not an incorrect statement, but is not a change to a store of energy so did not gain any credit. A small proportion of students referred to the chemical store of energy decreasing.

Approximately two-thirds of students gained at least 1 mark, although only about 10% of students scored both marks.

04.2 There were two routes that students could use to answer this question. Many students who took the first route got as far as the third marking point but then did not subtract their answer from 840 m.

Just under a third of students gained full credit, with slightly over half gaining 3 marks.

04.3 Most students omitted the first step in this calculation and did not add the 3920 J to the initial kinetic energy of the drone. However, marking point 2 could still be scored using any energy value when substituting into the kinetic energy equation. The most common approach was to use 150 J as the maximum kinetic energy.

A noticeable minority of students converted 2.5 kg into grams.

Some students forgot to square the speed when substituting into the equation. Other students struggled to re-arrange the equation. One relatively common mistake was to correctly rearrange the equation for v^2 (eg $v^2 = \frac{4070}{05 \times 2.5}$) but then square this value to determine v (eg $v = \left(\frac{4070}{0.5 \times 2.5}\right)^2$) rather than determining the square root.

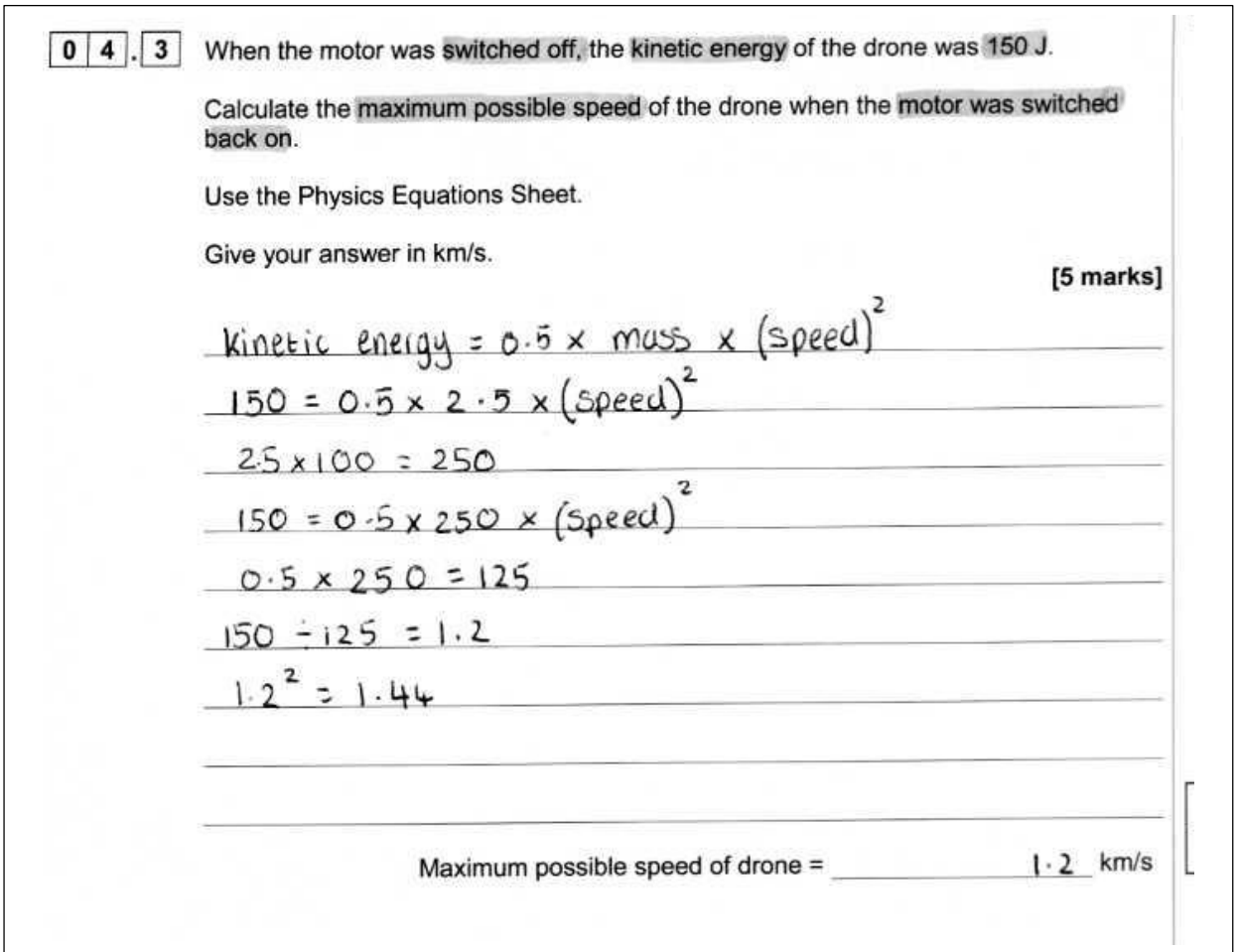
A minority of students remembered to convert their final answer into km/s.

Almost 60% of students scored 2 marks, with only the highest-attaining students managing to gain 4 or 5 marks.

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6.1.1.1 Energy stores and systems

Answer 14 · Examiner comments June 2024 | 8464/P/1H | Original Q4



0 4 . 3 When the motor was switched off, the kinetic energy of the drone was 150 J.

Calculate the maximum possible speed of the drone when the motor was switched back on.

Use the Physics Equations Sheet.

Give your answer in km/s.

[5 marks]

Kinetic energy = 0.5 × mass × (speed)^2

150 = 0.5 × 2.5 × (speed)^2

2.5 × 100 = 250

150 = 0.5 × 250 × (speed)^2

0.5 × 250 = 125

150 ÷ 125 = 1.2

1.2^2 = 1.44

Maximum possible speed of drone = 1.2 km/s

This student has tried to use the kinetic energy equation but has made several errors along the way and, as a result, does not gain any marks.

The student used an incorrect value for the maximum kinetic energy, so does not score marking point 1.

Although a correct substitution of 150 J into the kinetic energy equation is shown in line 2 of the answer, the student has multiplied the mass by 100 in line 3 and then used the equation with the mass multiplied by 100 (line 4). It is the equation on line 4 that ultimately leads to the student's final answer. As an incorrect value for mass is used here, this is an incorrect substitution, so marking point 2 is not awarded.

On line 6, the student has rearranged the equation to give a value of 1.2, but the answer line demonstrates that the student thinks this is the maximum possible speed of the drone rather than a value for v^2, so marking point 3 is not scored.

The common mistake of squaring the calculated value of v^2 can be seen on line 7, but the student has chosen to ignore this line of reasoning when giving the final answer. The student has not attempted to convert the calculated speed of 1.2 m/s to km/s.

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Answer 15 · Examiner comments

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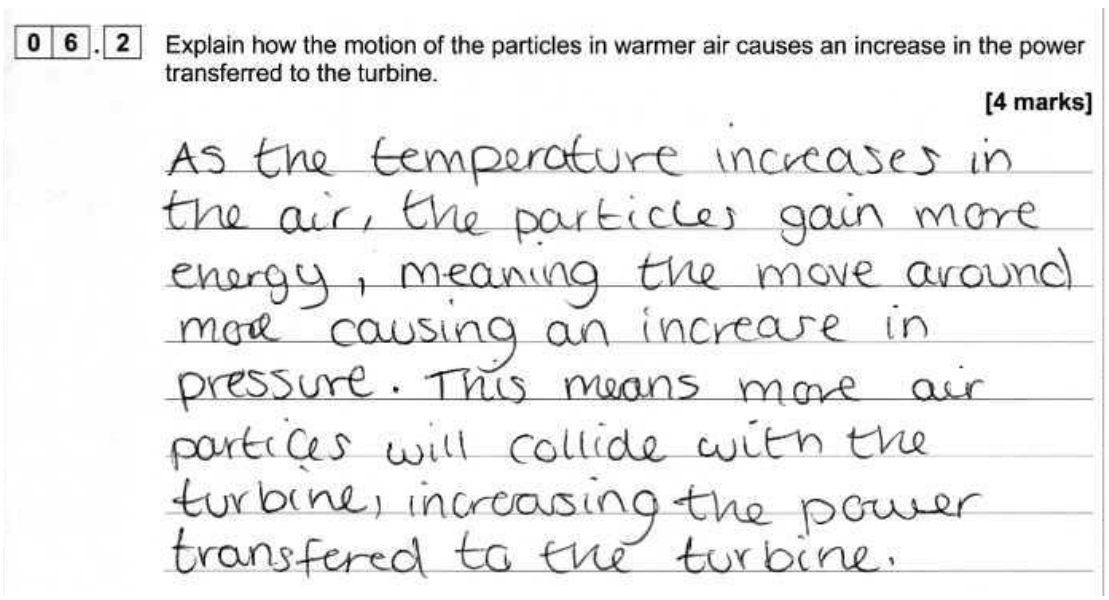
Question 6 (standard/high & high demand)

06.1 Most students struggled to appreciate that the process of compressing the air would reduce the useful energy, and that releasing the air would then reduce this energy further. This lack of understanding of the physics involved meant that a very small proportion of students were able to carry out the correct calculation. Most students who correctly multiplied the two efficiency values tended to also round their answer correctly.

Roughly 20% of students scored 3 marks.

06.2 Many students demonstrated some understanding of how the temperature affects the rate of energy transfer to the turbine. However, many of these answers lacked crucial details. Statements such as 'the number of collisions between the particles and the turbine increases' were common, but without a reference to frequency, or to the collisions happening in a fixed time, marking point 2 was not scored. The proportion of students who referred to the force from each collision was very low.

About 70% of students gained some credit for their answers.



0 6 . 2 Explain how the motion of the particles in warmer air causes an increase in the power transferred to the turbine.

[4 marks]

As the temperature increases in the air, the particles gain more energy, meaning the move around more causing an increase in pressure. This means more air particles will collide with the turbine, increasing the power transfered to the turbine.

This answer demonstrates some understanding, but lacks the detail needed to gain any marks. The student refers to particles gaining more energy but needed to refer to kinetic energy to gain the point. If the particles 'move around more' it could mean that they move a greater distance, rather than moving at a greater speed, so again marking point 1 is not scored. Similarly, 'more particles will collide with the turbine' does not have a reference to frequency or to time, so is not sufficient to score the second marking point.

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6.1.1.1 Energy stores and systems

Answer 15 · Examiner comments June 2024 | 8464/P/1H | Original Q6

06.3 This question proved to be relatively straightforward for a high proportion of students, with over 60% gaining full marks. Having an equation sheet which included all of the physics equations was, no doubt, helpful to many students.

Common errors included spurious conversions of the calculated mass into grams. Some students calculated the correct answer, but then tried to apply the efficiency equation to their answer, often going back to question 06.2 to find an efficiency to use. These responses could still score the first 3 marking points for calculating the mass of air in the tank.

Some students used their calculator to obtain an answer in standard form, but then wrote the answer out in full on the answer line, demonstrating that they did not understand how to give their answer in standard form.

06.4 Many students scored marks for referring to a reduction in wasted energy, but very few discussed both a reduction in the use of fossil fuels and an increase in the use of renewables, so it was very rare for a student to score full marks on this question. Roughly two-fifths of students gained at least 1 mark.

A large number of students seemed confused about what was being asked. Some students wrote about the use of transformers in the National Grid. Some appear to have misread 'efficient energy storage' as 'renewable energy resources' and based their answers around the relative benefits of solar panels and wind turbines. It was common to read answers explaining the impact of carbon dioxide in the atmosphere, but not actually answering the question. Many students seemed to think that the compressed air energy storage system was part of a carbon-capture and storage system.

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6.1.1.1 Energy stores and systems

Answer 15 · Examiner comments

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Answer 16 · Examiner comments

Question 2 (standard demand)

02.1 This question was more demanding than expected, with 40% of students able to gain any marks, although half of these students scored 2 marks. Students find the idea of energy stores very confusing. As in previous series, the mark scheme allows students to be awarded marks for answering in terms of transfers or transformations: this is the only way students were able to score marks on this question.

02.2 Nearly 90% of students did the calculation correctly and gained 2 of the 4 marks. Most of the students that scored 3 marks got the unit correct but missed the conversion of centimetres to metres. Less than 50% of students gave the correct unit, some clearly under the impression that elastic potential energy has a different unit from energy.

02.3 A little under 50% of students were able to gain a mark for suggesting that the length of the spring should be measured before and after it is compressed. Of those that did, approximately half suggested subtracting the two measured values for the second mark.

02.4 Approximately 30% of students identified that the large masses meant that the experiment should be done on the laboratory floor rather than on the table for safety reasons. Most students gained no marks as they wrote that the table would not be level or that as it was higher that would affect the readings.

02.5 Just under 80% of students correctly used the values from the graph to determine the value for Δy. Most incorrect answers gave it as either 300 or 330.

02.6 About three-quarters of students correctly determined Δx. The most common incorrect answer was 0.52.

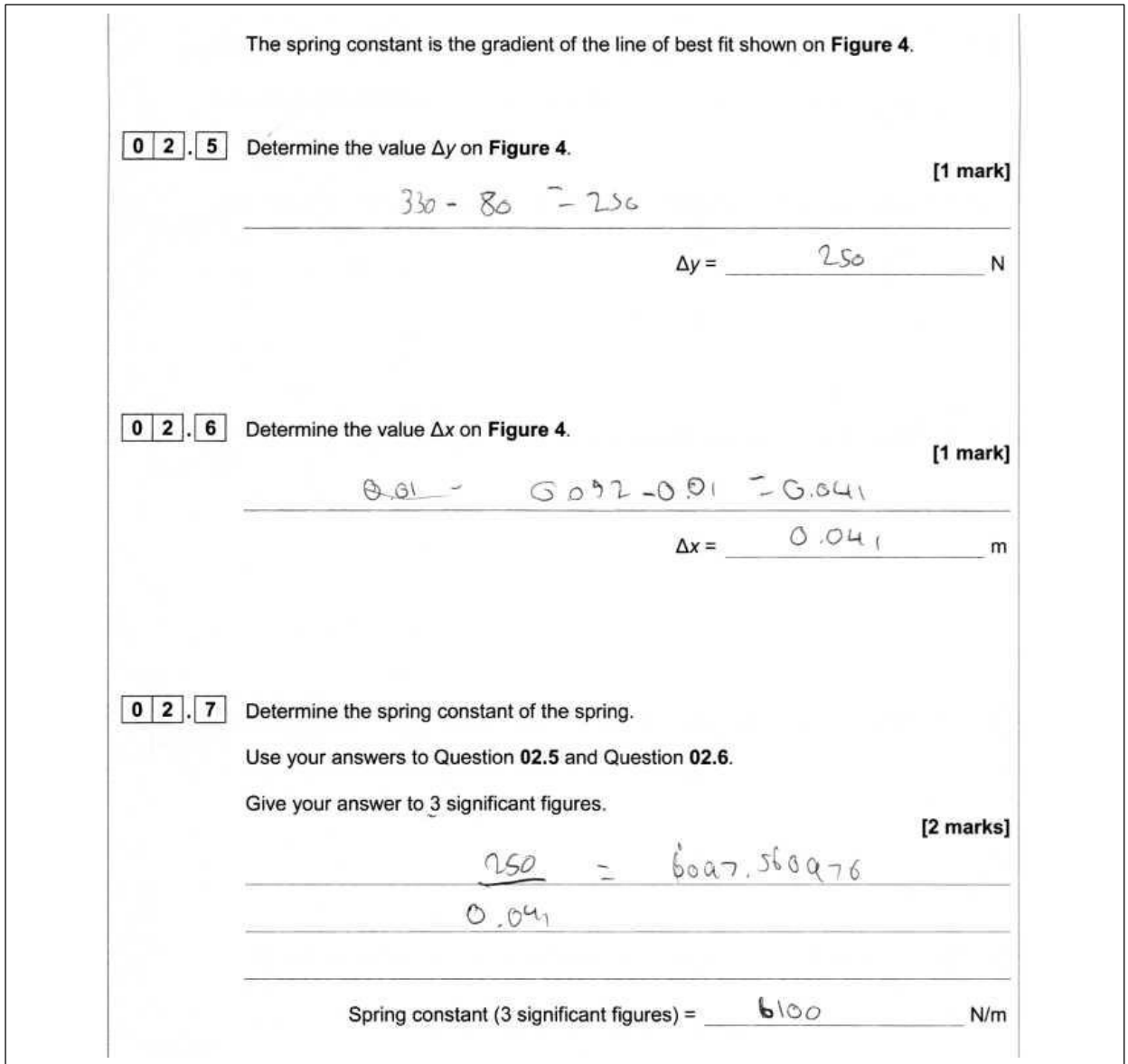
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6.1.1.1 Energy stores and systems

Answer 16 · Examiner comments June 2024 | 8464/P/2H | Original Q2

02.7 This question was reasonably well answered, with 75% of students gaining at least 1 mark. The error carried forward (ecf) meant that students could use their answers from questions 02.5 and 02.6 and many students were able to gain 2 marks for doing so even if their previous answers were wrong.

About 20% of students were able to do the calculation correctly but then couldn't give the answer to 2 significant figures. An answer of 595 was frequently seen.



The spring constant is the gradient of the line of best fit shown on **Figure 4**.

0 2 . 5 Determine the value Δy on **Figure 4**. **[1 mark]**

330 - 80 = 250

$\Delta y =$ 250 N

0 2 . 6 Determine the value Δx on **Figure 4**. **[1 mark]**

0.01 - 0.092 - 0.01 = 0.041

$\Delta x =$ 0.041 m

0 2 . 7 Determine the spring constant of the spring.

Use your answers to Question **02.5** and Question **02.6**.

Give your answer to 3 significant figures. **[2 marks]**

250 / 0.041 = 6097.560976

Spring constant (3 significant figures) = 6100 N/m

When ecf is allowed, students who give one value incorrectly can still gain subsequent marks in the next part of the question.

In this example the student gained the mark for question 02.5 but not for question 02.6. In their answer to question 02.7 they were awarded the first mark for dividing their answer to question 02.5 by their answer to question 02.6 and the second mark for giving the correct answer to this calculation to the correct number of significant figures.

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Answer 17 · Examiner comments

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Question 1 (Standard demand)

01.1 75% of students gained at least one mark on this question. 50% of students gained one mark, mostly for either stating that a thermal store of energy increased or that a kinetic store of energy increased. 25% of students gained 2 marks for making both statements and/or identifying that a chemical store of energy was decreasing.

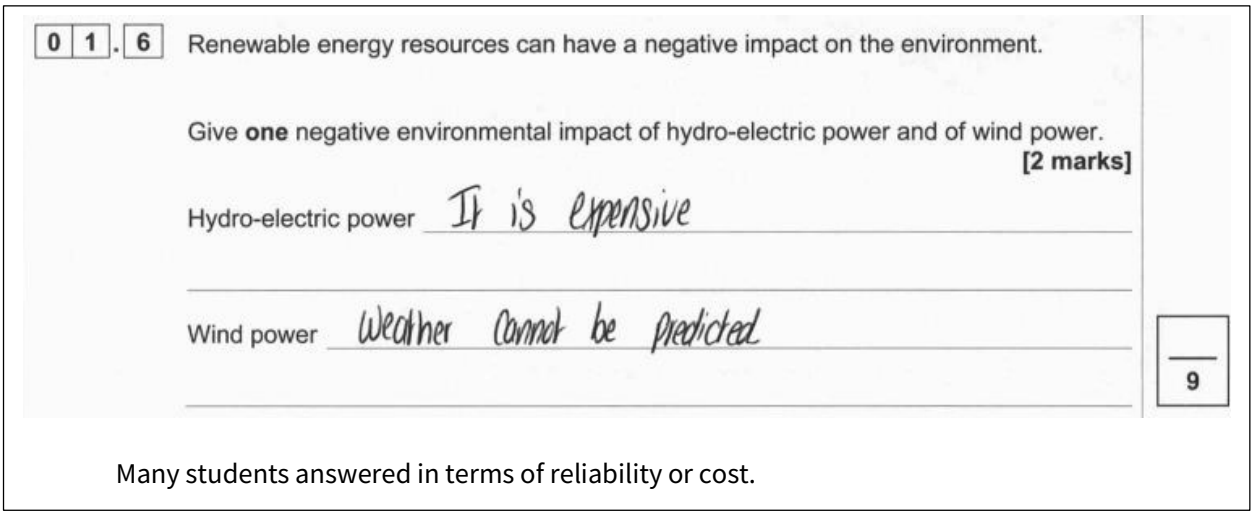
01.2 This question was reasonably well answered, with approximately 50% of students answering correctly.

01.3 This question was very well answered with 95% of students answering correctly by stating that the cars are powered by a battery or by electricity.

01.4 80% of students could correctly analyse the bar chart to conclude that the amount of fossil fuel that is burnt to generate electricity each year has decreased.

01.5 Only a very small number of students gained 2 marks on this question. 40% of students gained one mark for identifying that it is expensive, but the vast majority of those students did not state that *many* generators or resources are required.

01.6 Many students did not give a negative impact on the environment in their answer and described both types of resource as being unreliable. 40% of students were able to gain 1 mark mostly for giving a negative impact on the environment for wind power. Many students suggested that hydro-electric power has a damaging impact on habitats in the sea. 20% of students were able to give a negative impact on the environment for both resources.



0 1 . 6 Renewable energy resources can have a negative impact on the environment.

Give **one** negative environmental impact of hydro-electric power and of wind power.

[2 marks]

Hydro-electric power It is expensive

Wind power Weather cannot be predicted

9

Many students answered in terms of reliability or cost.

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Answer 18 · Examiner comments

Question 2 (Standard demand)

02.1 This standard demand calculation was well answered with over 80% of students gaining full marks. Nearly all students that did a correct substitution were able to rearrange correctly and calculate the final answer.

02.2 Students found this question quite demanding. Over 20% of students did not attempt the question. 40% of students were able to write something creditworthy. 85% of students wrote a creditworthy response. Half of students that gained marks wrote Level 1 responses, the most common Level 1 response just suggested measuring temperature with a thermometer. The 40% of students that wrote Level 2 or 3 answers went on to describe measuring the energy transferred with either a joulemeter or other method and/or measuring mass using a top pan balance.

02.3 Over 95% of students were able to gain at least 1 mark on this question. The majority of students who gained one mark identified that the amount of wasted energy is less. 45% of students gained a second mark for also identifying that the temperature increase of the aluminium block is greater.

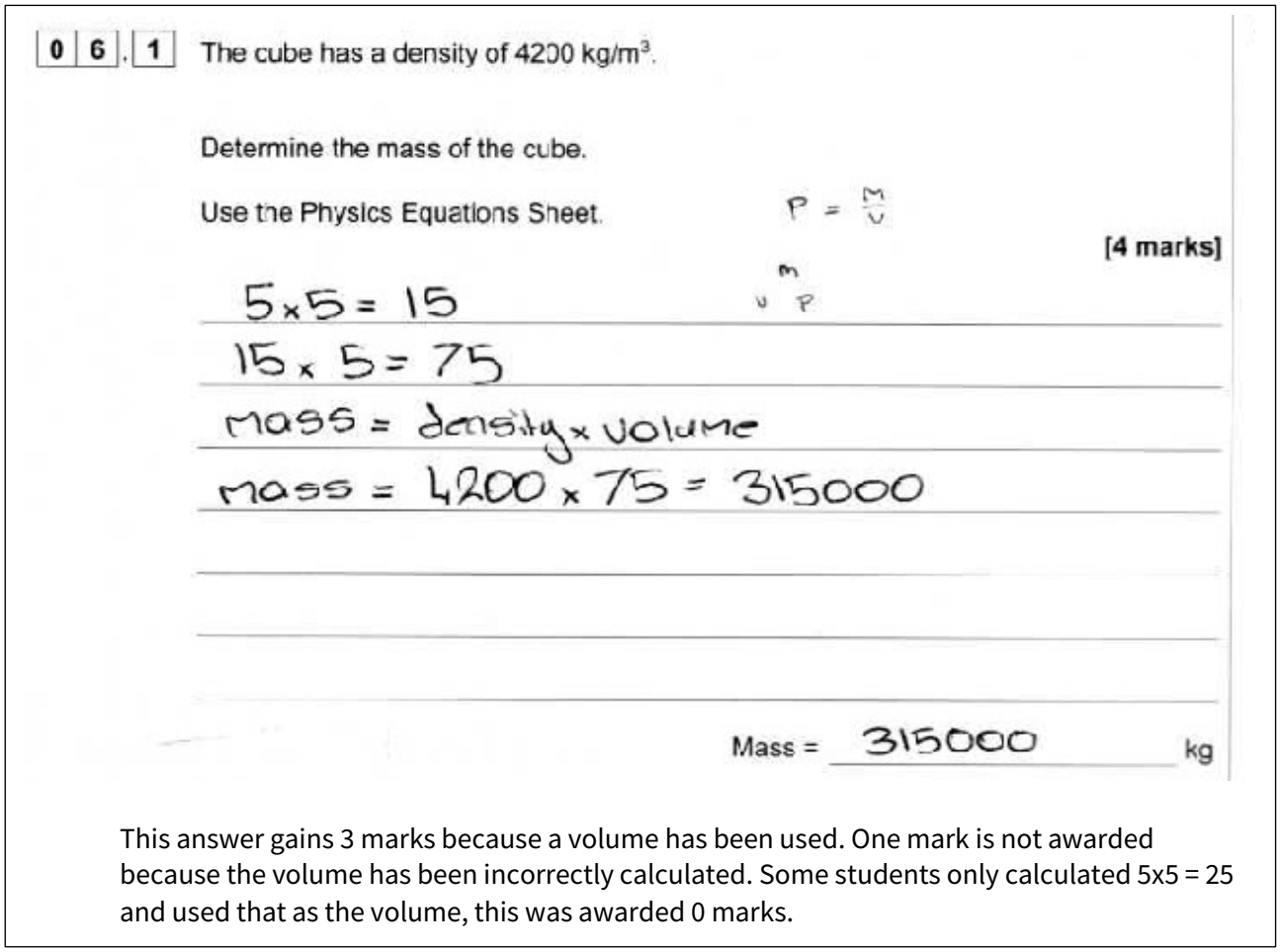
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Answer 19 · Examiner comments

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Question 6 (High demand)

06.1 Students that could not calculate the volume of the cube struggled to gain marks. When using the density equation students had to substitute a volume, or no marks are awarded. Some students used an area and not a volume. 80% of students gained a mark on this question but only 55% gained all 4 marks.



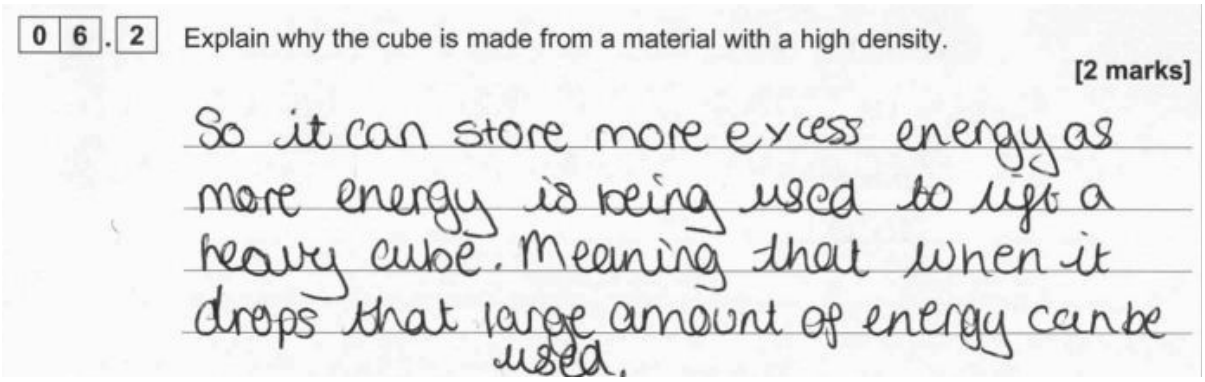
This answer gains 3 marks because a volume has been used. One mark is not awarded because the volume has been incorrectly calculated. Some students only calculated 5x5 = 25 and used that as the volume, this was awarded 0 marks.

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6.1.1.1 Energy stores and systems

Answer 19 · Examiner comments June 2025 | 8464/P/1H | Original Q6

06.2 26% of students gained a mark for identifying the either this meant the cube had a greater mass or that it can store more energy. Less than 5% of students made both statements.



This answer gains 1 mark for stating that more energy can be stored. There is the idea that the cube would be heavy, but the correct scientific terms must be used, so it must state that the mass will be large.

06.3 This high demand question performed as expected with only a small percentage of students gaining any marks. For marks to be awarded answers had to refer to the overall efficiency of the entire system, just quoting the efficiency equation from the equations sheet was insufficient.

06.4 This high demand question performed as expected with only a small percentage of students gaining any marks. The most common incorrect answer only stated that you should lift it faster.

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6.1.1.1 Energy stores and systems

Answer 19 · Examiner comments

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