AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.1.1.4

# Power

## 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.

6.1.1.4 Power

Answer 01 · Mark scheme

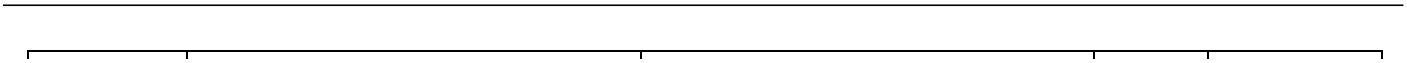
June 2018 | 8464/P/1H | Original Q5

| 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<br><br>ignore any reference to convection and / or radiation | 1 | |
| 05.2 | $T = 17.4 + \left(\frac{(20.8 - 17.4)}{2}\right)$<br>**or**<br>$T = 20.8 + \left(\frac{(20.8 - 17.4)}{2}\right)$ | 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** | |

### 6.1.1.4 Power

**Answer 01 · Mark scheme**

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



6.1.1.4 Power

Answer 02 · Mark scheme

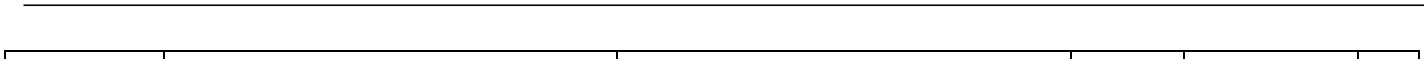
June 2019 | 8464/P/1H | Original Q3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. | ID |
|---|---|---|---|---|---|
| **03.1** | an energy resource that cannot be replenished as it is used | allow an energy resource that will run out<br><br>ignore cannot be re-used | 1 | AO1.1<br>AO1 in isolation<br><br>6.1.3 | E |
| **03.2** | | an answer of 30 (A) scores **4** marks | | AO2.1<br><br>6.2.4.1 | E |
| | 6.9 k(W) = 6900 (W) | | 1 | | |
| | 6900 = 230 × I | allow correct substitution of an incorrectly/not converted value for power | 1 | | |
| | $I = \frac{6900}{230}$ | allow a correct transformation using an incorrectly/not converted value for power | 1 | | |
| | I = 30 (A) | allow a correct calculation using an incorrectly/not converted value for power | 1 | | |
| **03.3** | direct potential difference is always in the same direction | allow direct current is always in the same direction | 1 | AO1.1<br><br>6.2.3.1 | E |
| | alternating potential difference changes direction | allow alternating current changes direction | 1 | | |
| **03.4** | lower potential difference across the cable | allow lower power/energy dissipation | 1 | AO1.1<br><br>6.1.2.2 | E |
| | it is more efficient<br><br>**OR**<br><br>(lower resistance gives) a greater current (for the same potential difference) (1)<br><br>so the car battery can charge faster (1) | allow it won't get as hot | 1 | 6.2.4.1 | |
| **Total** | | | **9** | | |

### 6.1.1.4 Power

**Answer 02 · Mark scheme**

June 2019 | 8464/P/1H | Original Q3



6.1.1.4 Power

Answer 03 · 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<br><br>which increases the (kinetic) energy of the particles (in the heating element) | allow there is a current in the heating element<br><br>allow internal store of energy increases<br><br>allow the particles (in the heating element) vibrate more rapidly | 1<br><br>1 | AO1.1<br><br>6.2.4.2<br>6.3.2.1<br>WS 1.2 | E |
| 05.2 | the starting temperature of the water | allow the starting temperature of the kettle | 1 | AO3.3a<br><br>6.2.4.2<br>WS 2.2 | E |
| 05.3 | (the heating element of) the kettle took time to heat up | | 1 | AO3.1a<br><br>6.2.4.2<br>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<br><br>**or**<br><br>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<br><br>allow the efficiency of the kettle changes as the mass of water changes | 1 | AO3.1b<br><br>6.2.4.2<br>WS 3.7 | E |

6.1.1.4 Power

Answer 03 · Mark scheme

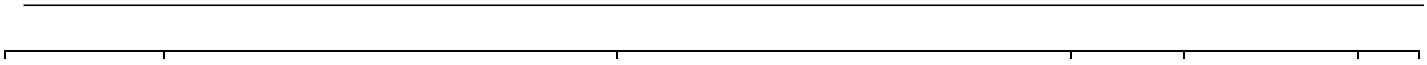
June 2019 | 8464/P/1H | Original Q5

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

### 6.1.1.4 Power

**Answer 03 · Mark scheme**

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



6.1.1.4 Power

Answer 04 · Mark scheme

June 2019 | 8464/P/2H | Original Q1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. | ID |
|---|---|---|---|---|---|
| 01.1 | (4 - 0) + (10 - 7)<br>**or** 4 + 3<br>**or** 10 - 3<br><br>7 (s) | an answer of 7 (s) gains **2** marks | 1<br><br>1 | AO2<br>6.5.4.1.5 | E |
| 01.2 | gradient = $\frac{0-2}{24-14}$<br><br>(-)0.2 ($m/s^2$) | an answer of 0.2 ($m/s^2$) gains **2** marks<br><br>allow readings from any two points correctly substituted<br>allow correct use of $a = \frac{\Delta v}{t}$ | 1<br><br>1 | AO2<br>6.5.4.1.5 | E |
| 01.3 | (there are no wires) to get tangled / disconnected | allow easier to move arms<br><br>allow wires are inconvenient<br><br>allow easier to transfer data | 1 | AO3<br>6.6.2.4 | E |
| 01.4 | wave speed = frequency × wavelength | allow v = f λ<br><br>allow any correct re-arrangement | 1 | AO1<br>6.6.1.2 | E |
| 01.5 | 300 000 000 = 2 400 000 000 × λ<br><br>λ = $\frac{300\,000\,000}{2\,400\,000\,000}$<br><br>λ = 0.125 (m) | an answer of 0.125 (m) or 0.13 (m) scores **3** marks<br><br>allow λ = 0.13 (m) | 1<br><br>1<br><br>1 | AO2<br>6.6.1.2 | E |
| 01.6 | range is far enough (for most uses)<br><br>power is not too great so the battery will not drain quickly | allow power not too great so the phone will not overheat<br><br>allow the range per milliwatt is greatest or 4 metres | 1<br><br>1 | AO3<br>6.6.2.4 | E |

### 6.1.1.4 Power

**Answer 04 · Mark scheme**

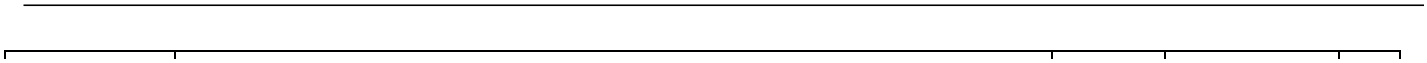


| | | | | | |
|---|---|---|---|---|---|
| **Total** | | | **11** | | |

### 6.1.1.4 Power

**Answer 04 · Mark scheme**

June 2019 | 8464/P/2H | Original Q1



6.1.1.4 Power

Answer 05 · Mark scheme

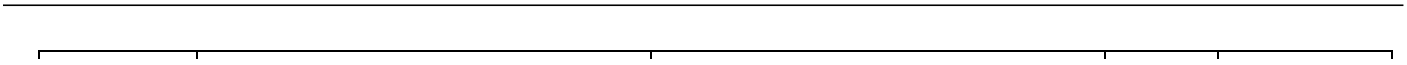
November 2021 | 8464/P/1H | Original Q1

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

### 6.1.1.4 Power

**Answer 05 · Mark scheme**

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



6.1.1.4 Power

Answer 06 · Mark scheme

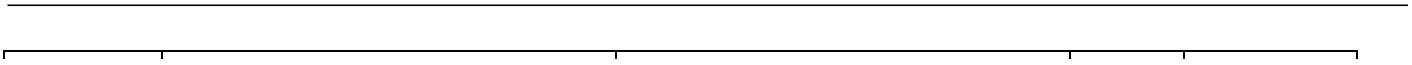
November 2021 | 8464/P/1H | Original Q5

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 05.1 | 240 mW = 0.24 W | | 1 | AO2 6.2.4.1 |
| | $0.24 = 2.5 \times I$ | allow a correct substitution using an incorrectly/not converted value of power | 1 | |
| | $I = \frac{0.24}{2.5}$ | allow a correct re-arrangement using an incorrectly/not converted value of power | 1 | |
| | $I = 0.096$ (A) | allow a correct calculation using an incorrectly/not converted value of power | 1 | |
| 05.2 | because the potential difference is always positive | allow because potential difference does not change direction | 1 | AO1 6.2.3.1 |
| 05.3 | potential difference is (directly) proportional to current | | 1 | AO2 6.2.1.4 |
| 05.4 | voltmeter: the reading is the same in both circuits | | 1 | AO2 6.2.2 |
| | ammeter: the reading in circuit **B** is twice the reading of circuit **A** | allow **1** mark for the reading in circuit **B** is bigger than circuit **A** | 2 | |
| **Total** | | | **9** | |

### 6.1.1.4 Power

**Answer 06 · Mark scheme**

November 2021 | 8464/P/1H | Original Q5



6.1.1.4 Power

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

6.1.1.4 Power

Answer 07 · Mark scheme

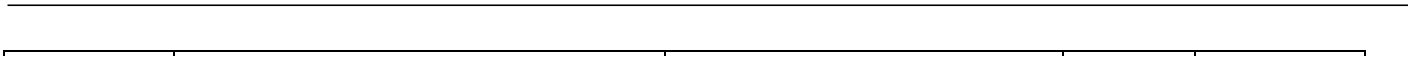
November 2021 | 8464/P/2H | Original Q5

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

### 6.1.1.4 Power

**Answer 07 · Mark scheme**

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



6.1.1.4 Power

Answer 08 · Mark scheme

June 2022 | 8464/P/1H | Original Q1

## Question 1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.1 | 16 500(GW) **and** 30 000 (GW) read from graph | | 1 | AO3 6.1.3 |
| | percentage = $\frac{16500}{30000}$ (×100%) | allow a correct substitution using a value of 15300 or 18000 for gas | 1 | |
| | percentage = 55 (%) | allow an answer consistent with a value of 15300 or 18000 for gas | 1 | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.2 | coal and gas | | 1 | AO1.1 6.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.3 | the national grid | | 1 | AO1 6.2.4.3 |

6.1.1.4 Power

Answer 08 · Mark scheme

June 2022 | 8464/P/1H | Original Q1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.4 | potential difference increases<br><br>current is reduced<br><br>so there is less / low energy loss (to the surroundings) | allow large potential difference<br><br>allow small current<br><br>allow less / low heating in the transmission cables<br><br>ignore resistance<br><br>do **not** allow no energy loss | 1<br><br>1<br><br>1 | AO1<br>6.2.4.3 |

| Total Question 1 | | 8 |
|---|---|---|

Answer 09 · Mark scheme

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

## 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<br>6.1.1.3<br>6.3.2.2<br>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**<br>• measure mass of oil using the top pan balance<br>• measure start temperature of oil using the thermometer<br>• place beaker of oil on heater<br>• switch on heater to heat oil<br>• measure final temperature of oil using the thermometer<br>• measure energy transferred using joulemeter<br>• calculate increase in temperature ($\Delta\theta$)<br>• 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<br>ignore the heater / oil is hot | 1 | AO1<br>6.1.1.3<br>RPA14 |

6.1.1.4 Power

Answer 09 · Mark scheme

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

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

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

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.5 | thermistor | | 1 | AO1<br>6.2.1.4 |

6.1.1.4 Power

Answer 09 · Mark scheme

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

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.6** | 250 (Ω) | allow an answer in the range 240 (Ω) to 260 (Ω)<br><br>allow **1** mark for temperature = 160 (°C) | 2 | AO3<br>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<br>6.3.1.2 |

| | | |
|---|---|---|
| **Total Question 2** | | **15** |

6.1.1.4 Power

Answer 10 · Mark scheme

June 2022 | 8464/P/1H | Original Q5

## Question 5

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 05.1 | reverse the connections to the LED / battery | allow reverse the potential difference across the LED / diode | 1 | AO3 6.2.1.4 |
| | because an LED / diode only allows current through in one direction | allow because an LED / diode has a large resistance in the reverse direction | 1 | |

6.1.1.4 Power

Answer 10 · Mark scheme

June 2022 | 8464/P/1H | Original Q5

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 05.2 | 290 mA = 0.29 A | | 1 | AO2 6.2.4.1 |
| | $0.98 = V \times 0.29$<br>**or**<br>$R = \frac{0.98}{0.29^2}$ | allow a correct substitution of an incorrectly / not converted current<br>allow $R$ = 11.652…<br>ignore $0.98 = (0.29)^2 \times R$ | 1 | |
| | $V = \frac{0.98}{0.29}$ | allow $V = 11.65 \times 0.29$<br>allow a correct substitution of an incorrectly / not converted current | 1 | |
| | $V$ = 3.379… | allow a correct rearrangement using an incorrectly / not converted current | 1 | |
| | $V$ = 3.4 (V) | allow a correct calculation using an incorrectly / not converted current<br>allow a correctly rounded answer to 2 sig figs consistent with their calculated value of $V$ using numbers from the question | 1 | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 05.3 | electrons in the atom fall to a lower energy level | | 1 | AO1 6.4.1.1 |

6.1.1.4 Power

Answer 10 · Mark scheme

June 2022 | 8464/P/1H | Original Q5

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 05.4 | $1.4 = Q \times 200$ | | 1 | AO2 6.2.4.2 6.2.1.2 |
| | $Q = \frac{1.4}{200}$ | | 1 | |
| | $Q = 0.0070$ (C) | | 1 | |
| | $0.0070 = I \times 2.8 \times 10^{-4}$ | allow a correct substitution of their calculated value of $Q$ | 1 | |
| | $I = \frac{0.0070}{2.8\times10^{-4}}$ | allow a correct re-arrangement using their value of $Q$ | 1 | |
| | $I = 25$ (A) | allow an answer consistent with their value of $Q$ | 1 | |
| | **OR** | | | |
| | $1.4 = P \times 2.8 \times 10^{-4}$ (1) | | | |
| | $P = \frac{1.4}{2.8\times10^{-4}}$ (1) | | | |
| | $P = 5000$ (W) (1) | | | |
| | $5000 = 200 \times I$ (1) | allow a correct substitution of their calculated value of $P$ | | |
| | $I = \frac{5000}{200}$ (1) | allow a correct re-arrangement using their value of $P$ | | |
| | $I = 25$ (A) (1) | allow an answer consistent with their value of $P$ | | |

| Total Question 5 | | 14 |
|---|---|---|

6.1.1.4 Power

Answer 11 · Mark scheme

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

## Question 1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.1** | geothermal | | 1 | AO1<br>6.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.2** | $36 \times 10^9$ J | | 1 | AO2<br>6.1.3 |

Answer 11 · Mark scheme

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

| 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**<br>**Figure 1**<br>• the power output from wind increased<br>• because more wind turbines were built<br>• the power output from solar increased<br>• because more solar panels were built<br>• power output from wind and solar may have increased due to climate change<br>For 2015 and 2016<br>• wind power was lower in 2016 than in 2015<br>• because 2016 was less windy than 2015<br>**Figure 2**<br>• for most of the year the electricity generated from wind is greater than from solar.<br>• the electricity generated from wind is greater in winter than in summer<br>• because winter is windier than summer<br>• the electricity generated from solar is greater in summer than in winter<br>• because hours of sunlight are longer in summer<br>• because the intensity of sunlight is greater in summer<br>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 |
|---|---|

6.1.1.4 Power

Answer 12 · Mark scheme

June 2023 | 8464/P/1H | Original Q3

## Question 3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.1** | potential difference is increased<br><br>(and) current decreases<br><br>(so) energy/power losses in the transmission cables decrease | allow transformer **X** is a step up transformer<br><br><br>allow (so) there is less heating in the transmission cables | 1<br><br>1<br><br>1 | AO1<br>6.2.4.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.2** | $11\,000 \times I_s = 400\,000 \times 660$<br><br>$I_s = \frac{400\,000 \times 660}{11\,000}$<br><br>$I_s = 24\,000$ (A) | | 1<br><br>1<br><br>1 | AO2<br>6.2.4.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.3** | the street lamps are connected in parallel | | 1 | AO3<br>6.2.2 |

Answer 12 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.4** | resistance (of the LDR) increases | allow resistance (of the circuit) increases | 1 | AO1 |
| | (so) the current decreases | allow so the LDR has a greater (share of the) potential difference | 1 | AO3 |
| | (so) the potential difference across R decreases | dependent on MP1 | 1 | AO3<br>6.2.1.4<br>6.2.1.3<br>6.2.2<br>6.2.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.5** | 20 mA = 0.020 A | | 1 | AO2<br>6.2.4.1 |
| | $6.0 = 0.020^2 \times R$ | allow a correct substitution using an incorrectly / not converted value of current. | 1 | |
| | $R = \frac{6.0}{0.020^2}$ | allow a correct re-arrangement using their incorrectly / not converted value of current. | 1 | |
| | $R$ = 15000 (Ω)<br>**OR**<br>20 mA = 0.020 A (1)<br>$V = \frac{6.0}{0.020} = 300$ (1)<br>$R = \frac{300}{0.020}$ (1)<br>$R$ = 15000 (Ω) (1) | allow an answer consistent with their incorrectly / not converted value of current | 1 | |

| Total Question 3 | 14 |
|---|---|

6.1.1.4 Power

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)<br><br>internal / thermal energy (of the surroundings / whisk / food) | ignore sound | 1<br><br>1 | AO1<br>6.2.4.2<br>6.1.2.1<br>6.1.1.1 |

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

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

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

6.1.1.4 Power

Answer 13 · Mark scheme



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

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.6** | 230 (V) | | 1 | AO1<br>6.2.3.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.7** | decreases | | 1 | AO1<br>6.2.4.1 |

| **Total Question 1** | **12** |
|---|---|

6.1.1.4 Power

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<br><br>gravitational potential energy of the drone increases | | 1<br><br>1 | AO2<br>6.1.1.1 |

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

6.1.1.4 Power

Answer 14 · Mark scheme

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

| 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<br>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** |
|---|---|

6.1.1.4 Power

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<br><br>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<br><br>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 |
| | mass = $48 \times 5.0 \times 10^5$ | | 1 | 6.3.2.2 6.1.1.3 |
| | 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 | allow named renewable resources | 1 | |
| | **or** | | | |
| | (most) renewable resources do not generate electricity all the time | allow renewable resources are unreliable | | |
| | (so) efficient energy storage will help to meet the demand for energy / electricity | | 1 | |

| Total Question 6 | 17 |
|---|---|

6.1.1.4 Power

Answer 16 · Mark scheme

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

## Question 1

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

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.2** | biofuel | allow a named biofuel<br>allow biogas<br>allow wood<br><br>ignore fossil fuels | 1 | AO1<br>6.1.3 |

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

6.1.1.4 Power

Answer 16 · Mark scheme



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

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

| Total Question 1 | 9 |
|---|---|

6.1.1.4 Power

Answer 17 · Mark scheme

June 2025 | 8464/P/1H | Original Q3

## Question 3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 03.1 | circuit with a cell, (switch) and resistor in series | allow battery for cell | 1 | AO2 |
| | ammeter in series (with the resistor and the cell) | | 1 | AO1 |
| | voltmeter in parallel with resistor | | 1 | AO1<br>6.2.1.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 03.2 | $I$ = 0.45 (A) | subsequent marks may be awarded if an incorrectly / not converted value of $I$ is used | 1 | AO2<br>6.2.1.3 |
| | $2.7 = 0.45 \times R$ | | 1 | |
| | $R = \frac{2.7}{0.45}$ | | 1 | |
| | $R$ = 6 (Ω) | allow 6.0 (Ω) | 1 | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 03.3 | straight line through the origin in **both** 1st and 3rd quadrant | | 1 | AO1<br>6.2.1.4 |

6.1.1.4 Power

Answer 17 · Mark scheme

June 2025 | 8464/P/1H | Original Q3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 03.4 | $R$ = 2200 (Ω) | subsequent marks may be awarded if an incorrectly / not converted value of $R$ is used | 1 | AO2 |
| | $P = 0.012^2 \times 2200$ | | 1 | AO2 |
| | $P$ = 0.3168 (W) | allow $P$ = 0.32<br>allow $P$ = 0.317 | 1 | AO2 |
| | resistors **A**, **B** and **C** | dependent on MP1 **and** MP3 | 1 | AO3 |
| | **OR** | | | 6.2.4.1 |
| | | the first three marks may be awarded for calculating $I_{max}$ for any of the resistors | | |
| | $R$ = 2200 (Ω) (1) | subsequent marks may be awarded if an incorrectly / not converted value of $R$ is used | | |
| | $2.0 = I^2 \times 2200$ (1) | | | |
| | $I$ = 0.030…(1) | | | |
| | resistors **A**, **B** and **C** (1) | dependent on MP1 **and** MP3 | | |

| Total Question 3 | 12 |
|---|---|

6.1.1.4 Power

Answer 18 · Mark scheme

June 2025 | 8464/P/1H | Original Q5

## Question 5

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 05.1 | 230 (V)<br><br>50 (Hz) | allow about 230 (V) | 1<br><br>1 | AO1<br>6.2.3.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 05.2 | live – brown<br><br>neutral – blue | | 1<br><br>1 | AO1<br>6.2.3.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 05.3 | alternating (potential difference) continuously changes direction<br><br>direct (potential difference) is always in the same direction | | 1<br><br>1 | AO1<br>6.2.3.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 05.4 | energy / power is transferred by the laptop (when being used)<br><br>(so) the power delivered to the battery is reduced | <br><br>allow (so) the rate at which energy is transferred to the battery is lower | 1<br><br>1 | AO2<br><br>AO3<br><br>6.1.1.4<br>6.1.2.1 |

6.1.1.4 Power

Answer 18 · Mark scheme

June 2025 | 8464/P/1H | Original Q5

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 05.5 | $P = 15 \times 4.8$ | | 1 | AO2 6.2.4.1 6.2.4.2 6.1.1.4 |
| | $P = 72$ (W) | | 1 | |
| | $\Delta P = 97 - 72 = 25$ (W) | | 1 | |
| | $25 = \frac{225\,000}{t}$ | subsequent marks may be awarded if an incorrect / not converted value of $E$ is used. | 1 | |
| | $t = 9000$ (s) | | 1 | |
| | $t = 2.5$ (hours) | | 1 | |

| Total Question 5 | 14 |
|---|---|

6.1.1.4 Power

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<br><br>subsequent marks may be awarded if volume is incorrectly calculated | 1 | AO2<br>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) | | | |

6.1.1.4 Power

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<br>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<br>6.1.1.4 |
| | (so) the cube / weight / mass is lifted more quickly | MP2 dependent on MP1 | 1 | |

| Total Question 6 | 10 |
|---|---|

Answer 01 · Examiner comments

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

# 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.

6.1.1.4 Power

Answer 02 · Examiner comments — June 2019 | 8464/P/1H | Original Q3

**Question 3 (Standard/high demand)**

**03.1** Just over 70% of students described a non-renewable resource correctly, as either a resource which is not replenished as it is used, or as a resource which is finite and will run out.

**03.2** Slightly more than 40% of students gained full marks on this question. Around one in seven students gained 3 marks, mostly for failing to convert 6.9 kW into watts, or for making an incorrect conversion. Around 35% of students gained no marks on this question.

**03.3** About a third of students gained 2 marks on this question but over half the students gained 0 marks. Answers describing current or potential difference were accepted, but a proportion of students incorrectly described direct current as what happens in a series circuit, and alternating as what happens in a parallel circuit. Other misconceptions included students who suggested that direct potential difference takes a constant value but alternating potential difference changes value. While this may be true, it does not explain the difference between direct and alternating.

Answer 02 · Examiner comments — June 2019 | 8464/P/1H | Original Q3

**03.4** Just under half of students scored 1 mark, with around a further 15% of students gaining both marks. Many students gave answers in terms of the risk of electrocution or safety, which did not gain credit. Many students wrote of more electricity going through a lower resistance cable, which was not sufficient: they needed to either mention a lower potential difference across the cable, or a greater current in the cable for the same potential difference.

Answer 03 · 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

6.1.1.4 Power

**Answer 03 · 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.

**Answer 05 · 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.

6.1.1.4 Power

**Answer 05 · 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.

**Answer 06 · Examiner comments** November 2021 | 8464/P/1H | Original Q5

**Question 5 (High demand)**

**05.1** Of those students who attempted to convert 240 mW to watts, there was confusion evident about whether mW referred to milliwatts or megawatts. Around 45% of students gained at least 3 marks.

**05.2** Many students incorrectly suggested that the changing frequency of the potential difference explained the answer. Only around 15% of students answered correctly.

**05.3** Almost 30% of students correctly identified the directly proportional relationship.

**05.4** Very few students were able to correctly identify that the potential difference in both circuits would be the same. To gain full marks when discussing the ammeter readings, students had to realise that since the potential difference across each resistor is the same, and all resistors have the same resistance, the current in each resistor is the same. The current in the ammeter in circuit B is therefore double that of circuit A. The question was targeted at the highest ability students, and very few students were able to reason this through and state this relationship.

6.1.1.4 Power

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.

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.

6.1.1.4 Power

Answer 08 · Examiner comments



**Question 01 (Standard demand)**

**01.1** Just under half the students gained all three marks on this question, with just over 40% failing to score any marks.

Errors were made reading the graph, with a fair number of students misreading the scale to obtain an incorrect peak value for gas, leading to a maximum mark of 2 on this question. It was common for students to think that the peak value of demand was the maximum value on the y-axis, which prevented any marks from being scored. Some students tried to determine the peak demand by adding the total supply and demand at 6 pm, which resulted in no marks being awarded. A small proportion of students gave an answer greater than 100%.

**01.2** Nearly 70% of the students chose the correct energy resources.

**01.3** Just over six in ten students recalled the name of the national grid.

Many students thought that the question was referring to a Wi-Fi signal, a mobile phone signal, or the internet. In many cases this led them to try to answer question **01.4** by also writing about mobile phone networks or Wi-Fi signals, which they were unable to do successfully. Some students gave answers such as national power grid, or national electricity grid, which did gain the mark.

**01.4** About 10% of students gained all three marks on this question, with approximately 15% gaining two marks, and around a fifth of students gaining just one mark.

The most commonly awarded mark was for identifying that the potential difference is increased by a step-up transformer. However, there was a clear misconception among many students that greater efficiency referred to increased rate of delivery of electricity. It was not uncommon for students to suggest that a step-up transformer increases the speed of the current so that electricity can get to consumers more quickly, for example. Some students thought that a step-up transformer physically lifted the cables up above the ground. It was reasonably common for students to suggest that step-up transformers were positioned high above the ground to ensure better network coverage, or that they give a better signal with fewer connection issues, which seemed to correspond with responses to question **01.3** about mobile phone networks or Wi-Fi networks.

6.1.1.4 Power

Answer 09 · 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.

6.1.1.4 Power

Answer 09 · 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.

6.1.1.4 Power

Answer 10 · Examiner comments — June 2022 | 8464/P/1H | Original Q5

**Question 05 (Standard/high and high demand)**

**05.1** Most students were unable to answer this question correctly, with only about 10% of students gaining any marks, and less than 5% gaining both marks.

Common suggestions which would not work included moving the LED closer to the battery, swapping the voltmeter and ammeter, moving the resistor, removing the resistor, reducing the resistance of the resistor, or placing the resistor after the LED.

**05.2** Around a fifth of students gained full marks on this question, with a third of students gaining 4 marks.

Although the simplest way to calculate the answer was to use $P = VI$, a significant minority of students decided that a 5-mark calculation needed two equations to arrive at the correct answer. This was possible, by using $P = I^2R$ and then $V = IR$, an approach which could gain full marks. However, most students who attempted this alternative route neglected to convert mA to A.

**05.3** Around 15% of students chose the correct description.

**05.4** This extended calculation was answered well, with around 45% of students gaining all 6 marks. Just under 10% of students gained 3 marks, and about 35% gaining no marks.

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Answer 11 · 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.

6.1.1.4 Power

Answer 12 · Examiner comments — June 2023 | 8464/P/1H | Original Q3

**Question 03 (Standard/high and high demand)**

**03.1** Just over half of all students gained at least one mark on this question. Many students seemed to think that greater efficiency means that energy is transferred at a greater rate. It was also common for answers to suggest that the transformer either increases or decreases resistance, which was ignored.

**03.2** Slightly less than 60% of students gained full marks on this calculation. Many students who did not score anything attempted to use $V=IR$ for the primary coil and then the secondary coil. Students who used the correct equation but gained or lost a zero in their answer at some point could score a maximum of 2 marks.

**03.3** Only about 25% of students answered this multiple-choice question correctly. This was the third most common answer, with more students selecting that current is dissipated to the surroundings, and that the cables have electrical resistance.

**03.4** About a quarter of students scored at least one mark, but very few gained more than this. Some thought that the LDR was an LED, suggesting that as it gets darker the LDR needs to emit more light so the current must increase, for example. Some thought that the total resistance of the circuit must remain constant, so as the resistance of the LDR decreased, the resistance of the fixed resistor must increase. Many students struggled to express themselves, finding it difficult to

Answer 12 · Examiner comments — June 2023 | 8464/P/1H | Original Q3

express which potential difference they were writing about – the potential difference across the battery, the fixed resistor or the LDR.

**03.5** Approximately a fifth of students gained all 4 marks, with about half of all students scoring 3 marks on this calculation. Many students did not attempt to convert mA to A, and of those who did many conversions were incorrect. Of the students scoring 0 marks, it was reasonably common for them to neglect to square the current when using $P = I^2 R$.

Answer 13 · Examiner comments

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

# Question 1 (standard demand)

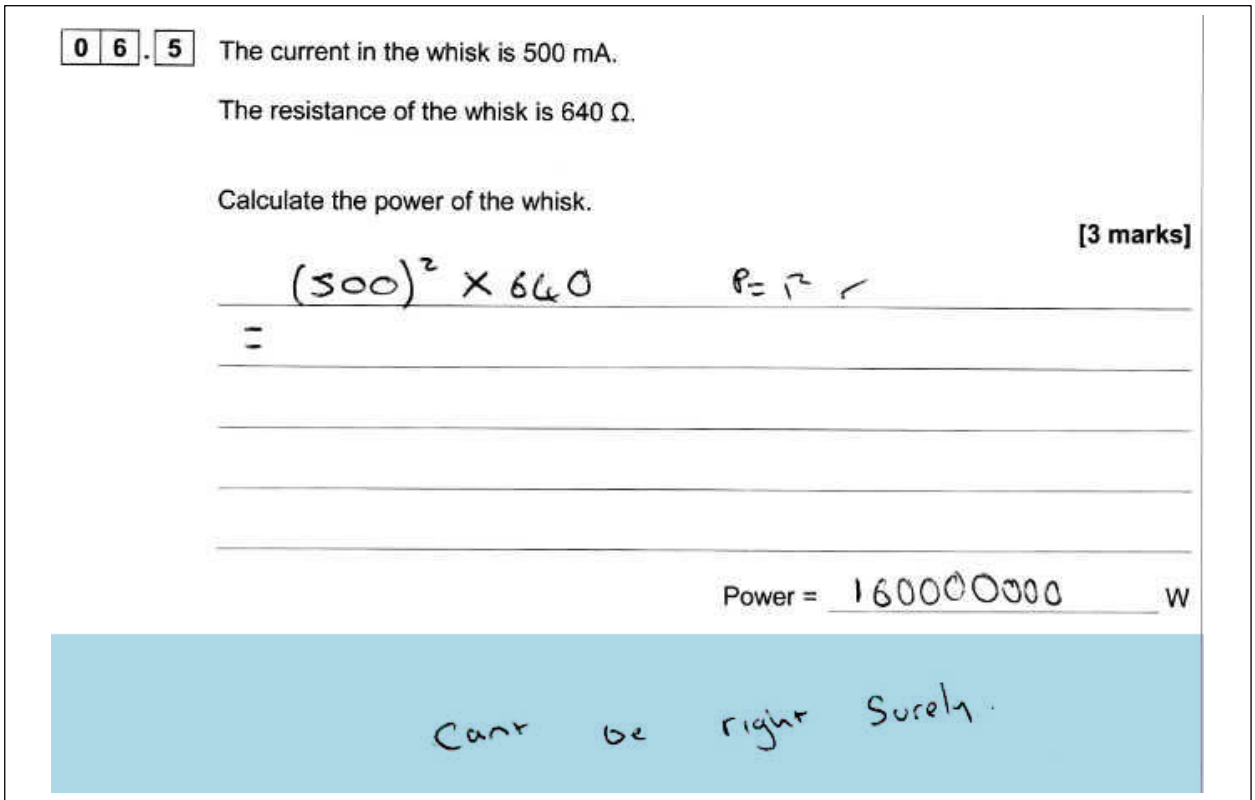
**01.1** Almost all students scored at least 1 mark on this question, with nearly two-thirds scoring both marks. The most common incorrect answers were an increase in electrical energy and an increase in chemical energy.

**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

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

# 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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### 6.1.1.4 Power

**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

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

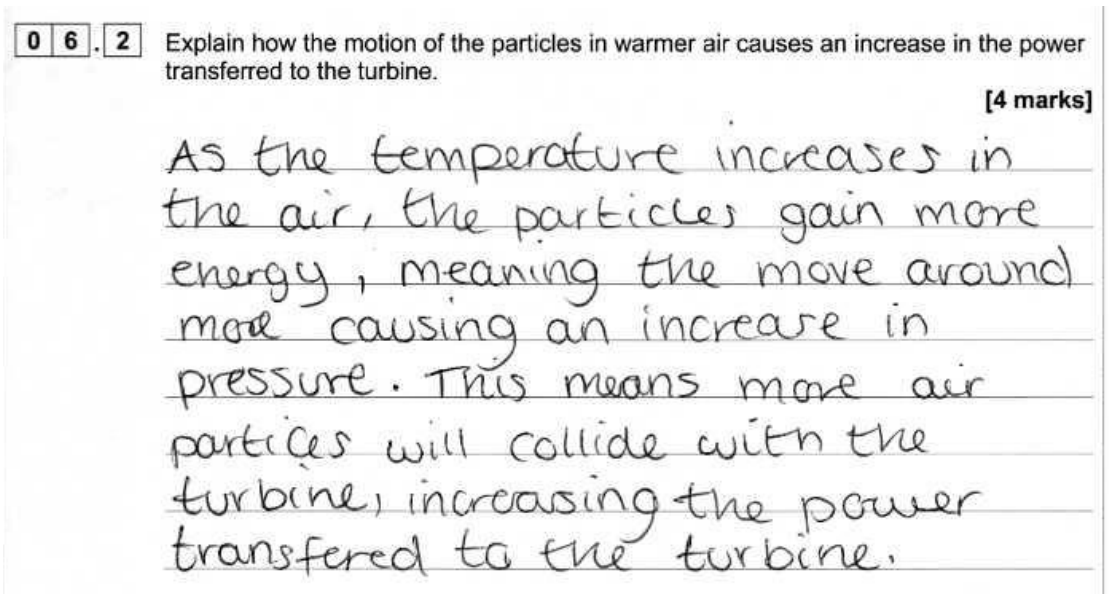
# Question 6 (standard/high & high demand)

**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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### 6.1.1.4 Power

**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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6.1.1.4 Power



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Answer 16 · Examiner comments

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

# 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.

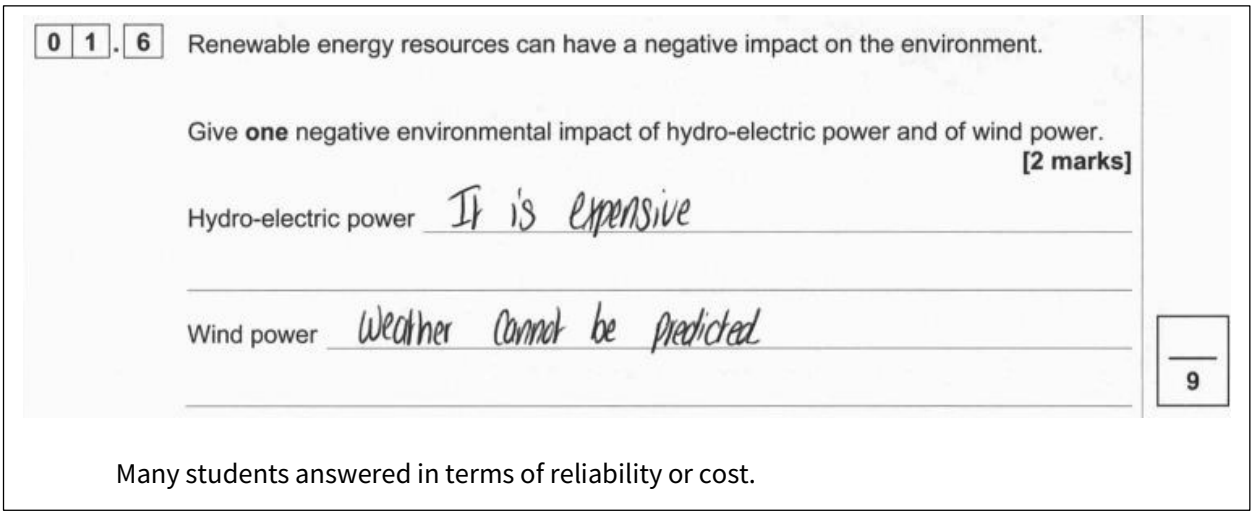
**01.2** This question was reasonably well answered, with approximately 50% of students answering correctly.

**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.

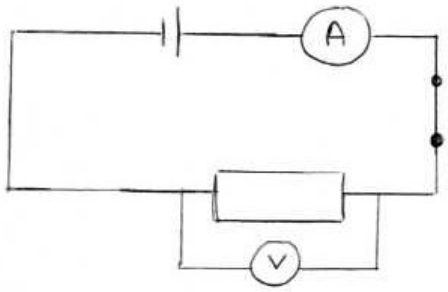
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Answer 17 · Examiner comments

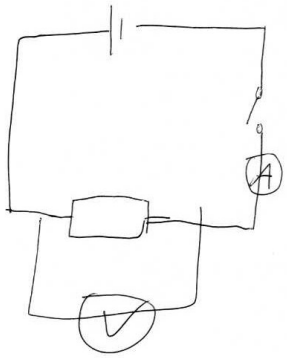
June 2025 | 8464/P/1H | Original Q3

# Question 3 (Standard and standard/high demand)

**03.1** Nearly 90% of students gained at least 1 mark on this question. 40% gained all three marks for using all the correct circuit symbols and drawing an ammeter in series and voltmeter in parallel with the resistor. 25% of students gained 2 marks due to having one error, which most commonly was having an incorrect circuit symbol or having the voltmeter in series.




It is expected that students draw circuit diagram accurately. This an excellent example, scoring all 3 marks.




There should be no lines through the symbols, this example shows incorrect circuit symbols and there is a significant gap in the circuit next to the cell.

**03.2** This calculation was reasonably well answered. Over 70% of students gained at least 3 marks. Nearly all students that did a correct substitution were able to rearrange correctly and calculate the final answer. 45% of students did a correct conversion of the current to amps and did the calculation correctly so gained 4 marks.

**03.3** 75% of students draw a straight line through the origin in both 1st and 3rd quadrant so gained the mark. A number of students only drew the line in the 1st quadrant, so did not gain the mark. Some students drew the IV curve for a lamp.

**03.4** There were two different valid calculations students could do to determine which resistors in figure 3 were suitable to be used. The most common method was to determine the power when a current of 0.012A was in a resistor. 10% of students gained a mark for converting the resistance in ohms but could not get any further. 45% of students completed a valid calculation so gained 3 marks. Only 15% went on to draw the correct conclusion based on their calculation and were awarded 4 marks.

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Answer 18 · Examiner comments

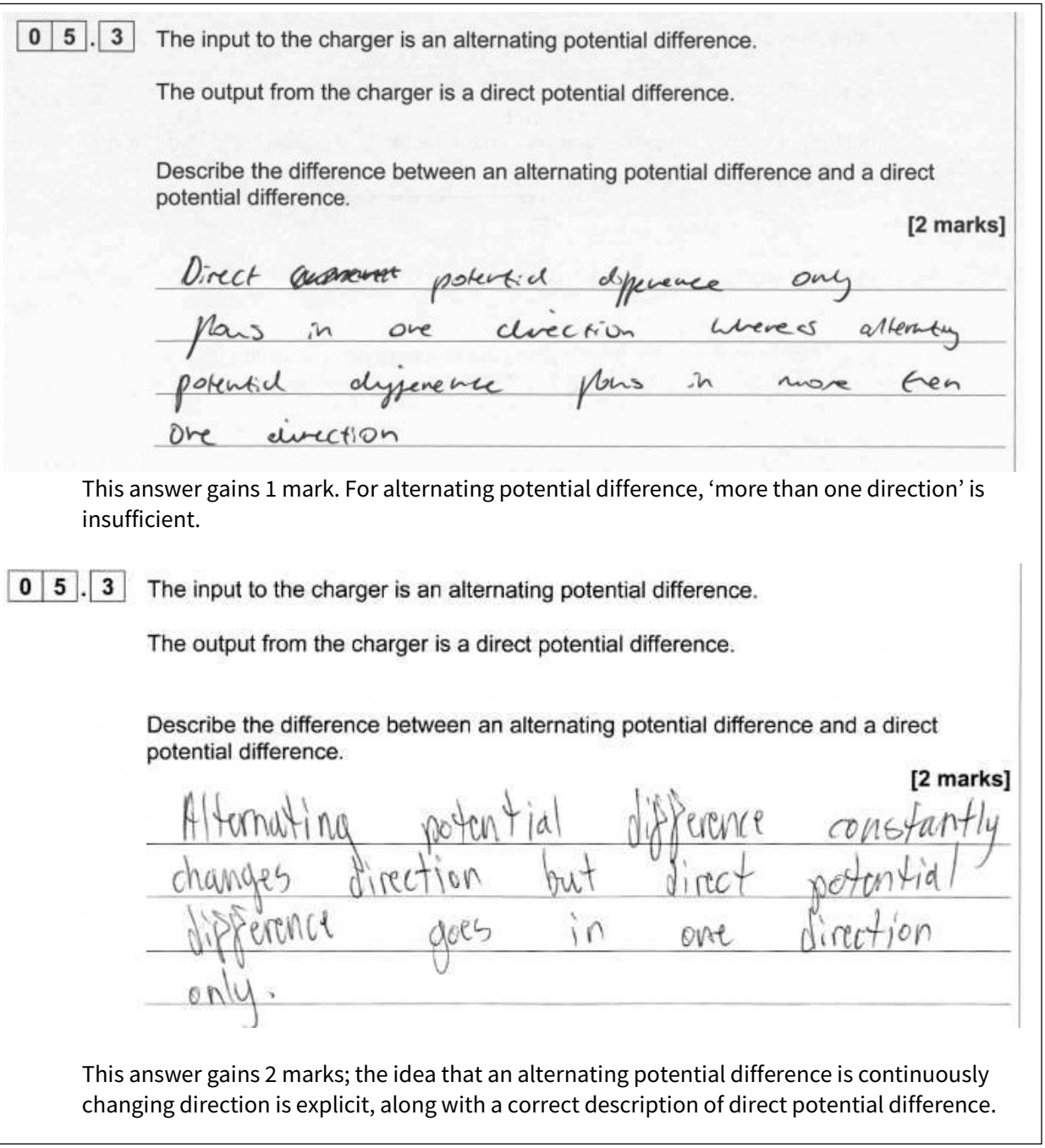
June 2025 | 8464/P/1H | Original Q5

# Question 5 (Standard/high and high demand)

**05.1** 55% of students gave one correct value and 20% gave both correct. Where, only one was correct, the frequency was more commonly known.

**05.2** 75% of students correctly named both wires and the correct colour of insulation. Where only one mark was awarded, it was most common to see the live wire and colour correct, but the name of the second wire was incorrect. Incorrect responses often gave the colour of the earth wire.

**05.3** 43% gained 1 mark. The vast majority of these were awarded the mark for direct (potential difference) is always in the same direction. Under 10% of students also gained the mark for the alternating potential difference. For alternating potential difference, the idea that it is continuously changing direction must be explicit.



0 5 . 3 The input to the charger is an alternating potential difference.

The output from the charger is a direct potential difference.

Describe the difference between an alternating potential difference and a direct potential difference.

[2 marks]

Direct potential difference only flows in one direction whereas alternating potential difference flows in more than one direction

This answer gains 1 mark. For alternating potential difference, 'more than one direction' is insufficient.



0 5 . 3 The input to the charger is an alternating potential difference.

The output from the charger is a direct potential difference.

Describe the difference between an alternating potential difference and a direct potential difference.

[2 marks]

Alternating potential difference constantly changes direction but direct potential difference goes in one direction only.

This answer gains 2 marks; the idea that an alternating potential difference is continuously changing direction is explicit, along with a correct description of direct potential difference.

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### 6.1.1.4 Power

**Answer 18 · Examiner comments** June 2025 | 8464/P/1H | Original Q5

**05.4** 60% of students correctly identified that the laptop is using energy as it is still being used. Only a very small number correctly explained that this meant that the rate at which the energy is stored in the battery decreases.

**05.5** This multi-step calculation proved to be more challenging than in previous years. Only approximately 15% of students gained full marks. 50% of students calculated the power of the laptop but could not get any further. Some students calculated the time in seconds correctly but could not convert the answer to hours. Students are reminded that they should show their working for multi-step calculations.

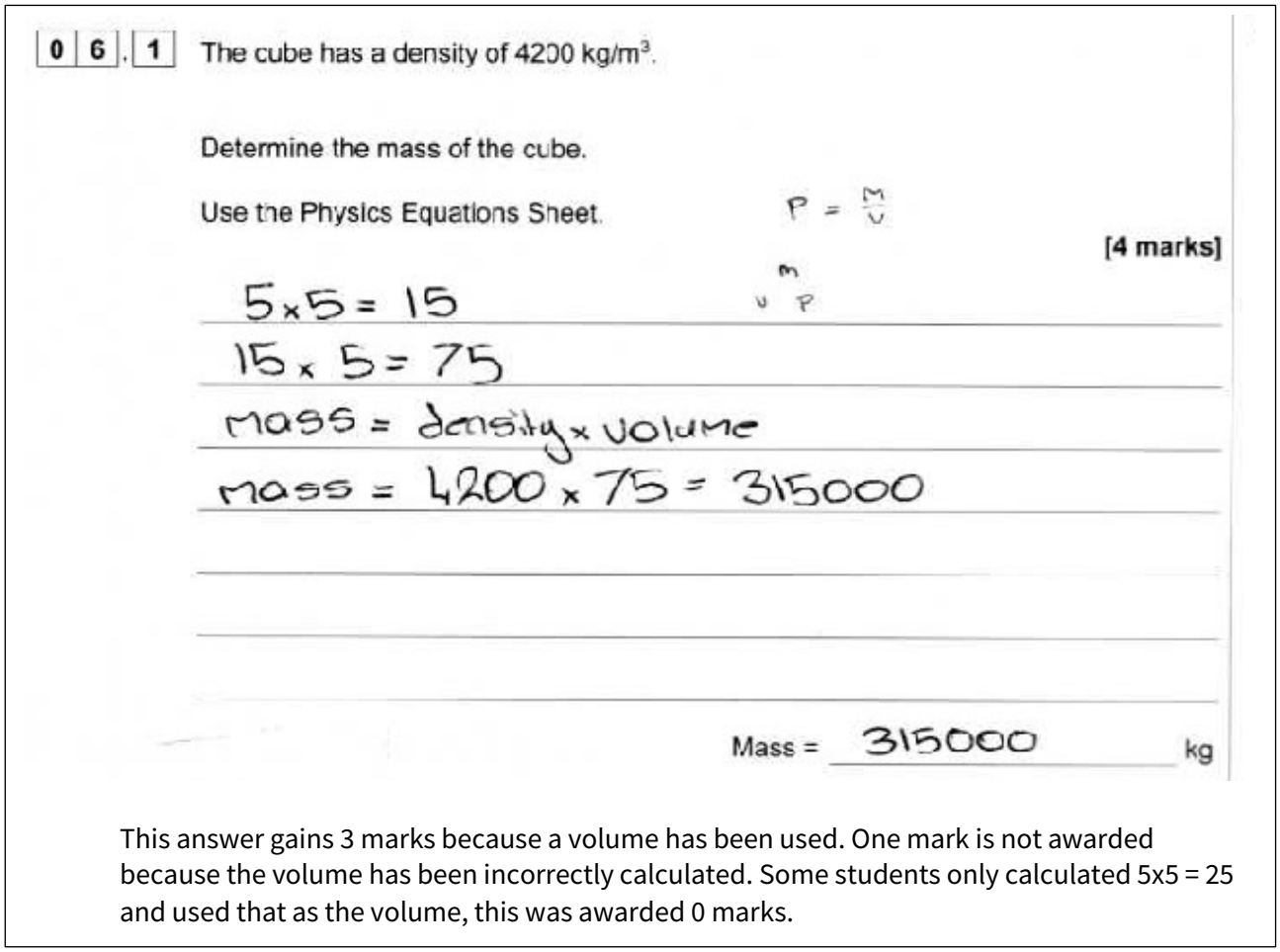
6.1.1.4 Power

Answer 19 · Examiner comments

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

# 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.



0 6 . 1 The cube has a density of 4200 kg/m$^3$.

Determine the mass of the cube.

Use the Physics Equations Sheet. $P = \frac{M}{V}$

[4 marks]

$\frac{M}{V} P$

5 x 5 = 15

15 x 5 = 75

mass = density x volume

mass = 4200 x 75 = 315000

Mass = 315000 kg

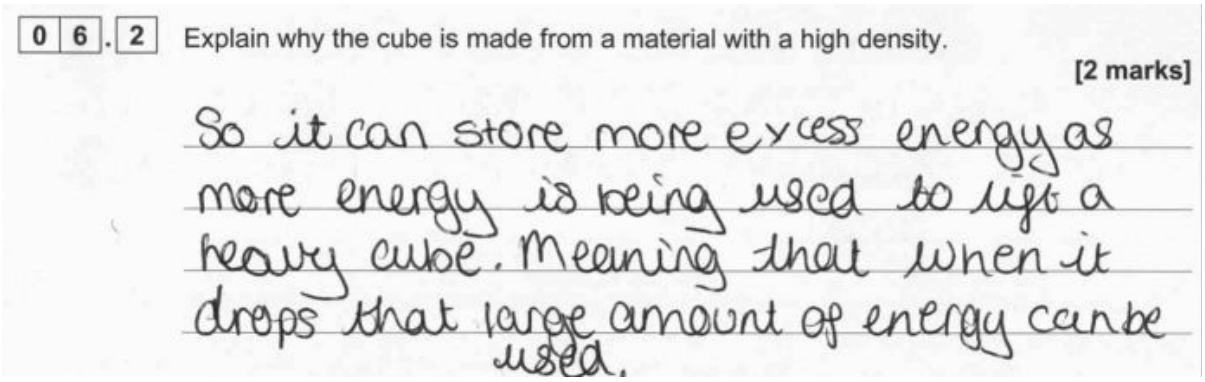
This answer gains 3 marks because a volume has been used. One mark is not awarded because the volume has been incorrectly calculated. Some students only calculated 5x5 = 25 and used that as the volume, this was awarded 0 marks.

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### 6.1.1.4 Power

**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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6.1.1.4 Power

Answer 19 · Examiner comments



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