AQA GCSE PHYSICS (HIGHER) · 8463

# PHYSICS



## MARK SCHEME

### 4.2.4 ENERGY TRANSFERS (PACK 3)

| SCORE | PERCENTAGE |
| --- | --- |
| /182 | % |

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## Q1.

(a) the store of chemical energy in the battery has reduced

**1**

(b) P = 3.90 × 1.86

**1**

P = 7.254

*allow 7.25 or 7.3*

**1**

W

**1**

(c) **comparison with compact power source**

5 times as many charges

**1**

(only) twice the mass

*allow (only) twice as heavy as the compact*

**1**

**comparison with the high capacity power source**

although half the number of charges

**1**

(only) one third the mass

*allow (only) a third as heavy as the high capacity*

**1**

**or**

calculation of charge / mass ratio for large power source

$= \frac{5}{200} (1)$

*allow mass / charge ratio*

$= \frac{200}{5}$

= 0.025 (1)

*allow 40*

calculation of charge / mass ratio for high capacity and compact power sources (1)

*allow mass / charge ratio*

charge / mass ratio greatest for large source (1)

*allow lowest mass / charge ratio*

**[8]**



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## Q2.

(a) a curve in the first and third quadrants only, passing through origin

1

decreasing gradient

1

(b) any **two** from:

- $I_1 = I_2 + I_3$
- $I_2 = I_3$
- $I_1 = 2I_2$
- $I_1 = 2I_3$

*allow **1** mark for each correct description given in words*

2

(c) $3 = I^2 \times 12$

1

$$I = \sqrt{\left(\frac{3}{12}\right)}$$

1

$I = 0.5$ (A)

1

$Q = 0.5 \times 60 = 30$

*allow Q = their calculated I × 60*

1

$Q_{total} = 60$

*allow an answer that is consistent with their calculated value of I*

1

**or**

$3 = I^2 \times 12$ (1)

$$I = \sqrt{\left(\frac{3}{12}\right)}$$

$I = 0.5$ (A) (1)

$I_{total} = 1.0$ (A) (1)

*allow $I_{total}$ = their I × 2*

$Q = 1.0 \times 60 = 60$ (1)

*allow an answer that is consistent with their calculated value of I*

coulombs **or** C

1

*an answer of 60 scores **5** calculation marks*



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(d) **Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.

**5–6**

**Level 2:** Relevant points (reasons / causes) are identified, and there are attempts at logically linking. The resulting account is not fully clear.

**3–4**

**Level 1:** Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

**1–2**

**No relevant content**

**0**

**Indicative content**

- resistance of LDR changes when light intensity changes
- when light intensity increase resistance of LDR decreases

- overall resistance of circuit decreases
- potential difference across total resistance remains unchanged
- current in ammeter increases

- potential difference across fixed resistor increases
- potential difference across LDR decreases
- reading on the voltmeter decreases

- potential difference is shared between the components in series
- the lower the resistance of the LDR the smaller the share of the potential difference
- reading on the voltmeter decreases

**[16]**

## Q3.

(a) $\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}} (\times 100)$

$\textit{allow efficiency} = \frac{\textit{useful output}}{\textit{total input}} \textit{(×100)}$

**1**

(b) $(\text{efficiency} =) \frac{1.2 \times 10^{18}}{1.3 \times 10^{18}} (\times 100)$

**1**

= 0.92
**or**
92 (%)

*allow an answer that rounds to 0.92*

**or**
92 (%)

**1**

*ignore units*
*an answer of 0.92 or 92 (%) scores **2** marks*



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(c) at a high potential difference and a low current

**1**

(d) $\text{power} = \frac{\text{energy transferred}}{\text{time}}$

*allow* $P = \frac{E}{t}$

**1**

(e) $8000 = \frac{E}{1200}$

*if a conversion of 8000 has been attempted, this mark can be awarded*

**1**

(E =) 1200 × 8000

*if a conversion of 8000 has been attempted, this mark can be awarded*

**1**

(E =) 9 600 000 (kJ)

*this answer only*

**1**

*an answer of 9 600 000 (kJ) scores **3** marks*

(f) any **four** from:

(environmental advantages)
- renewable / sustainable (energy source)
- conserves fossil fuels
- no release of pollutant gases e.g. sulfur dioxide
- no release of greenhouse gases

*allow does not release carbon dioxide*

- does not contribute to global warming

(environmental disadvantages)
- noise pollution
- visual pollution
- bird kill
- not always windy so more use of fossil fuel power stations

*ignore destruction of habitat*

***max 3** marks if only refers to advantages or disadvantages*

*ignore references to cost*

**4**

**[12]**

## Q4.

(a) 870 000 × 36

**1**

31 320 000 (J)
**or**



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$3.1 \times 10^7$ (J)

*allow 31 000 000 (J)*
***or** 31 300 000(J))*

**1**

*an answer 31 320 000 (J) scores **2** marks*

(b) some energy was wasted / dissipated

*allow efficiency is always less than 100%*

**1**

(and) transferred to thermal energy

**1**

(c) 27 (%)

**1**

(d) **similarity**

any **one** from:

- contain same amount of aluminium
- contain (very) similar amounts of silicon

*ignore same amount of silicon unless their answer to part **(c)** was 28%*

- oxygen makes up the highest percentage

*allow both contain aluminium, iron, oxygen and silicon*

**1**

**difference**

any **one** from:

- Moon rock contains more iron (than Earth rock)
- Moon rock contains less oxygen (than Earth rock)
- Moon rock contains less silicon (than Earth rock)

*allow ecf from part **(c)***

**1**

*do **not** allow 2 marks for silicon as both similarity and difference*

(e) scientists discover new evidence which the existing theory cannot explain

**1**

(f) gravitational potential energy = mass × gravitational field strength × height

*allow $E_p = mgh$*

**1**

(g) $86\,000\,000 = 2150 \times 1.6 \times h$

**1**

$$(h =) \frac{86\,000\,000}{2150 \times 1.6}$$

**1**

(h =) 25 000 (m)

**1**

*an answer 25 000 (m) scores **3** marks*

**[12]**



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**Q5.**

(a) (in circular motion) the direction is (constantly) changing

1

(so) velocity is (constantly) changing

1

(and) acceleration is rate of change of velocity

*allow*

$$acceleration = \frac{change\ in\ velocity}{time}$$

1

(b) $$s = \frac{2.6^2 - 1.4^2}{2 \times 0.31}$$

1

(c) $$0.72 = \frac{190}{P_{input}}$$

*allow* $\frac{72}{100} = \frac{190}{P_{input}}$

1

$$P_{input} = \frac{190}{0.72}$$

1

$P_{input}$ = 264 (W)

*allow an answer that rounds to 264 (W)*

1

264 = 36 × I

*allow their calculated*
*$P_{input}$ = 36 × I*

1

I = 7.33 (A)

1

I = 29 (A)

*allow an answer that rounds to 29 (A)*
*allow their value for I × 4 correctly calculated*

1

*an answer of 29 (A) scores **6** marks*

(d) old theory suggests Moon rocks would be different from Earth rocks

1

(but) new evidence shows they are similar

*this mark is dependent on scoring the first mark*

1

*allow **1** mark for new evidence (from studying Moon rocks) could not be explained by the old theory*



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**[12]**

## Q6.

(a) earth

1

(b) it can prevent an electric shock from the toaster

1

(c) 230 V

1

(d) (the potential difference) for the alternating supply changes direction

*allow current*

1

(the potential difference) for the alternating supply changes magnitude

*allow current*

*allow converse*

*allow potential difference of alternating supply is greater*

1

(e) there is an overall decrease

*allow there is an decrease in percentage energy loss until 2013*

1

but there is a (small) increase since 2013

1

(f) 1.92, 1.72, 1.70, 1.74, 1.77

1

(1.92 + 1.72 + 1.70 + 1.74 + 1.77)/5

1

1.77(%)

*an answer of 1.77(%) scores **3** marks*

1

**[10]**

## Q7.

(a) E = 15 000 × 36

1

E = 540 000

1

E = 540 (kJ)

*an answer of 540 (kJ) scores **3** marks*

1

(b) (the motor in) scooter **B** has a higher power

1

therefore



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(because both motors have the same efficiency) scooter **B** will have a greater kinetic energy

**1**

(c) the battery in scooter **B** has a greater store of chemical energy

**1**

(d) energy transferred = power × time

*allow E = P × t*

**1**

(e) 20 × 60

**1**

E = 1 200 × 700

**1**

E = 840 000 (J)

*an answer of 840 000 (J) scores **3** marks*

**1**

**[10]**

## Q8.

(a) atoms with the same number of protons

*allow atoms of the same element*

**1**

but with a different number of neutrons

**1**

(b) protons = 11

**1**

neutrons = 12

**1**

(c) electrons falling to a lower energy level

**1**

(d)

| | |
|---|---|
| **Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account. | 3-4 |
| **Level 1:** Facts, events or processes are identified and simply stated but their relevance is not clear. | 1-2 |
| No relevant content | 0 |
| **Indicative content**<br>**solid**<br>• atoms closely packed<br>• atoms in a regular arrangement<br>• atoms vibrate about a fixed position | |



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| | |
|---|---|
| **liquid**<br>• atoms are close together<br>• atoms are not in regular arrangement<br>• atoms can move past each other<br>**gas**<br>• atoms are well separated<br>• atoms are not in regular arrangement<br>• atoms move randomly at high speeds | |

**4**

(e) 60 × 60

**1**

E = 150 × 3600

**1**

E = 540 000 (J)

*an answer of 540 000 (J) scores **3** marks*

**1**

(f) less energy transferred

**1**

not as bright

**1**

**[14]**

## Q9.

(a) 80

**1**

E = 5.0 × 4200 × 80

**1**

E = 1 700 000 (J)

*an answer of 1 700 000 (J) or*
*1 680 000 (J) scores **3** marks*
*allow 1 680 000*

**1**

(b) in part **A** the increase in internal energy raises the temperature of the water

**1**

in part **B** the increase in internal energy changes the state

**1**

without changing the temperature

**1**

(c) the heater would continue to transfer energy which would not be transferred to the water

**1**



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so would raise the temperature of the device

1

causing it to be damaged

1

(d) brown

blue

green and yellow stripes

*allow **1** mark for 2 correct*

2

(e) it stops the casing of the appliance becoming live

1

(f) $P = I^2R$

$I = \sqrt{(P/R)}$

1

P = 2 500 (W)

1

$I = \sqrt{(2\ 500 / 17)}$

1

I = 12.1267812

1

I = 12 (A)

*an answer of 12 (A) scores **5** marks*

1

**[17]**

## Q10.

(a) 230 V

1

(b) Earth

*must be in the correct order*

1

Neutral

1

(c) It is easy to identify each wire.

1

(d) current

*must be in the correct order*

1

shock

1

(e) 50 Hz

1



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(f) output = 25 × 16

1

400 (kV)

1

*allow 400 (kV) with no working shown for **2** marks*

(g) It reduces the energy lost due to heating

1

(h) It is safer for consumers

1

**[11]**

## Q55.

(a) **A**: (transmission) cable(s) / line(s)

*allow power for transmission*
*ignore wire(s)*
*ignore overhead / electrical*

1

**B**: <u>step-down transformer</u>

1

(b) increased

*answers must be in this order*

1

decreased

1

(c) gas

*no marks if the wrong power station is selected*

1

any **one** from:

- (gas power stations) can supply electricity quickly
  *ignore gas has a short start-up time*
- coal and oil powered stations cannot supply electricity quickly enough.

1

**[6]**

## Q56.

(a) any **four** from:

*similarities:*

(both) heat water to produce steam (which turns a turbine linked to turning a generator)

(both are) reliable / can generate electricity 24 hours per day.

*allow (both) provide base load energy / power*

*differences:*

- nuclear power uses nuclear <u>fission</u> to release energy
- fossil fuels are burnt
- fossil fuels releases carbon dioxide
- nuclear fuels produce radioactive waste



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- nuclear fuels generate more energy per kilogram.

*allow nuclear fuels transfer nuclear energy to thermal / electrical energy but fossil fuels transfer chemical energy to thermal / electrical energy*

*for full marks similarities and differences must be given*

*ignore they are both non-renewable*

**4**

(b) (i) any **two** from:

- nuclear power stations have high commissioning / decommissioning costs

*allow fossil fuel power stations do not have high commissioning / decommissioning costs*

- nuclear fuels produce radioactive waste

*allow there is no radioactive waste produced from fossil fuels*

- storage / disposal of (nuclear) waste a problem.

*ignore cost and availability of fuel*

*allow (nuclear) waste takes many years to decay*

*allow nuclear power stations have a longer start-up time*

*allow for **2** marks (nuclear) waste stays radioactive for many years*

**2**

(ii) any **two** from:

- an increase in use of renewable energy sources

*allow increased use of nuclear fuels*

*allow named examples of renewable energy sources*

- supply of fossil fuels is decreasing
- improved technologies for storing (nuclear) waste **or** decommissioning of (nuclear) power stations
- to meet targets for reduction of greenhouse gases.

*allow to reduce carbon dioxide emissions*

*allow for **2** marks: fossil fuels will become more expensive as the supply decreases.*

**2**

(c) to increase the voltage

*do **not** allow power / energy for voltage or current*

**1**

(so) reduce current

**1**

(which) reduces energy losses (due to heating effects in the cables)

*allow "heat" for energy*

*allow more efficient energy transfer / transmission*

*do **not** allow stops energy losses*

**1**

(d) any **three** from:

- chemicals used are a risk to health

*eg contaminated water supply may make people ill*

- (more) traffic on the roads would cause pollution / danger to locals



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- (Earth tremors) could damage buildings / houses
- the sites may spoil the landscape / destroy habitats
- the sites may devalue properties
- money will be spent on fossil fuels rather than renewables so $CO_2$ emissions don't reduce.

*no credit given for just repeating points given in the question.*

**3**

**[14]**

## Q57.

(a) energy efficient means a small proportion of wasted energy

**1**

(b) plasma (TV)

**1**

(c) 1.8

*allow 1 mark for correct substitution eg 0.3 x 6*

**2**

kWh

*box takes precedent*

**1**

**[5]**

## Q58.

(a) electrical

*for full marks an indication of an energy transfer must be given*

*ignore electricity*

**1**

(to) kinetic (of air / motor / fan)

**1**

(and) sound

*ignore noise*

**1**

(and) energy that heats (the hair / surroundings)

*allow heat (energy)*

*allow light with a correct explanation e.g. glowing element, indicator light*

**1**

(b) energy cannot be created / destroyed

*accept energy is conserved*

**1**

**[5]**

## Q59.

(a) wood

**1**



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(b) **Advantage:**

Breaks in overhead power lines are easier to find than in underground cables.

**1**

**Disadvantage:**

Overhead power lines are more dangerous than underground cables if they break.

**1**

**[3]**

## Q60.

(a) VAWT generates electricity at (wind) speeds lower than HAWT do

*ignore quoted figures without comparative statements*

*accept for **2** marks generates electricity over a greater range of (wind)speeds*

**1**

VAWT generates electricity at higher (wind)speeds

**1**

VAWT can generate electricity over a longer time period

*allow VAWT generates more electricity (over a given time period)*

*allow VAWT doesn't need to turn (into the wind)*

*(ignore the converse)*

*ignore the wind can come from any direction*

**1**

(b) any **two** from:

*if no reference to power / output allow max **1** mark*

*if cause and effect are the wrong way round allow max **1** mark*

- very little power / output until 2 (m/s)

  *allow no power / output until 2 (m/s)*

  *allow a value between 1.5 – 2 (m/s)*

- as wind speed increases, power / output increases . . .

- . . . at an increasing rate

  *allow figures to show this*

**2**

(c) (i) 150 (metres)

*allow any value in the range 141 – 159 (metres)*

**1**

(ii) (No, because) the sound level is 20dB less than 30dB / less than a whisper at a distance of 1000m (is worth 2 marks)

*allow at the nearest house for a distance of 1000m*

*allow **1** mark for reading the sound level at 1000m (20dB)*

***or***

*allow **1** mark for (no) the noise level will be very low (at*



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*1000m)*

*allow **1** mark for (Yes)*

*no additional noise is justified in the country side / on the island*

***2** marks can be gained for a 'Yes' answer*

*allow **1** mark for (Yes)*

*we don't know how many wind turbines would be installed / many wind turbines create more noise*

**2**

(d) reduces energy loss (in cables)

*allow 'heat' for energy*

*allow power for energy*

*allow to increase efficiency (of power transmission)*

*ignore less electricity wasted*

*do **not** accept prevents or stops energy loss*

**1**

**[9]**

## Q61.

(a) (i) step-up

**1**

(ii) increases voltage / decreases current

*ignore changes to power*

*ignore resistance*

*allow step-up for increasing*

**1**

decreased energy loss from power cables / wires

*allow heat for energy*

*ignore electricity / power loss*

*do **not** accept no energy loss*

**1**

(b) any **two** factors from:

- cost of electricity

*ignore cost of fuel*

- amount of electricity / power produced
- disposal of waste (radioactive / fossil fuel)

**or**

radioactive waste has long half-life

*ignore pollution unqualified*

*accept waste could be be toxic*

*ignore radiation unqualified*

- cost of commissioning
- cost of decommissioning

*ignore demolishing*

- availability of uranium / plutonium / nuclear fuel / fossil fuels

*ignore non-renewable / will run out*

- availability of sites to build nuclear power stations
- security hazard qualified / safety issue qualified



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*ignore dangerous unqualified*

- carbon emissions / global warming
- start-up time
- start-up time

*if no marks are given allow **1** mark for cost unqualified*

**2**

**[5]**

## Q62.

(a) chemical

**1**

electrical

**1**

kinetic

**1**

*must be in correct order*

(b) (i) 70(%)

*allow 0.7*

*allow* $\frac{7}{10}$ ***or*** $\frac{70}{100}$

*ignore units*

**1**

(ii) increase

**1**

**[5]**

## Q63.

(a) (i) generator

**1**

(ii) power line(s)

*ignore National Grid*

*do **not** accept electrical line*

**or**

(power) <u>cable(s)</u>

*allow electric / electrical / high voltage for power>*

*ignore wires*

*do **not** accept electronic*

**1**

(b) voltage

**1**

current

**1**

*correct order only*

(c) (i) hydroelectric



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1

(ii) nuclear

1

(iii) any **one** advantage and any **one** disadvantage from the following:

**advantages**

- renewable
- no fuel cost
- no fuel burnt
- no air pollution

*accept does not produce carbon dioxide / $CO_2$ / sulfur dioxide / $SO_2$*

*accept does not cause global warming / acid rain*

*do **not** accept high power output*

1

**disadvantages**

- unreliable / not always windy
- visual pollution

*allow eyesore / ugly*

*ignore destroys habitats / landscape*

- high set-up cost

*ignore cost to run*

*ignore start-up time*

- many turbines needed
- low (power) output

*allow kills birds*

*allow noisy / sound pollution*

1

**[8]**



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## Q1.

(a) This question tested students' understanding of energy stores which is new to this specification. 60% of students chose the correct answer.

(b) A relatively straightforward calculation where the students were given the equation. Over 80% of students scored at least 2 marks and over 30% scored 3 marks. The most common incorrect unit given was the joule. Those who scored zero usually divided the quantities instead of multiplying them despite the equation being provided in the question.

(c) If data is given in the question, it will be expected that students use the data in their answers. In this case, examiners were looking for numerical comparisons not just qualitative descriptions or simply quoting figures from the table.

26% of students scored on this question and most of those scored no more than 2 marks with a very small number scoring 3 or more.

Simple numerical comparisons such as 'twice as much mass' of '4 more charges' were given credit. Unfortunately, even these simple comparisons were rarely made. Those students that made quantitative comparisons tended to not make full comparisons between the compact and high capacity, therefore only scoring a maximum of 2 marks.

Some students provided outstanding responses and compared the mass and number of charges by calculating ratios. Some were able to analyse the charge/mass ratio correctly and form appropriate conclusions.

## Q2.

(a) 33% of students drew a curve in the correct quadrants which passed through the origin with decreasing gradient to score two marks. 25% of students then curved their lines back towards the **x**-axis at the ends and so did not score the gradient mark. The most common mistake was to draw a straight line in the correct quadrants through the origin as for a fixed resistor. A few drew the graph for a diode. Some students drew a curve or straight line through the second and fourth quadrants, and some drew a line or curve which was in one quadrant only, or intersected more than two quadrants.

(b) Responses to this question were very mixed. 24% of students scored two marks and 24% of students scored one mark. Many students talked about the current being strongest close to the battery, and weaker further away. Voltage was also discussed in some responses.

Many students just stated that the current split which was not sufficient. However, there were some excellent concise answers that demonstrated a very good understanding of current in parallel circuits.

(c) Half of the students found this multistep calculation question very challenging and scored no marks. 13 % of students scored five marks for correctly calculating a charge flow of 30 C but did not double this to determine the total.

Those who were unable to calculate the correct current could still have scored three marks for multiplying their incorrectly calculated current by 60, then doubling this



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number and finally naming the correct unit. Very few of these scored anything other than the unit mark. Those that did multiply a number by 60 often did not gain credit because it was unclear what their number represented.

(d) Very few students achieved a level 3 response in this question. 38% of students gained at least one mark. A large number of students listed what they could recall about circuits despite this not being relevant to the question − information such as which meter is connected in series, which in parallel and what other components are in the circuit.

The majority of students were unable to recognise the symbol for the LDR with many stating it was a thermistor. Those that did recognise the symbol for the LDR often did not recall the correct link between light intensity and resistance or even the function of the LDR. Many students thought that the LDR was the actual light that was switched on and off by the light intensity. Many students who started the question well, correctly identifying the LDR and linking that correctly to how the resistance of the LDR would change, failed to explain how this change in resistance would affect the readings on the ammeter and voltmeter. Very few students demonstrated an understanding of how resistance affects current.

## Q3.

**Foundation**

(a) 33% of students failed to attempt this question. Of those who did, most stated that efficiency equalled total input energy divided by useful output energy. Some used different equations such as V = IR or didn't write an equation at all but just gave numbers. 9% of students achieved the mark.

(b) 32% of students failed to attempt this question. 4% of students gave a correct answer.

There was evidence that some students were unable to work with standard form as students who had the correct equation shown in their working often gave an answer that included $10^{35}$

Many others just used $1.2 \times 10^{18}$ and gave answers based on this number.

(c) More students answered in terms of low potential difference and a high current than the correct response.

(d) There are two equations applicable to this question given on the Physics Equations Sheet. The great majority of students who gave correct responses answered in terms of energy = power × time

The most common incorrect response was energy = power ÷ time. 29% of students did not attempt this question.

(e) 25% of students achieved all three marks for this question. As the power was in kW and with the answer required in kJ, students often attempted a unit conversion, usually obtaining an answer of 9600, which gained two marks. Although in some cases this answer was given on the answer line with no working shown and therefore no marks could be awarded.

(f) This question on environmental advantages **and** disadvantages of wind turbines discriminated well between students. Students had to give both advantages and disadvantages to achieve full marks, with referring to just one of these e.g.



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advantages resulting in a maximum of three marks. 40% of students achieved at least one mark with 1% receiving full credit.

**Higher**

(a) 45% of students were able to recall the equation with most incorrect responses answering in terms of input energy ÷ output energy.

Some students gave responses where the terms were subtracted and others used different equations such as V = IR

(b) The majority of students who used the correct equation were able to calculate values given in standard form with 38% of students achieving full marks. Others were unable to correctly divide using standard form and gave an answer that included $10^{35}$. Few students worked in terms of percentages with most answering 0.92.

Others who had an incorrect equation written for part **(a)** gave an answer of 1.08 or 108% therefore not appreciating that it is impossible to have an efficiency of this value.

(c) More students answered in terms of low potential difference and a high current than the correct response.

(d) 63% of students were able to recall the equation with the two equations applicable to this question given on the Physics Equations Sheet being seen with a roughly 50 : 50 split.

Energy = power ÷ time, was the most common incorrect response.

(e) 32% of students achieved three marks here. Those who were able to recall the correct equation, often lost marks due to confusion over kJ and kW conversions usually giving a final response of 9600, which was awarded two marks. 6.6 was also a common response from the use of the required equation as power ÷ time. A few gave correct answers in standard form.

(f) Many students didn't realise that the question asked for **environmental** advantages and disadvantages and gave general points relating to reliability, cost etc. Students were using general terms such as 'environmentally friendly' and 'non-polluting' without continuing to expand and give more scientific detail related to these terms.

The most common correct responses were renewable, lack of carbon dioxide produced, bird kill and visual pollution, although many different descriptions of this were credited. Comments such as taking up land space or destroying habitats were ignored.

78 of students were able to achieve some credit, with 20% of students receiving three or four marks.

## Q4.

(a) Around three quarters of students gained the two marks for this calculation.

10% did not attempt it, and a small number of students divided the two given numbers.

Some students worked out the correct answer, then divided by 1000, possibly because the answer of 31 320 000 J looked very large.



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(b) Around one quarter of students did not attempt this question. Few realised that this was a question about useful and wasted energy and only 6% gained both marks. Those who scored one mark tended to get it for the mention of thermal / heat energy.

A common incorrect response was to refer to the energy being 'lost' rather than 'wasted'. Many seemed to think that the Moon's gravity affected how the energy from the batteries was transferred to kinetic energy.

(c) Around 6% of students did not attempt this question. Around one third gave the correct value of 27%.

A fairly common incorrect answer was 73%, where the given values had been added, but not subtracted from 100.

There were a large number of answers in the region of 27, indicating that students knew what to do but either added the values together incorrectly or subtracted from 100 incorrectly. In some cases, working was shown which confirmed this.

(d) 12% of students did not attempt this question. Around one third of students were able to correctly identify both a similarity and a difference from the table, the majority choosing the aluminium and iron percentages respectively.

Despite the instruction to use the table of data, many students stated similarities and differences in texture, hardness, gravity, colour, density, etc. Such answers gained no marks.

Some students, although using the table, did not score marks because they did not 'add value' to the data. This was relevant for the 'difference' mark, where a qualitative description of the difference was required. For instance, an answer or 'iron' or 'iron is different' did not gain a mark, whereas 'Moon rock contains a higher percentage of iron' did.

(e) Around 85% of student responses were correct. Responses for the incorrect options were fairly evenly spread, with 'scientists change their theories to make the theories more popular' being chosen more than the other two.

(f) This was the first occasion in this paper where an equation had to be recalled. Nearly one third of students left this blank.

Of those who wrote something, some wrote an equation which was totally unconnected to the quantities listed. Some wrote expressions which were not equations, i.e. did not have an equals sign. Some wrote equations in the form of chemical equations, e.g. gravitational potential energy + mass ⟶ gravitational field strength + height.

Of those who wrote a mathematical equation connecting the given quantities, less than 20% gave a correct form of the equation to gain the mark.

(g) More than one quarter of students left this blank, which tied in with the fact that many had left the previous question blank because they did not know the gravitational potential energy equation.

Of the students who attempted this calculation, many had difficulty manipulating an equation linking four quantities. Many combinations of the given values were seen, the most popular being to multiply the energy value by one of the other two quantities and then divide by the third. Some students took all three numbers, or just two of them and multiplied them together.



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## Q5.

(a) Over 11% of students made no attempt to answer this question and more than three quarters scored no marks.

Few students realised that this question was linked to the vector nature of velocity and acceleration. Indeed, several students stated that the question was incorrect because the moon could not be accelerating because it was moving at constant speed.

Students who attempted an incorrect explanation attributed the acceleration to a variety of causes − global warming, astronauts landing on the moon and the earth's changing magnetic field were fairly common answers.

Students who scored marks for this question usually cited the constant change in direction of the moon, linking this to a change in velocity, but omitting the link between velocity and acceleration.

(b) Around half of students chose the correct response to the calculation. The next most popular choice was the final box, which was similar to the correct one, but with '2' as a multiplier. The other two responses were equally chosen.

(c) Around 3% of students performed this complex calculation correctly to gain all six marks. Some students attempted calculations, but it was often difficult to follow the line of reasoning. Strings of figures, apparently randomly multiplied or divided, were often seen, with no attempt to explain what was being worked out. It would benefit students to explain, just with a word or two, what they think they are working out. Some students attempted to deal with all stages of this multi-stage calculation in one equation − such answers seldom scored any marks.

Of those whose working was clear enough to follow, the most frequent mistake was working out the input power as 72% of the output power, ending up with a smaller value for the input power than the output. However, such answers could go on to gain up to three of the marks by using the P = IV equation and/or multiplying by four.

(d) In order to gain marks, students needed to refer to the old theory and what it would suggest about the composition of Moon rocks compared to Earth rocks. Very few answers made reference to the old theory, so very few students gained marks.

Many answers stated that if the Moon rocks had a similar composition to Earth rocks, it was likely that they originated from the same place − this is what was stated in the question so there was no credit for repeating it.

There was evidence that a number of students had mis-read or failed to understand the question, as they referred to the Giant Impact Hypothesis as being incorrect because the Earth would have been destroyed in a collision.

## Q55.

(a) A wide range of incorrect labels were seen. For the transmission cables we allowed just 'cables' or 'lines', but 'wires' or 'pylons' was incorrect. For the step-down transformer this whole phrase was the only acceptable answer; 'transformer' was insufficient. Incorrect responses included meter, electricity or power box, power station, generator and transmitter.

(b) The purpose of transformers in the National grid is not well understood, but half of the students gained 1 mark.



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(c) Most students selected the correct power station to meet a sudden demand for electricity, but did not always gain the second mark for a valid reason. Start-up time was referred to in the table, so some value had to be added by giving a comparative statement. For example,' gas has the shortest start-up time' was creditworthy.

## Q56.

(a) The question asked for similarities and differences between generating power using nuclear fuels and using fossil fuels. A lot of students gave information about how the fuels had formed, how they are mined and aspects of commissioning and decommissioning the power stations, none of which answered the question. Quite a lot of students thought that both fuels were burnt. The marking points that were seen most were that fossil fuels are burnt and that they release carbon dioxide, or another named gas.

(b) (i) A few responses were very comprehensive and covered all the points in the mark scheme. However, a lot of students had not interpreted the graph correctly, and had not read the question carefully. They thought the graph compared how much power could be generated from a given mass of fuel, so gave 'fossil fuels release more energy' as a reason why nuclear fuels are used less than fossil fuels to generate power. Many said that nuclear fuels are less readily available and cost more, even though they were directed to give different reasons from these in the question.

(ii) Most students gained 1 mark for saying that fossil fuels are running out. Some had misunderstood the question and said there would be an increase in demand for electricity.

(c) Some students gave very good answers to this question about the use of step-up transformers in the National Grid. A few confused voltage and current, and some said that step-up transformers stop energy losses in the cables, rather than reducing it. However, the terms 'power', 'electricity', 'current' and 'voltage' were often poorly used and are obviously not understood.

(d) Fracking is a topical issue, but students did not have to know anything about the process in order to answer the question. The majority of responses just included statements copied from the report, without adding any value, so did not gain credit. A few students said that the earth tremors might damage houses, or that habitats would be destroyed, both of which were creditworthy.

## Q57.

(a) Most students knew that energy efficient means a small proportion of energy is wasted.

(b) Around 80 per cent of the students correctly identified from the Sankey diagrams that the plasma TV wastes the largest proportion of input energy.

(c) Students could generally substitute correctly into the equation, but then often carried out an incorrect calculation, obtaining 0.18 or 18 instead of 1.8. A common mistake was to change hours into minutes. An incorrect unit was often given.

## Q58.

(a) This question was generally well answered. Some students just wrote a list of the forms of energy involved which did not gain full marks because there was no indication of the energy transfers involved. Others seemed to be confused as to



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which forms of energy were useful and which were wasted. Some mentioned light energy, but this could only be credited if a correct explanation was given. References to electricity or noise as forms of energy were incorrect.

(b) A large proportion of the responses simply restated the question. Many incorrectly said no energy is wasted. Several answers referred to safety, such as to prevent the hairdryer blowing up.

## Q59.

(a) Most students could not identify the example of a biofuel. This part of the specification is not well understood.

(b) Most students gained at least 1 mark, usually for selecting the disadvantage of overhead power lines. Many thought that overhead power lines would transmit electricity more quickly than underground cables.

## Q60.

(a) A comparison of the two types of wind turbine was required. Some responses only included figures quoted from the question, without a comparative statement, so did not gain the marks. Many students mentioned that the wind could come from any direction for the VAWT, but needed to say that the VAWT did not need to turn into the wind. A common incorrect response was a shorter start-up time.

(b) Few students gained more than 1 mark. Most of these students gained the mark for stating the higher the wind speed the higher the power output. Some expressed this poorly and confused the cause and effect saying as the power output increased the wind speed increased. A maximum of 1 mark was allowed if it was implied that the power output affected the wind speed. Some students just quoted figures from the graph without clearly stating any link, which was insufficient. Quoted values were only creditworthy if they indicated the increasing rate shown by the graph, or the zero power output between 0 and 2 m / s. References to the alternative marking points were rarely seen.

(c) (i) Less than a third of the students read the graph correctly. Some read the axes the wrong way round.

(ii) Students had to be clear that the sound level at 1000m was either 20dB, less than 30dB or less than a whisper. Many students said the sound level would only be a whisper, which is incorrect. Some students gained 1 mark for saying the sound level would be very low. Responses that explained why residents would be justified in opposing the construction of wind turbines were rarely seen. Some answers included descriptions of other wind turbine problems or advantages, which were treated as neutral responses.

(d) There was an assortment of confused responses demonstrating a lack of understanding. Many thought that a higher voltage would transmit electricity faster or more easily, others thought a lower current would be safer or prevent damage to the National Grid, whilst others said it would reduce noise or referred to transformers. The word electricity was often incorrectly substituted for energy. Some students realised it was to do with reducing energy loss from the cables, but those who said no energy would be lost, or a high voltage prevented energy loss, did not gain the mark. Reduced energy loss was required.

## Q61.



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(a) (i) Around a third of the students gave step-up transformer, others generally gave step-down or just named parts from the diagram, eg pylon.

(ii) Only about a third of students realised that the voltage was increased, but relatively few went on to explain that this increase would result in decreased energy loss from the cables. Many students answered unacceptably in terms of power or voltage loss, or electricity moving through the cables faster.

(b) About half of the students were able to give one acceptable factor, usually cost or the disposal of waste. There were many vague answers in terms of pollution, non-renewable fuels and 'danger'. Many students gave pre-prepared answers in terms of advantages and disadvantages of nuclear fuels which did not really address the question set.

## Q62.

(a) Almost two-thirds of students gained three marks. Of the incorrect responses, many students named electrical energy in the batteries, rather than chemical, and chemical energy in the wires instead of electrical.

(b) (i) Many students carried out a calculation to work out the efficiency of the fan, even though this was not necessary given the figures on the diagram. Quite a few added all three numbers up to give an answer of 200, or described the efficiency as being 'good' rather than giving a figure. Some quoted that 30% of the energy was wasted, which did not answer the question.

(ii) By far the most common answer was that the energy transferred from the fan decreases the temperature of the surroundings. Less than a third of students selected 'increase'.

## Q63.

(a) (i) Over half of students answered correctly, but a common error when naming the generator was to name it a transformer. Some students had confused the diagram with simplified versions showing the National Grid and named part A as a power station or factory.

(ii) Many students incorrectly named part B as some sort of wire. Only a quarter of students gave the required answer of (power) cables or power lines.

(b) Few students gained both marks here; some scored one for either voltage or current in the correct space. Almost half of students scored no marks at all.

(c) (i) Over three-quarters of students correctly stated that a hydroelectric power station would be best to meet peak demands.

(ii) Most students could identify nuclear as a non-renewable energy resource, although a common answer was geothermal, which is renewable.

(iii) Many students gave 'renewable energy source' as an advantage of wind turbines. Statements such as 'environmentally friendly' was too vague, something relating to no air pollution was needed. If cost was mentioned it had



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to be linked to no fuel. Many said it was free, which was not enough for a mark. Most students gave ‘not always windy’ or ‘noisy’ as disadvantages. Cost had to relate to high set-up cost.