

Powering Earth

Q1.(2018)

A ✓

Q2.(2018)

B ✓

Q3.(2018)

A ✓

Q4.a(2018)

As resistance or Ω or R decreases the power or W or P increases / ORA ✓

1

3.1a

ALLOW inversely proportional / as one goes up the other goes down

Q4.b(2018)

As resistance or Ω decreases the current or I increases / ORA ✓

2

2 × 1.1

ALLOW correct answers seen in (a)(i)

AND one from:

(As current is increased the power increases because) $P = VI$ (and V is constant) / ORA ✓

(As current is increased the power increases because) $P = I^2R$ (and I increases by the same factor as R increases) / ORA ✓

(As current is increased the power increases because) $P = V^2/R$ and V constant for these mains appliances so R goes down when P goes up / ORA ✓

ALLOW as R goes up I goes down / power of current increases so resistance goes down / large current causes low resistance

Q4.c(2018)

FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 2.6 (kWh) award 4 marks

4

0.75 (hours) seen ✓

0.5 (kW) seen ✓

(E =) $0.5 \times 0.75 \times 7$ or 2.625 seen ✓

1.2

ALLOW 3/4 (hour)

1.2

2.1

ALLOW incorrect conversions or no conversions for time and power (i.e. time x 7 x power)
e.g. $((45 \times 7) / 3600) \times 500$ ✓
e.g. $45 \times 7 \times 500$ ✓
e.g. $45 \times 7 \times 0.5$ or 2625 or 262500 or 2600 ✓✓
so $0.5 \times 0.75 \times 7$ or 2.625 seen ✓✓✓

(E =) 2.6 (kWh) to 2sf ✓

2.1

No ECF for sig fig mark for calculated answer

Q4.d(2018)

<p>Direct voltage: Voltage does not change direction / stays at + or stays at – ✓</p> <p>Alternating voltage: Voltage changes direction / becomes + and – ✓</p>	2	2 × 1.1	<p>ALLOW current or p.d. in description for voltage ALLOW stays in one direction/ goes one way ALLOW does not oscillate IGNORE just stays the same or is constant / goes straight to the house or appliance / from a battery</p> <p>ALLOW current or p.d. in description for voltage ALLOW goes in both directions or both ways or two ways but DO NOT ALLOW goes in many or multiple directions ALLOW oscillates IGNORE just changes or switches / from the mains</p> <p>ALLOW answers on a labelled diagram with 0 or clear + and –</p>
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Q4.e(2018)

It is insulated / it has a plastic case / it is double insulated / case cannot become live ✓	1	1.1	ALLOW no touchable metal parts / does not have a metal case / cannot get an (electric) shock
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Q4.f(2018)

<p>Chemical store (involved in this process) / Thermal store (involved this process) ✓</p> <p>and then any two from: (Chemical store) being emptied ✓ (Thermal store) being filled ✓ Amount of energy gained (by thermal store) = amount of energy lost (by chemical store) ✓</p>	3	<p>1 × 2.1</p> <p>2 × 3.2b</p>	<p>ALLOW heat energy store</p> <p>ALLOW Chemical store being emptied ✓✓ Thermal store being filled ✓✓ Amount of energy gained by thermal store = amount of energy lost by chemical store ✓✓✓</p> <p>If no marks awarded ALLOW chemical energy converted to thermal energy ✓ but DO NOT ALLOW energy is created</p>
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Q5.(2019)

D ✓

Q6.(2019)

<p>Renewable (energy) can be regained in your lifetime / does not run out / infinite / sustainable OR Non-renewable (energy) will run out / cannot be regained in your lifetime / finite / cannot be replenished / used faster than it is made ✓</p> <p>Renewable examples: wind / geothermal / tidal / wave / solar / biomass / wood / biofuel ✓</p> <p>Non-renewable examples: fossil fuel / coal / oil / gas / nuclear ✓</p>	3	3 × 1.1	<p>ALLOW examples of use of renewable energy e.g. solar panels or solar cells / wind turbines / hydroelectric</p> <p>IGNORE just power stations</p>
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Q7.(2019)

(step up transformers) increases <u>voltage</u> / power transmitted at high <u>voltage</u> / (step up transformers) decreases <u>current</u> ✓	2	2 × 1.1	ALLOW pd for voltage
idea of less power wasted / less energy wasted / less heat in power lines / less thermal transfer ✓			IGNORE just ideas about efficiency DO NOT ALLOW so no power wasted / no energy wasted (as heat in power lines) / no thermal transfer

Q8.(2019)

FIRST CHECK THE ANSWER ON ANSWER LINE If answer = in inclusive range 3600 to 3900 (A) award 3 marks	3		
(secondary pd) in inclusive range 2.4×10^5 to 2.6×10^5 ✓		2.2	ALLOW vertical line in inclusive range 2.4×10^5 to 2.6×10^5 (V)
answer to marking point one × 2400 = current in primary coil × 160 000 ✓		2 × 2.1	ALLOW ECF from their reading of secondary pd
(Current in primary coil =) in inclusive range 3600 to 3900 (A) ✓			

Q9.a(2020)

FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 500 (A) award 3 marks

$$I^2 = P / R \quad \checkmark$$

$$I^2 = 750\,000 / 3 = 250\,000 \quad \checkmark$$

$$I = 500 \text{ (A)} \quad \checkmark$$

Q9.b(2020)

Any two from: Step up transformers (used after power station) / AW ✓ (Transformers) increase voltage (before grid) / AW ✓ (Transformers) decrease current ✓ Reduces heat loss (in wires) / AW ✓	3	2 × 1.2	
AND Doubling voltage reduces power loss by a factor of 4 / inverse square law / ORA / AW ✓		3.2b	ALLOW any correct numerical comparison, e.g. quadrupling V decreases P loss by factor of 16, halving V quadruples power loss.

Q10.(2020)

Any three from:

Connecting live to earth ✓

A person may be part of the live to earth connection ✓

A person may touch the water / AW ✓

There is a potential difference between the live wire and the person/Earth ✓

(Which may cause) an electrical shock ✓

Q11.(2020)

Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.

Level 3 (5–6 marks)

Detailed comparison of advantages and disadvantages of each type of turbine.

AND

Detailed analysis of data which is used to make judgements about each energy source.

There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.

Level 2 (3–4 marks)

Detailed comparison of advantages and disadvantages of each type of turbine.

AND

Some analysis of data which is used to make judgements about each energy source.

OR

Comparison of advantages and disadvantages of each type of turbine.

AND

Detailed analysis of data which is used to make judgements about each energy source.

There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.

Level 1 (1–2 marks)

Comparison of advantages and disadvantages of each type of turbine.

OR

An attempt to calculate the energy produced by each source.

There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.

0 marks

No response or no response worthy of credit.

6

2 × 1.2
4 × 3.1b

AO1.2 – Demonstrates knowledge and understanding of wind and wave power.

Advantages

- Both are renewable / sustainable / give free energy once set up
- Tidal turbines do not take a lot of land
- Tidal turbines can be placed further from people, so noise or visual pollution reduced
- Both do not produce carbon dioxide / greenhouse gases
- Tidal reliably happen twice a day

Disadvantages

- Wind is unreliable / turbines do not work if there is not enough wind or too much wind
- Tide times and size vary
- Both can damage wildlife / produce visual and noise pollution
- Wind farms take a lot of land (which can be used for crops)
- Both are expensive to build / set up

AO3.1b – Analyses information to evaluate wind and wave power.

- Density of water > density of air
- Need a greater volume of air through wind turbine (per s)
- $m (= d \times V = 1.20 \times 38000) = 45\,600 \text{ kg}$
- $m (= d \times V = 1020.00 \times 8) = 8160 \text{ kg}$
- $KE(/s) (= \frac{1}{2}mv^2 = \frac{1}{2} \times 45600 \times 25) = 570\,000 \text{ J(/s)}$
- $KE(/s) (= \frac{1}{2}mv^2 = \frac{1}{2} \times 8160 \times 25) = 102\,000 \text{ J(/s)}$
- Wind turbine produces more energy than the wave turbine (per s) at same speed

AO3.2a - Analyses information to make judgements on wind and wave power

- Wave turbine has higher overall efficiency
- More wave turbines needed for same speeds / ORA
- Radius of wind turbine must be larger than radius of water turbine for same speed / ORA

Q12.(2021)

C

Q13.(2021)

Any **two** from:

It is reliable / non-renewables are unreliable ✓

Accidents are rare / still a safe resource ✓

Renewables do not produce enough energy / nuclear
power produces more energy for less fuel / AW ✓

There is a plentiful supply of nuclear fuel / nuclear fuel is
sustainable ✓

To meet the demand of consumers ✓

No greenhouse gases / no CO₂ produced ✓

Q14.(2022)

B ✓

Q15.(2022)

B ✓

Q16.(2022)

D ✓

Q17.(2022)

A ✓

Q18.(2022)

A ✓

Q19.(2023)

A

Q20.(2023)

A

Q21.(2023)

D

Q22.a(2023)

<p>Any two from:</p> <p>(Demand) increases at/from 14:00 ✓</p> <p>(Demand) peaks during range 17:00 to 20:00 ✓</p> <p>(Demand) dips (slightly) during the peak / increases and then decreases (during the peak) ✓</p> <p>(Demand) decreases at/from 19:00 to 20:00 ✓</p> <p>(Demand) decreasing at 23:00 / less at 23:00 than 14:00 ✓</p>	2	2 × 3.1a	<p>ALLOW times using non 24-hour clock e.g., 2(pm) and 11(pm)</p> <p>IGNORE reasons and explanations for changes</p> <p>ALLOW peak at any time in this range e.g., peaks at 18:00 / up until 18:00 / to 18:00</p> <p>ALLOW decrease at/from any time in this range e.g., decreases at 19:30</p> <p>ALLOW demand at 14:00 is high and demand at 23:00 is low</p> <p>Alternative method using MW:</p> <p>increases at/from 27 500 or 27 800 (MW)</p> <p>peaks during range 32 000 to 33 000 (MW)</p> <p>dips (slightly) during the peak / increases and then decreases</p> <p>decreases at/from 32 500 to 33 000 (MW)</p> <p>decreasing at 23:00 / less at 23:00 than 14:00 / at 23:00 is 22 000 to 23 000 (MW)</p> <p>ALLOW mixture of time and MW but must be different marking points</p>
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Q22.b(2023)

<p>Any two from:</p> <p>Gas fired power stations are quick to start up ✓</p> <p>(Rapid) increase in demand / extra energy/power needs to be generated ✓</p> <p>(Because) people are waking up / people need to make breakfast / people are using (electrical) devices ✓</p>	2	2 × 3.2a	<p>ALLOW needs to be a power station that is quicker (to start)</p> <p>ALLOW make sure enough power is available / to meet the demand / know demand is going to increase</p> <p>IGNORE references to incorrect times and just ALLOW for the action that increases the demand e.g., people use showers / cook food / switch TV on for 1 mark</p>
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Q22.c(2023)

First check the answer on answer line
If answer = 62.5 (%) award 3 marks

(Peak =) 32 800
OR
(Baseload =) 20 500 ✓

$$\frac{20\,500}{32\,800} \times 100 \quad \checkmark$$

62.5 (%) ✓

3

2.2

ALLOW (peak =) in the range 32 700 to 32 900
(baseload =) in the range 20 400 to 20 600

2 × 1.2

ALLOW answer in the inclusive range 0.62 to 0.63
for 2 marks

ALLOW answer in the inclusive range 62 to 63 for
3 marks

ALLOW ECF for correct substitution e.g.:

baseload 20250
peak 32800 (1 mark)

$$\frac{20\,250}{32\,800} \times 100 \quad (1 \text{ mark})$$

Q22.d(2023)

Fossil fuel / nuclear ✓

1

1.1

ALLOW gas / diesel / coal / oil

IGNORE electric

DO NOT ALLOW any renewable resources

Q23.a(2023)

First check the answer on answer line
If answer = 33 000 (V) award 2 marks

$$4500 \times 132\,000 = 18\,000 \times \text{p.d.}$$

OR

$$(\text{p.d.} =) \frac{4500 \times 132\,000}{18\,000} \quad \checkmark$$

$$(\text{p.d.} =) 33\,000 \text{ (V)} \quad \checkmark$$

Q23.b(2023)

Any one from:

98% of the energy output is useful ✓

98% of the energy input is usefully transferred ✓

2% of the energy output is wasted or dissipated ✓

1

1.1

ALLOW power for energy throughout question

ALLOW 98% of the energy is used
IGNORE only works 98% of the time

ALLOW 2% of energy (output) is 'lost' (to the
surroundings) / 98% of energy is not 'lost' (to the
surroundings)

Q24.a(2024)

Live and neutral ✓

Q24.b(2024)

Any one from:	1	2.2	
May cause a (loud) bang/pop/noise/sound ✓			IGNORE explosion
May cause wires to get hot / may cause insulation/wires to melt / may cause smoke / may cause fire ✓			ALLOW causes sparks / causes a (burning) smell IGNORE removes the safety of the earth wire / causes damage / appliance melt
May cause fuse(s) to blow / may cause RCD(s) to trip ✓			IGNORE causes a power cut IGNORE changes in current / overpower the electrics

Q24.c(2024)

First check the answer on the answer line If answer = 42 (kWh) award 2 marks	2	2 × 2.1	
(E =) $2.4 \times 2.5 \times 7$ ✓			ALLOW 2.4×17.5 ALLOW $2.4 \times 2.5 = 6$ for 1 mark
(E =) 42 (kWh) ✓			ALLOW 4.2×10^n as the final answer for 1 mark

Q25.a(2024)

Any one from:	1	3.1a	
As current increases, danger increases / ORA ✓			ALLOW alternative wording for danger e.g., cardiac arrest / difficulty breathing / effects more serious / effects get worse / risks increase / becomes fatal
As time for current to flow increases, danger increases / ORA ✓			IGNORE as the current increases the time decreases (so danger increases) IGNORE ideas that are not trends e.g. no danger at low currents / no effects until past 500 mA

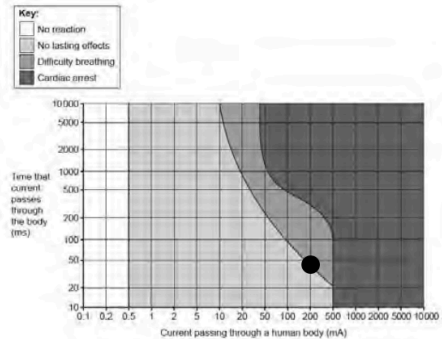
Q25.b(2024)

10 000 (ms) ✓	1	2.2	ALLOW 10 seconds / 10 s DO NOT ALLOW incorrect unit e.g., 10 000 m/s or 10 000 s
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Q25.c(2024)

First check the answer on the answer line If answer = 0.045 (C) award 3 marks	3		
Unit conversion: $150 \text{ mA} = 0.15 \text{ A}$ ✓		1.2	
(charge =) 0.15×0.3 ✓		2.1	ALLOW $(1.5 \times 10^n) \times 0.3$ for 1 mark
(charge =) 0.045 (C) ✓		2.1	ALLOW 4.5×10^n as the final answer for 2 marks

Q25.d(2024)

To prevent difficulty breathing / no lasting effects ✓	1	3.2a	<p>IGNORE to prevent cardiac arrest IGNORE to prevent electrocution</p> 
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Q25.e(2024)

If RCD A

Any two from:

(Safer as) current lower ✓

Current is 10/low so no lasting effects ✓

Time is 100/high but no lasting effects ✓

Very sensitive ✓

If RCD B

Any two from:

(Safer as) switches off faster ✓

Current is 30/high but no lasting effects ✓

Time is 40/low so no lasting effects ✓

Will not keep shutting off supply accidentally ✓

2

2 × 3.1b

Both marks for RCD **A** or both marks for RCD **B**,
maximum 1 mark if RCD **A** and RCD **B** selected

Answer must be comparative

ALLOW any time at a current of 10 has no lasting effects for 2 marks

ALLOW calculation to demonstrate a smaller charge flow e.g.,
RCD **A** charge flow is 0.001 C, but RCD **B** charge flow is 0.0012

Answer must be comparative

ALLOW time up to 500 at a current of 30 has no lasting effects for 2 marks

Q26.(2024)

Step-up

Potential difference

Step-down

Decreases ✓

Q27.a(2024)

First check the answer on the answer line
If answer = 9.6 (A) award 2 marks

$$240 \times 0.8 = 20 \times I_s$$

OR
($I_s =$) $(240 \times 0.8) \div 20 \checkmark$
($I_s =$) 9.6 (A) $\checkmark$

2

2 × 2 .1

ALLOW equation in any form e.g., $192 \div 20$

Q27.b(2024)

First check the answer on the answer line
If answer = 0.8 award 3 marks

Efficiency = useful E output ÷ total E input $\checkmark$
(Efficiency =) $140 \div 175 \checkmark$
(Efficiency =) 0.8 $\checkmark$

3

1.2

ALLOW equation in any form

2.1

2.1

ALLOW 80% for 3 marks
ALLOW 0.8% or 80 for 2 marks
ALLOW unit added e.g. 0.8 J or 80 J for 2 marks

Q27.c(2024)

First check the answer on the answer line
If answer = 50 (W) award 3 marks

$$P = I^2 R \checkmark$$

(P =) $0.25^2 \times 800 \checkmark$
(P =) 50 (W) $\checkmark$