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|-------------|---------------|------------------|
| Surname     | Centre Number | Candidate Number |
| Other Names |               | 0                |



**GCSE – NEW**

3430UC0-1



**SCIENCE (Double Award)**

**Unit 3: PHYSICS 1  
HIGHER TIER**

MONDAY, 19 JUNE 2017 – MORNING

1 hour 15 minutes

| For Examiner's use only |              |              |
|-------------------------|--------------|--------------|
| Question                | Maximum Mark | Mark Awarded |
| 1.                      | 15           |              |
| 2.                      | 8            |              |
| 3.                      | 9            |              |
| 4.                      | 10           |              |
| 5.                      | 4            |              |
| 6.                      | 14           |              |
| <b>Total</b>            | <b>60</b>    |              |

**ADDITIONAL MATERIALS**

In addition to this examination paper, you may require a calculator and a ruler.

**INSTRUCTIONS TO CANDIDATES**

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space use the continuation page(s) at the back of the booklet, taking care to number the question(s) correctly.

**INFORMATION FOR CANDIDATES**

The number of marks is given in brackets at the end of each question or part-question.

Question 6(a) is a quality of extended response (QER) question where your writing skills will be assessed.



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**Equations**

|   |   |
|---|---|
| current = $\frac{\text{voltage}}{\text{resistance}}$  | $I = \frac{V}{R}$                             |
| total resistance in a series circuit  | $R = R_1 + R_2$                               |
| total resistance in a parallel circuit  | $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ |
| energy transferred = power $\times$ time  | $E = Pt$                                      |
| power = voltage $\times$ current  | $P = VI$                                      |
| power = current <sup>2</sup> $\times$ resistance  | $P = I^2R$                                    |
| % efficiency = $\frac{\text{energy (or power) usefully transferred}}{\text{total energy (or power) supplied}} \times 100$ |   |
| density = $\frac{\text{mass}}{\text{volume}}$   | $\rho = \frac{m}{V}$                          |
| units used (kWh) = power (kW) $\times$ time (h)<br>cost = units used $\times$ cost per unit                               |   |
| wave speed = wavelength $\times$ frequency  | $v = \lambda f$                               |
| speed = $\frac{\text{distance}}{\text{time}}$   |   |

**SI multipliers**

| Prefix | Multiplier          |
|--------|---------------------|
| p      | $1 \times 10^{-12}$ |
| n      | $1 \times 10^{-9}$  |
| $\mu$  | $1 \times 10^{-6}$  |
| m      | $1 \times 10^{-3}$  |

| Prefix | Multiplier         |
|--------|--------------------|
| k      | $1 \times 10^3$    |
| M      | $1 \times 10^6$    |
| G      | $1 \times 10^9$    |
| T      | $1 \times 10^{12}$ |



*Answer all questions.*

1. The Energy Saving Trust aims to help everyone save energy every day in order to reduce the environmental damage that energy production does to the environment. It provides advice to households and businesses and gives tips for energy savings such as not leaving appliances on standby and choosing the most energy efficient appliances.

The efficiency of washing machines depends on how they are used as they can wash clothes at a variety of temperatures. Many clothes retailers and washing detergent manufacturers recommend washing clothes at 30 °C in order to be more energy efficient. According to the Energy Saving Trust “*Washing clothes at 30 °C rather than at higher temperatures uses around 40% less energy.*”

The table below gives data for different washing temperatures for a particular washing machine.

| Washing temperature (°C) | Mean power (W) | Wash time (minutes) |
|--------------------------|----------------|---------------------|
| 30                       | 500            | 60                  |
| 40                       | 500            | 90                  |
| 50                       | 500            | 120                 |

- (a) (i) Use equations from page 2 to calculate the cost of washing clothes at 40 °C. The cost of one unit of electricity is 16 p. [4]

Cost = ..... p

- (ii) The Energy Saving Trust suggests that washing clothes at 30 °C reduces energy use by at least 40% compared to washing at higher temperatures. Use the data in the table to investigate the validity of this claim. [3]

*Space for calculations*

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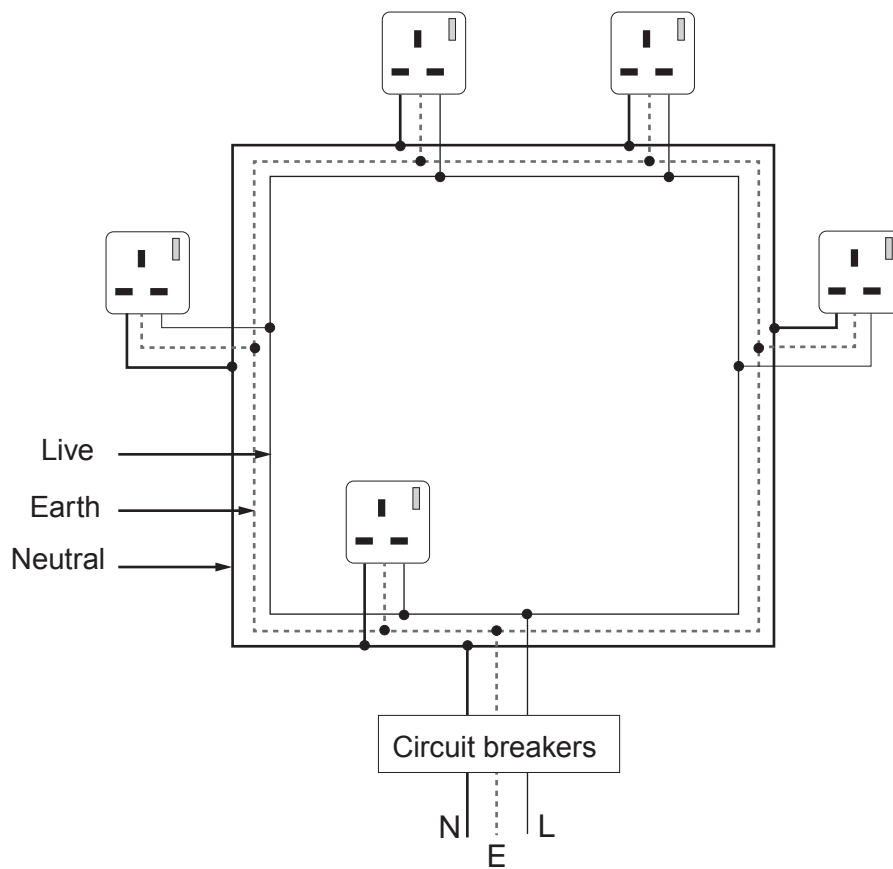
- (iii) Washing clothes at  $30^{\circ}\text{C}$  saves money on household bills. Explain why reducing energy consumption also helps the environment. [2]

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- (b) The washing machine is connected to the ring main shown below. The voltage in the ring main is 230 V.



- (i) State which wire the fuse must be connected to. [1]

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- (ii) Describe the function of the earth wire. [2]

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(c) When the voltage is 230V, the mean power of the washing machine during a wash is 500W. However when heating the water it must be able to produce a maximum power of 2400W. The householder has 3A, 5A and 13A fuses available and chooses to fit a 3A fuse into the plug. Investigate whether or not this is a suitable choice. [3]

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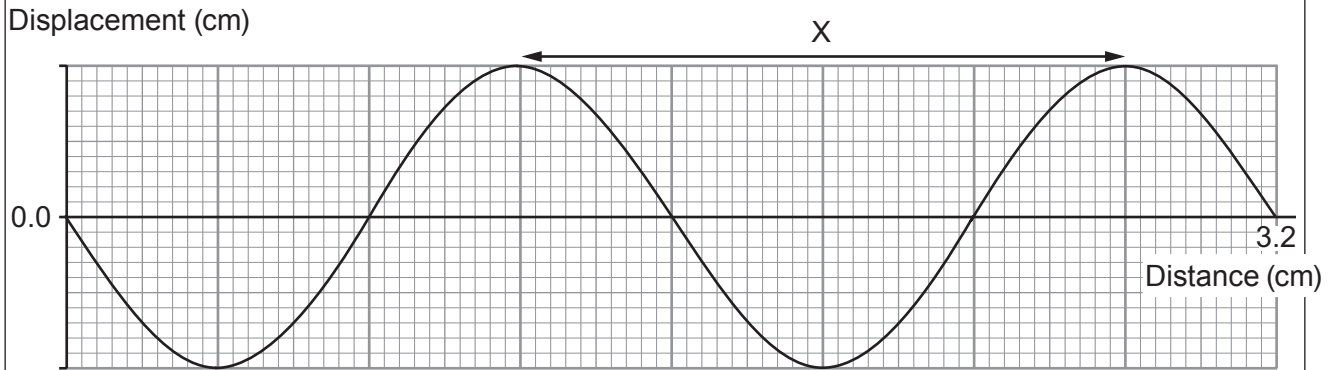
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2. A teacher demonstrates water waves in a ripple tank.

(a) The diagram represents the waves produced at a particular frequency.



(i) Use the information in the diagram to calculate the distance X.

[2]

X = ..... cm

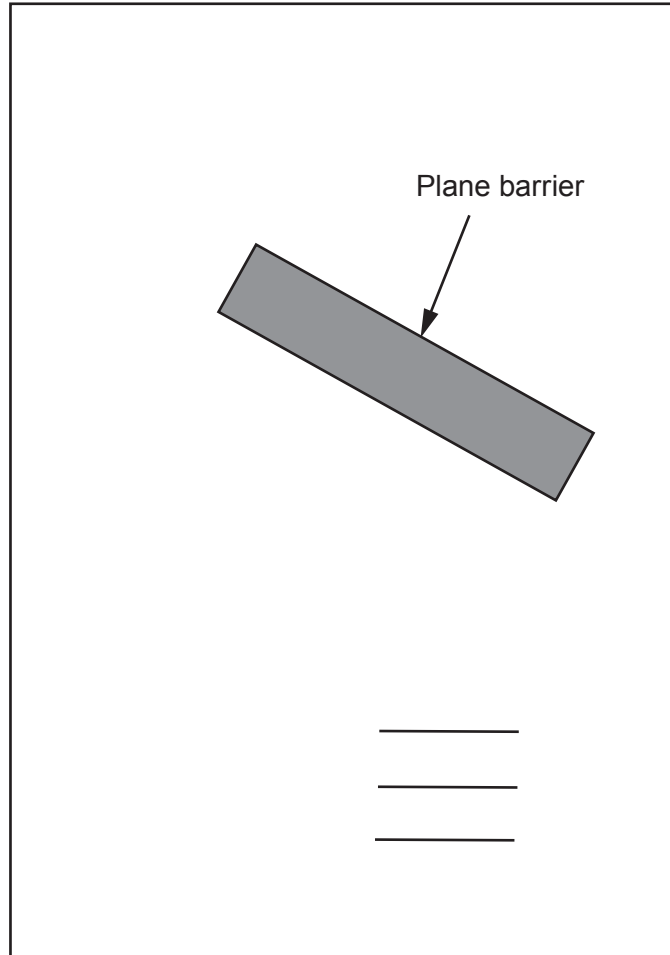
(ii) A wave takes 5 s to travel 40 cm along the surface of the water in the ripple tank. Use equations from page 2 and the information above to calculate the frequency of the wave.

[4]

Frequency = ..... Hz



- (b) Wavefronts travel towards a plane barrier. **Complete the diagram** to show the path of the wavefronts as they are incident on and reflect off the barrier. [2]



3. (a) A student is investigating the current-voltage characteristic of a filament lamp. In the space below, **draw a circuit diagram** of the circuit she would use. [3]

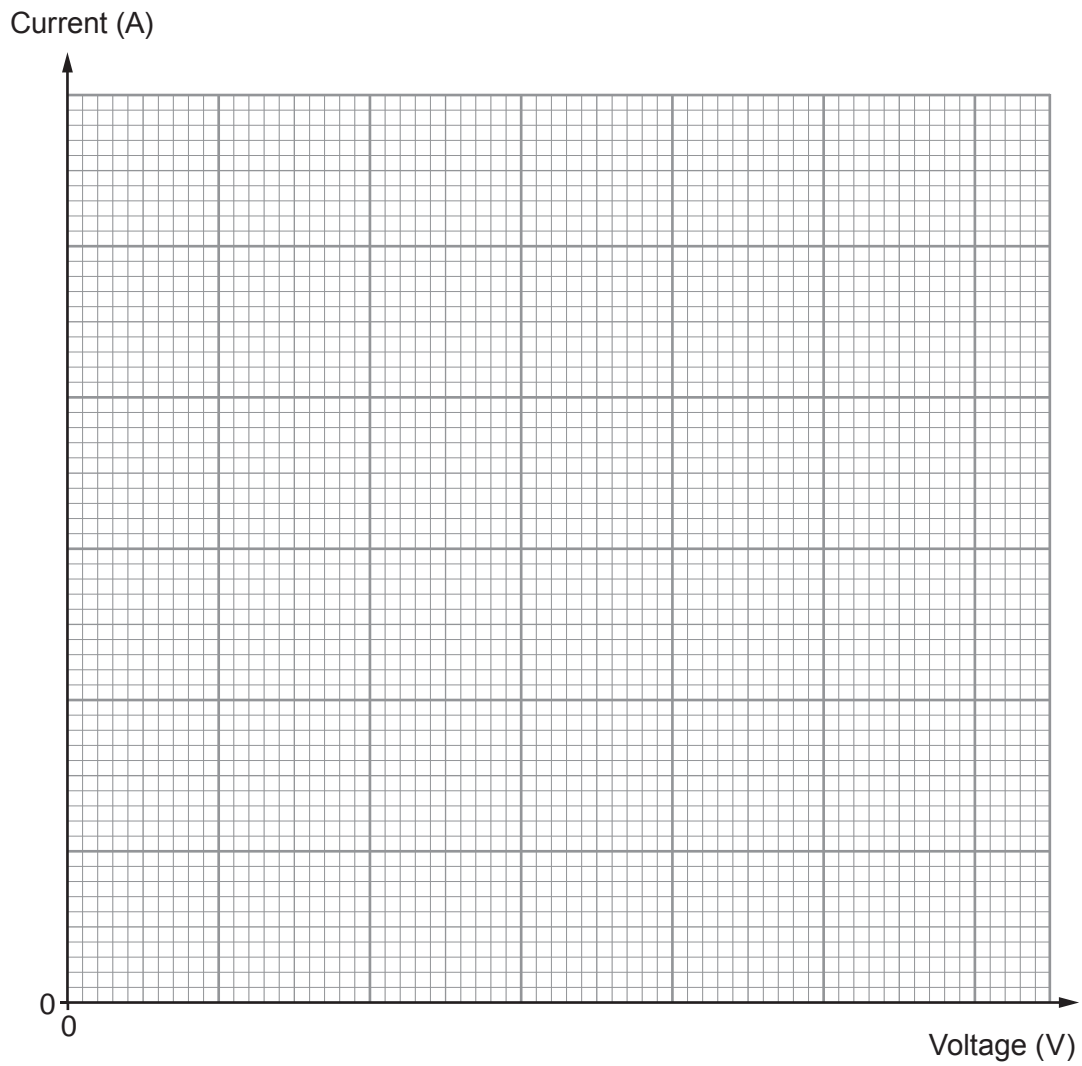
- (b) The student collects the following results.

| Voltage (V) | Current (A) |
|-------------|-------------|
| 0.0         | 0.00        |
| 2.0         | 0.40        |
| 4.0         | 0.76        |
| 6.0         | 0.94        |
| 10.0        | 1.08        |
| 12.0        | 1.10        |



(i) Plot the data on the grid below and draw a suitable line.

[3]



(ii) She concludes that the resistance of the lamp decreases as voltage increases. Explain using calculations, whether you agree or disagree with this conclusion. [3]

*Space for calculations*

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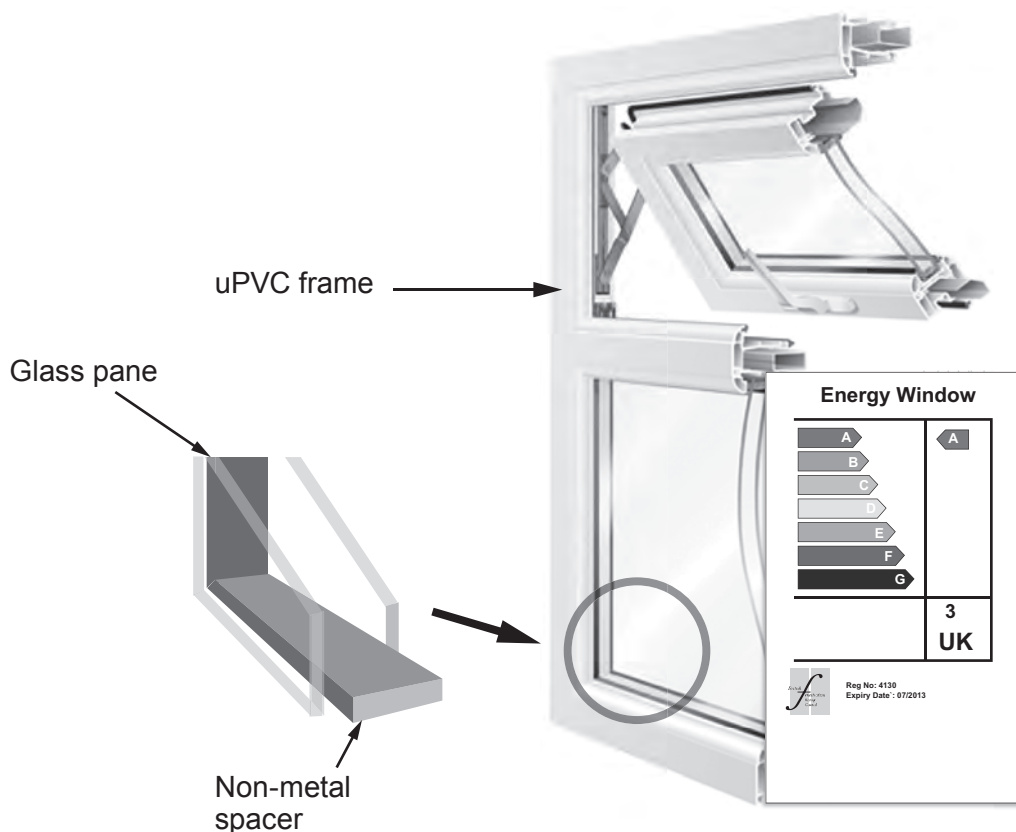
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4. All properties lose heat through their windows and roof. Energy-efficient installations such as uPVC windows and loft insulation keep homes warmer as well as reducing energy bills.

(a) A homeowner replaces aluminium framed double glazed windows which contain metal spacers between the panes of glass with uPVC windows. This new frame is made of uPVC and the window panes are separated by non-metal spacers.



(i) Explain why the aluminium window loses heat at a faster rate than the new uPVC window. Include reference to particles in your answer. [4]

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(ii) The photograph shows an uninsulated loft.



Explain how heat is lost through the roof of a house when the loft is not insulated. You should refer to the ceiling, the loft space and the roof tiles in your answer. [3]

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(b) Explain why reducing energy losses from our homes benefits the environment. [3]

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5. Electromagnetic (em) waves are used extensively in a wide variety of applications. The table below gives information about different regions of the electromagnetic (em) spectrum. It shows ranges for wavelengths and frequencies.

| Region      | Wavelength (m)                            | Frequency (Hz)                             |
|-------------|---|--|
| radio       | $> 1 \times 10^{-1}$                      | .....                                      |
| microwave   | $1 \times 10^{-3}$ to $1 \times 10^{-1}$  | $3 \times 10^9$ to $3 \times 10^{11}$      |
| infra-red   | .....                                     | $3 \times 10^{11}$ to $4 \times 10^{14}$   |
| visible     | .....                                     | $4 \times 10^{14}$ to $7.5 \times 10^{14}$ |
| ultraviolet | $1 \times 10^{-8}$ to $4 \times 10^{-7}$  | $7.5 \times 10^{14}$ to $3 \times 10^{16}$ |
| X-ray       | $1 \times 10^{-11}$ to $1 \times 10^{-8}$ | $3 \times 10^{16}$ to $3 \times 10^{19}$   |
| gamma ray   | $< 1 \times 10^{-11}$                     | .....                                      |

- (a) Complete the table above using the ranges below. [3]

$(7.5 \times 10^{-7}$  to  $1 \times 10^{-3})$      $(< 3 \times 10^9)$      $(> 3 \times 10^{19})$      $(4 \times 10^{-7}$  to  $7.5 \times 10^{-7})$

- (b) All em waves transfer energy. The shortest waves are the most ionising. The table below shows energy values in an **incorrect order**. Arrange the energy values in the **correct order**. [1]

| Region    | Energy (J) in <b>incorrect order</b>       | Energy (J) in <b>correct order</b> |
|-----------|--|------------------------------------|
| radio     | $> 2 \times 10^{-14}$                      | .....                              |
| microwave | $3 \times 10^{-19}$ to $5 \times 10^{-19}$ | .....                              |
| visible   | $2 \times 10^{-17}$ to $2 \times 10^{-14}$ | .....                              |
| X-ray     | $2 \times 10^{-24}$ to $2 \times 10^{-22}$ | .....                              |
| gamma ray | $< 2 \times 10^{-24}$                      | .....                              |

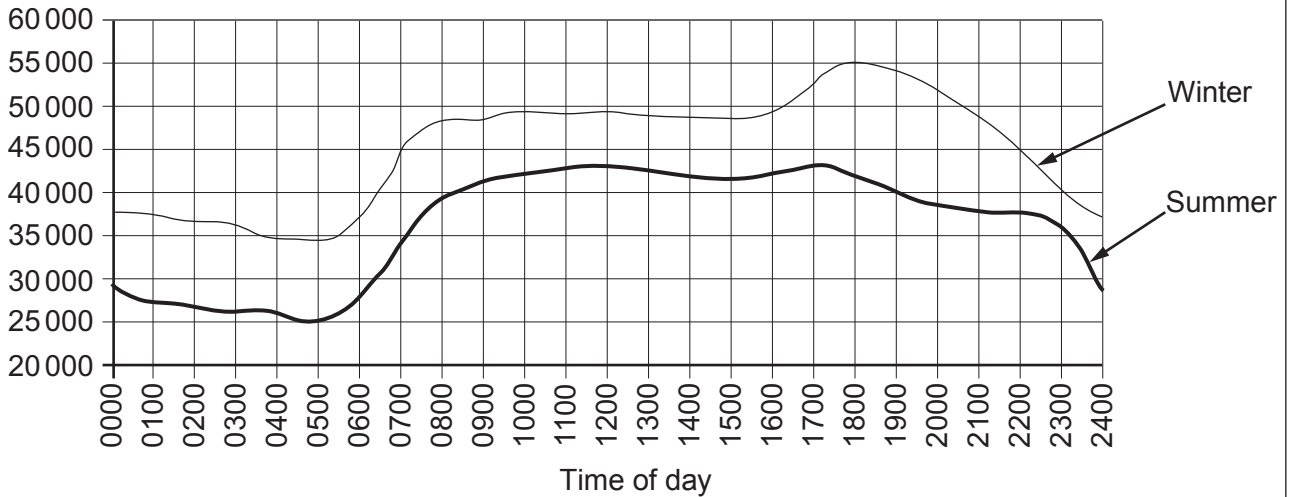




(b) Information about the National Grid is shown below.

**Typical summer and winter demands**

National Grid demand (MW)



**Network size**

- Maximum demand 63 GW
- Output capacity 79.9 GW
- Annual mean electrical energy used in the UK 360 TWh
- Length of 400 kV grid 11 500 km
- Length of 275 kV grid 9 800 km
- Length of 132 kV (or lower) grid 5 250 km

**Energy losses at maximum demand**

- Heating in cables 860 MW
- Fixed losses 260 MW
- Sub-station transformer heating losses 145 MW
- Generator transformer heating losses 155 MW

Total losses = 1 420 MW

(i) Use the information above and an equation from page 2 to calculate the % efficiency of the National Grid system at maximum demand. [3]

% efficiency = .....



(ii) Use the equation:

$$\text{power} = \frac{\text{energy transferred}}{\text{time}}$$

to calculate the annual mean power used in GW.  
(1 year = 8 766 hours)

[3]

Mean power = ..... GW

(iii) Tick (✓) the boxes next to the **two** correct statements about the data opposite. [2]

At maximum demand there is spare capacity of 16.9GW

Maximum demand is equivalent to 85% of total capacity

The difference in minimum demand between summer and winter is approximately 10 000 MW

The times of peak demand in summer and winter are **exactly** the same

The difference in maximum demand between summer and winter is 15 000 MW

**END OF PAPER**

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