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

# GCSE

3430U30-1

S19-3430U30-1

# SCIENCE (Double Award)

## Unit 3 – PHYSICS 1
## FOUNDATION TIER

FRIDAY, 14 JUNE 2019 – MORNING

1 hour 15 minutes

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1.** | **6** | |
| **2.** | **5** | |
| **3.** | **5** | |
| **4.** | **9** | |
| **5.** | **6** | |
| **6.** | **14** | |
| **7.** | **15** | |
| **Total** | **60** | |

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01

**ADDITIONAL MATERIALS**

In addition to this paper you will 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 additional pages 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.

The assessment of the quality of extended response (QER) will take place in question **5**.

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**Equations**

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

**SI multipliers**

| Prefix | Multiplier |
|---|---|
| m | $1 \times 10^{-3}$ |
| k | $1 \times 10^{3}$ |
| M | $1 \times 10^{6}$ |

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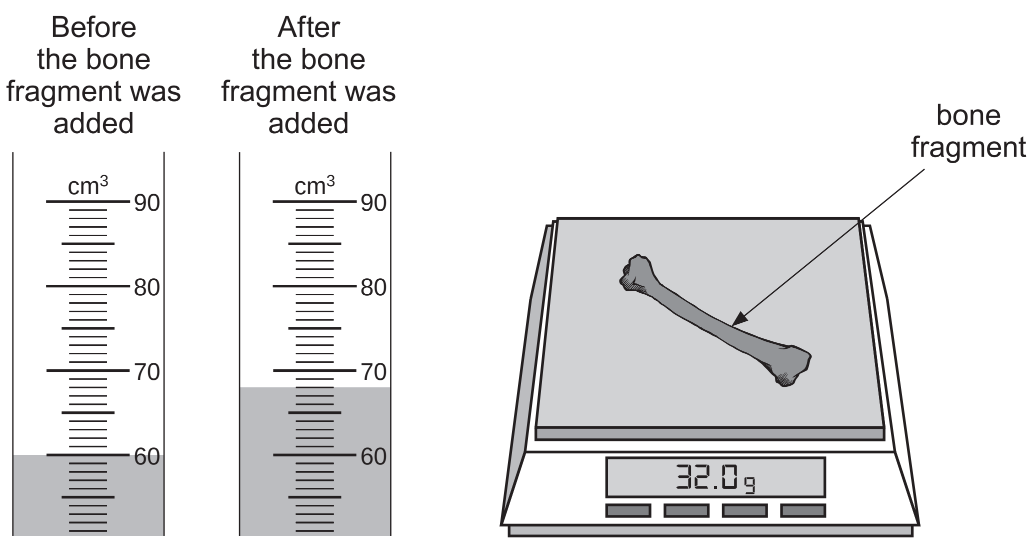
*Answer* **all** *questions.*

**1.** The diagrams below show the apparatus used to find the density of a fragment of bone. The diagram of the measuring cylinder shows the water level before and after the bone fragment was added.




*(a)* (i) Use the information in the diagrams to **complete the table below**. [2]

| | |
|---|---|
| Mass of bone | .................................................... g |
| Volume of bone | .................................................... $cm^3$ |

(ii) Use an equation from page 2 to calculate the density of the bone fragment. [2]

Density = .............................................. $g/cm^3$

*(b)* Explain, in terms of particles, why bone has a greater density than water. [2]

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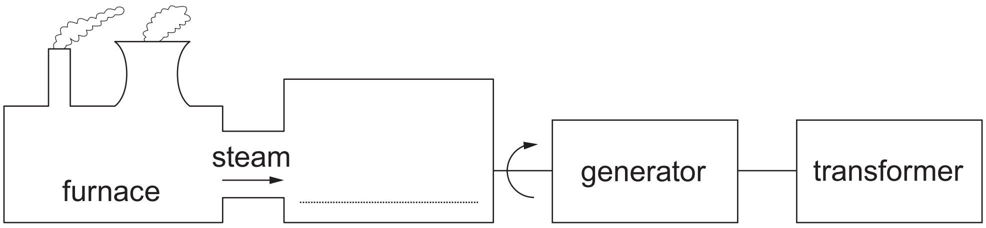
**2.** The diagram below shows the main parts of a thermal power station that uses coal to produce electricity.




*(a)* (i) **Complete the labelling on the diagram**. [1]

(ii) Draw **one** line from each part of the power station to the energy change it produces. [2]

| | |
|---|---|
| | kinetic energy to electrical energy |
| furnace | |
| | chemical energy to electrical energy |
| generator | |
| | chemical energy to thermal (heat) energy |

*(b)* Some energy values for this power station are listed below.

Input energy = 15 000 kJ
Heat energy = 10 500 kJ
Electrical energy = 4 500 kJ

Use this information and the equation below to calculate the % efficiency of the power station. [2]

$$\%\text{ efficiency} = \frac{\text{energy [or power] usefully transferred}}{\text{total energy [or power] supplied}} \times 100$$

% efficiency = ..............................................

5



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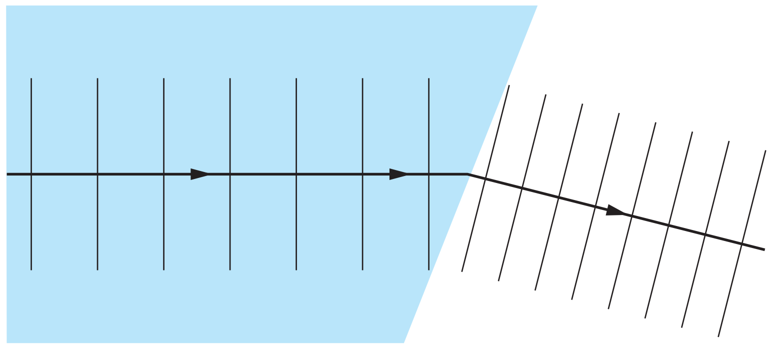
**3.** A ripple tank is used to demonstrate what happens to water waves as they travel from deep water into shallow water.

The results are shown in the diagram below.




*(a)* The water waves change direction at the boundary between deep and shallow water.

State the name of this effect. ............................................................................ [1]

*(b)* Tick (✓) the boxes next to the **two** correct statements that describe the water waves. [2]

| | |
|---|---|
| The frequency of the waves is higher in shallow water | ☐ |
| The amplitude of the waves is the same in deep and shallow water | ☐ |
| The wave speed is less in shallow water | ☐ |
| The wavelength decreases as the waves pass from deep to shallow water | ☐ |

*(c)* In deep water the waves have a wavelength of 3 cm and a frequency of 5 Hz. Use this information and an equation from page 2 to calculate the wave speed. [2]

Wave speed = ................................................ cm/s

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**Turn over.**

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**4.** The Government intends to phase out the use of petrol and diesel cars by 2040 and switch to electric vehicles. Two such electric vehicles are the Voltsa and the Ampra. The Voltsa has an electric motor only. The Ampra has both an electric motor and a petrol engine. The table gives information about these electric vehicles and a petrol only car.

| | Voltsa | Ampra | Petrol only |
|---|---|---|---|
| Distance travelled on one tank of fuel (km) | | 450 | 600 |
| Distance travelled on one charge (km) | 150 | 60 | |
| Cost of one full charge (p) | 264 | 90 | |
| Mean volume of petrol used (litres/100 km) | 0 | 4 | 7 |
| Cost of petrol (p/litre) | | 120 | 120 |
| Mean $CO_2$ produced over 100 km (g/100 km) | 0 | 7 000 | 12 000 |

Use the information in the table to answer the following questions.

*(a)* (i) Eric travels 110 km each day. He is concerned about his carbon footprint. Why would he choose a Voltsa rather than an Ampra? [1]

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(ii) Calculate the mass of $CO_2$ produced if the Ampra is driven 250 km. [2]

Mass of $CO_2$ = .............................................. g

*(b)* (i) The Voltsa can be charged fully in six hours using a 4 kW charger. When 1 kWh of electricity is generated it produces 0.4 kg of carbon dioxide. Calculate how much $CO_2$ is produced to fully charge the Voltsa. [2]

Mass of $CO_2$ = .............................................. kg

(ii) Ian says that the $CO_2$ data for the Voltsa is misleading. Explain why. [2]

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*(c)* Ian drives 600 km every week. He says he is not going to buy the more expensive **Voltsa** since it will not save him money to run compared to his **petrol only** car. Explain whether you agree with Ian. [2]

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**5.** Name the different regions found within the electromagnetic spectrum **and** describe how they are similar to **and** different from, one another. [6 QER]

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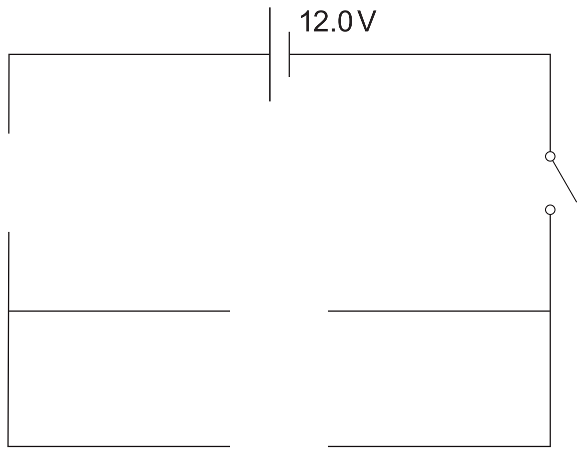
Examiner only

**6.** A thermistor is a type of resistor whose resistance changes with temperature. Thermistors are used as temperature sensors.

To investigate a thermistor, students set up the following circuit to take measurements of current through the thermistor and the voltage across it.



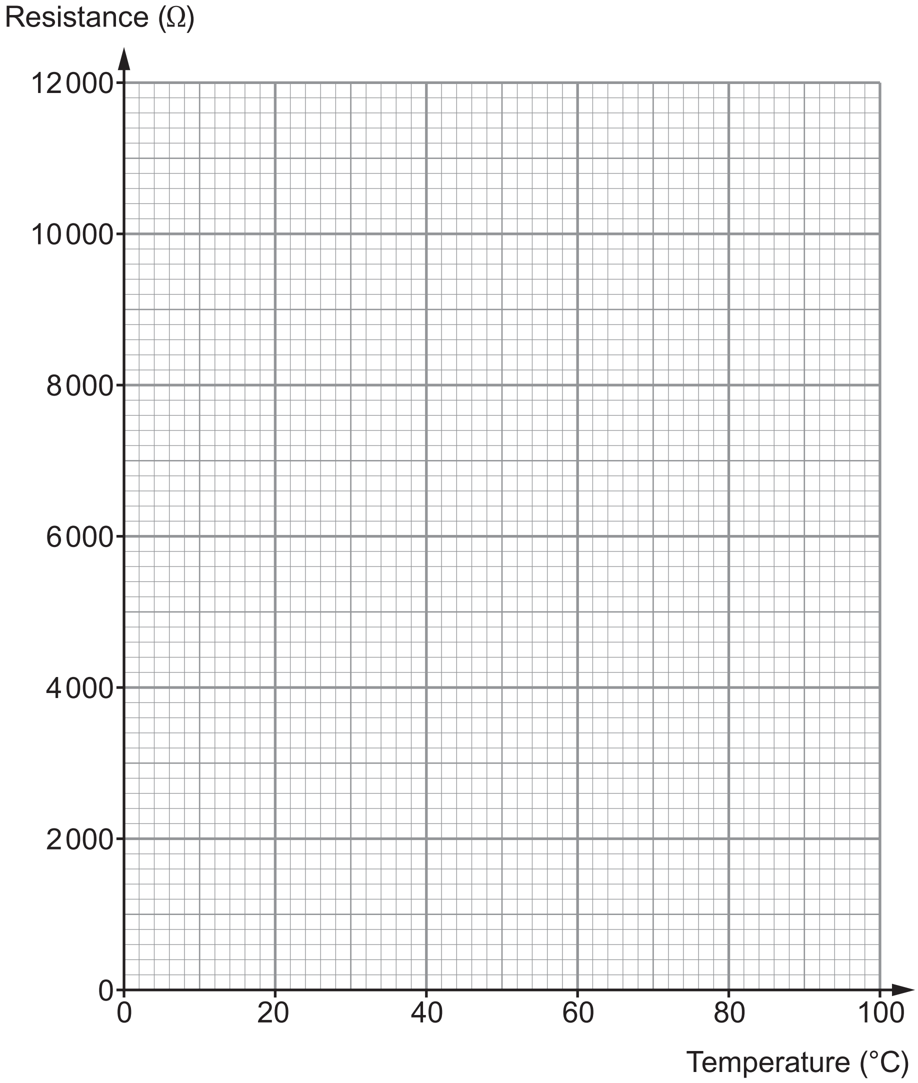

*(a)* **Complete** the circuit diagram using the correct circuit symbols. [3]

Examiner only

*(b)* The students place the thermistor in water. They take current and voltage readings at different temperatures. These are used to calculate the resistance of the thermistor at each temperature. The results are shown in the table below.

| Temperature (°C) | Current (mA) | Voltage (V) | Resistance (Ω) |
|---|---|---|---|
| 20 | 1.0 | 12.0 | 12 000 |
| 40 | 2.2 | 12.0 | 5 400 |
| 60 | 4.8 | 12.0 | 2 500 |
| 80 | 8.6 | 12.0 | 1 400 |
| 100 | 20.0 | 12.0 | 600 |

(i) Plot the data on the grid below and draw a suitable line. [3]



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(ii) Describe what happens to the resistance of the thermistor as the temperature increases. [2]

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*(c)* (i) Use your graph to find the resistance of the thermistor at 50 °C. [1]

Resistance at 50 °C = .............................................. Ω

(ii) Use an equation from page 2 to calculate the current through the thermistor at 50 °C. [3]

Current = .............................................. A

*(d)* A temperature sensor needs to vary in resistance by at least 3600 Ω as the temperature changes from 40 °C to 80 °C. Use the results from the experiment to explain whether the thermistor used by the students would be suitable. [2]

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| 14 |

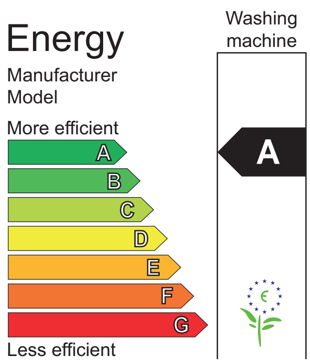




Turn over.

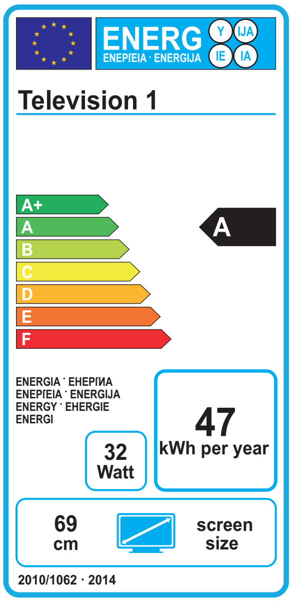
**7.** Energy rating labels are compulsory on most household appliances such as fridges, dishwashers, washing machines and televisions. These labels allow customers to compare appliances. In addition, the labels give other information about the appliances such as how noisy they are.

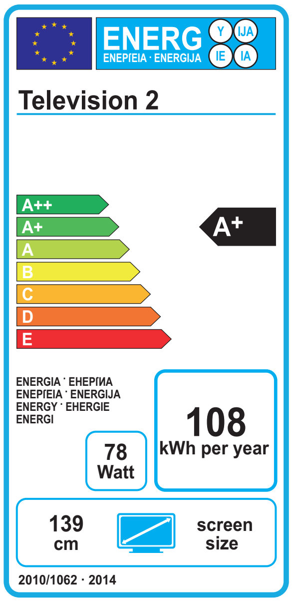
Labels used to rate appliances are from A, the most efficient, to G, the least efficient.

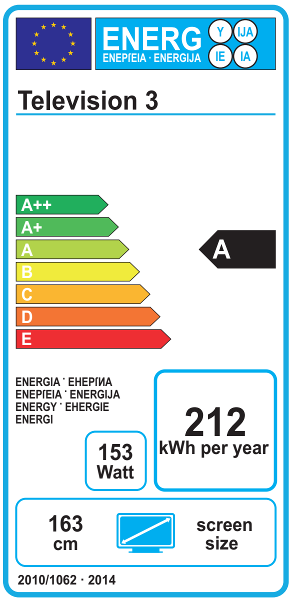


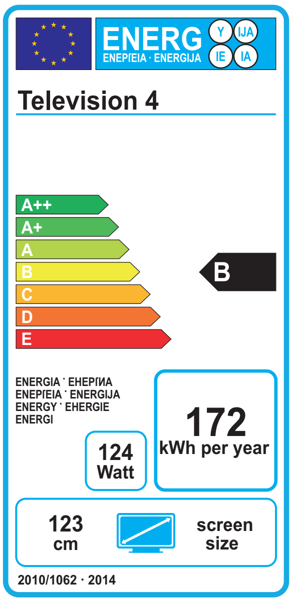

As manufacturers have designed more efficient devices, new categories, e.g. A+, A++ and A+++ have been added to the labels.

The energy rating labels of four televisions are given below and opposite.






Information on the cost of each television is given below.

| Television | Purchase cost (£) |
|---|---|
| 1 | 280 |
| 2 | 1 000 |
| 3 | 1 500 |
| 4 | 800 |

*(a)* Use the information from the labels and the table to tick (✓) the **three** correct statements below. [3]

Television **1** uses less energy per second than television **2** ☐

The largest televisions always use the most energy ☐

The purchase cost of television **2** is 1.5 times that of television **3** ☐

More expensive televisions always use less energy ☐

Television **3** uses 40 units more per year than television **4** ☐

Televisions with the same energy rating, e.g A+, don't always have the same power ☐



Turn over.

Examiner only

*(b)* It is claimed that power is proportional to screen size. Use the data for television **1** and television **2** to determine if this claim is true. [3]
*Space for calculations.*

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*(c)* (i) Use the equation:

$$\text{time (h)} = \frac{\text{units used (kWh)}}{\text{power (kW)}}$$

and data from the energy label to calculate how many hours the label suggests that television **2** is used for in 1 year. [2]

Hours used = ..................................................

(ii) Use an equation from page 2 to calculate the cost of using television **2** for 1 year if 1 unit (kWh) of electricity costs 16 p. Give your answer in pounds (£). [2]

Cost = £ ..................................................

Examiner only

(iii) The expected lifespan of a television is 10 years. Simon concludes that it will be more cost effective to buy and run television **2** for 10 years but Sarah disagrees and claims that television **4** will be cheaper. Use the data to determine who is right. [3]
*Space for calculations.*

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(iv) Other than to save money, why should consumers be encouraged to choose appliances that use less energy? [2]

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