

Print copy of braille text (UEB)

**[Braille page 1]**

WJEC GCSE

3420U10-1

PHYSICS – Unit 1:

Electricity, Energy and Waves

FOUNDATION TIER

MONDAY, 16 JUNE 2025 – MORNING

1 hour 45 minutes (plus your additional time allowance)

**ADDITIONAL MATERIALS**

In addition to this examination paper you will need a calculator and a tactile ruler.

**ITEMS INCLUDED WITH QUESTION PAPER**

A separate Diagram Booklet.

A separate Equations and SI Multipliers Booklet.

Wikki Stix and sticky labels for Question 7.

**[Braille page 2]**

**INSTRUCTIONS TO CANDIDATES**

Write your name, centre number and candidate number on your paper.

Answer ALL questions.

Write your answers on your paper.

**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 6.

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**[Braille page 3]**

Answer ALL questions.

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1. Look at the diagram for Question 1 in the separate Diagram Booklet.

Electromagnetic induction takes place in generators and transformers.

The diagram shows a simple generator of electricity.

Look at Graph A for Question 1 in the separate Diagram Booklet.

The coil spins at a steady speed in the direction shown.

The voltage produced is shown in Graph A.

(a) (i) Write down the maximum voltage produced.

Ans: \_\_\_\_ V [1 mark]

**[Braille page 4]**

(ii) Tomos says the coil spins once in 0.1 seconds.

State whether you agree with Tomos by choosing ONE of the two statements below.

**Statement A:** I AGREE with Tomos because the coil spins once in 0.1 seconds.

**Statement B:** I DISAGREE with Tomos because the coil spins once in 0.2 seconds.

Ans: I choose statement \_\_\_\_ [1 mark]

(b) **What is** the direction of the current in the coil when it is in the position shown in the diagram.

Choose the correct answer from the following list:

P = A to B

Q = C to B

R = D to C

Ans: \_\_\_\_ [1 mark]

**[Braille page 5]**

(c) Look at Graphs B – E for Question 1 (c) in the separate Diagram Booklet.  
The **four** graphs show the voltages produced after making changes to the coil.

(i) State which graph, B, C, D or E, would be produced if the number of turns of wire on the coil were doubled.

Ans: Graph \_\_\_\_ [1 mark]

(ii) State which graph, B, C, D or E, would be produced by the original coil if it were spun twice as fast.

Ans: Graph \_\_\_\_ [1 mark]

(Total for Question 1 = 5 marks)

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**[Braille page 6]**

2. This question is about transformers.

Apparatus with a metal core and a primary and secondary coil can be used to investigate transformers.

(a) Complete the sentences below by choosing the correct word(s) for each space from the following lists.

A transformer works because I. \_\_\_\_ current in the primary coil produces a changing II. \_\_\_\_ field in the III. \_\_\_\_ core. This induces an alternating voltage across the secondary coil.

I. an alternating / a direct / a constant

II. magnetic / electric / gravitational

III. iron / copper / aluminium

Ans: I. \_\_\_\_

Ans: II. \_\_\_\_

Ans: III. \_\_\_\_

[3 marks]

**[Braille page 7]**

(b) A 200-TURN coil is used as the primary coil and remains in place throughout the investigation.

(i) The secondary coils available to fit the transformer have the following number of turns.

100    200    400    800    1200

They are used to investigate how the number of turns in the secondary coil affects the output voltage.

I. State which of the above coils would be used so the output voltage is smaller than the input voltage.

Ans: \_\_\_\_ turns [1 mark]

II. State which of the above coils would be used to give the maximum output voltage.

Ans: \_\_\_\_ turns [1 mark]

**[Braille page 8]**

(ii) Different secondary coils (A, B and C) are used.

The results are shown on the graph for Question 2 (b) (ii) in the separate Diagram Booklet.

I. Complete the sentence below by choosing the correct word or phrase from each of the following lists.

As the input voltage increases, the output voltage X \_\_\_\_ at Y \_\_\_\_ rate.

X: increases / decreases / stays the same

Y: an increasing / a decreasing / a constant

Ans: X = \_\_\_\_

Ans: Y = \_\_\_\_

[2 marks]

**[Braille page 9]**

II. A 10 V lamp needs a 10 V supply to operate at normal brightness.

State which secondary coil, A, B or C, would be used to operate a 10 V lamp at normal brightness from a 5 V input voltage.

Ans: \_\_\_\_ [1 mark]

III. State which secondary coil, A, B or C, has an output which is always double the input voltage.

Ans: \_\_\_\_ [1 mark]

(Total for Question 2 = 9 marks)

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**[Braille page 10]**

3. Look at the three diagrams for Question 3 in the separate Diagram Booklet.

The diagrams show three experiments (A, B and C) used to demonstrate methods of heat transfer.

(a) (i) State which experiment, A, B or C, demonstrates convection.

Ans: \_\_\_\_ [1 mark]

(ii) State which experiment, A, B or C, demonstrates radiation.

Ans: \_\_\_\_ [1 mark]

**[Braille page 11]**

(b) (i) In experiment B, the time for the match to drop off each metal is measured. The results are shown in Table 1 below.

Table 1

| Metal     | Time taken to drop off (s) |
|-----------|----------------------------|
| aluminium | 13                         |
| brass     | 18                         |
| copper    | 15                         |
| steel     | 20                         |

Use the results in Table 1 to arrange the 4 metals in order STARTING WITH THE BEST CONDUCTOR.

Ans: \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ [1 mark]

**[Braille page 12]**

(ii) Table 2 **below** shows the thermal conductivity of metals.  
The larger the number the better the conductor.

Table 2

| Metal     | Thermal conductivity<br>(units) |
|-----------|---------------------------------|
| aluminium | 205                             |
| brass     | 109                             |
| copper    | 385                             |
| steel     | 50                              |

Explain whether the results from experiment B in Table 1 agree with the data in Table 2.

**Ans: \_\_\_\_ (3 print lines) [2 marks]**

**[Braille page 13]**

(c) Complete the following sentence.

Heat energy transfers along the metal rods in experiment B because the end of each rod in the middle of the ring is \_\_\_\_ than the end that holds the match.

**Ans: \_\_\_\_ [1 mark]**

**(Total for Question 3 = 6 marks)**

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**[Braille page 14]**

4. This question is about lamps connected in a circuit.

**(a) Look at the diagram for Question 4 (a) in the separate Diagram Booklet.**  
The diagram shows the current in lamps  $L_1$  and  $L_3$

State the currents in lamps  $L_2$  and  $L_4$

**Ans:  $L_2 =$  \_\_\_\_ A**

**Ans:  $L_4 =$  \_\_\_\_ A**

**[2 marks]**

**[Braille page 15]**

(b) Look at the diagram for Question 4 (b) in the separate Diagram Booklet.

The diagram is the same circuit as for Question 4 (a) but it shows the voltages across lamps  $L_1$ ,  $L_3$  and the battery.

State the VOLTAGES across lamps  $L_2$  and  $L_4$

Ans:  $L_2 = \underline{\quad}$  V

Ans:  $L_4 = \underline{\quad}$  V

[2 marks]

(c) Use information from both circuit diagrams and the equation given below,

$$\text{power} = \text{voltage} \times \text{current}$$

to calculate the power of lamp  $L_1$

Give the unit for power.

Ans: power =  $\underline{\quad}$

Ans: unit =  $\underline{\quad}$

[3 marks]

**[Braille page 16]**

(d) (i) Use information from both circuit diagrams and the equation given below,

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

to calculate the resistance of lamp  $L_1$

Ans: resistance =  $\underline{\quad} \Omega$  [2 marks]

(ii) Owain says that setting up the circuit without lamp  $L_1$  will not affect the current through the battery.

Explain whether you agree.

Ans:  $\underline{\quad}$  (3 print lines) [2 marks]

(Total for Question 4 = 11 marks)

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**[Braille page 17]**

5. An experiment to determine how the speed of water waves depends on depth is described below.

Look at the diagram for Question 5 in the separate Diagram Booklet.  
The diagram shows the apparatus described in the description for the experiment.

1. Measure the length of the tray and record the result.
2. Add water to the tray to give a depth of 0.5 cm.
3. Lift the end of the tray up a few cm and gently drop on the desk.
4. Start the stopwatch when the wave produced hits the end of the tray.
5. Record how long it takes the waves to travel 3 lengths of the tray.

**[Braille page 18]**

6. Repeat steps 3–5 four more times.

7. Repeat steps 2–6, increasing the depth each time by 0.5 cm up to 3.0 cm.

(a) (i) Explain why step 5 helps to improve the accuracy of the experiment.

Ans: \_\_\_\_ (2 print lines) [1 mark]

(ii) Explain why step 6 helps to improve the accuracy of the experiment.

Ans: \_\_\_\_ (3 print lines) [2 marks]

(b) The length of the tray is 40 cm.

At one depth, the time for the wave to travel 3 LENGTHS is 2.4 s.

(i) Calculate the distance travelled by the wave in 3 LENGTHS of the tray.

Ans: distance = \_\_\_\_ cm [1 mark]

**[Braille page 19]**

(ii) Use the equation **given below**,

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

to calculate the speed of the water wave.

**Ans:** speed = \_\_\_\_ cm/s **[2 marks]**

**(Total for Question 5 = 6 marks)**

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**[Braille page 20]**

**6. Look at the diagram for Question 6 in the separate Diagram Booklet.**

The diagram shows how light passes through an optical fibre.

Explain how optical fibres transmit information in this way AND describe their advantages over satellites for long distance communication.

**Ans:** \_\_\_\_ (14 print lines) **[6 QER marks]**

**(Total for Question 6 = 6 marks)**

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**[Braille page 21]**

**7. Look at the diagram for Question 7 in the separate Diagram Booklet.**

The diagram shows a **cross**-section of the Earth.

Four monitoring stations A, B, C and D are shown **on the surface of the Earth**. The path of earthquake (seismic) waves to B and C are shown spreading out from an earthquake at X.

(a) ADD LINES WITH ARROWS to the diagram to show the paths of the earthquake waves to A and D.

**A spare tactile diagram, Wikki Stix and sticky labels are available for this question. [2 marks]**

(b) The type of earthquake waves detected at A and B are different from the ones arriving at C and D.

**[Braille page 22]**

(i) Name the type of earthquake waves detected at C but not at A.

**Ans:** \_\_\_\_ **[1 mark]**

(ii) Geologists used seismic records to develop a model of the structure of the Earth.

Describe what these seismic records tell us about the structure of the Earth.

Ans: \_\_\_\_ (8 print lines) [3 marks]

(Total for Question 7 = 6 marks)

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**[Braille page 23]**

8. Look at the diagram for Question 8 in the separate Diagram Booklet.

The diagram is a graph.

The graph shows how air pressure varies with height above sea level.

(a) Passenger jets fly 12,000 m above sea level.

(i) Use the graph to find the air pressure at this height.

Ans: pressure = \_\_\_\_ kPa [1 mark]

(ii) Calculate the difference in air pressure between the inside and outside of the jet.

Assume the air pressure in the cabin of the jet is the same as the air pressure at sea level.

Ans: pressure difference = \_\_\_\_ kPa [2 marks]

**[Braille page 24]**

(b) A window in a passenger jet is shown in the diagram for Question 8 (b) in the separate Diagram Booklet.

It is 0.40 m wide and 0.25 m high.

(i) Calculate the area of the window (assume it is a rectangle).

Ans: area = \_\_\_\_ m<sup>2</sup> [2 marks]

(ii) Use the equation given below,

$$\text{force} = \text{pressure difference} \times \text{area}$$

to calculate the force on the window due to the pressure difference when flying at a height of 12,000 m above sea level.

Ans: force = \_\_\_\_ N [3 marks]

**[Braille page 25]**

(c) Information shown on a screen during the flight is given below.  
Use the information below and in the graph to explain the change in air pressure with height in terms of molecules.

Height above sea level = 12,000 m

Aircraft speed = 900 km/h

Temperature at sea level = 17°C

Outside temperature = -55°C

Ans: \_\_\_\_ (5 print lines) [3 marks]

(Total for Question 8 = 11 marks)

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**[Braille page 26]**

9. In the UK, domestic electricity has a voltage of 230 V and a frequency of 50 Hz.

It is an alternating current (a.c.) supply, rather than a direct current (d.c.) supply.

(a) State the difference between a.c. and d.c.

Ans: \_\_\_\_ (2 print lines) [1 mark]

**[Braille page 27]**

(b) A science class investigates the cost and efficiency of different kettles. They collect and compare data for two different kettles.

The data is shown in the table below.

|                                          | Kettle X | Kettle Y |
|------------------------------------------|----------|----------|
| Power                                    | 2200 W   | 2.4 kW   |
| Time to boil (s)                         | 90       | 90       |
| Mass of water (kg)                       | 0.6      | 0.6      |
| Heat energy transferred to the water (J) | 188,100  | _____    |

**[Braille page 28]**

(i) Not all of the heat energy transferred by the kettle is transferred to the water.

I. Use data from the table and an equation from **the separate list of equations** to calculate the total electrical energy transferred by kettle X when it is boiled ONCE.

**Ans:** total electrical energy transferred by kettle X = \_\_\_\_ J **[2 marks]**

II. Use data from the table, an equation from **the separate list of equations** and your answer to part (i) I. to determine the % efficiency of kettle X.

**Ans:** % efficiency = \_\_\_\_ **[2 marks]**

**[Braille page 29]**

(ii) The students compare the cost of using each of the kettles. They estimate that each kettle will be boiled 10 times per day.

I. Calculate the time that each kettle is used per day in hours.

**Ans:** time = \_\_\_\_ hours **[1 mark]**

II. Use equations from **the separate list of equations** to calculate the cost of using kettle Y per day if 1 unit of electricity costs 30p.

**Ans:** cost per day = \_\_\_\_p **[3 marks]**

(iii) It is suggested that kettle X will cost more to use per day than kettle Y, when used for the same time.

Explain whether you agree with this suggestion.

**Ans:** \_\_\_\_ (3 print lines) **[2 marks]**

**(Total for Question 9 = 11 marks)**

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**[Braille page 30]**

10. Drax power station is a fuel-burning power station.

In 1986, Drax was the largest power station in the UK.

It consisted of 6 coal-fired generators with a total capacity of about 4000 MW, powering millions of homes.

By 2018, Drax had converted four of the coal-fired generators to run on biomass, producing 70% of its electrical power through burning compressed wood pellets.

(a) Look at the diagram for Question 10 (a) in the separate Diagram Booklet.

The **simplified** diagram shows a fuel-burning power station.

Describe the processes involved in producing electrical power from a fuel.

**Ans: \_\_\_\_ (7 print lines) [3 marks]**

**[Braille page 31]**

(b) Burning biomass does not produce sulfur dioxide.

State AND explain another environmental advantage of burning biomass rather than coal.

**Ans: \_\_\_\_ (4 print lines) [2 marks]**

(c) The demand for electricity depends on the weather.

In the winter, demand increases by 750 MW for every degree the temperature drops below 14°C.

In the summer, demand increases by 350 MW for every degree rise over 20°C, from a mean demand of 40,000 MW.

(i) Suggest why demand for electricity increases as the temperature increases above 20°C in the summer.

**Ans: \_\_\_\_ (2 print lines) [1 mark]**

**[Braille page 32]**

(ii) On one summer's day, the demand for electricity increased to 45,600 MW. Chris suggests that the temperature must have risen to 30°C, but Ella states that it must be 36°C.

Determine who is correct.

You must show your working.

Ans: \_\_\_\_ (2 print lines) [3 marks]

(Total for Question 10 = 9 marks)

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**TOTAL FOR PAPER = 80 MARKS**

**END OF PAPER**

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