# Electrical Quantities

## Question Paper

| Course | CIE IGCSE Physics |
|---|---|
| Section | 4. Electricity & Magnetism |
| Topic | Electrical Quantities |
| Difficulty | Hard |

| | |
|---|---|
| **Time Allowed** | 60 |
| **Score** | /43 |
| **Percentage** | /100 |

## Question 1a

State, in terms of their structure, why metals are good conductors of electricity.

[1 mark]

## Question 1b

**Extended tier only**

A cylindrical metal wire $W_1$, of length $L$ and cross-sectional area $A$, has a resistance of 16 $\Omega$.

A second cylindrical wire $W_2$, of length $\dfrac{L}{2}$ and cross-sectional area $2A$, is made from the same metal.

Determine

(i)     the resistance of $W_2$,

resistance of $W_2$ = ..........................................................[2]

(ii)     the effective resistance of $W_1$ and $W_2$ when connected in parallel

resistance of parallel pair = ..........................................................[2]

[4 marks]

## Question 1c

**Extended tier only**

The parallel pair of resistors in **(b)(ii)** is connected to a battery that is made from three cells in series, each of electromotive force (e.m.f.) $E$. There is a current in each resistor.

(i)     State the e.m.f. of the battery.

[1]

(ii)    The current in the battery is $I_B$, the current in $W_1$ is $I_1$ and the current in $W_2$ is $I_2$.

Place a tick in **one** box to indicate how these three currents are related.
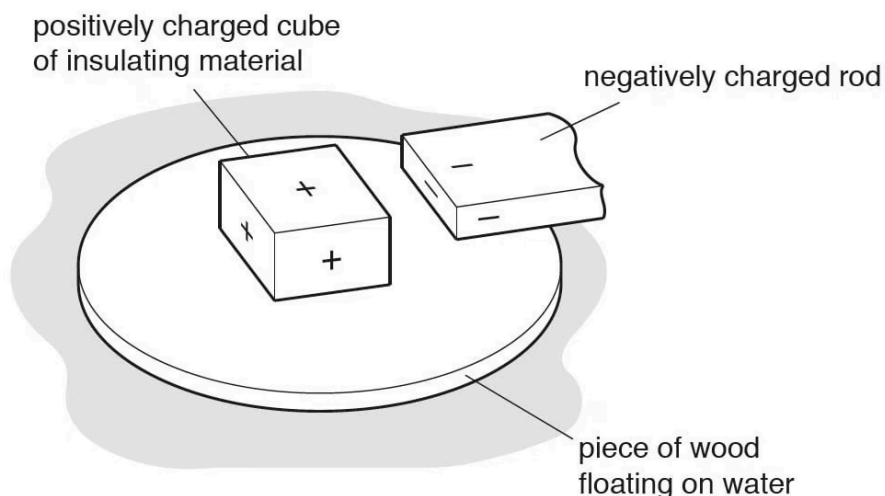
☐ $I_1 > I_2 > I_B$
☐ $I_1 > I_B > I_2$
☐ $I_2 > I_1 > I_B$
☐ $I_2 > I_B > I_1$
☐ $I_B > I_1 > I_2$
☐ $I_B > I_2 > I_1$
☐ $I_1 = I_2 = I_B$

[1]
**[2 marks]**

## Question 2a

(i)    Fig. 8.1 shows a positively charged cube of insulating material. The cube is fixed to a piece of wood that is floating on water. A negatively charged rod is held above the piece of wood and brought close to the cube, as shown.



**Fig. 8.1**

State and explain any movement of the piece of wood.

[2]

(ii)   Fig. 8.2 shows two cubes of insulating material. One is positively charged and the other is negatively charged. The cubes are fixed to a piece of wood that is floating on water. Charged rods are held above the piece of wood and brought close to the cubes, as shown.
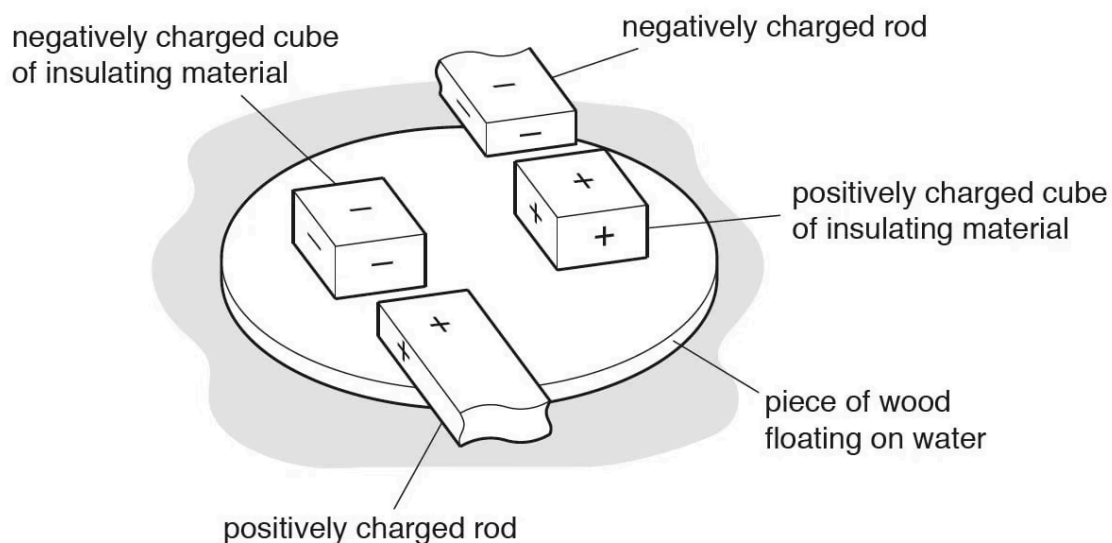
**Fig. 8.2**

State and explain any movement of the piece of wood.

[2]

**[4 marks]**

## Question 2b

In terms of a simple electron model, describe the differences between conductors and insulators.

**[2 marks]**

## Question 2c

**Extended tier only**

On Fig. 8.3, draw the electric field pattern around a single-point positive charge.

$\oplus$

**Fig. 8.3**

[1 mark]

## Question 3a

**Extended tier only**

(i)    Describe what is meant by an electric field.

[1]

(ii)    State what is meant by the direction of an electric field.

[1]
**[2 marks]**

## Question 3b

Fig. 8.1 shows a polystyrene ball covered with aluminium paint. The polystyrene ball is suspended between two charged metal plates by an insulated thread.
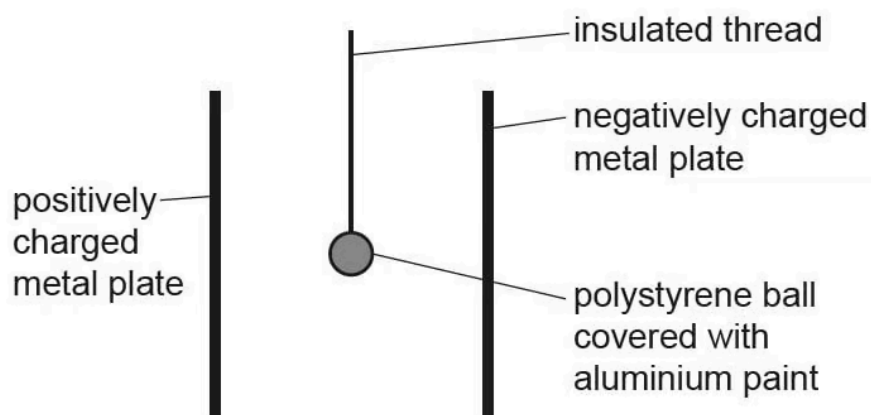


Fig. 8.1

The ball oscillates between the two charged plates.

Explain why the ball oscillates.

**[4 marks]**

## Question 3c

**Extended tier only**

There is a current of 0.29 A in an electrical circuit.

Calculate the time taken for a charge of 15 C to flow through the electrical circuit.

time = ........................................................

**[3 marks]**

## Question 4a

**Extended tier only**

A light-emitting diode (LED) is a diode that emits light when there is a current in it.

Draw a circuit diagram showing an LED, connected so that it is lit, in series with a battery and a fixed resistor. Use standard electrical symbols.

**[4 marks]**

## Question 4b

The p.d. across the LED when lit is 3.1 V and the current in the LED is 0.030 A.

Calculate the value of the resistance of the LED when lit.

resistance = ........................................................

**[2 marks]**

## Question 4c

Fig. 8.1 shows a power supply of e.m.f. 10.5 V connected in series with a lamp and a heater.

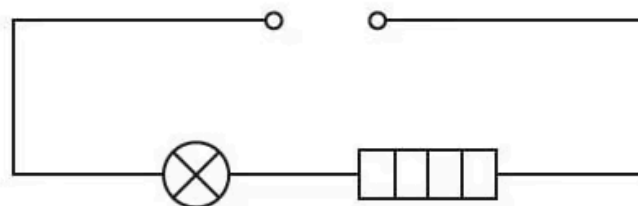The p.d. across the lamp is 2.1 V and the current in the lamp is 1.5 A.



**Fig. 8.1**

Calculate:

(i)     the resistance of the heater

resistance = ...................................................... [2]

(ii)     the power of the heater.

power = ...................................................... [2]

**[4 marks]**

## Question 5a

**Extended tier only**

A light polystyrene ball is coated in conducting paint and suspended from a thread as shown in Fig. 1

The ball is given a positive charge



**Fig. 1**

Draw the electric field lines around the positively charged ball.

[2 marks]

## Question 5b

A second, identical ball is suspended close to the first one. The second ball is also given a positive charge.

A student predicts that both balls will hang straight downward, due to the effect of gravity.

State whether the student is correct, and explain your answer.

[4 marks]

## Question 5c

**Extended tier only**

Sketch the arrangement of the two balls hanging next to each other.

Add field lines to your diagram, in support of your answer to part (b).

[4 marks]