

Name of the Student: _____

Max. Marks : 21 Marks

Time : 21 Minutes

Q1.

A student buys a portable loudspeaker that is powered by its own internal battery. The battery in the loudspeaker is initially uncharged.

- (a) The battery is connected to a charger that maintains a constant potential difference of 5.0 V across the battery. It takes 2.6 hours for the battery to become fully charged. The average current in the battery during this time is 2.0 A.

The battery is disconnected from the charger.

The fully-charged battery operates the loudspeaker for 12 hours before it is completely discharged.

Calculate the average output power of the battery during these 12 hours.

average output power = _____ W

(2)

- (b) A mobile phone transmits data to the loudspeaker using microwaves. The data are processed at the loudspeaker to produce sound waves.

Microwaves and sound waves travel at different speeds.

Describe **two** other differences between microwaves and sound waves.

1 _____

2 _____

(2)

- (c) A second loudspeaker receives the same data from the mobile phone. The two loudspeakers act as coherent sources of sound waves.

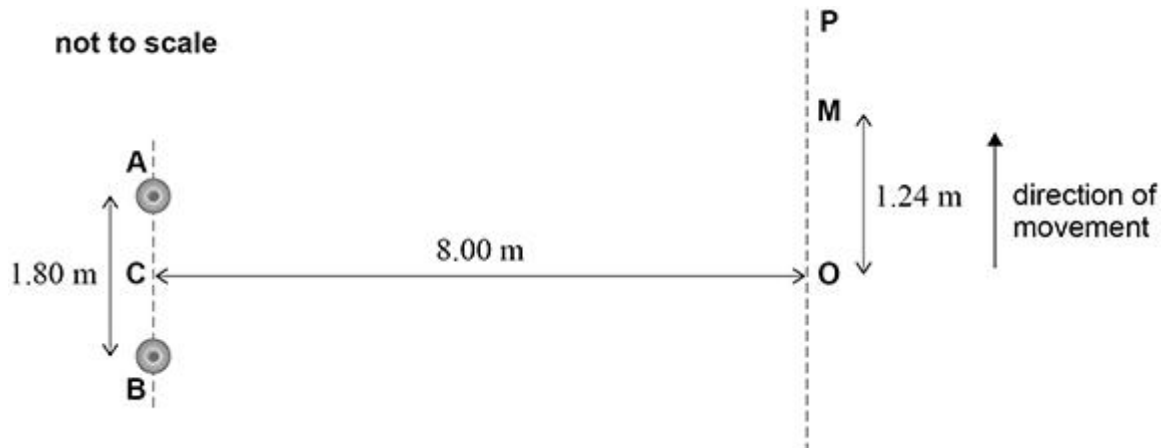
State the **two** conditions required for the sources to be coherent.

1 _____

2 _____

(2)

The figure below shows two loudspeakers **A** and **B** that act as coherent point sources of sound of a single frequency.



C is the midpoint between **A** and **B**.
Distances **OA** and **OB** are equal.
OP is perpendicular to **CO**.

The student uses a sound-level meter to measure the intensity of the sound. The meter detects a maximum intensity at **O**.
The student moves the meter along **OP**. The intensity decreases and reaches a first minimum at **M**.
The intensity then increases as the meter moves towards **P**.

The student records the following distances:

AB = 1.80 m
CO = 8.00 m
OM = 1.24 m.

(d) Show that the difference between the path lengths **AM** and **BM** is approximately 0.3 m.

(2)

(e) The speed of sound is 340 m s^{-1} .

Determine the frequency of the sound waves.

frequency = _____ Hz

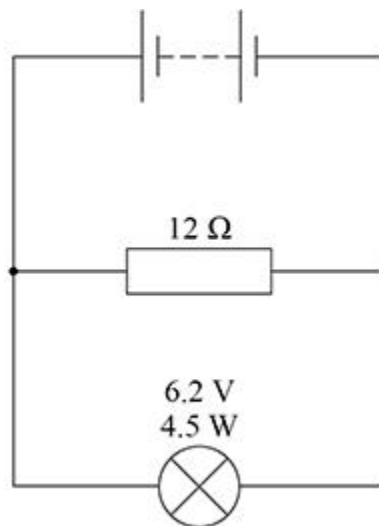
(2)

(Total 10 marks)

Q2.

A student assembles the circuit in **Figure 1**.

Figure 1



The battery has an internal resistance of 2.5Ω .

(a) Show that the resistance of the 6.2 V , 4.5 W lamp at its working potential difference (pd) is about 9Ω .

(1)

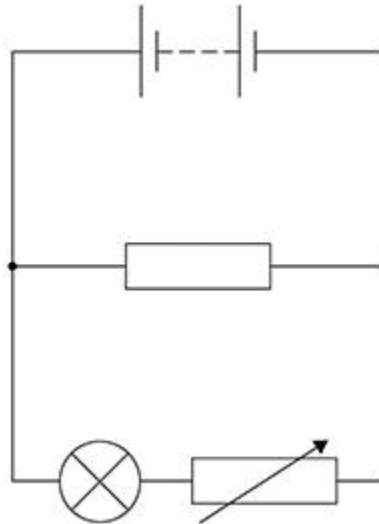
(b) The terminal pd across the battery is 6.2 V .

Calculate the emf of the battery.

emf = _____ V (3)

The student makes a variable resistor to control the brightness of the lamp. **Figure 2** shows her circuit.

Figure 2



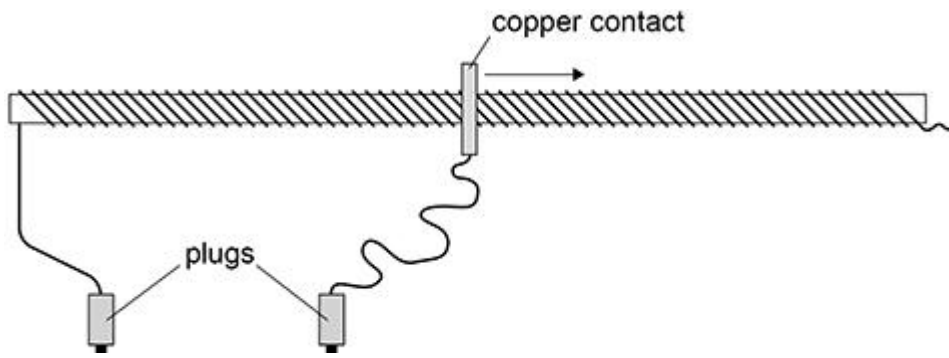
- (c) She uses a resistance wire with a diameter of 0.19 mm to make the variable resistor. A 5.0 m length of this wire has a resistance of 9.0 Ω.

Calculate the resistivity of the wire.

resistivity = _____ Ω m (3)

- (d) **Figure 3** shows the 5.0 m length of wire wrapped around a tube to make the variable resistor.

Figure 3



Two plugs connect the variable resistor into the circuit. A moveable copper contact is used to vary the length of wire in series with the lamp.

When the contact is placed on the tube at one particular position, the lamp is dim.

The contact is then moved slowly to the right as shown in **Figure 3**.

Explain, without calculation, what happens to the brightness of the lamp as the contact is moved.

(2)

- (e) The student now makes a different circuit by connecting the variable resistor **in parallel** with the lamp.

The contact is returned to its original position on the tube as shown in **Figure 3** and the lamp is dim. The contact is again slowly moved to the right.

Explain, without calculation, what happens to the brightness of the lamp as the contact is moved.

(2)

(Total 11 marks)