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10: Two wires, X and Y, are made of the same material. The wires are connected in series. The current in the wires is I, as shown.



Wire X has twice the diameter of wire Y.

The mean drift velocity of electrons in wire X is v.

Which of the following is the mean drift velocity of electrons in wire Y?

☒ **A** $0.25v$

☒ **B** $0.5v$

☒ **C** $2v$

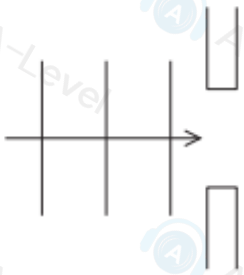
☒ **D** $4v$

(Total for Question 10 = 1 mark)

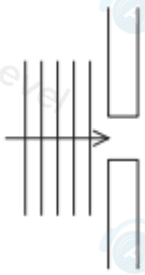
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4 The four diagrams represent moving wavefronts that are one wavelength apart. In each set-up, diffraction will occur as the wavefront passes through the gap.

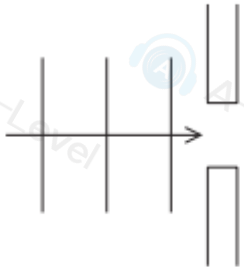
Which set-up will produce the greatest diffraction?



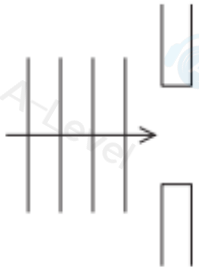
A



B



C



D

☒ **A**

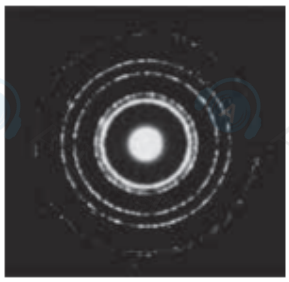
☒ **B**

☒ **C**

☒ **D**

(Total for Question 4 = 1 mark)

5 A narrow beam of electrons is passed through a graphite crystal and is then incident on a fluorescent screen. The pattern observed on the screen is shown.



Which of the following conclusions about the electrons can be made from this pattern?

- ☒ **A** The electrons are being attracted to the graphite nuclei.
- ☒ **B** The electrons are being scattered by the graphite nuclei.
- ☒ **C** The electrons are being diffracted by the graphite crystal.
- ☒ **D** The electrons are being refracted by the graphite crystal.

(Total for Question 5 = 1 mark)

1 The temperature of a thermistor and the temperature of a metal wire are increased.

Which row of the table gives the changes in resistance of the thermistor and the metal wire as the temperature is increased?

	Resistance of thermistor	Resistance of metal wire
☒ **A**	decreases	decreases
☒ **B**	decreases	increases
☒ **C**	increases	decreases
☒ **D**	increases	increases

(Total for Question 1 = 1 mark)

8 A water wave meets a small gap in a barrier.

Which row of the table correctly describes the speed and wavelength of the water wave after passing through the gap?

	speed	wavelength
☒ **A**	unchanged	decreased
☒ **B**	decreased	unchanged
☒ **C**	increased	increased
☒ **D**	unchanged	unchanged

(Total for Question 8 = 1 mark)

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2 Unpolarised light with a power of 8 W is incident on a polarising filter.

What is the power of the light after passing through the filter?

- ☒ **A** 8W
- ☒ **B** 4W
- ☒ **C** 2W
- ☒ **D** 0

(Total for Question 2 = 1 mark)

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1 Waves may spread out as they pass an object.

Which of the following is the name of this process?

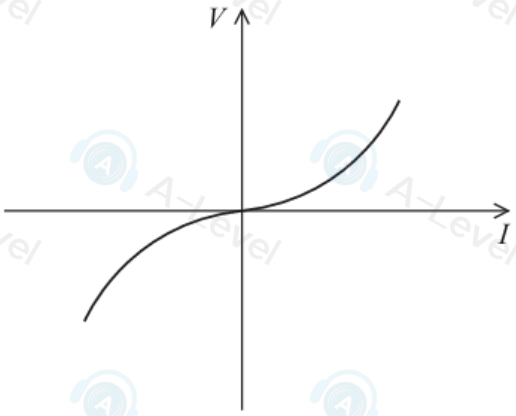
- ☒ **A** diffraction
- ☒ **B** interference
- ☒ **C** reflection
- ☒ **D** refraction

(Total for Question 1 = 1 mark)

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a cross ☒.

1 The graph shows how potential difference V varies with current I for an electrical component.



Which electrical component is represented by this graph?

- ☒ **A** diode
- ☒ **B** filament lamp
- ☒ **C** ohmic conductor
- ☒ **D** thermistor

(Total for Question 1 = 1 mark)

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1 The spreading of a wave as it passes around an obstacle is called

- ☒ **A** diffraction.
- ☒ **B** polarisation.
- ☒ **C** reflection.
- ☒ **D** refraction.

(Total for Question 1 = 1 mark)

5 A current in a wire causes the temperature of the wire to increase.

Which row of the table describes the changes to the wire as the temperature increases?

	Amplitude of lattice vibrations in the wire	Resistance of the wire
☒ **A**	decreases	decreases
☒ **B**	increases	decreases
☒ **C**	decreases	increases
☒ **D**	increases	increases

(Total for Question 5 = 1 mark)

2 Which of the following describes the oscillations in polarised waves?

- ☒ **A** in a single plane which is perpendicular to the direction of wave travel
- ☒ **B** in many planes, which include the direction of wave travel
- ☒ **C** in many directions and parallel to the direction of wave travel
- ☒ **D** in one direction and perpendicular to the direction of wave travel

(Total for Question 2 = 1 mark)

2 A filament lamp is a source of unpolarised light.

A polarising filter is placed between a filament lamp and an observer. The filter is rotated in the plane perpendicular to the direction of travel of the light.

Which of the following is observed as the filter is rotated through an angle of 90°?

- ☒ **A** The light intensity changes from maximum to minimum.
- ☒ **B** The light intensity changes from minimum to maximum.
- ☒ **C** The light intensity does not change.
- ☒ **D** The light intensity is zero throughout the rotation.

(Total for Question 2 = 1 mark)

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1 The equation $I = nqvA$ relates the current in a sample of a material to the movement of free charge carriers in the sample.

Which of the following is a correct definition of one of the terms in this equation?

A n represents the number of charge carriers in the sample

B q represents the total charge stored in the sample

C v represents the drift velocity of the charge carriers in the sample

D A represents the surface area of the sample

(Total for Question 1 = 1 mark)

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8 The temperature of a thermistor is increased.

Which of the following has the greatest impact on the resistance of the thermistor when the temperature is increased?

A increased kinetic energy of conduction electrons

B increased lattice vibrations

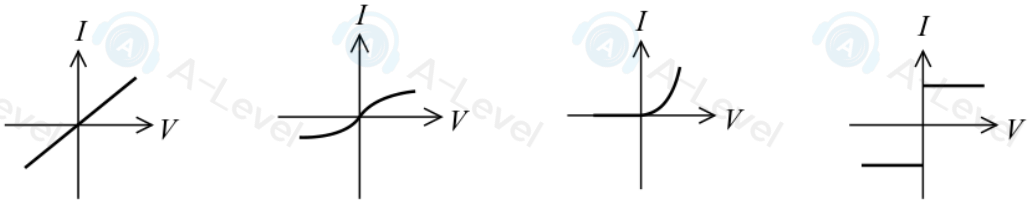
C increased number of collisions between conduction electrons and atoms

D increased number of conduction electrons

(Total for Question 8 = 1 mark)

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7 Which graph shows how current varies with potential difference for an ohmic conductor at constant temperature?

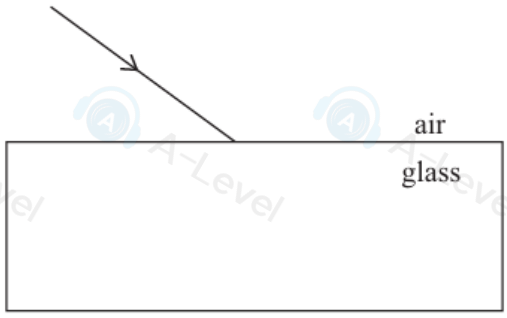


☒ **A** ☒ **B** ☒ **C** ☒ **D**

(Total for Question 7 = 1 mark)

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12: A student uses a ray box to direct a narrow ray of light onto the surface of a glass block, as shown.



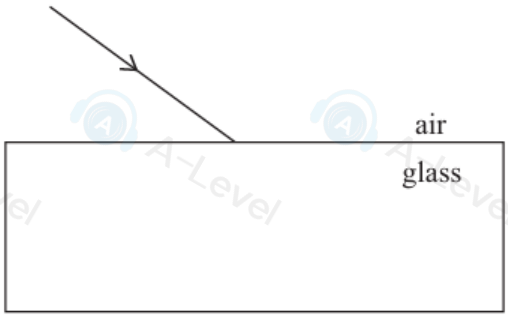
(a) (i) Determine the angle of incidence.

(1)

Angle of incidence = ...

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12: A student uses a ray box to direct a narrow ray of light onto the surface of a glass block, as shown.



(a) (i) Determine the angle of incidence.

(1)

Angle of incidence = ...

(ii) Calculate the angle of refraction in the glass block.

refractive index of glass block = 1.5

(2)

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(b) The light from the ray box is unpolarised. When reflected by glass, some of this light will become polarised.

(i) Explain the difference between unpolarised light and polarised light.

(3)

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(b) The light from the ray box is unpolarised. When reflected by glass, some of this light will become polarised.

(i) Explain the difference between unpolarised light and polarised light.

(3)

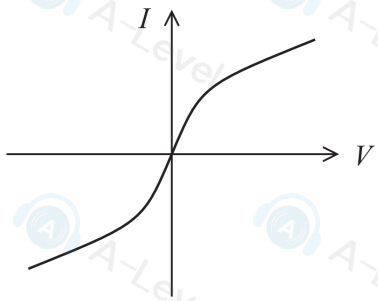
(ii) The student uses a polarising filter to view the light reflected by the glass block.

Explain what she would observe as she rotates the filter.

(3)

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15 The graph shows how the current I through a filament lamp varies with the potential difference V applied across it.



*(a) Explain the shape of the graph in terms of particle behaviour.

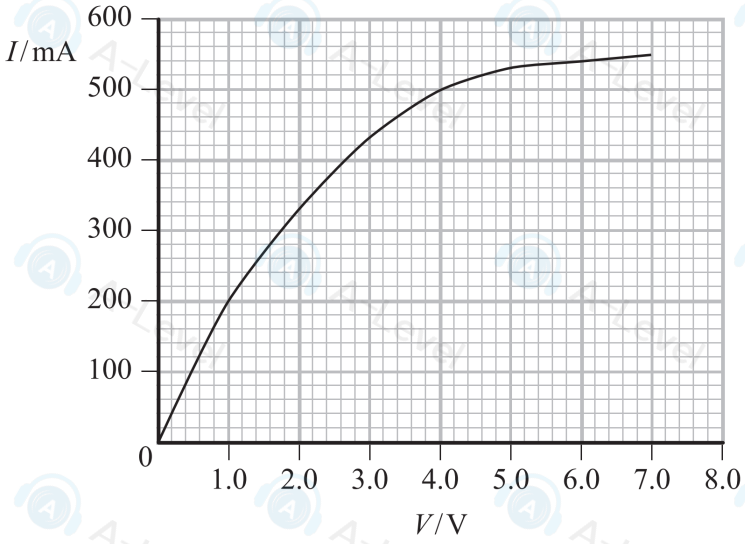
(5)

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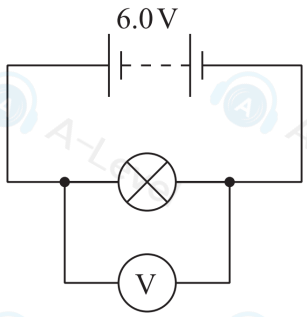
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(b) The current-potential difference graph for a particular filament lamp is shown below.



This filament lamp is connected across a battery of e.m.f. 6.0 V as shown below.



The voltmeter reading is 4.2 V.

Determine the internal resistance of the battery.

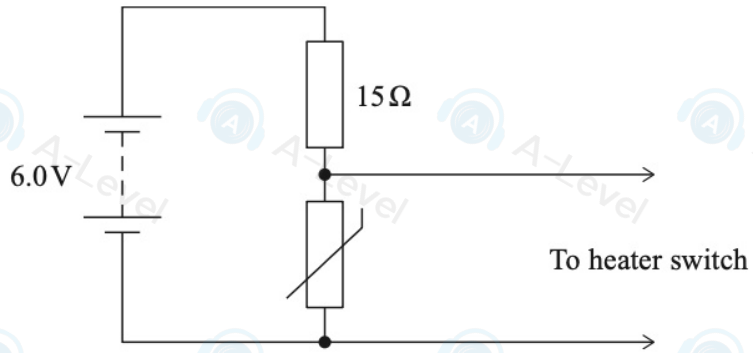
(3)

Internal resistance = ...

(Total for Question 15 = 8 marks)

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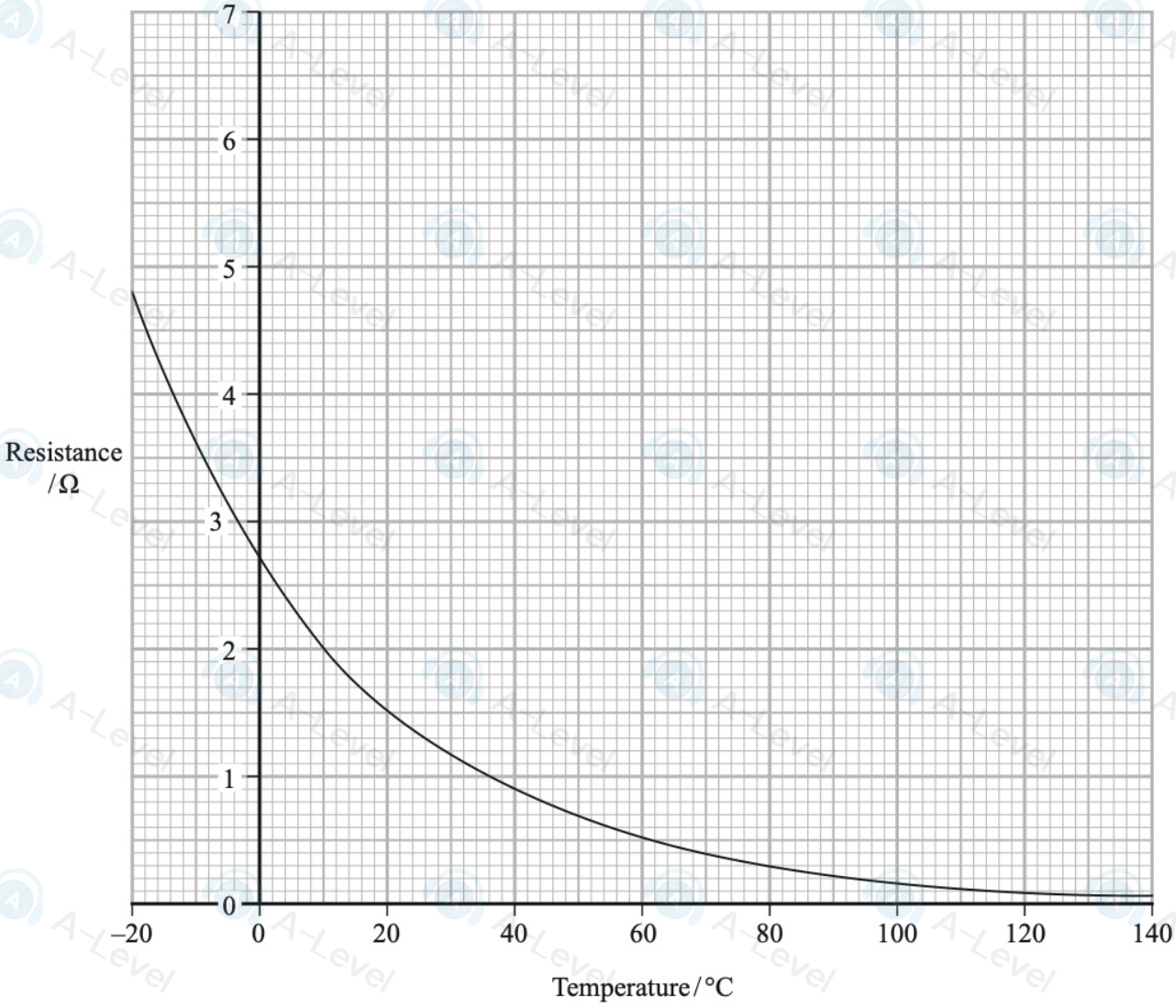
14 A temperature-sensing circuit consists of a fixed resistor and a thermistor, as shown.



The circuit supplies a potential difference (p.d.) to operate the heater switch.

The heater switches on when the p.d. across the thermistor is greater than 0.7 V.

The resistance of the thermistor varies with temperature as shown on the graph.



(a) Deduce whether this circuit would switch on the heater when the temperature falls below 10 °C.

You should include a calculation of the p.d. across the thermistor when the temperature is 10 °C.

(6)

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15 A radio station uses a frequency of 693 kHz for its broadcasts.

(a) Explain how it is possible to receive these broadcasts in a house on the other side of a hill from the radio station. Your answer should include an appropriate calculation.

(4)

(b) The radiation flux of the radio waves arriving at a particular house is 8.3×10^{-9} W m^{-2}.

Calculate the energy arriving at a person's head from these radio waves in one hour.

area of head = 0.025 m^2

(3)

Energy = ...

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*(c) A student makes the following comment about the answer to part (b).

"Although this electromagnetic wave energy is a very small value and safe, the same amount of electromagnetic energy at an ultraviolet frequency could be dangerous."

Explain this comment.

(4)

(Total for Question 15 = 11 marks)

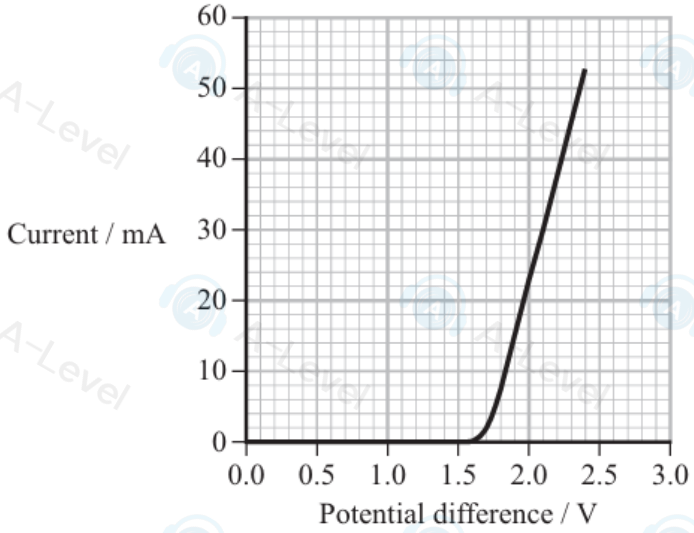
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14 A student investigated the electrical properties of a light emitting diode (LED).

He varied the potential difference (p.d.) across the LED, and recorded corresponding values of the current in the LED. The graph shows the results.



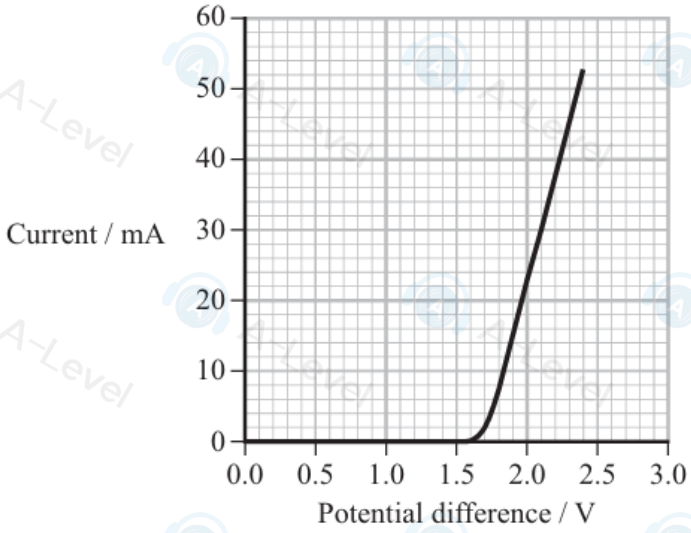
(a) Draw a circuit diagram the student could use for this investigation.

(3)

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(3)

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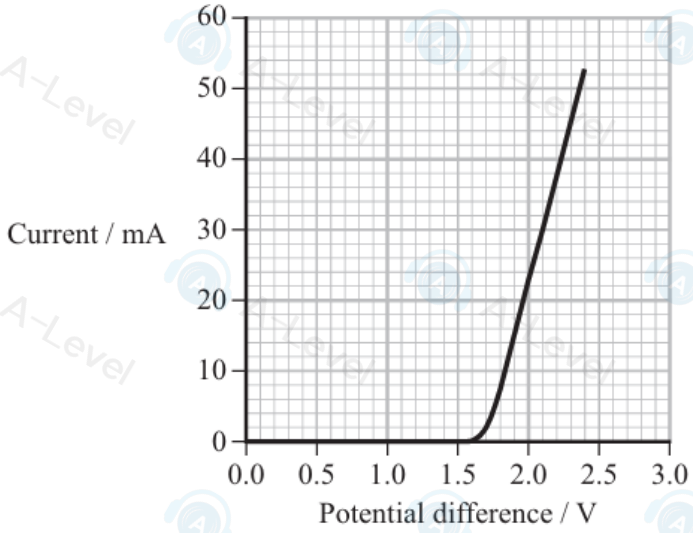
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(b) Determine the power of the LED when the p.d. across the LED was 2.2 V.

(3)

14 A student investigated the electrical properties of a light emitting diode (LED).

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(3)

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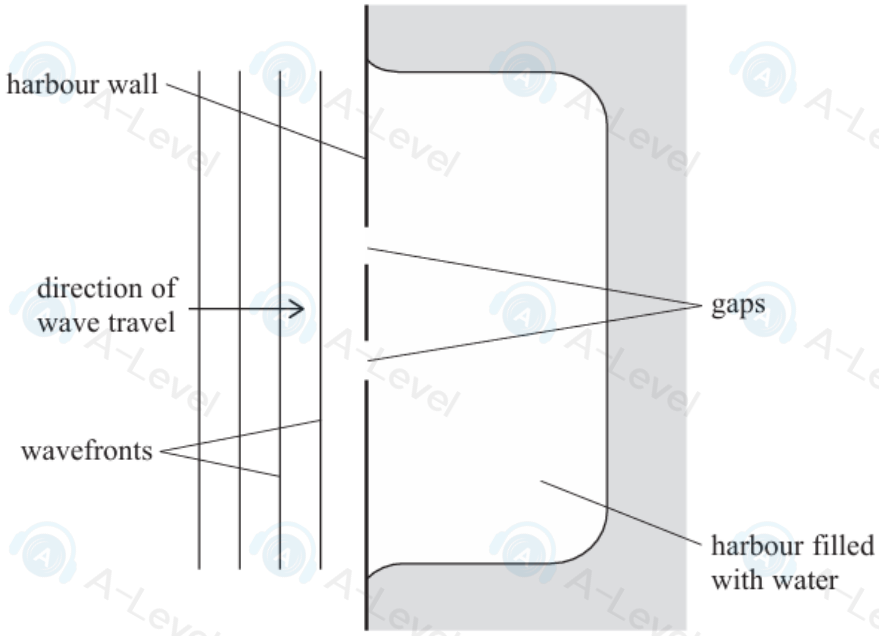
(b) Determine the power of the LED when the p.d. across the LED was 2.2 V.

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17 Boats can shelter from waves on the sea in a harbour.

The diagram shows a harbour where boats can enter and leave through two gaps in the harbour wall.



Waves on the sea are diffracted as they pass through the gaps in the harbour wall.

(a) Describe how Huygens' construction can be used to predict the shape of diffracted wavefronts.

(2)

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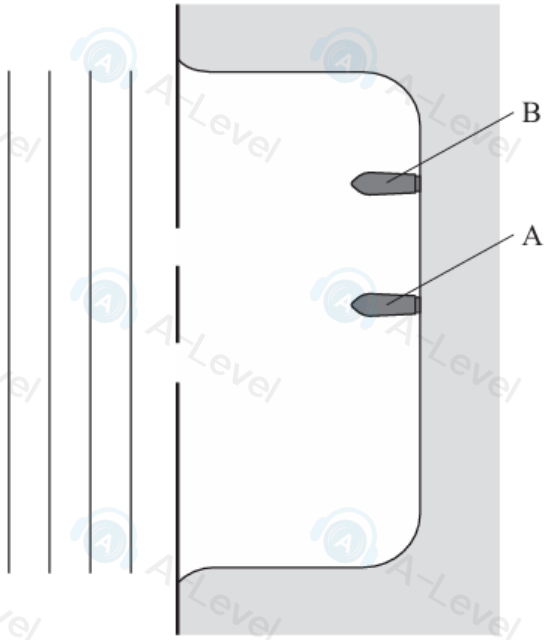
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*(b) The wavefronts in the sea arrive parallel to the harbour wall. The wavelength of the waves varies as the weather varies.

There are identical boats at two positions, A and B, in the harbour, as shown.



As the wavelength of the waves varies:

- the boat at position A always oscillates with a large amplitude
- the boat at position B sometimes oscillates with a large amplitude and sometimes oscillates with a very small amplitude.

Explain why the boats oscillate as described.

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