Pearson Edexcel International Advanced Level

Wednesday 15 October 2025

Afternoon (Time: 1 hour 30 minutes)

Paper reference **WPH12/01A**

Physics

International Advanced Subsidiary/Advanced Level

UNIT 2: Waves and Electricity

Question Paper

You must have:
Scientific calculator, ruler, protractor and Answer book
Do not return this question paper with the answer book

Turn over ▶

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P 8 7 4 4 1 R A

Pearson

SECTION A

Answer ALL questions.

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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2 The equation $n\lambda = d\sin\theta$ can be used to determine the wavelength of laser light that has passed through a diffraction grating.

Which of the following is represented by d in the equation?

A distance between adjacent lines on the diffraction grating

B distance between the diffraction grating and the screen

C number of lines per metre on the diffraction grating

D order of the maximum observed on the screen

(Total for Question 2 = 1 mark)

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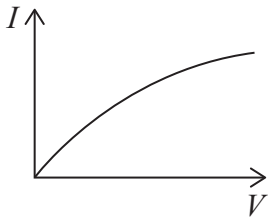
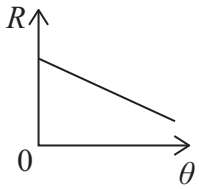
3 The graph shows the current-voltage characteristic for a filament lamp.

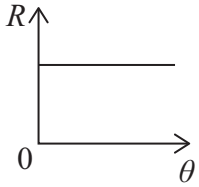


Choose the graph that best shows how the resistance R of the lamp changes with temperature θ in °C

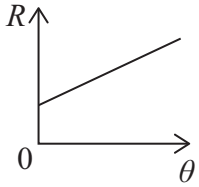
A



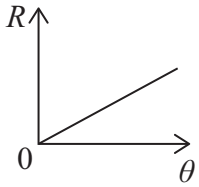
B



C

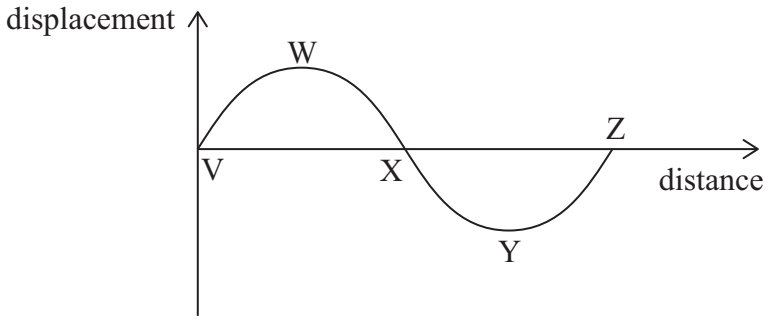


D



(Total for Question 3 = 1 mark)

4 A sound wave travels through air. The diagram represents the displacement of air particles along the wave at an instant in time.



There is a compression at position V.

At which position is there a rarefaction?

A W

B X

C Y

D Z

(Total for Question 4 = 1 mark)

5 Solar panels are devices that use sunlight as a source of energy to generate electricity. A solar panel has a surface area of $1.54\,m^2$. The intensity of radiation incident on the Earth's surface is $1050\,W\,m^{-2}$. The manufacturer states that the maximum output power of the solar panel is 250 W.

Which of the following could be used to calculate the maximum efficiency of the solar panel?

A $\frac{250 \times 1.54}{1050}$

B $\frac{1050}{250 \times 1.54}$

C $\frac{250 \times 1.54}{250}$

D $\frac{250}{1050 \times 1.54}$

(Total for Question 5 = 1 mark)

---

6 A small metal cube, with sides of length x, is connected in a circuit. The current through the cube, between opposite faces, is I and the potential difference across the cube is V.

Which of the following gives the resistivity of the metal?

A $\frac{Vx}{I}$

B $\frac{V}{Ix}$

C $\frac{Ix}{V}$

D $\frac{I}{Vx}$

(Total for Question 6 = 1 mark)

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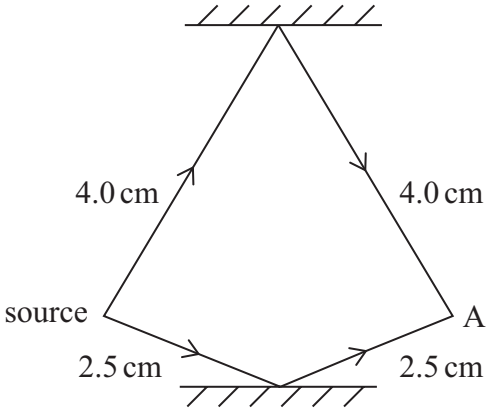
7 Two waves, each with a wavelength of 2 cm, leave a single source in phase and follow the paths shown.



Which of the following is the phase difference, in radians, between the two waves as they meet at point *A*?

A $\frac{\pi}{4}$

B $\frac{\pi}{2}$

C π

D $\frac{3\pi}{2}$

(Total for Question 7 = 1 mark)

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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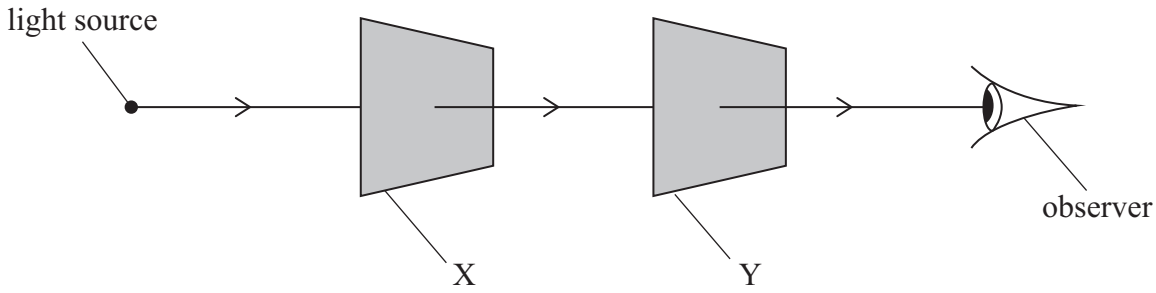
9 Two polarising filters, X and Y, are arranged between a light source and an observer, as shown.



The intensity of light reaching the observer is a maximum.

The observer rotates filter X. The observer then rotates filter Y so that the intensity of light is a maximum again.

Which row of the table shows possible angles of rotation for the filters?

	Header	Header
A	90°	180°
B	180°	270°
C	270°	90°
D	360°	270°

(Total for Question 9 = 1 mark)

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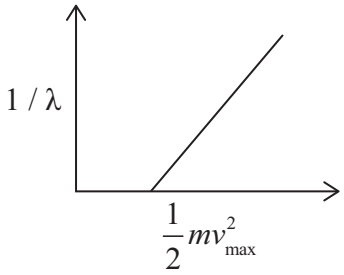
10 Light of wavelength λ travelling at speed c is incident on a metal surface.

Photoelectrons are emitted from the surface with a maximum kinetic energy $\frac{1}{2}mv^2_{max}$

The graph shows the relationship between 1 / λ and $\frac{1}{2}mv^2_{max}$



Which of the following shows how the gradient of the graph can be used to determine the Planck constant h?

A $h = \frac{1}{\text{gradient}}$

B $h = \frac{1}{\text{c} \times \text{gradient}}$

C $h = \frac{\text{c}}{\text{gradient}}$

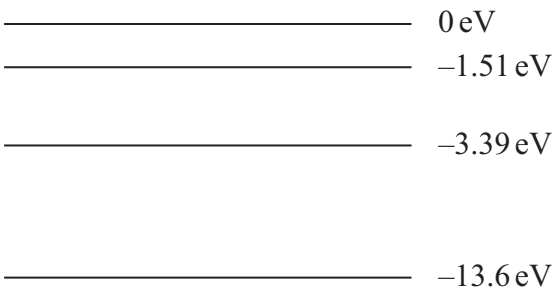
D h = gradient

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

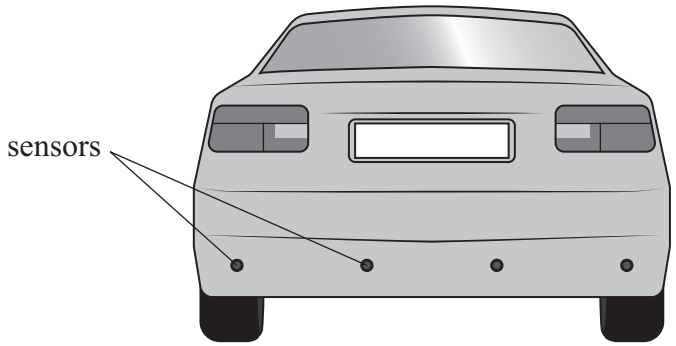
11 The diagram shows some of the energy levels for hydrogen.



Identify the transition which would result in the emission of light of wavelength 660 nm.

(Total for Question 11 = 4 marks)

12 Sensors can be fitted to the rear bumper of a car to help the driver reverse the car safely.



The sensors emit ultrasound pulses. Pulses that hit an object behind the car are reflected back to the sensors. The time taken for the reflected pulse to return is measured so that the distance to the object can be determined.

(a) State why it is necessary to emit the ultrasound in pulses.

(1)

(b) A car manufacturer claims that the sensors are able to detect objects from a distance of 0.10 m from the car.

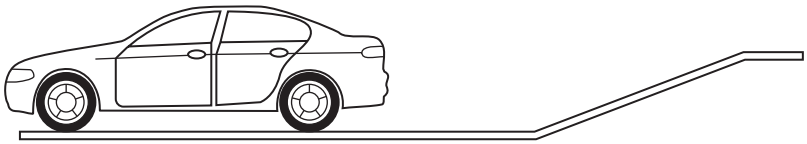
Calculate the maximum duration of each pulse.

speed of sound in air = 340 m s^{-1}

(3)

(c) (i) Suggest why the sensors may not help the driver when reversing towards an ascending ramp.

(1)



(ii) Suggest why the sensors may not help the driver when reversing towards a thin post.

(1)

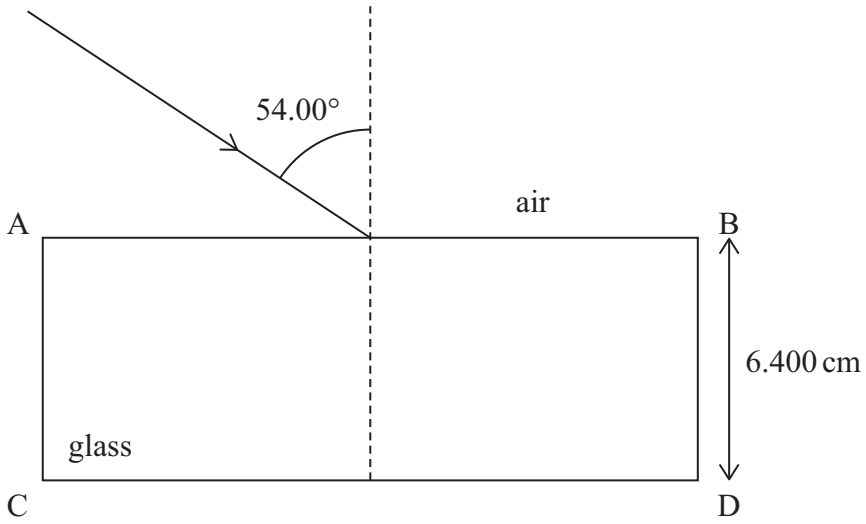
(Total for Question 12 = 6 marks)

13 The refractive index of glass varies with the colour of light.

refractive index of glass for red light = 1.513

refractive index of glass for violet light = 1.532

(a) A ray of white light is incident on side AB of a rectangular glass block, as shown.

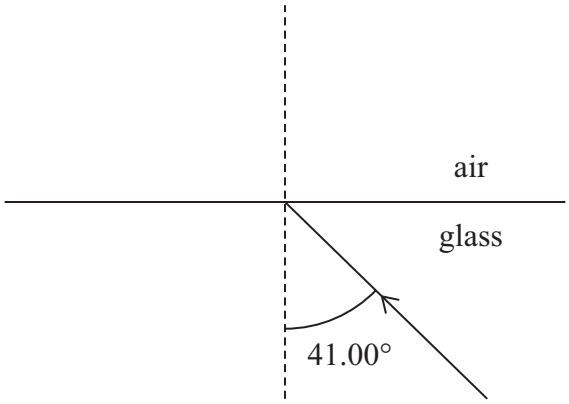


The red light and violet light from the incident ray arrive at slightly different points on side CD.

Determine the distance between these points.

(5)

(b) White light is incident on a boundary between glass and air, as shown.



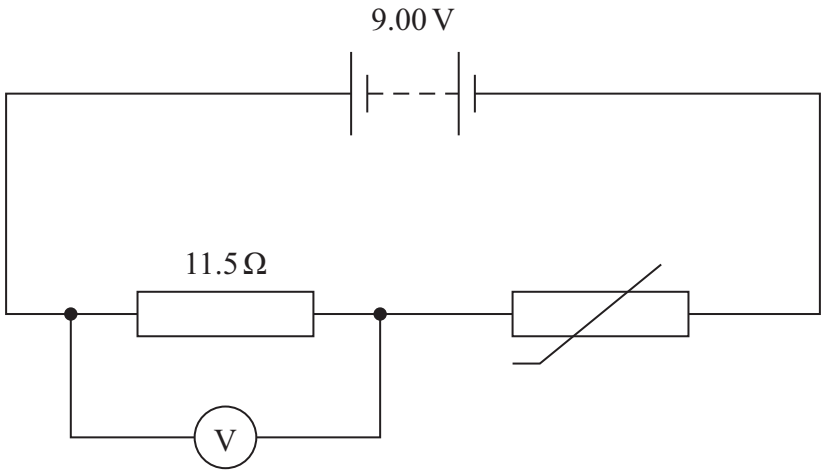
Explain what happens to the red light and the violet light when meeting the boundary.

Your answer should include calculations.

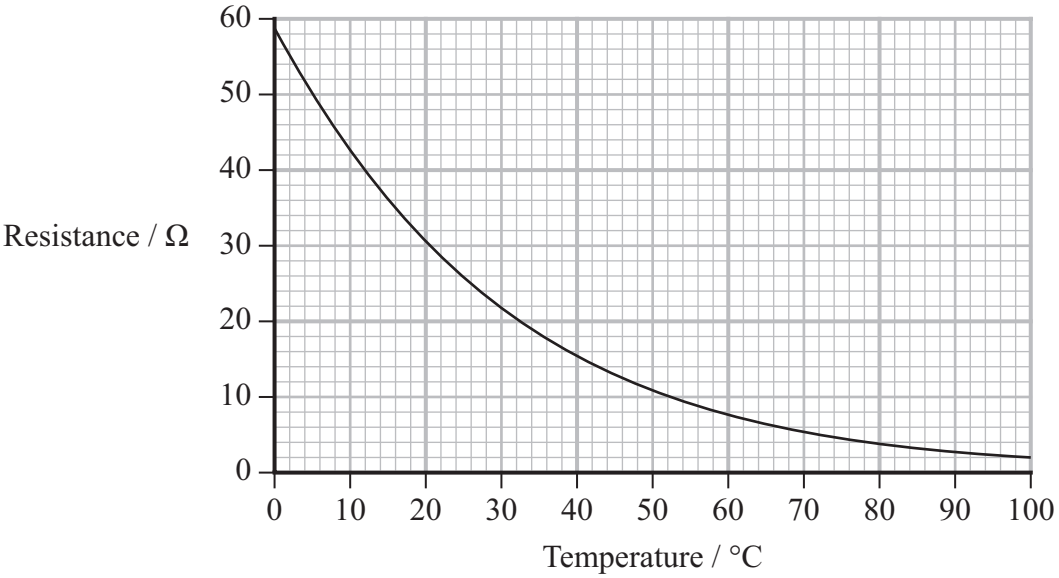
(4)

(Total for Question 13 = 9 marks)

14 A student connected the circuit shown. The battery has negligible internal resistance.



The graph shows how the resistance of the thermistor varies with temperature.



(a) The reading on the voltmeter is 3.42 V.

Determine the temperature of the thermistor.

(4)

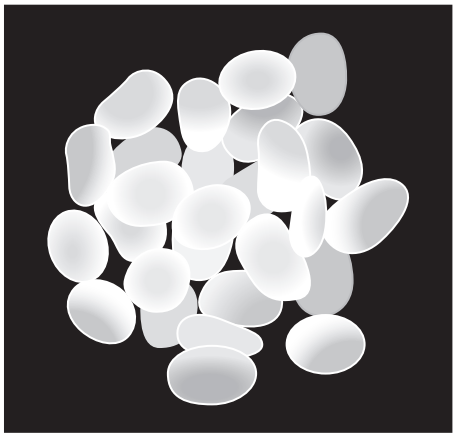
(b) The student suggests that if the e.m.f. of the battery is doubled, the reading on the voltmeter will double.

Assess whether the student's suggestion is correct.

(4)

(Total for Question 14 = 8 marks)

***15** The images show some toy 'glow-in-the-dark' stones. After being exposed to sunlight the stones glow, emitting light.



The packaging states that the stones work with any light source. A student tests this by illuminating the stones with light from a red laser, a green laser and a violet laser in turn. The red and green lasers have no effect on the stones, but the glow is seen immediately when the violet laser is shone on the stones.

The light produced by the lasers has the following wavelengths:

red = 650 nm

green = 530 nm

violet = 405 nm

Suggest how these observations could be explained by the photon nature of light but not the wave nature of light.

(6)

(Total for Question *15 = 6 marks)

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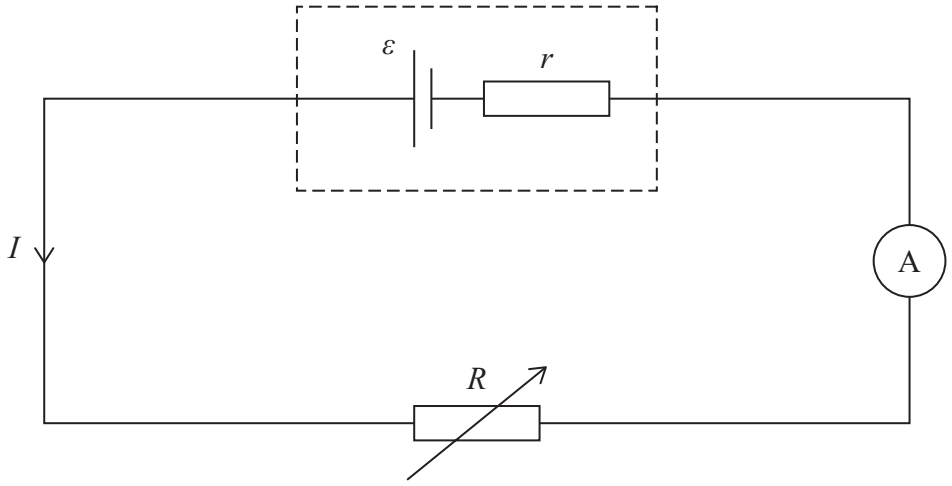
16 A student set up the circuit shown to determine the e.m.f. ε and internal resistance r of a cell.

I is the current in the circuit and R is the resistance of the variable resistor.

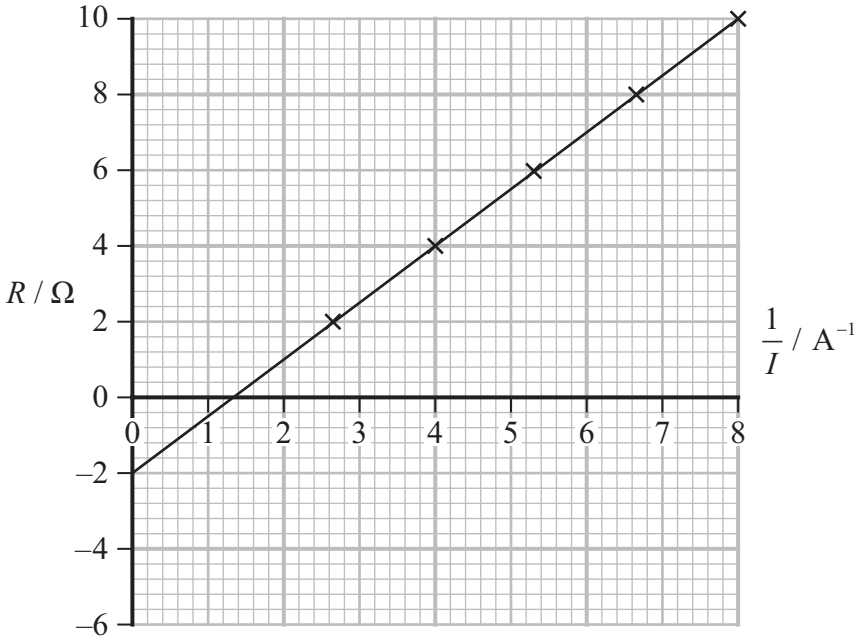


(a) Show that for this circuit, $R = \frac{\varepsilon}{I} - r$.

(2)

(b) The student varied R and measured corresponding values of I.

The student then plotted a graph of R against $\frac{1}{I}$, as shown.



Determine ε and r for the cell.

(3)

(c) The student adjusts the variable resistor so that R increases.

Explain how this will affect the power dissipated by the internal resistor.

(3)

(d) They added a second, identical cell in series with the first cell and repeated the experiment.

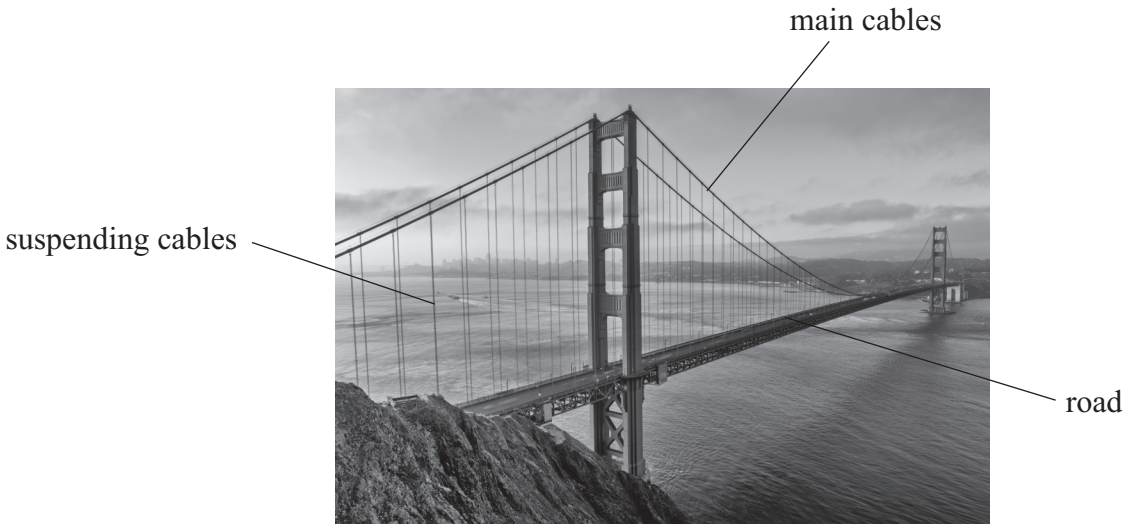
Add a line to the graph to show the results of this experiment.

(3)

(Total for Question 16 = 11 marks)

17 The photograph shows the Golden Gate Bridge in San Francisco, USA.

The bridge has two main cables. Attached to these cables are smaller suspending cables, which support the road.



(Source: © Don White /Getty Images)

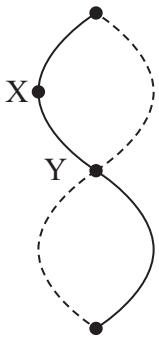
Wind causes each suspending cable to oscillate, so standing waves form on the suspending cables.

(a) Explain how a standing wave can form on a cable that is fixed at both ends.

(3)

(b) The diagram shows a standing wave on a cable that is fixed at both ends. X and Y are two points on the cable.

(3)



Describe the motion of points X and Y on the cable.

(c) In strong winds, the Golden Gate Bridge emits a humming sound.

(i) One of the suspending cables on the bridge has a mass of 2.10×10^3 kg and a length of 87.0 m.

Show that the mass per unit length μ of the cable is about $24\,\text{kg}\,\text{m}^{-1}$.

(2)

(ii) The lowest frequency of the humming sound produced by the bridge is 280 Hz.

The total mass of the road on the bridge is 140×10^6 kg.

The weight of the road is supported equally by 500 suspending cables.

The range of lengths of the suspending cables is from 3.5 m to 160 m.

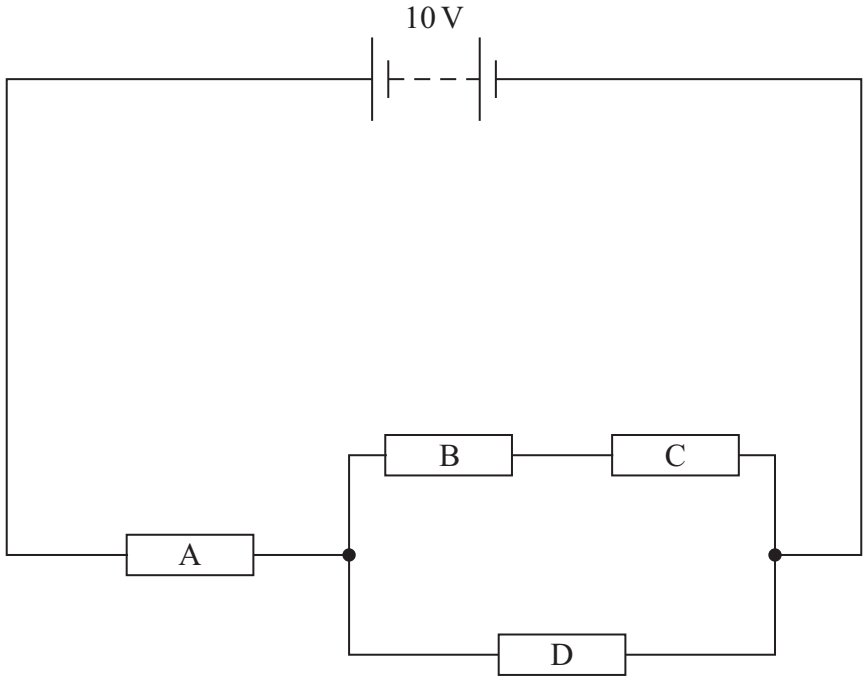
The value of μ for all of the suspending cables is $24\,\text{kg}\,\text{m}^{-1}$.

Deduce whether the lowest frequency standing waves on the suspending cables could be producing the humming sound.

(6)

(Total for Question 17 = 14 marks)

18 Four identical resistors, A, B, C and D, are placed in a circuit, as shown.



(a) Determine the power dissipated in each of the resistors.

resistance of each resistor = 2.0 Ω.

(6)

(b) Explain, without further calculation, what would happen to the power dissipated by resistor A if resistor D were disconnected from the circuit.

(2)

(c) If the resistors in the circuit used in (a) were replaced with filament lamps, the resistance of each lamp would be different depending on the potential difference across it.

Explain, in terms of particles, why the resistance of a filament lamp increases as the potential difference across the filament increases.

(4)

(Total for Question 18 = 12 marks)

TOTAL FOR SECTION B = 70 MARKS
TOTAL FOR PAPER = 80 MARKS

List of data, formulae and relationships

Acceleration of free fall	$g = 9.81 \text{ m s}^{-2}$	(close to Earth's surface)
Electron charge	$e = -1.60 \times 10^{-19} \text{ C}$	
Electron mass	$m_e = 9.11 \times 10^{-31} \text{ kg}$	
Electronvolt	$1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$	
Gravitational field strength	$g = 9.81 \text{ N kg}^{-1}$	(close to Earth's surface)
Planck constant	$h = 6.63 \times 10^{-34} \text{ J s}$	
Speed of light in a vacuum	$c = 3.00 \times 10^{8} \text{ m s}^{-1}$	

Unit 1

Mechanics

Kinematic equations of motion

$$s = \frac{(u + v)t}{2}$$

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

Forces

$$\Sigma F = ma$$

$$g = \frac{F}{m}$$

$$W = mg$$

Momentum

$$p = mv$$

Moment of force

$$\text{moment} = Fx$$

Work and energy

$$\Delta W = F\Delta s$$

$$E_k = \frac{1}{2}mv^2$$

$$\Delta E_{grav} = mg\Delta h$$

Power

$$P = \frac{E}{t}$$

$$P = \frac{W}{t}$$

Efficiency

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy input}}$$

$$\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}}$$

Materials

Density $\rho = \frac{m}{V}$

Stokes' law $F = 6\pi\eta rv$

Hooke's law $\Delta F = k\Delta x$

Elastic strain energy $\Delta E_{el} = \frac{1}{2} F\Delta x$

Young modulus $E = \frac{\sigma}{\varepsilon}$ where

Stress $\sigma = \frac{F}{A}$

Strain $\varepsilon = \frac{\Delta x}{x}$

Unit 2

Waves

Wave speed	$v = f\lambda$
Speed of a transverse wave on a string	$v = \sqrt{\frac{T}{\mu}}$
Intensity of radiation	$I = \frac{P}{A}$
Refractive index	$n_1 \sin\theta_1 = n_2 \sin\theta_2$
	$n = \frac{c}{v}$
Critical angle	$\sin C = \frac{1}{n}$
Diffraction grating	$n\lambda = d\sin\theta$

Electricity

Potential difference	$V = \frac{W}{Q}$
Resistance	$R = \frac{V}{I}$
Electrical power, energy	$P = VI$
	$P = I^2R$
	$P = \frac{V^2}{R}$
	$W = VIt$
Resistivity	$R = \frac{\rho l}{A}$
Current	$I = \frac{\Delta Q}{\Delta t}$
	$I = nqvA$
Resistors in series	$R = R_1 + R_2 + R_3$
Resistors in parallel	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

Particle nature of light

Photon model	$E = hf$
Einstein's photoelectric equation	$hf = \phi + \frac{1}{2}mv^2_{\max}$
de Broglie wavelength	$\lambda = \frac{h}{p}$

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Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Wednesday 15 October 2025

Afternoon (Time: 1 hour 30 minutes)

Paper reference **WPH12/01A**

Physics

International Advanced Subsidiary/Advanced Level
UNIT 2: Waves and Electricity
Answer book

You must have:
Scientific calculator, ruler, protractor and Question paper

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- **Show all your working out** in calculations and **include units** where appropriate.

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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P 8 7 4 7 7 A 0 1 1 6

Pearson

SECTION A

Answer ALL questions.

For questions 1–10, in Section A, select one answer from A to D and put a cross in the box ☒. If you change your mind, put a line through the box ☒ and then mark your new answer with a cross ☒.

1

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 1 = 1 mark)

2

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 2 = 1 mark)

3

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 3 = 1 mark)

4

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 4 = 1 mark)

5

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 5 = 1 mark)

6

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 6 = 1 mark)

7

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 7 = 1 mark)

8

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 8 = 1 mark)

9

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 9 = 1 mark)

10

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11

(4)

(Total for Question 11 = 4 marks)

12

(a)

(1)

.....

.....

(b)

(3)

.....

.....

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.....

.....

.....

(c) (i)

(1)

.....

.....

(ii)

(1)

.....

.....

(Total for Question 12 = 6 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

13

(a)

(5)

(b)

(4)

(Total for Question 13 = 9 marks)

14

(a)

(4)

(b)

(4)

(Total for Question 14 = 8 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

15

(6)

(Total for Question 15 = 6 marks)

DO NOT WRITE IN THIS AREA

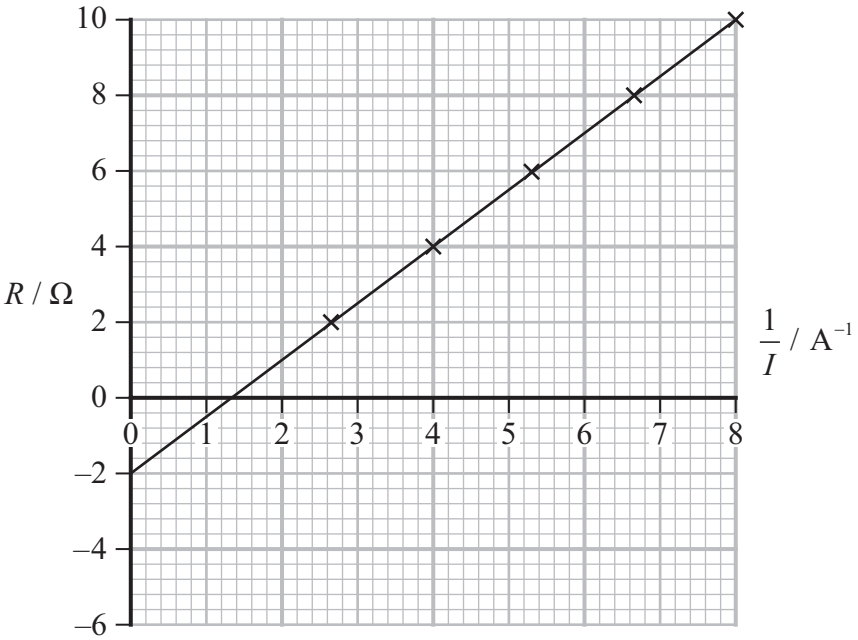
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

16

(a)

(2)



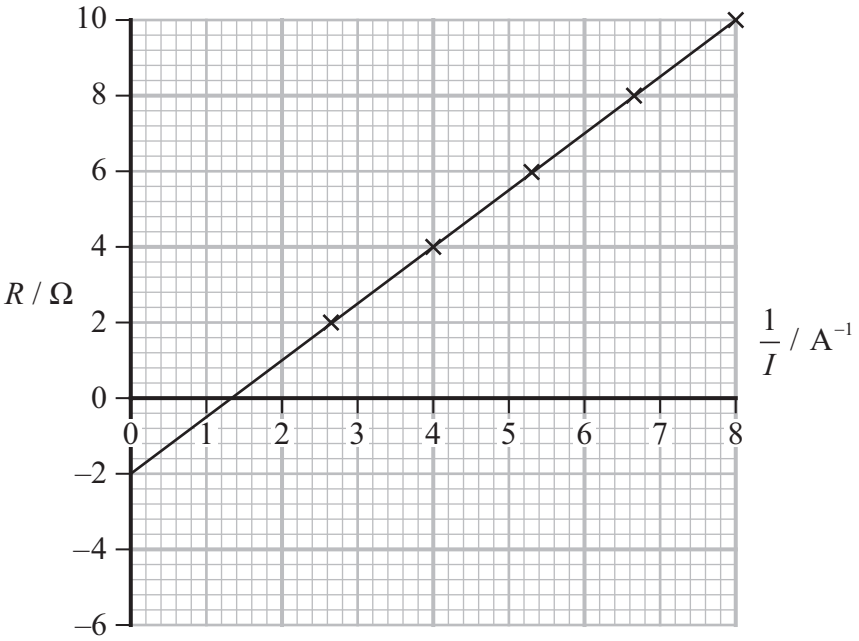
(b)

(3)

(c)

(3)

(d)



(3)

(Total for Question 16 = 11 marks)

17

(a)

(3)

(b)

(3)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(c)

(i)

(2)

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.....

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.....

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(ii)

(6)

(Total for Question 17 = 14 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

18

(a)

(6)

(b)

(2)

(c)

(4)

(Total for Question 18 = 12 marks)

TOTAL FOR SECTION B = 70 MARKS
TOTAL FOR PAPER = 80 MARKS

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA