# Pearson Edexcel International Advanced Level

## Wednesday 13 May 2026

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 and Answer Book (sent separately).
Do not return this question paper with the Answer Book.

- The list of data, formulae and relationships is printed at the end of this booklet.

*Turn over* ▶

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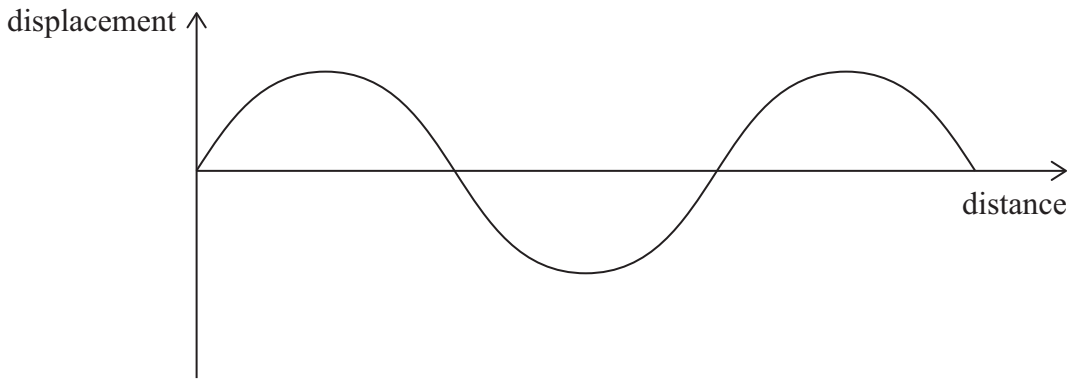
Pearson

## SECTION A

**Answer ALL questions.**

**1** The graph shows how displacement varies with distance for a transverse wave.




Which of the following can be determined directly from this graph?

**A** frequency

**B** period

**C** velocity

**D** wavelength

**(Total for Question 1 = 1 mark)**

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**2** The work function for sodium is $3.8 \times 10^{-19}$ J. A frequency $f$ of electromagnetic radiation causes the photoelectric effect for sodium.

Which of the following expressions describes $f$?

**A** $f > \dfrac{6.63 \times 10^{-34}}{3.8 \times 10^{-19}}$

**B** $f < \dfrac{6.63 \times 10^{-34}}{3.8 \times 10^{-19}}$

**C** $f > \dfrac{3.8 \times 10^{-19}}{6.63 \times 10^{-34}}$

**D** $f < \dfrac{3.8 \times 10^{-19}}{6.63 \times 10^{-34}}$

**(Total for Question 2 = 1 mark)**

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**3** The SI base unit for current is the ampere A.

Which of the following is **not** an equivalent unit to A?

**A** $C\,s^{-1}$

**B** $J\,\Omega^{-1}$

**C** $V\,\Omega^{-1}$

**D** $W\,V^{-1}$

**(Total for Question 3 = 1 mark)**

**4** A negative temperature coefficient thermistor has a constant current. The charge carrier density is $n$ and the average drift velocity of the charge carriers is $v$.

The temperature of the thermistor is increased. The current remains constant.

Which row of the table describes how $n$ and $v$ change?

| | ***n*** | ***v*** |
|---|---|---|
| **A** | decrease | increase |
| **B** | decrease | decrease |
| **C** | increase | increase |
| **D** | increase | decrease |

**(Total for Question 4 = 1 mark)**

**5** Wave-particle duality is an important concept in Physics.

Which of the following is **not** explained by the wave model?

**A** atomic line spectra

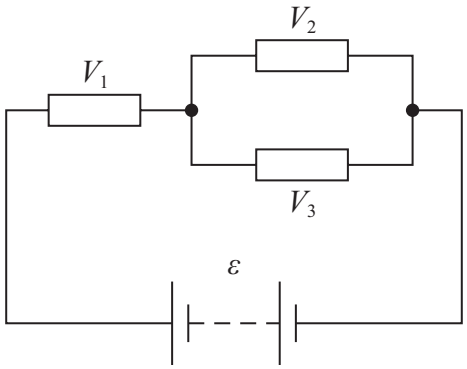
**B** electron diffraction

**C** polarisation of light

**D** refraction of sound

**(Total for Question 5 = 1 mark)**

**6** Three resistors, each of different resistance, are connected to a battery of e.m.f. $\varepsilon$. The battery has negligible internal resistance. The potential difference across each resistor is labelled, as shown.




Which of the following relationships is always correct for all values of resistance?

**A** $V_1 = V_2$

**B** $V_1 = V_2 + V_3$

**C** $\varepsilon = V_1 + V_2$

**D** $\varepsilon = V_1 + V_2 + V_3$

**(Total for Question 6 = 1 mark)**

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**7** The pulse-echo technique can be used with ultrasound to produce an image of a human organ.

The quality of the image depends on the pulse duration and the wavelength of the ultrasound.

Which of the following describes the effect of decreasing pulse duration?

**A** less diffraction when the pulse is reflected

**B** poorer resolution

**C** decreased chance of interference between the incident and reflected pulses

**D** increased chance of interference between the incident and reflected pulses

**(Total for Question 7 = 1 mark)**

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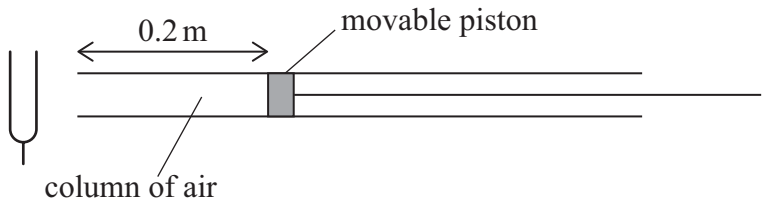
**8** A vibrating tuning fork is held next to an open glass tube containing a column of air, as shown. The length of the column of air is adjusted by moving a piston. When the length of the air column is 0.2 m, a stationary wave with one antinode and one node is produced and a sound can be heard.




The length of the air column is increased until another sound is heard.

Which of the following is the length of the new column of air?

**A** 0.4 m

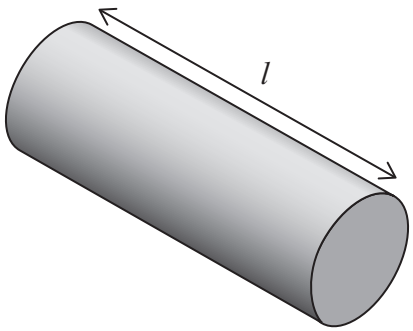
**B** 0.6 m

**C** 0.8 m

**D** 1.0 m

**(Total for Question 8 = 1 mark)**

**9** A cylinder of conducting putty has a length $l$, as shown.




The resistance between the two circular ends of the putty is $R$.

The same piece of conducting putty is rolled into a new cylinder of length $2l$.

Which of the following is the resistance between the two circular ends of this new cylinder of putty?

**A** $\frac{R}{2}$

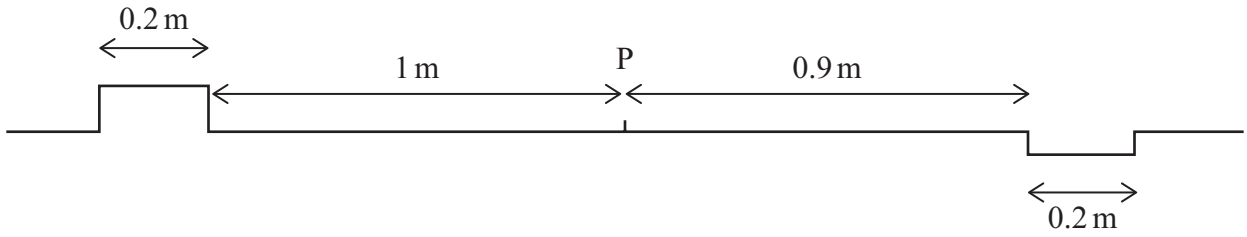
**B** $R$

**C** $2R$

**D** $4R$

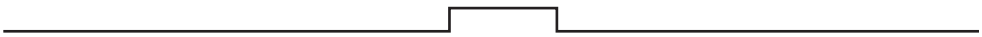
**(Total for Question 9 = 1 mark)**

**10** Two pulses are travelling towards each other on a length of string. They each have a speed of $1\,m\,s^{-1}$ and the distance of the front of each pulse to a point P is shown.

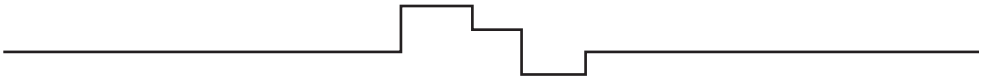



Which of the following shows the shape of the wave on the string 1 second later?

**A**



**B**



**C**

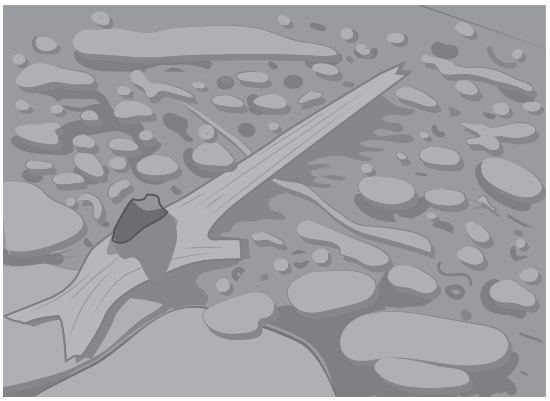
**D**

**(Total for Question 10 = 1 mark)**

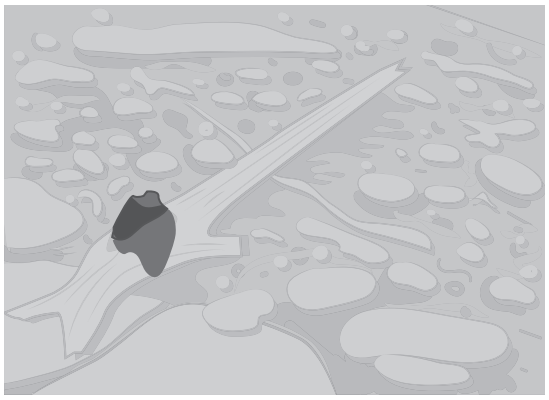
**TOTAL FOR SECTION A = 10 MARKS**

## SECTION B

**11** When light is reflected off water, it can be plane polarised. A photograph of the surface of a pond is taken with and without a polarising filter.



**A**



**B**

Deduce which photograph has been taken using a polarising filter.

**(Total for Question 11 = 3 marks)**

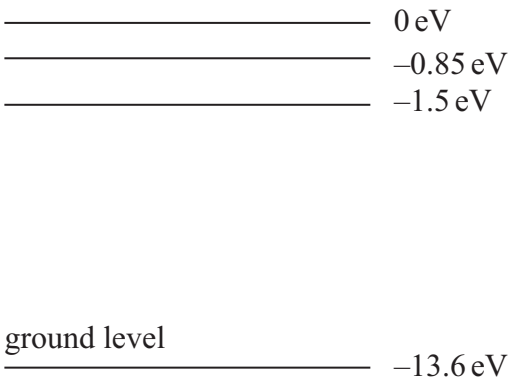
**12** A cello is a musical instrument with four strings each of length 69 cm. The highest frequency that a full-length cello string should produce is 220 Hz. When plucked, the string forms a standing wave with one antinode at the centre. A cello string should not have a tension of more than 200 N.

Deduce whether the required tension in the string to produce 220 Hz is less than 200 N.

mass of 69.0 cm string = 1.17 g

**(Total for Question 12 = 5 marks)**

**13** The diagram shows some of the energy levels for an atom of hydrogen. The atom is initially in the ground state.




The atom of hydrogen absorbs a photon of electromagnetic radiation with an energy of 12.1 eV.

**13** (a) Calculate the frequency of the electromagnetic radiation.

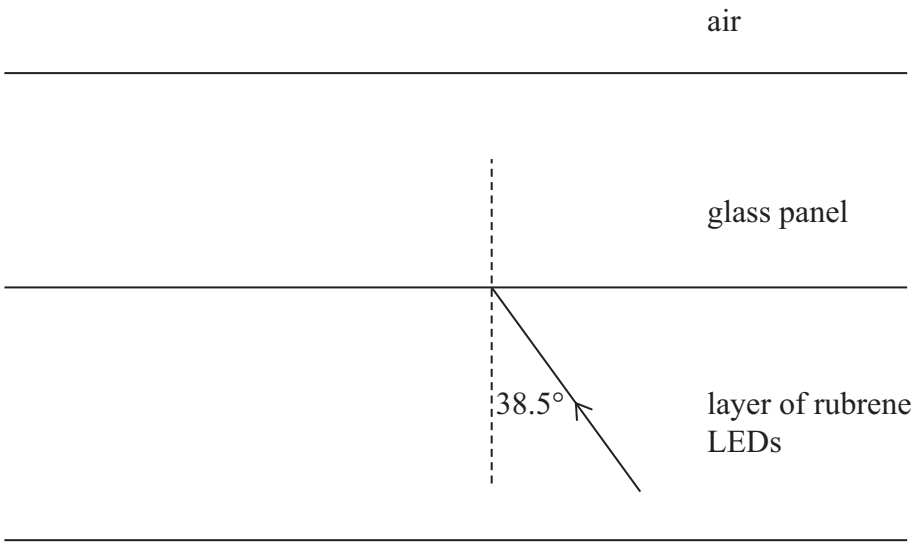
**(3)**

**13** (b) Explain what happens when this photon with an energy of 12.1 eV is absorbed by the atom of hydrogen.

**(4)**

**(Total for Question 13 = 7 marks)**

**14** Some television screens use light emitting diodes (LEDs) that have been made with new materials such as rubrene. A television screen consists of a glass panel covering a layer of rubrene LEDs. A ray of light produced by an LED is shown.




**14** (a) The refractive index of the glass is 1.52

**14** (a) (i) Show that the angle of refraction in the glass is about 45°.

refractive index of rubrene = 1.72

**(2)**

**14** (a) (ii) Explain, with the aid of a calculation, whether the ray of light will be refracted at the boundary between glass and air.

**(3)**

**14** (b) An important property of the materials used to construct the LEDs is a refractive index which is close to the refractive index of glass.

Explain why this is important in the manufacture of television screens.

**(2)**

**(Total for Question 14 = 7 marks)**

**15** The power of light incident on a light dependent resistor (LDR) is $4.62 \times 10^{-7}$ W.
The resistance of the LDR is 800 Ω.
The area of the LDR perpendicular to the light is $2.1 \times 10^{-5}$ m$^2$.

The power of the light is altered so that the intensity of the light is now $2.0 \times 10^{-5}$ W m$^{-2}$.
The resistance of the LDR is now 500 kΩ.

A website suggests that the resistance of an LDR is inversely proportional to the intensity of light incident on the LDR.

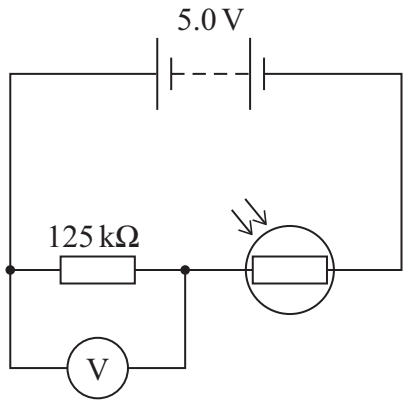
**15** (a) Determine whether the relationship suggested by the website is correct. You should use the data above.

**(3)**

**15** (b) A student is going to make a circuit for a light meter using the LDR. He requires the voltmeter to read about 1 V when it is dark and the voltmeter reading to increase as the light intensity increases.

Assume the light intensity in the dark is $2.0 \times 10^{-5}$ W m$^{-2}$.

He draws this circuit.

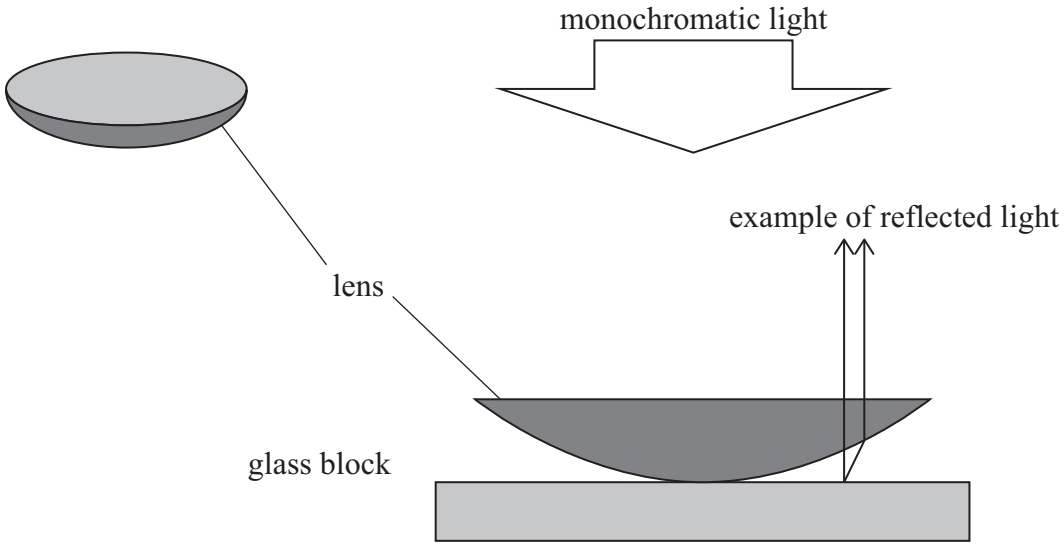



Determine whether this circuit will achieve the student's requirements.

**(6)**

**(Total for Question 15 = 9 marks)**

**16** An interference pattern known as Newton's rings can be produced using a lens with a flat side and a curved side, as shown. The lens is placed on a glass block.




view from the side

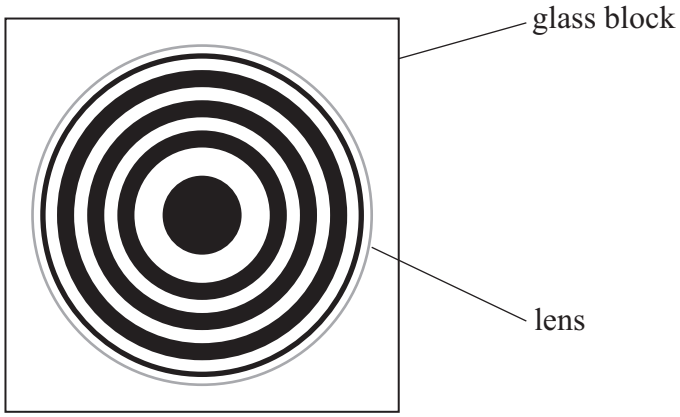
Monochromatic light is directed at the lens. The light partially reflects from the bottom of the lens. The rest of the light is transmitted and is then partially reflected from the surface of the glass block. One example of this is shown.

**16** (a) The light that is reflected by the glass block undergoes a change of phase. The change of phase is equal to a phase difference of 180°.

Explain what is meant by 'a phase difference of 180°'. You may draw a diagram.

**(2)**

**16***(b) An interference pattern of rings is seen when looking down on the arrangement, as shown.

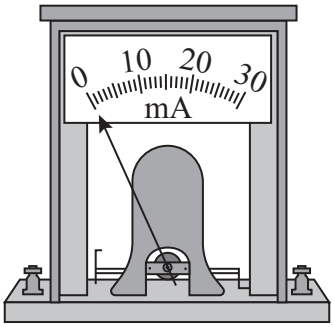



Explain the formation of the dark central circle and the rings.

**(6)**

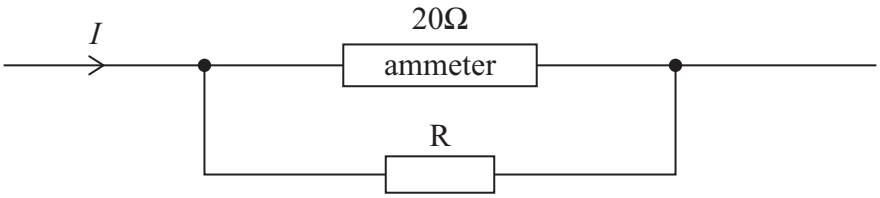
**(Total for Question 16 = 8 marks)**

**17** A demonstration ammeter can read current values up to a maximum of 30 mA, as shown.




The resistance of the ammeter is 20 Ω.

If a current *I* that is larger than 30 mA, is to be measured, a resistor must be added in parallel to the ammeter.




A resistor R of resistance 1.28 Ω is added to the ammeter.

**17** (a) Determine the value of *I* that will cause the current through the ammeter to be 30 mA.

**(4)**

**17** (b) Resistor R must be made so that its value of resistance is accurate.

This can be done by making it using a coiled length of constantan wire.

A data sheet states that for a wire diameter of 0.45 mm, the length required is 0.416 m.

**17** (b) (i) Deduce whether this would result in the required resistance of 1.28 Ω.

resistivity of constantan = $4.89 \times 10^{-7}$ Ω m

**(3)**

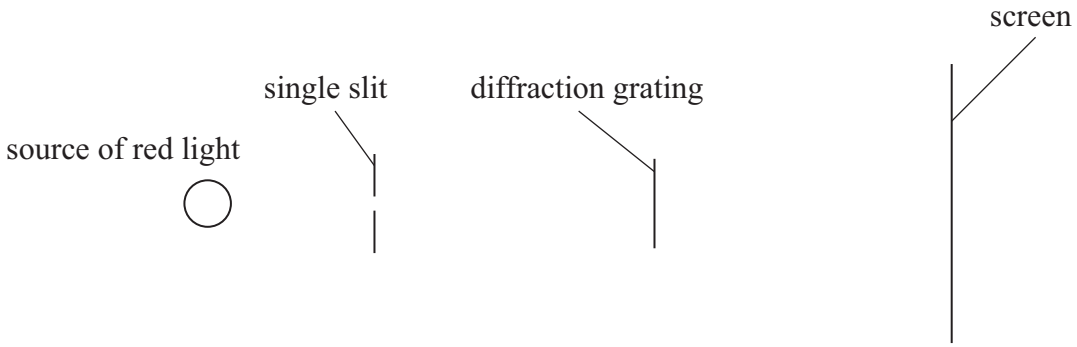
**17** (b)(ii) Constantan is a metal.

Explain how the resistance of a metal is affected by an increase in temperature.

**(3)**

**(Total for Question 17 = 10 marks)**

**18** A student investigated the diffraction of light. She used a source of red light, a single slit, a diffraction grating and a screen.




**18** (a) The single slit transmits light which is coherent.

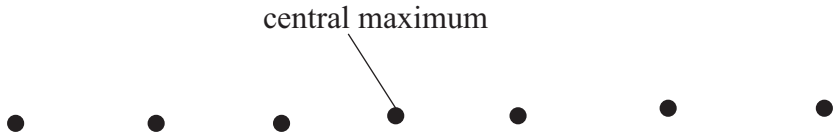
State what is meant by coherent.

**(1)**

**18** (b) Describe how Huygens' construction can be used to predict the shape of diffracted wavefronts from the single slit.

**(2)**

**18** (c) A series of red dots appear on the screen.




The student measures the distance between the two first order maxima.

**18** (c) (i) State the other measurement she should make to determine the angle between the two first order maxima.

**(1)**

**18** (c)(ii) She determines the angle between the two first order maxima as 22.6°

Show that the distance between each line on the diffraction grating is about $3.3 \times 10^{-6}$ m.

wavelength of red light = 650 nm

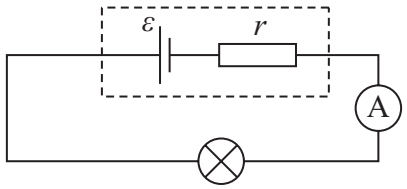
**(3)**

**18** (c)(iii) Calculate the maximum number of red dots that could be seen.

**(3)**

**(Total for Question 18 = 10 marks)**

**19** A cell with e.m.f. $\varepsilon$ and internal resistance $r$ is connected in series with a filament bulb and an ammeter, as shown.




The resistance of the filament bulb is 5.0 Ω and the ammeter reads 0.1 A.

**19** (a) State what is meant by an e.m.f.

**(1)**

**19** (b) Calculate the total charge that passes through the filament bulb in 3 minutes.

**(2)**

**19** (c) The filament bulb is replaced by a light emitting diode (LED). The resistance of the LED is 50 Ω when the ammeter reads 25 mA.

**19** (c) (i) Calculate the rate of energy transferred by the LED.

**(2)**

**19** (c) (ii) Show that the e.m.f. $\varepsilon$ of the cell is between 1 V and 2 V.

**(3)**

**19** (c)(iii) Both the filament bulb and LED are labelled with an operating potential difference of 1.5 V.

The filament bulb did not light when connected to this cell but the LED did light.

Explain why. You do not have to do further calculations.

**(3)**

**(Total for Question 19 = 11 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 $F = 6\pi\eta r v$

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 | $\lambda = \frac{h}{p}$ |

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 13 May 2026

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 and Question paper (sent separately).

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.
- In the question marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.
- 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

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶

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## 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**

**(Total for Question 11 = 3 marks)**

**12**

**(Total for Question 12 = 5 marks)**

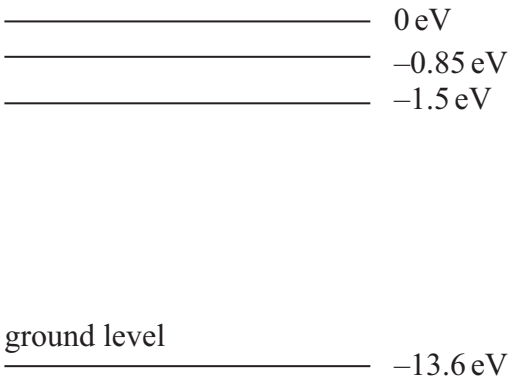
**13** (a)

**(3)**

Frequency = .....

**13** (b)

**(4)**




**(Total for Question 13 = 7 marks)**

**14** (a) (i)

**(2)**

**14** (a) (ii)

**(3)**

**14** (b)

**(2)**

**(Total for Question 14 = 7 marks)**

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

**15** (a)

**(3)**

**15** (b)

**(6)**

**(Total for Question 15 = 9 marks)**

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

**16** (a)

**(2)**

**16*** (b)

**(6)**

**(Total for Question 16 = 8 marks)**

**17** (a)

**(4)**

$I =$ .....

**17** (b) (i)

**(3)**

**17** (b)(ii)

**(3)**

**(Total for Question 17 = 10 marks)**

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

**18** (a)

**(1)**

**18** (b)

**(2)**

**18** (c) (i)

**(1)**

**18** (c)(ii)

**(3)**

**18** (c)(iii)

**(3)**

Maximum number of red dots = .....

**(Total for Question 18 = 10 marks)**

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

**19** (a)

**(1)**

.....

.....

**19** (b)

**(2)**

.....

.....

Total charge = .....

**19** (c) (i)

**(2)**

.....

.....

Rate of energy transfer = .....

**19** (c) (ii)

**(3)**

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

**19** (c)(iii)

**(3)**

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**(Total for Question 19 = 11 marks)**

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

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