Write your name here

| Surname | Other names |
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| | |

**Pearson Edexcel**
**International**
**Advanced Level**

Centre Number | | | | | |

Candidate Number | | | | |

# Physics

## Advanced Subsidiary
## Unit 3: Exploring Physics

Friday 8 May 2015 – Morning
**Time: 1 hour 20 minutes**

Paper Reference
**WPH03/01**

**You must have:**
Ruler

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **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.*

## Information

- The total mark for this paper is 40.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- The list of data, formulae and relationships is printed at the end of this booklet.
- Candidates may use a scientific calculator.

## Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- 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 1–5, 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** In an experiment to determine the Young modulus of a material in the form of a wire, which of the following instruments should be used to measure the diameter of the wire?

☒ **A** electronic balance

☒ **B** metre rule

☒ **C** micrometer screw gauge

☒ **D** vernier calipers

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

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**2** Four readings are taken of the diameter of a wire:

0.27 mm 0.29 mm 0.72 mm 0.26 mm

Which of the following should be recorded as the mean value?

☒ **A** 0.39 mm

☒ **B** 0.385 mm

☒ **C** 0.273 mm

☒ **D** 0.27 mm

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

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**3** Which of the following is the SI unit for resistivity?

☒ **A** $\Omega\ m^{-1}$

☒ **B** $\Omega\ m$

☒ **C** $\Omega$

☒ **D** $m\ \Omega^{-1}$

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

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**4** In an experiment to determine the resistivity of the material of a wire, which of the following measurements of the wire would **not** be required?

☒ **A** diameter

☒ **B** length

☒ **C** mass

☒ **D** resistance

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

**5** In an experiment to determine the Planck constant a student uses light of wavelength $\lambda$ = 595 nm. Which of the following is the correct value of $\lambda^{-1}$?

☒ **A** 1.68 nm

☒ **B** $1.68 \times 10^{-6}$ $nm^{-1}$

☒ **C** $1.68 \times 10^{6}$ $nm^{-1}$

☒ **D** $1.68 \times 10^{6}$ $m^{-1}$

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

**TOTAL FOR SECTION A = 5 MARKS**

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## SECTION B

**Answer ALL questions in the spaces provided.**

**6** A student has been asked to carry out an experiment to determine the internal resistance of a 1.5 V cell. The circuit will contain the following components: the cell, a switch, a variable resistor, an ammeter and a voltmeter.

(a) Draw a circuit diagram of the circuit.

**(1)**

(b) State why this experiment is considered to be low risk.

**(1)**

.....

.....

(c) The teacher says that the resistance of the variable resistor should **not** be reduced to zero.

Suggest why.

**(1)**

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.....

**(Total for Question 6 = 3 marks)**

**7** A student is asked to plan an experiment to determine the energy stored in a stretched spring when it is extended by 300 mm. The student is told to use a graphical method.

For a 1 N load the extension of the spring is 40 mm.

Write a plan which could be used for this experiment.

You should:

(a) draw a labelled diagram of the experimental set-up and list any additional apparatus required,

**(3)**

(b) state which quantity is the independent variable and which quantity is the dependent variable,

**(2)**

(c) state and explain your choice of measuring instruments for the independent and dependent variables,

**(4)**

(d) describe how you would ensure that your measurement of the extension is as accurate as possible,

**(2)**

(e) comment on whether repeat readings are appropriate in this case,

**(1)**

(f) explain how the data collected will be used to determine the energy stored,

**(4)**

(g) explain the main source of uncertainty and/or systematic error,

**(1)**

(h) comment on safety.

**(1)**

**(Total for Question 7 = 18 marks)**

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**8** In an investigation of the inverse square law for light, a student measured the radiation flux $I$ of the light at different distances $d$ from a light bulb.

Her results table is shown below.

| $d$/m | $I$/W m$^{-2}$ | $\frac{1}{d^2}$ / |
|---|---|---|
| 0.125 | 996 | 64.0 |
| 0.25 | 276 | 16.0 |
| 0.375 | 109.3 | 7.1 |
| 0.5 | 48 | 4.0 |
| 0.75 | 18 | |
| 1 | 3.3 | |

(a) Add a unit for $\frac{1}{d^2}$ to the table.

**(1)**

(b) Criticise the results table.

**(2)**

.....

.....

.....

.....

(c) Complete the table.

**(2)**

(d) The relationship between $I$ and $d$ is given by

$$I = \frac{k}{d^2}$$

where $k$ is a constant.

Explain why a graph of $I$ on the $y$-axis against $\frac{1}{d^2}$ on the $x$-axis should be a straight line through the origin.

**(2)**

.....

.....

.....

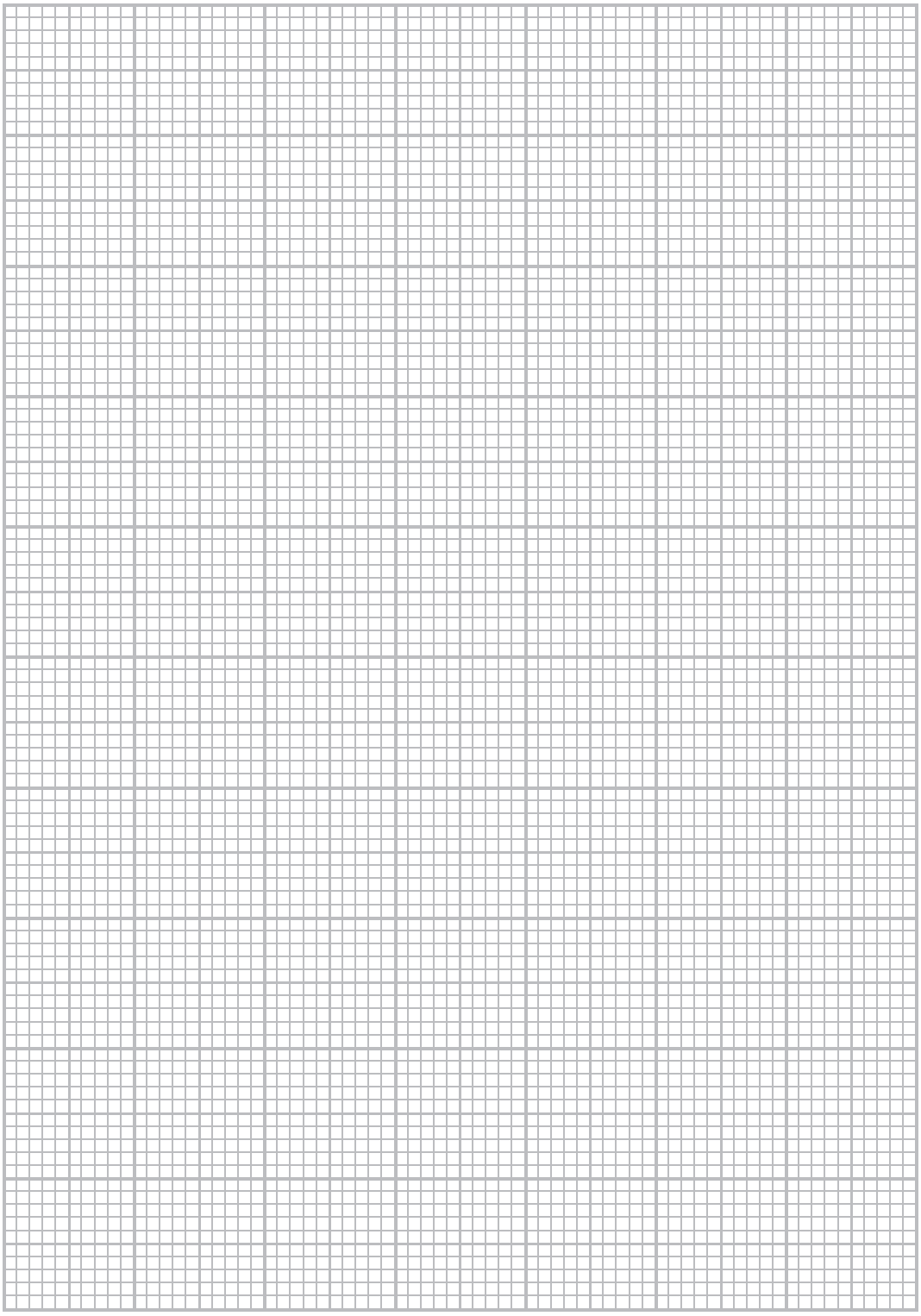
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(e) Plot a graph of $I$ on the $y$-axis against $\frac{1}{d^2}$ on the $x$-axis on the grid provided and draw a line of best fit.

**(5)**



(f) Use your graph to determine $I$ when $d$ = 20 cm.

**(2)**

.....

.....

.....

.....

.....

$I$ = ..... W m$^{-2}$

**(Total for Question 8 = 14 marks)**

**TOTAL FOR SECTION B = 35 MARKS**

**TOTAL FOR PAPER = 40 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 | $v = u + at$<br>$s = ut + \frac{1}{2}at^2$<br>$v^2 = u^2 + 2as$ |
| Forces | $\Sigma F = ma$<br>$g = F/m$<br>$W = mg$ |
| Work and energy | $\Delta W = F\Delta s$<br>$E_k = \frac{1}{2}mv^2$<br>$\Delta E_{grav} = mg\Delta h$ |

*Materials*

| | |
|---|---|
| Stokes' law | $F = 6\pi\eta rv$ |
| Hooke's law | $F = k\Delta x$ |
| Density | $\rho = m/V$ |
| Pressure | $p = F/A$ |
| Young modulus | $E = \sigma/\varepsilon$ where<br>Stress $\sigma = F/A$<br>Strain $\varepsilon = \Delta x/x$ |
| Elastic strain energy | $E_{el} = \frac{1}{2}F\Delta x$ |

***Unit 2***

*Waves*

| | |
|---|---|
| Wave speed | $v = f\lambda$ |
| Refractive index | ${}_1\mu_2 = \sin i / \sin r = v_1/v_2$ |

*Electricity*

| | |
|---|---|
| Potential difference | $V = W/Q$ |
| Resistance | $R = V/I$ |
| Electrical power, energy and efficiency | $P = VI$<br>$P = I^2R$<br>$P = V^2/R$<br>$W = VIt$ |
| | $\%\ \text{efficiency} = \dfrac{\text{useful energy output}}{\text{total energy input}} \times 100$ |
| | $\%\ \text{efficiency} = \dfrac{\text{useful power output}}{\text{total power input}} \times 100$ |
| Resistivity | $R = \rho l/A$ |
| Current | $I = \Delta Q/\Delta t$<br>$I = nqvA$ |
| Resistors in series | $R = R_1 + R_2 + R_3$ |
| Resistors in parallel | $\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$ |

*Quantum physics*

| | |
|---|---|
| Photon model | $E = hf$ |
| Einstein's photoelectric equation | $hf = \phi + \frac{1}{2}mv^2_{max}$ |

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