Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Friday 11 January 2019

Morning (Time: 1 hour 20 minutes) | Paper Reference **WPH03/01**

Physics

Advanced Subsidiary
Unit 3: Exploring Physics

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

Turn over ▶

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P 5 4 5 0 0 A 0 1 1 6

Pearson

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 Which of the following is an SI base quantity?

☒ **A** charge

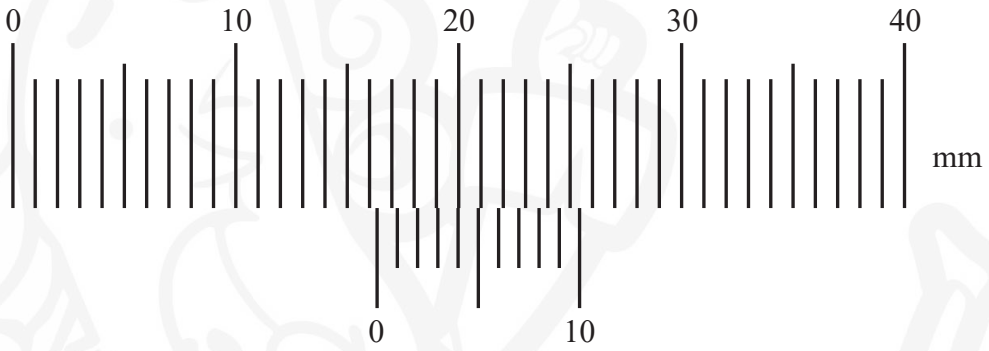
☒ **B** coulomb

☒ **C** second

☒ **D** time

(Total for Question 1 = 1 mark)

2 What is the reading on the vernier scale?



☒ **A** 10.6 mm

☒ **B** 16.4 mm

☒ **C** 20.0 mm

☒ **D** 25.4 mm

(Total for Question 2 = 1 mark)

Questions 3, 4, and 5 refer to an experiment to determine the acceleration of free fall by measuring the time taken for a tennis ball to fall through a given height. The height is measured with a measuring tape.

3 The times recorded are

0.96 s 0.98 s 0.89 s 0.99 s

Which is the best statement of the time the ball took to fall?

☒ **A** 0.955 s

☒ **B** 0.96 s

☒ **C** 0.976 s

☒ **D** 0.98 s

(Total for Question 3 = 1 mark)

4 Which of the following quantities is also required in the calculation?

☒ **A** initial velocity of the ball

☒ **B** mass of the ball

☒ **C** diameter of the ball

☒ **D** density of the ball

(Total for Question 4 = 1 mark)

5 Which of the following is **not** a possible source of error in the experiment?

☒ **A** reaction time

☒ **B** zero error on the measuring tape

☒ **C** parallax error in reading the height

☒ **D** ball not reaching terminal velocity

(Total for Question 5 = 1 mark)

TOTAL FOR SECTION A = 5 MARKS

SECTION B

Answer ALL questions in the spaces provided.

6 A student investigates how the current varies with potential difference for a filament lamp.

(a) Draw a circuit diagram for this investigation.

(3)

(b) The student uses digital meters. The manufacturer states that these meters are more accurate than analogue meters.

State one other advantage of using digital meters rather than analogue meters.

(1)

.....

.....

.....

(c) The student checks for zero errors before taking readings.

Explain another experimental technique the student should use in order to make the investigation as accurate as possible.

(2)

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(Total for Question 6 = 6 marks)

7 A student is asked to determine the density of glass as accurately as possible. He has been provided with a box of 10 glass microscope slides.

The approximate size of the slides is given on the box.

Length 76 mm
Width 26 mm
Thickness 0.9 mm

Write a plan for this experiment.

You should:

(a) state the quantities to be measured,

(1)

(b) list the apparatus required,

(2)

(c) for two of the quantities listed in (a) explain your choice of measuring instrument,

(4)

(d) comment on whether repeat readings are appropriate,

(1)

(e) suggest how to make the measurements of thickness as accurate as possible,

(2)

(f) explain how the measurements made will be used to determine the density,

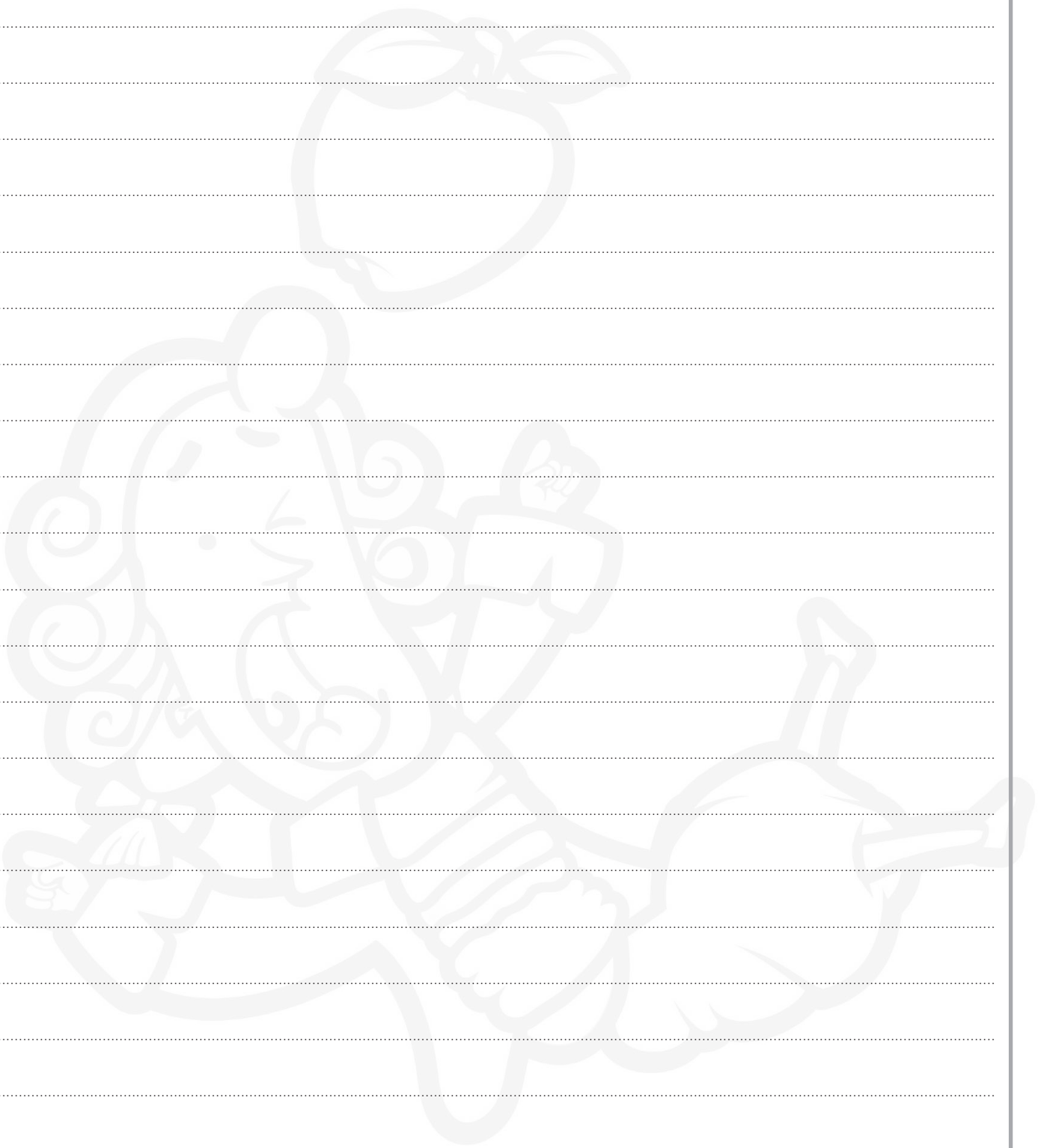
(2)

(g) state the main sources of uncertainty and/or systematic error,

(2)

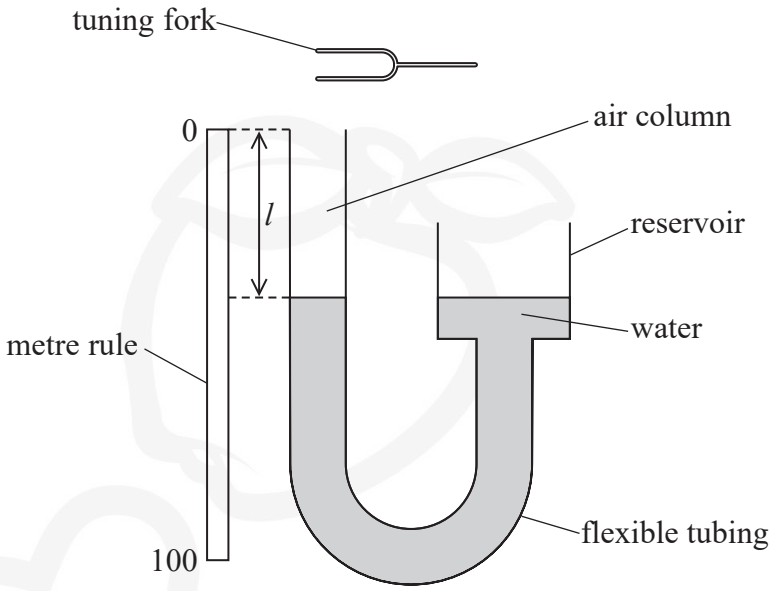
(h) comment on safety.

(1)



(Total for Question 7 = 15 marks)

8 A student determined the speed v of sound using standing waves in an air column.
A diagram of the apparatus is shown.



The student held a vibrating tuning fork above the air column and moved the reservoir up and down to change the length l of the air column. She determined the shortest length at which a sound of maximum loudness was heard. This happens when the standing wave is formed in the air column.

She recorded the length l, as shown in the diagram, using the metre rule.

She repeated this for a number of tuning forks, each marked with a different frequency f.

Her results are shown in the table.

f / Hz	l / m
256	0.322
320	0.25
348	0.228
512	0.160

(a) Criticise these results.

(2)

(b) The student used l to calculate the wavelength λ of the standing wave.

f / Hz	l / m	λ / m	
256	0.322	1.29	
320	0.25	1.00	
348	0.228	0.912	
512	0.160	0.640	

Explain why the student calculated λ as $4l$.

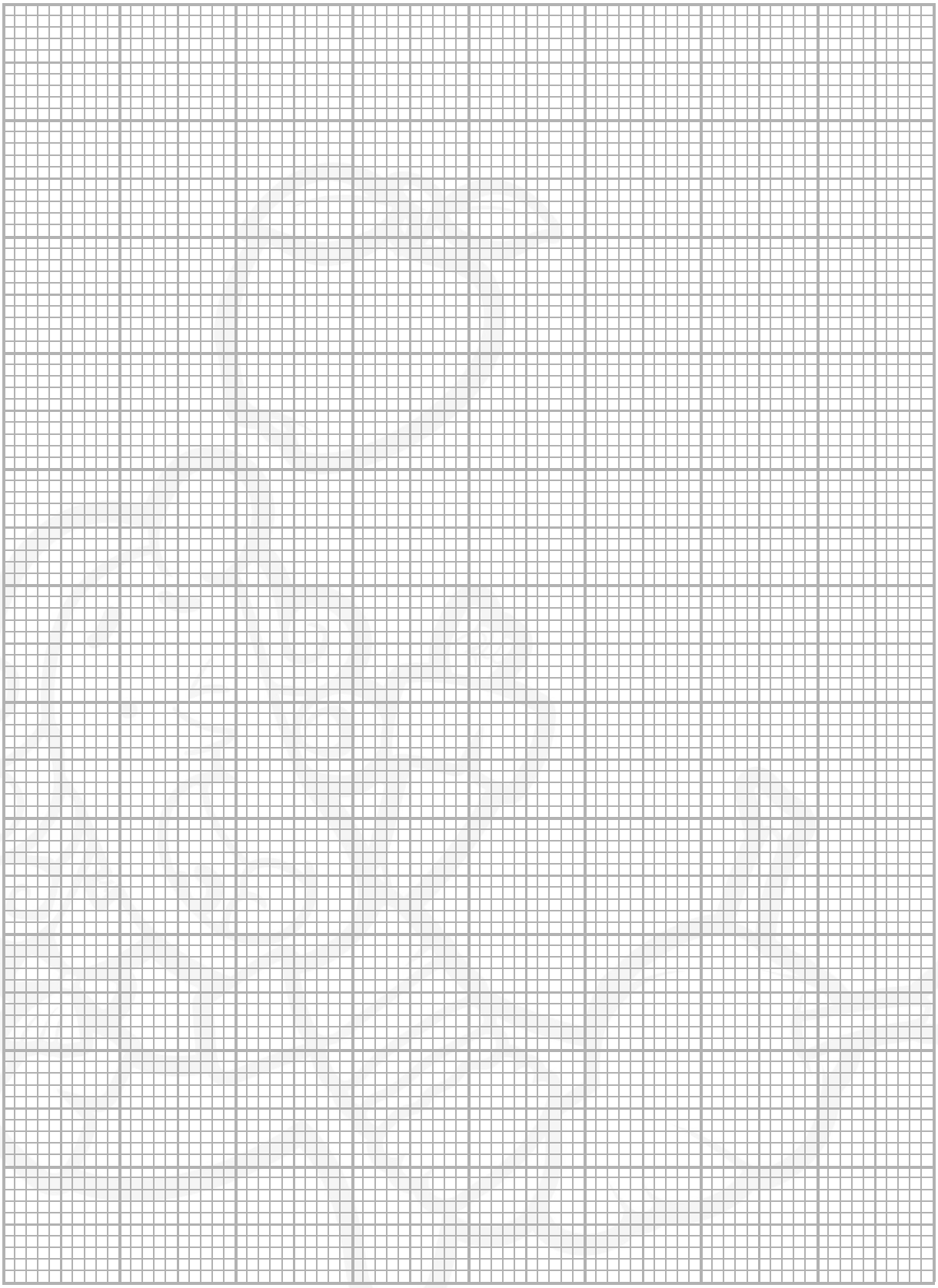
(2)

(c) (i) Show that a graph of λ on the y-axis against $1/f$ on the x-axis should be a straight line through the origin.

(2)

(ii) Plot a graph of λ on the y-axis against $1/f$ on the x-axis on the grid provided. Use the extra column in the table to show your processed data.

(5)



(d) Use your graph to determine a value for the speed of sound in air v.

(2)

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(e) Suggest a reason why your calculated value for v may differ from the accepted value for v.

(1)

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.....

.....

v = ...

(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

$v = u + at$

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

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

Forces

$\Sigma F = ma$

$g = F/m$

$W = mg$

Work and energy

$\Delta W = F\Delta s$

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

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

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

Stress $\sigma = F/A$

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	$P = VI$ $P = I^2R$ $P = V^2/R$ $W = VIt$

$$\% \text{ efficiency} = \frac{\text{useful energy output}}{\text{total energy input}} \times 100$$

$$\% \text{ efficiency} = \frac{\text{useful power output}}{\text{total power input}} \times 100$$

Resistivity	$R = \rho l/A$
Current	$I = \Delta Q/\Delta t$ $I = nqvA$
Resistors in series	$R = R_1 + R_2 + R_3$
Resistors in parallel	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

Quantum physics

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

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