Write your name here

| Surname | Other names |
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**Edexcel GCE**

Centre Number | Candidate Number

# Physics

## Advanced Subsidiary
## Unit 3B: Exploring Physics
## International Alternative to Internal Assessment

Thursday 21 May 2009 – Afternoon
**Time: 1 hour 20 minutes**

Paper Reference
**6PH07/01**

**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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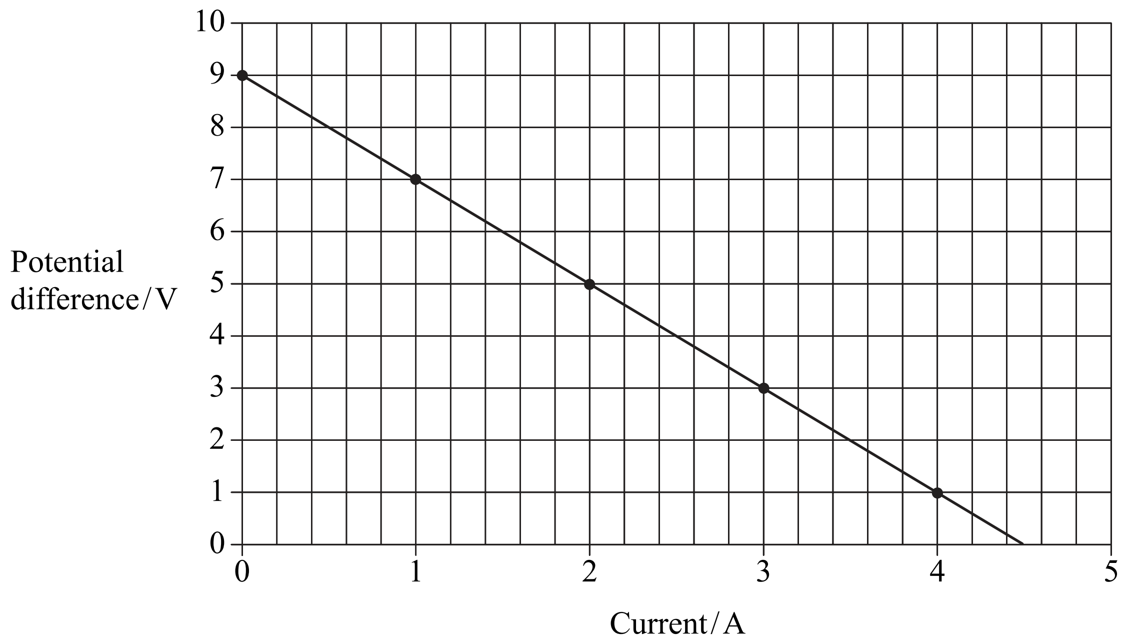
## SECTION A

**Answer ALL questions.**

**For questions 1–4, 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 measure the internal resistance of a battery a graph similar to the one below was drawn.




Which of the following quantities is the internal resistance of the battery?

☐ **A** intercept with the current axis

☐ **B** intercept with the potential difference axis

☐ **C** negative of the gradient

☐ **D** area under the graph

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

**2** In an experiment to measure the viscosity of motor oil a ball bearing is dropped into a long measuring cylinder full of the oil. The student needs to time how long the ball bearing takes to fall a set distance.

Which of the following would improve the accuracy of the measurements?

1 repeating the readings and calculating an average
2 ensuring that readings are taken at eye level
3 using a measuring cylinder with a smaller cross-sectional area

☒ **A** 1 only

☒ **B** 1 and 2 only

☒ **C** 2 and 3 only

☒ **D** 1, 2 and 3

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

**3** In an experiment to measure the acceleration of free fall, $g$, a table tennis ball is dropped from a measured height. The time it takes to reach the ground is measured using a stop watch. The experiment is repeated.

(a) The measured times are:

0.95 s, 0.96 s, 0.99 s

Which of the following should be stated as the average result?

**(1)**

☒ **A** 0.96 s

☒ **B** 0.966 s

☒ **C** 0.967 s

☒ **D** 0.97 s

(b) Which of the following equations could be used directly to calculate $g$?

**(1)**

☒ **A** $v = u + at$

☒ **B** $v^2 = u^2 + 2as$

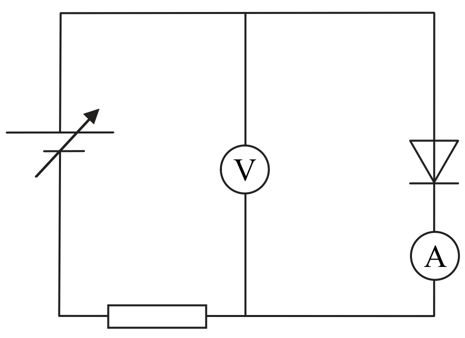
☒ **C** $s = \frac{1}{2}(u + v)t$

☒ **D** $s = ut + \frac{1}{2}at^2$

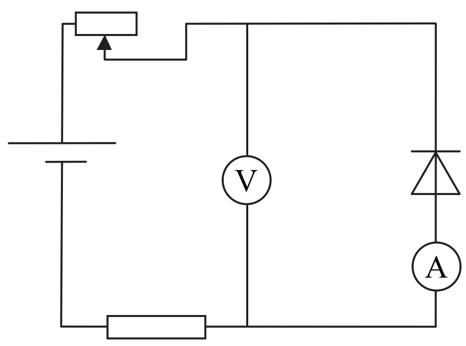
**(Total for Question 3 = 2 marks)**

**4** An experiment involves measuring the potential difference across a diode when it just begins to conduct.

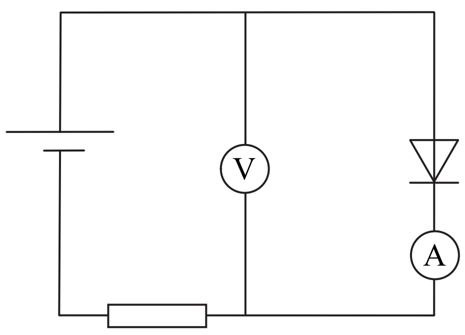
Which of the following circuits would allow this measurement to be made?



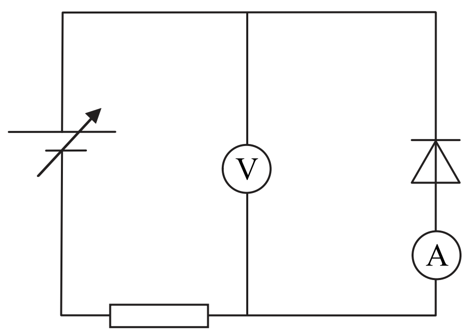

**A**




**B**




**C**




**D**

☒ **A**

☒ **B**

☒ **C**

☒ **D**

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

**TOTAL FOR SECTION A = 5 MARKS**

## SECTION B

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

**5** A student is asked to determine the resistivity of iron using a length of iron wire.

Describe an experiment which could be carried out to achieve this.

Include

- a statement of the measurements to be taken,
- a list of the apparatus required,
- a diagram of the apparatus,
- an explanation of how the measurements will be used to determine the resistivity,
- one precaution the student should take to improve the accuracy of the result.

**(7)**

**(Total for Question 5 = 7 marks)**

**6** An engineer carried out an investigation to determine the Young modulus of a sample of a material.

(a) How would the engineer determine the Young modulus of the material from a stress-strain graph?

**(1)**

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(b) The engineer obtained three sets of data. The values for the Young modulus were 14.2, 14.7 and 15.1 GPa.

Determine the average value and state its uncertainty.

**(2)**

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(c) In a data book the Young modulus of this material is given as $10^{10}$ Pa. Suggest whether your answer to (b) is consistent with the data book value.

**(2)**

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(d) Explain why it is more useful for engineers to determine the Young modulus rather than stiffness for such a sample.

**(1)**

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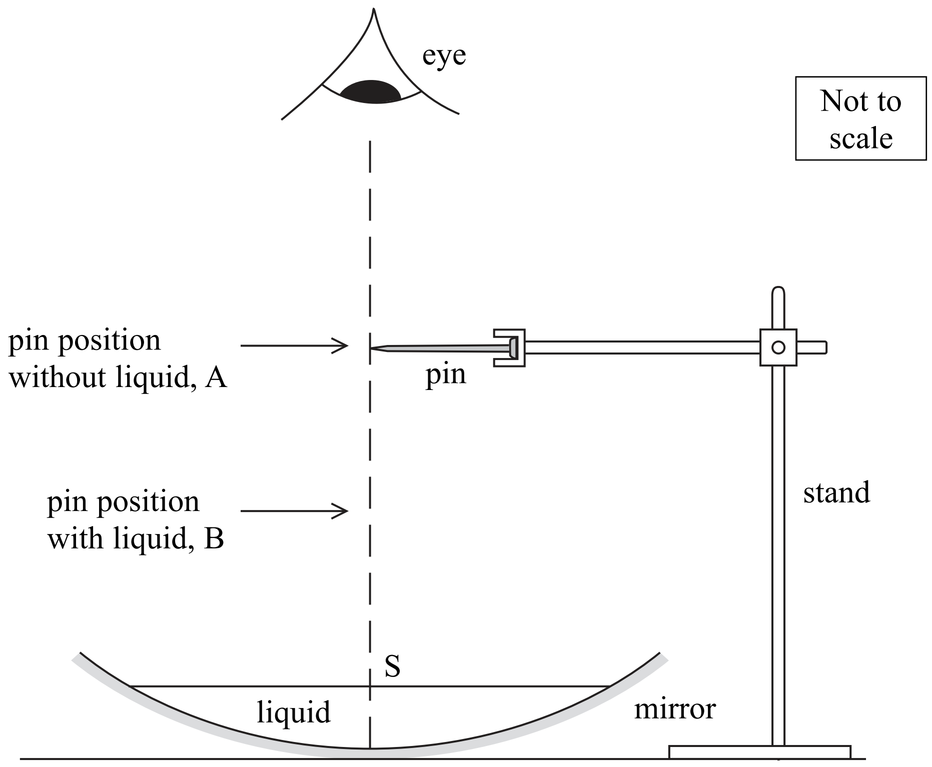
**(Total for Question 6 = 6 marks)**

**7** A student has been asked to find the refractive index of a liquid. She has found instructions for a method which uses a concave mirror and a long pin. These are arranged as in the diagram.




The pin is held in a clamp on a retort stand and is moved up and down until it seems to the student that the pin and its image are in the same place, A. The liquid is then poured into the mirror and the pin moved until it again appears to be in the same place as its image, B. The distances, SA and SB, from the surface of the liquid S to A and B are then measured. The refractive index of the liquid $\mu$ is given by $\mu = \frac{SA}{SB}$.

For one liquid the student finds that SA is 230 mm and SB is 172 mm.

(a) Explain how you would measure the distances SA and SB. You may add to the diagram if you wish.

**(3)**

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(b) Explain how the student could improve the accuracy of the measurements taken.

**(2)**

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(c) Calculate the refractive index of the liquid.

**(2)**

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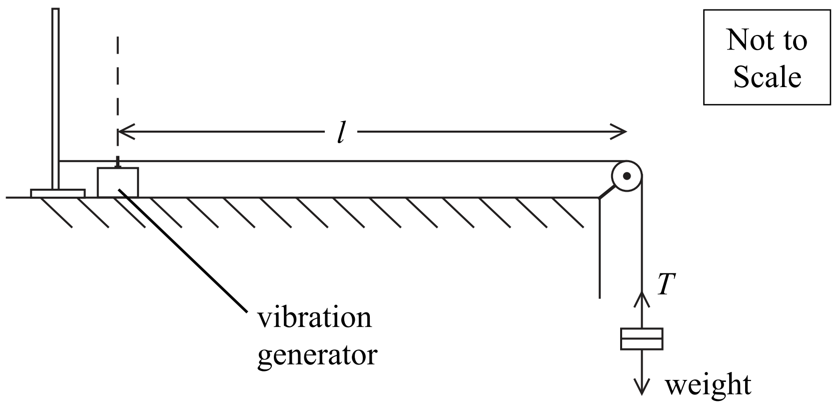
**(Total for Question 7 = 7 marks)**

**8** A student is asked to investigate stationary waves on a stretched wire.

She sets up the arrangement shown in the diagram.




She is given the equation

$$f = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$$

where $f$ = the frequency of the vibration generator

$l$ = length of wire between vibration generator and the pulley

$T$ = tension in wire

$\mu$ = mass per unit length of wire.

(a) Draw on the diagram the waveform that would be observed when the wire is vibrating with one antinode, assume there is a node at the vibration generator.

**(1)**

(b) She varies the tension by changing the weight. She then changes the length $l$ of wire to give the same waveform. The frequency is kept constant. The table shows her readings.

| $T$/N | $l$/m | |
|---|---|---|
| 1.0 | 0.4 | |
| 2.0 | 0.566 | |
| 3.0 | 0.693 | |
| 4.0 | 0.81 | |
| 5.0 | 0.91 | |

Criticise this set of readings.

**(2)**

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(c) Use the equation to predict that a graph of $l^2$ against $T$ should produce a straight line.

**(2)**

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(d) Plot a graph of $l^2$ against $T$ on the grid below. Use the extra column in the table for your values of $l^2$.

**(6)**

(e) The mass of a 1.000 m length of the wire was found to be $6.2 \times 10^{-4}$ kg.

Determine the gradient of your graph and hence calculate a value for the frequency *f*.

**(4)**

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**(Total for Question 8 = 15 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>$W = VIt$<br>$\% \text{ efficiency} = \frac{\text{useful energy output}}{\text{energy input}} \times 100$<br>$\% \text{ efficiency} = \frac{\text{useful power output}}{\text{power input}} \times 100$ |
| 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 | $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ |

*Quantum physics*

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

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