Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Wednesday 7 January 2015 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
WPH01/01

You must have:
Ruler, protractor

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 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.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- 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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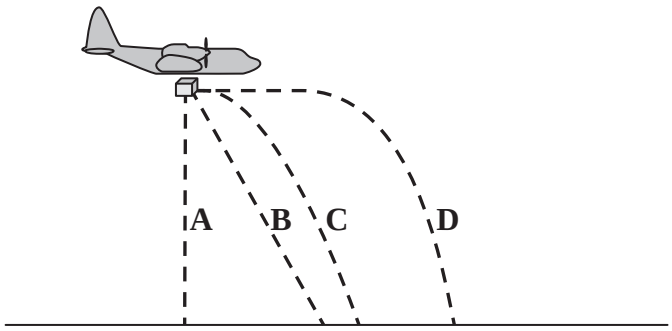
PEARSON

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 plane is travelling horizontally at a constant speed. It releases a package of supplies when in the position shown.



Which of the following shows the path of the package after release?

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 1 = 1 mark)

2 A marble is dropped from the roof of a building and takes 3.2 s to reach the ground.

The approximate height of the building is

☒ **A** 16 m

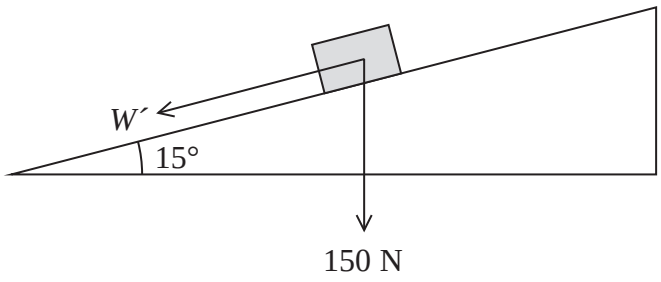
☒ **B** 31 m

☒ **C** 50 m

☒ **D** 100 m

(Total for Question 2 = 1 mark)

3 A box of weight 150 N is placed on an inclined plane. The component of the box's weight acting along the plane is W'.



W' in newtons is given by

☒ **A** $\frac{150}{\cos 15°}$

☒ **B** $150 \times \cos 15°$

☒ **C** $\frac{150}{\sin 15°}$

☒ **D** $150 \times \sin 15°$

(Total for Question 3 = 1 mark)

4 In which of the following is a vector fully described?

☒ **A** A car travels north.

☒ **B** A crane moves a load 20 m east.

☒ **C** A train travels at a rate of 35 m s^{-1}.

☒ **D** A lift moves upwards with a kinetic energy of 2.5 kJ.

(Total for Question 4 = 1 mark)

5 A ball is thrown vertically upwards with a velocity of +3.0 m s^{-1}.

At the maximum height, the acceleration of the ball is

☒ **A** 0 m s^{-2}

☒ **B** – 3.0 m s^{-2}

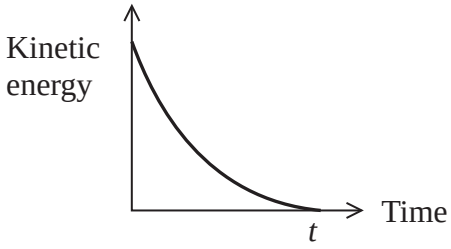
☒ **C** + 9.8 m s^{-2}

☒ **D** – 9.8 m s^{-2}

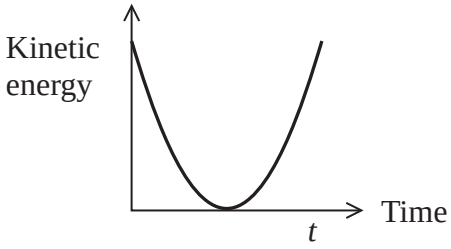
(Total for Question 5 = 1 mark)

6 A ball is thrown vertically upwards. It reaches a maximum height, moves downwards and is caught by the thrower at a time *t*.

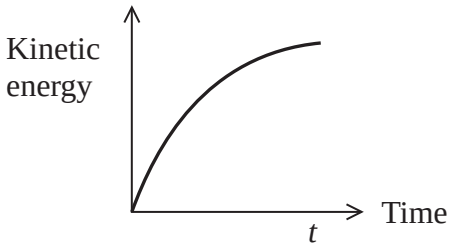
Which of the following is the kinetic energy-time graph for the ball?



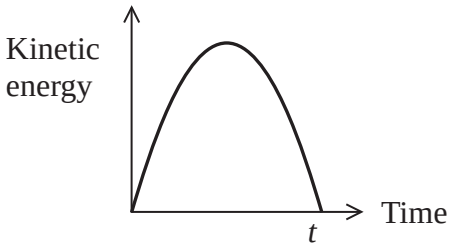
A



B



C



D

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 6 = 1 mark)

7 A material that is able to undergo plastic deformation under compression is said to be

☒ **A** brittle.

☒ **B** ductile.

☒ **C** hard.

☒ **D** malleable.

(Total for Question 7 = 1 mark)

8 A girl of mass 30 kg and a boy of mass 45 kg sit on a frictionless floor holding the two ends of a rope. The boy pulls on the rope. The girl moves towards the boy with an inital acceleration of 3 m s^{-2}.

The boy

☒ **A** moves towards the girl with an initial acceleration greater than 3 m s^{-2}.

☒ **B** moves towards the girl with an initial acceleration less than 3 m s^{-2}.

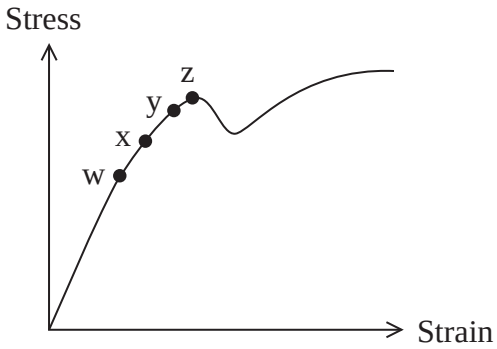
☒ **C** moves towards the girl with an initial acceleration of 3 m s^{-2}.

☒ **D** remains stationary.

(Total for Question 8 = 1 mark)

9 A thin wire of uniform cross-sectional area is stretched by an increasing force.

The corresponding stress-strain graph is shown.



Points w, x, y and z are shown on the graph.

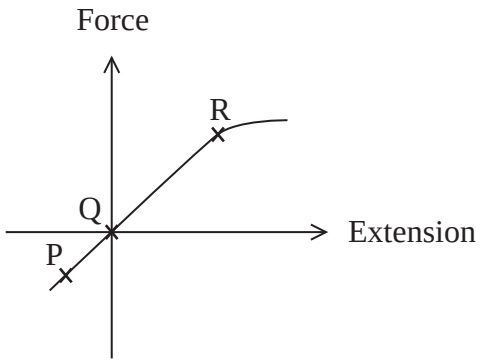
Select the row of the table that correctly identifies the yield point, the limit of proportionality and the elastic limit.

	Yield point	Limit of proportionality	Elastic limit
☒ **A**	y	w	x
☒ **B**	z	w	y
☒ **C**	y	x	w
☒ **D**	z	x	y

(Total for Question 9 = 1 mark)

10 A force is applied across the ends of a spring and the following force-extension graph is drawn.

Three points, P, Q and R, are marked on the graph. At point Q the applied force is zero.



In the table below, the spring is represented using diagrams drawn to scale. The spring at Q is represented by .

Select the row from the table that correctly represents the length of the spring at positions P, Q and R.

	P	**Q** (no applied force)	**R**
☒ **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 (a) A manufacturer of spring balances needs to select a spring that produces an extension of 0.80 cm for each 100 g mass added.

Show that the manufacturer will need to select a spring with a spring constant of about 120 N m^{-1}.

(3)

(b) The manufacturer states that the maximum mass that can be hung on the spring balance is 1.2 kg.

Explain why it is necessary to state the maximum mass.

(3)

(Total for Question 11 = 6 marks)

12 A bungee jump consists of three main stages:

- free fall jump until the rope is straight
- deceleration as the bungee rope stretches
- upwards motion as the bungee rope contracts.



(a) Complete the table to describe the energy transfers of the bungee jumper. Ignore any changes that could be due to air resistance.

(2)

Stage of jump	Energy transfer
free fall jump	gravitational potential energy → kinetic energy
deceleration as the bungee rope stretches	
upwards motion as the bungee rope contracts	

(b) A bungee jumper, of mass 54 kg, is going to jump from a platform that is 65 m above the ground. For the jump to be safe, his height above the ground must never be less than 10 m.

(i) Show that the maximum transfer of gravitational potential energy during a safe jump is about 30 kJ.

(2)

(ii) Hence calculate the tension in the rope when the bungee jumper is 10 m above the ground.

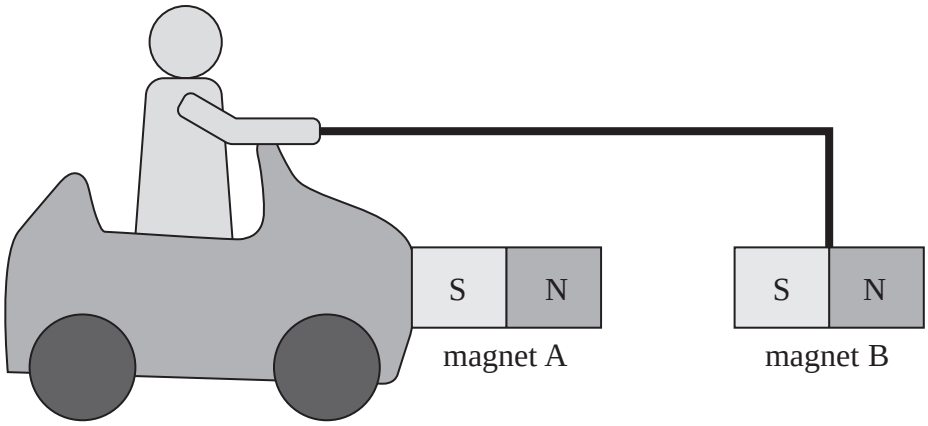
initial length of rope = 23 m

(3)

Tension = ...

(Total for Question 12 = 7 marks)

13 Opposite poles of a magnet attract one another. Using this principle, a student tried to design a toy car that could be self-propelled using a magnetic force. His design is shown below.



Magnet A is attached to the body of the toy car and magnet B is suspended from the driver's hand by a rigid rod. Magnet A is identical to magnet B.

The student stated that as long as the opposite poles of the magnets are facing one another, the attractive force created should cause the toy car to start moving forward.

Explain why in practice this could never work.

(3)

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(Total for Question 13 = 3 marks)

14 A man is walking at a constant horizontal velocity of 1.2 m s^{-1} in the rain. To the man the rain appears to be falling vertically at a velocity of 1.8 m s^{-1}.

Draw a labelled vector diagram, to scale, and use it to determine the actual velocity of the rain.

(5)

Magnitude of the actual velocity of the rain = ...

Angle of the rain to the vertical = ...

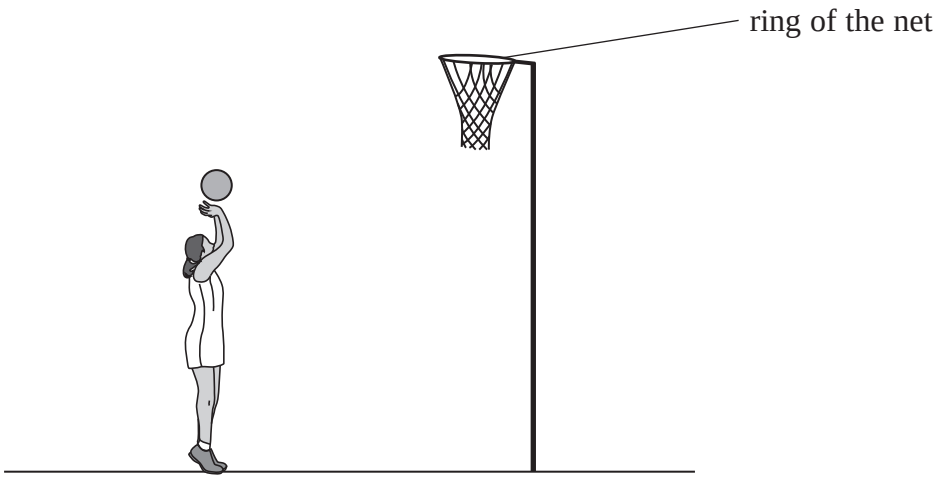
(Total for Question 14 = 5 marks)

15 In a game of netball, a goal is scored when the ball passes through the ring at the top of the net.



(a) On the diagram below draw the path the ball should take if a goal is to be scored.

(1)



(b) A student is given the following information for a particular attempt at a goal.

initial velocity of ball on release = 4.5 m s^{-1}
release angle of ball = 60° from the horizontal
horizontal distance from centre of ball to centre of ring = 1.5 m

(i) Show that the time taken to travel the horizontal distance of 1.5 m is about 0.7 s.

(3)

(ii) Calculate the vertical displacement of the ball when it has travelled a horizontal distance of 1.5 m and hence comment on whether a goal will be scored.

vertical distance of ring from release point = 0.70 m

(4)

Vertical displacement = ...

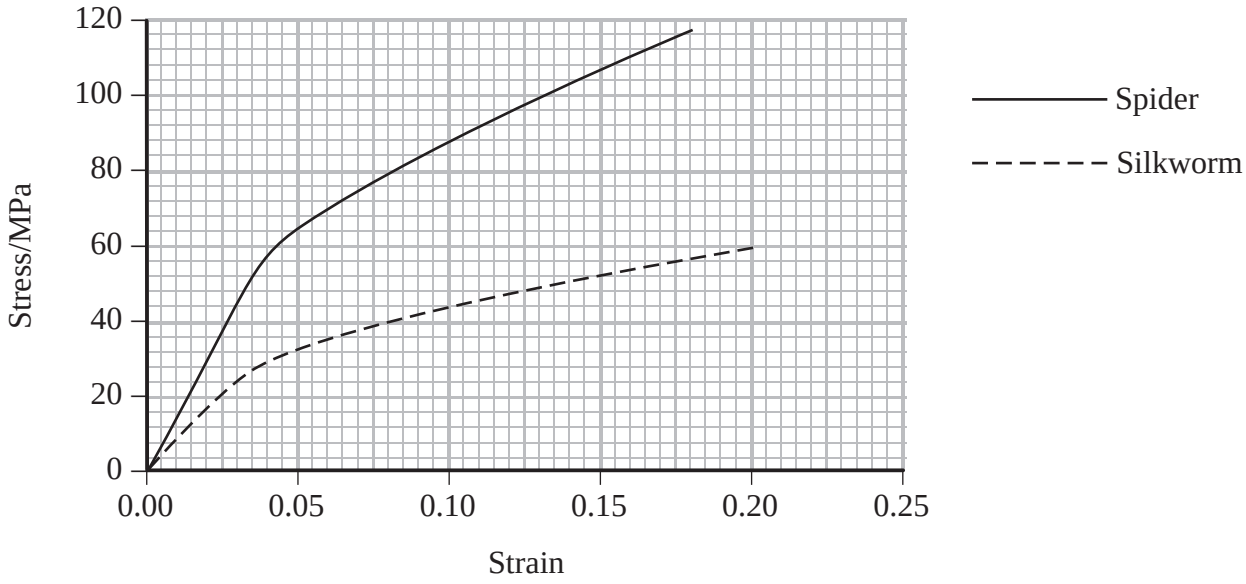
Comment .....

(iii) Explain how air resistance would have affected the calculation in (b)(i).

(2)

(Total for Question 15 = 10 marks)

16 Silk is a natural protein fibre produced by spiders and silkworms. It is a material of high tensile strength. The graph gives the stress-strain curves, up to the point of fracture, for silk produced by spiders and by silkworms.



(a) (i) State what is meant by high tensile strength.

(1)

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*(ii) Spiders use silk to build webs to catch insects. Use the graph to explain how the properties of spider silk make it more suitable than silkworm silk for building webs to catch insects.

(4)

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(b) (i) Use the graph to determine the Young modulus of spider silk for small stresses.

(2)

Young modulus = ...

(ii) An insect flies into a spider's web and becomes attached to a single thread. This creates a tension in the thread of 580 μN. The thread extends by approximately 3% of the original length.

Calculate the radius of a single thread of spider silk.

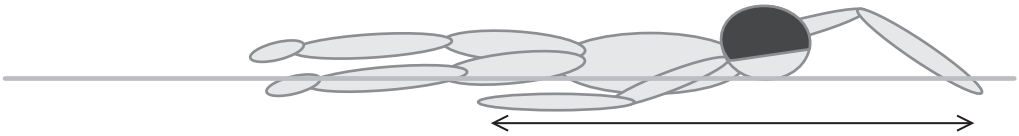
(4)

Radius = ...

(Total for Question 16 = 11 marks)

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17 The diagram shows a swimmer.



(a) The swimmer exerts an average horizontal backward force of 65 N on the water during each stroke. The length of each stroke is 1.4 m.

(i) Show that the work done by the swimmer on the water during each stroke is about 90 J.

(2)

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(ii) The stroke rate of the swimmer is 55 strokes per minute. Calculate the power developed by the swimmer's arms.

(2)

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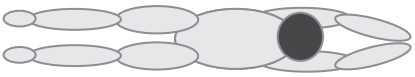
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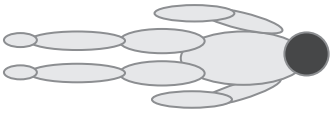
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Power = ...

(b) An investigation was carried out on the drag forces acting on the swimmer.
The swimmer pushed off from the side of the pool with his arms straight ahead of him and his velocity was measured as he glided through the water.
This was repeated with the swimmer's arms at his sides.

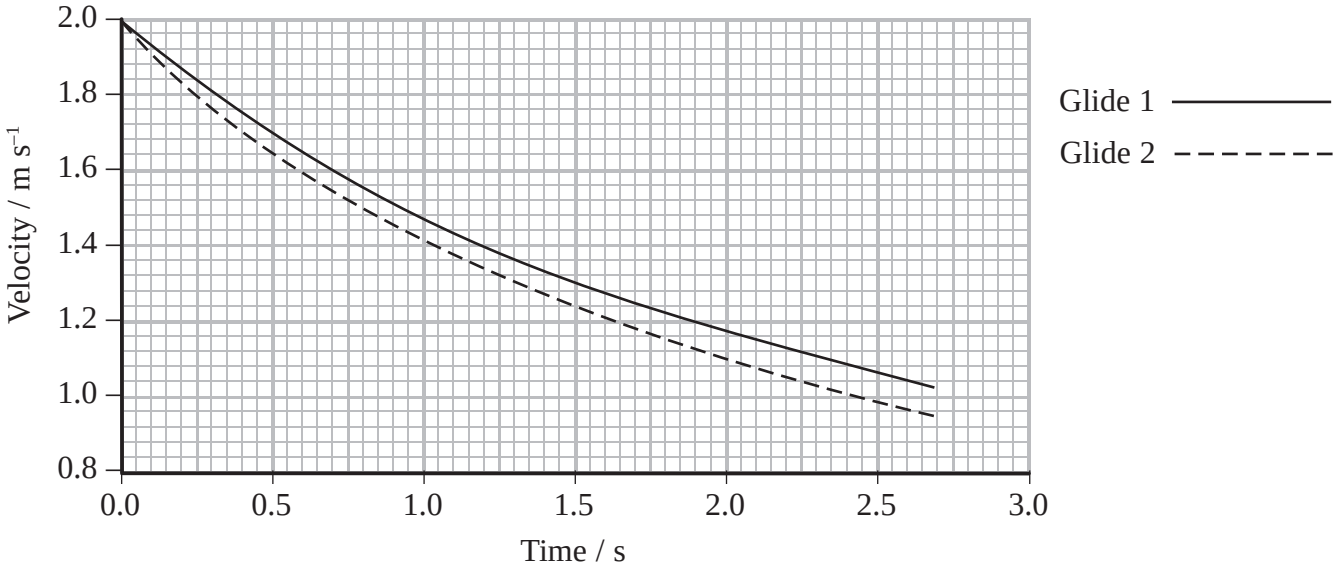


Glide 1



Glide 2

A velocity-time graph was plotted for both glides.



*(i) Use the graph to describe and explain the motion of the swimmer when performing Glide 1 and Glide 2.

(4)

(ii) The drag force can be calculated using

$$\text{Drag force} = \frac{1}{2} C\rho A v^2$$

where

C = drag coefficient

ρ = density of the water

A = cross-sectional area of the swimmer

v = velocity of the swimmer.

Demonstrate that the drag coefficient is a quantity with no units.

(2)

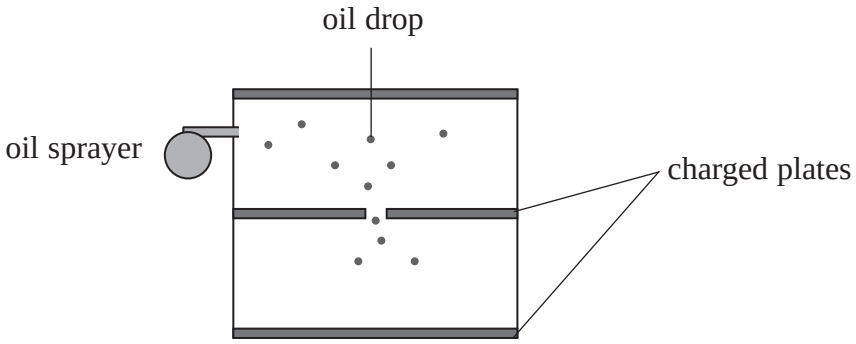
(iii) Suggest and explain an additional measure that a swimmer could use to reduce the drag force acting on him.

(2)

(Total for Question 17 = 12 marks)

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18 In 1909 Robert Millikan did an experiment to find the charge on an electron. Tiny charged oil drops were dropped between two charged plates.



The radius of an oil drop had to be determined so that its weight could be calculated.

Before the plates were charged, Millikan observed how long it took for an oil drop to fall through the air between two fixed points. The terminal velocity and hence the radius could then be calculated.

(a) (i) Complete the free-body force diagram below for an oil drop falling freely through the air.

(2)



(ii) Explain why the oil drop reaches a terminal velocity.

(2)

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(b) An oil drop is travelling at terminal velocity.

(i) The oil drop takes 11.9 s to fall a distance of 10.2 mm.
Show that the terminal velocity of the oil drop is about 0.001 m s^{-1}.

(2)

(ii) Assuming that the upthrust is negligible, show that the radius of the oil drop is about 3 μm.

density of oil = 920 kg m^{-3}
viscosity of air = 1.82×10^{-5} Pa s

(4)

(iii) It is very difficult to measure the radius of such an oil drop directly.
Suggest why.

(2)

(c) Explain why it was necessary for Millikan to maintain the air between the plates at a constant temperature.

(2)

(d) A student tried to model Millikan's method for finding the radius of the oil drop. The student dropped a ball bearing and recorded the time it took to pass between two light gates, a known distance apart.

Explain why this is **not** a good model for Millikan's method.

(2)

(Total for Question 18 = 16 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

$$v = u + at$$
$$s = ut + \tfrac{1}{2}at^2$$
$$v^2 = u^2 + 2as$$

Forces

$$\Sigma F = ma$$
$$g = F/m$$
$$W = mg$$

Work and energy

$$\Delta W = F\Delta s$$
$$E_k = \tfrac{1}{2}mv^2$$
$$\Delta E_{grav} = mg\Delta h$$

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 $E_{el} = \tfrac{1}{2}F\Delta x$