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

Monday 17 October 2016 – Morning
Time: 1 hour 30 minutes

Paper Reference
WPH01/01

You must have:
Ruler and 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.
- 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 Which of the following SI units can **only** be used with a scalar quantity?

☒ **A** m

☒ **B** s

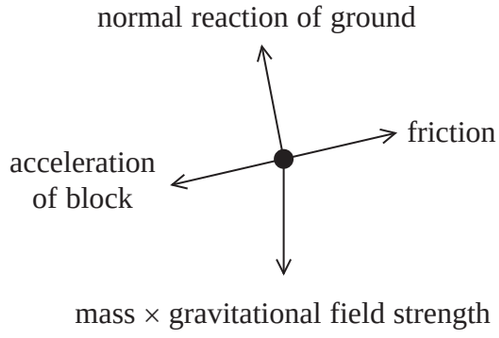
☒ **C** $m\ s^{-1}$

☒ **D** $m\ s^{-2}$

(Total for Question 1 = 1 mark)

2 A free-body force diagram can be used to represent the forces acting on an object.

Which of the following should **not** appear on the free-body force diagram for a block sliding down a slope?



☒ **A** normal reaction of ground

☒ **B** mass × gravitational field strength

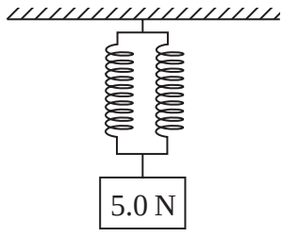
☒ **C** friction

☒ **D** acceleration of block

(Total for Question 2 = 1 mark)

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3 A load of 5.0 N is supported by two identical springs each of spring constant 25 N m^{-1}.



Assuming that the limit of proportionality of the springs is not exceeded, the extension of each spring is

☒ **A** 0.1 m

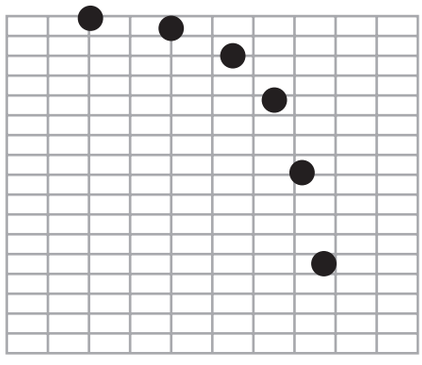
☒ **B** 0.2 m

☒ **C** 5 m

☒ **D** 10 m

(Total for Question 3 = 1 mark)

4 The diagram is taken from a multiflash photograph of an object falling in a vertical plane.



Select the row of the table that correctly describes the horizontal velocity and the vertical velocity of the object.

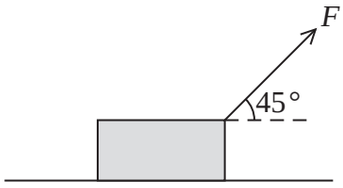
	Horizontal velocity	Vertical velocity
☒ **A**	decreasing	increasing
☒ **B**	decreasing	no change
☒ **C**	no change	increasing
☒ **D**	no change	no change

(Total for Question 4 = 1 mark)

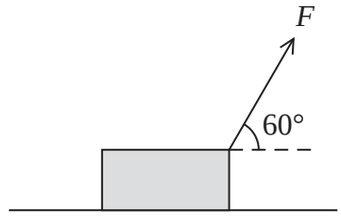
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5 A force F is applied to a box causing the box to move along a horizontal surface.

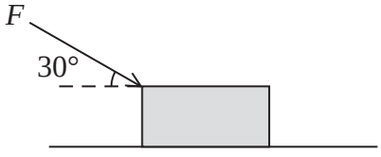
Which of the following would produce the most work done by F on the box for a given horizontal displacement?



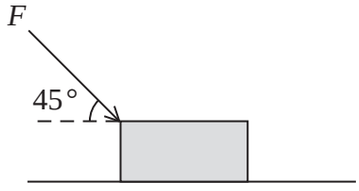
A



B



C



D

☒ **A**

☒ **B**

☒ **C**

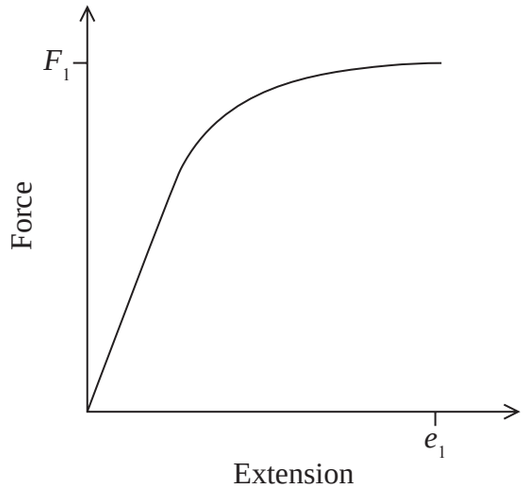
☒ **D**

(Total for Question 5 = 1 mark)

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Use the graph below to answer questions 6 and 7.

The force-extension graph for a wire is shown.
When a force F_1 is applied across the ends of the wire, an extension e_1 is produced.



6 Which of the following correctly describes the work done W to extend the wire?

☒ **A** $W = 0.5\ F_1 e_1$

☒ **B** $W > 0.5\ F_1 e_1$

☒ **C** $W = \frac{F_1}{e_1}$

☒ **D** $W < \frac{F_1}{e_1}$

(Total for Question 6 = 1 mark)

7 It can be deduced from the graph that, up to force F_1, the material is

☒ **A** brittle.

☒ **B** elastic.

☒ **C** malleable.

☒ **D** tough.

(Total for Question 7 = 1 mark)

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8 A child throws a ball vertically upwards and then catches it when it falls back down. When the ball is caught, the ball exerts a force on the child's hand.

According to Newton's third law there will also be

☒ **A** a downwards force of the ball on the hand.

☒ **B** a downwards force of the hand on the ball.

☒ **C** an upwards force of the ball on the hand.

☒ **D** an upwards force of the hand on the ball.

(Total for Question 8 = 1 mark)

9 An object of radius r and mass m falls through air of viscosity η. At terminal velocity v

$$mg = 6\pi\eta rv$$

For this equation to apply which of the following assumptions is **not** correct?

☒ **A** The air flow around the object is laminar.

☒ **B** The object is a small sphere.

☒ **C** The speed of the object is very high.

☒ **D** The upthrust is negligible.

(Total for Question 9 = 1 mark)

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10 Computer printers form an image by placing a series of correctly placed microscopic dots on to paper.

If the temperature of the ink is too high, the size of the dots will increase, producing a darker image.



correct temperature ink



temperature of ink too high

Select the row of the table that correctly describes the effect of the increase in temperature on the viscosity and flow rate of the ink.

	Viscosity of the ink	Flow rate of the ink
☒ **A**	increases	increases
☒ **B**	increases	decreases
☒ **C**	decreases	increases
☒ **D**	decreases	decreases

(Total for Question 10 = 1 mark)

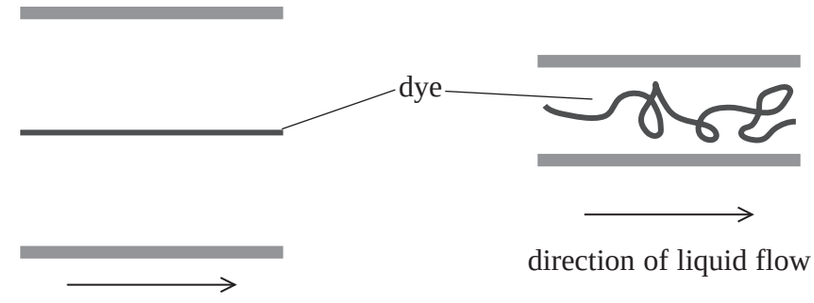
TOTAL FOR SECTION A = 10 MARKS

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SECTION B

Answer ALL questions in the spaces provided.

11 A small drop of dye was injected into the centre of the flow of a liquid moving freely through a pipe. This was repeated for a pipe with a smaller diameter. The dye was seen to take the following paths.



(a) Describe the differences between the flow of the liquid through the large diameter pipe and the smaller diameter pipe.

(3)

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(b) Suggest a possible reason, other than the diameter, for the difference in the flow between the two pipes.

(1)

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(Total for Question 11 = 4 marks)

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12 A water fountain in a lake is operated by an electric pump. The pump pushes water to a height of 5.5 m.



The manufacturers of the pump claim that the pump can move a mass of 22 000 kg of water per hour.

(a) Calculate the minimum power output of the pump.

(3)

Minimum power output = ...

(b) Explain why the power output calculated in (a) is a minimum value.

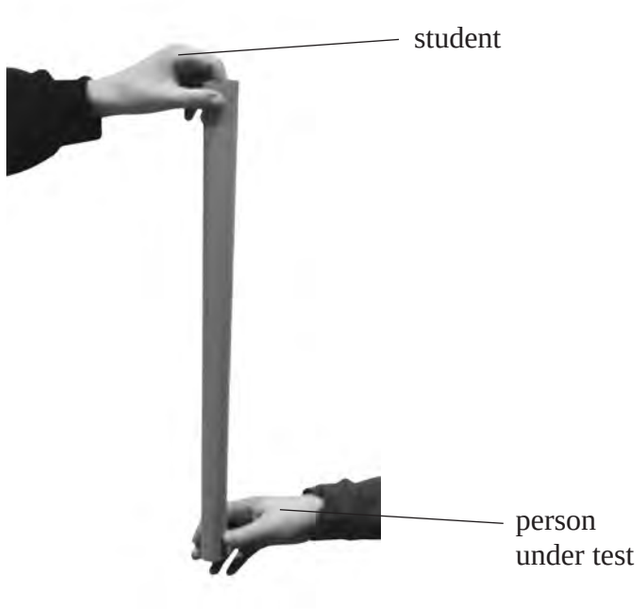
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(Total for Question 12 = 5 marks)

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13 The reaction time of a person can add approximately 0.2 s to a measured time. A student decided to make a basic device to measure a person's reaction time. The only equipment the student used was a strip of card 50 cm long, a ruler and a calculator.

To use the timer the student holds the card vertically so that it will fall between the fingers and thumb of the person under test as shown.
The person under test holds their hand in the position shown, but not touching the card.

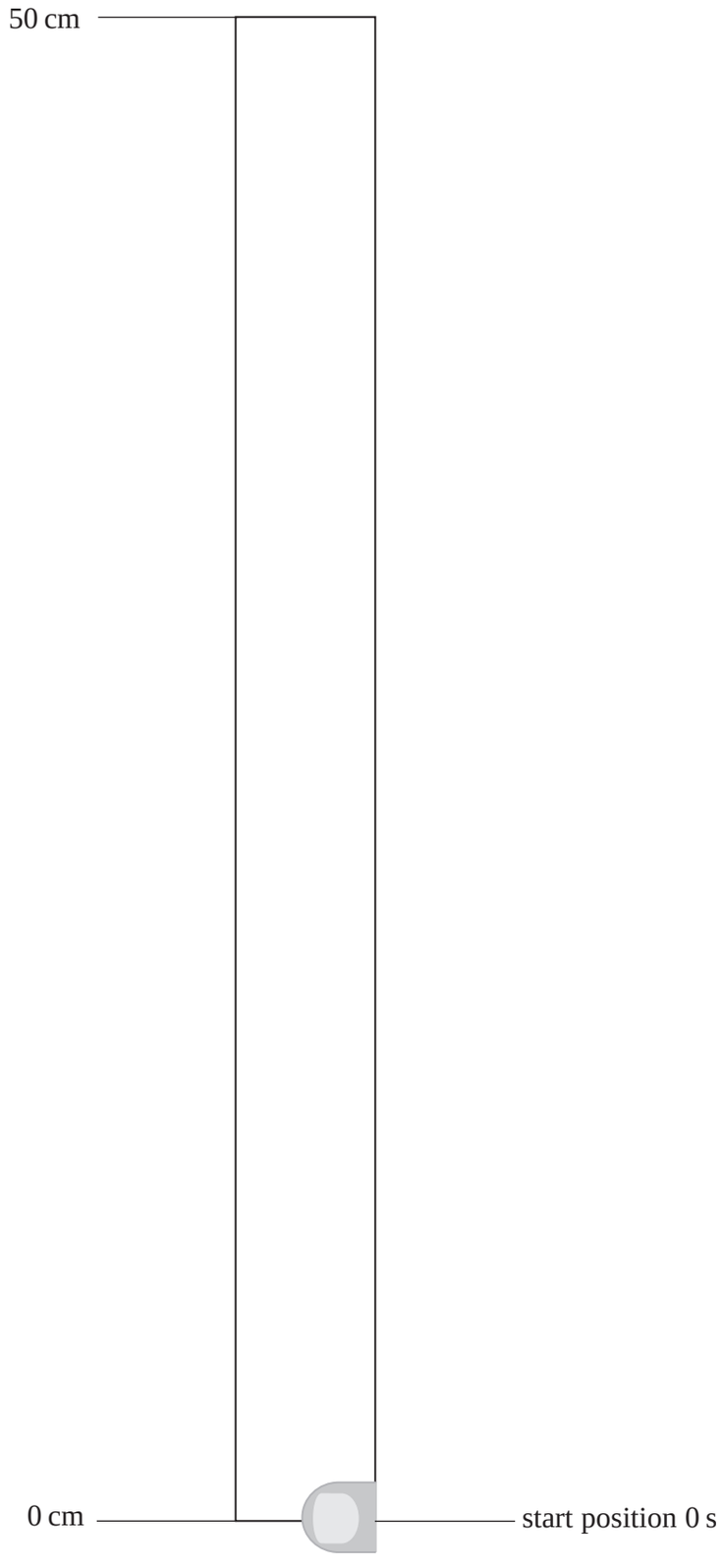


The student releases the strip and the person under test grabs it as quickly as possible, marking the position on the card at which it is caught.

Mark on the scale diagram on the opposite page the positions at which the card will be caught for reaction times of 0.10 s and 0.30 s. Show all working out in the space below.

(4)

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(Total for Question 13 = 4 marks)

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14 The aim of a high jump event is to jump over a horizontal bar at the greatest possible height without knocking the bar off. The Fosbury flop and Straddle jump are two styles of jump that can be used by athletes in high jump events.



Fosbury flop

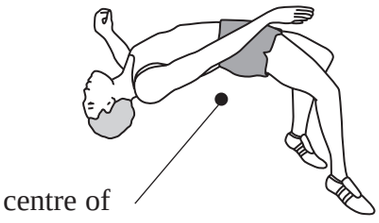


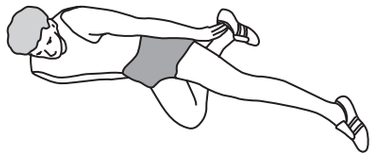
Straddle jump

(a) The diagrams below show the positions of the athletes as they pass over the bar. The approximate position of the centre of gravity of the athlete using the Fosbury flop has been drawn.

Mark the approximate position of the centre of gravity of the athlete using the Straddle jump.

(1)





*(b) Suggest, with an explanation, why most athletes prefer to use the Fosbury flop.

(3)

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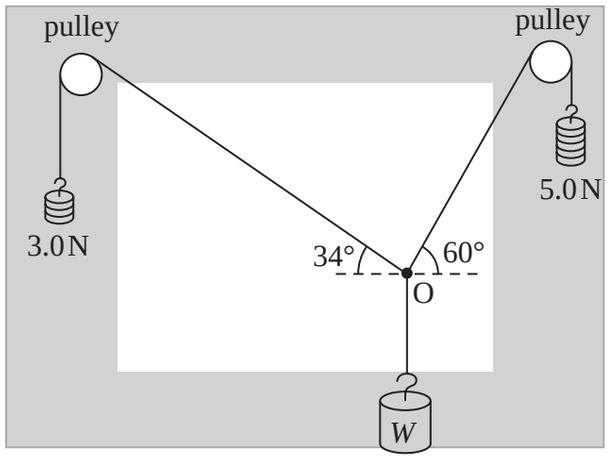
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(Total for Question 14 = 4 marks)

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15 The diagram shows the apparatus that can be used to determine the weight of a given body using vector addition.

Three pieces of string are tied together at point O. Two of the strings pass over frictionless pulleys and weights of 3.0 N, 5.0 N and an unknown weight *W* are attached as shown, so that the system is in equilibrium.



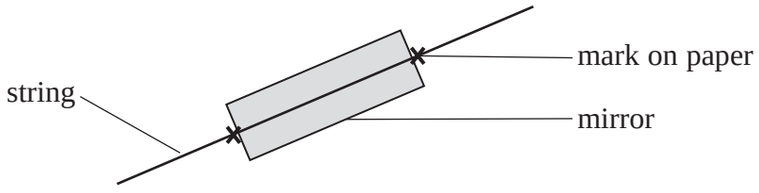
(a) Draw a scaled vector diagram, on the grid below, of the forces acting on point O. Use your diagram to determine the magnitude of the unknown weight *W*.

(4)

Magnitude of *W* = ...

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(b) The angles are determined by marking the positions of the strings on a sheet of paper behind the strings. To improve accuracy, a mirror is placed behind each string.



Explain how the use of the mirror improves the accuracy of this experiment.

(2)

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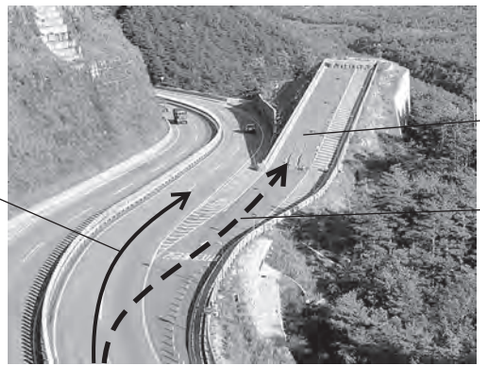
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(Total for Question 15 = 6 marks)

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16 An escape lane is an emergency area placed next to a steep, downhill section of a road. It allows vehicles with brake failure to slow down and stop away from the other traffic.

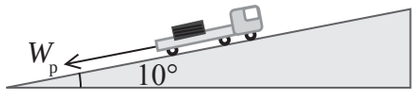
One type of escape lane uses a gravity ramp. These are built with an upwards gradient to slow the vehicle.



(a) Explain how using the ramp enables a vehicle to stop.

(2)

(b) An escape lane consists of a ramp at an angle of 10° to the horizontal and is 180 m in length. A lorry of mass 2.8×10^3 kg enters the escape lane due to brake failure.



(i) Show that the component of the weight of the lorry parallel to the ramp is about 5×10^3 N.

(3)

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(ii) The lorry uses the full length of the ramp while stopping and the frictional force of the road surface can be assumed to be negligible.

Calculate the maximum work done on the lorry bringing it to rest.

(2)

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Maximum work done on the lorry = ...

(iii) Calculate the maximum speed of the lorry so that it could be stopped by the ramp.

(2)

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Maximum speed of the lorry = ...

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(c) Another type of escape lane uses a mechanical-arrestor system. This uses a series of steel nets set up along an escape lane to stop a vehicle. The nets are connected to the barriers at the sides of the escape lane using long steel strips that extend beyond their elastic limit as the vehicle slows down.



(i) State one advantage of building a mechanical-arrestor escape ramp compared to a gravity ramp.

(1)

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(ii) Suggest why it is necessary for the steel strips to extend beyond their elastic limit.

(2)

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(Total for Question 16 = 12 marks)

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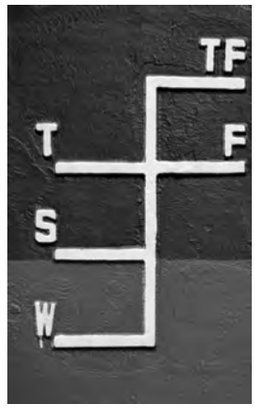
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17 As a ship is loaded, it moves lower in the water so that the water level rises up the side of the ship. The Plimsoll line, on the side of the ship, shows the maximum depth to which the ship can be immersed when loaded with cargo.

(a) The photograph shows the Plimsoll line markings on a ship.



tropical fresh water

tropical salt water

fresh water

salt water (summer)

salt water (winter)

The maximum loading depth depends upon:

- the ship's dimensions
- the time of year
- water density

(i) Use the idea of upthrust to explain why a ship would be lower in the water when loaded.

(3)

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*(ii) Explain why the marking for tropical fresh water is higher up the side of the ship than the marking for tropical salt water.

(3)

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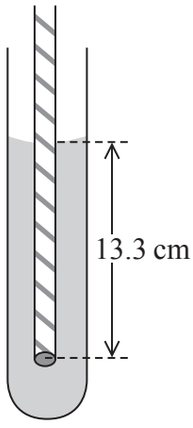
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(b) A student devised a simple experiment to demonstrate the change in position of a ship when in water of different salt concentrations.

The student placed a straw, sealed and weighted at the bottom, into a test tube containing distilled water. The length of straw below the surface of the water was then measured.



The straw settled in a position so that the length below the surface of the water was 13.3 cm. The experiment was then repeated using water containing 20% salt.

Calculate the length of straw now below the surface of the water.

density of distilled water = 998 kg m^{-3}
density of distilled water containing 20% salt = 1150 kg m^{-3}

(5)

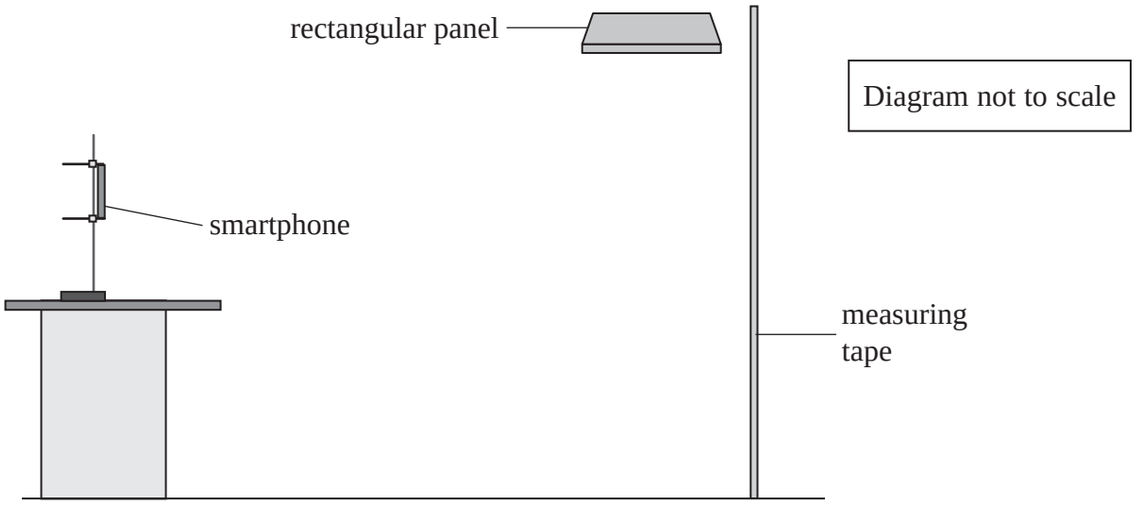
Length below surface = ...

(Total for Question 17 = 11 marks)

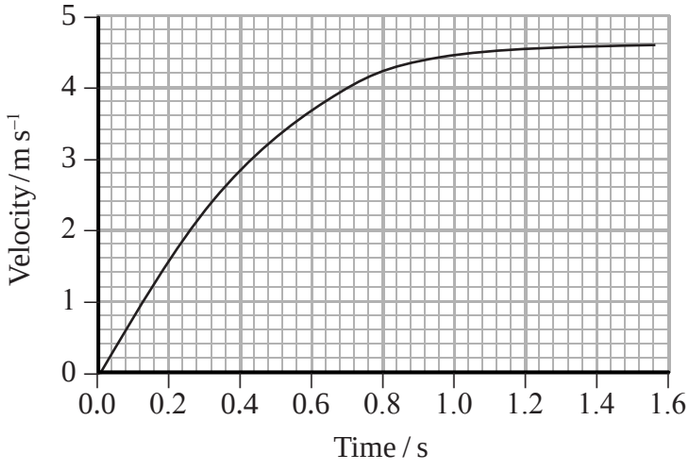
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18 A student investigated the motion of a small rectangular panel. The panel was held above the floor next to a measuring tape.

The panel was released and, using a video camera on a smartphone, its motion as it fell to the floor was recorded. Using the position of the panel at regular time intervals the velocity of the panel was obtained.



The velocity-time graph shows the motion of the panel until it reaches the floor.



(a) Show that the panel was dropped from a height of approximately 5 m.

(3)

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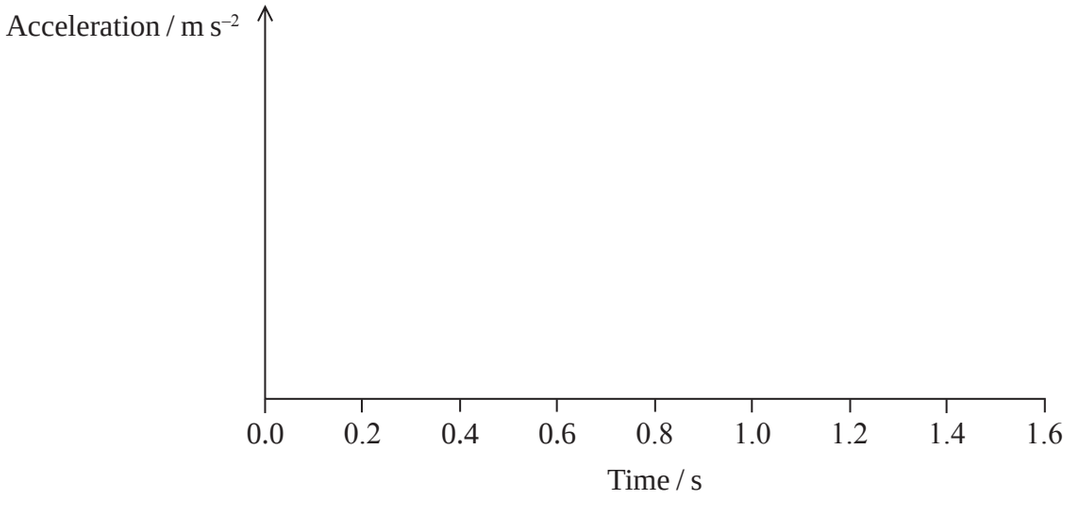
(b) (i) Use the graph to calculate the maximum acceleration of the panel.

(3)

Maximum acceleration = ...

(ii) Without further calculation sketch an acceleration-time graph for the panel on the axes below.

(4)



(c) Explain how the student can check the reliability of these results.

(2)

(Total for Question 18 = 12 marks)

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19 A contact lens is a thin plastic lens placed directly onto the eye to correct vision. Contact lenses are commonly made from a silicone hydrogel material.

The Young modulus of the material used in a contact lens can determine how well the lens fits the eye and how well the lens functions at correcting vision.

(a) State the meaning of the term Young modulus.

(1)

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(b) Suggest how the fit of a lens and its function are affected when it is made from a material with a high Young modulus.

(2)

Fit .....

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Function .....

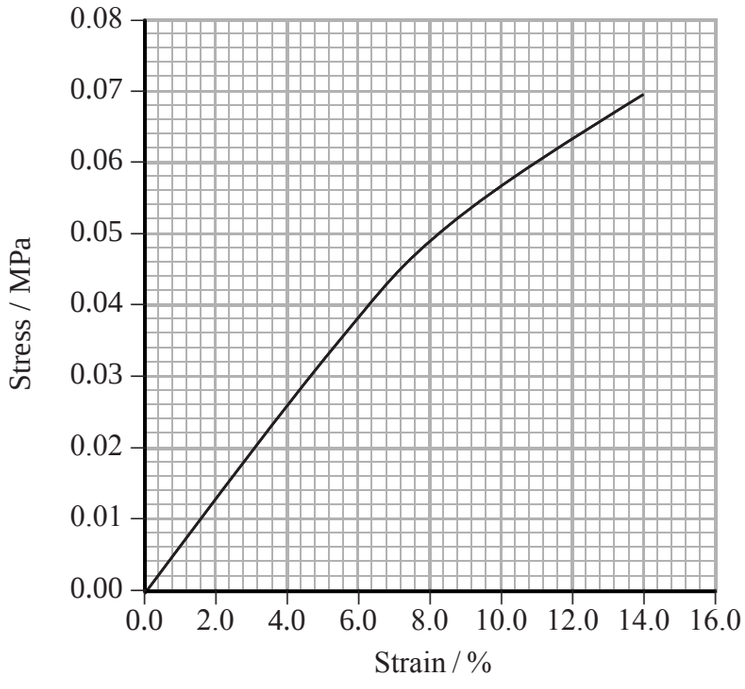
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(c) To investigate the properties of a contact lens, a lens manufacturer placed a rectangular sample of a silicone hydrogel material in a tensile testing machine and a tensile force was exerted on the sample.

The resulting stress-strain graph for the sample is shown.



(i) Show that the Young modulus of the silicone hydrogel is about 0.6 MPa.

(2)

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(ii) When a force of 0.101 N is applied across the sample, a strain of 8% is produced.

Determine the thickness of the sample.

width of sample = 5.5×10^{-3} m

(4)

Thickness of the sample = ...

*(iii) The thickness of a lens is not uniform. An actual lens is placed in the tensile testing machine.

Explain why the extension produced is greater where the thickness of the lens is smaller.

(3)

(Total for Question 19 = 12 marks)

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

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

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