Write your name here

Surname	Other names

Pearson
Edexcel GCE

Centre Number	Candidate Number

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Tuesday 19 May 2015 – Morning
Time: 1 hour 30 minutes

Paper Reference
6PH01/01

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 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 ▶

P44922A

1/1/1/1/1/1/
P 4 4 9 2 2 A 0 1 2 8

PEARSON

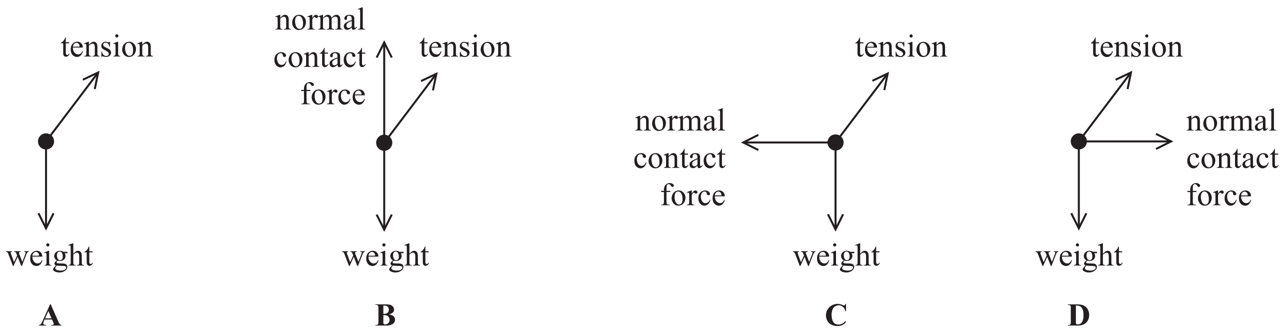
SECTION A

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 climber slides down a rope attached to a rock face, as shown in the photograph.

Select a possible free-body force diagram for the climber.



☐ **A**

☐ **B**

☐ **C**

☐ **D**

(Total for Question 1 = 1 mark)

P 4 4 9 2 2 A 0 2 2 8

2 The correct definition of the term centre of gravity is the point at which

☒ **A** all of the force acts on a body.

☒ **B** gravity acts on a body.

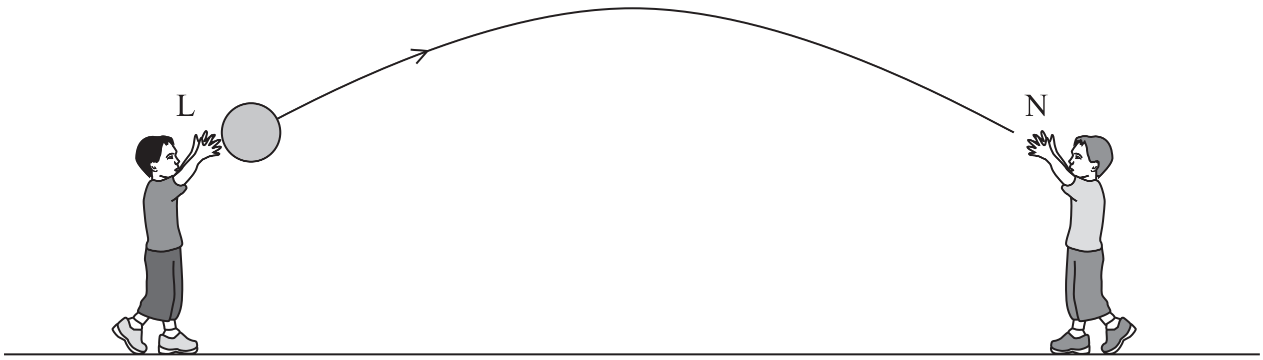
☒ **C** the weight of a body may be considered to act.

☒ **D** the weight is concentrated.

(Total for Question 2 = 1 mark)

3 A ball is thrown from position L and caught at position N.

L and N are the same height above the ground. The trajectory of the ball is shown.



If vectors directed upwards are taken as positive, and air resistance is neglected then the acceleration of the ball at L is $-g$ and its speed is v.

Select the row of the table that correctly gives the acceleration and speed of the ball as it reaches N.

	Acceleration	Speed
☒ **A**	$-g$	v
☒ **B**	$-g$	$-v$
☒ **C**	g	v
☒ **D**	g	$-v$

(Total for Question 3 = 1 mark)

Questions 4 and 5 refer to the experiment described below.

A student carries out an experiment to calculate a value for *g*, the acceleration of free fall. A marble is dropped from a height of 2.0 m and the time taken for the marble to fall to the floor is recorded.

The following readings were obtained:

0.55 s 0.57 s 0.49 s 0.56 s

4 Which of the following times should the student use to determine their value for *g*?

☒ **A** 0.54 s

☒ **B** 0.55 s

☒ **C** 0.56 s

☒ **D** 0.57 s

(Total for Question 4 = 1 mark)

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5 Select the equation that would, by itself, enable the student to calculate a value for *g*.

☒ **A** $mgh = \frac{1}{2}mv^2$

☒ **B** $s = ut + \frac{1}{2}at^2$

☒ **C** $v = u + at$

☒ **D** $v^2 = u^2 + 2as$

(Total for Question 5 = 1 mark)

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6 In the manufacture of cars, mild steel sheets are formed into panels of an appropriate shape.

Mild steel can be shaped in this way because it is

☒ **A** brittle.

☒ **B** hard.

☒ **C** malleable.

☒ **D** strong.

(Total for Question 6 = 1 mark)

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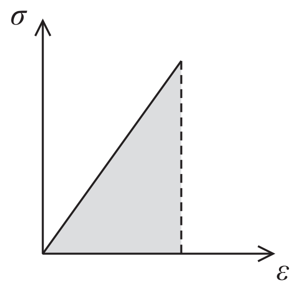
7 A force was applied across the ends of an iron bar. The following stress-strain graph was obtained.



The shaded area represents

☒ **A** $\dfrac{\text{work done}}{2 \times \text{volume}}$

☒ **B** $\dfrac{\text{work done}}{\text{volume}}$

☒ **C** $\dfrac{2 \times \text{work done}}{\text{volume}}$

☒ **D** work done

(Total for Question 7 = 1 mark)

8 A box is dropped from a plane flying at a constant velocity and height.

Assuming that air resistance is negligible, as the box falls to the ground its horizontal position will

☒ **A** remain unchanged.

☒ **B** lag behind the plane.

☒ **C** move ahead of the plane.

☒ **D** remain directly under the plane.

(Total for Question 8 = 1 mark)

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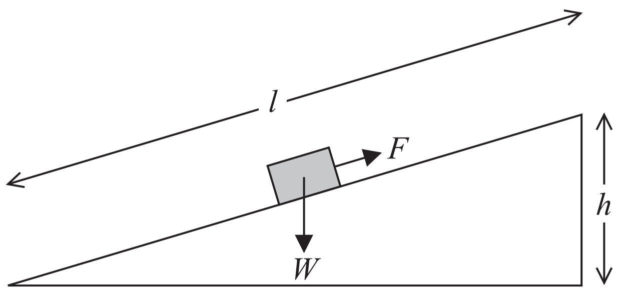
9 A student uses a force F to push a block of weight W all the way up a frictionless ramp, at a constant speed.



The work done by the student can be calculated using

☒ **A** Fh

☒ **B** $(F–W)\,l$

☒ **C** Wh

☒ **D** Wl

(Total for Question 9 = 1 mark)

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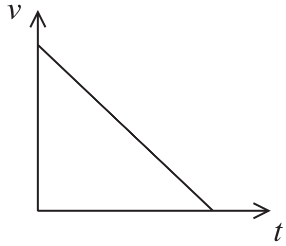
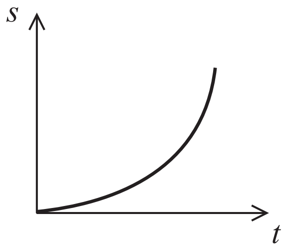
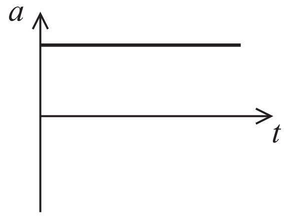
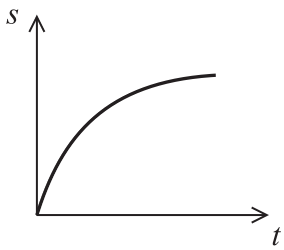
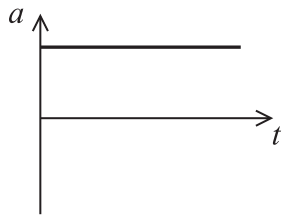
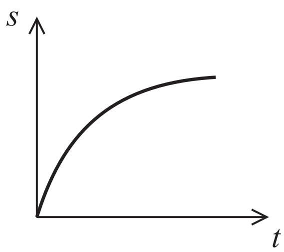
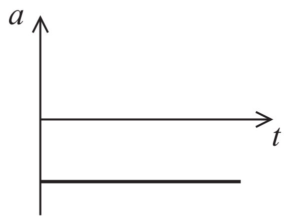
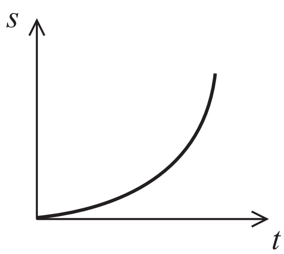
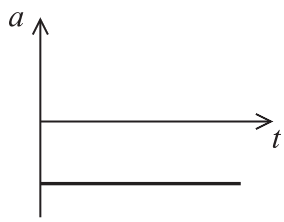
10 A ball is rolled along a horizontal surface. Frictional forces slow the ball to rest.

The velocity-time graph for the ball is shown.



Select the row of the table that correctly gives the corresponding displacement-time and acceleration-time graphs for the ball.

	Displacement-time graph	**Acceleration-time graph**
☒ **A**		
☒ **B**		
☒ **C**		
☒ **D**		

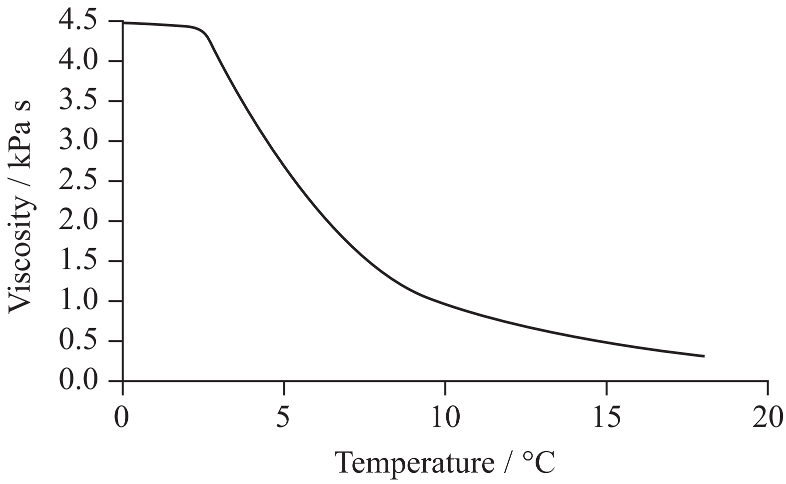
(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 The graph shows the effect of temperature on viscosity for butter.



A student wants to spread butter on some bread.

Explain why it is easier to use butter at room temperature than straight from the fridge.

(2)

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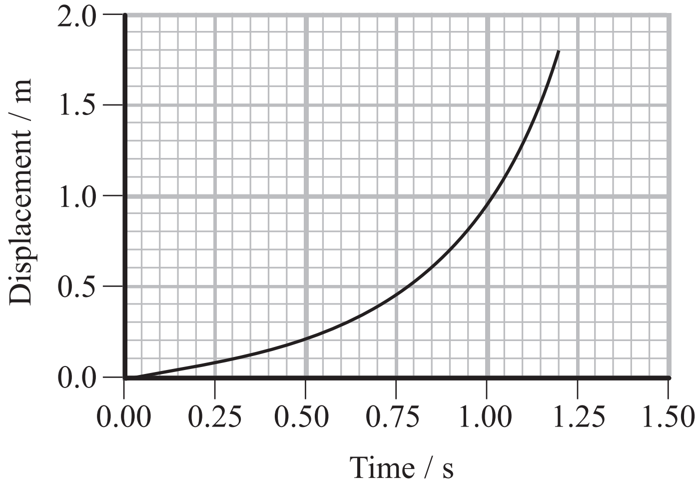
(Total for Question 11 = 2 marks)

12 A small, gas-filled balloon was dropped from a height. The displacement-time graph for the balloon is shown.



As the displacement of the balloon from its point of release increased, gravitational potential energy was transferred to kinetic energy and thermal energy.

(a) State why the rate of energy transfer was greatest at 1.20 s.

(1)

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(b) By calculating the change in gravitational potential energy of the balloon between 1.05 s and 1.20 s, show that the average rate at which the gravitational potential energy was transferred during this time interval was about 0.2 W.

mass of balloon and air = 0.004 kg

(3)

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(Total for Question 12 = 4 marks)

13 (a) State what is meant by work done.

(1)

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(b) A car of mass 1.5×10^3 kg is travelling on a country road towards a village at 55 miles per hour. The speed limit in the village is 30 miles per hour.

When the brakes are applied, there is a constant braking force of 3750 N.

Calculate the minimum distance before reaching the village that the driver should apply the brakes to avoid exceeding the speed limit.

55 miles per hour = 24.6 m s^{-1}

30 miles per hour = 13.4 m s^{-1}

(3)

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Minimum distance = ...

(Total for Question 13 = 4 marks)

14 Physical quantities can be vectors or scalars.

(a) Describe what is wrong with each of the following statements.

(3)

A car has a mass of 10 000 N acting vertically downwards.

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The velocity of light from the Sun is 3×10^8 m s^{-1}.

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The car slowed down with an acceleration of 2.5 m s^{-2}.

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(b) A car travels 45 km due north and then 30 km due east.

(i) Calculate the total distance travelled by the car.

(1)

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Total distance travelled = ...

(ii) Calculate the displacement of the car.

(3)

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Magnitude of displacement = ...

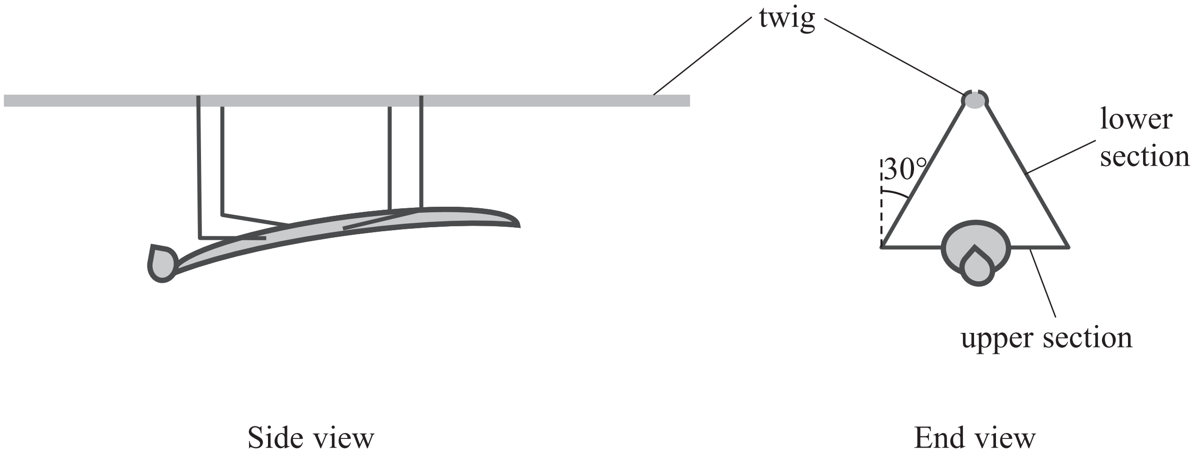
Direction = ...

(Total for Question 14 = 7 marks)

15 The photograph shows a praying mantis hanging from a thin twig. Four of the praying mantis's six legs are in contact with the twig. The tension in the legs balances the weight to keep the praying mantis stationary.

© Robert Clamp

(a) The diagrams show a simplified model of the situation. For each leg in contact with the twig, the upper section is horizontal and the lower section is at an angle of 30° to the vertical.



(i) Calculate the tension in the lower section of each leg in contact with the twig assuming that these tensions are all equal.

mass of praying mantis = 5.4×10^{-4} kg

(4)

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Tension = ...

(ii) A student suggests that the tension in each leg in contact with the twig is 25% of the weight of the praying mantis. State why this is **not** correct.

(1)

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(b) The praying mantis moves around the twig so that it is now standing upright and on top of the twig.

State the difference between the stress in the legs when the praying mantis is beneath the twig and when it is on top of the twig.

(1)

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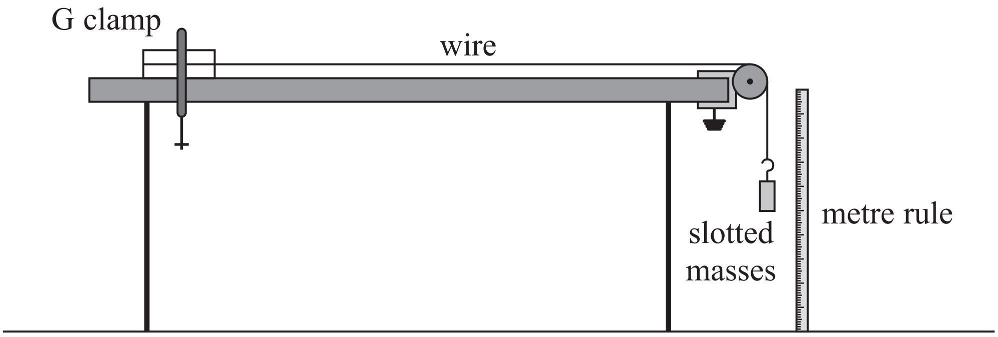
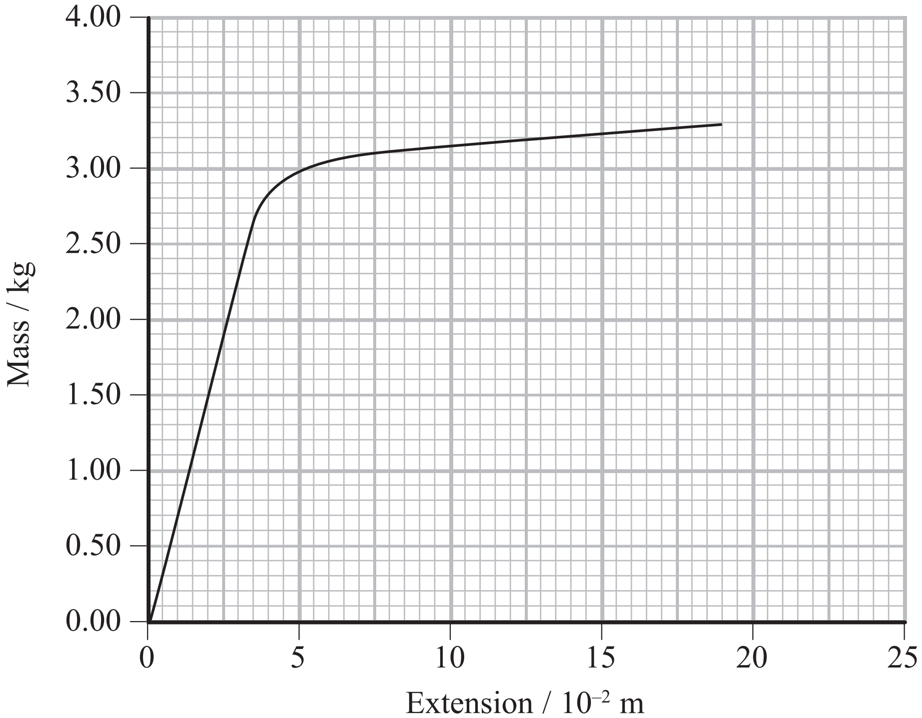
(Total for Question 15 = 6 marks)

16 The diagram shows the equipment a student used to investigate the behaviour of a material in the form of a wire under an increasing tension.



Masses were added up to a maximum of 3.30 kg. Each time a mass was added the extension of the wire was calculated.

(a) The following mass-extension graph was obtained.



(i) Initially the extension increased linearly.

State what is meant by 'increased linearly' in relation to this graph and what can be concluded about the wire from this observation.

(2)

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(ii) Use the graph to calculate the maximum energy that the wire could store while behaving linearly.

(3)

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Maximum energy = ...

(iii) Describe the behaviour of the wire when the added mass was greater than 2.9 kg.

(2)

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(b) The student modifies the investigation.

(i) Suggest **one** modification that would produce a greater extension for a given mass.

(1)

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(ii) Suggest **two** measuring techniques that could be used to ensure the accuracy of the measured extensions.

(2)

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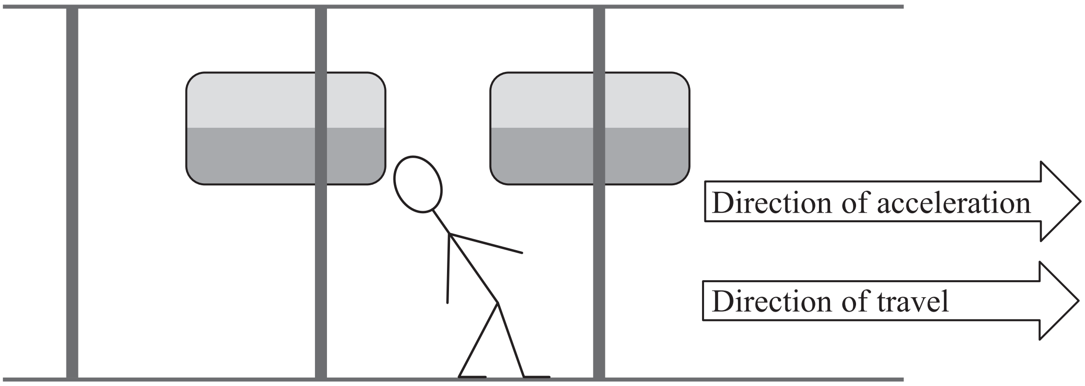
(Total for Question 16 = 10 marks)

17 A passenger is standing in a train.

(a) The train accelerates and he falls backwards.



Use Newton's first law of motion to explain why he falls backwards.

(3)

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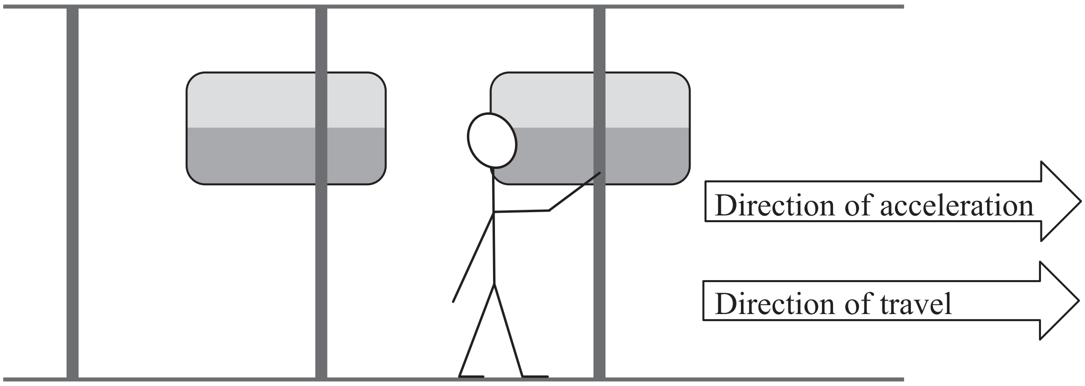
*(b) As the train leaves the next station the passenger holds on to a vertical support as the train accelerates. This prevents the passenger falling backwards.



With reference to Newton's laws of motion, explain why holding on to a vertical support prevents the passenger falling backwards.

(5)

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(Total for Question 17 = 8 marks)

18 A student investigated the physics of football.

(a) She used the equations of motion to model the behaviour of a ball when kicked at different angles to the horizontal. She predicted the height of the ball when it reached the goal, presuming it was kicked from the same place, with the same initial speed, each time. The results are shown in the table below.

Angle to the horizontal / °	**Height of the ball when it reached the goal / m**
10	–0.78
20	1.0
30	2.8
40	4.7

(i) State the significance of the negative value of height for an angle of 10°.

(1)

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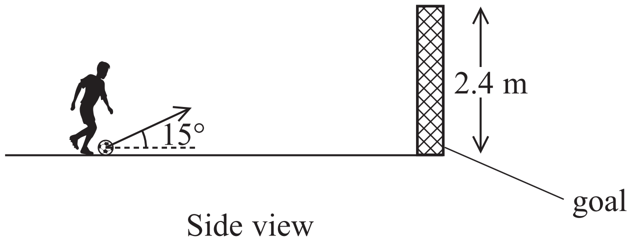
(ii) On the diagram below, sketch and label the predicted path of the ball for angles of 20° and 40°.

(2)

P 4 4 9 2 2 A 0 1 8 2 8

(b) (i) During a football match the ball is kicked towards the goal, at an angle of 15° to the horizontal, from a distance of 11 m as shown.



Side view

The ball has a diameter of 0.22 m and an initial speed of 26 m s^{-1}.

By means of a calculation, determine whether or not the ball will pass into the goal. You may ignore the effects of air resistance.

(6)

(ii) Air resistance would cause an additional force on the ball.

Explain the effect this would have on the ball's motion.

(2)

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(Total for Question 18 = 11 marks)

19 An exhibit in a science museum requires the observer to use a pump to create air bubbles in a column of liquid. The bubbles then rise through the liquid.

(a) (i) Complete the free-body force diagram for a bubble as it rises through the liquid.

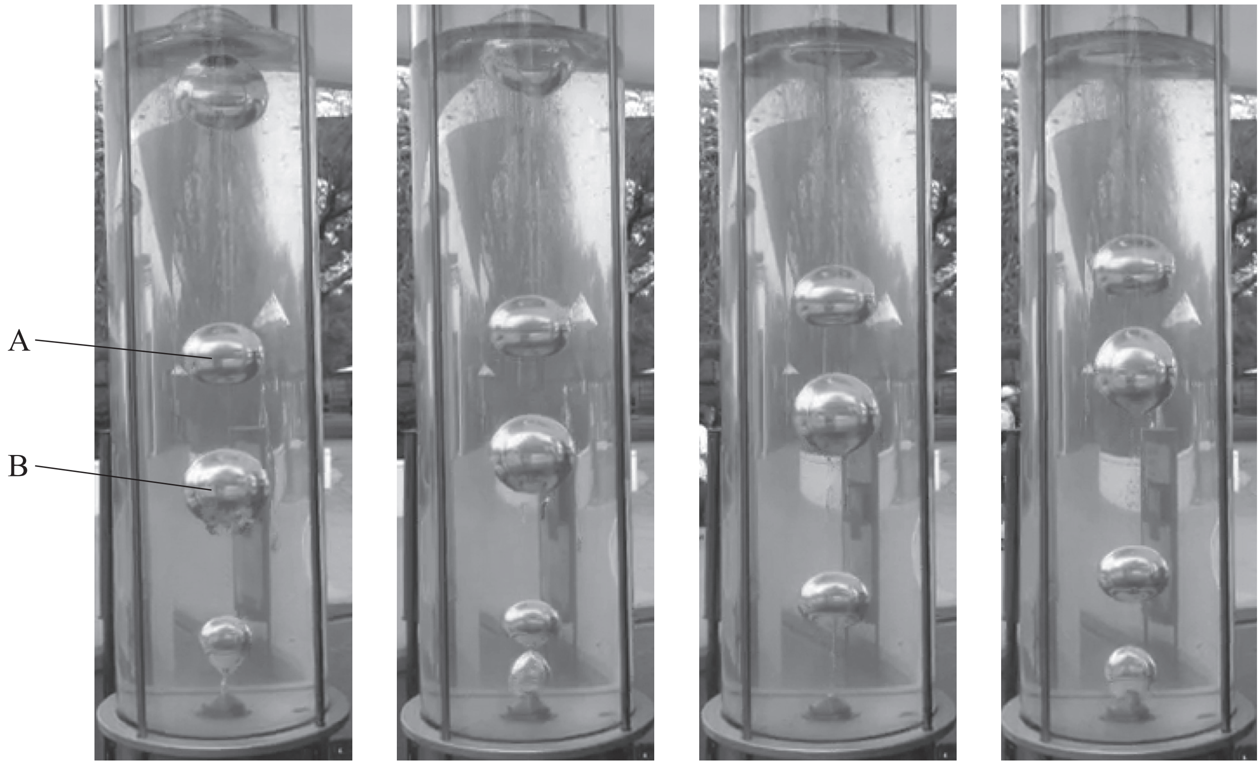
(3)

*(ii) It is observed that larger bubbles reach the top of the column of liquid in less time than smaller bubbles.

By considering the forces acting on a bubble as it rises, explain this observation.

(3)

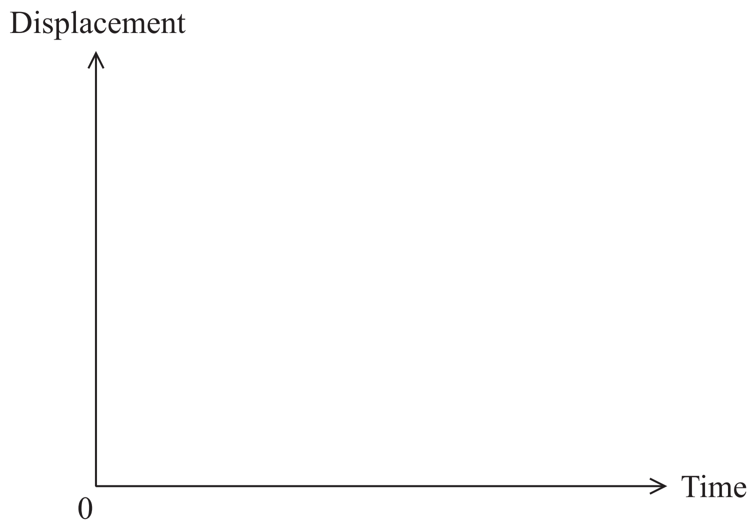
(b) The following photographs were taken at 0.33 s intervals.



Photograph 1 time = 0 | Photograph 2 | Photograph 3 | Photograph 4

(i) Sketch on the axes below two labelled lines to show how the displacements of the smaller bubble A and the larger bubble B vary with time over the four images.

(2)



(ii) The photographs are at a scale of 1 to 12. By using measurements from the photographs, calculate the speed of bubble B between photographs 2 and 3.

(4)

Speed of bubble B = ...

(c) A student wishes to determine the total drag force acting on a bubble.

(i) Explain why it might not be possible to use Stokes' law to calculate the drag force acting on a bubble.

(2)

*(ii) Describe an additional measurement that would need to be taken from the photograph and how it could be used to determine the drag force, assuming that the bubble has reached its terminal velocity.

(4)

(Total for Question 19 = 18 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 $E_{el} = \tfrac{1}{2}F\Delta x$

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