Edexcel Physics Unit 1

Past Paper Pack

2009-2013

Write your name here

Surname	Other names

Edexcel GCE

Centre Number	Candidate Number

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Tuesday 13 January 2009 – Afternoon
Time: 1 hour 20 minutes

Paper Reference
6PH01/01

You do not need any other materials.

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

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- 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 1–10, 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 The table shows some physical quantities. Which row correctly identifies scalar and vector quantities?

		Scalar	Vector
☒	**A**	distance	acceleration
☒	**B**	time	speed
☒	**C**	velocity	force
☒	**D**	work	power

(Total for Question 1 = 1 mark)

2 A cyclist travelling at a speed of 4.2 m s^{-1} accelerates at 1.1 m s^{-2}. In a time of 7.4 s the distance travelled is

☒ **A** 30 m

☒ **B** 35 m

☒ **C** 61 m

☒ **D** 91 m

(Total for Question 2 = 1 mark)

3 Which of these units is the same as the newton?

☒ **A** kg m s^{-1}

☒ **B** kg m s^{-2}

☒ **C** kg m^2 s^{-2}

☒ **D** kg m^2 s^{-3}

(Total for Question 3 = 1 mark)

4 A student is asked to determine the output of a motor as it lifts an object. He measures the height through which the object is raised, the time taken and the weight of the object.

To find the power he must calculate

☒ **A** height × weight × time

☒ **B** $\frac{\text{height} \times \text{weight}}{\text{time}}$

☒ **C** $\frac{\text{time} \times \text{weight}}{\text{height}}$

☒ **D** $\frac{\text{weight}}{\text{height} \times \text{time}}$

(Total for Question 4 = 1 mark)

5 A football is kicked at a speed of 12 m s^{-1} at an angle of 35° to the horizontal. The horizontal component of its velocity, in m s^{-1}, is given by

☒ **A** 12 cos 35°

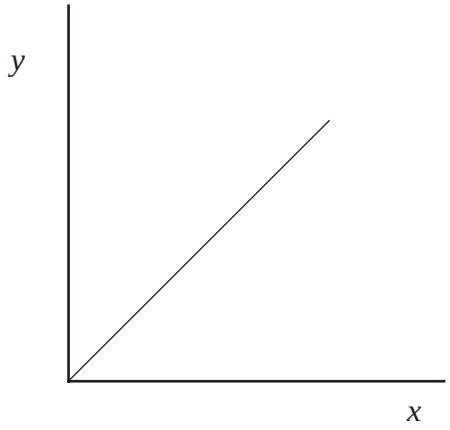
☒ **B** 12 sin 35°

☒ **C** $\frac{12}{\cos 35°}$

☒ **D** $\frac{12}{\sin 35°}$

(Total for Question 5 = 1 mark)

6 The diagram shows a graph plotted using the results from an experiment in which a metal wire was stretched.



The gradient of the graph equals the Young modulus of the metal.

Which row gives the correct labels for the axis?

		y	*x*
☒	**A**	extension	force
☒	**B**	force	extension
☒	**C**	strain	stress
☒	**D**	stress	strain

(Total for Question 6 = 1 mark)

7 A pigeon of mass 0.45 kg is flying with kinetic energy 58 J.
Its speed is

☒ **A** 8.0 m s^{-1}

☒ **B** 11 m s^{-1}

☒ **C** 16 m s^{-1}

☒ **D** 22 m s^{-1}

(Total for Question 7 = 1 mark)

8 A ball bearing is dropped through a liquid and its terminal velocity measured.
The experiment is repeated at a different temperature.

Which row could correctly describe this second experiment?

		Temperature	Viscosity	Terminal velocity
☒	**A**	lower	greater	faster
☒	**B**	lower	greater	slower
☒	**C**	higher	greater	slower
☒	**D**	higher	smaller	slower

(Total for Question 8 = 1 mark)

9 Velocity can be found from the

☒ **A** area under a displacement-time graph

☒ **B** area under a force-time graph

☒ **C** gradient of a displacement-time graph

☒ **D** gradient of an acceleration-time graph

(Total for Question 9 = 1 mark)

10 A freely falling object on Earth has a speed of 5.0 m s^{-1}.

After falling a further 20 m its speed is

☒ **A** 15 m s^{-1}

☒ **B** 20 m s^{-1}

☒ **C** 25 m s^{-1}

☒ **D** 45 m s^{-1}

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 The Saturn V rocket used in NASA's space programme had a mass of 3.04×10^6 kg. It took off vertically with a thrust force of 3.40×10^7 N.

(a) Show that the resultant force on the rocket is about 4×10^6 N.

(3)

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(b) Calculate the initial acceleration.

(2)

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.....

Initial acceleration = ...

(c) After 150 s the rocket reached a speed of 2390 m s^{-1}.

Calculate its average acceleration.

(2)

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.....

.....

Average acceleration = ...

(d) Suggest why the initial acceleration and average acceleration are different.

(1)

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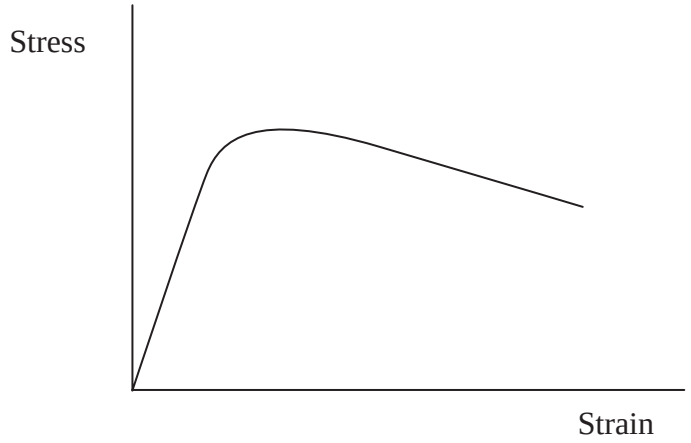
(Total for Question 11 = 8 marks)

12 The graph shows how stress varies with strain for a given material.



(a) Explain what is meant by each of the following terms

(3)

limit of proportionality (L)

.....

.....

tensile strength

.....

.....

yield point (Y)

.....

.....

(b) Using crosses and the letters shown above, mark the 'limit of proportionality' (L) and the 'yield point' (Y) on the graph.

(2)

(Total for Question 12 = 5 marks)

13 When a ball moves through air, the airflow is laminar around the front of the ball and turbulent behind it.

(a) State what is meant by

(2)

laminar flow

.....

.....

turbulent flow

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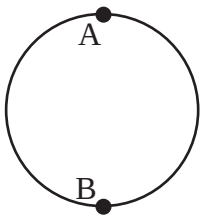
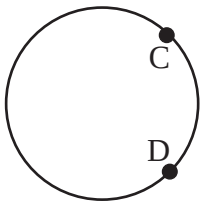
(b) The diagram shows a ball for which the airflow becomes turbulent beyond points A and B. Add to the diagram to show the airflow around the ball. The ball is moving to the left.

(2)



(c) It is suggested that 'dimples' on a golf ball decrease the area over which there is turbulent flow so it is only produced beyond points C and D.



Explain how decreasing the area over which there is turbulent flow would increase the range of a golf ball.

(2)

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(Total for Question 13 = 6 marks)

14 (a) What is meant by Newton's first law of motion?

(2)

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(b) Newton's third law identifies pairs of forces.

(i) State **two** ways in which the forces in a pair are identical.

(2)

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.....

(ii) State **two** ways in which the forces in a pair differ.

(2)

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.....

(iii) One of the forces acting on a car can be described as follows:

'The Earth exerts a downward gravitational force of 12 000 N on the car'.

Describe its Newton's third law pair force.

(2)

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(Total for Question 14 = 8 marks)

*** 15** You are asked to determine the acceleration of free fall at the surface of the Earth, g, using a free fall method in the laboratory.

(a) Describe the apparatus you would use, the measurements you would take and explain how you would use them to determine g.

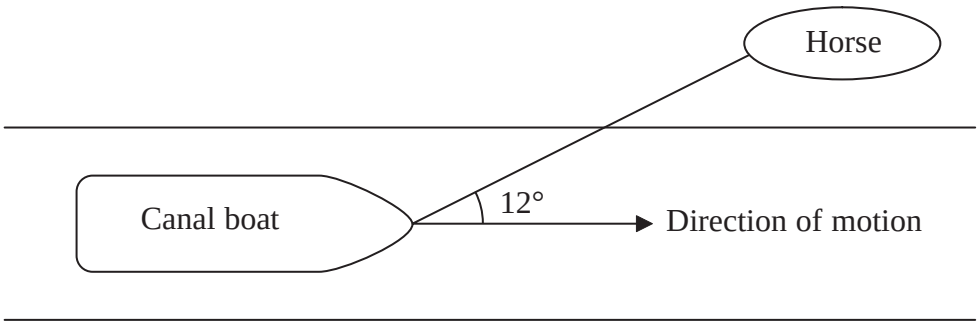
(6)

(b) Give **one** precaution you would take to ensure the accuracy of your measurements.

(1)

(Total for Question 15 = 7 marks)

16



A horse is pulling a canal boat using a rope at 12° to the direction of motion of the boat. The tension in the rope is 1150 N.

(a) The canal boat is moving at a steady speed. Calculate the resistive force opposing the boat's forward motion.

(2)

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.....

Force = ...

(b) Calculate the work done on the boat by the horse when the canal boat is towed 500 m along the canal.

(2)

.....

.....

Work = ...

(c) Explain why using a longer rope could allow the horse to do the same work while producing a lower tension in the rope.

(2)

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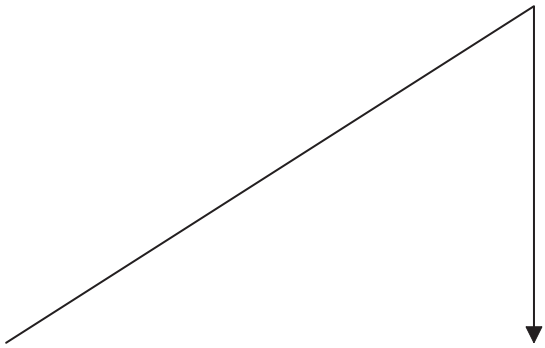
.....

(Total for Question 16 = 6 marks)

***17** In the fifteenth century, an explanation of projectile motion went as follows:

When you throw an object you give it a force called impetus. It moves in a straight line until the impetus is used up. Then the object falls vertically to the ground.

The diagram shows the path described.



(a) Correct the diagram to show the path followed by a projectile according to modern observations. Assume it has the same initial direction.

(1)

(b) Explain why a projectile follows the path you have drawn. Your answer should include reference to horizontal velocity.

(3)

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(c) When a toy balloon is hit quickly up at an angle, it appears to follow a path similar to the one described by the fifteenth century explanation.

Explain why the balloon follows this path.

(3)

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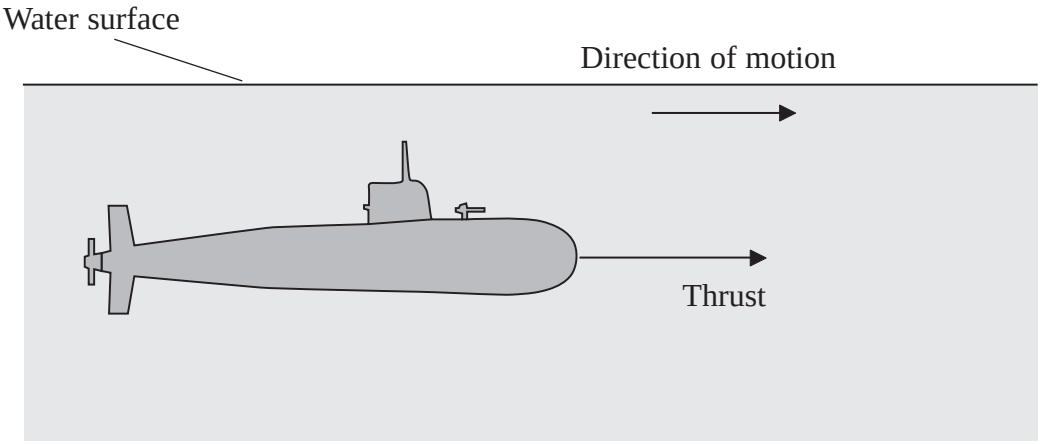
(Total for Question 17 = 7 marks)

***18** The diagram shows a submarine and one of the forces acting on it. The submarine moves at a constant depth and speed in the direction shown.



(a) Add labelled arrows to show the other **three** forces on the submarine.

(2)

(b) State **two** equations that show the relationship between the forces acting on the submarine.

(2)

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(c) The submarine has a volume of 7100 m^3.
Show that the weight of the submarine is about 7×10^7 N.

Density of sea water = 1030 kg m^{-3}

(2)

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(d) The submarine can control its depth by changing its weight. This is done by adjusting the amount of water held in ballast tanks.

As the submarine dives to greater depths the increased pressure of the surrounding water produces a compressive strain.

(i) Explain what is meant by compressive strain.

(1)

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(ii) This decreases the volume of the submarine. Explain the action that should be taken to maintain a constant depth as the volume of the submarine is decreased.

(2)

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(iii) The submarine is made from steel. Suggest why a material, such as fibreglass, which has a much smaller Young modulus than steel would be unsuitable at greater depths.

(2)

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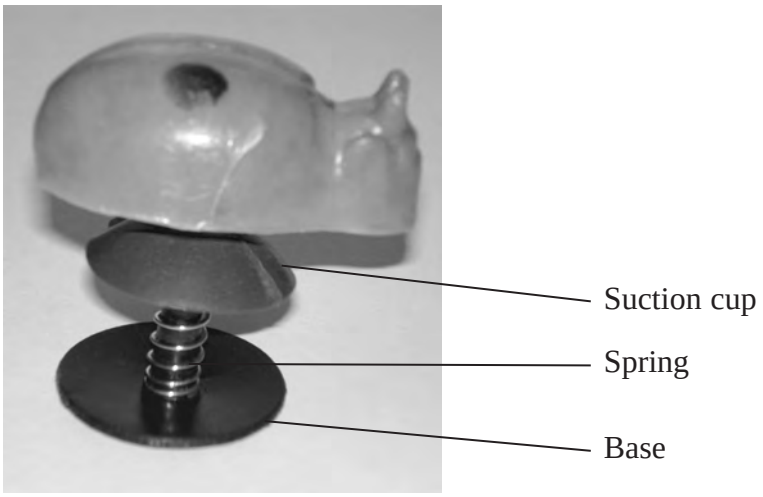
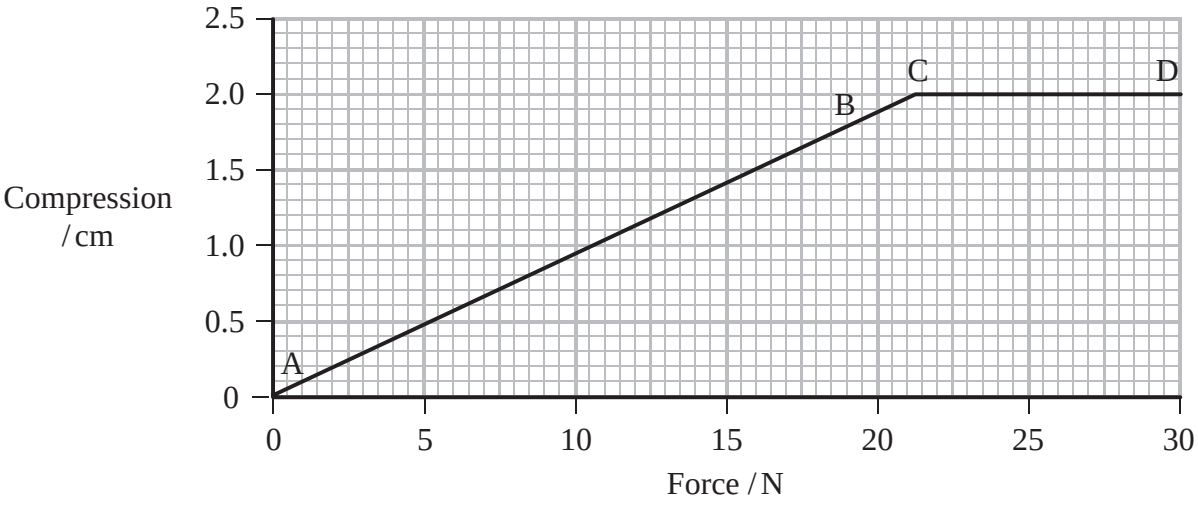
(Total for Question 18 = 11 marks)

19 The picture shows a jumping toy on which a student carries out some experiments.



The top of the toy is pushed down, compressing the spring. The suction cup adheres to the base and holds the toy down. After a short time, the suction cup leaves the base, causing the toy to jump.

A compression–force graph is obtained for the spring in the toy.



(a) (i) Explain the shape of section AB of the graph.

(1)

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(ii) Explain why section CD of the graph is horizontal.

(1)

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(b) Show that the stiffness of the spring is about 1000 N m^{-1}.

(2)

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(c) As the suction cup is about to leave the base the compression of the spring is 0.018 m.

(i) Calculate the energy stored in the spring at this stage.

(2)

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.....

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Energy stored = ...

(ii) Calculate the maximum possible height reached by the toy.

Mass of toy = 7.3×10^{-3} kg

(2)

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.....

.....

Height = ...

(iii) State an assumption made in your calculation.

(1)

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.....

(d) The student uses a camera to video the movement of the toy in front of a metre rule. The video is then used to find the maximum height reached by the toy.

(i) Explain the advantage of using the video camera over making observations just by eye.

(2)

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(ii) The student repeats this procedure several times and records the following data:

0.45 m, 0.44 m, 0.36 m, 0.46 m, 0.45 m.

mean maximum height = 0.45 m

Why is the student justified in using 0.45 m as the mean?

(1)

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.....

(Total for Question 19 = 12 marks)

TOTAL FOR SECTION B = 70 MARKS

TOTAL FOR PAPER = 80 MARKS

Write your name here

Surname	Other names

Edexcel GCE

Centre Number	Candidate Number

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Thursday 21 May 2009 – Afternoon **Time: 1 hour 20 minutes**	Paper Reference **6PH01/01**

You do not need any other materials.	Total Marks

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Turn over ▶

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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 set of quantities is all scalar?

☒ **A** acceleration, displacement, velocity

☒ **B** energy, mass, power

☒ **C** extension, force, gravitational potential energy

☒ **D** weight, kinetic energy, work

(Total for Question 1 = 1 mark)

2 A material is described as 'not easy to scratch or indent'.

The material is best described as

☒ **A** hard

☒ **B** plastic

☒ **C** stiff

☒ **D** tough

(Total for Question 2 = 1 mark)

3 A force of 24 N and a force of 15 N act at right angles to each other.

The size of their resultant force is

☒ **A** 15.8 N

☒ **B** 24.3 N

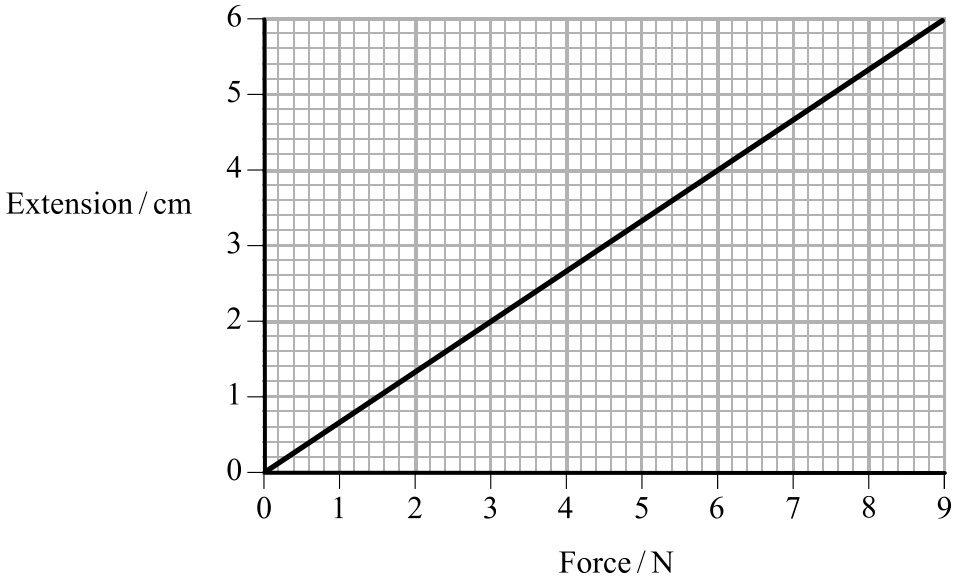
☒ **C** 28.3 N

☒ **D** 39.0 N

(Total for Question 3 = 1 mark)

Use the following graph to answer Questions 4 and 5.

The graph shows how extension varies with applied force for a spring.



4 The stiffness of the spring in $N\,m^{-1}$ is

- ☒ **A** 1.5
- ☒ **B** 54
- ☒ **C** 67
- ☒ **D** 150

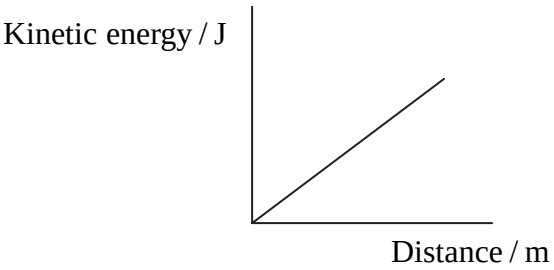
(Total for Question 4 = 1 mark)

5 The energy stored in the spring when it is extended by 6.0 cm is

- ☒ **A** 0.27 J
- ☒ **B** 0.54 J
- ☒ **C** 54 J
- ☒ **D** 108 J

(Total for Question 5 = 1 mark)

6 The graph shows how kinetic energy varies with distance for a train accelerating from a station.



The quantity represented by the gradient of the graph is

☒ **A** acceleration

☒ **B** force

☒ **C** power

☒ **D** velocity

(Total for Question 6 = 1 mark)

7 A car of known mass has a constant acceleration. The resultant force acting on the car can be found by applying

☒ **A** Newton's first law

☒ **B** Newton's second law

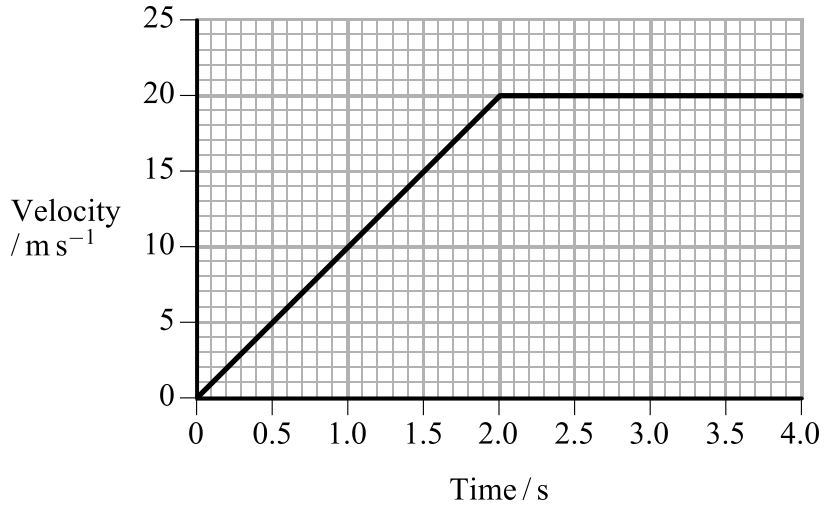
☒ **C** Newton's third law

☒ **D** Stokes's law

(Total for Question 7 = 1 mark)

Use the following graph to answer Questions 8 and 9.

8 The graph shows how velocity varies with time for an object.



The total distance travelled by the object in 4 s is

☒ **A** 20 m

☒ **B** 40 m

☒ **C** 60 m

☒ **D** 80 m

(Total for Question 8 = 1 mark)

9 The acceleration at 3 s is

☒ **A** 10 m s^{-2}

☒ **B** 7 m s^{-2}

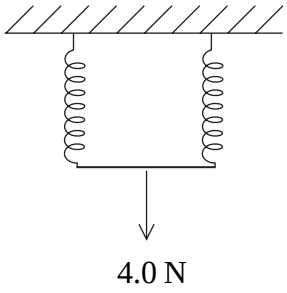
☒ **C** 5 m s^{-2}

☒ **D** 0 m s^{-2}

(Total for Question 9 = 1 mark)

10 A spring extends by 10 cm when a force of 8.0 N is applied. The limit of proportionality is not exceeded.

Two of these springs are arranged side by side and a force of 4.0 N is applied.



The extension for this arrangement of springs is

☒ **A** 2.5 cm

☒ **B** 5.0 cm

☒ **C** 10 cm

☒ **D** 20 cm

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

***11** (a) Explain the difference between scalar and vector quantities.

(1)

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(b) When asked to run one complete lap around a track, a student says, "However fast I run, my average velocity for the lap will be zero".

Comment on his statement.

(3)

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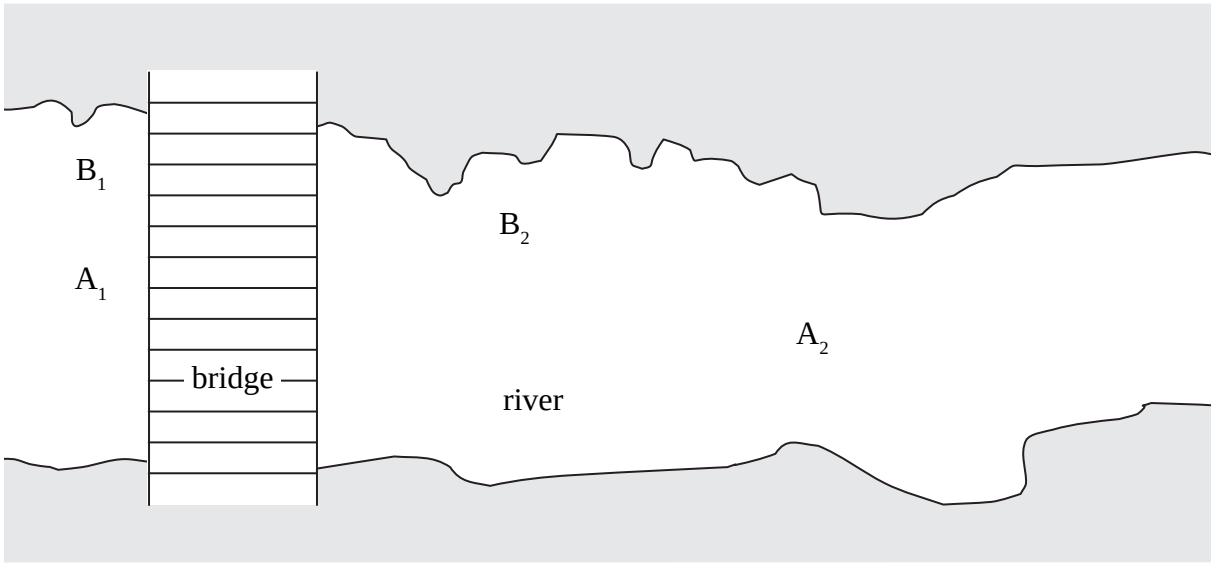
(Total for Question 11 = 4 marks)

12 In the game of Poohsticks, sticks are dropped into a river from one side of a bridge to see which reaches the other side first.



A stick is dropped into the centre of the river at A_1 and moves at a steady speed to A_2, winning the game.

Another stick is dropped into the river near its edge at B_1, and ends up swirling around at B_2.

(a) Add to the diagram to show the water flow at A_2 and at B_2.

(2)

(b) Name and describe the type of water flow at A_2 and at B_2.

(4)

A_2 .....

.....

B_2 .....

.....

(Total for Question 12 = 6 marks)

13 (a) Explain the meanings of the terms brittle and ductile.
Sketch stress-strain graphs and use them to illustrate your answer.

(4)

Brittle .....

.....

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Ductile .....

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(b) Give an example of a ductile material and a situation where its ductile behaviour is desirable.

(2)

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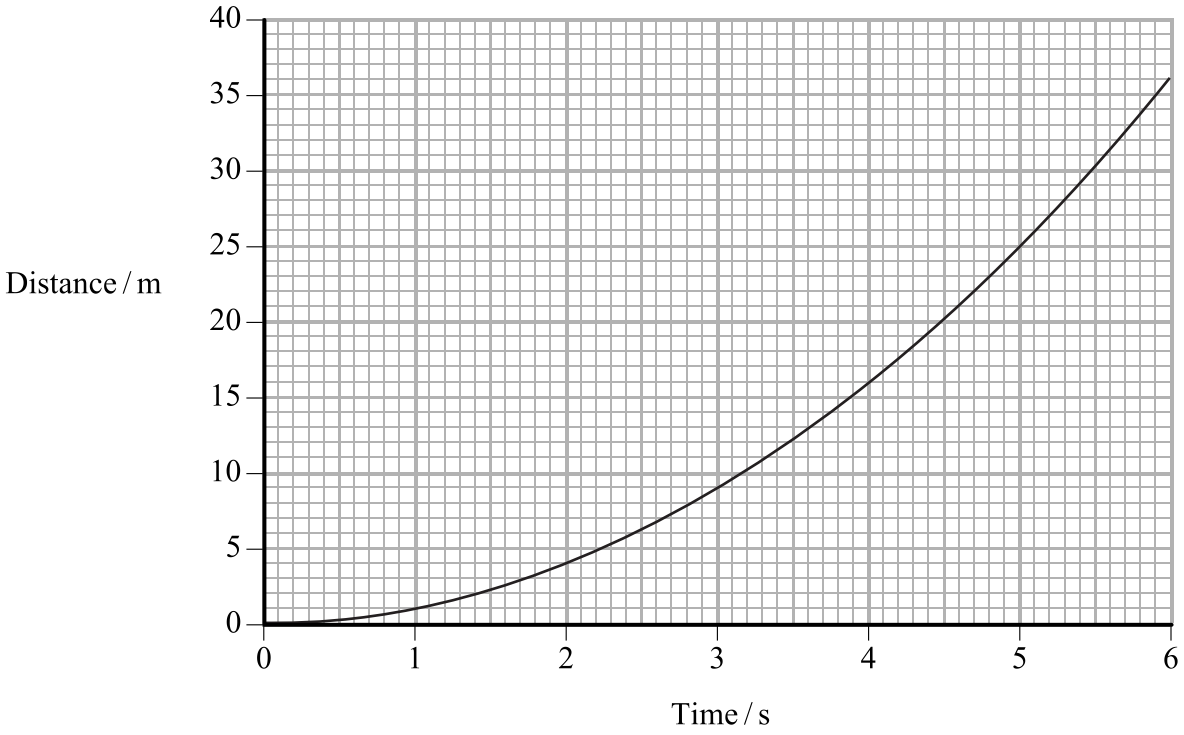
(Total for Question 13 = 6 marks)

14 The graph shows how displacement varies with time for an object which starts from rest with constant acceleration.



(a) Use the distance-time graph to determine the speed of the object at a time of 4.0 s.

(3)

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Speed = ...

(b) Calculate the acceleration.

(2)

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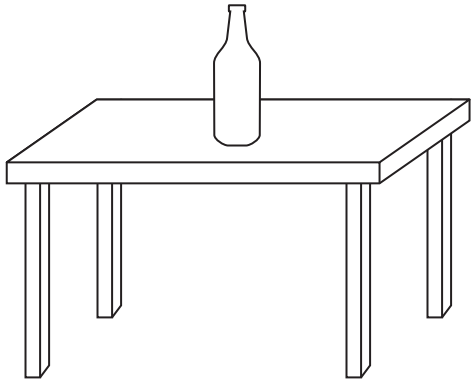
.....

Acceleration = ...

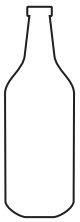
(Total for Question 14 = 5 marks)

15 A student is asked to provide an explanation of why a bottle on a table remains stationary.



(a) Complete a free-body force diagram for the bottle.

(2)



(b) The student writes the following incorrect explanation.

The force of gravity pulls the bottle down.
The bottle pushes down on the table, so by Newton's first law,
the table pushes up with an equal and opposite force.
According to Newton's third law, if the forces are balanced,
nothing can move.

The student's explanation contains errors.

Rewrite the student's explanation correctly.

(3)

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(Total for Question 15 = 5 marks)

16 In 2008 a new energy scheme opened on the Scottish island of Eigg. The scheme uses solar, hydroelectric and wind energy. There are also stand-by diesel generators.

(a) In a feasibility study, the following information was collected about one possible hydroelectric site:

mean rate of water flow into turbine = 0.13 $m^3 s^{-1}$
change in height of water = 30 m.

(i) Show that the power available to the turbine is about 40 kW.

density of water = 1000 kg m^{-3}

(3)

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.....

.....

(ii) The study suggests a typical output for the turbine might be only 6 kW. Suggest a reason for this inefficiency.

(1)

.....

.....

(b) Publicity for the scheme states:

> "The whole project involves one 100 kW hydroelectric system, two smaller 6 kW hydroelectric systems, a 24 kW wind farm and a 10 kW solar energy system. There are also two 80 kW diesel generators on stand-by."

(i) Calculate the maximum energy output from the solar energy system for a period of six hours.

(2)

.....

.....

Maximum energy output = ...

(ii) Discuss the suitability of the output of the stand-by diesel generators.

(2)

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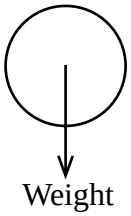
.....

(Total for Question 16 = 8 marks)

17 A science centre houses a display with tall, transparent tubes of different liquids. Visitors can pump air into the bottom of the tubes to create bubbles that rise to the top at different steady speeds.

(a) (i) Add labelled arrows to the diagram to show the other two forces acting on a bubble as it rises through a liquid.

(2)



(ii) With reference to the forces on the bubble, explain why the bubble initially accelerates and then reaches a steady upwards speed.

(4)

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.....

(iii) Write an expression which relates these forces for a bubble moving at a steady upwards speed.

(1)

.....

.....

(b) If the weight of the air in the bubble is ignored, the steady upwards speed is given by

$$v = \frac{2\rho r^2 g}{9\eta}$$

Where ρ is the density of liquid, r is the radius of the sphere and η is the coefficient of viscosity of the liquid.

(i) Explain why it is reasonable to ignore the weight of the air.

(2)

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(ii) Explain what happens to the speeds of the observed bubbles if the temperature of the liquid increases.

(2)

.....

.....

.....

(iii) It is possible to create a small bubble followed by a larger bubble.

Use the expression to explain why the larger bubble catches up with the smaller one.

(1)

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.....

.....

(Total for Question 17 = 12 marks)

18 Champagne bottles are often opened by 'firing' the cork out of the bottle. The world record for the horizontal distance travelled by a fired cork is 53 m.

The high pressure inside the bottle produces an average force of 150 N on the cork as it leaves the bottle. This force acts on the cork over a distance of 2.5×10^{-2} m.

(a) Show that the work done on the cork is about 4 J.

(2)

.....

.....

.....

(b) Calculate the maximum speed at which the cork could leave the bottle.

mass of cork = 7.5×10^{-3} kg

(2)

.....

.....

.....

Speed = ...

(c) The cork is fired from ground level at an angle of 40° to the horizontal with a speed of 32 m s^{-1}.

(i) Show that the vertical component of the velocity is about 20 m s^{-1}.

(1)

.....

.....

(ii) Calculate the horizontal distance travelled by the cork through the air.

(5)

.....

.....

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Distance = ...

(d) Suggest an explanation for the difference between your calculated value and the world record distance.

(2)

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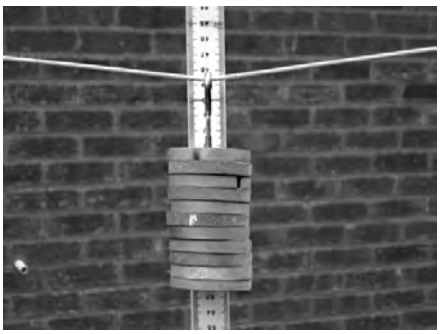
.....

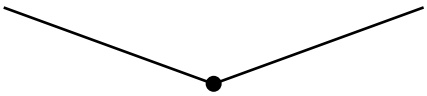
(Total for Question 18 = 12 marks)

19 A washing line has a negligible mass and is initially horizontal. A student investigates the effect of hanging masses from the midpoint of the washing line.



(a) Add to the diagram to show the forces acting at the midpoint of the line when a mass is hung from its midpoint.

(2)



(b) A mass of 1.10 kg is hung from the midpoint of the line.

(i) Show that the downward vertical force on the line is about 11 N.

(1)

.....

.....

.....

(ii) This force pulls the midpoint down a distance of 48.5 cm.

Show that the line is at an angle of about 84° to the vertical.

length of washing line when horizontal = 9.600 m

(2)

.....

.....

.....

(iii) Show that the tension in the line is less than 60 N.

(2)

.....

.....

.....

(iv) The washing line stretches so that the total length of the line is now 9.847 m.

Calculate the strain for the line.

(2)

.....

.....

.....

Strain = ...

(c) Calculate the value of the Young modulus for the line material.

cross-sectional area of the line = $6.6 \times 10^{-6}\,m^2$

(3)

.....

.....

.....

Young modulus = ...

(Total for Question 19 = 12 marks)

TOTAL FOR SECTION B = 70 MARKS

TOTAL FOR PAPER = 80 MARKS

Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Wednesday 13 January 2010 – Morning
Time: 1 hour 30 minutes

Paper Reference
6PH01/01

You do not need any other materials.

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.*
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  – *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.

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- 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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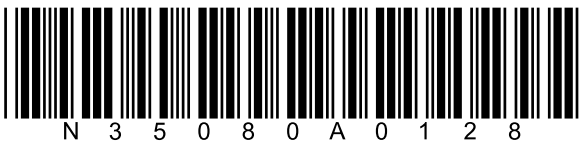

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SECTION A

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 is a scalar quantity?

☒ **A** displacement

☒ **B** force

☒ **C** time

☒ **D** velocity

(Total for Question 1 = 1 mark)

2 A substance which can undergo a large plastic deformation without cracking can be described as

☒ **A** brittle

☒ **B** hard

☒ **C** malleable

☒ **D** stiff

(Total for Question 2 = 1 mark)

3 A bus is travelling at a speed of 9.0 m s^{-1}. It then accelerates at a rate of 0.75 m s^{-2} for a time of 8.0 s. What is its final speed?

☒ **A** 6.0 m s^{-1}

☒ **B** 15 m s^{-1}

☒ **C** 17 m s^{-1}

☒ **D** 21 m s^{-1}

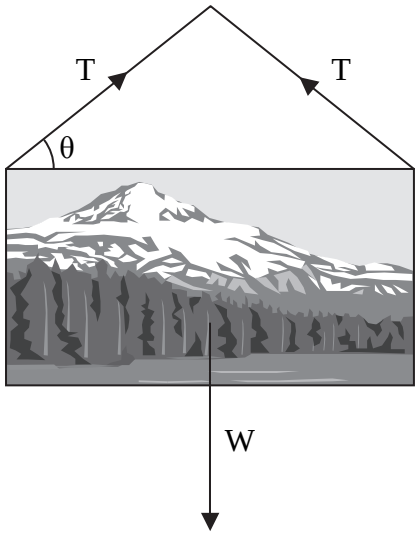
(Total for Question 3 = 1 mark)

4 Which of the following is not a SI base quantity?

- ☒ **A** force
- ☒ **B** length
- ☒ **C** mass
- ☒ **D** time

(Total for Question 4 = 1 mark)

5 The diagram shows the forces acting on a picture, of weight W, suspended by a cord. The tension in the cord is T.



Which of the following expressions shows the correct relationship between W and T?

- ☒ **A** $W = 2\ T \cos \theta$
- ☒ **B** $W = T \cos \theta$
- ☒ **C** $W = T \sin \theta$
- ☒ **D** $W = 2\ T \sin \theta$

(Total for Question 5 = 1 mark)

6 A person weighing 100 N stands on some bathroom scales in a lift. If the scales show a reading of 110 N, which answer could describe the motion of the lift?

☒ **A** Moving downwards and decelerating.

☒ **B** Moving downwards with a constant velocity.

☒ **C** Moving upwards and decelerating.

☒ **D** Moving upwards with a constant velocity.

(Total for Question 6 = 1 mark)

7 A spring extends by 9 cm when a force of 6 N is applied. The limit of proportionality is not exceeded.

Another identical spring is joined end to end with this spring and a force of 4 N is applied.

The extension for the pair of springs is

☒ **A** 3 cm

☒ **B** 6 cm

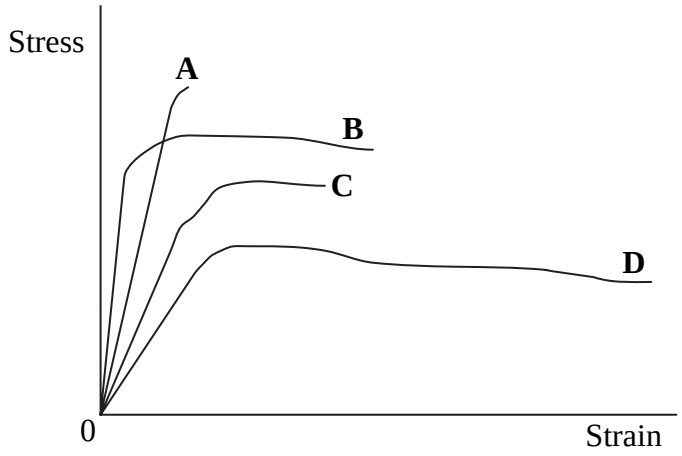
☒ **C** 12 cm

☒ **D** 18 cm

(Total for Question 7 = 1 mark)

Use the graph below for questions 8 and 9.

The graph shows stress–strain curves for samples of four different materials.



8 Which material has the greatest strength?

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 8 = 1 mark)

9 Which material has the greatest value for the Young modulus?

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 9 = 1 mark)

10 The acceleration of free fall on a particular planet is 8.0 m s^{-2}. An object is dropped from a height and hits the ground after 1.5 s. From what height was it dropped?

☒ **A** 6.0 m

☒ **B** 9.0 m

☒ **C** 11 m

☒ **D** 12 m

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 A brochure states that a particular type of wood is "extremely tough and does not become brittle over time".

(a) Describe what is meant by the following terms

(2)

tough

.....

.....

brittle

.....

.....

(b) A cricket bat made of wood is found to have a dent after striking a cricket ball.

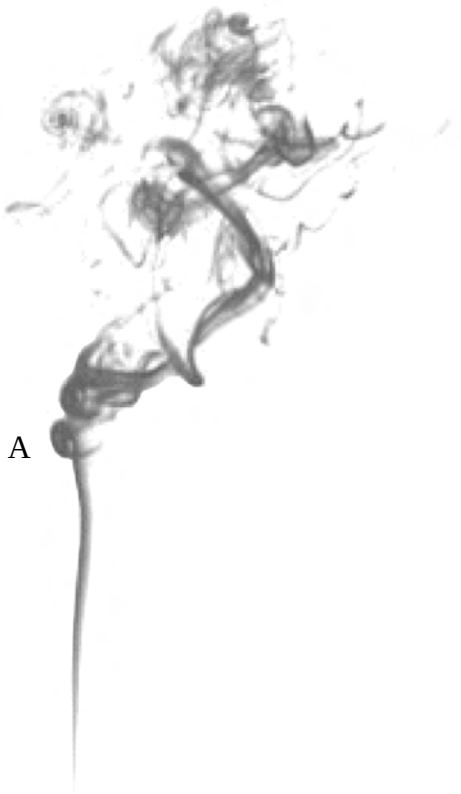
State the type of behaviour shown by the material of the cricket bat.

(1)

.....

(Total for Question 11 = 3 marks)

12 The photograph shows some smoke rising.



At A, the type of fluid flow changes.

Label the type of fluid flow below and above A and describe each of them.

Below A .....

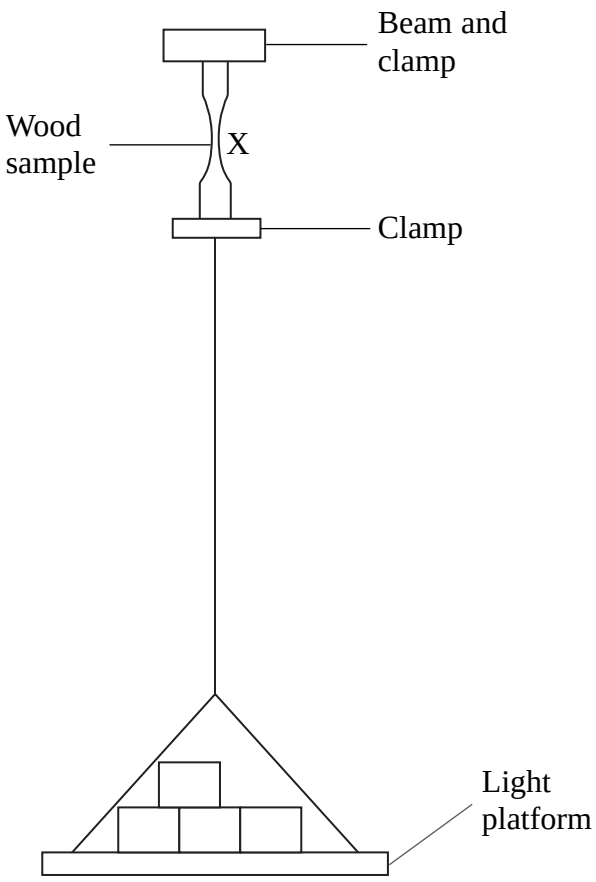
.....

Above A.....

.....

(Total for Question 12 = 4 marks)

13 A sample of wood is tested using the following arrangement.



The wood sample is clamped securely to a supporting beam. A light platform is suspended from the wood sample using another clamp.

The dimensions of the wood sample at X are known. Masses of 2 kg are added to the platform during the testing process.

(a) The wood sample breaks at X when the total suspended mass is 84 kg. The cross-sectional area at X is 1.3×10^{-5} m^2.

Show that the ultimate tensile strength is about 6×10^7 Pa.

(3)

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(b) Explain why this method of testing may produce a larger value than the true ultimate tensile strength.

(2)

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(c) Explain why the wood sample used for this test has the shape shown.

(2)

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.....

.....

.....

(d) Samples of wood of the same type are not entirely uniform. What should be done to ensure reliable results are obtained when carrying out this test?

(1)

.....

.....

(Total for Question 13 = 8 marks)

14 One account of the origin of the term *horsepower* is as follows.

In the eighteenth century, James Watt manufactured steam engines. He needed a way to demonstrate the benefits of these compared to the horses they replaced. He did some calculations based on horses walking in circles to turn a mill wheel.

Watt observed that a horse could turn the wheel 144 times in one hour. The horse travelled in a circle of radius 3.7 m and exerted a force of 800 N.

(a) Show that the work done by the horse in turning the wheel through one revolution was about 20 000 J.

(3)

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.....

(b) Calculate the average power of the horse in SI units.

(3)

.....

.....

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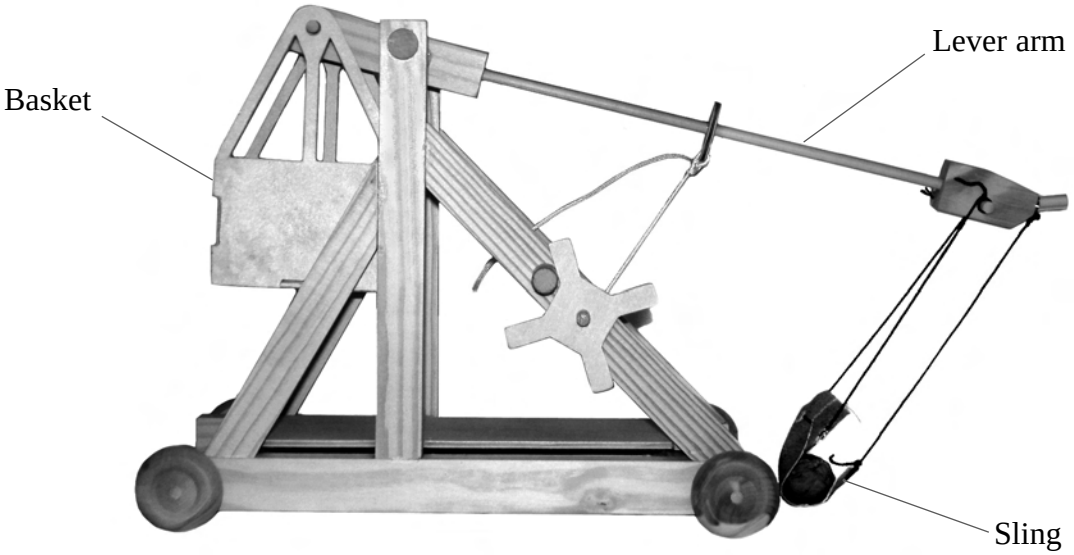
Average power = ...

(Total for Question 14 = 6 marks)

***15** The photograph shows a model of 'Warwolf', a siege engine used in the thirteenth century. It was used to attack castles by firing missiles from a sling.



To operate this model, coins are placed in the basket and a small projectile is placed in the sling. When the basket is released, it falls quickly, swinging the lever arm up and shooting the projectile from the sling.

(a) On one occasion the mass of coins placed in the basket is 0.41 kg. The basket falls through a vertical distance of 7.0 cm.

Calculate the maximum amount of energy available to launch the projectile.

(2)

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.....

.....

.....

Energy = ...

(b) An energy conversion calculation predicts a projectile speed of 16 m s^{-1}. The projectile is observed to fly out of the sling at an angle of 40° to the horizontal.

Resolve this velocity into horizontal and vertical components.

(3)

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.....

.....

Horizontal component = ...

Vertical component = ...

(c) The predicted range is 27 m. When measured, the range is found to be only 8 m.

Air resistance and friction in the machine are possible reasons for the difference.

Without further calculation, explain another reason why the projectile does not go as far as predicted.

(2)

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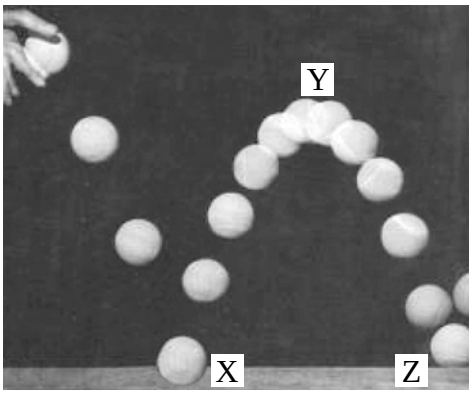
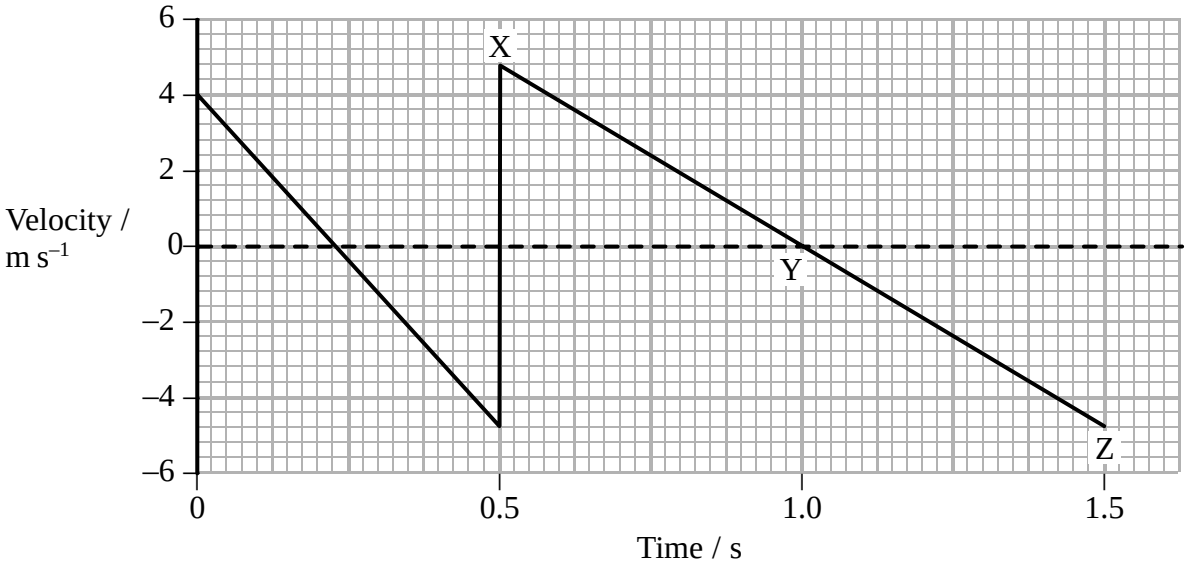
(Total for Question 15 = 7 marks)

***16** The photograph shows a sequence of images of a bouncing tennis ball.



A student plots the following graph and claims that it shows the vertical motion of the ball in the photograph.



(a) Without carrying out any calculations describe how the following can be found from the graph

(2)

(i) the vertical distance travelled by the ball between 0.5 s and 1.0 s

.....

(ii) the acceleration at Y.

.....

(b) The graph contains several errors in its representation of the motion of the ball.

Explain two of these errors.

(4)

Error 1

.....

.....

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Error 2

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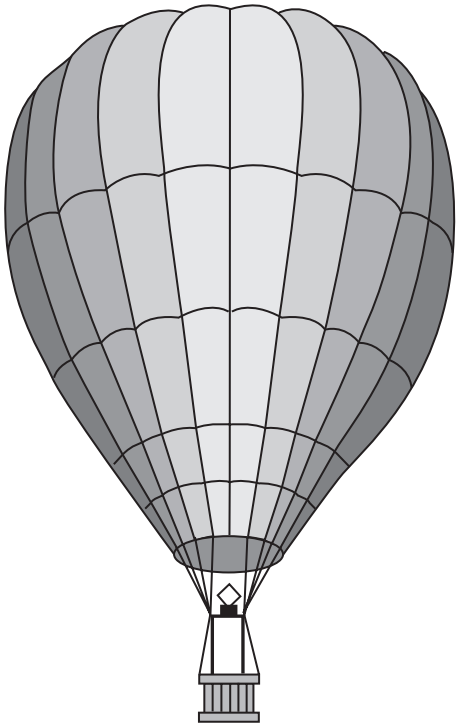
(Total for Question 16 = 6 marks)

17 A hot air balloon consists of an 'envelope' containing hot air, with a wicker basket suspended from it. The balloon flies because the heated air in the envelope is less dense than the surrounding air.



(a) The total volume of the hot air balloon is 2830 m^3. The total weight of the balloon, including the hot air in the envelope, is 33 100 N. The density of the surrounding air is 1.20 kg m^{-3}.

(i) Show that the resultant upward force on the balloon at the moment it is released is about 200 N.

(3)

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.....

(ii) Calculate the initial upward acceleration of the balloon. The mass of the balloon is 3370 kg.

(2)

.....

.....

.....

Acceleration = ...

(iii) The balloon is rising through air of viscosity 1.8×10^{-5} kg m^{-1} s^{-1}, at a speed of 2.0 m s^{-1}.

The effect of viscous drag on the balloon is negligible provided the air flow around the balloon is laminar.

Justify the statement in bold with the aid of a calculation. You may treat the whole balloon as a single sphere of radius 8.8 m.

(3)

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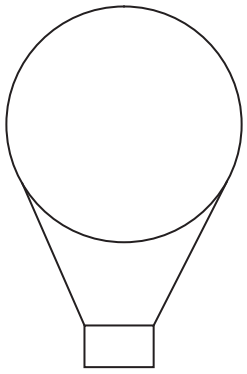
(b) Add labelled arrows to the diagram below to show the forces acting on a vertically ascending balloon.

(2)



(c) As the balloon rises the density of the surrounding air decreases. Explain why this density change limits the height to which the balloon will rise.

(2)

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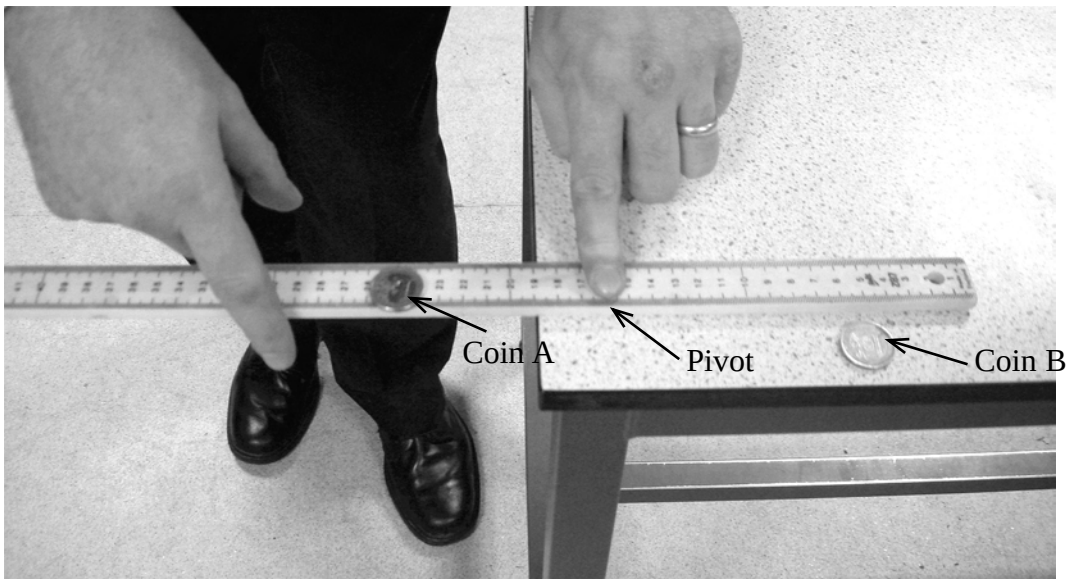
(Total for Question 17 = 12 marks)

18 The photograph shows a physics teacher carrying out a demonstration related to vertical motion.



A coin, A, is placed on top of the smooth ruler and another coin, B, is placed on the table.
One hand is acting as a pivot. The other hand gives the ruler a sharp horizontal tap.

Coin A falls vertically to the ground while coin B is pushed horizontally off the table.
Both coins are heard to strike the floor at the same instant.

(a) Use Newton's first law to explain why the coin A has no horizontal motion.

(2)

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.....

.....

(b) Explain how this demonstration shows the independence of vertical and horizontal motion.

(2)

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.....

(c) The table is 0.85 m high.

Show that the coin on the ruler strikes the ground with a speed of about 4 m s^{-1}.

(2)

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.....

.....

(d) After 0.42 s the second coin lands at a horizontal distance of 1.1 m from the table.

Calculate the velocity at which the coin strikes the ground.

(5)

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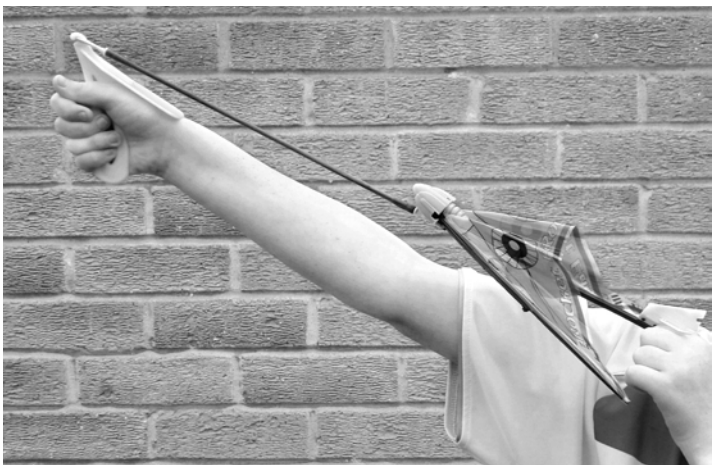
.....

Magnitude of velocity = ...

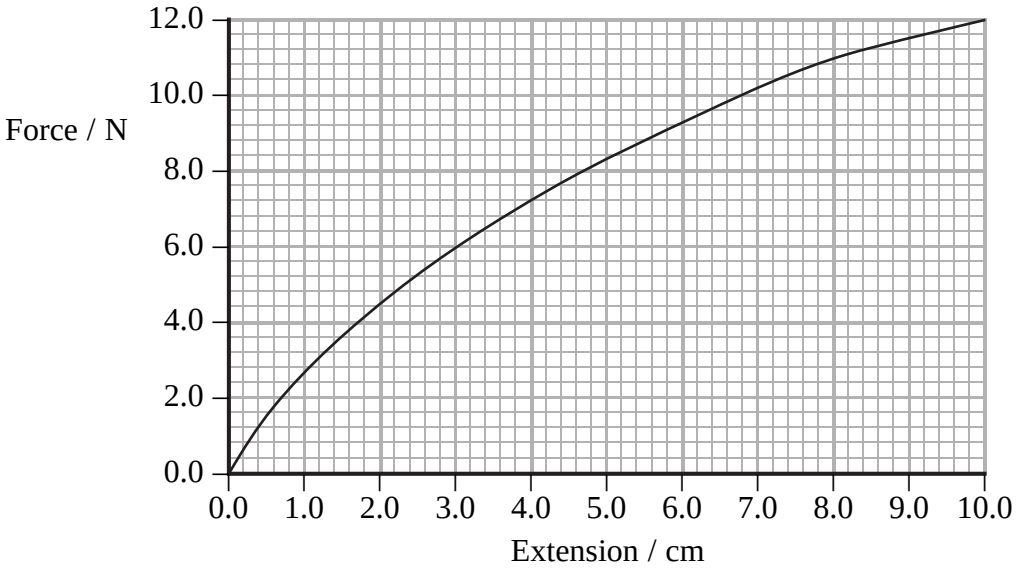
Angle of velocity to horizontal = ...

(Total for Question 18 = 11 marks)

*19 The photograph shows a long rubber band being used to launch a model aeroplane.



The following graph shows force against extension for the rubber band.



(a) Explain whether the rubber band obeys Hooke's law.

(2)

.....

.....

.....

(b) Use the graph to show that the elastic strain energy stored in the rubber band when it has an extension of 10.0 cm is less than 0.8 J.

(3)

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.....

.....

(c) The rubber band is extended by 10.0 cm before being released to launch the aeroplane. Calculate the maximum possible initial speed of the aeroplane.

Mass of aeroplane = 0.027 kg

(3)

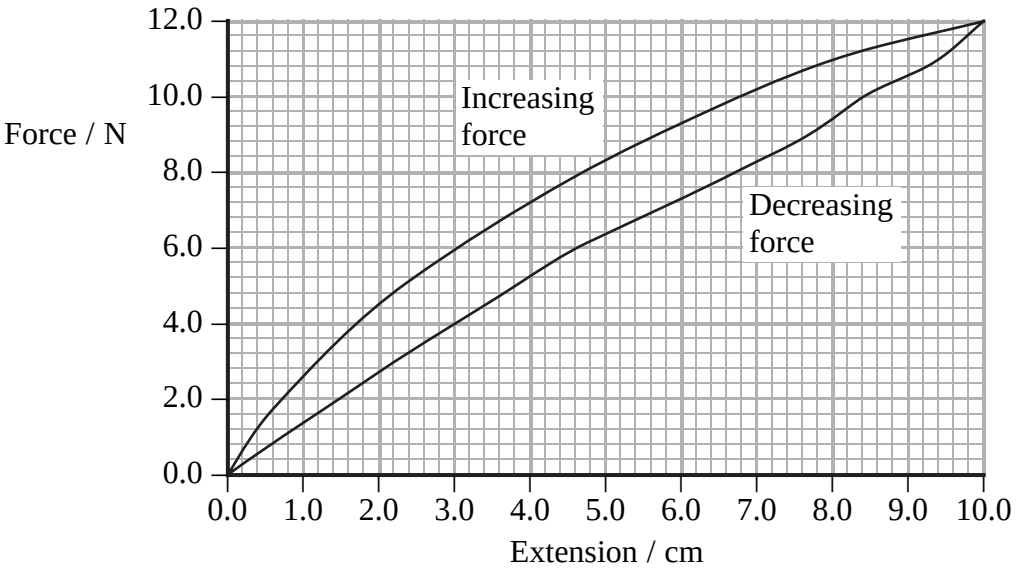
.....

.....

.....

Speed = ...

(d) The following graph shows two lines. Measurements were obtained by increasing the force on the band to 12 N and then decreasing the force.



(i) Describe the energy transfers taking place when the force on the band is increased and then decreased.

(2)

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.....

(ii) The maximum speed of the aeroplane will be less than that calculated in (c). Without further calculation use the graph to explain this.

(3)

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.....

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(Total for Question 19 = 13 marks)

TOTAL FOR SECTION B = 70 MARKS

TOTAL FOR PAPER = 80 MARKS

Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Thursday 27 May 2010 – Afternoon
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.
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- Check your answers if you have time at the end.

Turn over ▶

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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 Distance travelled can be found from the

☒ **A** area under a velocity-time graph

☒ **B** area under an acceleration-time graph

☒ **C** gradient of a force-time graph

☒ **D** gradient of a velocity-time graph

(Total for Question 1 = 1 mark)

2 Which of the following is a scalar quantity?

☒ **A** acceleration

☒ **B** displacement

☒ **C** force

☒ **D** work

(Total for Question 2 = 1 mark)

3 A car pulls a trailer of weight 2500 N with a force of 20 N for a distance of 8 km along a horizontal road.

How much work is done by the car in pulling the trailer?

☒ **A** 160 J

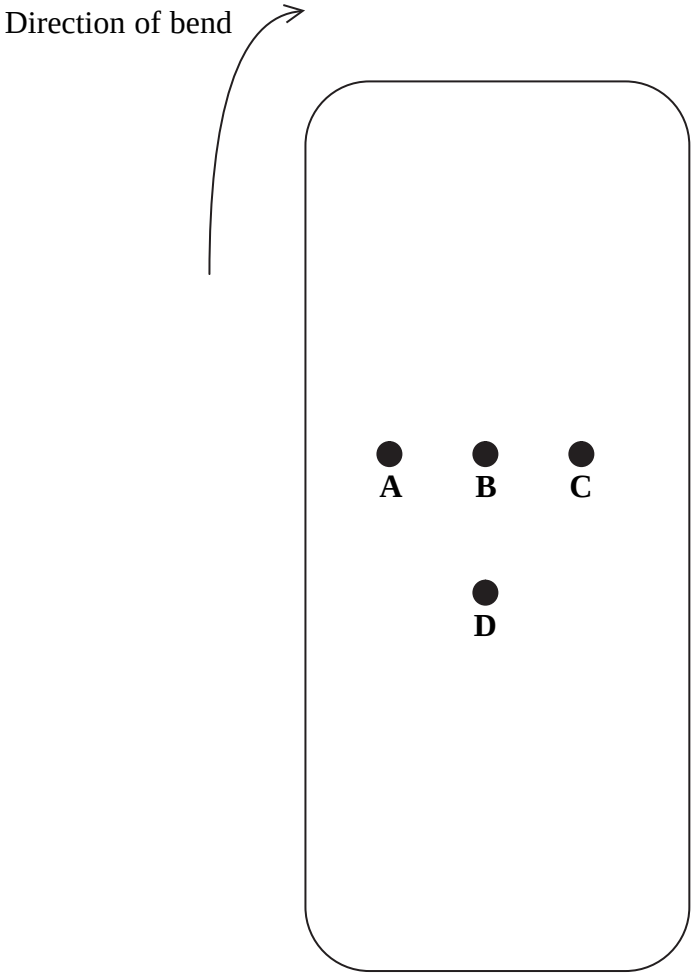
☒ **B** 20 000 J

☒ **C** 160 000 J

☒ **D** 20 000 000 J

(Total for Question 3 = 1 mark)

4 A person is standing at point C in a train carriage travelling round a sharp bend to the right. The person jumps up. Nearest which marked point is the person most likely to land?



- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 4 = 1 mark)

5 Which of the following units could be used for power?

☒ **A** kg m s^{-2}

☒ **B** kg m^2 s^{-2}

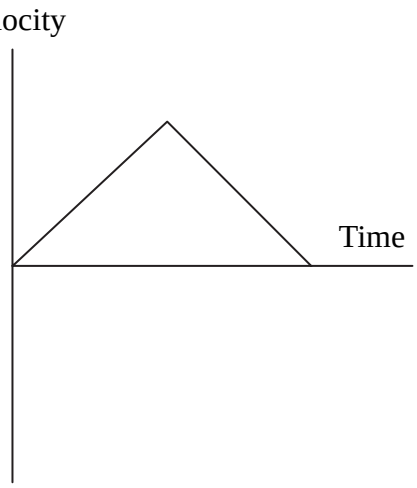
☒ **C** kg m^2 s^{-3}

☒ **D** kg^2 m^2 s^{-3}

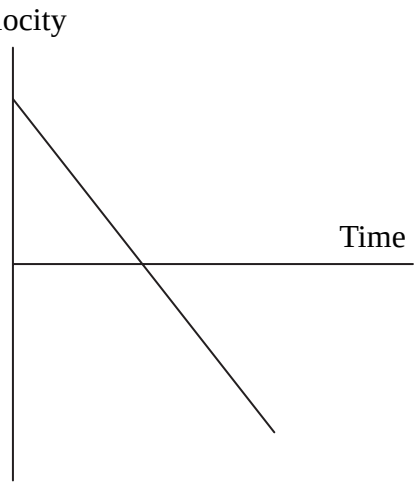
(Total for Question 5 = 1 mark)

6 A ball is thrown straight up in the air and caught when it comes down. Which graph best shows the velocity of the ball from the moment it is released until just before it is caught?

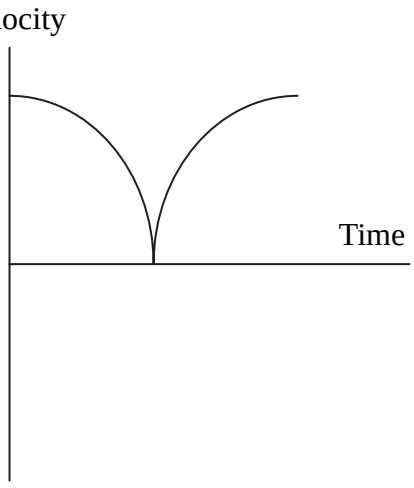
A



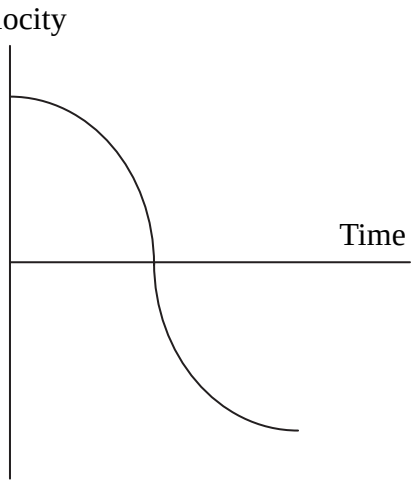
B



C



D



☒ **A** ☒ **B** ☒ **C** ☒ **D**

(Total for Question 6 = 1 mark)

7 A building has 5 floors. The windows on successive floors are separated by the same vertical distance. A brick is dropped from a window on each floor at the same time. The bricks should hit the ground at

- ☒ **A** decreasing time intervals
- ☒ **B** equal time intervals
- ☒ **C** increasing time intervals
- ☒ **D** the same time

(Total for Question 7 = 1 mark)

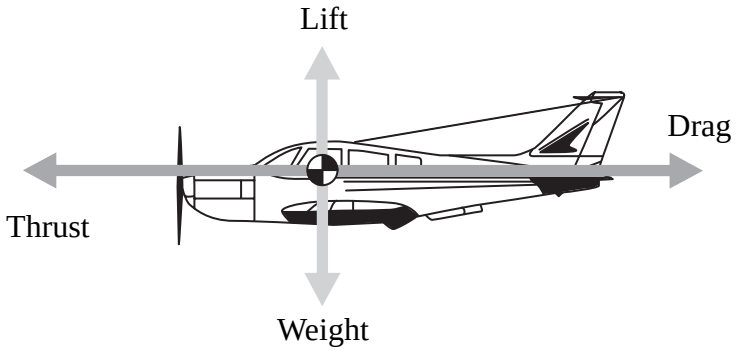
8 All ductile materials are also

- ☒ **A** brittle
- ☒ **B** hard
- ☒ **C** malleable
- ☒ **D** stiff

(Total for Question 8 = 1 mark)

Use the diagram below for questions 9 and 10.

The diagram shows four forces acting on an aeroplane.



9 Which of the following shows the correct two relationships if the aeroplane is climbing at a constant velocity?

		Relationship 1	Relationship 2
☒	**A**	lift > weight	thrust > drag
☒	**B**	lift > weight	thrust = drag
☒	**C**	lift = weight	thrust > drag
☒	**D**	lift = weight	thrust = drag

(Total for Question 9 = 1 mark)

10 The aeroplane is now flown at a constant altitude but an increasing speed.

Which of the following pairs of forces will have the same magnitude?

☒ **A** drag and weight

☒ **B** drag and thrust

☒ **C** lift and drag

☒ **D** lift and weight

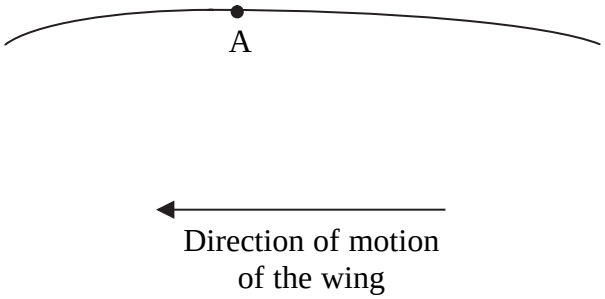
(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 The diagram shows part of the upper surface of an aeroplane wing.



At point A the air flow changes from laminar to turbulent.

Complete the diagram to show the airflow before and after point A.

(Total for Question 11 = 2 marks)

*12 Explain the difference between elastic deformation and plastic deformation. Use the behaviour of the same material or object to illustrate both types of deformation.

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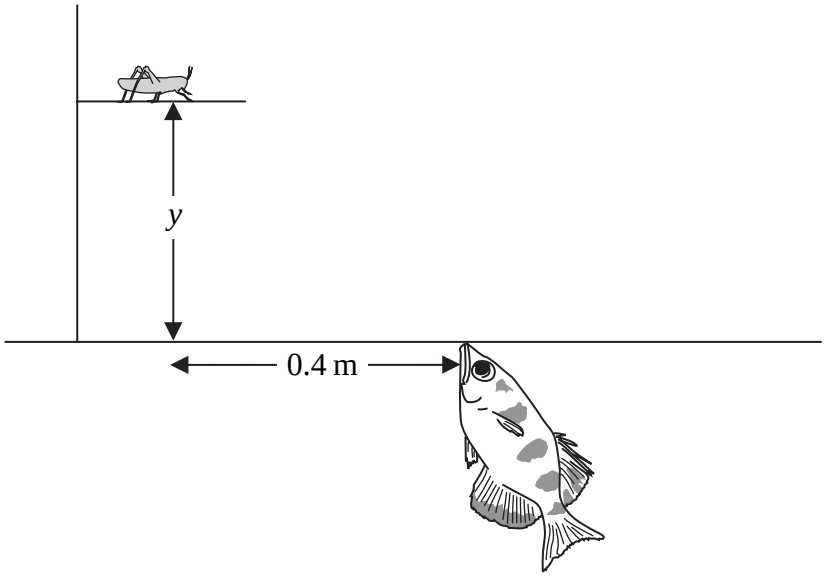
(Total for Question 12 = 4 marks)

13 Archer fish spit water droplets at insects from the surface of the water.

(a) The Archer fish spits a droplet of water with a velocity of 3.5 m s^{-1} at an angle of 70° to the horizontal, aiming for an insect on a branch above the surface of the water. The horizontal distance to the insect is 0.4 m.



(i) Show that the initial horizontal component of velocity for the droplet is about 1 m s^{-1}.

(2)

.....

.....

(ii) Calculate the vertical distance, *y*, to the insect if the droplet hits the insect.

(5)

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Distance = ...

(b) Sketch the path of the water droplet on the diagram above.

(1)

(Total for Question 13 = 8 marks)

14 One method used to find the viscosity of a liquid is to measure the terminal velocity of a solid spherical object falling through it.

In such an experiment the following data are provided:

weight of sphere = 4.8×10^{-3} N
radius of sphere = 2.5×10^{-3} m
volume of sphere = 6.5×10^{-8} m^3
density of liquid = 1300 kg m^{-3}

(a) Show that the upthrust is about 8×10^{-4} N.

(2)

.....

.....

.....

.....

(b) The terminal velocity is found to be 4.6×10^{-2} m s^{-1}. Use this value to show that the viscosity of the liquid is about 2 kg m^{-1} s^{-1}.

(3)

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.....

(c) The students carrying out this experiment wish to repeat it on another day using the same equipment. State another relevant variable that needs to be controlled to make this a fair test.

(1)

.....

(Total for Question 14 = 6 marks)

15 The photograph shows the top of an inspection cover for a drain.

(a) The cover is marked 'ductile'. It is made from ductile iron, which was invented in 1943. It replaced the previous form of cast iron, which was more brittle.

Explain the meaning of the following terms:

(2)

Ductile .....

.....

Brittle .....

.....

(b) The cover is also marked '35 kN'. This refers to the load it must be able to support.

Calculate the mass that would produce this load.

(2)

.....

Mass = ...

(Total for Question 15 = 4 marks)

16 There has been a proposal to build a train tunnel underneath the Atlantic Ocean from England to America. The suggestion is that in the future the trip of 5000 km could take as little as one hour.

Assume that half the time is spent accelerating uniformly and the other half is spent decelerating uniformly with the same magnitude as the acceleration.

(a) Show that the acceleration would be about 2 m s^{-2}.

(2)

.....

.....

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.....

.....

(b) Calculate the maximum speed.

(2)

.....

.....

Speed = ...

(c) Calculate the resultant force required to decelerate the train.

mass of train = 4.5×10^5 kg

(2)

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Force = ...

(Total for Question 16 = 6 marks)

17 A kite is held by a string and flies because of lift produced by the flow of air.

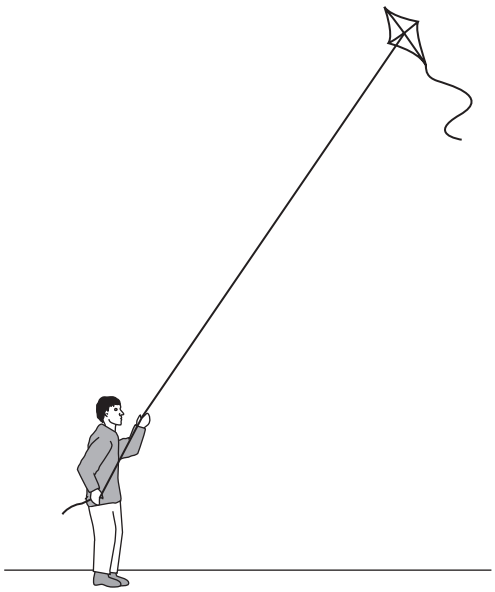


Figure 1

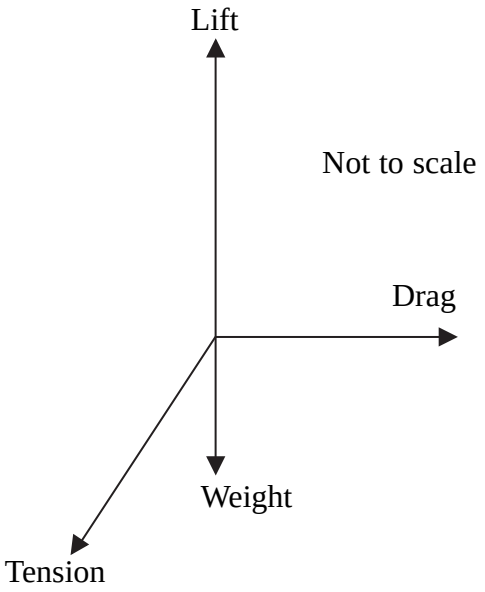


Figure 2

Figure 2 shows a free-body force diagram for the kite.

(a) Sketch a labelled vector diagram to show that the four forces are in equilibrium.

(1)

(b) The lift is 4.3 N, the drag is 6.0 N and the weight is 0.44 N.

Calculate the tension in the string. State its magnitude and direction from the horizontal.

(4)

Magnitude of tension = ...

Direction of tension from the horizontal = ...

(c) (i) The wind speed decreases so the girl flying this kite walks into the wind at a constant speed of 2.0 m s^{-1} to maintain the forces shown. Calculate the work done by the girl as she walks 25 m.

(2)

Work done = ...

(ii) Calculate the rate at which work is done by the girl.

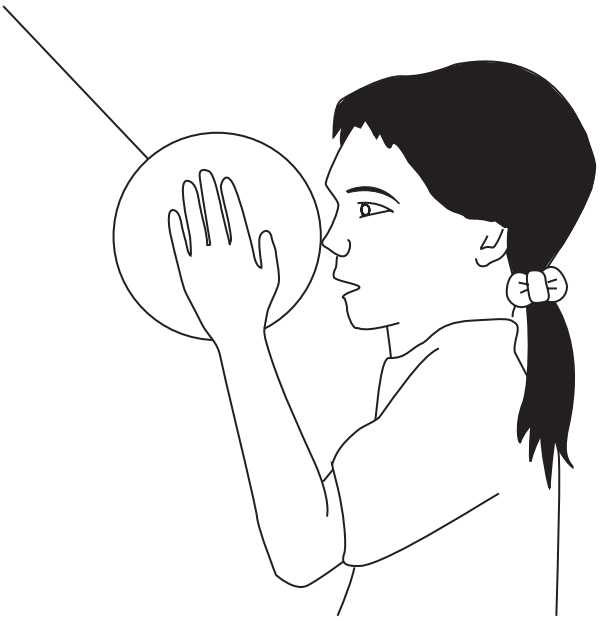
(2)

Rate at which work is done = ...

(Total for Question 17 = 9 marks)

***18** In a demonstration of energy transfer, a large pendulum is made by suspending a 7.0 kg bowling ball on a long piece of wire.

A student is invited to pull the ball back until it just touches her nose and then to release it and stand perfectly still while waiting for the ball to return.



The following instructions are given:

> Do not push the ball – just release it.
> Do not move your face before the ball returns.

(a) Explain this demonstration and the need for these instructions.

(6)

(b) The bowling ball is raised through a vertical distance of 1.5 m.

(i) Calculate the gravitational potential energy gained by the ball.

(2)

.....

.....

.....

Gravitational potential energy = ...

(ii) Calculate the speed of the ball at the bottom of its swing.

(2)

.....

.....

.....

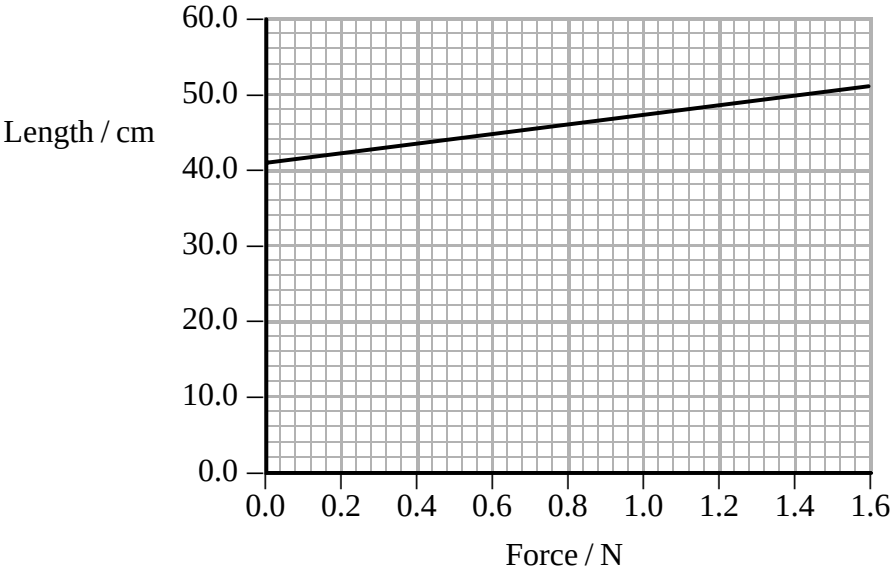
Speed = ...

(Total for Question 18 = 10 marks)

*19 The photograph shows a tin bought from a joke shop. When the lid is removed, a long spring, covered in fabric to resemble a snake, flies out of the tin.

The spring on its own is shown here.

The graph shows length against force for the spring.



(a) Explain whether the spring obeys Hooke's law.

(2)

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(b) Show that the spring constant k of the spring is about 20 N m^{-1}.

(3)

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.....

k = ...

(c) The original length of the spring is 41.0 cm and the length of the tin is 9.0 cm.

(i) Calculate the force that must be applied to the spring to get it into the tin.

(2)

.....

.....

.....

.....

Force = ...

(ii) Calculate the energy stored in the spring when it is compressed to fit into the tin.

(2)

.....

.....

.....

.....

Energy = ...

(d) In fact the bottom of the tin contains a device that makes a squeak when the spring is released, making the internal length of the tin less than 9.0 cm.

Explain the effect this has on the speed at which the spring leaves the tin.

(3)

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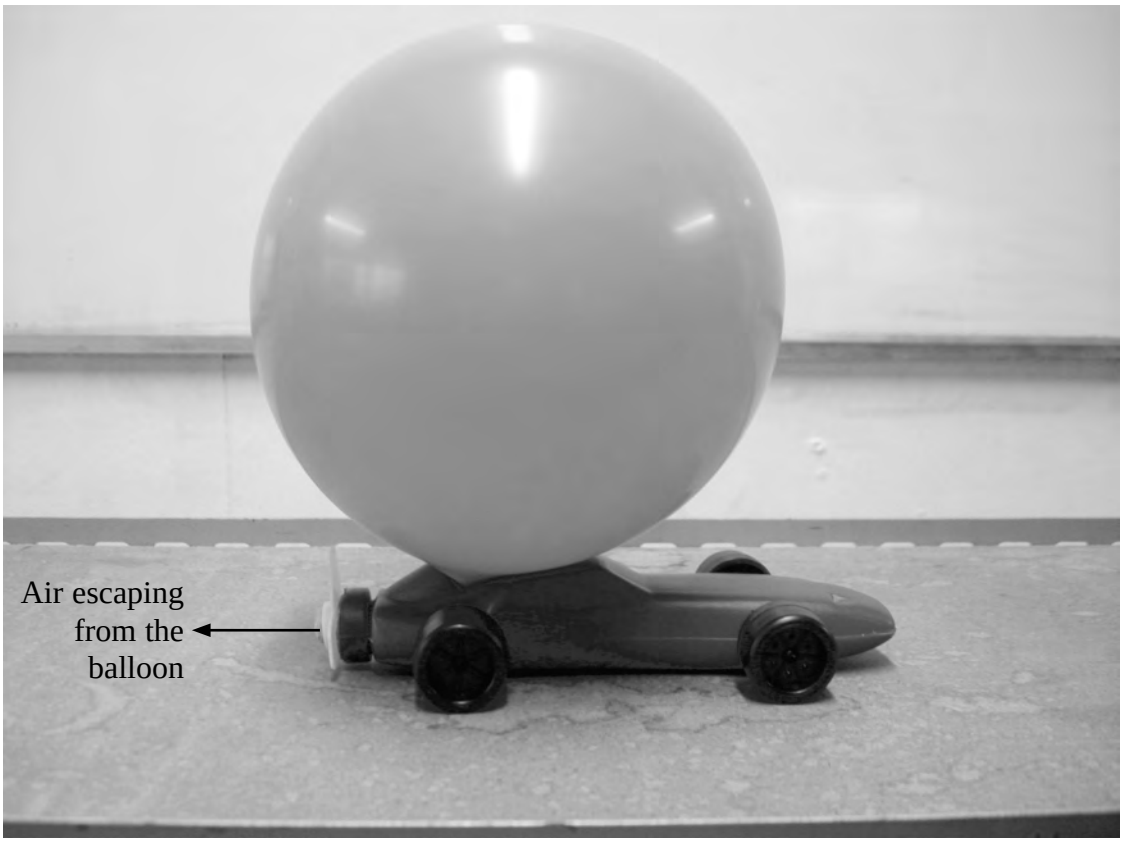
(Total for Question 19 = 12 marks)

20 The photograph shows a toy car driven by air from a deflating balloon.



When the air in the inflated balloon is released, the car starts to move forwards.

(a) Use Newton's first and third laws of motion to explain why the air coming out of the balloon causes this.

(3)

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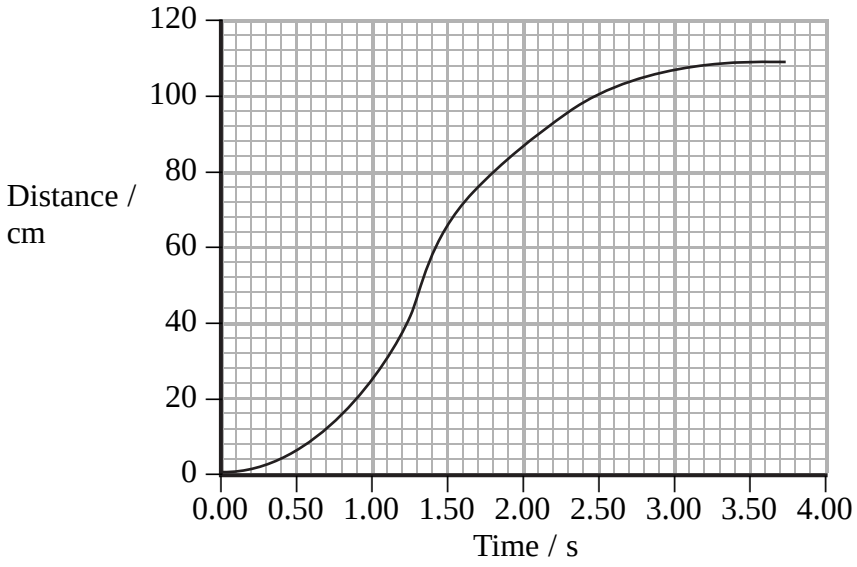
(b) The following distance-time graph is obtained for the car.



(i) Show that the maximum speed reached is between 100 and 150 cm s^{-1}.

(3)

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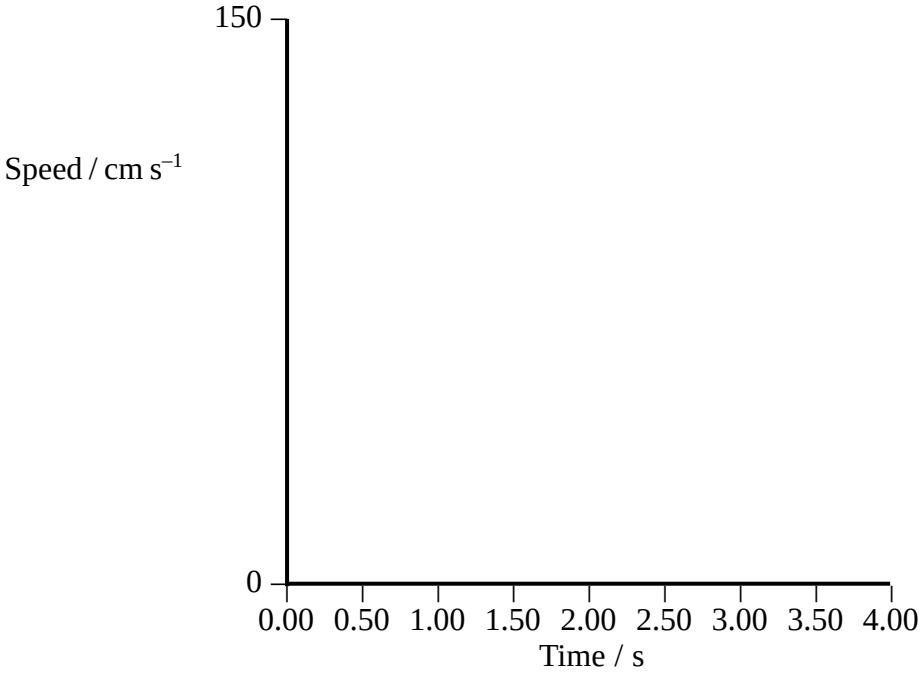
(ii) Sketch the shape of the corresponding speed-time graph on the axes below.

(3)



(Total for Question 20 = 9 marks)

TOTAL FOR SECTION B = 70 MARKS

TOTAL FOR PAPER = 80 MARKS

Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Wednesday 12 January 2011 – Morning
Time: 1 hour 30 minutes

Paper Reference
6PH01/01

You do not need any other materials.

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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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 Acceleration can be found from the

☒ **A** area under a distance-time graph.

☒ **B** area under a velocity-time graph.

☒ **C** gradient of a distance-time graph.

☒ **D** gradient of a velocity-time graph.

(Total for Question 1 = 1 mark)

2 Which table is correct for scalar and vector quantities?

☒ **A**

	has magnitude	has a direction
scalar	✓	✓
vector	✗	✓

☒ **B**

	has magnitude	has a direction
scalar	✗	✓
vector	✓	✓

☒ **C**

	has magnitude	has a direction
scalar	✓	✗
vector	✓	✓

☒ **D**

	has magnitude	has a direction
scalar	✓	✓
vector	✓	✗

(Total for Question 2 = 1 mark)

3 Which of the following is **not** a unit of energy?

☒ **A** $N\ s^{-1}$

☒ **B** kW h

☒ **C** N m

☒ **D** W s

(Total for Question 3 = 1 mark)

Use the following information to answer Questions 4 and 5.

A body is acted on by a vertical force of 18 N and a horizontal force of 32 N.

4 The angle to the horizontal of the resultant force is given by

☒ **A** $\cos^{-1}(18/32)$

☒ **B** $\tan^{-1}(18/32)$

☒ **C** $\sin^{-1}(32/18)$

☒ **D** $\tan^{-1}(32/18)$

(Total for Question 4 = 1 mark)

5 The magnitude of the resultant force in N is

☒ **A** $32 + 18$

☒ **B** $32^2 + 18^2$

☒ **C** $\sqrt{32+18}$

☒ **D** $\sqrt{32^2 + 18^2}$

(Total for Question 5 = 1 mark)

6 Which of the following statements is true for the two forces in a Newton's third law pair?

☒ **A** They have different magnitudes and act in different directions.

☒ **B** They act in different directions on the same body.

☒ **C** They have the same magnitude and are different types of force.

☒ **D** They are the same type of force and act on different bodies.

(Total for Question 6 = 1 mark)

7 A ball is dropped from rest from a building 35.0 m high.

If air resistance is neglected the ball hits the ground with a speed of

☒ **A** 8.4 m s^{-1}

☒ **B** 13.1 m s^{-1}

☒ **C** 18.5 m s^{-1}

☒ **D** 26.2 m s^{-1}

(Total for Question 7 = 1 mark)

8 A physics book gives this definition:

A material which shows a large plastic deformation under compression.

This is the definition for

☒ **A** ductile

☒ **B** hard

☒ **C** malleable

☒ **D** stiff

(Total for Question 8 = 1 mark)

9 A ball bearing is released in a measuring cylinder filled with oil. To increase the time taken for the ball bearing to reach the bottom, which one of the following would have to increase?

- ☒ **A** the temperature of the oil
- ☒ **B** the viscosity of the oil
- ☒ **C** the gravitational field strength
- ☒ **D** the density of the ball bearing

(Total for Question 9 = 1 mark)

10 Which of the following is a vector quantity?

- ☒ **A** distance
- ☒ **B** force
- ☒ **C** speed
- ☒ **D** work

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

***11** During a lesson on Newton's laws of motion, a student says, "We don't really need to bother with Newton's first law because it is included in his second law".

State Newton's first two laws of motion and explain how Newton's second law includes the first law.

(5)

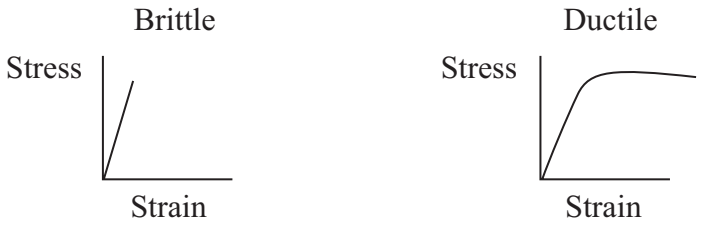
(Total for Question 11 = 5 marks)

***12** Explain why the wire used when measuring the Young Modulus of copper in a school laboratory is long and thin.

(5)

(Total for Question 12 = 5 marks)

13 The graphs show the behaviour of brittle and ductile materials.



(a) Use the graphs to help you describe brittle and ductile behaviour.

(2)

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(b) In 2006, three Chinese vases, dating from the 17th Century, were smashed when a man fell down the stairs at the Fitzwilliam Museum in Cambridge. The vases were made of porcelain.

A restoration expert put the vases back together. She said, "It wasn't a difficult job. The museum collected all the pieces and they fitted back together perfectly."

Explain why it was possible to fit the pieces back together perfectly.

(2)

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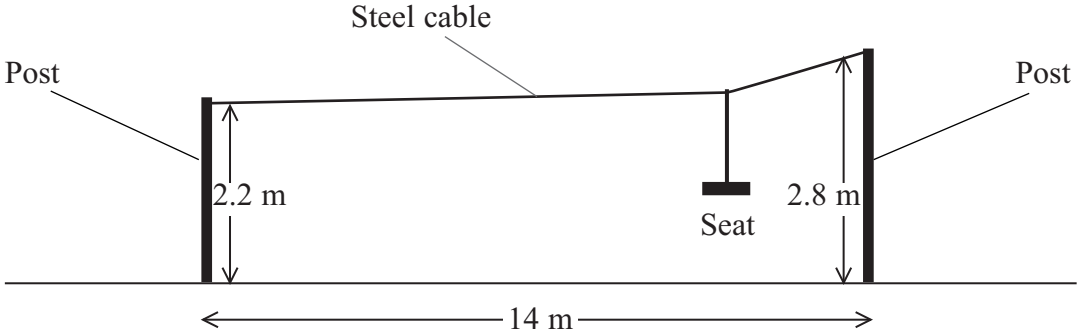
(Total for Question 13 = 4 marks)

14 A playground ride consists of a steel cable running at an angle between two posts of unequal height as shown in the diagram.



A child sits on the seat which moves on runners along the cable from the high end to the lower end.

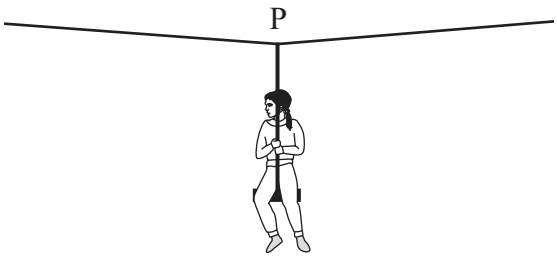
(a) (i) Show that her maximum possible speed when she arrives at the lower post is about 3 m s^{-1}.

(4)

(ii) State an assumption that you have made.

(1)

(b) The diagram below shows the child at a point P where both sides of the cable make an angle of 2° to the horizontal.



(i) Add labelled arrows to the diagram to show the forces acting on the cable at the point P.

(2)

(ii) The total mass of the child and seat is 40 kg.

Show that the tension in the cable is about 6000 N.

(3)

(Total for Question 14 = 10 marks)

15 (a) (i) A small solid particle is falling through water. Add labelled arrows to the diagram below to show the forces acting on the particle.

(3)

(ii) Explain the condition for the particle to fall at its terminal velocity.

(2)

.....

.....

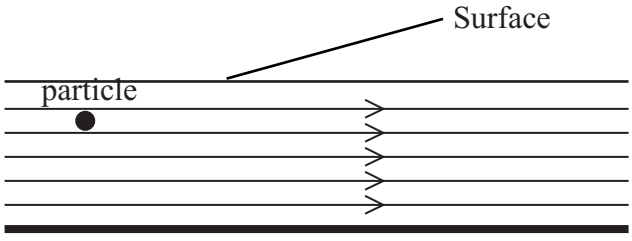
.....

(b) Flowing water can be used to move solid particles from one place to another.

(i) The diagram below shows water moving horizontally with a laminar flow.

Add to the diagram to show the path of the particle falling through this water flow.

(1)



(ii) Complete the diagram below to show water moving with turbulent flow.

(1)

(iii) Describe the difference between laminar and turbulent flow.

(1)

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(iv) Suggest why turbulent flow may be used to move small solid particles.

(1)

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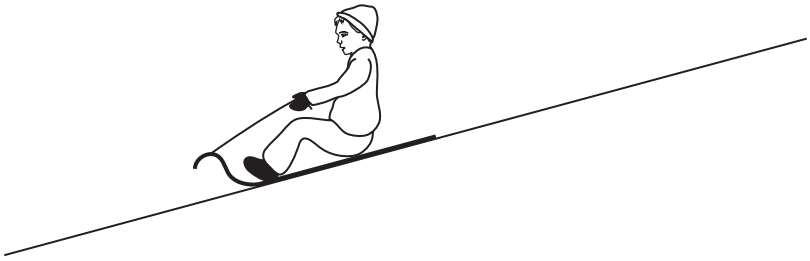
(Total for Question 15 = 9 marks)

16 (a) A child is going down a snowy hill on a sledge.



Complete, in the space below, a free-body force diagram for the child and sledge.
Treat the child and sledge as a single body object.

(2)

(b) The child and sledge are pulled across level ground by an adult.

(i) They are pulled 11 m from rest in 4.9 s.

Show that the average acceleration is about 1 m s^{-2}.

(2)

.....

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(ii) The child and sledge have a combined mass of 40 kg.

Calculate the average resultant force on the child and sledge.

(2)

.....

.....

.....

.....

Average resultant force = ...

(c) The force applied by the adult is 200 N at an angle of 20° to the horizontal.

(i) Calculate the average resistive force acting while the sledge is being pulled.

(2)

Average resistive force = ...

(ii) Calculate the average power developed by the adult in pulling the sledge 11 m.

(3)

Average power = ...

(Total for Question 16 = 11 marks)

17 The photograph shows what happens when soft mint sweets are dropped into a bottle containing a fizzy drink. There is a sudden release of gas which forces a long stream of fluid out of the bottle.

A student decides to calculate the amount of kinetic energy transferred to the fluid in this process. In one experiment, the student places the bottle at an angle of 50° to the horizontal, adds the sweets and measures the maximum horizontal distance travelled by the fluid. The student then calculates that the fluid left the bottle at a speed of 7.5 m s^{-1}.

(a) (i) Show that the initial horizontal component of the fluid's velocity is about 5 m s^{-1}.

(1)

.....

.....

(ii) Show that the initial vertical component of the fluid's velocity is about 6 m s^{-1}.

(1)

.....

.....

(iii) Use these values to calculate the maximum horizontal distance travelled by the fluid. Assume the fluid leaves the bottle at ground level.

(4)

.....

.....

.....

.....

.....

.....

Maximum distance = ...

(b) (i) Calculate the total amount of kinetic energy transferred to the fluid.

total mass of bottle, contents and sweets before the experiment = 2.24 kg
total mass of bottle, contents and sweets after the experiment = 0.79 kg

(2)

Kinetic energy = ...

(ii) Give a reason why your value of kinetic energy might be higher than the true value.

(1)

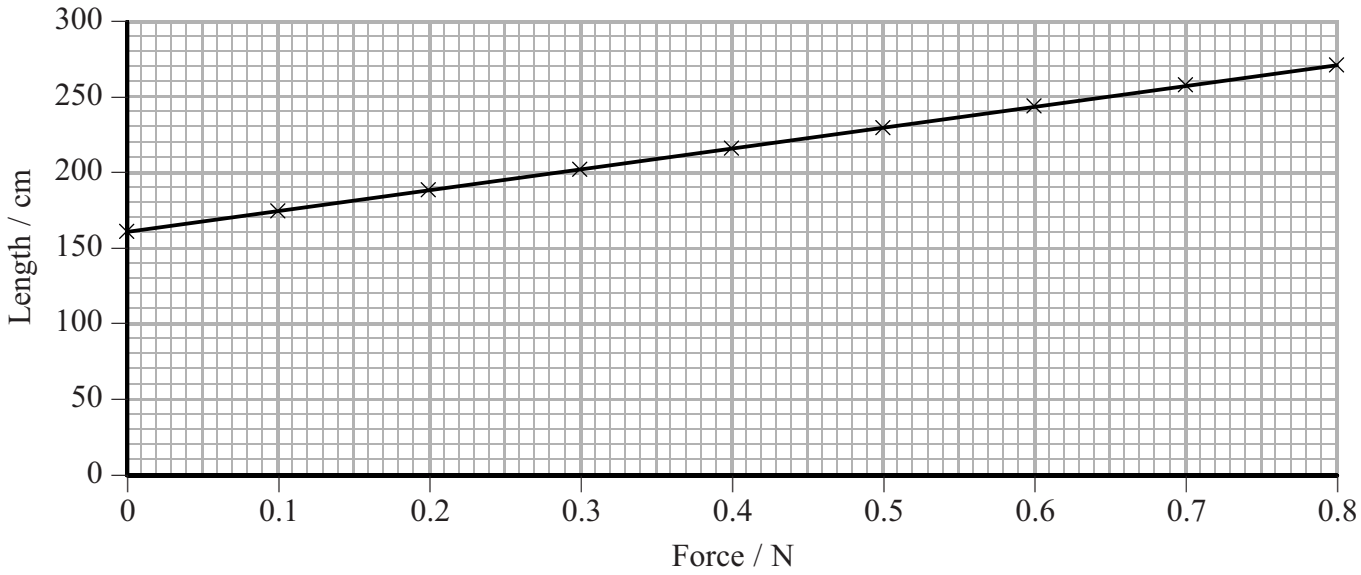
(iii) Explain why your value of kinetic energy might be lower than the true value.

(2)

(Total for Question 17 = 11 marks)

18 A Slinky is a long spring made of metal. One end of a Slinky is fixed to the ceiling. The force acting on the Slinky was varied by hanging weights from the other end.

The graph shows the results.



(a) (i) Explain whether the results follow Hooke's law.

(2)

(ii) Show that the stiffness of the Slinky is about 0.7 N m^{-1}.

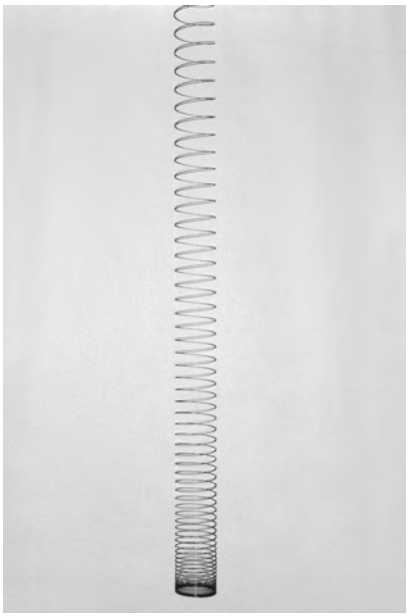
(3)

(iii) Calculate the elastic strain energy stored in the Slinky when the applied force is 0.70 N.

(3)

Elastic strain energy = ...

(b) The photograph shows part of the Slinky hanging from a person's hand.



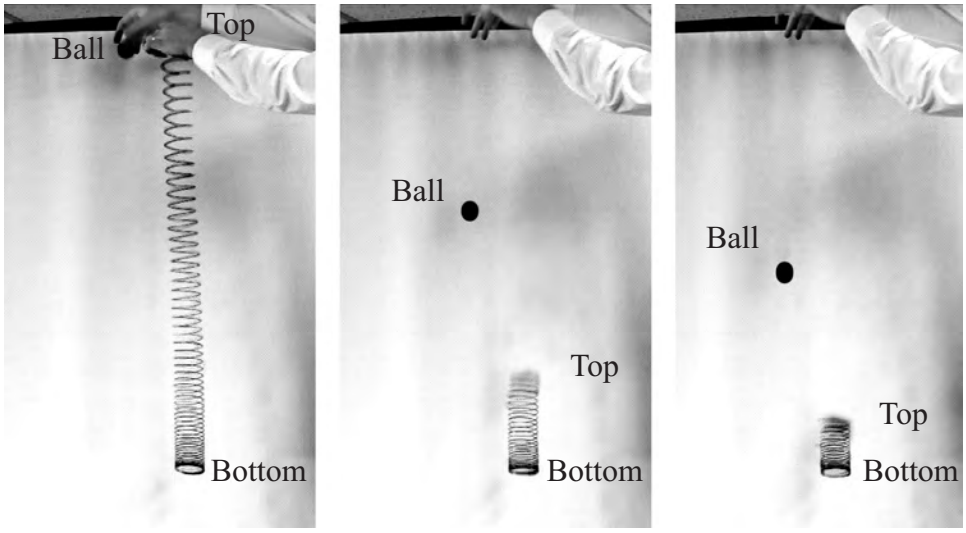
(i) Explain why the coils are extended more at the top than the bottom.

(2)

(ii) Mark and label the approximate position of the centre of gravity of the Slinky on the photograph above.

(1)

(iii) A ball is dropped from the same height, and at the same time, as the top of the Slinky is released. The three photographs below show what happens.



*(1) By considering the forces acting on the top coils of the Slinky, explain why they fall faster than the ball.

(3)

(2) Suggest why the bottom coils remain in the same position in the three photographs.

(1)

(Total for Question 18 = 15 marks)

TOTAL FOR SECTION B = 70 MARKS

TOTAL FOR PAPER = 80 MARKS

Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Tuesday 24 May 2011 – 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 ▶

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P 3 8 4 1 4 A 0 1 2 4

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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 is **not** a vector quantity?

☒ **A** displacement

☒ **B** force

☒ **C** weight

☒ **D** work

(Total for Question 1 = 1 mark)

2 Which of the following units is equivalent to the SI unit for energy?

☒ **A** kg m s^{-2}

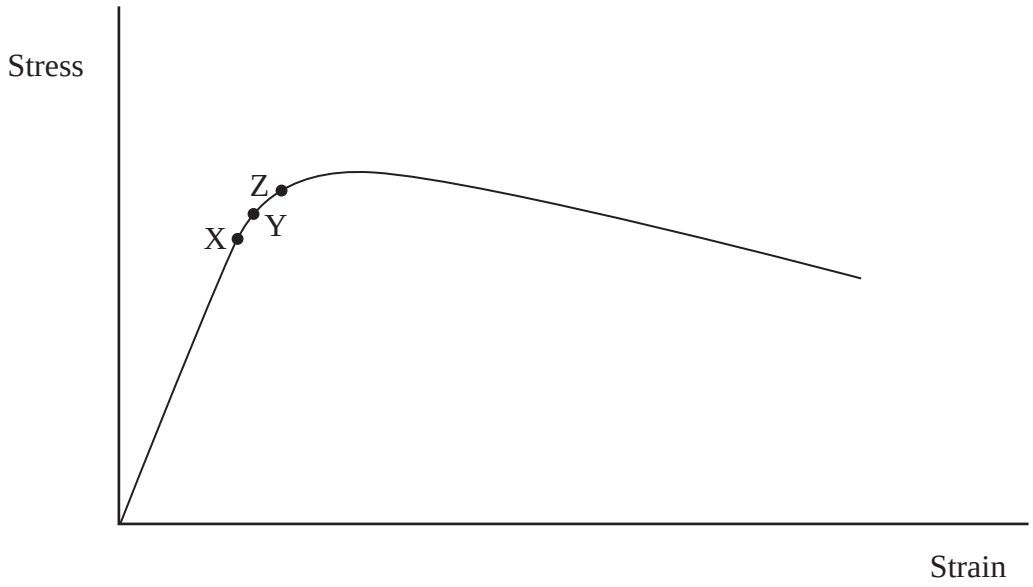
☒ **B** kW h

☒ **C** N m^{-1}

☒ **D** W s

(Total for Question 2 = 1 mark)

3 The graph shows how tensile stress varies with tensile strain for a wire.



Which row of the table could give the correct terms for points X, Y and Z?

		X	Y	Z
☒	**A**	Elastic limit	Yield point	Maximum tensile stress
☒	**B**	Limit of proportionality	Elastic limit	Yield point
☒	**C**	Elastic limit	Maximum tensile stress	Limit of proportionality
☒	**D**	Limit of proportionality	Yield point	Maximum tensile stress

(Total for Question 3 = 1 mark)

4 The acceleration of free fall on Mars is 3.7 m s^{-2}.

If an object on Mars is launched vertically upwards with an initial speed of 40 m s^{-1}, its speed after 3.0 s will be

☒ **A** 11 m s^{-1}

☒ **B** 29 m s^{-1}

☒ **C** 36 m s^{-1}

☒ **D** 51 m s^{-1}

(Total for Question 4 = 1 mark)

5 The gravitational field strength on Mars is 3.7 N kg^{-1}.

A 5.0 kg object is raised through a height of 150 cm on Mars. The change in gravitational potential energy is

☒ **A** 19 J

☒ **B** 28 J

☒ **C** 49 J

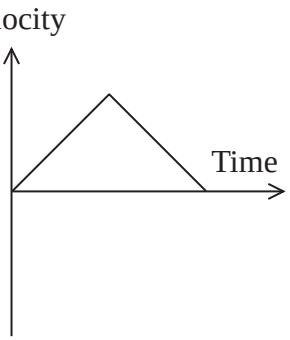
☒ **D** 74 J

(Total for Question 5 = 1 mark)

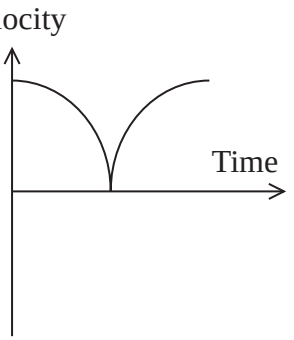
6 A ball is dropped to the ground and caught when it bounces up again.

Which of the following graphs shows the velocity of the ball?

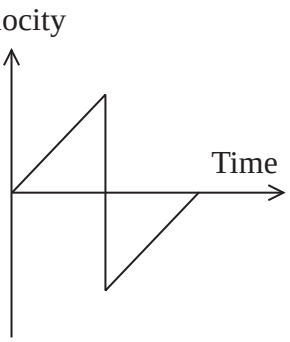
A



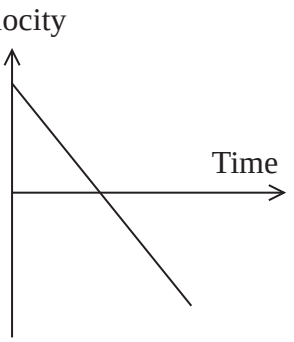
B



C



D



☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 6 = 1 mark)

7 A material which resists plastic deformation by scratching is described as

- ☒ **A** brittle
- ☒ **B** hard
- ☒ **C** malleable
- ☒ **D** stiff

(Total for Question 7 = 1 mark)

8 A child goes down a slide. Which of the diagrams correctly represents the forces acting on the child?

A **B** **C** **D**

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 8 = 1 mark)

9 The gradient of a displacement-time graph gives

- ☒ **A** acceleration
- ☒ **B** displacement
- ☒ **C** force
- ☒ **D** velocity

(Total for Question 9 = 1 mark)

10 A table tennis ball is released beneath the surface of water and moves upwards.

The relationship between the forces acting on the ball when it reaches terminal velocity is

☒ **A** weight = upthrust

☒ **B** weight + drag = upthrust

☒ **C** weight = upthrust + drag

☒ **D** weight = drag

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 (a) What is meant by a vector quantity?

(1)

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(b) A car is driven around a bend at a constant speed.

Explain what happens to its velocity.

(2)

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(Total for Question 11 = 3 marks)

12 The photograph shows someone using a vacuum cleaner.

(a) A force of 38 N is applied at an angle of 60° to the horizontal. The vacuum cleaner moves across the floor at a constant speed.

Calculate the magnitude of the horizontal resistive force acting on the vacuum cleaner.

(2)

.....

.....

.....

Resistive force = ...

(b) The room is 5.5 m long. The vacuum cleaner is pushed 20 times across the room to clean the carpet.

Calculate the work done against the horizontal resistive force.

(2)

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.....

.....

Work done = ...

(c) Each 5.5 m length takes a time of 9.0 s.

Calculate the rate at which this work is done.

(2)

.....

.....

Rate of work done = ...

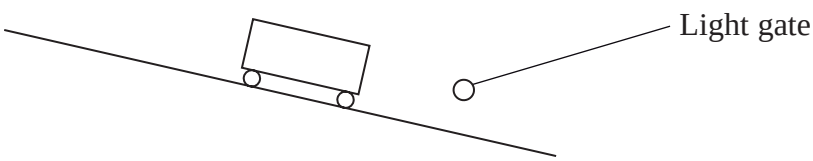
(Total for Question 12 = 6 marks)

13 A student is required to measure the speed of a trolley rolling down a slope. This could be done using a ruler and stopwatch but the student prefers a method using ICT.

(a) The student uses a light gate as shown in the diagram.

Describe how the student obtains the measurements needed to calculate speed.

(2)



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(b) The student thinks that the stopwatch method is less reliable than the ICT method.

Discuss what makes using a stopwatch less reliable.

(2)

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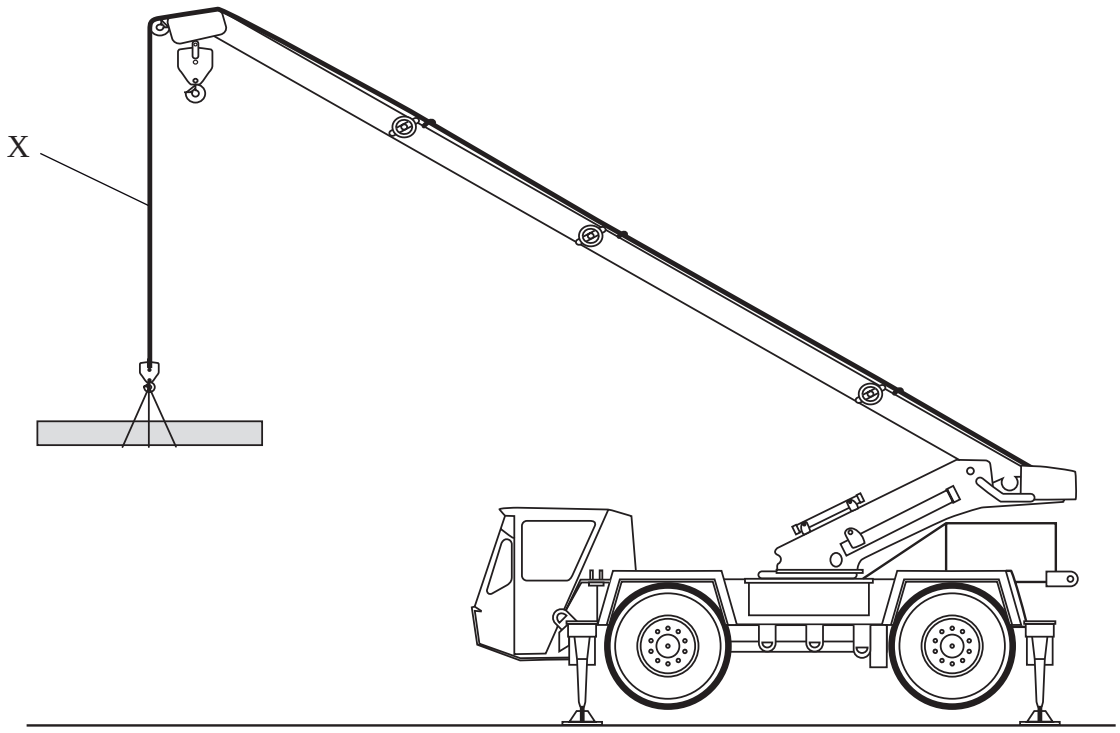
(Total for Question 13 = 4 marks)

14 The diagram shows a crane lifting a concrete beam.

mass of beam = 1300 kg
diameter of steel cable = 1.1 cm



(a) Show that the stress in the cable at point X is about 0.1 GPa.

(4)

(b) The original length of the cable with no load is 15 m.

Calculate its extension when lifting the beam.

Young modulus for steel = 195 GPa

(3)

Extension = ...

(c) The steel cable consists of six strands each made of thirty seven wires.

Suggest why this is preferred to a single piece of steel.

(1)

(Total for Question 14 = 8 marks)

15 You are asked to find the Young modulus for a metal using a sample of wire.

*(a) Describe the apparatus you would use, the measurements you would take and explain how you would use them to determine the Young modulus for the metal.

(8)

(b) State **one** safety precaution you would take.

(1)

(c) Explain **one** experimental precaution you would take to ensure you obtain accurate results.

(2)

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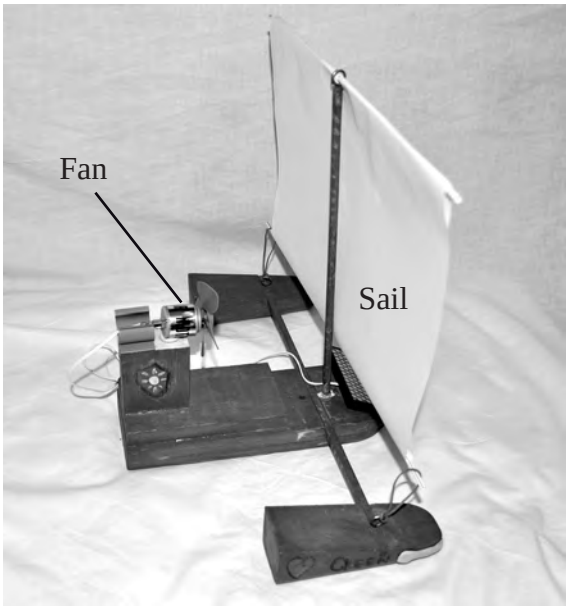
(Total for Question 15 = 11 marks)

16 The photograph shows a solar-powered model boat built by some technology students.



This boat has a solar-powered fan attached. The fan blows air towards the sail.

(a) The technology students explain to a physics student that the fan exerts a force on the air and the air then exerts an equal force on the sail to drive the boat forwards. Assume that these two forces are equal for the rest of the question.
The physics student tells them that according to Newton's laws of motion this will not work.

(i) Identify the Newton's third law force that pairs with the force of the fan on the air.

(1)

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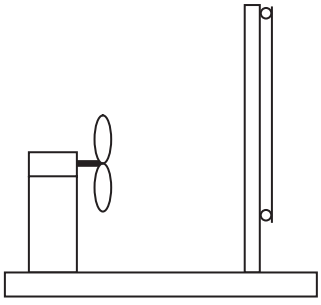
(ii) The boat is placed in the water and the fan switched on. The boat remains at rest.
Add labelled arrows to the diagram below to show the **four** forces acting on the boat in this situation.

(2)



*(iii) Use Newton's laws of motion to explain why the boat does not move horizontally.

(3)

(b) The physics student suggests that the boat is more likely to work if the fan is reversed to point in the opposite direction.

Explain this suggestion.

(2)

(c) Calculate the volume of water, in m^3, which must be displaced so that the boat will float.

mass of boat = 130 g
density of water = 1000 kg m^{-3}

(2)

Volume = ...

(Total for Question 16 = 10 marks)

17 A student carries out an experiment in which a column of liquid glycerol flows through a narrow glass tube. The time taken for the top of the glycerol column to fall a known distance between two markers is measured with a stopwatch. The experiment is repeated at different temperatures.

The student records the following results.

Temperature / °C	Time taken / s	Average speed / m s^{-1}
26.5	4.2	0.019
35.5	2.4	0.033
42.5	1.5	
50.0	1.2	0.067
61.5	0.5	0.160

(a) (i) The table shows the average speed of flow for four of the temperatures. Calculate the missing value and enter it in the table. The distance between the markers is 0.080 m.

(1)

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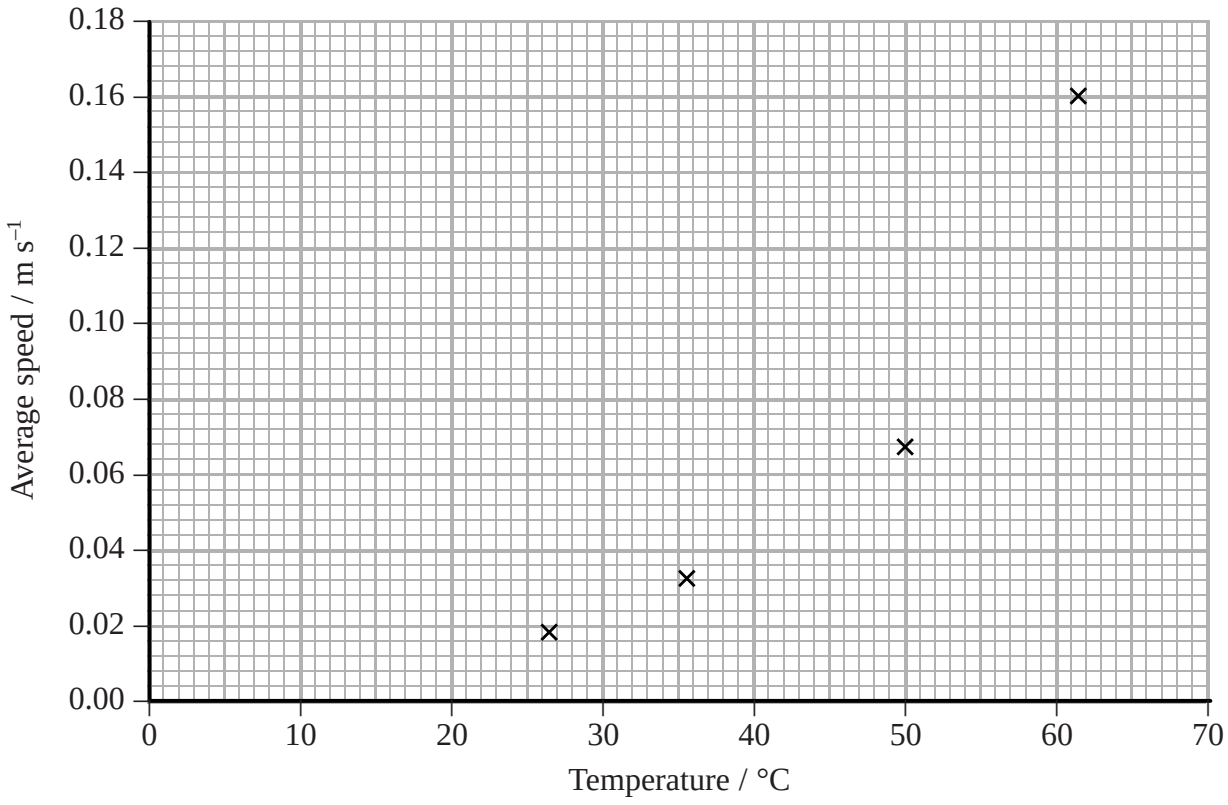
(ii) Add this point to the graph below and draw a best-fit line for the student's data.

(2)



(iii) Use these results to explain how the viscosity of glycerol varies with temperature.

(2)

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(b) This experiment depends on the flow remaining laminar and not becoming turbulent.

(i) Explain these **two** terms and complete the diagrams to illustrate each type of flow through a vertical tube.

(4)

laminar .....

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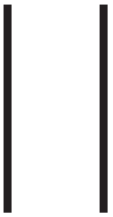

turbulent .....

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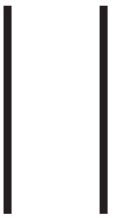

(ii) Explain the effect turbulence would have on the rate of flow.

(2)

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(c) The student thinks that the value measured for 61.5 °C is the most likely point to be incorrect based on the technique described at the start of the question.

Explain why this should be so.

(2)

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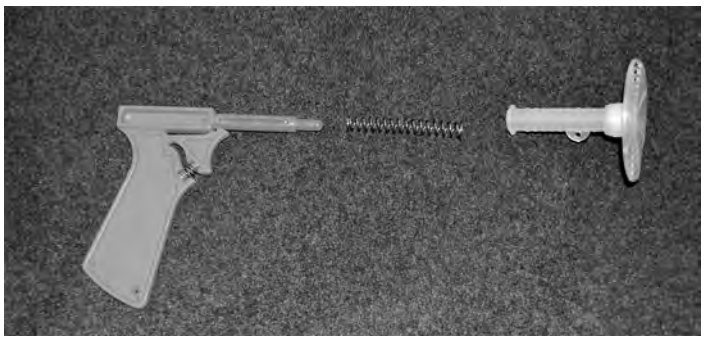
(Total for Question 17 = 13 marks)

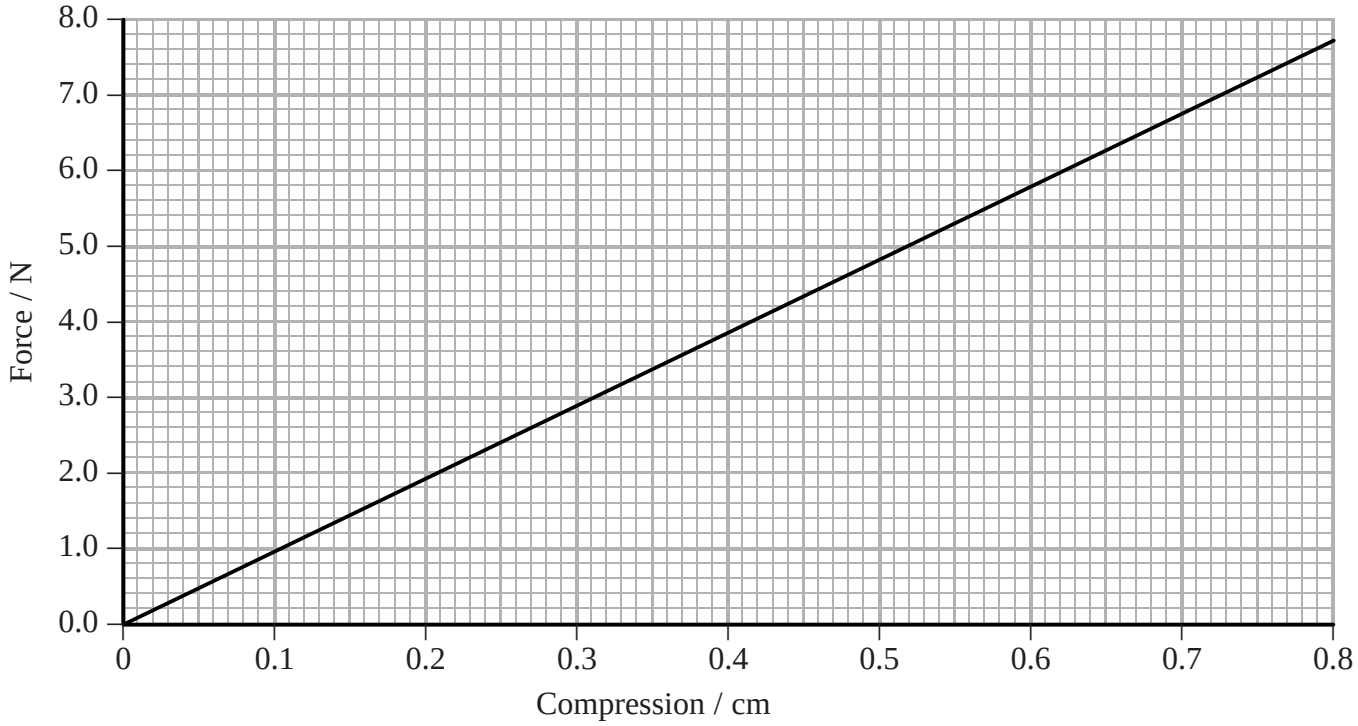
18 The photograph shows a flygun.

The flygun consists of a handle, a spring and a disc as shown in the photograph below.



When the trigger is pulled, the compressed spring is released, launching the disc at the fly.

A force-compression graph for the spring is shown.



(a) Show that the force constant for the spring is about 1000 N m^{-1}.

(2)

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(b) The spring is 6.3 cm long. When it is compressed in the gun, the length of the spring is reduced to 1.6 cm.

Assuming that the spring obeys Hooke's law throughout the compression, show that the energy stored in the spring before firing the gun is about 1 J.

(2)

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(c) The disc and spring have a combined mass of 9.4 g.

(i) Show that the maximum speed at which they can be fired is about 15 m s^{-1}.

(2)

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(ii) State an assumption that you have made.

(1)

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(d) The gun is fired at a fly on a wall 3.0 m away. The gun is fired horizontally.

(i) Calculate the velocity of the disc as it hits the wall. Ignore the effects of air resistance.

(4)

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Magnitude of velocity = ...

Angle to the horizontal = ...

(ii) The fly is 20 cm below the horizontal level at which the gun is fired. Show that the disc is close enough to hit the fly if it does not move. The disc has a radius of 3 cm.

(3)

(e) Suggest an advantage of the disc used over a solid disc.

(1)

(Total for Question 18 = 15 marks)

TOTAL FOR SECTION B = 70 MARKS

TOTAL FOR PAPER = 80 MARKS

Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Thursday 12 January 2012 – Afternoon
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
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Turn over ▶

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P 3 9 8 4 7 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 Which statement about scalar and vector quantities is correct?

☒ **A** Scalars have direction only.

☒ **B** Scalars have distance only.

☒ **C** Vectors have magnitude and direction.

☒ **D** Vectors have magnitude and distance.

(Total for Question 1 = 1 mark)

2 Which of the following is a unit equivalent to the pascal?

☒ **A** kg m s^{-1}

☒ **B** kg m s^{-2}

☒ **C** kg m^{-1} s^{-2}

☒ **D** kg m^{-2} s^{-2}

(Total for Question 2 = 1 mark)

3 A model boat is crossing a stream. The stream is travelling east at a speed of 1.5 m s^{-1}.
The boat is heading north at a speed of 0.5 m s^{-1}.

The magnitude of the resultant velocity is

☒ **A** $(1.5 + 0.5)$ m s^{-1}

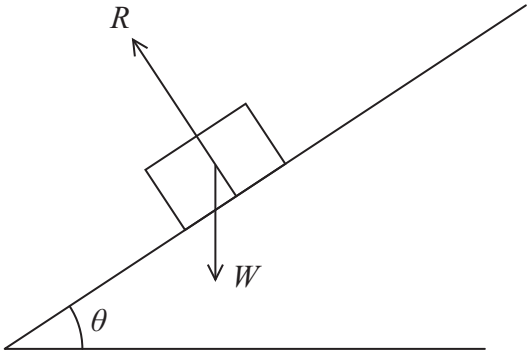
☒ **B** $(1.5^2 + 0.5^2)$ m s^{-1}

☒ **C** $\sqrt{(1.5+0.5)}$ m s^{-1}

☒ **D** $\sqrt{(1.5^2+0.5^2)}$ m s^{-1}

(Total for Question 3 = 1 mark)

Questions 4 and 5 refer to the diagram below.



The diagram shows the forces acting on an object on an inclined surface.

4 The component of R parallel to the inclined surface is

- ☒ **A** 0
- ☒ **B** 1
- ☒ **C** $R \cos \theta$
- ☒ **D** $R \sin \theta$

(Total for Question 4 = 1 mark)

5 The object in the diagram would

- ☒ **A** remain at rest on the surface.
- ☒ **B** move down the surface at constant speed.
- ☒ **C** accelerate down the surface.
- ☒ **D** move up the surface at constant speed.

(Total for Question 5 = 1 mark)

6 In the expression $F = 6\pi\eta rv$

- ☒ **A** η represents density and v represents viscosity.
- ☒ **B** r represents radius and η represents density.
- ☒ **C** r represents radius and v represents viscosity.
- ☒ **D** η represents viscosity and v represents velocity.

(Total for Question 6 = 1 mark)

7 A wire of cross-sectional area A and length x is stretched by a force F. The Young modulus of the material of the wire is E.

The extension Δx is given by

- ☒ **A** AE/Fx
- ☒ **B** Ex/FA
- ☒ **C** FA/Ex
- ☒ **D** Fx/AE

(Total for Question 7 = 1 mark)

8 On a newly discovered planet, an object of mass 8.0 kg has a weight of 60 N.

The gravitational field strength on this planet is

- ☒ **A** 0.13 N kg^{-1}
- ☒ **B** 7.5 N kg^{-1}
- ☒ **C** 9.8 N kg^{-1}
- ☒ **D** 480 N kg^{-1}

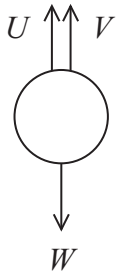
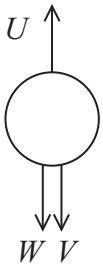
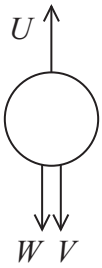
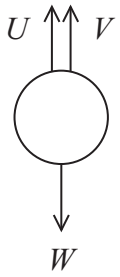
(Total for Question 8 = 1 mark)

9 A small bubble is rising through a liquid at a constant speed.

Which row of the table correctly summarises the forces in both the diagram and the equation?

V = viscous drag, U = upthrust, W = weight

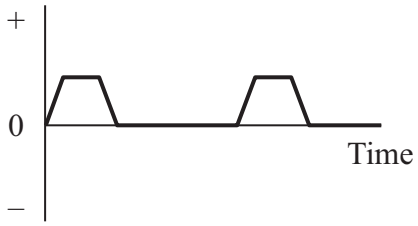
The force arrows are not drawn to scale.

☒	**A**		$W = V + U$
☒	**B**		$W = V + U$
☒	**C**		$U = W + V$
☒	**D**		$U = W + V$

(Total for Question 9 = 1 mark)

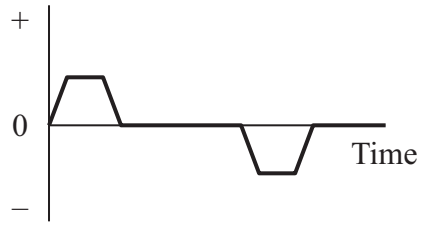
10 A lift carries people from one floor up to the floor above. Which graph shows how the acceleration of the lift varies with time for the complete journey? Assume that the upward direction is positive.

Acceleration



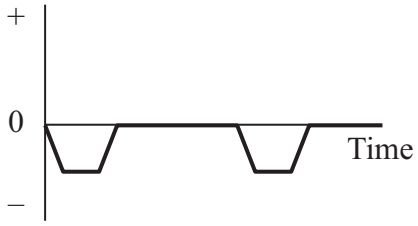
A

Acceleration



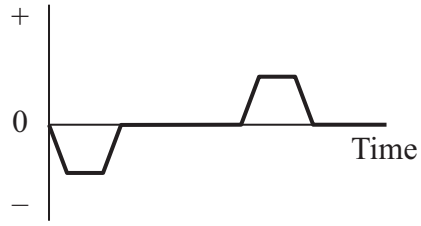
B

Acceleration



C

Acceleration



D

☒ **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 Explain the difference between compressive strain and tensile strain.

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(Total for Question 11 = 2 marks)

12 The photograph shows oil being poured into a cold frying pan and spreading out.

Explain the difference that using a hot pan would make to how the oil spreads.

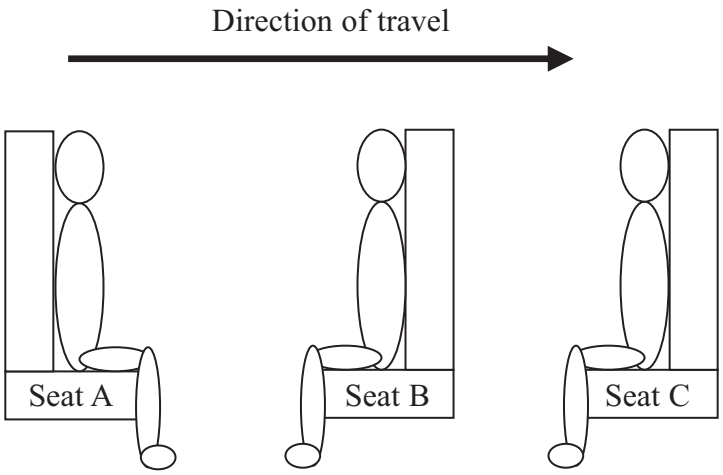
(Total for Question 12 = 2 marks)

***13** The metal copper probably gets its name from the Mediterranean island of Cyprus, which was an important source of the metal in ancient times. Copper was versatile because it could be beaten to make large flat objects, such as shields, as well as being drawn into wires which could be used decoratively.

Name and define the property of copper that makes it suitable for this method of making shields and the property that makes it suitable for making wires.

(Total for Question 13 = 5 marks)

***14**



The diagram shows three passengers sitting on a train that is travelling at a high speed in the direction shown. Seat belts are not used on trains.

With reference to one of Newton's laws of motion, explain why seat C is the safest seat for a passenger to be sitting on in the event of a rapid deceleration. You may assume that the seats all remain fixed firmly to the floor and do not break.

(Total for Question 14 = 4 marks)

15

The photograph shows a lawnmower being used to cut grass.

(a) (i) In order to push the lawnmower, a minimum force of 650 N must be applied to the handle of the lawnmower at an angle of 42° to the horizontal.

Show that the horizontal component of the force is about 500 N.

(2)

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(ii) The lawnmower is used to cut 15 strips of grass, each 7 m long.

Calculate the work done by the person pushing the lawnmower.

(2)

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Work done = ...

(b)

This photograph shows a lawnmower with the top section of the handle horizontal.

Explain how this changes the minimum force required to push the lawnmower.

(2)

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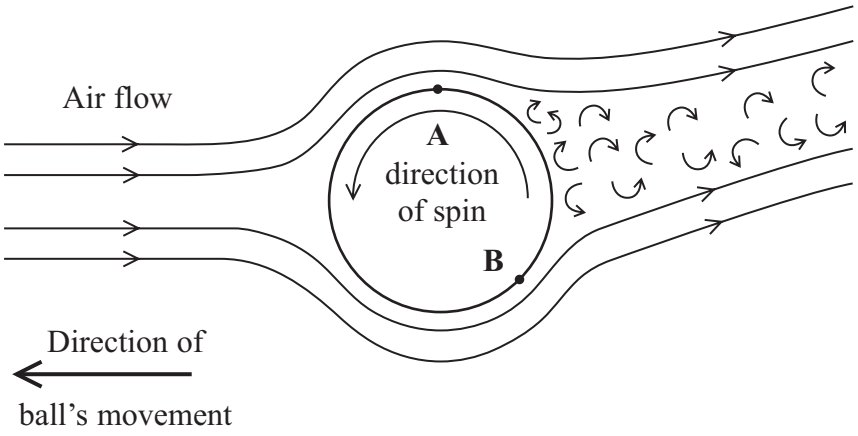
(Total for Question 15 = 6 marks)

16 In the game of table tennis a ball is hit from one end of the table to the other over a small net.

(a) Making a table tennis ball spin when it is hit can affect its flight. The diagram shows the path of air around a spinning ball. It contains regions of laminar flow and turbulent flow. The flow changes from one to the other at points A and B.



(i) Explain what is meant by laminar flow and turbulent flow.

(2)

Laminar flow

.....

.....

Turbulent flow

.....

.....

(ii) The ball is spinning in the direction shown in the diagram.

Suggest why there is a larger region of turbulent flow on the top of the ball than the bottom.

(1)

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(b) The diagram shows that the air is deflected upwards after passing the ball.

Explain why this means there must be a downwards component of force on the ball in addition to its weight.

(2)

(c) Spinning a table tennis ball allows it to be hit harder and still hit the table on the other side of the net.

(i) A table tennis ball is hit, without any spin, from one end of a table so that it leaves the bat horizontally with a speed of 31 m s^{-1}. The length of the table is 2.7 m.

Show that the ball falls a vertical distance of about 4 cm as it travels the length of the table.

(3)

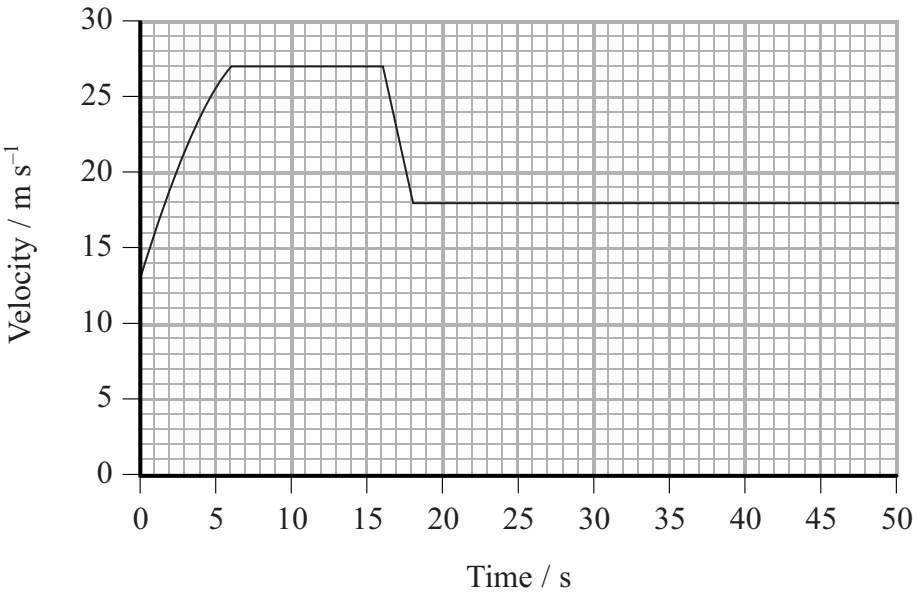
(ii) The net is 15 cm high. Explain how the spin helps the ball hit the table on the other side of the net.

(3)

(Total for Question 16 = 11 marks)

17 The speeds of cars travelling through roadworks on major roads are often monitored by 'average speed check' cameras. This is done by timing a car between two cameras a large distance apart.

The graph shows how the velocity of a car varies with time as it passes between two average speed check cameras. The car passes the cameras at time $t = 0$ s and $t = 50$ s.



A constant driving force is applied to the car for the first 6 s. At time $t = 16$ s the driver realises the car is travelling too fast for the 22 m s^{-1} speed limit (50 miles per hour) and applies the brakes until time $t = 18$ s.

(a) Calculate the acceleration at time $t = 3$ s.

(3)

Acceleration = ...

(b) Describe and explain the shape of the line in the first 6 s.

(4)

(c) Describe the resultant force on the car between times $t = 6$ s and $t = 16$ s.

(1)

(d) Show that the average speed of the car does not exceed the average speed limit of 22 m s^{-1}.

(4)

(Total for Question 17 = 12 marks)

18 The photograph shows a wind turbine. Kinetic energy of the wind is transferred to electrical energy by the turbine as the blades rotate.

(a) Explain why we can say that the wind is doing work on the blades.

(2)

(b) The area swept out by one blade, as it turns through 360°, is 6000 m^2. Wind at a speed of 9 m s^{-1} passes the turbine.

(i) Show that the volume of air passing through this area in 5 seconds is about 300 000 m^3.

(2)

(ii) Calculate the mass of this air.

density of air = 1.2 kg m^{-3}

(2)

Mass = ...

(iii) Calculate the kinetic energy of this mass of air.

(2)

Kinetic energy = ...

(iv) Betz's law states that a turbine cannot usefully transfer more than 59% of the kinetic energy of the wind.

Use this law to find the maximum power output of the wind turbine.

(2)

Maximum power = ...

(c) Suggest a reason why it is not possible to usefully transfer 100% of the kinetic energy of the wind.

(1)

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.....

(d) Suggest the limitations of using wind turbines to provide power.

(2)

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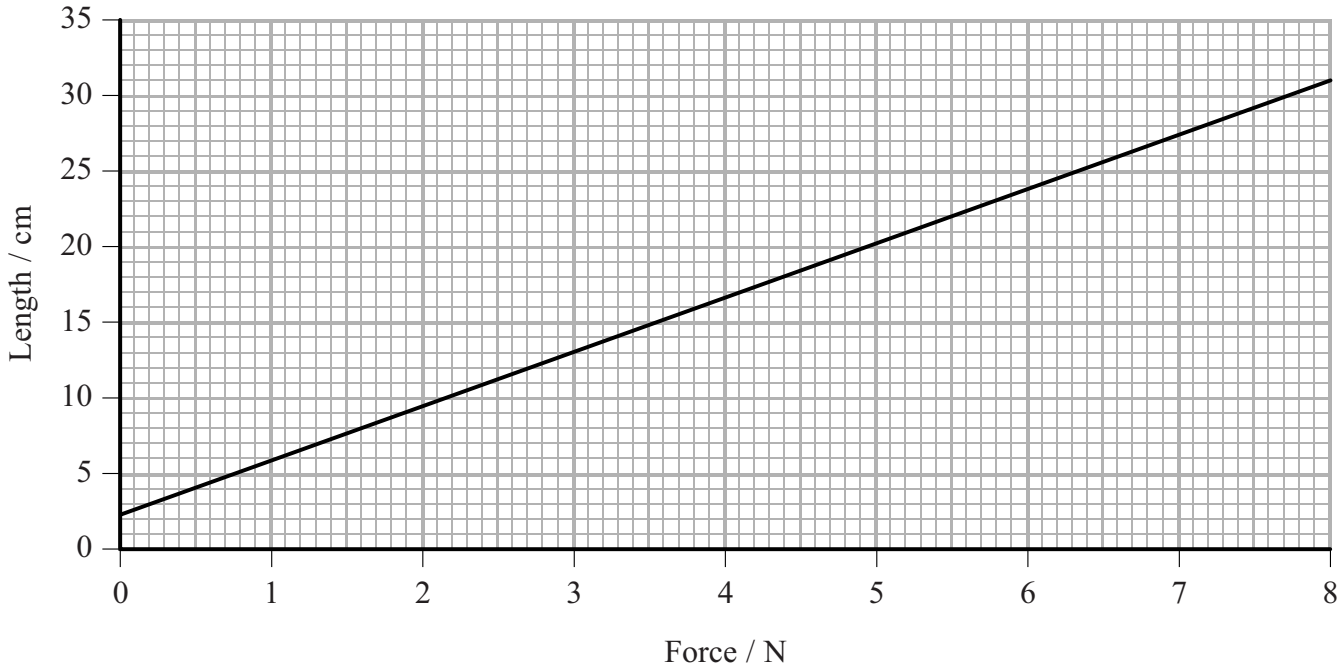
(Total for Question 18 = 13 marks)

19 A student investigates how the length of a spring varies with force by hanging masses on it. The graph shows the results.



(a) The student concludes that the spring does **not** obey Hooke's law because the line does not pass through the origin.

Explain why this conclusion is incorrect.

(2)

(b) Show that the spring constant is about 30 N m^{-1}.

(2)

(c) When the student is removing the masses the spring is accidentally released when its length is 23 cm. The spring flies up into the air.

(i) Show that the energy stored in the spring is about 0.6 J when its length is 23 cm.

(2)

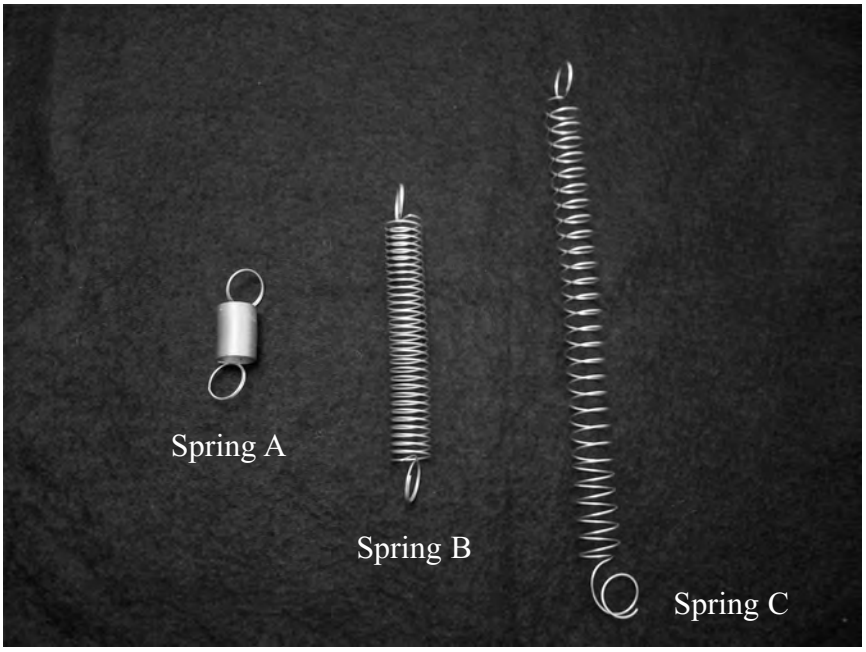
(ii) Calculate the maximum height the spring could reach above its point of release.

mass of spring = 5 g

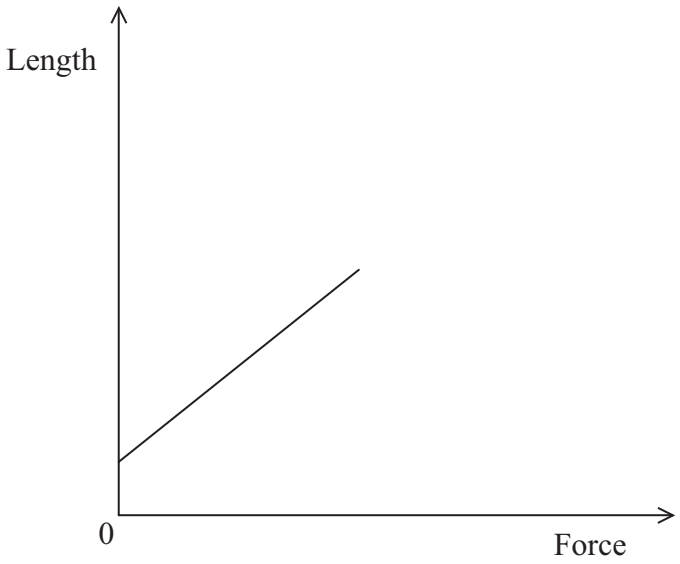
(3)

Maximum height = ...

(d) Several other students carry out similar investigations using identical springs. The photograph shows some of their springs at the end of their investigations.



Spring A is the same length before and after the investigation. The graph for this spring is shown below.



On the axes opposite sketch the graph for spring C and use it to help you describe the difference in the behaviour of springs A and C.

(6)

(Total for Question 19 = 15 marks)

TOTAL FOR SECTION B = 70 MARKS

TOTAL FOR PAPER = 80 MARKS

Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Thursday 17 May 2012 – 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 ▶

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1/1/1/1/

P 3 9 8 5 3 A 0 1 2 4

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 these quantities is **not** measured in an SI base unit?

☒ **A** distance

☒ **B** force

☒ **C** mass

☒ **D** time

(Total for Question 1 = 1 mark)

2 Displacement can be found from the

☒ **A** area under a distance-time graph.

☒ **B** area under a velocity-time graph.

☒ **C** gradient of a distance-time graph.

☒ **D** gradient of a velocity-time graph.

(Total for Question 2 = 1 mark)

3 A wire of length x is stretched by a force F. The extension is Δx.

A second wire of the same material and cross-sectional area is stretched by the same force. If it has twice the length of the first wire its extension will be

☒ **A** $1/2\ \Delta x$

☒ **B** Δx

☒ **C** $2\Delta x$

☒ **D** $4\Delta x$

(Total for Question 3 = 1 mark)

4 Which equation shows a scalar quantity as the product of two vector quantities?

- ☒ **A** energy = power × time
- ☒ **B** force = stiffness × extension
- ☒ **C** mass = density × volume
- ☒ **D** work = force × displacement

(Total for Question 4 = 1 mark)

5 A material which can be drawn into a wire is described as being

- ☒ **A** brittle.
- ☒ **B** ductile.
- ☒ **C** hard.
- ☒ **D** soft.

(Total for Question 5 = 1 mark)

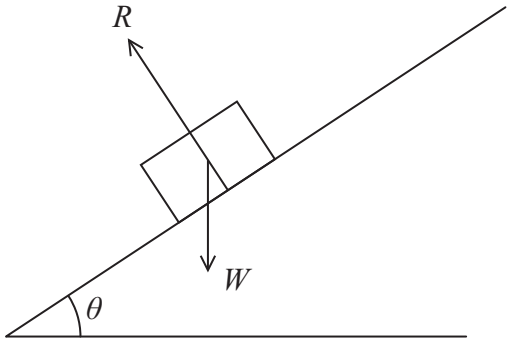
6 A bowling ball of mass 7.0 kg is travelling at a speed of 4.0 m s^{-1}.

The kinetic energy of the ball is

- ☒ **A** 14 J
- ☒ **B** 28 J
- ☒ **C** 56 J
- ☒ **D** 112 J

(Total for Question 6 = 1 mark)

7



The diagram shows an object on an inclined surface.

The component of the weight W parallel to the surface is

☒ **A** 0

☒ **B** 1

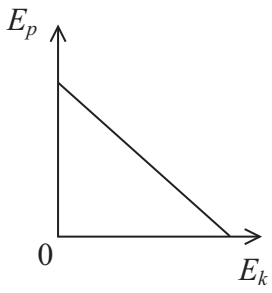
☒ **C** $W \cos \theta$

☒ **D** $W \sin \theta$

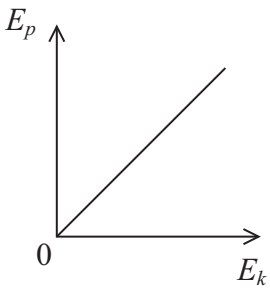
(Total for Question 7 = 1 mark)

8 A stone is dropped from a bridge into a river.

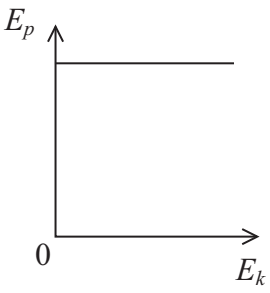
Which graph correctly shows the variation of gravitational potential energy E_p with kinetic energy E_k for the falling stone?



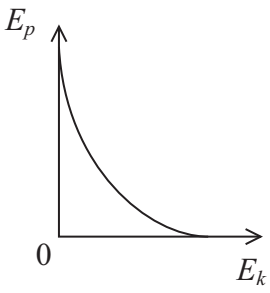
A



B



C



D

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 8 = 1 mark)

9 A motor raises a mass m through a height Δh in time t.

The power of the motor is given by

☒ **A** $mgt\Delta h$

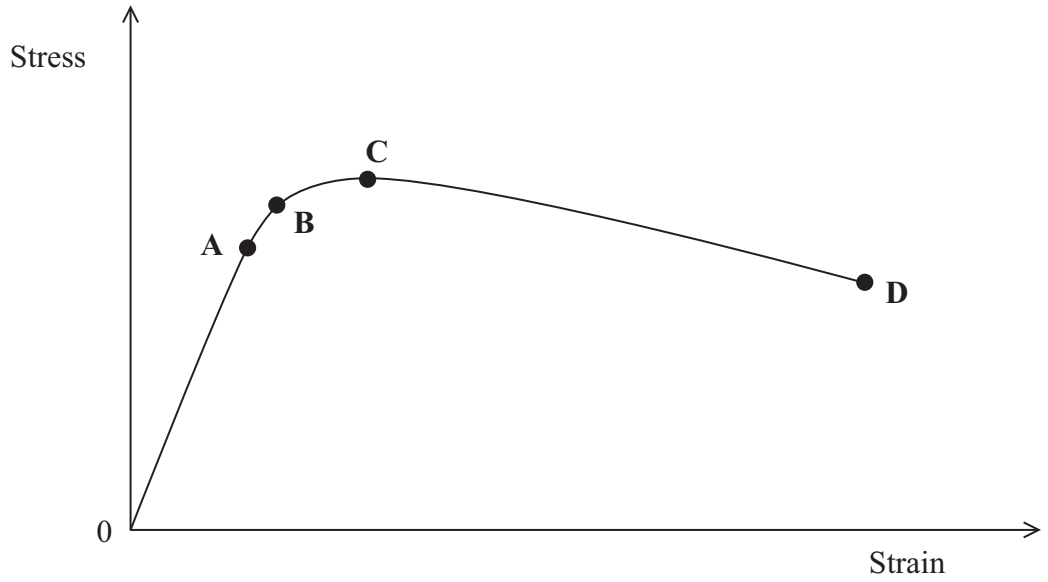
☒ **B** $\frac{mg}{t\Delta h}$

☒ **C** $\frac{mg\Delta h}{t}$

☒ **D** $\frac{mgt}{\Delta h}$

(Total for Question 9 = 1 mark)

10 The graph shows the stress-strain graph for a wire.



Which point would give the value for maximum tensile stress?

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 10 = 1 mark)

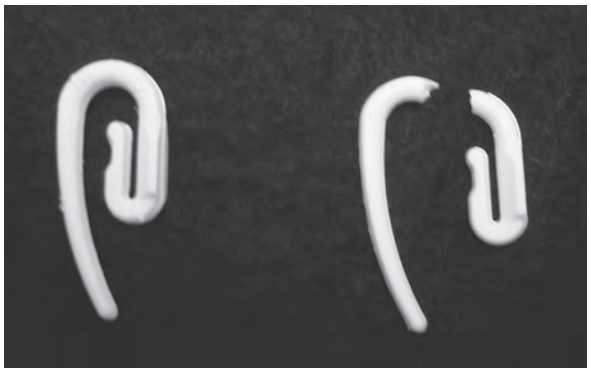
TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

***11** A student is taking down some curtains and notices that several of the curtain hooks snap when they are bent.

The photograph shows an unsnapped hook and a snapped hook.



The student thinks that it is odd that the material the hooks are made from is referred to as plastic when the hooks don't show plastic behaviour.

The student finds the following list of terms used to describe materials.

Brittle Ductile Hard Malleable Tough

Only one of these terms describes the behaviour of the hooks.

Explain what is meant by 'the hooks don't show plastic behaviour' and state and explain the term from the list that correctly describes the behaviour.

(4)

(Total for Question 11 = 4 marks)

12 A student entering a physics classroom sees the following sentences on the board. These sentences are being used as examples in an explanation of Newton's third law.

The car tyre exerts a frictional contact force of 300 N backwards on the road.

The road exerts a frictional contact force of 300 N forwards on the car tyre.

State Newton's third law.

Explain how the sentences provide a good example of a Newton's third law pair.

(5)

(Total for Question 12 = 5 marks)

13 Metrology is the science of measurement and World Metrology Day is May 20th. In 2010, the day was used to celebrate the 50th anniversary of the SI system.

A metrologist from the National Physical Laboratory said on a radio programme that the SI system uses units that everyone can understand. He stated the following example.

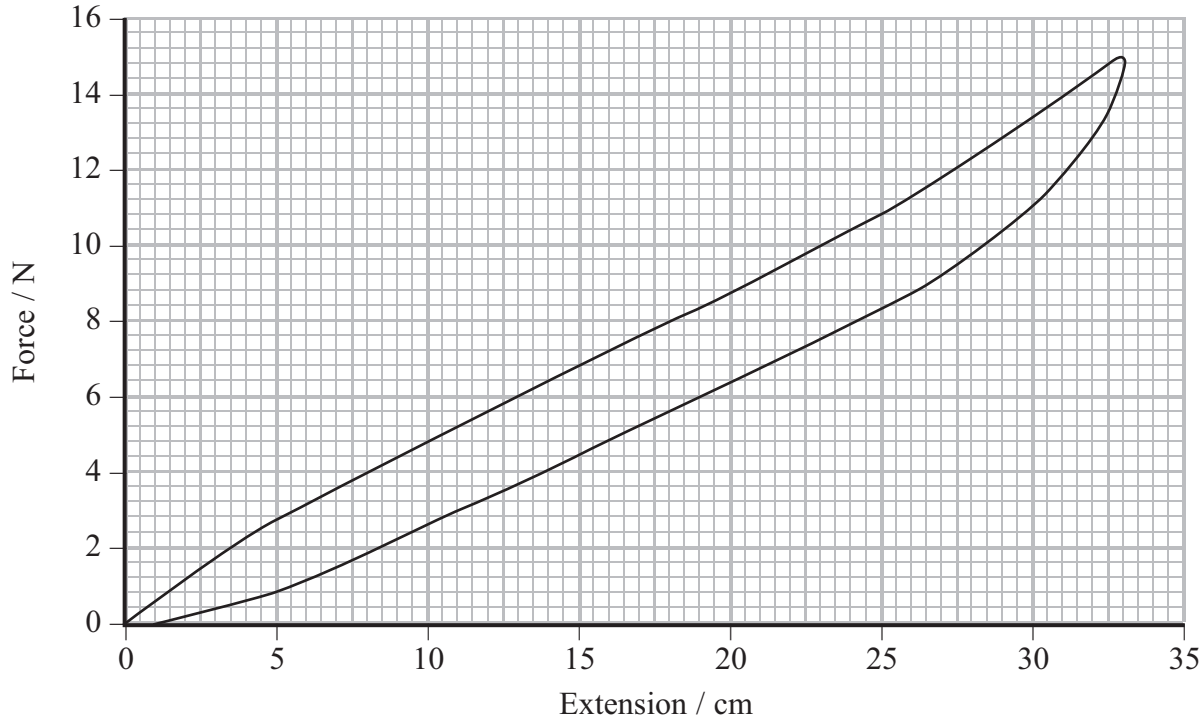
> "If you hold an apple in your hand it's about a *newton*, if you raise it through one metre that's about a *joule* and if you do it in one second that's about a *watt*."

Assuming that the apple has a mass of 100 g, explain and justify the statements made about the three words in italics.

(6)

(Total for Question 13 = 6 marks)

14 A student investigates the effect of varying the stretching force applied to the elastic waistband of some trousers.



The graph produced by the student shows the stretching force against extension for the elastic waistband. The top line was recorded as the force increased and the lower line as the force decreased.

(a) Explain whether the elastic waistband obeys Hooke's law.

(2)

(b) Show that, in this investigation, the work done on the elastic waistband in stretching it is less than 3 J.

(2)

(c) Suggest how the elastic properties of the waistband help in keeping the trousers in place.

(2)

(d) The line for the decreasing force is lower than the line for the increasing force.

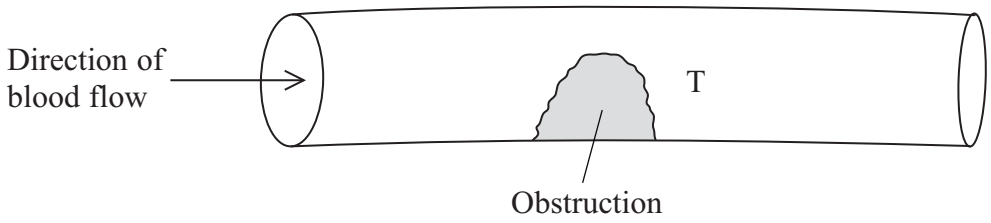
Explain the significance of this.

(2)

(Total for Question 14 = 8 marks)

15 Blood clots can lead to heart attacks. Blood flow through arteries is normally laminar, but an obstruction may cause the blood flow to become turbulent. This can lead to the formation of blood clots.

(a) The diagram shows an artery containing an obstruction.



After passing the obstruction the laminar flow becomes turbulent in the area marked T.

(i) Add flow lines to the diagram to show laminar flow changing to turbulent flow after passing the obstruction.

(2)

(ii) Explain what is meant by laminar flow and turbulent flow.

(2)

Laminar flow

.....

.....

.....

Turbulent flow

.....

.....

.....

(b) In one experiment on blood flow, the viscosity of the blood and the velocity of blood flow were measured.

(i) Describe how you would expect the velocity of blood flow to vary with the viscosity.

(1)

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(ii) Suggest and explain how a rise in the temperature of the blood would affect the velocity of flow.

(2)

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(Total for Question 15 = 7 marks)

16 The photograph shows an arrangement used to launch a light, foam rocket at a school science competition.

The rocket is launched at the level of one end of a long table and lands at the other end at the same level. The students measure the horizontal distance travelled by the rocket and the time of flight.

(a) The rocket travels 1.88 m in a time of 0.88 s.

(i) Show that the horizontal component of the initial velocity of the rocket is about 2 m s^{-1}.

(2)

(ii) Show that the vertical component of the initial velocity of the rocket is about 4 m s^{-1}.

(2)

(iii) Calculate the initial velocity of the rocket.

(4)

Magnitude of initial velocity = ...

Angle to the horizontal of the initial velocity = ...

(b) The students obtained their data by filming the flight. When they checked the maximum height reached by the rocket they found it was less than the height predicted using this velocity.

(i) Suggest why the maximum height reached was less than predicted.

(1)

(ii) Give two advantages of filming the flight to obtain the data.

(2)

1 .....

2 .....

(Total for Question 16 = 11 marks)

17 Soil is usually made up of a variety of particles of different sizes. The photograph shows what happens when soil is mixed up with water and the particles are allowed to settle.

(a) The dot below represents a particle of the soil falling through water.

(i) Add labelled arrows to show the three forces acting on the particle as it falls through the water.

(2)

*(ii) Explain why a particle held stationary in water and then released accelerates downwards at first but then reaches a steady downwards speed.

(4)

(iii) Write an expression showing the relationship for these forces when the particle is falling at a steady speed.

(1)

.....

.....

(b) A typical particle of sand in the sample has the following properties:

diameter = 1.6×10^{-3} m

volume = 2.1×10^{-9} m^3

density = 2.7×10^{3} kg m^{-3}

weight = 5.7×10^{-5} N

(i) Show that the upthrust acting on the particle is about 2×10^{-5} N.

density of water = 1.0×10^{3} kg m^{-3}

(2)

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(ii) Calculate the steady downwards speed this particle would achieve if allowed to fall through water.

viscosity of water = 1.2×10^{-3} Pa s

(3)

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.....

Speed = ...

(c) The different types of particles in soil can be defined according to their diameters, as in the following table.

Soil particle	Particle diameter
clay	less than 0.002 mm
silt	0.002 mm – 0.05 mm
sand	0.05 mm – 2.00 mm
fine pebbles	2.00 mm – 5.00 mm
medium pebbles	5.00 mm – 20.00 mm
coarse pebbles	20.00 mm – 75.00 mm

The photograph shows that when soil is allowed to settle in water, the pebbles tend to be found towards the bottom, followed by sand, silt and clay in succession.

Explain why this happens. Assume that all particles have the same density.

(3)

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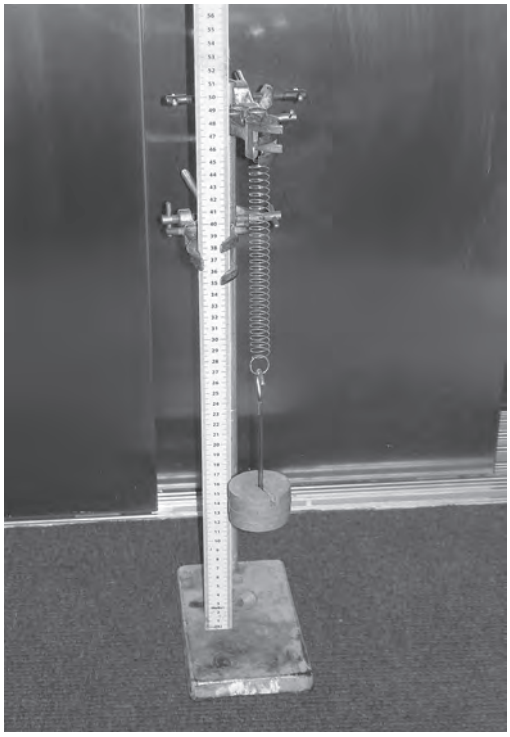
(Total for Question 17 = 15 marks)

18 A student uses a mass hanging on a spring to investigate the motion of a lift travelling between two floors.

The photograph shows the apparatus used which is placed in the lift.



(a) The weight of the mass hanging on the spring is 3.90 N.

It produces an extension of 12.2 cm.

Show that the spring constant is about 30 N m^{-1}.

(2)

(b) The lift takes 7.0 s to travel between floors, starting and ending at rest.

The student makes a video of the apparatus and constructs the following table from the observations made. The student notes three phases of the motion.

Phase of motion	Duration of phase / s	Average extension of spring / cm	Average acceleration / m s^{-2}
Start	2.0	12.7	0.4
Middle	3.0	12.2	0.0
End	2.0	11.7	–0.4

(i) Show that the spring exerts a force of about 4 N on the mass during the start phase.

(2)

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(ii) Show how the average acceleration during the start phase is calculated.

mass hanging on spring = 0.40 kg

(2)

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.....

.....

.....

(iii) Use the values in the table to calculate the speed at the end of the start phase.

(2)

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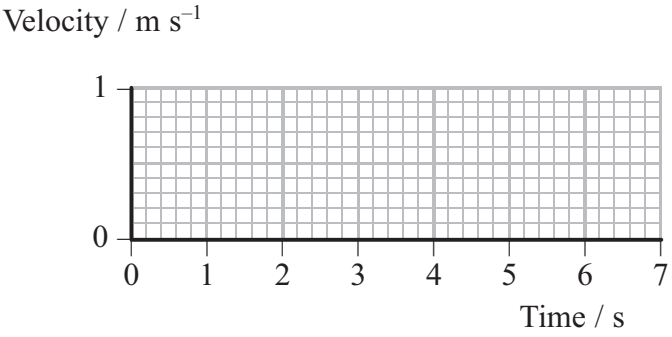
.....

Speed = ...

(iv) Complete the graph to show the motion of the lift.

(2)



(v) Use your graph to find the distance travelled between the floors.

(2)

Distance = ...

(vi) Explain how the data for the average extension of the spring shows that the lift is moving upwards.

(2)

(Total for Question 18 = 14 marks)

TOTAL FOR SECTION B = 70 MARKS

TOTAL FOR PAPER = 80 MARKS

Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Friday 11 January 2013 – Afternoon
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
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Turn over ▶

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1/1/1/1/

P 4 1 6 2 7 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 An object of weight 7 N is raised from a height of 2 m to a height of 8 m.

The change in gravitational potential energy is

☒ **A** 42 J

☒ **B** 56 J

☒ **C** 412 J

☒ **D** 549 J

(Total for Question 1 = 1 mark)

2 Which of the following is a derived SI unit?

☒ **A** joule

☒ **B** metre

☒ **C** power

☒ **D** time

(Total for Question 2 = 1 mark)

3 A student is asked to solve the following problem:

An object is thrown upwards with a speed of 25 m s^{-1}. How high will it be when the speed is 12 m s^{-1}?

Which equation will allow the problem to be solved in a single calculation?

☒ **A** $s = ut + \frac{1}{2} at^2$

☒ **B** $s = (u + v)t/2$

☒ **C** $v = u + at$

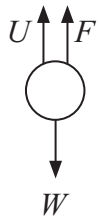
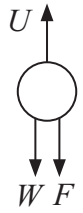
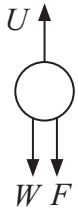
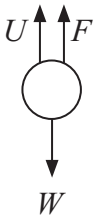
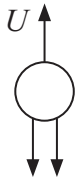
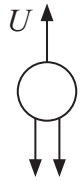
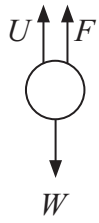
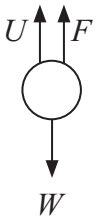
☒ **D** $v^2 = u^2 + 2as$

(Total for Question 3 = 1 mark)

4 When beer is being brewed it can contain bubbles of gas rising through it as well as solid particles, such as grain particles, falling through it.

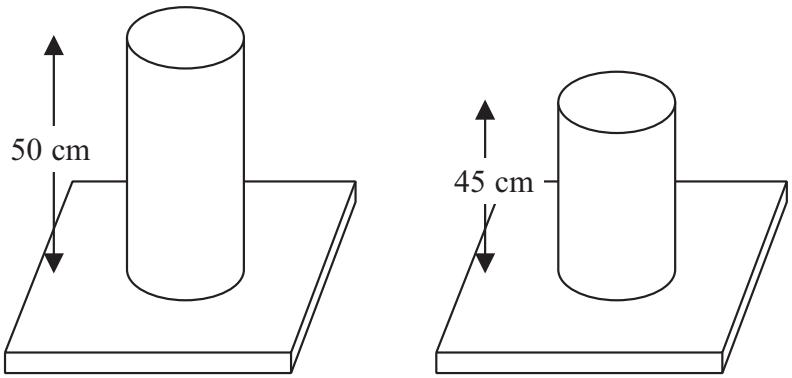
Which row of the table correctly shows the forces on a rising gas bubble and a falling solid particle?

F = viscous drag, U = upthrust, W = weight

	Gas bubble	Solid particle
☒ **A**		
☒ **B**		
☒ **C**		
☒ **D**		

(Total for Question 4 = 1 mark)

5 A cylinder of length 50 cm has a force applied to it. The new length of the cylinder is 45 cm.



The quantity determined using $\frac{5\text{ cm}}{50\text{ cm}}$ is

☒ **A** compressive strain.

☒ **B** compressive stress.

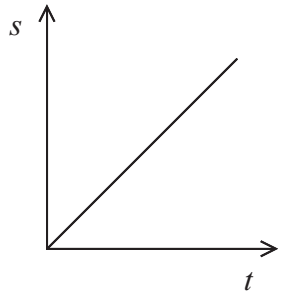
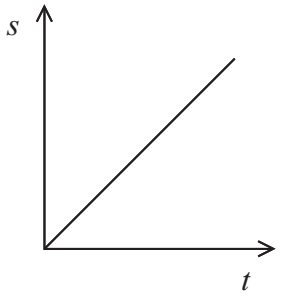
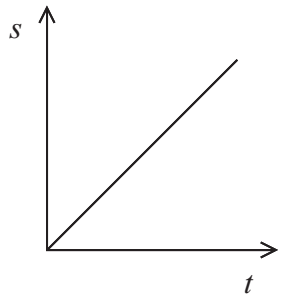
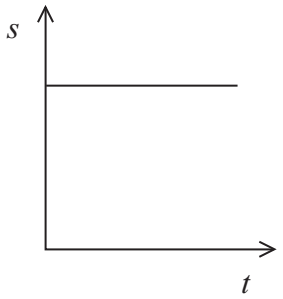
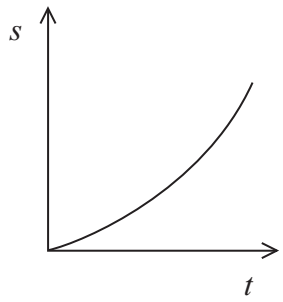
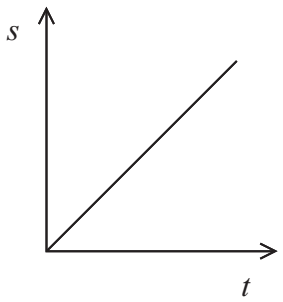
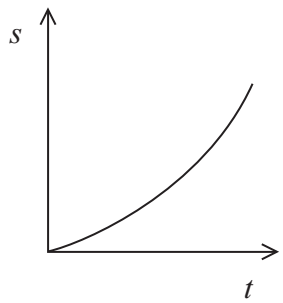
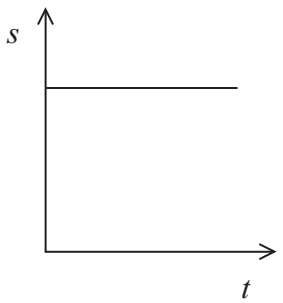
☒ **C** tensile strain.

☒ **D** tensile stress.

(Total for Question 5 = 1 mark)

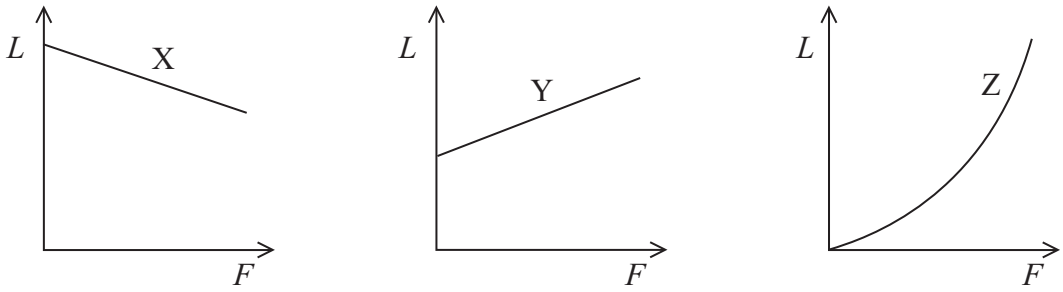
6 An object is thrown horizontally from the roof of a building.

Which pair of displacement–time graphs correctly shows the vertical and horizontal components of displacement for the object until it lands? Assume that there is no air resistance.

	Vertical	Horizontal
☒ **A**		
☒ **B**		
☒ **C**		
☒ **D**		

(Total for Question 6 = 1 mark)

7 Three springs X, Y and Z have forces applied to them. For each spring a graph is plotted of length L of the spring against force F. The graphs are shown below:



Which of the springs obey Hooke's law?

☒ **A** X and Y

☒ **B** X and Z

☒ **C** Y and Z

☒ **D** Y only

(Total for Question 7 = 1 mark)

8 A car of mass 1400 kg is travelling at 25 m s^{-1}.

The kinetic energy of the car is

☒ **A** 17.5 kJ

☒ **B** 35.0 kJ

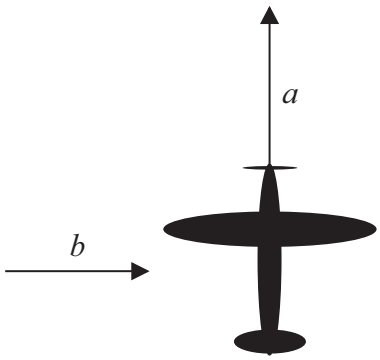
☒ **C** 438 kJ

☒ **D** 875 kJ

(Total for Question 8 = 1 mark)

Questions 9 and 10 refer to the information below.

An aeroplane is flying horizontally and heading north through the air. Its speed through the air is a and the wind is blowing east with a speed b.



9 The speed over the ground is given by

☒ **A** $a + b$

☒ **B** $a^2 + b^2$

☒ **C** $\sqrt{a + b}$

☒ **D** $\sqrt{a^2 + b^2}$

(Total for Question 9 = 1 mark)

10 The angle from north at which the plane flies over the ground is given by

☒ **A** $\cos^{-1} a/b$

☒ **B** $\sin^{-1} b/a$

☒ **C** $\tan^{-1} a/b$

☒ **D** $\tan^{-1} b/a$

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 Car engines use motor oil as a lubricant. Motor oils need to operate over a range of temperatures because they may be at 0 °C or below when the engine is started but be up to 160 °C when the engine is running. At all times motor oils need to be thin enough to allow the parts to move smoothly but thick enough to remain on the moving parts.

Explain why the engine may experience difficulties if the temperature becomes too hot or cold.

(2)

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(Total for Question 11 = 2 marks)

***12** A student reads the following statement in a text book:

Unlike many metals, lead is malleable but not ductile.

Explain the statement.

(4)

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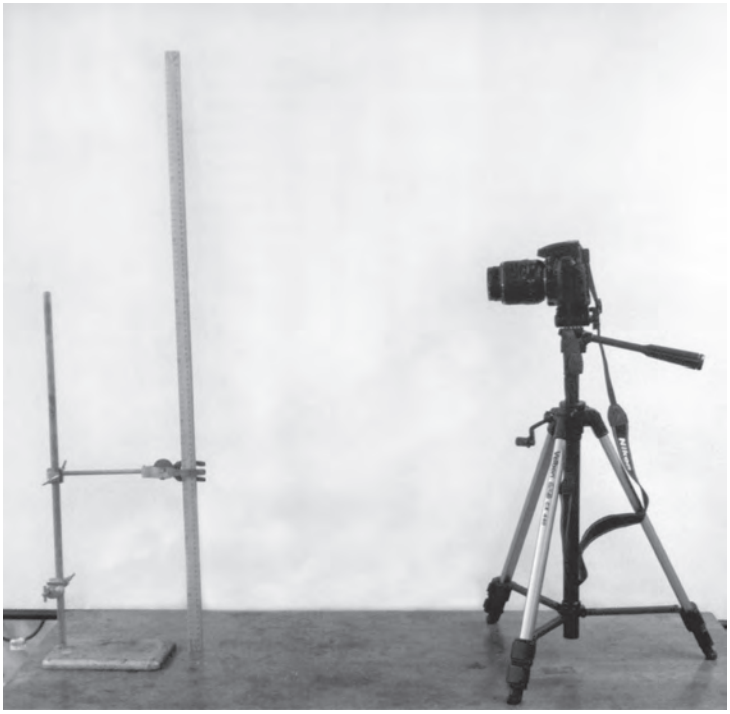
(Total for Question 12 = 4 marks)

13 A student carries out an experiment to find the acceleration of free fall.



(a) In this experiment the student releases a small steel ball in front of a metre rule and uses a video camera to record its motion. The camera captures 30 images per second, which may be played back one image at a time.

(i) Explain how the acceleration of free fall could be determined using the recording.

(4)

(ii) Describe a systematic error which could arise.

(1)

(b) Describe one property of the steel ball that makes it suitable to use in this experiment and explain why this property makes it suitable.

(2)

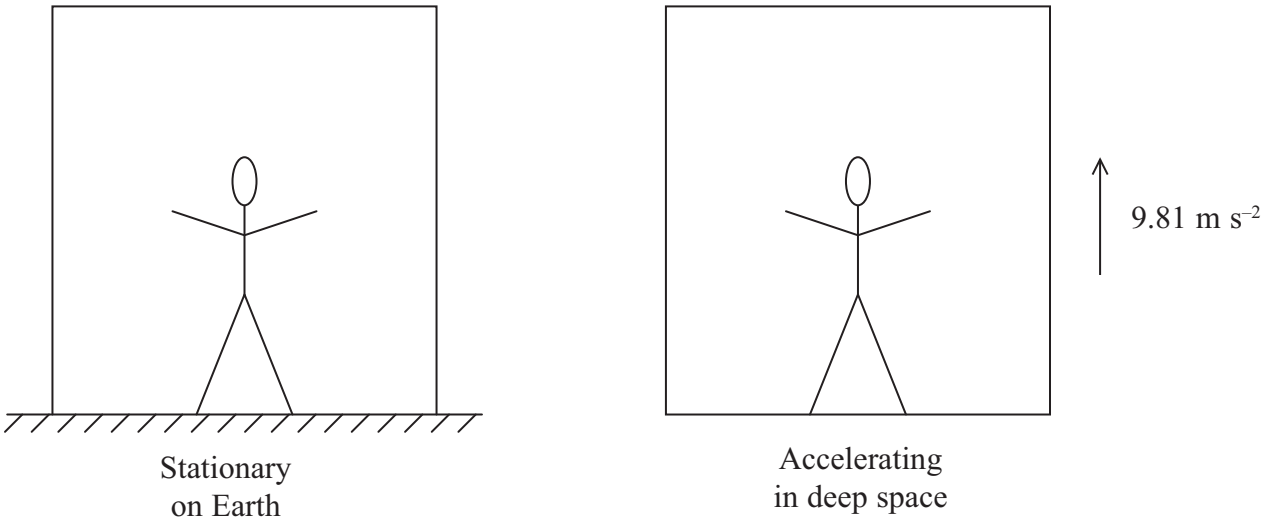
(c) Explain an advantage of using a video camera to take measurements for this experiment rather than using a stopwatch.

(2)

(Total for Question 13 = 9 marks)

***14** Einstein imagined a person in a large box without windows. He suggested that, with no way to see outside, the person could not tell whether they were:

- experiencing gravity on Earth
- in deep space far away from any effects of gravity but being accelerated at a rate of 9.81 m s^{-2}.



Stationary on Earth

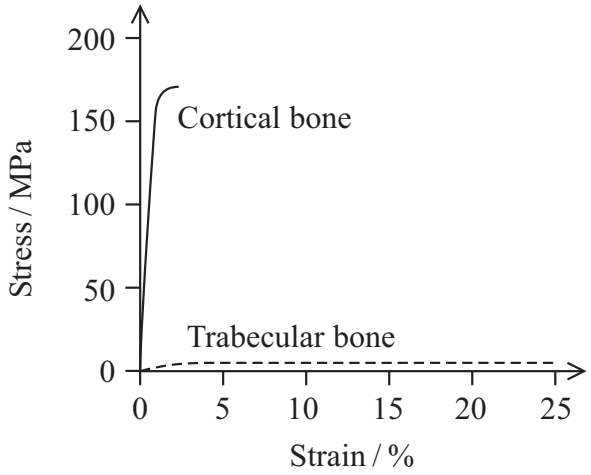
Accelerating in deep space

Account for Einstein's suggestion by explaining in each case what a person standing in the box would feel through their feet. It may help to assume the person has mass *m*.

(6)

(Total for Question 14 = 6 marks)

15 The graph shows the stress–strain curve for two types of human bone under compression.



(a) Use the graph to identify and describe **one** property of cortical bone.

(2)

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(b) The table gives the following information for the two types of bone.

Material	Young modulus / GPa	Maximum compressive stress / MPa	Maximum tensile stress / MPa
Cortical bone	17.9	170	120
Trabecular bone	0.076	2.2	

(i) State the difference between compressive stress and tensile stress.

(1)

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(ii) State how the graph could be used to confirm the value of the Young modulus for cortical bone.

(1)

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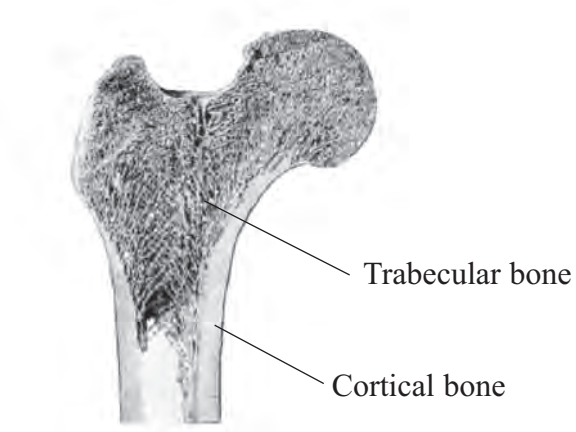
(iii) A person of mass 90 kg stands on one foot. Show that the maximum weight which can be supported is about 70 times this person's weight. Assume all the weight is supported by the femur (thigh bone) and that it is made of cortical bone.

cross-sectional area of femur = 3.7×10^{-4} m^2

(4)

(iv) It is stated in a text book that a femur can support about 30 times a person's weight.



Explain how the structure shown in the diagram would account for the difference from the calculated value.

(2)

(Total for Question 15 = 10 marks)

16 The photograph shows a sequence of pictures of a man jumping 30 m from a cliff into the water below.

- Ignore the first picture and consider the second as representing the instant he jumps.
- Ignore the final picture (the splash), taking the tenth picture as showing the time at which he has fallen 30 m.

(a)

The diagram shows the tenth picture of the man.

It is useful to mark the centre of gravity of the man for each picture before taking measurements to analyse the motion.

State what is meant by centre of gravity and mark its approximate position on the diagram.

(2)

(b) The vertical distance between consecutive pictures increases, but the horizontal distance remains the same. Explain this observation.

(2)

(c) By considering the vertical motion for pictures 2 to 10, show that the pictures are taken at a rate of about 3 per second.

vertical height fallen = 30 m

(3)

(d) The vertical height between the second and tenth pictures is 30 m. Take measurements from the photograph and use them to show that the horizontal distance between these pictures is between 12 m and 15 m.

Record your measurements below.

(3)

(e) Calculate the horizontal velocity and vertical velocity of the man for the tenth picture.

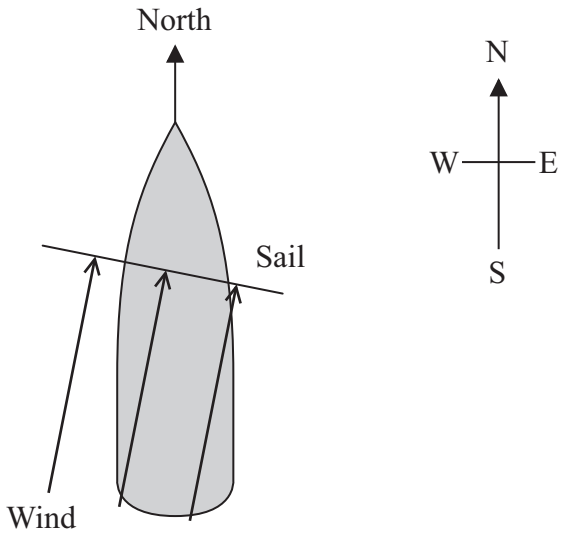
(4)

Horizontal velocity = ...

Vertical velocity = ...

(Total for Question 16 = 14 marks)

17 A stationary boat is pointing north as shown in the diagram. A wind starts blowing at 10 m s^{-1} in a direction 20° east of north against the sail. The boat starts to move northwards.



(a) (i) The wind exerts a force per unit area of 84 N m^{-2} on the sail, which is at right angles to the wind direction.

Show that the component of force in a northerly direction is about 1400 N.

area of sail = 18 m^2

(3)

(ii) When the wind starts to blow the water exerts a force on the boat to the west.

Explain why.

(2)

(iii) Draw a vector diagram showing the forces exerted on the boat by the wind and the water and the resultant force calculated in part (a)(i).

(2)

(iv) Assuming the boat is starting from rest in still water, calculate the initial acceleration of the boat.

mass of boat = 400 kg

(2)

Initial acceleration = ...

(b) Later the wind, still at a speed of 10 m s^{-1}, is blowing towards the north and the boat is travelling northwards at a steady speed of 5 m s^{-1}. The force on the sail is now 380 N towards the north.

(i) Suggest why the force on the sail is less than in part (a).

(1)

(ii) Calculate the rate at which the wind does work against the forces that resist the boat's motion.

(2)

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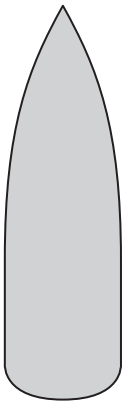
Rate at which the wind does work = ...

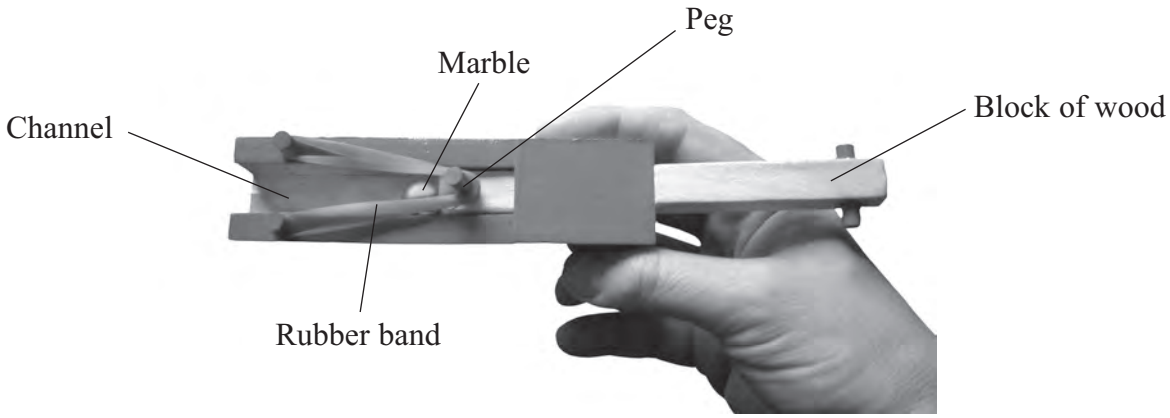
(iii) There is now a force exerted southwards on the boat. A suggested reason for this force is because of turbulence developing at the rear of the boat. Add flow lines to the diagram to show the path of water around the boat and label the regions of laminar and turbulent flow.

(2)



(Total for Question 17 = 14 marks)

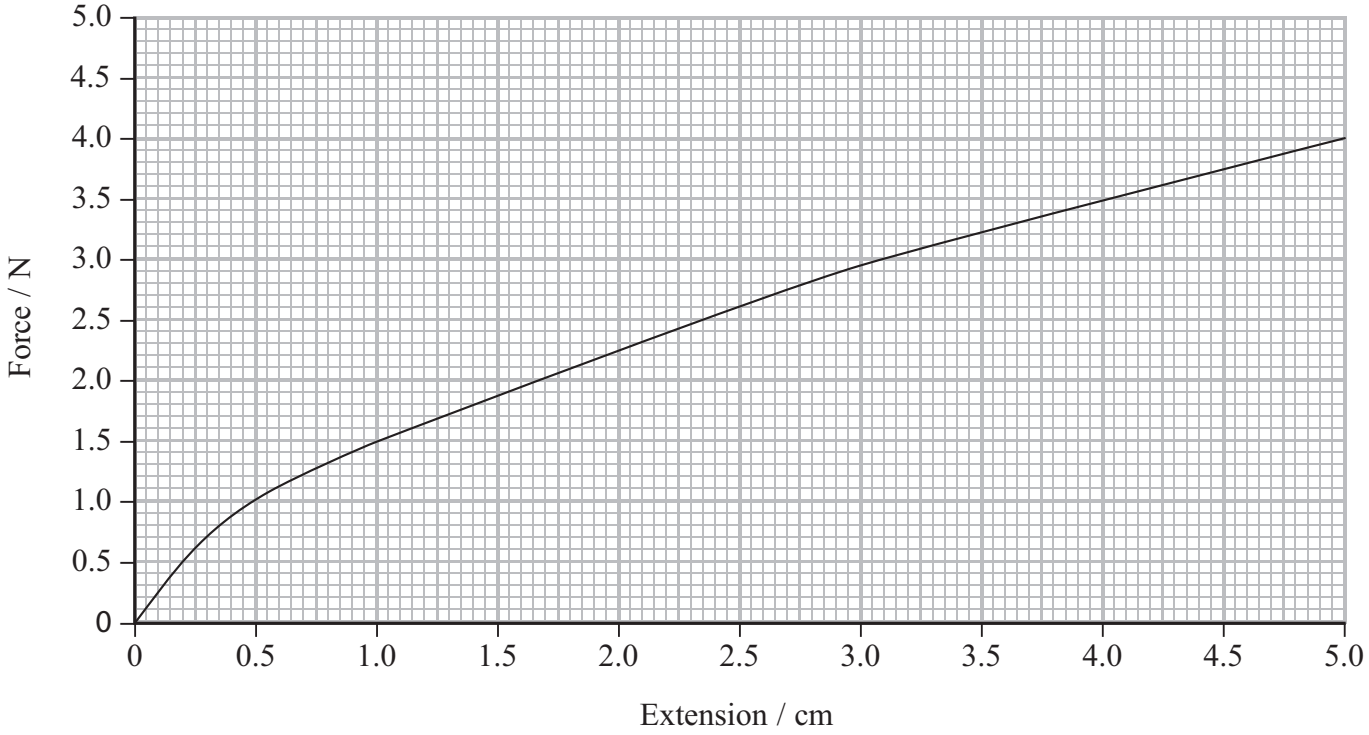
18 The photograph shows a marble launcher.



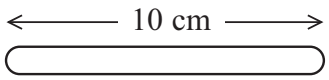
To load: pull the block of wood backwards, stretching the rubber band, place a marble into the channel.

To launch: release the block so it is pulled forward by the rubber band, pushing the marble through the channel.

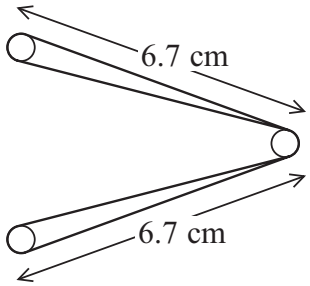
(a) The graph shows the results of an experiment to investigate the properties of the rubber band.



(i) The diagram shows the arrangement of the rubber band when it is stretched ready to launch a marble. The unstretched length of the rubber band is 10 cm.



Unstretched rubber band



Stretched rubber band

Use the graph to show that the tension is about 3 N.

(2)

(ii) A student uses the graph to obtain an approximate value of the energy stored before launching. Show that 0.06 J is a reasonable approximate value.

(2)

(iii) The student launches the marble vertically in order to determine the energy transferred to it when it is launched. Show that the maximum possible height attainable is about 2 m.

mass of marble = 3.8 g

(2)

(b) The student obtains the following set of measurements for the height reached.

30.0 cm, 30.3 cm, 25.8 cm, 29.7 cm

(i) Explain why the student obtained a value of 30.0 cm for the height reached.

(2)

.....

.....

.....

.....

(ii) Explain why the height reached is so much less than 2 m.

(2)

.....

.....

.....

.....

(iii) Suggest how the marble launcher could be adapted so that the height reached by the marble could be increased.

(1)

.....

.....

.....

(Total for Question 18 = 11 marks)

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

Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Monday 20 May 2013 – Afternoon
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 ▶

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P 4 1 6 3 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 Which pair of quantities does **not** contain a vector and a scalar?

☒ **A** acceleration and time

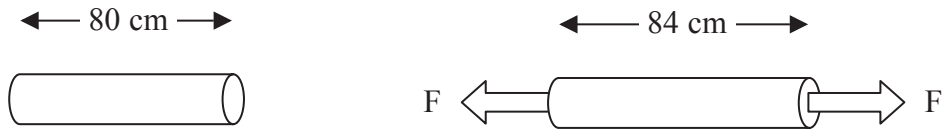
☒ **B** force and displacement

☒ **C** mass and acceleration

☒ **D** velocity and time

(Total for Question 1 = 1 mark)

2 A wire of length 80 cm has a force F applied. The new length of the wire is 84 cm.



The strain is given by

☒ **A** $\frac{4}{84}$

☒ **B** $\frac{4}{80}$

☒ **C** $\frac{80}{84}$

☒ **D** $\frac{84}{80}$

(Total for Question 2 = 1 mark)

3 Which of the following is a derived SI quantity?

☒ **A** force

☒ **B** length

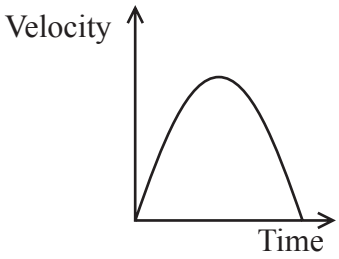
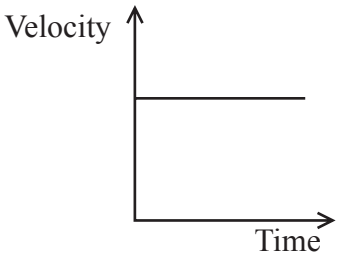
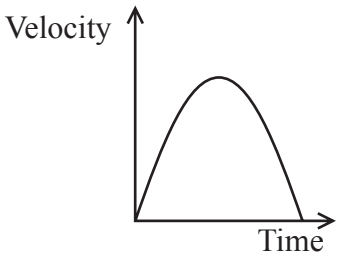
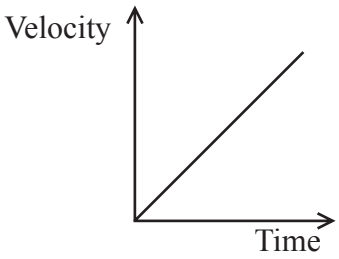
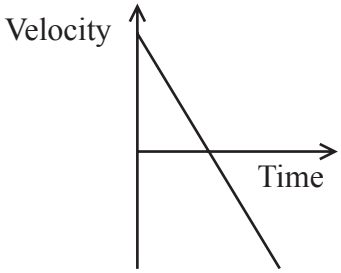
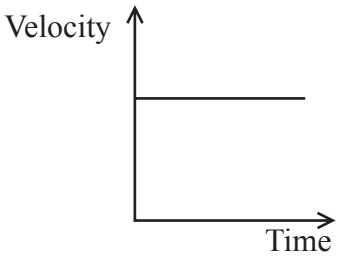
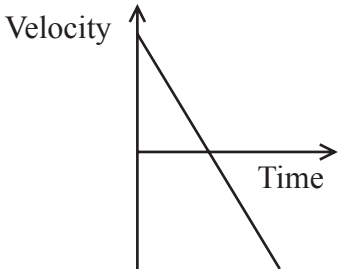
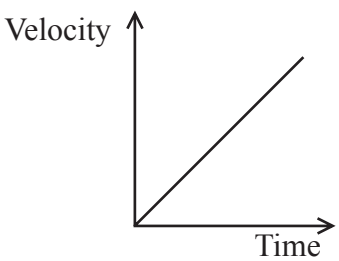
☒ **C** second

☒ **D** watt

(Total for Question 3 = 1 mark)

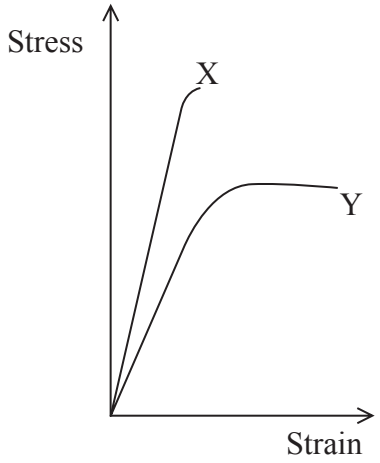
4 A projectile is launched at an angle of 45° to the horizontal.

Ignoring air resistance, which pair of graphs correctly shows how the vertical and horizontal components of velocity vary with time for the projectile until it lands?

	Vertical component	Horizontal component
☒ **A**		
☒ **B**		
☒ **C**		
☒ **D**		

(Total for Question 4 = 1 mark)

5 The graph shows stress against strain up to the breaking point for two materials X and Y.

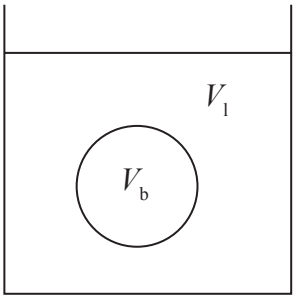


Which row in the table correctly identifies the behaviour of each material?

	X	Y
☒ **A**	brittle	ductile
☒ **B**	ductile	brittle
☒ **C**	ductile	hard
☒ **D**	brittle	hard

(Total for Question 5 = 1 mark)

6 A ball of volume V_b and density ρ_b is released in a volume V_l of liquid with density ρ_l.



The upthrust on the ball is given by

☒ **A** $V_b \rho_b g$

☒ **B** $V_b \rho_l g$

☒ **C** $V_l \rho_b g$

☒ **D** $V_l \rho_l g$

(Total for Question 6 = 1 mark)

7 A hanging basket of weight W is supported by three chains of equal length, each at an angle θ to the vertical.

The tension, T, in each chain is given by

☒ **A** $T = \dfrac{3W}{\cos\theta}$

☒ **B** $T = \dfrac{3W}{\sin\theta}$

☒ **C** $T = \dfrac{W}{3\cos\theta}$

☒ **D** $T = \dfrac{W}{3\sin\theta}$

(Total for Question 7 = 1 mark)

8 Which of the following descriptions of a material implies that it undergoes significant plastic deformation?

☒ **A** brittle

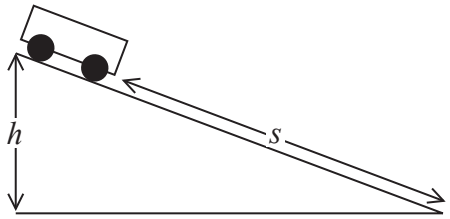
☒ **B** hard

☒ **C** malleable

☒ **D** stiff

(Total for Question 8 = 1 mark)

9 A trolley rolls down a slope from rest. The trolley moves through a vertical height h while rolling a distance s along the slope.



The maximum possible speed is given by

☒ **A** $2gs$

☒ **B** $2gh$

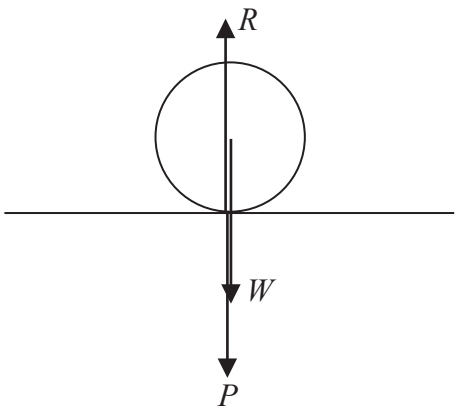
☒ **C** $\sqrt{(2gs)}$

☒ **D** $\sqrt{(2gh)}$

(Total for Question 9 = 1 mark)

10 An apple is at rest on the ground.

The diagram shows three forces of equal magnitude.



W = weight of apple

P = push of apple on ground

R = normal contact force of ground on apple

Which row in the table shows Newton's first and third laws being applied correctly.

	Newton's first law	Newton's third law
☒ **A**	$P = W$	$R = P$
☒ **B**	$R = P$	$W = R$
☒ **C**	$W = R$	$P = W$
☒ **D**	$W = R$	$R = P$

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 Viscosity is sometimes given units of kg m^{-1} s^{-1} and sometimes Pa s.

Show that these are equivalent.

(2)

.....

.....

.....

.....

.....

(Total for Question 11 = 2 marks)

12 (a) State what is meant by centre of gravity.

(1)

.....

.....

.....

(b) The picture shows a snooker cue. It is made from wood of uniform density and takes the form of a rod with decreasing diameter towards one end.

(i) On the picture, mark the position of the centre of gravity of the snooker cue.

(1)

(ii) State a simple method to test if this is the correct position.

(1)

.....

.....

(Total for Question 12 = 3 marks)

13 Queues of cars often form behind cyclists on narrow, rural roads.

Sometimes cars that would normally travel at 65 km hour^{-1} may be limited to about 20 km hour^{-1} by a cyclist.

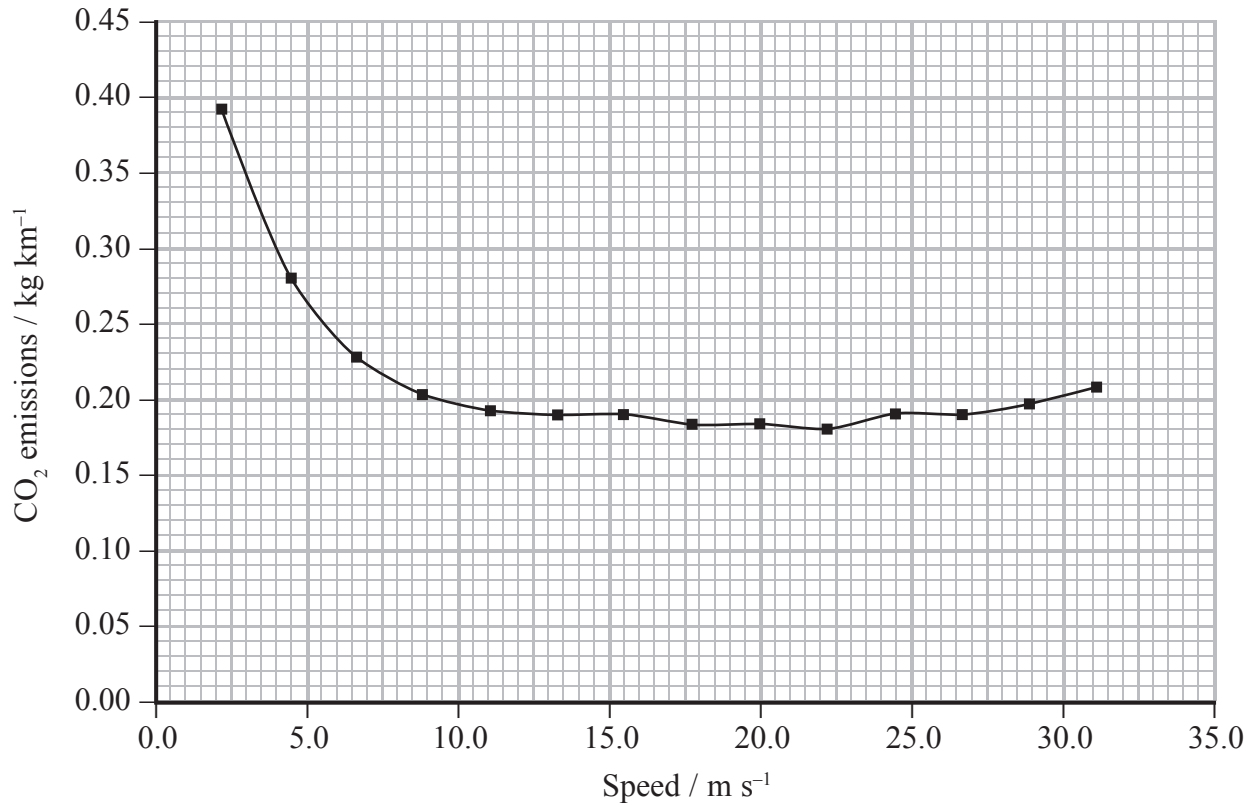
(a) Show that 65 km hour^{-1} is about 18 m s^{-1}.

(1)

.....

.....

(b) The graph shows the amount of carbon dioxide emitted per kilometre by a typical car at different speeds.



During a 10 minute journey a cyclist, travelling at 5 m s^{-1}, has an average of three cars queuing behind him. The cars would otherwise be travelling at 18 m s^{-1}. The cars emit more carbon dioxide because they are travelling slowly.

(i) Calculate the extra carbon dioxide emitted by the 3 cars due to travelling at this reduced speed for 10 minutes.

(4)

Extra carbon dioxide emitted = ...

(ii) If the cyclist had made the same journey in his car at 18 m s^{-1}, his car would have emitted 0.54 kg of carbon dioxide. Comment on the significance of this.

(1)

(Total for Question 13 = 6 marks)

14 The gravitational field strength on the Moon is about 1/6 of the gravitational field strength on the Earth.

(a) On the Moon, an astronaut dropped a golf ball. He later wrote "When I dropped the ball, it took about three seconds to land."

Show that the astronaut would need to be over 7 m tall for the ball to take 3 s to land.

(2)

(b) The astronaut hit the ball with a golf club. He wrote "The ball, which would have gone thirty to forty yards on the Earth, went over two hundred yards. The ball stayed up in the black sky for almost thirty seconds."

Assume an initial velocity of 18 m s^{-1} at 34° to the horizontal.

(i) Show that the astronaut's suggested time of flight of 30 s is over twice the actual value.

(3)

(ii) Show that the value given for the initial velocity leads to a value for the horizontal distance travelled by the ball in agreement with his stated value.

200 yards = 183 m

(3)

*(c) A projectile would have a greater range on the Moon than the Earth because of the lower gravitational field strength and because of the lack of an atmosphere.

Explain how each of these factors would increase the range of the projectile.

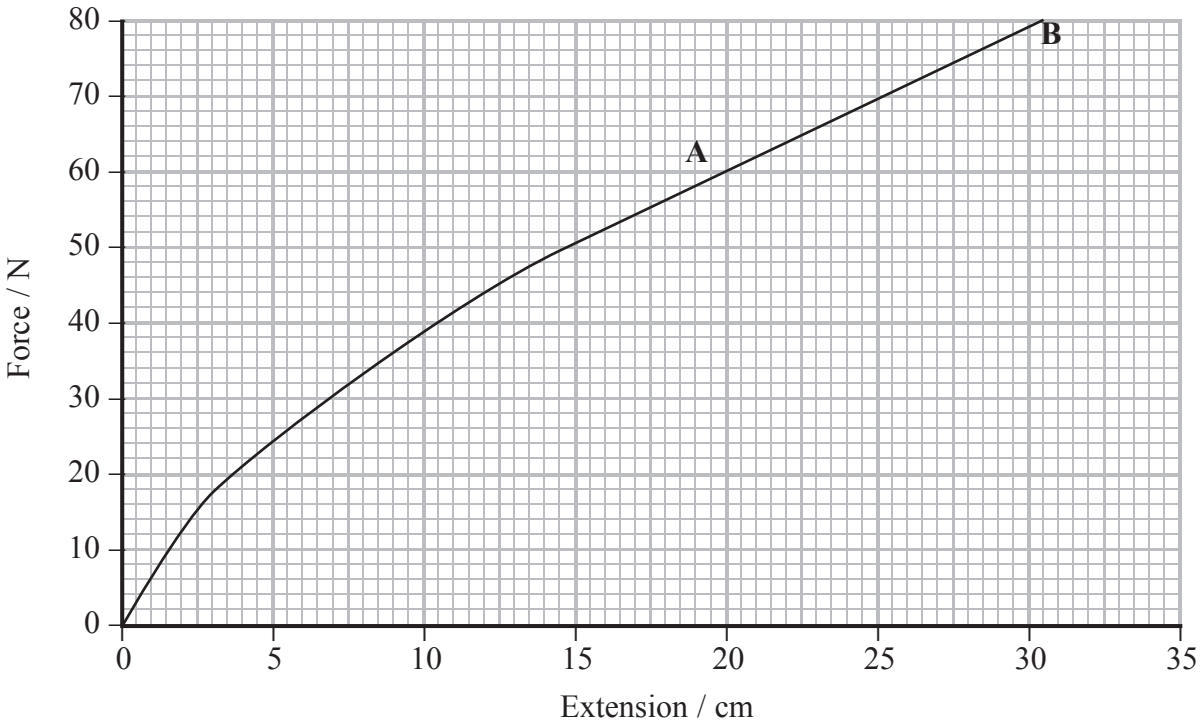
(3)

(Total for Question 14 = 11 marks)

15 The photographs show an exercise device and someone using it. The device contains two rubber cords which are extended when the device is used.

A student investigates the properties of the device by hanging weights on it and measuring the extension.

The student obtains the following graph for her results.



(a) The student notices that her graph is a straight line between A and B and concludes that the device obeys Hooke's law.

Comment on this conclusion.

(2)

.....

.....

.....

(b) (i) Describe how the student could use the graph to obtain an estimate of the total work done.

(2)

.....

.....

.....

.....

(ii) The student sets up a spreadsheet to investigate the work done in stretching the device each time a weight is added.

	A	B	C	D
1	Total stretching force / N	Extension / cm	Change in extension / m	Work done (force × change in extension) / J
2	0	0.0	0.000	0.00
3	10	1.6	0.016	0.16
4	20	3.5	0.019	0.38
5	30	7.0	0.035	1.05
6	40	10.5	0.035	1.40
7	50	14.5	0.040	2.00
8	60	20.0	0.055	3.30
9	70	25.2	0.052	3.64
10	80	30.5	0.053	4.24
11			Total work done	16.17

Explain why this spreadsheet results in an over-estimate for the total work done.

(2)

(c) The student eats a packet of crisps and then uses the exercise device. The energy content in a packet of crisps is 540 kJ. During exercise this energy is converted and 25% of it is transferred to mechanical work.

The student extends the device fully 15 times in 1 minute. An accurate value for the work done in fully extending the device is 14.7 J.

Calculate the time it would take the student, working at this rate, to transfer 25% of the energy from the crisps to mechanical work.

(3)

Time = ...

(d) Explain whether more or less work would be done applying the same maximum total stretching force to a similar exercise device with rubber cords of twice the cross-sectional area.

(2)

(Total for Question 15 = 11 marks)

16 The 'Stealth' roller coaster at the Thorpe Park theme park is advertised as reaching 135 km hour^{-1} from rest in 2.3 seconds.

Most roller coasters are driven slowly up to the top of a slope at the start of the ride. However the carriages on 'Stealth' are initially accelerated horizontally from rest at ground level by a hydraulic launch system, before rising to the top of the first slope.

(a) (i) Calculate the average acceleration of the carriages.

135 km hour^{-1} = 37.5 m s^{-1}

(2)

Average acceleration = ...

(ii) Calculate the minimum average power which must be developed by the launch system.

mass of carriages and passengers = 10 000 kg

(3)

Minimum average power = ...

(iii) Suggest why the power in (ii) is a minimum value.

(1)

*(b) The force required to launch 'Stealth' is not always the same. The ride is monitored and the data from preceding launches is used to calculate the required force.

If the mass of the passengers for a particular ride is significantly more than for preceding launches, this can lead to 'rollback'. This is when the carriages do not quite reach the top of the first slope and return backwards to the start.

Explain why 'rollback' would occur in this situation.

(3)

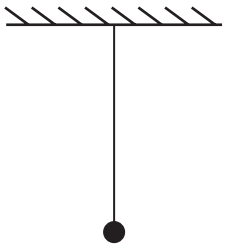
(c) Suggest why roller coasters may have a greater acceleration when the lubricating oil between the moving parts has had time to warm up.

(2)

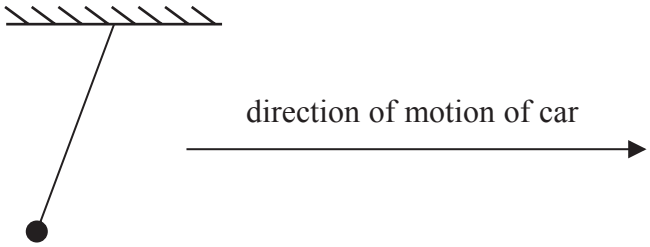
(Total for Question 16 = 11 marks)

17 Many hand held devices such as smartphones and tablet computers contain accelerometers. These allow changes in orientation of the device to be tracked.

A student models a simple accelerometer by attaching a small mass on a string to the roof of a car.



When the car starts moving, the string is seen to change position as shown below.



(a) (i) Complete a free body force diagram for the mass when the car starts moving.

(2)

(ii) Draw a vector diagram, in the space below, to show how the resultant force on the mass is produced.

(2)

(iii) When the string is at 7° to the vertical, show that the acceleration of the car is about 1 m s^{-2}.

(2)

(b) Sketch the positions of the mass and string when the car is moving in the same direction and is:

(i) moving with constant velocity,

(ii) undergoing a much greater acceleration than in (a)(iii),

(iii) decelerating.

(3)

(i) moving with constant velocity,

(ii) undergoing a much greater acceleration than in (a)(iii),

(iii) decelerating.

(c) Explain why the string would **not** become horizontal, however great the acceleration.

(2)

(d) Suggest why many devices contain 3 accelerometers, arranged at right angles to each other.

(1)

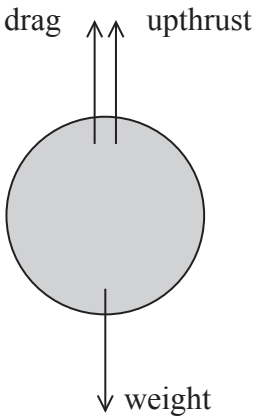
(Total for Question 17 = 12 marks)

18 The Greek philosopher Aristotle (4th Century BC) stated that heavy objects fall more quickly than lighter objects.

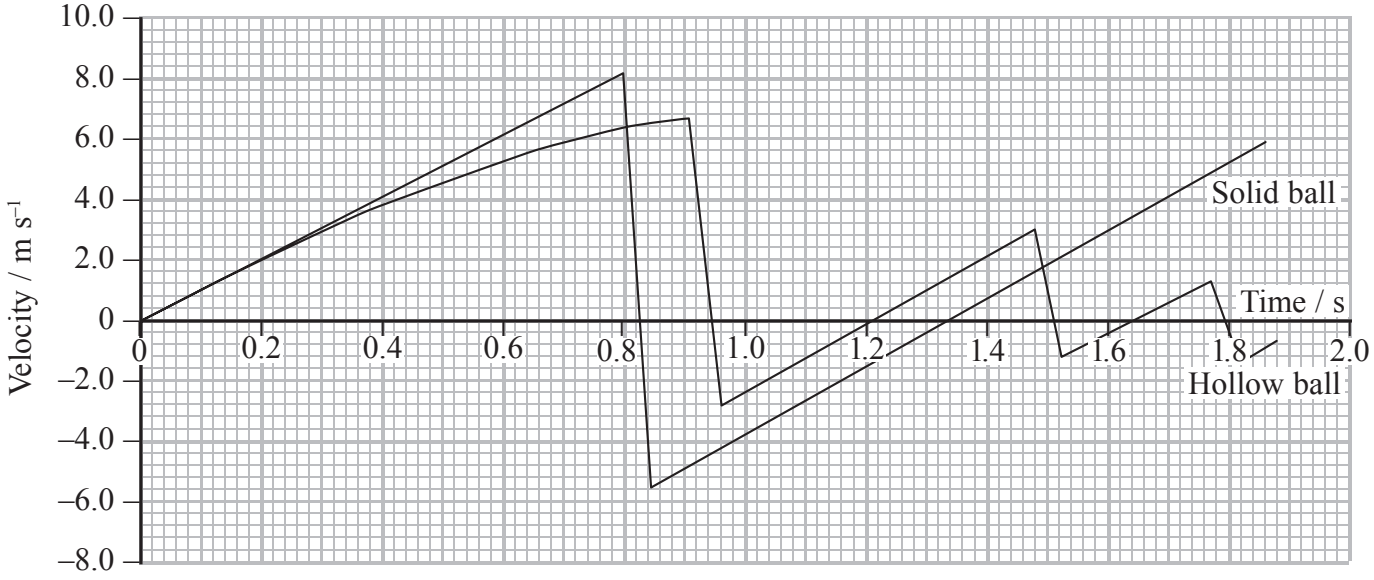
In the 17th Century Galileo reported that a cannon ball and a much smaller musket ball, dropped at the same time, reached the ground together.

A student carries out an experiment, dropping two balls of the same size at the same time. One of the balls is hollow and the other is solid.

The diagram shows the forces acting on each ball as it falls.



The velocity-time graph shows the motion of the two balls from the time they are dropped.



(a) State how the graphs show that neither ball reaches terminal velocity.

(1)

.....

.....

.....

(b) (i) By drawing a tangent to the graph, show that the acceleration of the hollow ball at time $t = 0.60$ s is about $7\,ms^{-2}$.

(2)

(ii) Show that the resultant force on the hollow ball at $t = 0.60$ s is about 0.02 N.

mass of hollow ball = 2.4 g

(2)

(iii) Show that the drag force on the hollow ball at $t = 0.60$ s is about 0.01 N. You may neglect upthrust.

(2)

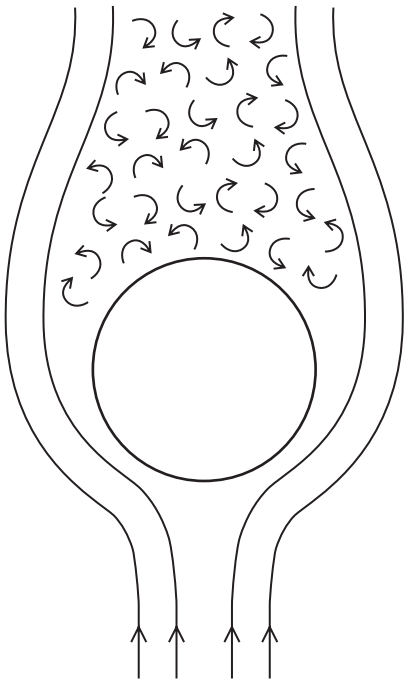
(iv) Demonstrate that the Stokes' law force is **not** sufficient to produce this drag force.

radius of hollow ball = 2.0 cm

viscosity of air = 1.8×10^{-5} Pa s

(2)

(c) The diagram shows the air flow around the hollow ball as it falls.



(i) Add labels to show laminar flow and turbulent flow.

(1)

(ii) Suggest why the drag is much greater than the Stokes' law force.

(1)

(d) Without further calculation, use the graph to describe the motion of the solid ball.

(3)

(Total for Question 18 = 14 marks)

TOTAL FOR SECTION B = 70 MARKS

TOTAL FOR PAPER = 80 MARKS

Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Monday 20 May 2013 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6PH01/01R

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 ▶

P43321A

1/1/1/1/C2

P 4 3 3 2 1 A 0 1 3 2

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 is a vector quantity?

☒ **A** kinetic energy

☒ **B** mass

☒ **C** power

☒ **D** velocity

(Total for Question 1 = 1 mark)

2 Which of these statements about work is **not** correct?

☒ **A** For work to be done a force must always be applied.

☒ **B** When work is done energy is transferred.

☒ **C** Work done is the product of force and distance moved perpendicular to the force.

☒ **D** Work done is a scalar quantity.

(Total for Question 2 = 1 mark)

3 Concrete pillars may be used to support heavy roofs.

Concrete is used because it has a

☒ **A** high compressive strength.

☒ **B** high tensile strength.

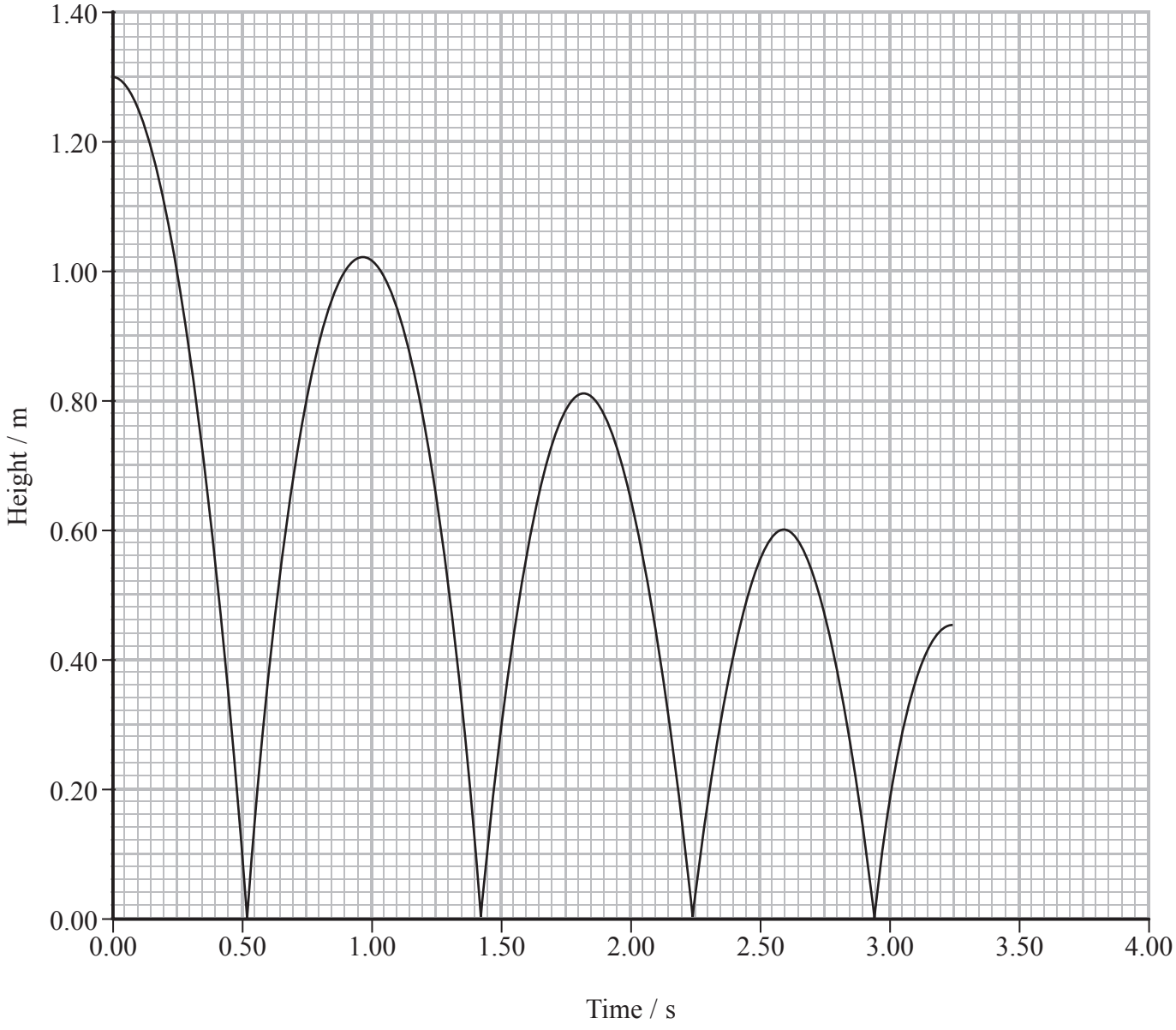
☒ **C** low stiffness.

☒ **D** low Young modulus.

(Total for Question 3 = 1 mark)

Questions 4, 5 and 6 refer to the graph below.

A ball is dropped from a height of 1.3 m. The graph shows how the height above the ground varies with time for several bounces.



4 At 2.6 s the magnitude of the displacement from the starting position is

- ☒ **A** 0.20 m
- ☒ **B** 0.60 m
- ☒ **C** 0.70 m
- ☒ **D** 1.30 m

(Total for Question 4 = 1 mark)

5 How can the velocity of the ball at time $t = 2.5$ s be determined from the graph?

☒ **A** Calculate the area between the graph and the time axis up to $t = 2.5$ s.

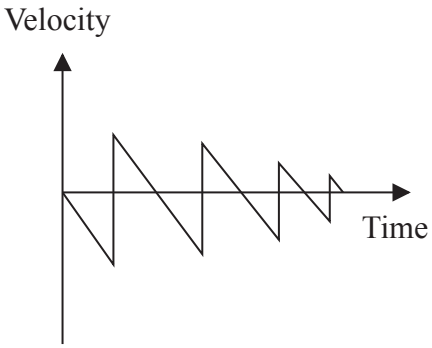
☒ **B** Divide the displacement at $t = 2.5$ s by 2.5 s.

☒ **C** Divide the height at $t = 2.5$ s by 2.5 s.

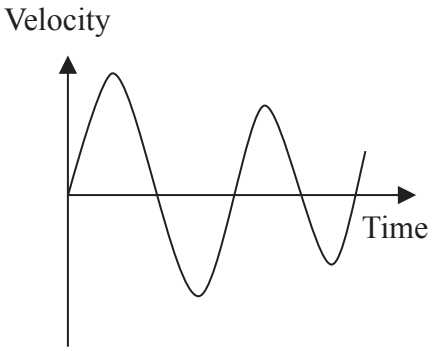
☒ **D** Draw a tangent to the graph at $t = 2.5$ s and calculate its gradient.

(Total for Question 5 = 1 mark)

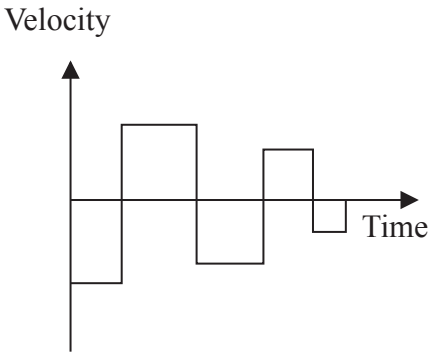
6 Which of the following graphs could be the velocity-time graph for the ball?



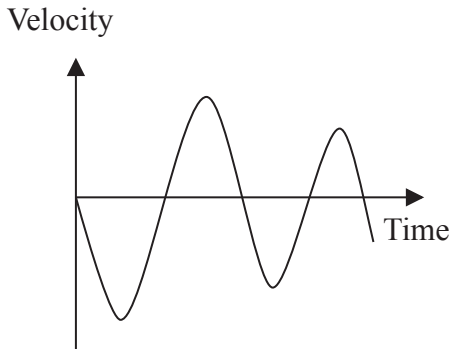
A



B



C



D

☒ **A**

☒ **B**

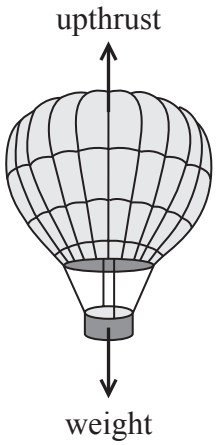
☒ **C**

☒ **D**

(Total for Question 6 = 1 mark)

Questions 7 and 8 refer to the diagram below.

The diagram shows the forces acting on a hot air balloon when at a constant height.

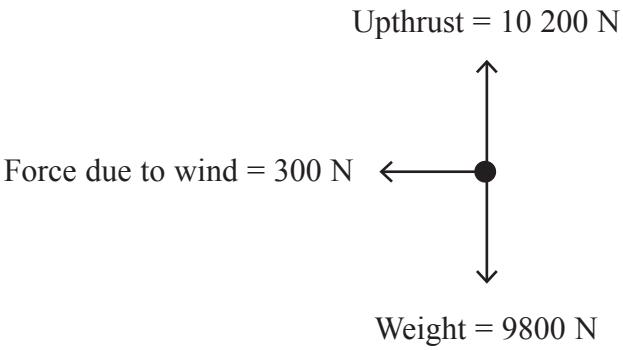


7 Select the row in the table that correctly describes the situation when the air in the balloon is heated.

	Observation	Reason
☒ **A**	Balloon rises	Weight > Upthrust
☒ **B**	Balloon falls	Weight > Upthrust
☒ **C**	Balloon rises	Weight < Upthrust
☒ **D**	Balloon falls	Weight < Upthrust

(Total for Question 7 = 1 mark)

8 Below is a free-body force diagram for the balloon when a wind is blowing.



The magnitude of the resultant force acting on the balloon is

☒ **A** 400 N

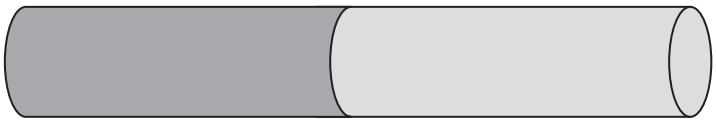
☒ **B** 500 N

☒ **C** 700 N

☒ **D** 9 805 N

(Total for Question 8 = 1 mark)

9 A steel wire and a brass wire, with identical cross sectional areas and lengths, are fused together. The Young modulus for steel is approximately twice that of brass.



The combined wire is stretched.

The ratio $\frac{\text{extension of steel wire}}{\text{extension of brass wire}}$ is approximately

☒ **A** 2.0

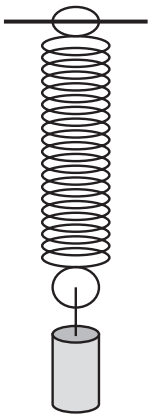
☒ **B** 1.0

☒ **C** 0.50

☒ **D** 0.25

(Total for Question 9 = 1 mark)

10 A spring is suspended from a bar. When a load of 6.0 N is added to the bottom of the spring, its length changes from 0.040 m to 0.13 m.



To find the spring constant of the spring you would use

☒ **A** $\frac{0.13\,\text{m}}{6.0\,\text{N}}$

☒ **B** $\frac{6.0\,\text{N}}{0.13\,\text{m}}$

☒ **C** $\frac{6.0\,\text{N}}{0.090\,\text{m}}$

☒ **D** $\frac{0.090\,\text{m}}{6.0\,\text{N}}$

(Total for Question 10 = 1 mark)

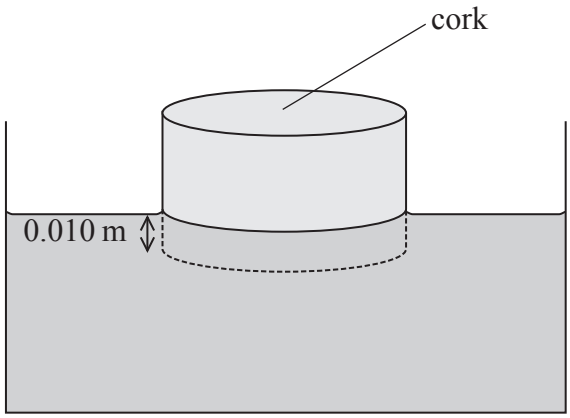
TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 A cylinder of cork of cross-sectional area 5.0×10^{-3} m^2 floats on water with its axis vertical. The length of the cork below the surface of the water is 0.010 m.

density of water = 1000 kg m^{-3}



(a) Show that the weight of water displaced by the cork is about 0.5 N.

(3)

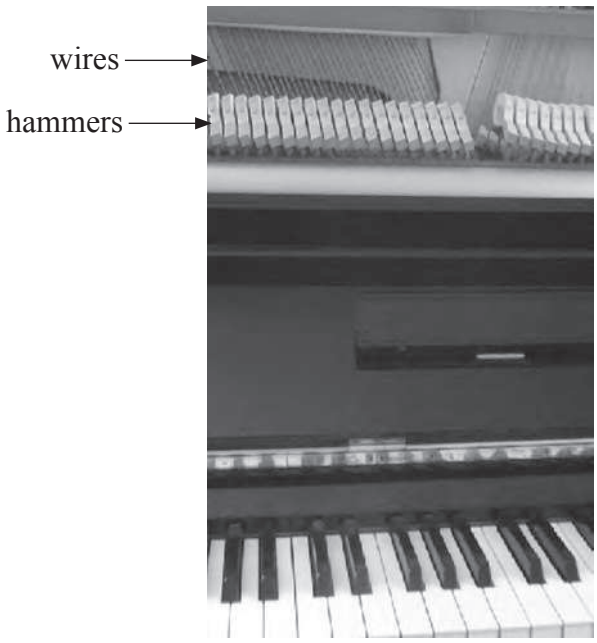
(b) State the weight of the cork and justify your answer.

(2)

(Total for Question 11 = 5 marks)

12 When a note is played on a piano, a soft hammer is made to hit a wire. This causes the wire to vibrate creating a sound.

The wires used in pianos are hard, stiff and have a high tensile strength.



(a) Explain the meaning of the terms hard, stiff and high tensile strength.

(i) Hard

(1)

(ii) Stiff

(1)

(iii) High tensile strength

(1)

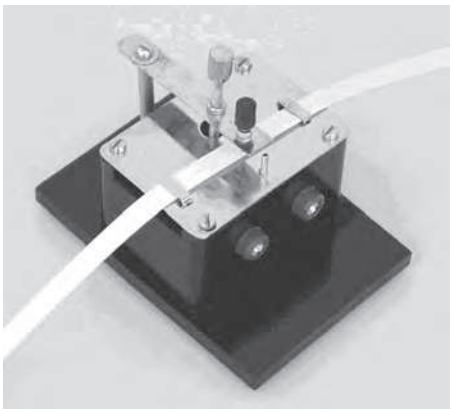
*(b) It is important that a piano wire has a high elastic limit.

Explain why this is important.

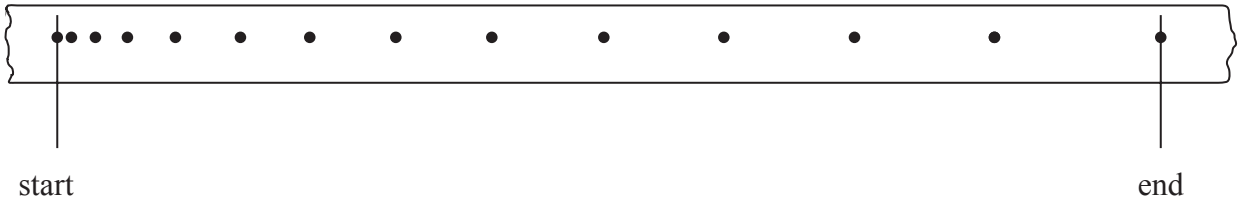
(3)

(Total for Question 12 = 6 marks)

13 A trolley moves down a ramp from rest. Attached to the trolley is a strip of paper which is pulled through a ticker tape timer. The ticker tape timer makes 50 dots each second on the strip of paper.



The strip of paper is shown below. The start and the end of the journey are indicated.



(a) (i) Using measurements from the tape show that the final velocity of the trolley is about 1 m s^{-1}

(2)

(ii) Hence calculate the average acceleration of the trolley.

(2)

Average acceleration = ...

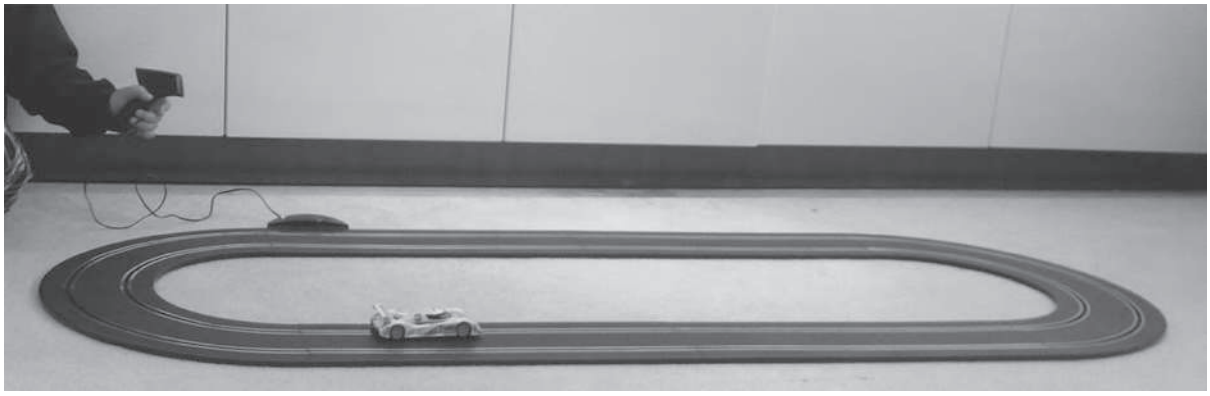
(b) Using a ticker tape timer is one method of measuring the speed of a moving object in a laboratory. Another method is to use a light gate with a data logger and computer.

Suggest an advantage of using the light gate method rather than using a ticker tape timer.

(1)

(Total for Question 13 = 5 marks)

14 The picture shows a track for racing toy electric cars. A guide pin fits in a groove in the track to keep the car on the track. A small electric motor in the car is controlled, with a hand-controller, via contacts in the track.



A child places a car of mass 95 g on the track. She adjusts the controller to a power of 4.2 W so the car accelerates from rest for 0.40 s.

(a) (i) Show that the energy transferred by the motor in 0.40 s is about 2 J.

(2)

.....

.....

.....

(ii) Calculate the speed of the car at 0.40 s.

(2)

.....

.....

.....

Speed = ...

(iii) Suggest why the actual speed of the car is less than the calculated speed.

(1)

.....

.....

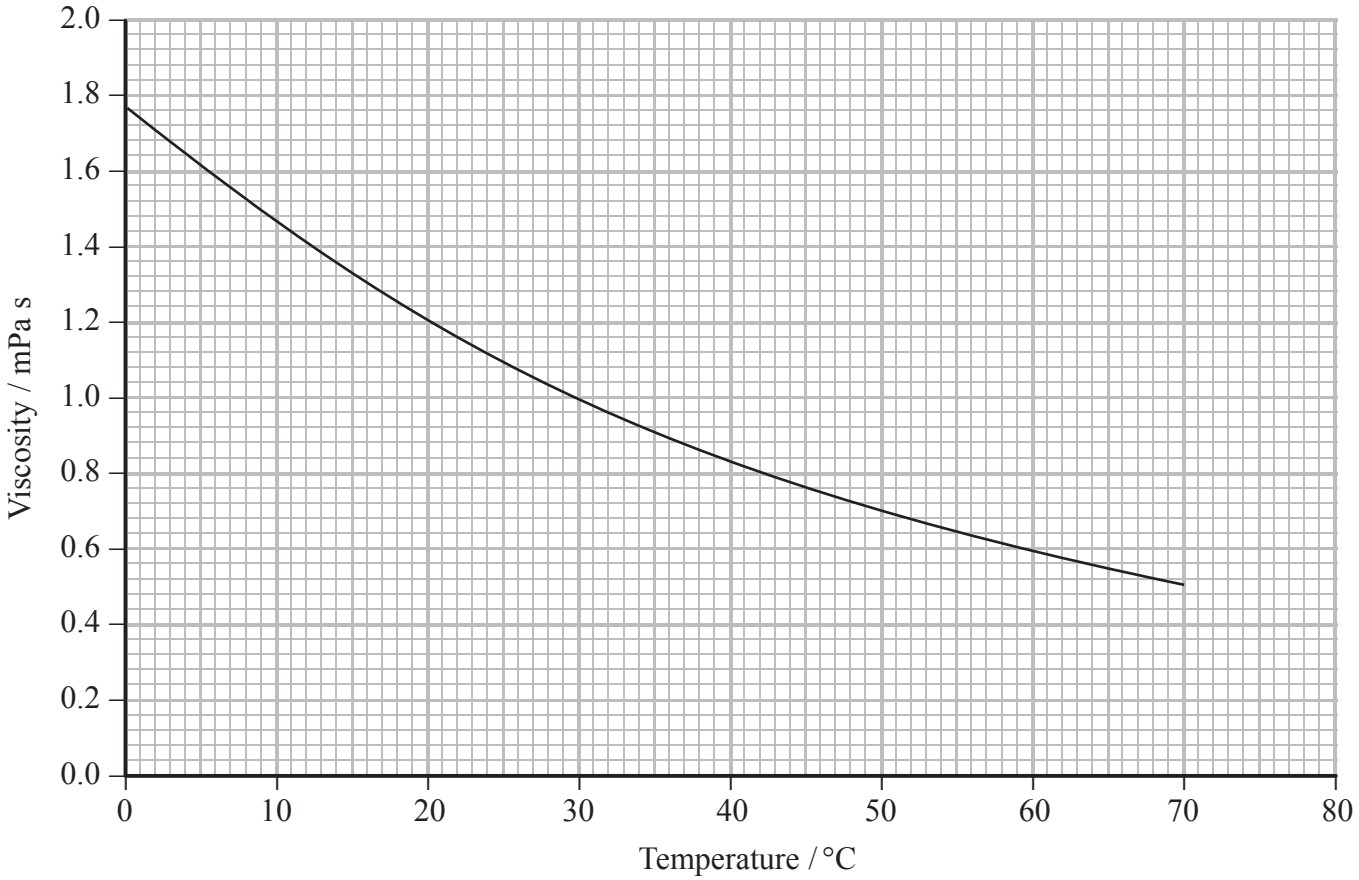
(b) At high speed the guide pin may become disengaged from the groove.

Use Newton's first law to explain why the car would then leave the track at a corner.

(2)

(Total for Question 14 = 7 marks)

15 The graph shows how the viscosity of ethanol varies with temperature.



(a) Describe how the viscosity of ethanol varies with temperature.

(2)

(b) (i) Use Stoke's law to show that the SI unit of viscosity is Pa s.

(2)

(ii) A small sphere is dropped into a large volume of ethanol at 24 °C.

Show that, if the drag were due to viscous forces alone, the terminal velocity would be about 4 ms^{-1}.

Assume that upthrust is negligible.

radius of sphere = 5.0×10^{-4} m

room temperature = 24 °C

mass of sphere = 4.0×10^{-6} kg

(3)

*(c) Diesel is used as the fuel in some vehicles. Diesel is not renewable, so alternatives are being researched. Biodiesel is a fuel made from vegetable oil; biodiesel on its own is not suitable for use in vehicles.

The table gives some information about diesel, biodiesel and ethanol.

	Viscosity / mPa s at 0 °C	**Viscosity / mPa s at 40 °C**	**Energy / MJ kg^{-1}**	**Freezing point / °C**
Diesel	4.9	2.6	43	–30
Biodiesel	17.3	4.6	39	–12
Ethanol	1.8	0.9	27	–114

Blends of biodiesel with ethanol are being researched as a renewable alternative to diesel fuels for use in vehicles all year round.

Using the information in the table, suggest why these blends are being researched.

(3)

(Total for Question 15 = 10 marks)

16 The photograph shows an athlete performing a long jump.

At take-off his horizontal speed is 8.0 m s^{-1} and his vertical speed is 2.8 m s^{-1}.

(a) Show that the total time the athlete spends in the air is about 0.6 s.

Assume that his centre of gravity is at the same height at take-off and landing.

(3)

(b) Calculate the horizontal distance jumped by the athlete.

(2)

Horizontal distance = ...

(c) In reality, when the athlete lands his centre of gravity is 50 cm lower than its position at take-off.

Calculate the extra horizontal distance this enables the athlete to jump.

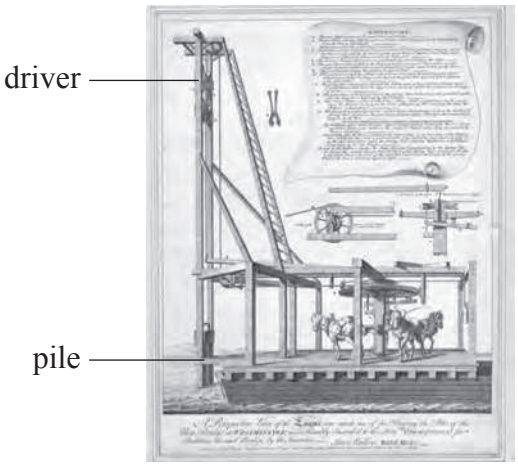
(4)

Extra horizontal distance = ...

(Total for Question 16 = 9 marks)

17 Pile drivers have been used for centuries to push piles into the ground for use as foundations of buildings and other structures. A large mass (the driver) is raised and then dropped onto an object (the pile) which is pushed into the ground.

The picture shows the pile driver that was used to build a London bridge in the 17th century.



(a) (i) The driver on the pile driver above had a mass of 810 kg and could be dropped a maximum distance of 6.0 m onto the pile.

Show that the energy transferred from the driver is about 50 kJ.

(2)

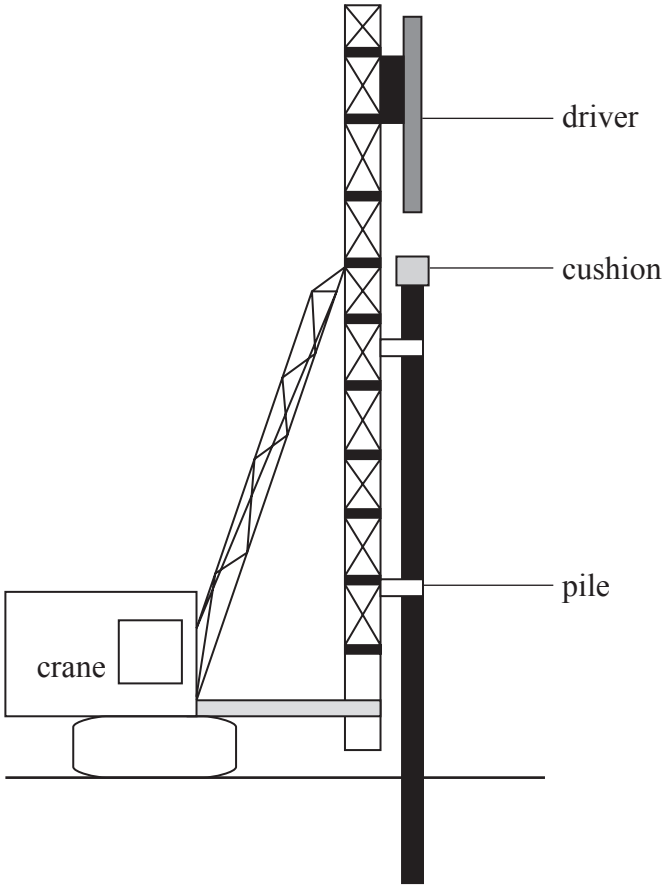
(ii) In one instance, 40% of this energy is used usefully to drive in the pile. The pile moves 0.20 m into the ground.

Determine the average resistive force acting on the pile as it moves through the ground.

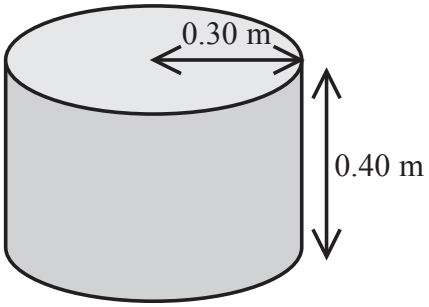
(3)

Average resistive force = ...

(b) In order to protect the driver on modern pile drivers, a cushion made of wood is placed on the pile.



The cushion is a cylindrical piece of wood of Young modulus = 120 MPa



The cushion is compressed when hit by the driver.

(i) The maximum compressive force applied to the wood during impact is 7.0×10^5 N. Show that the compression of the cushion is about 0.01 m.

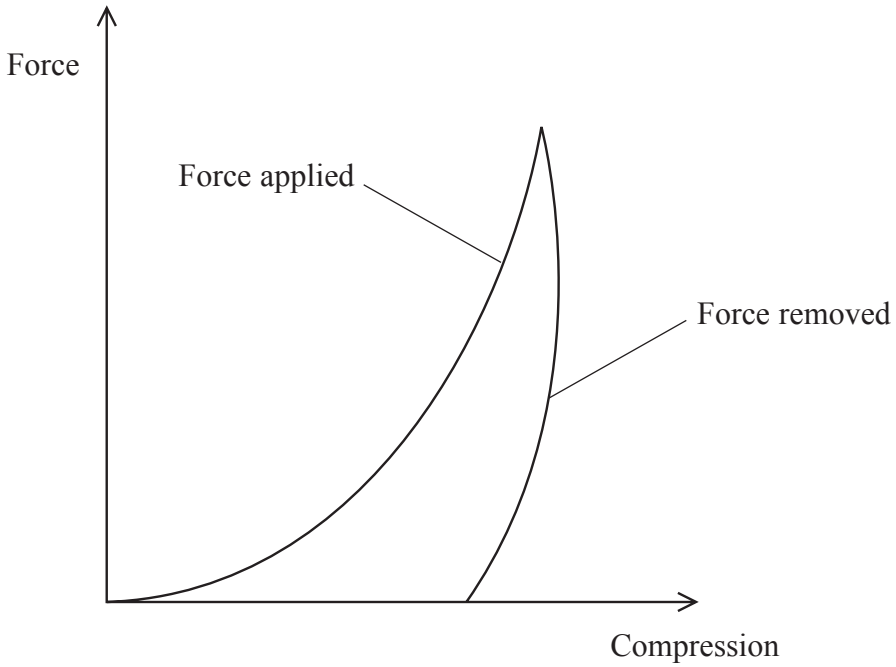
(3)

(ii) Calculate the energy stored in the cushion under compression.

(2)

Energy stored = ...

*(iii) The graph shows how the compression of the wooden cushion varies with force, as the force is applied and removed during an impact.



Use the graph to explain the following:

1. the wooden cushion has to be replaced after a few hundred impacts,

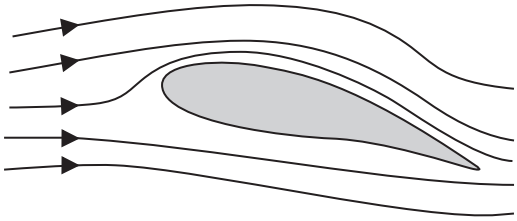
(2)

2. with each impact the temperature of the wooden cushion rises slightly.

(1)

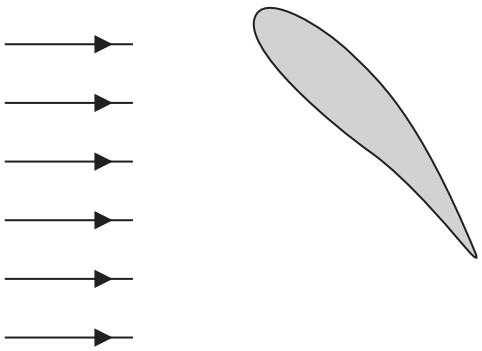
(Total for Question 17 = 13 marks)

18 The cross section of the wing of a bird is an aerofoil shape.



Direction of flight ←

In order to fly higher, a bird can tilt its wings more. If it tilts them too much, as shown in the diagram below, the air flow above the wing becomes turbulent.



Direction of flight ←

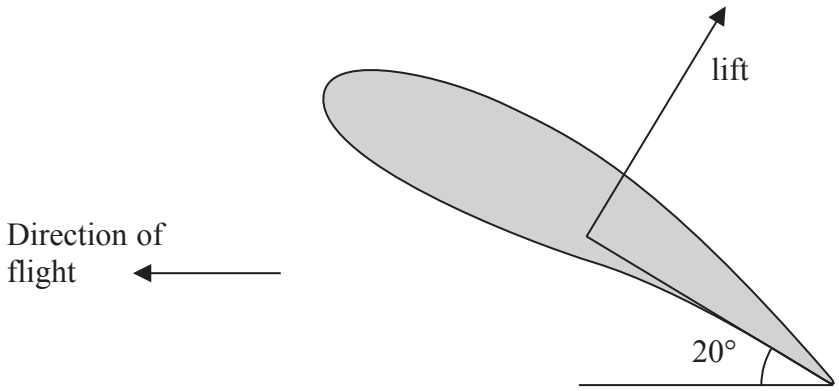
(a) Complete the diagram above to show the airflow around the wing.

(2)

(b) The tilting of the wing results in the air exerting a force on the wing which is called lift. The lift force acts perpendicular to the wing.

The total vertical component of the lift produced by both wings when tilted at an angle of 20° to the horizontal is enough to keep the bird flying at a constant height.

mass of bird = 0.063 kg



(i) Show that the total lift acting on the bird is about 1 N.

(3)

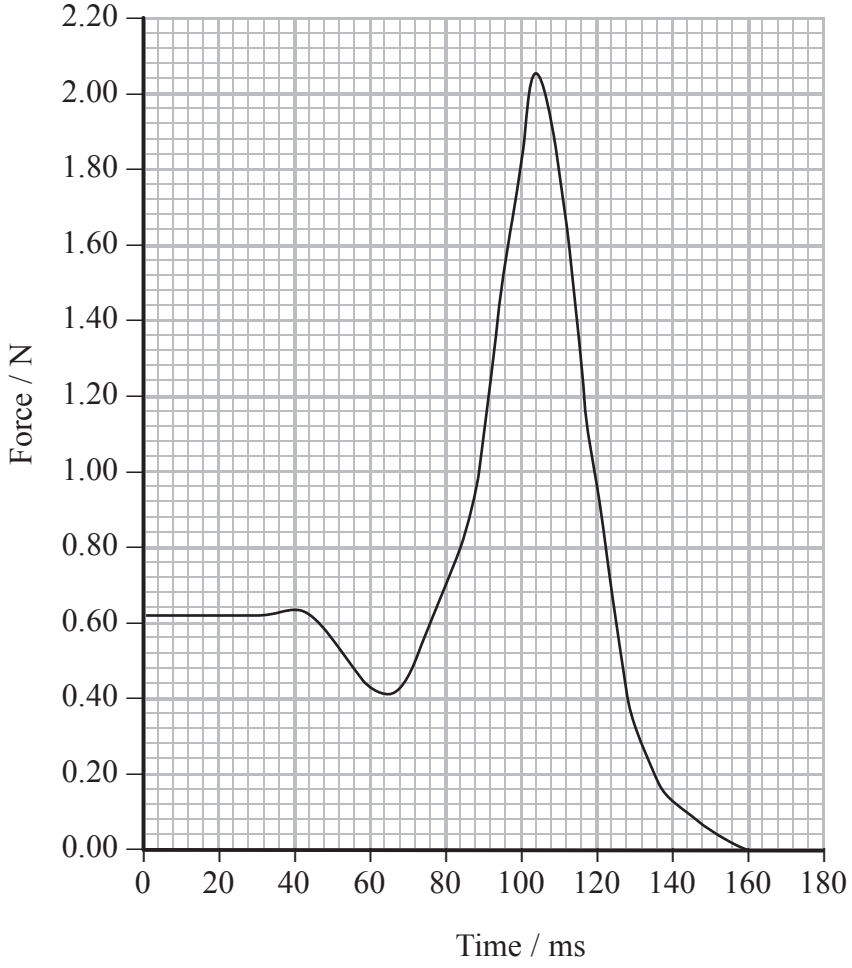
(ii) Assuming that the only forces acting on the bird are the weight and lift, calculate its acceleration at this instant.

(3)

Acceleration = ...

(c) When some birds take off from the ground there is no lift initially. These birds push off from the ground with their legs.

The following graph shows the downward force exerted by the leg on the ground during take off.



(i) With reference to Newton's laws explain how the downward force from the leg enables the bird to take off.

(4)

(ii) Use the graph to calculate the maximum acceleration of the bird during take off.

mass of bird = 0.063 kg

(3)

Maximum acceleration = ...

(Total for Question 18 = 15 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 $E_{el} = \tfrac{1}{2}F\Delta x$