Write your name here

Surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number | Candidate Number

Physics

Advanced Subsidiary
Unit 1: Physics on the Go

Thursday 12 October 2017 – Morning
Time: 1 hour 30 minutes

Paper Reference
WPH01/01

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 on these questions with your spelling, punctuation and grammar, as well as the clarity of expression.*
- The list of data, formulae and relationships is printed at the end of this booklet.
- Candidates may use a scientific calculator.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Pearson

SECTION A

Answer ALL questions.

For questions 1–10, in Section A, select one answer from A to D and put a cross in the box ☒. If you change your mind, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Which of the following SI units is **only** used with a vector quantity?

☒ **A** s

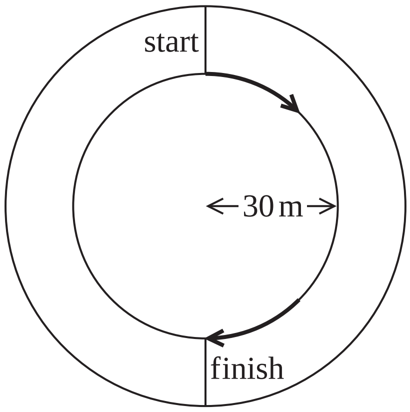
☒ **B** m^3

☒ **C** $m\,s^{-1}$

☒ **D** $m\,s^{-2}$

(Total for Question 1 = 1 mark)

2 An athlete runs a race around half of a circular track of radius 30 m using the inside lane.



At the end of the race, what is the magnitude of the displacement of the athlete from the starting point?

☒ **A** 30 m

☒ **B** 60 m

☒ **C** 30π m

☒ **D** 60π m

(Total for Question 2 = 1 mark)

3 A ball of mass 0.040 kg is dropped from a height of 1.5 m.

What is the kinetic energy of the ball just before it hits the ground?

- ☒ **A** 0.045 J
- ☒ **B** 0.060 J
- ☒ **C** 0.39 J
- ☒ **D** 0.59 J

(Total for Question 3 = 1 mark)

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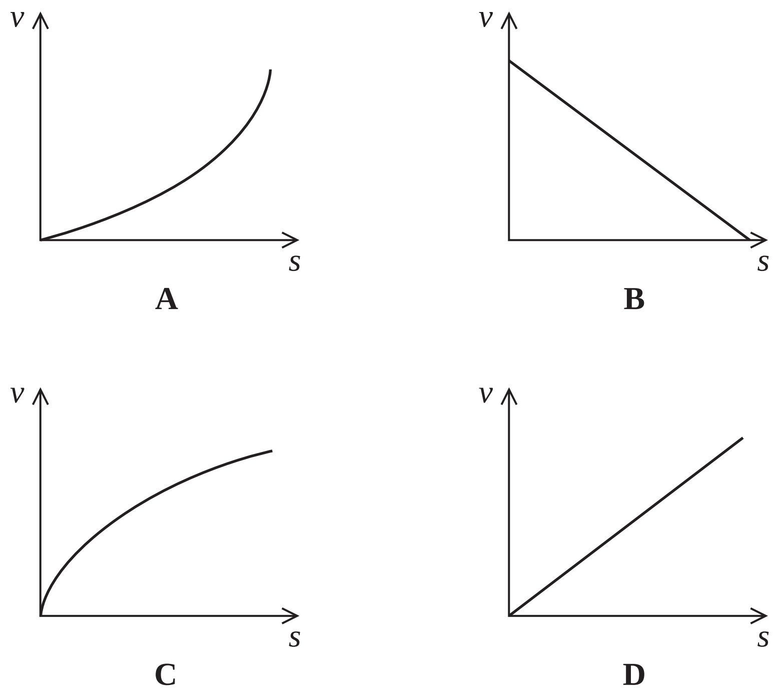
4 An object is dropped from rest in a vacuum.

Which of the following is the correct graph of velocity *v* against displacement *s* for the motion of the object?



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

(Total for Question 4 = 1 mark)

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5 As raindrops fall they reach a terminal velocity.

Which of the following properties has a negligible effect on the terminal velocity of a raindrop?

☒ **A** density of water

☒ **B** viscosity of air

☒ **C** viscosity of water

☒ **D** volume of raindrop

(Total for Question 5 = 1 mark)

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6 Sea shells are the protective outer casing of some sea creatures. The shell is left behind when the creature dies and the shell is moved around on the seabed by the tides and waves.

Shells washed up on the beach are found to be as smooth as when the creature was alive.

This is because the material from which the shell is made is

☒ **A** hard.

☒ **B** stiff.

☒ **C** strong.

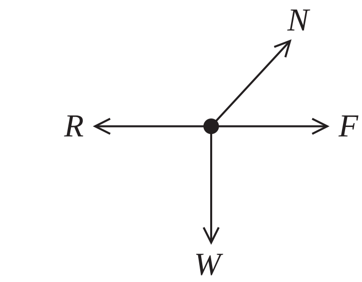
☒ **D** tough.

(Total for Question 6 = 1 mark)

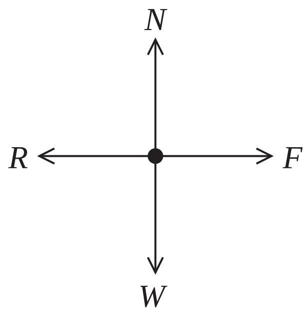
7 Four forces act on an athlete running at a constant velocity.

air resistance *R*
friction between shoe and ground *F*
normal contact force *N*
weight *W*

Which of the following free-body force diagrams correctly shows the forces acting on the athlete?



A



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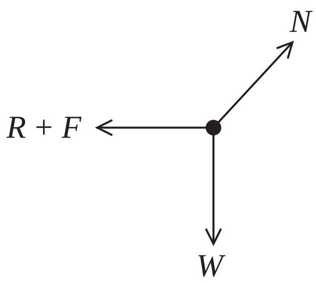

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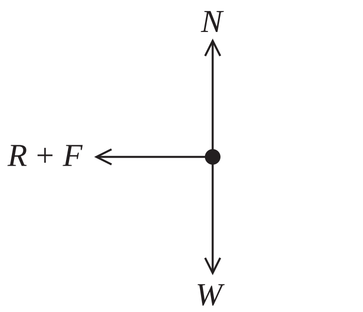


D

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 7 = 1 mark)

8 A bird flies with a velocity of 4 m s^{-1} through the air, heading due south. Due to the wind, the air is moving at 3 m s^{-1} in a direction from east to west.

The magnitude of the resultant velocity of the bird is

☒ **A** 3 m s^{-1}

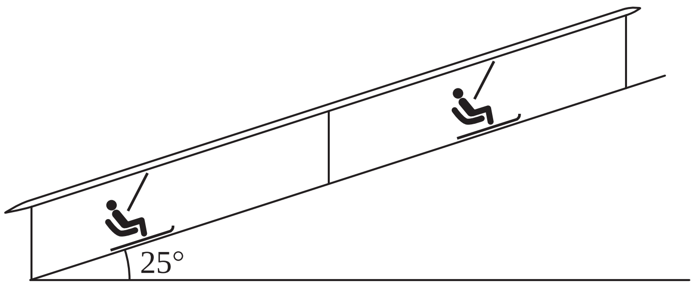
☒ **B** 4 m s^{-1}

☒ **C** 5 m s^{-1}

☒ **D** 7 m s^{-1}

(Total for Question 8 = 1 mark)

9 A ski lift carries skiers along a 450 m slope that is at an incline of 25° to the horizontal.



It can be assumed that the motor has to lift an average additional mass of 80 kg for each skier using the ski lift.

Which of the following expressions represents the work done against gravity when lifting an individual skier up the slope?

☒ **A** $\frac{80 \times g \times 450}{\cos 25°}$

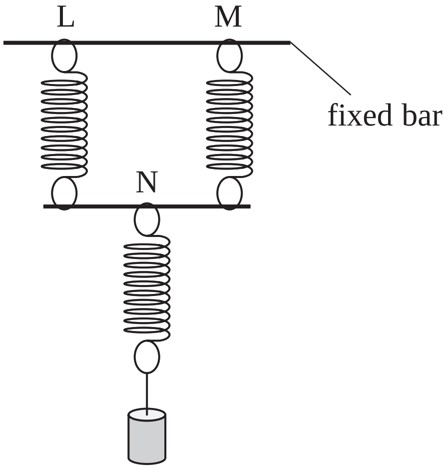
☒ **B** $\frac{80 \times g \times 450}{\sin 25°}$

☒ **C** $80 \times g \times 450 \times \cos 25°$

☒ **D** $80 \times g \times 450 \times \sin 25°$

(Total for Question 9 = 1 mark)

10 Three identical springs L, M and N are connected, as shown.
Spring N has a load attached to its lower end. The extension of spring L is x.



Which row of the table gives the extensions of the springs?

	Extension of L	Extension of M	Extension of N
☒ **A**	x	x	x
☒ **B**	x	$\frac{x}{2}$	x
☒ **C**	x	x	$\frac{x}{2}$
☒ **D**	x	x	$2x$

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 Honey is stored in jars at room temperature. Under certain conditions, small crystals form in the honey and move around to form larger crystals.
The following extract was taken from a honey producer's website.

> Honey crystallisation is most rapid around 10 °C–15 °C. At temperatures below 10 °C the crystallisation is slowed down. Low temperatures change the viscosity.

Explain how the lower temperatures affect the movement of small crystals in honey.

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(Total for Question 11 = 3 marks)

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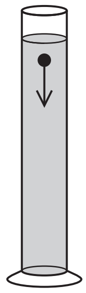
12 A small ball bearing is released at the top of a measuring cylinder containing oil, as shown.



The sphere falls, reaching a maximum velocity of $7.1 \times 10^{-3}\,\mathrm{m\,s^{-1}}$.

(a) Calculate the maximum drag force acting on the ball bearing.

(2)

radius of ball bearing = $4.0 \times 10^{-3}\,\mathrm{m}$
viscosity of oil = $0.98\,\mathrm{Pa\,s}$

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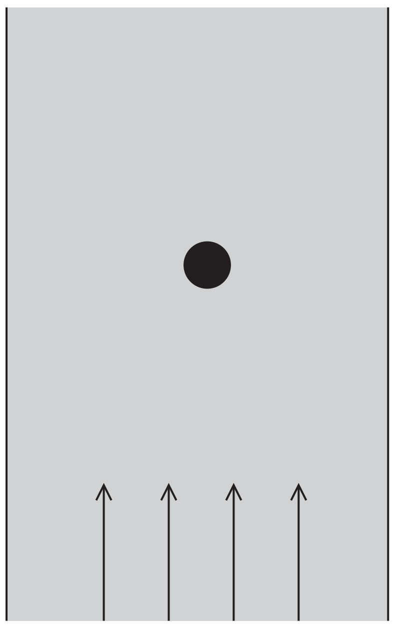
Maximum drag force = ...

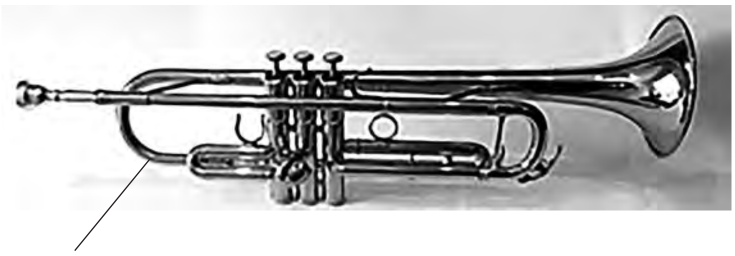
(b) Add to the diagram below to show the flow of the oil around the ball bearing as it falls through the measuring cylinder.

(2)



(Total for Question 12 = 4 marks)

13 Trumpets are commonly made from brass, an alloy of copper and zinc. The main tube of a trumpet may be produced by pulling brass tubing to reduce its diameter and then bending it into shape.



(a) Explain how a property of brass enables it to be pulled to reduce the diameter of the tubing.

(2)

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(b) Explain the additional property of brass that enables the tubing to be bent into shape.

(2)

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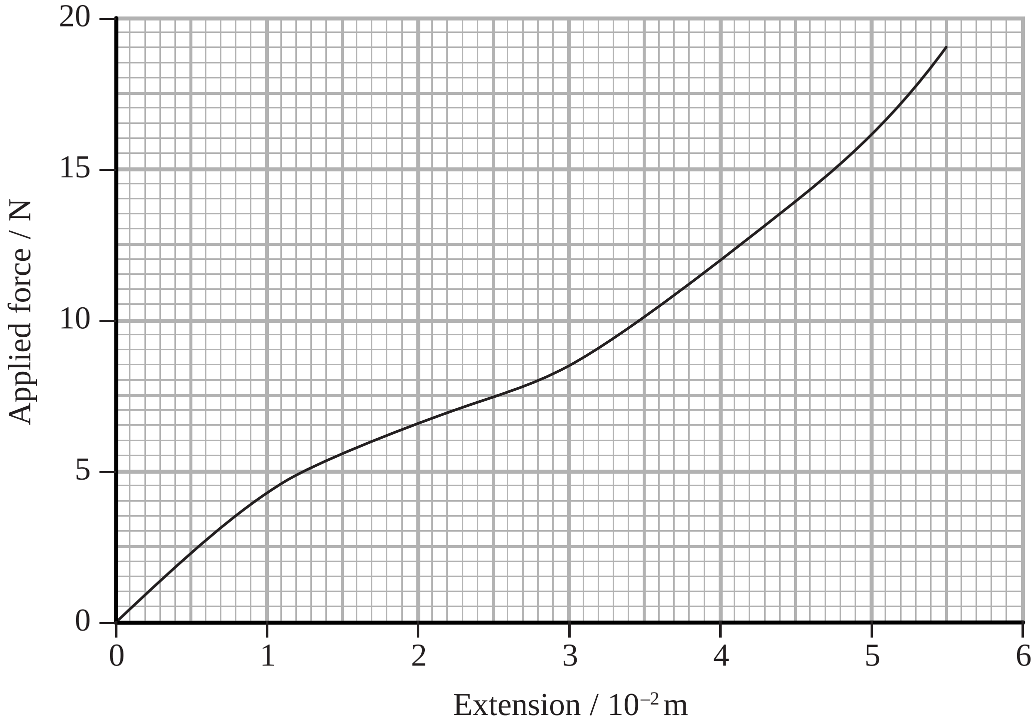
(Total for Question 13 = 4 marks)

14 A student carried out an experiment to measure the extension of a rubber band. She determined the extension of the rubber band as the applied force was increased. She plotted a graph of the results.



(a) Determine the work done in stretching the rubber band.

(3)

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Work done = ...

(b) Sketch, on the axes above, a possible graph for the unloading of the rubber band.

(2)

(Total for Question 14 = 5 marks)

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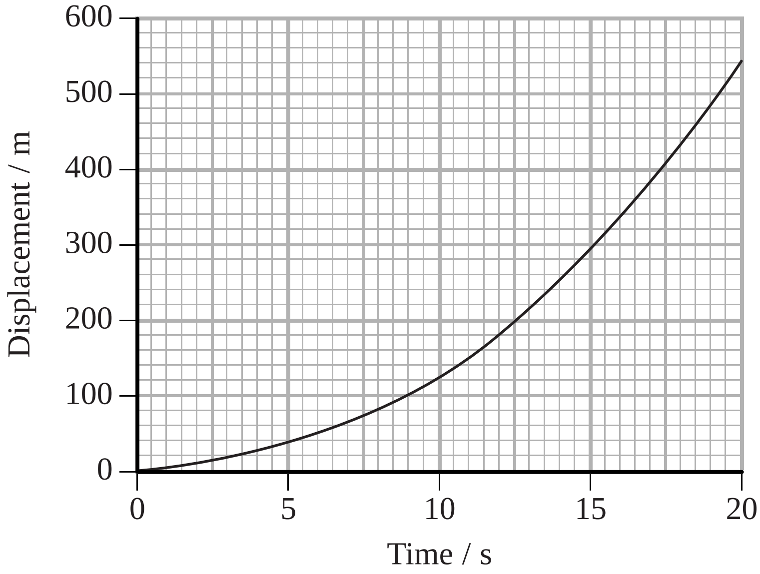
15 The graph shows how the displacement of a racing car along a straight track varies with time.



(a) A student used the graph to calculate the velocity of the car at 15 s.

The student wrote: Velocity = displacement / time
= 300/15
= 20 m s^{-1}

State why this value is incorrect and calculate the correct velocity at 15 s.

(3)

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Velocity of the car at 15 s = ...

(b) The gradient of the graph continued to increase as the car travelled along the track. After 20 s the rate of increase of the gradient began to decrease.

Explain why the rate of increase of the gradient decreased.

(2)

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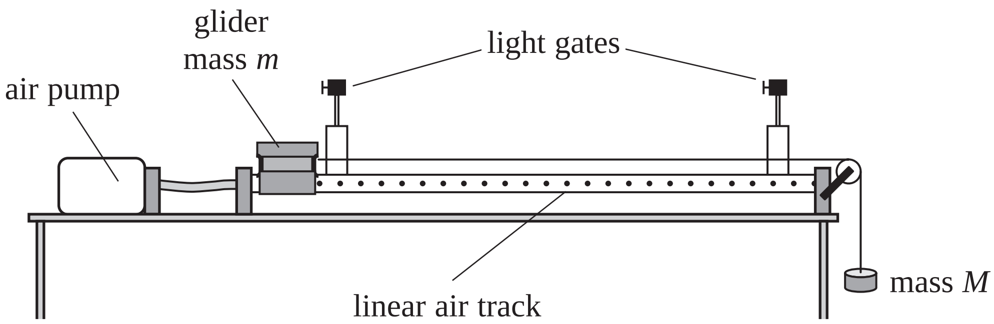
(Total for Question 15 = 5 marks)

16 A student carries out an experiment to investigate the motion of an object undergoing constant acceleration. The student uses a linear air track to provide a frictionless surface for a glider of mass *m*. A mass *M* is attached to the glider using a light inextensible thread placed over a frictionless pulley.



The air pump is switched on and the glider is released.

(a) Explain why the glider moves with constant acceleration.

(3)

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(b) One light gate is placed at the release position of the glider and a second light gate is placed further along the track. Both light gates are connected to a computer and the time taken for the glider to travel between the two gates is recorded.

(i) The manufacturer of the light gate states that the light gate system has a precision of 10 ms.

State what is meant by precision.

(1)

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*(ii) The student is to use the equation $s = ut + \frac{1}{2}at^2$, where $u = 0$, and a graphical method to determine the acceleration.

Describe the procedure the student should use to determine the acceleration.

(5)

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(Total for Question 16 = 9 marks)

17 The photograph shows a cyclist performing a jump. To produce the photograph, the camera shutter is opened at regular time intervals.

*(a) With reference to the photograph, describe the motion of the cyclist as he performs the jump.

(4)

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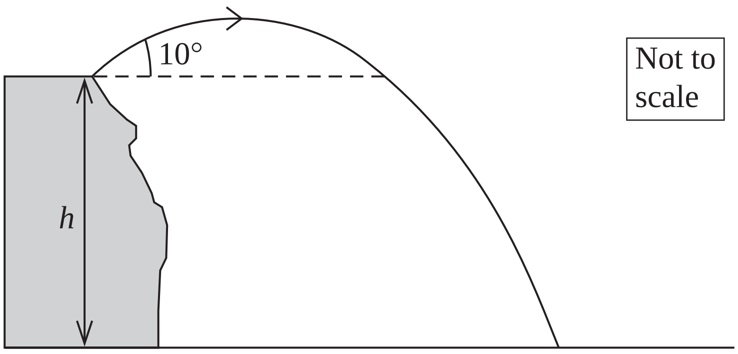
(b) The path of the cyclist is shown. The cyclist takes off with a velocity of $9.5\,\text{m}\,\text{s}^{-1}$ at an angle of 10° to the horizontal. The total time taken for the jump is 1.8 s.



(i) Calculate the vertical height h.

(3)

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h = ...

(ii) Calculate the horizontal distance jumped by the cyclist.

(3)

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Horizontal distance jumped = ...

(c) The cyclist briefly has a feeling of 'weightlessness' during his jump.

Explain why.

(2)

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(Total for Question 17 = 12 marks)

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18 A physicist investigates the behaviour of materials used in packaging.

(a) A sample of plastic ribbon is supported so that it hangs vertically. A mass of 960 g is used to apply a vertical load and the sample of plastic ribbon extends.

Calculate the strain produced in the sample of plastic ribbon due to the load.

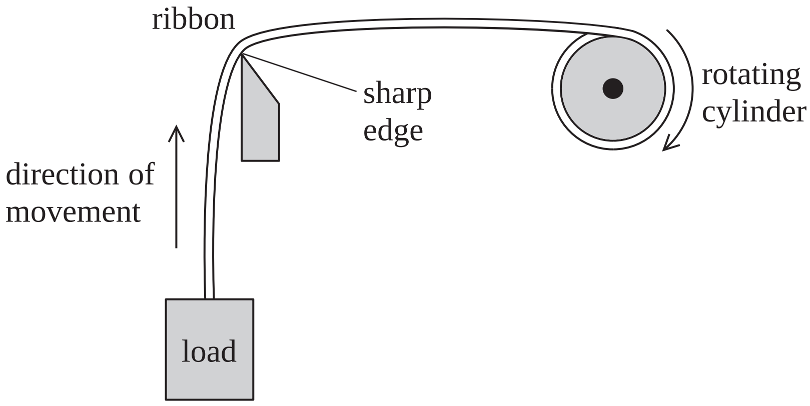
(4)

Young modulus of plastic ribbon = 2.5×10^{9} Pa
width of plastic ribbon sample = 1.0×10^{-2} m
thickness of plastic ribbon sample = 1.0×10^{-4} m

Strain = ...

(b) When a plastic ribbon is pulled over a sharp edge and then released, the ribbon becomes permanently curled, as shown.

Physicists investigating this effect carried out a series of experiments using the equipment shown.



A rotating cylinder pulls the ribbon over a sharp edge. A tension is created in the ribbon by attaching a load to the free end.

As the ribbon is pulled over the sharp edge, the tension in its upper surface is greater than the tension in its lower surface. When the tension is removed, the ribbon curls.

Suggest why the difference in the two tensions causes the ribbon to become permanently curled.

(3)

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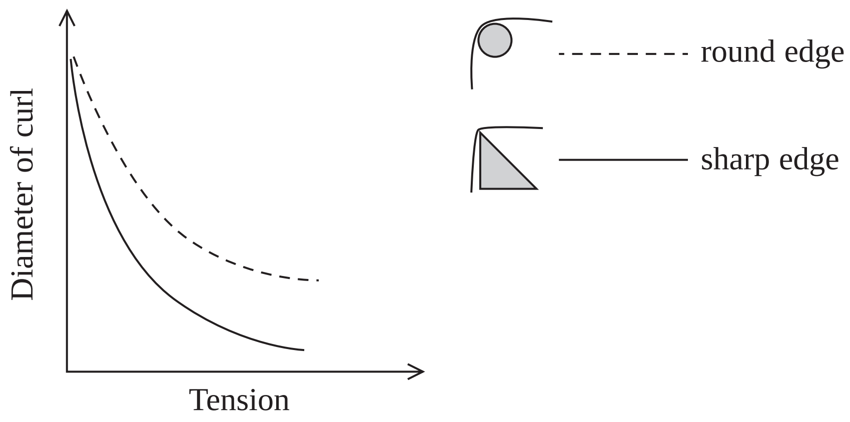
(c) The physicists repeated their investigation by pulling the ribbon with different tensions, over a round edge and over a sharp edge. The graph shows how the diameter of the curl varied with the tension for each edge.



(i) State how the diameter of the curl varies with tension for a given edge.

(1)

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(ii) State how the diameter of the curl is affected by the shape of the edge for a given tension.

(1)

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(iii) Reducing the speed of the rotating cylinder decreases the diameter of the curls.

Explain why.

(2)

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(Total for Question 18 = 11 marks)

19 A water-propelled jet pack enables a 'flyer' to be lifted up into the air. Water is pumped up through a pipe to the pack and is then ejected at high speed downwards, from a nozzle at the base of the jet pack.

(a) Explain, with reference to Newton's laws of motion, how the ejection of water from the base of the jet pack lifts the flyer into the air.

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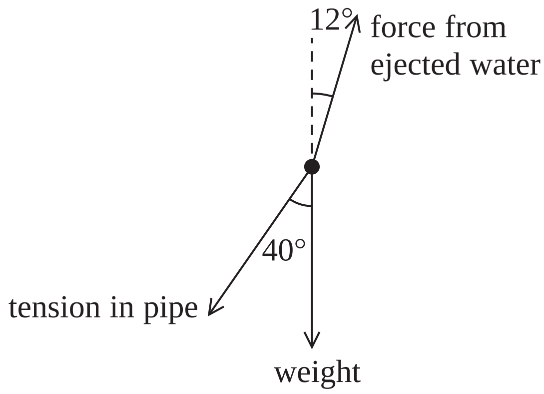
(b) The flyer, the jet pack and the water contained in the jet pack at any instant can be considered to be a system. The diagram shows the forces acting on the system.



(i) Show that the maximum weight that can be lifted is about 700 N.

(3)

tension in pipe = 310 N
force from ejected water = 960 N

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(ii) As the flyer initially rises from the surface of the water, the tension in the pipe can be considered to be negligible.

Calculate the minimum initial vertical acceleration of the flyer system. Assume that the weight of the flyer system is the value calculated in part (b)(i).

(3)

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Minimum initial vertical acceleration = ...

(c) The rate at which the water leaves the jet pack through the nozzle is $49.0\,\text{kg}\,\text{s}^{-1}$.

(i) Show that the velocity of the water as it leaves the jet pack is about $10\,\text{m}\,\text{s}^{-1}$.

(3)

cross sectional area of nozzle = $4.60 \times 10^{-3}\,\text{m}^2$
density of sea water = $1030\,\text{kg}\,\text{m}^{-3}$

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(ii) A flyer stays at a constant height of 12 m above the surface of the sea.

It can be assumed that the water enters the jet pack at the same speed it leaves the nozzle.

Calculate the minimum power of the pump that can be used by the system.

(4)

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Minimum power of the pump = ...

(Total for Question 19 = 17 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
$v = u + at$
$s = ut + \frac{1}{2}at^2$
$v^2 = u^2 + 2as$

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

Work and energy
$\Delta W = F\Delta s$
$E_k = \frac{1}{2}mv^2$
$\Delta E_{grav} = mg\Delta h$

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

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