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

Tuesday 24 May 2016 – Morning
Time: 1 hour 30 minutes

Paper Reference
WPH01/01

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 ▶

P46650A

1/1/1/1/1/

P 4 6 6 5 0 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 of the following is equivalent to the joule in terms of SI base units?

☒ **A** kg m^2 s^{-3}

☒ **B** kg m^2 s^{-2}

☒ **C** kg m s^{-2}

☒ **D** kg m s^{-1}

(Total for Question 1 = 1 mark)

2 A wind turbine generates 550 W of electrical power for an average of 7 hours each day.

What is the total energy, in MJ, generated each day?

☒ **A** 0.23

☒ **B** 14

☒ **C** 230

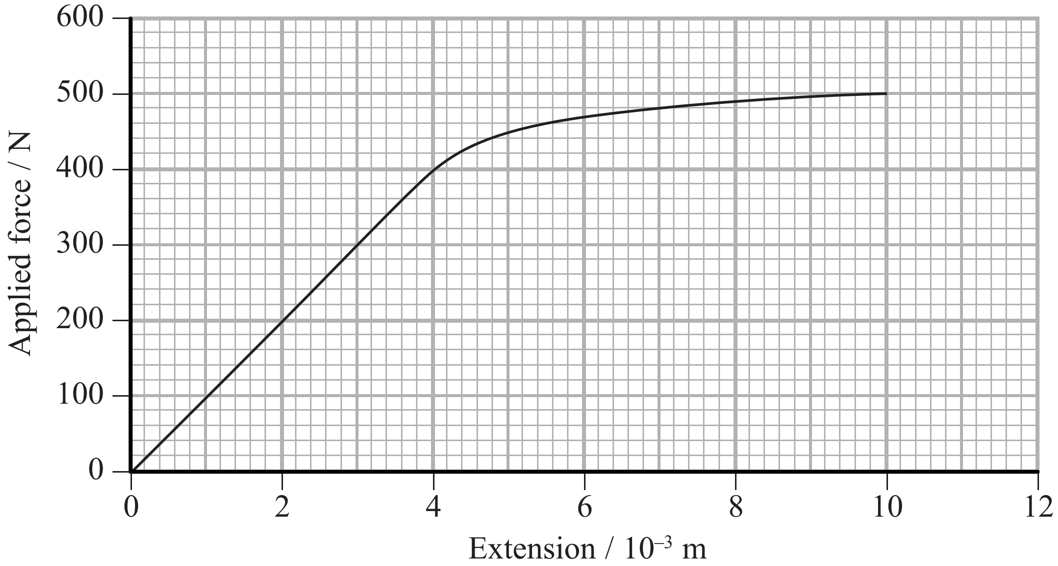
☒ **D** 14000

(Total for Question 2 = 1 mark)

Questions 3 and 4 refer to the information below.

A student applied a range of forces to the ends of a copper wire and measured the corresponding new length of the wire.

The force-extension graph for the wire is shown.



3 What is the maximum force that could be applied and then removed such that the wire would go back to its original length?

☒ **A** 200 N

☒ **B** 300 N

☒ **C** 400 N

☒ **D** 500 N

(Total for Question 3 = 1 mark)

4 What is the elastic strain energy stored in the wire when it is extended by 4 mm?

☒ **A** 0.8 J

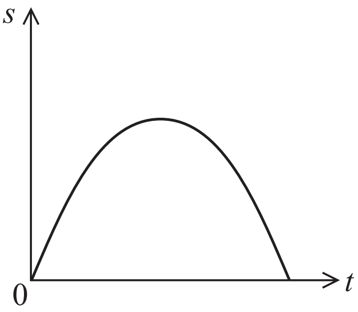
☒ **B** 1.6 J

☒ **C** 800 J

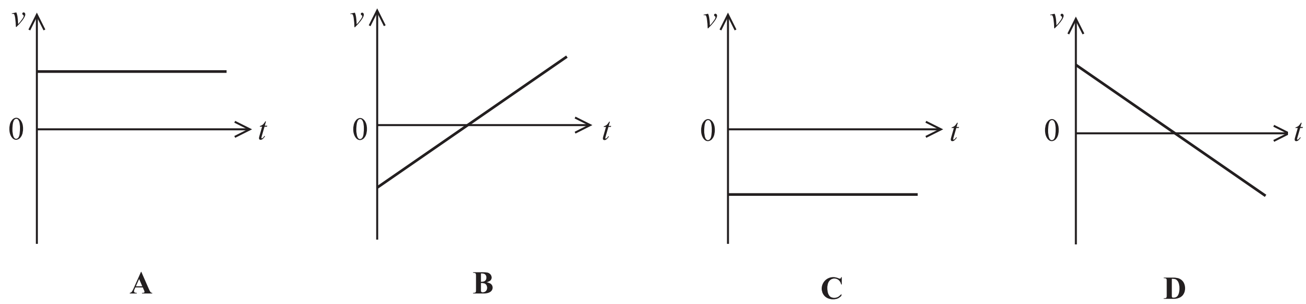
☒ **D** 1600 J

(Total for Question 4 = 1 mark)

5 The displacement-time graph for an object is shown.



Which of the following is the corresponding velocity-time graph?



☒ **A**

☒ **B**

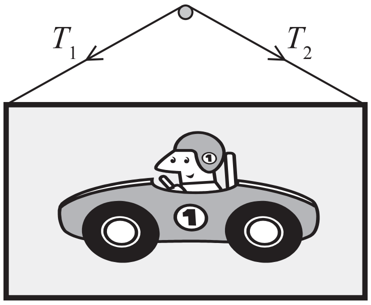
☒ **C**

☒ **D**

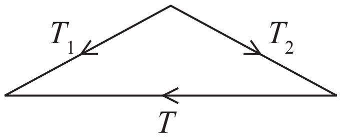
(Total for Question 5 = 1 mark)

P 4 6 6 5 0 A 0 4 2 8

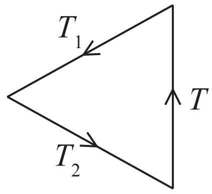
6 A picture is hung using a wire placed over a small hook as shown.



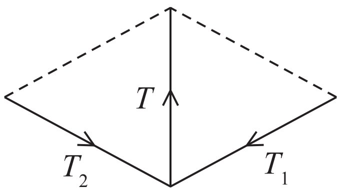
T_1 and T_2 are the tension forces acting on the hook.
Which of the following correctly shows the vector diagram for the resultant force T of the two tensions?



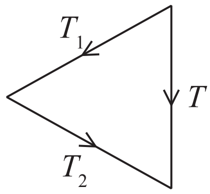
A



B



C



D

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 6 = 1 mark)

7 A ball of mass m falls through a height h to the ground.

What is the kinetic energy of the ball halfway to the ground?

☒ **A** mgh

☒ **B** $\frac{mgh}{2}$

☒ **C** $\sqrt{mgh}$

☒ **D** $\sqrt{\frac{mgh}{2}}$

(Total for Question 7 = 1 mark)

8 A car travels at a speed of 20 m s^{-1} due east and then turns around and travels at a speed of 40 m s^{-1} due west.

Taking the direction of due east as positive, select the correct row from the table.

	Change in speed / m s^{-1}	Change in velocity / m s^{-1}
☒ **A**	20	−60
☒ **B**	20	60
☒ **C**	60	−60
☒ **D**	60	60

(Total for Question 8 = 1 mark)

9 A football is kicked across a football pitch with an initial vertical component of velocity u. The ball lands back on the pitch after a time of flight t.

Which of the following equations can be used to determine t?

- ☒ **A** $\frac{u}{2g}$
- ☒ **B** $\frac{u}{g}$
- ☒ **C** $\frac{g}{u}$
- ☒ **D** $\frac{2u}{g}$

(Total for Question 9 = 1 mark)

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10 A ball was placed on top of a compressed spring. When the spring was released the ball was accelerated vertically upwards.

If this were to be repeated on the Moon, the acceleration of the ball would be

- ☒ **A** less as the weight of the ball is greater.
- ☒ **B** less as the weight of the ball is less.
- ☒ **C** greater as the weight of the ball is greater.
- ☒ **D** greater as the weight of the ball is less.

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 A crane supports a load of 950 N with a steel cable. If the breaking stress of steel is 500 MPa, calculate the smallest diameter cable that can be used.

(3)

Smallest diameter of cable = ...

(Total for Question 11 = 3 marks)

12 A student was asked to define the yield point of a material. The student said ‘the stress at which there is a large extension.’

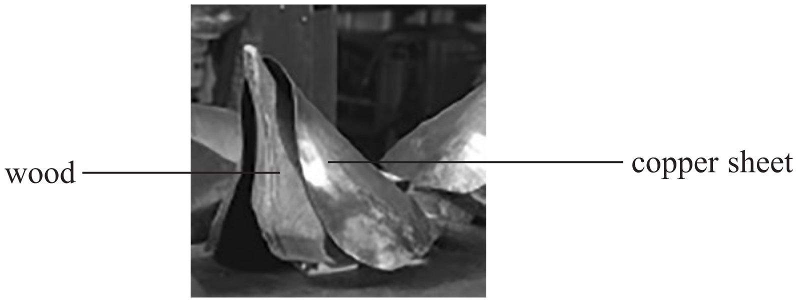
Explain why the student’s definition is incorrect.

(2)

(Total for Question 12 = 2 marks)

13 The Olympic flame for the 2012 Games held in London consisted of 204 separate copper petals supported by steel stems.

Each petal was made using a thin copper sheet wrapped around a shaped piece of wood.



(a) Explain why copper was a suitable material from which to make the petals.

(2)

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(b) Explain why steel was a suitable material from which to make the stems.

(2)

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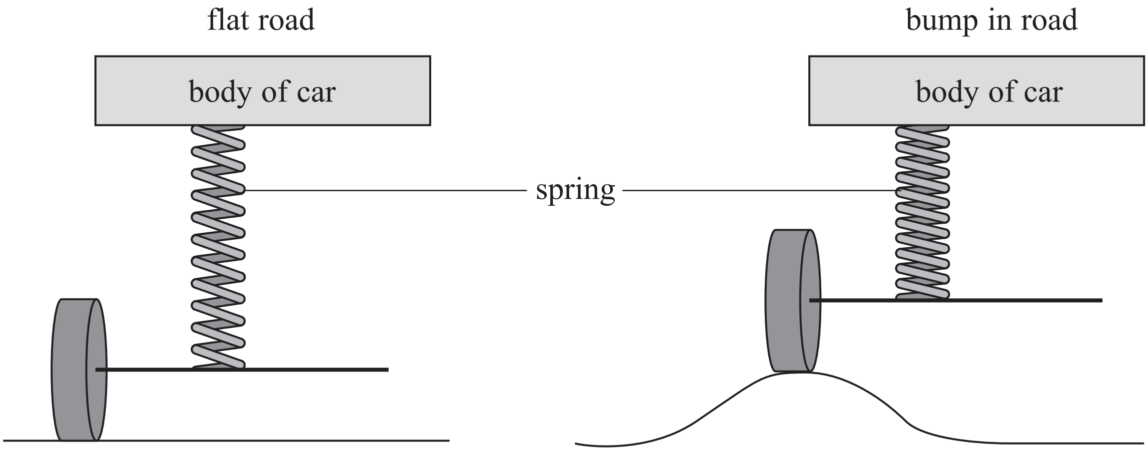
(Total for Question 13 = 4 marks)

14 Cars have a suspension system which includes springs that are compressed by the weight of the car. This is necessary to keep the body of the car at approximately the same level, when the surface of a road is uneven.

The diagrams show a simplified suspension system for one wheel when on a flat road and when on a bump in the road.



(a) The surface of a racing track is much smoother than the surface of a road. Racing cars are therefore able to use springs with a greater stiffness constant *k*.

(i) Suggest what the effect would be of using springs with a greater value *k* when driving on a bumpy road.

(2)

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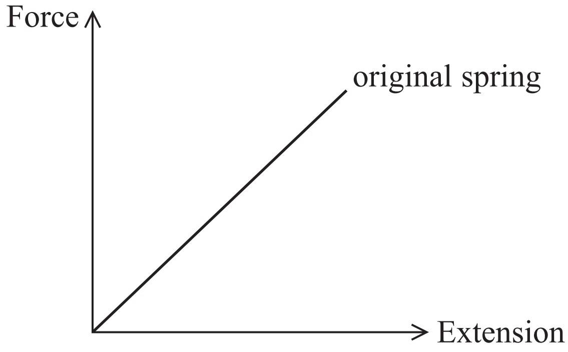
(ii) Add an appropriate line to the force-extension graph for the new spring with a higher value of *k*.

(1)



(b) A spring used in the front suspension of a car has an initial length of 0.316 m and a new length of 0.205 m when under a load of 4.07 kN.

Calculate the spring constant of the spring.

(3)

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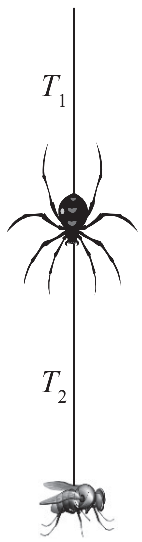
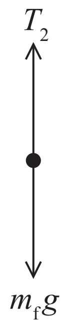
Spring constant = ...

(Total for Question 14 = 6 marks)

15 A spider of mass m_s is hanging from a thread of spider silk. A fly of mass m_f is hanging from another thread of silk below the stationary spider.

The magnitudes of the tensions in each thread of silk are T_1 and T_2 as shown in the diagram. The free-body force diagram for the fly is also shown.





Free-body force diagram for the fly

(a) (i) Complete the free-body force diagram below for the spider.

(3)

(ii) Write equations for the forces acting on the spider and for the forces acting on the fly.

(2)

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(b) The spider produces more silk, so the length of the thread of silk above the spider increases. The spider and the fly both accelerate towards the ground.

Assuming that the mass of the silk is negligible, calculate their acceleration.

$m_s = 6.5 \times 10^{-4}$ kg

$m_f = 8.0 \times 10^{-5}$ kg

$T_1 = 1.9 \times 10^{-3}$ N

(3)

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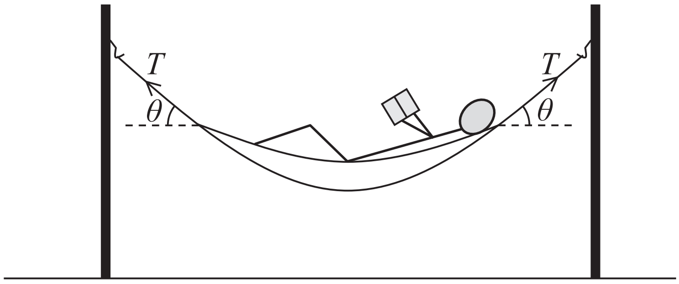
Acceleration = ...

(Total for Question 15 = 8 marks)

16 A hammock is suspended between two rigid poles. Both ropes supporting the hammock are at an angle of θ to the horizontal as shown.



(a) When a man of mass 80 kg lies in the hammock, θ is 40°.

Show that the tension T in each of the hammock's supporting ropes is about 650 N.

mass of hammock and ropes = 4 kg

(3)

*(b) The force of the supporting ropes could cause the poles to fall inwards.

By considering the vertical and horizontal components of the tension in one of the supporting ropes, explain why a larger value of θ creates a smaller force on the poles supporting the hammock.

(5)

(Total for Question 16 = 8 marks)

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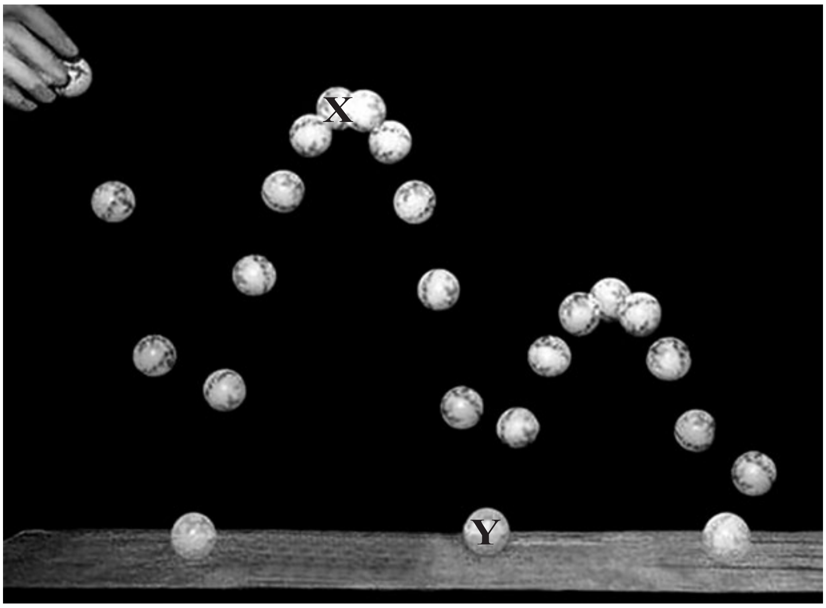
17 The photograph shows a sequence of images of a bouncing ball. 20 images were taken per second.



(a) (i) Show that the distance the ball fell between point X and point Y is about 0.4 m.

(3)

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(ii) Use measurements from the photograph to calculate the horizontal velocity of the ball.

(4)

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Horizontal velocity = ...

(b) The vertical position of the ball a short time before a bounce was always higher than the vertical position the same time after a bounce.

Explain the difference in height of the ball before and after each bounce.

(2)

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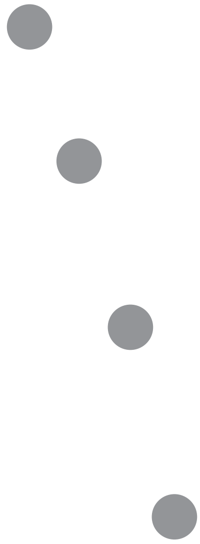
(c) The ball was released with a small horizontal velocity.

(i) The position of the ball in the first 4 images is shown below.

Draw in the first 4 positions of the ball had it been released with no horizontal velocity.

(2)



(ii) Explain why you have drawn the ball in these positions.

(2)

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(Total for Question 17 = 13 marks)

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18 The photograph shows a rower during a race. During each stroke the rower applies a force to the end of each oar. The other end of each oar exerts a force on the water.

*(a) At the start of the race the boat is stationary.

Using Newton's laws of motion, explain why the boat begins to move through the water as the rower applies a force.

(4)

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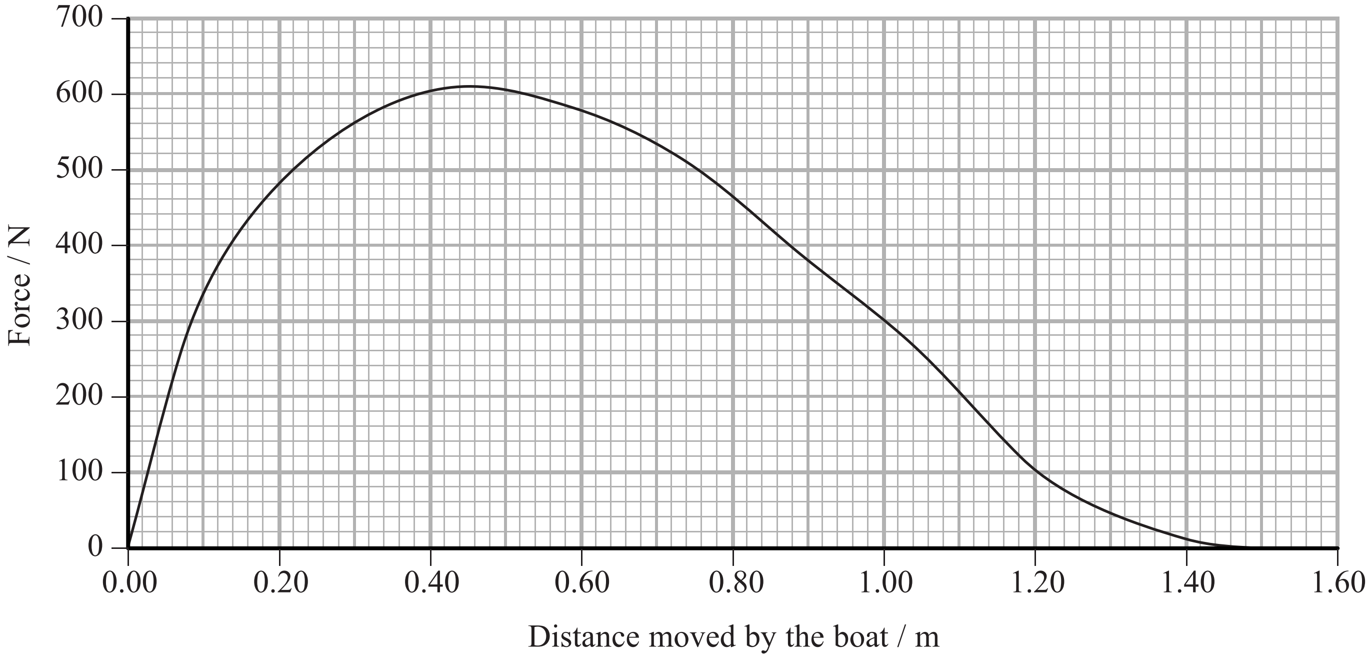
(b) The graph shows how the force applied to the boat varies with the distance moved by the boat during one complete stroke.



(i) Use the graph to show that the work done on the boat during one stroke is about 500 J.

(3)

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(ii) Hence calculate the average power developed.

average stroke rate = 24 strokes per minute

(3)

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Average power = ...

(c) The work done by the rower is greater than the kinetic energy gained by the rower and the boat.

Suggest **two** reasons why.

(2)

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(d) Suggest why the rower and the boat gain different amounts of kinetic energy during each stroke.

(1)

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(Total for Question 18 = 13 marks)

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19 Stokes' law can be used to calculate the resistive force F acting on an object as it moves through a fluid.

The equation for Stokes' law is

$$F = 6\pi\eta rv$$

(a) Stokes' law is only valid if the flow around the object is laminar.

(i) State what is meant by laminar flow.

(1)

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(ii) State the conditions required for the flow around the object to be laminar.

(2)

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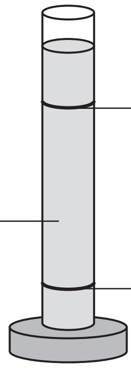
(b) A student carried out an experiment to determine the viscosity of glycerol using the apparatus shown.



A ball bearing was released at the top of a measuring cylinder containing glycerol.
A stopwatch was used to measure the time taken to fall between the markers.
This was repeated for ball bearings of different sizes.

The following equation was used to calculate the viscosity η.

$$\frac{4\pi r^3}{3}\rho_b g - \frac{4\pi r^3}{3}\rho_g g = 6\pi r \eta v$$

r = radius of ball bearing
ρ_b = density of ball bearing
ρ_g = density of glycerol
v = terminal velocity

(i) The density of the glycerol and the ball bearing are known.

State **two** other quantities the student would have to measure directly to calculate the viscosity.

(2)

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(ii) State the quantity that is represented by the term $\frac{4\pi r^3}{3}\rho_b g$.

(1)

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....

(iii) State the quantity that is represented by the term $\frac{4\pi r^3}{3}\rho_g g$.

(1)

....

....

(iv) Describe how the results obtained and a graphical method can be used to determine a value for the viscosity of the glycerol.

(4)

(c) Glycerol can be pumped into waste systems to remove nitrogen during the treatment of waste water.

Explain the effect that low temperatures could have on the supply of glycerol to a waste system.

(2)

(Total for Question 19 = 13 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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