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 15 May 2018 – 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 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

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 Physical quantities are either scalar or vector.

Select the row of the table which correctly identifies a scalar quantity and a vector quantity.

	Scalar	Vector
☒ **A**	power	work done
☒ **B**	velocity	power
☒ **C**	weight	velocity
☒ **D**	work done	weight

(Total for Question 1 = 1 mark)

2 The unit for the viscosity of a fluid may be expressed as Pa s.

Which of the following expresses Pa s in SI base units?

☒ **A** $\mathrm{kg\,m\,s^{-1}}$

☒ **B** $\mathrm{kg\,m\,s^{-2}}$

☒ **C** $\mathrm{kg\,m^{-1}\,s^{-1}}$

☒ **D** $\mathrm{kg\,m^{-1}\,s^{-2}}$

(Total for Question 2 = 1 mark)

3 A material undergoes significant plastic deformation under compression.

Which of the following describes this material?

☒ **A** brittle

☒ **B** ductile

☒ **C** malleable

☒ **D** tough

(Total for Question 3 = 1 mark)

4 The manufacturer of a car claims that the car can accelerate from rest to $30\,m\,s^{-1}$ in 7.5 s.

What is the average acceleration of the car over this time period?

☒ **A** $0.53\,m\,s^{-2}$

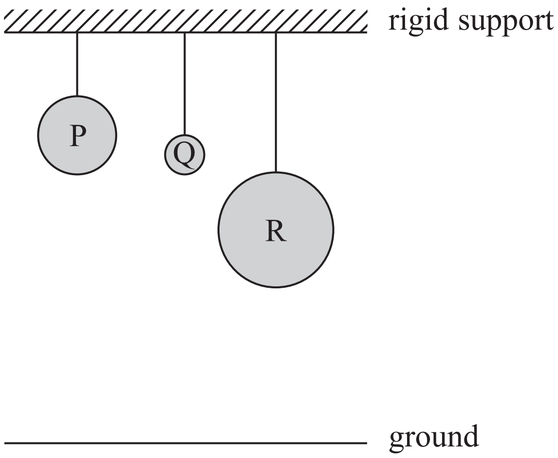
☒ **B** $2.0\,m\,s^{-2}$

☒ **C** $4.0\,m\,s^{-2}$

☒ **D** $8.0\,m\,s^{-2}$

(Total for Question 4 = 1 mark)

5 Three spheres P, Q and R of the same mass are lifted from the ground and suspended from a rigid support as shown.



The greatest change in gravitational potential energy is seen in sphere(s)

☒ **A** P.

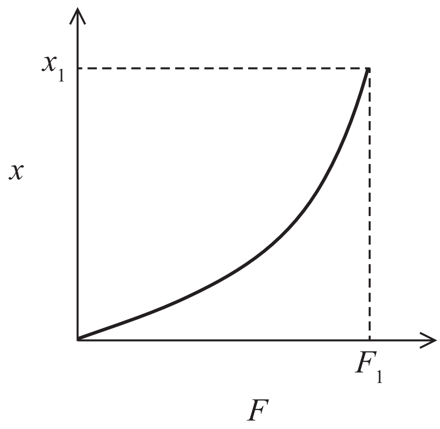
☒ **B** P and Q.

☒ **C** P and R.

☒ **D** R.

(Total for Question 5 = 1 mark)

6 The graph shows how the extension x of a spring varies with the applied force F.



Select the expression that best describes the work done W in extending the spring.

☒ **A** $W = F_1x_1$

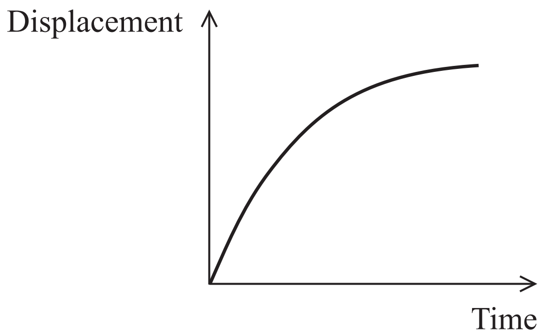
☒ **B** $W = \frac{1}{2}F_1x_1$

☒ **C** $W < \frac{1}{2}F_1x_1$

☒ **D** $W > \frac{1}{2}F_1x_1$

(Total for Question 6 = 1 mark)

7 A displacement-time graph for the motion of an object is shown.



Which of the following statements is correct?

☒ **A** There is a decreasing resultant force acting on the object in the direction of the motion.

☒ **B** There is an increasing resultant force acting on the object in the direction of the motion.

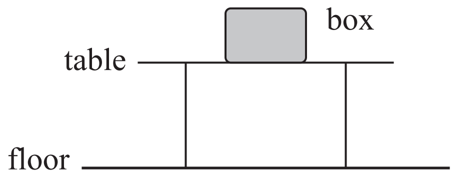
☒ **C** There is a resultant force acting on the object opposite to the direction of motion.

☒ **D** There is no resultant force acting on the object.

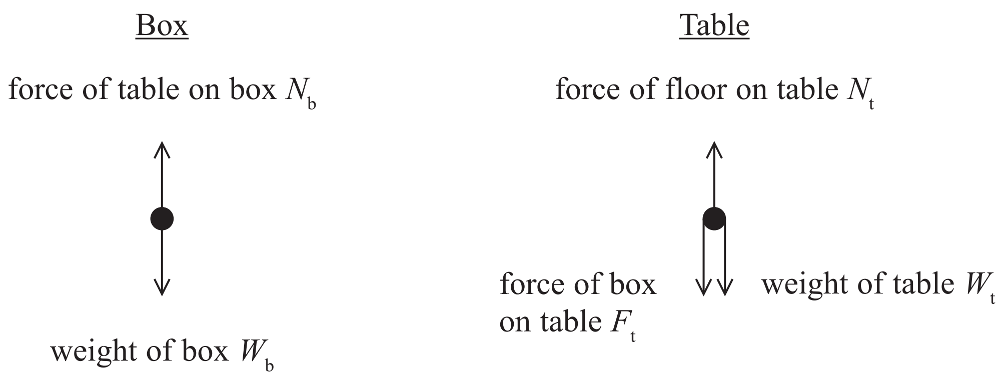
(Total for Question 7 = 1 mark)

Questions 8 and 9 refer to the information below.

A box is placed on a table. The box and table are both stationary.



The diagrams show the direction of the forces acting on the box and on the table.



8 Which pair of forces are equal in magnitude according to Newton's first law?

☒ **A** F_t and N_b

☒ **B** N_t and N_b

☒ **C** W_b and N_b

☒ **D** W_t and N_t

(Total for Question 8 = 1 mark)

9 Which pair of forces are equal in magnitude according to Newton's third law?

☒ **A** F_t and N_b

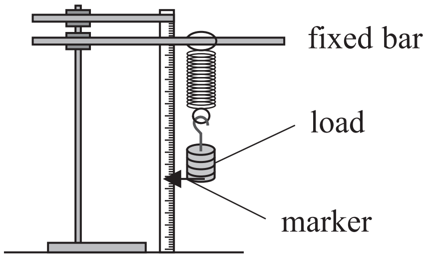
☒ **B** N_t and N_b

☒ **C** W_b and N_b

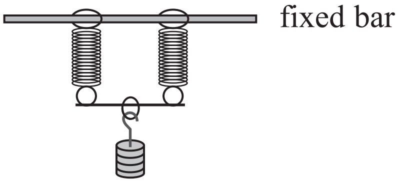
☒ **D** W_t and N_t

(Total for Question 9 = 1 mark)

10 A student investigated Hooke's law using the equipment shown. As each additional load was added, the new position of a marker along a metre rule was recorded and the extension calculated.



The investigation was repeated with an additional identical spring, arranged as shown.



For a given applied load, which of the following statements is correct?

☒ **A** The extension is doubled because the spring constant is doubled.

☒ **B** The extension is doubled because the spring constant is halved.

☒ **C** The extension is halved because the spring constant is doubled.

☒ **D** The extension is halved because the spring constant is halved.

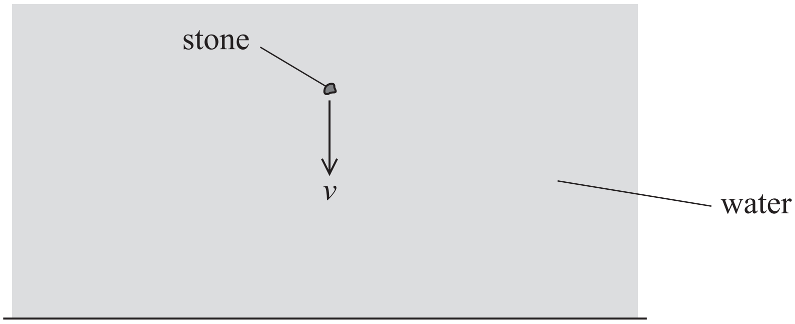
(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 A small stone is released at the surface of a lake. Immediately after it is released the resultant downward force on the stone is 1.0×10^{-5} N. The stone initially accelerates through the water and then reaches a steady downwards speed v as shown.



(a) Calculate v.

(2)

diameter of stone = 1.1×10^{-3} m
viscosity of water = 9.0×10^{-4} Pa s

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v = ...

(b) State **one** assumption made when calculating the answer to part (a).

(1)

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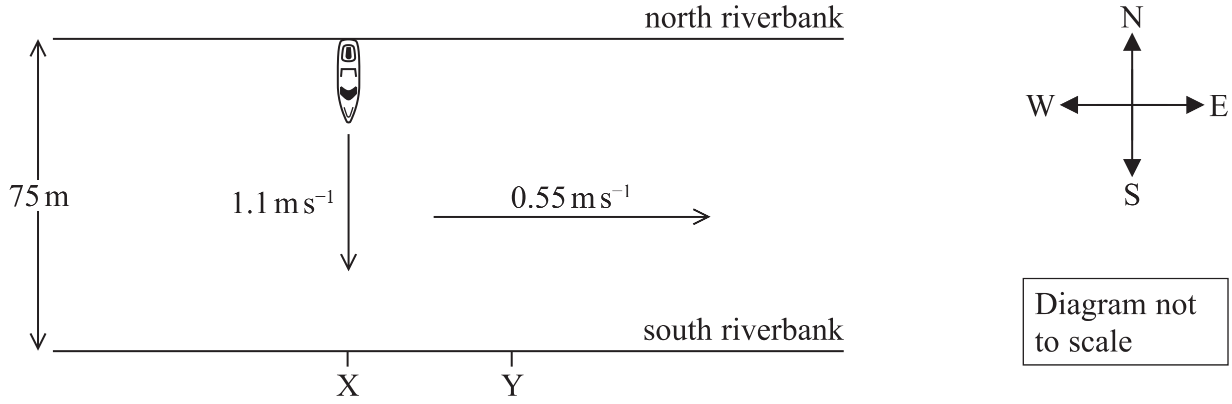
(Total for Question 11 = 3 marks)

12 A boat heads across a river towards X at a speed of $1.1\,\mathrm{m\,s^{-1}}$ as shown. The speed of the river from west to east is $0.55\,\mathrm{m\,s^{-1}}$.



The boat reaches the south riverbank at Y.

Determine the distance XY.

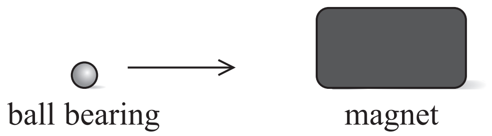
(3)

width of river = 75 m

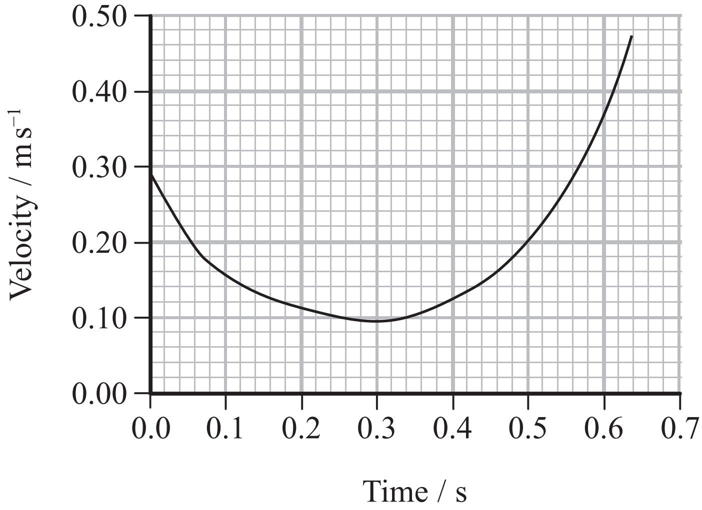
XY = ...

(Total for Question 12 = 3 marks)

13 A ball bearing moves across a horizontal bench towards a magnet as shown.



The velocity-time graph for the horizontal motion of the ball bearing up to the point of contact with the magnet is shown.



(a) Explain the shape of the graph.

(3)

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(b) Calculate the maximum acceleration of the ball bearing.

(3)

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Maximum acceleration = ...

(Total for Question 13 = 6 marks)

14 The toughness of a sample of a material can be measured using an Izod impact test.

(a) State what is meant by a tough material.

(1)

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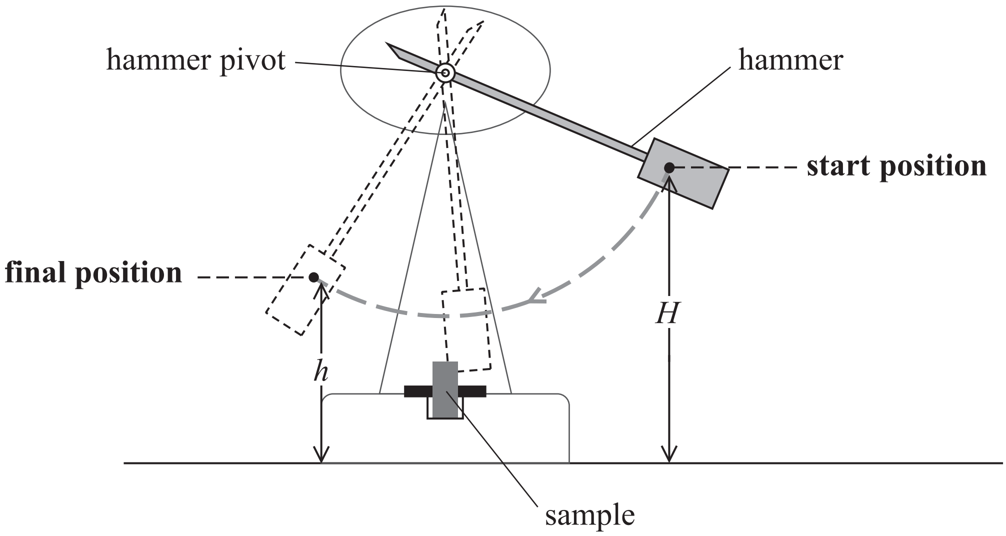
(b) The diagram shows an Izod impact tester. A sample of the material is placed in the tester as shown. A pivoted hammer of mass m is released from a height H and strikes the sample. The sample breaks. The height h to which the hammer rises after the impact is measured.



(i) Name the point on the hammer to which the heights H and h are measured.

(1)

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(ii) State an equation for the energy transferred to the sample.

(1)

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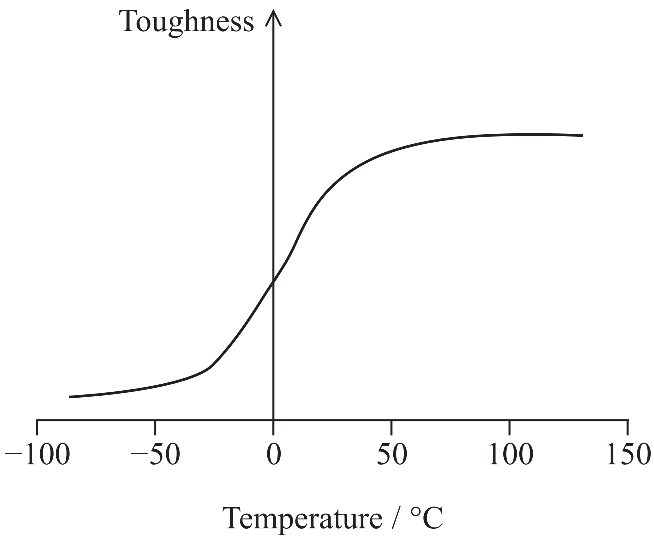
(c) The Izod impact test can be used to measure the toughness of steel at different temperatures. The toughness of a particular type of steel varies with temperature as shown in the graph.



The brittleness and malleability of the steel also vary with temperature.

With reference to brittleness and malleability, explain how the toughness of this type of steel varies with temperature.

(3)

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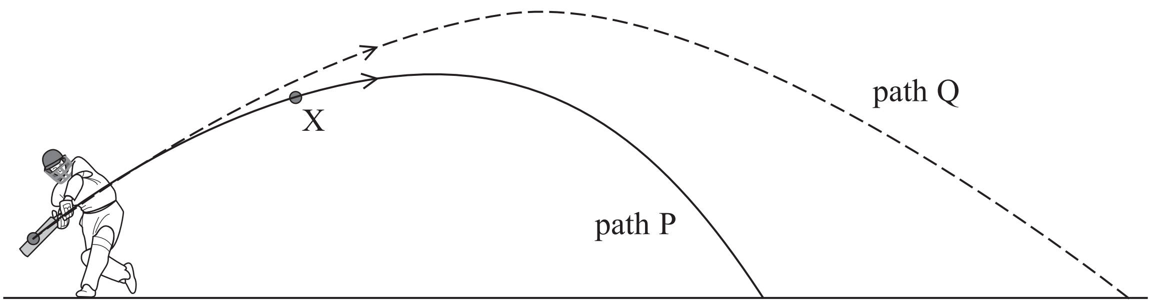
(Total for Question 14 = 6 marks)

15 In a game of cricket, a player hits the ball, which takes path P.

Air resistance acted on the ball as it travelled through the air. If there was no air resistance, the ball would have followed path Q.



(a) (i) Draw a free-body force diagram for the ball when at the position marked X on path P.

(2)

*(ii) Explain the differences between path P and path Q.

(4)

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(b) The ball was given an initial velocity of $35\,m\,s^{-1}$ at an angle of 25° to the horizontal. The horizontal distance from the player to the 'boundary' is 85 m. The player scores six 'runs' if the ball lands beyond the 'boundary' before it bounces.

Determine whether six 'runs' will be scored. Ignore the effects of air resistance.

(4)

(Total for Question 15 = 10 marks)

16 (a) A student states Newton's first law of motion as

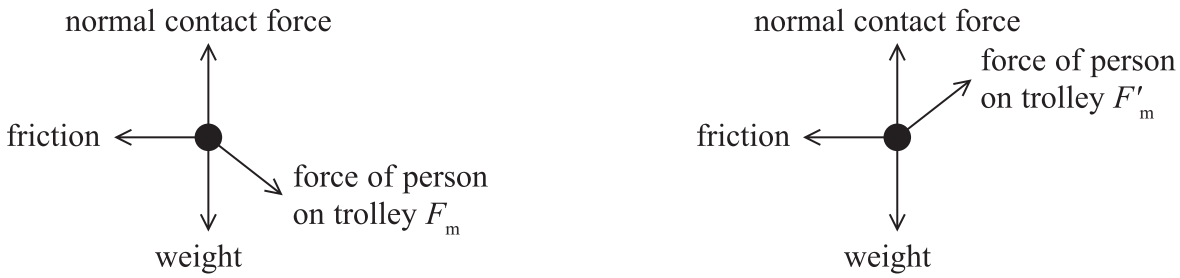
If there is no external force, there will be no motion.

Criticise this statement.

(3)

*(b) The diagrams show a person pushing a trolley and pulling a trolley.

The angle θ between the arms of the person and the horizontal is the same for both pushing and pulling. Corresponding diagrams showing the forces on the trolley for pushing and pulling are also shown.



It can be assumed that the frictional force between the trolley and the ground is proportional to the normal contact force of the ground on the trolley.

Explain why pulling the trolley a certain distance requires the person to do less work than pushing the trolley the same distance.

(5)

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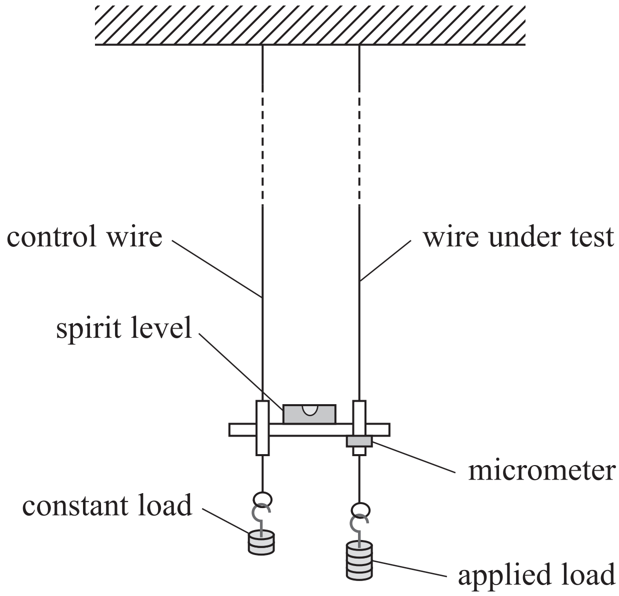
(Total for Question 16 = 8 marks)

17 A student determined the Young modulus of a material, in the form of a wire, using the equipment shown. A control wire, with a constant load, was used as a comparison for measuring the extension of the wire under test.



Every time a known weight was added to the applied load the micrometer was adjusted until the spirit level was horizontal. The movement of the applied load was the same as the movement of the micrometer.

(a) List any additional measurements that are required for the student to determine a value for the Young modulus of the material.

(2)

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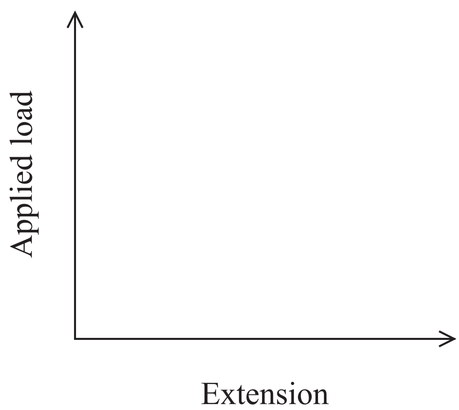
(b) The student plotted a graph of the applied load against the extension of the wire.

(i) Sketch the graph that you would expect the student to obtain.

(1)



(ii) Explain how the student can use the graph to determine the Young modulus of the material.

(2)

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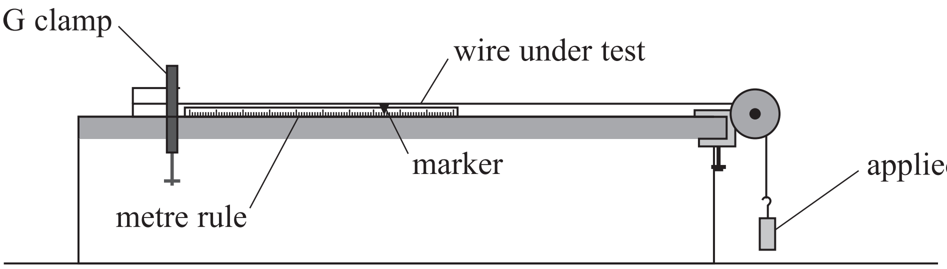
(c) A simpler method to determine the Young modulus of a material in the form of a wire is shown.

The position of a marker along a metre rule is recorded each time the applied load is increased.



Explain two advantages of using the first method, rather than the second method, to determine the Young modulus.

(4)

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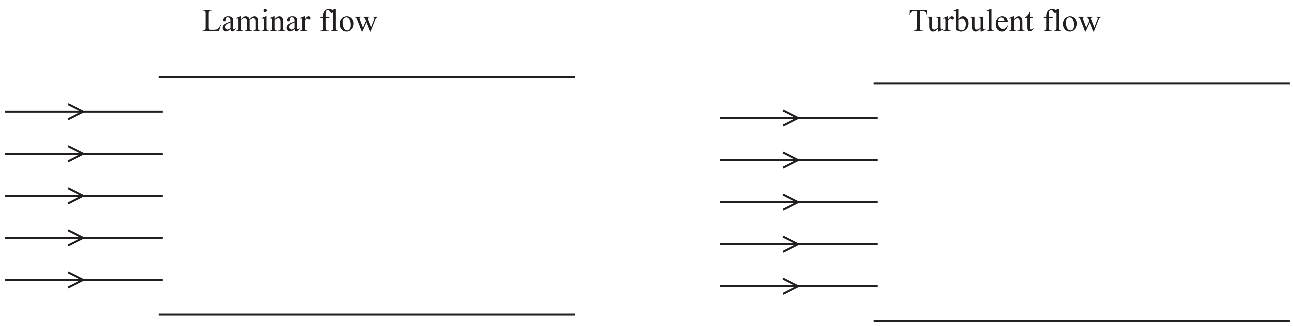
(Total for Question 17 = 9 marks)

18 The flow of the blood around the body is mostly laminar. The speed of the blood in the body is greatest on leaving the heart and at this point turbulent flow can occur.

(a) Add to the diagrams to show laminar flow and turbulent flow.

(2)



(b) A student wishes to estimate the power output P of the heart. He argues that the heart has to pump out blood at a speed v and raise it to a height h above the heart.
He proposes the following equation for P.

$$P = \frac{1}{2}\rho Q v^2 + \rho Q g h$$

where Q is the volume of blood passing a point per second and ρ is the density of the blood.

(i) Derive this equation for P using the principle of conservation of energy.

(4)

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(ii) Calculate the power output P of the heart when pumping blood to a height of 0.40 m above the heart. Assume that the speed of the blood has not changed since leaving the heart.

(3)

$\rho = 1100\,\text{kg}\,\text{m}^{-3}$
$Q = 95\,\text{cm}^3\,\text{s}^{-1}$
$v = 0.45\,\text{m}\,\text{s}^{-1}$

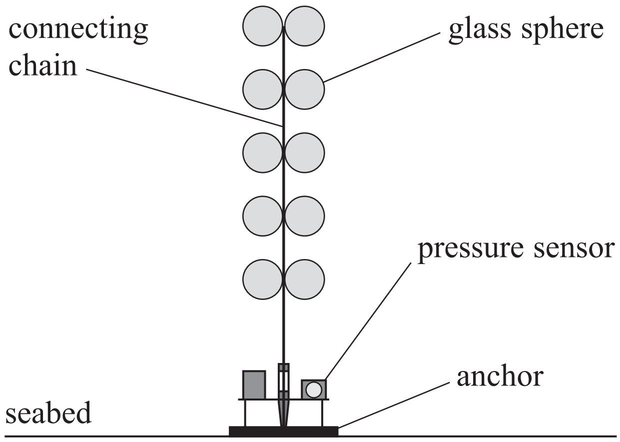
$P =$ ....

(iii) Suggest why, in practice, P will have to be greater than the value calculated in (b)(ii).

(2)

(Total for Question 18 = 11 marks)

19 An underwater system for detecting earthquakes is placed on the seabed. The system includes a pressure sensor and 10 glass spheres. The system is connected to a detachable anchor. Regular signals are sent, via satellite, to a central control station.



(a) The system and anchor are released just below the surface of the sea. They accelerate for a few seconds and then fall to the seabed at a constant velocity.

(i) Calculate the initial acceleration of the system and anchor.

(3)

total upthrust acting on the system and anchor = 2500 N
total mass of system and anchor = 470 kg

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Initial acceleration = ...

(ii) Explain why, after a few seconds, the system and anchor fall to the seabed at a constant velocity.

(2)

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(iii) Calculate the drag force acting on the system and anchor as they fall at a constant velocity.
(1)

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Drag force = ...

(b) The system is re-floated every two years so that the batteries can be replaced. To re-float the system, the anchor is detached from the system and the glass spheres cause the system to rise to the surface of the water, leaving the anchor behind.

The total upthrust on the system due to the 10 glass spheres is 2500 N. It can be assumed that the upthrust on the rest of the system is negligible.

Calculate the diameter of one glass sphere.
(5)

density of sea water = $1030\,\text{kg}\,\text{m}^{-3}$

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Diameter of one glass sphere = ...

(c) When selecting the material for the connecting chain, all the forces that act on the chain are considered.

(i) Explain why the connecting chain should be made of a high strength material.

(2)

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(ii) Suggest what causes an additional force on the connecting chain when the system is on the seabed.

(1)

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(Total for Question 19 = 14 marks)

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

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List of data, formulae and relationships

Acceleration of free fall	$g = 9.81\ \mathrm{m\ s^{-2}}$	(close to Earth's surface)
Electron charge	$e = -1.60 \times 10^{-19}\ \mathrm{C}$	
Electron mass	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$	
Electronvolt	$1\ \mathrm{eV} = 1.60 \times 10^{-19}\ \mathrm{J}$	
Gravitational field strength	$g = 9.81\ \mathrm{N\ kg^{-1}}$	(close to Earth's surface)
Planck constant	$h = 6.63 \times 10^{-34}\ \mathrm{J\ s}$	
Speed of light in a vacuum	$c = 3.00 \times 10^{8}\ \mathrm{m\ s^{-1}}$	

Unit 1

Mechanics

Kinematic equations of motion

$$v = u + at$$
$$s = ut + \tfrac{1}{2}at^2$$
$$v^2 = u^2 + 2as$$

Forces

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

Work and energy

$$\Delta W = F\Delta s$$
$$E_k = \tfrac{1}{2}mv^2$$
$$\Delta E_{grav} = mg\Delta h$$

Materials

Stokes' law $F = 6\pi\eta rv$

Hooke's law $F = k\Delta x$

Density $\rho = m/V$

Pressure $p = F/A$

Young modulus $E = \sigma/\varepsilon$ where
Stress $\sigma = F/A$
Strain $\varepsilon = \Delta x/x$

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

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