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 11 January 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 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.
- 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 The unit for power is the watt.

Which of the following is equivalent to the watt?

☒ **A** kg m s^{-2}

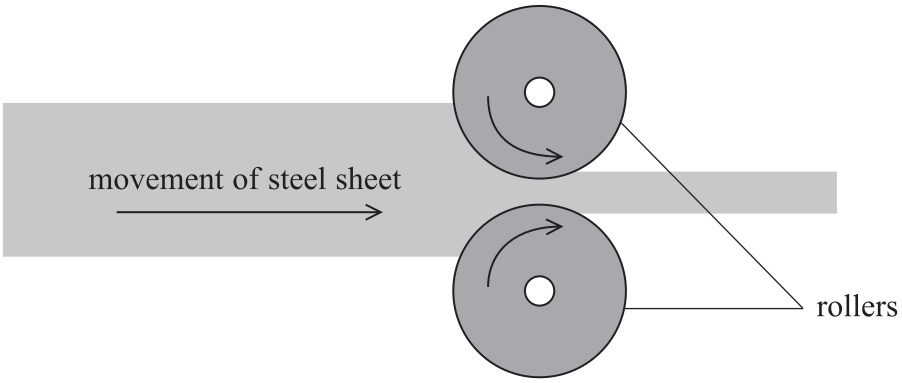
☒ **B** kg m^2 s^{-2}

☒ **C** kg m s^{-3}

☒ **D** kg m^2 s^{-3}

(Total for Question 1 = 1 mark)

2 The thickness of a steel sheet is reduced by passing it between two rollers.



The thickness reduces because steel is

☒ **A** ductile.

☒ **B** hard.

☒ **C** malleable.

☒ **D** stiff.

(Total for Question 2 = 1 mark)

3 Measured quantities can be either vectors or scalars.

Select the row from the table that is **not** correct.

	Measurement	Vector or scalar
☒ **A**	21 °C	scalar
☒ **B**	120 s	scalar
☒ **C**	$-6.5\,\mathrm{m\,s^{-2}}$	vector
☒ **D**	15 J	vector

(Total for Question 3 = 1 mark)

4 A projectile is launched at an angle θ to the horizontal and takes a time t to reach its maximum height.

Which of the following equations could be used to determine the initial velocity u of the projectile?

☒ **A** $u = \dfrac{gt}{\cos\theta}$

☒ **B** $u = \dfrac{-gt}{\cos\theta}$

☒ **C** $u = \dfrac{gt}{\sin\theta}$

☒ **D** $u = \dfrac{-gt}{\sin\theta}$

(Total for Question 4 = 1 mark)

5 The flow of a fluid through a pipe is laminar.

Which of the following statements correctly describes the velocity of the fluid?

☒ **A** At a particular position the velocity is constant.

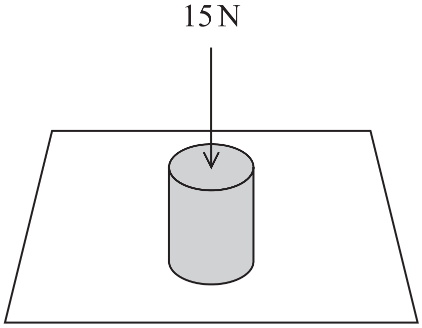
☒ **B** At a particular position the velocity is continually changing.

☒ **C** The velocity is a maximum at the edges of the pipe.

☒ **D** The velocity is always the same in adjacent layers.

(Total for Question 5 = 1 mark)

6 A solid cylinder of diameter 0.025 m is placed on a table. A force is applied to the cylinder, as shown.



The stress in the cylinder, in pascals, can be calculated using

☒ **A** $\dfrac{15}{\pi(0.025)^2}$

☒ **B** $\dfrac{15 \times 2}{\pi(0.025)^2}$

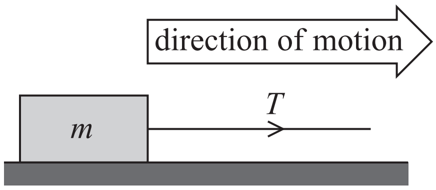
☒ **C** $\dfrac{15 \times 4}{\pi(0.025)^2}$

☒ **D** $\dfrac{15}{2\pi(0.025)^2}$

(Total for Question 6 = 1 mark)

---

7 A box of mass *m* is pulled along the floor by a horizontal rope. The tension in the rope is *T*. The box moves from rest with an average acceleration *a*.



Which of the following is the correct expression for the frictional force *F* acting on the box?

☒ **A** $F = T + ma$

☒ **B** $F = T - ma$

☒ **C** $F = T + ma + mg$

☒ **D** $F = T - ma - mg$

(Total for Question 7 = 1 mark)

Questions 8 and 9 refer to the information below.

A student carried out an experiment to determine the Young modulus of a material in the form of a wire. The original length and diameter of the wire were measured. A load was applied to the wire and the corresponding extended length was measured.

8 Which of the following combinations of original length and diameter would produce the greatest extension for a given load?

	Original length	Diameter
☒ **A**	long	large
☒ **B**	long	small
☒ **C**	short	large
☒ **D**	short	small

(Total for Question 8 = 1 mark)

9 The diameter of the wire was measured using a micrometer and found to be 0.35 mm. The micrometer reads to the nearest 0.01 mm.

Which of the following is the most appropriate percentage uncertainty to use with this measurement?

☒ **A** 2.9%

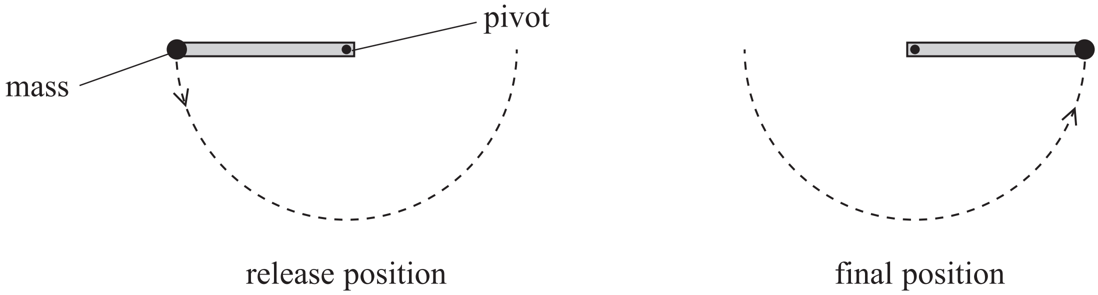
☒ **B** 5.8%

☒ **C** 3%

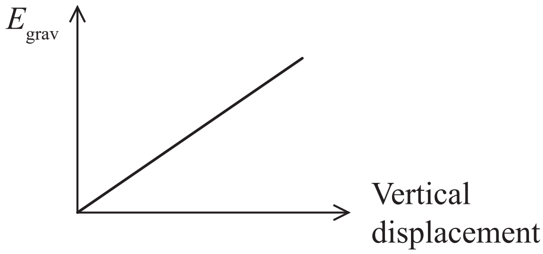
☒ **D** 6%

(Total for Question 9 = 1 mark)

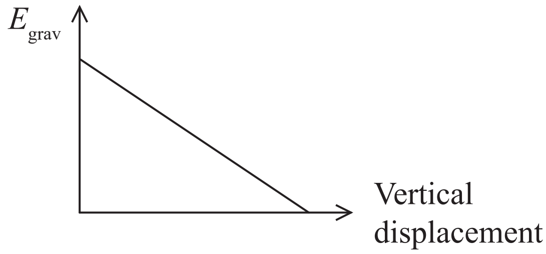
10 A mass is fixed to one end of a metre rule, which is pivoted at the other end. The mass and metre rule are held horizontally and released, as shown in the first diagram. The mass moves to its final position, as shown in the second diagram.



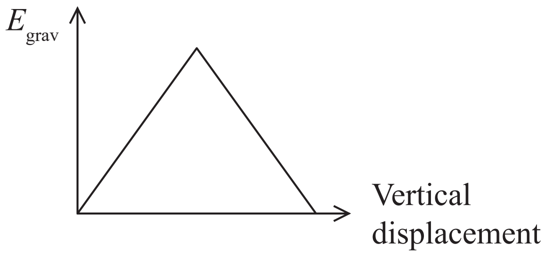
Which of the following is the graph of gravitational potential energy E_{grav} of the mass against vertical displacement for the motion of the mass?



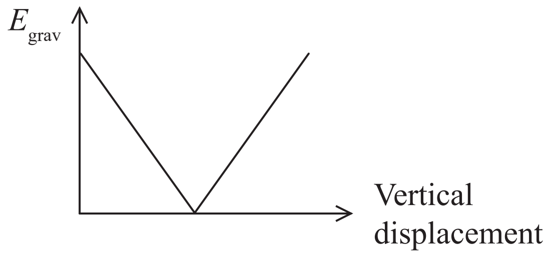
A



B



C



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 The 'lead' in a pencil consists of a graphite and clay mixture. The greater the quantity of clay in the mixture, the greater the hardness of the pencil.

(a) State what is meant by the term hardness.

(1)

....

....

(b) Some paint manufacturers use pencils to test the hardness of paints using the equipment shown.

A pencil of known hardness is placed into a pencil tester and the tester is pushed across a surface coated in the paint under test.

This is repeated using pencils of increasing hardness until the paint becomes scratched.

(i) State what can be deduced about the hardness of the pencil when the paint becomes scratched.

(1)

....

....

(ii) Suggest **two** reasons why this method may not produce reliable results.

(2)

....

....

....

....

(Total for Question 11 = 4 marks)

BLANK PAGE

12 Treadmills may be used in a gym. To increase the difficulty of the training, the gradient of the treadmill can be increased.

(a) A person on a treadmill warms up by running at a constant speed of $2.5\,\mathrm{m\,s^{-1}}$ with the treadmill horizontal. He then sets the treadmill to an angle of 3.0° to the horizontal and continues to run at the same speed.

Calculate the additional power that his legs would have to supply when running for 10 minutes with the treadmill at this angle.

(4)

mass of athlete = 80.0 kg

Additional power = ...

(b) Suggest why running on a treadmill is easier than running on a running track.

(1)

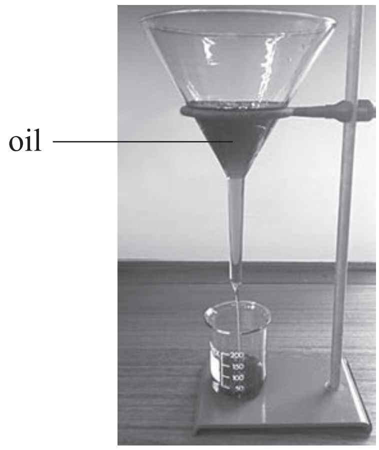
(Total for Question 12 = 5 marks)

DO NOT WRITE IN THIS AREA

13 A student was investigating the viscosity of an oil.

(a) She carried out a simple experiment to measure the rate of flow of the oil.

She poured the oil into a funnel and allowed it to drain into a beaker. The time *t* for the volume in the beaker to reach 150 cm^3 was measured using a digital stopwatch.



State how the student can determine the rate of flow of the oil in $m^3 s^{-1}$.

(2)

....

....

....

(b) The method in (a) gave only a single value for the rate of flow. The student wanted to improve her experiment by using a graphical method to determine the rate of flow. She used the same set-up, but placed the beaker on a balance and recorded the mass of the beaker and the oil every 2 seconds.

(i) State how the measurements could be used to plot a graph and obtain a value for the rate of flow of the oil in $m^3 s^{-1}$. Assume that the rate of flow of oil is constant.

(3)

....

....

....

....

....

....

....

(ii) State one advantage and one disadvantage of using the graphical method to determine the rate of flow of the oil compared to the method in (a).

(2)

Advantage ....

....

....

Disadvantage ....

....

....

(c) The student repeated the experiment in (b) using samples of the oil with different temperatures.

Explain how the rate of flow of the oil will vary with temperature.

(2)

....

....

....

....

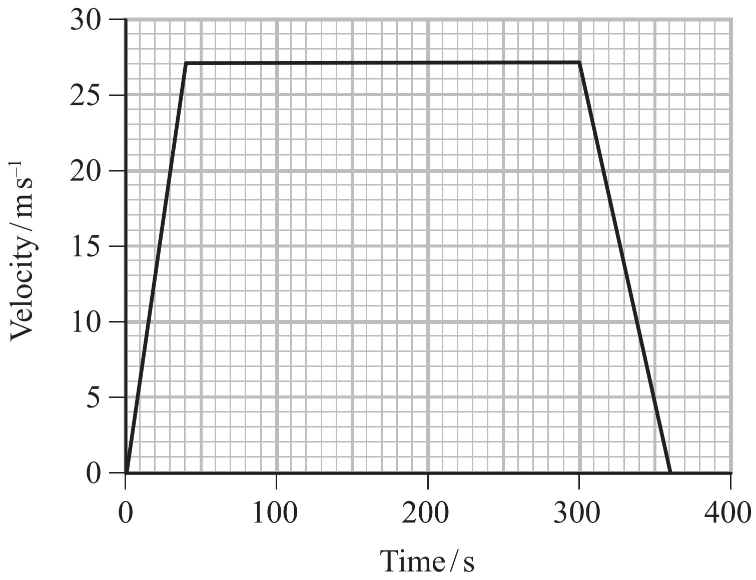
....

(Total for Question 13 = 9 marks)

BLANK PAGE

14 A train moves between two stations.

(a) A simplified velocity-time graph for the motion of the train is shown.



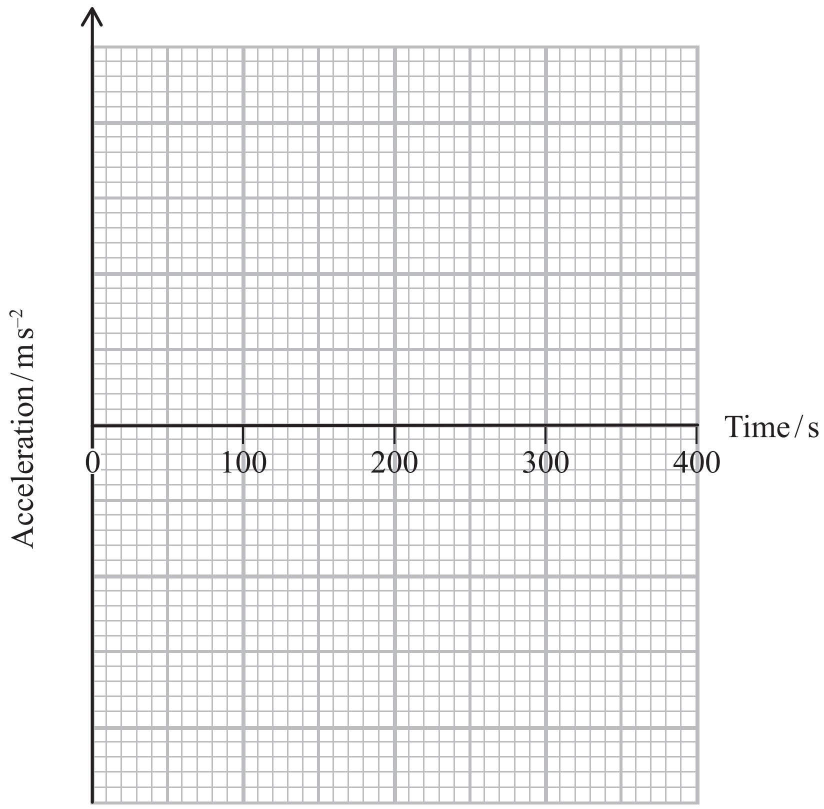
Draw a corresponding acceleration-time graph for the motion of the train. Show all working in the space below.

(6)

....

....

....



(b) While the train is moving at a constant speed, a passenger throws a ball horizontally out of a window, as shown in Figure 1.

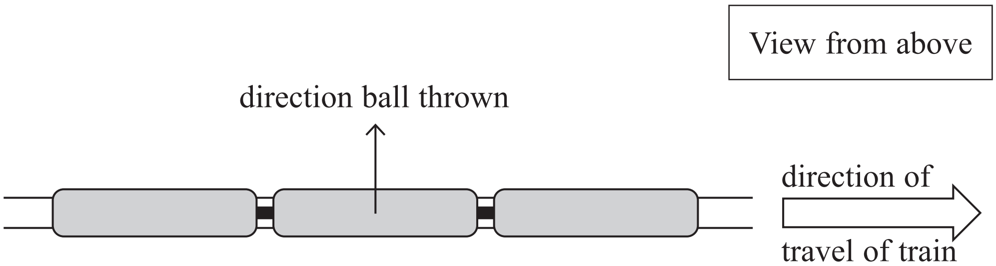


Figure 1

(i) The path of the ball when viewed from above is shown in Figure 2. Any effects of the air have been ignored.

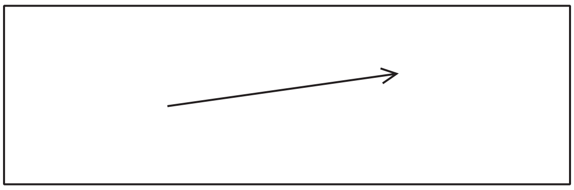


Figure 2

Explain the shape of this path.

(2)

....

....

....

....

....

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(ii) The path of the ball when viewed from the side is shown in Figure 3. The effect of air resistance has been ignored.

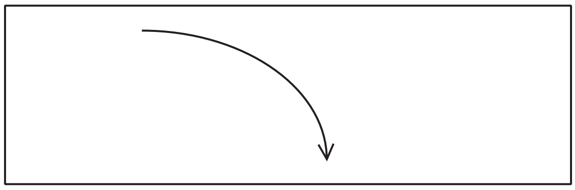


Figure 3

Explain the shape of this path.

(2)

....

....

....

....

....

(iii) Figures 2 and 3 are shown again below. Add to these figures the path of the ball if the effect of air resistance is not ignored.

(2)

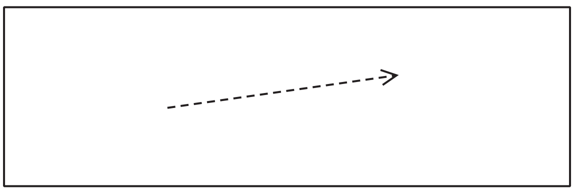


Figure 2

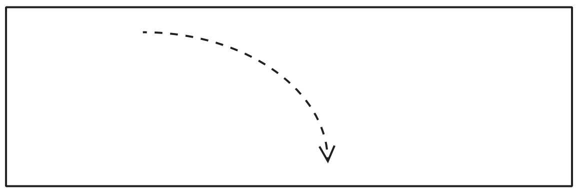
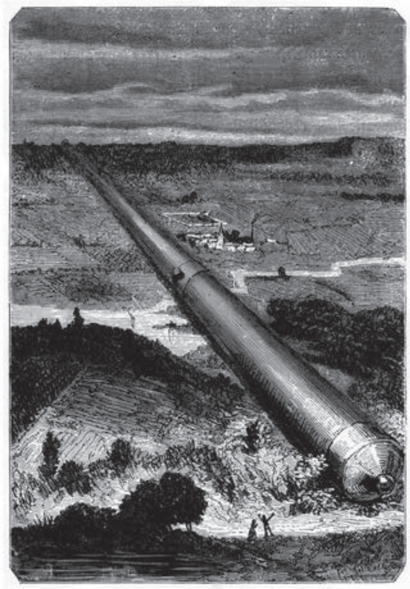


Figure 3

(Total for Question 14 = 12 marks)

15 In 1865, in his book 'From the Earth to the Moon', the writer Jules Verne wrote about sending men to the Moon. In order to escape the Earth's gravitational field, Verne proposed firing a capsule from a cannon of length 220 m, as shown in this illustration from the book.



(a) The velocity of the capsule at the end of the cannon was estimated to be 11 km s^{-1}.

(i) Calculate the acceleration of the capsule through the cannon.

(3)

....

....

....

....

....

Acceleration = ...

(ii) It can be assumed that only 50% of the energy supplied by the gunpowder in the cannon would have been transferred to the capsule.

Determine the mass of gunpowder that would have been required to obtain a maximum speed of $11\,\mathrm{km\,s^{-1}}$.

(4)

mass of capsule = $1500\,\mathrm{kg}$
energy released from gunpowder = $3\,\mathrm{MJ\,kg^{-1}}$

Mass of gunpowder = ...

*(b) In order to land safely on the surface of the Moon, Verne suggested that gases could be ejected from the capsule to reduce its speed.

Explain how ejecting gases from the capsule could reduce its speed. Your answer should include reference to Newton's laws of motion.

(5)

(Total for Question 15 = 12 marks)

16 A student suspended a spring from a retort stand and hung a mass from the free end of the spring.

(a) Show that the extension of the spring was about 0.05 m.

(2)

weight of mass on spring = 0.88 N
spring constant of spring = 18 N m^{-1}

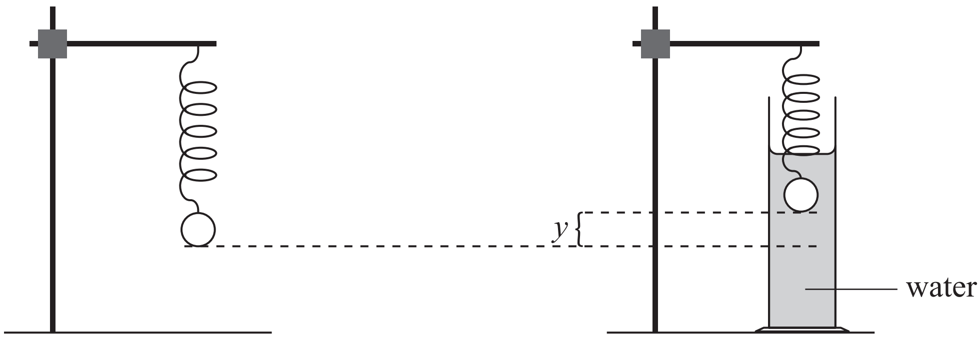
....

....

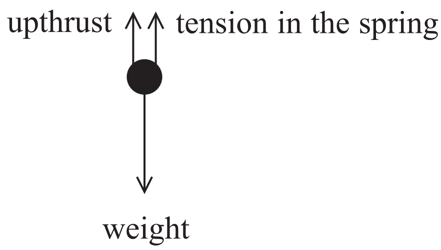
....

....

(b) The mass on the spring was placed in a measuring cylinder of water and the mass moved upwards a distance y, as shown, then remained stationary.



The free-body force diagram for the mass in water is shown.



(i) Explain why the stationary position of the mass was higher in water than in air.

(3)

....

....

....

....

....

....

(ii) Determine y. You may assume that the extension of the spring when the mass was in air was 0.050 m.

(4)

density of water = $1.0 \times 10^3\,\mathrm{kg\,m^{-3}}$
spring constant of spring = $18\,\mathrm{N\,m^{-1}}$
volume of mass = $3.4 \times 10^{-5}\,\mathrm{m^3}$
weight of mass on spring = 0.88 N

y = ...

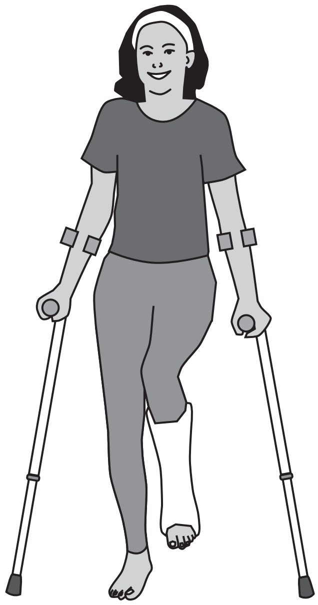
*(c) The student replaced the water in the measuring cylinder with oil. The value of y decreased.

Explain why y decreased.

(3)

(Total for Question 16 = 12 marks)

17 After breaking a leg, a girl was given crutches.



(a) The free-body force diagram for the girl when standing with the crutches is shown.

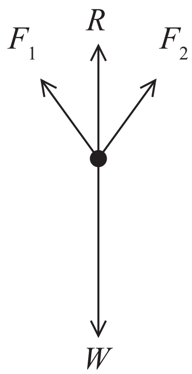


Diagram not to scale

Half of the girl's weight W is supported by the reaction force R of the ground on her leg. Half of her weight is supported by F_1 and F_2, the forces of the crutches on her body. F_1 and F_2 are at the same angle to the vertical.

(i) Show that the magnitudes of F_1 and F_2 are equal.

(2)

....

....

....

....

....

(ii) Calculate the magnitude of F_1.

(3)

$W = 650\,\text{N}$
angle of F_1 to the vertical = 10°

....

....

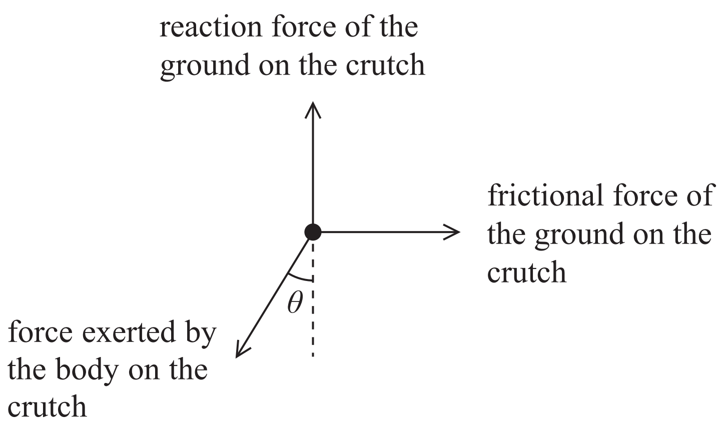
....

....

....

Magnitude of F_1 = ...

(b) The diagram below shows the forces acting on one of the crutches. The crutch is at an angle θ to the vertical. The weight of the crutch has been ignored.



There is a maximum frictional force that the ground can exert on the crutch.

Explain what will happen if the girl moves the base of the crutch too far from her foot.

(3)

....

....

....

....

....

....

....

(c) The crutch is made from an aluminium alloy. The table shows properties of the alloy at room temperature.

strain at fracture	17%
ultimate tensile stress	310 MPa
stress at the yield point	280 MPa
Young modulus	65 GPa

(i) Explain what is meant by strain at fracture of 17%.

(2)

....

....

....

....

(ii) Show that the strain at the yield point is about 0.4%. You may assume that stress is directly proportional to strain up to the yield point.

(2)

....

....

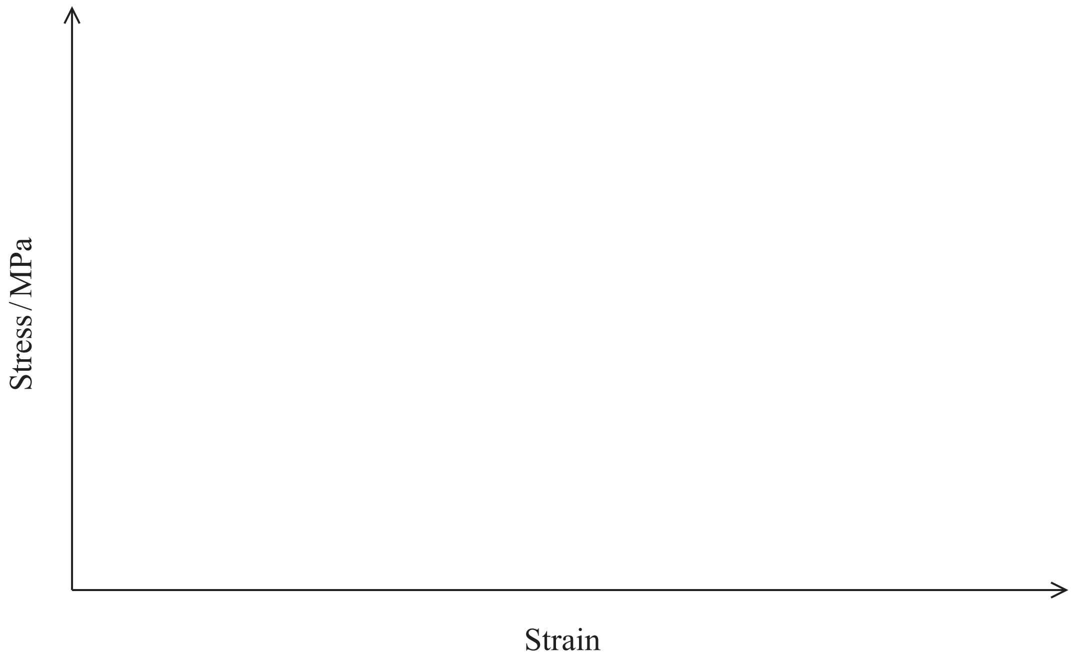
....

....

P 5 1 6 2 9 A 0 2 2 2 4

(iii) Use data from the table to sketch the stress-strain graph for the aluminium alloy. Scales are not required, but you should mark significant values on the axes.

(4)



(Total for Question 17 = 16 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 $E_{el} = \tfrac{1}{2}F\Delta x$