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 January 2017 – 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 ▶

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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 expresses the joule in base units?

☐ **A** $kg\,m\,s^{-1}$

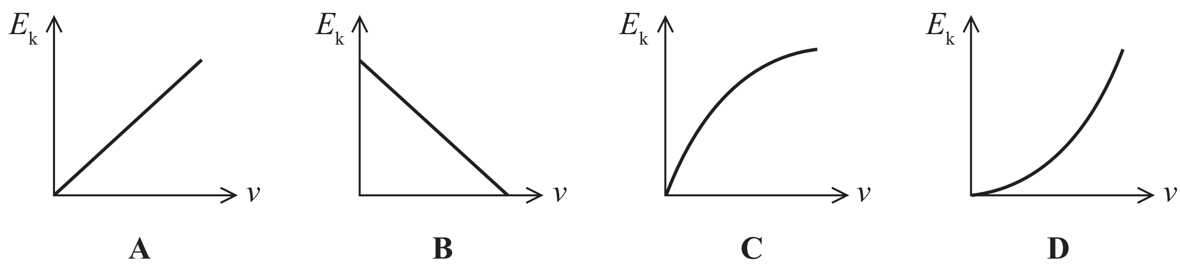
☐ **B** $kg\,m\,s^{-2}$

☐ **C** $kg\,m^2\,s^{-1}$

☐ **D** $kg\,m^2\,s^{-2}$

(Total for Question 1 = 1 mark)

2 Select the graph that correctly shows the variation of an object's kinetic energy E_k with its velocity v.



☐ **A**

☐ **B**

☐ **C**

☐ **D**

(Total for Question 2 = 1 mark)

P 4 8 3 6 0 A 0 2 2 4

3 A block of mass m is placed on a bench and a horizontal force F is applied to the block. The block accelerates along the bench, travels a distance d in time t and reaches a velocity v.

The work done by the force F on the block is

☒ **A** Fd

☒ **B** Ft

☒ **C** Fv

☒ **D** mgd

(Total for Question 3 = 1 mark)

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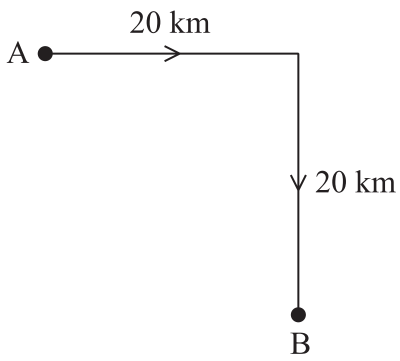
4 To travel from position A to position B, a car drives 20 km due east and then 20 km due south.



Select the row from the table that correctly expresses the magnitudes of the total distance travelled and the total displacement of the car at the end of this journey.

	Distance / km	Displacement / km
☒ **A**	$\sqrt{20^2 + 20^2}$	$\sqrt{20^2 + 20^2}$
☒ **B**	$\sqrt{20^2 + 20^2}$	40
☒ **C**	40	$\sqrt{20^2 + 20^2}$
☒ **D**	40	40

(Total for Question 4 = 1 mark)

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P 4 8 3 6 0 A 0 3 2 4

Turn over ▶

Questions 5 and 6 refer to the information below.

Two groups of students were asked to perform an experiment to determine the acceleration of free-fall. Each group repeated their experiment three times to check their results. In each experiment a steel ball fell through a height of just under 1 m and the time for the ball to fall was measured.

- **Group 1** used a stopwatch to measure the time.
- **Group 2** used light gates connected to a data logger to measure the time.

5 The students measured the height the ball fell using a metre rule.

The height should be recorded as

☒ **A** 85 cm

☒ **B** 0.85 m

☒ **C** 0.850 m

☒ **D** 8.5×10^{-1} m

(Total for Question 5 = 1 mark)

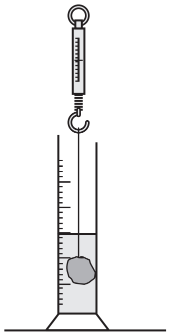
6 Select the row from the table that correctly describes the reliability and validity of the results obtained for each group.

	Group 1		Group 2	
	Reliable	**Valid**	**Reliable**	**Valid**
☒ **A**	✗	✓	✗	✓
☒ **B**	✓	✗	✗	✓
☒ **C**	✗	✓	✓	✓
☒ **D**	✓	✗	✓	✓

(Total for Question 6 = 1 mark)

7 An object of volume $2.4 \times 10^{-5}\,m^3$ was suspended from a spring balance in air and its weight, in newtons, was read from the scale.

The object was then placed in a measuring cylinder containing water of density $1000\,kg\,m^{-3}$.



The reading on the spring balance

☒ **A** decreased by $(2.4 \times 10^{-5}) \times (1000)$

☒ **B** decreased by $(2.4 \times 10^{-5}) \times (1000) \times (9.81)$

☒ **C** increased by $(2.4 \times 10^{-5}) \times (1000)$

☒ **D** increased by $(2.4 \times 10^{-5}) \times (1000) \times (9.81)$

(Total for Question 7 = 1 mark)

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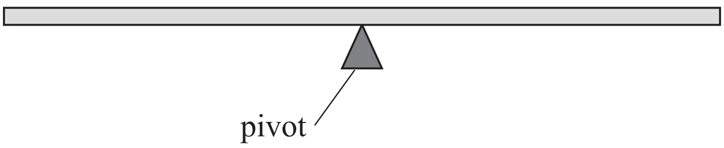
8 A uniform rod is found to balance when a pivot is placed at the midpoint O as shown.



The rod is replaced with one made from two different materials. The right-hand half of the new rod has double the density but half the diameter of the left-hand half of the rod.

Where should the pivot be placed in order to balance the replacement rod?

☒ **A** at O

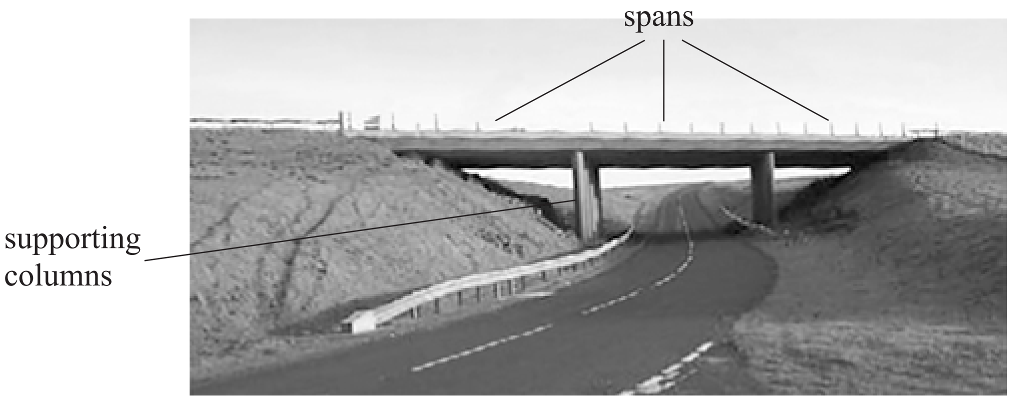
☒ **B** to the left of O

☒ **C** to the right of O

☒ **D** there is no balance point

(Total for Question 8 = 1 mark)

9 Concrete is used in both the spans and the supporting columns in a bridge. The spans need to be reinforced with steel but the supporting columns do not.



This is because concrete is

☒ **A** strong under both tension and compression.

☒ **B** strong under tension and weak under compression.

☒ **C** weak under both tension and compression.

☒ **D** weak under tension and strong under compression.

(Total for Question 9 = 1 mark)

10 A 1.8 kg mass is suspended from the end of a spring of original length 0.040 m. The spring extends and is now three times its original length.

The work done on the spring is

☒ **A** 0.072 J

☒ **B** 0.11 J

☒ **C** 0.71 J

☒ **D** 1.1 J

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 A wind turbine is used to generate electricity. When the wind speed is $10\,m\,s^{-1}$, the power input into the wind turbine is 3.2 kW.

Calculate the mass of air per second turning the turbine.

(3)

Mass of air per second turning the turbine = ...

(Total for Question 11 = 3 marks)

12 Under certain conditions, many materials obey Hooke's law.

(a) State Hooke's law and describe the conditions under which it is valid.

(2)

(b) Describe the behaviour of a spring when it is stretched beyond the region where Hooke's law is obeyed.

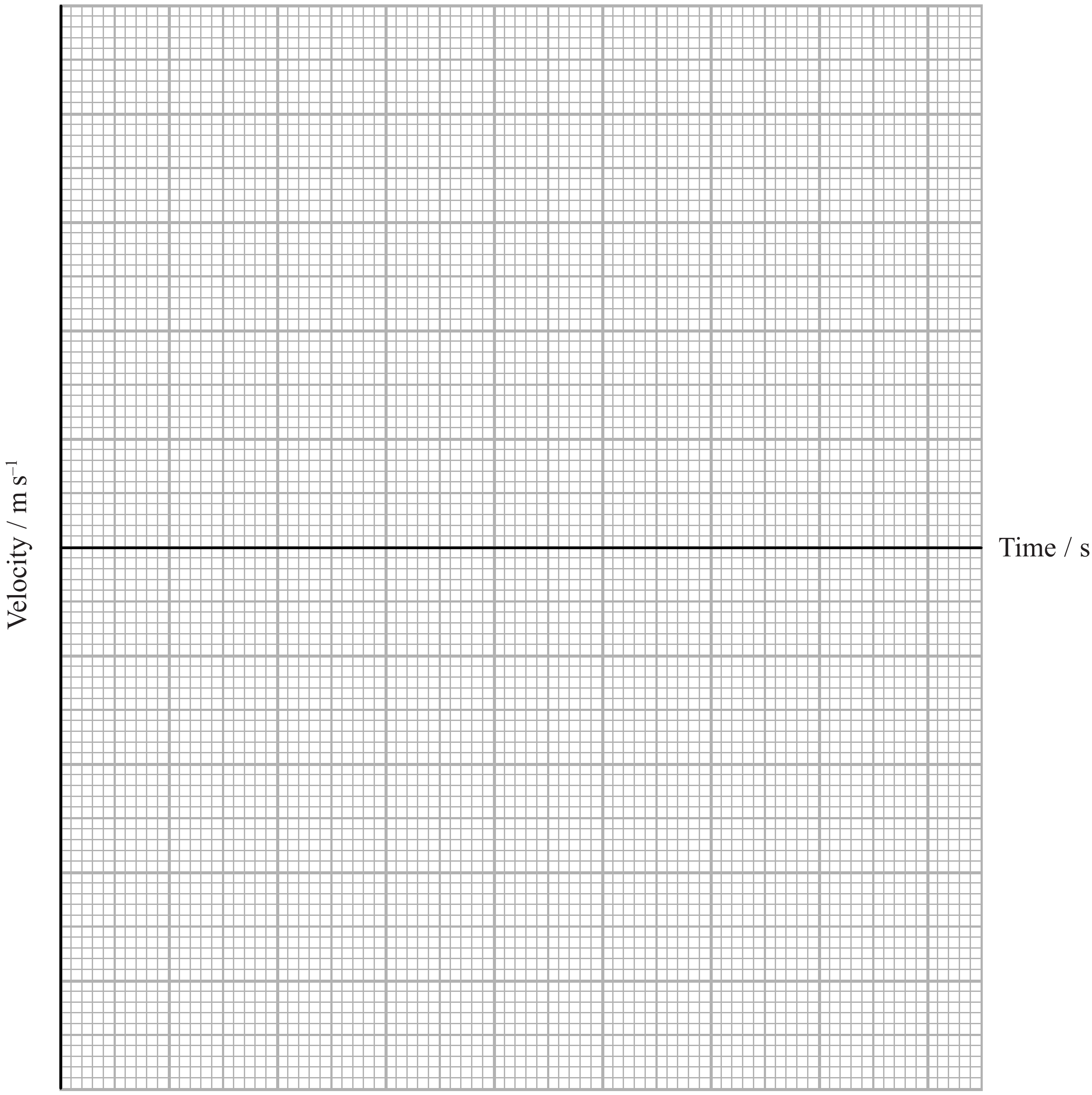
(2)

(Total for Question 12 = 4 marks)

13 A ball is dropped and reaches the ground after 0.42 s. The ball bounces and is caught at the same height from which it was dropped.

Draw, on the graph paper below, the velocity-time graph for the motion of the ball. You may assume that the time the collision with the ground takes and all frictional forces are negligible. Show your working in the space provided.

(5)



(Total for Question 13 = 5 marks)

14 The manufacture of glassware requires high temperatures.

(a) Hot glass can be drawn into thin strands to be used in optical fibres.

Explain, in terms of the properties of glass, why this technique requires high temperatures.

(3)

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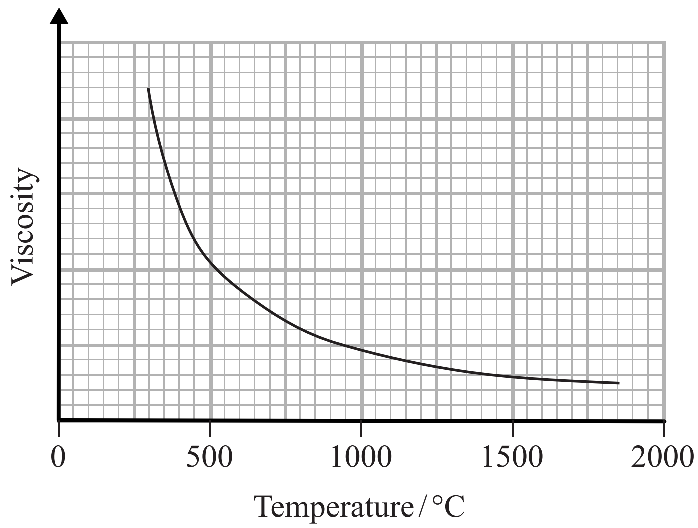
(b) The technique of glass blowing allows hot glass to be manipulated into a variety of shapes.

The graph shows the variation of viscosity with temperature for glass.



Explain why high temperatures are required for this technique.

(2)

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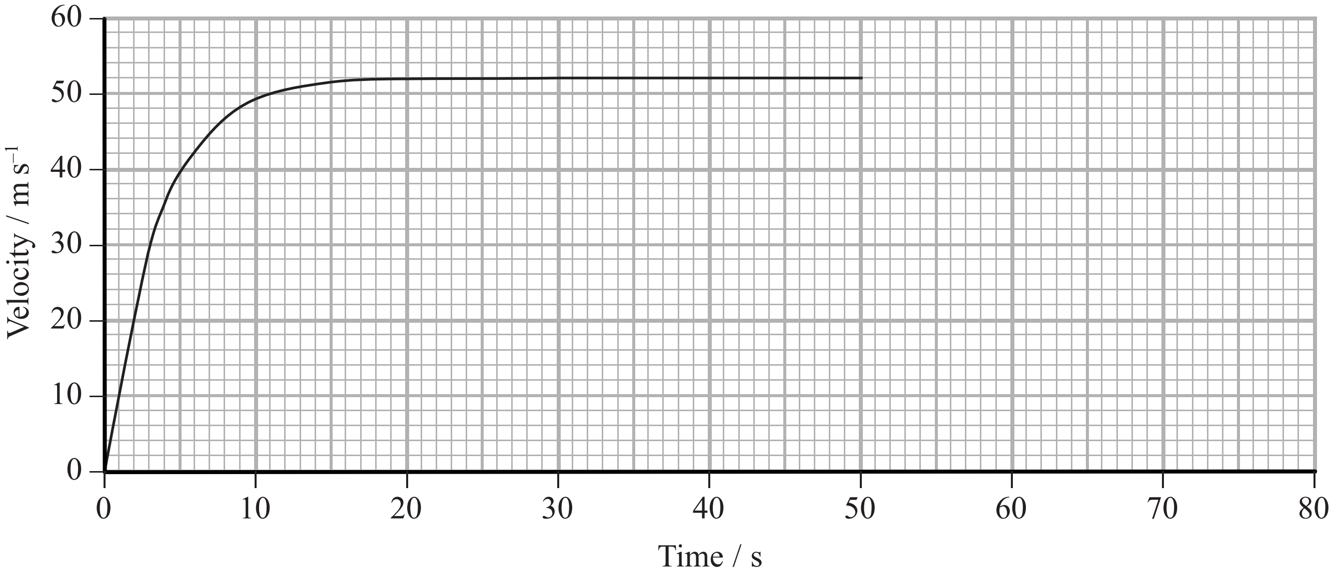
(Total for Question 14 = 5 marks)

15 A skydiver jumped out of a plane and fell for 50 s before opening his parachute.

The graph shows how the skydiver's velocity varied with time over the first 50 s of his jump.



*(a) Explain the shape of the graph.

(4)

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(b) Sketch, on the graph above, the motion of the skydiver after he opens his parachute.

(2)

(c) (i) Explain the effect of the mass of the skydiver on the terminal velocity reached before he opened his parachute.

(2)

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(ii) Explain how the skydiver could decrease this terminal velocity as he falls.

(2)

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(d) The skydiver's jump was being filmed by another skydiver. Both skydivers jumped out of the plane at the same time. During the period of filming only the skydiver who was being recorded opened his parachute.

When viewing the recording after the jump, it appeared as though the skydiver being filmed moved upwards as he opened his parachute.

Explain this apparent movement.

(2)

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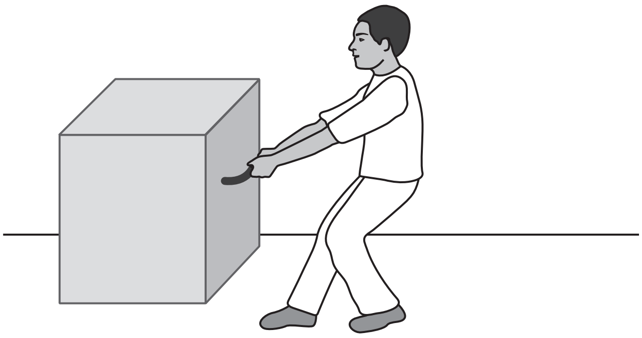
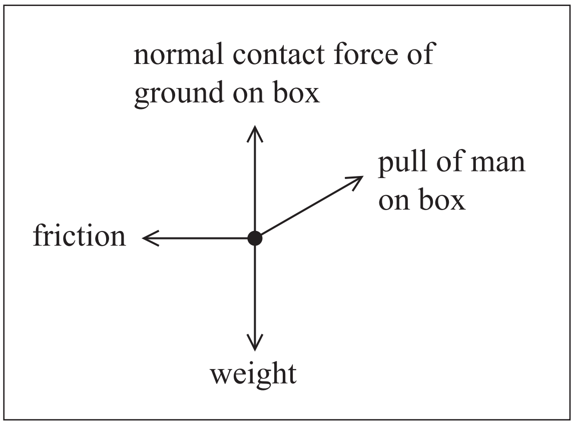
(Total for Question 15 = 12 marks)

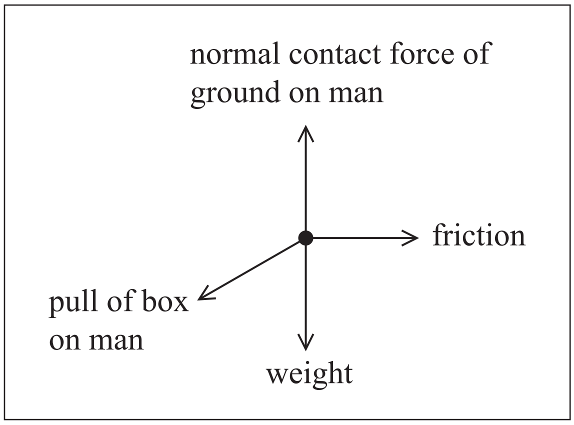
16 A man pulls a box towards him at a constant speed by pulling on a handle as shown.



The free-body force diagrams for the box and the man are shown.



free-body force diagram
for the box



free-body force diagram
for the man

(a) (i) Identify the pair of forces that have the same magnitude due to Newton's third law.

(1)

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(ii) State one difference and one similarity, other than their magnitude, between these two forces.

(2)

Difference ....

Similarity ....

(b) The angle between the pull of the man on the box and the horizontal is 35°. The mass of the box is 85.0 kg.

(i) Show that the pull of the man on the box is about 400 N.

normal contact force of the ground on the box = 620 N

(4)

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(ii) The box moves at a constant speed towards the man.

Calculate the frictional force between the box and the ground.

(3)

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Frictional force between the box and the ground = ...

(iii) The man increases his pull on the box. The man and the box start to move together in the same direction with an acceleration of $0.200\,m\,s^{-2}$.

Calculate the frictional force between the ground and the man.

mass of man = 90.0 kg

(4)

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Frictional force between the ground and the man = ...

(Total for Question 16 = 14 marks)

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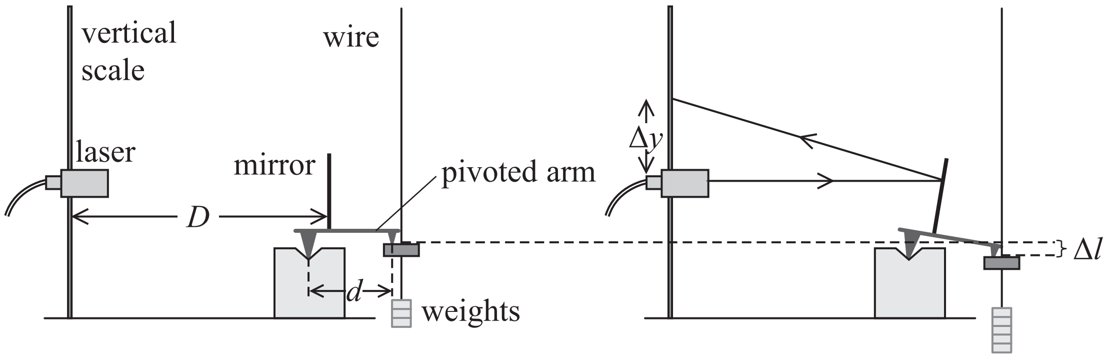
17 A student carried out an experiment to determine the Young modulus of a material in the form of a wire. The wire was suspended from a rigid support and weights were added to the free end. The corresponding extensions Δl were determined.

The diagram shows how an optical lever was used to measure the extension of the wire. The light from a laser was reflected by the mirror and moved upwards a distance Δy along a vertical scale as the wire extended. The distance D from the mirror to the scale and the length d of the pivoted arm were measured.



The following formula was used to determine a precise value for the extension of the wire Δl.

$$\Delta l = \frac{d\Delta y}{2D}$$

Before the weights were added to the wire, the student measured the diameter and the original length of the wire.

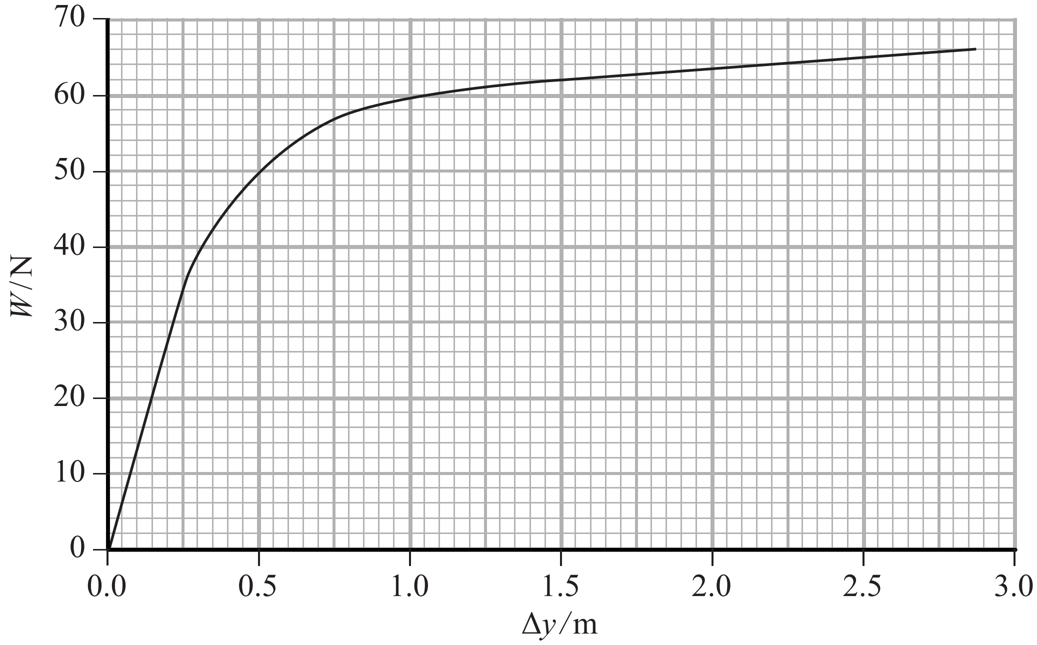
(a) Describe the measurements that would be taken, and how they would be used, to accurately determine the diameter of the wire.

(2)

(b) Explain why the optical lever was required to measure the extension of the wire.

(2)

(c) The student plotted the following graph of weight W against the distance moved by the reflected light Δy.



(i) Given that $\Delta l = \dfrac{d\Delta y}{2D}$, use the graph to determine the extension Δl of the wire and hence obtain a value for the Young modulus of the material of the wire.

$D = 7.0\,\text{m}$
$d = 0.055\,\text{m}$
cross-sectional area of wire $= 2.0 \times 10^{-7}\,\text{m}^2$
original length of wire $= 0.65\,\text{m}$

(5)

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Young modulus = ...

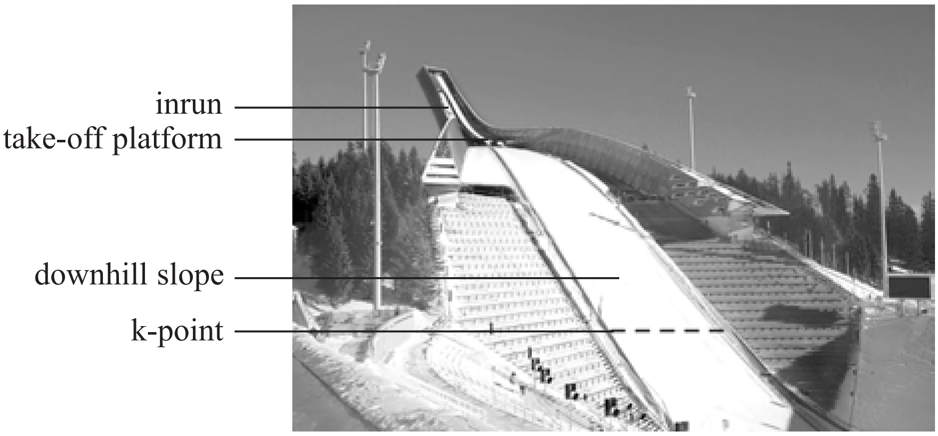
(ii) The student measured the distance moved by the reflected light Δy for the unloading of the wire.

Sketch, onto the axes above, a possible graph for the unloading of the wire.

(2)

(Total for Question 17 = 11 marks)

18 In a competition, ski jumpers ski down an inrun and then take off from a platform. They aim to land as far as possible along a downhill slope. The scoring is based on the distance travelled by the ski jumper beyond the k-point, which is positioned 120 m along the downhill slope.



*(a) Before the competition begins, the ski jumpers have practice runs. If any ski jumper lands too far beyond the k-point, the initial start point on the inrun for the competition will be at a lower position.

Explain, in terms of the initial energy of the ski jumper, why starting at a lower position will result in a safer landing.

(4)

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(b) A ski jumper leaves the take-off platform horizontally with a velocity of $28\,\text{m}\,\text{s}^{-1}$ and lands 4.0 s later.

(i) Calculate the angle to the horizontal at which she is moving just before she lands.

(4)

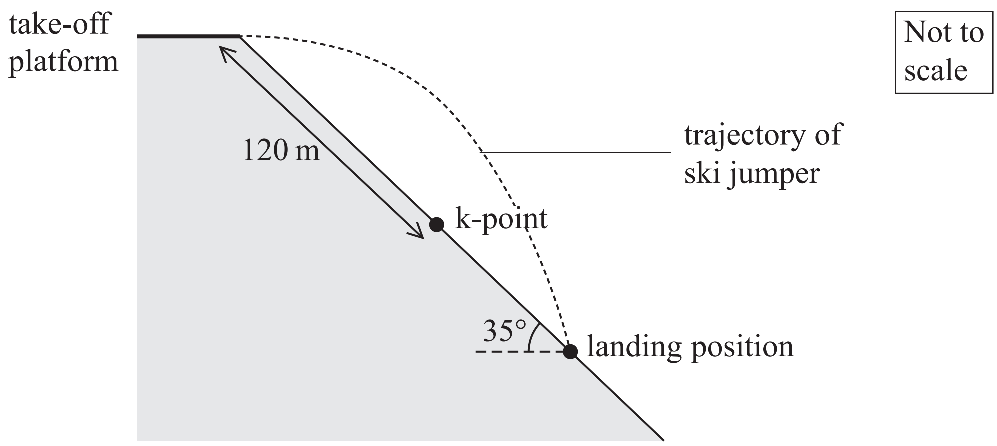
Angle of ski jumper to horizontal before landing = ...

(ii) The ski jumper receives 60 points if she lands at the k-point and then 1.8 points for every additional metre along the slope beyond the k-point.

The downhill slope has a constant gradient at 35° to the horizontal.

Determine the total points scored for the jump.

(4)



Total points scored for the jump = ...

(c) The calculations in (b) assumed that the only force acting on the ski jumper was the gravitational force.

State one other force that acts on the ski jumper and discuss how this force might affect the distance travelled by the ski jumper.

(4)

(Total for Question 18 = 16 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	$g = 9.81 \text{ m s}^{-2}$	(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 $E_{el} = \tfrac{1}{2}F\Delta x$

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