Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Friday 9 May 2025

Morning (Time: 1 hour 30 minutes) | **Paper reference** **WPH11/01**

Physics

International Advanced Subsidiary/Advanced Level
UNIT 1: Mechanics and Materials

You must have:
Scientific calculator, ruler

Total Marks

Instructions:

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **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.*
- **Show all your working out** in calculations and **include units** where appropriate.

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.*
- In the question marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.
- The list of data, formulae and relationships is printed at the end of this booklet.

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: A cube of volume V is placed in a liquid of density ρ. The cube displaces a weight W of the liquid.

Which of the following gives the magnitude of the upthrust acting on the cube?

☒ **A** $V \times W$

☒ **B** V

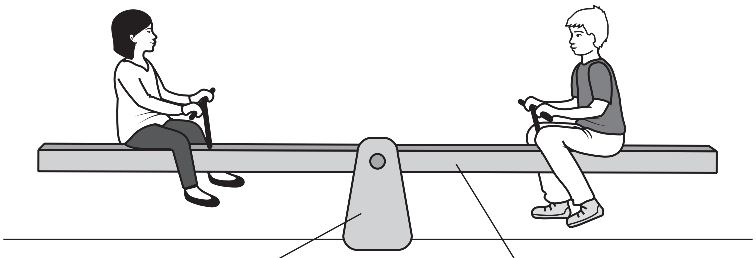
☒ **C** $V \times \rho$

☒ **D** W

(Total for Question 1 = 1 mark)

2: A see-saw is a uniform beam that balances on a support. The beam can rotate around the top of the support.

Two children of equal weight sit on a see-saw at equal distances from the support, as shown.

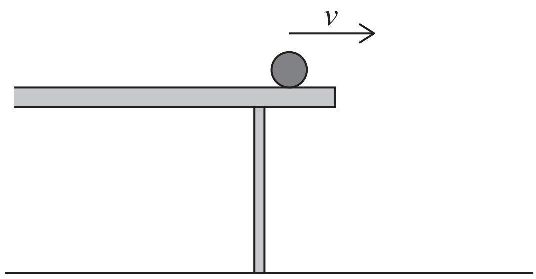


Which row of the table describes the resultant force and resultant moment on the beam?

		Resultant force	Resultant moment
☒	**A**	zero	zero
☒	**B**	zero	anticlockwise
☒	**C**	downwards	zero
☒	**D**	downwards	anticlockwise

(Total for Question 2 = 1 mark)

3: The diagram shows a ball of mass m moving at speed v along a horizontal table.



The ball leaves the table. The time taken between the ball leaving the table and landing on the floor is t.

A second ball of mass $2m$ moves at speed $2v$ along the table.

Which of the following gives the time taken between the second ball leaving the table and landing on the floor?

☒ **A** $2t$

☒ **B** t

☒ **C** $\frac{t}{2}$

☒ **D** $\frac{t}{4}$

(Total for Question 3 = 1 mark)

4: The forces acting on a person sitting on a chair are weight and normal contact force.

Which of the following gives a reason why these forces do **not** form a Newton's third law pair?

☒ **A** The chair is stationary.

☒ **B** The forces act in opposite directions.

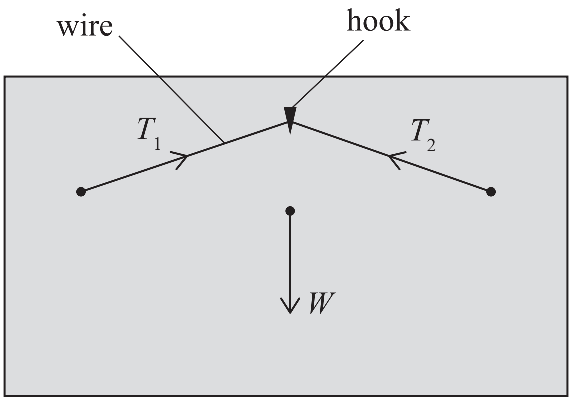
☒ **C** The forces act on the same object.

☒ **D** The forces have the same magnitude.

(Total for Question 4 = 1 mark)

5: A wire is used to hang a picture from a hook on a wall.

The wire exerts forces T_1 and T_2 on the picture. The picture has weight W, as shown.



Not to scale

Which of the following describes the relationship between the forces when the picture is hanging on the wall?

☒ **A** $\overrightarrow{W} = \overrightarrow{T_1} + \overrightarrow{T_2}$

☒ **B** $\overrightarrow{W} + \overrightarrow{T_1} + \overrightarrow{T_2} = 0$

☒ **C** $\overrightarrow{W} = \overrightarrow{T_1} - \overrightarrow{T_2}$

☒ **D** $\overrightarrow{W} + \overrightarrow{T_1} - \overrightarrow{T_2} = 0$

(Total for Question 5 = 1 mark)

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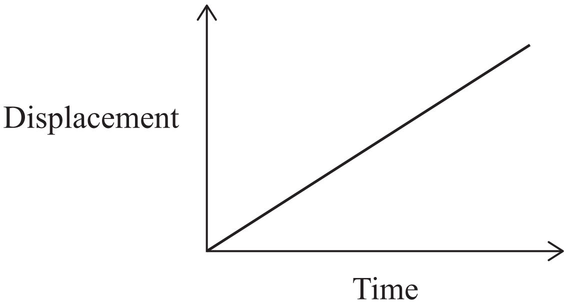
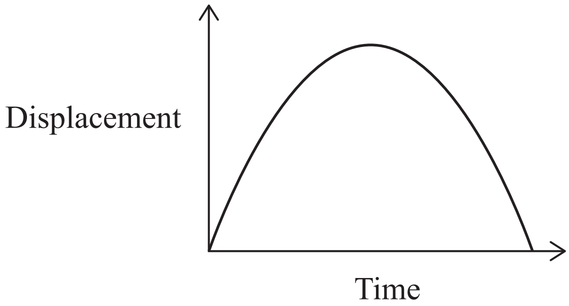
6: An object has a constant non-zero acceleration.

Which of the following displacement-time graphs could represent the motion of the object?



A



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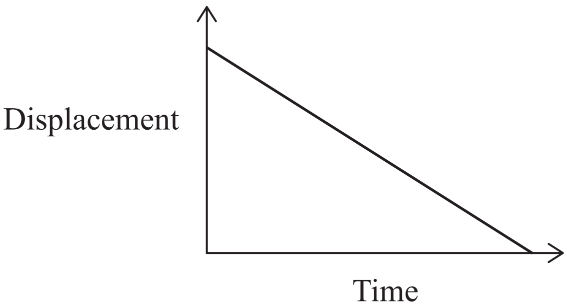

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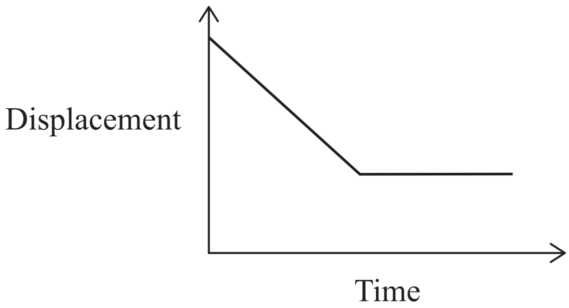


D

☒ **A**

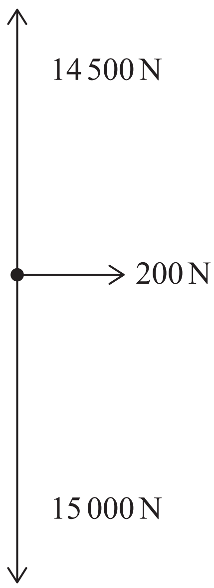
☒ **B**

☒ **C**

☒ **D**

(Total for Question 6 = 1 mark)

7: The forces acting on a helicopter are shown. The helicopter is represented by the dot.



Not to scale

Which of the following expressions gives the magnitude of the resultant force, in newtons, on the helicopter?

☒ **A** $(15\,000^2 - 14\,500^2) + 200^2$

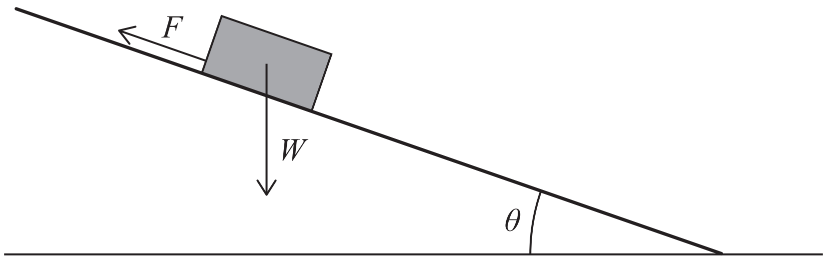
☒ **B** $\sqrt{(15\,000^2 - 14\,500^2) + 200^2}$

☒ **C** $(15\,000 - 14\,500)^2 + 200^2$

☒ **D** $\sqrt{(15\,000 - 14\,500)^2 + 200^2}$

(Total for Question 7 = 1 mark)

8: A box of weight W slides down a ramp. The ramp is at an angle θ to the horizontal. A frictional force F acts on the box, as shown.



Which of the following is correct when the box moves at a constant speed?

☒ **A** $F = W\cos\theta$

☒ **B** $F < W\cos\theta$

☒ **C** $F = W\sin\theta$

☒ **D** $F < W\sin\theta$

(Total for Question 8 = 1 mark)

9: The driver of a car applies the brakes. The frictional force F between the tyres and the road is constant. The average power dissipated by F is 50 kW.

The car moves a distance of 13 m in a time of 2.3 s before coming to rest.

Which of the following expressions gives F in newtons?

☒ **A** $\dfrac{50 \times 10^3 \times 2.3}{13}$

☒ **B** $\dfrac{50 \times 10^3 \times 13}{2.3}$

☒ **C** $\dfrac{13}{50 \times 10^3 \times 2.3}$

☒ **D** $\dfrac{2.3}{50 \times 10^3 \times 13}$

(Total for Question 9 = 1 mark)

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10: A toy train of mass $3m$ is moving with a speed v.
A toy truck of mass m is moving with a speed $2v$ in the opposite direction, as shown.

The train and truck collide and move off together.

Which of the following expressions gives the new speed of the train and truck?

☒ **A** $\frac{v}{4}$

☒ **B** $\frac{4v}{5}$

☒ **C** v

☒ **D** $\frac{5v}{4}$

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

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SECTION B

Answer ALL questions in the spaces provided.

11: A resultant force of 4800 N acts on a boat.

The acceleration of the boat is $0.31\,\mathrm{m\,s^{-2}}$.

Calculate the weight of the boat.

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Weight of boat = ...

(Total for Question 11 = 3 marks)

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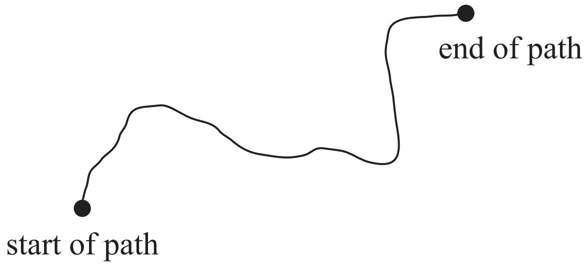
12: A person rides a bicycle along the path shown.



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(a) At the end of the path, the magnitude of the displacement from the start is less than the distance travelled by the person.

Describe why the displacement is less than the distance travelled by the person.

(2)

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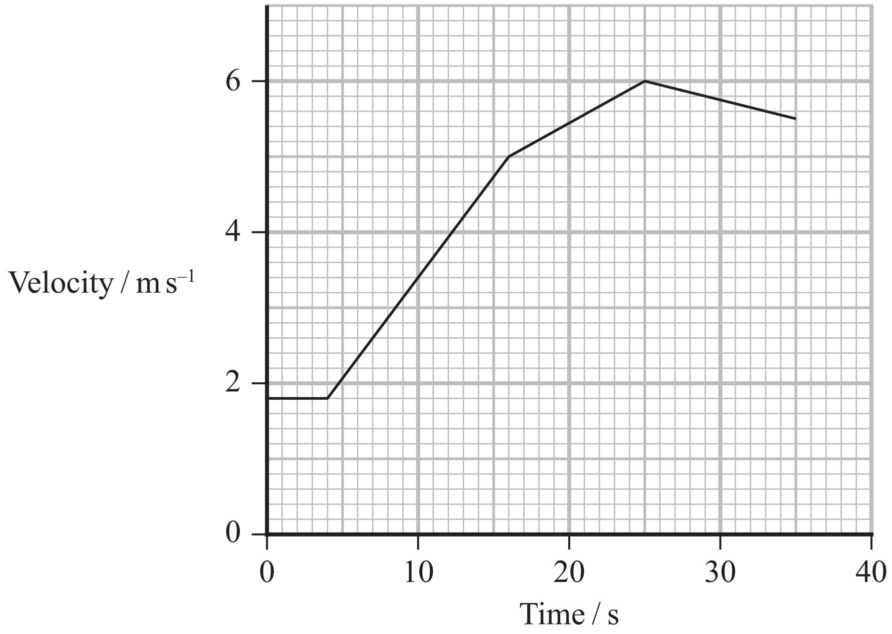
(b) The velocity-time graph for part of the bicycle ride is shown.



Determine the maximum acceleration of the person on the bicycle.

(3)

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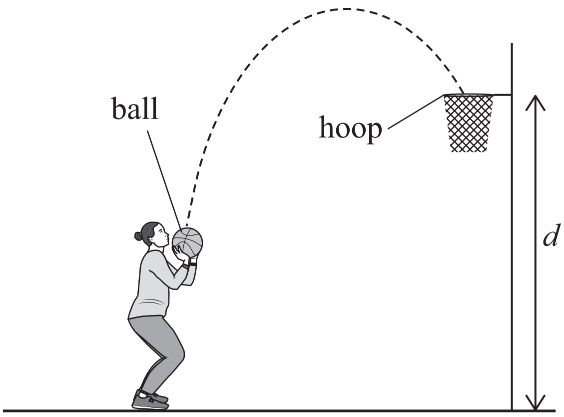
Maximum acceleration = ...

(Total for Question 12 = 5 marks)

13: In a game of basketball, points are scored by throwing a ball so that it falls through a hoop.

The rules state that the distance d between the hoop and the floor should be 3.0 m.

A basketball player throws the ball so that it falls through the hoop, as shown.



The ball was thrown from a height of 1.7 m above the floor.

The initial vertical component of the velocity of the ball was $5.1\,\mathrm{m\,s^{-1}}$.

As the ball entered the hoop, the vertical component of the velocity of the ball was $2.1\,\mathrm{m\,s^{-1}}$.

Deduce whether d was 3.0 m.

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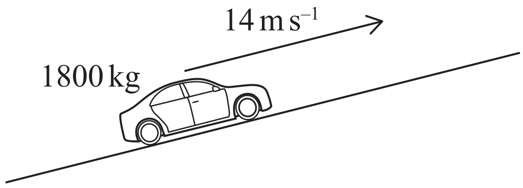
(Total for Question 13 = 3 marks)

14: The brakes in a car reduce the kinetic energy of the car. In an electric car, some of this energy is transferred to the battery in the car.

An electric car of mass 1800 kg moves at a speed of $14\,\mathrm{m\,s^{-1}}$ up a hill, as shown.



The driver applies the brakes to bring the car to a stop. During braking, the vertical displacement of the car is 0.76 m and the energy stored in the battery increases by 45 kJ.

Calculate the efficiency of using the brakes to charge the battery.

Efficiency = ...

(Total for Question 14 = 4 marks)

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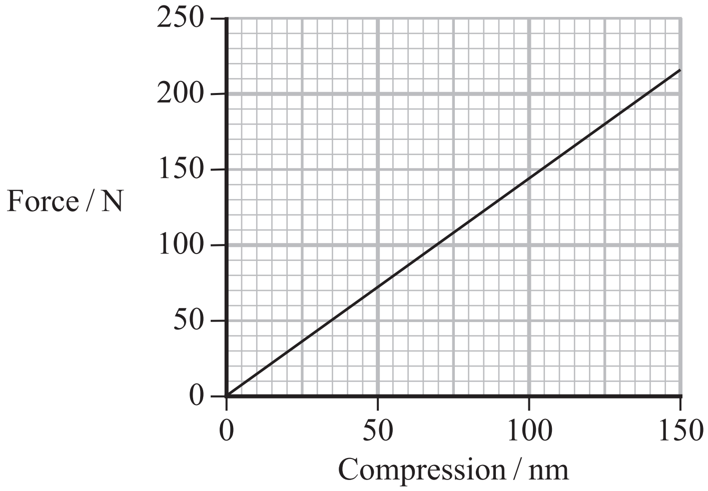
15: A builder uses bricks to build a wall.

As the wall gets taller, the force on a brick at the bottom of the wall increases.

A force-compression graph for this brick is shown.



(a) Determine the increase in elastic strain energy in the brick as the force increases from 85 N to 140 N.

(3)

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Increase in elastic strain energy = ...

(b) The brick undergoes elastic deformation.

State what is meant by elastic deformation.

(1)

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(Total for Question 15 = 4 marks)

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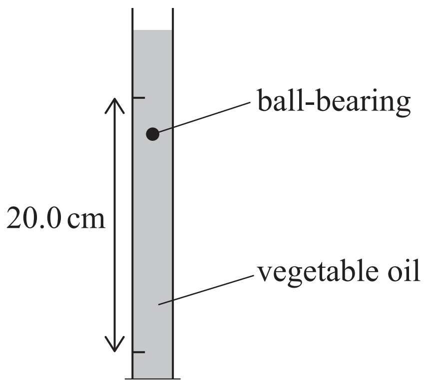
16: A student used a falling-ball method to determine the viscosity of vegetable oil.

He measured the diameter of a ball-bearing.

He dropped the ball-bearing into a measuring cylinder containing vegetable oil, as shown.



The ball-bearing reached terminal velocity. The student then measured the time taken for the ball-bearing to fall 20.0 cm.

(a) Give one other measurement needed to determine the viscosity of the oil.

(1)

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(b) The diameter of the ball-bearing was 1.24 mm. The time taken to fall 20.0 cm was 1.3 s. The student calculated a value of 5.6×10^{-5} N for the viscous drag on the ball-bearing.

Calculate the viscosity of the oil.

(3)

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Viscosity = ... Pa s

(c) The student repeated the experiment. He used the same oil at a lower temperature.

Explain how using oil at a lower temperature affected the time taken for the ball-bearing to fall 20.0 cm.

(3)

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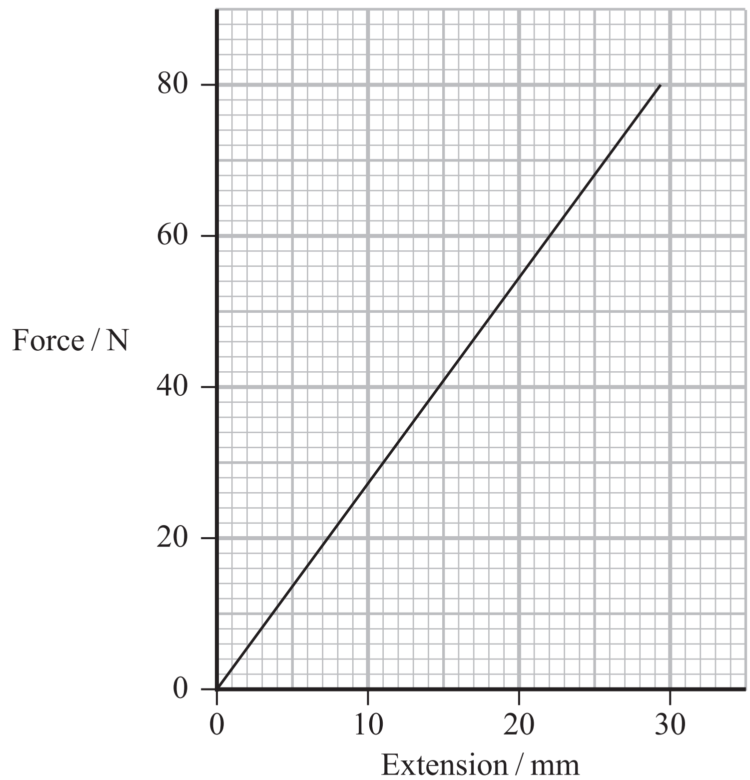
(Total for Question 16 = 7 marks)

17: A violin is a musical instrument that has four strings, as shown.

(Source: © bob_sato_1973/Getty Images)

(a) A force-extension graph for a sample of one of the strings is shown below.



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The table shows the stiffness for samples of three of the strings on the violin.

Each sample was the same original length as the sample used to obtain the graph.

String	Stiffness / N m^{-1}
X	1700
Y	2700
Z	6100

Deduce which string was used to obtain the force-extension graph.

(4)

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(b) The fourth string on the violin has an original length of 0.750 m.

When the tension applied to the string is 36 N, the new length of the string is 0.752 m.

The radius of the string is 0.85×10^{-3} m.

Determine the Young modulus of the material used to make the string.

(5)

Young modulus = ...

(Total for Question 17 = 9 marks)

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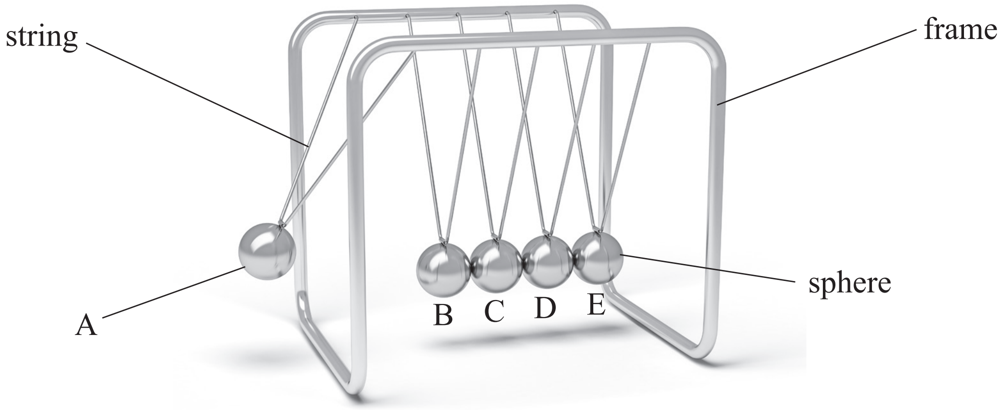
18: A 'Newton's cradle' has five identical steel spheres, A, B, C, D and E. Each sphere hangs on string from a frame, as shown.



(Source: © f9photos/Getty Images)

(a) Each sphere has a radius of 7.0×10^{-3} m.

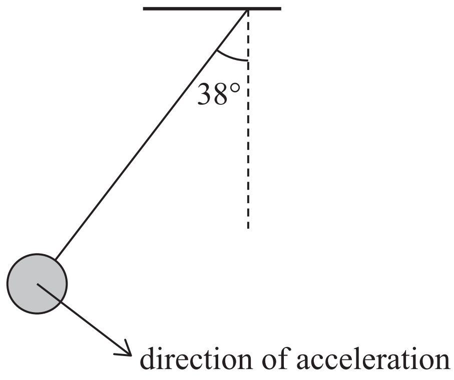
Calculate the mass of one sphere.

density of steel = $7.8 \times 10^{3}\,\text{kg}\,\text{m}^{-3}$

(3)

Mass of one sphere = ...

(b) A student pulls sphere A, so the string is at an angle of 38° to the vertical, as shown.
The student then releases sphere A.



Determine the initial acceleration of sphere A when released.

(2)

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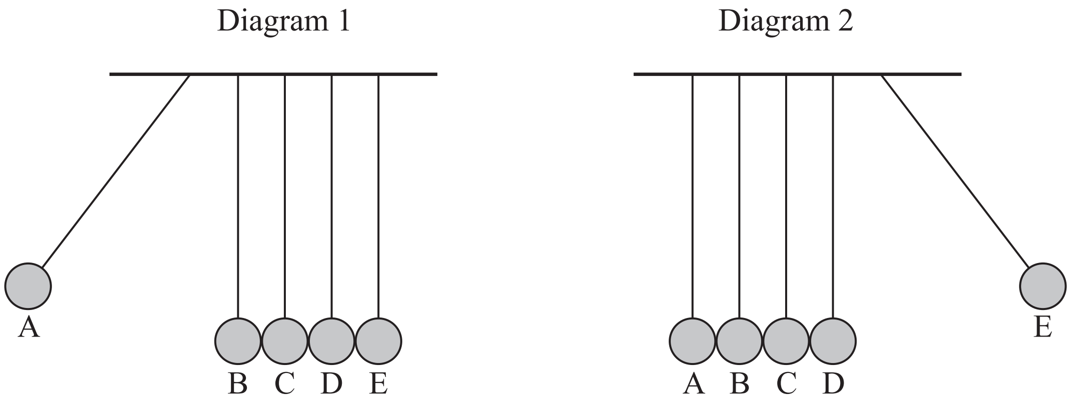
Initial acceleration = ...

*(c) Diagram 1 shows the position of the spheres when sphere A is released.

After being released, sphere A collides with sphere B and comes to rest.

Spheres B, C and D remain at rest. Sphere E moves away from sphere D.

Diagram 2 shows the position of the spheres when sphere E reaches the highest point.



Describe the changes in energy and momentum of spheres A and E, from the time sphere A is released until sphere E reaches its highest point.

Ignore the effects of air resistance.

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(Total for Question 18 = 11 marks)

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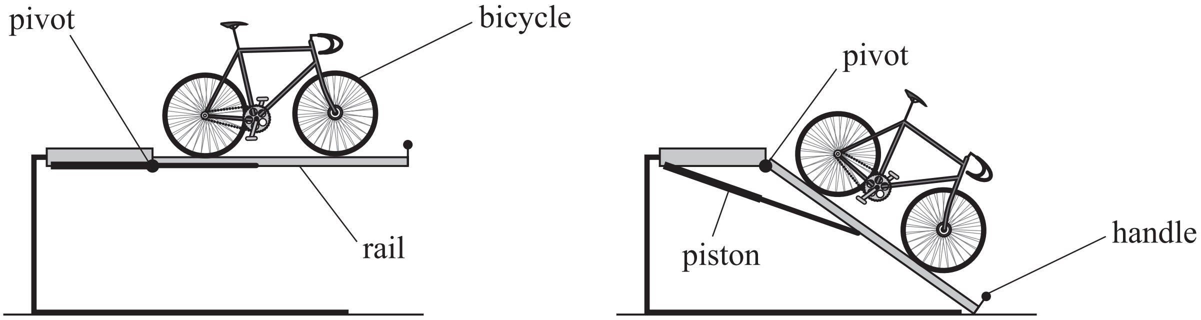
19: A student stores her bicycle on a rack.

The bicycle rests on a rail that can rotate about a pivot.
To take the bicycle off the rack, the student uses a handle to lower one end of the rail to the ground.

A piston applies a force to the rail as the rail is lowered to the ground.

The diagrams show the bicycle on the rack before and after the rail has been lowered to the ground.



(a) When the rail is in equilibrium, the principle of moments applies.

State what is meant by the principle of moments.

(1)

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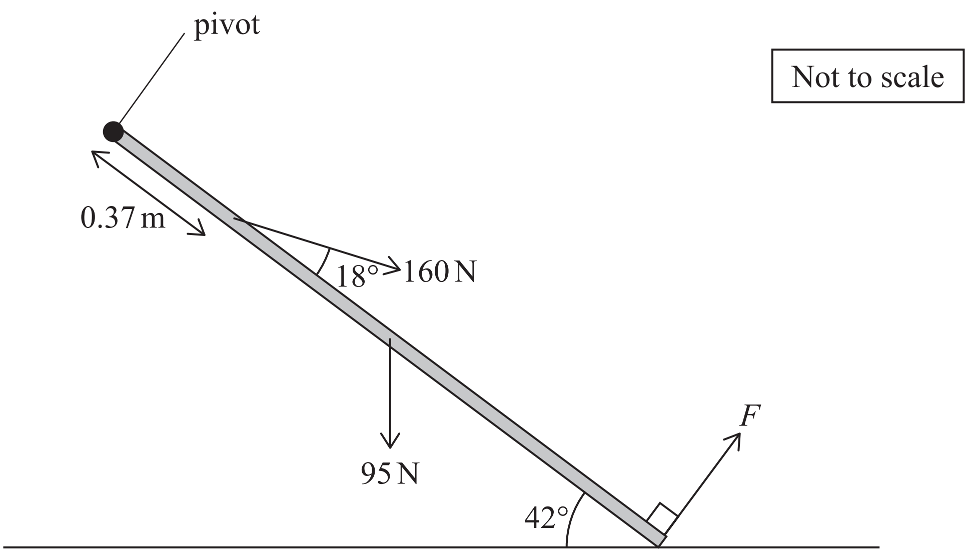
P 7 8 7 5 3 A 0 2 5 3 2

(b) After taking the bicycle off the rack, the student lifts the rail back to its original position.

(i) The uniform rail has a length of 1.40 m and a weight of 95 N.

The student applies a force F to the handle, perpendicular to the rail. The piston applies a force of 160 N to the rail.

The diagram shows these forces acting on the rail.



Determine the minimum value of F needed to lift the end of the rail off the ground.

(5)

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Minimum value of F = ...

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(ii) The student could have lifted the rail by applying a vertical upwards force to the handle.

The force needed to lift the rail is different when the force is vertical compared with when the force is perpendicular to the rail.

Explain how the minimum vertical force needed is different.

You do not need to include any further calculations.

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(Total for Question 19 = 9 marks)

20: A skydiver jumped from an aeroplane.

(a) The initial vertical velocity of the skydiver was zero.

During the first 1.5 s, the skydiver moved a vertical distance of 11 m.

Air resistance may be considered negligible if the mean acceleration of the skydiver is greater than 0.95 *g*.

Deduce whether the air resistance acting on the skydiver was negligible during the first 1.5 s.

(4)

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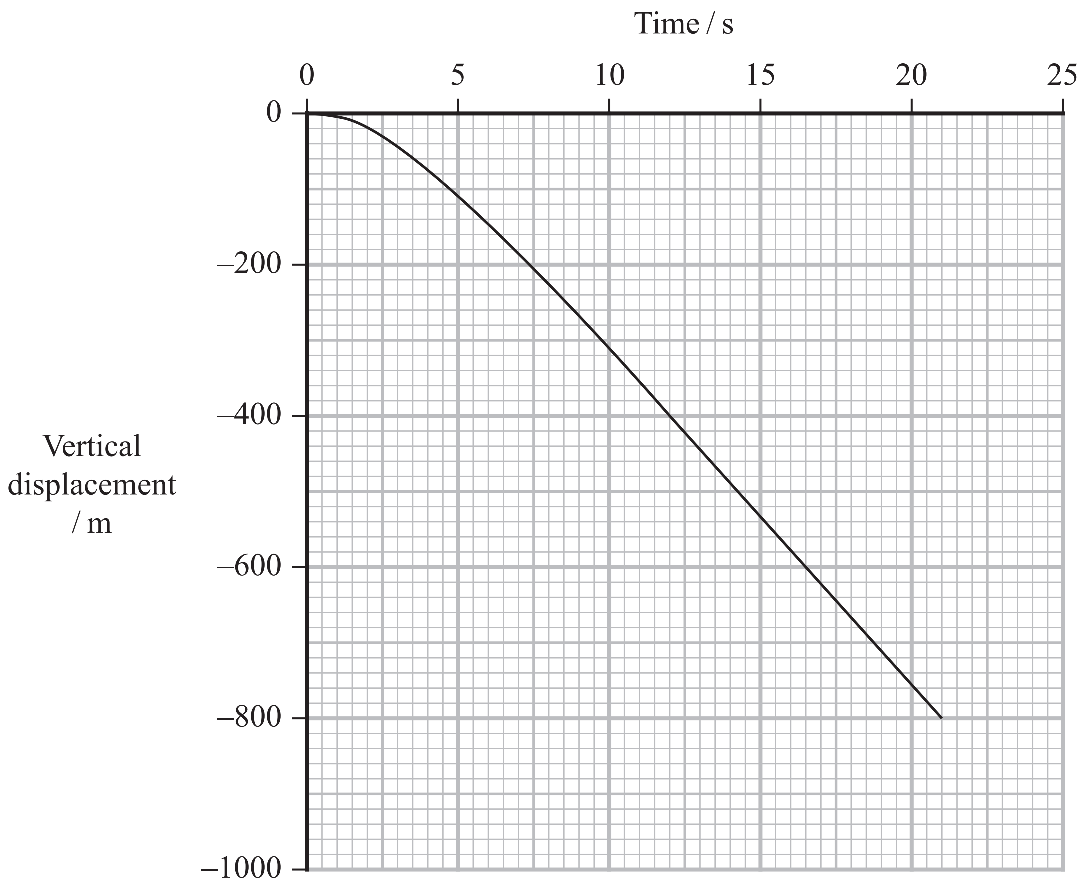
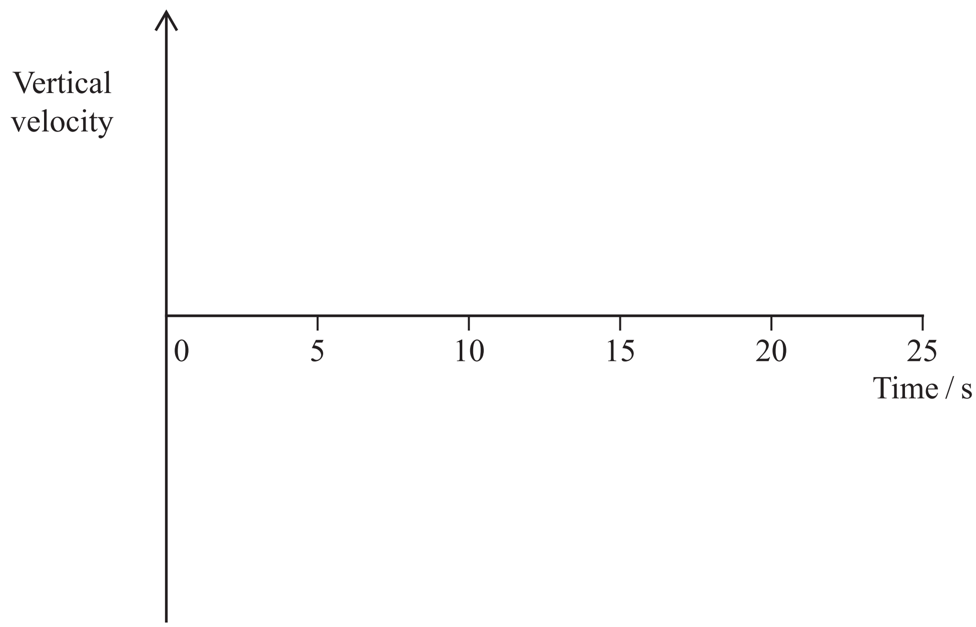
(b) The displacement-time graph for the skydiver between jumping from the aeroplane and opening his parachute is shown.



Sketch the velocity-time graph, on the axes below, for the skydiver between jumping from the aeroplane and opening his parachute.

(2)



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(c) After jumping from the aeroplane, the skydiver accelerated and then reached a terminal velocity before opening his parachute.

Explain how energy conservation applies to the skydiver before opening his parachute.

(4)

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(d) The skydiver opened his parachute and his speed changed. After a time, he reached a terminal velocity.

Explain how the forces on the skydiver caused his acceleration to vary after his parachute opened.

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(Total for Question 20 = 15 marks)

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

List of data, formulae and relationships

Acceleration of free fall	$g = 9.81\ \mathrm{m\,s^{-2}}$	(close to Earth's surface)
Gravitational field strength	$g = 9.81\ \mathrm{N\,kg^{-1}}$	(close to Earth's surface)

Unit 1

Mechanics

Kinematic equations of motion

$$s = \frac{(u+v)t}{2}$$

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

Forces

$$\Sigma F = ma$$

$$g = \frac{F}{m}$$

$$W = mg$$

Momentum

$$p = mv$$

Moment of force

$$\text{moment} = Fx$$

Work and energy

$$\Delta W = F\Delta s$$

$$E_\mathrm{k} = \frac{1}{2}mv^2$$

$$\Delta E_\mathrm{grav} = mg\Delta h$$

Power

$$P = \frac{E}{t}$$

$$P = \frac{W}{t}$$

Efficiency

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy input}}$$

$$\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}}$$

Materials

Density

$$\rho = \frac{m}{V}$$

Stokes' law

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

Hooke's law

$$\Delta F = k\Delta x$$

Elastic strain energy

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

Young modulus

$$E = \frac{\sigma}{\varepsilon} \text{ where}$$

$$\text{Stress } \sigma = \frac{F}{A}$$

$$\text{Strain } \varepsilon = \frac{\Delta x}{x}$$