Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Wednesday 8 October 2025

Afternoon (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, protractor

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 ▶

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 a unit for a vector quantity?

☐ **A** J

☐ **B** kg

☐ **C** N

☐ **D** W

(Total for Question 1 = 1 mark)

2 A lamp has a constant power input and a constant efficiency.

Which row of the table describes how the useful power output and total energy output vary with time?

	Useful power output	**Total energy output**
☐ **A**	constant	constant
☐ **B**	constant	increases
☐ **C**	increases	constant
☐ **D**	increases	increases

(Total for Question 2 = 1 mark)

3 Which of the following is **always** true of the forces in a Newton's third law pair?

☐ **A** The forces act on the same object.

☐ **B** The forces act in the same direction.

☐ **C** The forces cause acceleration.

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

(Total for Question 3 = 1 mark)

P 7 8 8 3 1 A 0 2 2 8

4 A ball bearing falls through oil at a terminal velocity.

Which row of the table is correct when the temperature of the oil decreases?

		Viscosity of oil	Terminal velocity of ball bearing
☒	**A**	decreases	decreases
☒	**B**	decreases	increases
☒	**C**	increases	decreases
☒	**D**	increases	increases

(Total for Question 4 = 1 mark)

5 A balloon moves upwards at terminal velocity.

The forces acting on the balloon are upthrust U, viscous drag D and weight W.

Which of the following statements about the magnitudes of the forces acting on the balloon is correct?

☒ **A** $U = W$

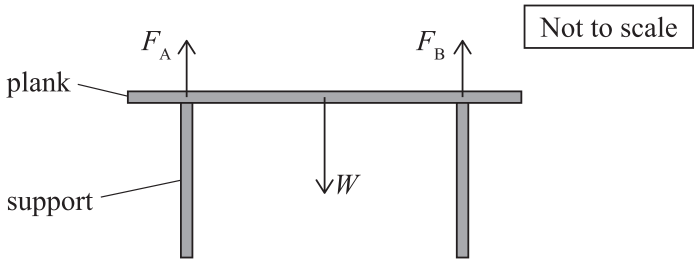
☒ **B** $U = D$

☒ **C** $U < D$

☒ **D** $U > W$

(Total for Question 5 = 1 mark)

6 A plank of wood has weight W. The plank rests on two supports. The forces from the supports on the plank are F_A and F_B, as shown.



Which of the following vector equations gives the relationship between F_A, F_B and W?

☒ **A** $\overrightarrow{F_A} - \overrightarrow{F_B} = \overrightarrow{W}$

☒ **B** $\overrightarrow{F_A} = \overrightarrow{F_B} - \overrightarrow{W}$

☒ **C** $\overrightarrow{F_A} + \overrightarrow{F_B} - \overrightarrow{W} = 0$

☒ **D** $\overrightarrow{F_A} + \overrightarrow{F_B} + \overrightarrow{W} = 0$

(Total for Question 6 = 1 mark)

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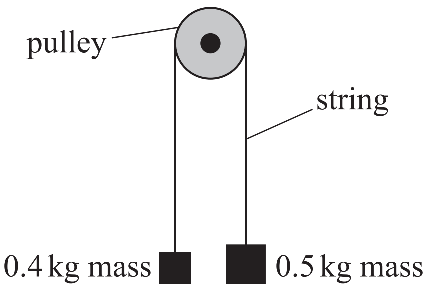
7 A student uses a piece of string to attach a mass of 0.4 kg to a mass of 0.5 kg. She then places the string over a pulley, as shown.



Which of the following gives the acceleration of the 0.5 kg mass in $m\,s^{-2}$?

☒ **A** $\dfrac{(0.5 - 0.4) \times 9.81}{0.5}$

☒ **B** $\dfrac{(0.5 - 0.4) \times 9.81}{0.5 + 0.4}$

☒ **C** $\dfrac{0.5 \times 9.81}{0.5 - 0.4}$

☒ **D** $\dfrac{0.5 \times 9.81}{0.5 + 0.4}$

(Total for Question 7 = 1 mark)

8 The table shows information about two wires made from different metals.

Wire	Length	Cross-sectional area	Young modulus of metal
P	L	A	E
Q	L	$\frac{A}{2}$	$2E$

A tensile force applied to P produces an extension Δx.
The same tensile force is applied to Q.

Which of the following is the extension of Q?

☒ **A** $\frac{\Delta x}{4}$

☒ **B** $\frac{\Delta x}{2}$

☒ **C** Δx

☒ **D** $4\Delta x$

(Total for Question 8 = 1 mark)

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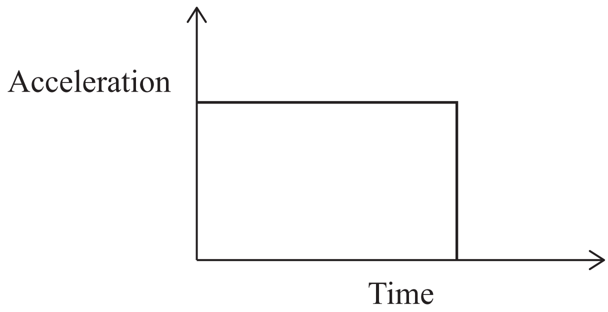
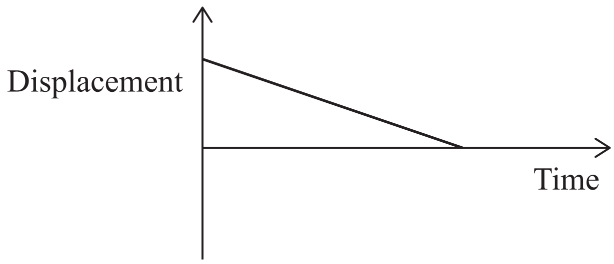
9 The acceleration-time graph for the motion of an object is shown.

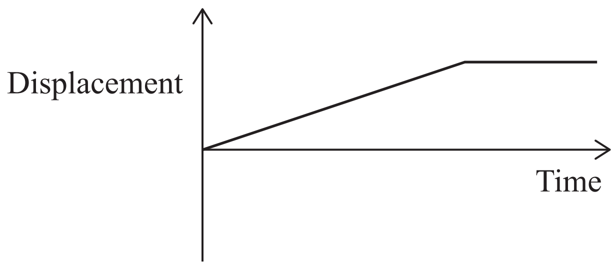


Which of the following could be the displacement-time graph for the motion of the object?

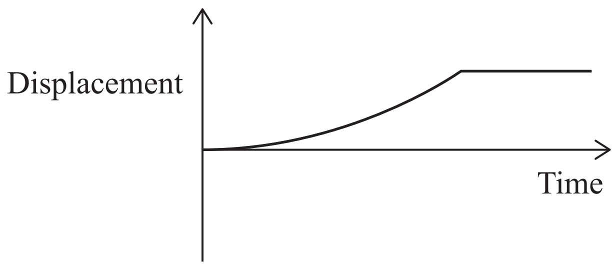
☒ **A**



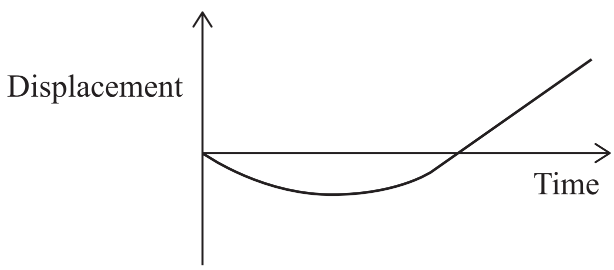
☒ **B**



☒ **C**



☒ **D**



(Total for Question 9 = 1 mark)

10 Two objects, R and S, are falling vertically and accelerating due to gravity.
Air resistance is negligible.

R has mass m and S has mass $2m$.

Initially, each object has momentum p.

After time t object R has momentum $2p$.

Which of the following gives the momentum of object S after time t?

- ☒ **A** $2p$
- ☒ **B** $3p$
- ☒ **C** $4p$
- ☒ **D** $5p$

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 A lorry has a mass of 4500 kg.

The forward force on the lorry is 6700 N.

The total resistive force on the lorry is 900 N.

Calculate the acceleration of the lorry.

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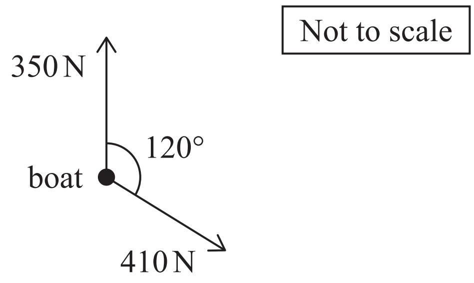
Acceleration = ...

(Total for Question 11 = 2 marks)

12 A sailing boat is moving through water.
The force of the wind on the boat is 350 N towards north.
The force of the water on the boat is 410 N at an angle of 120° from north, as shown.



Determine the magnitude and direction of the resultant force on the boat using a scaled vector diagram.

Magnitude of resultant force = ...

Angle of resultant force from north = ...

(Total for Question 12 = 4 marks)

13 A student used two different methods to investigate the acceleration of a freely falling object.

(a) In the first method, the student dropped a ball from rest at a known height. He used a stopwatch to measure the time taken for the ball to reach the ground. He repeated this several times. He then calculated the mean acceleration of the ball.

Explain why there was a large uncertainty in the calculated value of acceleration.

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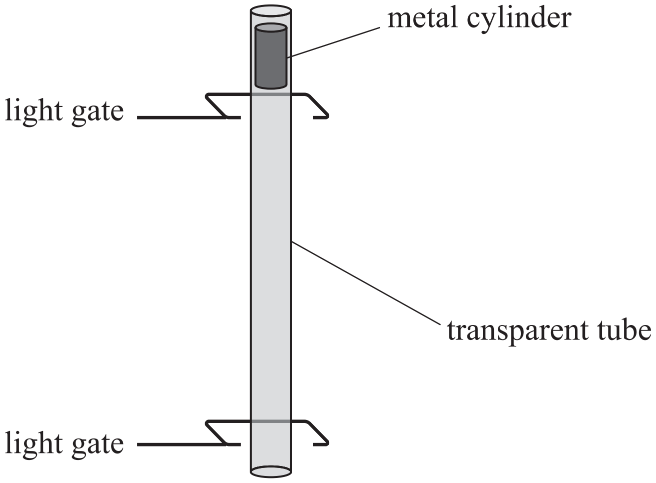
(b) In the second method, the student positioned light gates near the top and bottom of a transparent vertical tube. He dropped a metal cylinder into the tube, as shown.



The time taken for the metal cylinder to pass through each light gate was recorded by a data logger.

The student measured the distance between the light gates.

(i) Give one other measurement needed to determine the acceleration of the metal cylinder.

(1)

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(ii) The speed of the metal cylinder through the first light gate was $1.39\,m\,s^{-1}$.
The speed of the metal cylinder through the second light gate was $2.96\,m\,s^{-1}$.
The distance between the light gates was 355 mm.

Calculate the acceleration of the metal cylinder.

(2)

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Acceleration = ...

(Total for Question 13 = 5 marks)

14 Two rocks in outer space are moving at different speeds along the same path.

(a) State the principle of conservation of momentum.

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(b) Rock A has a mass of 43 kg and a velocity of $7.8\,\mathrm{m\,s^{-1}}$.

Rock B has a mass of 56 kg and moves in the same direction as rock A. The kinetic energy of rock B is 4.1×10^3 J.

Rock B collides with rock A. After the collision, rock B continues to move in the same direction with a momentum of $530\,\mathrm{kg\,m\,s^{-1}}$.

Calculate the new velocity of rock A.

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New velocity of rock A = ...

(Total for Question 14 = 6 marks)

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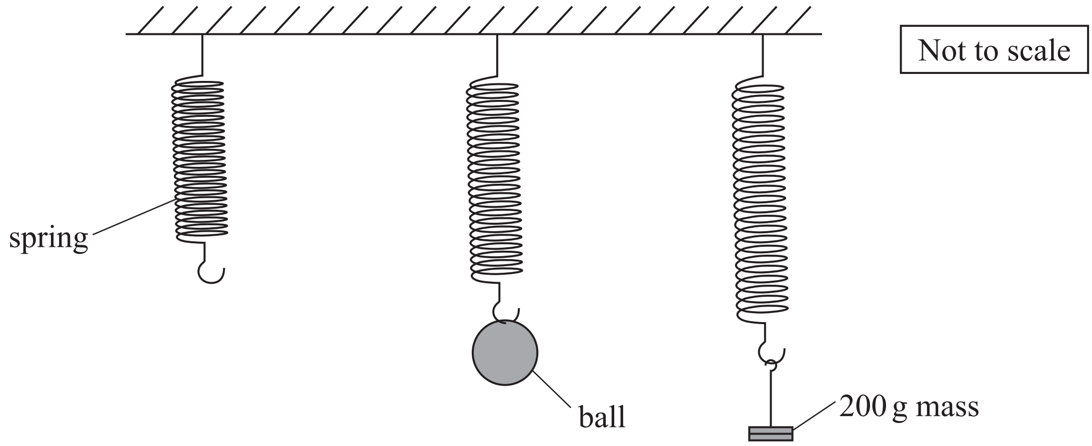
P 7 8 8 3 1 A 0 1 3 2 8

15 A student investigated a spring.

The student measured the unstretched length of the spring. The student suspended different objects from the spring, as shown. She measured the new length of the spring each time.



(a) The unstretched length of the spring was 0.250 m.

When the ball was suspended from the spring, the length of the spring was 0.295 m.

When the 200 g mass was suspended from the spring, the length of the spring was 0.375 m.

Calculate the weight of the ball.

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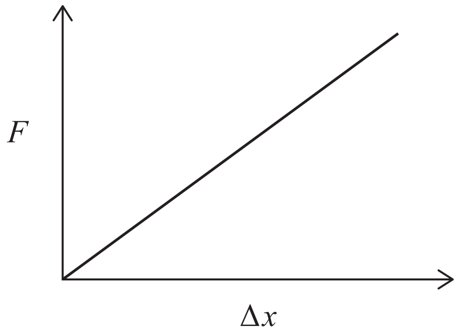
Weight of ball = ...

(b) The sketch graph shows how the extension Δx of the spring varies with the total force F on the spring.



Explain why the elastic strain energy stored by the spring is proportional to F^2.

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(Total for Question 15 = 7 marks)

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16 The photograph shows an athlete using a running blade.

running blade

(Source: © sportpoint/Getty Images)

(a) The value of the Young modulus for the material used to make the running blade is 19 GPa.

(i) State which property of the material relates to the Young modulus.

(1)

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(ii) A sample of the material has a length of 0.450 m.
In a laboratory test, a compressive stress of 150 MPa is applied to the sample.
The sample deforms elastically.

Determine the new length of the sample.

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New length = ...

(b) The running blade is made from a single material.

The table shows the compressive breaking stress of three materials used to make different running blades.

Material	Compressive breaking stress / MPa
Glass fibre	320
Carbon fibre	400
Hybrid fibre	340

The cross-sectional area of the running blade is $8.5\,cm^2$. The maximum compressive force that can be applied to the running blade before it breaks is $330\,kN$.

Deduce which material the running blade is made from.

(3)

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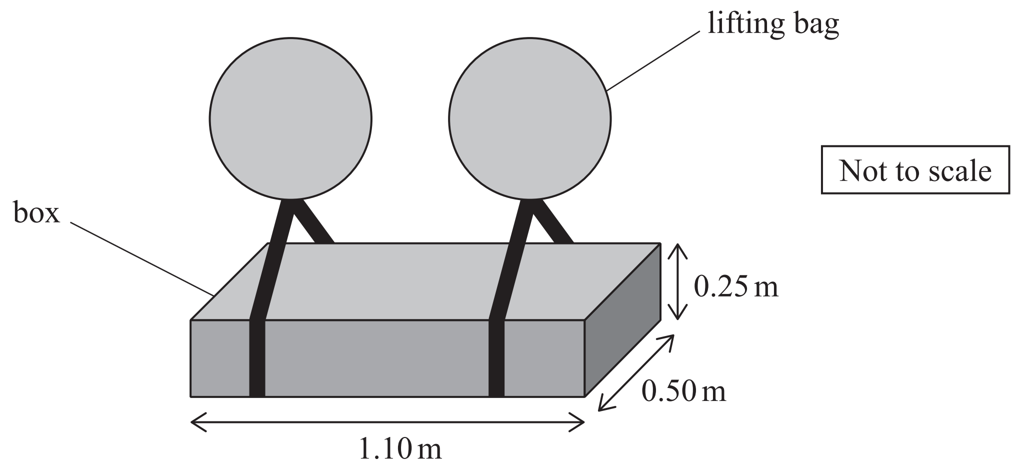
(Total for Question 16 = 8 marks)

17 A ‘lifting bag’ is a bag that can be filled with air and used to lift heavy objects from the bottom of the sea.

Lifting bags are attached to an object and then filled with air.

(a) A person attaches two spherical lifting bags to a box at the bottom of the sea, as shown.



The total weight of the box and two lifting bags filled with air is 2500 N.
The diameter of each spherical lifting bag is 50 cm.

Deduce whether the box will lift from the bottom of the sea.

density of seawater = 1020 kg m^{-3}

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(b) As the person filled the lifting bags, a small bubble of air escaped and moved upwards through the seawater.

(i) Calculate the terminal velocity of the bubble of air predicted by Stokes' law.

weight of air in bubble = 1.82×10^{-6} N
upthrust on bubble = 4.77×10^{-4} N
viscosity of seawater = 8.60×10^{-4} Pa s
radius of bubble = 2.25×10^{-3} m

(3)

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Terminal velocity = ...

(ii) Give two reasons why the terminal velocity of the bubble may be different from the value predicted by Stokes' law.

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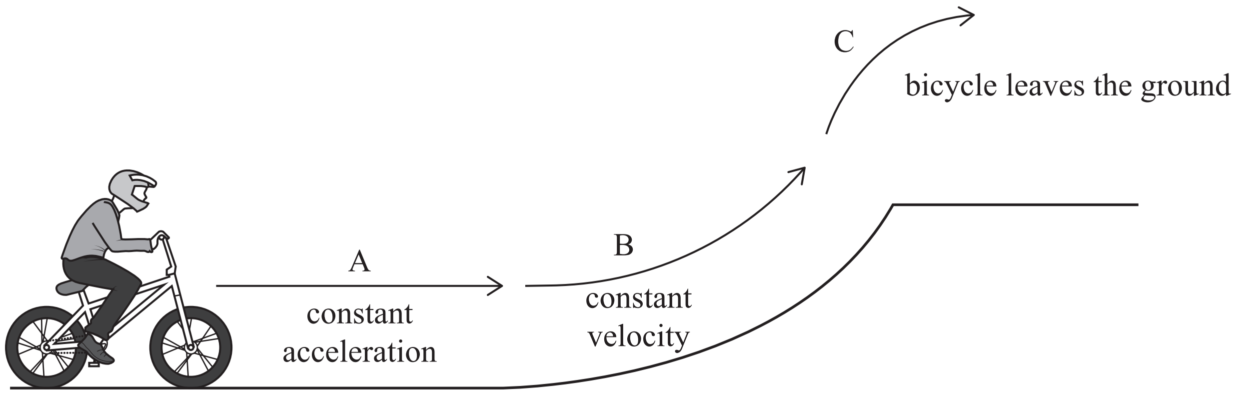
(Total for Question 17 = 11 marks)

18 In the sport of bicycle motocross (BMX) a person rides a bicycle over small hills and ramps.

A person rides a bicycle to the top of a hill with enough speed for the bicycle to leave the ground.

The diagram shows three stages, A, B and C, of the motion of the bicycle.



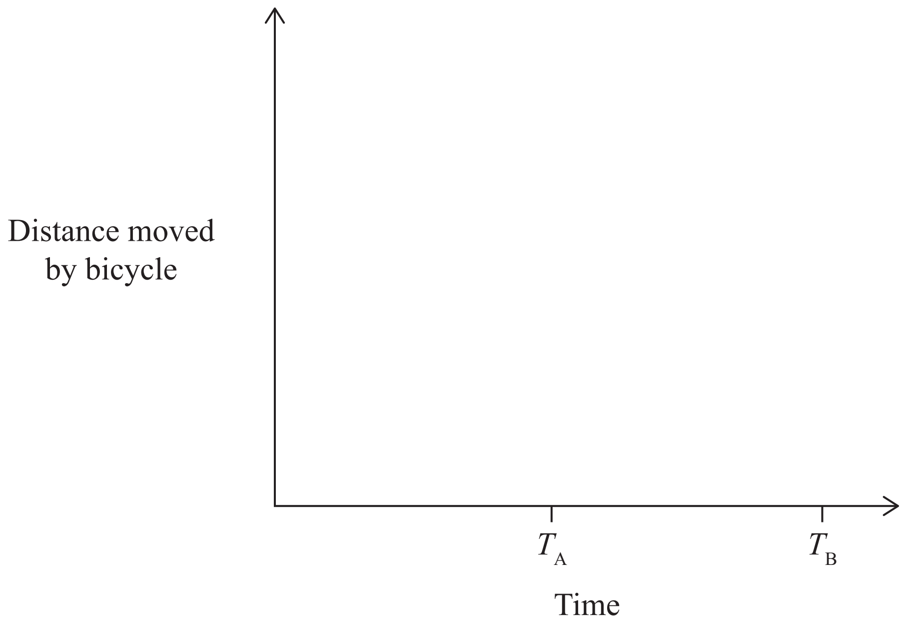
In stage A the bicycle moves with constant acceleration on a horizontal surface until time T_A.

In stage B the bicycle moves with constant velocity up a curved ramp until time T_B.

In stage C the bicycle leaves the ground.

(a) Complete the sketch graph for stages A and B.

(2)



*(b) Explain how the useful power output of the person varies through stages A, B and C.

You should consider energy changes during each stage.
Assume that air resistance is negligible.

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(Total for Question 18 = 8 marks)

19 In the sport of shot put, a person launches a heavy ball called a 'shot' into the air.

The photograph shows a person about to launch a shot.

(Source: © Lim Weixiang - Zeitgeist Photos/Getty Images)

(a) The shot is very dense and has a large mass.

Explain why the equations of motion can be used to give an accurate prediction for the path of the shot.

(2)

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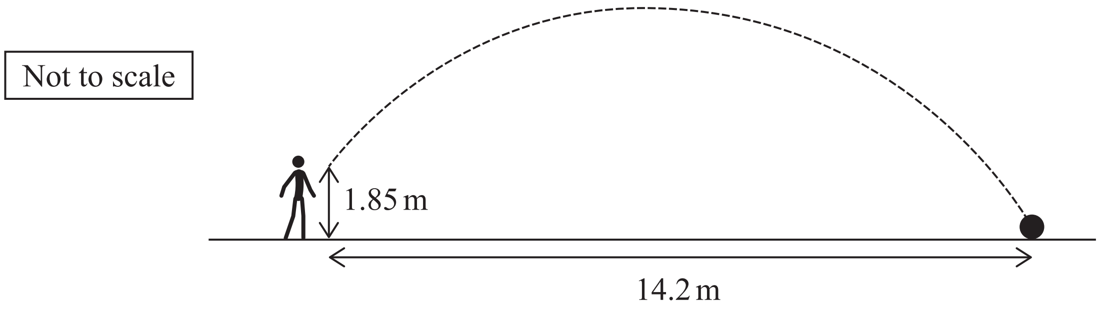
(b) The shot was released from a height of 1.85 m above the ground. The shot travelled a horizontal distance of 14.2 m before landing on the ground, as shown.



The shot moved through the air for a time of 1.61 s.

(i) Show that the horizontal speed of the shot was about 8.8 m s^{-1}.

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(ii) Determine the velocity of the shot at the point it was released.

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Magnitude of velocity = ...

Angle to horizontal = ...

(Total for Question 19 = 9 marks)

20 The photograph shows Tower Bridge, a bridge in London. The middle part of the bridge can be raised in two sections to allow boats to travel along the river. Each section can rotate about a pivot.

(Source: © BrianAJackson/Getty Images)

(a) State what is meant by the principle of moments.

(1)

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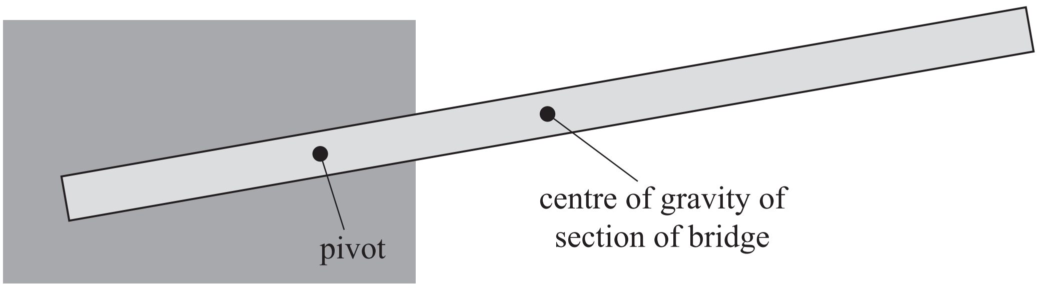
(b) To raise a section of the bridge, a motor applies a moment about the pivot.

(i) The diagram shows a section of the bridge being raised.



Explain the direction of the moment about the pivot, caused by the motor, as the section is raised.

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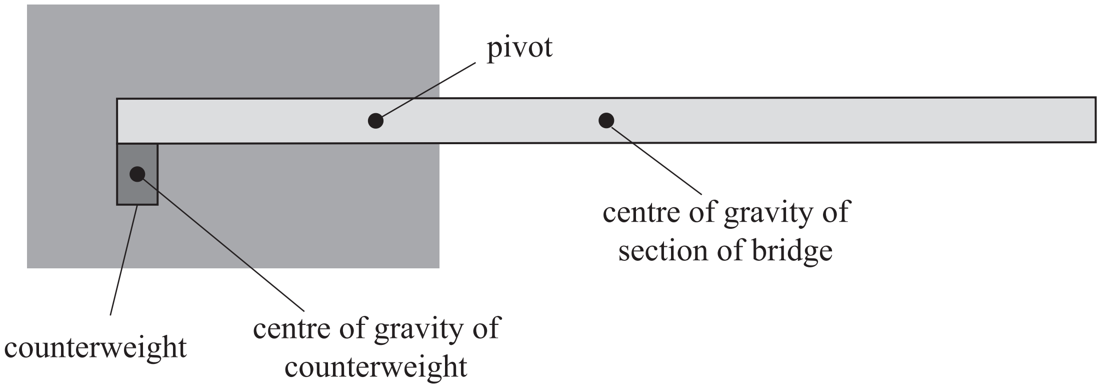
(ii) Each section of the bridge has a heavy counterweight fixed to one end, as shown.



Explain how adding the counterweight affects the work done by the motor to raise the section of the bridge.

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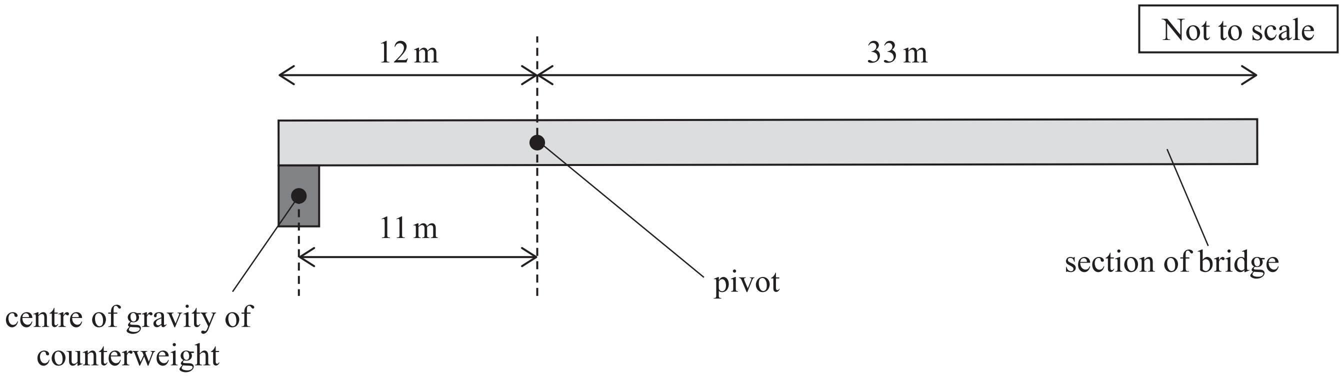
(iii) The section of the bridge is uniform. The pivot is 12 m from one end of the section of the bridge and 33 m from the other end.

The perpendicular distance from the centre of gravity of the counterweight to the pivot is 11 m, as shown.



A bus was moving across Tower Bridge when the motor began to raise the section of the bridge.

When the centre of gravity of the bus was 28 m from the pivot, the section of the bridge was in equilibrium.

Determine the magnitude of the moment produced by the motor on this section of the bridge.

weight of bus = 71 kN
weight of section of bridge = 1.2×10^7 N
weight of counterweight = 4.0×10^6 N

(4)

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Magnitude of moment produced by motor = ...

(Total for Question 20 = 10 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)
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

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

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

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

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