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EDEXCEL GCSE PHYSICS: QUESTIONS BY TOPIC

Forces and Their Effects (9)

GCSE Physics (Foundation) Topic 9

17 questions · 170 marks · Mark schemes included

Pearson Edexcel GCSE (9-1) Physics 1PH0, Foundation Tier, June 2018 - June 2025

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 Piccadilly Business Centre, Unit C, Aldow Enterprise Park
Blackett Street, Manchester, M12 6AE

HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.

Click any row below to jump straight to that question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

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QUESTIONS

17 questions · 170 marks · lowest tariff first



7-MARK QUESTIONS

3 questions in this booklet



2 (a) Complete the following sentences using words from the box below.

electrostatic	friction	gravitational	magnetic
---------------	----------	---------------	----------

(i) The force that keeps the Earth in orbit around the sun is

..... attraction.

(1)

(ii) The force that opposes motion between two surfaces is

(1)

(iii) The force that can move small pieces of paper towards a plastic comb

is attraction.

(1)

(b) Which of these statements is true for a vector quantity?

(1)

- ☒ **A** It has size only
- ☒ **B** It has direction only
- ☒ **C** It has direction and size
- ☒ **D** It does not have direction or size

(c) Figure 3 shows a force of 200 N acting at the end of a plank of wood.

The force acts at right angles to the plank and at 3.0 m away from a pivot.

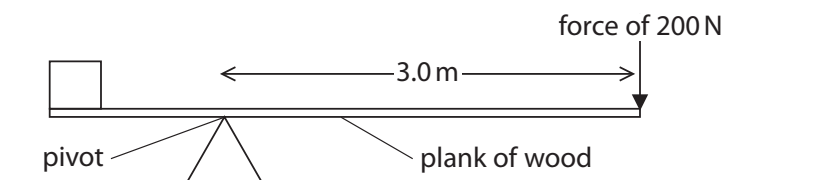


Figure 3

Calculate the moment of the 200 N force about the pivot.

State the unit of the moment of the force.

Use the equation

moment of a force = force $\times$ distance at right angles to the direction of the force

(3)

moment of the force about the pivot = ... unit

(Total for Question 2 = 7 marks)



2 (a) Figure 2 shows four items of equipment that can be used in investigations.

In which of these does a force cause rotation?

(1)



spring balance

☒ **A**



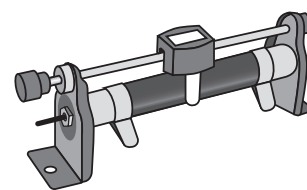
plotting compass

☐ **B**



thermometer

☒ **C**



variable resistor

☐ **D**

Figure 2

(b) Figure 3 shows a force, F , acting on a ruler.

The ruler has a pivot at one end.

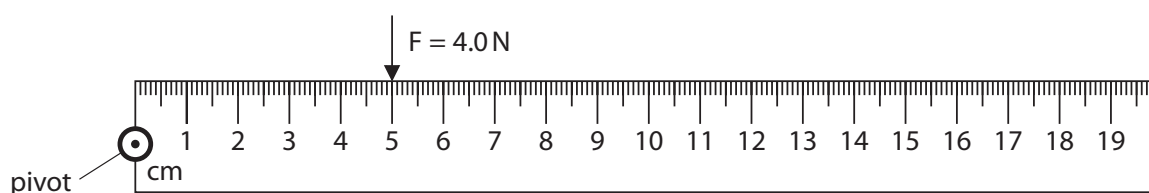


Figure 3

Calculate the moment of the force, F , around the pivot.

Give your answer in units of Nm.

Use the equation

$$\text{moment of a force} = \text{force} \times \text{distance from pivot}$$

(2)

moment = ... Nm

(c) A 20cm ruler has a pivot at its centre.

The ruler is balanced when no forces act on the ruler.

Figure 4 shows two forces, Y and Z, acting on the ruler.

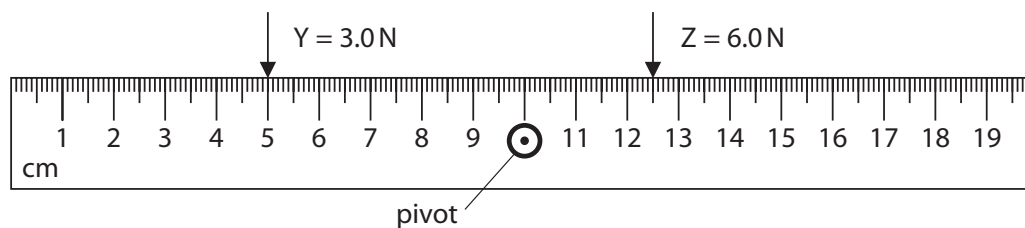


Figure 4

Use the principle of moments to show that the ruler in Figure 4 is balanced.

(2)

.....

.....

.....

.....

(d) Figure 5 shows an arrangement of three gears, P, Q and R.

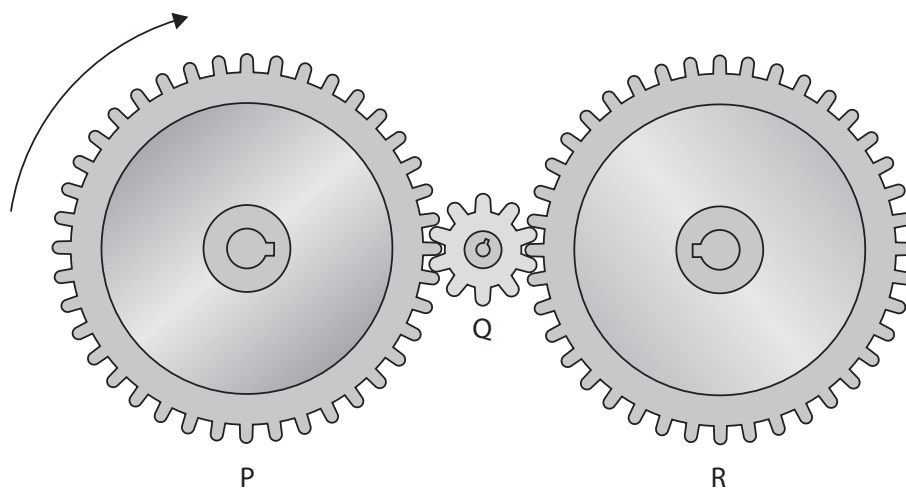


Figure 5

P and R have the same number of teeth.

P rotates in the direction shown.

State how the speed **and** direction of rotation of R compare with the speed and direction of rotation of P.

(2)

speed

direction

(Total for Question 2 = 7 marks)

2 (a) Which of these forces keeps the Moon in orbit around the Earth?

(1)

- ☐ A gravitational
- ☐ B friction
- ☐ C electrostatic
- ☐ D contact

(b) (i) Figure 3 shows a rock and a long lever.

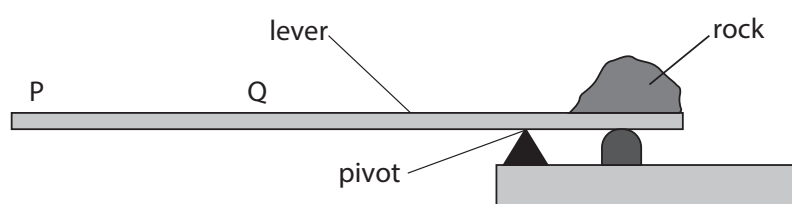


Figure 3

The lever is used to try to move the rock.

The lever is pushed downwards at Q with a force of 375 N.
Q is 1.4 m from the pivot.

Calculate the moment of the force at Q about the pivot.

Use the equation

$$\text{moment of a force} = \text{force} \times \text{distance from pivot}$$

(2)

moment of force = ... Nm

- (ii) When the force of 375 N is pushed down at Q, the rock does not move.

Explain why pushing down at P with a force of 375 N may be more successful in moving the rock.

(2)

.....

.....

.....

.....

- (c) Figure 4 shows a uniform ruler that can rotate about a pivot. The ruler is balanced by adding weights to each side.

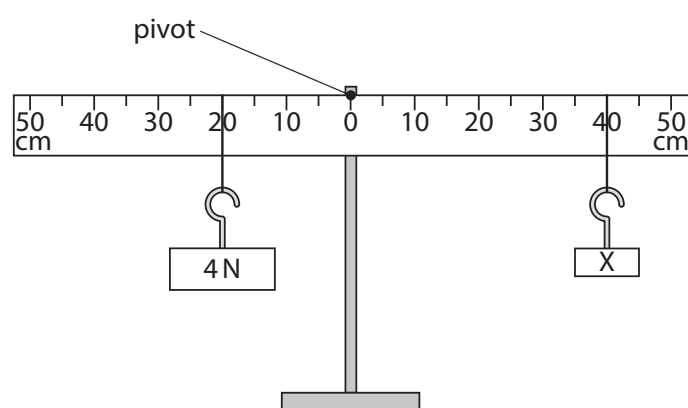


Figure 4

Calculate the value of X, the unknown weight, that keeps the ruler balanced.

(2)

$$X = \dots\dots\dots \text{ N}$$

(Total for Question 2 = 7 marks)



8-MARK QUESTIONS

2 questions in this booklet



1 (a) Figure 1 shows an object under the surface of the sea.

(i) Which arrow shows where the pressure on the object is greatest?

(1)

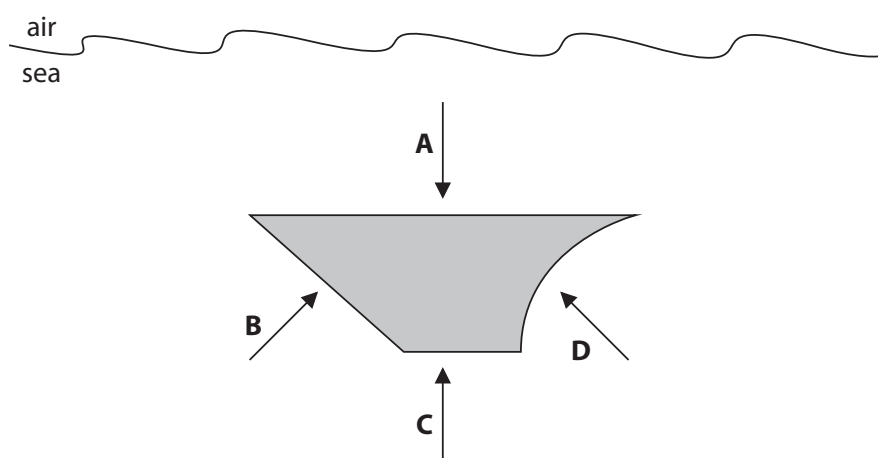


Figure 1

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(ii) Figure 2 shows two blocks of stone resting on the bottom of the sea.

Both blocks have the same height.

Area Y is 4 times bigger than area X.

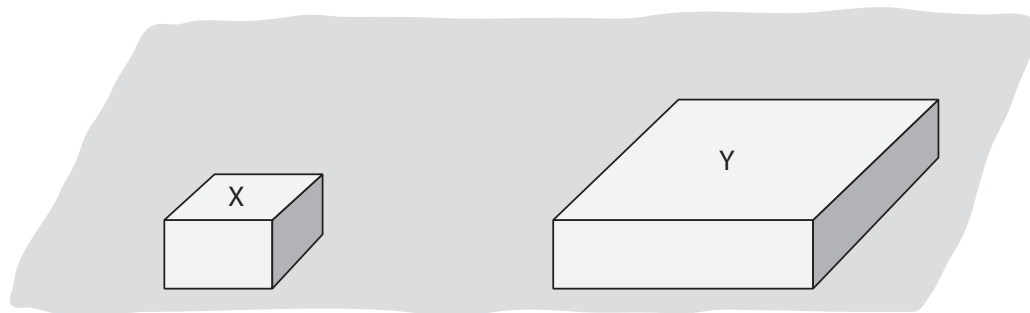


Figure 2

What is the pressure due to the water on the top surface of block Y?

(1)

- ☐ **A** one quarter of the pressure on X
- ☐ **B** the same as the pressure on X
- ☐ **C** twice the pressure on X
- ☐ **D** four times the pressure on X

(b) A diver is swimming underwater in a lake.

The diver wears the meter shown in Figure 3.

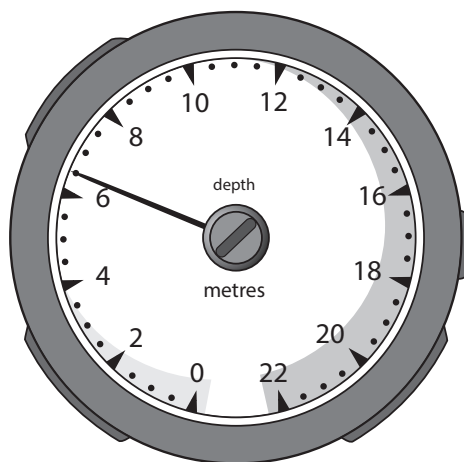


Figure 3

(i) The meter shows the depth of the diver below the surface of the water.

State the depth shown on the meter in Figure 3.

State the unit.

(2)

depth = ... unit = ...

(ii) State how the pressure of the water on the diver changes as the diver swims down from the surface of the lake.

(1)

.....

.....

(iii) State why the total pressure on the diver is greater than just the pressure due to the water above the diver.

(1)

.....

.....

(c) An aeroplane takes off from the ground.

State **two** factors that affect the pressure of the atmosphere on the aeroplane as the aeroplane goes higher in the atmosphere.

(2)

1.....

.....

2.....

.....

(Total for Question 1 = 8 marks)



- 2 (a) Figure 2 shows two gear wheels, **P** and **Q**.

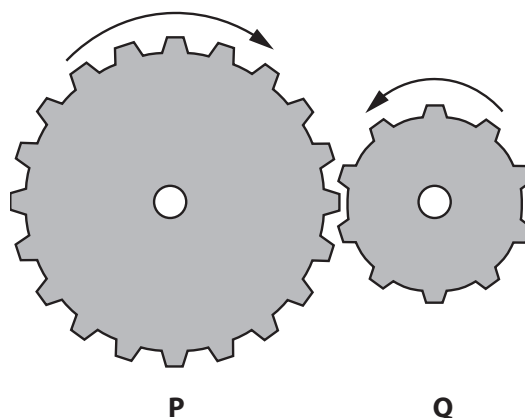


Figure 2

P has 20 teeth.

Q has 10 teeth.

- (i) **P** rotates once.

How many times does **Q** rotate when **P** rotates once?

(1)

- ☐ **A** 200 times
- ☐ **B** 20 times
- ☐ **C** 10 times
- ☐ **D** 2 times

- (ii) A third gear wheel is added to the system in Figure 2 so that this third wheel **rotates in the opposite direction to Q but at the same speed as Q**.

1. Draw an X on Figure 2 to show the position of this third gear wheel.
2. State how many teeth this third gear wheel has.

(2)

number of teeth = ...

(b) Figure 3 shows a 9.0 N force acting on a ruler.

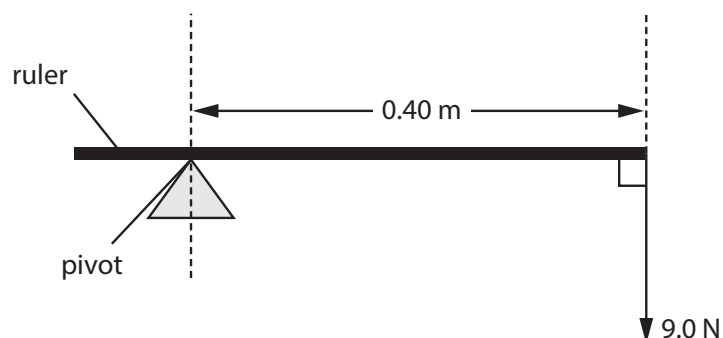


Figure 3

Calculate the moment of the 9.0 N force about the pivot.

Use the equation

$$\text{moment} = \text{force} \times \text{perpendicular distance of force from pivot}$$

(2)

moment = ... Nm

(c) Another ruler is balanced at its midpoint.

Figure 4 shows two forces, **F** and **G**, acting on this ruler.

The ruler is balanced (in equilibrium).

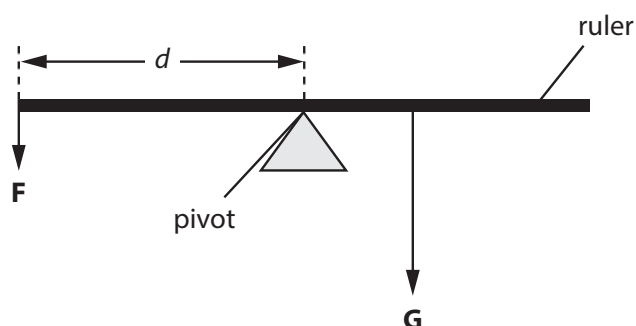


Figure 4

The moment of force **F** about the pivot = 2.4 N m.

(i) Use the principle of moments to state the moment of force **G** about the pivot.

(1)

moment of force **G** = ... N m

(ii) Force **F** = 8.0 N.

The moment of force **F** about the pivot = 2.4 N m.

Calculate the distance, *d*, of force **F** from the pivot.

Use the equation

moment = force × perpendicular distance of force from pivot
(2)

distance = ... m

(Total for Question 2 = 8 marks)

9-MARK QUESTIONS

3 questions in this booklet



- 5 (a) (i) Figure 9 shows two gears.

Gear Q moves clockwise as shown by the arrow.

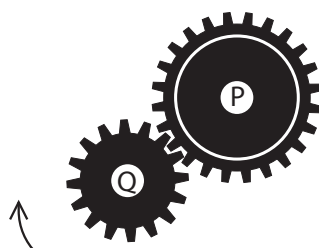


Figure 9

Which of these describes how gear P moves?

(1)

- ☐ A anticlockwise, slower than gear Q
- ☐ B anticlockwise, faster than gear Q
- ☐ C clockwise, slower than gear Q
- ☐ D clockwise, faster than gear Q

- (ii) Figure 10 shows the number of teeth on the gears.

Gear P has 24 teeth, gear Q has 16 teeth.

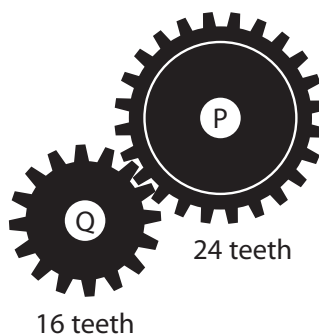


Figure 10

Which of these gives the ratio of the number of teeth on gear P to the number of teeth on gear Q?

(1)

- ☐ A $24 - 16$
- ☐ B $16 + 24$
- ☐ C $3 : 2$
- ☐ D $2 : 3$

(b) Figure 11 shows a lever used to lift a heavy load.

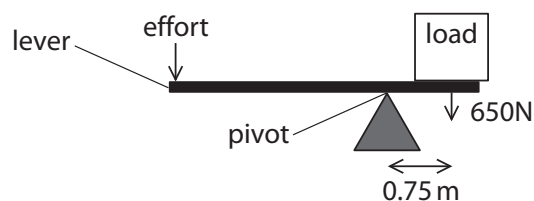


Figure 11

- (i) The weight of the load is 650 N.
The centre of the load is 0.75 m from the pivot.

Calculate the moment of the load about the pivot.
State the unit.

Use the equation

$$\text{moment} = \text{force} \times \text{distance from the pivot}$$

(3)

moment = ... unit

- (ii) State the principle of moments.

(1)

.....

.....

- (iii) An effort of 160 N is applied to the end of the lever to balance the load in Figure 11.

Calculate the distance between the effort and the pivot.

(3)

distance = ... m

(Total for Question 5 = 9 marks)

3 (a) (i) Figure 6 shows two gears.

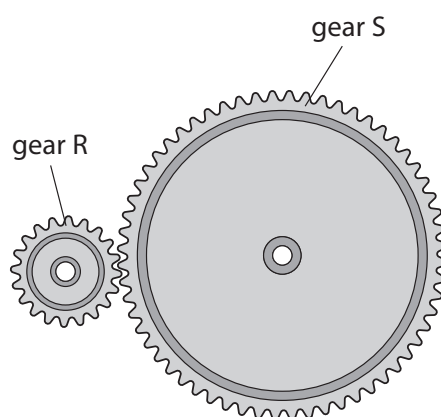


Figure 6

Gear R and gear S can rotate.

Gear R has 20 teeth.

Gear S has 60 teeth.

Gear S rotates through 2 complete revolutions.

Calculate how many complete revolutions gear R rotates by.

(2)

gear R has rotated through revolutions

(ii) Figure 7 shows two gears, S and T.

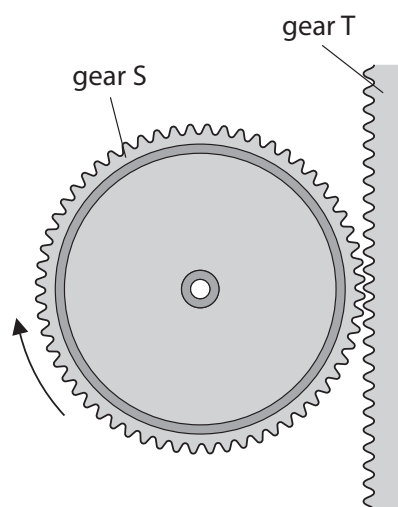


Figure 7

Gear S can rotate on a fixed axle.

Gear T can move up and down.

Gear S has 60 teeth.

The distance between each of the teeth on gear S and on gear T is 2 mm.

Gear S moves through one complete revolution in the direction shown.

Which of these describes the motion of gear T?

(1)

- ☐ **A** 60 mm up
- ☐ **B** 60 mm down
- ☐ **C** 120 mm up
- ☐ **D** 120 mm down

- (b) (i) Figure 8 shows a force of 70 N turning a lever about point P.

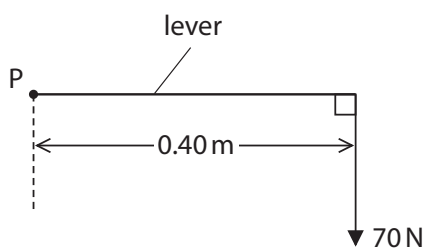


Figure 8

Calculate the moment of the 70 N force about point P.

State the unit.

Use the equation

$$\text{moment} = \text{force} \times \text{distance normal to the direction of the force}$$

(3)

moment = ... unit

(ii) Figure 9 shows a worker using a wheelbarrow to move some sand.

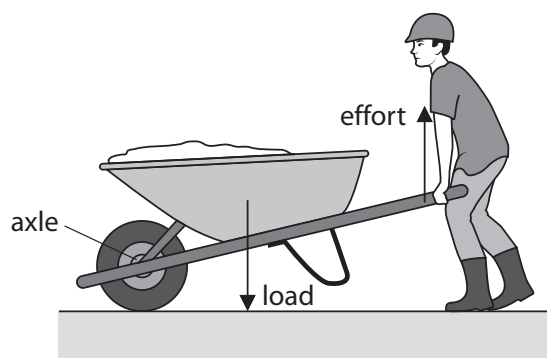


Figure 9

The load is equal to the total weight of the sand and the wheelbarrow.

The effort is the force that the worker applies to the wheelbarrow handles.

The worker applies just enough effort to lift the load.

Explain why the effort is smaller than the load.

(2)

.....

.....

.....

.....

(iii) Some sand falls down and sticks between the wheel and the axle.

State why it might be harder to push the wheelbarrow along when there is some sand between the wheel and the axle.

(1)

.....

.....

(Total for Question 3 = 9 marks)

- 3 (a) Figure 5 shows water coming out of holes in the side of a can.

The holes are at different heights.

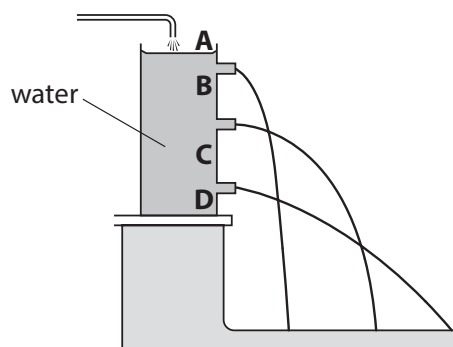


Figure 5

At which of these points is the pressure the lowest?

(1)

- ☒ A
- ☒ B
- ☒ C
- ☒ D

- (b) A student wants to find the pressure they exert on the floor.

The student starts by standing on a piece of squared paper and drawing around the base of their shoe, as shown in Figure 6.

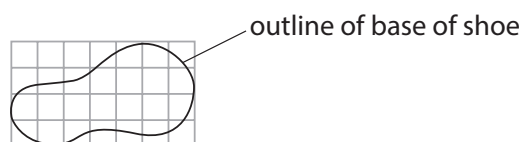


Figure 6

The area of each square is 25 cm^2 .

The student estimates that the base of the shoe covers about 12 squares.

- (i) Use this estimate to calculate the area of the base of the shoe.

(2)

area of base of shoe = ... cm^2

- (ii) Suggest **one** change that could be made to the squared paper so that the student can give a better estimate of the area of the base of the shoe.

(1)

- (iii) The total area of the base of a student's shoes is 0.031 m^2 .

The weight of the student is 680 N .

Calculate the pressure that the student exerts on the ground.

State the unit.

Use the equation

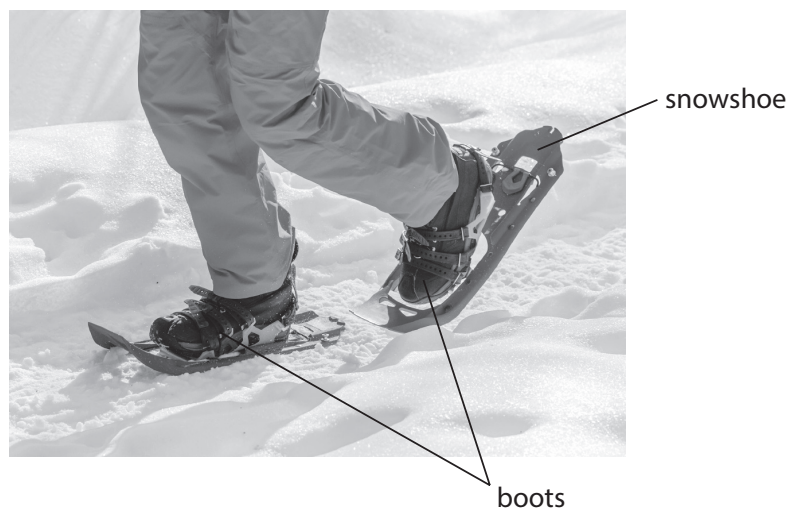
$$P = \frac{F}{A}$$

(3)

pressure = ... unit



(c) Figure 7 shows a person wearing snowshoes.



(Source: Pearson Asset Library)

Figure 7

Snow shoes are designed for walking on deep, soft snow.

Explain why they are better suited for this than boots.

(2)

(Total for Question 3 = 9 marks)

11-MARK QUESTIONS

5 questions in this booklet



4 (a) (i) Which of these forces keeps the Moon moving around the Earth?

(1)

- ☐ A contact
- ☐ B electrostatic
- ☐ C gravitational
- ☐ D magnetic

(ii) Which of these is a scalar quantity?

(1)

- ☐ A velocity
- ☐ B momentum
- ☐ C energy
- ☐ D acceleration

(b) Figure 7 shows a box at rest on a floor.

The force that the floor exerts on the box is shown by the vector in Figure 7.

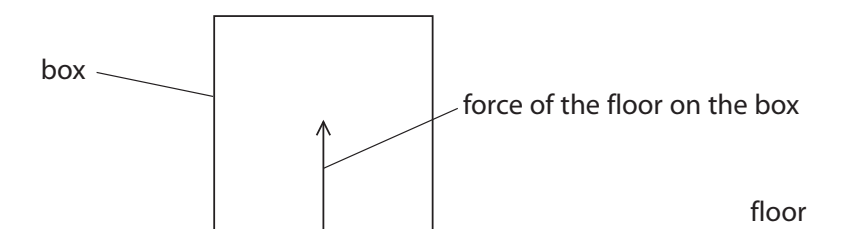


Figure 7

Add another vector to the diagram in Figure 7 to show the weight of the box.

(2)

(c) Figure 8 shows part of a cart.

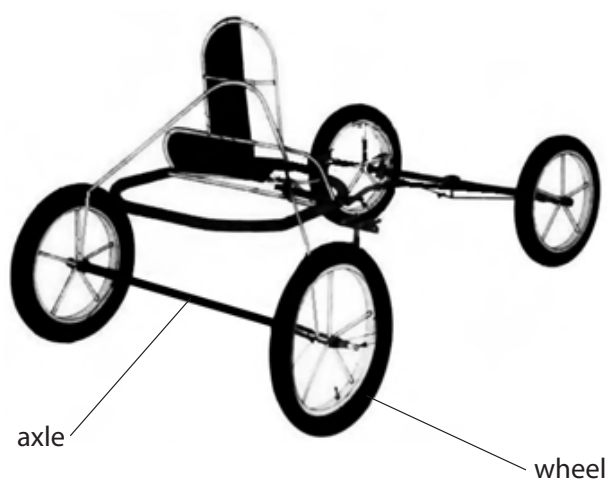


Figure 8

When the wheels turn the axles become warm.

(i) Explain why the axles become warm when the wheels turn.

(2)

.....

.....

.....

.....

(ii) Give **one** way of reducing the heating of the axles when the wheels turn.

(1)

.....

.....

- (d) (i) Complete the equation that relates efficiency, useful energy transferred by a device and total energy supplied to the device.

(1)

efficiency = _____

- (ii) In one second an engine has a total energy input of 7500 J.

In one second 3200 J is transferred to the surroundings as wasted energy.

Calculate the useful energy transferred by the engine.

(1)

useful energy transferred = ... J

- (iii) Calculate the efficiency of this engine.

(2)

efficiency of the engine = ...

(Total for Question 4 = 11 marks)



10 (a) Figure 23 shows some water in a tank.



Figure 23

- (i) The bottom of the tank has an area of 0.80 m^2 .

The force on the bottom of the tank, due to the water, is 2400 N .

Calculate the pressure, due to the water, on the bottom of the tank.

(3)

pressure = ... Pa

- (ii) More water is added to the tank.

Explain how the pressure on the bottom of the tank changes when more water is added to the tank.

(2)

.....

.....

.....

.....

(iii) Figure 24 shows an object on the bottom of the tank of water.

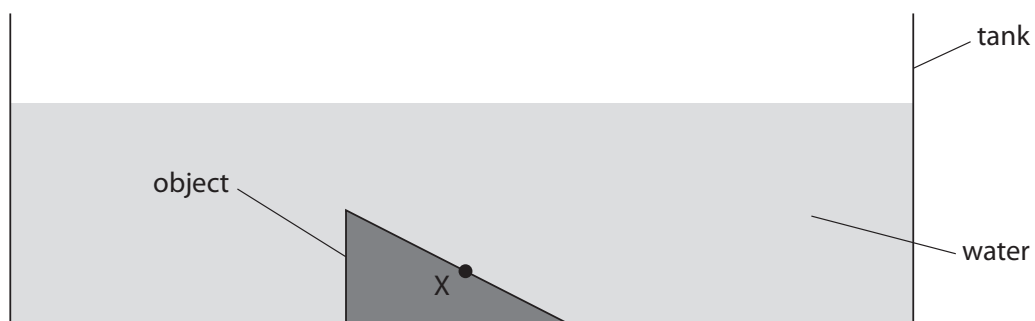


Figure 24

Draw an arrow on Figure 24 to show the direction of the force exerted by the water on the surface of the object at point X.

(1)

- (b) Figure 25 is a graph showing how the atmospheric pressure changes with the height above sea level on the Earth's surface.

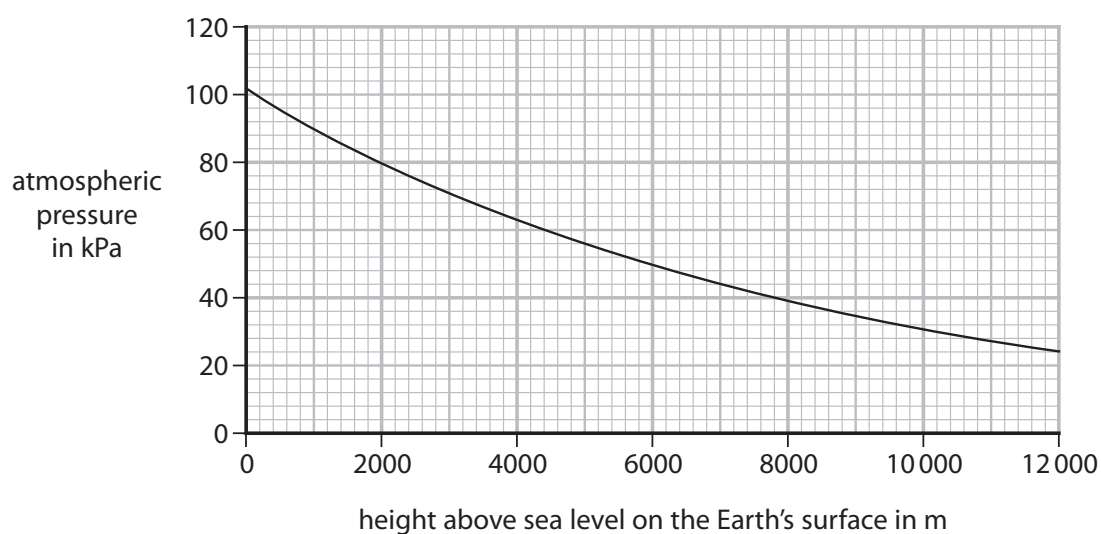


Figure 25

- (i) An aeroplane descends from 6000 m to 2000 m.

Use the graph to find the change in atmospheric pressure as the aeroplane descends.

(2)

change in pressure = ... kPa

- (ii) Suggest **one** reason why the atmospheric pressure is greater at 2000 m than at 6000 m.

(1)

.....

.....



(c) Figure 26 shows two drawings of the same person on a bed.

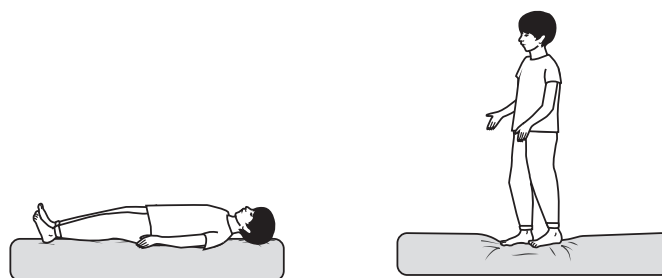


Figure 26

Explain why the person exerts a different pressure on the bed when standing up than when lying down.

(2)

.....

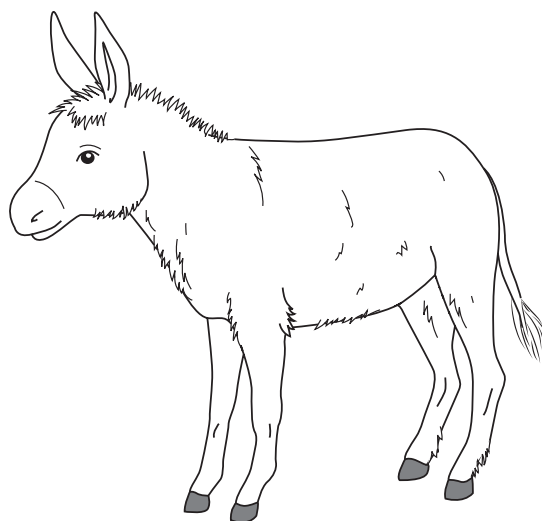
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.....

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(Total for Question 10 = 11 marks)

10 (a)

**Figure 23**

A donkey has a weight of 2500 N.

The area of each hoof is 0.022 m².

- (i) Calculate the average pressure that the donkey exerts on the ground.

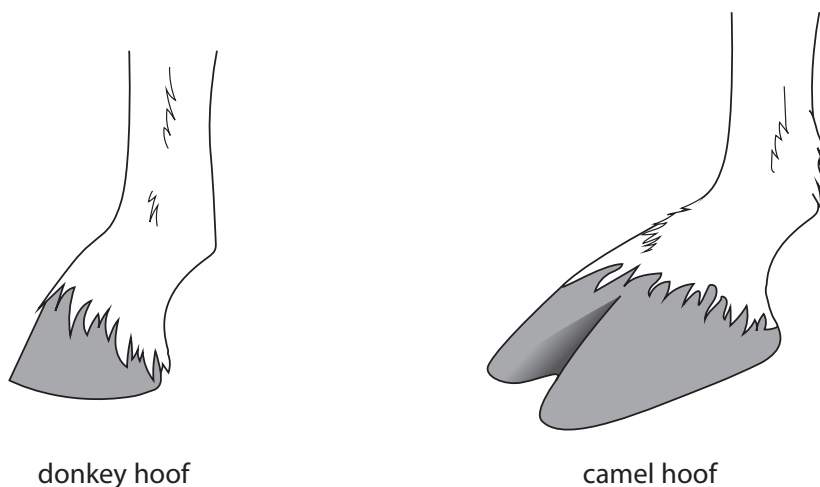
Use the equation

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

(2)

average pressure = ... Pa

- (ii) Figure 24 shows how the shape of a camel's hoof is different from the shape of a donkey's hoof.



Both diagrams are drawn to the same scale.

Figure 24

The camel and the donkey have the same mass.

Explain how a camel's hoof is a more suitable shape than a donkey's hoof for walking on soft ground.

(2)

.....

.....

.....

- (b) A student carries out an investigation to show how pressure varies with depth in water.

A pressure sensor is attached to a rule.

The rule and pressure sensor are lowered into the water in a tank, as shown in Figure 25.

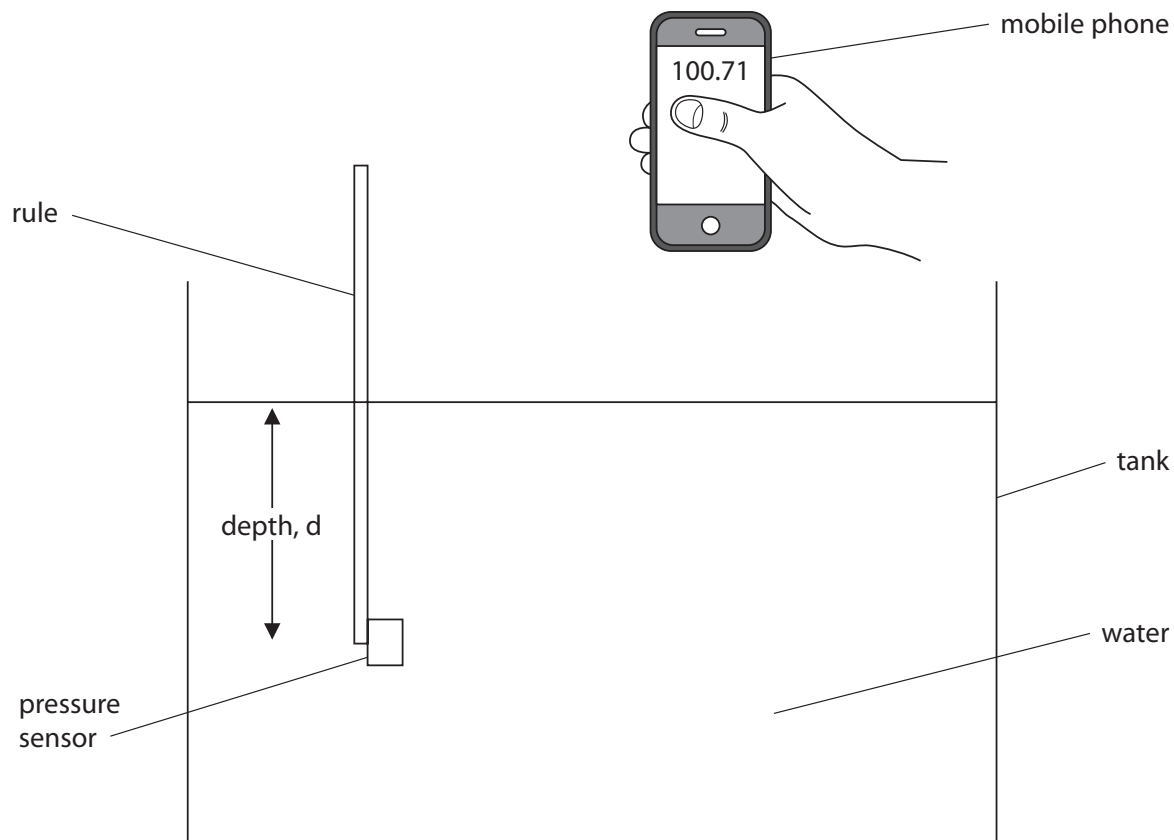


Figure 25

The depth of the pressure sensor below the surface of the water is read from the scale on the rule.

The pressure is displayed on the student's mobile phone which receives a signal from the pressure sensor.

Figure 26 gives some of the readings.

depth in m	pressure in kPa
0.050	99.15
0.100	99.70
0.150	100.15
0.200	100.70
0.250	101.15
0.300	101.70

Figure 26

Figure 27 shows a graph with some of the results plotted, but two of the points are missing.

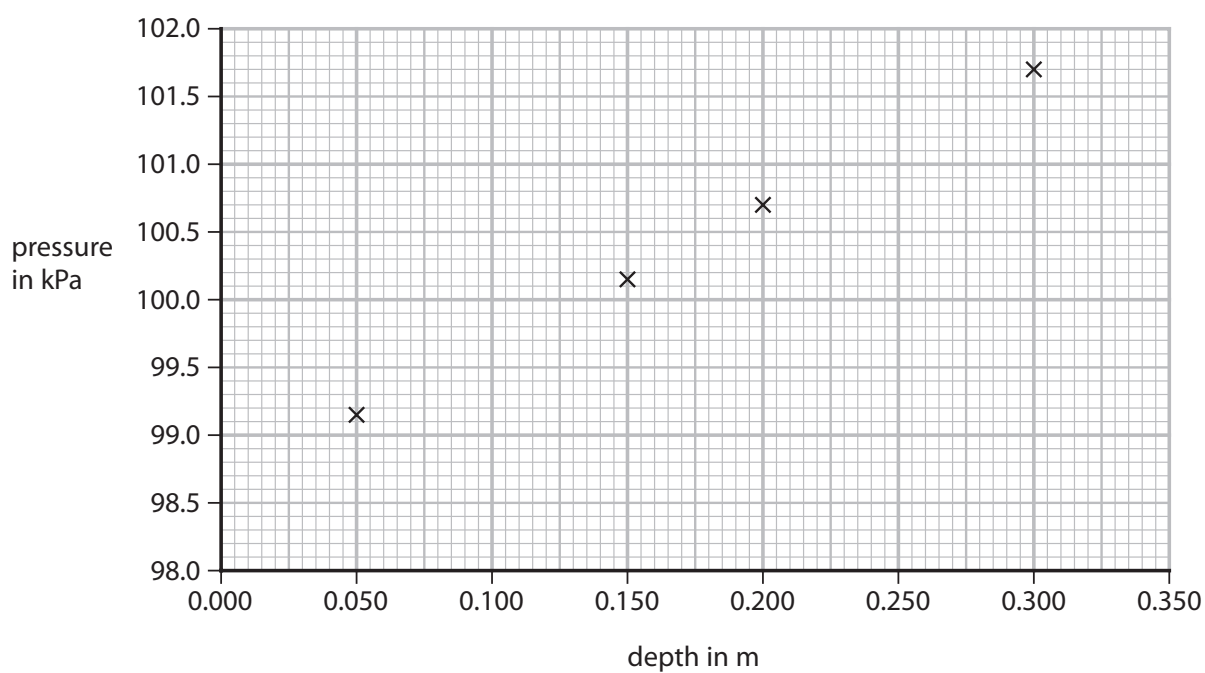


Figure 27

- (i) Plot the two missing points on the graph. (2)
- (ii) Draw a line of best fit through the points on the graph. (1)



(iii) Which of the following equations represents the variation of pressure with depth of water below the surface?

(1)

☐ **A** $y = ax^2 + b$

☐ **B** $y = mx$

☐ **C** $Y = mc - x$

☐ **D** $y = mx + c$

(iv) Use the graph in Figure 27 to predict the pressure at the surface of the water.

(1)

pressure at the surface of the water = ... kPa

(c) The student repeats the investigation in part (b) using seawater and draws a graph of the results.

The seawater is more dense than the water used in part (b).

Compare the graph for seawater with the graph in Figure 27.

(2)

.....

.....

.....

.....

(Total for Question 10 = 11 marks)



10 This question is about pressure.

(a) Figure 22 shows windows in an aeroplane.

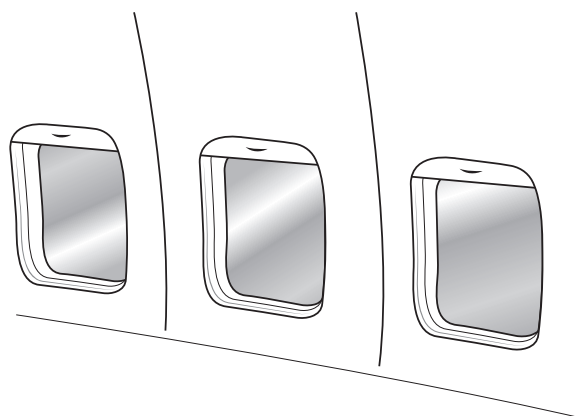


Figure 22

The aeroplane is high above the Earth's surface.

The atmospheric pressure outside the aeroplane is 23 000 Pa.

The air pressure inside the aeroplane is 80 000 Pa.

- (i) Calculate the pressure difference between inside and outside of the aeroplane.

(1)

pressure difference = ... Pa

- (ii) The surface area of the window is 0.094 m².

Calculate the size of the force on the window due to the cabin air pressure of 80 000 Pa.

Use the equation

$$P = \frac{F}{A}$$

(2)

force = ... N

- (iii) On the same aeroplane, a different window has a smaller surface area.

Explain how the force due to the air pressure inside the cabin on the small window differs from the force on the larger window.

(2)

- (iv) Figure 23 shows a cross-section through the aeroplane including one window.

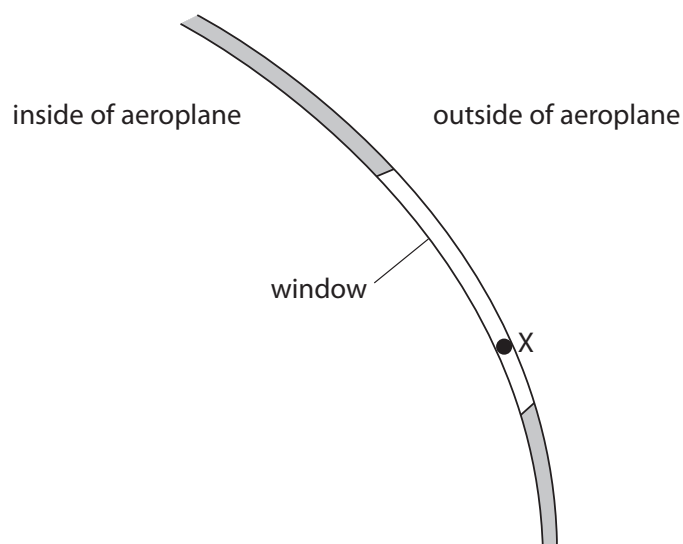


Figure 23

Draw an arrow on Figure 23 to show the direction of the resultant force due to the air pressure inside the cabin on the window at point X.

(2)

- (b) Figure 24 shows the atmospheric pressure at different heights above the Earth's surface.

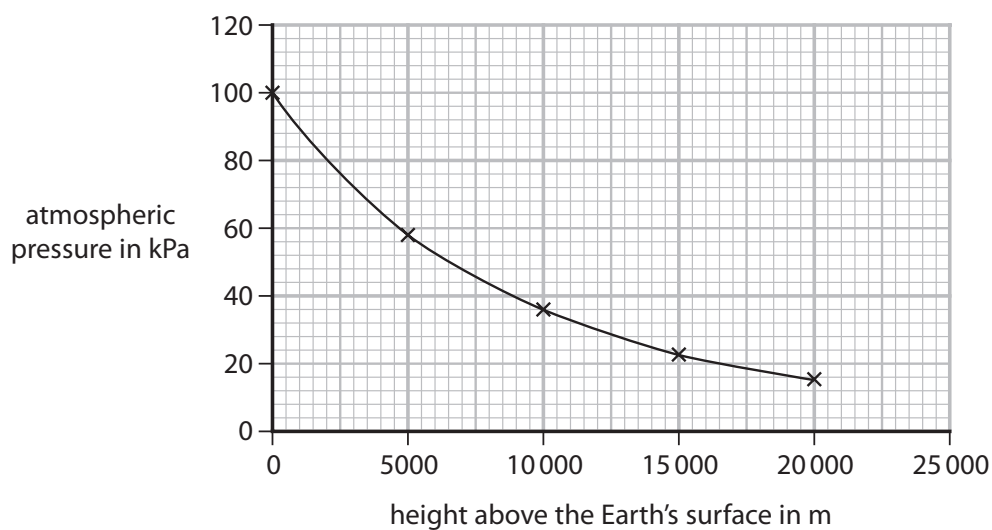


Figure 24

- (i) Describe how the atmospheric pressure changes with height above the Earth's surface.

Use data from Figure 24 to support your answer.

(3)

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- (ii) Suggest **one** reason why the atmospheric pressure changes with height above the Earth's surface.

(1)

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.....

(Total for Question 10 = 11 marks)

10 (a) Figure 25 shows an object at the bottom of a beaker of water.

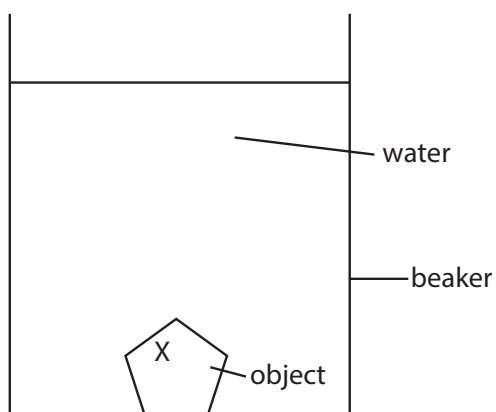


Figure 25

Which diagram shows the direction of the force exerted by the water on the object at point X?

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(b) Figure 26 shows an ice skater standing on one skate.

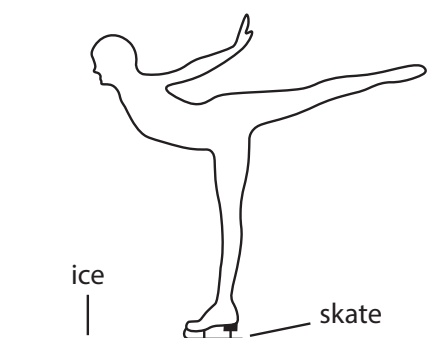


Figure 26

Calculate the force the skate exerts on the ice.

pressure of skate on ice = 4.8×10^7 Pa

area of blade in contact with ice = 1.2×10^{-5} m²

Use the equation

$$\text{force} = \text{pressure} \times \text{area}$$

Give your answer to 2 significant figures.

(3)

force = ... N

(c) Figure 27 shows how atmospheric pressure changes with height above sea level.

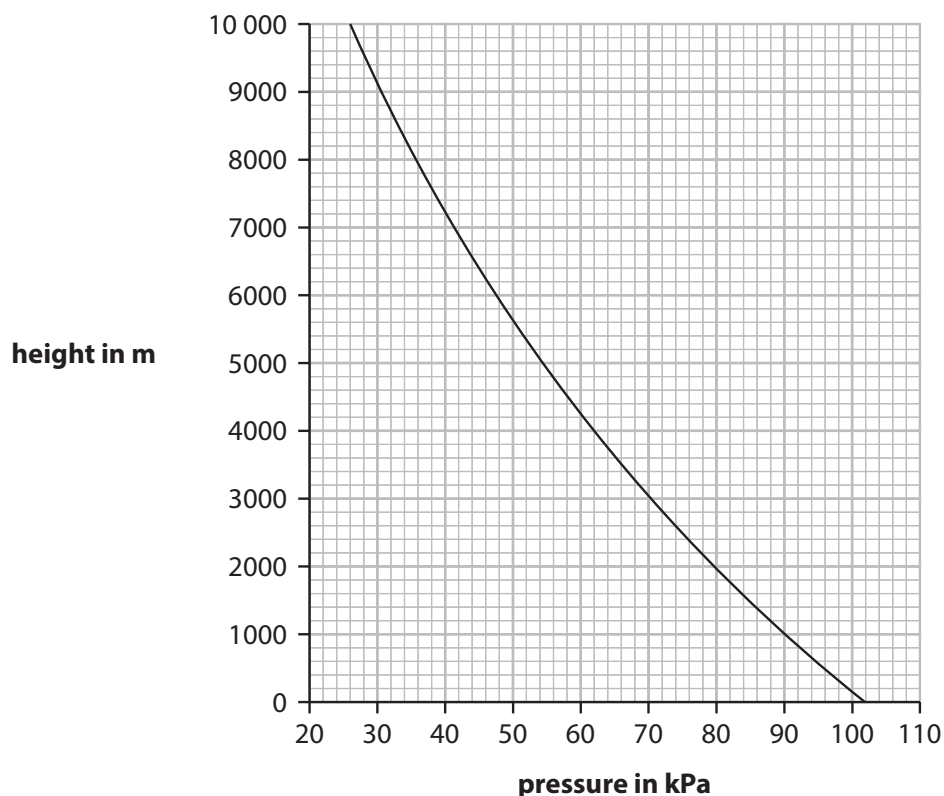


Figure 27

- (i) Using the graph, describe how atmospheric pressure changes with height above sea level.

(2)

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- (ii) The top of Mount Everest is 8850 m above sea level.
Using the graph, estimate the atmospheric pressure at the top of Mount Everest.

(1)

pressure = ... kPa

- (iii) On a different day, the pressure at sea level is 104 kPa and the pressure at a height of 2500 m is 74 kPa.

Calculate the percentage change in pressure from sea level to the height of 2500 m.

(2)

percentage change = ... %

- (d) Figure 28 is a model representing molecules of the Earth's atmosphere.

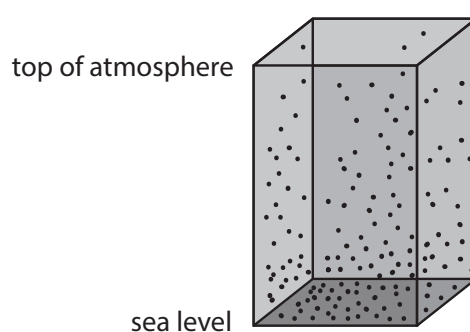


Figure 28

Use Figure 28 to explain how the density of the air varies with height above sea level.

(2)

.....

.....

.....

.....

(Total for Question 10 = 11 marks)

12-MARK QUESTIONS

1 question in this booklet



7 (a) Which of these is a vector?

(1)

- ☐ A distance
- ☐ B force
- ☐ C mass
- ☐ D work done

(b) Figure 17 shows a balanced seesaw with two children on it.

The pivot is at the centre of the seesaw.

The seesaw is balanced with no children sitting on it.

Child P has a weight of 150 N.

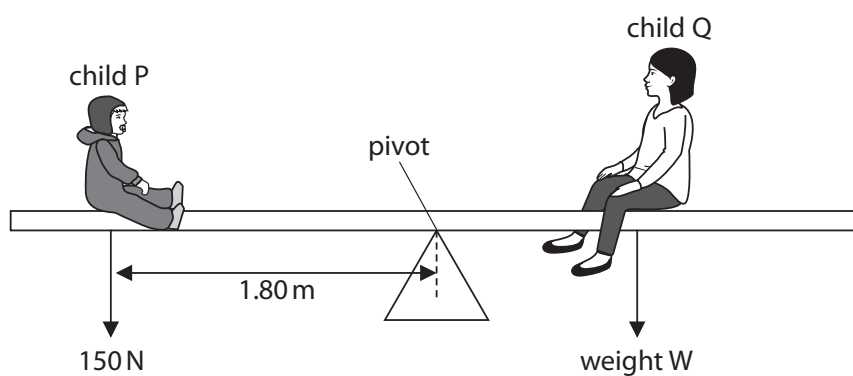


Figure 17

(i) Calculate the moment of the weight of child P about the pivot in N m.

Use the equation

$$\text{moment of a force} = \text{force} \times \text{distance to pivot}$$

(2)

moment = ... N m

- (ii) Figure 18 shows the same balanced seesaw, with the distance of child Q to the pivot labelled as well.

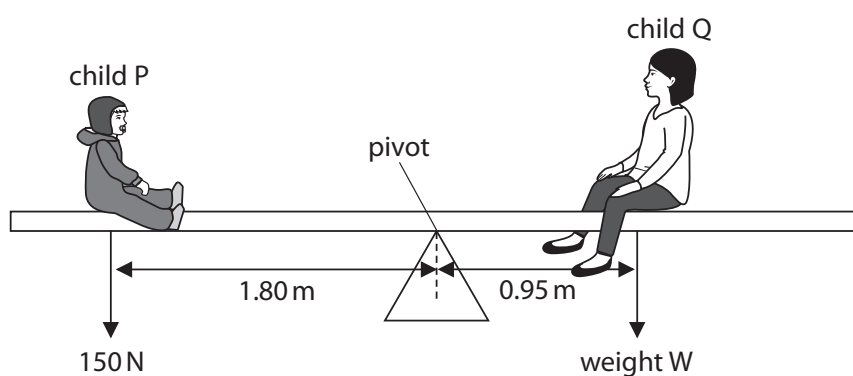


Figure 18

Calculate the value of W , the weight of child Q.

Use the idea of moments and the equation

$$\text{the moment of } W = \text{the moment of the weight of child P}$$

Give your answer to 2 significant figures.

(3)

$W = \dots\dots\dots \text{ N}$

*(c) Figure 19 shows a crowbar being used to lift a heavy weight.

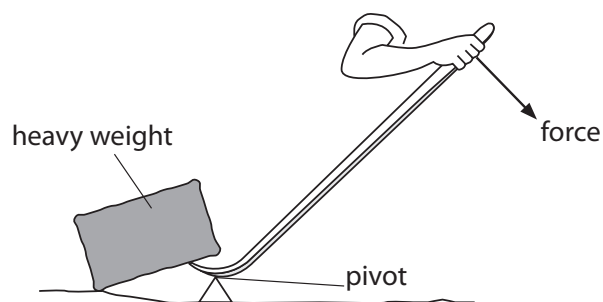


Figure 19

Explain how the crowbar enables a person to lift a heavy weight.

You should include the idea of moments in your answer.

It may help to label some distances in Figure 19 and use those distances in your explanation.

(6)

(Total for Question 7 = 12 marks)

13-MARK QUESTIONS

3 questions in this booklet



- 7 (a) The graph in Figure 14 shows the variation in atmospheric pressure with the height above sea level.

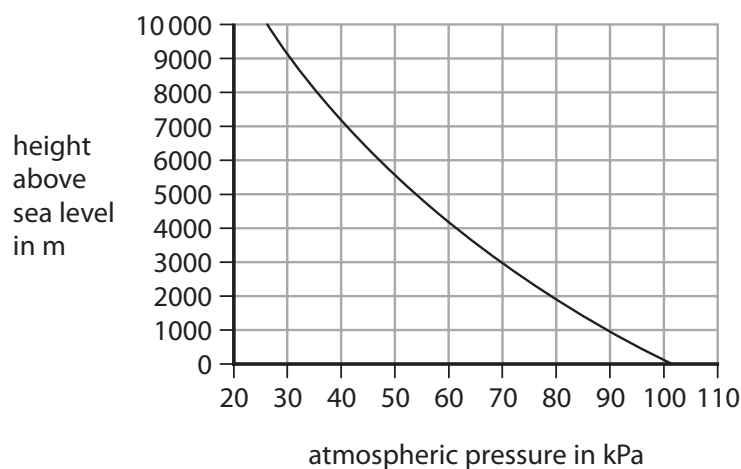


Figure 14

- (i) Use the graph to estimate the atmospheric pressure at 3000 m above sea level.

(1)

atmospheric pressure = ... kPa

- (ii) Use the graph to estimate the atmospheric pressure at 6000 m above sea level.

(1)

atmospheric pressure = ... kPa

- (iii) Suggest a reason why the atmospheric pressure decreases with height above sea level.

(1)

.....

.....

(b) Figure 15 shows different water levels in two similar water containers with taps.

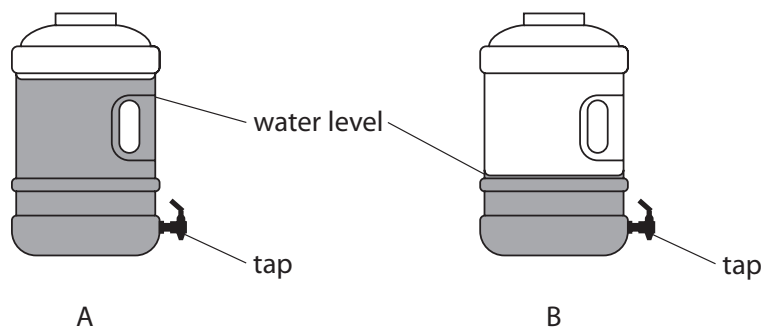


Figure 15

Explain why the water runs out of the tap of container A faster than out of the tap of container B.

(2)

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(c) 10 m of sea water exerts the same pressure as the atmosphere.

A submarine is at a depth of 50 m below the surface of the sea.

Calculate how many times greater the pressure is on the submarine than atmospheric pressure.

(2)

pressure = ... times greater

9 (a) Figure 23 shows a drone.



© Liubov Kotliar/123RF

Figure 23

The drone has four spinning blades.

The upward force produced enables the drone to rise in the air.

The speed at which the blades spin is measured in turns per minute.

Figure 24 shows how the upward force produced by the four blades depends on the speed at which the blades spin.

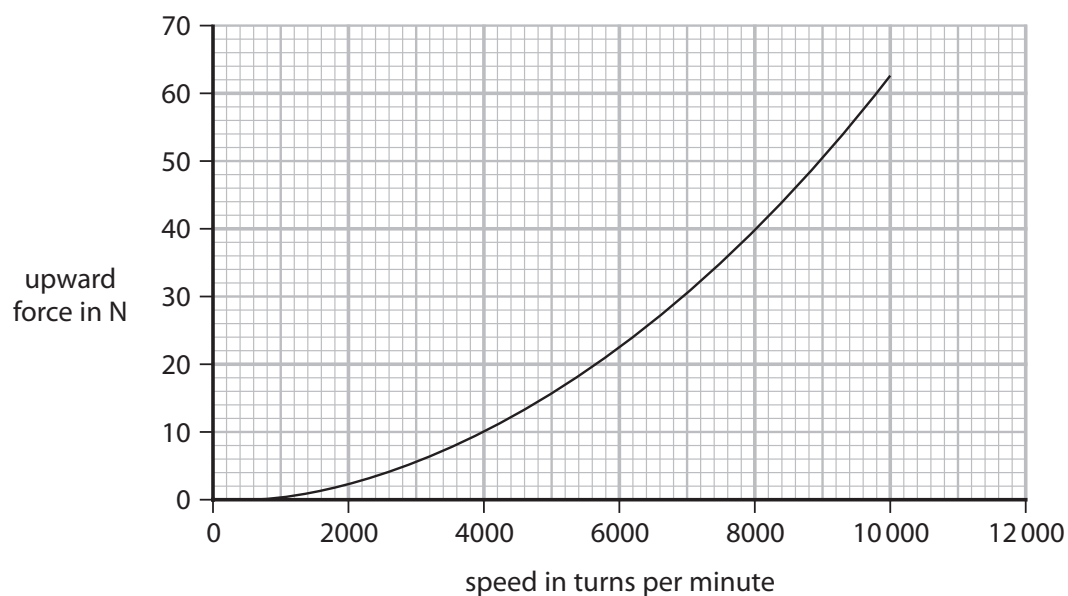


Figure 24

Describe the relationship between upward force and speed shown by this graph.

(2)

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.....

- (b) A different drone has a mass of 4.5 kg.

This drone rises from the ground to a height of 20 m.

- (i) Calculate the change in gravitational potential energy when the drone rises through a height of 20 m.

The gravitational field strength $g = 10 \text{ N/kg}$.

(2)

change in gravitational potential energy = ... J

- (ii) State the amount of useful work done by the blades as the drone rises through 20 m.

(1)

useful work done = ... J

- (iii) It takes 4 s for the drone to rise through 20 m.

Calculate the useful power developed by the blades in this time of 4 s.

(2)

useful power developed = ... W



- 7 (a) Figure 14 is a graph of atmospheric pressure against height above the surface of the Earth.

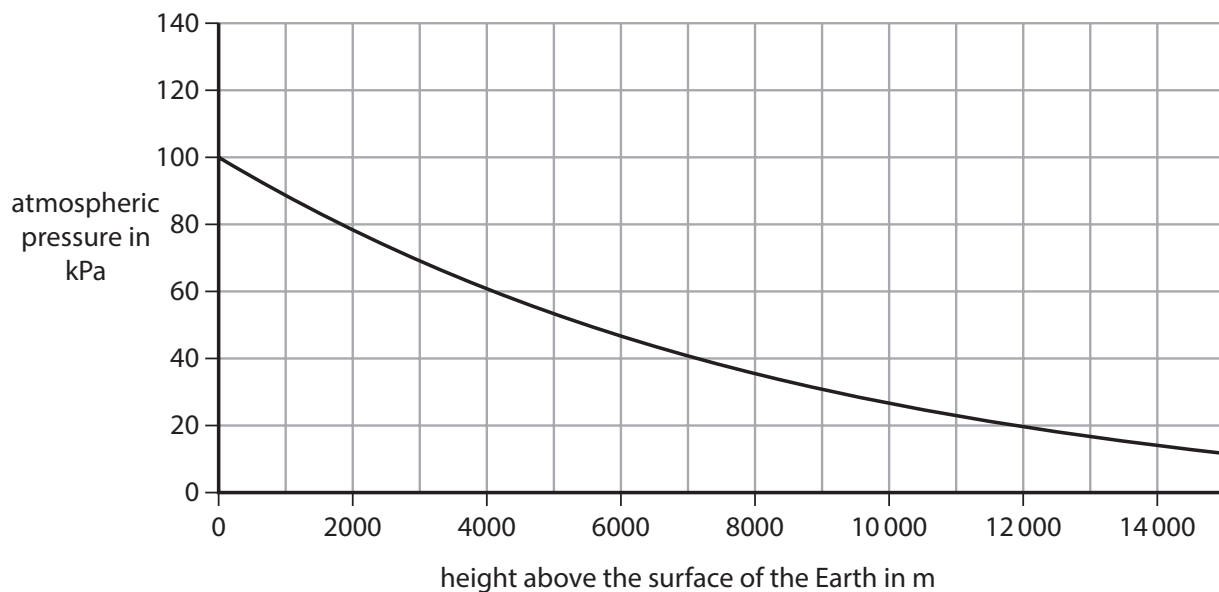


Figure 14

- (i) The atmospheric pressure at 3000 m above the surface of the Earth, as shown in Figure 14, is

(1)

- ☐ A 80 kPa
☐ B 70 kPa
☐ C 60 kPa
☐ D 50 kPa

- (ii) Use Figure 14 to describe how the atmospheric pressure depends on the height above the surface of the earth.

(2)

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- (b) Figure 15 shows an oxygen cylinder used to provide patients with oxygen in hospital.



(Source: Pearson Asset Library)

Figure 15

The volume of the cylinder, V_1 , is 2.3 litres.

The pressure of gas in the cylinder, P_1 , is 15 MPa.

Oxygen is released from the cylinder to the patient at a pressure of $P_2 = 0.35$ MPa.

- (i) Show that the total volume, V_2 , of oxygen that can be released to the patient is about 100 litres at this pressure.

Use the equation

$$V_2 = \frac{P_1 \times V_1}{P_2}$$

(2)

- (ii) The oxygen from the cylinder flows to the patient at 6 litres/minute.

Calculate the time taken for the 100 litres of oxygen to be used up at this rate.

(1)

time taken minutes

- (iii) A patient requires oxygen for a longer period of time.

Suggest what could be done to supply oxygen over this longer period of time.

(1)

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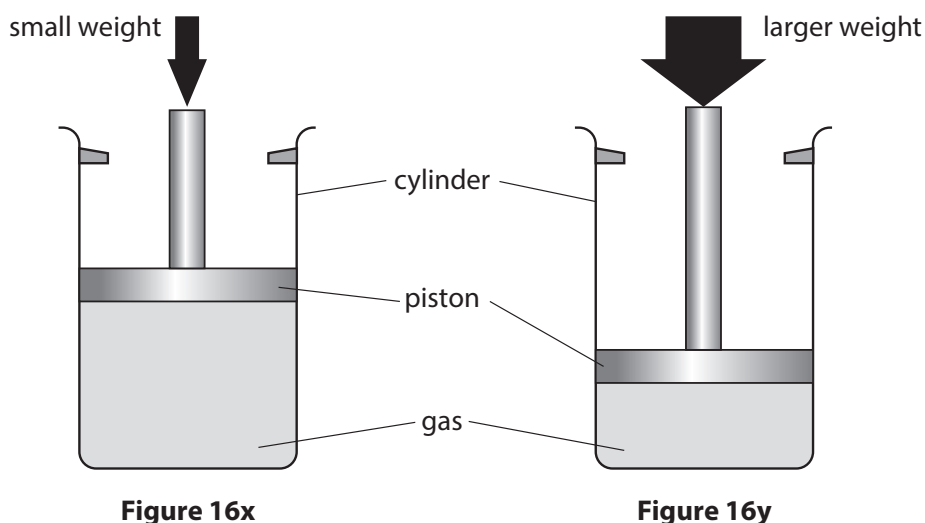


*(c) Figure 16 shows a cylinder containing some gas.

A piston prevents the gas escaping.

In Figure 16x a small weight pushes down and the volume and pressure of the gas are measured.

Following this, in Figure 16y, a larger weight pushes down and the volume and pressure of the gas are measured again.



Explain why the pressure and volume of the gas in the cylinder change when the larger weight pushes down on the piston.
The temperature of the gas does not change.

Your answer should include

- how the volume and pressure change
- how the gas particles exert a force on the piston

(6)

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(Total for Question 7 = 13 marks)

MARK SCHEMES

official Pearson Edexcel mark schemes



Question number	Answer	Mark
2(a)	(i) gravitational (1) (ii) friction (1) (iii) electrostatic (1)	(3) AO1

Question number	Answer	Mark
2(b)	C It has direction and size Option C is the only correct combination for a vector quantity	(1) AO1

Question number	Answer	Additional guidance	Mark
2(c)	substitution (1) (moment) = $200 \times 3(.0)$ evaluation (1) 600 (Nm) unit (1) Nm	 award full marks for correct answer without working independent mark ignore J / Joules	(3) AO2

(Total for Question 2 = 7 marks)

Question number	Answer	Mark
2 (a)	B plotting compass A is incorrect because a force causes a linear movement. C is incorrect because the liquid column expands or contracts linearly. D is incorrect because the slider is moved linearly	(1) AO1

Question number	Answer	Additional guidance	Mark
2 (b)	substitution (1) (moment =) $4(.0) \times 5(.0) (/100)$ evaluation (1) (moment =) $0.2(0)$ (Nm)	2 to any incorrect power of ten scores 1 mark e.g. 20 or 2000 etc award full marks for the correct answer without working	(2) AO2

Question number	Answer	Additional guidance	Mark
2 (c)	identification of clockwise and anticlockwise moment (1) $3(.0) \times 5(.0) (/100)$ $6.0 \times 2.5 (/100)$ values (of both moments) are equal (1)	15 and 15 seen or 0.15 and 0.15 seen Accept Y is half the force (as Z) but twice the distance (from the pivot as Z) for this mark may be implied by = sign (turning effect) of the two forces are equal	(2) AO2

Question number	Answer	Additional guidance	Mark
2 (d)	(speed of R is) same (as speed of) P (1) (sense/direction of R is) same (as sense/direction of P) (1)	clockwise / to the right mark may be awarded by arrow on diagram (provided it is not contradicted by a statement)	(2) AO1

Total 7 marks

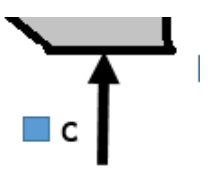
Question Number	Answer	Mark
2(a)	A gravitational B,C and D are incorrect because the only force that keeps the Moon in orbit around the Earth is gravitational	(1) A01.1

Question Number	Answer	Additional guidance	Mark
2(b)(i)	substitution (1) 375×1.4 evaluation (1) 525 (Nm)	525 to any other power of 10 scores 1 mark award full marks for the correct answer without working	(2) A02.1

Question Number	Answer	Additional guidance	Mark
2(b)(ii)	an explanation linking: the distance (from the pivot) is increased (1) increasing the moment/turning effect of the force (1)	accept further away accept (makes it) easier to turn / lift accept less force / effort (to move)	(2) A02.2

Question Number	Answer	Additional guidance	Mark
2 (c)	anticlockwise moment (1) $4 \times 20 = 80 \text{ (N cm)}$	accept $4 \times 0.2 = 0.8 \text{ (N m)}$ accept $4 \times 2 = 8 \text{ (ratio idea)}$	(2) AO2.1
	OR substitution (1) $X \times 40 = 4 \times 20$ evaluation (1) $X = 2.0 \text{ (N)}$	accept rearranged $X = \frac{4 \times 20}{40}$ accept $X \times 0.40 = 4 \times 0.20$ accept $X \times 4 = 4 \times 2$ accept 2 (N) award full marks for the correct answer without working	AO2.2

Total for Question 2 = 7 mark

Question number	Answer	Additional guidance	Mark
1 ai	 A, B and D are incorrect because they are all closer to the surface		(1)

Question number	Answer	Additional guidance	Mark
1 aii	B. the same as the pressure on X A,C and D are incorrect because the pressure does not depend on surface area		(1)

Question number	Answer	Additional guidance	Mark
1 bi	6.5 (1) m (1)	metres / meters allow M independent marks	(2)

Question number	Answer	Additional guidance	Mark
1 bii	the pressure increases		(1)

Question number	Answer	Additional guidance	Mark
1 biii	there is additional pressure due to the atmosphere		(1)

Question number	Answer	Additional guidance	Mark
1 c	Any two from: height of atmosphere (above aeroplane) (1) density of atmosphere (1) the temperature (of the atmosphere) (1)	less air above the aeroplane accept oxygen for air in this context the air gets thinner the air gets colder	(2)

Total for question 1 = 7 marks

Question	Answer	Additional guidance	Mark
2(c)(i)	2.4 (Nm) (1)		(1) AO2.1

Question	Answer	Additional guidance	Mark
2(c)(ii)	substitution (1) $2.4 = 8.0 \times \text{distance}$ rearrangement and evaluation (1) $(\text{distance} =) \frac{2.4}{8.0} = 0.3 \text{ (m)}$	award full marks for the correct answer without working if no other mark scored, accept for 1 mark $\text{distance} = \frac{\text{moment}}{\text{force}}$ OR accept for 1 mark 3.3 OR	(2) AO2.1

		accept for 1 mark 19.2	
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(Total for question 2 = 8 marks)

Question Number:	Answer	Mark
5(a)(i)	A anticlockwise, slower than gear Q The only correct answer is A <i>B is not correct as P is the larger gear and can only move slower than gear Q and anticlockwise</i> <i>C is not correct as gear P must be moving anticlockwise as gear Q is moving clockwise</i> <i>D is not correct as gear P must be moving anticlockwise as gear Q is moving clockwise</i>	(1) AO 3 2a

Question Number:	Answer	Mark
5(a)(ii)	C 3:2 The only correct answer is C <i>A is not correct as it is a subtraction</i> <i>B is not correct as it is an addition</i> <i>D is not correct as it gives the ratio of teeth on Q to teeth on P</i>	(1) AO 1 2

Question Number:	Answer	Additional guidance	Mark
5(b)(i)	substitution(1) (moment) = 650×0.75 evaluation(1) 490 unit (1) Nm	accept any value that rounds to 490 e.g. 487.5 allow a maximum of 1 mark out of the first two marking points for a power of ten error independent mark award full marks for the correct answer without any working	(3) AO 1 1 AO 2 1

Question Number:	Answer	Additional guidance	Mark
5(b)(ii)	(sum of the) clockwise moments (about a point) = (sum of the) anticlockwise moments (about that point) (1)	idea that moments on each side of a pivot can be balanced	(1) AO 1 1

Question Number:	Answer	Additional guidance	Mark
5(b)(iii)	substitution(1) $160 \times \text{distance of effort from pivot} = 490$ rearrangement (1) $\text{distance of effort from pivot} = \frac{490}{160}$ evaluation (1) $3.1(\text{m})$	substitution and rearrangement in either order accept $160 \times \text{distance of effort from pivot} = 487.5$ $160 \times \text{distance from pivot} = 650 \times 0.75$ accept $\frac{650 \times 0.75}{160}$ $\frac{487.5}{160}$ accept any value which rounds to 3 maximum of two marks for a power of ten error award full marks for the correct answer without working	(1) AO 2 1

(Total for Question 5 = 9 marks)

Question number	Answer	Additional guidance	Mark
3ai	evaluation of gear ratio (1) 1:3 evaluation of number of revolutions (1) 6	allow 1 mark if 60/20 or 20/60 or 20:60 or 60:20 seen award full marks for the correct answer without working	(2)

Question number	Answer	Additional guidance	Mark
3aii	D 120mm down A and C are incorrect because gear T moves down B is incorrect because gear T moves 2mm per tooth		(1)

Question number	Answer	Additional guidance	Mark
3 bi	substitution (1) (moment=) 0.40×70 evaluation (1) 28 Nm (1)	independent mark award full marks for the correct answer without working	(3)

Question number	Answer	Additional guidance	Mark
3 bii	an explanation linking the effort is at a bigger distance (1) from fulcrum (than the load) (1)	allow reverse argument for load (magnitudes of) moments are the same allow wheel/axle/pivot for fulcrum	(2)

Question number	Answer	Additional guidance	Mark
3 biii	(there will be more) friction (between the axle and wheel)	inside the bearing	(1)

Total for question 3 = 9 marks

Question Number	Answer	Mark
3(a)	A the highest point in the can B, C and D are incorrect because they are lower in the can and more pressure is exerted	(1) AO1.1

Question Number	Answer	Additional guidance	Mark
3(b)(i)	use (1) 12 x 25 evaluate (1) 300 (cm²)	300 to any other power of ten scores 1 mark award full marks for the correct answer without working	(2) AO2.1

Question Number	Answer	Additional guidance	Mark
3b(ii)	(use paper with) smaller divisions/squares (1)	accept suggested square area less than 25cm² accept use larger paper (so the shoe fits easier) ignore repeating	(1) AO3b

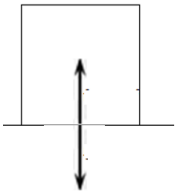
Question Number	Answer	Additional guidance	Mark
3 (b)(iii)	substitution (1) $(P =) \frac{680}{0.031}$ evaluation (1) 22 000 (Pa) OR substitution (1) $(P =) \frac{680}{0.062}$ evaluation (1) 11 000 (Pa) unit (1) Pa OR N/m² OR Pascal	accept any answer that rounds to 22 000 or 2.2×10^4 power of ten error scores 1 mark accept any answer that rounds to 11 000 or 1.1×10^4 power of ten error scores 1 mark award first 2 marks for the correct answer without working independent mark do not accept Nm² do not accept n for N accept for 3 marks: 22 kPa OR 11 kPa OR 2.2 N/cm² OR 1.1 N/cm²	(3) AO2.1 AO1.1

Question Number	Answer	Additional guidance	Mark
3 (c)	an explanation linking: (snowshoes have a) large(r) (surface) area (than boots) (1) reduces the pressure (on the snow) (1)	accept reverse argument throughout accept do not sink into snow/ stay on top of the snow	(2) AO2.2

Total for Question 3= 9 marks

Question Number:	Answer	Mark
4(a)(i)	C gravitational The only correct answer is C <i>A is not correct as the moon does not touch the Earth</i> <i>B is not correct as the Earth does not carry a charge</i> <i>D is not correct as the Earth has a magnetic field but it does not extend far enough to have any effect on the moon</i>	(1) AO 2 1

Question Number:	Answer	Mark
4(a)(ii)	C energy The only correct answer is C <i>A is not correct as velocity is a vector quantity</i> <i>B is not correct as momentum is a vector quantity</i> <i>D is not correct as acceleration is a vector quantity</i>	(1) AO 1 1

Question Number:	Answer	Additional guidance	Mark
4(b)	 arrowed line vertically downwards (anywhere) (1) same length as vertical arrow upwards (1)	more than one line drawn 1 mark maximum judge by eye	(2) AO 1 1

Question Number:	Answer	Additional guidance	Mark
4(c)(i)	an explanation linking: wheel rubs on axle (as it rotates) OR friction (between the wheel and the axle) (1) causes heating/transfer of (thermal) energy/ work being done (1)	allow generates heat	(2) AO 1 1

Question Number:	Answer	Additional guidance	Mark
4(c)(ii)	any one from: lubrication/oil (1) (ball) bearings / ball-race (1) go slower (1)	anything that lubricates – grease etc.	(1) AO 1 1

Question Number:	Answer	Mark
4(d)(i)	efficiency = <u>useful</u> (energy transferred by the device) (x100) total (energy supplied to the device)	(1) AO 1 1

Question Number:	Answer	Additional guidance	Mark
4(d)(ii)	determine useful energy (1) 7500 - 3200 = 4300		(1) AO 2 1

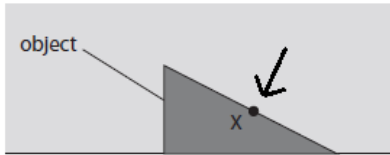
Question Number:	Answer	Additional guidance	Mark
4(d)(iii)	substitution (1) efficiency = $\frac{4300}{7500}$ evaluation (1) 0.57	allow ECF from (i) and/ or (ii) for 1 mark maximum accept 57(.33)(%), 0.6, 60(%) award full marks for the correct answer without working	(2) AO 2 1

(Total for Question 4 = 11 marks)



Question number	Answer	Additional guidance	Mark
10 ai	recall (1) $p = \frac{F}{A}$ substitution (1) $(p) = \frac{2400}{0.8}$ evaluation $(p) = 3000 \text{ (Pa)} \quad (1)$	may be implied by a correct substitution award full marks for the correct answer without working	(3) AO2

Question number	Answer	Additional guidance	Mark
10 aii	an explanation linking greater pressure (on bottom of tank) (1) with greater force due to water (above bottom of tank) (1)	more weight of water more depth/height of water ignore simply 'more water' or 'greater amount of water'	(2) AO1

Question number	Answer	Additional guidance	Mark
10 aiii	 an arrow perpendicular to the sloping side and pointing towards X	judge by eye	(1) AO1

Question number	Answer	Additional guidance	Mark
10 bi	data points correctly identified (1) 50 $\pm$2 80 $\pm$2 evaluation (1) (-)30 $\pm$4 kPa	award 1 mark if 80 and 50 seen ignore the lack of minus sign allow ecf from incorrect reading of either pressure at 2000m or pressure at 6000m for one mark	(2) AO3

Question number	Answer	Additional guidance	Mark
10 bii	any one suggestion of greater density of atmosphere (1) greater depth of atmosphere (above the aeroplane) (1) greater temperature (of the atmosphere) (1)	accept reverse argument more particles (per cubic metre) the air gets thicker greater weight of the atmosphere	(1) AO1

Question number	Answer	Additional guidance	Mark
10 c	an explanation linking the area (of contact between person and bed) is smaller when standing up (1) same weight (over smaller area) so the pressure is greater when standing up (1)	accept reverse arguments weight is more concentrated / not distributed / not spread across bed (when standing up) uses $p = F/A$ argument (as a consequence of the smaller area, pressure is bigger)	(2) AO2

Total for question 10 = 11 marks



Question number	Answer	Additional guidance	Mark
10 (a) (i)	substitution (1) (pressure =) $\frac{2500}{4 \times 0.022}$ evaluation (1) 28 000 (Pa)	any number rounding to 28 000 e.g. 28 400, 28 410, 28 409 award full marks for the correct answer without working award one mark for numbers that round to 110 000 (Pa) (missing 4 in denominator) award 1 mark for 454 545 (times by 4)	(2) AO2

Question number	Answer	Additional guidance	Mark
10 (a) (ii)	An explanation linking any two from camel less likely to sink into the soft ground (1) (same) force / weight is distributed / spread out (1) camel's hoof has greater (surface) area (than donkey) (1) camel's hoof exerts less pressure (than it would if hoof were smaller) (1)	ORA for donkey ignore pressure is spread out wider if no other marks scored then allow 1 mark for split in camel hoof enables better grip (as it walks)	(2) AO3

Question number	Answer	Additional guidance	Mark
10 (b)(i)	Points plotted to within $\pm$ 1 small square (0.100, 99.7) (1) (0.250, 101.2) (1)		(2) AO2

Question number	Answer	Additional guidance	Mark
10 (b)(ii)	best fit straight line passing through at least four of the points (1)	do not accept tramlining (multiple lines / curves) ignore slight shakiness in drawing	(1) AO2

Question number	Answer	Mark
10 (b)(iii)	D $y = mx + c$ A is incorrect because the graph is a straight line and this equation describes a parabola. B is incorrect because the line intercepts the Y axis at a positive value and this equation describes a line passing through the origin. C is incorrect because this equation describes a line which intercepts the Y axis at a negative value.	(1) A02

Question number	Answer	Additional guidance	Mark
10 (b)(iv)	answer between 98.6 and 98.8 (kPa)	allow ecf from their line of best fit in b(ii)	(1) A03

Question number	Answer	Additional guidance	Mark
10 (c)	any two from pressure(s) would be greater (values) (1) steeper gradient of graph (1) both straight lines (1) intercept (on pressure axis) the same (1)	credit mark points seen on graph bigger gradient / steeper line (of best fit) both linear pressure at surface is the same	(2) A03

Total 11 marks

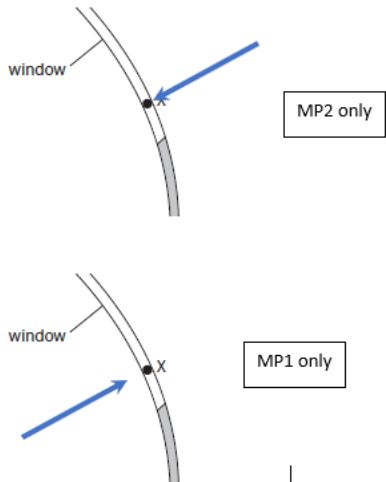
Total for paper = 100 marks



Question number	Answer	Additional guidance	Mark
10 (a) (i)	(80 000 – 23 000) 57 000 (Pa) (1)	-57 000 (Pa)	(1) AO2

Question number	Answer	Additional guidance	Mark
10 (a) (ii)	substitution (1) $80\,000 = \frac{F}{0.094}$ rearrangement and evaluation (1) (F=) 7500 (N)	alternative method re-arrangement (1) (F =) P x A or (F=) 80 000 x 0.094 (substitution and) evaluation (1) accept 7520 (N), award full marks for correct answer without working. allow 1 mark max for substitution using pressure of 57 000 or an answer that rounds to 5400 e.g. 5358 (calculated net force)	(2) AO2

Question number	Answer	Additional guidance	Mark
10 (a) (iii)	force is less (on small window) (1) pressure is the same (1)	force is greater on large window	(2) AO1

Question number	Answer	Additional guidance	Mark
10 (a) (iv)	arrow pointing towards outside of aeroplane (1) arrow is normal to surface at X (judge by eye) (1) Examples: 	may be inside or outside of aeroplane. need not touch X do not award if two or more conflicting arrows drawn must touch X or dot at X independent marks	(2) AO1

Question number	Answer	Additional guidance	Mark
10 (b) (i)	increase in height results in decrease in pressure (1) non-linear relationship (1) use of numerical data (1) at least two different pressure and height values from the graph	pressure decreases with height accept inversely proportional in this context accept negative correlation double the height does not result in half the pressure pressure not does change evenly description of graph e.g. curved / not straight calculation of change in pressure e.g. 5000m to 10000 m pressure went down by 22	(3) AO3

Question number	Answer	Additional guidance	Mark
10 (b) (ii)	any one from air becomes less dense (1) smaller weight (of air) above (1) lower temperature (1)	accept oxygen / atmosphere for air air gets thinner / (air) particles further apart / fewer particles / less particles less air above / smaller height of air above ignore change in value of g with height	(1) AO1

Total 11 marks

Question	Answer	Mark
10(a)	 This shows the only direction normal to surface, acting towards surface	(1) AO3.1

Question	Answer	Additional guidance	Mark
10(b)	substitution (1) (force =) $4.8 \times 10^7 \times 1.2 \times 10^{-5}$ evaluation (1) 576 (N) their evaluation rounded to 2sf (1) 580 (N)	award full marks for the correct answer (580) without working award 1 mark for 5.76 to any other power of ten award 2 marks for 5.8 to any other power of ten	(3) AO2.1



Question	Answer	Additional guidance	Mark
10(c)(i)	a description including: pressure increases as height decreases (1) OR as height increases pressure decreases (1) non-linear (1)	negative correlation implication of non-linear e.g. curved OR not proportional OR gradient increases as height increases OR gradient decreases as pressure increases	(2) A03.2

Question	Answer	Additional guidance	Mark
10(c)(ii)	accept any answer from 30 to 34 (kPa) (1)		(1) A03.2

Question	Answer	Additional guidance	Mark
10(c)(iii)	substitute into % calculation (1) $\frac{74 - 104}{104} \times 100$ evaluation (1) (-) 29 (%)	$\frac{104 - 74}{104} \times 100$ any number rounding to (-)29(%) e.g. (-)28.8(%) award full marks for the correct answer without working award 1 mark for (-)0.29 OR (-)0.288	(2) A02.1

Question	Answer	Additional guidance	Mark
10(d)	an explanation linking: density decreases as height increases (1) with (because) particles are further apart (higher up) (1)	ignore gravity accept reverse arguments density decreases as you go higher accept fewer particles per unit volume accept particles more spaced out	(2) AO3.2

(Total for question 10 = 11 marks)

Question number	Answer	Mark
7 (a)	B force A, C and D are all scalars; B is the only vector	(1) AO1

Question number	Answer	Additional guidance	Mark
7 (b) (i)	substitution (1) moment of force = 150×1.8 evaluation (1) moment of force = 270 (N m)	 award full marks for the correct answer without working	(2) AO2

Question number	Answer	Additional guidance	Mark
7 (b) (ii)	substitution (1) $W \times 0.95 = 270$ rearrangement and evaluation (1) $W = \left(\frac{270}{0.95} \right) = 280 \text{ (N)}$ any answer to 2 sf (1)	ecf from (i) any number that rounds to 280 (N) e.g. 284.2 (N) award 2 marks to here for the correct answer without working	(3) AO2

Question number	Indicative content	Mark
*7(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • benefit → easier with a lever (AO2) • crowbar easier to lift/move (AO2) • (applied force) is less (AO1) • distance to pivot from (applied) force is (considerably) bigger than distance of load/weight to pivot (AO2) • labelled distances in figure xx (AO2) • force (applied) $\times x = \text{load} \times y$ i.e. principle of moments used (AO1) • relevant mention of clockwise and anticlockwise moments (AO1) • specific application to crowbar (AO2)	(6) AO1, AO2

AO targeting 3 marks AO1 strand 1 and 3 marks AO2 strand 1

Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)
Level 3	5-6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)



Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> elements of physics understanding with some linking to scientific ideas/practical application two isolated statements	<u>Possible candidate responses</u> easier to lift big distance to pivot you can apply your weight onto the crowbar
Level 2	3–4	<u>Additional guidance</u> mostly relevant physics understanding with application of scientific ideas makes some link between force and distance OR some reference to moments	<u>Possible candidate responses</u> less force needed as there is a bigger distance to pivot OR because of moments you need less force
Level 3	5–6	<u>Additional guidance</u> accurate and relevant physics understanding with detailed application of scientific ideas Some reference to crowbar. makes links between force and distance AND refers to moments	<u>Possible candidate responses</u> If moment of weight = moment of crowbar, then the further away you are, you need less force to move the weight the bigger the distance to the pivot, the less force you need to provide the same moment

Total for Q7 = 12 marks

Question Number:	Answer	Mark
7(a)(i)	70 (kPa)	(2) AO 3 1a

Question Number:	Answer	Mark
7(a)(ii)	between 46 and 48 (kPa)	(1) AO 3 1a

Question Number:	Answer	Additional guidance	Mark
7(a)(iii)	any one from: the atmosphere gets less dense / thinner / has fewer molecules (as height above sea level increases) (1) or there is less air/oxygen (as the height above sea level increases)(1)	accept particles less weight pushing down	(1) AO 1 1

Question Number:	Answer	Additional guidance	Mark
7(b)	an explanation linking 2 from: pressure in a liquid increases with depth (1) the greater the height of water (in the container)(1) the more force (pushing water out) (1)	allow greater {weight of / volume of/amount of /more} water greater force/pressure/push (on water)	(2) AO 2 1

Question Number:	Answer	Additional guidance	Mark
7(c)	use of 50/10 (1) 6 (times)(1)	5 seen in answer line addition of 1 atmosphere award full marks for the correct answer without working	(2) AO 2 2

Question Number:	Answer	Mark
7(d)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative (example) content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • same force at tip and head of the thumb tack • flat end has a large surface area • pointed end has a very small surface area • using pressure = force / area • at pointed end the pressure is large • large pressure , tip goes into wood • at flat end the pressure is much less • the flat end does not damage the thumb	(1) AO 1 2

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	- Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) - Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	- Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) - Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	- Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) - Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

(Total for Question 7 = 13 marks)

Question number	Answer	Additional guidance	Mark
9 (a)	(upward) force increases with speed (1) relationship is non-linear (1)	allow reverse argument changing rate / increases exponentially / initially no upward force (until 1000 turns per minute)	(2)

Question number	Answer	Additional guidance	Mark
9(bi)	recall and substitution into (1) $\text{gpe} = m \times g \times h$ $(\text{gpe}) = 4.5 \times 10 \times 20$ evaluation (1) 900(J)	allow 90(J) for 1 mark award full marks for the correct answer without working	(2)

Question number	Answer	Additional guidance	Mark
9bii	900(J)	allow ecf from bi	(1)

Question number	Answer	Additional guidance	Mark
9biii	recall and substitution (1) power = work done / time taken (power =) $900 / 4$ evaluation (1) 200 (W)	allow ecf from bi or bii 230(W) 225(W) award full marks for the correct answer without working	(2)

Question number	Indicative content	Mark
*9(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • Chemical energy stored in battery • Transferred to KE in motors • Transferred to GPE as it rises • Thermal energy wasted (at each stage) • Energy transferred to surroundings (at each stage)	(6)

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Summary for guidance

Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> Isolated fact e.g. a description of least one energy store or interpretation of diagram without mentioning energy stores or types	<u>Possible candidate responses</u> Chemical energy stored in the battery or energy transferred from the battery to the motors and then to the blades. Some energy is lost at each stage.
Level 2	3–4	<u>Additional guidance</u> Description of at least one energy transfer	<u>Possible candidate responses</u> KE (of blades) is transferred to GPE (as the drone rises) or (thermal) energy is transferred to the surroundings
Level 3	5–6	<u>Additional guidance</u> Description of two or more energy transfers	<u>Possible candidate responses</u> Chemical energy in the battery is transferred to KE of the blades AND Thermal energy is wasted in the motors when they turn.

Question 9 = 13 marks



Question Number	Answer	Additional guidance	Mark
7(a)(i)	B 70 kPa A is incorrect because it is the atmospheric pressure at a height of about 2000m above the Earth C is incorrect because it is the atmospheric pressure at a height of 4000m above the Earth's surface D is incorrect because it is the atmospheric pressure at a height of about 5500m above the surface of the Earth		(1) AO3.2b

Question Number		Additional guidance	Mark
7a(ii)	a description including: the atmospheric pressure decreases as the height above the surface of the Earth increases (1) idea of non-linear (relationship) (1)	accept reverse argument Ignore negative correlation accept exponential accept inversely proportional ignore indirectly proportional ignore curved	(2) AO2.2

Question Number	Answer	Additional guidance	Mark
7(b)(i)	substitution (1) $(V_2 =) \frac{15 \times 2.3}{0.35}$ evaluation (1) 99 (litres)	accept any value rounding to 99 99 to any other power of ten scores 1 mark award full marks for the correct answer with no working accept alternative method to calculate a different variable e.g. substitution (1) $P_2 = \frac{15 \times 2.3}{100}$ Evaluation (1) $(P_2 =) 0.345$	(2) AO2.1

Question Number	Answer	Additional guidance	Mark
7(b)(ii)	evaluation (1) $\left(\frac{100}{6}\right) = 16.7 \text{ (mins)}$	accept any value between 16 and 17 (mins) award the mark for the correct answer with no working	(1) AO2.1

Question Number	Answer	Additional guidance	Mark
7(b)(iii)	any one from: reduce the amount of oxygen per minute / flow rate (to patient) (1) use a larger (capacity) cylinder (1) use a new cylinder when this one is empty (1)	must relate to time or rate for this marking point accept reduce the pressure (of oxygen released) accept use hospital mains supply (of oxygen) accept use multiple cylinders	(1) AO2.2

Question number	Indicative content	Mark
*7(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive, and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO2.1/ AO3 How volume and pressure change - the weights on the piston compress the gas (by applying a force) - larger weight causes the volume to decrease - pressure increases when the volume decreases (in a smaller volume) particles collide more frequently (with surface)	(6) AO2.2, AO3.3a

	• (more frequent collisions) causes a gas particles to exert a greater force (on container) • $P=F/A$ How particles exert force • gas particles collide with piston (sides of container) • there is a change in momentum of the gas particles • force equals rate of change of momentum • force is exerted over an area causing pressure • force exerted by weight is balanced by force exerted by gas	
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Level	Mark	Descriptor
	0	• No awardable content
Level 1	1–2	• Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable (AO3) • The explanation attempts to link and apply knowledge and understanding to scientific ideas, flawed or simplistic connections made between elements in the context of the question.(A02)
Level 2	3–4	• Interpretation and evaluation of the information on both variables synthesises mostly relevant understanding (AO3) • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas some logical connections made between elements in the context of the question(A02)
Level 3	5–6	• Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding (AO3) • Then explanation is supported is supported throughout by linkage and application of knowledge and understanding of scientific ideas some logical connections made between elements in the context of the question (AO2)

Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> Isolated fact about volume, pressure, movement of gas particles	<u>Possible candidate responses</u> smaller volume (of gas) pressure is increased gas particles collide
Level 2	3–4	<u>Additional guidance</u> Limited explanation linking weight/force with pressure and volume OR linking movement of gas particles/ collisions (with walls) to force exerted by gas	<u>Possible candidate responses</u> the volume gets smaller, and the pressure goes up OR gas particles collide causing a force gas particles have more frequent collisions
Level 3	5–6	<u>Additional guidance</u> Detailed explanation that includes linking weight/force with pressure and volume and linking collisions to force or frequency of collisions	<u>Possible candidate responses</u> a larger weight gives a greater pressure and a smaller volume, the gas particles exert a force through collisions in Y, the volume is smaller, and the pressure is bigger and the particles have more frequent collisions

Total for Question 7 = 13 marks