AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.5.1.3 GRAVITY (PACK 2)

SCORE	PERCENTAGE
/235	%

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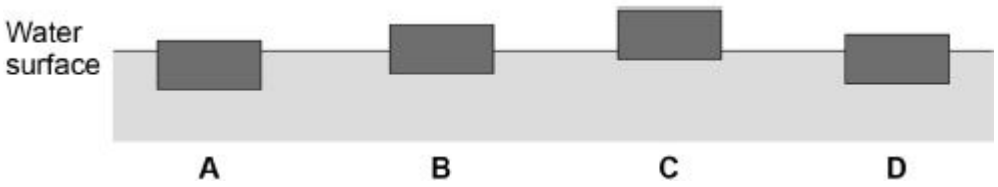
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Q1.

Figure 1 shows four blocks of different materials floating on water.

The four blocks are the same volume.

Figure 1



(a) Which of the blocks has the smallest weight?

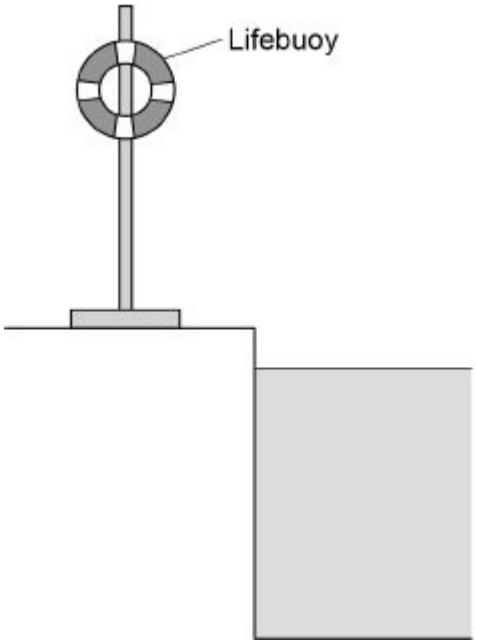
Tick **one** box.

A ☐ B ☐ C ☐ D ☐

(1)

Figure 2 shows a lifebuoy next to a deep swimming pool.

Figure 2



(b) The lifebuoy has a mass of 2.5 kg.

gravitational field strength = 9.8 N/kg

Calculate the weight of the lifebuoy.

Use the equation:

weight = mass × gravitational field strength

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_____

_____

_____

_____

Weight = _____ N

(2)

(c) When thrown into the water the lifebuoy floats. The two forces acting on the lifebuoy are the weight of the lifebuoy downwards and upthrust upwards.

How big is the upthrust on the lifebuoy compared to the weight of the lifebuoy?

Tick **one** box.

The upthrust is greater than the weight. ☐

The upthrust is less than the weight. ☐

The upthrust is the same as the weight. ☐

(1)

(d) Write down the equation which links acceleration, mass and resultant force.

_____

(1)

(e) A rope is used to pull the lifebuoy to the side of the swimming pool.

A resultant force of 4.0 N acts on the lifebuoy.

The mass of the lifebuoy is 2.5 kg.

Calculate the acceleration of the lifebuoy.

_____

_____

_____

_____

Acceleration = _____ m/s^2

(3)

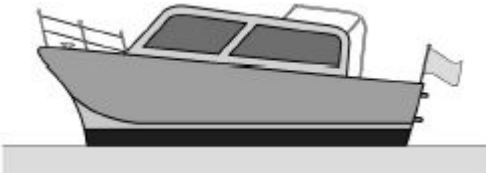
(Total 8 marks)

Q2.

Figure 1 shows a boat floating on the sea. The boat is stationary.

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Figure 1



(a) **Figure 2** shows part of the free body diagram for the boat.

Complete the free body diagram for the boat.

Figure 2



(2)

(b) Calculate the mass of the boat.

Use the information given in **Figure 2**.

gravitational field strength = 9.8 N/kg

Give your answer to **two** significant figures.

_____

_____

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_____

_____

Mass = _____ kg

(4)

(c) When the boat propeller pushes water backwards, the boat moves forwards.
The force on the water causes an equal and opposite force to act on the boat.

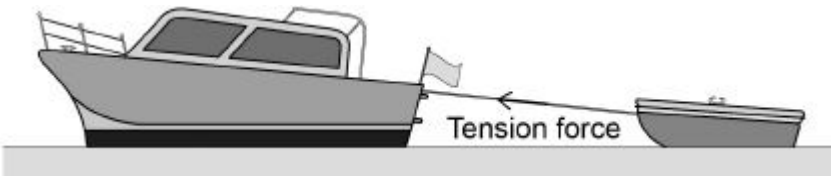
Which law is this an example of?

_____

(1)

(d) **Figure 3** shows the boat towing a small dinghy.

Figure 3



The tension force in the tow rope causes a horizontal force forwards and a vertical force upwards on the dinghy.

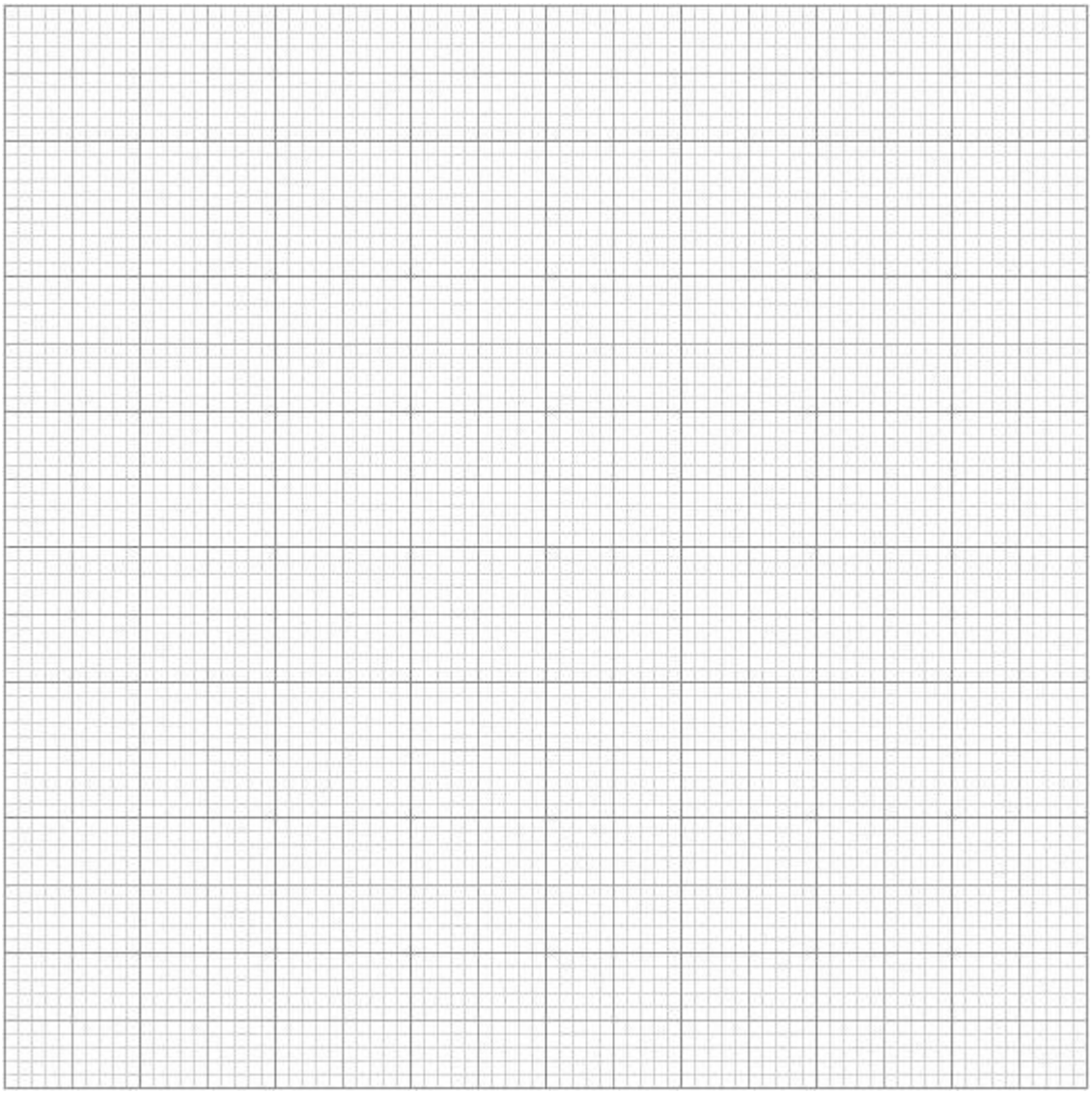
horizontal force forwards = 150 N
vertical force upwards = 50 N

Figure 4 shows a grid.

Draw a vector diagram to determine the magnitude of the tension force in the tow rope and the direction of the force this causes on the dinghy.

Figure 4

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Magnitude of the tension force in the tow rope = _____ N

Direction of the force on the dinghy caused by the tension force in the tow rope = _____

(4)

(Total 11 marks)

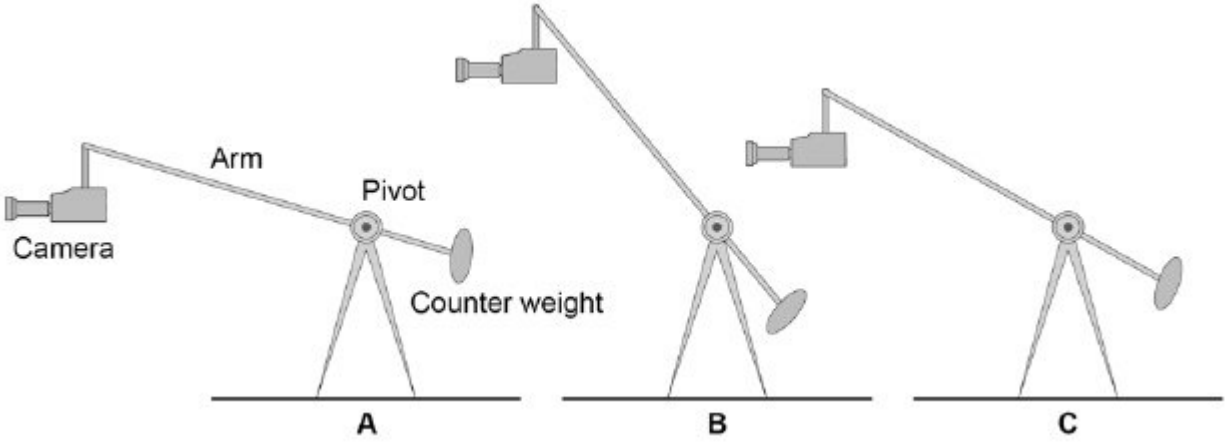
Q3.

A camera boom is used at a television studio to allow filming from different positions.

Figure 1 shows the arm of the boom in three different positions.

Figure 1

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(a) In which position will the weight of the camera cause the largest moment about the pivot?

Tick **one** box.

A ☐ **B** ☐ **C** ☐

Give the reason for your answer.

_____

_____

(2)

(b) Complete the sentence.

Choose the answer from the box.

decreases	**does not change**	**increase**

When the moment caused by the weight of the camera increases, the moment caused by the counterweight _____ .

(1)

(c) The camera has a mass of 5.0 kg

gravitational field strength = 9.8 N/kg

Calculate the weight of the camera.

Use the equation:

weight = mass × gravitational field strength

Give the unit.

Choose the answer from the box.

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joule	kilogram	newton

_____

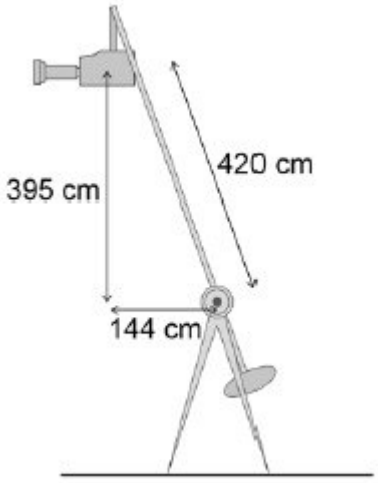
_____

Weight = _____ Unit _____

(3)

Figure 2 shows the camera boom in a new position, **D**.

Figure 2



(d) Write the equation which links distance, force and moment of a force.

_____

(1)

(e) Calculate the moment about the pivot caused by the weight of the camera when the arm of the boom is in position **D**.

_____

_____

_____

_____

_____

Moment = _____ Nm

(3)

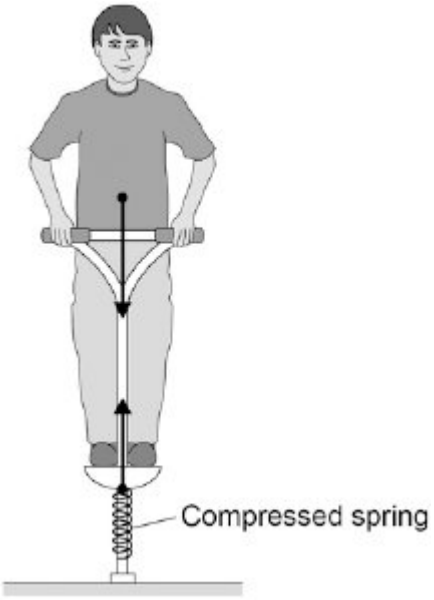
(Total 10 marks)

Q4.

The figure below shows the forces acting on a child who is balancing on a pogo stick.

The child and pogo stick are not moving.

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(a) The downward force of the child on the spring is equal to the upward force of the spring on the child.

This is an example of which one of Newton's Laws of motion?

Tick **one** box.

First Law ☐

Second Law ☐

Third Law ☐

(1)

(b) Complete the sentence.

Use an answer from the box.

elastic potential	**gravitational potential**	**kinetic**

The compressed spring stores _____ energy.

(1)

(c) The child has a weight of 343 N.

Gravitational field strength = 9.8 N / kg

Write down the equation which links gravitational field strength, mass and weight.

_____

(1)

(d) Calculate the mass of the child.

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_____

_____

_____

Mass = _____ kg

(3)

(e) The weight of the child causes the spring to compress elastically from a length of 30cm to a new length of 23cm.

Write down the equation which links compression, force and spring constant.

_____

(1)

(f) Calculate the spring constant of the spring.

Give your answer in newtons per metre.

_____

_____

_____

Spring constant = _____ N / m

(4)

(Total 11 marks)

Q5.

Alpha particles, beta particles and gamma rays are types of nuclear radiation.

(a) Describe the structure of an alpha particle.

_____

_____

(1)

(b) Nuclear radiation can change atoms into ions by the process of ionisation.

(i) Which type of nuclear radiation is the least ionising?

Tick (✔) **one** box.

alpha particles ☐

beta particles ☐

gamma rays ☐

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(1)

(ii) What happens to the structure of an atom when the atom is ionised?

_____

_____

(1)

(c) People working with sources of nuclear radiation risk damaging their health.

State **one** precaution these people should take to reduce the risk to their health.

_____

_____

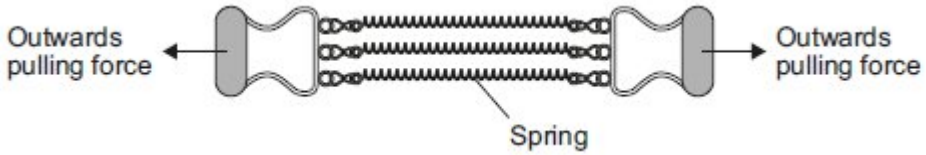
(1)

(Total 4 marks)

Q6.

Figure 1 shows an exercise device called a chest expander. The three springs are identical.

Figure 1



A person pulls outwards on the handles and does work to stretch the springs.

(a) Complete the following sentence.

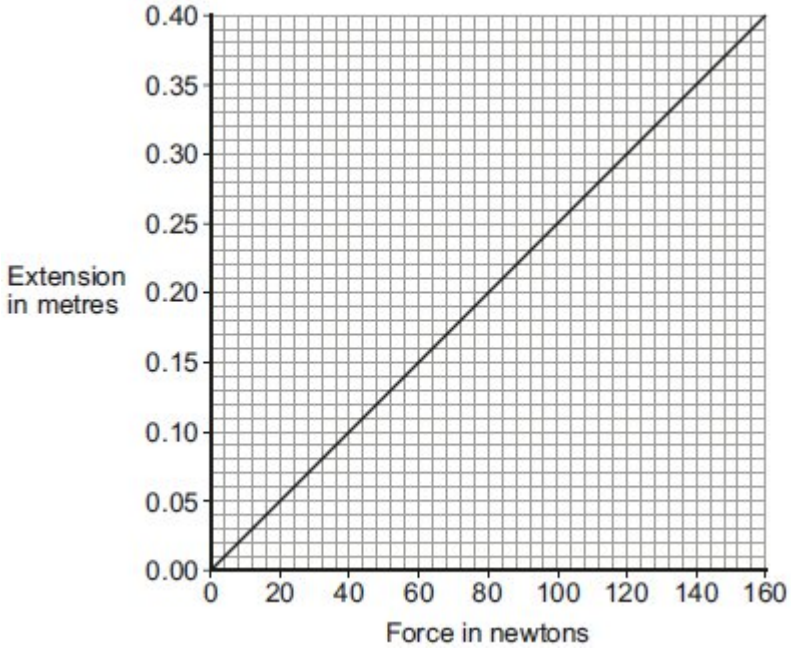
When the springs are stretched _____ _____ energy is stored in the springs.

(1)

(b) **Figure 2** shows how the extension of a single spring from the chest expander depends on the force acting on the spring.

Figure 2

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(i) How can you tell, from **Figure 2**, that the limit of proportionality of the spring has not been exceeded?

_____

_____

(1)

(ii) Use data from **Figure 2** to calculate the spring constant of the spring.
Give the unit.

_____

_____

_____

Spring constant = _____ Unit _____

(3)

(iii) Three identical resistors joined in parallel in an electrical circuit share the total current in the circuit.

In a similar way, the three springs in the chest expander share the total force exerted.

By considering this similarity, use **Figure 2** to determine the total force exerted on the chest expander when each spring is stretched by 0.25 m.

_____

_____

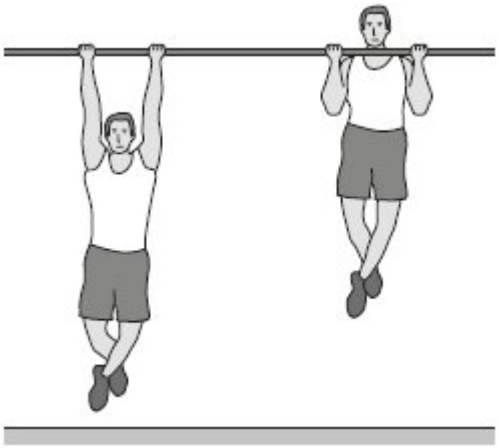
Total force = _____ N

(2)

(c) The student in **Figure 3** is doing an exercise called a chin-up.

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Figure 3



Each time the student does one chin-up he lifts his body 0.40 m vertically upwards.
The mass of the student is 65 kg.
The student is able to do 12 chin-ups in 60 seconds.

Calculate the power developed by the student.

Gravitational field strength = 10 N/kg

_____

_____

_____

_____

_____

Power = _____ W

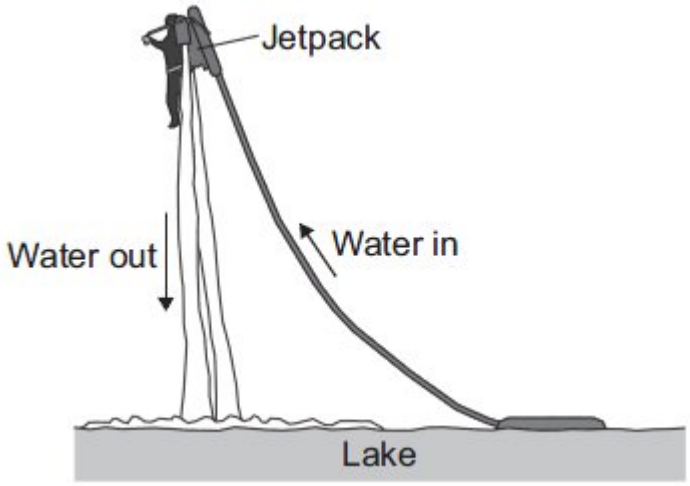
(3)

(Total 10 marks)

Q7.

The diagram below shows a person using a device called a jetpack. Water is forced downwards from the jetpack and produces an upward force on the person.

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(a) State the condition necessary for the person to be able to remain stationary in mid-air.

_____

_____

(1)

(b) The person weighs 700 N and the jetpack weighs 140 N.

(i) Calculate the combined mass of the person and the jetpack.

Gravitational field strength = 10 N/kg

_____

_____

_____

Combined mass = _____ kg

(2)

(ii) Increasing the upward force to 1850 N causes the person to accelerate upwards.

Calculate the acceleration of the person and the jetpack. Give the unit.

_____

_____

_____

_____

Acceleration = _____ Unit _____

(3)

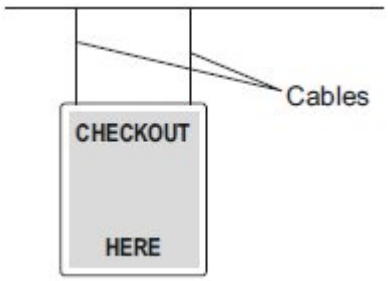
(Total 6 marks)

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Q8.

A sign hangs from the ceiling using two cables, as shown in **Figure 1**.

Figure 1



(a) On **Figure 1**, mark the centre of mass of the sign using an X.

(1)

(b) Use the correct answer from the box to complete the sentence.

concentrated	**greatest**	**pivoted**

The centre of mass of an object is the point where the mass appears

to be _____ .

(1)

(c) A breeze made the sign swing forwards and backwards like a pendulum.
The frequency of oscillations of the sign was 2 hertz.

Calculate the periodic time for the sign.

_____

_____

_____

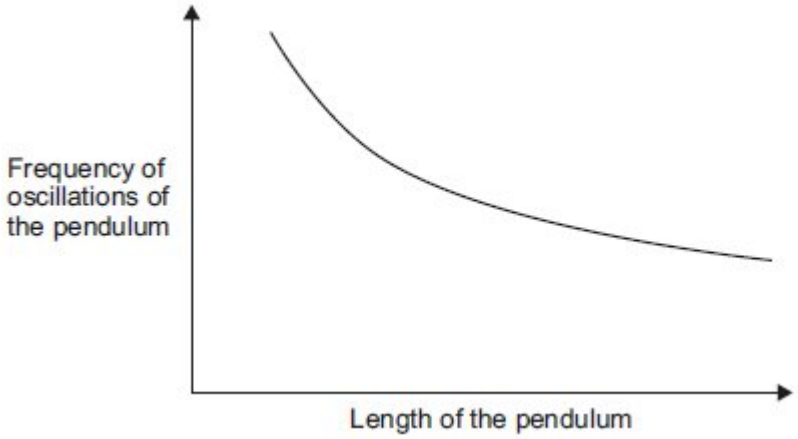
Periodic time = _____ seconds

(2)

(d) **Figure 2** is a sketch graph showing how the frequency of the oscillations of a pendulum changes as the length of the pendulum is increased.

Figure 2

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Give **one** way the sign could be made to swing with a lower frequency.

Use **only** the information in the sketch graph.

_____

_____

(1)

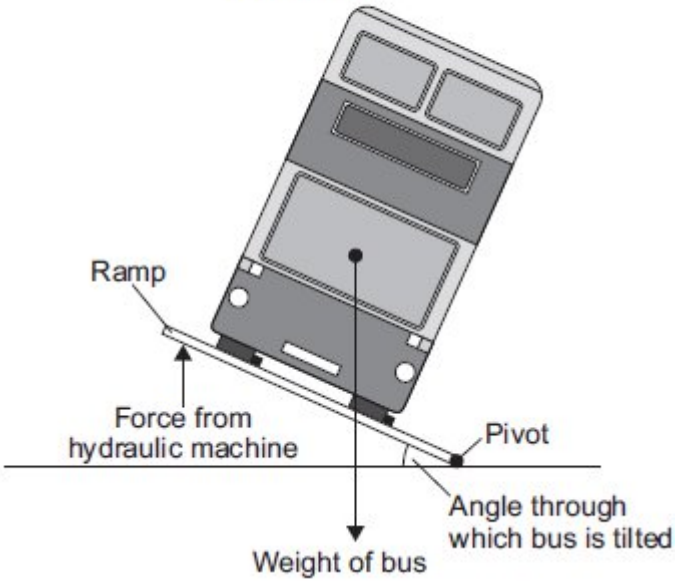
(Total 5 marks)

Q9.

Before a new bus can be used on the roads, it must pass a stability test.
Figure 1 shows how the bus is tested.

Figure 1

Front view



(a) (i) The bus will topple over if the ramp is tilted at too great an angle.

Explain why.

_____

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_____

_____

_____

(2)

(ii) The bus is tested to angles of tilt far greater than it would experience in normal use.

Suggest **two** reasons why.

1. _____

_____

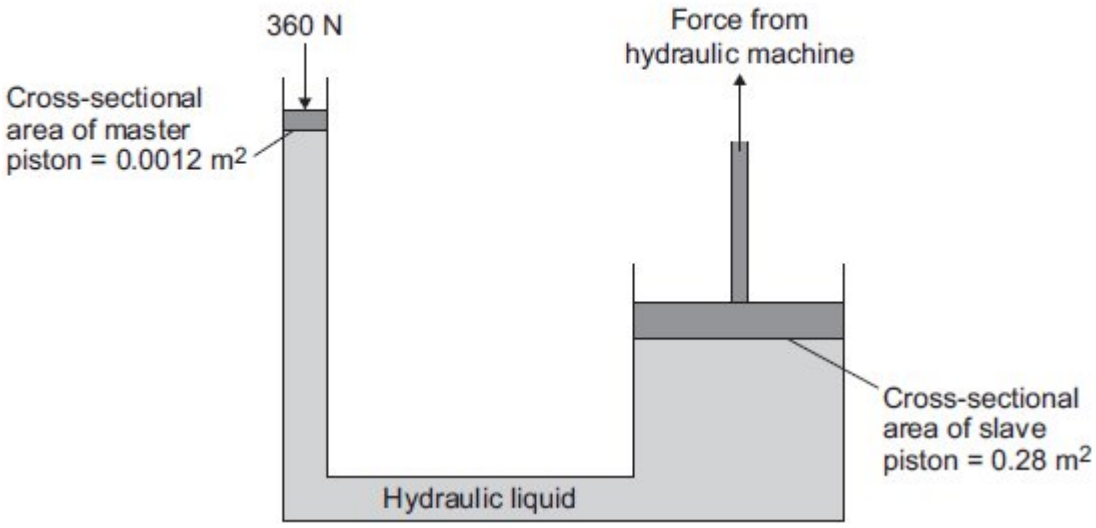
2. _____

_____

(2)

(b) **Figure 2** shows the hydraulic machine that is used to make the ramp tilt.

Figure 2



The pressure applied to the hydraulic liquid at the master piston is the same as the pressure applied by the hydraulic liquid to the slave piston.

(i) State the property of the liquid that keeps the pressure at both pistons the same.

_____

(1)

(ii) A 360 N force acts on the master piston.

Use information from **Figure 2** to calculate the force applied by the hydraulic liquid to the slave piston.

_____

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_____

_____

_____

Force = _____ N

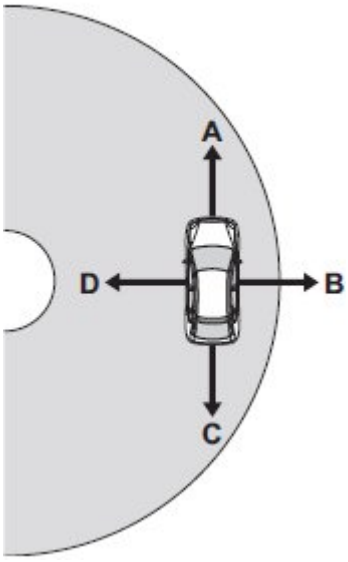
(3)

(Total 8 marks)

Q10.

(a) **Figure 1** shows a car travelling around a bend in the road. The car is travelling at a constant speed.

Figure 1



There is a resultant force acting on the car. This resultant force is called the centripetal force.

(i) In which direction, **A**, **B**, **C** or **D**, does the centripetal force act on the car?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(ii) State the name of the force that provides the centripetal force.

_____

(1)

(iii) State **two** factors that affect the size of the centripetal force acting on the car.

1. _____

2. _____

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(2)

(b) **Figure 2** shows a racing car.

Figure 2



© braverabbit/iStock/Thinkstock

The racing car should not roll over when racing.

State **two** features of the car that make it difficult for the car to roll over.

1. _____

_____

2. _____

_____

(2)

(Total 6 marks)

Q11.

On 14 October 2012, a skydiver set a world record for the highest free fall from an aircraft.

After falling from the aircraft, he reached a maximum steady velocity of 373 m / s after 632 seconds.

(a) Draw a ring around the correct answer to complete the sentence.

This maximum steady velocity is called the | frictional / initial / terminal | velocity.

(1)

(b) The skydiver wore a chest pack containing monitoring and tracking equipment. The weight of the chest pack was 54 N.

The gravitational field strength is 10 N / kg.

Calculate the mass of the chest pack.

_____

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_____

Mass of chest pack = _____ kg

(2)

(c) During his fall, the skydiver's acceleration was not uniform.

Immediately after leaving the aircraft, the skydiver's acceleration was 10 m / s^2.

(i) Without any calculation, estimate his acceleration a few seconds after leaving the aircraft.

Explain your value of acceleration in terms of forces.

Estimate _____

Explanation _____

_____

_____

_____

_____

_____

(3)

(ii) Without any calculation, estimate his acceleration 632 seconds after leaving the aircraft.

Explain your value of acceleration in terms of forces.

Estimate _____

Explanation _____

_____

_____

_____

_____

_____

(3)

(Total 9 marks)

Q12.

A student carries out an investigation using a metre rule as a pendulum.

(a) **Diagram 1** shows a metre rule.

Diagram 1

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(i) Draw, on **Diagram 1**, an **X** to show the position of the centre of mass of the rule.

(1)

(ii) State what is meant by the 'centre of mass of an object'.

_____

_____

(1)

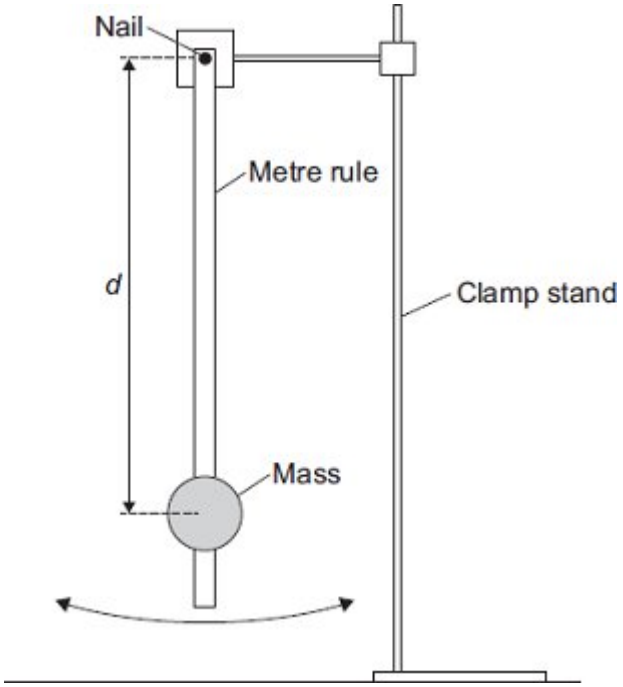
(b) The student taped a 100 g mass to a metre rule.

She set up the apparatus as shown in **Diagram 2**.

She suspended the metre rule from a nail through a hole close to one end, so she could use the metre rule as a pendulum.

The distance d is the distance between the nail and the 100 g mass.

Diagram 2



(i) Draw, on **Diagram 2**, a **Y** to show a possible position of the centre of mass of the pendulum.

(1)

(ii) The student carried out an investigation to find out how the time period of the pendulum varies with *d*.

Some of her results are shown in the table.

Time for 10 swings in seconds

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d in cm	First test	Second test	Third test	Mean value	Mean time for 1 swing in seconds
10.0	15.3	15.4	15.5	15.4	1.54
30.0	14.7	14.6	14.7	14.7	1.47
50.0	15.3	15.6	15.4	15.4	1.54
70.0	16.5	16.6	16.5		

Complete the table.

You may use the space below to show your working.

_____

_____

(3)

(iii) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Describe how the student would carry out the investigation to get the results in the table in part (ii).

You should include:

- any other apparatus required
- how she should use the apparatus
- how she could make it a fair test
- a risk assessment
- how she could make her results as accurate as possible.

_____

_____

_____

_____

_____

_____

_____

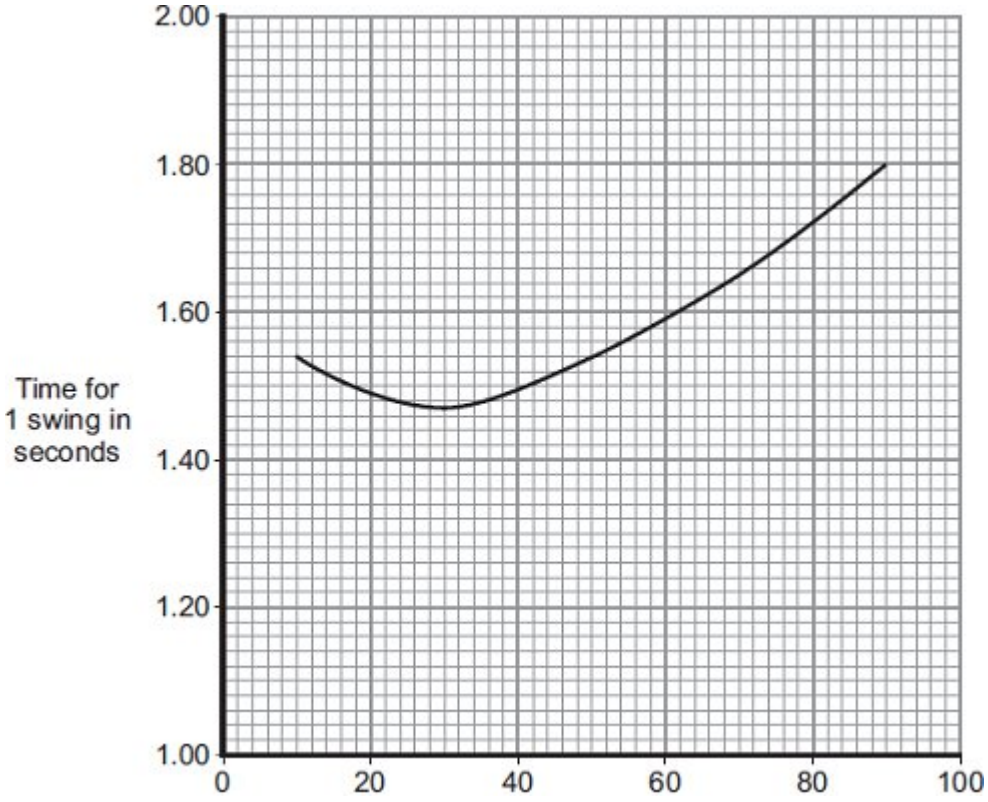
_____

_____

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(6)

(c) A graph of the student's results is shown below.



(i) Describe the pattern shown by the graph.

(2)

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(ii) The student thinks that the measurements of time for d = 10 cm might be anomalous, so she takes a fourth measurement.

Her four measurements are shown below.

15.3 s 15.4 s 15.5 s 15.3 s

State whether you consider any of these measurements to be anomalous.

Justify your answer.

_____

_____

_____

_____

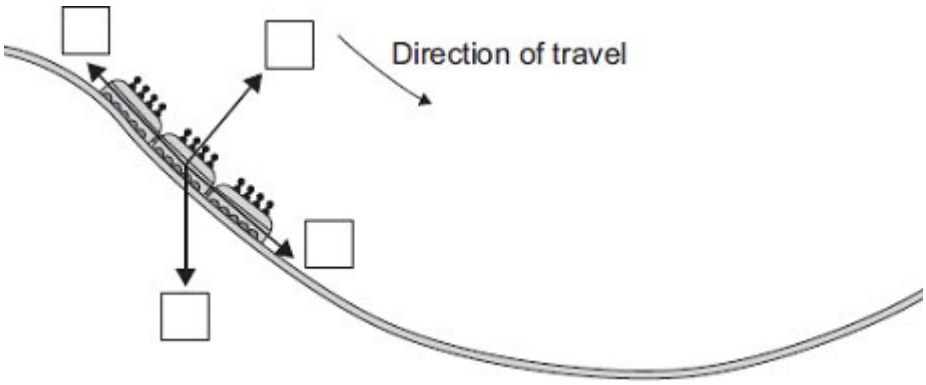
(2)

(Total 16 marks)

Q13.

The diagram shows the passenger train on part of a rollercoaster ride.

(a) Which arrow shows the direction of the resultant force acting on the passenger train?
Put a tick (✓) in the box next to your choice.



(1)

(b) For part of the ride, the maximum gravitational field strength acting on the passengers seems 3 times bigger than normal.

Normal gravitational field strength = 10 N/kg

(i) Calculate the maximum gravitational field strength that seems to act on the passengers during the ride.

_____

_____

Maximum gravitational field strength = _____ N/kg

(1)

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(ii) One of the passengers has a mass of 75 kg.

Calculate the maximum weight this passenger seems to have during the ride.

Show clearly how you work out your answer.

_____

_____

Maximum weight = _____ N

(2)

(Total 4 marks)

Q14.

(a) The diagram shows the forces acting on a parachutist in free fall.



The parachutist has a mass of 75 kg.

Calculate the weight of the parachutist.

gravitational field strength = 10 N/kg

Show clearly how you work out your answer and give the unit.

_____

_____

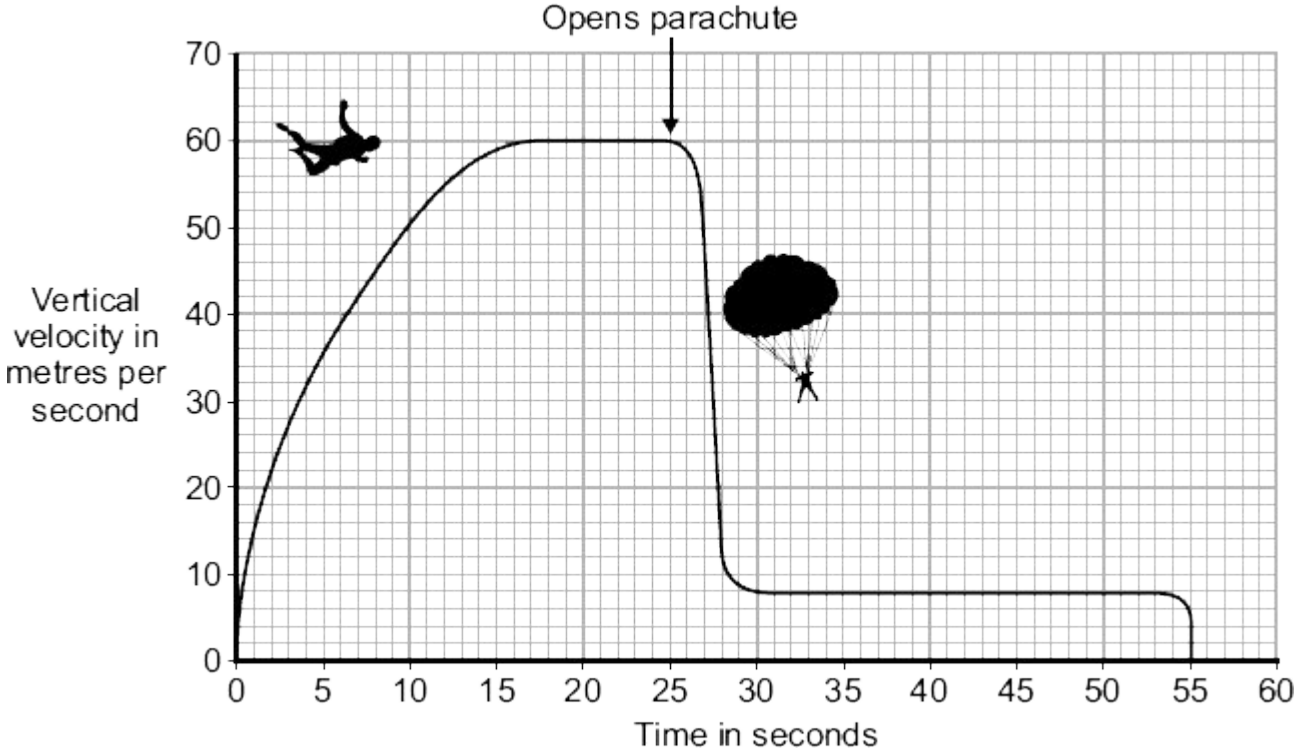
Weight = _____

(3)

(b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The graph shows how the vertical velocity of a parachutist changes from the moment the parachutist jumps from the aircraft until landing on the ground.

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Using the idea of forces, explain why the parachutist reaches a terminal velocity and why opening the parachute reduces the terminal velocity.

_____

_____

_____

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_____

_____

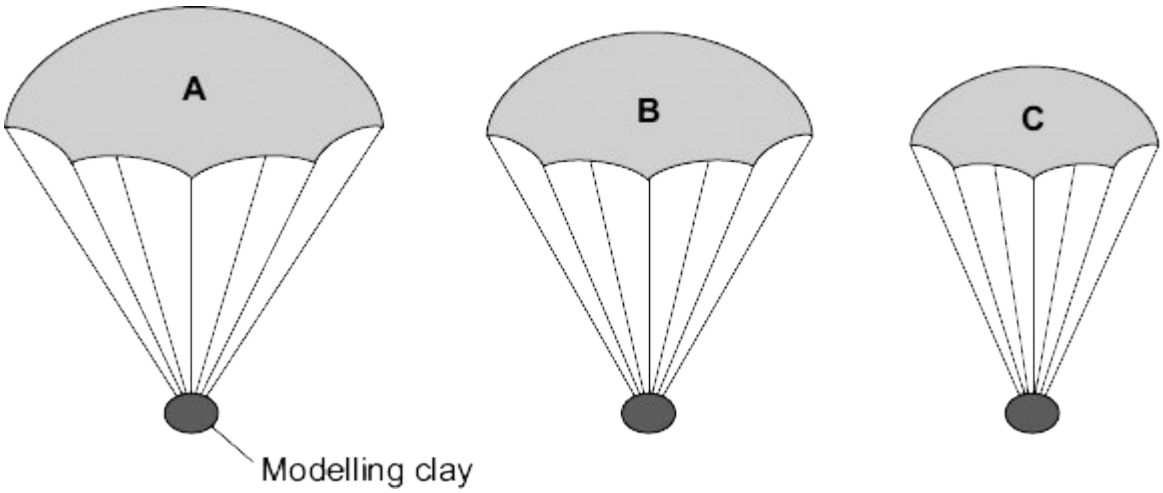
(6)

(c) A student wrote the following hypothesis.

'*The larger the area of a parachute, the slower a parachutist falls.*'

To test this hypothesis the student made three model parachutes, **A**, **B** and **C**, from one large plastic bag. The student dropped each parachute from the same height and timed how long each parachute took to fall to the ground.

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(i) The height that the student dropped the parachute from was a control variable.

Name **one** other control variable in this experiment.

_____

(1)

(ii) Use the student's hypothesis to predict which parachute, **A**, **B** or **C**, will hit the ground first.

Write your answer in the box. ☐

Give a reason for your answer.

_____

_____

_____

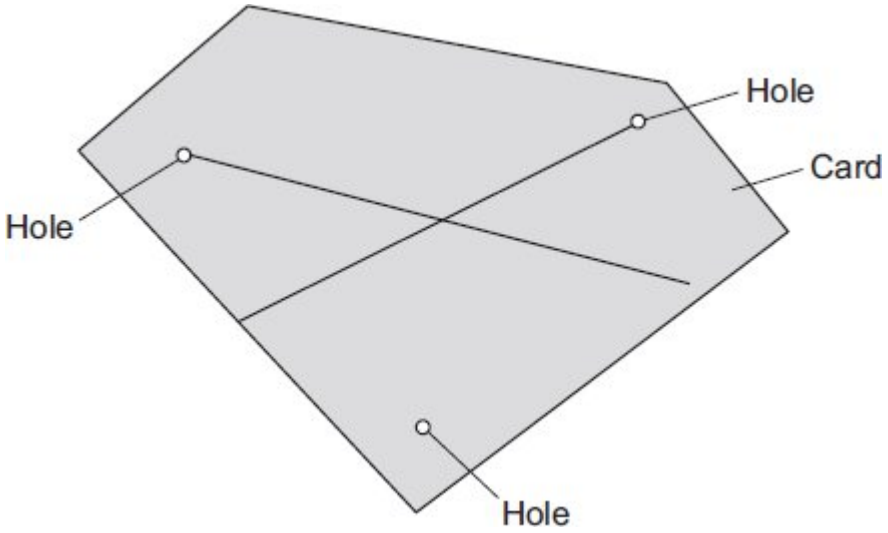
(2)

(Total 12 marks)

Q15.

A student was asked to find the centre of mass of a thin sheet of card. The diagram shows the result of the student's experiment. The student drew two lines onto the card. The centre of mass is where the two lines cross.

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(a) Describe how the student found the correct positions to draw the **two** lines.

You may include a labelled diagram in your answer.

(3)

(b) Explain how the student can check that the position found for the centre of mass is accurate.

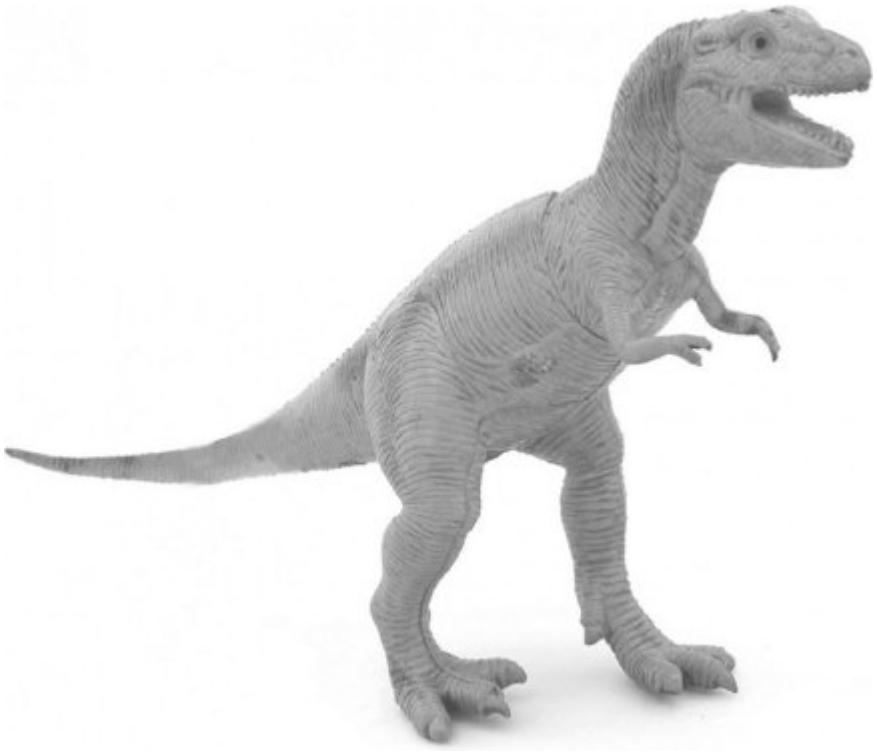
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(2)
(Total 5 marks)

Q16.

The drawing shows a plastic toy which can stand on its feet.

(a) (i) Draw an **X** on the diagram so that the centre of the **X** marks the likely position of the centre of mass of the toy.



Photograph supplied by Hemera/Thinkstock

(1)

(ii) Explain the reason for your choice in part (a)(i).

_____

_____

(1)

(b) Suggest **two** ways in which the design of the toy could be altered to make the toy more stable.

1. _____

_____

2. _____

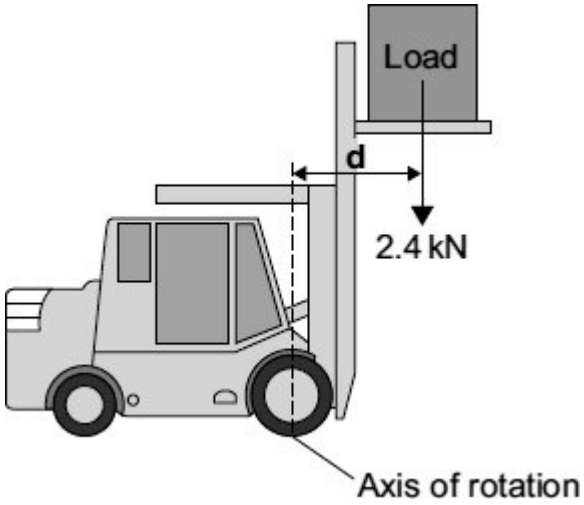
_____

(2)
(Total 4 marks)

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Q17.

The diagram shows a fork-lift truck with a load of 2.4 kN. The clockwise moment caused by this load is 2880 Nm.



(a) Use the equation in the box to calculate the distance **d**.

moment	=	force	×	perpendicular distance from the line of action of the force to the axis of rotation

Show clearly how you work out the answer and give the unit.

_____

_____

_____

Distance **d** = _____

(3)

(b) This warning notice is in the driver's cab.

Warning

Maximum load 10.0 kN

This load must not be exceeded

Explain in terms of moments why the maximum load must not be exceeded.

_____

_____

_____

_____

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_____

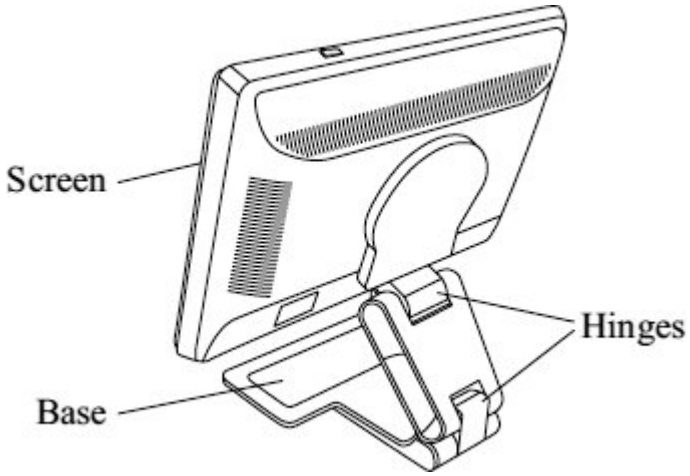
_____

(2)

(Total 5 marks)

Q18.

The diagram shows a back view of a computer monitor.



(a) In normal use, the monitor is *stable*.

(i) Explain the meaning, in the above sentence, of the word *stable*.

_____

_____

_____

_____

(2)

(ii) State the relationship between the total clockwise moment and the total anticlockwise moment about any axis of the monitor when it is stable.

_____

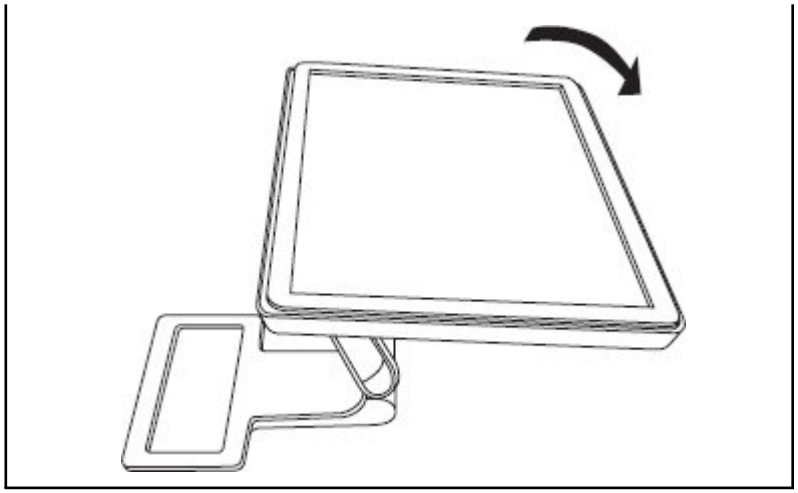
_____

(1)

(b) The instruction booklet explains that the screen can be tilted.
It also includes a warning.

Caution
The monitor can tip over if the screen is tilted too far back.

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Explain why the monitor will tip over if the screen is tilted too far back.

Include the words *centre of mass, weight* and *moment* in your explanation.

_____

_____

_____

_____

_____

_____

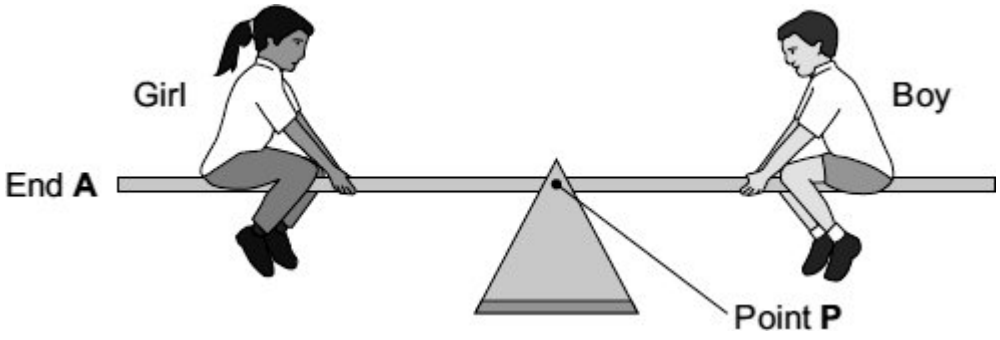
(3)

(Total 6 marks)

Q19.

Two children visit a playground.

(a) The diagram shows them on a see-saw. The see-saw is balanced.



Complete the following sentences by drawing a ring around the correct word or line in the box.

(i) The turning effect of the girl's weight is called her

force.
load.

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moment.

(1)

(ii) Point **P** is the axis of

balance
rotation
turning

of the see-saw.

(1)

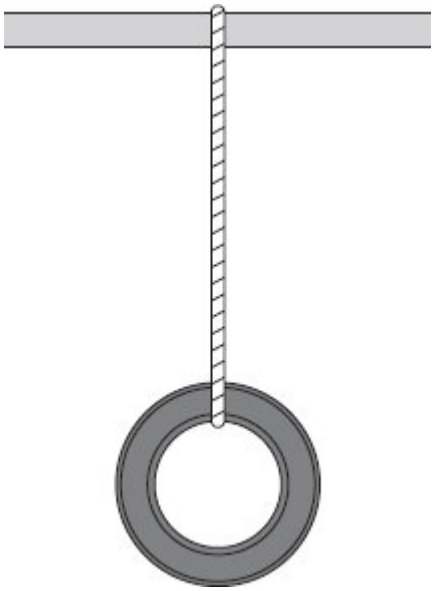
(iii) To make end **A** of the see-saw go up,

the boy moves nearer to point **P**.
the girl moves nearer to point **P**.
the girl moves nearer to end **A**.

(1)

(b) In another part of the playground, a tyre has been suspended from a bar.

(i) Draw an **X** on the diagram so that the centre of the **X** marks the centre of mass of the tyre.



(1)

(ii) Complete the sentence by using the correct word or phrase from the box.

above	**below**	**to the left of**	**to the right of**

If the suspended tyre is pushed, it will come to rest with its centre of mass directly _____ the point of suspension.

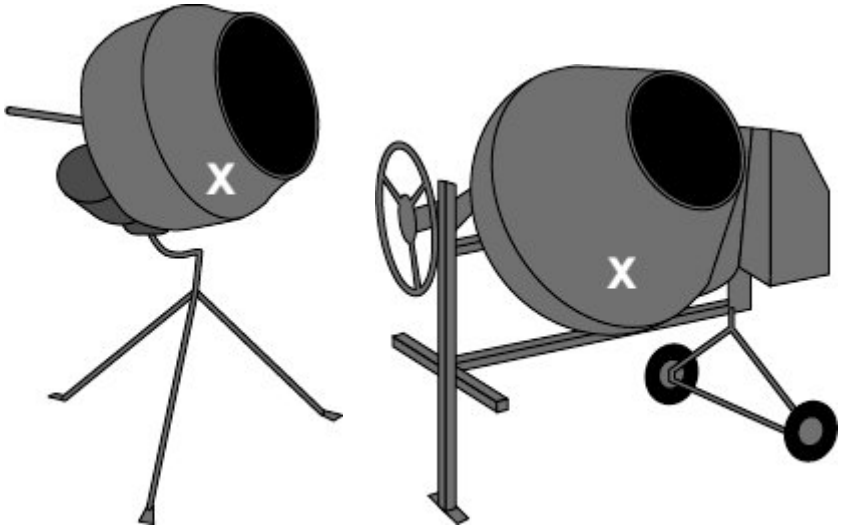
(1)

(Total 5 marks)

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Q20.

The diagrams show two concrete mixers.



Concrete mixer **A** Concrete mixer **B**

On each diagram, the centre of the white **X** marks the centre of mass of the concrete mixer and its contents.

(a) Complete the sentence to explain what the term *centre of mass* means.

The centre of mass of a concrete mixer and its contents is _____

_____

_____

(1)

(b) Both diagrams are drawn to the same scale.

Concrete mixer **B** is more stable than concrete mixer **A**.

The two features which make concrete mixer **B** more stable are:

1. _____

_____

2. _____

_____

(2)

(c) Use the terms 'line of action of the weight' and 'resultant moment' to explain why a stable concrete mixer does not fall over when it is given a small push.

_____

_____

_____

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_____

_____

(2)

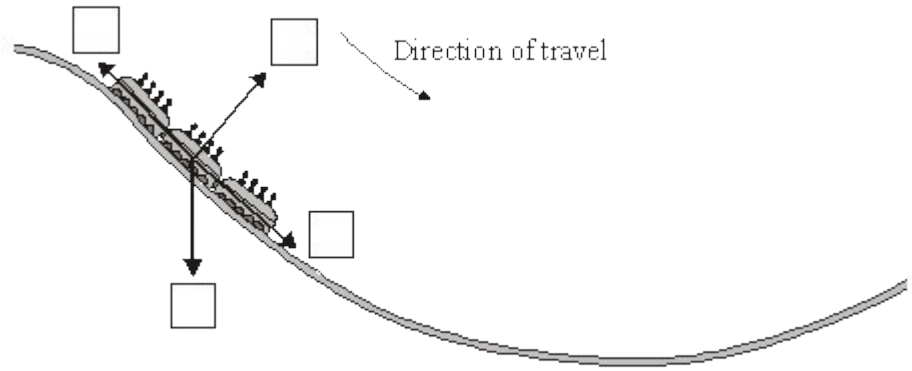
(Total 5 marks)

Q21.

The diagram shows the passenger train on part of a rollercoaster ride.

(a) Which arrow shows the direction of the resultant force acting on the passenger train?

Put a tick (✓) in the box next to your choice.



(1)

(b) At the bottom of the slope, the passengers in the train all have the same speed but they each have a different kinetic energy.

Why is the kinetic energy of each passenger different?

_____

_____

(1)

(c) For part of the ride, the maximum gravitational field strength acting on the passengers seems 3 times bigger than normal.

Normal gravitational field strength = 9.8 N/kg

(i) Calculate the maximum gravitational field strength that seems to act on the passengers during the ride.

_____

_____

Maximum gravitational field strength = _____ N/kg

(1)

(ii) One of the passengers has a mass of 80 kg.

Calculate the maximum weight this passenger seems to have during the ride.

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Show clearly how you work out your answer.

_____

_____

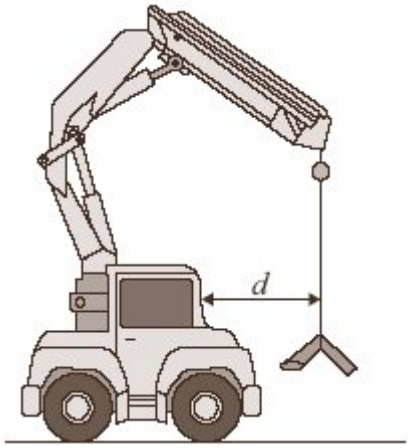
Maximum weight = _____ N

(2)

(Total 5 marks)

Q22.

The diagram shows a small mobile crane. It is used on a building site.



The distance, d, is measured to the front of the cab.

The table shows information from the crane driver's handbook.

Load in kilonewtons (kN)	**Maximum safe distance, *d*, in metres (m)**
10	6.0
15	4.0
24	2.5
40	1.5
60	1.0

(a) What is the relationship between the load and the maximum safe distance?

_____

_____

_____

(2)

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(b) The crane driver studies the handbook and comes to the conclusion that a load of 30 kN would be safe at a distance, *d*, of 2.0 metres.

Is the driver correct?

Explain your answer.

_____

_____

_____

_____

(2)

(c) What is the danger if the driver does not follow the safety instructions?

_____

_____

(1)

(d) How should the data in the table have been obtained?

Put a tick (✓) in the box next to your answer.

average results from an opinion poll of mobile crane drivers ☐

copied from a handbook for a similar crane ☐

results of experiments on a model mobile crane ☐

results of experiments on this mobile crane ☐

(1)

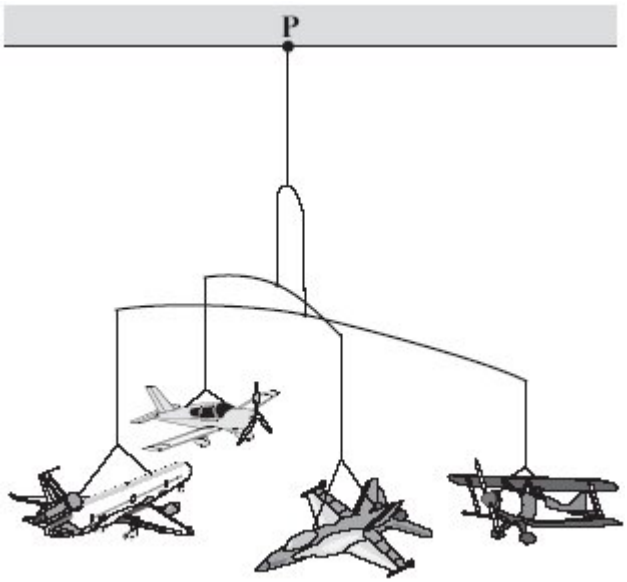
(Total 6 marks)

Q23.

(a) The diagram shows a child's mobile. The mobile hangs from point **P** on the ceiling of the child's bedroom.

(i) Mark the position of the centre of mass of the mobile by drawing a letter **X** on the diagram. Do this so that the centre of the **X** marks the centre of mass of the mobile.

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(1)

(ii) Explain why you have chosen this position for your letter **X**.

_____

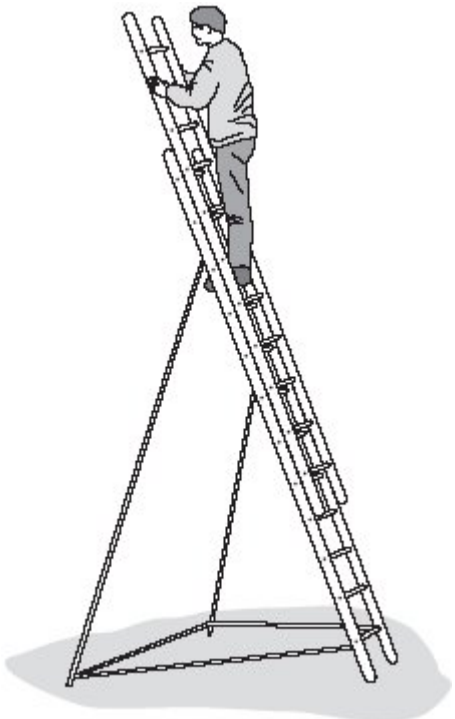
_____

_____

_____

(2)

(b) The diagram shows a device which helps to prevent a ladder from falling over.



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Use the term *centre of mass* to explain why the ladder, in the situation shown, is unlikely to topple over.
You may add to the diagram to illustrate your explanation.

_____

_____

_____

_____

_____

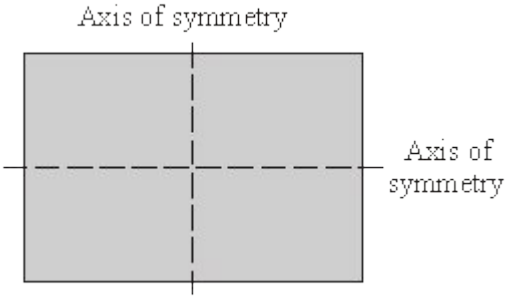
_____

(3)

(Total 6 marks)

Q24.

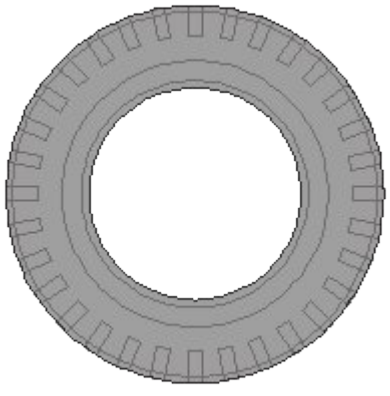
(a) The diagram shows a rectangle made out of a sheet of cardboard.



Draw an **X** on the diagram so that the centre of the **X** is at the centre of mass of the rectangle.

(1)

(b) The drawing shows a car tyre.



(i) Where is the centre of mass of the tyre?

_____

(1)

(ii) Explain your answer to (b)(i).

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_____

_____

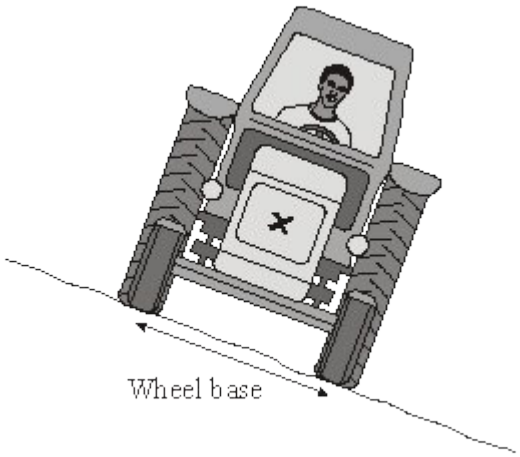
(1)

(Total 3 marks)

Q25.

Tractors are often used on sloping fields, so stability is important in their design.

On the diagram, the centre of the **X** marks the centre of mass of the tractor.



(a) Explain why the tractor has **not** toppled over. You may add to the diagram to help you to explain.

_____

_____

_____

_____

_____

_____

(3)

(b) Give **two** features of the tractor which affect its stability and state how each feature could be changed to increase the tractor's stability.

Feature 1 _____

_____

Feature 2 _____

_____

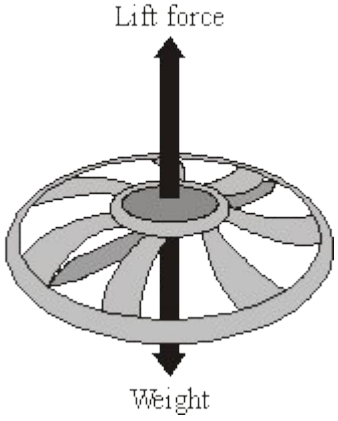
(2)

(Total 5 marks)

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Q26.

The diagram shows the forces on a small, radio-controlled, flying toy.



(a) (i) The mass of the toy is 0.06 kg.
Gravitational field strength = 10 N/kg

Calculate the weight of the toy.

Show clearly how you work out your answer and give the unit.

_____

_____

Weight = _____

(3)

(ii) Complete the following sentence by drawing a ring around the correct line in the box.

When the toy is hovering stationary in mid-air, the lift force is

bigger than
the same as
smaller than

the weight of the toy.

(1)

(b) When the motor inside the toy is switched off, the toy starts to *accelerate* downwards.

(i) What does the word *accelerate* mean?

_____

(1)

(ii) What is the direction of the resultant force on the falling toy?

_____

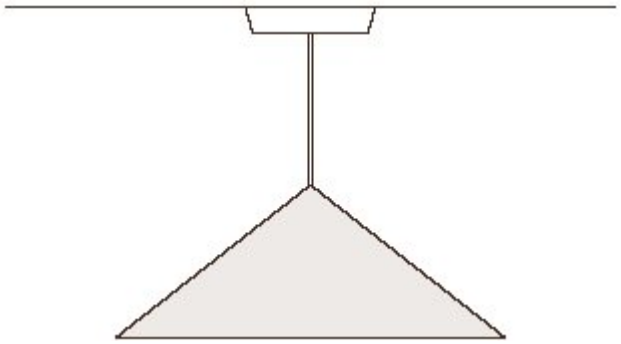
(1)

(Total 6 marks)

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Q27.

(a) The diagram shows a lampshade hanging from the ceiling. Draw an **X** on the diagram so that the centre of the **X** marks the centre of the mass of the lampshade.



(1)

(b) Complete the sentence using the correct word or phrase from the box.

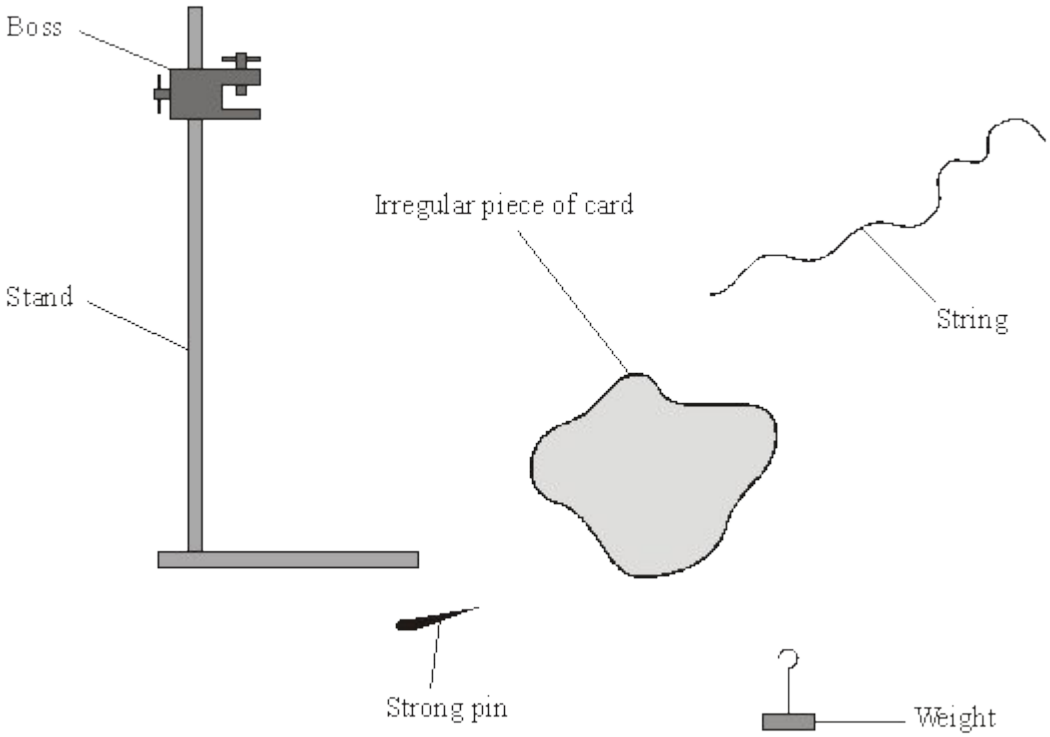
above	**below**	**to the left of**	**to the right of**

A suspended object will come to rest with its centre of mass directly

_____ the point of suspension.

(1)

(c) The diagrams show equipment that a student uses to find the centre of mass of a thin sheet of card.



Arrange these sentences in the correct order to describe how the student can find the centre of mass of the card.

The sequence starts with sentence **D** and finishes with sentence **E**.

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A A line is drawn on the card marking the position of the string.

B The pin is put through one of the holes in the card and held in the boss.

C This is repeated using the other hole.

D Two holes are made in the card with each hole near to the edge of the card.

E The centre of mass is where the lines cross on the card.

F The weight is tied to the string and then the string is hung from the pin.

D					**E**

(3)

(Total 5 marks)

Q28.

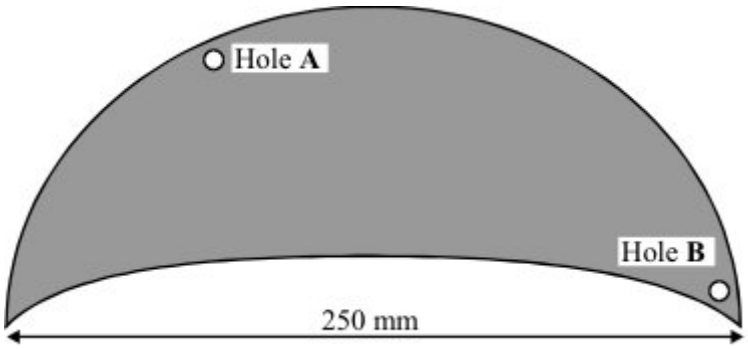
(a) Every object has a *centre of mass*. What is meant by the *centre of mass*?

_____

_____

(1)

(b) The drawing shows a thin sheet of plastic. The sheet is 250 mm wide. Two holes, each with a radius of 2 mm, have been drilled through the sheet.



Describe how you could use:

- a clamp and stand
- a steel rod 100 mm long and with a radius of l mm
- a weight on a thin piece of string (= a plumb line)
- a ruler
- a pen which will write on the plastic sheet

to find the centre of mass of the plastic sheet.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

_____

_____

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_____

_____

_____

_____

_____

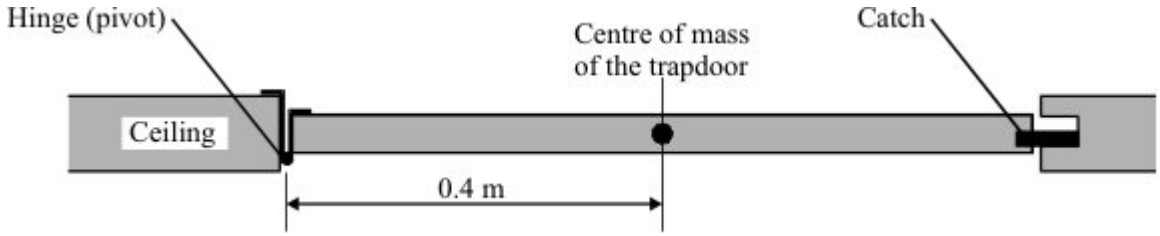
_____

_____

_____

(5)

(c) There is a trapdoor in the ceiling of a house.
The trapdoor weighs 44 N.
The drawing shows a side view of the trapdoor.



(i) Complete the **three** spaces to give the equation which is used to calculate the turning effect of a force.

_____ = _____ × perpendicular between _____ line of action and pivot

(1)

(ii) Calculate the turning effect, about the hinge, due to the weight of the trapdoor.

Show clearly how you work out your final answer and give the unit.

_____

_____

Turning effect = _____

(3)

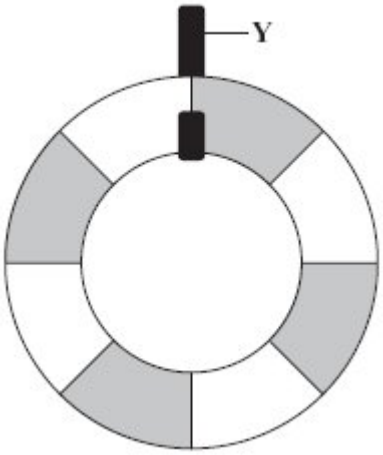
(Total 10 marks)

Q29.

(a) The diagram shows a lifebelt. It is hanging freely from hook **Y**.

(i) On the diagram, mark with an **X** the point where you think the centre of mass of the lifebelt will be.

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(1)

(ii) Explain why you have chosen this point.

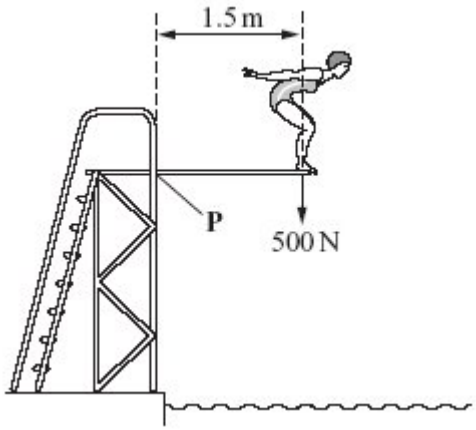
_____

_____

_____

(2)

(b) The drawing shows Susan on a diving board. She is 1.5 metres from point **P** and she weighs 500 N.



Calculate her moment (turning effect) about point **P**.
Show clearly how you work out your answer and give the unit.

_____

_____

Moment about **P** = _____

(3)

(c) Susan has a case with wheels.

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When she packs this case, she puts the heaviest items at the end where the wheels are.
This means that the heaviest items are less likely to crush the other contents and it helps her to find things when she opens the case.

Explain another advantage of packing her case in this way.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

_____

_____

_____

_____

_____

_____

_____

_____

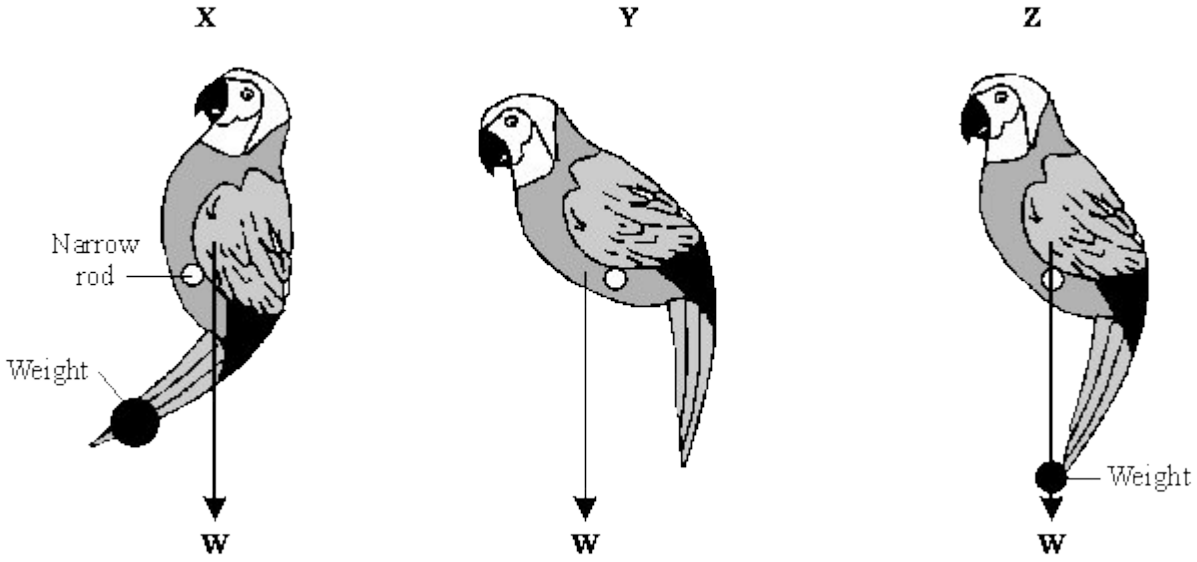
(4)

(Total 10 marks)

Q30.

(a) The diagram shows three similar toys. Each toy should be able to balance on a narrow rod. The arrows show the direction in which the weight of the toy acts.

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Only one of the toys balances on the rod, the other two fall over. Which **one** of the toys is balanced? Explain the reason for your choice.

_____

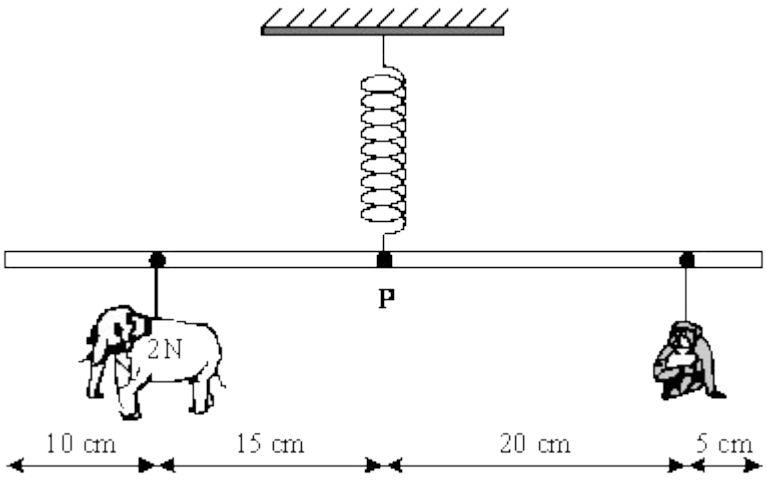
_____

_____

_____

(3)

(b) The diagram shows a simple toy. Different animal shapes can be positioned so that the 50 cm rod balances horizontally.



(i) Calculate the moment exerted by the elephant shape of weight 2N about the pivot **P**. Show clearly how you work out your answer and give the unit.

_____

_____

Moment = _____

(3)

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(ii) Use the following relationship to calculate the weight of the monkey shape.

total clockwise moment = total anticlockwise moment

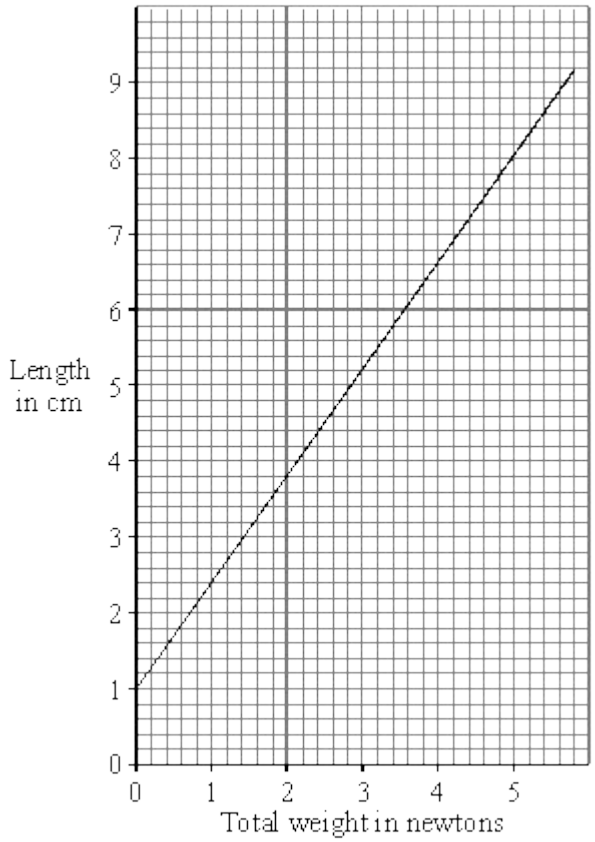
_____

_____

Weight = _____ N

(2)

(c) The graph shows how the length of the spring changes as the total weight of the different animal shapes change.



Use the graph to find how much the spring extends when the elephant shape and the monkey shape are hung from the rod. Show how you get your answer.

_____

_____

Extension of spring = _____ cm

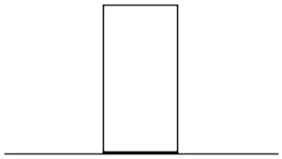
(2)

(Total 10 marks)

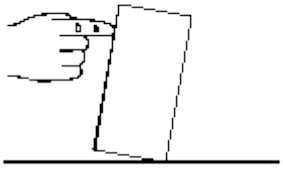
Q31.

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A child stands a wooden brick on its end as shown in the diagram.



The child then pushes the brick to make it tilt.



How far must the brick be tilted to make it fall over?

Explain your answer.

(You may draw a labelled diagram if you wish.)

_____

_____

_____

(Total 2 marks)

Q32.

Choose words from this list to complete the sentences below.

balanced	electricity	gravity
joules	magnetism	newtons

When you drop something it falls.

This is because it is pulled to the Earth by _____

We measure forces in units called _____

When a falling object reaches the ground, it stops moving.

This means that the forces acting on it are now _____

(Total 3 marks)

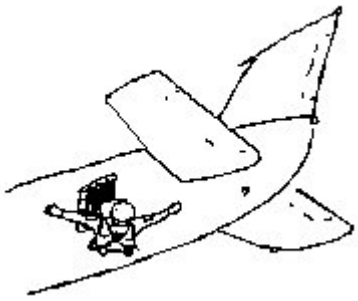
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Q33.

A sky-diver steps out of an aeroplane.

After 10 seconds she is falling at a steady speed of 50m/s.

She then opens her parachute.



After another 5 seconds she is once again falling at a steady speed.

This speed is now only 10m/s.

(a) Calculate the sky-diver's average acceleration during the time from when she opens her parachute until she reaches her slower steady speed. (Show your working.)

_____

_____

_____

(3)

(b) Explain, as fully as you can:

(i) why the sky-diver eventually reaches a steady speed (with or without her parachute).

_____

_____

_____

_____

(3)

(ii) why the sky-diver's steady speed is lower when her parachute is open.

_____

(1)

(c) The sky-diver and her equipment have a total mass of 75kg. Calculate the gravitational force acting on this mass. (Show your working.)

_____

_____

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Answer _____ N

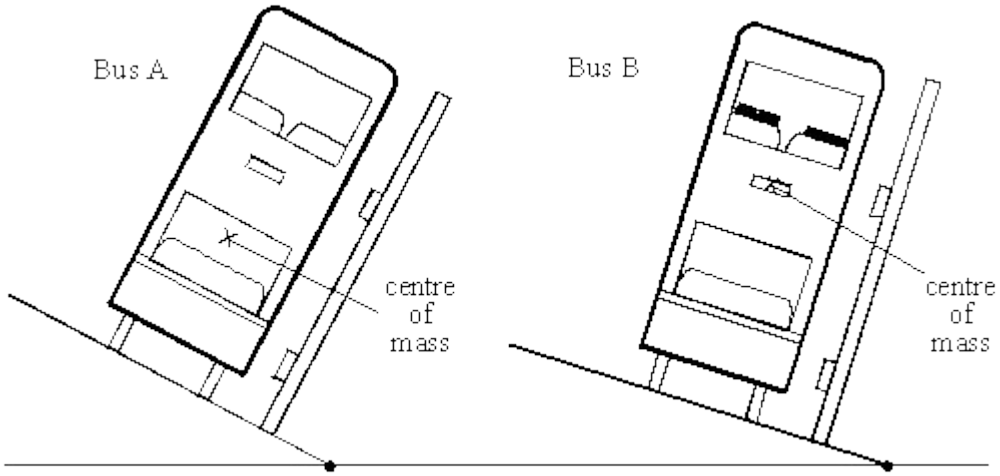
(1)

(Total 8 marks)

Q34.

The diagram shows two buses. Bus A is empty. Bus B contains bags of sand upstairs to represent passengers.

Each bus has been tilted as far as it can without falling over.



(a) Each bus will topple over if it is tilted any further.

Explain, in as much detail as you can, why this will happen.

(You can draw on one of the diagrams as part of your answer if you want to.)

_____

_____

_____

(2)

(b) What difference does it make to the stability of the bus when the upper deck is full of "passengers"? Explain your answer as fully as you can.

_____

_____

_____

(3)

(c) Why are the bags of sand in bus B only put upstairs?

_____

_____

(1)

(Total 6 marks)

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