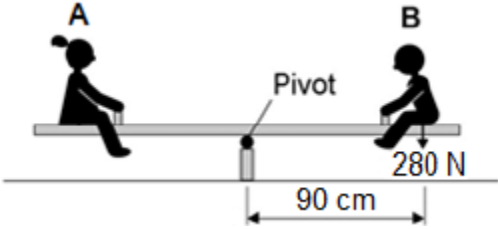


1

Two children, **A** and **B**, are sitting on a see-saw, as shown in the figure below.

The see-saw is balanced.



- (a) Use the following equation to calculate the moment of child **B** about the pivot of the see-saw.

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

Give your answer in newton-metres

Moment = _____ Nm

(2)

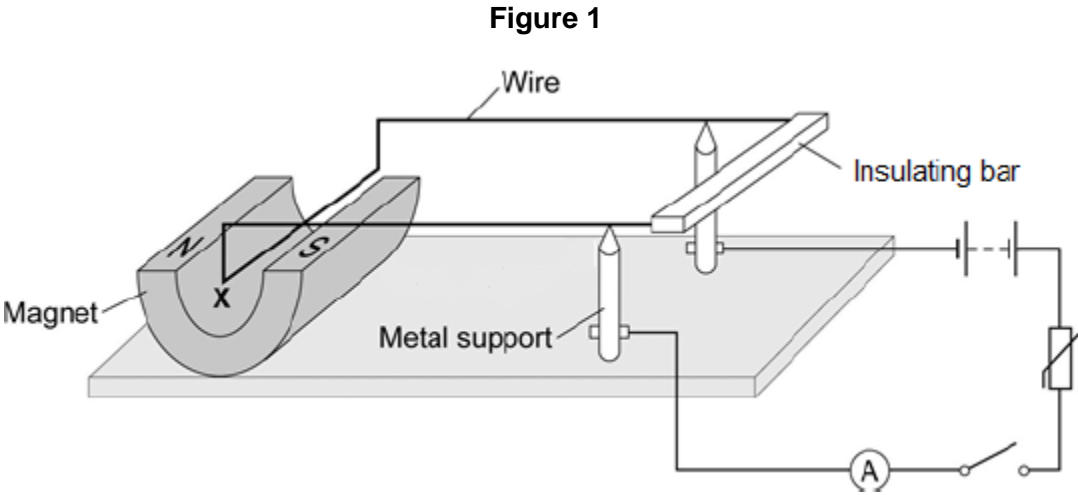
- (b) Use the idea of moments to explain what happens when child **B** moves closer to the pivot.

(3)

(Total 5 marks)

2

Figure 1 shows a piece of apparatus called a current balance.



When the switch is closed, the part of the wire labelled X experiences a force and moves downwards.

(a) What is the name of the effect that causes the wire X to move downwards?

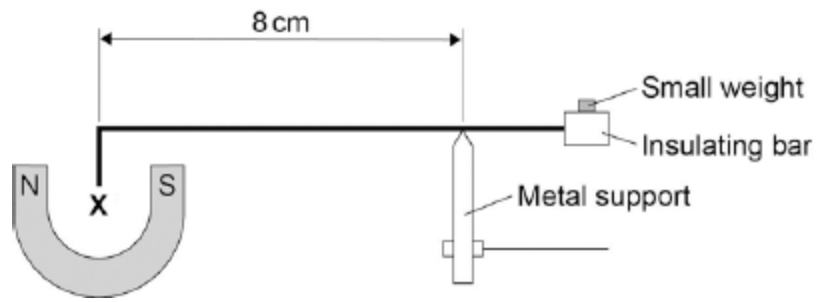
(1)

(b) Suggest one change you could make to the apparatus in Figure 1 that would increase the size of the force that wire X experiences.

(1)

- (c) **Figure 2** shows how a small weight placed on the insulating bar makes the wire **X** go back and balance in its original position.

Figure 2



The wire **X** is 5 cm long and carries a current of 1.5 A.

The small weight causes a clockwise moment of 4.8×10^{-4} Nm.

Calculate the magnetic flux density where the wire **X** is positioned

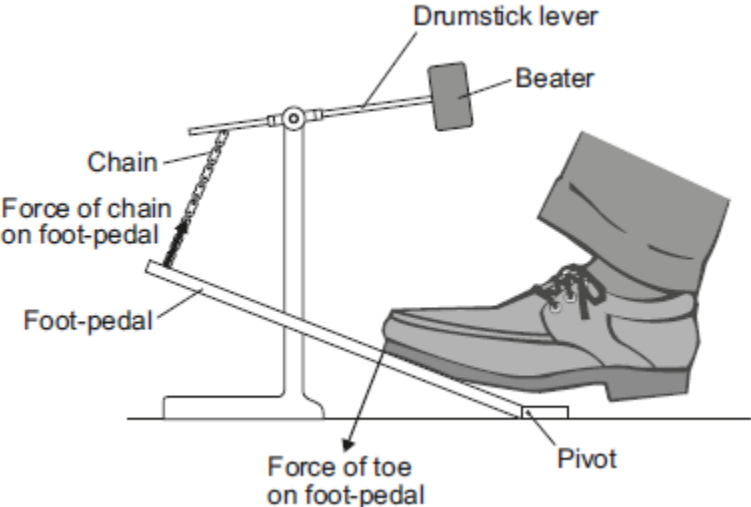
Give the unit.

Magnetic flux density = _____ Unit _____

(6)
(Total 8 marks)

3

A drum is hit by a beater attached to a drumstick lever. The drumstick lever is attached to a foot-pedal by a chain, as shown below.



(a) State how the size of the force of the chain on the foot-pedal compares with the size of the force of the toe on the foot-pedal.

(1)

(b) The foot-pedal is pushed halfway down and held stationary.

The force of the toe and the force of the chain each create a moment which acts on the foot-pedal.

Compare the size and direction of the moments of the toe and the chain.

Tick (✓) **one** box.

Size	Direction	Tick (✓)
The moments are equal	same	<input type="checkbox"/>
The moments are equal	opposite	<input type="checkbox"/>
The moment of the force of the toe is greater	same	<input type="checkbox"/>

(1)

(c) How can the drummer create a greater moment about the pivot without increasing the force he applies?

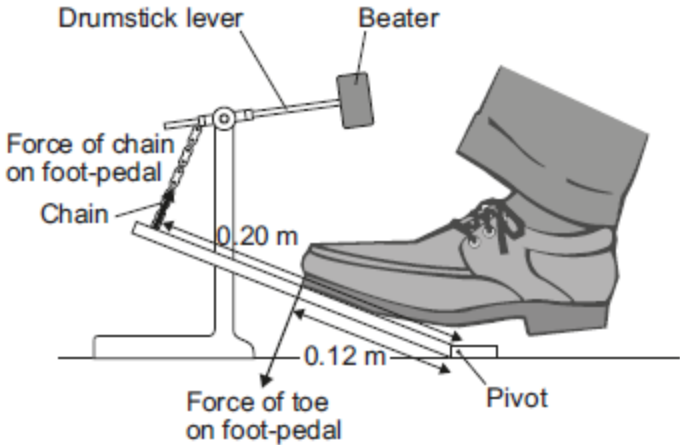
(1)

(Total 3 marks)

4

A drum is hit by a beater attached to a drumstick lever. The drumstick lever is attached to a foot-pedal by a chain, as shown in the **Figure 1**.

Figure 1



(a) When the toe is pushed down the force creates a moment on the foot-pedal.

(i) State what is meant by the moment of a force.

(1)

(ii) The foot-pedal is pushed halfway down and held stationary. The toe and the chain both exert a force on the foot-pedal.

Compare the sizes and directions of the moments caused by the force of the toe and the force of the chain on the foot-pedal.

(1)

- (iii) The drummer's toe pushes with a 1.5 N force on the foot-pedal.
The perpendicular distance from the pivot to the force is 0.12 m.
The perpendicular distance from the pivot to the chain is 0.20 m.

Calculate the force of the chain acting on the foot-pedal.

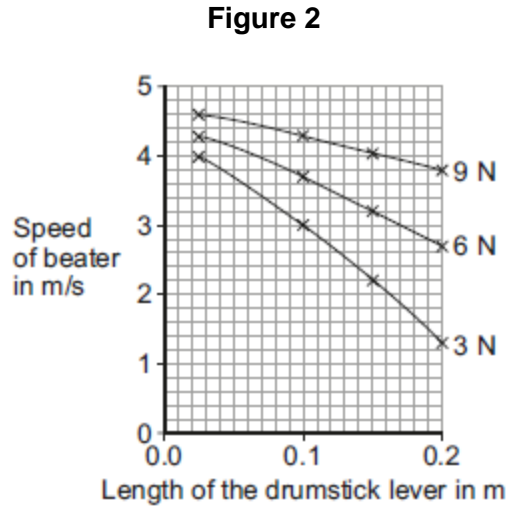
Force = _____ N

(3)

(b) The foot-pedal is pushed with different forces to make the beater move at different speeds.

The higher the speed at which the beater hits the drum, the louder the sound the drum makes.

Figure 2 shows how the length of the drumstick lever affects the speed of the beater for three different forces.



The drummer needs to be able to sometimes play the drum quietly and sometimes loudly.

How does the **length** of the drumstick lever affect the variation in loudness of the sound from the drum when applying:

a force of 3 N? _____

a range of forces from 3 N to 9 N? _____

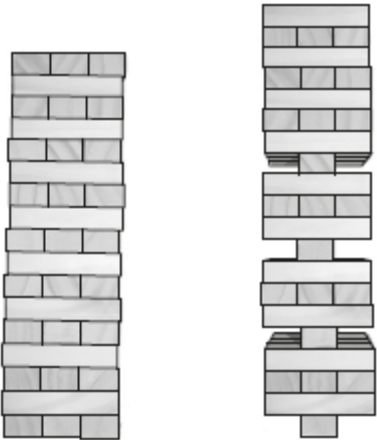
(2)
(Total 7 marks)

5

In a balancing game, wooden blocks are used to build a tower. The shape of the tower at the start of the game is shown in **Figure 1**. During the game, some of the blocks are taken out and put on top of the tower as shown in **Figure 2**. This causes the centre of mass of the tower to change.

Figure 1

Figure 2



(a) (i) State what is meant by the term 'centre of mass'.

(1)

(ii) Give **two** reasons why the tower in **Figure 2** is less stable than the tower in **Figure 1**.

1. _____

2. _____

(2)

(b) **Figure 3** shows a different arrangement for the wooden blocks.

Figure 3



A block was placed in position **A** and an identical block was placed in position **B** at the same time.

Explain why the tower did not fall over. You should include reference to moments in your answer.

(2)

(Total 5 marks)

6

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

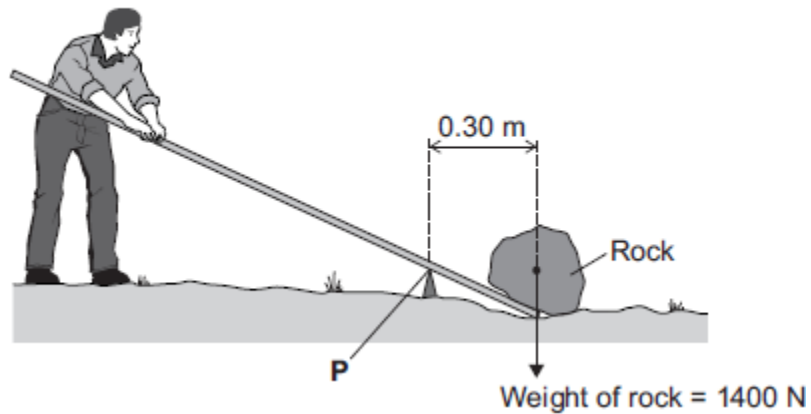
balancing	stretching	turning
------------------	-------------------	----------------

A moment is the _____ effect of a force.

(1)

(b) **Figure 1** shows how a lever can be used to lift a heavy rock.

Figure 1



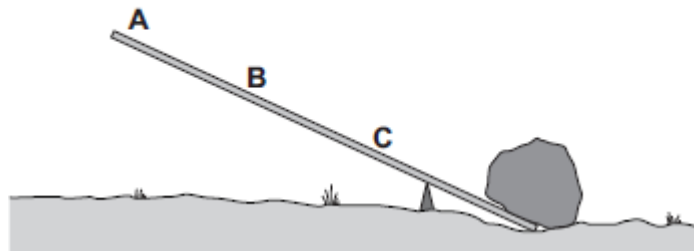
Calculate the moment of the weight of the rock about point P.

Moment = _____ newton metres

(2)

(c) **Figure 2** shows three positions on the lever, A, B and C, where the person could have applied a force to lift the rock.

Figure 2



Which position, A, B or C, needs the smallest force to lift the rock?

Draw a ring around the correct answer.

A B C

Give the reason for your answer.

(2)

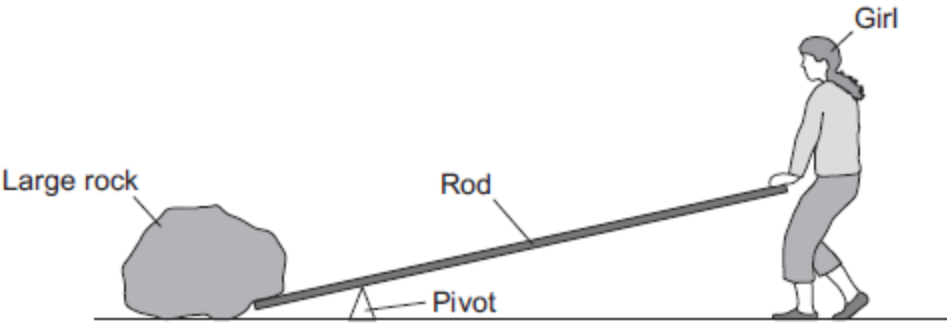
(Total 5 marks)

7

Levers and hydraulic systems can act as force multipliers.

(a) **Figure 1** shows a girl trying to lift a large rock using a long rod as a lever.

Figure 1



The girl is pushing down on the rod but is just unable to lift the rock.

Which of the following changes would allow her to lift the rock?

Tick (✓) **two** boxes.

Change	Tick (✓)
Move the pivot away from the rock	
Make the rod longer	
Push the rod upwards	
Push down on the rod with a greater force	

(2)

(b) Liquids are used in hydraulic systems because they are virtually incompressible.

Explain how the spacing of particles in a liquid cause it to be virtually incompressible.

(2)

(c) **Figure 2** shows a man using a car jack to lift his car.

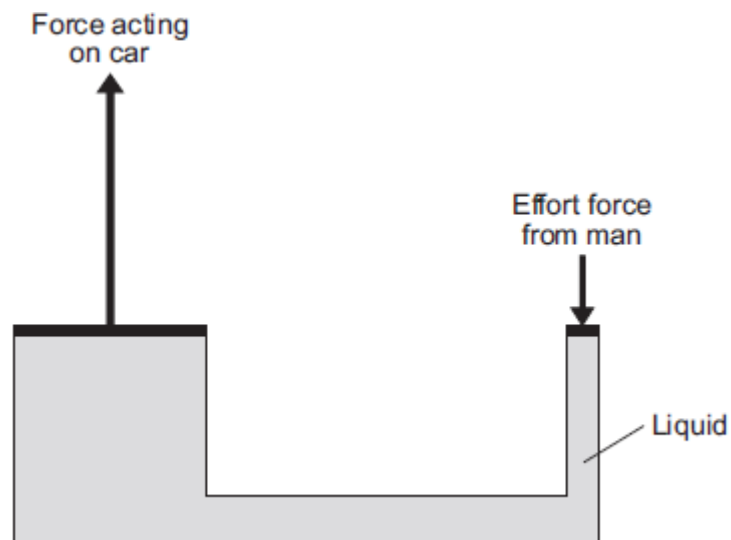
Figure 2



© lisafx/iStock/Thinkstock

Figure 3 shows a simple diagram of a car jack.

Figure 3



- (i) The man pushes down with an effort force. This results in a much larger force acting upwards on the car.

Use information from **Figure 3** to explain how.

(4)

- (ii) Which of the following statements about the forces in **Figure 3** is correct?

Tick (✓) **one** box.

	Tick (✓)
The force acting on the car moves a greater distance than the effort force.	
The force acting on the car moves less distance than the effort force.	
The force acting on the car moves the same distance as the effort force.	

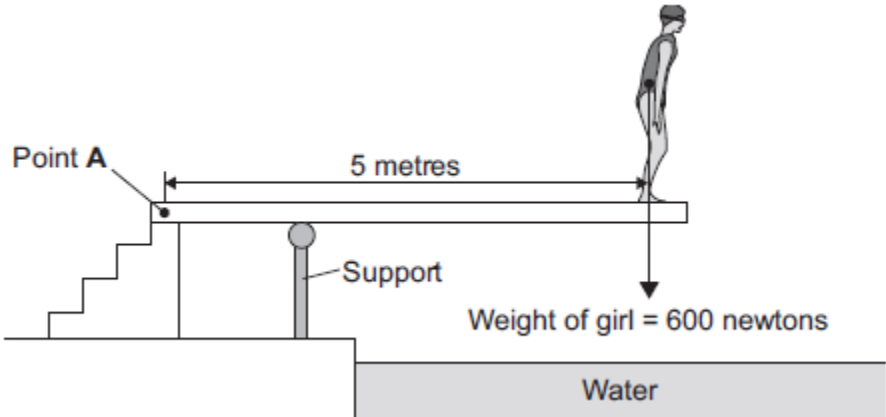
(1)

(Total 9 marks)

8

Figure 1 shows a girl standing on a diving board.

Figure 1



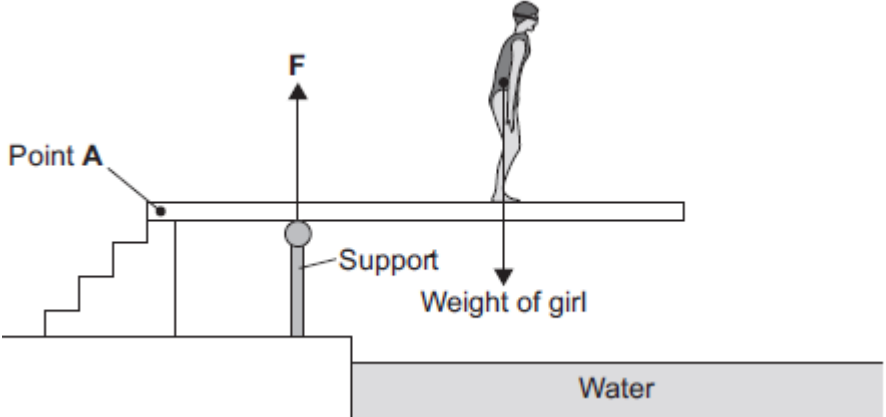
(a) Calculate the moment of the girl's weight about Point A.

Moment = _____ newton metres

(2)

(b) Figure 2 shows the girl standing at a different place on the diving board. The support provides an upward force **F** to keep the diving board balanced.

Figure 2



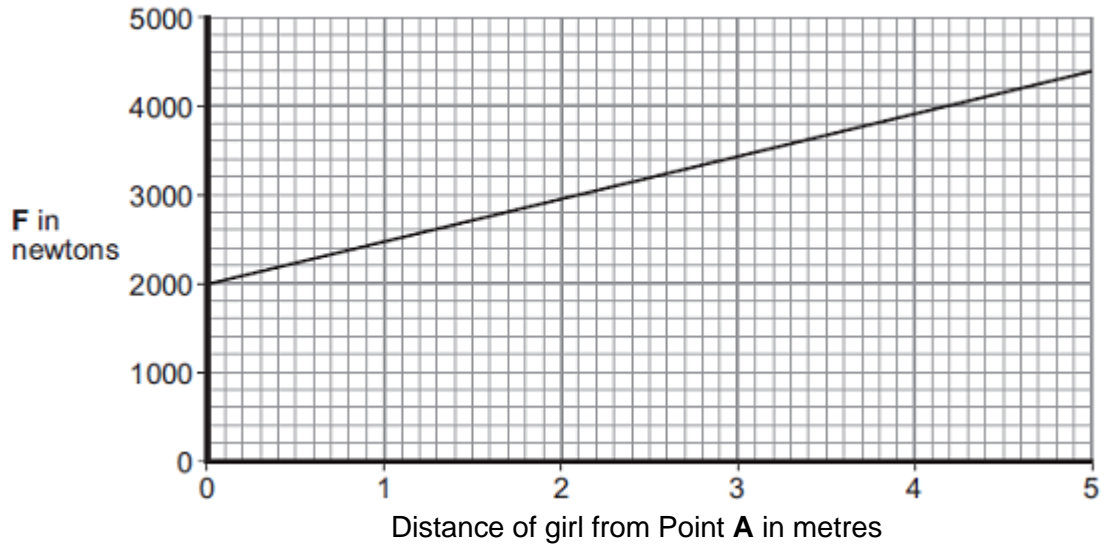
Complete the following sentence.

The diving board is not turning. The total clockwise moment is balanced by the total _____.

(1)

(c) **Figure 3** shows how the upward force **F** varies with the distance of the girl from Point **A**.

Figure 3



(i) Use **Figure 3** to determine the upward force **F** when the girl is standing at a distance of 3 metres from point **A**.

Upward force **F** = _____ newtons

(1)

(ii) What conclusion should be made from **Figure 3**?

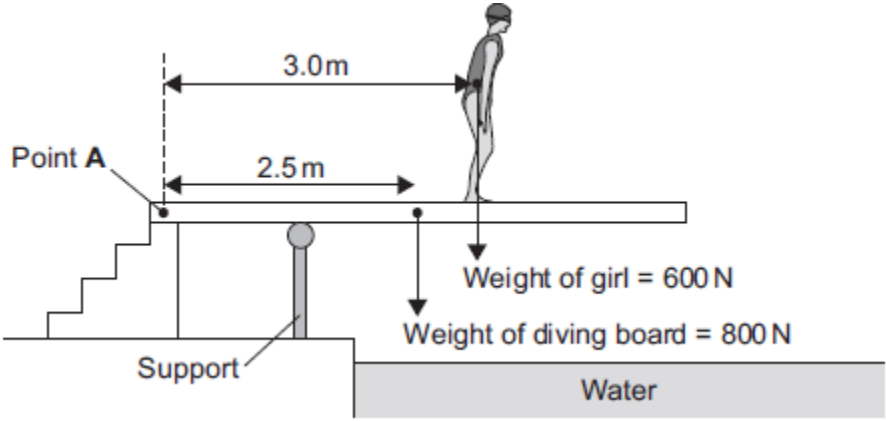
(1)

(Total 5 marks)

9

(a) **Figure 1** shows a girl standing on a diving board.

Figure 1



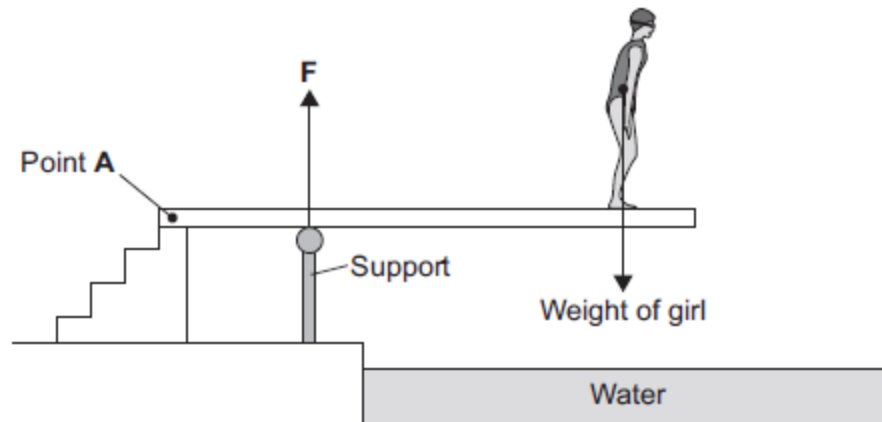
Calculate the total clockwise moment of the weight of the diving board and the weight of the girl about Point A. Give the unit.

Total clockwise moment about Point A = _____

(4)

- (b) **Figure 2** shows the girl standing at a different place on the diving board.
 The support provides an upward force **F** to keep the diving board balanced.

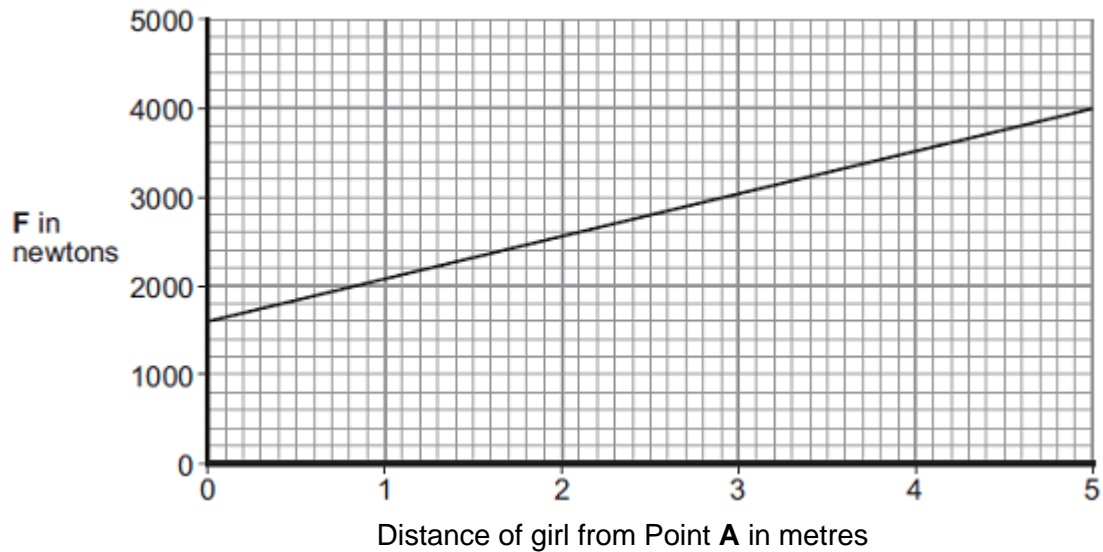
Figure 2



\$"

Figure 3 shows how the upward force **F** varies with the distance of the girl from Point **A**.

Figure 3



\$"

Explain, in terms of clockwise and anticlockwise moments, why the upward force **F** increases as shown in **Figure 3**.

(3)
(Total 7 marks)

10

Forces have different effects.

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

slowing	stretching	turning
---------	------------	---------

The moment of a force is the _____ effect of the force.

(1)

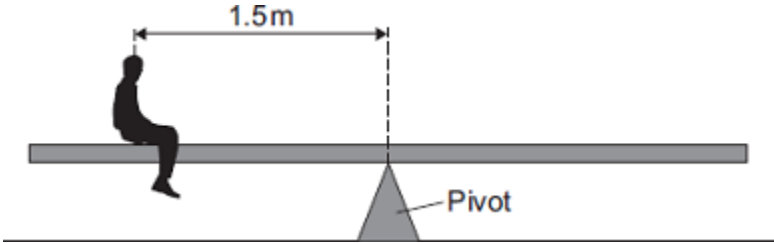
(ii) What is meant by the centre of mass of an object?

(1)

(b) Some children build a see-saw using a plank of wood and a pivot. The centre of mass of the plank is above the pivot.

Figure 1 shows a boy sitting on the see-saw. His weight is 400 N.

Figure 1



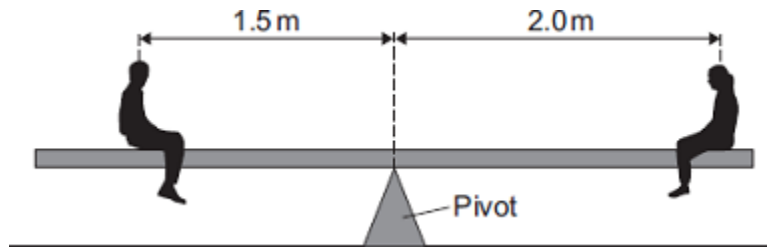
Calculate the anticlockwise moment of the boy in Nm.

Anticlockwise moment = _____ Nm

(2)

(c) **Figure 2** shows a girl sitting at the opposite end of the see-saw. Her weight is 300 N.

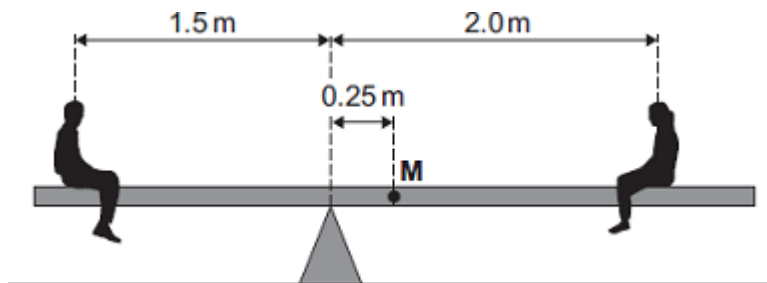
Figure 2



The see-saw is now balanced.

The children move the plank. Its centre of mass, **M**, is now 0.25 m from the pivot as shown in **Figure 3**.

Figure 3



The boy and girl sit on the see-saw as shown in **Figure 3**.

(i) Describe **and** explain the rotation of the see-saw.

(3)

- (ii) The boy gets off the see-saw and a bigger boy gets on it in the same place. The girl stays in the position shown in **Figure 3**. The plank is balanced. The weight of the plank is 270 N.

Calculate the weight of the bigger boy.

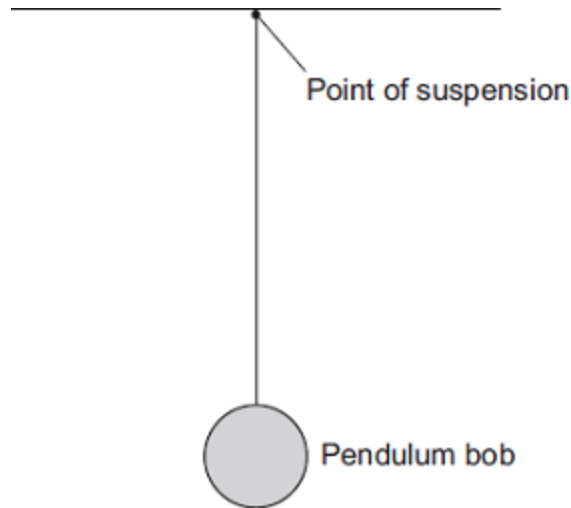
Weight of the bigger boy = _____ N

(3)

(Total 10 marks)

11

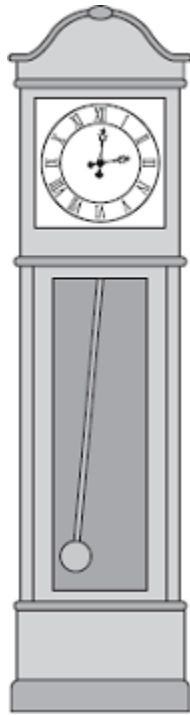
- (a) The diagram shows a pendulum.



Draw an X on the diagram above, so that the centre of the **X** marks the centre of mass of the pendulum bob.

(1)

(b) A large clock keeps time using the swing of a pendulum.



(i) The frequency of the swinging pendulum is 0.5 hertz.

Calculate the periodic time of the pendulum.

Periodic time = _____ seconds

(2)

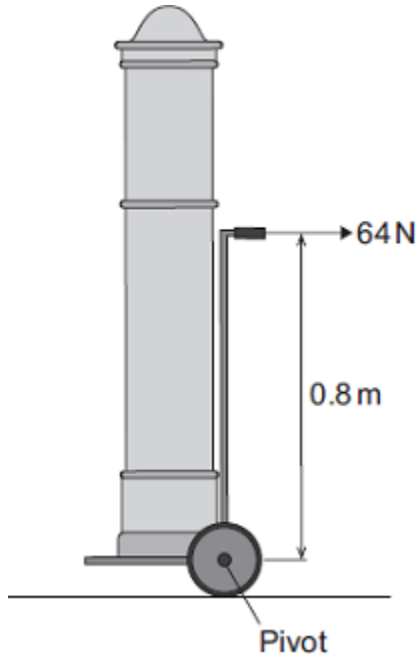
(ii) Calculate the number of complete swings the pendulum would make in 60 seconds.

Use your answer from part (b)(i) in your calculation.

Number of swings in 60 seconds = _____

(2)

- (c) The diagram shows a clock on a trolley.
The trolley is being used to move the clock.

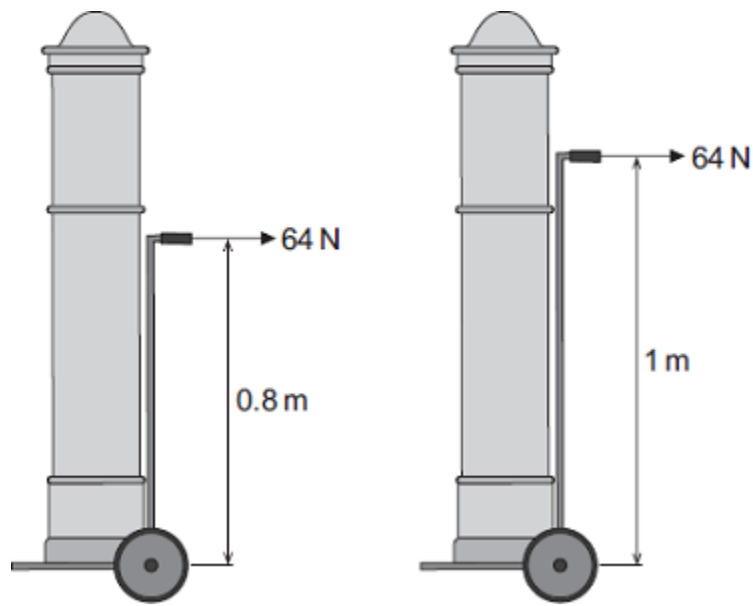


Calculate the moment of the 64 N force about the pivot.

Moment of the force = _____ Nm

(2)

(d) The design of the trolley is now changed to make it taller.

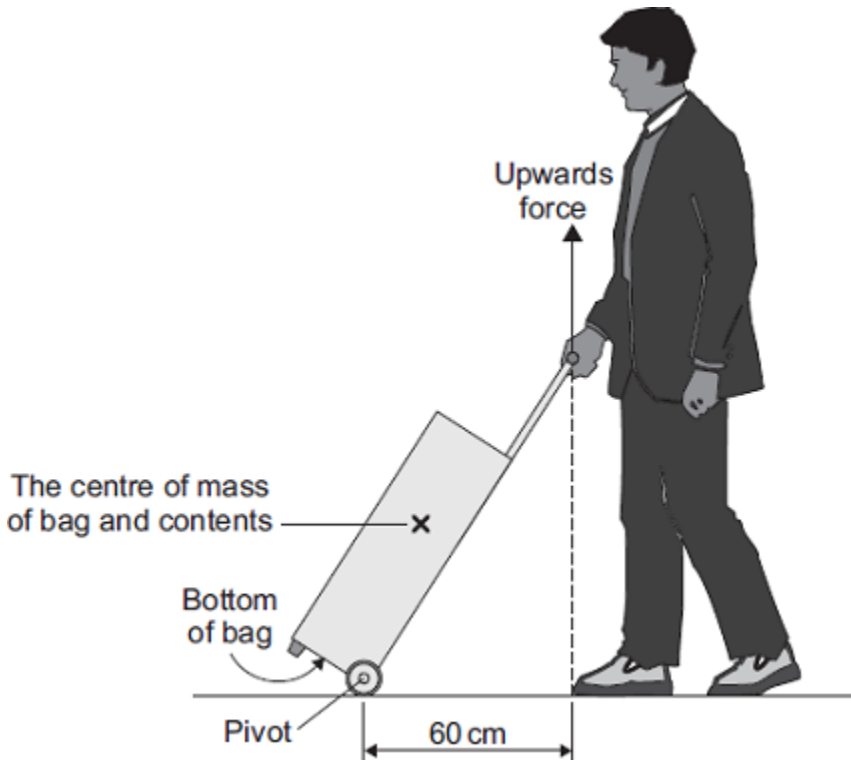


How does making the trolley taller affect the moment produced by the 64 N force about the pivot?

(1)
(Total 8 marks)

12

The diagram shows a man standing in an airport queue with his wheeled bag.



- (a) The man applies an upward force to the handle of his bag to stop the bag from falling. The moment of this force about the pivot is 36 Nm.

Calculate the upward force the man applies to the handle of his bag.

Force = _____ N

(2)

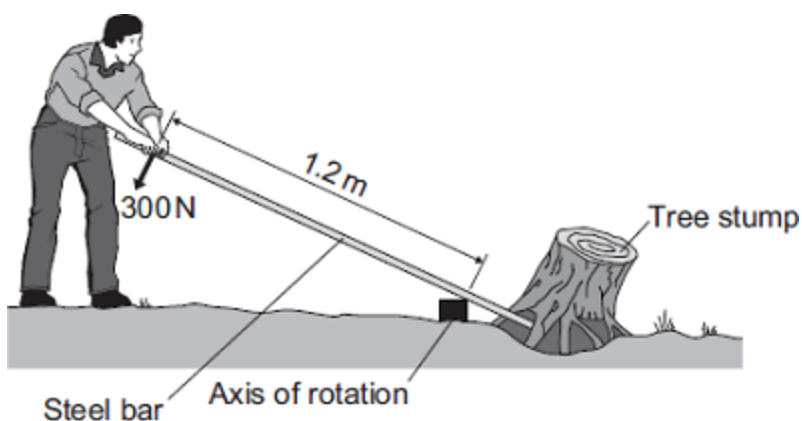
(b) When the man lets go of the bag handle, the bag falls and hits the floor.

Explain why.

(2)
(Total 4 marks)

13

The diagram shows a gardener using a steel bar to lift a tree stump out of the ground.



When the gardener pushes with a force of 300 N, the tree stump just begins to move.

(a) Use the equation in the box to calculate the moment produced by the 300 N force.

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

Show clearly how you work out your answer.

Moment = _____ newton metres

(2)

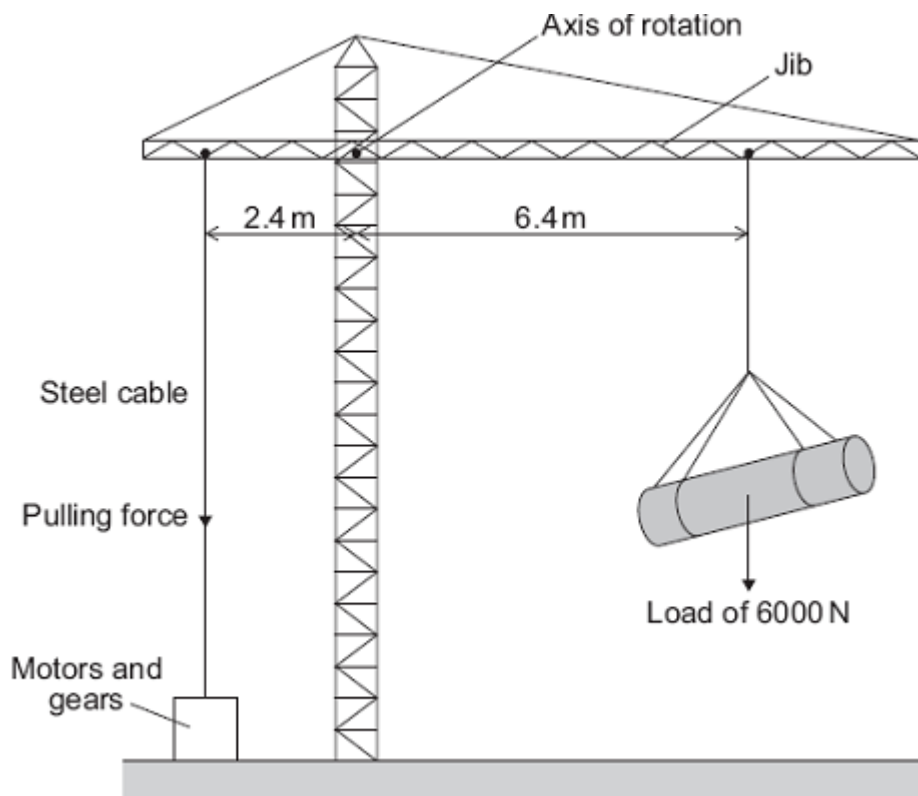
- (b) Using a longer steel bar would have made it easier for the gardener to lift the tree stump out of the ground.

Explain why.

(2)
(Total 4 marks)

14

The diagram shows a design for a crane. The crane is controlled by a computer.



The purpose of the motors and gears is to change the pulling force in the steel cable. This is done so that the jib stays horizontal whatever the size of the load or the position of the load.

- (a) Calculate the moment caused by the load in the position shown in the diagram.

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

Moment = _____

(3)

(b) Calculate the pulling force that is needed in the steel cable to keep the jib horizontal.

Show clearly how you work out your answer.

Pulling force = _____ N

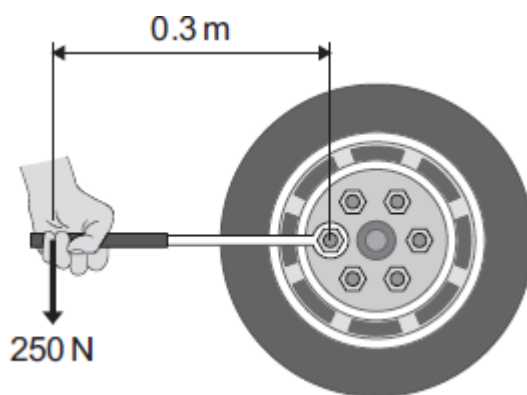
(2)

(Total 5 marks)

15

A company makes a wheel wrench with an extending handle. The company claims that the extending handle makes it easier to loosen the wheel nuts on a car.

The diagram shows the wheel wrench being used without the handle extended.



(a) (i) Use the equation in the box to calculate the moment produced by the force on the wrench.

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

Show clearly how you work out your answer.

Moment = _____ newton metres

(2)

(ii) Units can be written in words or symbols.

Which of the following is the unit for a moment written using symbols?

Draw a ring around your answer.

nm

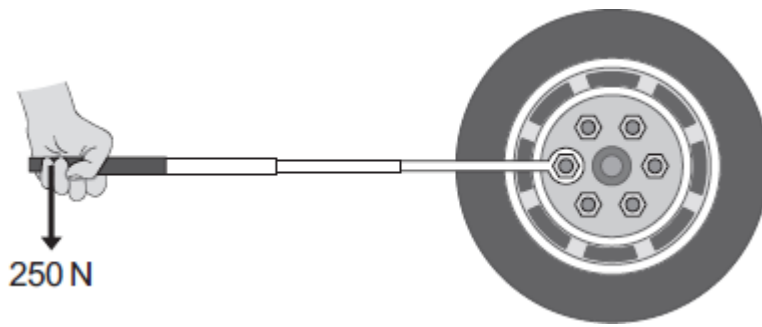
Nm

nM

NM

(1)

(b) The wheel nut will not move and so the handle of the wrench is extended.



It is now easy to loosen the wheel nut using the same force as before.

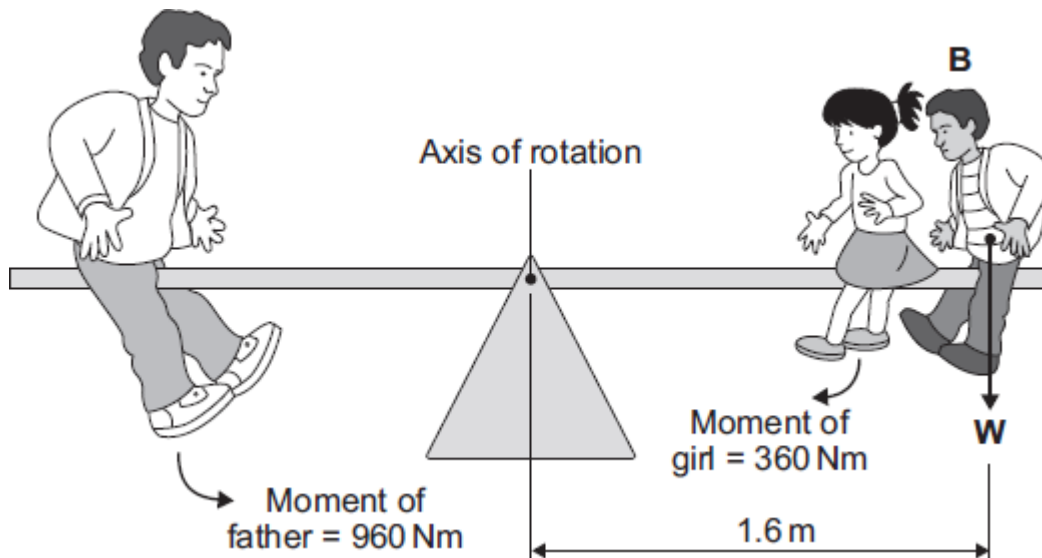
Explain why.

(2)

(Total 5 marks)

16

The diagram shows a father and his two children sitting on a playground see-saw. The see-saw is not moving.



(a) What is the total clockwise moment of the two children about the axis of rotation?

Explain the reason for your answer.

(3)

(b) (i) What is the clockwise moment of the boy, **B**, about the axis of rotation?

Moment = _____ Nm

(1)

(ii) Use the information in the diagram to calculate the weight, **W**, of the boy, **B**.

Show clearly how you work out your answer.

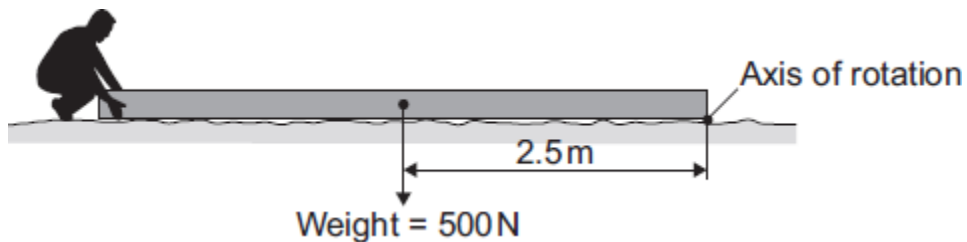
Weight of boy **B** = _____ N

(2)

(Total 6 marks)

17

The diagram shows someone starting to lift the end of a heavy wooden pole.



(a) Use the equation in the box to calculate the moment produced by the weight of the pole.

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

Moment = _____ Nm

(2)

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

The smallest force needed to lift the end of the pole will be

- | |
|--------------|
| bigger than |
| the same as |
| smaller than |

the weight of the pole.

(1)

(ii) Give a reason for your answer to part (b)(i).

(1)

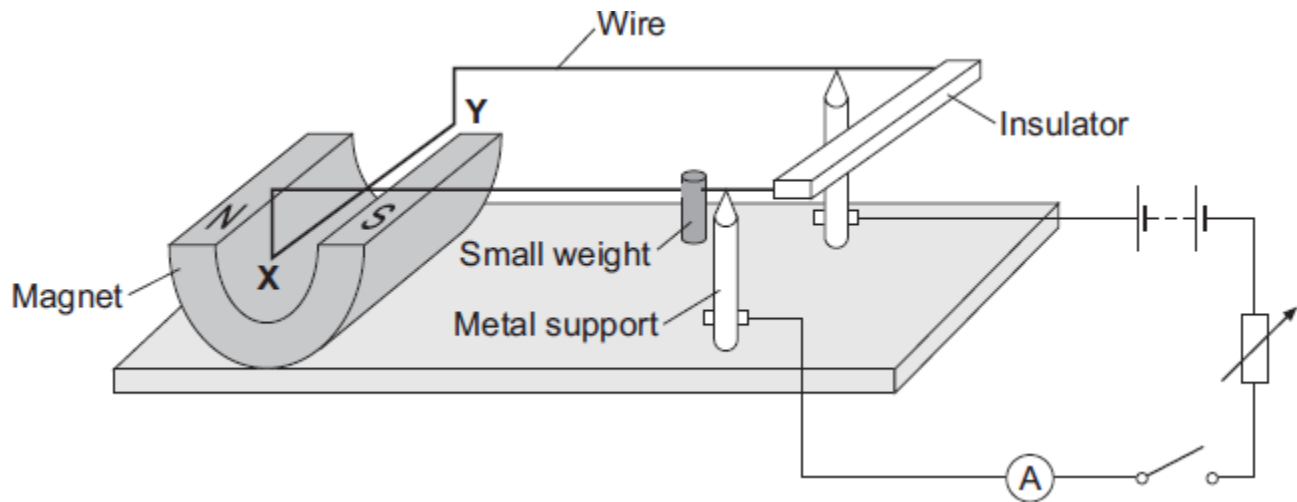
(c) How could the person lifting the end of the pole increase the moment?

(1)

(Total 5 marks)

18

The diagram shows a device called a current balance.



- (a) (i) When the switch is closed, the part of the wire labelled **XY** moves upwards.

Explain why.

(2)

- (ii) What is the name of the effect that causes the wire **XY** to move?

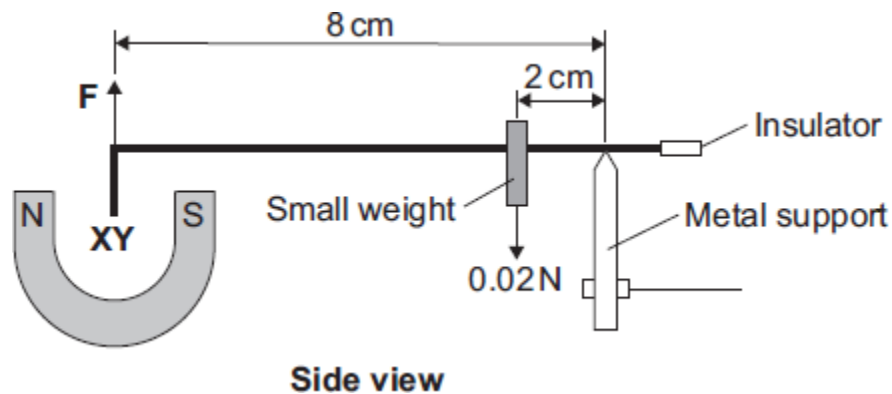
(1)

- (iii) An alternating current (a.c.) is a current which reverses direction. How many times the current reverses direction in one second depends on the frequency of the alternating supply.

Describe the effect on the wire **XY** if the battery is replaced by an a.c. supply having a frequency of 5 hertz.

(2)

- (b) The diagram shows how a small weight can be used to make the wire **XY** balance horizontally.



Use the data in the diagram and the equation in the box to calculate the force, **F**, acting on the wire **XY**.

$$\text{moment} = \text{force} \times \begin{matrix} \text{perpendicular distance from the} \\ \text{line of action of the force to the axis} \\ \text{of rotation} \end{matrix}$$

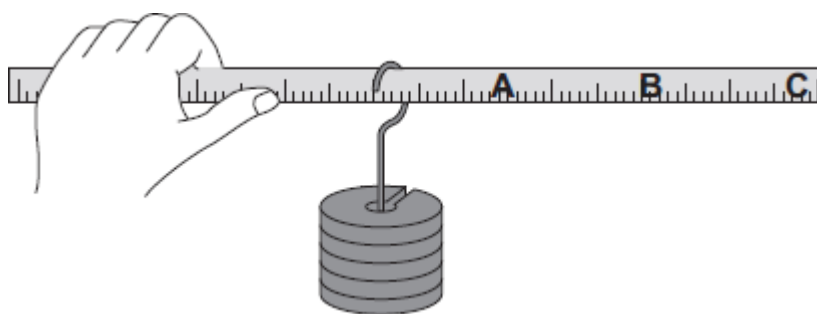
Show clearly how you work out your answer.

Force = _____ N

(3)
(Total 8 marks)

19

- (a) A student holds a ruler at one end and slides a weight along the ruler.



At which point, **A**, **B** or **C**, will the turning effect of the weight feel greatest?

Write your answer, **A**, **B** or **C**, in the box.

Point

(1)

- (b) Complete the following sentence by drawing a ring around the correct word in the box.

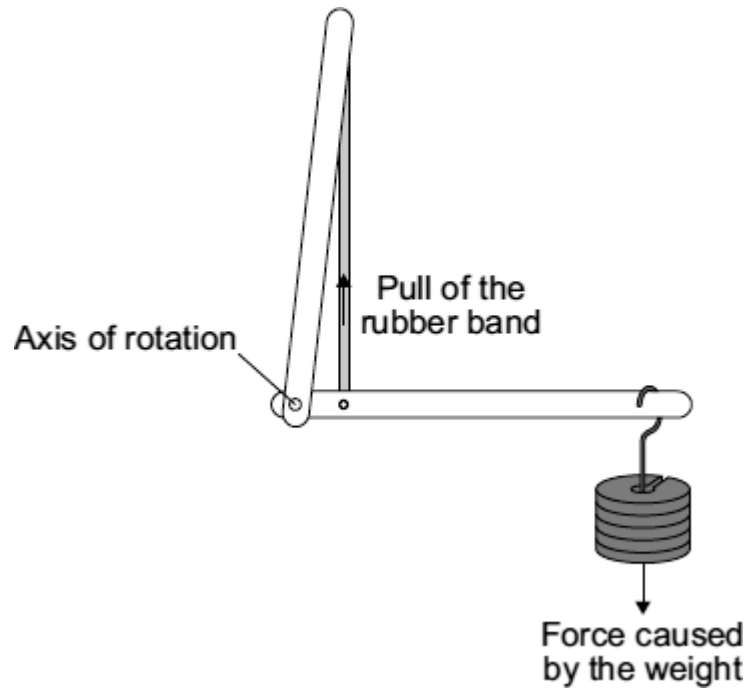
The turning effect of a force is called the

axis
equilibrium
moment

of the force.

(1)

- (c) In a human arm, the biceps muscle provides the force needed to hold the arm horizontal. A student uses a model in which a rubber band represents the biceps muscle.



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

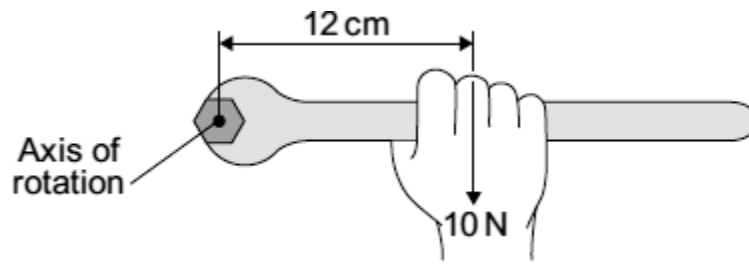
To hold the model arm horizontal, the pull from the rubber band will be

bigger than
smaller than
the same as

the force caused by the weight.

(1)

(d) The diagram shows a long spanner.



Use the equation in the box to calculate the moment, in N cm, being produced.

$\text{moment} = \text{force} \times \text{perpendicular distance from the line of action of the force to the axis of rotation}$
--

Show clearly how you work out your answer.

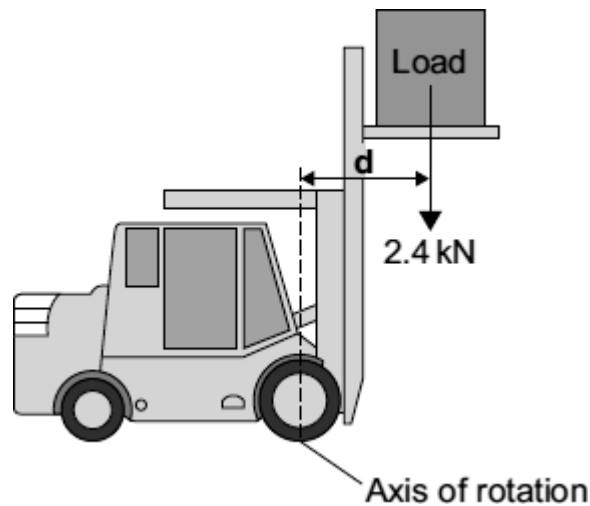
Moment = _____ N cm

(2)

(Total 5 marks)

20

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**.

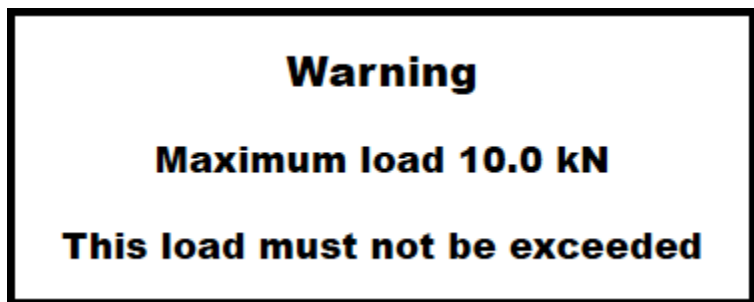
$\text{moment} = \text{force} \times \text{perpendicular distance from the line of action of the force to the axis of rotation}$
--

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.



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

(2)

(Total 5 marks)

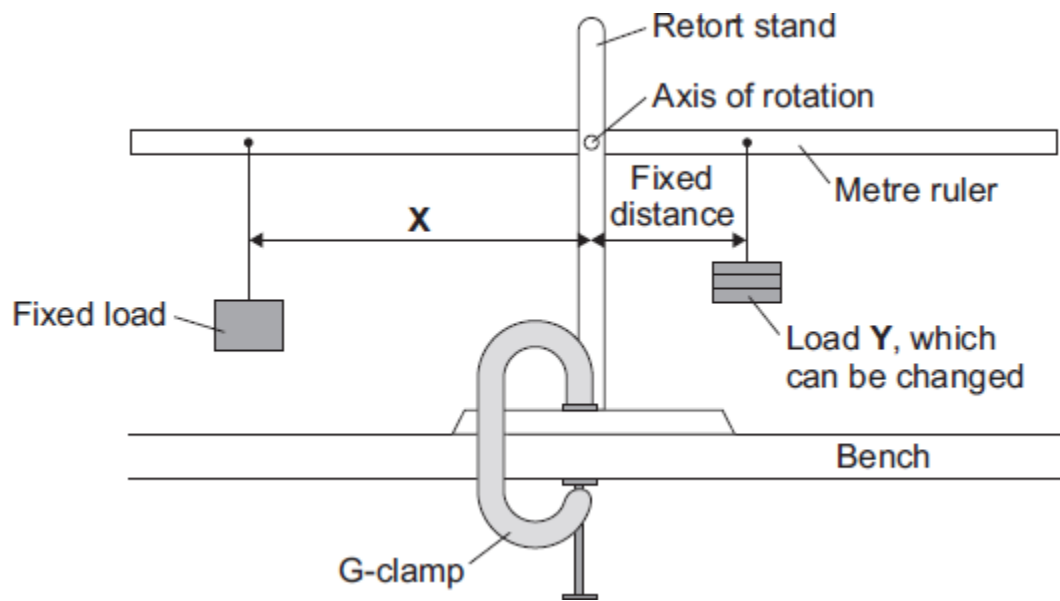
21

- (a) A student investigates the moment of a force.

- (i) What does the word *moment* mean in this sentence?

(1)

(ii) The diagram shows how she sets up her apparatus.



Suggest the purpose of the G-clamp.

(1)

- (iii) A horizontal rod fits into a hole at the centre of the metre ruler. This is the axis of rotation. The student changes the load **Y** and adjusts the distance **X** until the metre ruler is horizontal. She takes six pairs of measurements which are shown in the table.

Load Y in newtons	Distance X in centimetres
1	7
2	14
3	21
4	28
5	35
6	42

Explain fully how distance **X** varies with load **Y**.

(2)

- (iv) The weight of the ruler can be ignored in this experiment.

Which statement gives the reason why?

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

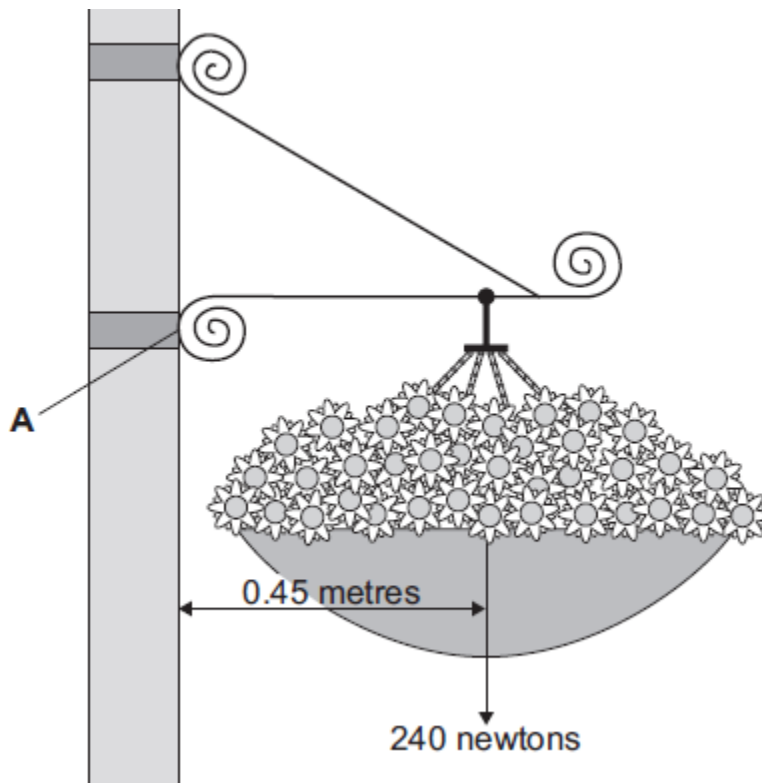
The weight of the ruler is so small it is negligible.

The centre of mass of the ruler is at the axis of rotation.

The ruler is a symmetrical object.

(1)

(b) In the summer, a town council fits hanging baskets to some of its lamp posts.



Use the information in the diagram and the equation in the box to calculate the moment produced by the weight of the hanging basket about an axis through point **A**.

$\text{moment} = \text{force} \times \text{perpendicular distance from the line of action of the force to the axis of rotation}$
--

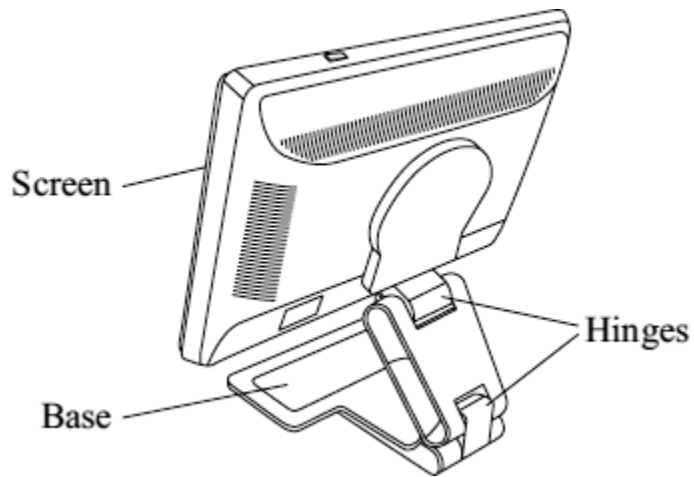
Show clearly how you work out your answer **and** give the unit.

Moment = _____

(3)
(Total 8 marks)

22

The diagram shows a back view of a computer monitor.



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

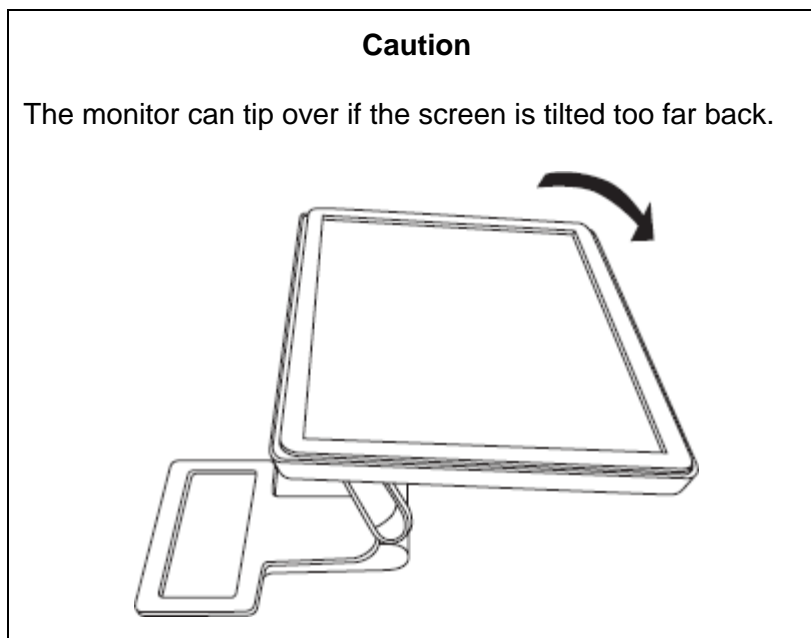
(i) Explain the meaning, in the above sentence, of the word *stable*.

(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.



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.

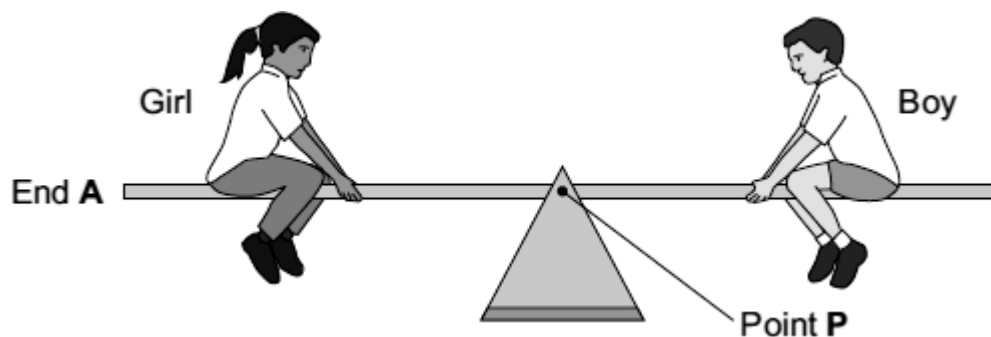
(3)

(Total 6 marks)

23

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.
moment.

(1)

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

balance
rotation
turning

of the see-saw.

(1)

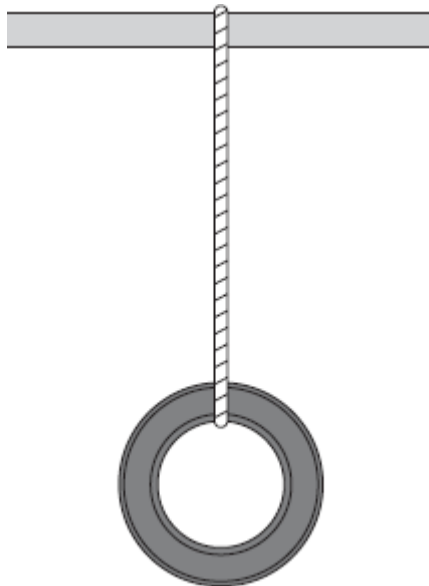
(iii) To make end **A** of the see-saw go up,

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.

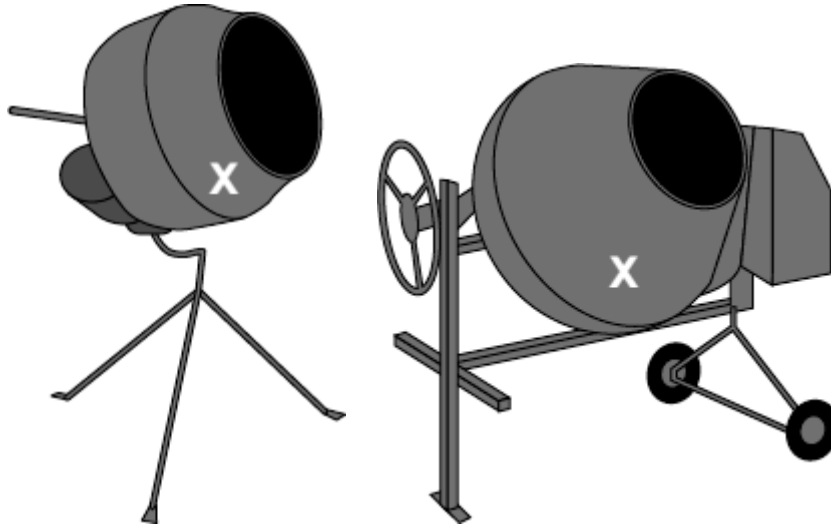
above	below	to the left of	to the right of
--------------	--------------	-----------------------	------------------------

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)

24

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)

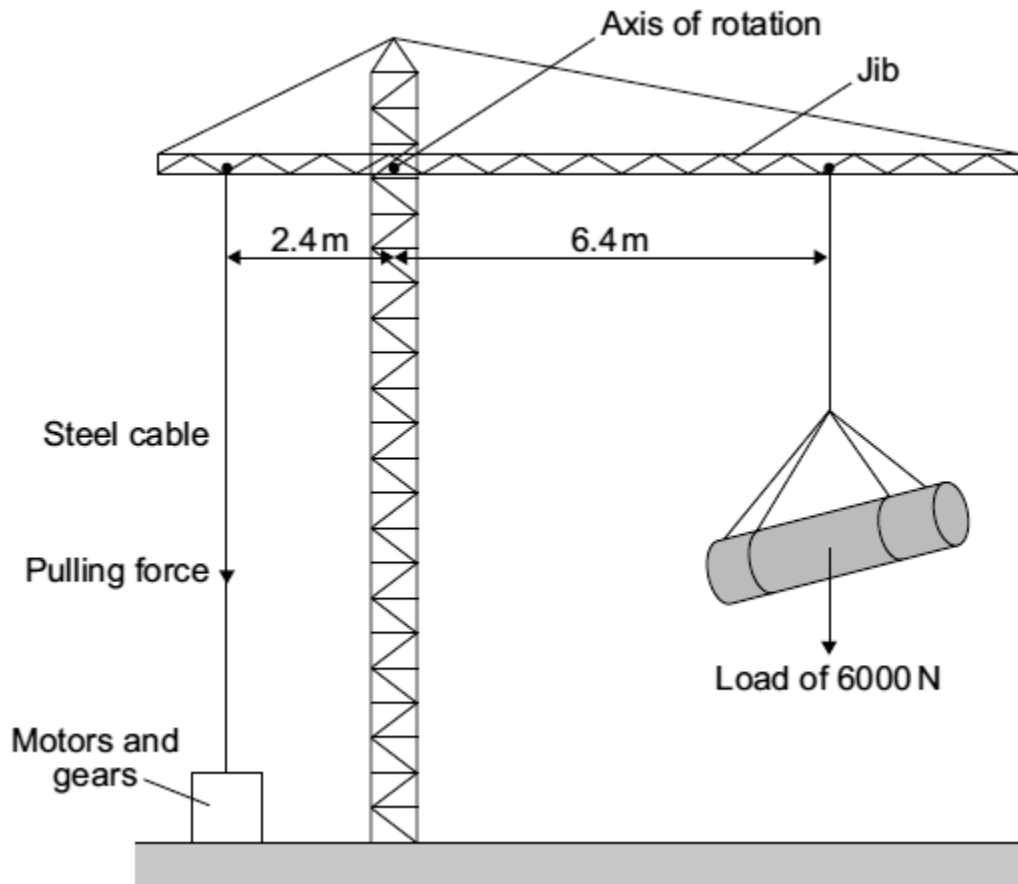
(c) Use the terms 'line of action of the weight' and 'resultant moment' to explain why a stable concrete mixer does not fall over when it is given a small push.

(2)

(Total 5 marks)

25

The diagram shows a design for a crane. The crane is controlled by a computer.



The purpose of the motors and gears is to change the pulling force in the steel cable. This is done so that the jib stays horizontal whatever the size of the load or the position of the load.

- (a) Calculate the moment caused by the load in the position shown in the diagram.

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

Moment = _____

(3)

- (b) Calculate the pulling force that is needed in the steel cable to keep the jib horizontal.

Show clearly how you work out your answer.

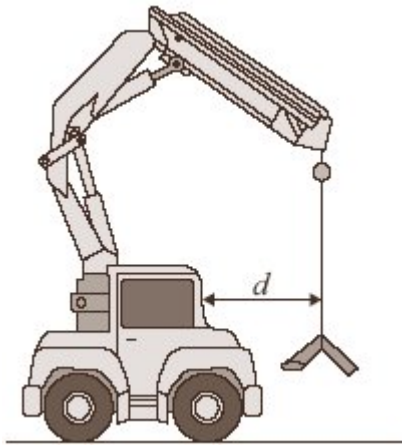
Pulling force = _____ N

(2)

(Total 5 marks)

26

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)

- (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

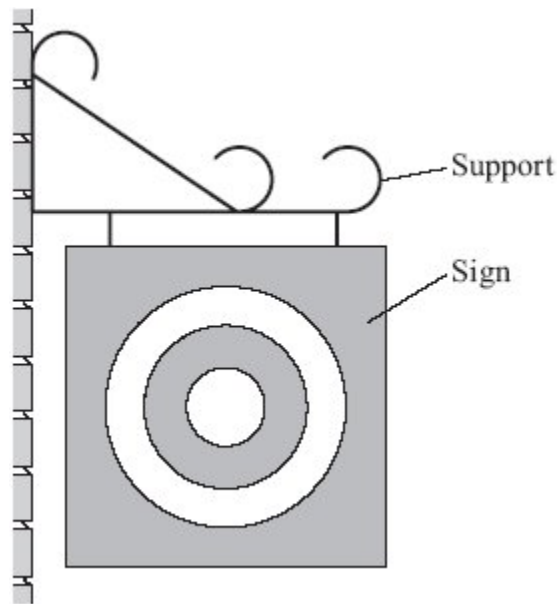
results of experiments on this mobile crane

(1)

(Total 6 marks)

27

The drawing shows a sign which hangs outside a shop.



(a) Draw an **X** on the sign so that the centre of your **X** is at the centre of mass of the sign.

(1)

(b) Use a ruler to draw **one** axis of symmetry on the sign.

(1)

(c) One force which acts on the sign is its weight.

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

The moment of the weight produces

- | |
|-----------------|
| an accelerating |
| a balancing |
| a turning |

effect.

(1)

(Total 3 marks)

28

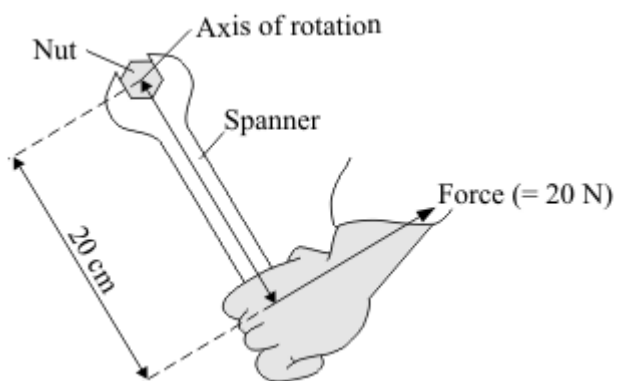
A spanner gives a turning effect to undo a nut.

(a) Complete the sentence.

The turning effect of a force is called the _____ of the force.

(1)

(b) The diagram shows a spanner being used.



Calculate the spanner's turning effect in newton metres.

Show clearly how you work out your answer.

Turning effect = _____ Nm

(2)

(c) Give **two** ways in which you can increase the spanner's turning effect.

1. _____

2. _____

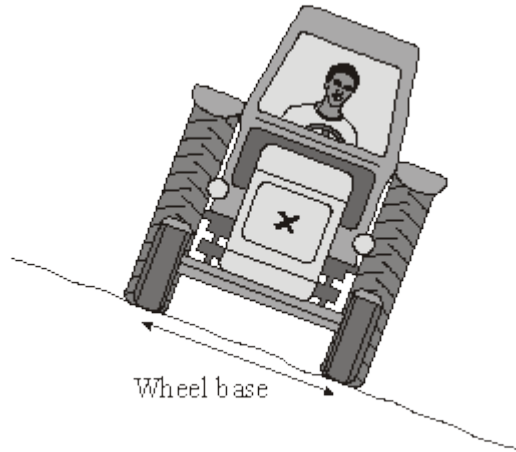
(2)

(Total 5 marks)

29

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 _____

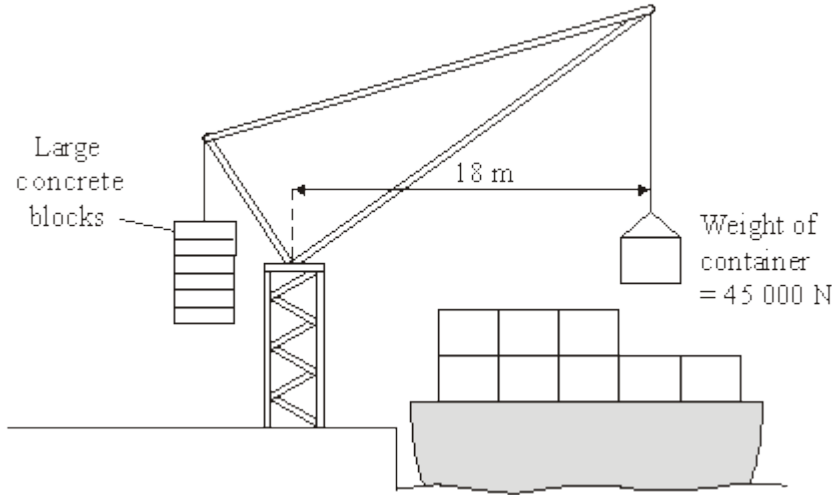
Feature 2 _____

(2)

(Total 5 marks)

30

The diagram shows a crane which is loading containers onto a ship.



(a) Calculate the moment of the container which is being loaded.

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

Moment of the container = _____

(3)

(b) Suggest and explain the purpose of the large concrete blocks.

(3)

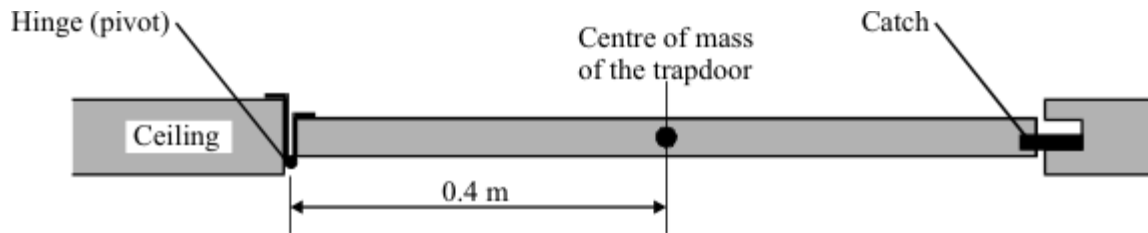
(Total 6 marks)

31

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

(1)

- (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 = _____

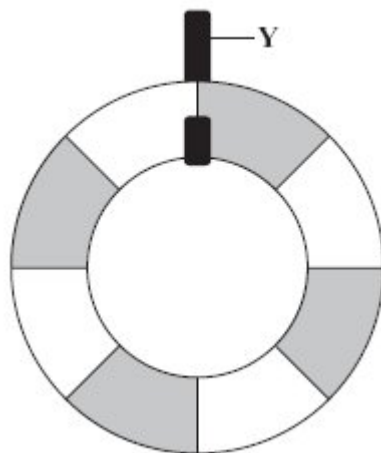
(3)

(Total 10 marks)

32

- (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.

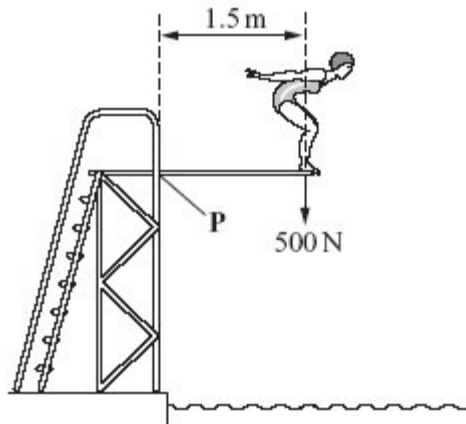


(1)

(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.



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.

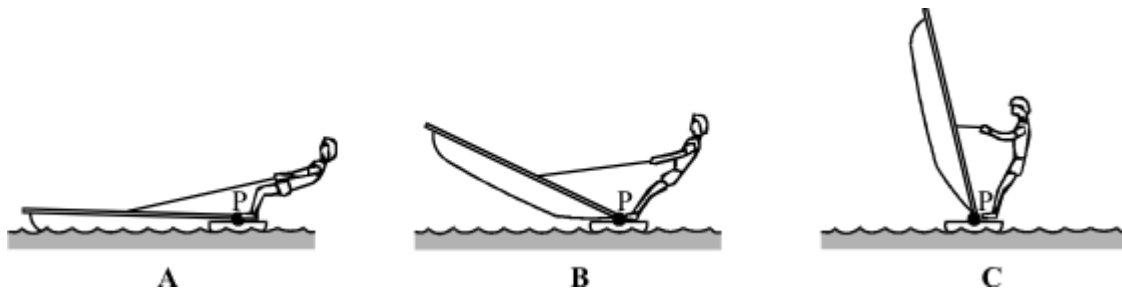
To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

(4)

(Total 10 marks)

33

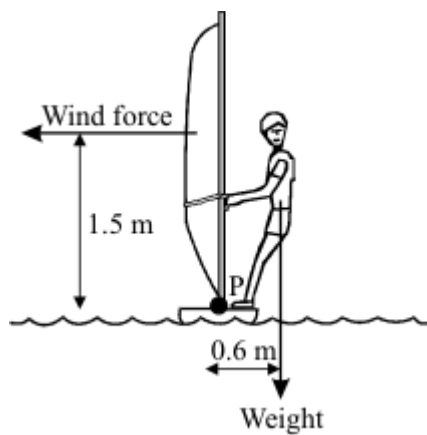
- (a) The diagrams show a windsurfer pulling up the sail of a sailboard. The mast pivots at point P.



In which position, **A**, **B** or **C** must the windsurfer pull with the largest force? Give a reason for your answer.

(2)

(b) Once the mast is upright, the windsurfer and the sailboard are *in equilibrium*.



(i) What does *in equilibrium* mean?

(1)

(ii) The weight of the windsurfer is 700 newtons. Calculate the moment exerted by the windsurfer on the sailboard. Show clearly how you work out your answer.

Moment = _____ Nm

(2)

(iii) Calculate the horizontal force of the wind on the sail. Show clearly how you work out your answer.

Force = _____ N

(2)

(c) As the wind speed increases the windsurfer leans further out from the sailboard.

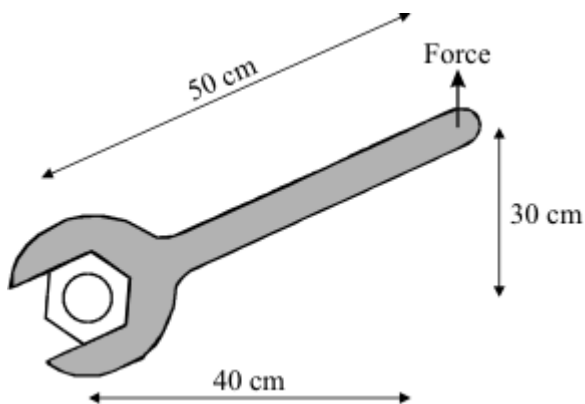


This position allows the windsurfer and sailboard to stay in equilibrium. Explain why.

(3)
(Total 10 marks)

34

The diagram shows a spanner being used to undo a tight nut.



The nut was tightened using a moment of 120 newton metres.

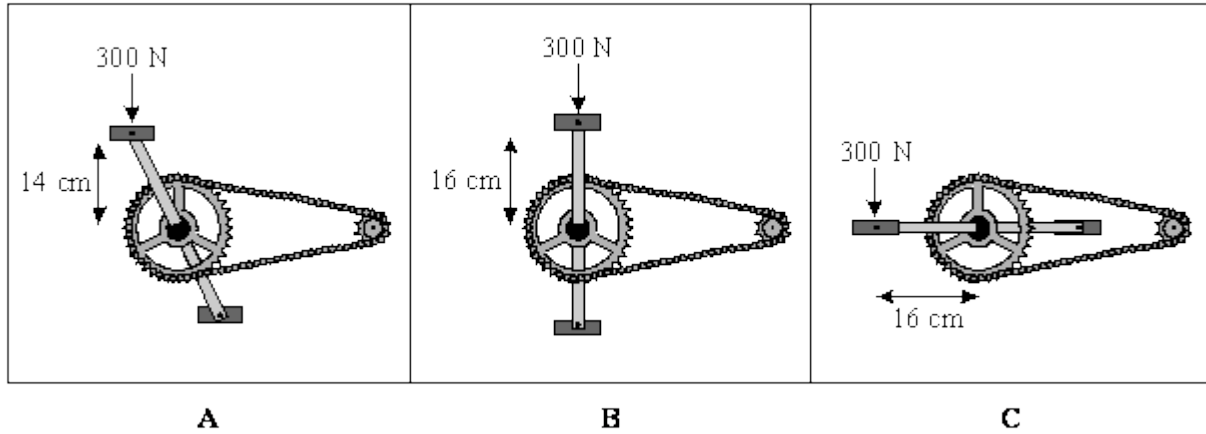
Calculate the force needed to undo the nut. Show clearly how you work out your answer.

Force = _____ N

(Total 2 marks)

35

For part of the ride the cyclist pushed on the pedals with a constant vertical force of 300 N. The simplified diagrams show the pedals in three different positions.



(i) Which position, **A**, **B**, or **C**, gives the largest moment on the pedal?

(1)

(ii) Calculate the size of the largest moment on the pedal, in Newton metres.

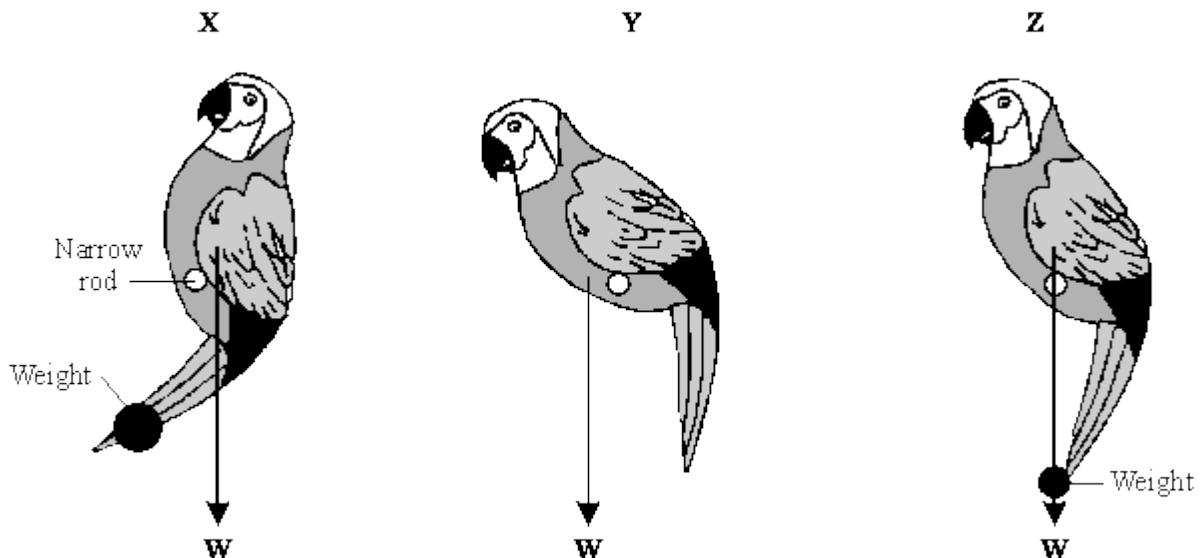
Moment = _____ Nm

(2)

(Total 3 marks)

36

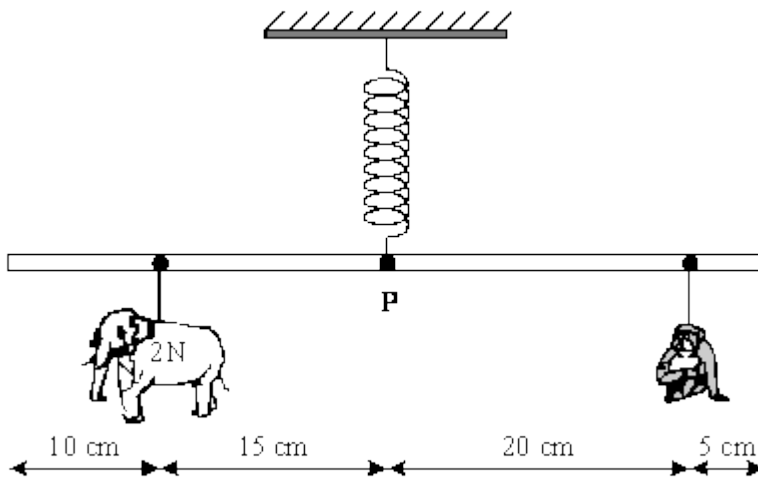
(a) The diagram shows three similar toys. Each toy should be able to balance on a narrow rod. The arrows show the direction in which the weight of the toy acts.



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)

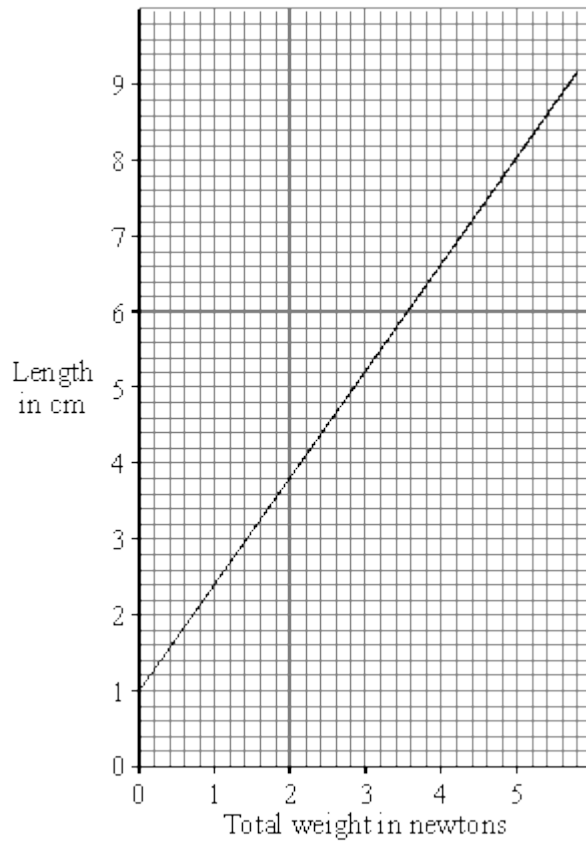
(ii) Use the following relationship to calculate the weight of the monkey shape.

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

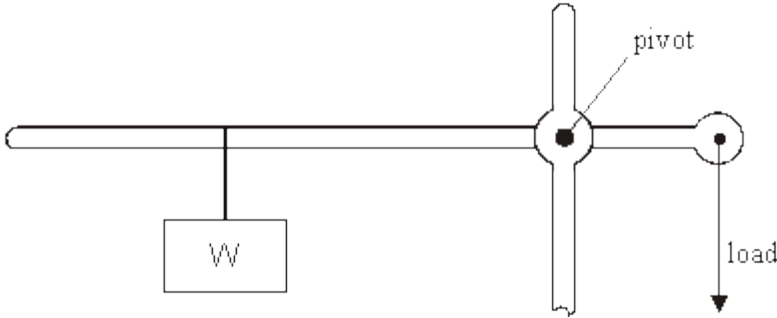
(2)

(Total 10 marks)

37

The diagram below shows an outline of a balance. The balance is used to weigh lorries. A fraction of the weight of a lorry is used as the load on the right side of the pivot.

A standard weight W is moved along the arm until the weight of the load is balanced.



- (a) As the weight W is moved away from the pivot it can support a heavier load. Why is this?

(2)

- (b) (i) The weight W is 100 N. When it is 0.2 m from the pivot it balances the load. Calculate the moment of the weight W about the pivot.

Answer _____ Nm

(2)

- (ii) The load is one hundredth of the weight of the lorry and is 0.02 m from the pivot. Calculate the weight of the lorry.

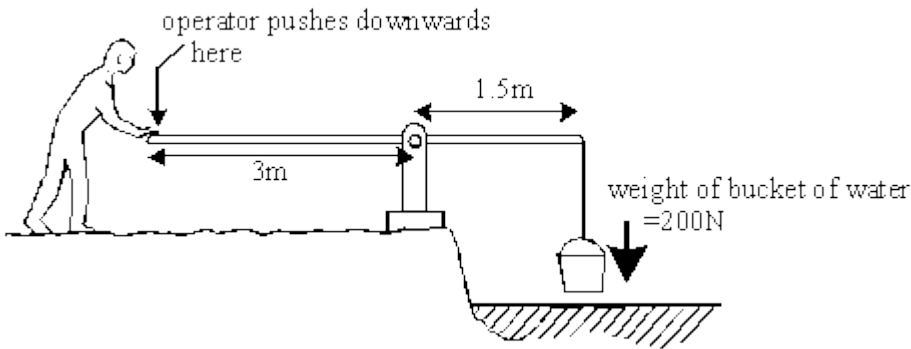
Answer _____ N

(2)

(Total 6 marks)

38

The diagram shows a simple machine for lifting water from a river.



(a) Calculate the turning force (moment) of the bucket of water.

(Show your working.)

Answer _____ Nm (newton metre)

(2)

(b) What can you say about the size of downwards force the operator must use to balance the moment of the bucket of water?

(Explain your answer, using numbers if you can.)

(4)

(Total 6 marks)

39

A spanner makes it a lot easier to loosen a bolt.



You cannot usually loosen a bolt with your fingers.

It is easier with a spanner.

Choose words from this list to complete the sentences below.

lever

piston

pivot

pulley

turning effect

The spanner is a simple _____

You use it to produce a bigger _____ on the bolt.

A longer spanner works better.

This is because there is a bigger distance between your force and the _____

(Total 3 marks)