Moments

Questions

Name: _____

Class: _____

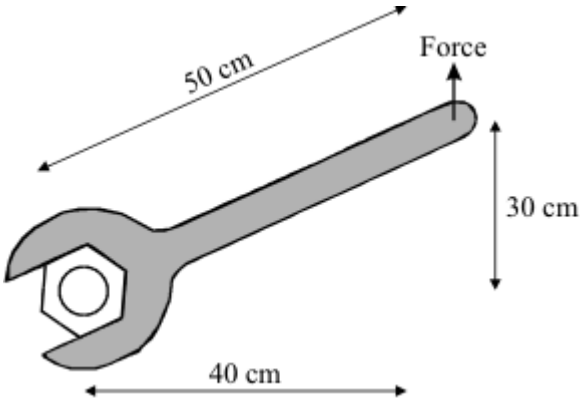
Date: _____

Time: **56 minutes**

Marks: **56 marks**

Comments:

1 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.

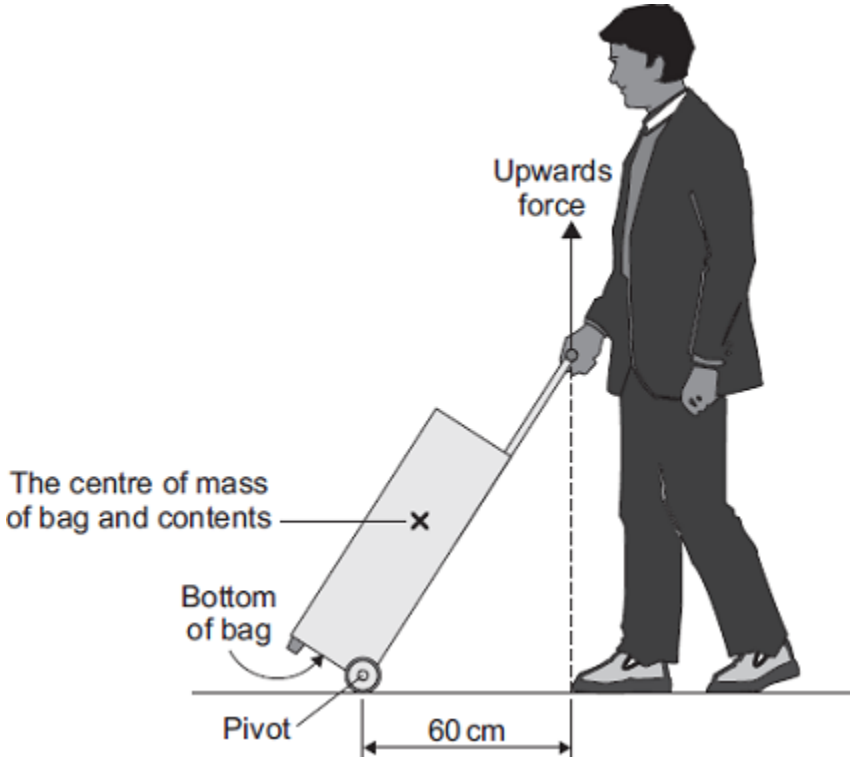
_____

_____

Force = _____ N

(Total 2 marks)

2 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.

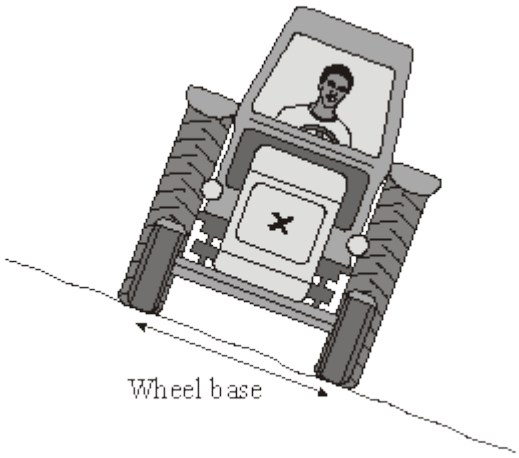
Explain why.

(2)

(Total 4 marks)

3 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 _____

_____

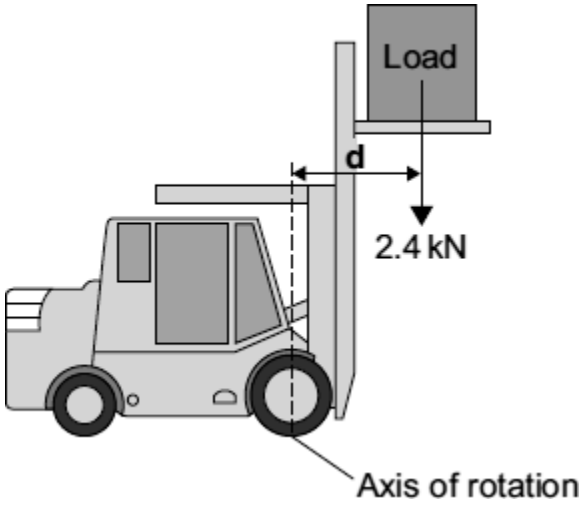
Feature 2 _____

_____

(2)

(Total 5 marks)

4 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.

_____

_____

_____

_____

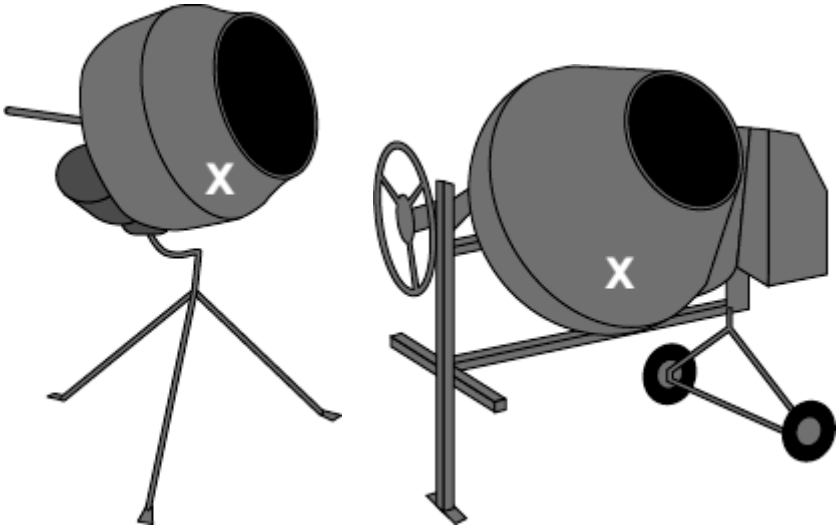
_____

_____

(2)

(Total 5 marks)

5 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.

_____

_____

_____

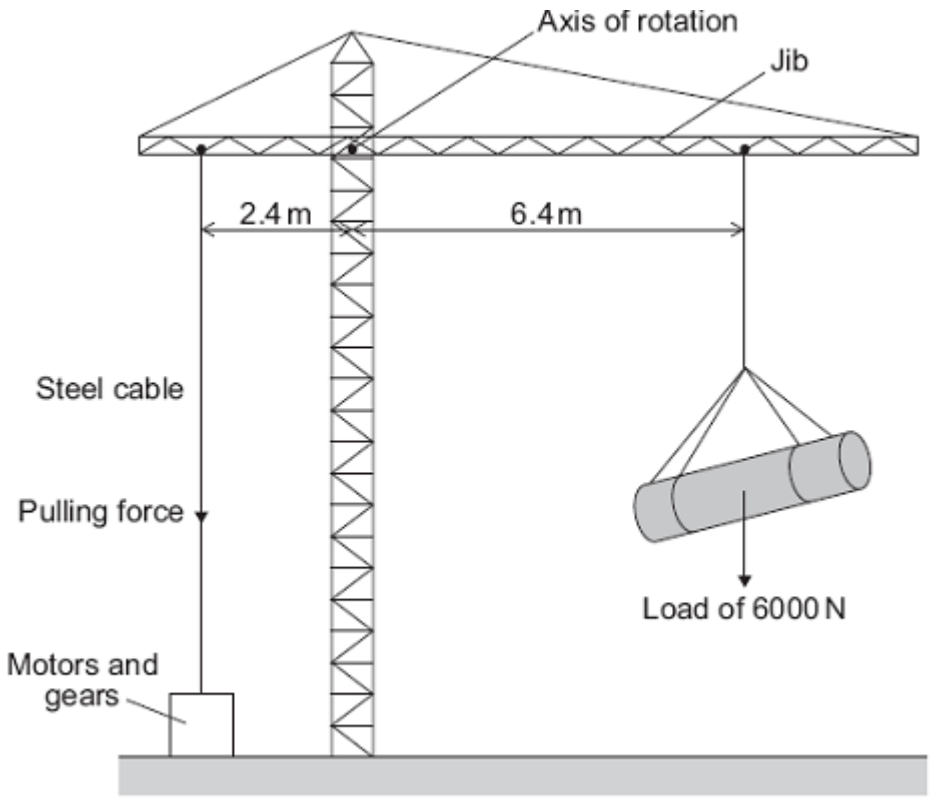
_____

_____

(2)

(Total 5 marks)

6 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.

_____

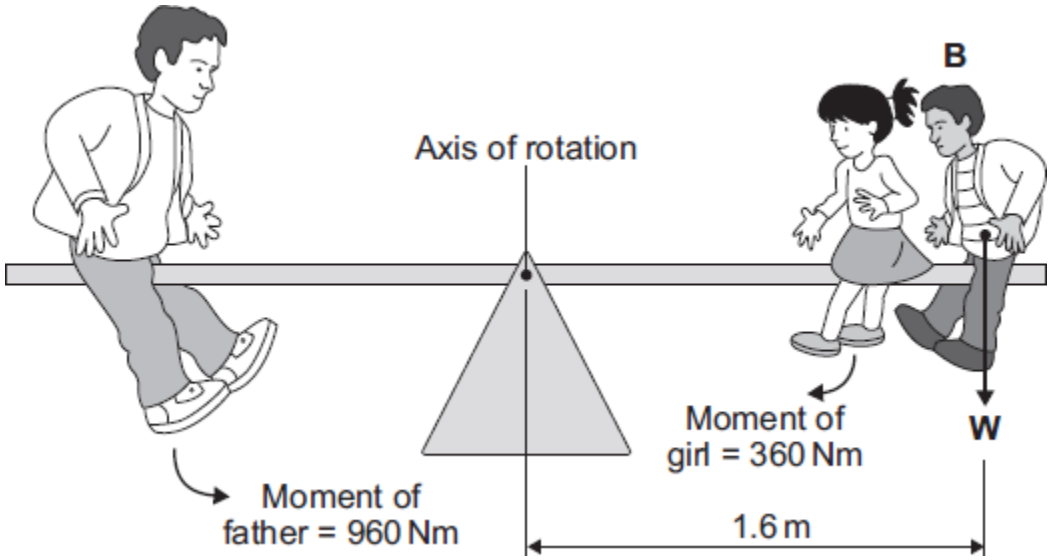
_____

Pulling force = _____ N

(2)

(Total 5 marks)

7 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**.

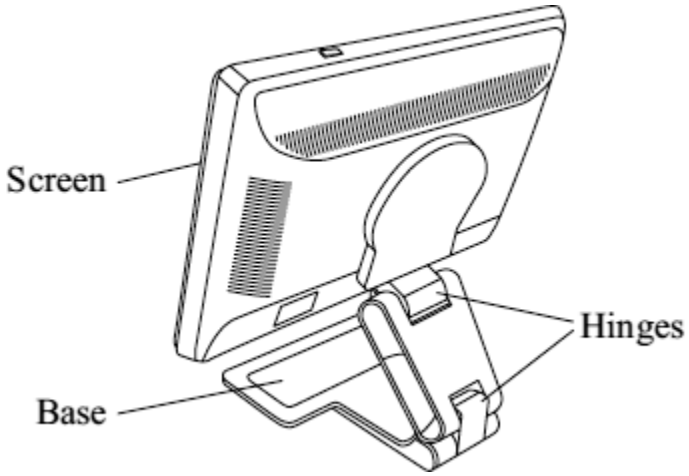
Show clearly how you work out your answer.

Weight of boy **B** = _____ N

(2)

(Total 6 marks)

8 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)

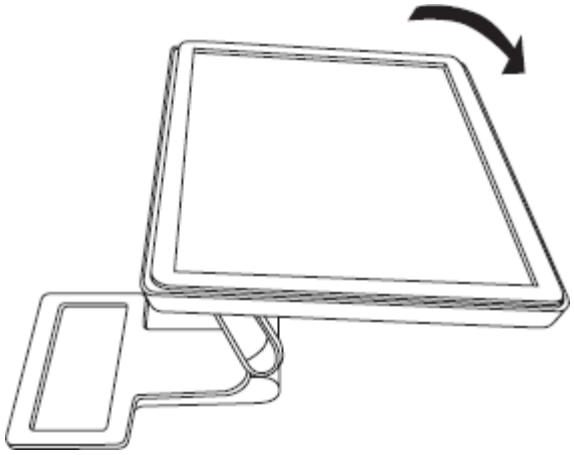
(ii) State the relationship between the total clockwise moment and the total anticlockwise moment about any axis of the monitor when it is stable.

(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.



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.

_____

_____

_____

_____

_____

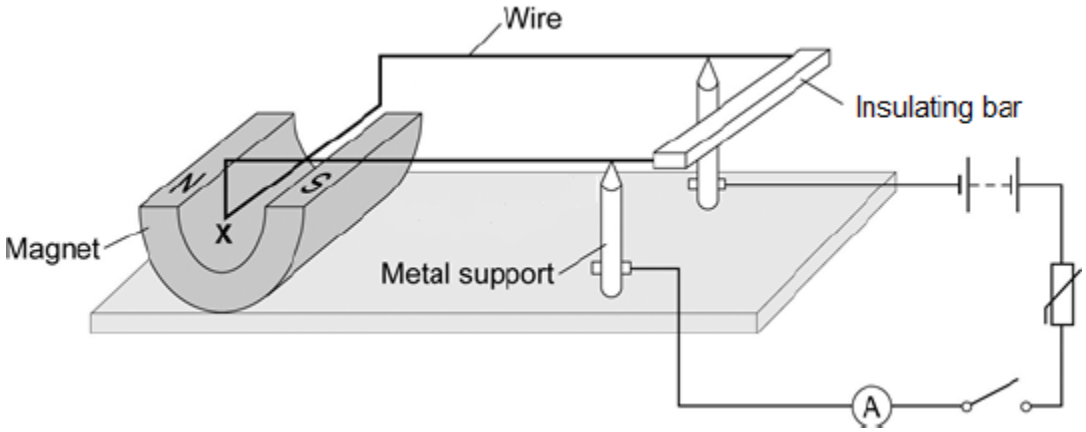
_____

(3)

(Total 6 marks)

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

Figure 1



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)

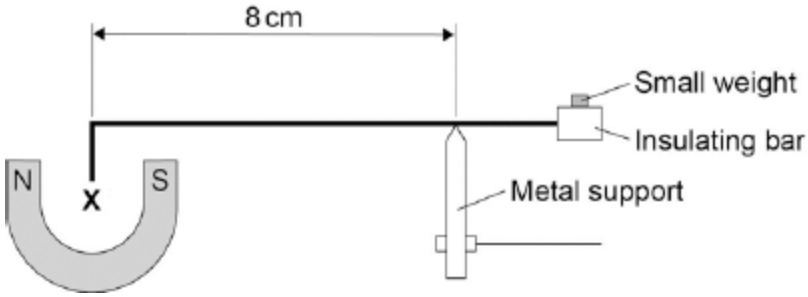
(b) Suggest one change you could make to the apparatus in **Figure 1** that would increase the size of the force that wire **X** experiences.

_____

(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)

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?

_____

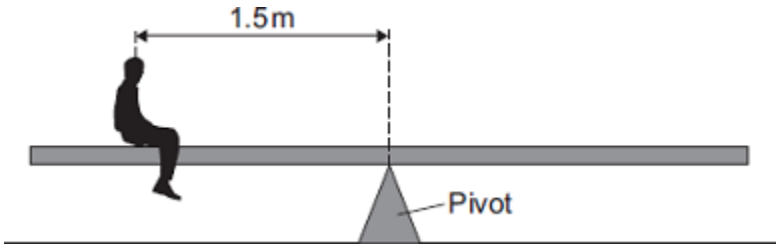
_____

(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.

_____

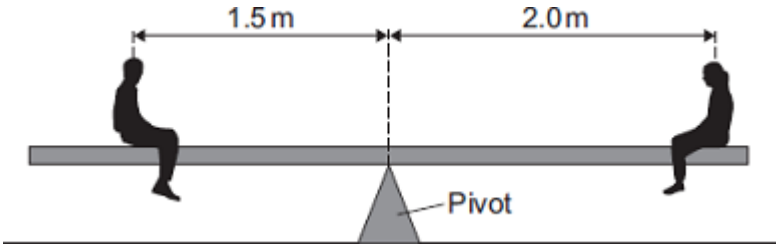
_____

Anticlockwise moment = _____ Nm

(2)

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

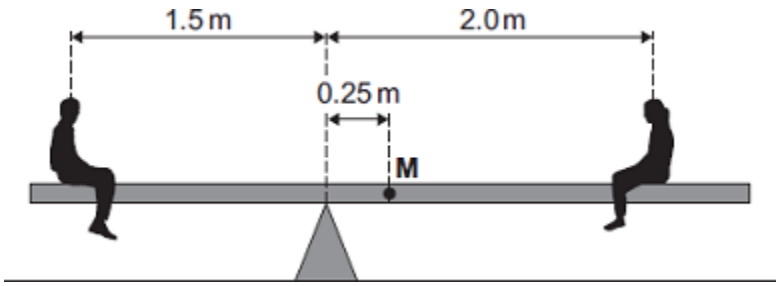
Figure 2



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)