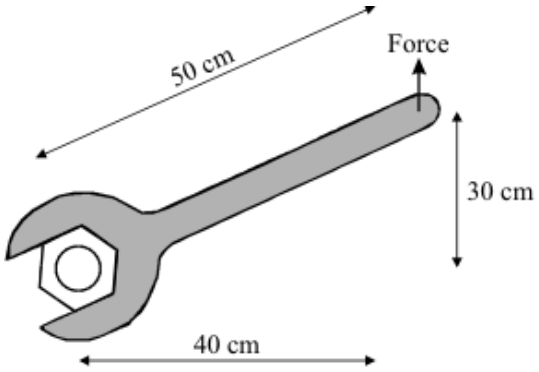
Q1. The diagram shows a spanner being used to undo a tight nut.



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

Use the following equation to calculate the force needed to undo the nut. Show clearly how you work out your answer.

moment = force × perpendicular distance from pivot

.....

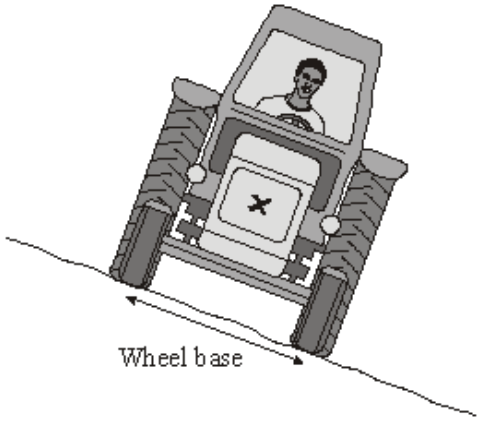
.....

Force = ... N

(Total 2 marks)

Q2. 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 .....

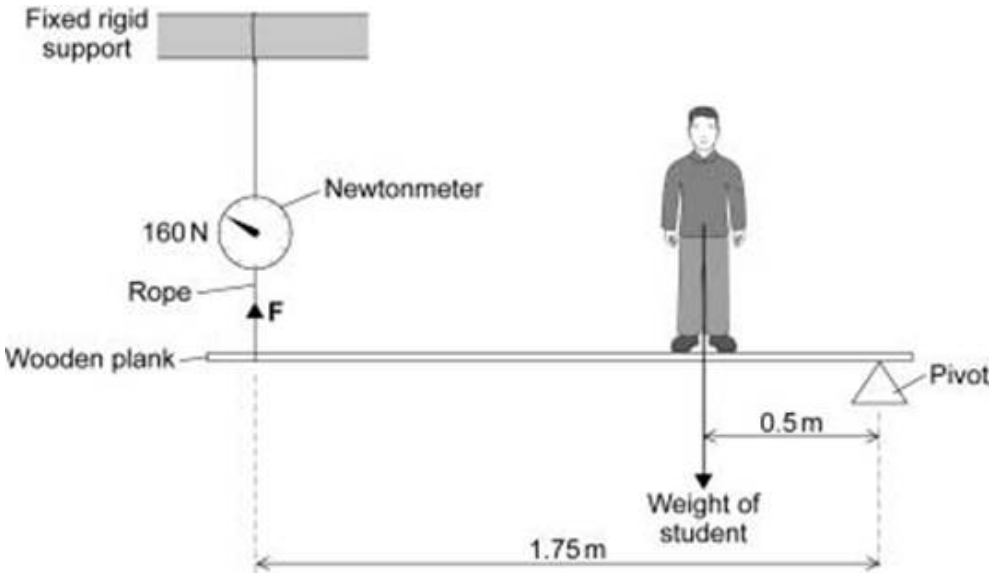
.....

Feature 2 .....

.....

(2)
(Total 5 marks)

Q3. A student wants to weigh himself but the only balance available is a newtonmeter that measures up to 200 newtons.
The diagram shows how the student solved the problem using moments.



(a) Use the information in the diagram to calculate the weight of the student given by this method.

Write down the equation you use, and then show clearly how you work out your answer and give the unit.

.....

.....

.....

.....

.....

.....

.....

.....

Weight = ...

(5)

(c) Even though all the measurements are accurate the student's weight obtained by this method is inaccurate.

Explain why.

.....

.....

.....

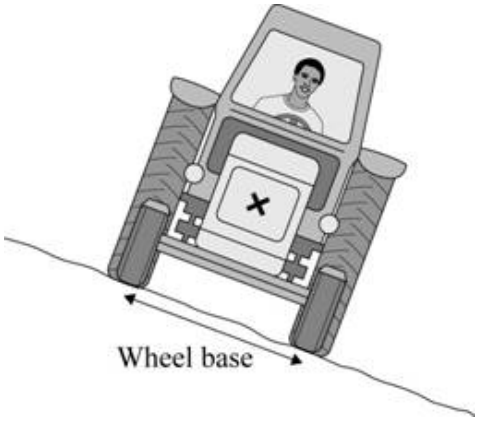
.....

.....

(2)
(Total 7 marks)

Q4. 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) What is meant by the term *centre of mass*?

.....

.....

(1)

(b) Explain how the design of the tractor could be changed in order to increase the tractor's stability.

.....

.....

.....

.....

(2)

(c) Explain why the tractor does not topple over. You may add to the diagram to help your explanation.

.....

.....

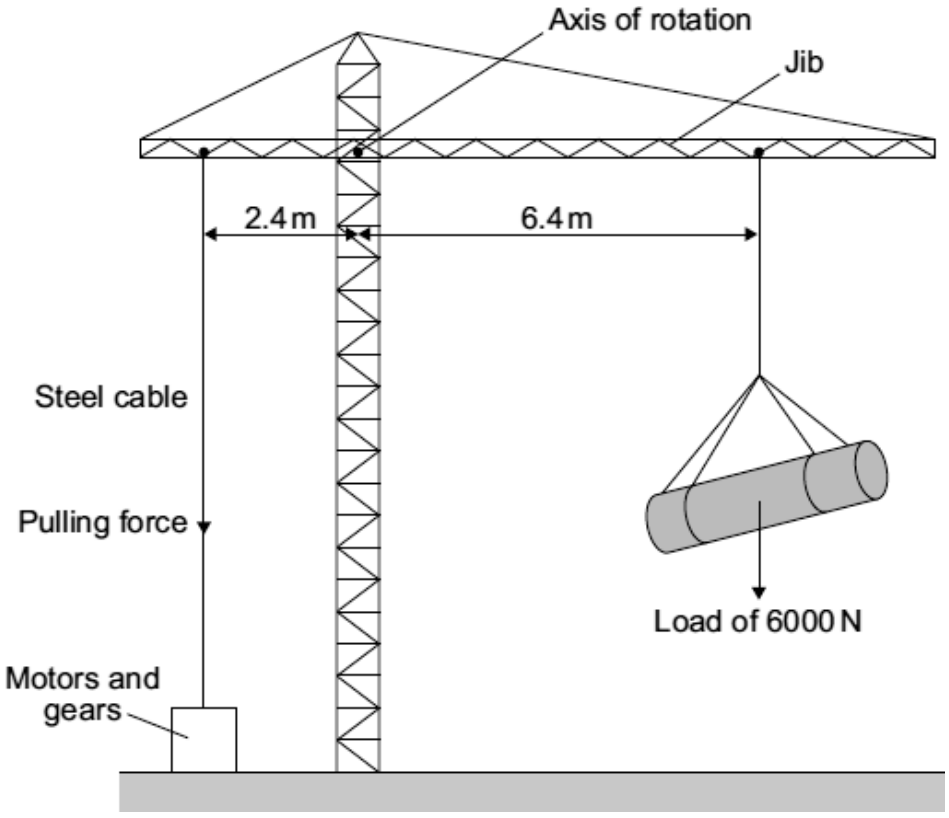
.....

.....

.....

(3)
(Total 6 marks)

Q5. 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.

Use the equation in the box to answer questions (a) and b).

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

(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.

.....

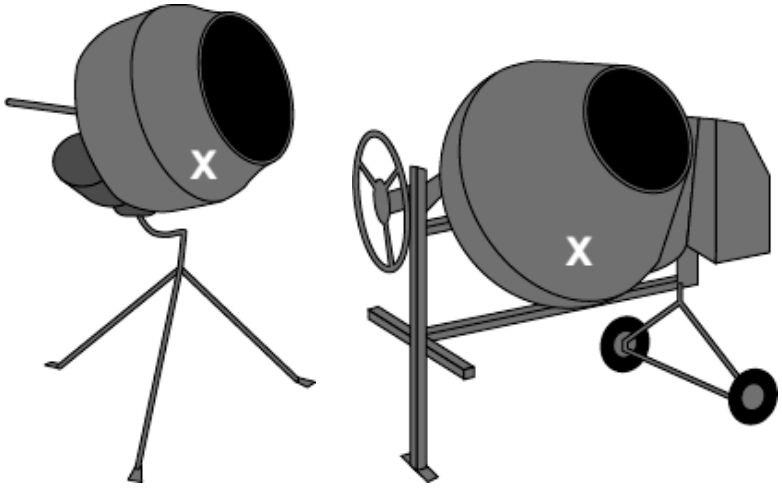
.....

Pulling force = ... N

(2)

(Total 5 marks)

Q6. 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.

.....

.....

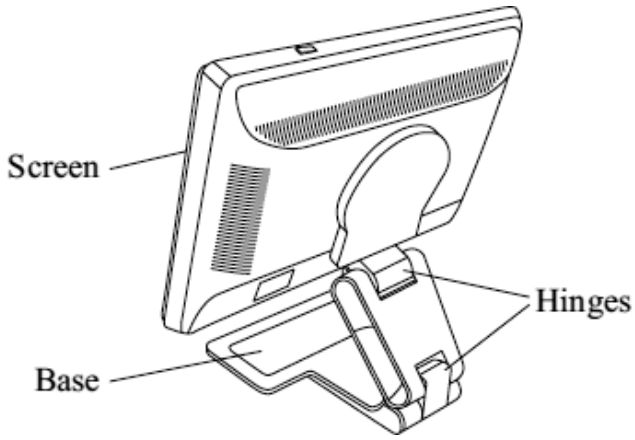
.....

.....

.....

(2)
(Total 5 marks)

Q7. 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.

.....

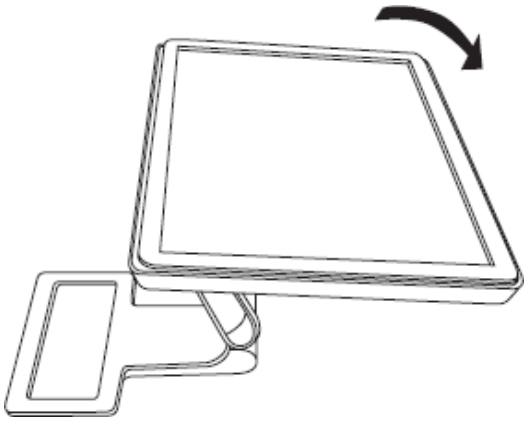
.....

(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.

.....

.....

.....

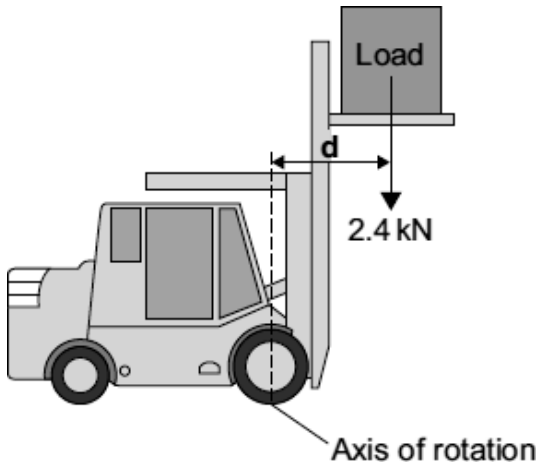
.....

.....

.....

(3)
(Total 6 marks)

Q8. 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.

.....

.....

.....

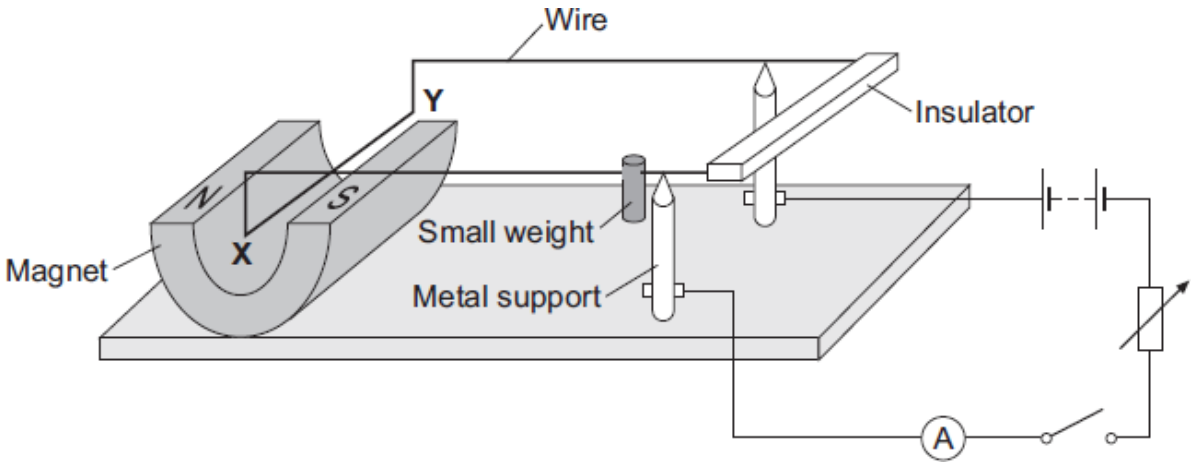
.....

.....

.....

(2)
(Total 5 marks)

Q9. 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.

.....

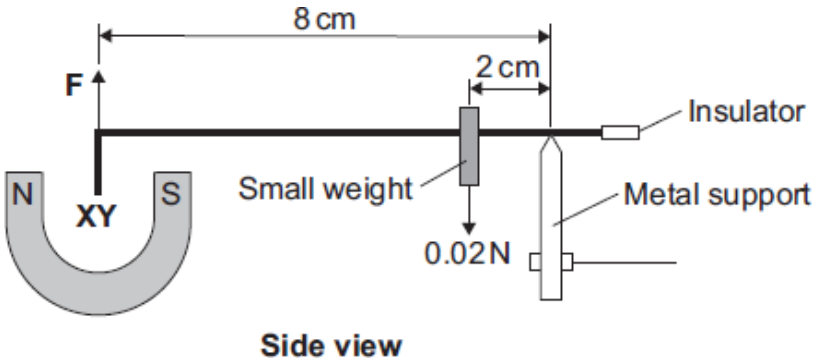
.....

.....

.....

(2)

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



Side view

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

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.

.....

.....

.....

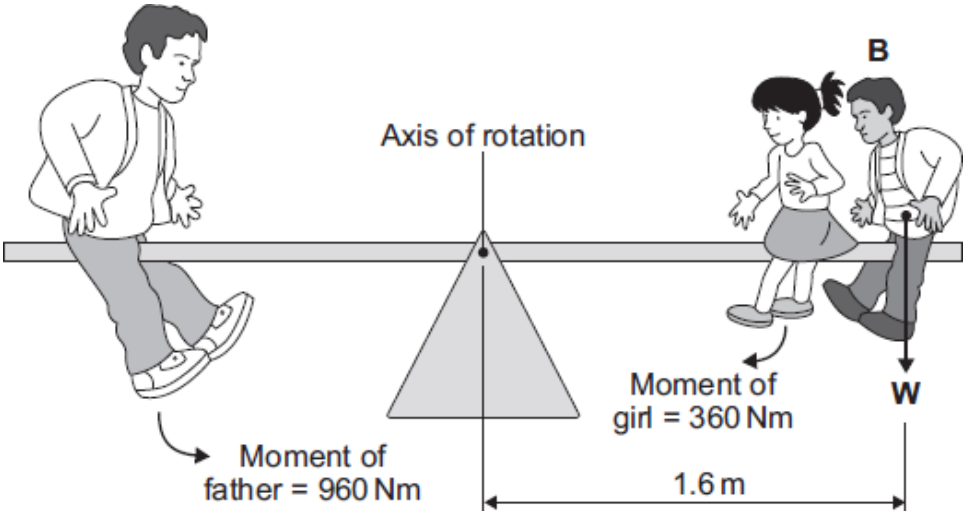
.....

Force = ... N

(3)

(Total 8 marks)

Q10. 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 and the equation in the box to calculate the weight, **W**, of the boy, **B**.

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.

.....

.....

.....

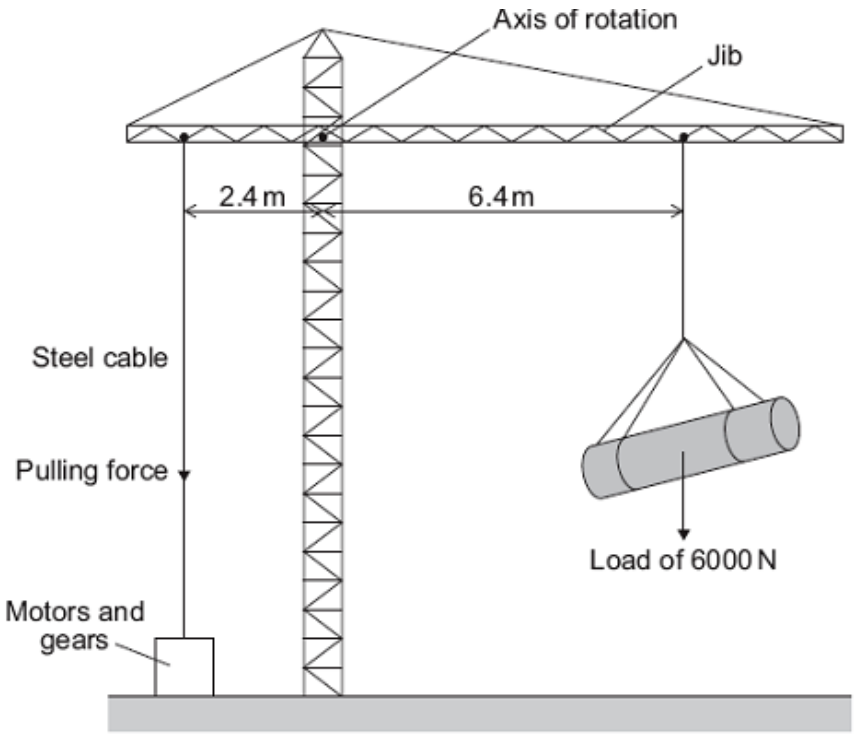
.....

Weight of boy **B** = ... N

(2)

(Total 6 marks)

Q11. 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.

Use the equation in the box to answer questions (a) and (b).

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

(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.

.....

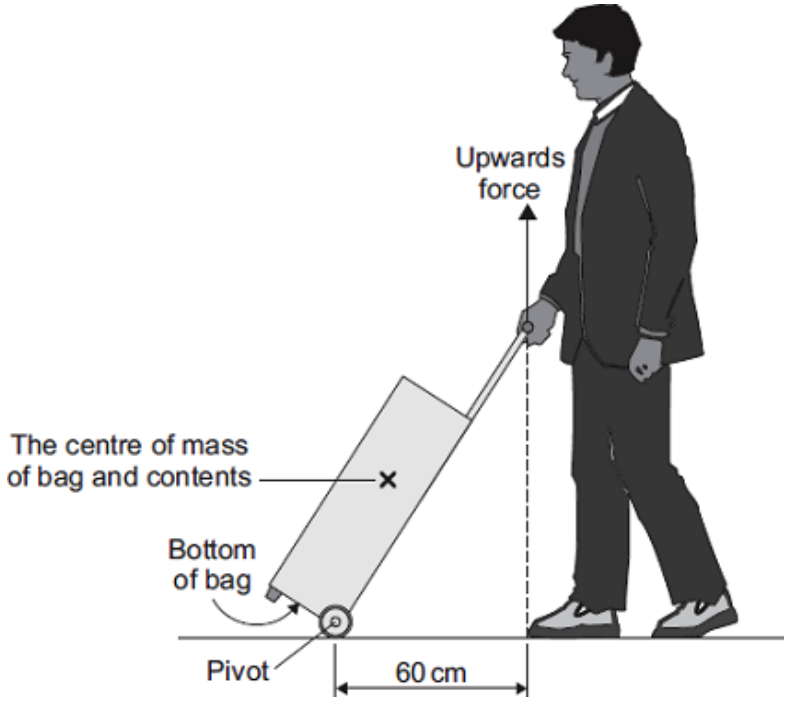
.....

Pulling force = ... N

(2)

(Total 5 marks)

Q12. 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.

Use the correct equation from the Physics Equations Sheet.

.....

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.....

.....

Force = ... N

(2)

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

Explain why.

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(2)

(c) During his holiday the man visits the Foucault Pendulum in Paris, France.
The pendulum makes 10 complete swings every 160 seconds.

Calculate the frequency of the pendulum and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

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.....

.....

Frequency = ...

(3)

(Total 7 marks)