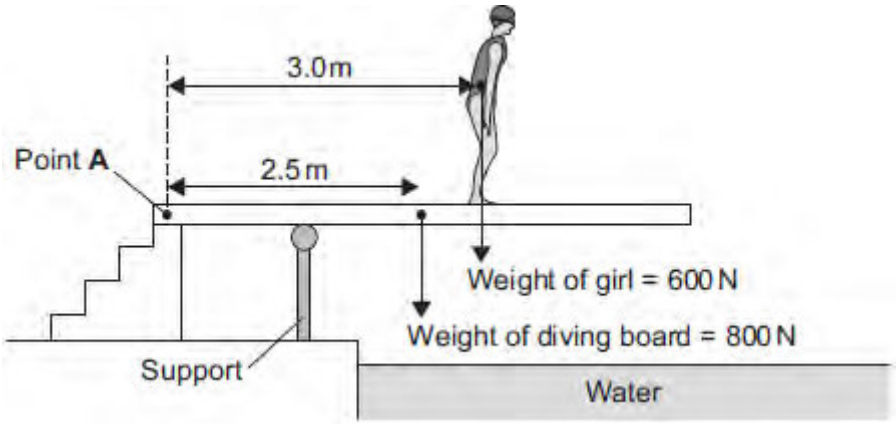
Q1.(a) **Figure 1** shows a girl standing on a diving board.

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.

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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

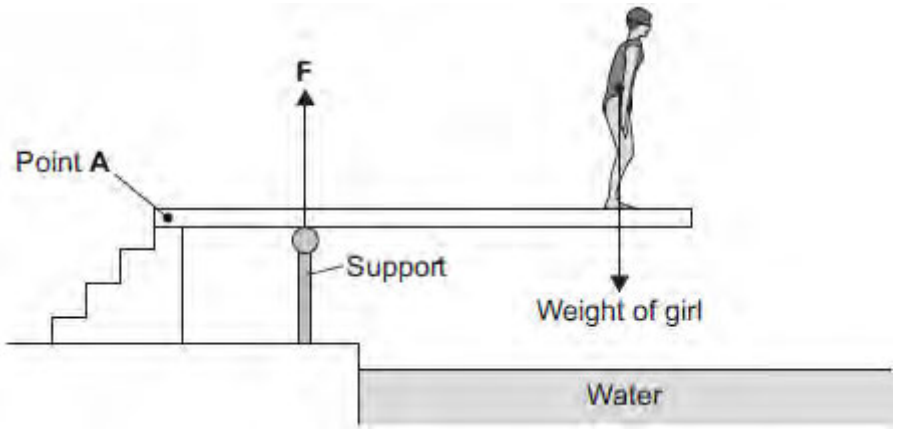
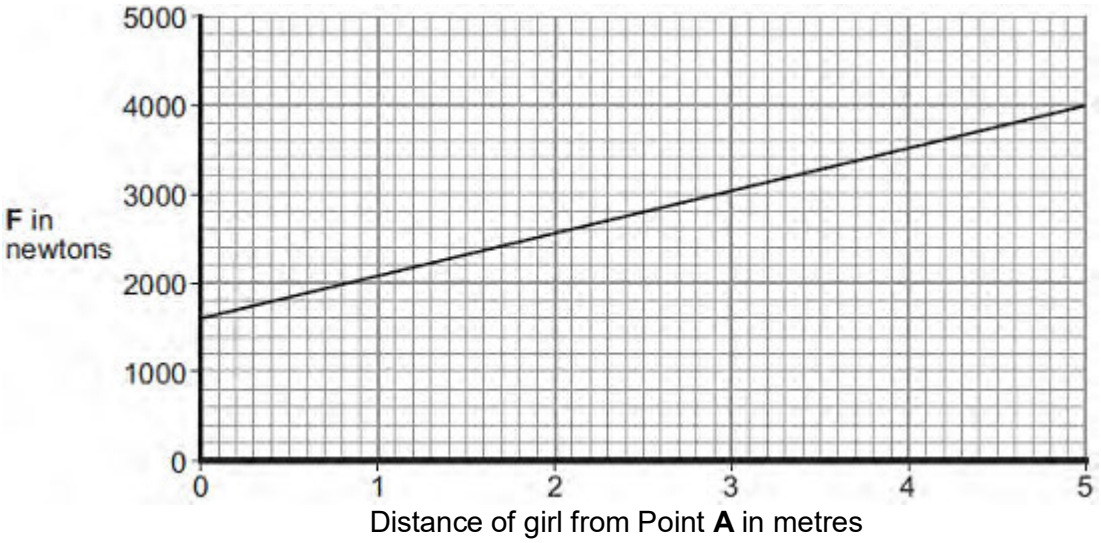


Figure 3 shows how the upward force **F** varies with the distance of the girl from Point **A**.

Figure 3



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

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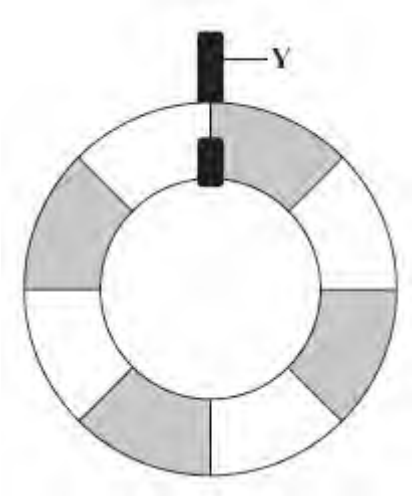
.....

(3)

(Total 7 marks)

Q2. (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.

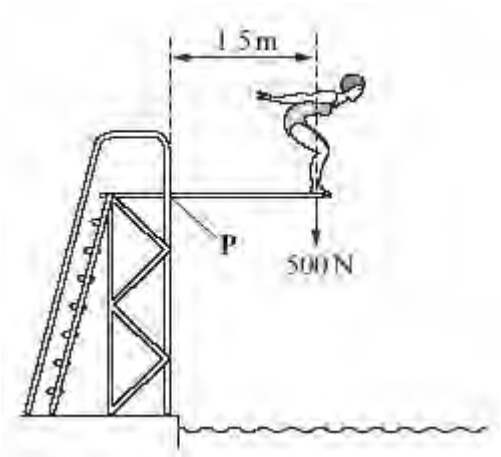
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(2)

(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.

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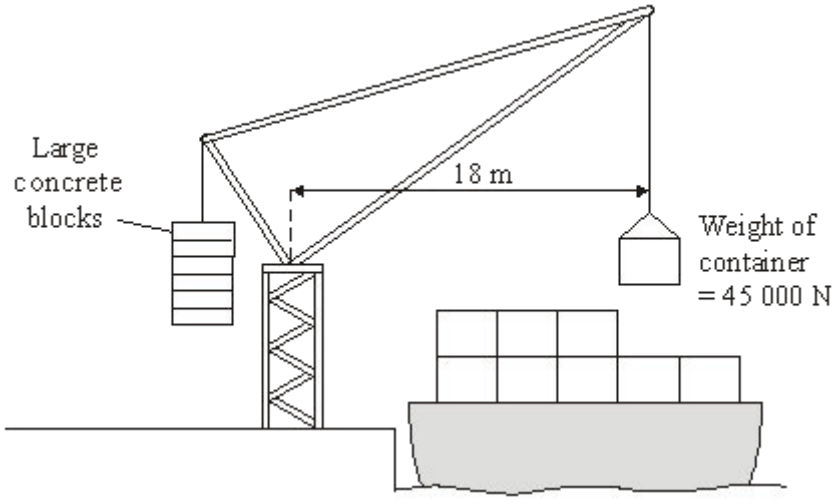
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(4)
(Total 10 marks)

Q3. 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.

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(3)

(Total 6 marks)

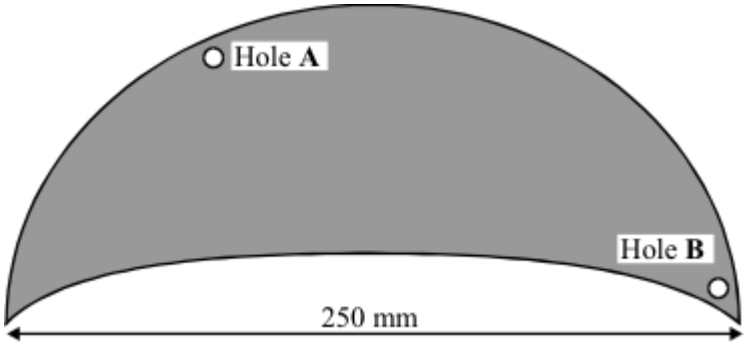
Q4. (a) Every object has a *centre of mass*. What is meant by the *centre of mass*?

.....

.....

(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 I 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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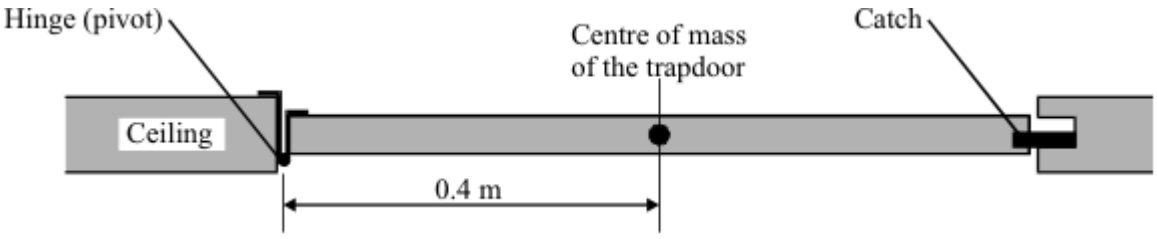
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(5)

(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)

Q5. (a) A student investigates the moment of a force.

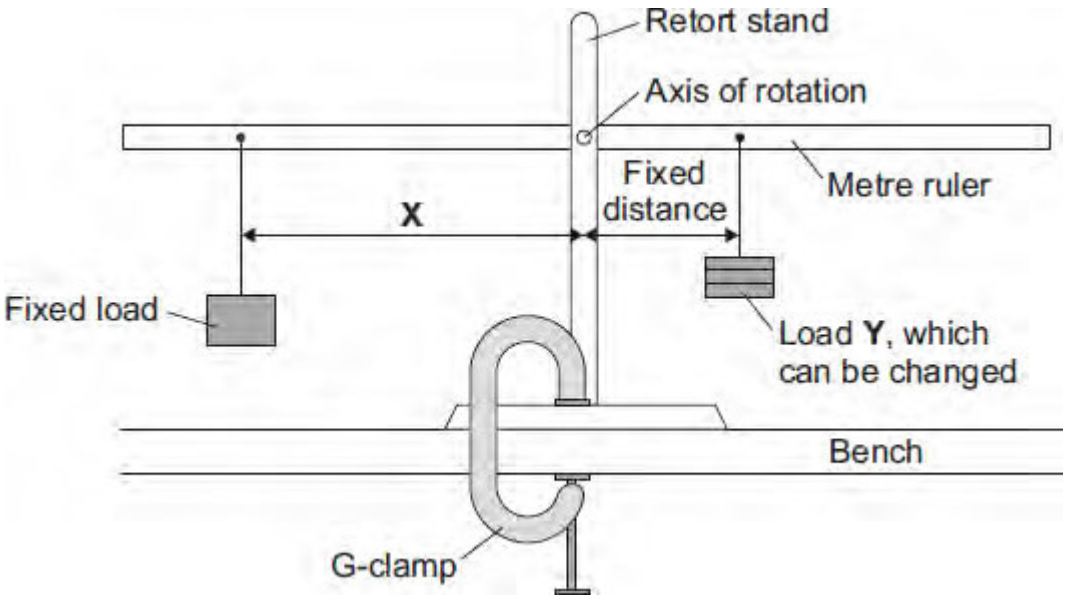
(i) What does the word *moment* mean in this sentence?

.....

.....

(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**.

.....

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(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.

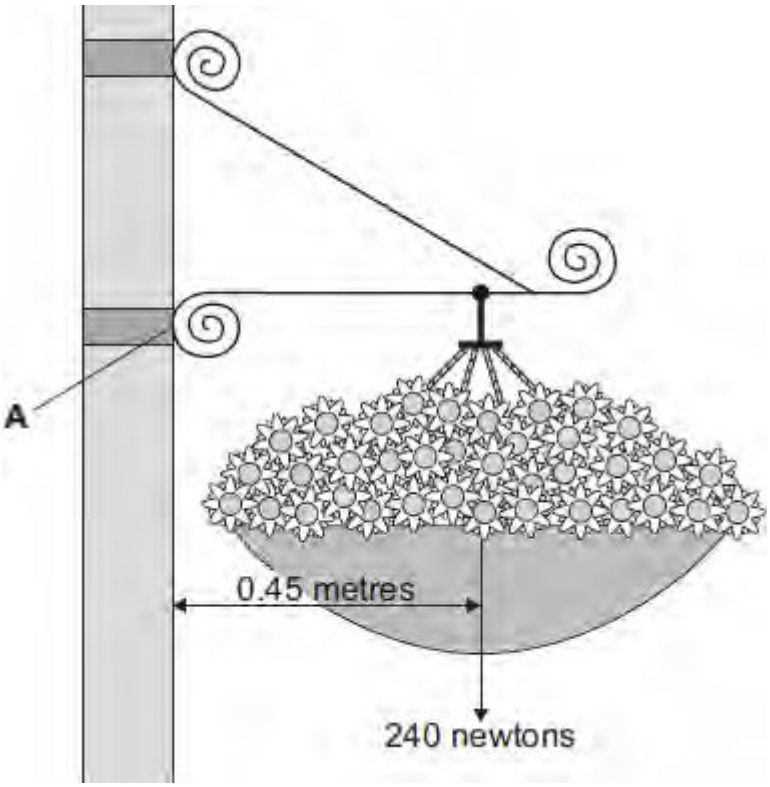
The weight of the ruler is so small it is negligible. ☐

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**.

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 **and** give the unit.

.....

.....

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Moment =.....

(3)

(Total 8 marks)

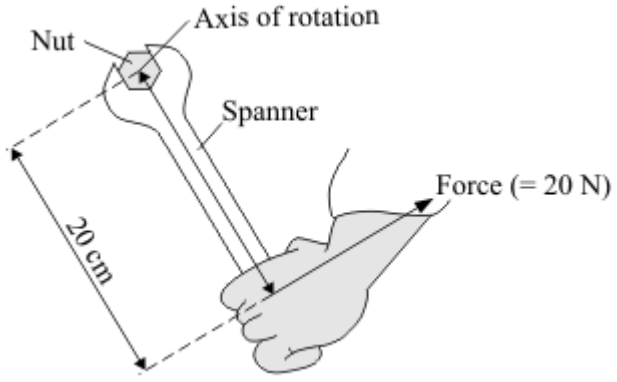
Q6. A spanner gives a turning effect to undo a nut.

(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.

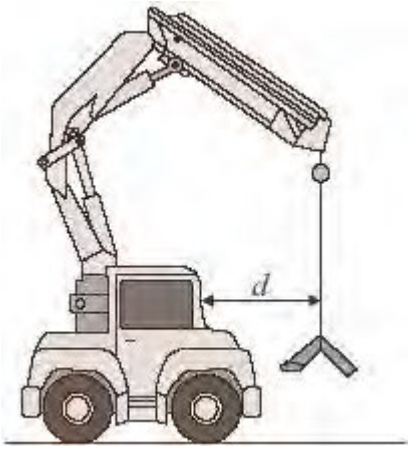
1 .....

2 .....

(2)

(Total 5 marks)

Q7. 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.

.....

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(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)