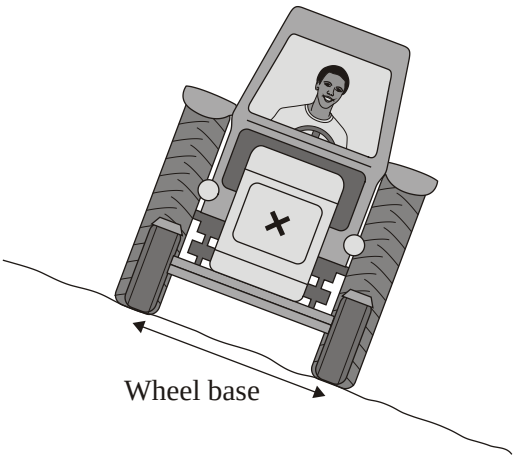
Moments & Stability Name .....

1. 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.

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(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 .....

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Feature 2 .....

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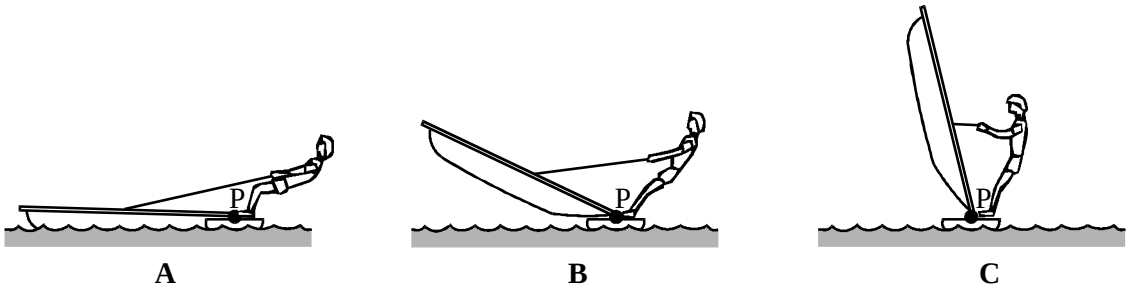
(2)
(Total 5 marks)

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



A **B** **C**

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

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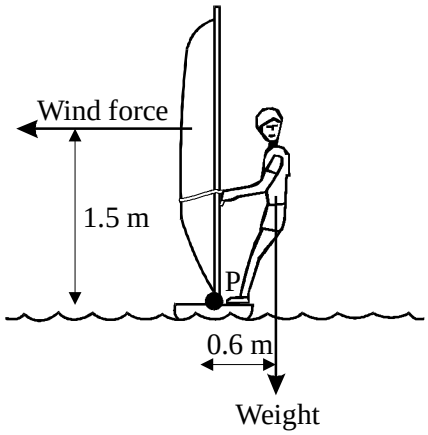
(2)

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



(i) What does *in equilibrium* mean?

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(1)

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

moment = force × perpendicular distance from pivot

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Moment = ... Nm

(2)

(iii) Use the relationship below to calculate the horizontal force of the wind on the sail. Show clearly how you work out your answer.

total clockwise moment = total anticlockwise moment

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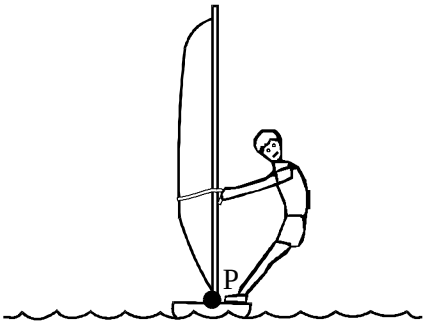
Force = ... N

(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.

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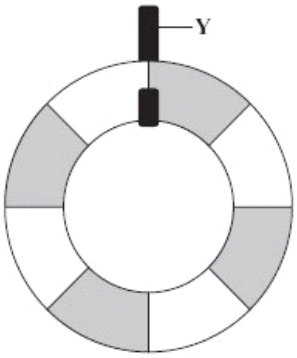
(3)

(Total 10 marks)

3. (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) 

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.

Explain another advantage of packing her case in this way.

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(4)
(Total 7 marks)