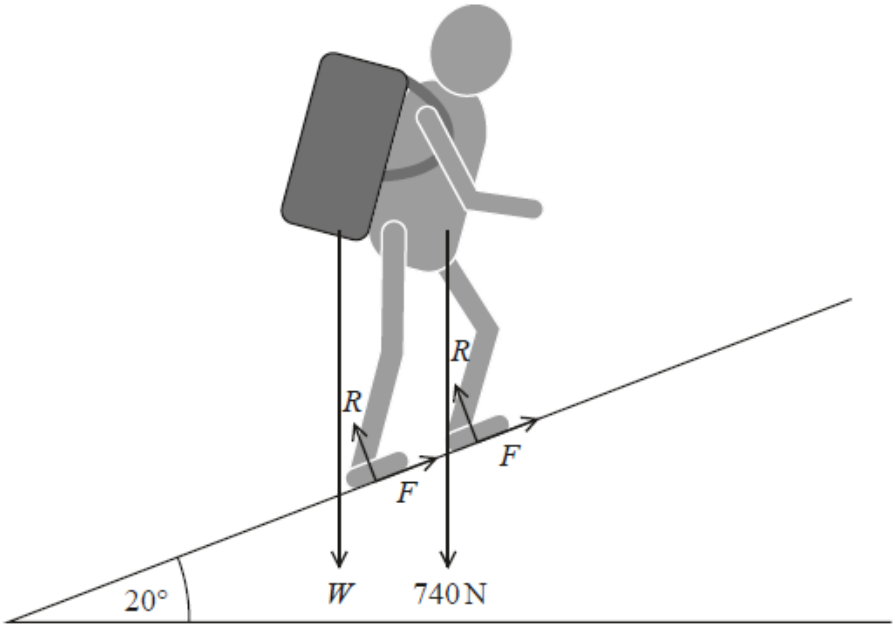
Questions

Q1.

A hiker of weight 740N walks up a hill carrying a large bag of weight *W*. The hiker stops for a moment in the position shown.



The normal force *R* of the ground on the hiker is the same at each foot. The frictional force between each foot and the ground is *F*. The hill is at an incline of 20° to the horizontal.

The hiker repacks his bag, placing the heavier items at the bottom of the bag.

Explain why this may cause *R* on the front foot to decrease.

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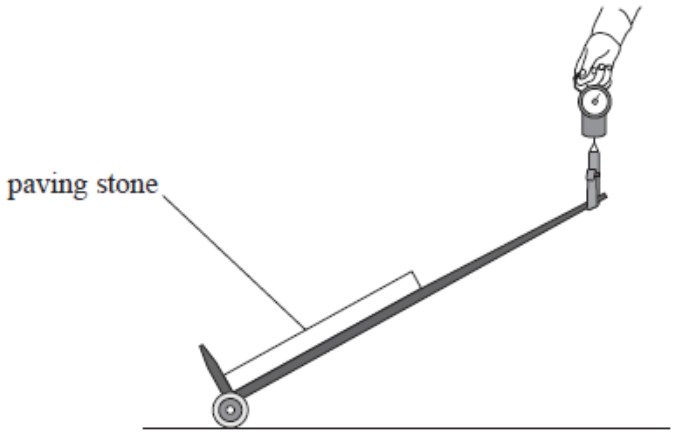
(Total for question = 2 marks)

Q2.

A gardener used a trolley to move a paving stone.



A force meter was attached to the handle of the trolley.

The gardener recorded the following measurements when the trolley was at rest in the position shown in the diagram.

mass of trolley and paving stone = 18.5 kg

length of trolley = 97 cm

force on handle = 50 N

Determine the distance of the centre of gravity of the loaded trolley from the wheels.

(3)

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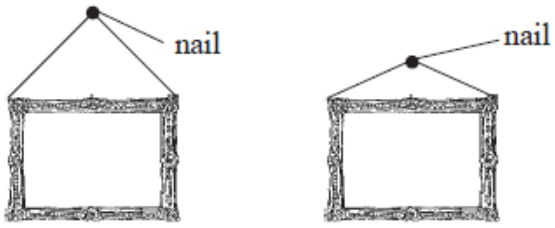
Distance = ...

(Total for question = 3 marks)

Q3.

A thin wire of negligible mass is used to hang a picture on a wall. The wire is hung over a nail

and can be attached to the picture using arrangement 1 or arrangement 2, as shown.



arrangement 1 arrangement 2

It was observed that if the wire was not hung with its midpoint over the nail, as in Diagram 1, the picture moved and then remained in the position shown in Diagram 2.

Diagram 1 Diagram 2

Use the idea of moments to explain why.

(3)

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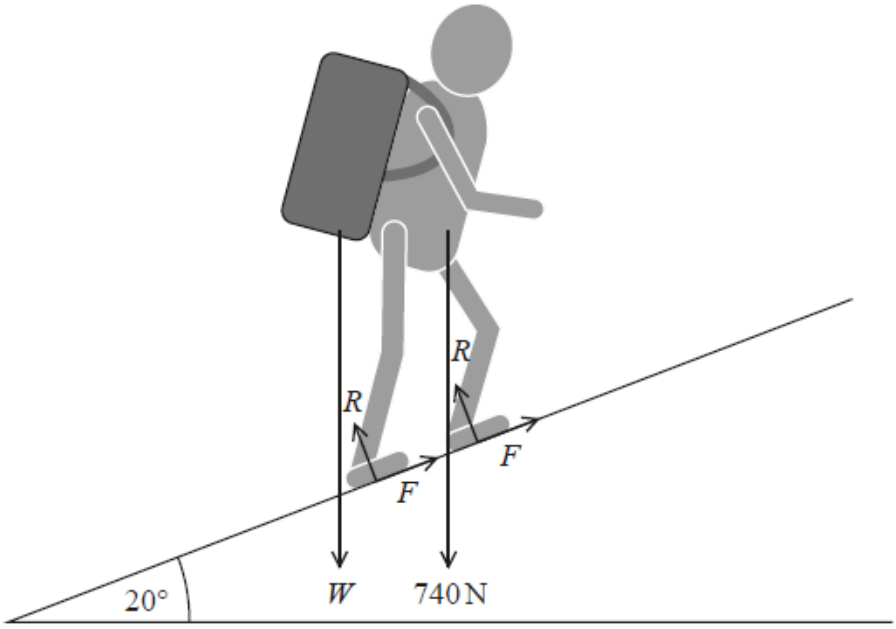
(Total for question = 3 marks)

Q4.

A hiker of weight 740N walks up a hill carrying a large bag of weight *W*. The hiker stops for a moment in the position shown.



The normal force R of the ground on the hiker is the same at each foot. The frictional force between each foot and the ground is F. The hill is at an incline of 20° to the horizontal.

An expression for the components of force perpendicular to the ground acting on the hiker is

$$740\cos 20 + W\cos 20 - 2R = 0$$

(i) Explain why this expression is correct.

(2)

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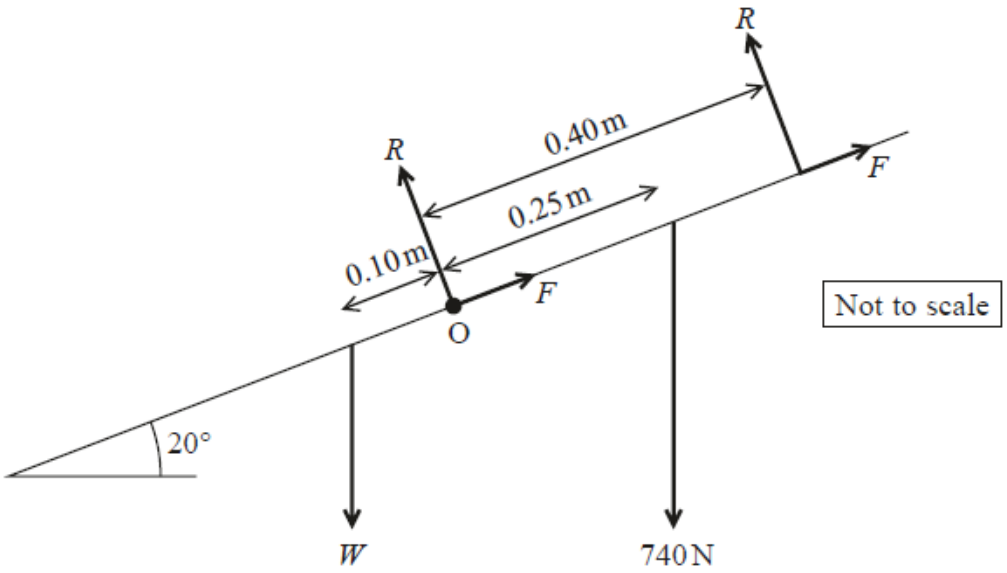
(ii) The diagram shows the lines of action of the forces acting on the hiker and backpack. Position O represents the middle of the back foot of the hiker.



Determine W. You should take moments about O.

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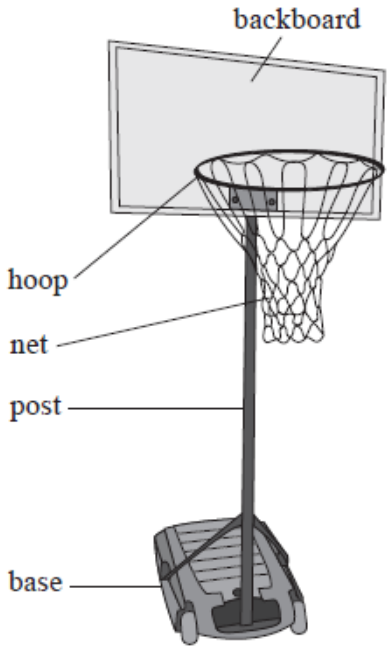
W = ...

(Total for question = 8 marks)

Q5.

A portable basketball set has a base and a post arrangement. The post arrangement consists of a post, backboard, hoop and net. The base can be filled with water to increase stability.



(a) The base has a capacity of 85.0 litres.

Show that the maximum weight of the base is about 870N.

mass of 1.00 litre of water = 1.00 kg
mass of base when empty = 3.50 kg

(2)

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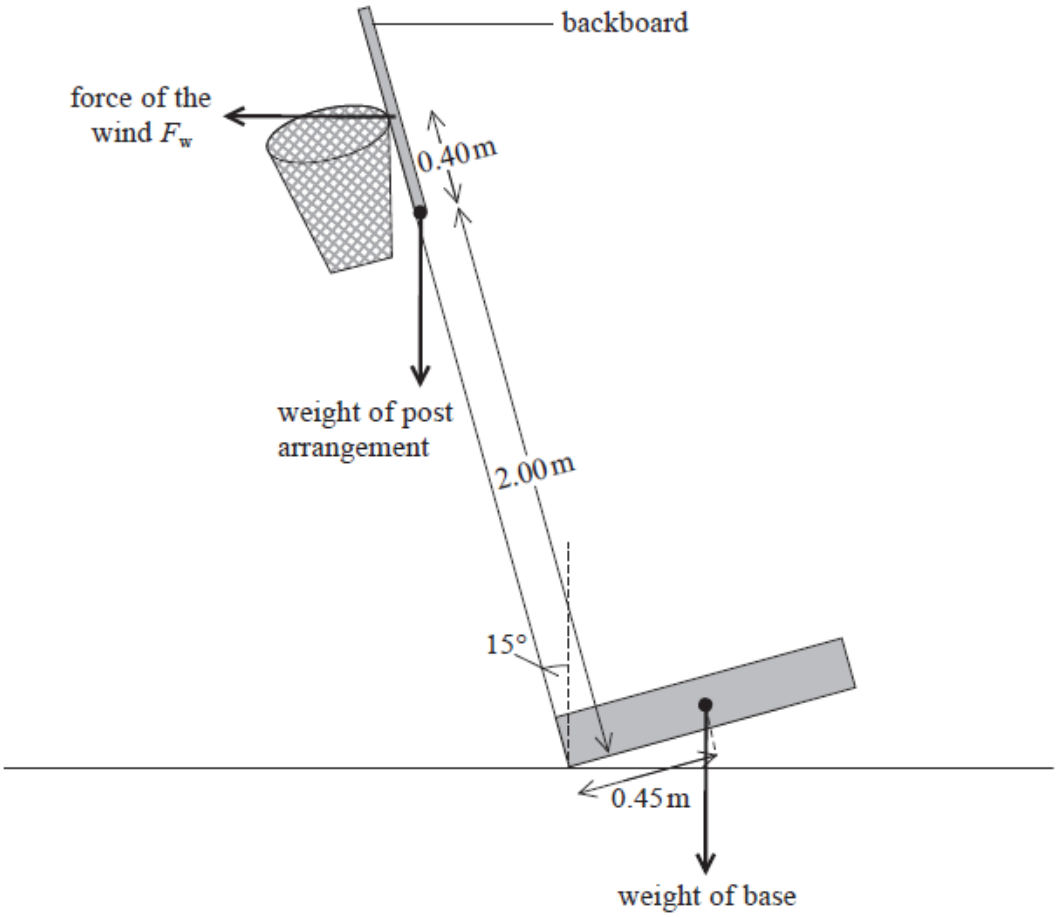
(b) Due to the large area of the backboard, the basketball set may topple over when the wind blows.



Calculate the minimum force of the wind F_w that will cause the basketball set to be blown over when it is at the angle shown. Ignore the effect of the wind on the base.

weight of post arrangement = 27.0 N

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Minimum force of the wind F_w = ...

(c) The base is filled with sand instead of water. The density of sand is greater than the density of water.

State and justify what would happen to the value of F_w calculated in part (b).

(3)

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(Total for question = 10 marks)