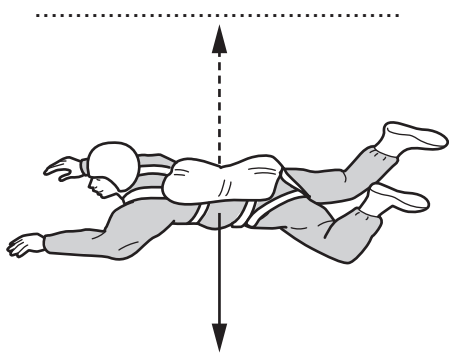
1 The weight of a skydiver is 750 N.

The weight of the skydiver acts downwards, as shown in the diagram.

While the skydiver is falling, another force acts upwards.

The upward force varies as the skydiver falls.



weight = 750 N

(not to scale)

The skydiver is accelerating between time = 0 and time = 20 s of the fall.

Between time = 20 s and time = 40 s the skydiver is falling at a constant speed.

(a) On the diagram, write the name of the upward force on the dotted line above the upward force.

[1]

(b) Suggest a value for the upward force on the skydiver at time = 10 s.

..... N [1]

(c) Determine the value of the upward force on the skydiver at time = 30 s.

..... N [1]

[Total: 3]

2 A sailor uses a winch to raise a sail on a boat. Diagram A shows the sailor turning the winch.

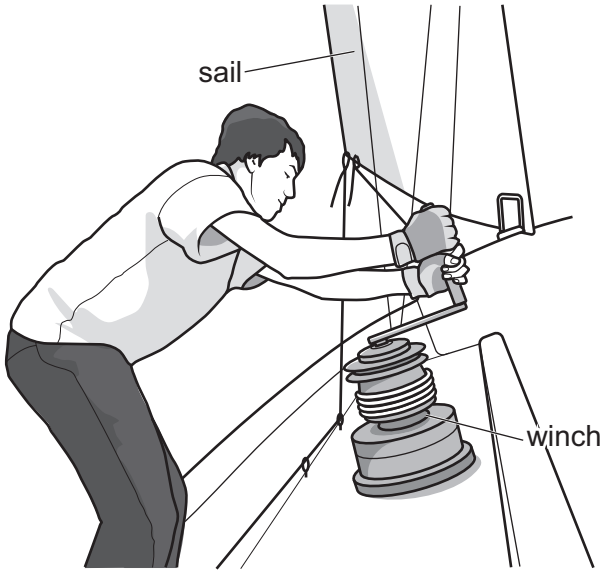


Diagram A

The sailor applies a force of 200 N at a distance of 30 cm from the pivot in the winch, as shown in diagram B.

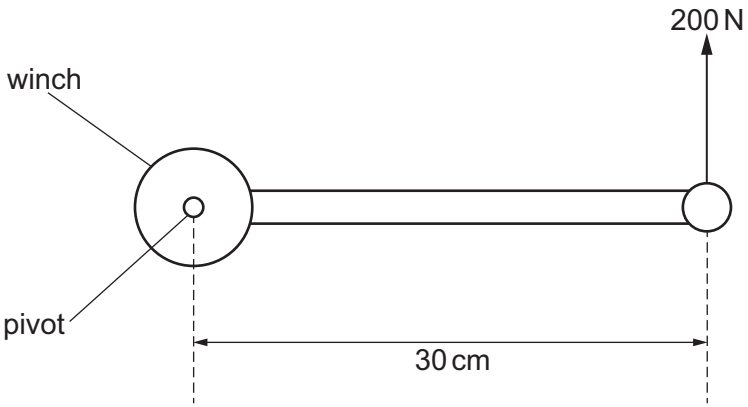


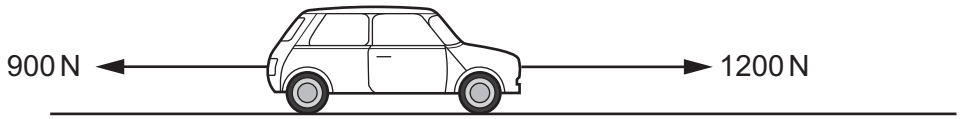
Diagram B

Calculate the moment of this force about the pivot.

moment of force = ... N cm [3]

[Total: 3]

3 The diagram shows the horizontal forces acting on a car.



(not to scale)

Calculate the resultant horizontal force on the car.

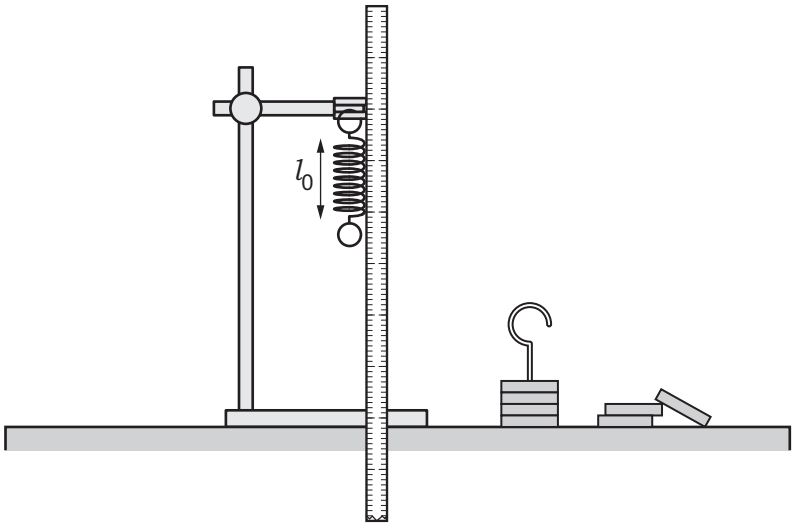
size of force = ... N

direction ..... [3]

[Total: 3]

4 A student suspends a spring from a clamp stand and measures the length l_0 of the spring.

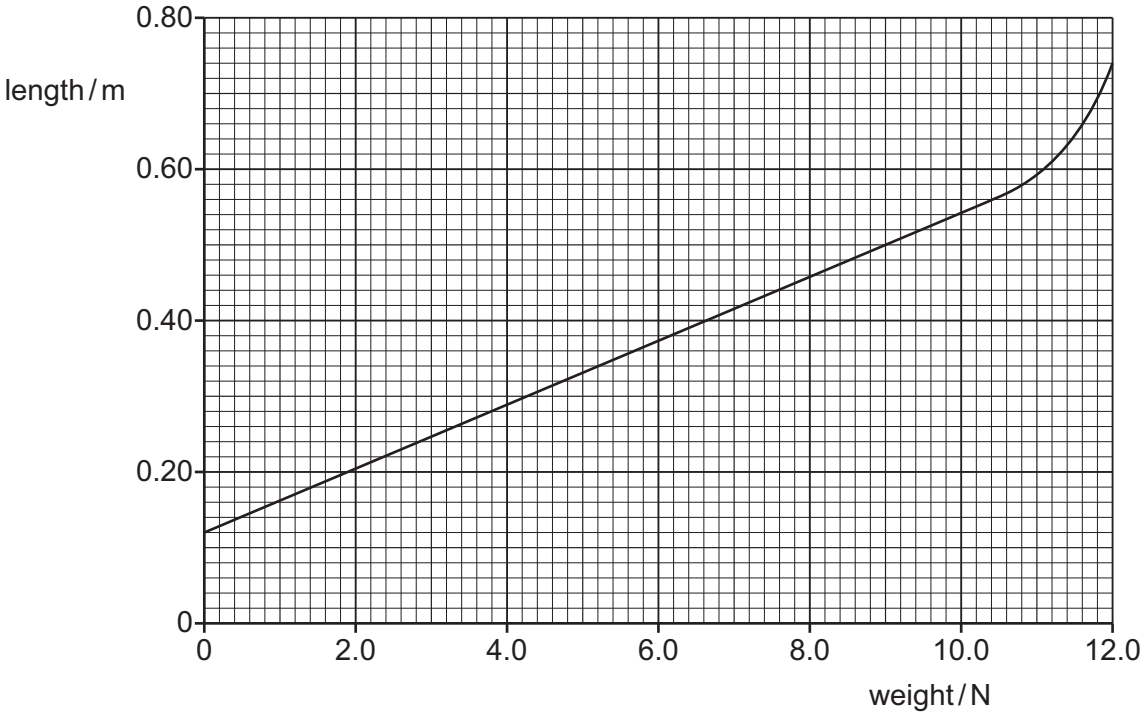
The diagram shows the apparatus.



(not to scale)

The student then suspends loads of different weights from the spring and measures the length of the spring for each load. He then plots a graph of the length of the spring against weight.

This is the graph that the student plots.



(a) Using the graph, determine the initial length l_0 of the spring.

l_0 = ... [1]

(b) State what is meant by the limit of proportionality and, using the graph, determine the weight of the load that causes this spring just to reach the limit of proportionality.

limit of proportionality .....

.....

.....

weight = ... [2]

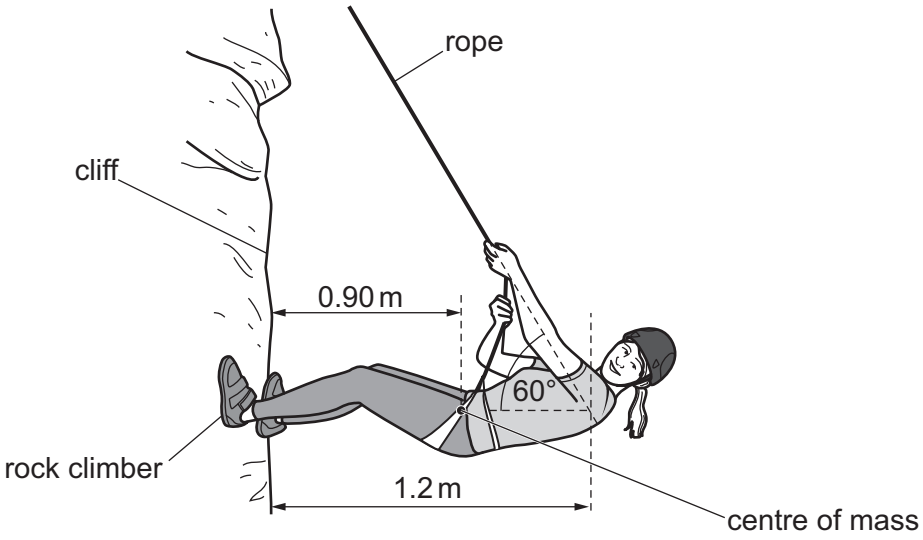
(c) Using the graph, determine the spring constant of this spring.

spring constant = ... [3]

[Total: 6]

5 A rock climber, of total mass 62 kg, holds herself in horizontal equilibrium against a vertical cliff. She pulls on a rope that is fixed at the top of the cliff and presses her feet against the cliff.

The diagram shows her position.



(not to scale)

State the **two** conditions needed for equilibrium.

1. .....

2. ..... [2]

[Total: 2]

6 A force is a vector quantity.

State **two** features of a vector quantity.

1. .....

2. ..... [2]

[Total: 2]

7 A force is a vector quantity.

State the names of **two** other quantities that are vectors.

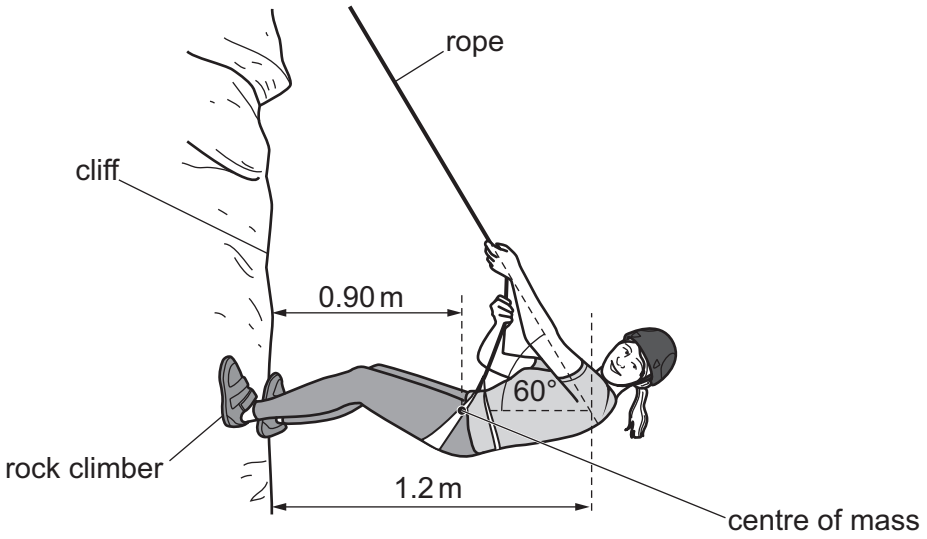
1. .....

2. ..... [2]

[Total: 2]

8 A rock climber, of total mass 62 kg, holds herself in horizontal equilibrium against a vertical cliff. She pulls on a rope that is fixed at the top of the cliff and presses her feet against the cliff.

The diagram shows her position.



(not to scale)

(a) The climber's centre of mass is 0.90 m from the cliff.

Calculate the moment about her feet due to her weight.

moment = ... [2]

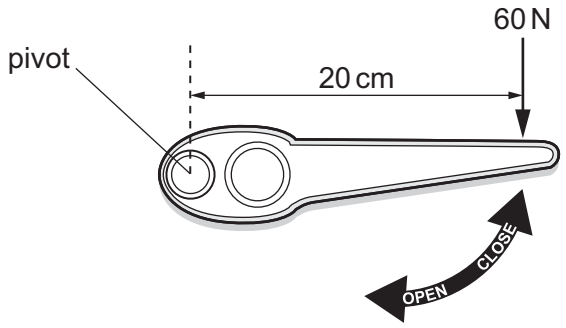
(b) The line of the rope meets the horizontal line through her centre of mass at a distance of 1.2 m from the cliff, as shown in the diagram. The rope is at an angle of 60° to the horizontal.

Determine the tension in the rope.

tension = ... [3]

[Total: 5]

9 The diagram shows the handle used to open and close a cupboard door on an aeroplane.



(not to scale)

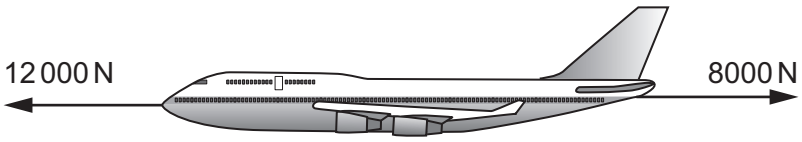
A force of 60 N acts at a distance of 20 cm from the pivot of the handle.

Calculate the moment of the 60 N force about the pivot.

moment = ... N cm [3]

[Total: 3]

10 The diagram shows an aeroplane flying. There are horizontal forces acting on the aeroplane, as shown in the diagram.



(not to scale)

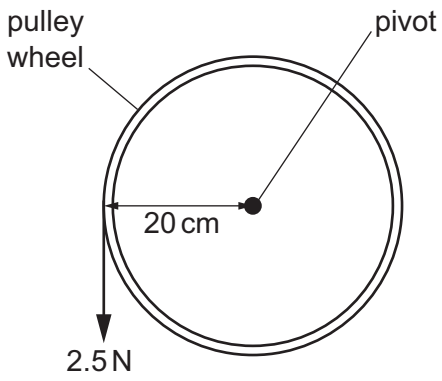
State the name of the effect producing the 8000 N force on the aeroplane.

..... [1]

[Total: 1]

11 A pulley wheel is used to raise a load.

The diagram shows the force on the pulley from the load.



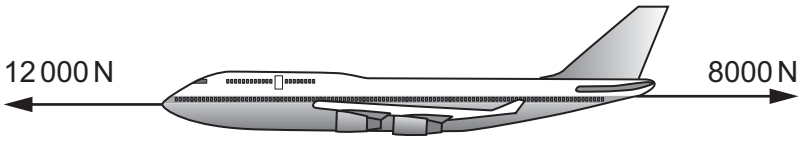
The weight of the load is 2.5 N and the weight acts at a distance of 20 cm from the pivot of the pulley wheel.

Calculate the moment of the weight of the load about the pivot.

moment = ... N cm [3]

[Total: 3]

12 The diagram shows an aeroplane flying. There are horizontal forces acting on the aeroplane, as shown in the diagram.



(not to scale)

(a) Calculate the resultant horizontal force on the aeroplane.

resultant force = ... N

direction of resultant force ..... [3]

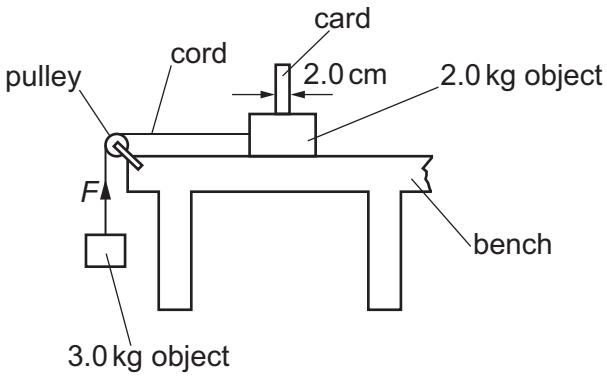
(b) At a later time in the flight, the resultant horizontal force on the aeroplane is zero.

Describe the horizontal motion of the aeroplane.

..... [1]

[Total: 4]

13 The diagram shows an object of mass 2.0 kg on a bench. This object is connected by a cord, passing over a pulley, to an object of mass 3.0 kg.



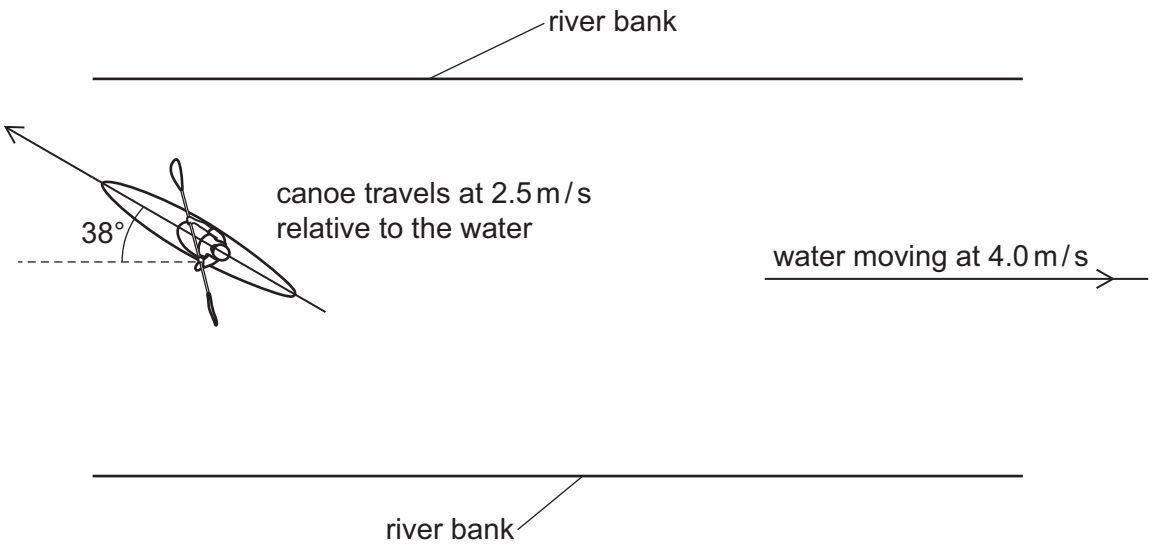
The 2.0 kg object is released from rest and accelerates at 4.0 m / s^2.

Calculate the upward force *F* exerted by the cord on the 3.0 kg object.

force *F* = ... [3]

[Total: 3]

14 The diagram shows water in a river moving parallel to the river bank at 4.0 m / s and a canoe travelling in the river.



The canoe travels at 2.5 m / s relative to the water and heads at an angle of 38° to the river bank.

Draw a scale diagram to determine the canoe's resultant velocity and state the scale you used.

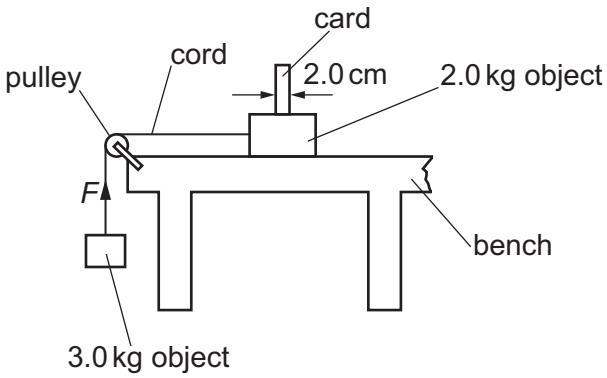
scale .....

magnitude of resultant velocity .....

direction of resultant velocity (angle from the river bank) ..... [4]

[Total: 4]

15 The diagram shows an object of mass 2.0 kg on a bench. This object is connected by a cord, passing over a pulley, to an object of mass 3.0 kg.



The 2.0 kg object is released from rest and accelerates at 4.0 m / s^2.

Calculate the resultant force acting on the 2.0 kg object.

force = ... [2]

[Total: 2]

16 Force is a vector.

Draw a circle around **two** other quantities in the list which are vectors.

acceleration **density** **energy** **mass**

momentum **power** **refractive index**

[2]

[Total: 2]

17 A battery provides energy to an electric car.

The electric car has an acceleration of $2.9\,m/s^2$ when it moves from rest. The combined mass of the car and its driver is 1600 kg.

Calculate the force required to produce this acceleration.

force = ... [2]

[Total: 2]