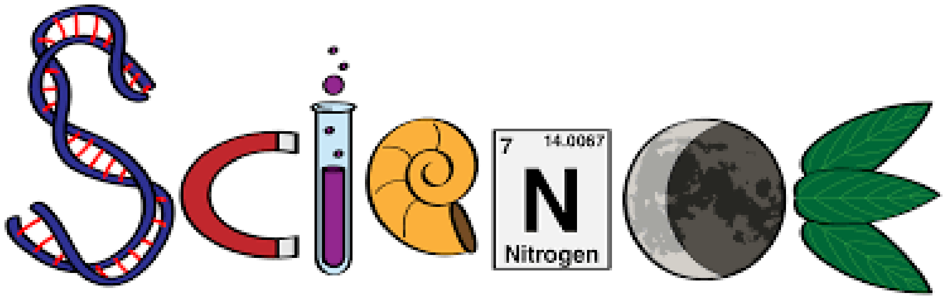
Meopham School



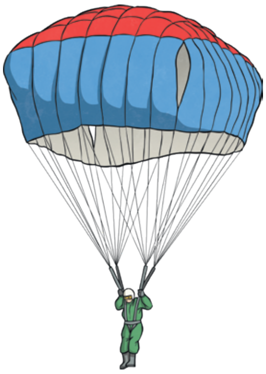
HOMEWORK BOOKLET

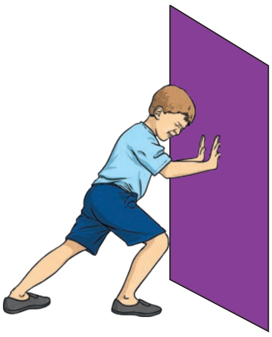
P5 Higher

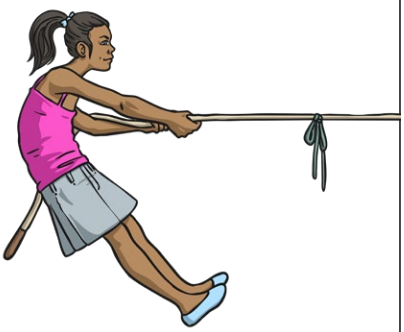
Forces in Action

Homework1

Draw arrows on the pictures below to show the forces acting in them.







Hooke's Law

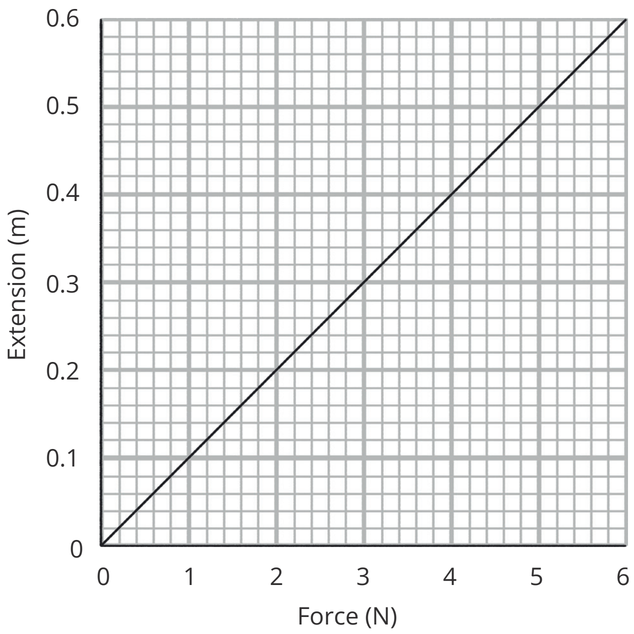
Homework1

The extension of some elastic objects can be described by Hooke's law.

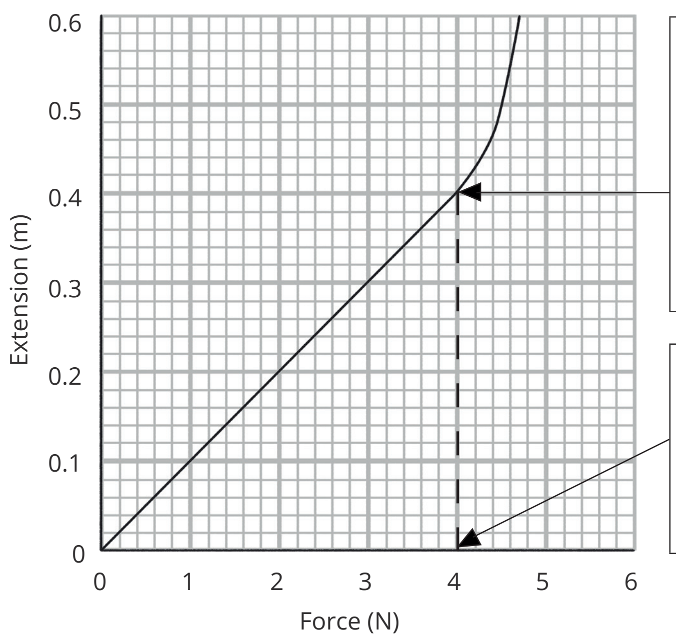
force = spring constant × extension

When a spring obeys Hooke's law, the extension of the spring is **directly proportional** to the force applied. This means that if you double the force, the extension also doubles.

On a graph, this is shown by a straight line through the origin.



At the elastic limit, the spring will no longer return to its original shape. Once a spring has reached its elastic limit, it no longer obeys Hooke's law.



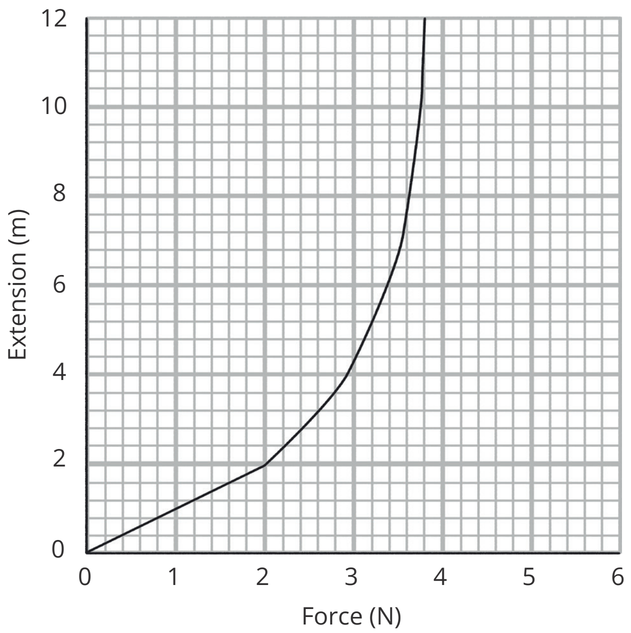
This is the point at which the straight line starts to curve. You can place a ruler along the straight part of the graph to help you identify where this happens.

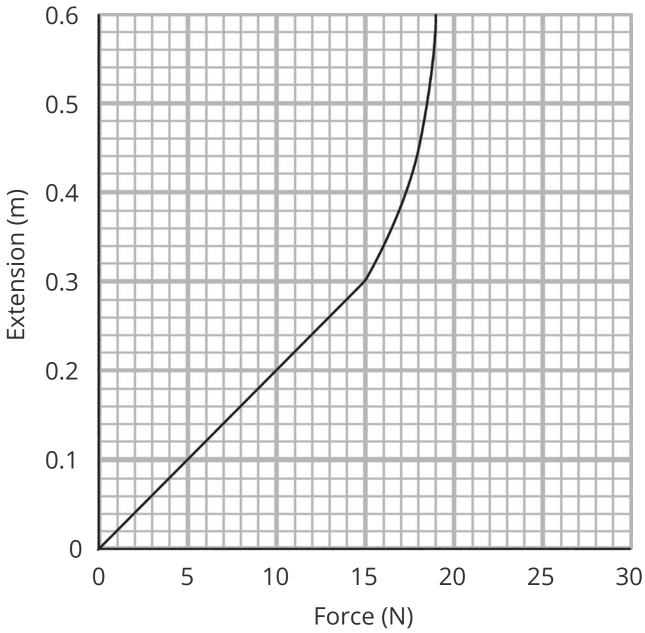
From this point the spring no longer obeys Hooke's law. It has reached its elastic limit.

You can read the force at which the spring reaches its elastic limit from the x-axis.

The elastic limit is reached at 4N.

1. Label the elastic limit in each of the example graphs below and identify the maximum force that could be applied to the spring to ensure it can return to its original size.





maximum force = ____________________

maximum force = ____________________

2. A spring extends by 0.04m when a force of 3N is applied.

Calculate the extension of the spring when a force of 6N is applied, assuming the spring has not reached its elastic limit.

____________________m

3. A force of 7N is applied to a spring. The spring extends by 0.2m.

Calculate the spring constant of the spring.

____________________N/m

Work Done and Deformation

Homework 2

Work done is the energy transferred by the action of a force. The energy transferred when a spring is deformed can be calculated using the equation:

elastic potential energy = 0.5 × spring constant × (extension)^2

1. Calculate the work done when:

a) A spring with a spring constant of 20 N/m is extended by 0.1 m.

____

____

work done = ______________ J

b) A spring with a spring constant of 3.4 N/m is extended by 0.3 m.

____

____

work done = ______________ J

c) A spring with a spring constant of 53 N/m is extended by 20 cm.

____

____

work done = ______________ J

d) A spring with a spring constant of 26 N/m is extended by 40 cm.

____

____

work done = ______________ J

2. A 0.05 m spring with a spring constant of 36 N/m is hung from a clamp stand. A mass is added to one end of the spring. The spring is now 0.15 m long.

Calculate the work done to stretch the spring.

____

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____

work done = ______________ J

Speed, Distance and Time

Homework 2

1. For each question, find the speed given the distance travelled and the time taken. Give your answer in metres per second (m/s). Where appropriate, round to two decimal places.

   a. Distance = 30m

      Time = 45 seconds

   b. Distance = 50m

      Time = 10 seconds

   c. Distance = 27m

      Time = 20 seconds

   d. Distance = 380m

      Time = 90 seconds

2. For each question, find the distance travelled given the speed and the time taken. Give your answer in metres.

   a. Speed = 2.7m/s

      Time = 30 seconds

   b. Speed = 15m/s

      Time = 40 seconds

   c. Speed = 10m/s

      Time = 12.7 seconds

   d. Speed = 4.5m/s

      Time = 60 seconds

3. For each question, find the time taken given the speed and the distance travelled. Give your answer in seconds. Where appropriate, round to two decimal places.

   a. Speed = 1.2m/s

      Distance = 100m

   b. Speed = 7.3m/s

      Distance = 70m

Homework 2

c. Speed = 0.8m/s

Distance = 24m

d. Speed = 1.5m/s

Distance = 32m

4. Dan is running a 10km race. He wants to beat his personal record of 42 minutes and 12 seconds. What average speed does Dan have to exceed to beat his record? Give your answer to one decimal place and in kilometres per hour.

5. A train leaves Leicester at 15:44 and arrives at Derby at 16:11. Given this is a journey of 35 miles, find the average speed of the train. Give your answer to one decimal place and in miles per hour (mph).

6. A speed boat company offers $1\frac{1}{2}$ hour trips. The boat can travel between 60 and 85mph.

a. What is the maximum distance the boat can travel in this time?

b. What is the minimum distance the boat can travel in this time?

Challenge

Homework 2

In Northern Ireland, the maximum speed limit is 70mph. In the Republic of Ireland, the maximum speed limit is 120km/h.

Which country has the higher speed limit?

You can use the fact that 5 miles ≈ 8 kilometres.

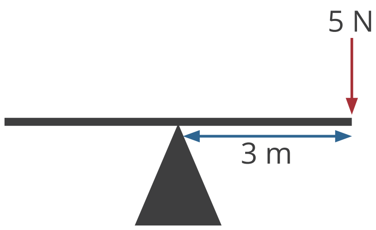
Moments

Homework 3

1. A force is applied to each of the see-saws shown below.

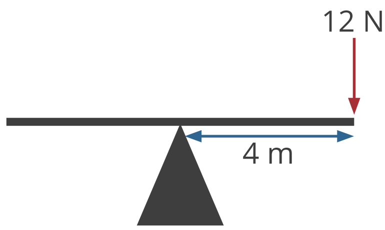
   Calculate the moment of each force.

a)



moment of the force = ______________ Nm

b)

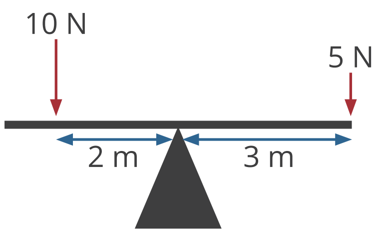


moment of the force = ______________ Nm

2. A force is applied to each side of the see-saws shown below.

   Calculate the resultant moment of the forces acting on each see-saw.
   State the direction that the see-saw will tilt.

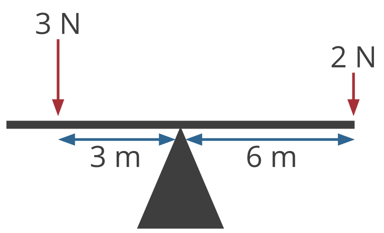
a)



resultant moment = ______________ Nm

direction = ______________

b)

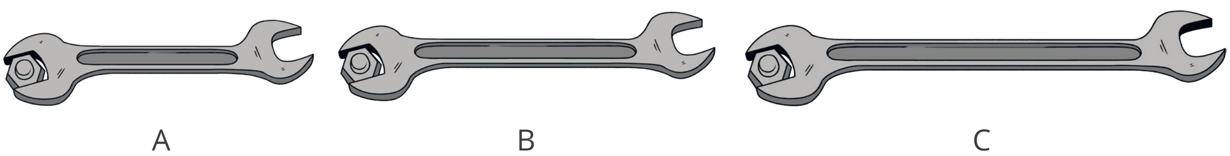


resultant moment = ______________ Nm

direction = ______________

3. A person has three different spanners that they could use to loosen a bolt.

   Explain which of the three spanners would require the least effort to turn the bolt.



Homework 3

4. A person is using a lever to open a tin of paint. The lid requires a moment of 3 Nm to open. The person can use a maximum force of 15 N.

Calculate the shortest length of lever that the person can use to open the paint can.

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length = ________________ m

5. The see-saw shown below is balanced. The person on the left-hand side of the see-saw is 0.6 m from the pivot and exerts a force of 686 N. The person on the right-hand side of the see-saw has a mass of 28 kg.

gravitational field strength on Earth = 9.8 N/kg

Calculate the distance from the pivot to the person on the right-hand side of the see-saw.

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distance = ________________ m

Forces Equations **Match and Draw**

Homework 3

Draw **one** line from each variable to show how it can be calculated.

weight =	force × distance (along the line of action of the force)
work done =	mass × gravitational field strength
force applied to a spring =	speed × time
distance travelled =	$\frac{\text{change in velocity}}{\text{time taken}}$
acceleration =	spring constant × extension
resultant force =	mass × velocity
momentum = **HT only**	mass × acceleration