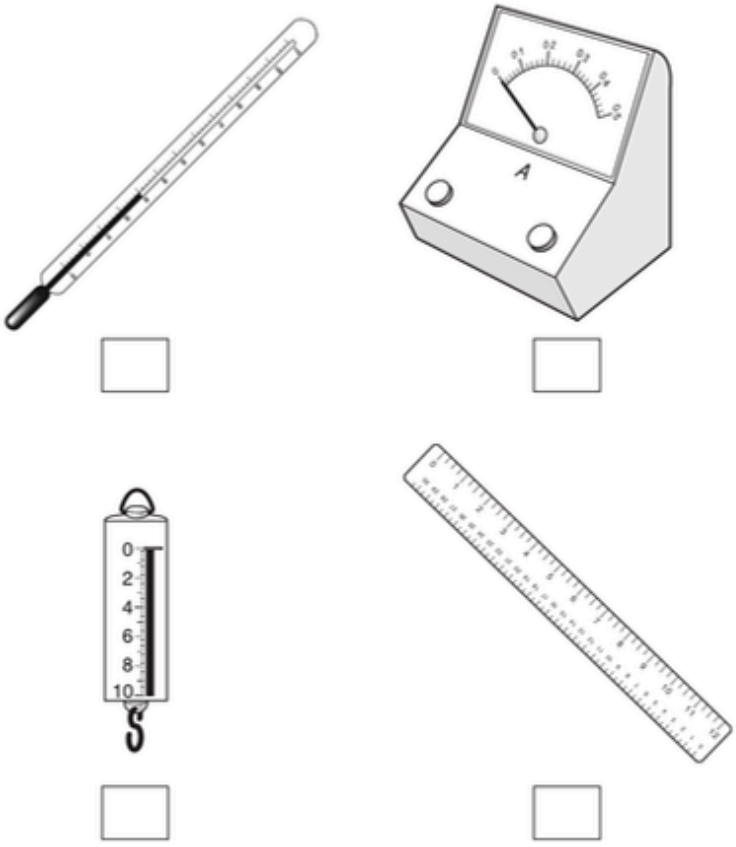
Motion and Forces

Forces are all around us, shaping how things move, speed up and slow down — a fundamental KS3 physics topic that underpins GCSE Science.

(b) (i) Which piece of equipment should Tasha use to measure the forces on the block?

Tick the correct box.



(ii) Give the name of the equipment used to measure force.

_____

3bi
1 mark

3bii
1 mark

KS3 Science SATs, Tier 3-6, Paper 1 (2009) - Q3(b)

(b) (i) Stefan is snowboarding. Gravity acts on Stefan.
On the diagram below, draw an arrow to show the direction of the force of gravity.



1bi
1 mark

(ii) When Stefan wants to slow down, he pushes one edge of the snowboard into the snow.



What force between the board and the snow makes him slow down?

_____

1bii
1 mark

Modern Tuition

11. Russell investigated the relationship between mass and weight.
He weighed five different masses using a force meter.

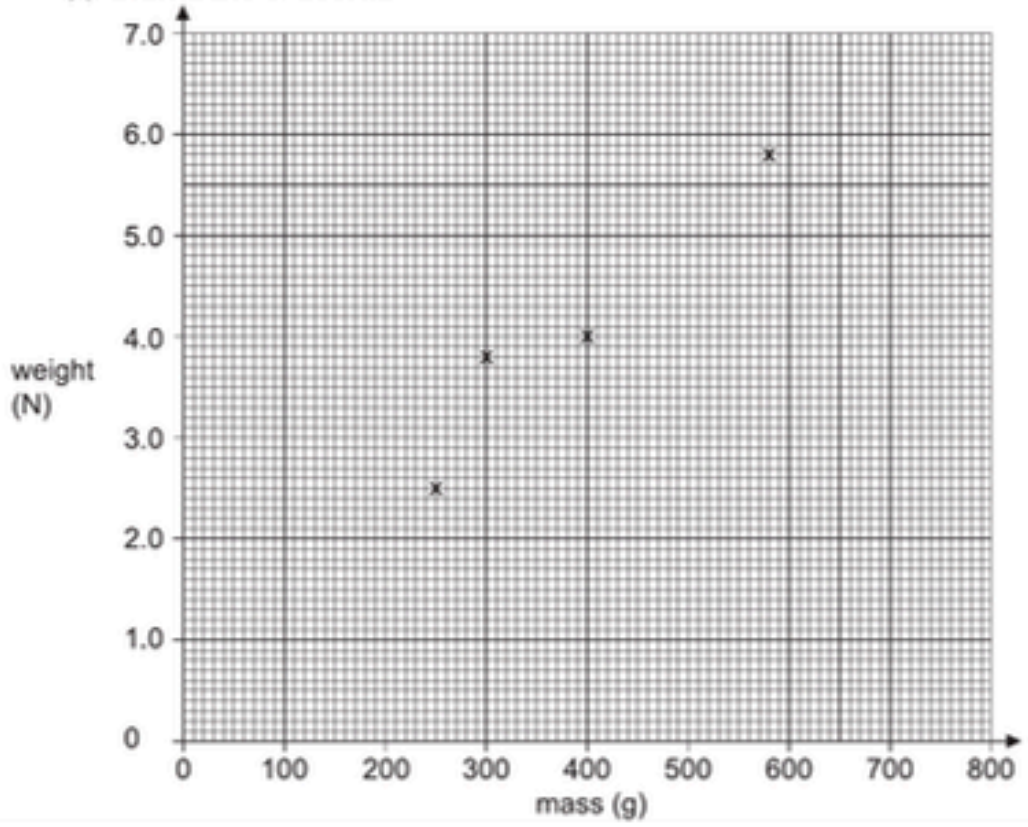
His results are shown in the table.

mass (g)	weight (N)
150	1.5
250	2.5
300	3.8
400	4.0
580	5.8

(a) He plotted four of his results on a grid as shown below.

(i) Plot the point for the 150 g mass on the graph.

(ii) Draw a line of best fit.



11ai
1 mark

11aii
1 mark

Modern Tuition

(b) One of the points Russell plotted does **not** fit the pattern.

Circle this point on the graph.

11b
1 mark

(c) Use your graph to predict:

(i) the mass of an object weighing 6.5 N;

_____ g

11ci
1 mark

(ii) the weight of an object of mass 50 g.

_____ N

11cii
1 mark

(d) Give **one** reason why it is more useful to present the results as a line graph rather than a table.

_____

_____

11d
1 mark

Modern Tuition

6. Tom is doing a bungee jump from a bridge.



He is attached to one end of an elastic rope.
The other end of the rope is attached to the bridge.
Tom jumps from the bridge.

(a) (i) What force makes Tom fall towards the ground?

6ai
1 mark

_____

(ii) Tom does **not** hit the river below the bridge.
What makes Tom stop falling before he hits the river?

6aii
1 mark

_____

(b) The next person to do a bungee jump is Jill.

Jill weighs less than Tom.
Complete the sentence below using words from the box.

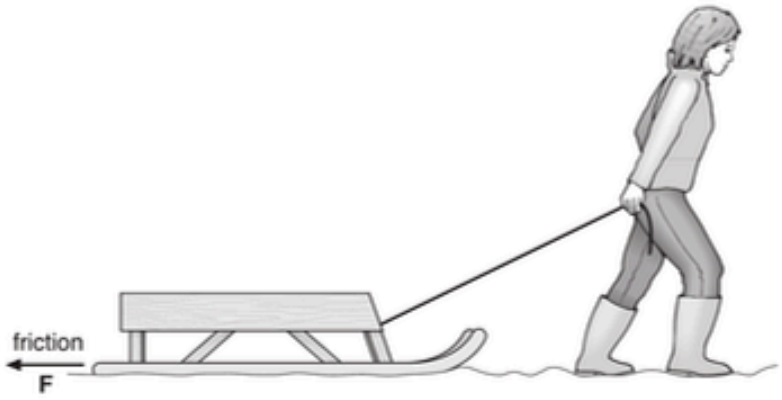
more than	less than	the same as

6b
1 mark

When Jill jumps, the rope will stretch _____

it did when Tom jumped.

Modern Tuition



(a) (i) Draw an arrow on the rope to show the direction of the force of the rope on the sledge.

Label the arrow **R**.

4ai
1 mark

(ii) Draw an arrow on the diagram to show the direction of the force of gravity on the sledge.

Label the arrow **G**.

4aii
1 mark

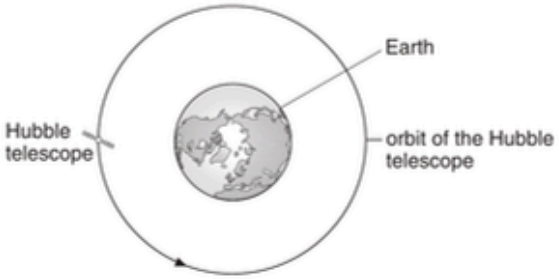
(b) Force **F** is the friction between the sledge and the snow.
Sally then pulled the sledge over a concrete path.

Friction is less on snow than on concrete.
Give the reason for this.

4b
1 mark

KS3 Science SATs, Tier 3-6, Paper 2 (2007) - Q4

2. The diagram below shows the Hubble telescope in orbit around the Earth.



not to scale

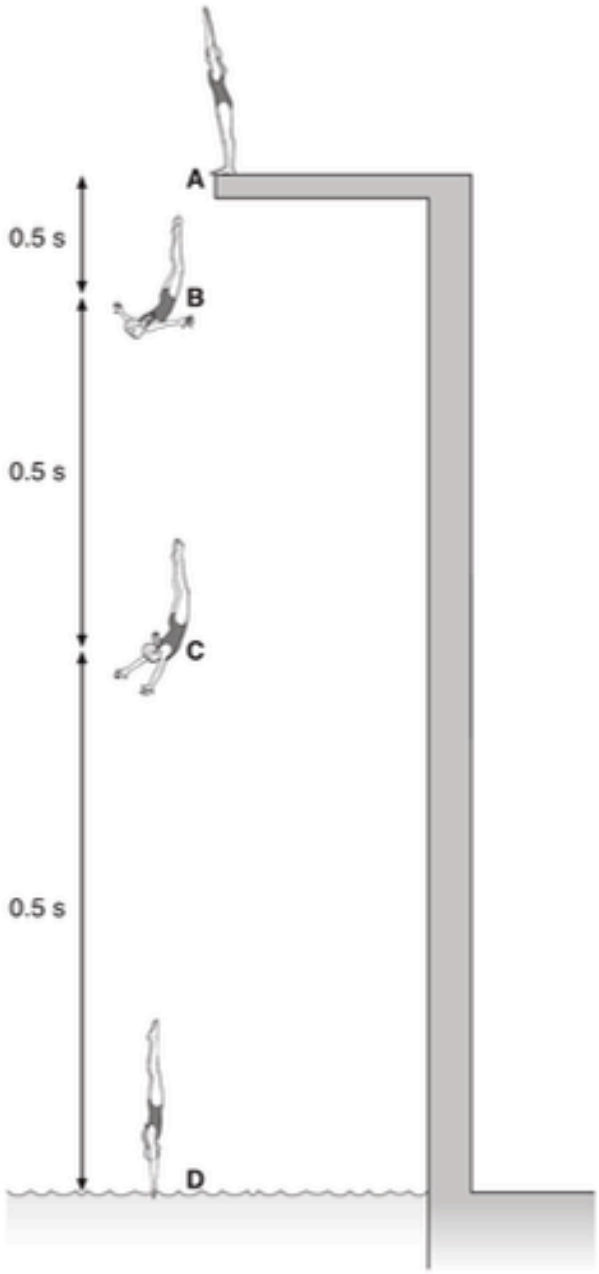
(a) Which force keeps the telescope in orbit around the Earth?
Tick the correct box.

air resistance	☐	friction	☐
gravity	☐	magnetism	☐

2a
1 mark

KS3 Science SATs, Tier 3-6, Paper 2 (2008) - Q2

9. The drawings below show Caroline diving into a swimming pool.
As she falls, gravitational potential energy is changed into kinetic energy.



(a) Why does Caroline have **no** kinetic energy at A?

1 mark

Modern Tuition

(b) The table shows Caroline's gravitational potential energy and kinetic energy at four stages of the dive.

stage of the dive	total energy (kJ)	gravitational potential energy (kJ)	kinetic energy (kJ)
A	8	8	0
B	8	7	1
C	8	4	4
D	8	0	

(i) Write the missing kinetic energy value for stage D in the table.

1 mark

(ii) As Caroline falls there is **no** loss of energy to the air.
How do the energy values for stages A, B, C and D show this?

_____

_____

1 mark

(c) (i) Give the name of the force that causes Caroline to speed up as she falls.

_____

1 mark

(ii) Caroline takes 0.5 s to fall from A to B **and** from B to C **and** from C to D.
How can you tell from the drawings opposite that she is speeding up as she falls?

_____

_____

1 mark

(d) When Caroline enters the water she slows down.
Give the name of the force that slows her down.

_____

1 mark

Modern Tuition

3. (a) Tasha puts a small block of wood on a smooth surface.



She puts different forces on the block.
The diagrams below show the size and direction of these forces.

Will each block move to the **left**, to the **right** or **stay still**?
Tick the correct box in each row.

	forces on block	moves to the left ←	moves to the right →	stays still
(i)		☐	☐	☐
(ii)		☐	☐	☐
(iii)		☐	☐	☐
(iv)		☐	☐	☐

3ai 1 mark

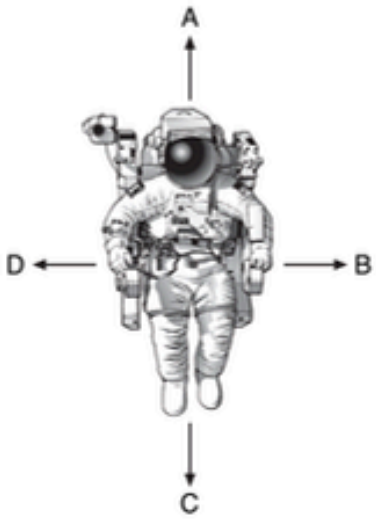
3aii 1 mark

3aiii 1 mark

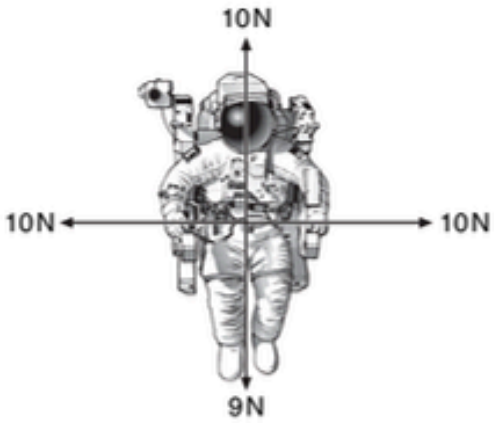
3aiv 1 mark

Modern Tuition

16. The drawing below shows an astronaut in space.
He has four small jets attached to his space suit.
These jets produce forces on the **astronaut** in the directions A, B, C and D.



(a) The drawing below shows the size and direction of four forces acting on the astronaut.

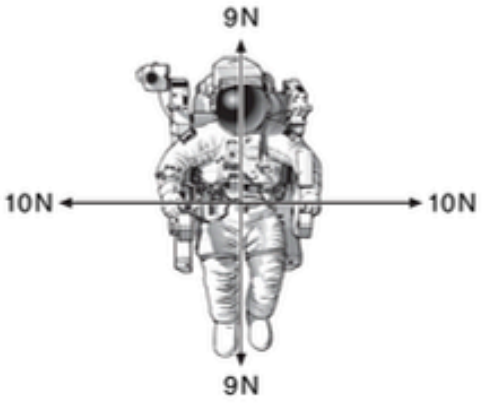


In which direction, A, B, C or D, will the astronaut move?
Give the letter.

16a
1 mark

Modern Tuition

(b) The drawing below shows the size and direction of four different forces acting on the astronaut.



What will happen to the astronaut when the jets produce these four forces?

_____ 16b 1 mark

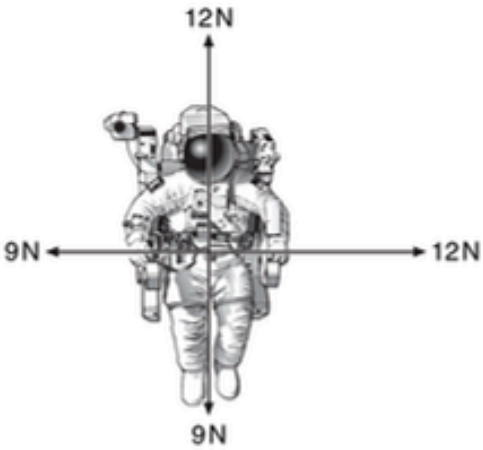
Explain your answer.

_____

_____ 16b 1 mark

(c) The drawing below shows the size and direction of four different forces acting on the astronaut.

Draw an arrow on the diagram below to show the direction in which he will move.

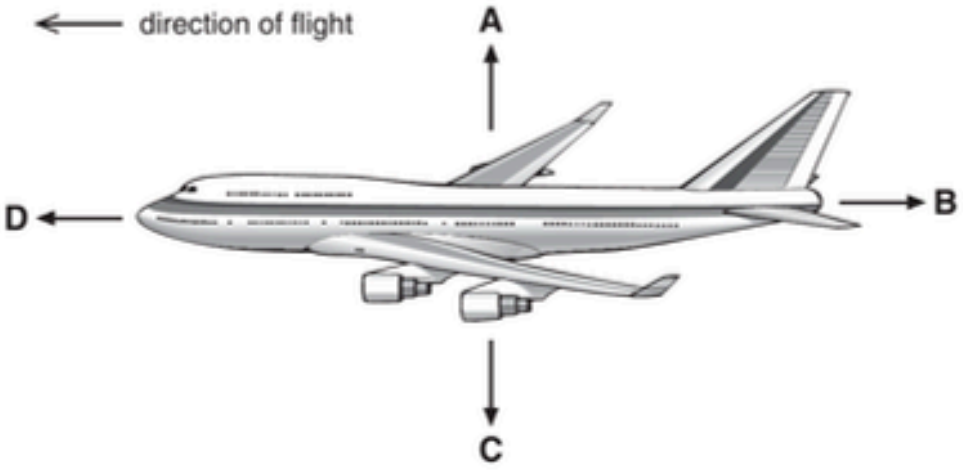


16c 1 mark

maximum 4 marks

Modern Tuition

17. The diagram shows four forces acting on a plane in flight.



(a) Which arrow represents air resistance?
Give the letter.

_____

17a
1 mark

(b) (i) When the plane is flying at a constant height, which two forces must be balanced?
Give the letters.

_____ and _____

17bi
1 mark

(ii) When the plane is flying at a constant speed in the direction shown, which two forces must be balanced?
Give the letters.

_____ and _____

17bii
1 mark

Modern Tuition

(c) (i) Just before take-off, the plane is speeding up along the ground.

Which statement is true?
Tick the correct box.

Force B is zero.	☐
Force B is greater than force D.	☐
Force D is equal to force B.	☐
Force D is greater than force B.	☐

☐ 17ci
1 mark

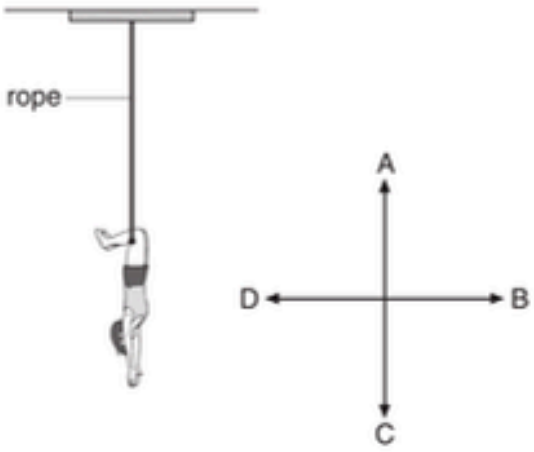
(ii) Which statement is true about the plane just as it leaves the ground?
Tick the correct box.

Force C is zero.	☐
Force C is greater than force A.	☐
Force A is equal to force C.	☐
Force A is greater than force C.	☐

☐ 17cii
1 mark

Modern Tuition

6. The diagram below shows Jo hanging on a trapeze (swing) in a circus.



(a) (i) Which arrow, A, B, C or D, shows the direction of Jo's weight?

5ai

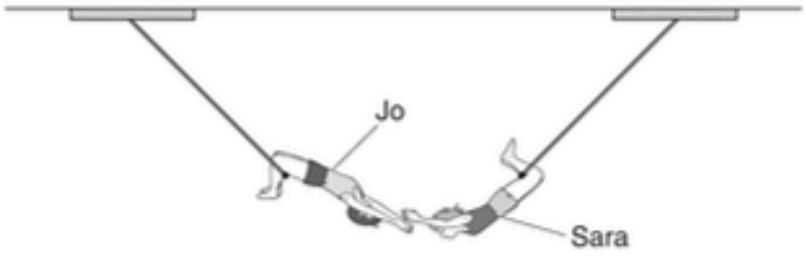
1 mark

(ii) Which arrow, A, B, C or D, shows the direction of the force of the rope on Jo?

5aii

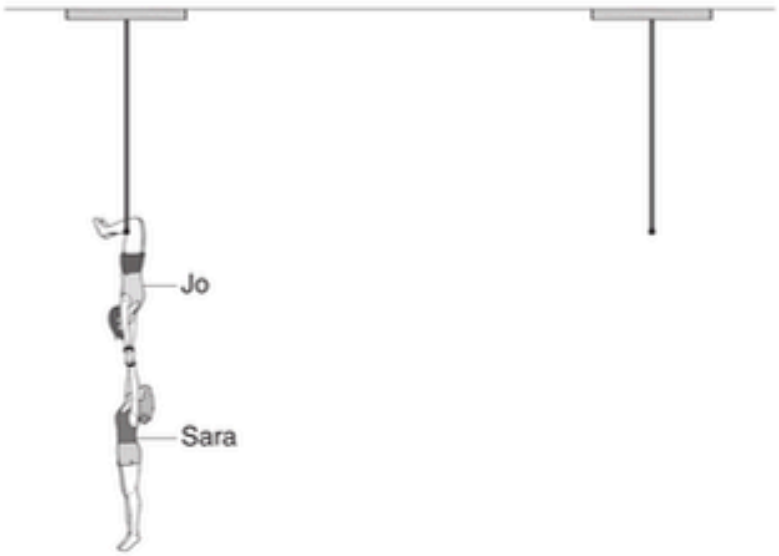
1 mark

(b) Sara swings towards Jo.



Modern Tuition

Sara lets go of her trapeze and Jo catches her.



(i) What happens to the downward force on the rope of Jo's trapeze?
Tick the correct box.

increases	decreases	stays the same	there is **no** force
☐	☐	☐	☐

6bi
1 mark

(ii) Explain your answer.

_____

6bii
1 mark

(c) Jo lets go of the trapeze and both Sara and Jo fall into a safety net below them.

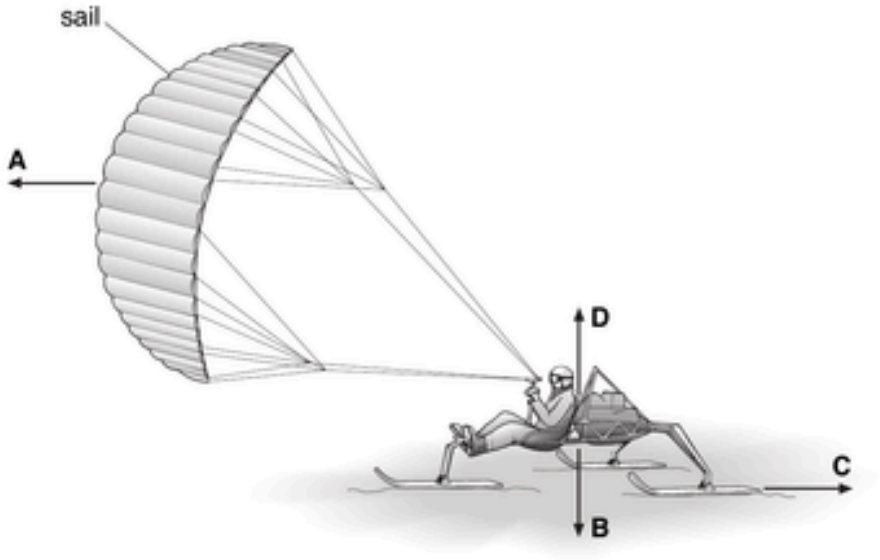
What happens to the downward force on the rope when Jo lets go?

_____

6c
1 mark

Modern Tuition

2. The drawing shows a snow-buggy being pulled by a sail.
The buggy rests on three skis on the snow.



(a) The drawing shows four forces that act when the snow-buggy is moving.

Draw a line from each force in the list below to the correct letter from the diagram.
Draw only **three** lines.

force	letter
the weight of the buggy	A
the force pulling the buggy along	B
the friction between the skis and the snow	C
	D

2a
1 mark

2a
1 mark

2a
1 mark

Modern Tuition

(b) A scientist travelled 80 kilometres (km) each day in the buggy.

How many kilometres did he travel in 10 days?

_____ km

2b
1 mark

(c) The buggy carried the scientist, food and equipment for the journey. The table shows how the total mass changed.

	total mass at start of journey (kg)	total mass at end of journey (kg)
mass of buggy, scientist, food and equipment	295	130

The buggy sank deeper into the snow at the start of the journey than at the end.

Why did it sink deeper at the start? Use the table to help you.

_____

_____

2c
1 mark

(d) The buggy rests on three skis instead of three wheels.

Why are skis better than wheels for travelling on snow?

_____

_____

2d
1 mark

(e) When a bigger sail is used, the buggy goes faster.

How does a bigger sail help the buggy to go faster?

_____

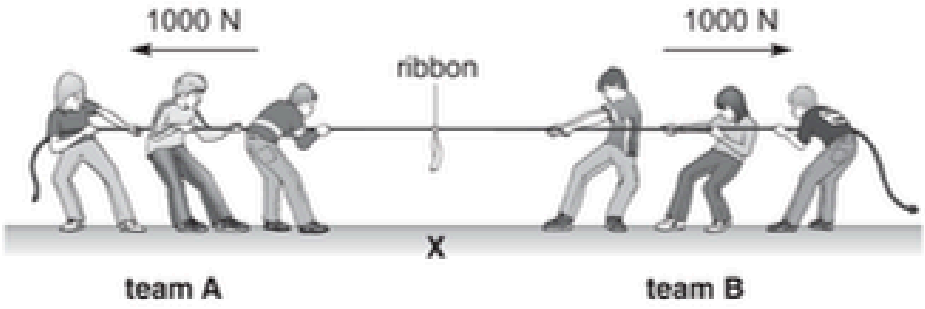
_____

2e
1 mark

Modern Tuition

3. The drawings in parts (a), (b) and (c) show two teams of pupils in a tug-of-war. There is a ribbon tied to the middle of the rope.

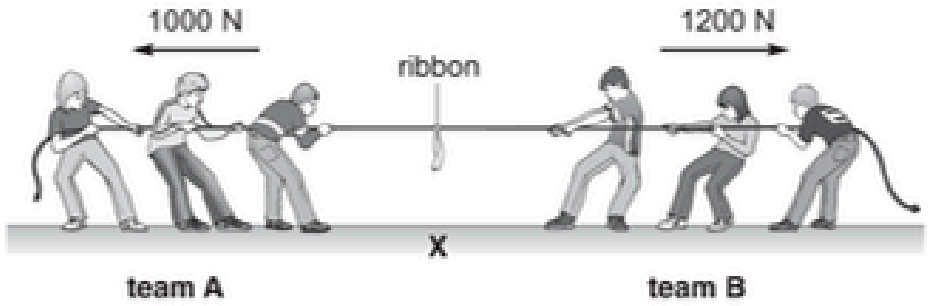
(a) The sizes and directions of the forces of each team are shown.



The ribbon stays above point X on the ground.
Give the reason for this.

3a
1 mark

(b) The teams then pull with the forces shown below.

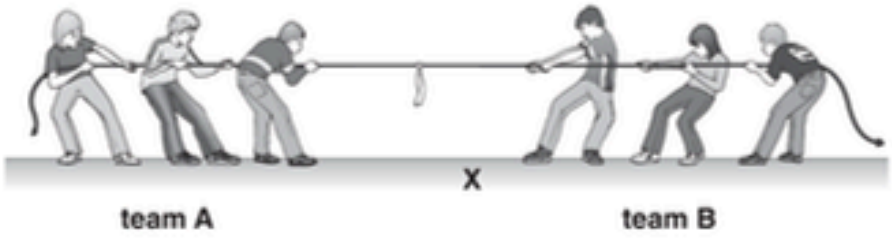


Draw an arrow on the rope to show the direction in which the ribbon will move.

3b
1 mark

Modern Tuition

(c) Later, the ribbon was to the left of point X as shown below.



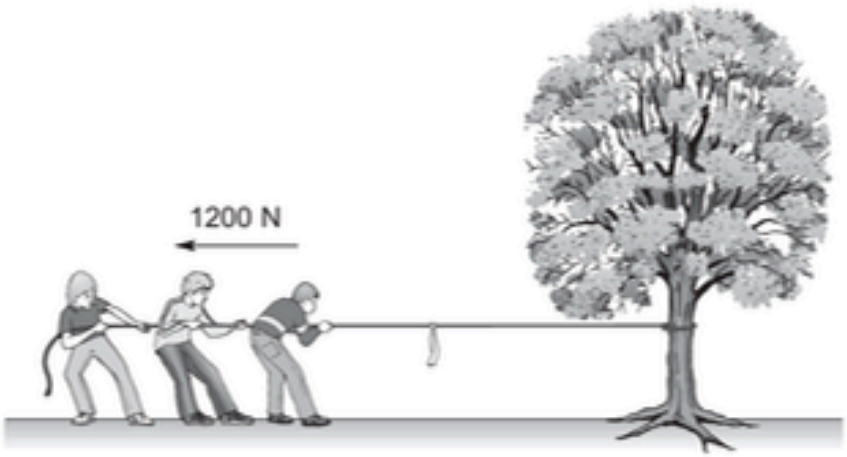
Why did the ribbon move towards the left?

_____

_____

3c
1 mark

(d) Team A practises by pulling a rope tied to a tree.



The team pulls with a force of 1200 N but the tree does **not** move.

What is the force of the tree on the rope?
Tick the correct box.

zero	☐	less than 1200 N	☐	1200 N	☐	more than 1200 N	☐

3d
1 mark

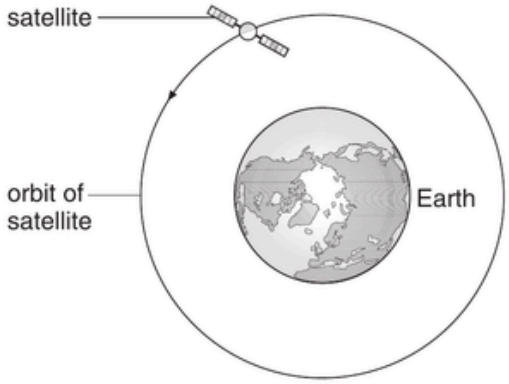
(e) The pupils do **not** slip because there is a force between their shoes and the ground. What is the name of this force?

_____

3e

Modern Tuition

(c) The diagram shows a satellite in orbit around the Earth.



not to scale

(i) Give **one** use of a satellite.

_____

_____

2ci

1 mark

(ii) Which force keeps the satellite in orbit around the Earth?
Tick the correct box.

gravity	☐	friction	☐
air resistance	☐	magnetism	☐

2cii

1 mark

Modern Tuition

(d) In very cold weather a mixture of salt and sand is spread on roads.

Why are salt **and** sand used?
Tick the **two** correct boxes.

Salt makes the roads white.	☐	Sand dissolves in water.	☐
Salt makes water freeze.	☐	Sand increases friction between car tyres and the road.	☐
Salt makes ice melt.	☐	Sand makes water freeze.	☐

☐ 4d
1 mark

☐ 4d
1 mark

KS3 Science SATs, Tier 3-6, Paper 2 (2008) - Q4(d)

(c) The frame of a bike is made of aluminium.



(i) Give **one** reason why aluminium is a suitable material for the frame.

_____

_____

☐ 5ci
1 mark

(ii) A force between the tyres and the road stops the bike skidding.

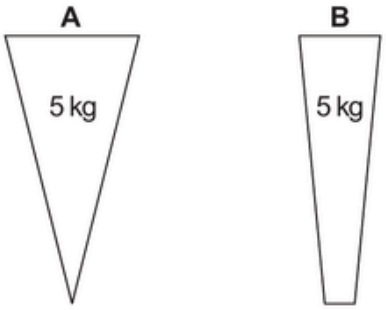
What is the name of this force?

_____

☐ 5cii

KS3 Science SATs, Tier 3-6, Paper 1 (2008) - Q5(c)

(d) David can use a different blade to split the logs.
The diagram below shows two different blades **A** and **B**.



The formula for pressure is: $\text{pressure} = \frac{\text{force}}{\text{area}}$

Which blade puts more pressure on the log?
Write the letter.

_____

Explain your answer in terms of area. Use the formula to help you.

_____

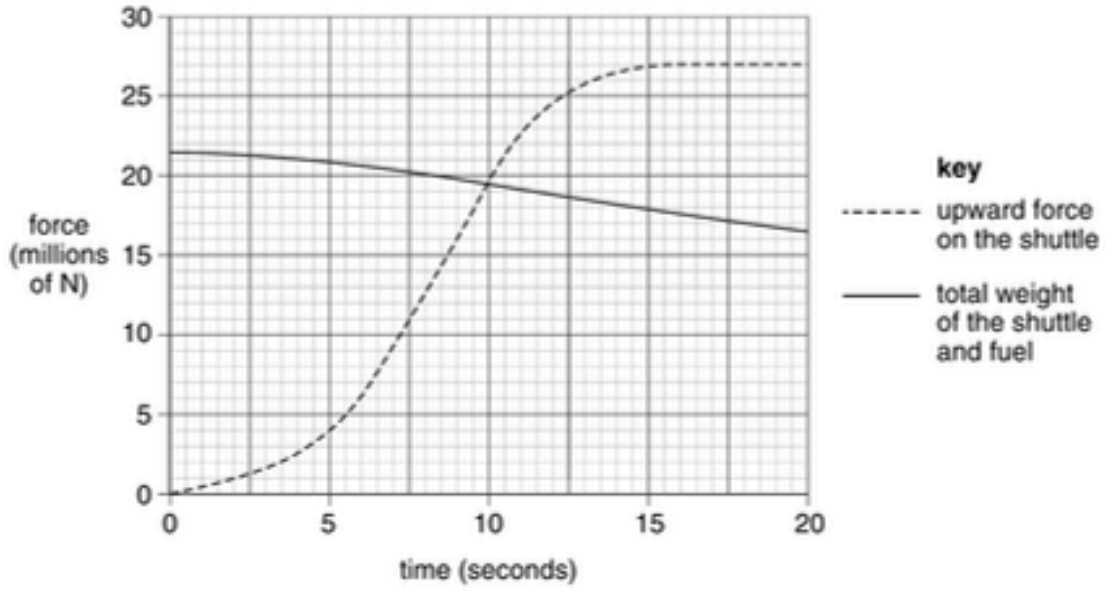
_____

13d

1 mark

Modern Tuition

(c) The graph below shows how the upward force and the weight of the shuttle, including fuel, change during the first 20 seconds, after the fuel is ignited.



Why does the total weight of the shuttle **decrease** during the first 20 seconds?

_____

_____

13c
1 mark

(d) (i) Look at the graph. At 20 seconds, what is the value of:

the upward force on the shuttle?

_____ millions of N

the total weight of the shuttle and fuel?

_____ millions of N

13di
1 mark

(ii) At 20 seconds, what is the **resultant** force on the shuttle?

_____ millions of N

13dii
1 mark

(iii) Use the graph to explain why the shuttle **cannot** take off before 10 seconds.

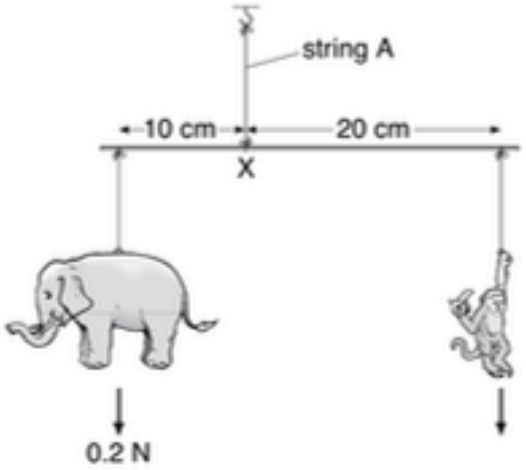
_____

_____

13diii

Modern Tuition

14. A father makes a simple mobile for his young son. He uses plastic animals as shown below.



(a) (i) The elephant weighs 0.2 N.

What is the turning moment produced by the elephant about point X? Give the unit.

14ai 1 mark

_____

14ai 1 mark

_____

(ii) What is the turning moment produced by the monkey about point X?

14aii 1 mark

_____

_____

(iii) What is the weight of the monkey?

14aiii 1 mark

_____ N

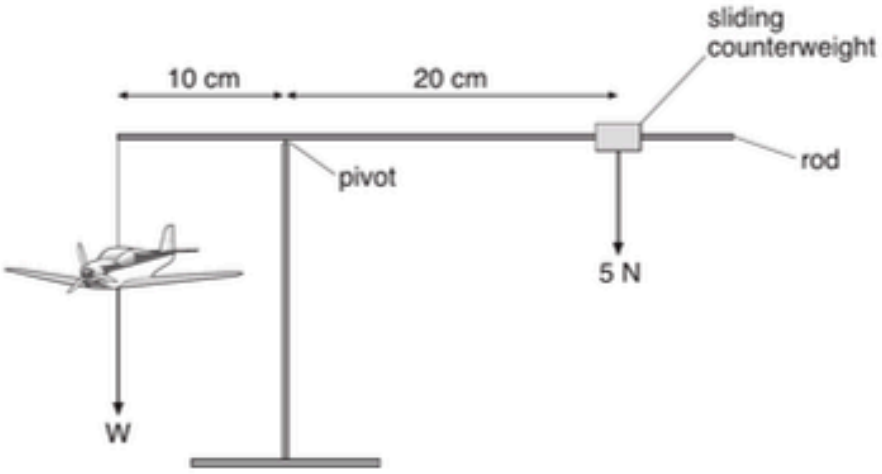
(b) What is the size of the tension (force) in string A?

14b 1 mark

_____ N

Modern Tuition

10. Zena has a model plane attached to a rod as shown below.
The plane is balanced by a sliding counterweight.



not to scale

(a) The rod is balanced horizontally.

(i) Calculate the turning moment produced by the counterweight about the pivot.
Give the unit.

10ai
1 mark

_____

_____

10ai
1 mark

(ii) What is the turning moment produced by the plane about the pivot?

10aii
1 mark

_____

(iii) Calculate the weight, W, of the plane.

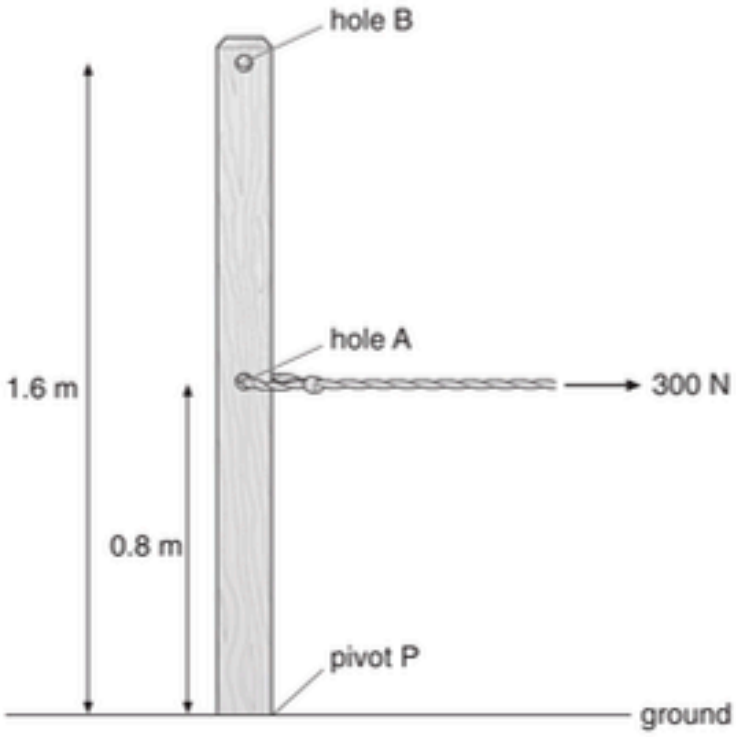
10aiii
1 mark

_____

_____ N

Modern Tuition

12. A builder tried to remove a wooden post from the ground by pulling with a rope.



(a) (i) The builder attached a rope to hole A, 0.8 m above the ground.
He pulled with a horizontal force of 300 N.

Calculate the turning moment about the pivot P.
Give the unit.

12ai
1 mark

_____

12ai
1 mark

_____

(ii) He then attached a rope to hole B, 1.6 m above the ground.
He pulled with a horizontal force.

What force would produce the same turning moment as before?

12aii
1 mark

_____ N

Modern Tuition

(b) The post breaks off and falls on the ground as shown.



The weight of the broken post is 120 N.
The area in contact with the ground is 0.2 m^2.

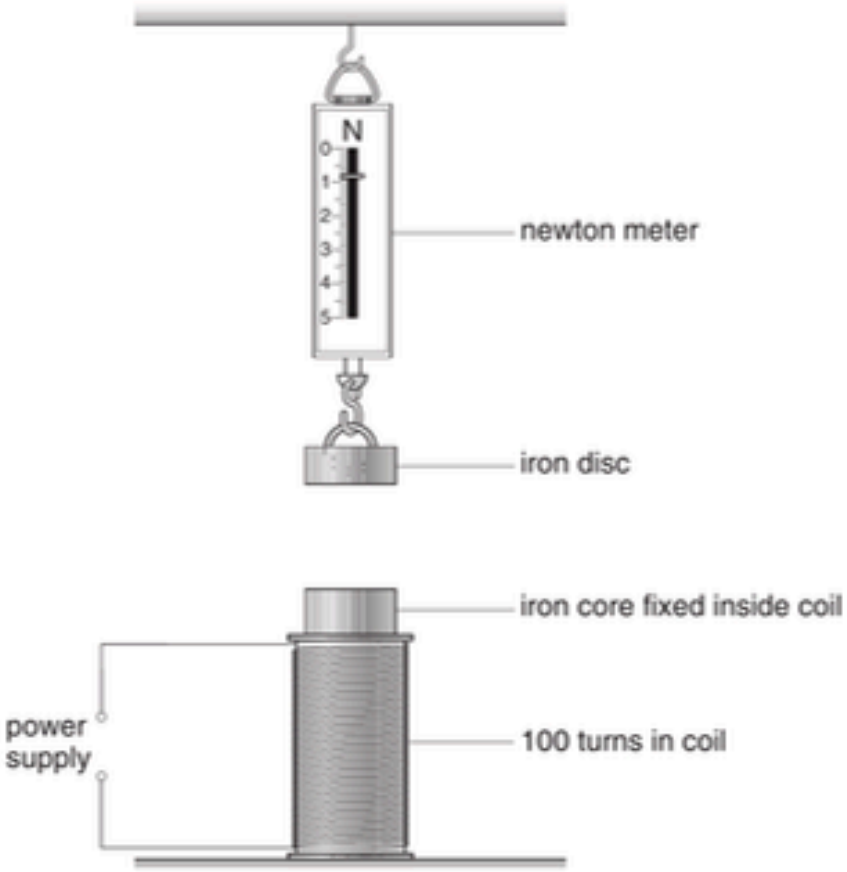
Calculate the pressure of the broken post on the ground.
Give the unit.

12b
1 mark

12b
1 mark

Modern Tuition

8. Mary used the apparatus below to test the strength of an electromagnet. She used the reading on the newton meter to measure the force of the magnet on the iron disc.



(a) Explain why the reading on the newton meter increases when a current passes through the coil.

8a
1 mark

8a
1 mark

(b) When a current passes through the coil, some of the electrical energy is changed to thermal energy.
What would happen to the coil if the current passing through it was too large?

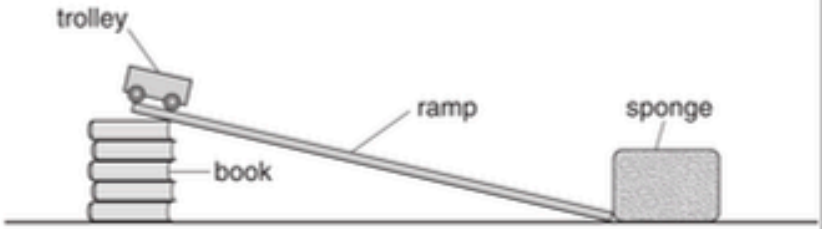
8b
1 mark

Modern Tuition

8. Yasmin investigated the stopping distance of a trolley.

She let go of the trolley.

It hit a sponge at the bottom of the ramp.



She measured how far the sponge moved.

This is the stopping distance.



(a) Yasmin did the investigation five times.
She changed the steepness of the ramp each time.

(i) How could she make this ramp steeper?

8ai

1 mark

(ii) Yasmin's results are shown in the table.

steepness of ramp	stopping distance (cm)
A	10
B	16
C	16
D	28
E	34

She predicted, 'The steeper the ramp, the greater the stopping distance'.
If Yasmin was correct, which ramp was the steepest? Write the letter.

8aii

KS3 Science SATs, Tier 3-6, Paper 1 (2008) - Q8(a)

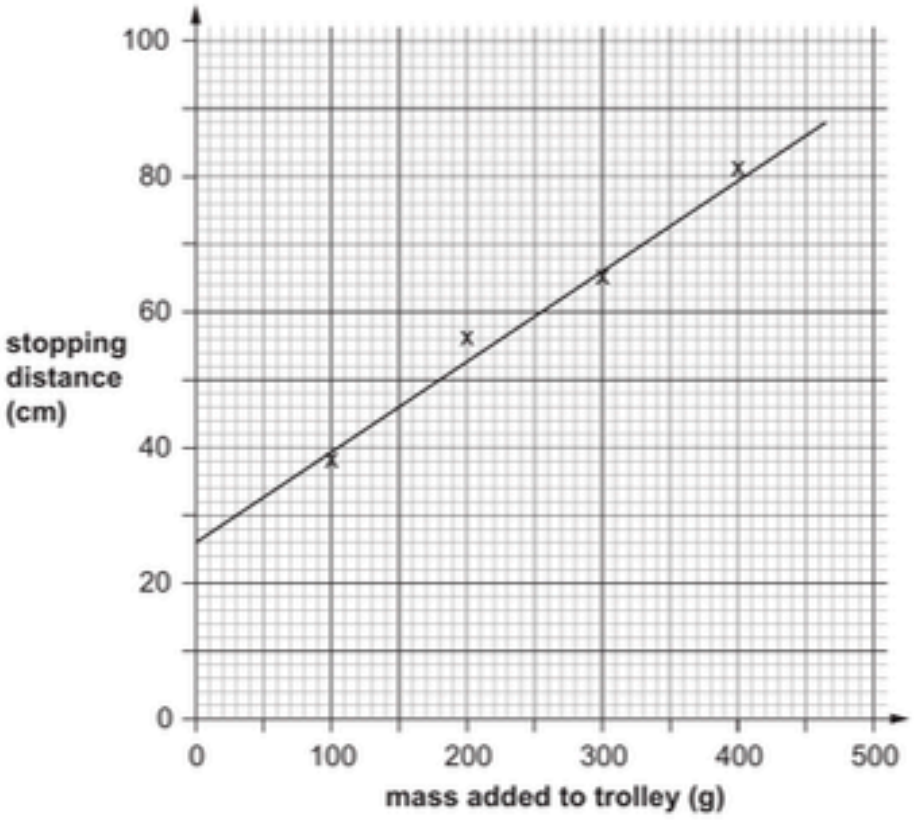
(iii) Yasmin looked at her results and decided she should repeat her investigation.
Look at Yasmin's results.

Suggest why she decided to repeat her investigation.

_____

5aiii
1 mark

(b) Yasmin then investigated the stopping distance of a trolley with different masses on it.
The graph shows her results.



(i) What would be the stopping distance if 0 g were on the trolley?

_____ cm

5bi
1 mark

(ii) Complete the sentence with **decreases**, **increases** or **stays the same**.

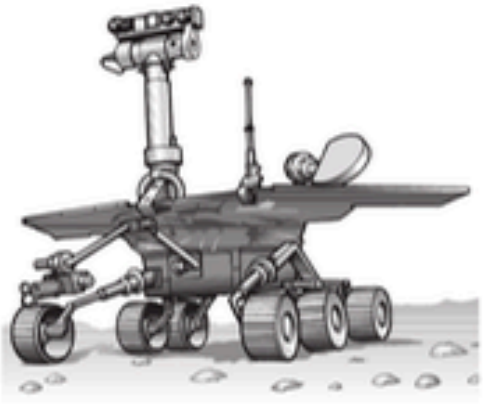
As the mass added to the trolley increases,

the stopping distance _____ .

5bii
1 mark

Modern Tuition

13. The drawing below shows a space buggy on the surface of Mars.



(a) The distance between Earth and Mars is 192 000 000 km.

It took a spacecraft 200 days to take the buggy from Earth to Mars.

Calculate the speed at which the spacecraft travelled.
Give the unit.

13a
1 mark

13a
1 mark

(b) The weight of the buggy was 105 N on Earth and 40 N on Mars.

Why was the weight of the buggy less on Mars than on Earth?

13b
1 mark

Modern Tuition

(c) The buggy uses solar panels to generate electrical energy.

The solar panels generate less electrical energy on Mars than on Earth.
Give a reason why.

_____

_____

13c
1 mark

(d) The weight of the buggy was 40 N on Mars.
When the buggy landed on Mars it rested on an area of 0.025 m^2.

Calculate the pressure exerted by the buggy on the surface of Mars.
Give the unit.

_____

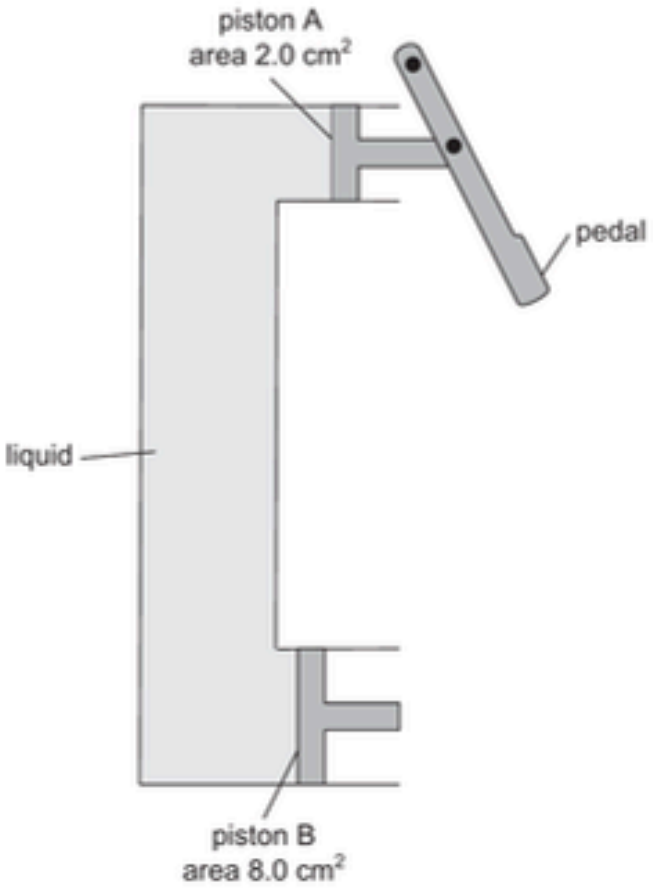
_____

13d
1 mark

13d
1 mark

Modern Tuition

10. The diagram below shows a container filled with a liquid.



At each end of the container there is a piston.
Piston A has a smaller area than piston B.

(a) (i) Rebekah pushes on the pedal. This produces a force of 200 N on piston A.

Calculate the pressure that piston A exerts on the liquid.
Give the unit.

10ai
1 mark

10ai
1 mark

(ii) The liquid in the container exerts the same pressure on piston B.

Use this pressure to calculate the force on piston B.

10aii

N

Modern Tuition

9. Jenny put a spring over a wooden rod.

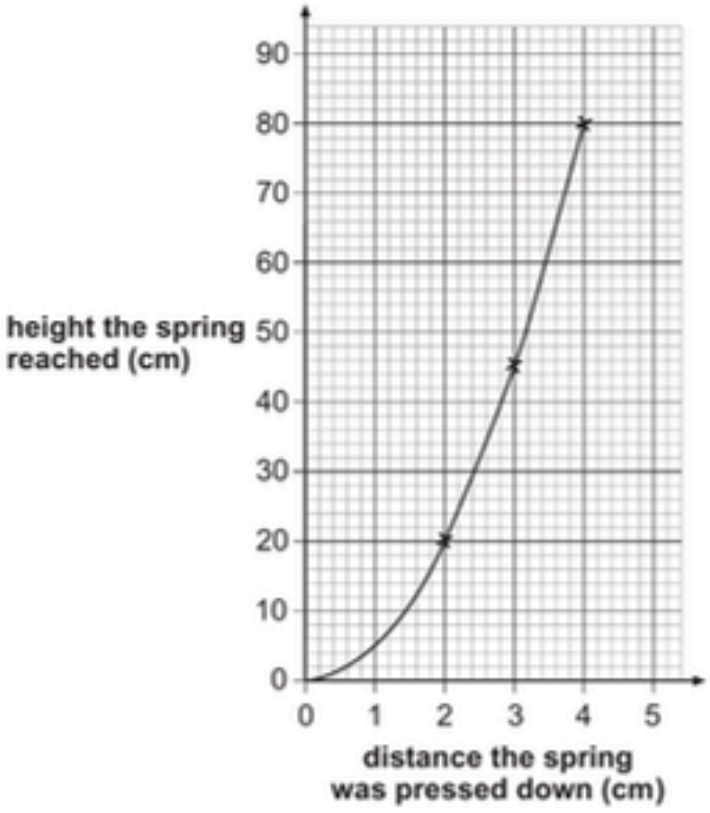
She pressed the spring down 2 cm.

She let go of the spring and measured the height it reached.



not to scale

Jenny repeated her experiment. She pressed the spring down more each time. Her results are shown in the graph below.



Modern Tuition

(a) Use Jenny's graph to complete the table below.

distance the spring was pressed down (cm)	height the spring reached (cm)
2	
3	
4	

1 mark

(b) Jenny said, 'If I double the distance I press the spring down, the height it reaches will also double'.

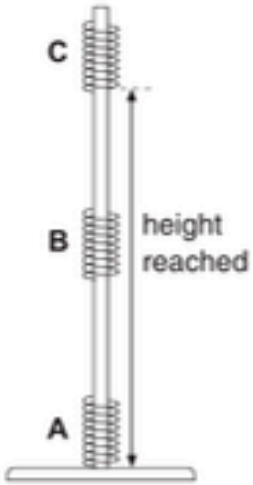
How do the results show she was wrong?

_____

_____

1 mark

(c) This diagram shows the moving spring in three different positions.



Complete the sentences below by choosing words from the box.
You can use each word more than once.

most	some	least

(i) When the spring is moving at **B** it has _____ kinetic energy and _____ gravitational potential energy.

1 mark

(ii) When the spring reaches **C** it has _____ gravitational potential energy and _____ kinetic energy.

1 mark

(iii) When the spring stops at **A** it has _____ kinetic energy and _____ gravitational potential energy.

1 mark

Modern Tuition

13. Oliver clamped a wooden plank to a desk. There was a 40 cm overhang as shown in diagram 1.

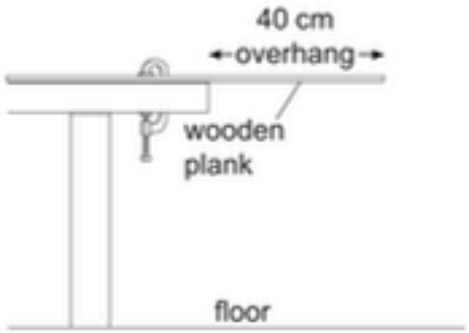


diagram 1

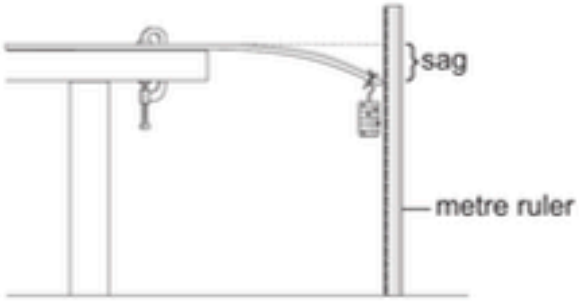
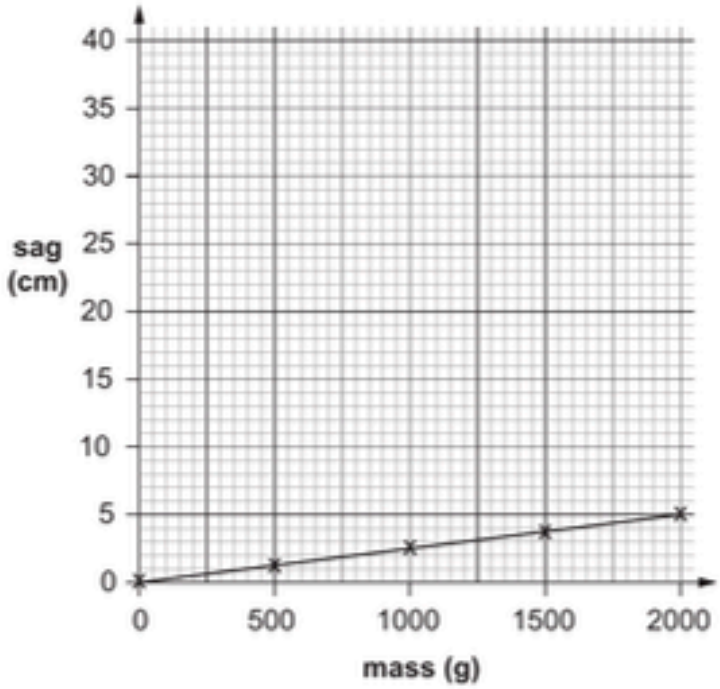


diagram 2

Oliver added masses to the end of the wooden plank as shown in diagram 2.
He measured the sag.
The graph below shows his results.



(a) What measurements would Oliver need to take to work out the sag?

_____

_____

Modern Tuition

(b) Oliver repeated his test with a new plank with an 80 cm overhang.
His results are shown below.

mass (g)	sag (cm)
0	1.0
500	15.0
1000	25.0
1500	31.0
2000	35.0

(i) Plot the results from Oliver's second test on the grid opposite.
Use the points to draw a line of best fit.

13bi
1 mark

(ii) In the second test the plank sagged with **no** mass added to it.
Explain what caused this sag.

13bi
1 mark

13bii
1 mark

(c) Compare the results of Oliver's two tests.

(i) How are the results **similar** for each test?

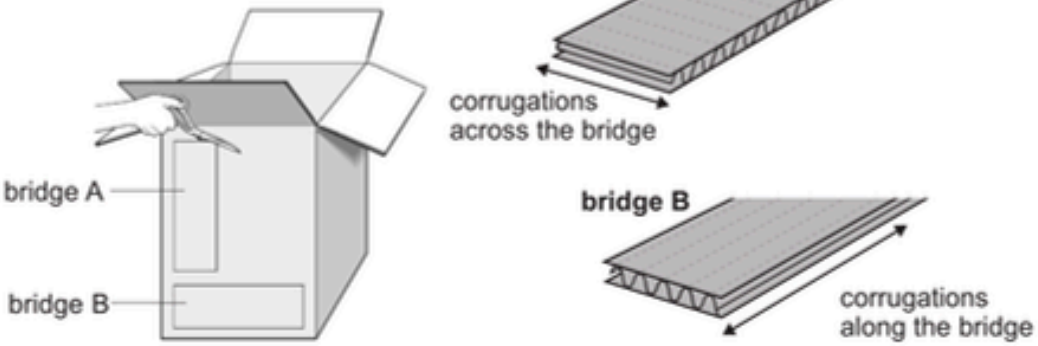
13ci
1 mark

(ii) How are the results **different** in the second test?

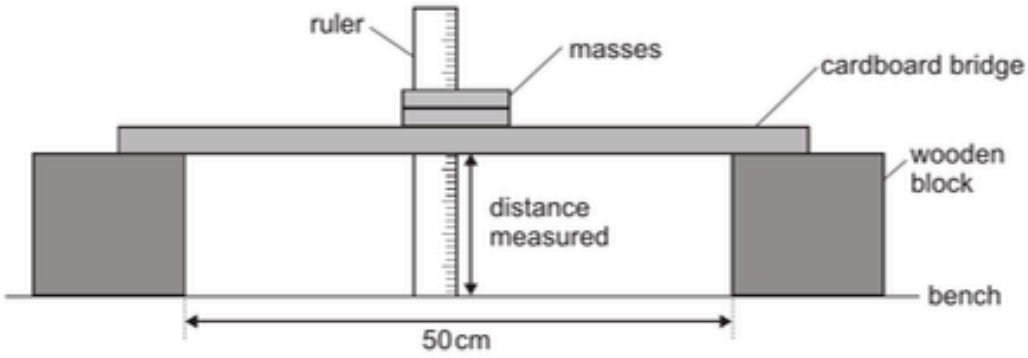
13cii
1 mark

Modern Tuition

13. Joe makes two bridges from strips of cardboard cut as shown.



Joe tests the bridges by adding masses to them. He measures the distance from the bench to the bottom of each bridge for different masses as shown.



13a
1 mark

(a) Suggest **two** things Joe must do to make his test fair.

1. _____

13a
1 mark

2. _____

Here are Joe's results.

mass added to bridge (g)	distance from bench to bottom of bridge (cm)	
	bridge A	bridge B
0	7.2	7.2
100	7.1	7.0
200	7.0	6.5
250	6.8	6.1
300	3.0	5.6
350	0.0	5.0

Modern Tuition