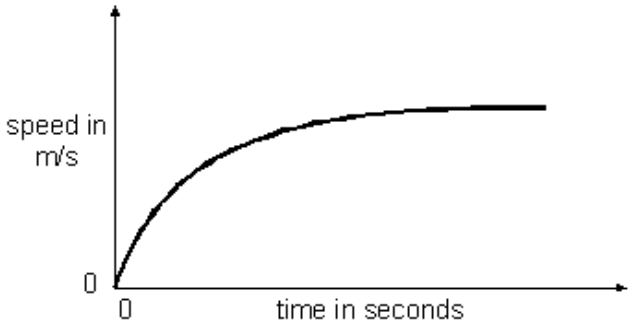
7.3.10 Change in movement

38 minutes

53 marks

Q1. The graph shows the results of a test in which a car accelerates to its maximum speed.



(a) (i) Describe how the acceleration of the car changes after the car has started to move.

.....

.....

1 mark

(ii) How does the **resultant** force on the car change?

.....

.....

1 mark

The car has a mass of 1000 kg and the maximum forward force on the car, produced by the engine, is 4000 N.

It is claimed that the car will accelerate from 0 to 24 m/s in 6 seconds.

(b) Use calculations, with the correct units, to show that the claim is false.

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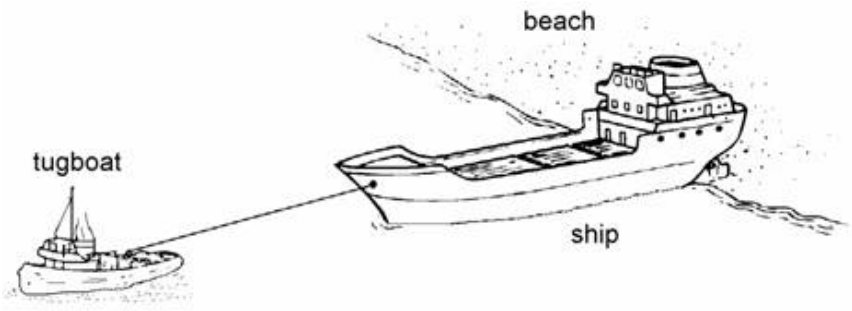
3 marks
Maximum 5 marks

##

In a storm, a small ship was blown onto a beach. Now it is calm and there is no wind. A tugboat is trying to pull the ship off the beach.



(a) The tugboat pulls the ship with a force of 25 000 N.

The ship does not move because of the force of friction acting on it.

(i) Tick **one** box to show the size of the frictional force acting on the ship.

zero	☐
more than zero but less than 25 000 N	☐
25 000 N	☐
more than 25 000 N	☐

1 mark

(ii) Add an arrow to the drawing to show the direction of the frictional force acting on the ship.

1 mark

(b) When the tide is higher, the tugboat again pulls the ship with a steady force of 25 000 N. The ship begins to move.

Once the ship is off the beach, the tugboat continues to pull the ship with a force of 25 000 N.
A frictional force due to the water acts on the ship.

(i) At first, the speed of the ship increases.

Tick **one** box to describe the frictional force acting on the ship while its speed is increasing.

- zero ☐
- more than zero but less than 25 000 N ☐
- 25 000 N ☐
- more than 25 000 N ☐

1 mark

(ii) After a short while, the ship reaches a steady speed. The tugboat continues to pull with a force of 25 000 N.

Tick **one** box to describe the frictional force acting on the ship while it is going at a steady speed.

- zero ☐
- more than zero but less than 25 000 N ☐
- 25 000 N ☐
- more than 25 000 N ☐

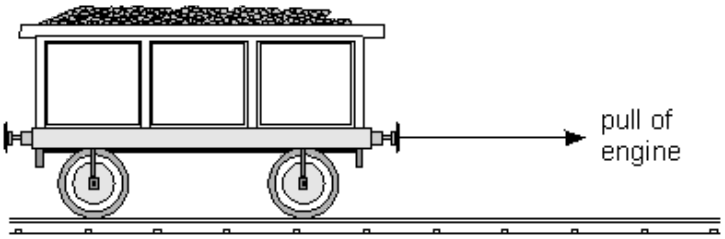
1 mark

(iii) The ship is towed to the north. What is the direction of the frictional force acting on the ship?

.....

1 mark
Maximum 5 marks

Q3.



(a) A railway engine is being used to try to pull a wagon along a level track. The wagon's brakes are on, and the wagon does not move.

(i) Draw **one** arrow on the diagram to show the direction of the force which prevents the wagon from moving.

1 mark

(ii) Is the force which prevents the wagon from moving **greater than**, **equal to** or **less than** the pull of the engine?

.....

1 mark

(b) (i) When the wagon's brakes are off, the engine pulls the wagon forwards. A frictional force also acts on the wagon. In what direction does the frictional force act?

1 mark

(ii) The pull of the engine is 5000 N. When the wagon's speed is increasing, how large is the frictional force?
Tick the correct box.

zero	☐
between 0 and 5000 N	☐
5000 N	☐
more than 5000 N	☐

1 mark

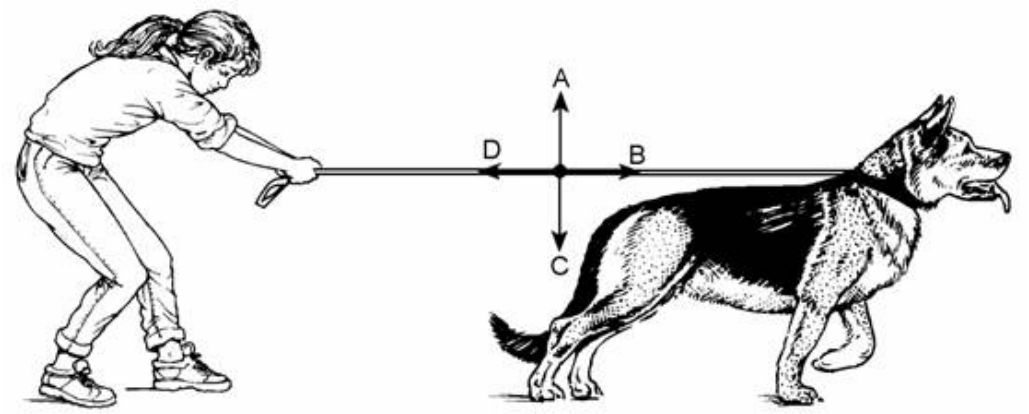
(c) After a while, the wagon travels at a steady speed. The engine is still pulling with a force of 5000 N.

How large is the frictional force now?
Tick the correct box.

zero	☐
between 0 and 5000 N	☐
5000 N	☐
more than 5000 N	☐

1 mark
Maximum 5 marks

Q4.



(a) Megan's dog is pulling on his lead.
Which arrow, A, B, C or D, shows the direction of this force?
Give the letter.

.....

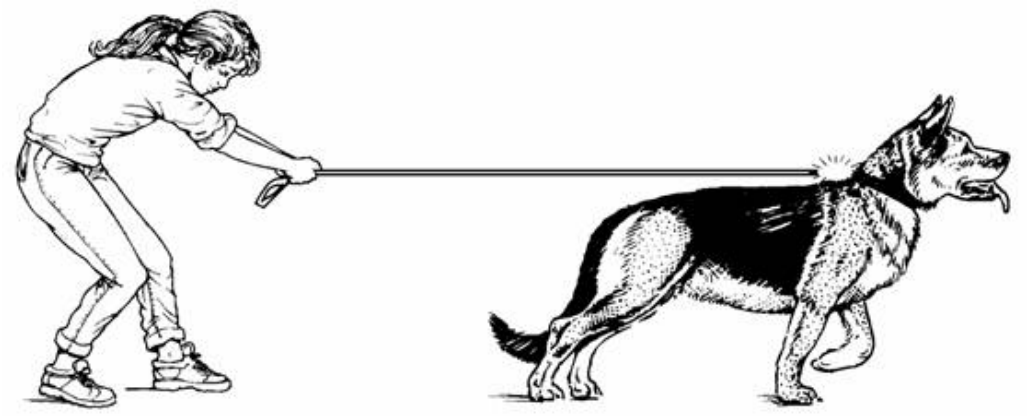
1 mark

(b) Megan has to pull to keep the dog still.
Which arrow shows the direction of this force? Give the letter.

.....

1 mark

(c) Suddenly the dog's collar breaks.



(i) When the collar breaks, the lead moves.
Draw an arrow on the diagram to show which way the lead starts to move.

1 mark

(ii) Why does the lead move when the collar breaks?

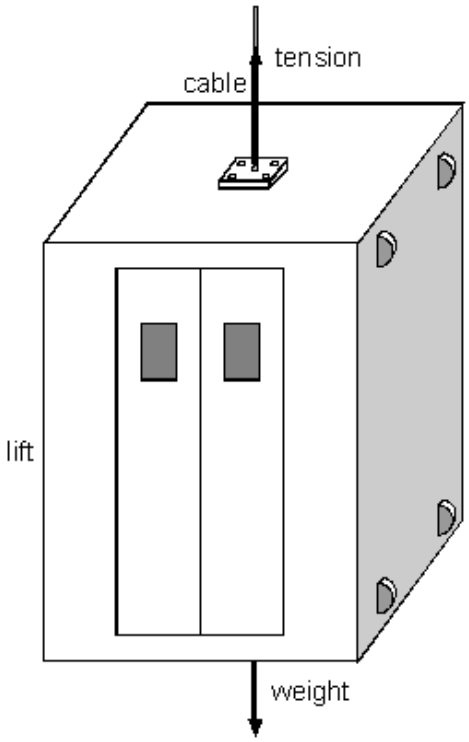
.....

.....

1 mark
Maximum 4 marks

##

The lift in a tall building hangs from a strong cable. The movement of the lift is affected by only two forces.
These forces are the **tension** in the cable and the **weight** of the lift.



(a) The lift is **not** moving. How do the sizes of the two forces compare?
Tick the correct box.

The tension is greater than the weight.	☐
The tension equals the weight.	☐
The tension is less than the weight.	☐
It is impossible to know which is greater.	☐

1 mark

(b) When the lift is moving upwards and its speed is increasing, how do the sizes of the two forces compare?

.....

1 mark

(c) When the lift is moving upwards at a constant speed, how do the sizes of the two forces compare?

.....

1 mark

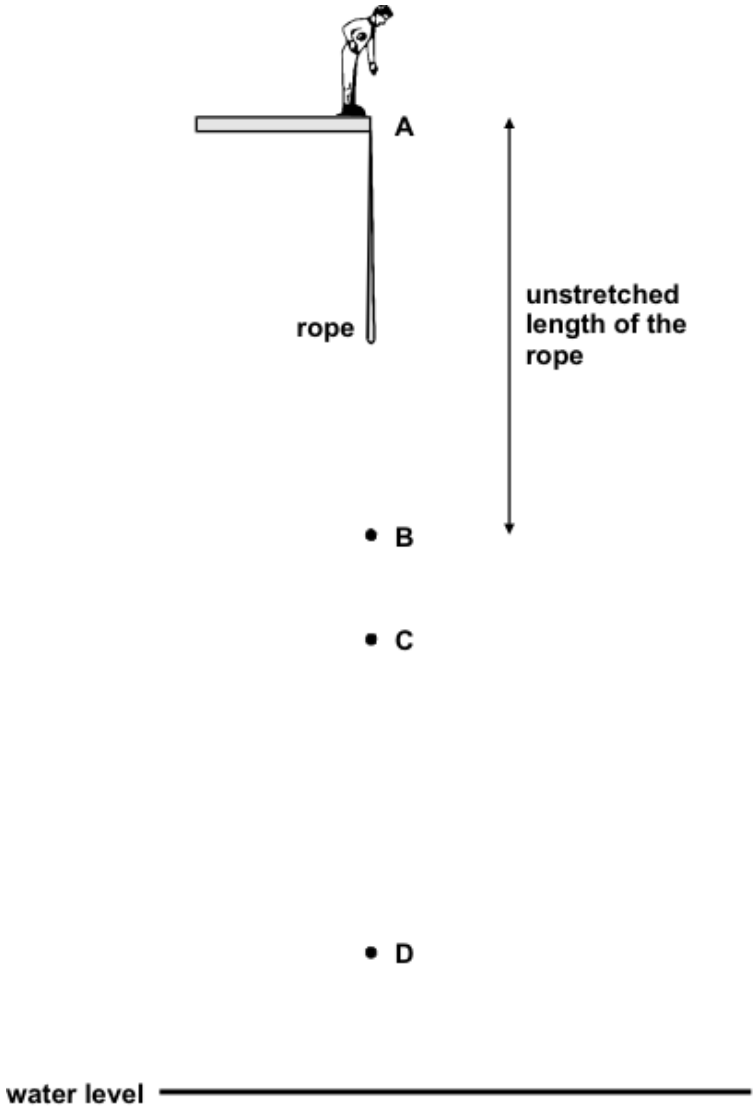
(d) Near the top of the building the lift is moving upwards, but slowing down. How do the sizes of the two forces now compare?

.....

1 mark
Maximum 4 marks

##

A man does a 'bungee jump' over a lake. He jumps from point A with an elasticated rope tied to his ankles. The rope reaches down to point B when it is not being stretched.



The man falls past B, and the rope begins to stretch. He falls past point C to point D, which is the lowest point he reaches. Then he begins to move upwards again. Eventually he comes to rest at point C.

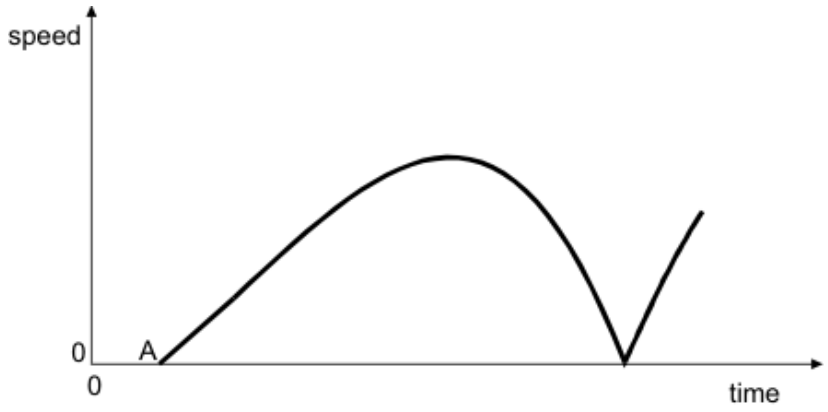
(a) (i) At which point, A, B, C or D, is the man when the tension in the rope is greater than his weight? .....

1 mark

(ii) At which point, A, B, C or D, is the man when the tension in the rope is equal to his weight? .....

1 mark

(b) The graph shows how the man's speed varies with time as he falls from point A to point D and bounces back upwards.



The point when the man jumped from A has been labelled on the curve.
Label the points on the curve when the man was at points B, C and D as he fell.

3 marks

(c) The total energy of the man and the rope includes the man's potential energy, his kinetic energy, and the elastic (strain) energy stored in the stretched rope.

Describe how the elastic (strain) energy in the rope changes as the man falls from point A to point D.

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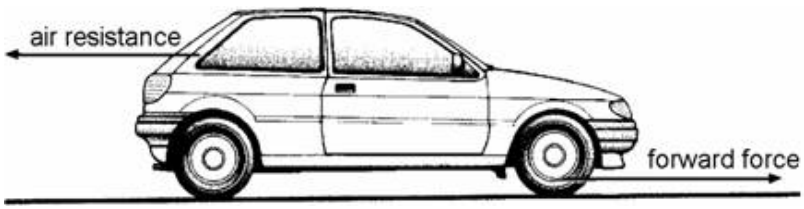
2 marks
Maximum 7 marks

Q7. When a car is being driven along, two horizontal forces affect its motion. One is air resistance and the other is the forward force.



(a) (i) Explain how molecules in the air cause air resistance.

.....

.....

1 mark

(ii) Explain why air resistance is larger when the car is travelling faster.

.....

.....

1 mark

(b) (i) Compare the sizes of the forward force and the air resistance when the car is speeding up.

The forward force is .....

.....

1 mark

(ii) Compare the sizes of the two forces while the car is moving at a steady 30 miles per hour.

The forward force is .....

.....

1 mark

(c) The forward force has to be larger when the car is travelling at a steady 60 mph than when it is travelling at a steady 30 mph. Why is this?

.....

.....

1 mark

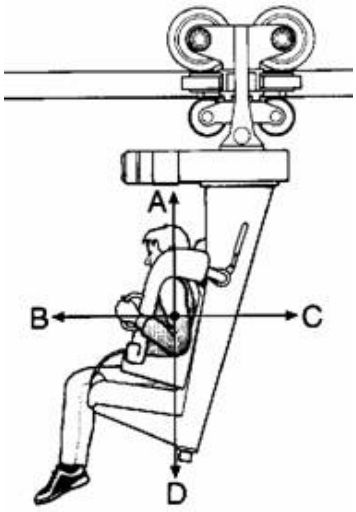
(d) The forward force is the result of the tyres **not** being able to spin on the road surface. What is the name of the force that stops the tyres spinning?

.....

1 mark

Maximum 6 marks

Q8. (a) The diagram shows Alan sitting on a ride at a theme park.



(i) Which arrow shows Alan's weight?

Give the correct letter. .....

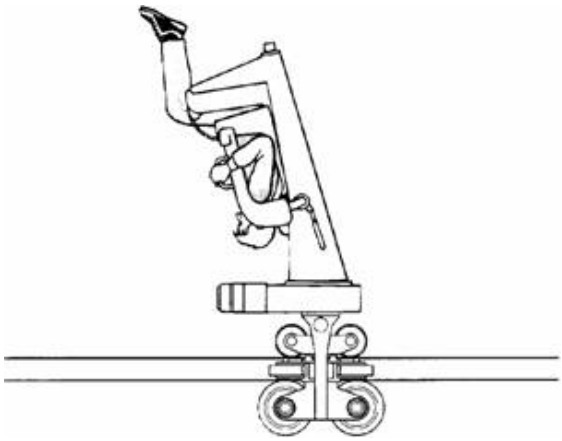
1 mark

(ii) Alan begins to move forwards. Which arrow shows the force which makes Alan move faster?

Give the correct letter. .....

1 mark

(b) During the ride, Alan is upside down.



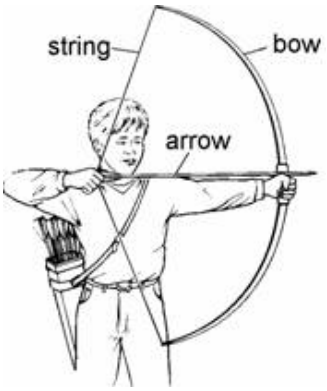
Draw an arrow on the diagram to show the direction of Alan's weight while he is upside down.

1 mark

Maximum 3 marks

##

The drawing shows a boy with a bow and arrow. He is holding the **arrow** and pulling it back.



(a) Two horizontal forces act on the arrow. These are the force exerted by the boy's hand and the force exerted by the string. The arrow is **not** moving.

The boy pulls the arrow with a force of 150 N. What is the size of the force exerted by the string on the arrow?

..... N

1 mark

(b) When the boy lets go of the arrow, it starts to move forward.

Explain why it starts to move.

.....

.....

1 mark

(c) The arrow flies across a field and hits a target.

Two forces act on the arrow while it is in the air. Air resistance acts in the opposite direction to the movement, and gravity acts downwards. These two forces **cannot** balance each other, even when they are the same size. Why is this?

.....

.....

1 mark

(d) The arrow has a sharp pointed end. When the arrow hits the target, the sharp point exerts a very large pressure on the target.

Why does a sharp pointed end exert a larger pressure than a blunt end?

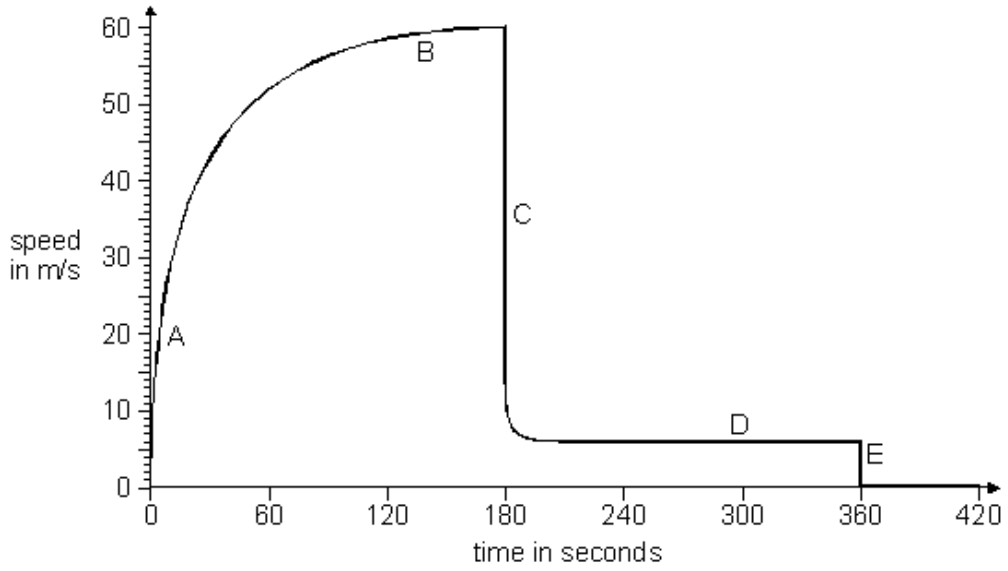
.....

.....

1 mark

Maximum 4 marks

Q10. A sky-diver jumped out of an aeroplane. After falling for some time she opened her parachute. The graph below shows how the speed of the sky-diver changed from the moment she jumped out of the aeroplane until she landed on the ground.



(a) What happened at 180 seconds and at 360 seconds after the sky-diver jumped out of the aeroplane?

180 seconds ……..

360 seconds ……..…….

2 marks

(b) There was an increase in air resistance on the sky-diver as her speed increased. Explain how the graph shows this.

…….

…….

1 mark

(c) Two sections of the graph show where the air resistance was equal and opposite to the sky-diver's weight. Which sections are they?

Give the letters.

…… and …….

1 mark

(d) (i) Use the graph to estimate how far the sky-diver fell between 180 s and 360 s.

……

……

1 mark

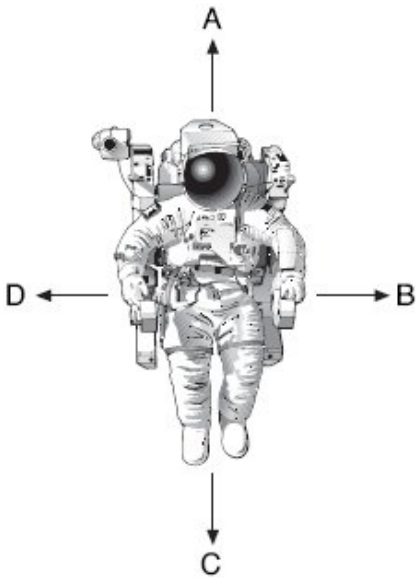
(ii) Why can this only be an approximate figure?

……

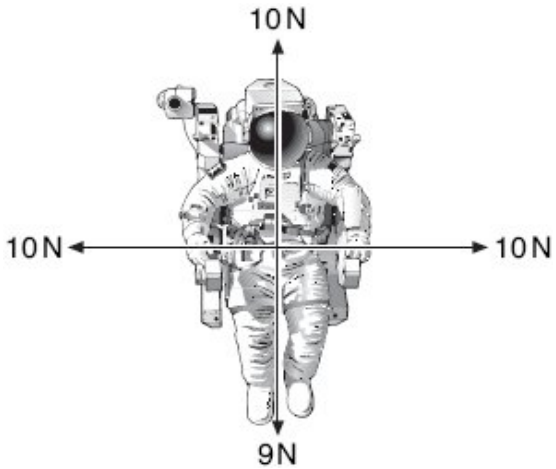
……

1 mark
Maximum 6 marks

Q11. 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.



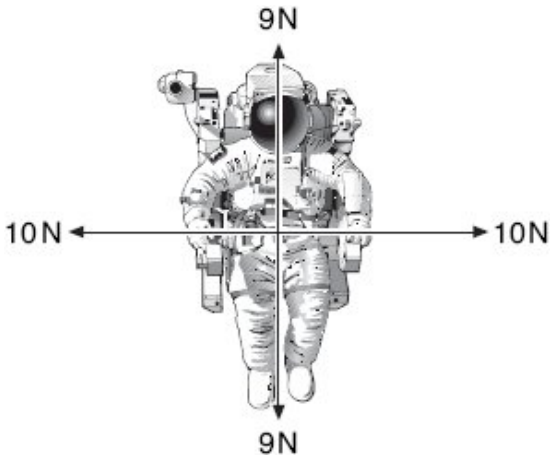
In which direction, A, B, C or D, will the astronaut move?

Give the letter.

.....

1 mark

(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?

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1 mark

Explain your answer.

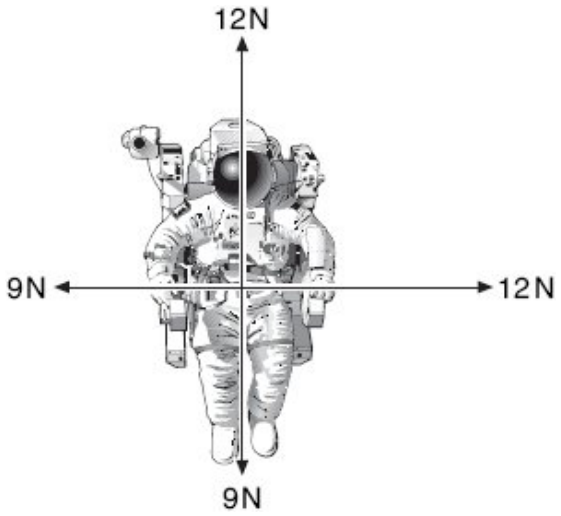
.....

.....

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.



1 mark
maximum 4 marks