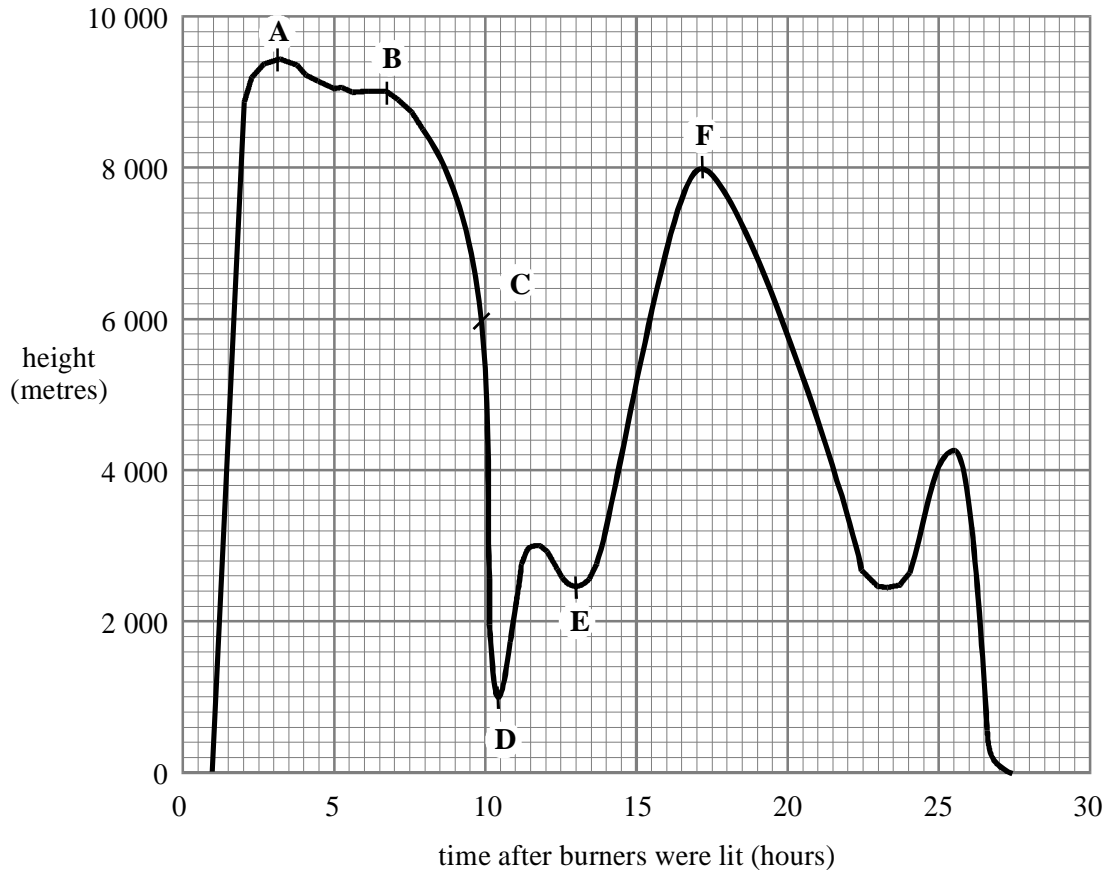


**Forces and their effects**

1. A hot air balloon called Global Challenger was used to try to break the record for travelling round the world.

The graph shows how the height of the balloon changed during the flight.



The balloon took off from Marrakesh one hour after the burners were lit and climbed rapidly.

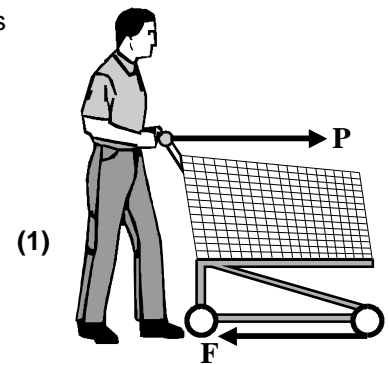
- (a) Use the graph to find:
- (i) the maximum height reached.  
Maximum height ..... metres.
  - (ii) the total time of the flight.  
Total time ..... hours.
- (2)
- (b) Several important moments during the flight are labelled on the graph with the letters **A**, **B**, **C**, **D**, **E** and **F**. At which of these moments did the following happen?
- (i) The balloon began a slow controlled descent to 2500 metres. ....
  - (ii) The crew threw out all the cargo on board in order to stop a very rapid descent .....  
.....
  - (iii) The balloon started to descend from 9000 metres. ....

(3)  
(Total 5 marks)

2. (a) A shopping trolley is being pushed at a constant speed. The arrows represent the horizontal forces on the trolley.

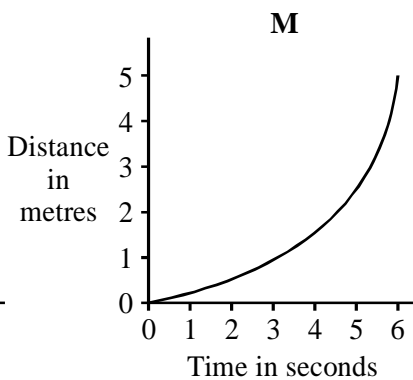
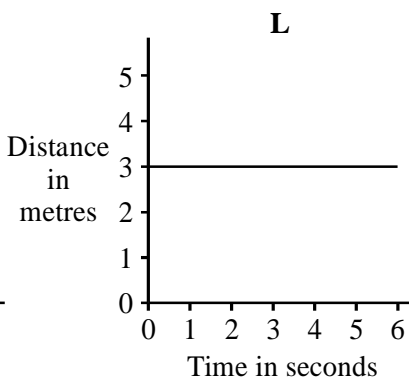
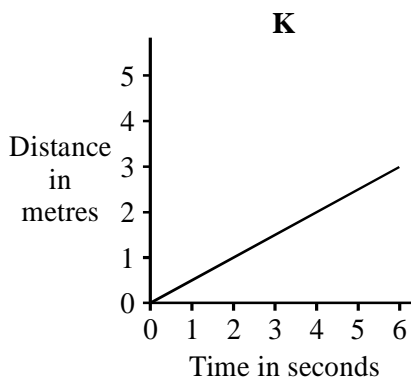
(i) How big is force **P** compared to force **F**?

.....



(1)

(ii) Which **one** of the distance-time graphs, **K**, **L** or **M**, shows the motion of the trolley? Draw a circle around your answer.



(1)

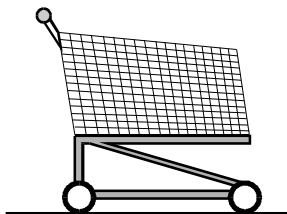
(b) Complete the sentence by crossing out the **two** words in the box that are wrong.

Acceleration is the rate of change of

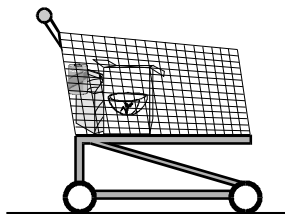
- |                                |
|--------------------------------|
| energy.<br>speed.<br>velocity. |
|--------------------------------|

(1)

(c) Three trolleys, **A**, **B** and **C**, are pushed using the same size force. The force causes each trolley to accelerate.



**A**



**B**



**C**

Which trolley will have the smallest acceleration?

.....

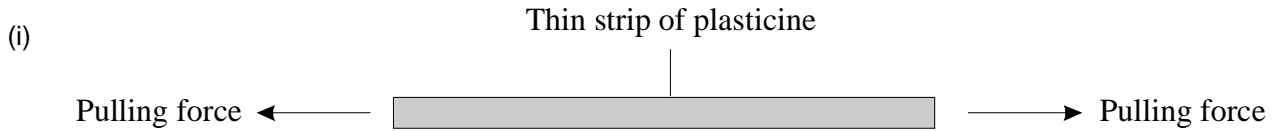
Give a reason for your answer.

.....

(2)

(Total 5 marks)

3. (a) The diagrams below show pairs of forces acting on different objects. In each case describe what happens when the forces are increased. Then describe what happens when the forces are removed.



When the forces are increased

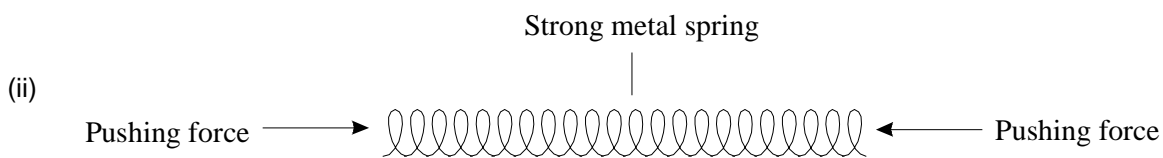
.....

.....

When the forces are removed

.....

.....



When the forces are increased

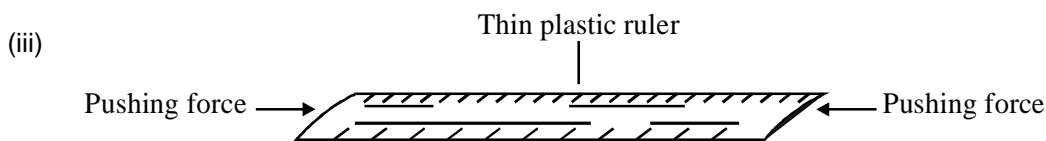
.....

.....

When the forces are removed

.....

.....



When the forces are increased

.....

.....

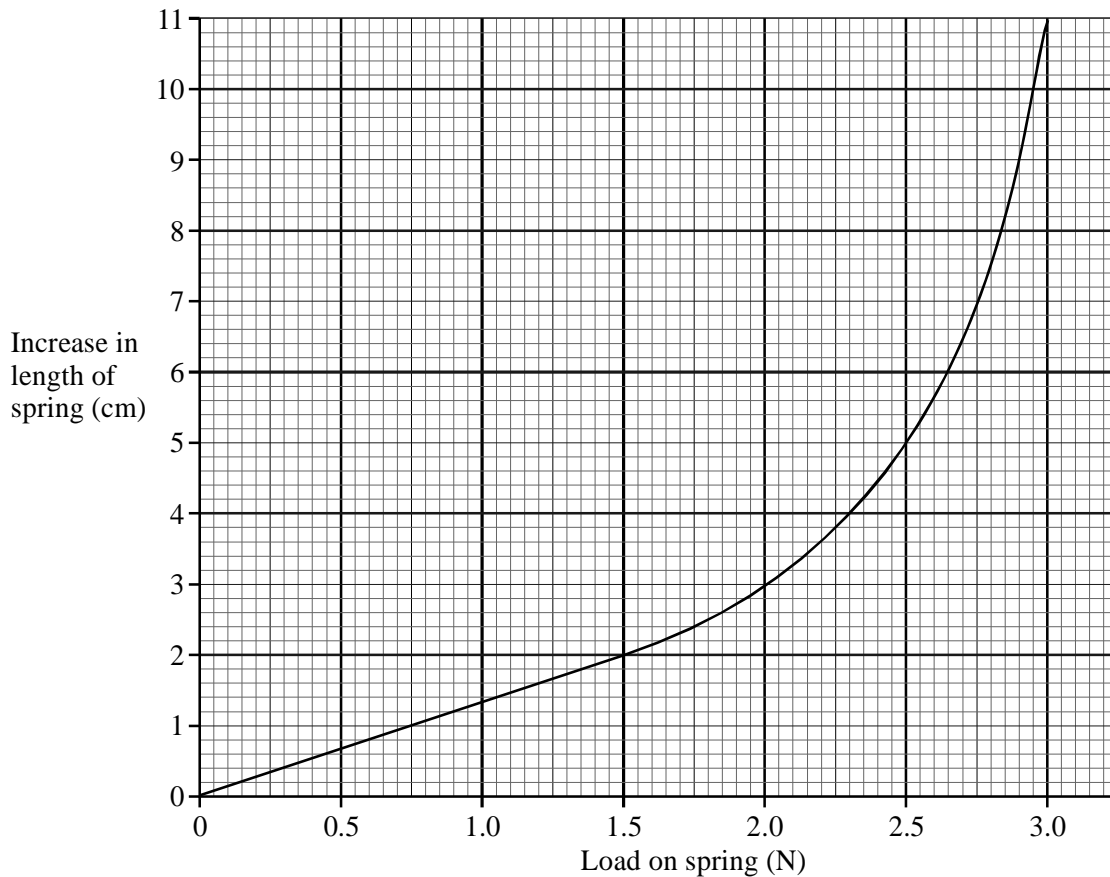
When the forces are removed

.....

.....

(6)

(b) The graph shows the increase in length of a spring against **load** (force).



The length of the spring with no load was 15 cm.

Use the graph to find:

(i) The load needed to produce an increase in length of 2 cm.

.....

(ii) The increase in length produced by a load of 2.3 N.

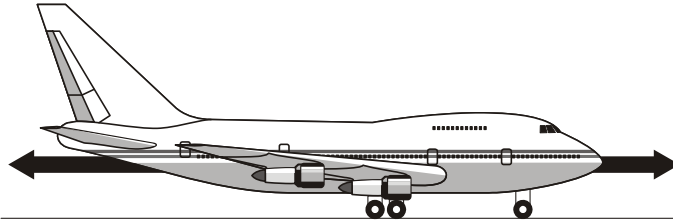
.....

(iii) The **length** of the spring when the load was 2.3 N.

.....

(3)  
(Total 9 marks)

4. (a) The diagram shows an aircraft and the horizontal forces acting on it as it moves along a runway. The resultant force on the aircraft is zero.



- (i) What is meant by the term *resultant force*?

.....  
 .....

(1)

- (ii) Describe the movement of the aircraft when the resultant force is zero.

.....  
 .....

(1)

- (b) The aircraft has a take-off mass of 320 000 kg. Each of the 4 engines can produce a maximum force of 240 kN.

Use the equation in the box to calculate the maximum acceleration of the aircraft.

resultant force = mass × acceleration
---------------------------------------

Show clearly how you work out your answer and give the unit.

.....  
 .....

Acceleration = .....

(3)

- (c) As the aircraft moves along the runway to take off, its acceleration decreases even though the force from the engines is constant.

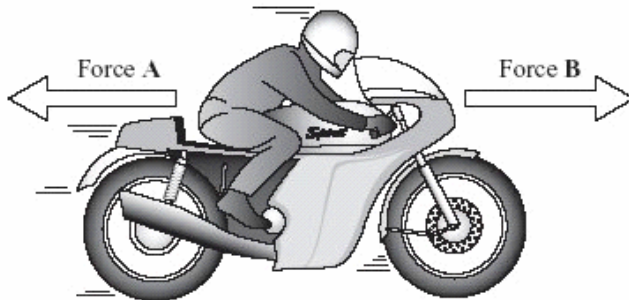
Explain why.

.....  
 .....

(2)

(Total 7 marks)

5. (a) The diagram shows the horizontal forces that act on a **moving** motorbike.



- (i) Describe the movement of the motorbike when force **A** equals force **B**.

.....  
 .....

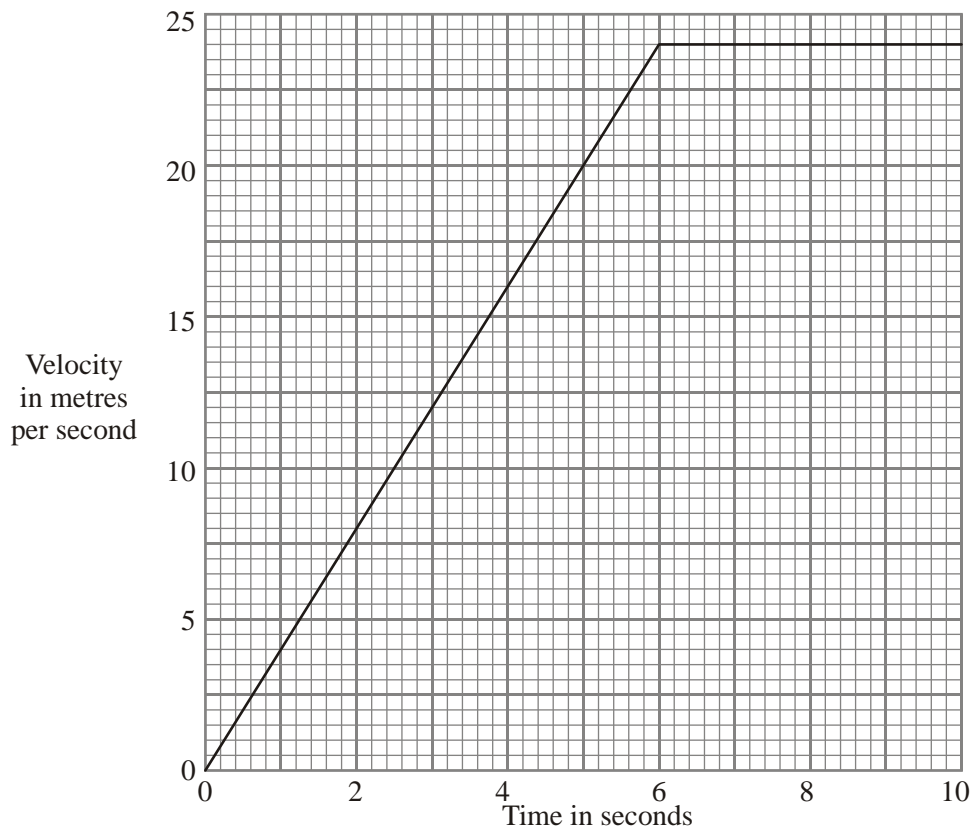
(2)

- (ii) What happens to the speed of the motorbike if force **B** becomes smaller than force **A**?

.....

(1)

- (b) The graph shows how the velocity of a motorbike changes when it is travelling along a straight road.



(i) What was the change in velocity of the motorbike in the first 5 seconds?  
..... (1)

(ii) Write down the equation which links acceleration, change in velocity and time taken.  
..... (1)

(iii) Calculate the acceleration of the motorbike during the first 5 seconds.  
Show clearly how you work out your answer and give the unit.  
.....  
.....  
Acceleration = ..... (3)

(c) A car is travelling on an icy road.  
Describe and explain what might happen to the car when the brakes are applied.  
.....  
.....  
.....  
..... (2)

(d) Name **three** factors, other than weather conditions, which would increase the overall stopping distance of a vehicle.  
1 .....  
.....  
2 .....  
.....  
3 .....  
..... (3)

(Total 13 marks)