

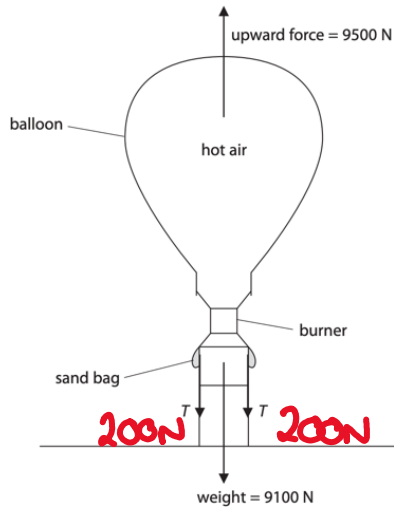
Task 3: Mechanics 2 - answers

Monday, 13 April 2020 11:14

3 A hot-air balloon is tied to the ground by two ropes.

The diagram shows the forces acting on the balloon.

The tension T in each rope is 200 N.



The ropes are untied and the balloon starts to move upwards.

(a) State the value of the force acting downwards on the balloon immediately after the ropes are untied and before the balloon starts moving.

(1)

force downwards = 9100 N

(b) (i) State the relationship between unbalanced force, mass and acceleration.

(1)

$$F = ma$$

(ii) The balloon has a total mass of 910 kg.

The initial unbalanced force on the balloon is 400 N upwards.

Calculate the initial acceleration.

(2)

$$F = ma \quad a = \frac{F}{m} = \frac{400}{910}$$

initial acceleration = 0.44 m/s²

(c) Explain how the upward acceleration of the balloon changes during the first few seconds of its flight.

(3)

As balloon accelerates upwards speed increases so drag increases!

The unbalanced force upwards decreases and so acceleration decreases!

(d) While the balloon is still accelerating, the pilot controls the balloon by pouring some sand from the bags.

Explain how this affects the upward acceleration of the balloon.

(2)

pouring sand reduces weight force downwards.

This increases the unbalanced force upwards and acceleration upwards increases!

(Total for Question 3 = 9 marks)

(a) The mass of the skydiver is 70 kg.

(i) State the equation linking weight, mass and g .

(1)

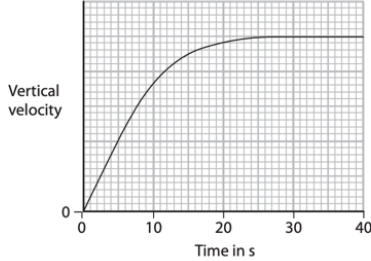
$Weight = mg$

(ii) Calculate the weight of the skydiver and state the unit.

(2)

70×9.81
 weight = 687 unit N

(b) The graph shows the vertical velocity of the skydiver during the first 40 s of the fall. His parachute is not open during this time.



Explain the shape of the graph.

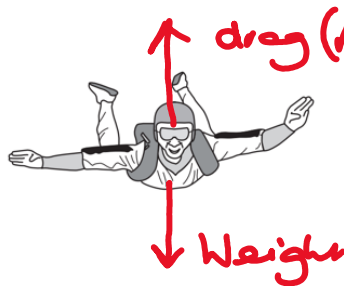
(4)

Between $0 \rightarrow 10$ secs, vertical velocity increases.
 Weight force down is greater than drag up \rightarrow skydiver accelerates down
 As velocity increases, drag increases
 So eventually weight = drag, no unbalanced force
 So no acceleration \rightarrow constant velocity \rightarrow flat line at 25 seconds!

(c) The diagram shows the skydiver falling at a constant velocity.

(3)

Add two labelled arrows to the diagram to represent the forces acting on the skydiver.

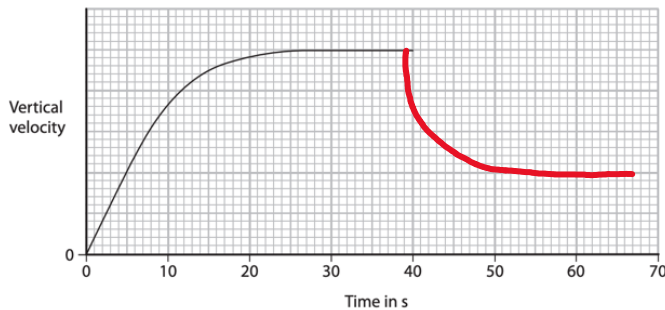


Arrows same length to show they balance

(d) The skydiver opens his parachute after 40 s.

Continue the line on the graph to show how the skydiver's vertical velocity changes and reaches terminal velocity.

(2)



(Total for Question 1 = 12 marks)