SUVAT 001 worked

20 November 2020 15:08

3 (a) A small stone is dropped from a height of 25 metres above the ground.

(i) Find the time taken for the stone to reach the ground. *(2 marks)*

(ii) Find the speed of the stone as it reaches the ground. *(2 marks)*

(b) A large package is dropped from the same height as the stone. Explain briefly why the time taken for the package to reach the ground is likely to be different from that for the stone. *(2 marks)*

$s = 25m \quad t = ? \quad v = ? \quad u = 0 \quad g = 9.81\,m/s^2$

$s = ut + \frac{1}{2}at^2 \Rightarrow \sqrt{\frac{2s}{a}} = t = 2.26s$

$v^2 = u^2 + 2as \Rightarrow v = 22.14\,m/s$

b) should be the same time but the surface area of a package is large so air resistance will produce a small force upwards.

2 A lift rises vertically from rest with a constant acceleration.

After 4 seconds, it is moving upwards with a velocity of $2\,m\,s^{-1}$.

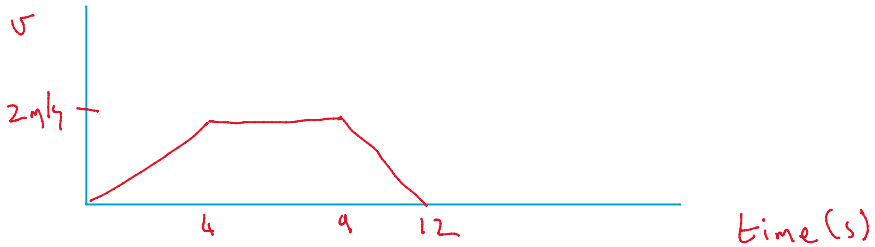
It then moves with a constant velocity for 5 seconds.

The lift then slows down uniformly, coming to rest after it has been moving for a total of 12 seconds.

(a) Sketch a velocity–time graph for the motion of the lift. *(4 marks)*

(b) Calculate the total distance travelled by the lift. *(2 marks)*

(c) The lift is raised by a single vertical cable. The mass of the lift is 300 kg. Find the maximum tension in the cable during this motion. *(4 marks)*



b) area $= \frac{1}{2}4\times2 + 5\times2 + \frac{1}{2}3\times2 = 17m$

c) will be in first section where accel $= \frac{\Delta v}{\Delta t} = \frac{2}{4}$

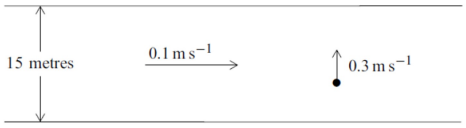
$= 0.5\,m/s^2$

Also have to overcome the $-9.81\,m/s^2$ (downwards) from g: $\therefore$ total accel $= 10.31\,m/s^2$

This requires a force $\Rightarrow F = ma = 300\times10.31$

This is the tension. $= 3093\,N$

5 A girl in a boat is rowing across a river, in which the water is flowing at $0.1\,\text{m s}^{-1}$. The velocity of the boat relative to the water is $0.3\,\text{m s}^{-1}$ and is perpendicular to the bank, as shown in the diagram.



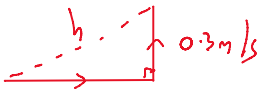
(a) Find the magnitude of the resultant velocity of the boat. *(2 marks)*

(b) Find the acute angle between the resultant velocity and the bank. *(3 marks)*

(c) The width of the river is 15 metres.

(i) Find the time that it takes the boat to cross the river. *(2 marks)*

(ii) Find the total distance travelled by the boat as it crosses the river. *(2 marks)*



want h:

$0.1^2 + 0.3^2 = h^2$

$\Rightarrow h = 0.32$ m/s

b) 

$\tan\theta = \frac{0.3}{0.1} \Rightarrow \theta = 71.6°$

c) i) $v = \frac{d}{t} \Rightarrow t = \frac{d}{v} = \frac{15}{0.3} =$ 50 sec

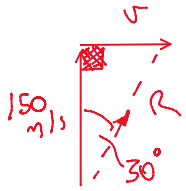
ii) using $h = 0.32$ m/s for 50 sec

$\therefore d = t \times v \Rightarrow d = 50 \times 0.32 = 16$ m (15.8 m)

5 An aeroplane flies in air that is moving due east at a speed of $V\,\text{m s}^{-1}$. The velocity of the aeroplane relative to the air is $150\,\text{m s}^{-1}$ due north. The aeroplane actually travels on a bearing of 030°.

(a) Show that $V = 86.6\,\text{m s}^{-1}$, correct to three significant figures. *(2 marks)*

(b) Find the magnitude of the resultant velocity of the aeroplane. *(3 marks)*

a) 

$\tan\theta = \frac{v}{150} \Rightarrow 150\tan(30) = v$

$\therefore v = 86.6$ m/s

b) $R = \sqrt{150^2 + (86.6)^2} = 173$

or better $\cos 30 = \frac{150}{R}$

$= 173$