Year 12 Physics Test **_SOLUTIONS_**

Uniform Circular Motion

1.

(a) Circumference of circle of motion $C = 2\pi r$

Time for one circumference is period T

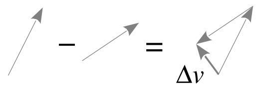
$$t = \frac{s}{v}$$

$$\therefore T = \frac{2\pi r}{v}$$

(b) $T = \frac{2\pi r}{v} = \frac{2\pi \times 9.6}{1.3} = 46 \text{ s}$

(c) $a = \frac{v^2}{r} = \frac{1.3^2}{9.6} = 0.18 \text{ ms}^{-2}$

(d) $\Delta\vec{v} = \vec{v}_B - \vec{v}_A =$

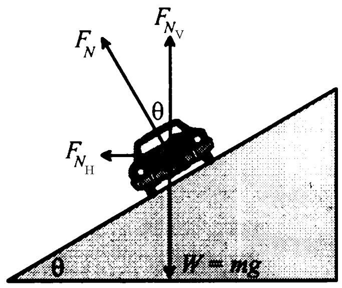


$\Delta\vec{v}$ is towards the centre, and $\vec{a} = \frac{\Delta\vec{v}}{\Delta t}$ (or acceleration is in the same direction as $\Delta\vec{v}$) so acceleration is towards the centre (the braaaains).

(e) Friction

2.

(a) Banking a curve means that the normal force (the road on the car) has a horizontal component. This horizontal component provides some (or all) of the centripetal acceleration for a car taking the curve. This means the friction does not need to provide as much acceleration.

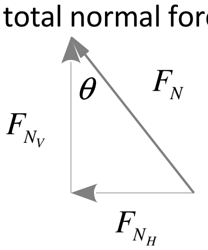


In the diagram, F_{NH} can be seen to provide at least some of the centripetal acceleration.

(b) The vertical component must still be sufficient to keep the car from sinking into the road, so $F_{N_V} = mg$.

For the horizontal component to provide exactly all the centripetal acceleration (friction of the tyres not needed) $F_{N_H} = F_c = ma_c = m\frac{v^2}{r}$

The total normal force is the vector sum of its components, so:



$$\tan\theta = \frac{F_{N_H}}{F_{N_V}}$$

$$\therefore \tan\theta = \frac{m\frac{v^2}{r}}{mg}$$

$$\therefore \tan\theta = \frac{v^2}{rg}$$