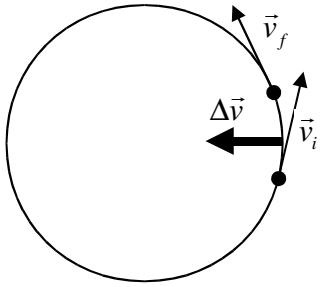
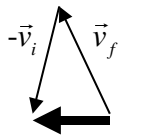
Year 12 Physics ***SOLUTIONS***

Practice Test – Circular Motion and Gravitation

1.

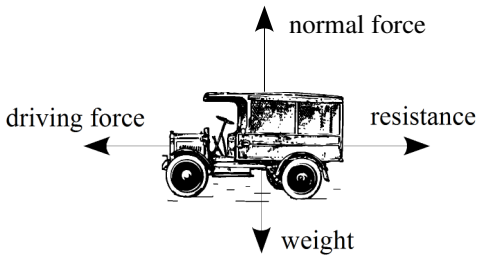




$\Delta\vec{v} = \vec{v}_f - \vec{v}_i$

2.

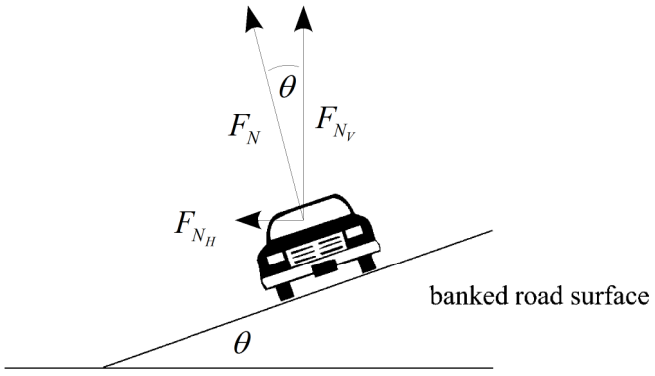
(a)

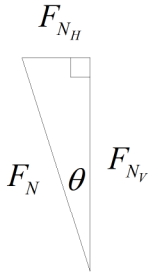


(b) $a = \dfrac{v^2}{r} = \dfrac{13^2}{112} = 1.5 \text{ ms}^{-2}$

(c) Friction

(d)





F_{N_V} = weight {so car doesn't sink into road}

$= mg$

F_{N_H} = centripetal force {so car doesn't rely on friction}

$= ma_c = \dfrac{mv^2}{r}$

$\tan\theta = \dfrac{F_{N_H}}{F_{N_V}} = \dfrac{\frac{mv^2}{r}}{mg} = \dfrac{v^2}{rg}$

3.

(a) Gravitation

(b) $v = \dfrac{2\pi r}{T}$ and $v = \sqrt{\dfrac{GM}{r}}$

$\therefore \dfrac{2\pi r}{T} = \sqrt{\dfrac{GM}{r}}$

$\therefore \dfrac{4\pi^2 r^2}{T^2} = \dfrac{GM}{r}$

$\therefore r = \sqrt[3]{\dfrac{GMT^2}{4\pi^2}}$

(c) $T_2 = 8T_1$

$r = \sqrt[3]{\dfrac{GMT^2}{4\pi^2}}$

$\dfrac{GM}{4\pi^2}$ is constant

$\therefore r \propto \sqrt[3]{T^2}$

$\therefore \dfrac{r_1}{r_2} = \dfrac{\sqrt[3]{T_1^2}}{\sqrt[3]{T_2^2}} = \dfrac{\sqrt[3]{T_1^2}}{\sqrt[3]{(8T_1)^2}} = \dfrac{\sqrt[3]{T_1^2}}{\sqrt[3]{8^2}\sqrt[3]{T_1^2}} = \dfrac{1}{4}$

So $r_1 : r_2 =$ 1:4

4.

(a) The centripetal acceleration of a satellite is provided by gravitation, which is towards the centre of mass of Earth. The centripetal force points towards the centre of the circle of motion.

(b) Low altitude: more detailed pictures

Polar orbits: survey different regions of the Earth throughout the day