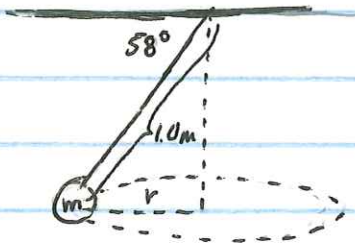
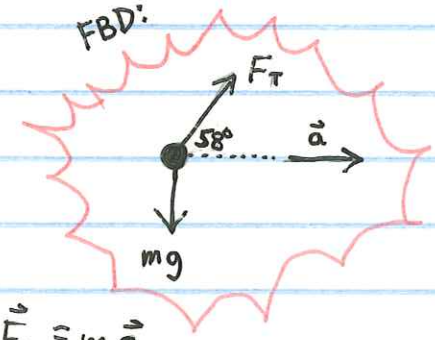
Uniform Circular Motion, Featuring 2D

1.





$\hat{y}$: $\sum \vec{F}_y = 0$

$F_T \sin 58° = mg$

$F_T = \frac{mg}{\sin 58°}$

$F_T = 2.600088\ N$

$\hat{x}$: $\sum \vec{F}_x = m\vec{a}$

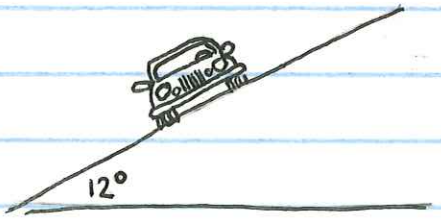
$F_T \cos 58° = \frac{mv^2}{r}$

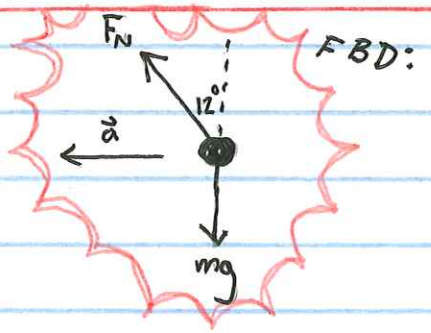
$v = \sqrt{\frac{mg \cos 58° (1.0m \cos 58°)}{m \sin 58°}} = 1.801409729\ldots$

$$v = 1.8\ m/s$$

2. $$v = 2.8\ m/s$$

3.





$\hat{y}$: $\sum \vec{F}_y = 0$

$F_N \cos 12° = mg$

$F_N = \frac{mg}{\cos 12°}$

$\hat{x}$: $\sum \vec{F}_x = m\vec{a}$

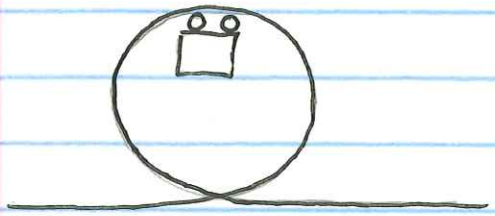
$F_N \sin 12° = \frac{mv^2}{r}$

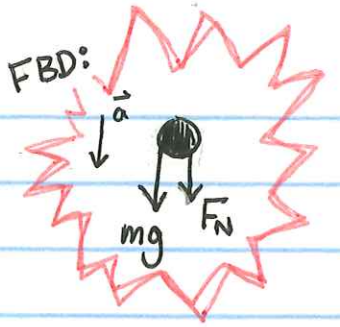
$mg \underbrace{\frac{\sin 12°}{\cos 12°}}_{\tan 12°} = \frac{mv^2}{r}$

$v = \sqrt{rg \tan 12°}$

$$v = 9.6\ m/s$$

4.





$$\sum \vec{F} = m\vec{a}$$

$$mg + F_N = \frac{mv^2}{r}$$

$$v = \sqrt{\frac{(mg + F_N)r}{m}}$$

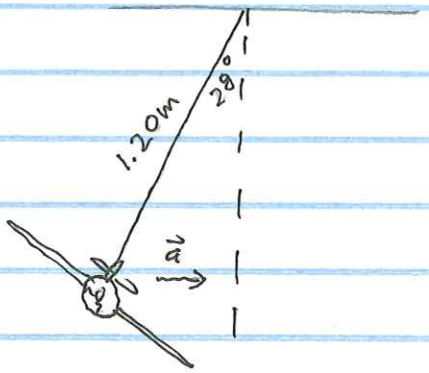
$$\boxed{v = 8.3\ m/s}$$

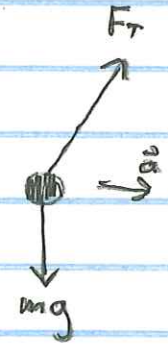
Text: 16. 73kg

20. 0.187

26. 170m

30. 45s





$\hat{x}$: $\sum \vec{F}_x = ma$

$F_T \sin 28° = m\frac{v^2}{r}$

$\hat{y}$ $\sum \vec{F}_y = 0$

$F_T \cos 28° = mg$

$F_T = \frac{mg}{\cos 28°}$

$\frac{mg \sin 28°}{\cos 28°} = \frac{mv^2}{r}$

$v = 1.71334763\ m/s$

$v = \frac{d}{t} = \frac{2\pi r}{T}$ (constant speed!)

$T = \frac{2\pi r}{v} = 2.06597431\ s$

$\boxed{T = 2.1\ s}$