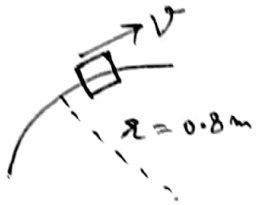
Q1. $m = 0.12\ kg$

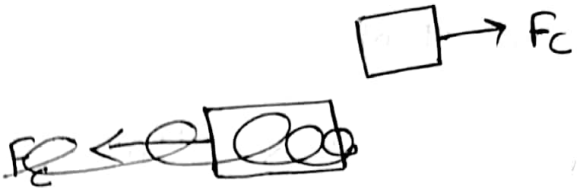
$r = 0.8\ m$

$v = 5\ m/s$

a)



b)



c) Magnitude of $a_c = \frac{v^2}{r}$

$a_c = \frac{(5)^2}{0.8} = 31.25\ m/s^2$

direction: radially inward

d) $F_c = m a_c$

$= 0.12 \times 31.25$

$= 3.75\ N$

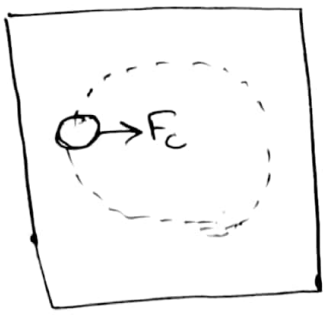
direction: radially inward.

e). The tension in the string exerts the centripetal force on the tape.

f). If we let go the string it would go in tangential direction to the circular motion.

Q3.

a)



The earth's gravitational force keep the moon orbitting earth.

b) $F_C = \frac{m v^2}{r} = 7.36 \times 10^{22} \times \frac{(1023)^2}{3.85 \times 10^8}$

$F_c = 2 \times 10^{20}\ N.$

Q4.

$F_c = 1400\,N$

$r = 50\,m$

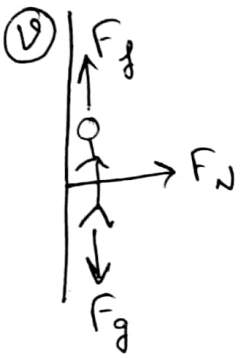
$m = 700\,kg$

$$F_c = \frac{m v^2}{r} \Rightarrow 1400 = \frac{700 \times v^2}{50}$$

$$\Rightarrow v = \sqrt{\frac{1400 \times 50}{700}} = 10\,m/s$$

Q6

a)



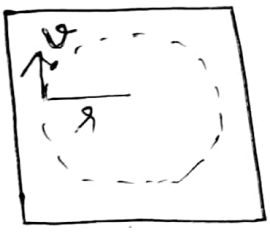
(i) Downward direction

(ii) Upward direction

(iii) Cylindrical structure surface

(iv) Radially inward.

b)



c) In y-direction. $F_g - F_f = 0$

$$F_g = F_f$$

d) $F_f = \mu F_N$

$F_g = mg$

$$\Rightarrow mg = \mu F_N \Rightarrow F_N = \frac{mg}{\mu}$$

e) $F_f = F_g = mg = 73 \times 10 = 730\ N$

f) Normal force is providing the Centripetal force.

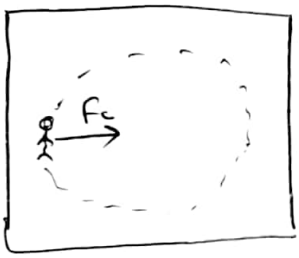
g) To keep the rider suspended against the wall Normal force will be equal to Centripetal force.

$$F_c = F_N = \frac{mv^2}{r}$$

$$F_f = F_g = \mu N$$

$$\Rightarrow \mu \times \frac{mv^2}{r} = mg \quad \Rightarrow v = \sqrt{\frac{gr}{\mu}} = \sqrt{\frac{1.5 \times 10}{0.5}} = 5.48\ m/s$$

Q7. a)



$$F_g = F_f = mg$$

$$\mu F_N = F_f \Rightarrow F_N = \frac{mg}{\mu}$$

$$F_N = F_c = \frac{mv^2}{r} \Rightarrow \frac{mv^2}{r} = \frac{mg}{\mu} \Rightarrow v = \sqrt{\frac{gr}{\mu}}$$

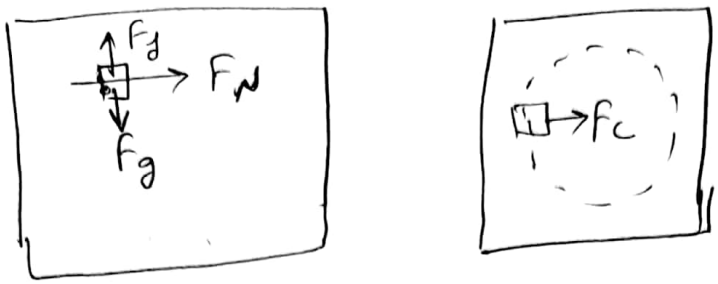
Independent of mass.

b) $v = \sqrt{\frac{10 \times 6}{0.67}} = 9.46\ m/s$

c) $v = \sqrt{\frac{10 \times 6}{0.67}} = 9.46\ m/s$

Q10

a)

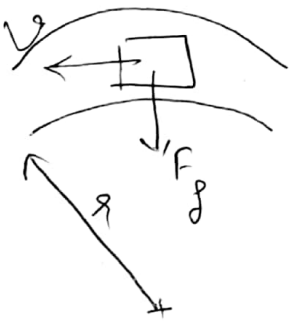


b) $F_c = \frac{mv^2}{r} = \frac{65 \times (17)^2}{15} = 1252.33N$

c) Normal force is causing the Centripetal force.

Q13

a)



Friction force $= \mu N = \mu mg$

Centripetal force $= \frac{mv_{max}^2}{r}$

$\mu mg = \frac{mv_{max}^2}{r} \Rightarrow v_{max} = \sqrt{\mu r g}$

Friction between tires and the road $= \mu = 0.7$

$v_{max} = \sqrt{0.7 \times 40 \times 10} = 16.73 \, m/s$

b) Friction between tires and road $= \mu = 0.4$

$v_{max} = \sqrt{0.4 \times 40 \times 10} = 12.65 \, m/s$

c) Friction between tires and road $= \mu = 0.2$

$v_{max} = \sqrt{0.2 \times 40 \times 10} = 8.94 \, m/s$

d) General relationship $= v_{max} = \sqrt{\mu r g}$