Physics lesson 1

Projectile motion

a) $S_y = 75m$

$a = 9.8 m/s^2$

$S = ut + \frac{1}{2}at^2$

$u = 0$

$\therefore S = \frac{1}{2}at^2$

$\frac{2S}{a} = t^2$

$\frac{2 \times 75}{9.8} = t^2$

$= 15.3...$

$t = \sqrt{15.3...}$

$= 3.9$ seconds

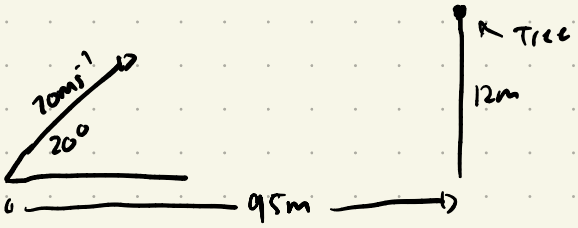
b) $v = \frac{d}{t}$

$d = vt$

$= 110 \times 3.9$

$= 429m$

Q21)



$v_y = \sin(20) \times 70$

$= 23.94 m/s$

$v_x = \cos(20) \times 70$

$= 65.77m$

95m away in x-direction

$\therefore v = \frac{d}{t}$

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

$= \frac{95}{65.77}$

$= 1.44$ seconds

$S_y = ut + \frac{1}{2}at^2$

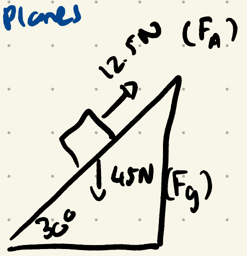
$= 23.94 \times 1.44 + \frac{1}{2} \times -9.8 \times 1.44^2$

$= 24.36m$ in air

$\therefore$ It will be high enough to clear the tree

Inclined Planes

Q7)



$F_{down} = F_g \times \sin\theta$

$= 45 \times \sin 30$

$= 22.5N$

$F_{net} = F_{down} - F_a$

$= 22.5 - 12.5$

$= 10N$

$F_g = mg$

$m = \frac{F_g}{g}$

$= \frac{45}{9.8}$

$= 4.59kg$

$F = ma$

$a = \frac{F}{m}$

$= \frac{10}{4.59}$

$= 2.17 m/s^2$

$S = ut + \frac{1}{2}at^2$

$u = 0m/s$

$\therefore s = \frac{1}{2}at^2$

$2s = at^2$

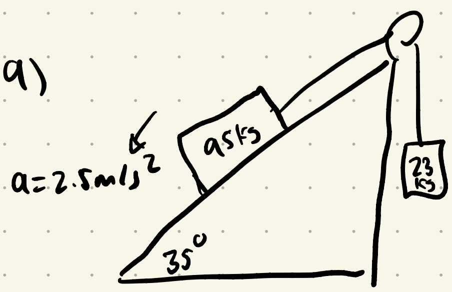
$\frac{2s}{a} = t^2$

$t = \sqrt{\frac{2s}{a}}$

$= \sqrt{\frac{2 \times 10}{2.17}}$

$= 3.04$ seconds

Q9)



$F_{net} = F_{down} - F_F - F_g$

$F_{net} = ma$

$= (95 + 23) \times 2.5$

$= 295N$

$F_{down} = 95 \times \sin(35) \times 9.8$

$= 534N$

$F_g = 23 \times 9.8$

$= 225.4N$

$F_{net} = F_{down} - F_F - F_g$

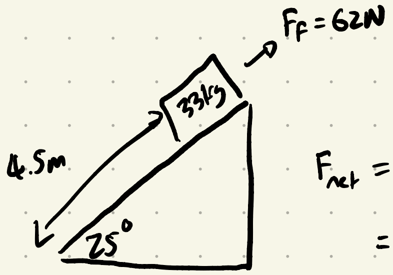
$\therefore 295 = 534 - F_F - 225.4$

$= 308.6 - F_F$

$F_F = 308.6 - 295$

$= 13.6N$ up the incline

Q8)



$F_{net} = F_{down} - F_F$

$= 33 \times 9.8 \times \sin(25) - 62$

$= 156.675 - 62$

$= 74.67N$

$F = ma$

$a = \frac{F}{m}$

$= \frac{74.67}{33}$

a) $= 2.26 m/s^2$

b) $s = ut + \frac{1}{2}at^2$

$u = 0$

$\therefore$

$s = \frac{1}{2}at^2$

$\sqrt{\frac{2s}{a}} = t$

$\sqrt{\frac{2 \times 4.5}{2.26}} = 1.99$ seconds

≈ 2 seconds

Circular Motion

Q9)

$m = 5$

$F = 80$

$v = 8$

$F = \frac{mv^2}{r}$

$r = \frac{mv^2}{F}$

$= \frac{5 \times 8^2}{80}$

$= 4m$

Q4) $m = 2kg$

$r = 150cm$
$= 1.5m$

max tension

15N

$\therefore$ max $F = 15N$

$15 = \frac{2 \times v^2}{1.5}$

$\sqrt{\frac{15 \times 1.5}{2}} = v$

$= 3.35 m/s$

Gravity

Q7)

$r_{earth} = 6.37 \times 10^6$

$\therefore$ above 10km

$10 \times 10^3 m$

$\therefore$

$\therefore r = 6.37 \times 10^6 + 10 \times 10^3$

$F_g = G\frac{M_e}{r^2}$

$= 6.67 \times 10^{-11} \times \frac{5.97 \times 10^{24}}{(6.37 \times 10^6 + 10 \times 10^3)^2}$

$= 9.78 N/kg$

Q4) $F_{earth} = G\frac{m}{r^2}$

$F_{new} = G\frac{2m}{(2r)^2}$

$= G\frac{2m}{4r^2}$

$= G\frac{m}{2r}$

$= \frac{1}{2}G\frac{m}{r}$

$= \frac{1}{2}F_{Earth}$

New planet will have half of earths gravity $(9.8 \div 2 = 4.9 m/s^2)$

Orbits

Q1c)

$$\frac{T_{Earth}^2}{r_{Earth}^3} = \frac{T_{mars}^2}{r_{mars}^3}$$

$r_{Mars} = 1.52\, r_{earth}$

$$\frac{365^2}{r^3} = \frac{T^2}{(1.52r)^3}$$

$$\frac{365^2(1.52r)^3}{r^3} = T^2$$

$365^2 \times 3.51181 = 467861$

$= 684$ days

Q2a) Triton

$T = 5.87$ days

$= 5.87 \times 24 \times 60 \times 60$ seconds

$= 507168$ seconds

$r = 377\,750$ Km

$= 377\,750 \times 10^3$ m

$$\frac{T^2}{r^3} = \frac{4\pi^2}{GM}$$

$$M = \frac{4\pi^2 r^3}{GT^2}$$

$$= \frac{4\pi^2 \times (377750 \times 10^3)^3}{6.67 \times 10^{-3} \times 507168^2}$$

$= 1.29 \times 10^{26}$ Kg

Electrostatics

Q11)

$F = 0.28N$

$Q_A = ?$

$Q_B = +6.5 \times 10^{-6} C$

$r = 0.80m$

$F = \frac{kQq}{r^2}$

$\frac{Fr^2}{kQ} = q$

$\frac{0.28 \times 0.8^2}{9 \times 10^9 \times 6.5 \times 10^{-6}} = 3.06 \times 10^{-6} C$

Q15)

$E = \frac{F}{q}$

$= \frac{750}{15 \times 10^{-6}}$

$= 5 \times 10^7 N/C$

Q18)

$m = 9.6 \times 10^{-26} kg$ $E = 20 N/C$

$v = 1200 m/s$

$q = 8.0 \times 10^{-19}$

a) Direction is downwards

$E = \frac{F}{Q}$

$F = EQ$

$= 8.0 \times 10^{-19} \times 20$

$= 1.6 \times 10^{-17} N$

b) $F = ma$

$a = \frac{F}{m}$

$= \frac{1.6 \times 10^{-17}}{9.6 \times 10^{-26}}$

$= 1.67 \times 10^8 m/s^2$

c) $v = \frac{d}{t}$

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

$= \frac{0.01}{1200}$

$= 8.33 \times 10^{-6} s$

d) $s = ut + \frac{1}{2}at^2$

$u = 0$

(initial velocity was in x-direction)

$\therefore s = \frac{1}{2} \times 1.66667 \times 10^8 \times (8.33 \times 10^{-6})^2$

$= 5.782 \times 10^{-3} m$