$\Rightarrow 20a = 49$

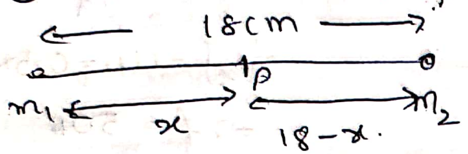
$\Rightarrow a = \frac{49}{20}$

$\Rightarrow a = 2.45 m/s^2$

WS-17 For 7th class

Ttask

① Given $m_1 = 8kg$; $m_2 = 2kg$



mass m At P $F_{net} = 0$

$\Rightarrow F_1 = F_2$

$\Rightarrow \frac{G m_1 m}{x^2} = \frac{G m_2 m}{(18-x)^2}$

$\Rightarrow 4 = \frac{x^2}{(18-x)^2}$

$\Rightarrow 2^2 = \left(\frac{x}{18-x}\right)^2$

$\Rightarrow 2 = \frac{x}{18-x}$

$\Rightarrow 36 - 2x = x$

$\Rightarrow 3x = 36$

$\Rightarrow x = 12cm$
$= 0.12m$

②

$d = 2R$

$F_1 = F$

$F_1 = \frac{G m_1 m_2}{r^2}$

$F_1 = \frac{G\left[d \frac{4\pi}{3} R^3\right]\left[d \frac{4\pi}{3} R^3\right]}{(2R)^2}$

$F_1 = \frac{G\left(\frac{4\pi}{3}\right)^2 d^2 (R^6)}{4R^2}$

$F_1 = \frac{G\left(\frac{4\pi}{3}\right) d^2 R^4}{4}$

$F_1 \propto R^4$

$R_1 = R \quad R_2 = 2R$

$\frac{F_1}{F_2} = \left(\frac{R_1}{R_2}\right)^4 = \left(\frac{R}{2R}\right)^4$

$\Rightarrow \frac{F_1}{F_2} = \frac{1}{16}$

$\Rightarrow F_2 = 16F$

mass = d × vol

$= d \times \frac{4\pi}{3} r^3$

③ Given $w = mg = 64N$

$h = \frac{1}{3}R$.

$w_h = m g_h = mg\left[\frac{R}{R+h}\right]^2$

$w_h = mg\left[\frac{R}{R + \frac{1}{3}R}\right]^2$

$= mg\left[\frac{R}{\frac{4R}{3}}\right]^2$

$\Rightarrow mg\left[\frac{3}{4}\right]^2 = \frac{9}{16} mg$

$w_h = \frac{9}{16} \times 64 = 36N$

④ $T_p = 8T_e$

$r_e = r$ ~ $r_p = ?$

$T^2 \propto r^3$

$\Rightarrow T^{\frac{2}{3}} \propto r$

$\Rightarrow \left[\frac{T_p}{T_e}\right]^{\frac{2}{3}} = \left(\frac{r_p}{r_e}\right)$

$\Rightarrow \left[\frac{8T_e}{T_e}\right]^{\frac{2}{3}} = \left[\frac{r_p}{r}\right]$

$\Rightarrow \left[2^3\right]^{\frac{2}{3}} = \frac{r_p}{r}$

$\Rightarrow 2^2 = \frac{r_p}{r}$

$\Rightarrow 4 = \frac{r_p}{r}$

$\Rightarrow \boxed{r_p = 4r}$

(5) $g_d = g_h$; Given $h = 64$ km

$\Rightarrow g[1 - \frac{d}{R}] = g[1 - \frac{2h}{R}]$

$\Rightarrow 1 - \frac{d}{R} = 1 - \frac{2h}{R}$

$\Rightarrow -\frac{d}{R} = -\frac{2h}{R}$

$\Rightarrow d = 2h$

$\Rightarrow d = 2(64)$
$= 128$ km

(6) Given $g_h = 64\% g$

$g_h = \frac{64}{100} g$.

$g_h = g\left[\frac{R}{R+h}\right]^2$

$\Rightarrow \frac{64}{100} g = g\left[\frac{R}{R+h}\right]^2$

$\Rightarrow \sqrt{\frac{64}{100}} = \frac{R}{R+h}$

$\Rightarrow \frac{8}{10} = \frac{R}{R+h}$

$\Rightarrow h = \frac{R}{4} = \frac{6400}{4}$

$\Rightarrow h = 1600$ km

(7) $H_{max} = 0.5$ m

$\frac{u^2}{2g} = 0.5$ m

$H_{max} \propto \frac{1}{g}$

$\Rightarrow \frac{H_m}{H_e} = \frac{g_e}{g_m}$

$\Rightarrow \frac{H_m}{0.5} = \frac{g_e}{\frac{1}{6} g_e}$

$\Rightarrow H_m = 6 \times 0.5$
$= 3$ m

(8) $g_d = [1 - \frac{d}{R}]$

% change in g

$= \frac{g_d - g}{g} \times 100$

$= \frac{[1 - \frac{d}{R}]g - g}{g}$

$= -\frac{d}{R} g \times 1\ldots$

$w_d = m \Delta g \ldots$

$= m \frac{d}{R} g \ldots$

$\Rightarrow mg \frac{16 \times 10\ldots}{64}$

$= 0.25\, mg$

$w_d = 0.25\, w_s$

(9) $\frac{M_e}{M_m} = \frac{3}{2}$; $\frac{R_e}{R_m} = \frac{6}{1}$

$W = mg$

$= m \frac{GM}{R^2}$.

$\frac{W_e}{W_m} = \frac{M_e}{M_m}\left[\frac{R_m}{R_e}\right]^2$

$= \frac{3}{2}\left[\frac{1}{6}\right]^2$

$= \frac{3}{2} \times \frac{1}{36} = \frac{1}{24}$.

(10) $R' = \frac{R}{2}$

$w = mg$

$w' = mg'$.

$w' = m(4g)$

$= 4mg$

$w' = 4w$

$\because g \propto \frac{1}{R^2}$

$\frac{g}{g'} = \left[\frac{R'}{R}\right]^2$

$\Rightarrow \frac{g}{g'} = \left[\frac{\frac{R}{2}}{R}\right]^2$

$\Rightarrow g' = 4g$

(18) (i) $g_e = g$; $R' = \frac{1}{2} R$

$g \propto \frac{1}{R^2}$

$\frac{g_e}{g'} = \left[\frac{R'}{R}\right]^2$

$\Rightarrow \frac{g_e}{g'} = \left[\frac{\frac{R}{2}}{R}\right]^2$

$\Rightarrow g' = 4g$

(ii) $R' = \frac{1}{3} R$ g'

$\frac{g}{g'} = \left[\frac{R'}{R}\right]^2 = \left[\frac{\frac{1}{3}R}{R}\right]\ldots$

$\Rightarrow g' = 9g$

(19) $R_1 = 10^{12}$ m

$R_2 = 10^{10}$ m

$T^2 \propto r^3$

$\Rightarrow T \propto r^{\frac{3}{2}}$

$\Rightarrow \frac{T_1}{T_2} = \left(\frac{R_1}{R_2}\right)^{\frac{3}{2}}$

$\Rightarrow \frac{T_1}{T_2} = \left(\frac{10^{12}}{10^{10}}\right)^{3/2}$

$\Rightarrow \frac{T_1}{T_2} = (10^2)^{\frac{3}{2}} = 10^3$

$\Rightarrow \frac{T_1}{T_2} = 1000$

(20) $g_m = \frac{1}{5} g_e$

$R_m = \frac{1}{4} R_e$.

$g = \frac{GM}{R^2}$

$\Rightarrow g \propto \frac{M}{R^2}$

$\Rightarrow \frac{g_e}{g_m} = \frac{M_e}{M_m}\left[\frac{R_m}{R_e}\right]^2$

$\Rightarrow \frac{g_e}{\frac{1}{5} g_e} = \frac{M_e}{M_m}\left[\frac{\frac{R_e}{4}}{R_e}\right]^2$

$\Rightarrow 5 = \frac{M_e}{M_m}\left[\frac{1}{4}\right]^2$

$\Rightarrow \frac{M_e}{M_m} = 80$

Task

Given $R = 6400$ km

(1) $g_h = 4\% g$

$\Rightarrow g\left[\frac{R}{R+h}\right]^2 = \frac{4}{100} g$

$\Rightarrow \frac{R}{R+h} = \sqrt{\frac{1}{25}}$

$\Rightarrow \frac{R}{R+h} = \frac{1}{5}$

$\Rightarrow 5R = R + h$

$\Rightarrow h = 4R$

$\Rightarrow h = 4(6400\text{ km})$

$\Rightarrow h = 25,600$ km

(2) Given $w = mg = 360$ N.

$w_d = mg_d = mg[1 - \frac{d}{R}]$

Given $d = 800$ km

$\therefore w_d = mg[1 - \frac{800}{6400}]$

$\Rightarrow 360[1 - \frac{1}{8}]$

$w_d = 360 \times \frac{7}{8} = 315$ N

(3) $R = \frac{u^2 \sin 2\theta}{g}$

$R_p = \frac{5R}{4}$

$\frac{R_p}{R_e} = \frac{g_e}{g_p}$

$\Rightarrow \frac{\frac{5R}{4}}{R} = \frac{g_e}{g_p}$

$\Rightarrow \frac{5}{4} = \frac{g_e}{g_p}$

$\Rightarrow \frac{g_p}{g_e} = \frac{4}{5}$

④ Given $M_e = 80 m_p$

$D_e = 2 D_p$

$\Rightarrow R_e = 2 R_p$

$g = \frac{GM}{R^2}$

$\Rightarrow g \propto \frac{M}{R^2}$

$\Rightarrow \frac{g_p}{g_e} = \frac{M_p}{M_e}\left[\frac{R_e}{R_p}\right]^2$

$\Rightarrow \frac{g_p}{9.8} = \frac{M_p}{80 M_p}\left[\frac{2R_p}{R_p}\right]^2$

$\Rightarrow \frac{g_p}{9.8} = \frac{1}{80} \times 4$

$\Rightarrow g_p = 0.49 \ m/sec^2$

⑤ $M_p = \frac{1}{9} M_e$; $R_p = \frac{1}{2} R$.

From $g = \frac{GM}{R^2}$

$\Rightarrow g \propto \frac{M}{R^2}$

$\Rightarrow \frac{g_p}{g_e} = \frac{M_p}{M_e}\left(\frac{R_e}{R_p}\right)^2$

$\Rightarrow \frac{g_p}{g} = \frac{\frac{1}{9}M_e}{M_e}\left(\frac{R}{\frac{1}{2}R}\right)^2$

$\Rightarrow \frac{g_p}{g} = \frac{1}{9} \times 4.$

$\Rightarrow g_p = \frac{4}{9} g$

$W_p = m g_p$

$= m \frac{4}{9} g$

$W_p = mg \frac{4}{9}$

$= 9 \times \frac{4}{9}$

$W_p = 4N$

⑥ $W_h = \frac{1}{4} W_g$

$\Rightarrow m g_h = \frac{1}{4} m g$

$\Rightarrow g\left(\frac{R}{R+h}\right)^2 = \frac{1}{4} g$

$\Rightarrow \left(\frac{R}{R+h}\right)^2 = \left[\frac{1}{2}\right]^2$

$\Rightarrow \frac{R}{R+h} = \frac{1}{2}$

$\Rightarrow R+h = 2R$

$\Rightarrow h = R.$

⑦ $M \to m_1 = x$, $m_2 = M - x = 1 - x.$

$F \propto m_1 m_2 \Rightarrow F \propto x(1-x)$

substitute $x = \frac{1}{2}, \frac{3}{5}, 1, 2$ seperately at $x = \frac{1}{2}$ we will get max force of attraction

at $x = \frac{1}{2}$

$F \propto \frac{1}{2}(1 - \frac{1}{2})$

$F \propto \frac{1}{4}$

⑨ Given $r_1 = 10^{13} m$

$r_2 = 10^{12} m.$

$T^2 \propto r^3$

$\Rightarrow T \propto r^{\frac{3}{2}}$

$\Rightarrow \frac{T_1}{T_2} = \left[\frac{r_1}{r_2}\right]^{\frac{3}{2}}$

$\Rightarrow \frac{T_1}{T_2} = \left[\frac{10^{13}}{10^{12}}\right]^{\frac{3}{2}}$

$\Rightarrow \frac{T_1}{T_2} = [10]^{\frac{3}{2}} = 10\sqrt{10}$

⑰ Given $h = 2R$

(i) $g_h = g\left[\frac{R}{R+h}\right]^2$

$\Rightarrow g_0 = g\left[\frac{R}{R+2R}\right]^2$

$\Rightarrow g_0 = g\left[\frac{R}{3R}\right]^2$

$\Rightarrow g_0 = \frac{g}{9}$

$\Rightarrow g = 9 g_0$

(ii) Given $g_d = 75\% g$

$\Rightarrow \left[1 - \frac{d}{R}\right] g = \frac{75}{100} g$

$\Rightarrow 1 - \frac{d}{R} = \frac{3}{4}$

$\Rightarrow \frac{d}{R} = 1 - \frac{3}{4}$

$\Rightarrow \frac{d}{R} = \frac{1}{4}$

$\Rightarrow d = \frac{R}{4}$

⑱ Given $M_p = 2M_e$, $R_p = 2R_e$.

$g \propto \frac{M}{R^2}$

$\Rightarrow \frac{g_p}{g_e} = \frac{M_p}{M_e}\left(\frac{R_e}{R_p}\right)^2 = \frac{2M_e}{M_e}\left(\frac{R_e}{2R_e}\right)^2$

$\Rightarrow \frac{g_p}{g} = 2 \times \frac{1}{4} = \frac{1}{2}$

$\Rightarrow g_p = \frac{g}{2}$

⑲ $r_1 = r$ $m_1' = 2m_1$

$m_2' = 2m_2$

$F_1 = F$ $r_2 = \frac{r_1}{2}$

$F_2 = ?$

$\frac{F_1}{F_2} = \frac{m_1 m_2}{m_1' m_2'}\left[\frac{r_2}{r_1}\right]^2$

$= \frac{m_1 m_2}{2m_1 2m_2}\left(\frac{\frac{r_1}{2}}{r_1}\right)^2$

$= \frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$

$\frac{F_1}{F_2} = \frac{1}{16}$

$F_2 = 16 F_1$

$F_2 = 16F$

⑳ By using $F = \frac{Gm_1m_2}{r^2}$

(a) $F = \frac{G \times 20 \times 30}{1^2}$

$F = 600 GN$

(b) $F = \frac{G \times 40 \times 60}{(\frac{1}{2})^2}$

$F = 9600 GN.$

(c) $F = \frac{G \times 30 \times 50}{2^2} = \frac{G \times 1500}{4}$

$F = 375 GN$

(d) $F = \frac{G \times 10 \times 40}{(\frac{5}{2})^2}$

$= \frac{G \times 400}{\frac{25}{4}}$

$F = 64 GN.$