DPP
DAILY PRACTICE PROBLEMS

Class : XIth
Date :

Solutions

SUBJECT : PHYSICS
DPP No. : 4

Topic :- GRAVITATION

1 **(a)**

Time period, $T = \frac{2\pi R}{\sqrt{\frac{GM_m}{R}}} = \frac{2\pi R^{3/2}}{\sqrt{GM_m}}$

Where the symbols have their meaning as given in the question

Squaring both sides, we get

$$T^2 = \frac{4\pi^2 R^3}{GM_m}$$

2 **(d)**

Orbital velocity $v_0 = \sqrt{\frac{GM}{r}} = \sqrt{\frac{gR^2}{r}}$ and $v_0 = r\omega$

This gives $r^3 = \frac{R^2 g}{\omega^2}$

3 **(d)**

Escape velocity $v_e = \sqrt{\frac{2GM}{R}}$

$$v_e = \sqrt{\frac{2G\ \frac{4}{3}\pi R^3 \times d}{R}}$$

$$\sqrt{2G\ \frac{4}{3}\pi R^3 \times d} = R\sqrt{\frac{8}{3}\pi G d}$$

where $d =$ mean density of earth

$\because\ v_e \propto R\sqrt{d}$

$$\therefore\ \frac{v_e}{v_p} = \frac{R_e}{R_p}\sqrt{\frac{d_e}{d_p}}$$

$$= \frac{R_e}{2R_e}\sqrt{\frac{d_e}{d_e}}$$

$= v_p = 2v_e$

$= 2 \times 11 = 22\text{kms}^{-1}$

5 **(d)**

Here, $u = 20$ ms^{-1}, $m = 500\text{g} = 0.5\text{kg}$, $t = 20$ s

Using Newton's equation of motion

$$s = ut + \frac{1}{2}gt^2$$

$$0 = 20 \times 20 + \frac{1}{2}(-g)(20)^2$$

or $\qquad g = 2\ \text{ms}^{-2}$

$\therefore$ Weight of body on planet $= mg$

$$= 0.5 \times 2 = 1\ \text{N}$$

8 **(c)**

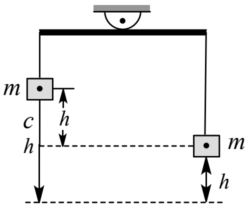
Angular momentum remains constant

$$mv_1d_1 = mv_2d_2 \Rightarrow v_2 = \frac{v_1d_1}{d_2}$$

9 **(b)**

As with height g varies as

$$g'' = \frac{g}{[1 + h/R]^2} = g\left[1 - \frac{2h}{R}\right]$$



and in according with figure $h_1 > h_2$, so W_1 will be lesser than W_2 and

$$W_2 - W_1 = mg_2 - mg_1 = 2mg\left[\frac{h_1}{R} - \frac{h_2}{R}\right]$$

or $\quad W_2 - W_1 = 2m\frac{GM}{R^2}\frac{h}{R}$

$$\left[\text{as } g = \frac{GM}{R^2} \text{ and } (h_1 - h_2) = h\right]$$

or $\quad W_2 - W_1 = \frac{2mhG}{R^3}\left(\frac{4}{3}\pi R^3\rho\right)$

$$= \frac{8}{3}\pi\rho Gmh \left[as\ M = \frac{4}{3}\pi R^3\rho\right]$$

11 **(c)**

Time period of nearby satellite

$$T = 2n\sqrt{\frac{r^3}{GM}}$$

$$= 2\pi\sqrt{\frac{R^3}{GM}}$$

$$= \frac{2\pi(R^3)^{1/2}}{\left[G\ \frac{4}{3}\pi R^3\rho\right]^{1/2}} = \sqrt{\frac{3\pi}{G\rho}}$$

12 **(a)**

The acceleration due to gravity (g) is given by

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

where M is mass, G the gravitational constant and R the radius.
Since, planets have a spherical shape

$$V = \frac{4}{3}\pi r^3$$

Also, mass (M) = volume(V) × density(ρ)

$$g = \frac{G\frac{4}{3}\pi R^3 \rho}{R^2}$$

$$\Rightarrow \qquad g = \frac{4G\pi\rho R}{3}$$

Given, $R_1{:}R_2 = 2:3$

$$\rho_1{:}\rho_2 = \frac{3}{2}$$

$$\therefore \qquad \frac{g_1}{g_2} = \frac{\rho_1 R_1}{\rho_2 R_2} = \frac{3}{2} \times \frac{2}{3} = 1$$

13 **(c)**

The maximum velocity with which a body must be projected in the atmosphere, so as to enable it to just overcome the gravitational pull, is known as escape velocity.
Escape velocity from earth's surface is

$$v_{\text{es}} = \sqrt{\frac{2GM_e}{R_e}}$$

$$= \sqrt{\frac{2G \cdot \frac{4}{3}\pi R_e^3 d_e}{R_e}} \qquad \left(\because M = \frac{4}{3}\pi R_e^3 d_e\right)$$

or $\quad v_{\text{es}} \propto \sqrt{d_e} \times R_e \quad$ ....(i)

similarly, for a planet

$$v'_{\text{es}} \propto \sqrt{d_p} \times R_p \quad ...(ii)$$

So, $$\frac{v_{\text{es}}}{v'_{es}} = \left(\frac{d_e}{d_p}\right)^{1/2} \times \frac{R_e}{R_p}$$

Given, $d_p = \frac{1}{4}d_e, R_p = 2R_e$

$$\frac{v_{\text{es}}}{v_{\text{es}}} = \left(\frac{d_e}{\frac{d_e}{4}}\right)^{\frac{1}{2}1} \times \frac{R_e}{2R_e}$$

$$= (4)^{1/2} \times \frac{1}{2}$$

$$= 2 \times \frac{1}{2} = 1$$

So, $$\frac{v_{\text{es}}}{v'_{\text{es}}} = 1{:}1$$

14 **(a)**

The value of acceleration due to gravity g at height h above the surface of earth is

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

Where R is radius of earth.

$$\therefore \quad \frac{g}{g_h} = \left(1+\frac{h}{R}\right)^2$$

15 **(b)**

$$v = \sqrt{\frac{GM}{r}}$$

16 **(b)**

Angular momentum is conserved in central field

17 **(d)**

The true weight of a body is given by mg and with height g decrease

So, $\frac{W_s}{W_E} = \frac{mg'}{mg} = \frac{1}{[1+(h/R)]^2}\left[\text{as } g' = \frac{g}{[1+(h/R)]^2}\right]$

But here, $h = 7R - R = 6R,\ ie, h/R = 6$

So, $W_S = \frac{W_E}{(1+6)^2} = \frac{10}{49} = 0.2\text{N}$

18 **(d)**

$$v_e = \sqrt{\frac{2GM}{(R+h)}}$$

19 **(a)**

$$g' = g\left(\frac{R}{R+h}\right)^2 = g\left(\frac{R}{R+2R}\right)^2 = \frac{g}{9}$$

20 **(c)**

$$\frac{g_m}{g_e} = \frac{G(M/8)}{GM/R_e^2} = \frac{R_e^2}{8R_m^2}; \ldots\text{(i)}$$

Given, $\frac{mg_m}{mg_e} = \frac{1}{6}$

or $\frac{g_m}{g_e} = \frac{1}{6}$ ...(ii)

From Eqs. (i) and (ii); $\frac{R_e^2}{8R_m^2} = \frac{1}{6}$

or $R_e = \sqrt{8/6}R_m$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	A	D	D	A	D	B	D	C	B	A
Q.	11	12	13	14	15	16	17	18	19	20
A.	C	A	C	A	B	B	D	D	A	C