DPP
DAILY PRACTICE PROBLEMS

Class : XIth
Date :

Solutions

SUBJECT : PHYSICS
DPP No. : 1

Topic :- GRAVITATION

1 **(c)**

It is self-evident that the orbit of the comet is elliptic with sun begin at one of the focus.

Now, as for elliptic orbits, according to kepler's third law,

$$T^2 = \frac{4\pi^2 a^3}{GM} \Rightarrow a = \left(\frac{T^2 GM}{4\pi^2}\right)^{1/3}$$

$$a = \left[\frac{(76 \times 3.14 \times 10^7) \times 6.67 \times 10^{-11} \times 2 \times 10^{10}}{4\pi^2}\right]^{1/3}$$

But in case of ellipse,

$2a = r_{\min} + r_{\max}$

$\therefore\ r_{\max} = 2a - r_{\min} = 2 \times 2.7 \times 10^{12} - 8.9 \times 10^{10}$

$\cong 5.3 \times 10^{12}\mathrm{m}$

2 **(b)**

Acceleration due to gravity $g = \frac{GM}{R^2}$, $\quad M = \left(\frac{4}{3}\pi R^3\right)\rho$

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

$\Rightarrow \quad g = \left(\frac{4G\pi R}{3}\right)\rho \qquad (\rho = \text{average density})$

$\Rightarrow g \propto \rho$ or $\rho \propto g$

3 **(c)**

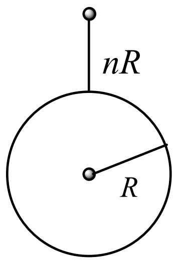
$g = \frac{GM}{R^2}$ and $K = \frac{L^2}{2I}$

If mass of the earth and its angular momentum remains constant then $g \propto \frac{1}{R^2}$ and $K \propto \frac{1}{R^2}$

i.e., if radius of earth decreases by 2% then g and K both increases by 4%

4 **(a)**

Acceleration due to gravity at a height above the earth surface



$$g^{'} = g\left(\frac{R}{R+\text{h}}\right)^2$$
$$\frac{g}{g^{'}} = \left(\frac{R+\text{h}}{R}\right)^2$$
$$\frac{g}{g^{'}} = \left(\frac{R+nR}{R}\right)^2$$
$$\frac{g}{g^{'}} = (1+n)^2$$

5 **(c)**

Gravitational potential

$$V = GM\left(\frac{1}{r_1}+\frac{1}{r_2}+\frac{1}{r_3}+\ldots\right)$$
$$= G\times 1\left(\frac{1}{1}+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+\ldots.\right)$$
$$= G\left(\frac{1}{1-1/2}\right) \qquad \left(\therefore \text{sum of GP} = \frac{a}{1-r}\right)$$
$$= 2G$$

6 **(b)**

$$\frac{\text{g}_e}{\text{g}_m} = \frac{R_e\rho_e}{R_m\rho_m} = \frac{2}{3}\times\frac{4}{1} = 6 \text{ or } \text{g}_m = \frac{\text{g}_e}{6}$$

For motion on earth, using the relation,

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

We have, $\frac{1}{2} = 0 + \frac{1}{2}\times 9.8r^2$ or $t = 1/\sqrt{9.8}s$

For motion on moon, $3 = 0 + \frac{1}{2}(9.8/6)t_1^2$

or $t_1 = 6\sqrt{9.8}s \quad \therefore \frac{t_1}{t} = 6$ or $t_1 = 6t$

7 **(c)**

Escape velocity,

$$v_{\text{ascape}} = \sqrt{\frac{2\,GM}{R}}$$
$$= R\sqrt{\frac{8}{3}\pi G\rho}$$

$\therefore v_e \propto R$ if $\rho =$ constant.

Since the planet is having double radius in comparision to earth, therefore escape velocity becomes twice *ie*, 22 kms^{-1} .

8 **(a)**

$$\frac{v_p}{v_e} = \sqrt{\frac{M_p}{M_e} \times \frac{R_e}{R_p}} = \sqrt{6 \times \frac{1}{2}} = \sqrt{3} \therefore v_p = \sqrt{3} v_e$$

12 **(c)**

$$\frac{v_e}{v_m} = \sqrt{\frac{g_e}{g_m} \frac{R_e}{R_m}} = \sqrt{6 \times 10} = \sqrt{60} = 8 \text{ (nearly)}$$

13 **(c)**

Gravitational potential energy of a body in the gravitational field, $E = \frac{-GM\,m}{r}$. When r decreases negative value of E increase ie, E decreases

14 **(b)**

Actually gravitational force provides the centripetal force

15 **(c)**

The earth moves around the sun is elliptical path, so by using the properties of ellipse

$r_1 = (1 + e)a$ and $r_2 = (1 - e)a$

$\Rightarrow a = \frac{r_1 + r_2}{2}$ and $r_1 r_2 = (1 - e^2)a^2$

Where $a =$ semi major axis

$b =$ semi minor axis

$e =$ eccentricity

Now required distance = semi latusrectum $= \frac{b^2}{a}$

$$= \frac{a^2(1 - e^2)}{a} = \frac{(r_1 r_2)}{(r_1 + r_2)/2} = \frac{2 r_1 r_2}{r_1 + r_2}$$

16 **(c)**

At a certain velocity of projection of the body will go out of the gravitational field of earth and never to return to earth. The initial velocity is called escape velocity

$$v_e = \sqrt{2gR}$$

Where g is acceleration due to gravity and R the radius. As is clear from above formula, that escape velocity dose not depends upon mass of body hence, it will be same for a body of 100kg as for 1kg body.

17 **(d)**

Telecommunication satellites are geostationary satellite

18 **(b)**

Weight of body at height above the earth's surface is

$$w' = \frac{w}{\left(1 + \frac{h}{r}\right)^2}$$

$$\Rightarrow \qquad 40 = \frac{80}{\left(1 + \frac{h}{r}\right)^2}$$

$$\Rightarrow \qquad h = 0.41r$$

19 **(d)**

As we know gas molecules cannot escape from earth's atmosphere because their root mean square velocity is less than escape velocity at earth's surface. If we fill this requirement, then gas molecules can escape from earth's atmosphere.

ie, $v_{\text{rms}} = v_{\text{es}}$

or $\sqrt{\frac{3RT}{M}} = \sqrt{2gR_e}$

or $T = \frac{2MgR_e}{3R}$ ....(i)

Given, $M = 2 \times 10^{-3}$kg, $g = 9.8$ ms^{-2}

$R_e = 6.4 \times 10^6$ m, $R = 8.31$ Jmol^{-1}–K^{-1}

Substituting in Eq. (i), we have

$$T = \frac{2 \times 2 \times 10^{-3} \times 9.8 \times 6.4 \times 10^6}{3 \times 8.31}$$

$$= 10^4 \text{ K}$$

20 **(d)**

$$v_0 = \sqrt{\frac{GM}{r}} = \sqrt{\frac{gR^2}{R + h}}$$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10

A.	C	B	C	A	C	B	C	A	C	A
Q.	11	12	13	14	15	16	17	18	19	20
A.	A	C	C	B	C	C	D	B	D	D