DPP

DAILY PRACTICE PROBLEMS

Class : XIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 7

Topic :- GRAVITATION

1 **(c)**

According to Kepler's third law, we have

$$T^2 \propto R^3$$

Hence, $\frac{T_A^2}{T_B^2} = \left(\frac{4R}{R}\right)^3 = \frac{64}{1}$

or $\frac{T_A}{T_B} = \frac{8}{1}$

or $\frac{2\pi\omega_B}{2\pi\omega_A} = \frac{8}{1}$

or $\frac{v_B \times 4R}{R \times v_A} = \frac{8}{1}$

or $\frac{v_B}{3v} = 2$

or $v_B = 6v$

2 **(c)**

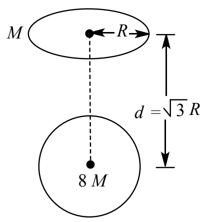
Launching the rocket in the direction of earth's rotation allows it to exploit the earth's rotational velocity *ie*, launching it from West to East. (It gains speed from velocity addition with the earth's rotational velocity.)

3 **(a)**

The escape velocity at the surface of earth is 11.2 kms^{-1}

4 **(d)**

From the figure the gravitational intensity due to the ring at a distance $d = \sqrt{3}R$ on its axis is



$$I=\frac{GM}{(d^2+R^2)^{3/2}}=\frac{GM\times\sqrt{3}R}{(3R^2+R^2)^{3/2}}=\frac{\sqrt{3}GM}{8R^2}$$

Force on sphere $=(8M)I=(8M)\times\frac{\sqrt{3}GM}{8R^2}$

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

5 **(c)**

According to Kepler's law

$$T^2\propto r^3$$

or $\quad 5^2\propto r^3 \quad$ ...(i)

and $\quad (T')^2\propto(4r)^3 \quad$ ...(ii)

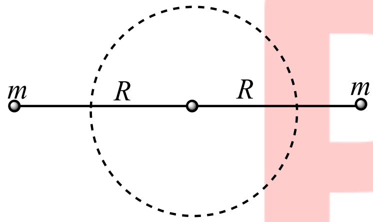
From Eqs.(i) and (ii), we have

$$\frac{25}{(T')^2}=\frac{r^3}{64r^3}$$

$$T=\sqrt{1600}=40\text{h}$$

6 **(b)**

Gravitational force provides necessary centripetal force



$$\frac{Gm^2}{(2R)^2}=\frac{mv^2}{R}$$

$$\Rightarrow v=\sqrt{\frac{Gm}{4R}}$$

7 **(a)**

$T=2\pi\sqrt{\frac{l}{g}}$. At the hill g will decrease so to keep the time period same the length of pendulum has to be reduced

8 **(b)**

This should be equal to escape velocity *i.e.*, $\sqrt{2gR}$

9 **(d)**

A person is safe, if his velocity while reaching the surface of moon from a height h' is equal to its velocity while falling from height h on earth. So

$$\sqrt{2g'h'}=\sqrt{2gh}$$

or $\quad h'=gh/g'=9.8\times3/1.96=15\text{m}$

10 **(d)**

$g_m = \frac{GM_m}{R_m^2}$ and $g_m = \frac{g_e}{6} = \frac{9.8}{6} m/s^2 = 1.63\ m/s^2$

Substituting $R_m = 1.768 \times 10^6 m$, $g_m = 1.63\ m/s^2$

and $G = 6.67 \times 10^{-11} N\text{-}m^2/kg^2$ We get

$M_m = 7.65 \times 10^{22} kg$

11 **(a)**

From Kepler's law, $T^2 \propto R^3$

or $\left(\frac{T_2}{T_1}\right)^2 = \left(\frac{R_2}{R_1}\right)^3 = \left(\frac{1.01\ R}{R}\right)^3 = (1 + 0.01)^3$

or $\frac{T_2}{T_1} = (1 + 0.01)^{3/2} = 1 + \left(\frac{3}{2} \times 0.01\right)$

or $\frac{T_2 - T_1}{T_1} = \frac{1.5}{100} = 1.5\%$

12 **(c)**

$\frac{g'}{g} = 1 - \frac{2h}{R} = 1 - \frac{2 \times 320}{6400} = 1 - \frac{1}{10} = \frac{9}{10}$

$\therefore$ % decrease in g $= \left(\frac{g - g'}{g}\right) \times 100$

$= \frac{1}{100} \times 100 = 10\%$

13 **(c)**

$v_e \propto \frac{1}{\sqrt{R}}$. If R becomes $\frac{1}{4}$ then v_e will be 2 times

14 **(d)**

Time period does not depends upon the mass of satellite

15 **(b)**

If missile is launched with escape velocity, then it will escape from the gravitational field and at infinity its total energy becomes zero

But if the velocity of projection is less than escape velocity then sum of energies will be negative. This shows that attractive force is working on the missile

16 **(a)**

Let R be the original radius of a planet. Then attraction on a body of mass m placed on its surface will be

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

If size of the planet is made double $ie, R' = 2R$, then mass of the planet becomes

$M' = \frac{4}{3}\pi(2R)^3\rho = 8 \times \frac{3}{4}\pi R^2\rho = 8M$

New force $F' = -\frac{GM'm}{R'^2} = -\frac{G8M \times m}{(2R)^2} = 2F$

ie, force of attraction increases due to the increase in mass of the planet

17 **(c)**

From Kepler 's third law of planetary motion,

$$T^2 \propto a^3$$

Given, $T_1 = 1\text{day}$ (geostationary)

$$a_1 = a, a_2 = 2a$$

$$\therefore \quad \frac{T_1^2}{T_2^2} = \frac{a_1^3}{a_2^3}$$

$$\Rightarrow \quad T_2^2 = \frac{a_2^3}{a_1^3} T_1^2 = \frac{(2a)^3}{a^3} \times 1 = 8$$

$$\Rightarrow \quad T_2 = 2\sqrt{2} \text{ days}$$

18 **(c)**

When gravitational force becomes zero, then centripetal force on satellite becomes zero and therefore, the satellite will become stationary in its orbit.

19 **(b)**

The period of revolution of geostationary satellite is the same as that of the earth.

Orbital velocity $v_o = \sqrt{gR_e}$

Escape velocity $v_e = \sqrt{2gR_e}$

where R_e is radius of earth.

$$\% \text{ increase} = \frac{v_e - v_o}{v_o} \times 100$$

$$\% \text{ increase} = \frac{\sqrt{2gR_e} - \sqrt{gR_e}}{\sqrt{gR_e}} \times 100$$

$$= (\sqrt{2} - 1) \times 100$$

$$= (1.141 - 1) \times 100 = 41.4\%$$

20 **(d)**

From Kepler's third law of planetary motion,

$$T^2 \propto R^3$$

$$\Rightarrow \quad \frac{T^2}{R^3} = \text{constant}$$

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