**Std.: 10 (English)** **Science - I**

## Chapter: 10:

**Q.1** **Textbook activity question** **4**

**1** What is the difference between space and sky?

**Ans** i. Sky is the region in which sunlight is scattered in the earth's atmospheremaking it visible from the surface of the planet, while space is everything beyond that.
ii. During day light, the sky appears to be blue while space is always dark.
iii. Sky has atmosphere while space does not have atmosphere.

**2** What is meant by a satellite?

**Ans** As astronomical object in space that orbits or circle around the earth or plants is called satellite.

**3** Which types of telescopes are orbiting around the earth? Why it is necessary to put them in space?

**Ans** i. The different types of telescope orbiting around the earth are optical telescope (Hubble), X ray telescope ( Chandra) etc.
ii. These telescope are placed is space because.
(a) Some of the light coming form heavenly bodies is absored by earth' atmosphere.
(b) The position of image in disturbed due to changes in pressure and turbulence in atmosphere.
(c) Optical telescope cannot be used during the day due to sunlight.
(d) During night city lights and cloudy weather cause difficulty in obervations.

**4** How many natural satellites does the earth have?

**Ans** How many natural satellites does the earth have?

**Q.2** **Give scientific reasons** **6**

**1** Geostationary satellites are not useful for studies of Polar regions.

**Ans** i. Geostationary satellites are High Earth orbit satellite and are placed at 35780 km above the earth's surface.
ii. A geostationary satellite revolves in the equatorial plane of the earth and thus it can never fly above the polar regions.
iii. Hence geostationary satellite are not useful for studies of polar regions.
iv. For this purpose, elliptical medium earth orbits passing over the polar region are used.
v. These orbits are called polar orbits.

**2** One can jump 6 times higher on Moon than on the Earth.

**Ans** (a) The acceleration due to gravity on Moon is $\frac{1}{6}$th of that on Earth.
(b) The formula $h = \frac{u^2}{2g}$ shows that with a specific initial velocity (u) we can jump six times higher on Moon than on the Earth.

**3** The escape velocity on moon is less than that on the earth.

**Ans** The escape velocity on moon is less than that on the earth.
Escape velocity from earth $V_{esc\,(1)} = \sqrt{\frac{2\,GM_1}{R_1}}$
Escape velocity from moon $V_{ess\,(2)} = \sqrt{\frac{2\,GM_2}{R_2}}$
$\frac{V_2}{V_1} = \sqrt{\frac{M_2}{M_1} \times \frac{R_1}{R_2}}$

$\frac{M_1\ (Earth)}{M_2\ (Moon)} = 81$ $\frac{R_1\ (Earth)}{R_2\ Moon} = 3.7$

$\frac{V_2}{V_1} = \sqrt{\frac{3.7}{81}} < 1$

So $V_2$ (moon) < $V_1$ (earth)

**Q.3 Solve Numerical problems.** **4**

**1** If mass of a planet is 8 times that of the earth and its radius is twice the radius of the earth, what will be the escape velocity of that planet? (Escape velocity for the earth – 11.2 km/s )

**Ans** Given :Mass of the planet, $M_P = 8\ M_E$

Radius of the planet, $R_P = 2\ R_E$

Escape velocity for the Earth, $V_{escE} = 11.2$ km/s

Escape velocity for the planet, $V_{escP} = ?$

$$V_{escP} = \sqrt{\frac{2\ GM_p}{R_p}}$$

$$= \sqrt{\frac{2G(8M_E)}{2R_E}}$$

$$= \sqrt{\frac{8}{2} \times \frac{2\ GM_E}{R_E}}$$

$$= \sqrt{\frac{8}{2}} \times \sqrt{\frac{2\ GM_E}{R_E}}$$

$$= \sqrt{4} \times V_{escE} \quad \because \quad V_{escE} = \sqrt{\frac{2\ GM_E}{R_E}}$$

$$= 2 \times 11.2$$

$V_{escE} = 22.4$ km/s

$$\boxed{\text{Escape velocity for the planet } = 22.4 \text{ km/s}}$$

**2** How much time a satellite in an orbit at height 35780 km above earth's surface would take, if the mass of the earth would have been four times its original mass?

**Ans** Height of orbit = 35780 km

Mass of earth = $4 \times 6 \times 10^{24}$ kg

Radii of earth = 6400 km

$$V = \sqrt{\frac{GM}{R}} = \sqrt{\frac{gr^2}{R}}$$

$$= \sqrt{\frac{9.8 \times (6.4 \times 10^6 \times 4)^2}{3.5780 \times 10^3 \text{m}}}$$

$$T = \frac{2\pi(rth)}{V} = \frac{2 \times 3.14 \times 35780 \times 10^3}{V}$$

Given G = gravitational constant = $6.67 \times 10^{-11}$ N $m^2/kg^2$

M mass of earth = $4 \times 6 \times 10^{24}$ kg

R = 6400 km

h = height of satellite above earth's surface = 35780 km

R + h = 6400 + 35780 = 42180 km = $42180 \times 10^3$ m.

$$V = \sqrt{\frac{GM}{R+h}}$$

$$= \sqrt{\left(\frac{6.67 \times 10^{-11} \times 4 \times 6 \times 10^{24}}{42180 \times 10^3}\right)}$$

v = 6.16 km/s

We know v = distance / time

= circumference / time

$= 2\pi r/T$

$$T = \frac{2\pi(R+h)}{v}$$

$$T = \frac{2 \times 3.14 \times 42.180}{6.16}$$

T = 43001.68 sec

T = 11.94 hr or approximately 12 hours.

**Q.4 Complete the given flow chart / table / diagram** **2**

**1** Complete the table

| | | |
|---|---|---|
| IRNSS | …….. | …….. |
| INSAT | Weather study and predict | …….. |
| IRS | …….. | Earths observation |

**Ans**

| | | |
|---|---|---|
| IRNSS | Navigational satellite | To fix the location in terms of latitude and longitude |
| INSAT | Weather study and predict | Weather satellite |
| IRS | Earth observation Satellite | Earths observation |

**Q.5 Give explanation using the given statements** **6**

**1** Complete the statement and explain the following:
The Initial velocity of the Mangalyaan must be greater than …… from earth.

**Ans** The Initial velocity of the Mangalyaan must be greater than **escape velocity** from earth.
**Explanation**:- If the satellite is to travel beyond the gravitational pull of earth its velocity must be more than the escape velocity from the earth.

**2** Complete the statement and explain the following:
If the height of the orbit of a satellite from the earth's surface is increased, the tangential velocity of the Satellite will ..... .

**Ans** If the height of the orbit of a satellite from the earth's surface is increased, the tangential velocity of the Satellite will **decrease**.
**Explanation**:- The gravitational force exerted by earth on the Satellite decreases, with the increase in the height of orbit of the Satellite from earth's surface. Hence the tangential velocity of the Satellite with decrease.

$v_c = \sqrt{\frac{GM}{R+h}}$

**Q.6 Solve Numerical problems** **12**

**1** Suppose the orbit of a satellite is exactly 35780 km above the earth's surface. Determine the tangential velocity of the satellite.

**Ans** Given :

$G = 6.67 \times 10^{-11}\ NM^2 / kg^2$

$M(earth) = 6 \times 10^{24}$ kg

$R(earth) = 6.4 \times 10^{6}$ m

$h = 35780$ km $= 35780 \times 10^{3}$ m

$V_c = \sqrt{\frac{GM}{R+h}}$

$= \sqrt{\frac{6.67\times10^{-11}\times6\times10^{24}}{6.4\times10^{6}+35780\times10^{3}}}$

$= \sqrt{\frac{6.67\times6\times10^{13}}{10^{3}\ (6400+35780)}}$ m/s

$= \sqrt{\frac{40.02\times10^{10}}{42180}}$ m/s

$= \sqrt{\frac{400200\times10^{6}}{42180}}$

$= \sqrt{9.488 \times 10^{6}}$ m/s

$= 3.08 \times 10^{3}$ m/s

= 3.08 km/s

**2** How much time will a satellite located 35780 km above the surface of earth take to complete one revolution critical velocity is 3.08 km/s

**Ans** Given :

R = 6400 km = 6.4 $\times 10^6$ m

h = 35780 km = 3.5780 $\times$ $10^7$ m

$V_C$ = 3.08 km/s = 3.08 $\times$ $10^3$ m/s

T = ?

The time required is

$$T = \frac{2\pi(R+h)}{V_c}$$

$$= \frac{2\times 3.14\times\left(6.4\times10^6+35.78\times10^6\right)}{3.08\times10^3}$$

$$= \frac{6.284\times10^3\times42.18}{3.08}$$

Approx 86060 s

23hrs 54min 20 sec

Approx 24 hrs

**3** How much time would a satellite in an orbit at a height of 35780 km above the earth's surface take to complete one revolution around earth. If the mass of earth was four times its original mass.

**Ans** Given :

(earth) R = 6400 km = 6.4 $\times$ $10^6$ m

(earth) M = 6 $\times$ $10^{24}$ kg.

$M^1$ = 4M = 4 $\times$ 6 $\times$ $10^{24}$ kg.

h = 35780 km = 35.78 $\times$ $10^6$ m.

G = 6.67 $\times$ $10^{-11}$ $NM^2$ / $kg^2$.

T = ?

$$T = \frac{2\pi(R+h)}{V_c}$$

$$V_C = \sqrt{\frac{GM'}{R+h}}$$

$$T = \frac{2\pi(R+h)}{\sqrt{\frac{GM'}{R+h}}}$$

$$\frac{2\pi(R+h)^{3/2}}{\sqrt{GM'}}$$

$$= \frac{2\pi\left(6.4\times10^6+35.78\times10^6\right)^{3/2}}{\sqrt{6.67\times10^{-11}\times4\times6\times10^{24}}}$$

$$= \frac{2\pi\left(42.18\times10^6\right)^{3/2}}{\sqrt{6.67\times24\times10^{13}}}$$

$$= \frac{2\pi\sqrt{(42.18)^3\times10^{18}}}{\sqrt{6.67\times2.4\times10^{14}}}$$

$$= 2\times3.142\sqrt{\frac{(42.18)^3\times10^4}{6.64\times2.4}}$$

= Approx 4.303 $\times$ $10^4$ S = 11.95hr

= Approx 4.303 $\times$ $10^4$ hr = 12 hr approx

**4** If the height of a satellite completing one revolution around the earth in T seconds is $h_1$ metres, then what would be the height of a satellite taking $2\sqrt{2}$ T seconds for one revolution?

**Ans** Given :

i. Time :T seconds

ii. Height : $h_1$

iii. Let us assume the height of the satellite completing one revolution in $2\sqrt{2}$ T seconds as $h_2$ Known :

$$T = T = \frac{2\pi r}{V_c},\ \text{i.e.},\ T = \frac{2\pi(R+h_1)}{\sqrt{\frac{GM}{(R+h_1)}}}$$

$$\therefore \quad T = 2\pi\sqrt{\frac{(R+h_1)^3}{GM}} \qquad \text{... (1)}$$

To be calculated :

Height $h_2$ in time $2\sqrt{2}$ T seconds

$$2\sqrt{2}\,T = 2\pi\sqrt{\frac{(R+h_2)^3}{GM}} \quad \ldots (2)$$

from Eqs. (1) and (2),

$$\therefore \quad \frac{T}{2\sqrt{2}\,T} = \frac{2\pi\sqrt{\frac{(R+h_1)^3}{GM}}}{\sqrt{\frac{(R+h_2)^3}{GM}}}$$

$$\therefore \quad \frac{1}{\sqrt{8}} = \frac{\sqrt{(R+h_1)^3}}{\sqrt{(R+h_2)^3}}$$

$$\therefore \quad \frac{1}{2} = \frac{(R+h_2)}{(R+h_2)}$$

$\therefore$ $R + h_2 = 2R + 2h_1$

$\therefore$ $h_2 = R + 2h_1$.

**Q.7 Answer the following** **9**

**1** What is meant by the orbit of a satellite? On what basis and how are the orbits of artificial satellites classified?

**Ans** **An orbit is a specific path (elliptical or circular) or trajectory around a planet in which a satellite revolves. Depending on the height of the satellite's orbit above the earth's surface, the satellite orbits are classified as below:**

**High Earth Orbits (HEO)**

a. **(Geosynchronous Satellites):** If the height of the satellite's orbit above earth's surface is greater than or equal to 35780 km, the orbit is called High earth orbits.

**Medium Earth Orbit (MEO) :**

b. **(Geostationary Satellites):** If the height of the satellite's orbit above the earth's surface is in between 2000 km and 35780 km, the orbits are called medium earth orbits.

**Low Earth Orbit (LEO):**

c. If the height of the satellite orbit above the earth's surface is in between 180 km and 2000 km, the orbits are called low earth orbits.

**2** State true or false stating reasons - A satellite needs a specific velocity to revolve in specific orbit.

**Ans** A satellite needs a specific velocity to revolve in specific orbit - **True**

Centri petal force on the satellite $\frac{mv_c^2}{R+h}$ is equal to gravitational force exerted by the earth on the satellite.

$$\frac{mv_c^2}{R+h} = \frac{GMm}{(R+h)^2}$$

$$V_c^2 = \frac{GMm\ (R+h)}{m \times (R+h)^2}$$

$$V_c = \sqrt{\frac{GM}{R+h}}$$

$\therefore$ if value of h changes value $V_c$ also changes.

This clearly shows satellite needs to be given a specific velocity in the tangential direction to keep it revolving in a specific orbit.

**3** What is meant by space debris ? Why there is used to manage the debris ?

**Ans** Space debris – In addition to the artificial satellite, some other objects such as non-functional satellites, parts of the launcher detached during launching and debris generated due to collision of satellite with other satellite or any other object in the space, revolve around the earth. All this forms space debris.

i. It is harmful to the artificial satellites.
ii. It can collide with these satellites or space crafts and damage them.
iii. Due to increasing debris, it will become difficult to launch new space craft.

**Q.8 Answer the following in detail** **15**

**1** Explain the satellite launch vehicle developed by ISRO with the help of schematic diagram.

**Ans** i. The satellite launch vehicles are used to place the satellites in their specific orbits.
ii. The structure of the launch vehicle is decided by the weight of satellite and type of satellite orbit.
iii. Fuel forms a major portion of the total weight of launch vehicle.
iv. The vehicle has to carry a large weight of the fuel with it.
v. To overcome this problem, launch vehicles with more than one stage are used.
vi. Due to this, the weight of vehicle can be reduced step by step after its launching.
vii. When fuel and engine at first stage is used, it takes the vehicle to a certain height, the empty, fuel tank

and engine are detached from the main body of vehicle and fall either into a sea or an unpopulated land.

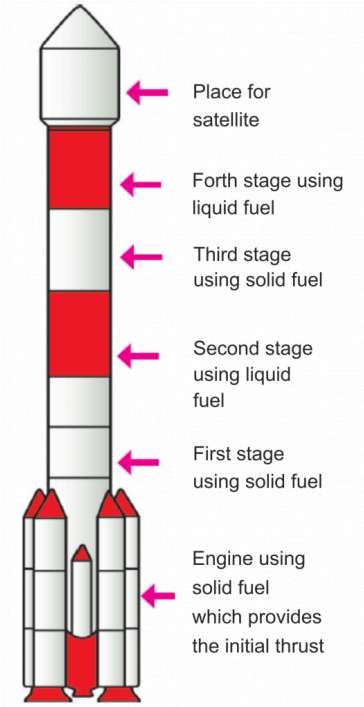
viii. The fuel in the second stage is ignited.

ix. The vehicle now contains only second stage fuel.

x. The weight now being reduced, the vehicle can now move with higher speed.

xi. Almost all vehicles are made of either two or more stages to use the fuel optimally.

xii. The Polar Satellite Launch Vehicle (PSLV) developed by ISRO in a schematic dig.




**2** What is meant by an artificial satellite? How are the satellites classified based on their functions?

**Ans** A manmade object orbiting the earth or any other planet is called an artificial satellite. Satellites work on solar energy and hence photovoltaic panels are attached on both sides of the satellite, which look like wings. Satellites are installed with various transmitters and other equipment to receive and transmit signals between the earth and the satellites.

Classification of satellites depending on their functions:

i. **Weather satellites :** Weather satellites collect the information regarding weather conditions of the region. It records temperature, air pressure, wind direction, humidity, cloud cover, etc. this information is sent to the space research station on the earth, and then with this information weather forecast is made.

ii. **Communication satellites :** In order to establish communication between different places on the earth through mobile phones or computer assisted internet, communication satellites are used. Many artificial satellites placed at various location in the earth's orbit are well interconnected and help us to have communication with any place, from anywhere, at any time and in any form including voicemail, email, photographs, audio mail, etc.

iii. **Broadcasting satellites :** Broadcasting satellites are used to transmit various radio and television programmes and even live programmes from any place on the earth to any other place. As a result, one can have access to information about current incidents, events, programmes, sports and other events right from his drawing room with theses satellites.

iv. **Navigational satellites :** Navigational satellites assist the surface, water and air transportation and coordinate their busy schedule. These satellites also assist the user with current live maps as well as real time traffic conditions.

v. **Military satellites :** Every sovereign nation needs to keep the real time information about the borders. Satellites help to monitor all movements of neighbouring countries or enemy countries. Military satellites also help to guide the missiles effectively.

vi. **Earth observation satellites :** These satellites observe and provide the real time information about the earth. These satellites also help us to collect the information about the resources, their management, continuous observation about a natural phenomenon and the changes within it.

vii. **Other satellites :** Apart from these various satellites, certain satellites for specific works or purposes are also sent in the space. E.g. India has sent EDUSAT for educational purpose; CARTOSAT for surveys and map making. Similarly, satellites with telescopes, like Hubble telescope or a satellite like International Space Station help to explore the universe. In fact, ISS (International Space Station) provides a temporary

residence where astronauts can stay for a certain short or long period and can undertake the research and study space activities.

**3** Why it is beneficial to use satellite launch vehicles made of more than one stage?

**Ans**
i. Earlier Satellite Launch Vehicles used to be a single stage vehicles.
ii. Such satellite launch vehicles used to be very heavy as well as expensive in terms of its fuel consumption.
iii. As a result, satellite launch vehicles with multiple stages were developed.
iv. In a multiples SLVs, as the journey of the launch vehicle progresses and the vehicle achieves a specific velocity and a certain height, the fuel of the first stage is exhausted and the empty fuel tank gets detached from the main body of the launch vehicle.
v. It falls back into a sea or on unpopulated land.
vi. As the fuel in the first stage is exhausted, the engine in the second stage is ignited.
vii. The weight of the launch vehicle is now less that what it was earlier and now it can move with higher velocity.
viii. It saves fuel consumption.
ix. It is beneficial to use a multistage satellite launch vehicle.