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# GRAVITATION

SUBJECT-PHYSICS
CHAPTER NUMBER-10



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## LEARNING OBJECTIVE

Students will be able

- Define acceleration due to gravity.
- Calculate value of acceleration due to gravity.

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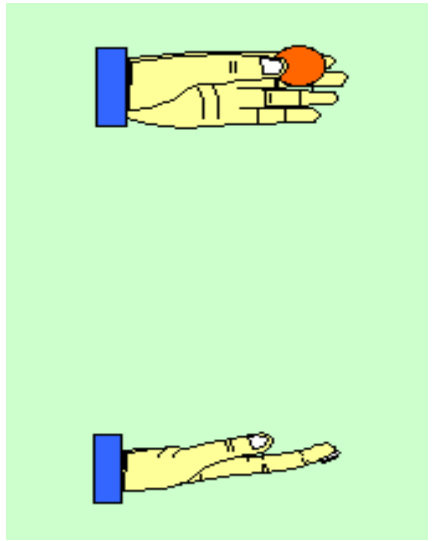
## Recapitulation

- State the universal law of gravitation.
- What are Important Characteristics of Gravitational forces?
- Write the importance of universal law of gravitation.
- What is the difference between gravity and gravitation?

**Acceleration Due to Gravity**

- When an object falls towards the earth there is a change in its acceleration due to the gravitational force of the earth. So this acceleration is called acceleration due to gravity.
- The acceleration due to gravity is denoted by g.
- The unit of g  is same as the unit of acceleration, i.e., $ms^{-2}$



# Mathematical Expression for *g*

From the second law of motion, force is the product of mass and acceleration.

$$F = ma$$

For free fall, acceleration is replaced by acceleration due to gravity.

Therefore, force becomes:

$$F = mg \qquad \text{....(i)}$$

But from Universal Law of Gravitation,

$$F = \frac{GMm}{d^2} \qquad \text{....(ii)}$$

From equations (i) and (ii), we get:

$$mg = \frac{GMm}{d^2}$$

$$\Rightarrow \qquad g = \frac{GM}{d^2}$$

Where $M$ is the mass of the earth and $d$ is the distance between the object and the earth.

For objects near or on the surface of the earth distance $d$ is equal to the radius of the earth $R$.

Thus, $$g = \frac{GM}{R^2} \qquad \text{.....(iii)}$$

## Value of acceleration due to gravity

Mass of the earth, $M = 6 \times 10^{24}$ kg

Radius of the Earth, $R = 6.4 \times 10^{6}$ m

Gravitational constant, $G = 6.67 \times 10^{-11}\ Nm^2/kg^2$

Therefore value of g on Earth,

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

$$= \frac{6.67 \times 10^{-11} \times 6 \times 10^{24}}{6.4 \times 10^{6} \times 6.4 \times 10^{6}} m/s^2$$

$$= 9.8\ m/s^2$$

**Q.A cricket ball thrown vertically upwards, reaches a maximum height of 5 meters. Find the initial speed of the ball.**

HOME ASSIGNMENT

- Calculate the value of g on the surface of earth.
- What do you mean by acceleration due to gravity?

# THANKING YOU
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