CBSE Test Paper 03

Chapter 10 Gravitation

1. Match the following with correct response. **(1)**

Column A	**Column B**
(1) Value of G	(A) Newton
(2) Object floats over water	(B) Density is less than water
(3) S.I unit of pressure	(C) Always constant
(4) S.I unit of weight	(D) Pascal

   a. 1-D, 2-A, 3-C, 4-B
   b. 1-B, 2-D, 3-A, 4-C
   c. 1-C, 2-B, 3-D, 4-A
   d. 1-A, 2-C, 3-B, 4-D

2. Gravitation force is a **(1)**
   a. non-central force
   b. short range force
   c. strongest force
   d. weakest force

3. Pressure at a point in the liquid is :- **(1)**
   a. Same in all directions
   b. Greater in the upward direction
   c. Greater in left side
   d. Greater in the downward direction

4. Which of the statements is correct? **(1)**
   a. Mass is constant and weight is variable
   b. Both Mass and weight are variable.
   c. Mass is variable and weight is constant.
   d. Both Mass and weight are constant.

5. As the contact area between two objects increases the pressure_____**(1)**
   a. decreases
   b. remains constant

c. increases
d. zero

6. If the acceleration due to gravity at a place is more, the weight of that object will:- **(1)**
   a. Decrease
   b. Remains same
   c. None of the above
   d. Increase
7. How does the force of gravitation between two objects change when the distance between them is reduced to half? **(1)**
   a. becomes one third
   b. becomes thrice
   c. reduced to half
   d. becomes four time
8. What do we call the gravitational force between the earth and an object? **(1)**
9. What do you mean by free fall? **(1)**
10. Who found out the value of gravitational constant (G)? **(1)**
11. Give a mathematical proof of the Archimedes principle? **(3)**
12. Two bodies of masses 3 kg and 12 kg are placed at a distance 12 m. A third body of mass 0.5 kg is to be placed at such a point that the force acting on this body is zero. Find the position of that point. **(3)**
13. On the earth, a stone is thrown from a height in a direction parallel to the earth's surface while another stone is simultaneously dropped from the same height. Which stone would reach the ground first and why? **(3)**
14. How does the force of gravitation between two objects change when the distance between them is reduced to half? **(3)**
15. A ball thrown up vertically returns to the thrower after 6s.
    Find
    a. the velocity with which it was thrown up.
    b. the maximum height it reaches and c) its position after 4s. **(5)**

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Answers

1. c. 1-C, 2-B, 3-D, 4-A

   Explanation:

   i. Value of G is always constant.

   ii. Object floats over water if its density is less than water.

   iii. S.I unit of pressure is Pascal.

   iv. S.I unit of weight is Newton.

2. d. weakest force

   Explanation: Gravitational force is a weak force. This force exists between each and every object but cannot be felt until the mass of the bodies are not extremely high like planets.

3. a. Same in all directions

   Explanation: Pressure is transmitted undiminished in any direction.

4. a. Mass is constant and weight is variable

   Explanation: Mass is an independent quantity but weight is dependent on gravity.As the gravity changes, weight also change.

5. a. decreases

   Explanation: In the case of contact forces between two objects as the area of contact between the two increases the pressure per square unit of measure will decrease.

6. d. Increase

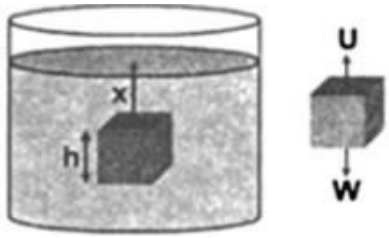
   Explanation: W = mg, weight of an object is directly proportional to acceleration due to gravity of an object.

7. d. becomes four time

   Explanation: Gravitational force is inversely proportional to square of the distance between them. Hence when distance is reduced to half the gravitational force will increase four times.

8. It is called force of gravity.

9. When an object falls with a constant acceleration, under the influence of force of gravitation of the earth, object is said to have free fall.
10. Henry Cavendish
11. Archimedes principle states that when a body is immersed partially or wholly in a liquid, its weight appears to be reduced and loss of weight is equal to the weight of liquid displaced by the body.



proof: Consider a body of height h and area of cross-section A placed in a liquid of density σ at a depth x below the free surface.

Let ρ be the density of the body

Now the pressure at the upper face of the body is,

$P_1 = P_0 + x\sigma g$

Where P_0 is atmospheric pressure.

The pressure at the lower face of the body is,

$P_2 = P_0 + (h + x)\sigma g$

Therefore downward thrust on the upper face of the body is,

$F_1 = P_1 A$

and upward thrust on the lower face of the body is,

$\mathrm{F}_2 = \mathrm{P}_2\mathrm{A}$

Since $P_2 > P_1$ therefore $F_2 > F_1$

The body will experience the net force F_2-F_1 in upward thrust.

$\therefore\ U = F_2 - F_1 = (P_2 - P_1)\,A$

$= A[(h + x)\sigma g - x\sigma g] = Ah\sigma g$

$= \mathrm{V}\sigma\mathrm{g}$

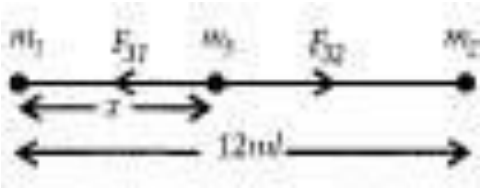
Where V is the volume of body = weight of liquid displaced by the body.

Now, the body experience two forces: weight of the body itself and upward thrust.

$\therefore$ Apparent weight of a body is,

$\mathrm{W_a} = \mathrm{w} - \mathrm{U}$

i.e. Apparent weight is less than the actual weight by equal to the weight of liquid displaced by the body.

12. 

Given, Mass of one body, m_1 = 3kg; and Mass of other body, m_2 = 12kg.

Let the mass of third body, m_3 = 0.5 kg be placed at a distance of 'x'm from m_1, as shown in figure.

Then force acting on m_3 due to m_1, is equal and opposite to the force acting on m_3 due to m_2, i.e the force on third body is zero;

$\therefore F_{31} = F_{32}$

$$\frac{Gm_1m_3}{x^2} = \frac{Gm_3m_2}{(12-x)^2}$$

Put the given values, we have,

$$\frac{3}{x^2} = \frac{12}{(12-x)^2}$$

$$\Rightarrow \left(\frac{12-x}{x}\right)^2 = \frac{12}{3} = 4 \Rightarrow \frac{12-x}{x} = 2$$

$\Rightarrow$ 12 - x = 2x $\Rightarrow$ 12 = 3x

$\Rightarrow$ x = 4 m

The position of required point is at a distance of 4 m form mass of 3 kg and

The position of required point is at distance of (12m - 4m)=8m from mass of 12 kg.

13. For both the stones, Their initial velocity, u = 0

Acceleration in downward direction = g

Using equation, S =ut + $\frac{1}{2}$ at^2

Now, h = ut + $\frac{1}{2}$ gt^2

$\Rightarrow$ h = 0 + $\frac{1}{2}$ gt^2

$\Rightarrow$ h = $\frac{1}{2}$ gt^2

$\Rightarrow$ t = $\sqrt{\frac{2h}{g}}$

Since time period depends upon the height and acceleration due to gravity. Here, both stones fall from same height and planet. Therefore, Both stones will take the same time to reach the ground.

14. According to universal law of gravitation,the gravitational force of attraction between any two objects of mass is proportional to the product of the masses and inversely proportional to the square of the distance between them. Hence if the distance is

reduced to half, then the gravitational force becomes four times larger than the previous value.

15. ∵ the ball returns back to the thrower in 6s, the time for its upward journey = 6 ÷ 2 = 3s

For the upward motion of the ball

Initial velocity (u) = ?

Final velocity (v) = 0 (∵ Ball comes to rest)

Time (t) = 3s

Acceleration due to gravity (g) = - 10 ms^{-2} [In upward direction g is -ve]

We know:

$v = u + gt$

$\Rightarrow 0 = u - 10 \times 3$

$\Rightarrow -u = -30$

$\Rightarrow u = 30\ ms^{-1}$

We know: $S = ut + 1/2\ gt^2$

$S = 30 \times 3 - \frac{1}{2} \times 10 \times (3)^2$

$\Rightarrow S = 90 - 45$

$S = 45$ m

For the downward motion of ball

Initial velocity (u) = 0

Time for downward fall (t) = 4 - 3 =1 s

Acceleration due to gravity (g) = 10 ms^{-1}

Distance covered in downward direction (S) = ?

We know: $S = ut + 1/2\ gt^2$

$S = 0 + t + \frac{1}{2} \times 10 \times (1)^2$

$\Rightarrow S = 0 + 5$

$\Rightarrow S = 5$ m

Position of ball after 4s from ground

= 45 - 5 = 40 m.