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CHAPTER 10

Gravitation

1. OBJECTIVE QUESTIONS

1. Newton's law of gravitation is valid
(a) on the earth only
(b) on the moon only
(c) in the laboratory only
(d) everywhere

Ans : (d) everywhere
Newton's law of gravitation is valid everywhere in the universe.

2. An astronaut in the orbit in a spacecraft feels weightlessness
(a) due to the absence of gravity inside
(b) due to the fact that spacecraft has no energy
(c) because acceleration in the orbit is equal to acceleration of gravity outside
(d) there is no gravity outside

Ans : (c) because acceleration in the orbit is equal to acceleration of gravity outside

3. The equation $F = \dfrac{Gm_1 m_2}{r^2}$ is valid for
(a) rectangular bodies   (b) circular bodies
(c) elliptical bodies   (d) spherical bodies

Ans : (d) spherical bodies

4. Newton's law of gravitation is valid
(a) in laboratory   (b) only on the earth
(c) only in our solar system   (d) everywhere

Ans : (d) everywhere
Newton's law of gravitation is a universal law.

5. When a body is thrown up, the force of gravity is
(a) in the upward direction
(b) in the downward direction
(c) zero
(d) in the horizontal direction

Ans : (b) in the downward direction
The acceleration due to gravity is always directed downwards towards the centre of the Earth for a freely falling body.

6. When an object is thrown upward, the force of gravity is
(a) opposite to the direction of motion
(b) in the same direction as the direction of motion
(c) becomes zero at the highest point

(d) increases as it rises up

Ans : (a) opposite to the direction of motion
When an object is thrown upwards, the force of gravity acts in the direction opposite to that of motion.

7. What happens to the acceleration due to gravity with the increase in altitude from the surface of the earth?
(a) Increases
(b) Decreases
(c) First decreases and then increases
(d) Remains same

Ans : (b) Decreases
Acceleration due to gravity decreases with the increase in altitude.

8. The acceleration due to gravity
(a) has the same value everywhere in space
(b) has the same value everywhere on the earth
(c) varies with the latitude on the earth
(d) is greater on the moon due to its smaller diameter

Ans : (c) varies with the latitude on the earth
The acceleration due to gravity varies with latitude on the earth.

9. Which of the following statements is/are correct?
1. Mass of an object is the measure of its inertia.
2. Heavier the object smaller is the inertia.
3. The mass of an object is variable.
(a) Only 1   (b) 1 and 3
(c) 2 and 3   (d) 1 and 2

Ans : (a) Only 1
Heavier the object, greater is the inertia. The mass of an object is constant.

10. The mass of a body is measured to be 12 kg on the earth. If it is taken to the moon, its mass will be
(a) 12 kg   (b) 6 kg

(c) 2 kg   (d) 72 kg

Ans : (a) 12 kg
Mass of the body is constant and does not change from place of place.

11. A solid of density D is floating in a liquid of density d. If V is the volume of solid submerged in the liquid and V' is the total volume of the solid, then V'/V is equal to

   (a) $\dfrac{d}{D}$ (b) $\dfrac{D}{d}$

   (c) $\dfrac{D}{d+D}$ (d) $\dfrac{D+d}{D}$

Ans : (b) $\dfrac{D}{d}$
As solid is floating in the liquid,
Hence, Weight of the solid body = Weight of liquid displaced by immersed part of the body

or $VD\rho g = V'dg$

or $\dfrac{V'}{V} = \dfrac{D}{d}$

12. Which of the following statements is true?
   (a) g is same at all places on the surface of earth.
   (b) g has its maximum value at the equator.
   (c) g is less at the earth's surface than at a height above it or a depth below it.
   (d) g is greater at the poles than at the equator.

Ans : (d) g is greater at the poles than at the equator.

13. If more force is required to bring a body into a unit acceleration, the body has
   (a) less mass
   (b) zero mass
   (c) more mass
   (d) mass is independent of force

Ans : (c) more mass

$$F = ma$$
If $a = 1$
then $F = m$

14. The weight of a body is 120 N on the earth. If it is taken to the moon, its weight will be about
   (a) 120 N   (b) 60 N
   (c) 20 N   (d) 720 N

Ans : (c) 20 N

15. The value of acceleration due to gravity at the Mount Everest is
   (a) g (b) $> g$
   (c) $< g$ (d) zero

Ans : (c) $< g$

16. Loss of weight of a body immersed in a liquid is
   (a) equal to the weight of the liquid displaced
   (b) more than the weight of the liquid displaced
   (c) less than the weight of the liquid displaced
   (d) zero

Ans : (a) equal to the weight of the liquid displaced

17. The type of force that exists between two charged bodies is
   (a) only gravitational   (b) only electrostatic
   (c) neither (a) nor (b)   (d) both (a) and (b)

Ans : (d) both (a) and (b)

18. Which of the following is correct?
   (a) Weight is a scalar quantity.
   (b) Weight is not a fundamental quantity.
   (c) Weight does not depend on acceleration due to gravity.
   (d) None of these

Ans : (b) Weight is not a fundamental quantity.
If the value of g changes the weight of the body changes.

19. Pascal is a unit of
   (a) pressure   (b) force
   (c) linear momentum   (d) energy

Ans : (a) pressure

20. Gravitational force is a
   (a) repulsive force   (b) attractive force
   (c) neither (a) nor (b)   (d) both (a) and (b)

Ans : (b) attractive force
Gravitational force is an attractive force.

21. A beaker is filled with a liquid of density ρ upto a height h. If the beaker is at rest, the mean pressure at the walls is
   (a) 0   (b) $h\rho g$
   (c) $h\rho g/2$ (d) $2h\rho g$

Ans : (c) $h\rho g/2$
Mean pressure at the walls of the beaker

$$= \dfrac{0 + h\rho g}{2} = h\rho g/2$$

22. A coin and a feather are dropped together in a vacuum. Then
   (a) the coin will reach the ground first
   (b) the feather will reach the ground first
   (c) both will reach the ground at the same time
   (d) the feather will not fall down

Ans : (c) both will reach the ground at the same time
In vacuum, all freely falling bodies have same acceleration.

23. "When a solid body is partially or completely immersed in a fluid, the fluid exerts an upward force on the body, whose magnitude is equal to the weight of the displaced fluid". This is known as
   (a) Archimedes' principle
   (b) Tyndall effect
   (c) Newton's lst law of motion
   (d) Bernoulli's theorem

Ans : (a) Archimedes' principle

24. Relative density of silver is 10.8. The density of water

is 10^3 kg/m^3. What is the density of silver is SI units?
(a) $10.8 \times 10^3 \text{ kg/m}^3$ (b) $12.3 \times 10^3 \text{ kg/m}^3$
(c) $10.8 \times 10^2 \text{ kg/m}^3$ (d) $11.7 \times 10^3 \text{ kg/m}^3$

Ans : (a) $10.8 \times 10^3 \text{ kg/m}^3$

$$\text{Density of silver} = \text{relative density}$$
$$\times \text{ density of water}$$
$$= 10.8 \times 10^3 \text{ kg/m}^3$$

25. Gravitational force is the
(a) weakest force   (b) strongest force
(c) short-range force   (d) non-central force

Ans : (a) weakest force
Gravitational force is the weakest force in nature.

26. The universal constant of gravitation G has the unit
(a) N   (b) m/s^2
(c) $(\text{N m}^2)/\text{kg}^2$ (d) J

Ans : (b) $(\text{N m}^2)/\text{kg}^2$

Gravitation constant, $\qquad G = \dfrac{Fr^2}{m_1 m_2}$

Hence, $\qquad \text{Unit of } G = \dfrac{\text{Newton} \, (\text{metre})^2}{(\text{ki} \log \text{ram})^2}$
$$= \dfrac{\text{Nm}^2}{\text{kg}^2}$$

27. Where will it be profitable to purchase one kilogram sugar?
(a) At poles   (b) At equator
(c) At $45°$ latitude   (d) at $40°$ latitude

Ans : (b) At equator
Since the value of g is minimum at the equator, so while purchasing 1 kg wt sugar at equator using spring balance, we will get more mass as compared to that at other place of earth.

28. What is the unit of relative density?
(a) kg m^3 (b) kg/m^3
(c) per m^3 (d) It is unitless

Ans : (d) It is unitless
$$\text{Relative Density} = \frac{\text{Density of substance}}{\text{Density of water at } 4°\text{C}}$$

29. The mass of a body is increased 4 fold and mass of other body is increased 16 fold. How should the distance between them be changed to keep the same gravitational force between them?
(a) 4 times   (b) $\frac{1}{4}$ times
(c) 8 times   (d) $\frac{1}{8}$ times

Ans : (c) 8 times
$$F = \frac{Gm_1 m_2}{d^2} = \frac{G(4m_1)(16m_2)}{d'^2}$$
$$d'^2 = 64 d^2$$
or $\qquad d' = 8d$

30. When you put an object on a spring balance, what do you measure?
(a) Weight   (b) Force

(c) Mass   (d) Acceleration

Ans : (a) Weight
We can measure weight of an object by spring balance and mass of an object by physical balance.

31. Acceleration due to gravity is maximum at (R is the radius of earth)
(a) a height $\dfrac{R}{2}$ from the earth's surface
(b) the centre of the earth
(c) the surface of the earth
(d) a depth $\dfrac{R}{2}$ from earth's surface

Ans : (c) the surface of the earth
Acceleration due to gravity at a height above or below the earth's surface decreases. It is zero at the centre of the earth. It is maximum at the surface of the earth.

32. The value of G was first determined experimentally by
(a) Newton   (b) Henry Cavendish
(c) Kepler   (d) Galileo

Ans : (b) Henry Cavendish
The value of universal gravitational constant G was first determined experimentally by English scientist Henry Cavendish in 1798.

33. The value of acceleration due to gravity is high if
(a) mass and radius both are small
(b) mass is small and radius is large
(c) mass is large and radius is small
(d) mass and radius both are large

Ans : (c) mass is large and radius is small
Acceleration due to gravity,
$$g = \frac{GM}{R^2}$$

34. An apple falls towards the earth because the earth attracts it. The apple also attracts the earth by the same force. Why do we not see the earth rising towards the apple?
(a) Acceleration of the earth is very large when compared to that of apple.
(b) Acceleration of the earth is equal to that of apple.
(c) Acceleration of the earth is neither high nor too low.
(d) Acceleration of the earth is very small when compared to that of apple.

Ans : (d) Acceleration of the earth is very small when compared to that of apple.
The mass of the earth is extremely large as compared to that of apple. So, acceleration of the earth is very small when compared to that of apple.

35. Which of the following is correct for mass?
(a) It is a vector quantity.
(b) It is not a fundamental property of material body.
(c) It is the force with which the earth attracts a body.

(d) It is the quantity of matter contained in a body.

Ans : (d) It is the quantity of matter contained in a body.

36. The value of g is zero
    (a) at the top of the atmosphere
    (b) at 20 km below the surface of the earth
    (c) at 20 km above the surface of the earth
    (d) at the centre of the earth

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Ans : (d) at the centre of the earth
The value of acceleration due to gravity is zero at the centre of the earth.

37. In spaceship moving in space, person experience weightlessness as the value of
    (a) mass is zero
    (b) acceleration due to gravity is zero
    (c) gravitational force is zero
    (d) none of these

    Ans : (b) acceleration due to gravity is zero
    $$W = mg$$
    In space, $\quad g = 0$
    Hence, $\quad W = 0$

38. A balloon of mass m is rising with an acceleration a. A fraction of its mass is detached from the balloon. Its acceleration will
    (a) decrease   (b) increase
    (c) remain the same   (d) none of these

    Ans : (b) increase

39. The buoyant force on a body acts in a
    (a) vertically downward direction
    (b) vertically upward direction
    (c) horizontal direction
    (d) direction between the horizontal and the vertical

    Ans : (b) vertically upward direction

40. The unit of $\frac{G}{g}$ is
    (a) kg m^{-1} (b) kg m^{-2}
    (c) $\text{m}^2 \text{kg}^{-1}$ (d) m kg^{-1}

    Ans : (c) $\text{m}^2 \text{kg}^{-1}$

$$g = \frac{GM}{R^2}$$
or $\qquad \frac{G}{g} = \frac{R^2}{M} = \frac{\text{m}^2}{\text{kg}} = \text{m}^2 \text{kg}^{-1}$

41. A piece of iron of density $7.8 \times 10^3 \text{ kg/m}^3$ and volume 100 cm^3 is totally immersed in water. Calculate apparent weight in water.
    (a) 6.8 N   (b) 60 N
    (c) 1.2 N   (d) 10 N

    Ans : (a) 6.8 N

    Apparent weight = true weight of iron piece
    $$- \text{ upthrust on iron piece in water}$$
    $$= W - F_B$$
    $$= 7.8 \text{ N} - 0.98 \text{ N}$$
    $$= 6.8 \text{ N}$$

42. Orbital velocity of earth satellite does not depend on
    (a) mass of the earth
    (b) mass of the satellite
    (c) radius of the earth
    (d) acceleration due to gravity

    Ans : (b) mass of the satellite
    Orbital velocity of earth satellite is
    $$v_0 = \sqrt{\frac{GM}{R+h}} = \sqrt{\frac{gR^2}{R+h}} \qquad \left(g = \frac{GM}{R^2} \right)$$
    Thus, it is independent of the mass of the satellite (m) but depends on the mass of the earth (M), radius of the earth (R), acceleration due to gravity (g) at earth's surface and height (h) of the satellite from the surface of earth.

2. FILL IN THE BLANK

DIRECTION : Complete the following statements with an appropriate word/term to be filled in the blank space (s).

1. Acceleration due to gravity is .... proportional to the density of the planet.
   Ans : directly

2. Dimensional formula of universal gravitational constant is ....
   Ans : $[\text{M}^{-1}\text{L}^3\text{T}^{-2}]$.

3. The force of .... is the centripetal force on the moon.
   Ans : gravity

4. The orbit of a geostationary orbit is called ....
   Ans : parking orbit.

5. The value of g will become 10% of its value at the earth's surface at a height .... above the surface of earth. Take radius of earth as 6400 km.
   Ans : 57,600

6. The force of gravity between two objects is inversely proportional to the square of the ....

Ans : distance between them

7. The acceleration due to gravity at the surface of a planet depends on the .... and the .... of the planet.

Ans : mass, radius

8. The weight of an object at .... is zero.

Ans : centre of the earth.

9. g_e and g_p denotes the acceleration due to gravity on the surface of the earth and another planet whose mass and radius are twice that of the earth. The relation that holds is ....

Ans : $g_p = \dfrac{1}{2} g_e$

10. If the earth rotates faster, the acceleration due to gravity at equator will ....

Ans : decreases

11. Acceleration due to gravity .... with depth below the surface of the earth.

Ans : decreases

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12. The constant of gravitation G is related to g by ....

Ans : $g = \dfrac{GM_e}{r^2}$

13. Weight of an object is .... at equator than at poles.

Ans : less

14. If the density of planet is increased, then the acceleration due to gravity at its surface will ....

Ans : increase

15. .... velocity of the planet is constant when it revolves in an elliptical orbit around the sun.

Ans : Areal

16. Every object inside the satellite is ....

Ans : weightless

3. TRUE/FALSE

DIRECTION : Read the following statements and write your answer as true or false.

1. The orbit speed of a satellite is inversely proportional to radius of its orbit.

Ans : False

2. For a spherically symmetric earth, the acceleration due to gravity should be same at the equator and at the poles

Ans : False

3. An object in a satellite experiences weightlessness.

Ans : True

4. If earth suddenly stops rotating about its axis, then the value of g will be same at all the places.

Ans : True

5. Weightlessness experienced while orbiting the earth in a spaceship is the result of zero gravity.

Ans : True

6. Force of gravity is least at the equator.

Ans : False

7. The gravitation force between a spherical shell and a point mass inside it is negative and finite.

Ans : False

8. It is possible to put on artificial satellite in to orbit in such a way that it will remain directly over New Delhi.

Ans : False

9. Copernicus discovered that the earth moves around the sun.

Ans : True

10. An astronaut cannot use a straw to sip a drink on the surface of the moon.

Ans : True

11. Acceleration due gravity at poles is greater than that at equator.

Ans : True

12. Weight of body at centre of the earth is zero.

Ans : True

13. If the earth stops rotating, acceleration due to gravity at poles increases.

Ans : False

14. Work is to be done on the system of two particles in increasing the distance between them.

Ans : True

4. MATCHING QUESTIONS

DIRECTION : In the section, each question has two matching lists. Choices for the correct combination of elements from **List-I** and **List-II** are given as options (a), (b), (c) and (d) out of which one is correct.

1.

List-I		List-II	
(P)	$r^3 = T^2 \times$ constant	(1)	$u = 0$
(Q)	$v = gt$	(2)	Weight

List-I		List-II	
(R)	$m \times g$	(3)	Free fall
(S)	$v^2 = u^2 + 2gh$	(4)	Kepler's law

	P	Q	R	S
(a)	4	1	2	3
(b)	4	2	3	1
(c)	2	4	1	3
(d)	1	4	2	3

Ans : (a) P-4, Q-1, R-2, S-3

2.

List-I		List-II	
(P)	g at height h	(1)	$g\left(1 - \dfrac{d}{R}\right)$
(Q)	g at depth d	(2)	minimum
(R)	g at equator	(3)	maximum
(S)	g at poles	(4)	$g\left(1 - \dfrac{2h}{R}\right)$

	P	Q	R	S
(a)	2	4	1	3
(b)	3	2	4	1
(c)	4	1	2	3
(d)	4	2	1	3

Ans : (c) P-4, Q-1, R-2, S-3

3.

List-I		List-II	
(P)	$G\dfrac{m_1 m_2}{R^2}$	(1)	g
(Q)	9.8 kg m s^{-2}	(2)	F
(R)	$N \text{ m}^2 \text{ kg}^{-2}$	(3)	G
(S)	$\dfrac{GM}{R^2}$	(4)	1 kgf

	P	Q	R	S
(a)	2	4	3	1
(b)	4	1	2	3
(c)	2	1	3	4
(d)	1	4	3	2

Ans : (a) P-2, Q-4, R-3, S-1

4.

List-I		List-II	
(P)	Mass	(1)	$6.67 \times 10^{-11} N \text{ m}^2 \text{kg}^{-2}$

List-I		List-II	
(Q)	Weight	(2)	9.8 m s^{-2}
(R)	Gravitational constant	(3)	Scalar
(S)	Acceleration due to gravity	(4)	Vector

	P	Q	R	S
(a)	3	2	1	4
(b)	3	4	1	2
(c)	3	1	2	4
(d)	2	4	3	1

Ans : (b) P-3, Q-4, R-1, S-2

5. ASSERTION AND REASON

DIRECTION : In each of the following questions, a statement of Assertion is given and a corresponding statement of Reason is given just below it. Of the statements, given below, mark the correct answer as:

(a) Both assertion and reason are true and reason is the correct explanation of assertion.
(b) Both assertion and reason are true but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Both Assertion and Reason are false.

1. **Assertion :** A man is sitting in a boat which floats on a pond. If the man drinks some water from the pond, the level of water in the pond will decrease.
Reason : The weight of the liquid displaced by the body is greater than the weight of the body.

Ans : (d) Both Assertion and Reason are false.
Water level in the pond remains unchanged. When the man drinks water from the pond, a larger volume of water is displaced by the boat and hence or original water level is maintained.

2. **Assertion :** At the centre of earth, a body has a centre of mass but no centre of gravity.
Reason : Acceleration due to gravity at the centre of the earth is zero.

Ans : (a) Both assertion and reason are true and reason is the correct explanation of assertion.
At the centre of the earth value of g is zero, weight of the body is also zero but its mass remains the same. The centre of mass of the body thus remains unchanged.

3. **Assertion :** A block of ice with a lead shot embedded in it floats on water contained in a vessels. The temperature of the system is kept at $0°C$ as the ice melts. When ice has melted completely, water level in the vessel rises.
Reason : The melted ice will raise the water level.

Ans : (d) Both Assertion and Reason are false.
The water level in the vessel remains unchanged. The

volume or melted ice and lead shot, is equal to the volume of the water displaced when the ice block with lead shot is initially placed in water.

4. **Assertion :** Kepler's second law of planetary motion is also known as Kepler's law of areas.
Reason : The line joining the planet and the sun sweeps equal areas in equal intervals of time.

Ans : (a) Both assertion and reason are true and reason is the correct explanation of assertion.

5. **Assertion :** During a journey from the earth to the moon and back, maximum fuel is spent to overcome the earth's gravity at take off.
Reason : Earth's mass is much greater than that of the moon.

Ans : (a) Both assertion and reason are true and reason is the correct explanation of assertion.
Since the earth's mass is much more than that of the moon, the gravitational force exerted by the earth on the spaceship is much greater than that exerted by the moon. The work done is much greater.

6. **Assertion :** It is the gravitational force exerted by the sun and the moon on the sea water that causes to the formation of tides in the sea.
Reason : Gravitational force of attraction is a strong force.

Ans : (c) Assertion is true but reason is false.
Gravitational force of attraction is the reason behind the formation of tides. It is a weak force.

7. **Assertion :** Any two objects in the universe attract each other by a force called gravitation force.
Reason : The force of gravitation exerted by the earth is called gravity.

Ans : (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

8. **Assertion :** Universal gravitational constant G is a scalar quantity.
Reason : The value of G is same through out the universe.

Ans : (a) Both assertion and reason are true and reason is the correct explanation of assertion.
The value of G is independent of direction and is a constant through out the universe.

9. **Assertion :** An object floats if it displaces an amount of liquid whose weight is greater than the actual weight of the object.
Reason : During floatation an object experiences no net force in the downward direction.

Ans : (b) Both assertion and reason are true but reason is not the correct explanation of assertion.
Net force = real weight − upthrust (weight of the liquid displaced).
The object rises above the liquid surface to an extent that the weight of the liquid displaced by the part of the object. Thus, an object will float when upward

thrust is greater than its actual weight. (The density of the object must be less than the density of the liquid).

10. **Assertion :** If we drop a stone and a sheet of paper from a balcony of first floor, then stone will reach the ground first.
Reason : The resistance due to air depends on velocity only.

Ans : (c) Assertion is true but reason is false.

11. **Assertion :** The density of a liquid depends upon the nature and temperature of the liquid.
Reason : The volume of the liquid depends upon temperature.

Ans : (a) Both assertion and reason are true and reason is the correct explanation of assertion.
$$\text{Density} = \text{mass/volume}$$
The density of a liquid depends on the kind of liquid and its temperature. Volume increases with increase in temperature and vice-versa. The density decreases with increase in temperature.

12. **Assertion :** When distance between two bodies is doubled and also mass of each body is doubled, then the gravitational force between them remains the same.
Reason : According to Newton's law of gravitation, product of force is directly proportional to the product mass of bodies and inversely proportional to square of the distance between them.

Ans : (a) Both assertion and reason are true and reason is the correct explanation of assertion.
$$F = G\frac{m_1 m_2}{r^2}$$

13. **Assertion :** The value of the acceleration due to gravity g on earth depends upon the average density of the earth.
Reason : It is the radius of the earth which determines the value of the g.

Ans : (b) Both assertion and reason are true but reason is not the correct explanation of assertion.
Since $g = G\frac{M}{R^2}$, the acceleration due to gravity depends both on average density and the average radius of the earth.

14. **Assertion :** The value of acceleration due to gravity changes with the height, depth and shape of the earth.
Reason : Acceleration due to gravity is zero at the centre of the earth.

Ans : (b) Both assertion and reason are true but reason is not the correct explanation of assertion.
The value of g changes with height, depth and is zero at the centre of the earth.

15. **Assertion :** When the orbital radius of a planet is made 4 times, its time period increases by 8 times.
Reason : Greater the height above the earth's surface, greater is the time period of revolution.

Ans : (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

According to Kepler's law, $T^2 \propto r^3$ or $T \propto r^{3/2}$

When r becomes four times, T is $4^{3/2}(= 2^3) = 8$ times.

16. **Assertion :** Weight of a body on earth is equal to the force with which the body is attracted towards the earth.
    Reason : Weight of a body is independent of the mass of the body.

    Ans : (c) Assertion is true but reason is false.

17. **Assertion :** By tying a stone to a wooden plank, an object can be made such that it floats in a river and sinks in the ocean.
    Reason : Density of river water is more than the density of sea-water.

    Ans : (d) Both Assertion and Reason are false.
    The density of sea-water is greater than the density of river water. Therefore, the buoyant force will be larger in sea-water which keeps the body float.

18. **Assertion :** When a body is thrown up, the acceleration due to gravity at the topmost point is zero.
    Reason : The acceleration due to gravity is always directed downwards towards the centre of the earth for a freely falling body.

    Ans : (d) Assertion is false but reason is true.
    Acceleration due to gravity at the topmost point in case of a stone thrown upward is not zero.

19. **Assertion :** An object floats on the surface of a liquid in a beaker. The whole system is allowed to fall freely under gravity. The upthrust on the object due to the liquid is equal to the weight of the liquid displaced.
    Reason : Archimedes' principle states that the upthrust on an object due to a fluid is equal to the weight of the fluid displaced.

    Ans : (d) Both Assertion and Reason are false.

20. **Assertion :** A sheet of paper falls slower, than one that is crumpled in to a ball?
    Reason : Sheet of paper has lesser weight than that is crumpled into a ball.

    Ans : (c) Assertion is true but reason is false.