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Section : Biology   139-216

1 Physical Quantities Motion & Force

PHYSICAL QUANTITIES

Physics is the branch of science which deals with the study of matter, energy, and the interaction between them.

- A **scalar** is a physical quantity that has only a magnitude (size) E.g. : Distance, speed, time, power, energy, etc.
- A **vector** is a physical quantity that has both a magnitude and a direction. E.g. Velocity, displacement, acceleration, force etc.

Some physical quantities like moment of **inertia**, **stress**, etc. are neither scalar nor vector. They are **tensor**.

Seven Fundamental Physical Quantities and their Units

Physical Quantity	SI Unit	Symbol
Length	meter	m
Mass	kilogram	Kg
Time	second	S
Electric Current	ampere	A
Temperature	kelvin	K
Luminous intensity	candela	Cd
Amount of substance	mole	mol

Some Derived Physical Quantities and their Units

S. No.	Physical Quantity	cgs unit	SI unit	Relation
1.	Force	dyne	newton	1 newton = 10^5 dyne
2.	Work	erg	joule	1 joule = 10^7 erg

- An object is said to be at rest if it does not change its position with respect to its surroundings with the passage of time.
- A body is said to be in motion if its position changes continuously with respect to the surroundings (or with respect to an observer) with the passage of time.
- The distance travelled by a body is the actual length of the path covered by a moving body irrespective of the direction in which the body moves.

Dispacement

- When a body moves from one position to another, the shortest (straight line) distance between the initial position and final position of the body, alongwith direction, is known as its displacement. The S.I. unit of displacement is metre (*m*). Displacement is a vector quantity.

Motion

- **Uniform motion :** A body has a **uniform motion** if it travels equal distances in equal intervals of time.

- **Non-uniform motion :** A body has a non-uniform motion if it travels unequal distances in equal intervals of time.
  Speed : Distance travelled by a moving body in (one second) unit time is called speed. The S.I. units of speed is ms^{-1}.

$$\text{Speed} = \frac{\text{Distance travelled}}{\text{Time taken}}$$

- The average distance covered by a body per unit time when the body is moving with non-uniform speed is known as **average speed.**

$$\text{Average speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

- **Velocity** of a body is defined as the displacement produced per unit time. It is the distance travelled by a body per unit time in a given direction. The S.I. unit of velocity is m/s.

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}}$$

Acceleration

- **Average Velocity :** It is defined as the total displacement covered divided by the total time taken.

$$\text{Average velocity} = \frac{\text{Total displacement}}{\text{Total time taken}}$$

- **Acceleration :** It is defined as the rate of change of velocity with time.

$$\text{Acceleration} = \frac{\text{Change in velocity}}{\text{Time taken}} \text{ or } a = \frac{v-u}{t}$$

The S.I. unit of acceleration is m/s^2.
Retardation: Negative acceleration is called 'retardation' or 'deceleration'.

- A body has uniform acceleration if it travels in a straight line and its velocity increases by equal amounts in equal intervals of time. For example, the motion of a freely falling body.
- A body has a non-uniform acceleration if the velocity increases by unequal amounts in equal intervals of time. In other words, a body has a non-uniform acceleration if its velocity changes at a non-uniform rate.
- **Equations of motion :** These are the equations which give relation between velocity, acceleration, distance covered, time taken for a body in uniform acceleration.

$$v = u + at$$
$$s = ut + \frac{1}{2}at^2$$
$$v^2 - u^2 = 2as$$

- In case the velocity of the object is changing at a uniform rate, then average velocity is given by the arithmetic mean

of initial velocity and final velocity for a given period of time, i.e.,

$$\text{average velocity} = \frac{\text{initial velocity} + \text{final velocity}}{2}$$

Mathematically, $v_{av} = \dfrac{u + v}{2}$

when v_{av} is the average velocity, u is the initial velocity and v is the final velocity of the object.

- **Graphical Representation of Motion :**
  (i) **Distance-time graph :** For uniform speed, a graph of distance travelled against time will be a straight line as shown by the line OA in figure given below.
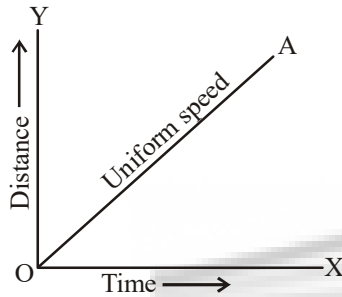

Fig. Distance-time graph for
uniform speed

If the speed of a body is non-uniform, then the graph between distance travelled and time is a curved line.
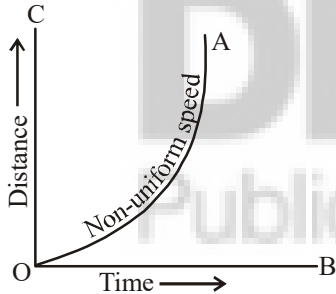

Fig. Distance-time graph for
non-uniform speed

  (ii) **Velocity-time graphs :**
(a) Velocity-time graph parallel to time axis (uniform motion)
  (i) The area of the graph under velocity-time curve gives the displacement of the body.
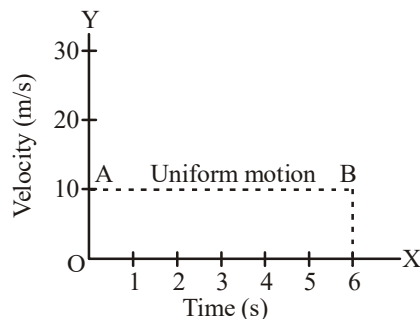
Displacement = Velocity × Time

Fig. Velocity-time graph for uniform motion

  (ii) The slope of velocity-time graph gives acceleration.

$$\text{Acceleration} = \frac{\text{Velocity}}{\text{Time}}$$

If the slope of graph is zero, the acceleration is zero.
  (iii) If the slope of velocity-time graph is positive, then acceleration is a positive. If the slope is negative, then acceleration is negative i.e. retardation.

(b) Velocity-time graph is a straight line which is not parallel to time axis (uniform accelerated motion).
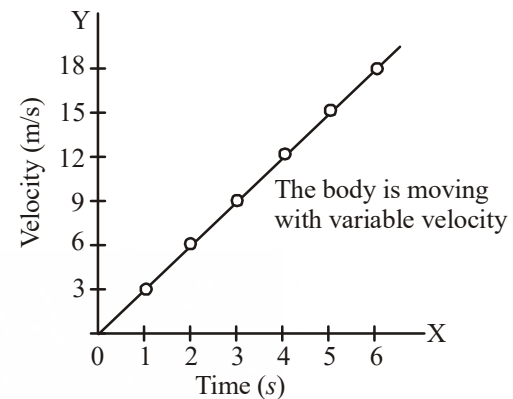
Fig. Graph between velocity and time
(motion with uniform acceleration)

(c) The velocity-time graph is a curve for motion with a variable acceleration.

Projectile Motion

Projectile is the name given to a body thrown with some initial velocity in any arbitrary direction and then allowed to move under the influence of a constant acceleration. The motion of a projectile is called projectile motion.

Example : A football kicked by the player, a stone thrown from the top of building, a bomb released from a plane.

The path followed by a projectile is called its **trajectory**, mostly, the trajectory of a projectile is parabolic.

Maximum height (H): When a projectile moves, it covers a maximum distance in vertical direction. This maximum distance is called the maximum height attained by the projectile.

$$\text{Maximum height} \quad H = \frac{U^2 \sin^2 \alpha}{2g}$$

Horizontal range (R): The horizontal distance between the point of projection and the point of landing of a projectile.

$$\text{Maximum range} \quad R = \frac{U^2 \sin^2 2\alpha}{g}$$

Time of flight (T): The time taken by the projectile to reach the point of landing from the point of projection.

$$\text{Time of flight} \quad T = \frac{2u \sin^2 \alpha}{g}$$

FORCE

- Force may be defined as a push or a pull which changes or tends to change the state of rest or uniform motion or direction of motion of a body. SI units is Newton.

  A force can do three things on a body.
  (a) It can change the speed of a body.
  (b) It can change the direction of motion of a body.
  (c) It can change the shape of the body.

- **Newton's First Law of Motion :** If a body is in a state of rest, it will remain in the state of rest and if it in the state of motion, it will remain moving in the same direction with the same velocity unless an external force is applied on it. Its S.I. unit is kg.

  A body with greater mass has greater inertia.

- The momentum of a moving body is defined as the product of its mass and velocity momentum is a vector quantity given by

  $$\vec{p} = m\vec{v}$$

  The SI unit of momentum is kilogram meter per second (kgm/s).

- **Newton's Second Law of Motion :** It states the rate of change of momentum of a body is directly proportional to the applied unbalanced force.

  Rate of change in momentum $\propto$ Force applied

- **Newton's Third Law of Motion :** According to this law, to every action, there is an equal and opposite reaction.

  When one object exerts a force (*action*) on another object, then the second object also exerts a force (*reaction*) on the first. These two forces are always equal in magnitude but opposite in direction.
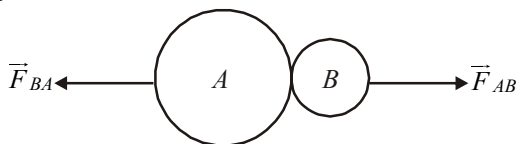
Fig. Newton's third law

- **Conservation of Momentum :** If the external force on a system is zero, the momentum of the system remains constant i.e. In an isolated system, the total momentum remains conserved.
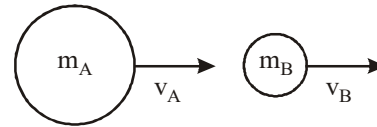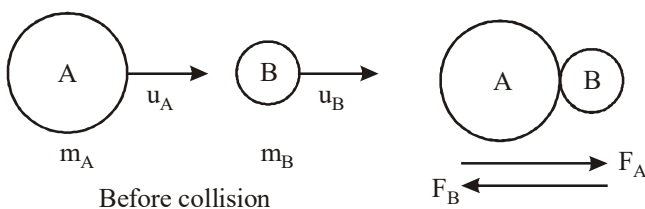
Before collision

After collision

A and B are two balls, the mass and initial velocities are shown, before collision. The two bodies collide and force is exerted by each body. There is change in their velocities due to collision. $(m_A u_A + m_B u_B)$ is the total momentum of the two balls A and B before collision and $m_A v_A + m_B v_B$ is their total momentum after the collision. The sum of momentum of the two objects before collision is equal to the sum of momenta after the collision provided there is no external unbalanced force acting on them. This is known as the law of conservation of momentum.

Circular Motion

- Motion of a body along a circular path is called circular motion.

- **Centripetal force -** while a body is moving along a circular path an external force required to act radially inward.

  A pseudo force that is equal and opposite to the centripetal force is called **centrifugal force**.

  Cream separator, centrifugal dryer, etc, work on the principle of centrifugal force.

Friction

Friction is a force that is created whenever two surfaces move or try to move across each other.

Friction always opposes the motion or attempted motion of one surface across another surface.

Instances where friction is important Walking , Driving ,Picking something up, Car brakes.

Exercise

DIRECTIONS : This section contains multiple choice questions. Each question has 4 choices (a), (b), (c) and (d) out of which only one is correct.

1. If a body is moving at constant speed in a circular path, its
    (a) velocity is constant and its acceleration is zero
    (b) velocity and acceleration are both changing direction only
    (c) velocity and acceleration are both increasing
    (d) velocity is constant and acceleration is changing direction

2. A graph is plotted showing the velocity of a car as a function of time. If the graph is a straight line, it means that
    (a) the car started at rest
    (b) acceleration was constant
    (c) acceleration was increasing
    (d) velocity was constant

3. If a car is traveling north on a straight road and its brakes are applied, it will
    (a) have no acceleration
    (b) accelerate to the south
    (c) accelerate to the north
    (d) accelerate either east or west

4. An object moves with a uniform velocity when
    (a) the forces acting on the object are balanced
    (b) there is no external force on it
    (c) Both of (a) and (b)
    (d) Either (a) or (b)

5. The acceleration of a car that speeds up from 12 meters per second to 30 meters per second in 15 seconds–
    (a) $2.4 \, \text{m/s}^2$ (b) $1.2 \, \text{m/s}^2$
    (c) $2 \, \text{m/s}^2$ (d) $5.2 \, \text{m/s}^2$

6. A particle experiences constant acceleration for 20 seconds after starting from rest. If it travels a distance s_1 in the first 10 seconds and distance s_2 in the next 10 seconds, then
    (a) $s_2 = s_1$ (b) $s_2 = 2s_1$
    (c) $s_2 = 3s_1$ (d) $s_2 = 4s_1$

7. Friction forces act
    (a) in the direction of force applied
    (b) in the direction of the motion
    (c) in the direction opposite to the direction of motion
    (d) None of these

8. In which of the following cases, the object does not possess an acceleration or retardation when it moves in
    (a) upward direction with decreasing speed
    (b) downward direction with increasing speed
    (c) with constant speed along circular path
    (d) with constant speed along horizontal direction

9. By applying a force of one Newton, one can hold a body of mass
    (a) 102 grams   (b) 102 kg
    (c) 102 mg   (d) None of these

10. The speed of a falling body increases continuously, this is because
    (a) no force acts on it
    (b) it is very light
    (c) the air exert the frictional force
    (d) the earth attract it

11. The effect of frictional force may be minimized by
    (a) using a smooth object
    (b) using a smooth plane
    (c) providing a lubricant at the surface of contact
    (d) All of these

12. If an object is in a state of equilibrium
    (a) it is at rest
    (b) it is in motion at constant velocity
    (c) it is in free fall
    (d) may be more than one of the above

13. If a boat is moving along at constant speed, it may be assumed that
    (a) a net force is pushing it forward
    (b) the sum of only vertical forces is zero
    (c) the buoyant force is greater than gravity
    (d) the sum of all forces is zero

14. When a motorcar makes a sharp turn at a high speed, we tend to get thrown to one side because
    (a) we tend to continue in our straight line motion
    (b) an unbalanced force is applied by the engine of the motorcar changes the direction of motion of the motorcar
    (c) we slip to one side of the seat due to the inertia of our body
    (d) All of these

15. When a bus suddenly starts, the standing passengers lean backwards in the bus. It is an example of
    (a) Newton's first law
    (b) Newton's second law
    (c) Newton's third law
    (d) None of Newton's law

16. Momentum has the same units as that of
    (a) couple   (b) torque
    (c) impulse   (d) force

17. When a force of newton acts on a mass of 1 kg that is free to move, the object moves with a
    (a) speed of 1 m/s
    (b) speed of 1 km/s
    (c) acceleration of 10 m/s^2
    (d) acceleration of 1m/s^2

18. If an object experience a net zero unbalanced force, then the body
    (a) can be accelerated
    (b) moves with constant velocity
    (c) cannot remain at rest
    (d) None of these

19. A hockey player pushes the ball on the ground. It comes to rest after travelling certain distance because
    (a) the player stops pushing the ball
    (b) no unbalanced force action on the wall
    (c) the ball moves only when pushes
    (d) the opposing force acts on the body.

20. The physical quantity which is the product of mass and velocity of a body is known as
    (a) inertia   (b) momentum
    (c) force   (d) change in momentum
21. Rate of change of momentum of an object is proportional to the
    (a) balanced force applied
    (b) applied unbalanced force in the direction of the force
    (c) time during which the force is applied
    (d) All of these
22. A book of weight 10 N is placed on a table. The force exerted by the surface of the table on the book will be
    (a) Zero   (b) 10 N
    (c) 20 N   (d) None of these
23. A moving object can come to rest only if it
    (a) has a frictional force acting on it
    (b) has no net force acting on it
    (c) is completely isolated
    (d) applies an impulse to something else
24. When a body is stationary-
    (a) There is no force acting on it
    (b) The force acting on it not in contact with it
    (c) The combination of forces acting on it balances each other
    (d) The body is in vacuum
25. A rider on horse falls back when horse starts running, all of a sudden because
    (a) rider is taken back
    (b) rider is suddenly afraid of falling
    (c) inertia of rest keeps the upper part of body at rest while lower part of the body moves forward with the horse
    (d) None of the above
26. A man getting down a running bus, falls forward because
    (a) due to inertia of rest, road is left behind and man reaches forward
    (b) due to inertia of motion upper part of body continues to be in motion in forward direction while feet come to rest as soon as they touch the road
    (c) he leans forward as a matter of habit
    (d) of the combined effect of all the three factors stated in (a), (b) and (c)
27. A force 10 N acts on a body of mass 20 kg for 10 sec. Change in its momentum is
    (a) 5 kg m/s   (b) 100 kg m/s
    (c) 200 kg m/s   (d) 1000 kg m/s
28. Swimming is possible on account of
    (a) first law of motion
    (b) second law of motion
    (c) third law of motion
    (d) newton's law of gravitation
29. A man is at rest in the middle of a pond on perfectly smooth ice. He can get himself to the shore by making use of Newton's
    (a) first law   (b) second law
    (c) third law   (d) all the laws
30. A parrot is sitting on the floor of a closed glass cage which is in a boy's hand. If the parrot starts flying with a constant speed, the boy will feel the weight of the cage as
    (a) unchanged   (b) reduced
    (c) increased   (d) nothing can be said
31. A cannon after firing recoils due to-
    (a) conservation of energy
    (b) backward thrust of gases produced
    (c) Newton's third law of motion
    (d) Newton's first law of motion
32. Newton's third law of motion leads to the law of conservation of-
    (a) angular momentum (b) energy
    (c) mass   (d) momentum
33. The force of friction acting on a car on different roads in the increasing order of magnitude will be
    (a) mud, tar, concrete and gravel roads
    (b) tar, concrete, gravel and mud roads
    (c) concrete, tar, gravel and mud roads
    (d) gravel, mud, tar and concrete roads
34. A fish is swimming upward at an angle of 30° with the horizontal. The direction of the force of gravity acting on it is–
    (a) upward   (b) downward
    (c) horizontal   (d) at an angle upward
35. Two blocks of mass 4 kg and 6 kg are placed in contact with each other on a frictionless horizontal surface. A push of 5N is applied on a heavier mass. The force on the lighter mass will be
    (a) 3 N   (b) 2 N
    (c) 5 N   (d) 50 N
36. Rockets work on the principle of conservation of
    (a) energy   (b) mass
    (c) momentum   (d) All of these
37. Motion of an object is the change in position with respect to a reference point known as
    (a) origin   (b) initial position
    (c) final position   (d) distance
38. Displacement is the
    (a) shortest distance between initial and final positions
    (b) the actual distance between initial and final positions
    (c) the distance traveled by the object
    (d) distance traveled by the object in a unit time
39. An object has traveled 10 km in 15 minutes, its displacement will be
    (a) 10 km   (b) Can be zero
    (c) More than 10 km   (d) All of the above
40. If an object covers equal distances in equal intervals of time, it is said to be in
    (a) Circular Motion   (b) Uniform Motion
    (c) Oscillatory Motion (d) Non-uniform Motion
41. Average velocity of an object is obtained by
    (a) Dividing the total distance traveled by the total time taken
    (b) Half of the sum of the initial velocity and the final velocity
    (c) Both (a) and (b)
    (d) None of the above

42. Negative value of acceleration signifies
    (a) The velocity is increasing
    (b) The velocity is decreasing
    (c) The velocity remains the same
    (d) The object comes to rest

43. In distance-time graphs
    (a) Distance is taken along the X- axis
    (b) Time is taken along the Y-axis
    (c) Straight line indicates uniform motion
    (d) Straight line indicates non-uniform motion

44. In velocity-time graphs
    (a) Velocity is taken along the Y-axis and Time is taken along the X-axis
    (b) Straight line indicates uniform acceleration
    (c) Straight line parallel to x-axis indicates uniform motion
    (d) All of the above

45. The equation(s) of motion can be represented as
    (a) $v = u + at$ (b) $s = ut + \frac{1}{2}at^2$
    (c) $2as = v^2 - u^2$ (d) All of these

46. A train travels 40 km at a uniform speed of 30 km h^{-1}. Its average speed after traveling another 40 km is 45 km h^{-1} for the whole journey. Its speed in the second half of the journey is
    (a) 45 km h^{-1} (b) 90 km h^{-1}
    (c) 60 km h^{-1} (d) None of these

47. A man walks on a straight road from his home to market 2.5km. away with a speed of 5 km/h. Finding the market closed, he instantly turns and walks back home with a speed of 7.5 km/h. The average speed of the man over the interval of time 0 to 40 min. is equal to –
    (a) 5 km/h   (b) 25/4 km/h
    (c) 30/4 km/h   (d) 45/8 km/h

48. A person is standing in an elevator. In which situation he finds his weight less than actual when –
    (a) The elevator moves upward with constant acceleration.
    (b) The elevator moves downward with constant acceleration
    (c) The elevator moves upward with uniform velocity
    (d) The elevator moves downward with uniform velocity

49. A ball is dropped from a window 24 meters high. How long will it take to reach the ground ?
    (a) 2.2 s   (b) 1.2 s
    (c) 4.5 s   (d) 0.2 s

50. A pitcher throws his fastball horizontally at 42.1 meters per second.
    How far does it drop before crossing the plate, 18.3 meters away?
    (a) 0.8 m   (b) 1.2 m
    (c) 2.2 m   (d) 0.93 m

51. Mohan takes 20 minutes to cover a distance of 3.2 kilometers due north on a bicycle, his velocity in kilometer/hour–
    (a) 8.1   (b) 9.6
    (c) 1.2   (d) 7.2

52. Two balls A and B of same masses are thrown from the top of the building. A, thrown upward with velocity V and B, thrown downward with velocity V, then –
    (a) Velocity of A is more than B at the ground
    (b) Velocity of B is more than A at the ground
    (c) Both A and B strike the ground with same velocity
    (d) None of these

53. A ball is released from the top of a tower of height h meters. It takes T seconds to reach the ground. What is the position of the ball in T/3 seconds –
    (a) h/9 meters from the ground
    (b) 7h/9 meters from the ground
    (c) 8h/9 meters from the ground
    (d) 17h/18 meters from the ground

54. When a bus suddenly takes a turn, the passengers are thrown outwards because of –
    (a) inertia of motion   (b) acceleration of motion
    (c) speed of motion   (d) Both (b) and (c)

55. A thief snatches a purse and runs due west, going 6.0 meters per second. A policeman, 15 meters to the east, sees the event and gives chase. If the officer is a good sprinter, going at 8.5 meters per second, how far does he have to run to catch the thief –
    (a) 12 m   (b) 51 m
    (c) 61 m   (d) 55 m

56. A car going at 24 meters per second passes a motorcycle at rest. As it passes, the motorcycle starts up, accelerating at 3.2 meters per second squared. If the motorcycle can keep up that acceleration, how long will it take for it to catch the car –
    (a) 12 s   (b) 14 s
    (c) 20 s   (d) 18 s

57. The initial velocity of a body is 15 m/s. If it is having an acceleration of 10 m/s^2, then the velocity of body after 10 seconds from start –
    (a) 110 m/s   (b) 105 m/s
    (c) 120 m/s   (d) 115 m/s

58. The rate of change of velocity is called :
    [RRB ALP-2018]
    (a) Force   (b) Momentum
    (c) Acceleration   (d) Speed

59. If a body is whirled in a circle the work done on it ....
    [RRB ALP-2018]
    (a) is negative   (b) is zero
    (c) cannot be determined (d) is positive

60. If the initial velocity of a car is 5 m/s, and the final velocity is 10 m/s in 5 s, then the acceleration is ....
    [RRB ALP-2018]
    (a) 10 m/s^2 (b) 5 m/s^2 (c) 0.1 m/s^2 (d) 1 m/s^2

61. If a ball is thrown vertically upwards with a velocity of 40 m/s. then what will be the magnitude of its displacement after 6 s ? /Take g = 10 m/s² **[RRB ALP-2018]**
    (a) 60 m   (b) 80 m   (c) 20 m   (d) 40 m

62. Definition of Force can be stated from :
    [RRB ALP-2018]
    (a) Newton's first law of motion
    (b) Newton's second law of motion
    (c) Newton's third law of motion
    (d) Newton's Law of gravitation

63. The tendency of undisturbed objects to stay at rest or to keep moving with the same velocity is called :
    [RRB ALP-2018]
    (a) Velocity   (b) Force
    (c) Momentum   (d) Inertia

64. What will be the acceleration produced when a force of 21 N is applied on an object of mass 3 kg ?
    [RRB ALP-2018]
    (a) 0.007 ms⁻²   (b) 0.7 ms⁻²
    (c) 7 ms⁻²   (d) 70 ms⁻²

65. The unit of momentum is : **[RRB ALP-2018]**
    (a) Kgms² (b) Kgms⁻¹ (c) Kgms (d) Kgms⁻²

66. Which of the following changes when a body performs uniform circular motion ? **[RRB ALP-2018]**
    (a) Mass   (b) Momentum
    (c) Speed   (d) Direction

67. If the distance travelled by an object is zero, then the displacement of the object : **[RRB ALP-2018]**
    (a) in negative   (b) is Zero
    (c) is positive   (d) May or may not be zero

68. The characteristic of .... is used in the breaking pads of cars. **[RRB ALP-2018]**
    (a) weight impulse force tension action
    (b) Positive effect of friction
    (c) zero effect of friction
    (d) Negative effect of friction

69. Momentum is measured as the product of: **[RRB ALP-2018]**
    (a) Mass and acceleration
    (b) Mass and acceleration
    (c) Mass and velocity
    (d) Mass and inertia

70. Negative acceleration is in the opposite direction of:
    [RRB ALP-2018]
    (a) velocity   (b) momentum
    (c) force   (d) distance

71. The tendency of undisturbed objects to stay at rest or to keep moving with the same velocity is called ....
    [RRB ALP-2018]
    (a) inertia   (b) force
    (c) energy   (d) momentum

72. If a body takes 't' seconds to go once round the circular path of radius 'r'. the velocity 'v' is given by:
    [RRB ALP-2018]

    (a) $v = \dfrac{t}{2\pi r}$ (b) $v = \dfrac{2\pi r}{t}$

    (c) $v = \dfrac{2\pi r^2}{t}$ (d) $v = \dfrac{\pi r}{2t}$

73. The second equation of motion gives the relation between:
    [RRB ALP-2018]
    (a) Velocity and time
    (b) Position and time
    (c) Position and velocity
    (d) Velocity and acceleration

74. If the kinetic energy of a body becomes 256 times its initial value, then the new linear momentum will be :
    [RRB ALP-2018]
    (a) 16 times the initial value
    (b) 8 times the initial value
    (c) 32 times the initial value
    (d) The same as the initial value

75. An Odometer is an instrument used to measure...... in automobiles. **[RRB ALP-2018]**
    (a) Distance   (b) Speed
    (c) Direction   (d) Odour

76. The SI unit of weight is a: **[RRB ALP-2018]**
    (a) Kg   (b) Newton
    (c) Gram   (d) Dyne

77. Which of the following physical quantities changes or tends to change the state of rest or of uniform motion of a body in a straight line ? **[RRB ALP-2018]**
    (a) Momentum   (b) Mass
    (c) Force   (d) Inertia

78. A body of mass 2 kg is thrown upward with initial velocity of 20m/s. After 2 seconds , its kinetic energy will be : g = 10 m/s² **[RRB ALP-2018]**
    (a) 100 J   (b) 0 J   (c) 400 J   (d) 200 J

79. Which of the following never occurs singly in nature ?
    [RRB ALP-2018]
    (a) Inertia   (b) Force
    (c) Momentum   (d) Velocity

80. The first equation of motion gives the relation between :
    [RRB ALP-2018]
    (a) position and time
    (b) velocity and time
    (c) position and velocity
    (d) velocity and acceleration

81. Which of the following statements is INCORRECT?
    [RRB ALP-2018]
    (a) The particles of matter are in stationary state.
    (b) The particles of matter attract each other.
    (c) The particles of matter have spaces between them.
    (d) The particles of matter are extremely small

82. When a bullet is fired from a gun, the gun moves in the opposite direction. This illustrates Newton's:
    [RRB ALP-2018]
    (a) first law of motion
    (b) first and second law of motion
    (c) third law of motion
    (d) second law of motion

83. Motion of a spinning 'top' is an example of ___
    [RRB NTPC 2016]
    (a) Centripetal Force
    (b) Centrifugal Force
    (c) Gravitational Force
    (d) Frictional Force

84. Velocity of a car does not depend on ___
[RRB NTPC 2016]
(a) Speedometer   (b) Change in direction
(c) Change in speed   (d) Change in acceleration

85. When the car takes a bend, the force that pushes us to the outside of the curve is the ___   **[RRB NTPC 2016]**
(a) Centripetal Force   (b) Centrifugal Force
(c) Frictional Force   (d) Tension Force .

86. Which one of the following is the correct unit of angular velocity?   **[RRB NTPC 2016]**
(a) m/minute   (b) cm/sec²
(c) cm/sec   (d) radians/sec

87. When the speed of car is doubled then what will be the braking force of the car to stop it in the same distance ?
[RRB NTPC 2016]
(a) four times   (b) two times
(c) half   (d) one fourth

88. Rain drops fall from great height. Which among the following statements is true regarding it?
[RRB NTPC 2016]
(a) they fall with that ultimate velocity which are different for different droplets
(b) they fall with same ultimate velocity
(c) their velocity increases and they fall With different velocity on the earth
(d) their velocity increases and they fall with same velocity of the earth

89. One early morning, with no traffic on roads Rahul while cycling down from Red Fort to his residence noted the distance covered and the total time taken to reach home. What can he calculate from this data?   **[RRB JE 2015]**
(a) Velocity   (b) Speed
(c) Acceleration   (d) Displacement

90. Which of the following have the same unit, ms^{-1} ?
[RRB JE Electrical 2019]
(a) Velocity and acceleration
(b) Speed and velocity

(c) Acceleration and momentum
(d) Speed and momentum

91. The moment of inertia of a rectangular section 3 cm wide and 4 cm deep about X-X axis passing through centre is-
[RRB JE Mechanical 2019]
(a) $20\,cm^4$ (b) $16\,cm^4$
(c) $12\,cm^4$ (d) $9\,cm^4$

92. If the line of action of all the forces are along the same line, then the forces are said to be-
[RRB JE Mechanical 2019]
(a) Coplanar parallel forces
(b) Non-coplanar non-concurrent forces
(c) Collinear forces
(d) Coplanar concurrent forces

93. In order to determine the effects of a force acting on a body, we must know–   **[RRB JE Civil 2019]**
(a) Nature of the force i.e. whether the force is push or pull
(b) All of the options
(c) Line of action of the force
(d) Magnitude of the force

94. Total distance covered in total time is termed as-
[RRB JE Civil 2019]
(a) Average speed   (b) Instantaneous speed
(c) Variable speed   (d) Uniform speed

95. A bus passes two persons moving in the direction of the moving bus at a speed of 3km/h and 5 km/h, respectively. The bus passes the first person in 10s and the second person in 11s. The speed of the bus is:
[RRB NTPC Stage-I 5th Jan. 2021]
(a) 25 km/h   (b) 24 km/h
(c) 27 km/h   (d) 28 km/h

96. If John travels a distance of 90 km at a speed of 30 km/h and returns at a speed of 60 km/h, his average speed is:
[RRB Group-D, 1 Sept. 2022]
(a) 40 km/h   (b) 45 km/h
(c) 60 km/h   (d) 30 km/h

Hints & Explanations

1. (b)   2. (b)   3. (b)
4. (c) An object moves with a uniform velocity when the forces acting on the object are balanced and there is no external force on it.
5. (b)   6. (c)
7. (b) Friction forces act in the direction opposite to the direction of motion.
8. (d)   9. (a)   10. (d)
11. (d) The effect of frictional force may be minimized by using a smooth object, using a smooth plane or by providing a lubricant at the surface of contact.
12. (d)   12. (d)
14. (d) When a motorcar makes a sharp turn at a high speed, we tend to get thrown to one side because we tend to continue in our straight line motion and an unbalanced force is applied by the engine of the motorcar changes the direction of motion of the motorcar. So, we slip to one side of the seat due to the inertia of our body.

15. (a)   16. (c)   17. (d)
18. (b)   19. (d)   20. (b)
21. (b) Rate of change of momentum of an object is proportional to the applied unbalanced force in the direction of the force.
22. (b)   23. (d)   24. (c)
25. (c)   26. (b)   27. (b)
28. (c)   29. (c)   30. (a)
31. (c)   32. (d)   33. (c)
34. (b)
35. (b) Acceleration on combination of two masses = F / (m_1 + m_2) = 5 / (4+6) = 0.5 m s^{-2}. Then, use this value of acceleration to findthe force on lighter object, F = m a = 4 × 0.5 = 2 N.
36. (c) Rockets are examples of third law of motion, i.e. the law of conservation of momentum.

37. (a) Motion of an object is the change in position with respect to a reference point called origin.
38. (a) Displacement is the shortest distance between initial and final positions.
39. (d) An object has traveled 10 km in 15 minutes, its displacement will be according to the direction it has followed.
40. (b) If an object covers equal distances in equal intervals of time, it is said to be in uniform motion.
41. (b) Average velocity of an object is obtained by taking the arithmetic mean of the initial and final velocity.
42. (b) Negative value of acceleration signifies deceleration or in other words the velocity is decreasing.
43. (c) In distance-time graphs, the distance is taken along the Y-axis, Time is taken along the X-axis. Straight line indicates uniform motion.
44. (d) In velocity-time graphs, Velocity is taken along the Y-axis and Time is taken along the X-axis. A straight line indicates uniform acceleration and a straight line parallel to X-axis indicates uniform motion.
45. (b) The equations of motion are
    (1) $v = u + at$
    (2) $s = ut + \dfrac{1}{2}at^2$
    (3) $2as = v^2 - u^2$
46. (b) Let speed of the train in later half = x, then the time taken to travel later 40 km = 40/x hours
    Total time taken = 40/30 + 40/x

    Average speed = $\dfrac{80}{4/3 + 40x} = 45$

    Solve the equation to find value of x
47. (d) A man walks from his home to market with a speed of 5 km/h. Distance = 2.5 km and time = $\dfrac{d}{v} = \dfrac{2.5}{5} = \dfrac{1}{2}$ hr.
    and he returns back with speed of 7.5 km/h in rest of time of 10 minutes.

    Distance = $7.5 \times \dfrac{10}{60} = 1.25$ km

    So, Average speed

    $= \dfrac{\text{Total distance}}{\text{Total time}} = \dfrac{(2.5 + 1.25)\,\text{km}}{(40/60)\,\text{hr}} = \dfrac{45}{8}\,\text{km/hr}.$
48. (b) The elevator moves downward with constant acceleration.
49. (a) In free fall, the acceleration is 9.8 m/s², there is uniform acceleration starting from rest, so $s = \dfrac{1}{2}at^2$

    and $t = \sqrt{\dfrac{2s}{a}} = \sqrt{\dfrac{2 \times 24\text{m}}{9.8\,\text{m/s}^2}} = 2.2$ s
50. (d) The time it takes the ball to get to the plate, at constant horizontal speed, is (18.3 m)/42.1 m/s) = 0.435 s.
    During that time, gravity makes it drop a distance of

    $s = \dfrac{1}{2}at^2 = \dfrac{1}{2}(9.8\,\text{m/s}^2)(0.435\,\text{s})^2 = 0.93$ m
51. (b) The total distance moved s = 3.2 km (due north)
    The total time taken t = 20 minutes

    $= \dfrac{20}{60}$ hours = $\dfrac{1}{3}$ hours

The velocity of the bicycle

$v = \dfrac{\text{Total distance covered}}{\text{Total time taken}} = \dfrac{s}{t}$

$v = \dfrac{3.2\,\text{km}}{(1/3)\,\text{h}} = 9.6\,\text{km/h}$ due north

52. (c) $v^2 = u^2 + 2gh \Rightarrow v = \sqrt{u^2 + 2gh}$
    So, for both the cases velocity will be equal.
53. (c) $\because h = ut + \dfrac{1}{2}gt^2 \Rightarrow h = 0 + \dfrac{1}{2}gT^2$

    After T/3 seconds, the position of ball,

    $h' = 0 + \dfrac{1}{2}g\left(\dfrac{T}{3}\right)^2 = \dfrac{1}{2} \times \dfrac{g}{9} \times T^2$

    $h' = \dfrac{1}{2} \times \dfrac{g}{9} \times T^2 = \dfrac{h}{9}$ m from top

    $\therefore$ Position of ball from ground = $h - \dfrac{h}{9} = \dfrac{8h}{9}$ m
54. (a) When a bus suddenly takes a turn, the passengers are thrown outwards because of inertia of motion.
55. (b) The thief runs a distance s in time t at 6.0 m/s, the policeman runs (s + 15m) in the same time, going 8.5 m/s. For both, time is distance over speed, so

    $t = \dfrac{s}{6.0\,\text{m/s}} = \dfrac{(s + 15\text{m})}{8.5\,\text{m/s}}$ from which s = 36 m.

    The policeman runs 51m.
56. (b) Both vehicles travel the same distance. For the car, going at constant speed, the distance is vt, for the motorcycle, it is $\dfrac{1}{2}$ at². Then

    $s = (22\,\text{m/s})\,t = \dfrac{1}{2}(3.2\,\text{m/s}^2)\,t^2$

    from which t = 14s.
57. (d) The initial velocity of a body u = 15 m/s.
    Acceleration of body a = 10 m/s²
    and time t = 10s
    If v is the velocity of body after 10s then from equation
    v = u + at
    We have v = 15 + 10 (10) = 15 + 100 = 115 m/s

58.	(c)	59.	(b)	60.	(d)	61.	(a)
62.	(b)	63.	(d)	64.	(c)	65.	(b)
66.	(d)	67.	(b)	68.	(b)	69.	(c)
70.	(a)	71.	(a)	72.	(b)	73.	(b)
74.	(a)	75.	(a)	76.	(b)	77.	(c)
78.	(b)	79.	(b)	80.	(b)	81.	(a)
82.	(c)	83.	(b)	84.	(a)	85.	(a)
86.	(d)	87.	(a)	88.	(a)	89.	(b)

90. (b) Speed and velocity are both measured using the same units. The SI unit of distance and displacement is the meter. The SI unit of time is the second. The SI unit of speed and velocity is the ratio of two - the meter per second.

$\text{Speed} = \dfrac{\text{distance}}{\text{time}}$

$\text{velocity} = \dfrac{\text{displacement}}{\text{time}}$

The SI unit of distance and displacement is meter (m). The SI unit of time is second (s).

Therefore, the SI unit of speed and velocity is m/s

91. (b) **Area Moment of Inertia:**
- It is a geometrical property of an area which reflects how its points are distributed with regards to an arbitrary axis.
- It is also known as **2nd moment of area of 2nd Moment of inertia.**
- Its SI unit is **'m⁴'**
- Mathematically, it is represented as

$$I_x = \iint y^2 dx dy \text{ and } I_y = \iint x^2 dx dy$$

Calculation:

Given:

width (b) = 3 cm, height (h) = 4 cm

For the rectangular section, the Moment of Inertia is given by

$$I_{xx} = \frac{bh^3}{12} = \frac{3 \times 4^3}{12} = 16 cm^4$$

92. (c) **Collinear forces: The forces, whose lines of action lie on the same line, are known as collinear forces.** When two or more forces act on a body, they are called to form a system of forces. Coplanar forces:

The forces, whose lines of action lie on the same plane, are known as coplanar forces.

93. (b) The effects of force, acting on the body, we must know these details are as follows:
- the magnitude of the force.
- line of action of the force
- nature of the force, i.e., whether the force is push or pull

94. (a) Average speed: The total path length traveled divided by the total time interval during which the motion has taken place is called the average speed of the particle.

$$\text{Average speed } (\bar{v}) = \frac{\text{total path length (S)}}{\text{total time taken (t)}}$$

95. (a) Let the speed of the bus is x km/h.

According to question,

$(x-3) \times 10 = (x-5) \times 11$

$\Rightarrow 10x - 30 = 11x - 55$

$\Rightarrow \boxed{x = 25 km/h}$

96. (a)

$$\text{Average speed} = \frac{90+90}{\dfrac{90}{30}+\dfrac{90}{60}} = \frac{180}{3+1.5} = \frac{1800}{45} = 40 km/h$$

1 Cell & Tissues

CELL BIOLOGY

Biology is the science of life. Biologist study the structure, function, growth, origin, evolution and distribution of living organism.

Father of biology & zoology: Aristotle

Father of Botany : Theophrastus.

Cell

Cell is a basic structural and functional unit of life.

- **Robert Hooke** in 1665 coined the word 'cell'.
- **Anton van Leeuwenhoek** first saw and described a live cell.
- **Robert Brown** later discovered the nucleus.
- Cell theory was proposed by **Schleiden and Schwann** in 1839 to explain the concept of the cellular nature of living organism.

Note : Every cell originates from pre-existing cell.

Cells are of 2 types: Prokaryotic cell and Eukaryotic cell

Difference between Prokaryotes and Eukaryotes.

	Prokaryotes		Eukaryotes
1	Size of cell is generally small.	1	Size of cell is generally large.
2	It contains single chromosome which is circular in shape.	2	It contains more than one chromosomes.
3	Nucleus absent.	3	Nucleus present
4	Cell division takes place by fission or budding.	4	Cell division takes place by mitosis and meiosis.
5	Membrane bound cell organelles are absent.	5	Membrane bound cell organelles present.

- A tissue is a group of cells of similar structure and function arranged in the body so as to give the highest possible efficiency to the function they perform.
- All living organisms are made up of cells. In unicellular or acellular organisms a single cell may constitutes a whole organism. *E.g. Amoeba, Chlamydomonas.* In multicellular organisms many cells group together in a single body and assume different functions. *E.g.* fungi, plants.
- Various cells of human body vary in structure according to their function.

Bone cell

Smooth muscle cell   Nerve cell   Human sperm
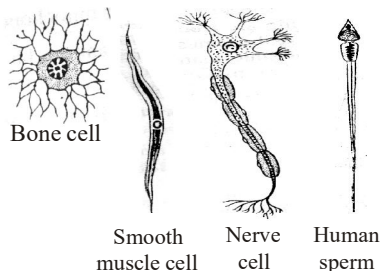
Various cells from the human body

- Each living cell perform certain basic functions that are characteristic of all living forms.

Structural Organisation of a Cell

(i) Plasma membrane or Cell membrane

It is the outermost covering of the cell which separates the contents of the cell from its external environment. It allows entry and exit of only certain materials so it is also called selectively permeable membrane. CO_2 and O_2 move across the membrane through *diffusion*.

It is made up of lipids and proteins. Fluid Mosaic Model of Plasma membrane was proposed by **Singer** and **Nicolson**.

Diffusion — It is the movement of a substance from a region of higher concentration to a region of lower concentration.

Osmosis — It is the movement of water through a selectively permeable membrane from a region of high water concentration to a region of low water concentration.

Fate of animal or plant cell in Hypertonic, Hypotonic and Isotonic solution

- **Hypertonic solution** — The concentration of solution is more than that of cell. Therefore, the cell will loose water by exosmosis and shrink.
- **Hypotonic solution** — The concentration of solution is less than that of cell. Therefore, the cell will gain water by endosmosis and swell up.
- **Isotonic solution** — The concentration of solution is same as that of cell. Therefore, there will be no movement of water, and cell size will remain same.

Functions : (i) It separates contents of the cell from external environment.

(ii) It helps in engulfing food by endocytosis as in *Amoeba*.

(ii) Cell wall

It is outermost covering which lies outside the plasma membrane. Plant cell wall is composed of a complex substance cellulose which provides structural strength to plants. Due to cell wall, plants, fungi and bacteria withstand much greater changes in the surrounding medium than animal cell. It is absent in animal cell.

Plasmolysis : Shrinking of protoplasm of a cell due to exosmosis when kept in hypertonic solution.

Functions : (i) It provides rigidity and strength to the cell.

(ii) It helps to sustain during unfavourable conditions.

(iii) Nucleus

It is the dark coloured, spherical or oval structure near the centre of a cell. It has a double layered covering called nuclear membrane Nucleus contains hereditary material called chromosomes.

Functions : (i) It plays an important role in cellular reproduction.

(ii) It plays an important role in inheritance of characters from parents to the offsprings.

- **Cytoplasm :** A large region of each cell enclosed by the cell membrane. It contains many specialised cell organelles which perform specific functions for the cell.

(iv) Endoplasmic Reticulum (ER)

It is a large network of membrane - bound tubules. It is two types-

(a) **Rough endoplasmic reticulum (RER)**-contains ribosomes attached to its surface. Ribosomes are site of protein synthesis.

(b) **Smooth endoplasmic reticulum (SER) –** It helps in manufacture of fats and lipids.

Functions: (i)It act as a channel for transport of materials within cytoplasm or between cytoplasm and nucleus.

(ii) In liver cells of vertebrates, SER detoxifies poisons and drugs

Animal cell

Plant cell

(v) Golgi apparatus

Discovered by **Camillo Golgi**. It consists of membrane bound vesicles arranged parallel to each other in stacks called cisternae, connected with ER.

Functions : (i) It helps in transport of substances synthesised near ER inside and outside the cell.

(ii) It helps in storage, modification and packaging of products in vesicles.

(vi) Lysosomes

These are membrane bound sacs filled with digestive enzymes. When cell gets damaged, lysosomes burst and enzymes digest their own cell. So, they are also called **"suicide bags"** of a cell.

Functions: It keeps the cell clean by digesting foreign materials and old worn-out cell organelles.

(vii) Mitochondria

These are double membrane bound organelles. The outer membrane is porous while the inner membrane is deeply folded providing large surface for ATP– generating chemical reactions. So, they are also called **"Power houses"** of the cell. Mitochondria have its own DNA and ribosomes.

Functions : It helps in ATP and Protein synthesis.

(viii) Plastids

They are present only in plant cells. They are two types – Chromoplasts (coloured plastids) and Leucoplasts (white plastids). Plastids that contain green colour pigment, chlorophyll are called chloroplasts. They also have their own DNA and ribosomes.

Functions: (i) Chloroplasts play an important role in photosynthesis in plants.

(ii) Leucoplasts store starch, oil and protein granules.

(ix) Vacuoles

These are storage sacs for solid or liquid contents. They are small sized in animal cell and large sized in plant cells.

Functions : (i) Vacuoles provide turgidity and rigidity to the cell.

(ii) Contractile vacuoles help in expelling excess water and wastes in some animals.

- Cells specialising in one function is carried out by a cluster of cells at a definite place in the body called a **tissue**. Blood, phloem and muscle are all example of tissues.

Difference between Plant and Animal Cells

	Plant Cell		Animal Cell
1	Plant cells are larger in size.	1	Animal cells are generally smaller in size.
2	Plastid present.	2	Plastid absent.
3	Cell wall present, made up of cellulose and chitin.	3	Cell wall absent.
4	Centrosome absent.	4	Centrosome present.
5	Vacuoles are larger in size.	5	Vacuoles are smaller in size.
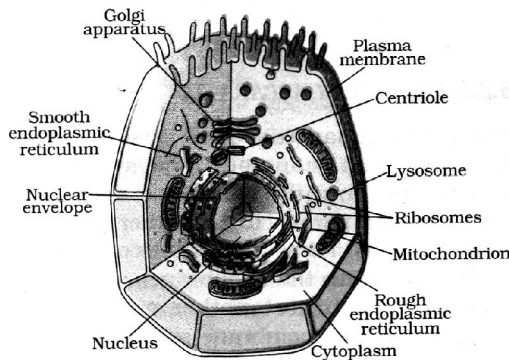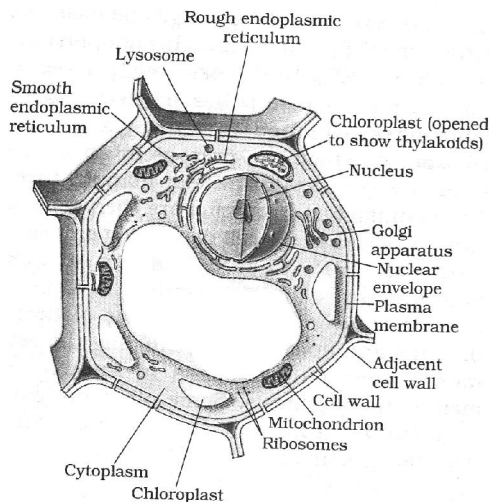
TISSUE

- **Are plants and animals made of same types of tissues :**

(i) Plants are stationary, adopted for sedentary mode of life while animals live active locomotive life.

(ii) The growth in plants is limited to certain regions while there is no such demarcation of dividing and non – dividing regions in animals.

Plant tissues

On the basis of dividing capacity plant tissues can be classified as :

1. Meristematic tissue

Growth of plants occurs only in regions where meristematic tissues are present. Depending on the region where they are present, they are classified as apical, lateral and intercalary meristem.

(a) **Apical meristem** – It is present at the growing tips of stem and root and increases the length of the stem and root.

(b) **Lateral meristem–** It increases the girth of stem or root. It is also called cambium.

(c) **Intercalary meristem–** It is located at the base of leaves or internodes on twigs.

2. Permanent tissue

The cells formed by meristematic tissue acquire permanent shape, size and function and lose the ability to divide.

A. **Simple permanent tissue –**

(i) **Parenchyma** – It consists of unspecialised cell with thin cell walls. The cells are loosely packed with large intercellular spaces. When it contains chlorophyll and performs photosynthesis it is called **chlorenchyma**. In aquatic plants, they have large air cavities and give buoyancy to the plants called **aerenchyma**.

Functions– (i) It provides support to the plants (ii) It stores food and water in stems and roots.

(ii) **Collenchyma–** The cells are living, elongated and irregularly thickened at the corners. They have very little intercellular spaces.

Functions– (i) It provides flexibility to plant parts like leaf and stem. (ii) It provides mechanical support.

(iii) **Sclerenchyma–** The cells are dead. They are long and narrow. Walls are thickened due to deposition of lignin.

Functions – (i) It makes plant hard and stiff., *eg.* Coconut husk. (ii) It provides mechanical strength.

Various types of simple tissues (a) parenchyma, (b) collenchyma and (c) sclerenchyma as shown below :

(a)

(b)

(c)
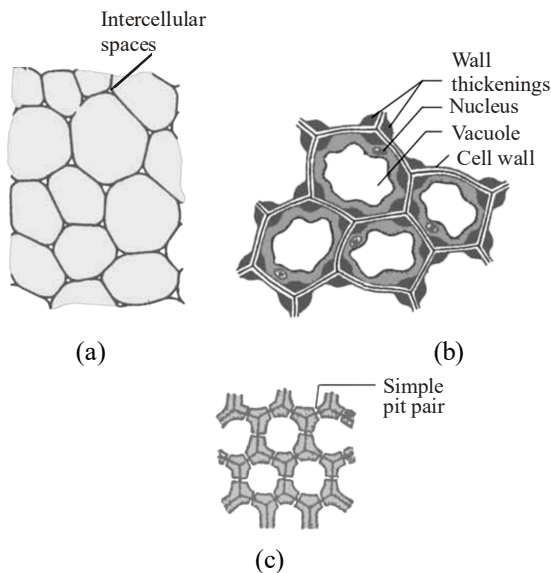
B. **Complex permanent tissue–** It is made of more than one type of cells. All cells perform same function. It is of two types – xylem and phloem.

Xylem– It consists of tracheids, vessels, xylem parenchyma and xylem fibres. Cell are thick walled and mostly dead.

Functions : (i) Tracheids and vessels transport water and minerals vertically.
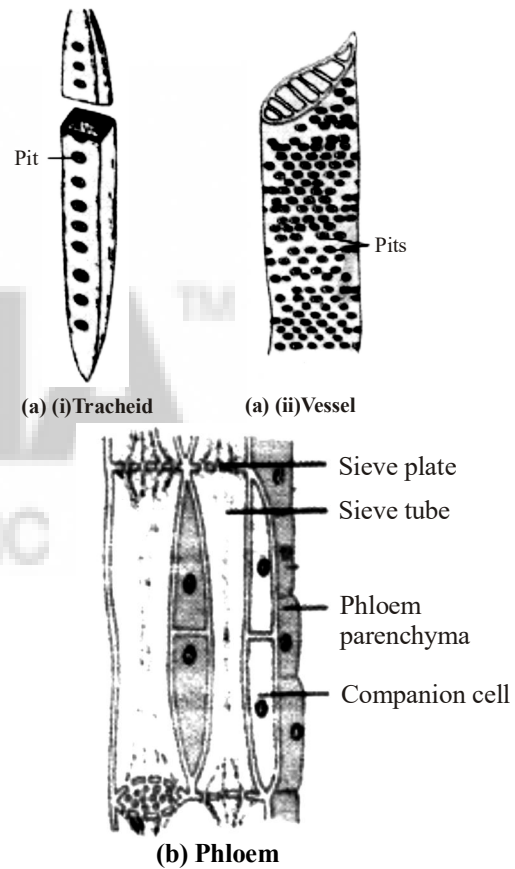
(ii) Fibres are supportive.

Phloem

It is made of sieve tubes, companion cells, phloem fibres, and phloem parenchyma. Except phloem fibres, phloem cells are living.

Function– (i) Transports food from leaves to other parts of the plant.

Various type of complex tissues : (a) Xylem (i) Tracheid (ii) Vessel (b) Phloem as shown below

(a) (i)Tracheid (a) (ii)Vessel

(b) Phloem

Animals Tissues

On the basis of functions performed, animal tissues are divided as :-

Epithelial tissue, connective tissue, muscular tissue and nervous tissue.

1. Epithelial tissue

It forms protective covering in the animal body, covers organs and separates different body systems. Different types of epithelial tissues on the basis of functions are–

(i) **Simple squamous epithelium –** Cells are extremely thin, flat and form delicate lining. Oesophagus, lining of mouth are made of it.

(ii) **Stratified squamous epithelium–** In the skin epithelial cells are arranged in many layers to prevent wear and tear.

(iii) **Columnar epithelium –** It is present in the inner lining of intestine, pillar like tall cells. In respiratory tract the epithelial cells have hair– like projections called cilia on the outer surface.

(iv) **Cuboidal epithelium –** It is made of cube– shaped cells. It forms lining of kidney tubules and ducts of salivary glands.

(v) **Glandular epithelium–** In glands, a portion of the epithelium tissue folds inwards.

2. **Connective tissue**

The cells are loosely packed and embedded in intercellular matrix. It is of following types :-

(i) **Areolar tissue –** It is found between skin and muscles, around blood vessels, nerves and bone marrow. It fills space inside organs, helps in repair of tissues.

(ii) **Adipose tissue –** It is fat storing, found below the skin and between internal organs.

(iii) **Bone –** It forms framework to support the body. Bone cells lie embedded in hard matrix composed of calcium and phosphorous.

(iv) **Ligament –** connects two bones.

(v) **Tendons –** connect muscles to bones.

(vi) **Cartilage –** It has widely spaced cells. It is present in nose, ear, trachea, larynx.

(vii) **Blood –** It is a fluid connective tissue. Fluid matrix is called **plasma** that contains red blood cells (RBCs), white blood cells (WBCs) and platelets unit.

(a)

(b)
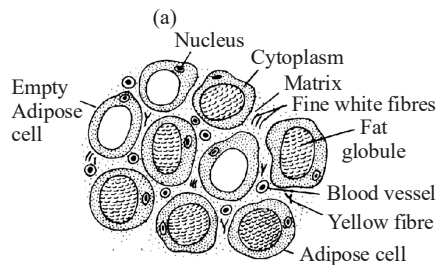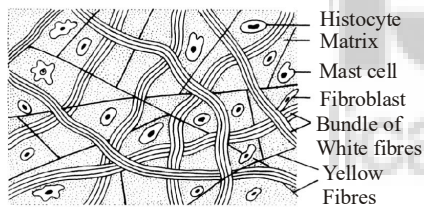
Connective tissues : (a) areolar tissues and (b) adipose tissue shown above

3. **Muscular tissue**

It consists of elongated cells called muscle fibres. They are responsible for movement in our body. The three types of muscles are :–

(i) **Striated muscles –** They have alternate light and dark bands or striations. The cells are long, cylindrical, unbranched and multinucleate. They move according to our will so as called voluntary muscles. Eg. muscles of hands and legs.

(ii) **Smooth muscles –** The cells are long with pointed ends and uninucleate. They are also called involuntary muscles eg. muscles found in iris of eye, ureters, bronchi of lungs, alimentary canal.

(iii) **Cardiac muscles –** The muscle cells are cylindrical, branched and uninucleate. They are involuntary. E.g. the muscles of heart.

Various types of muscles fibres : (a) striated muscle, (b) smooth muscle and (c) cardiac muscle as shown below :

(a)

(b)

(c)
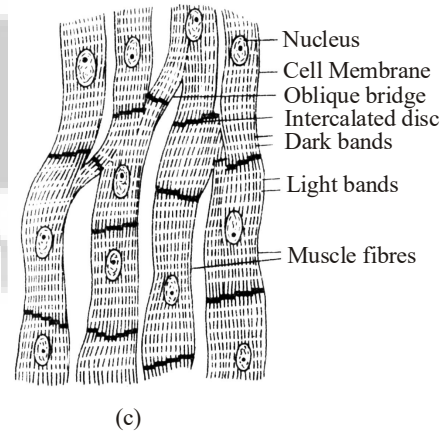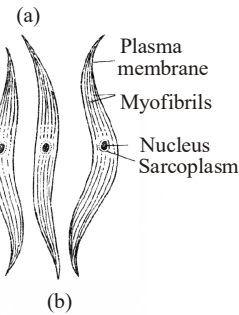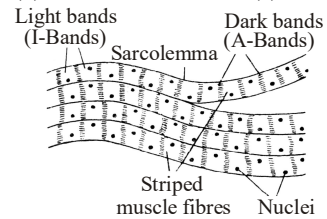
4. **Nervous tissue**

They are found in brain, spinal cord and nerves. They transmit the stimulus. A neuron consists of a cell body with a nucleus and cytoplasm. It has a long part called axon and many short, branched parts called dendrites. Many nerve fibres together form a nerve.
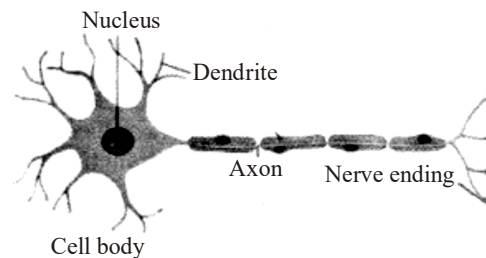
Neuron-unit of nervous tissue

Exercise

DIRECTIONS : This section contains multiple choice questions. Each question has 4 choices (a), (b), (c) and (d) out of which only one is correct.

1. Cell were first discovered by
   (a) Robert Hooke   (b) Leeuwenhoek
   (c) Purkinje   (d) Virchow

2. The plasma membrane is
   (a) permeable   (b) impermeable
   (c) selectively permeable   (d) both (a) and (b)

3. Nuclear material without cover is found in
   (a) mycoplasma and green algae
   (b) bacteria and fungi
   (c) bacteria and blue green algae
   (d) none of the above

4. The word 'prokaryote' means a cell
   (a) with many nuclei   (b) with one nucleus
   (c) with diffused nucleus (d) without chloroplast

5. Minute structures on bacterial cell are called
   (a) hair   (b) cilia
   (c) flagella (d) pili

6. Cell theory was proposed by
   (a) Schleiden and Schwann   (b) Robert Brown
   (c) Leeuwenhoek   (d) Purkinje

7. The undefined nuclear region in a bacteria is
   (a) nucleoid   (b) nucleus
   (c) chromosome   (d) nucleolus

8. Nucleus plays a crucial part in
   (a) metabolism   (b) cellular reproduction
   (c) lipid synthesis (d) protein synthesis

9. Which of the following is not present in prokaryotes ?
   (a) Ribosomes   (b) Cell wall
   (c) Plasma membrane (d) Nuclear membrane

10. Chemical nature of carrier molecules facilitating transport across plasma membrane is
    (a) starchy   (b) sugary
    (c) proteinaceous (d) fatty acidic

11. ER remains associated with
    (a) dictyosomes   (b) mitochondria
    (c) karyotheca   (d) chloroplast

12. Vacuole is surrounded by
    (a) plasmalemma   (b) cell wall
    (c) tonoplast   (d) plasmodesmata

13. The organisms that lack membranes are
    (a) Viruses   (b) Bacteria
    (c) Protozoans   (d) Fungi

14. The organelle attached to the ER is
    (a) ribosomes   (b) lysosomes
    (c) golgi bodies (d) proteins

15. Golgi bodies help in
    (a) excretion of steroids   (b) storage and secretion
    (c) translation   (d) transcription

16. According to fluid mosaic model plasma membrane is composed of
    (a) phospholipids, extrinsic and intrinsic proteins
    (b) phospholipids and oligosaccharides
    (c) phospholipids and hemicellulose
    (d) phospholipids and integral glycoproteins

17. The presence of .... organelle is only revealed by electron microscope.
    (a) chloroplast   (b) mitochondria
    (c) Golgi bodies (d) lysosome

18. One of these is the smallest in size
    (a) Ribosome   (b) Lysosome
    (c) Mitochondria (d) Chloroplast

19. The SER helps in building the cell membrane. This process is called
    (a) protein synthesis   (b) membrane abiogenesis
    (c) membrane biogenesis   (d) glycogenesis

20. Golgi apparatus is involved in the formation of :
    (a) lysosome   (b) vacuoles
    (c) plastids   (d) mitochondria

21. DNA is a component of
    (a) mitochondria   (b) chloroplast
    (c) cytoplasm   (d) (a) and (b) both

22. One of these is double membrane organelle
    (a) lysosome   (b) mitochondria
    (c) nucleus   (d) endoplasmic reticulum

23. The cell organelle containing the flattened membrane bounded cisternae are located near the nucleus is
    (a) mitochondria   (b) Golgi
    (c) centrioles   (d) nucleolus

24. The entry of mineral ions in a plant cell during absorption is by
    (a) passive absorption   (b) active absorption
    (c) osmosis   (d) endocytosis

25. The suicide bags of the cells are
    (a) plastids   (b) mitochondria
    (c) lysosomes   (d) ribosomes

26. The power houses of the cells are
    (a) mitochondria   (b) plastids
    (c) golgi complex (d) ribosomes

27. Vesicles are essential for the normal functioning of the Golgi apparatus because
    (a) they provide energy for chemical reactions.
    (b) they move proteins and lipids between different parts of the organelle.
    (c) they contribute to the structural integrity of the organelle.
    (d) they produce the sugars that are added to proteins.

28. Amino acid chains built by the ribosomes then move to the
    (a) golgi apparatus   (b) lysosome
    (c) endoplasmic reticulum   (d) mitochondria

29. Simple tissues are
    (a) parenchyma, xylem and collenchyma
    (b) parenchyma, collenchyma and sclerenchyma
    (c) parenchyma, xylem and sclerenchyma
    (d) parenchyma, xylem and phloem

30. The living cells providing tensile strength are
    (a) parenchyma   (b) collenchyma
    (c) sclerenchyma   (d) sclerotic cells

31. The energy currency of the cell is
    (a) ADP   (b) ATP
    (c) NADP   (d) FADP

32. The organelle that is present only in plant cells is
    (a) mitochondria   (b) endoplasmic reticulum
    (c) ribosomes   (d) plastids

33. Quiescent centre is found in
    (a) root tip   (b) cambium
    (c) shoot tip   (d) leaf tip

34. The conducting cells of xylem are
    (a) tracheary elements   (b) sieve elements
    (c) companion cells   (d) all the above

35. The chief function of vessels in the plant body is
    (a) to translocate food material
    (b) to conduct water and mineral salts
    (c) to support living cells
    (d) all the above
36. Inner surface of fallopian tubes, bronchi and bronchioles are lined by
    (a) squamous epithelium (b) ciliated epithelium
    (c) columnar epithelium (d) cubical epithelium
37. The organelles that contain their own genetic material are
    (a) Mitochondria, Vacuoles
    (b) Plastids, Golgi complex
    (c) Mitochondria, Plastids
    (d) Ribosomes, Nucleolus
38. The photosynthetic pigment is
    (a) chlorophyll (b) chronophyll
    (c) xanthophyll (d) fucoxanthin
39. Average life span of human R.B.C. is
    (a) 100 days (b) 90 days
    (c) 120 days (d) 80 days
40. Which set clearly identify striated muscles ?
    (a) Cylindrical, syncytial and unbranched
    (b) Spindle, unbranched and uninucleated
    (c) Cylindrical, striped and nucleated
    (d) Cylindrical, striped and branched
41. Cardiac muscle cells are cylindrical branched
    (a) uninucleate and voluntary
    (b) uninucleate and involuntary
    (c) multinucleate and voluntary
    (d) multinucleate and involuntary
42. Blood, phloem and muscle are
    (a) tissues (b) organs
    (c) cells (d) organ system
43. Certain specific regions where growth takes place in plants is called
    (a) perisperm (b) endosperm
    (c) meristem (d) stele
44. The fibrous tissue which connects the two bone is
    (a) connective tissue (b) tendon
    (c) ligament (d) adipose tissue
45. Largest number of cell bodies of neuron in our body are found in
    (a) retina (b) spinal cord
    (c) brain (d) tongue
46. Neurons are classified on the basis of
    (a) number of nucleus present
    (b) number of processes arising from the cell body
    (c) number of dendrites present
    (d) number of axons present
47. The girth of the stem or root increases due to
    (a) apical meristem (b) intercalary meristem
    (c) lateral meristem (d) None
48. The process of formation of permanent tissue in plants is called
    (a) scalarification (b) differentiation
    (c) cell thickening (d) specialisation
49. Tissues that have long and narrow cells are called
    (a) cuboidal epithelium (b) squamous epithelium
    (c) germinal epithelium (d) columnar epithelium
50. The vascular tissues of the plant function in
    (a) support
    (b) support and transport of materials
    (c) secretion of plant hormones
    (d) All of the above

51. Which tissue lacks blood supply and heals slowly?
    (a) Nervous (b) Muscle
    (c) Cartilage (d) Bone
52. The basic packing tissue is
    (a) sclerenchyma (b) collenchyma
    (c) xylem (d) parenchyma
53. The tissue in leafstalks below the epidermis is made up of
    (a) collenchyma (b) sclerenchyma
    (c) parenchyma (d) xylem
54. The thickening of the walls of the sclerenchyma tissues is due to
    (a) suberin (b) magnesium
    (c) lignin (d) calcium
55. The waxy, water resistant layer in the xerophytic plants is secreted by
    (a) endodermis (b) cortex
    (c) phloem (d) epidermis
56. Which of these options are not a function of Ribosomes ?
    (i) It helps in manufacture of protein molecules.
    (ii) It helps in manufacture of enzymes.
    (iii) It helps in manufacture of hormones.
    (iv) It helps in manufacture of starch molecules.
    (a) (i) and (ii) (b) (ii) and (iii)
    (c) (iii) and (iv) (d) (iv) and (i)
57. A person met with an accident in which two long bones of hand were dislocated. Which among the following may be the possible reason ?
    (a) Tendon break (b) Break of skeletal muscle
    (c) Ligament break (d) Areolar tissue break
58. Which of the following plant tissues is capable of cell division ? [RRB ALP-2018]
    (a) Meristem (b) Sclerenchyma
    (c) Xylem (d) Parenchyma
59. Which permanent tissue makes a plant hard and stiff ? [RRB ALP-2018]
    (a) Collenchymas (b) Sclerenchma
    (c) Parenchyma (d) Aerenchyma
60. Nodes of Ranvier are microscopic gaps found within. [RRB ALP-2018]
    (a) myelinated axons (b) osteoblasts
    (c) gland cells (d) chondroblasts
61. In which of the following tissues are the cells living elongated and irregularly thickened at the corners ? [RRB ALP-2018]
    (a) Parenchyma (b) Sclerenchyma
    (c) Aerenchyma (d) Collenchyma
62. What is a tissue? [RRB ALP-2018]
    (a) Cells which are similar in origin, but dissimilar in form and function
    (b) Cells which are dissimilar in origin, but are similar in form and function
    (c) Cells which are dissimilar in origin, form and function
    (d) Cells which are similar in origin, form and function
63. What is the basic unit of classification in taxonomy? [RRB ALP-2018]
    (a) Genus (b) Species (c) Family (d) Order
64. National Handloom day is celebrated every year on —— . [RRB NTPC Stage-I 8th Feb. 2021]
    (a) 19 January (b) 15 August
    (c) 19 July (d) 7 August

Hints & Explanations

1. (a) Robert Hooke observed a thin slice of cork under the microscope. He observed small box like structures which he named as cells.

2. (c) The plasma membrane allows the entry and exit of some of the materials in and out of the cell. It also prevents movement of some other materials. Some substances like carbon-dioxide or oxygen move across the cell membrane by a process called diffusion. On the other hand, substances like water moves across the cell membrane through the process called osmosis. Therefore, the cell membrane is called a selectively permeable membrane.

3. (c)   4. (c)   5. (d)   6. (a)

7. (1) In prokaryotes, the nucleoid is an irregularly shaped region within the cell where the genetic material is localised.

8. (b) Cell division is a process by which a cell, called the parent cell, divides into two cells, called daughter cells. In meiosis however, a cell is permanently transformed and cannot divide again. Cell division takes from 3 minutes to 6 hours to complete. The primary concern of cell division is the maintenance of the original cell's genome. Before division can occur, the genomic information which is stored in chromosomes must be replicated, and the duplicated genome separated cleanly between cells.

9. (d)   10. (c)   11. (c)   12. (c)

13. (a) A virus is a sub-microscopic particle (ranging in size from 20 - 300 nm) that can infect the cells of a biological organism. Viruses can replicate themselves only by infecting a host cell.

14. (a) The surface of the rough endoplasmic reticulum is studded with protein-manufacturing ribosomes giving it a "rough" appearance. The ribosomes only bind to the ER once it begins to synthesize a protein destined for sorting. The membrane of the rough endoplasmic reticulum is continuous with the outer layer of the nuclear envelope.

15. (b)   16. (a)   17. (d)

18. (a) A ribosome (20 mm) is generally considered the smallest cellular organelle.

19. (c) The smooth endoplasmic reticulum has functions in several metabolic processes, including synthesis of lipids, metabolism of carbohydrates and calcium concentration, drug detoxification, and attachment of receptors on cell membrane proteins.

20. (a) The Golgi apparatus is integral in modifying, sorting, and packaging the substances for cell secretion or for use within the cell. It primarily modifies proteins delivered from the rough endoplasmic reticulum, but is also involved in the transport of lipids around the cell, and the creation of lysosomes.

21. (d) Chloroplast and mitochondria are double membrane bound organelles. They both have circular DNA.

22. (b)   23. (b)   24. (b)

25. (c) Lysosomes are organelles that contain digestive enzymes (acid hydrolases). They digest excess or worn out organelles, food particles, and engulfed viruses or bacteria. The membrane surrounding a lysosome prevents the digestive enzymes inside from destroying the cell.

26. (a) In cell biology, a mitochondrion is a membrane-enclosed organelle, found in most eukaryotic cells. Mitochondria are sometimes described as "cellular power plants," because they generate most of the cell's supply of ATP, used as a source of chemical energy.

27. (b)

28. (c) A polypeptide built by the ribosome is translocated into the lumen of the ER for the post translational modification & then it moves to lysosomes for sorting process.

29. (b)   30. (b)

31. (b) Adenosine 5'-triphosphate (ATP) is a multifunctional nucleotide that is most important as a "molecular currency" of intracellular energy transfer. ATP transports chemical energy within cells for metabolism. It is produced as an energy source during the processes of photosynthesis and cellular respiration and consumed by many enzymes and a multitude of cellular processes including biosynthetic reactions, motility and cell division.

32. (d) Plastids are major organelles found in plants and algae. Plastids are responsible for photosynthesis, storage of products like starch and for the synthesis of many classes of molecules such as fatty acids and terpenes which are needed as cellular building blocks and/or for the function of the plant.

33. (a)   34. (a)   35. (b)   36. (b)   37. (c)

38. (a) Chlorophyll is a green pigment found in most plants, algae, and cyanobacteria. Chlorophyll absorbs most strongly in the blue and red but poorly in the green portions of the electromagnetic spectrum, hence the green color of chlorophyll-containing tissues like plant leaves.Chlorophyll is vital for photosynthesis, which helps plants obtain energy from light.

39. (c)   40. (a)   41. (b)

42. (a) Muscle tissue is separated into three distinct categories: visceral or smooth muscle, which is found in the inner linings of organs; skeletal muscle, which is found attached to bone in order for mobility to take place; and cardiac muscle which is found in the heart.Vascular tissue is a complex tissue found in vascular plants, meaning that it is composed of more than one cell type. The primary components of vascular tissue are the xylem and phloem. Connective tissue - It holds everything together. Blood is a connective tissue.

43. (c) A meristem is a tissue in plants consisting of undifferentiated cells (meristematic cells) and found in zones of the plant where growth can take place.

44. (c)   45. (c)   46. (b)

47. (b) The intercalary meristem increases the girth of the stem or root. The intercalary meristems occur only in monocot stems between mature tissues. They are cylindrical meristems located around the nodes and are an adaptation to grazing herbivores and landmowers.

48. (b) Differentiated plant cells generally cannot divide or produce cells of a different type. Therefore, cell division in the meristem is required to provide new cells for expansion and differentiation of tissues and initiation of new organs, providing the basic structure of the plant body.

49. (d)   50. (b)   51. (c)   52. (d)

53. (c) The tissue between the upper and lower epidermis is called the mesophyll which is made up of parenchyma. Parenchyma may be spherical, oval round, polygonal or elongated is shape. They performs various functions like photosynthesis, storage and secreation.

54. (c) Sclerenchyma is a supporting tissue. Two groups of sclerenchyma cells exist: fibres and sclereids. Their walls consist of cellulose and/or lignin. Sclerenchyma fibres are of great economical importance, since they constitute the source material for many fabrics flax, hemp, jute, ramie.

55. (d) A xerophyte or xerophytic organism is an organism, which is able to survive in an ecosystem with little to no water or moisture; usually in environments where heat accounts for a similar amount of water loss to that of transpiration.

56. (c)   57. (c)   58. (a)   59. (b)   60. (a)   61. (d)

62. (d)   63. (b)

64. (d) The Government of India decided to commemorate the 7th of August every year as the National Handloom Day. The first National Handloom Day was held on 7th August 2015 by Hon'ble Prime Minister Shri Narendra Modi in Chennai.