



ALIGARH MUSLIM
UNIVERSITY



AMU Medical 2013 Sample Paper



AMU

Medical Entrance Exam

Solved Paper 2013

Physics

1. Water is moving with a speed of 5.0 m/s through a pipe with a cross area of 4.0 cm^2 . The water gradually descends 10 m as the pipe increases to 8.0 cm^2 . If the pressure at the upper level is $1.5 \times 10^5 \text{ Pa}$, the pressure lower level will be

- (a) $2.8 \times 10^5 \text{ Pa}$ (b) $2.6 \times 10^5 \text{ Pa}$
(c) $2.4 \times 10^5 \text{ Pa}$ (d) $2.1 \times 10^5 \text{ Pa}$

2. Starting with the same initial conditions, an ideal gas expands from volume V_2 in three different ways. The work done by the gas is W_1 if the process purely isothermal, W_2 if purely isobaric and W_3 if purely adiabatic. Then

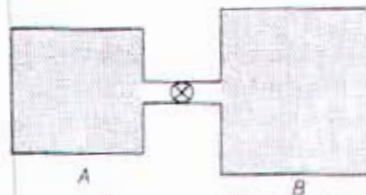
- (a) $W_2 > W_1 > W_3$ (b) $W_2 > W_3 > W_1$
(c) $W_1 > W_2 > W_3$ (d) $W_1 > W_3 > W_2$

3. 1 mole of an ideal gas expands isothermally so that its pressure falls $1.0 \times 10^5 \text{ Pa}$ to $0.5 \times 10^5 \text{ Pa}$. The change in entropy of the gas is equal to

- (a) 0 (b) 0.693 J/K
(c) 5.76 J/K (d) None of these

4. In the given figure container A holds an ideal gas at a pressure of $50 \times 10^5 \text{ Pa}$ and a temperature of 300 K. It is connected by a thin tube (and a closed) container B, with four times the volume of A. Container B holds same at a pressure of $1.0 \times 10^5 \text{ Pa}$ and a temperature of 400 K. The valve is open allow the pressures to equalize, but the

temperature of each container constant at its initial value. The final pressure in the two containers will be to



- (a) $1.5 \times 10^5 \text{ Pa}$ (b) $2.5 \times 10^5 \text{ Pa}$
(c) $2.1 \times 10^5 \text{ Pa}$ (d) $3.5 \times 10^5 \text{ Pa}$

5. Water standing in the open at 32°C evaporates because of the escape of some of the surface molecules. The heat of vaporisation (540 cal/g) is approximately equal to ϵn , where ϵ is the average energy of the escaping molecules and n is the number of molecules per gram. The value of ϵ is close to

- (a) $1.62 \times 10^{-20} \text{ J}$ (b) $4.23 \times 10^{-20} \text{ J}$
(c) $6.75 \times 10^{-20} \text{ J}$ (d) $8.31 \times 10^{-20} \text{ J}$

6. A vessel contains a mixture of 1 mole of oxygen and two moles of nitrogen at 300 K. The ratio of the rotational kinetic energy per O_2 molecule to that per N_2 molecule is

- (a) 1 : 2
(b) 2 : 1
(c) 1 : 1
(d) depends on the moment of inertia of the two molecules



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7. An oscillator consists of a block attached to a spring ($k = 400 \text{ N/m}$). At some time t , the position (measured from the system's equilibrium location), velocity and acceleration of the block are $x = 0.100 \text{ m}$, $v = -15.0 \text{ m/s}$, and $a = -90 \text{ m/s}^2$. The amplitude of the motion and the mass of the block are

- (a) 0.2 m, 0.84 kg
- (b) 0.3 m, 0.76 kg
- (c) 0.4 m, 0.54 kg
- (d) 0.5 m, 0.44 kg

8. An organ pipe A, with both ends open, has fundamental frequency 300 Hz. The third harmonic of another organ pipe B, with one end open, has the same frequency as the second harmonic of pipe A. The lengths of pipe A and B are

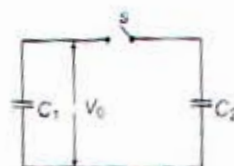
- (speed of sound in air = 343 m/s)
- (a) 57.2 cm and 42.9 cm
 - (b) 57.2 cm and 45.8 cm
 - (c) 42.9 cm and 32.2 cm
 - (d) 42.9 cm and 34.0 cm

9. The transverse displacement of a string fixed at both ends is given by $y = 0.06 \sin\left(\frac{2\pi x}{3}\right) \cos(120\pi t)$

where x and y are in metres and t is in seconds. The length of the string is 1.5 m and its mass is $3.0 \times 10^{-2} \text{ kg}$. The tension in the string is equal to

- (a) 648 N
- (b) 724 N
- (c) 832 N
- (d) 980 N

10. A capacitor of capacity $C_1 = 3.5 \mu\text{F}$ is charged to a potential difference $V_0 = 6.0 \text{ V}$ using a battery. The battery is then removed and the capacitor connected using a switch S , as shown in the figure, to an uncharged capacitor of capacity $C_2 = 6.5 \mu\text{F}$. The total final energy of the two capacitors after they are connected together then the charges $|q_1|$ and $|q_2|$ on the capacitors shall be



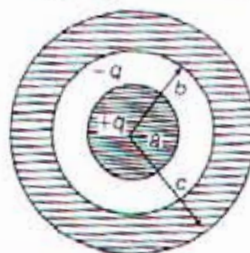
- (a) $63 \mu\text{C}$, $|q_1| = 7.35 \mu\text{C}$ and $|q_2| = 13.65 \mu\text{C}$
- (b) $22 \mu\text{C}$, $|q_1| = 10.5 \mu\text{C}$ and $|q_2| = 10.5 \mu\text{C}$
- (c) $22 \mu\text{C}$, $|q_1| = 7.35 \mu\text{C}$ and $|q_2| = 13.65 \mu\text{C}$
- (d) $22 \mu\text{C}$, $|q_1| = 13.65 \mu\text{C}$ and $|q_2| = 7.35 \mu\text{C}$

11. Two identical conducting spheres, fixed in place, attract each other with an electrostatic force of 0.108 N when separated by 50.0 cm, center to center. The spheres are then connected by a thin conducting wire. When the wire is removed the spheres repel each other with an electrostatic force of 0.0360 N. The initial charges on the spheres were

- (a) $9 \times 10^{-6} \text{ C}$, $-3 \times 10^{-6} \text{ C}$
- (b) $1 \times 10^{-6} \text{ C}$, $-3 \times 10^{-6} \text{ C}$
- (c) $-3 \times 10^{-6} \text{ C}$, $2 \times 10^{-6} \text{ C}$
- (d) $1 \times 10^{-6} \text{ C}$, $-2 \times 10^{-6} \text{ C}$

12. A non-conducting sphere of radius ' a ' has a net charge '+ q ' uniformly distributed throughout its volume. A spherical conducting shell having inner and outer radii ' b ' and ' c ' and a net charge '- q ' is concentric with the sphere (see the figure).

Read the following statements



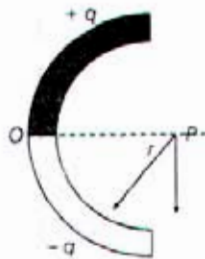
- (i) The electric field at a distance r from the center of the sphere for $r < a = \frac{1}{4\pi\epsilon_0} \frac{qr}{a^3}$
- (ii) The electric field at distance r for $a < r < b = 0$
- (iii) The electric field at distance r for $b < r < c = 0$



- (iv) The charge on the inner surface of the spherical shell = $-q$
 (v) The charge on the outer surface of the spherical shell = $+q$

Which of the above statements are true?

- (a) (i), (ii) and (v) (b) (i), (iii) and (iv)
 (c) (ii), (iii) and (iv) (d) (ii), (iii) and (v)
13. A thin glass rod is bent into a semi circle of radius r . A charge $+q$ is uniformly distributed along the upper half and a charge $-q$ is uniformly distributed along the lower half, as shown in the figure. The magnitude and direction of the electric field E produced at P , the centre of the circle, will be

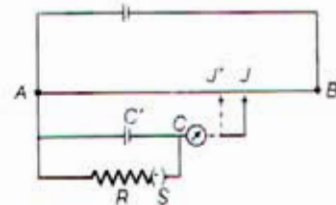


- (a) 0
 (b) $\frac{q}{\epsilon_0 \pi r^2}$ perpendicular to the line OP and directed downward
 (c) $\frac{q}{\epsilon_0 \pi r^2}$ perpendicular to the line OP and directed downward
 (d) $\frac{q}{\epsilon_0 \pi r^2}$ along the axis OP
14. A particle of positive charge Q is fixed at point P . A second particle of mass m and negative charge $-q$ moves at constant speed in a circle of radius r_1 , centered at P . The work W that must be done by an external agent on the second particle to increase the radius of the motion to r_2 , is given by
- (a) $W = \frac{Qq}{8\pi\epsilon_0} \left(\frac{1}{r_2} - \frac{1}{r_1} \right)$ (b) $W = \frac{Qq}{8\pi\epsilon_0} \left(\frac{1}{r_1} - \frac{1}{r_2} \right)$
 (c) $W = \frac{Qq}{4\pi\epsilon_0} \left(\frac{1}{r_2} - \frac{1}{r_1} \right)$ (d) $W = \frac{Qq}{4\pi\epsilon_0} \left(\frac{1}{r_1} - \frac{1}{r_2} \right)$

15. When 115 V is applied across a wire that is 10 m long and has a 0.30 mm radius, the current density is 1.4×10^4 A/m². The resistivity of the wire is

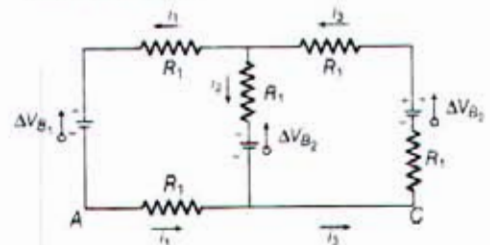
- (a) $2.0 \times 10^{-4} \Omega \cdot m$
 (b) $4.1 \times 10^{-4} \Omega \cdot m$
 (c) $8.2 \times 10^{-4} \Omega \cdot m$
 (d) $2.0 \times 10^{-3} \Omega \cdot m$

16. In the potentiometer circuit shown in the figure, the balance length $AJ = 58$ when switch S is open. When switch S is closed and the value of $R = 5 \Omega$, balance length $AJ' = 50$ cm. The internal resistance of the cell C' is



- (a) 1.2 Ω (b) 1.0 Ω
 (c) 0.8 Ω (d) 0.6 Ω

17. Figure shows a circuit with three ideal batteries in it. The circuit elements have the following values



$\Delta V_{B_1} = 3.0 \text{ V}, \Delta V_{B_2} = 6.0 \text{ V}$
 $R_1 = 2.0 \Omega, R_2 = 4.0 \Omega$

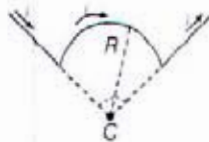
The currents i_1, i_2 and i_3 as shown in the circuit have the values

- (a) 0.50 A, -0.25 A, +0.25 A
 (b) 0.25 A, -0.50 A, -0.25 A
 (c) 0.50 A, 0.50 A, 1.0 A
 (d) -0.25 A, -0.50 A, 0.25 A



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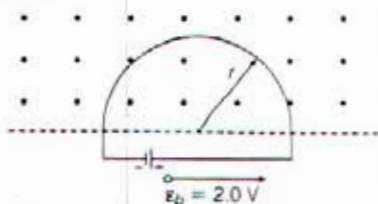
18. The wire in the figure carries a current i and consists of a circular arc of radius R and central angle $\frac{\pi}{2}$ rad, and two straight sections whose extensions intersect the center C of the arc. The magnetic field \mathbf{B} that the current produces at C is



- (a) $|\mathbf{B}| = \frac{\mu_0 i}{8R}$ into the plane of the figure
 (b) $|\mathbf{B}| = \frac{\mu_0 i}{8R}$ out of the plane of the figure
 (c) $|\mathbf{B}| = \frac{\mu_0 i}{8\pi R}$ into the plane of the figure
 (d) $|\mathbf{B}| = \frac{\mu_0 i}{8\pi R}$ out of the plane of the figure

19. Figure shows a conducting loop consisting of a half-circle of radius $r = 0.20$ m and three straight sections. The half-circle lies in a uniform magnetic field \mathbf{B} that is directed out of the page, the field magnitude is given by $B = (4.0 \text{ T/s}^2) t^2 + (2.0 \text{ T/s}) t + 3.0 \text{ T}$

An ideal battery with $\mathcal{E}_b = 2.0 \text{ V}$ is connected to the loop. The resistance of the loop is 2.0Ω . The current in the loop at $t = 10 \text{ s}$ will be close to



- (a) 3.6 A (b) 1.6 A
 (c) 6.2 A (d) 4.2 A

20. A current I flows along the length of an infinitely long, straight, thin walled pipe. Then

- (a) the magnetic field at all points inside the pipe is the same but not zero
 (b) the magnetic field at any point inside the pipe is zero

- (c) the magnetic field is zero only on the axis of the pipe
 (d) the magnetic field is different at different points inside the pipe

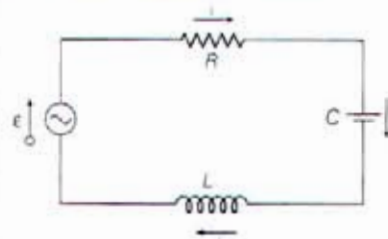
21. Two particles each of mass m and charge q , are attached to the two ends of a light rigid rod of length $2l$. The rod is rotated at constant angular speed about a perpendicular axis passing through its centre. The ratio of the magnitudes of the magnetic moment of the system and its angular momentum about the centre of the rod is

- (a) $\frac{q}{\pi m}$ (b) $\frac{q}{m}$ (c) $\frac{2q}{m}$ (d) $\frac{q}{2m}$

22. A $1.5 \mu\text{F}$ capacitor is charged to 60 V . The charging battery is then disconnected and a 15 mH coil is connected in series with the capacitor so that LC oscillations occur. Assuming that the circuit contains no resistance, the maximum current in the coil shall be close to

- (a) 1.4 A (b) 1.2 A
 (c) 0.8 A (d) 0.6 A

23. Figure shows a series $L-C-R$ circuit with $R = 200 \Omega$, $C = 15.0 \mu\text{F}$ and $L = 230 \text{ mH}$. If $\epsilon = 36.0 \sin 120 \pi t$, the amplitude I_0 of the current i in the circuit is close to



- (a) 109 mA (b) 126 mA
 (c) 150 mA (d) 164 mA

24. The magnetic component of a polarised wave of light is

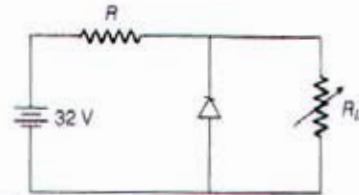
$$B_x = (4.0 \times 10^{-4} \text{ T}) \sin [1.57 \times 10^7 \text{ m}^{-1} y + \omega t]$$

The intensity of light is

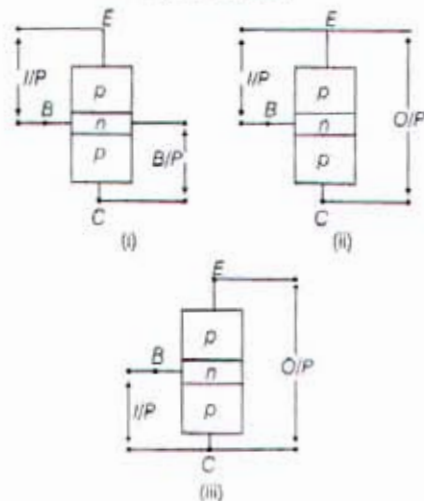
- (a) 1.9 kW/m^2 (b) 3.8 kW/m^2
 (c) 5.7 kW/m^2 (d) 7.6 kW/m^2



25. An object and its real image are located at distances 25 cm and 40 cm respectively from the two principal foci of a convex lens. The linear magnification of the image is near to
(a) + 1.3 (b) - 1.3
(c) + 1.8 (d) - 1.8
26. A glass plate of refractive index 1.5 is coated with a thin layer of thickness t and refractive index 1.8. Light of wavelength 648 nm travelling in air is incident normally on the layer. It is partly reflected at upper and lower surfaces of the layer and the two reflected rays interfere. The least value of t for which the rays interfere constructively is
(a) 30 nm (b) 60 nm
(c) 90 nm (d) 120 nm
27. Energy of a photon whose de-Broglie wavelength is equal to the wavelength of an electron accelerated through a potential difference of 125 V is near to
(a) 11.5 eV (b) 11.5 keV
(c) 125 eV (d) 1250 eV
28. Two radioactive materials X_1 and X_2 have decay constant 6λ and 3λ respectively. If initially they have the same number of nuclei, then the ratio of the number of nuclei of X_1 to that of X_2 will be $\frac{1}{e}$ after a time
(a) $\frac{1}{6\lambda}$ (b) $\frac{1}{3\lambda}$
(c) $\frac{3}{6\lambda}$ (d) $\frac{6}{9\lambda}$
29. The ionizing power and the penetration range of radioactive radiations increase in the order
(a) γ, β, α and γ, β, α respectively
(b) γ, β, α and α, β, γ respectively
(c) α, β, γ and α, β, γ respectively
(d) α, β, γ and γ, β, α respectively
30. A 24 V, 600 mW zener diode is used to provide a 24 V stabilized supply to a variable load R_L , as shown in the figure. The value of the resistance R is



- (a) 320 Ω (b) 640 Ω
(c) 960 Ω (d) 1280 Ω
31. In an $n-p-n$ transistor circuit, the collector current is 10 mA. If 90% of the electrons emitted reach the collector
(a) the emitter current will be nearly 9 mA and the base current will be nearly 1 mA
(b) the emitter current will be nearly 11 mA and the base current will be nearly 9 mA
(c) the emitter current will be nearly 11 mA and the base current will be nearly 1 mA
(d) the emitter and base currents will be 10 mA and 1 mA respectively
32. Three circuit connections of a $p-n-p$ transistor are given below



Which of the above represents the common-emitter configuration?

- (a) (i)
(b) (ii)
(c) (iii)
(d) None of the above

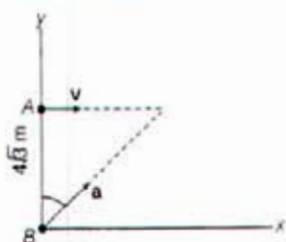


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33. The dimensions of the quantity $\mathbf{E} \times \mathbf{B}$ where \mathbf{E} represents the electric field and \mathbf{B} the magnetic field may be given as

- (a) MT^{-3} (b) $M^2LT^{-5}A^{-2}$
(c) $M^2LT^{-3}A^{-1}$ (d) $MLT^{-2}A^{-2}$

34. Particle A moves along the line $y = 4\sqrt{3}$ m with constant velocity \mathbf{v} of magnitude 2.0 m/s and directed parallel to the positive x -axis (see figure). Particle B starts at the origin with zero speed and constant acceleration \mathbf{a} (of magnitude 4.0 m/s^2) at the same instant that the particle A passes the y axis. The angle θ between \mathbf{a} and the positive y axis that would result in a collision between these two particles should have a value equal to



- (a) 30° (b) 45°
(c) 50° (d) 60°

35. In 1.0 s, a particle goes from point A to B , moving in a semi-circle of radius 1.0 m (as shown in the figure). The magnitude of the average velocity of the particle is



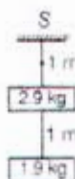
- (a) 3.14 m/s (b) 2.0 m/s
(c) 1.0 m/s (d) 0

36. A ball of mass 100 g is projected vertically upwards from the ground with a velocity of 49 m/s. At the same time another identical ball is dropped from a height of 98 m to fall freely along the same path as followed by the first ball. After sometime the two balls

collide and stick together. The velocity of the 'combined mass' just after the collision is

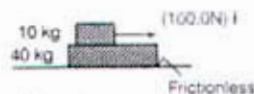
- (a) 4.9 m/s upward (b) 4.9 m/s downward
(c) 9.8 m/s upward (d) 9.8 m/s downward

37. Two blocks of masses 2.9 kg and 1.9 kg are suspended from a rigid support S by two inextensible wires each of length 1 m (figure). The upper wire has negligible mass and the lower wire has a uniform mass of 0.2 kg/m. The whole system of blocks, wires and support have an upward acceleration of 0.2 m/s^2 . The tension at the mid-point of the upper wire is



- (a) 20 N (b) 30 N (c) 40 N (d) 50 N

38. A 40 kg slab rests on a frictionless floor. A 10 kg block rests on top of the slab (as shown in the figure). The coefficient of static friction μ_s between the block and the slab is 0.60, whereas their kinetic friction coefficient μ_k is 0.40. The 10 kg block is pulled by a horizontal force $(100.0 \text{ N}) \mathbf{i}$. The resulting accelerations of the block and slab will be



- (a) $(2.0 \text{ m/s}^2) \mathbf{i}, 0$
(b) $(2.0 \text{ m/s}^2) \mathbf{i}, -(2.0 \text{ m/s}^2) \mathbf{i}$
(c) $(6.0 \text{ m/s}^2) \mathbf{i}, (1.0 \text{ m/s}^2) \mathbf{i}$
(d) $(4.0 \text{ m/s}^2) \mathbf{i}, 0$
(Take $g = 10 \text{ m/s}^2$)

39. A 140 g ball, in horizontal flight with a speed v_1 of 39.0 m/s, is struck by a bat. After leaving the bat, the ball travels in the opposite direction with speed $v_2 = 39.0 \text{ m/s}$. If the impact time Δt for the ball-bat collision is 1.20 ms, what average net force acts on the ball?

- (a) 1308 N (b) 1090 N (c) 9100 N (d) 980 N



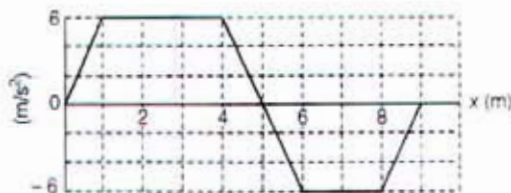
40. A horizontal cable accelerates a package across a frictionless horizontal floor. The amount of work that has been done by the cable's force on the package is given by $W(t) = (0.20 \text{ J/s}^2) t^2$. The average power $\langle P \rangle$ due to cable's force in the time interval $t_1 = 5 \text{ s}$ to $t_2 = 10 \text{ s}$ and the instantaneous power at $t = 3 \text{ s}$ are

- (a) 2.0 W, 1.80 W
(b) 2.0 W, 1.20 W
(c) 3.0 W, 1.80 W
(d) 3.0 W, 1.20 W

41. A body of mass 2.0 kg makes an elastic collision with another body at rest and continues to move in the original direction but with one-fourth of its original speed v . What is the mass of the other body and the speed of the two body center of mass?

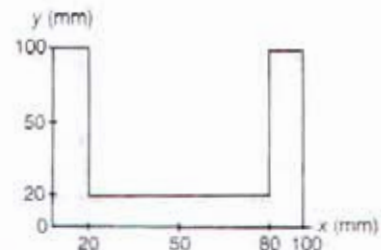
- (a) 1.0 kg and $\frac{2}{3}v$
(b) 1.2 kg and $\frac{5}{8}v$
(c) 1.4 kg and $\frac{10}{17}v$
(d) 1.5 kg and $\frac{4}{7}v$

42. Figure gives the acceleration of a 2.0 kg body as it moves from rest along x axis while a variable force acts on it from $x = 0 \text{ m}$ to $x = 9 \text{ m}$. The work done by the force on the body when it reaches (i) $x = 4 \text{ m}$ and (ii) $x = 7 \text{ m}$ shall be as given below



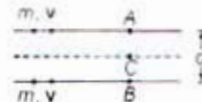
- (a) 21 J and 33 J respectively
(b) 21 J and 15 J respectively
(c) 42 J and 60 J respectively
(d) 42 J and 30 J respectively

43. The U shaped object shown in the figure has outside dimensions of 100 mm each side and each of its three sides is 20 mm wide. The respective values of the X, Y and Z coordinates of the center of mass of the object will be close to



- (a) (50, 50, 3) mm (b) (50, 50, 6) mm
(c) (50, 38, 3) mm (d) (50, 41, 3) mm

44. Two particles each of mass m and velocity v are travelling in the same direction along two parallel lines, in the plane of the paper, separated by a distance d . A and B are two points on their lines of motion and C is a point midway between the two lines (as shown in the figure). Read the following statements



- (i) The magnitude of the total angular momentum of the two-particle system around the point A will be $mv d$
(ii) The magnitude of the total angular momentum of the system around the point B will be $mv d$
(iii) The magnitude of the vector sum of angular momenta of the system around points A and B shall be zero
(iv) The magnitude of the angular momentum of the system around C will be zero

Which of the above statements is/are correct?

- (a) (i) and (ii) only (b) (iii) only
(c) (iii) and (iv) only (d) (i), (ii), (iii) and (iv)



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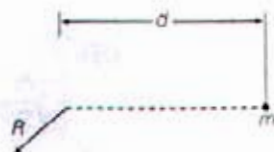
45. Three thin metal rods, each of mass M and length L , are welded to form an equilateral triangle. The moment of inertia of the composite structure about an axis passing through the centre of mass of the structure and perpendicular to its plane is

- (a) $\frac{1}{2} ML^2$ (b) $\frac{1}{3} ML^2$
(c) $\frac{2}{3} ML^2$ (d) $\frac{1}{4} ML^2$

46. Three uniform spheres, with masses $m_A = 350$ kg, $m_B = 2000$ kg and $m_C = 500$ kg have the (x, y) coordinates $(0, 0)$ cm, $(-80, 0)$ cm and $(40, 0)$ cm respectively. The gravitational potential energy, U , of the system and change in its value in terms of increase or decrease, if the sphere of mass m_B is removed, may be given as

- (a) $U = -1.92 \times 10^{-4}$ J and its value shall decrease if the sphere B is removed
(b) $U = -1.92 \times 10^{-4}$ J and its value shall increase if the sphere B is removed
(c) $U = -1.43 \times 10^{-4}$ J and its value shall decrease if m_B is removed
(d) $U = -1.43 \times 10^{-4}$ J and its value shall increase if m_B is removed

47. The figure shows a spherical hollow inside a lead sphere of radius R ; the surface of the hollow passes through the center of the sphere and 'touches' the right side of the sphere. The mass of the sphere before hollowing was M . With what gravitational force does the hollowed-out lead sphere attract a small sphere of mass m that lies at a distance d from the center of the lead sphere, on the straight line connecting the centers of the spheres and of the hollow?

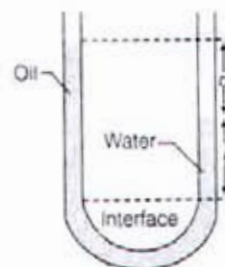


- (a) $\frac{GMm}{d^2} \left[1 - \frac{1}{8 \left(1 - \frac{R}{2d} \right)^2} \right]$
(b) $\frac{GMm}{d^2} \left[1 + \frac{1}{4 \left(1 - \frac{R}{2d} \right)^2} \right]$
(c) $\frac{GMm}{d^2} \left[1 - \frac{1}{4 \left(1 + \frac{R}{2d} \right)^2} \right]$
(d) $\frac{GMm}{d^2} \left[1 - \frac{1}{8 \left(1 + \frac{R}{2d} \right)^2} \right]$

48. A uniform wire of cross-sectional area ' A ' and Young's modulus ' Y ' is stretched within the elastic limit. If ' S ' is the stress in the wire, the elastic energy density stored in the wire in terms of the given parameters is

- (a) $\frac{S}{2Y}$ (b) $\frac{2Y}{S^2}$
(c) $\frac{S^2}{2Y}$ (d) $\frac{S^2}{Y}$

49. A U-tube contains two liquids in static equilibrium : Water of density $\rho_w (= 1000 \text{ kg/m}^3)$ is in the right arm and oil of unknown density ρ is in the left arm as shown in the figure. Measurement gives $l = 135$ mm and $d = 12.5$ mm. The density of oil is



- (a) 1092 kg/m^3 (b) 961 kg/m^3
(c) 915 kg/m^3 (d) 843 kg/m^3



50. Two spheres A and B having radii of 3 cm and 5 cm respectively are coated with carbon black on their outer surfaces. The wavelengths of radiations corresponding to maximum intensity of emission are 300 nm and 500 nm respectively. The respective powers radiated by them are in the ratio of

- (a) $\sqrt{\frac{5}{3}}$
(b) $\frac{5}{3}$
(c) $\left(\frac{5}{3}\right)^2$
(d) $\left(\frac{5}{3}\right)^4$

Chemistry

- The structure of diamagnetic nickel complex, $[\text{Ni}(\text{CN})_4]^{2-}$ is
(a) trigonal bipyramidal (b) tetrahedral
(c) square planar (d) distorted octahedral
- The known oxidation states for both V and CO are
(a) +2, +3, +4, +5 (b) +2, +3, +4, +5, +6
(c) +2, +3, +4 (d) +2, +3
- The expression for effective magnetic moment (μ_{eff}) is
(a) $\mu_{\text{eff}} = \sqrt{n(n+2)}$ BM (b) $\mu_{\text{eff}} = \sqrt{2(n+2)}$ BM
(c) $\mu_{\text{eff}} = \sqrt{n(2n+2)}$ BM (d) $\mu_{\text{eff}} = \sqrt{n(n+1)}$ BM
- Laughing gas is
(a) N_2O (b) NO (c) NO_2 (d) N_2O_5
- Which one of the following is ferromagnetic?
(a) Co (b) Mn (c) Al (d) Ag
- What type of hybridisation is involved in the metal ion of $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ complex?
(a) d^2sp^3 (b) sp^3d^2 (c) sp^3 (d) dsp^2
- In which of the following the hydration energy is higher than the lattice energy?
(a) SrSO_4 (b) BaSO_4
(c) MgSO_4 (d) RaSO_4
- Which one of the following does not exist?
(a) B_2 (b) N_2 (c) He_2^+ (d) Ne_2
- Who proposed dual nature of electron?
(a) de-Broglie (b) Einstein
(c) Bohr (d) Heisenberg
- The oxyacid of sulphur that contains a lone pair of electrons on sulphur is
(a) sulphurous acid
(b) sulphuric acid
(c) peroxodisulphuric acid
(d) pyrosulphuric acid
- The complex showing a spin only magnetic moment of 2.82 BM is
(a) $[\text{Ni}(\text{CO})_4]$ (b) $[\text{NiCl}_4]^{2-}$
(c) $[\text{Ni}(\text{PPh}_3)_4]$ (d) $[\text{Ni}(\text{CN})_4]^{2-}$
- In which of the following molecule/ion, all the bonds are not equal?
(a) XeF_2 (b) BF_4^- (c) C_2H_4 (d) SiF_4
- The correct order of electron gain enthalpy with negative sign of F, Cl, Br, and I, having atomic number 9, 17, 35 and 53 respectively, is
(a) $\text{F} > \text{Cl} > \text{Br} > \text{I}$ (b) $\text{Cl} > \text{F} > \text{Br} > \text{I}$
(c) $\text{Br} > \text{Cl} > \text{I} > \text{F}$ (d) $\text{I} > \text{Br} > \text{Cl} > \text{F}$
- Which of the following is the weakest base?
(a) $\text{Ca}(\text{OH})_2$ (b) KOH
(c) $\text{Li}(\text{OH})$ (d) $\text{Sr}(\text{OH})_2$
- Identify the positively charged sol.
(a) Hemoglobin (Blood) (b) As_2S_3
(c) Clay (d) Gold sols
- The following is an intensive property of a system
(a) total mass (b) total energy
(c) volume (d) energy mol^{-1}

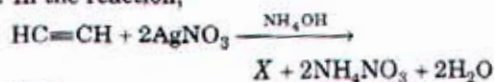


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17. Principle of paper chromatography is based on
(a) solid-liquid partition chromatography
(b) liquid-partition chromatography
(c) liquid-solid adsorption chromatography
(d) liquid-liquid sorption chromatography
18. Predict the correct shape of BH_4^- .
(a) Pyramidal, sp^3 (b) Octahedral, sp^3d^2
(c) Tetrahedral, sp^3 (d) None of these
19. The degree of ionisation of HF in 0.100 M aqueous solution is (freezing point of the solution = -0.197°C and K_f for water = 186°C)
(a) 6% (b) 12% (c) 3% (d) 9%
20. Which of the following solution has the highest boiling point?
(a) 1% glucose (b) 1% NaCl
(c) 1% sucrose (d) 1% CaCl_2
21. The percentage of iron present as Fe(III) in $\text{Fe}_{0.93}\text{O}_{1.0}$ is
(a) 8.3% (b) 9.6%
(c) 11.5% (d) 17.7%
22. Equimolar aqueous solutions of NaCl and BaCl_2 are prepared. If the freezing point of NaCl is -2°C , the freezing point of BaCl_2 solution is expected to be
(a) -2°C (b) -3°C
(c) -1.5°C (d) -1.66°C
23. An ion with mass number 37 possesses one unit of negative charge. If ion contains 11.1% more neutrons than electrons, the symbol of the ion, X, is
(a) ${}_{17}^{35}\text{X}^-$ (b) ${}_{17}^{36}\text{X}^-$
(c) ${}_{17}^{37}\text{X}^-$ (d) ${}_{17}^{37}\text{X}^{2-}$
24. The pH of a 0.05 M ammonia solution is 10.97. Find the ionisation constant the conjugate acid of ammonia, NH_4^+ .
Given, $\text{p}K_w = 14.0$ K_b for ammonia, $= 1.77 \times 10^{-5}$
(a) 4.77×10^{-6} (b) 9.77×10^{-3}
(c) 4.99×10^{-10} (d) 5.64×10^{-10}
25. Consider two standard half cells based on the reaction $\text{Ag}^+(aq) + e^- \longrightarrow \text{Ag}(s)$
The left half cell contains AgNO_3 at 1M, and the right half cell initially had the same conc. of AgNO_3 , but just enough $\text{NaCl}(aq)$ has been added to complete precipitate the $\text{Ag}^+(aq)$ as $\text{AgCl}(s)$. If cell emf is 0.295 V, the K_{sp} of AgCl approximately
(a) 1×10^{-12} (b) 6.60×10^{-12}
(c) 1×10^{-10} (d) 6.60×10^{-10}
26. Mg with its external $3s^2$ configuration is
(a) an insulator
(b) a conductor
(c) a semiconductor
(d) a superionic conductor
27. The average energy per molecule of a gas at a given temperature, T , is given by
(a) $\frac{3}{2}RT$ (b) $\sqrt{\frac{3RT}{M}}$
(c) $\sqrt{\frac{8(R/N_A)T}{\pi M}}$ (d) $\frac{3}{2}\left(\frac{R}{N_A}\right)T$
28. The rate of the reaction is given by rate, $r = k[\text{H}^+]^n$
If the rate becomes 100 times when the pH changes from 2 to 1 the order of the reaction is
(a) 0 (b) 1 (c) 2 (d) 3
29. Which of the following sets of quantum numbers is not possible?
(a) $n = 1, l = 0, m_l = 0, m_s = -\frac{1}{2}$
(b) $n = 1, l = 1, m_l = 0, m_s = +\frac{1}{2}$
(c) $n = 2, l = 1, m_l = 0, m_s = +\frac{1}{2}$
(d) $n = 3, l = 1, m_l = 0, m_s = +\frac{1}{2}$
30. Methyl benzoate can be prepared by
(a) $\text{C}_6\text{H}_5\text{COOH} + \text{CH}_3\text{OH} \xrightarrow{\text{H}^+}$
(b) $\text{C}_6\text{H}_5\text{COCl} + \text{CH}_3\text{OH} \xrightarrow{\text{Pyridine}}$
(c) $\text{C}_6\text{H}_5\text{COOH} + \text{CH}_3\text{N}_2 \longrightarrow$
(d) All of the above methods



31. In the reaction,



'X' is

- (a) Ag_2C (b) Ag_2C_2 (c) AgC (d) AgOH

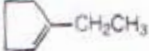
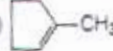
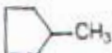
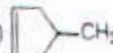
32. Acid anhydride on reaction with primary amines give

- (a) imine (b) 2° amine
(c) amide (d) imide

33. Which one of the following can not be made from 1-bromopropane in a single step?

- (a) Propane (b) Propene
(c) Propan-1-ol (d) Propyl amine

34. 5-oxohexanal is obtained by ozonolysis of

- (a)  (b) 
(c)  (d) 

35. Drugs that bind to the receptor site and inhibit its natural function are called

- (a) antagonists (b) agonists
(c) enzymes (d) molecular targets




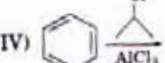
36. Which of the following carboxylic acids undergoes decarboxylation easily?

- (a) $\text{C}_6\text{H}_5\text{COCH}_2\text{COOH}$ (b) $\text{C}_6\text{H}_5\text{CHCOOH}$
(c) $\text{C}_6\text{H}_5\text{CHCOOH}$ (d) $\text{C}_6\text{H}_5\text{C(OH)COOH}$

37. Kjeldahl method for estimation of nitrogen is not applicable to

- (a) pyridine
(b) hexamethylene diamine
(c) propan-1-amine
(d) 2-phenylethanamine

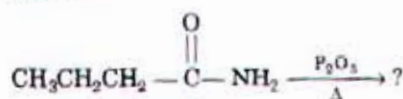
38. Which of the following reactions would give isopropylbenzene as the product?

- (I)  $\xrightarrow{\text{AlCl}_3}$ (II) 
(III)  (IV) 
- (a) I and IV only (b) II and III only
(c) II, III, IV only (d) All of the above

39. In which of the following resonance of $-\text{NH}_2$ is possible?

- (a) 1-aminobutane (b) Ethyl amine
(c) Benzyl amine (d) *p*-toluidine

40. The product obtained in the following reaction is



- (a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ (b) $\text{CH}_3\text{CH}_2\text{CH}_2-\text{CN}$
(c) $\text{CH}_3\text{CH}_2\text{CH}_2-\overset{\text{OH}}{\parallel}{\text{C}}-\text{NH}$ (d) None of the above

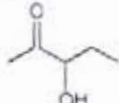
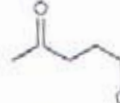
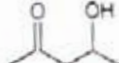
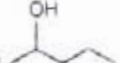
41. Which of the following will not give a primary amine?

- (a) $\text{CH}_3\text{CN} \xrightarrow{\text{LiAlH}_4}$
(b) $\text{CH}_3\text{NC} \xrightarrow{\text{LiAlH}_4}$
(c) $\text{CH}_3\text{CONH}_2 \xrightarrow{\text{LiAlH}_4}$
(d) $\text{CH}_3\text{CONH}_2 \xrightarrow{\text{Br}_2, \text{NaOH}}$

42. 2,4,6-trinitrochlorobenzene on warming with water produces

- (a) chlorobenzene
(b) picric acid
(c) phenol
(d) no compound since C-Cl bond is stable

43. Which of the following will be most readily dehydrated in acidic conditions?

- (a)  (b) 
(c)  (d) 

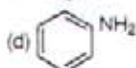
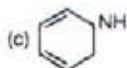
44. Wurtz reaction of methyl iodide yields an organic compound X. Which of the following reaction also yields X?

- (a) $\text{C}_2\text{H}_5\text{Cl} + \text{LiAlH}_4 \longrightarrow$
(b) $\text{C}_2\text{H}_5\text{Cl} + \text{Mg} \xrightarrow{\text{Dry ether}}$
(c) $\text{C}_2\text{H}_5\text{Cl} + \text{C}_2\text{H}_5\text{ONa} \longrightarrow$
(d) $\text{CHCl}_3\text{Cl} + \text{Ag (powder)} \xrightarrow{\Delta}$

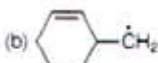
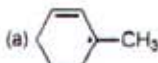


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45. Among the following amines, the strongest Bronsted base is



46. Most stable radical is



47. Which one of the following is a strong base?

- (a) NaOH (b) KOH (c) $\text{Ca}(\text{OH})_2$ (d) $\text{Mg}(\text{OH})_2$

48. The following elements belong to second transition series

- (a) V, La, Hf, Ta (b) Nb, Mo, Tc, Ru
(c) Ir, Os, Re, Ta (d) Re, Os, Ir, Pt

49. What is the oxidation state of Co in $[\text{Co}(\text{H}_2\text{O})_5\text{Cl}]^{2+}$?

- (a) +2 (b) +3 (c) +1 (d) +4

50. The unpaired electron in $\text{Ni}(\text{CO})_4$ is

- (a) 1 (b) 2 (c) 3 (d) 0

Biology

1. Flowering plants might have originated from

- (a) chlorophyte ancestors
(b) tracheophyte ancestors
(c) *Rhynia* type plants
(d) psilophytes

2. The drug 'marijuana' is obtained from

- (a) *Cannabis sativa* (b) *Papaver somniferum*
(c) *Atropa belladonna* (d) *Datura alba*

3. The plant disease which is not caused by a fungus is

- (a) brown rust of wheat
(b) red rot of sugar cane
(c) late blight of potato
(d) black rot of crucifers

4. In anaerobic sludge digestion during secondary treatment of sewage, biogas is produced, which is a mixture of

- (a) methane H_2S and H_2S
(b) methane and CO_2
(c) methane, H_2S , CO_2 and CO
(d) methane, H_2S , CO_2 , CO and ethane

5. During amplification of gene using PCR, *taq* polymerase is used between

- (a) denaturation and annealing
(b) annealing and extension
(c) extension and amplification
(d) None of the above

6. Full name of professor Misra, who is known as the Father of Ecology in India is

- (a) Ramesh Misra (b) Ramavtar Misra
(c) Ramakant Misra (d) Ramdeo Misra

7. Detritivores break down the detritus and process is known as

- (a) leaching (b) fragmentation
(c) lumification (d) mineralisation

8. An international treaty on ozone depletion known as Montreal Protocol was signed at Montreal in the year

- (a) 1981 (b) 1983
(c) 1985 (d) 1987

9. An ecologist uses the term 'biodiversity' for the variety of species of

- (a) all living plants
(b) all living animals
(c) Both (a) and (b)
(d) (a), (b) above and microbes also living in this natural habitats

10. Knock knee syndrome occurs due to the pollution of

- (a) nitrates
(b) phosphates
(c) fluorides
(d) heavy metals



11. The fluid mosaic model of cell membrane was given by
(a) SS Singer and GL Nicholson
(b) SJ Singer and HL Nicholson
(c) SJ Singer and GL Nicholson
(d) SS Singer and GL Nicholson
12. Hydroponics is
(a) growing plants without soil
(b) growing plants in water
(c) growing plants without matter
(d) All of the above
13. The electron from photosystem-II goes to photosystem-I and finally taken up by NADP leaving an electron hole in photosystem-II. This electron hole in photosystem-II is filled by the electron released from
(a) CO_2
(b) H_2O
(c) chlorophyll
(d) light
14. In photorespiration glycine enters from
(a) chloroplast to proxysome
(b) succinyl Co-A to succinic acid
(c) succinic acid to fumaric acid
(d) fumaric acid to malic acid
15. In TCA cycle substrate level phosphorylation takes place during the conversion of
(a) oxaloacetic acid to citric acid
(b) succinyl Co-A to succinic acid
(c) succinic acid to fumaric acid
(d) fumaric acid to malic acid
16. The aestivation in corolla of *Calotropis* is
(a) valvate
(b) twisted
(c) imbricate
(d) vexillary
17. The commonly found tissue in pulp of fruits like guava and in leaves of tea are
(a) collenchyma
(b) aerenchyma
(c) chlorenchyma
(d) sclereids
18. Among various categories of threatened species the percentage of angiosperms categorised as vulnerable is about
(a) 14%
(b) 19%
(c) 41%
(d) 51%
19. The fungus often studied in experimental genetics and also called as *Drosophila* of plant kingdom is
(a) *Erysiphe*
(b) *Neurospora*
(c) *Rhizopus*
(d) *Aspergillus*
20. The correct sequence of seral stages in hydrosere is
(a) plankton, submerged, floating, reed swamp, sedge meadow, woodland
(b) plankton, floating, submerged, reed swamp, sedge meadow, woodland
(c) plankton, submerged, floating, sedge meadow, reed swamp, woodland
(d) plankton, submerged, floating, sedge meadow, woodland, reed meadow
21. Charles Darwin returned to England in 1836 from his five year expedition but published his observation and conclusion in the form of a book in November.
(a) 1938
(b) 1839
(c) 1859
(d) 1869
22. Several plant pathogens can be controlled by the biocontrol agent
(a) *Phytophthora*
(b) *Trichoderma*
(c) *Albugo*
(d) *Saccharomyces*
23. Histology deals with the study of
(a) structures which can be discerned with naked eye
(b) tissues
(c) cells
(d) changes in form and structure during development
24. The following plant placed under dicots *Bt* lacks cotyledons is
(a) maize
(b) *Cuscuta*
(c) mustard
(d) linseed
25. Acetyl coenzyme-A can be formed through the process of
(a) glycolysis
(b) β -oxidation of fatty acid
(c) deamination of amino acids
(d) All of the above



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26. *Xanthomonas phaseoli* is responsible for disease known as
(a) wilt of paper (b) blight of beans
(c) wilt of potato (d) canker of tomato
27. To make soya sauce from soyabean meal the fungus used is
(a) *Penicillium* (b) *Aspergillus*
(c) *Agaricus* (d) *Saccharomyces*
28. *nigrum* is one of the species of genus
(a) *Mangifera* (b) *Solanum*
(c) *Triticum* (d) *Pisum*
29. Maximum modes of nutrition are found in
(a) Monera (b) Protista
(c) Fungi (d) Plantae
30. Katherine Esau a world known name is plant anatomy was born in
(a) Australia (b) Ukraine
(c) Austria (d) UK
31. When the margin of the thalamus grows upward enclosing ovary completely and getting fused with it while the other parts of flower arise above the ovary the ovary is said to be
(a) inferior (b) superior
(c) half inferior (d) half superior
32. Non-endospermous seeds are found in
(a) bean (b) gram
(c) pea (d) All of these
33. In maize seed, coleorrhiza is present adjacent to
(a) radicle (b) plumule
(c) scutellum (d) endosperm
34. The word meristem is derived from Greek, *meristos* meaning
(a) young (b) divided
(c) tissue (d) tip
35. The stele consists of
(a) endodermic, pericycle, vascular bundle and pith
(b) pericycle, vascular bundle and pith
(c) vascular bundle and pith
(d) vascular bundle only
36. During secondary growth the amount of secondary xylem produced is more than the secondary phloem because
(a) the cambium is more active on the inner side
(b) the cambium is more active on the outer side
(c) the cambium is equally active on both sides but the xylem is needed more
(d) the cambium has no role to play in this difference
37. The movement of cilia and flagella is due to the presence of
(a) radial spokes (b) central sheath
(c) singlet microtubules (d) exonym
38. In amino acid alanine is
(a) monoamino monocarboxylic amino acid
(b) sulphur containing amino acid
(c) monoamino dicarboxylic amino acid
(d) basic amino acid
39. In onion root tip during metaphase stage of mitosis the number of kinetic will be
(a) 4 (b) 8 (c) 16 (d) 32
40. Apoplastic path for the transport of water in root is through
(a) intercellular spaces
(b) intercellular spaces and cell walls
(c) cell walls only
(d) intercellular spaces, cell walls and endodermis
41. Source of mineral nutrients is
(a) soil
(b) minerals obtained from rocks
(c) rocks
(d) All of the above
42. The two reducing powers of light reaction are used in dark reaction during the formation of
(a) 3-phosphoglycerate from ribulose, 1,5-bisphosphate
(b) glyceraldehyde 3-phosphate from 3-phosphoglycerate
(c) sucrose from triose phosphate
(d) ribulose 1,5-bisphosphate from triose phosphate
43. The exponential growth can be expressed as $w_1 = w_0 e^{rt}$ whereas e denotes
(a) growth rate (b) time of growth
(c) base of nature logarithm (d) final size



44. The plant growth regulator kinetin is a/an
(a) growth derivative of purines
(b) derivative of carotenoids
(c) terpene
(d) gas
45. Vegetative propagation in water hyacinth takes place by
(a) rhizome (b) bulbil (c) leaf bud (d) offset
46. The body of ovule fused with funicle is called
(a) integuments (b) hilum
(c) micropyle (d) chalaza
47. Endosperm completely consumed by the developing embryo before seed maturation in
(a) pea, ground nut and castor
(b) ground nut bean and coconut
(c) pea, ground nut and bean
(d) None of the above
48. In Mendel's seven contrasting traits of pea total number of colours tested by him was
(a) 2 (b) 3 (c) 4 (d) 5
49. The double helix of DNA is made of polynucleotide chains where in backbone constituted by sugar phosphate and the bases are projected
(a) inside
(b) outside
(c) one base inside and the other outside
(d) Bases remain in line of sugar phosphate
50. Among the RNA polymerases, the RNA polymerase-II transcribes
(a) rRNA
(b) tRNA
(c) small nuclear RNAs
(d) heterogeneous nuclear RNA
51. Heterogamety is the term where an individual produces two types of gametes.
The most appropriate answer is/are
(a) male *Drosophila* fly (b) female *Drosophila* fly
(c) female bird (d) Both (a) and (c)
52. Induced abortion is also called
(a) STD (b) MTP
(c) IUD (d) PID
53. The site on antigen that are recognised by antibodies and receptors present on T and B-cells are
(a) antigenic determinants
(b) epitopes
(c) paratopes
(d) Both (a) and (b)
54. Cells responsible for cell-mediated response are
(a) T-cytotoxic cells (b) T-helper cells
(c) B-cells (d) All of these
55. HIV selectively targets
(a) B-memory cells (b) B-effector cells
(c) T-cytotoxic cells (d) T-helper cells
56. Disease which is always present at a low level in a given population or a region is termed as
(a) pandemic (b) endemic
(c) epidemic (d) notifiable disease
57. Oral contraceptive prevent pregnancy by
(a) killing the ovum
(b) blocking fertilisation
(c) preventing ovulation
(d) preventing implantation
58. A person may die due to allergic reaction or an anaphylactic shock, which is characterised by
(a) constriction of peripheral blood vessel
(b) blood capillaries become highly permeable causing loss of fluid from the blood
(c) drastic increase in the blood pressure
(d) All of the above
59. Endangered or threatened animals are protected from its extinction by *ex-situ* conservation in
(a) Wild Life Sanctuary
(b) Biosphere Reserves
(c) National Parks
(d) Zoological Parks
60. Population growth curve is sigmoid, if the growth pattern is
(a) logistic (b) geometric
(c) exponential (d) accretionary



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61. Which of the following statement is false with respect to prosthetic groups?
(a) Proteins
(b) Non-proteins
(c) Tightly bound to enzymes
(d) Metal compounds
62. Consumption of alcohol may lead to
(a) accumulation of acetaldehyde in liver
(b) synthesis of fat in liver
(c) lowering of blood glucose level of the body
(d) All of the above
63. Which of the following disease is cause by virus?
(a) Poliomyelitis (b) Tuberculosis
(c) Syphilis (d) Diphtheria
64. Halliker, a drought breed of cattle is found in
(a) Karnataka (b) Gujarat
(c) Andhara Pradesh (d) Madhya Pradesh
65. The inspiratory reserve volume + tidal volume + expiratory reserve volume is same as
(a) inspiratory capacity + expiratory reserve volume
(b) total lung capacity - functional residual capacity
(c) inspiratory capacity + functional residual capacity
(d) inspiratory capacity + residual volume
66. After surgical removal of an infected gall bladder, a person must be especial careful to restrict dietary intake of
(a) starch (b) protein (c) sugar (d) fat
67. Which of the following animals lack alimentary canals (complete digestive system)?
(a) Earthworms (b) Jellyfish
(c) Insects (d) Fishes
68. Most of our cells are surrounded by
(a) blood
(b) fluid equivalent to sea water in salts composition
(c) interstitial fluid
(d) pure water
69. In his laboratory apparatus, Stanley Miller synthesised
(a) proteins (b) DNA
(c) amino acids (d) protobionts
70. Which gas was probably least abundant in the early atmosphere?
(a) H₂O (b) O₂ (c) NH₃ (d) CO₂
71. Pulse is a direct measure of
(a) blood pressure (b) stroke volume
(c) cardiac output (d) heart rate
72. Name the character of phylum-Aschelminthes, which differentiates it from all other phyla of kingdom-Animalia.
(a) Parasitic mode (b) Round in shape
(c) Pseudocoelomate (d) Bilateral symmetry
73. In cockroach the flow of haemolymph is
(a) heart → head haemocoel → perivisceral sinus → pericardial sinus → ostia → heart
(b) heart → pericardial sinus → head haemocoel → perivisceral sinus → ostia → heart
(c) heart → head haemocoel → perivisceral sinus → ostia pericardial sinus → heart
(d) heart → ostia → perivisceral sinus → pericardial sinus → head haemocoel → heart
74. Which of the following is an oviparous mammal?
(a) *Balaenoptera* (b) *Delphinus*
(c) *Pteropus* (d) *Ornithorhynchus*
75. Functional kidney of mammals is
(a) archinephros type (b) ophisthonephros type
(c) pronephros type (d) metanephros type
76. Torsion is the characteristic of
(a) Gastropoda (b) Pelecypoda
(c) Cephalopoda (d) Amphineura
77. Temperature increases with height in which of the sphere
(a) Troposphere (b) Stratosphere
(c) Mesosphere (d) None of these
78. Maximum species diversity is seen in latitudinal range of
(a) 23.5°N to 66.5° N (b) 23.5°S to 66.5° N
(c) 23.5°N to 66.5° S (d) 66.5°N to 90° N
79. In a polluted environment, the maximum pollutant will occur in
(a) primary producers (b) tertiary consumers
(c) secondary consumers (d) primary consumers



80. Gir Lion Sanctuary Project was started in the year
(a) 1976 (b) 1972
(c) 1962 (d) 1952
81. Which of the following is not vestigial organ in human beings?
(a) Rudimentary ear muscles and third molars
(b) Coccygeal tail vertebrae and scalp muscles
(c) Vermiform appendix and nictitating membrane of the eye
(d) Ear pinna, patella, olecranon process
82. Which one of the following is considered as industrial pollution indicators?
(a) *Chameleon* (b) Lichens
(c) Bengal Tiger (d) *Biston betularia*
83. Wing of pigeon is homologous to the
(a) ear of a bat
(b) wing of butter fly
(c) fore leg of horse
(d) tail of rabbit
84. Which of the following is an X-linked recessive trait with locus in $X_q 28$ and related with factor VIII?
(a) Haemophilia-A
(b) Haemophilia-B
(c) Christmas disease
(d) Both (a) and (b)
85. Choose a false statement with reference to sickle-cell anaemia.
(a) Have genotype Hb^S / Hb^S
(b) Have genotype Hb^A / Hb^A
(c) Substitution of glutamic acid to valine
(d) Have sickle-shape RBC
86. The following is not a function of progesterone
(a) gestation
(b) inhibition of ovulation
(c) uterine growth and development
(d) stimulation of mammary secretion
87. 'YAC' refers to
(a) Yeast artificial cell
(b) Yeast artificial chromosome
(c) Yeast artificial colony
(d) None of the above
88. Which of the following statement is not correct?
(a) Starch is a polymer of α -glucose
(b) Starch is made up of amylose and amylopectin
(c) Amylose in linear structure consisting of several glucose residues joined by 1, 4-glycosidic linkage
(d) Amylopectin is a straight chain with several glucose residues joined only by 1, 4-glycosidic linkages
89. Individual subunits of polysaccharides are linked by
(a) glycosidic bonds
(b) phosphodiester bonds
(c) peptide bonds
(d) hydrogen bonds
90. Sucrose is made up of
(a) glucose-galactose
(b) glucose-glucose
(c) glucose-fructose
(d) fructose-fructose
91. Ontogenetically liver and pancreas are
(a) ectodermal
(b) mesodermal
(c) endodermal
(d) None of the above
92. One of the following ions are required for nerve impulse transmission at the neuromuscular junction
(a) magnesium (b) chloride
(c) calcium (d) iron
93. Which of the following as a protein deficient disease?
(a) Osteomalacia (b) Kwashiorkor
(c) Pellagra (d) Rickets
94. Originating in bone marrow, circulating in blood for 1-2 days, migrating to connective tissue and forming macrophage is a characteristic of
(a) eosinophils (b) basophiles
(c) monocytes (d) lymphocytes
95. In frog kidney the urea is eliminated by
(a) glomerular filtration (b) tubular secretion
(c) Both (a) and (b) (d) tubular absorption



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- 96.** The organ of corti is situated on the
(a) basilar membrane in the tympanic
(b) Reissner's membrane in the vestibular canal
(c) Basilar membrane in the median canal
(d) Reissner's membrane in the tympanic canal
- 97.** The following respond to pressure
(a) Meissner's corpuscle (b) pacinian corpuscle
(c) bulbs of Krause (d) organ of Ruffini
- 98.** Between breaths the intrapleural pressure is approximately ... mmHg less than atmospheric pressure.
(a) 1 (b) 4 (c) 8 (d) 10
- 99.** The peritubular capillaries of the nephron arise from the
(a) afferent arteriole
(b) efferent arteriole
(c) renal artery
(d) arcuate artery
- 100.** GnRH secreted from hypothalamus mainly stimulates the release of
(a) thyroxin from thyroid gland
(b) ADH from posterior pituitary
(c) FSH and LH from anterior pituitary
(d) aldosterone from adrenals

Answers

Physics

- | | | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (b) | 2. (a) | 3. (c) | 4. (a) | 5. (c) | 6. (c) | 7. (d) | 8. (a) | 9. (a) | 10. (c) |
| 11. (b) | 12. (b) | 13. (b) | 14. (d) | 15. (c) | 16. (c) | 17. (a) | 18. (a) | 19. (c) | 20. (b) |
| 21. (d) | 22. (d) | 23. (d) | 24. (a) | 25. (b) | 26. (c) | 27. (c) | 28. (b) | 29. (b) | 30. (a) |
| 31. (c) | 32. (b) | 33. (b) | 34. (a) | 35. (b) | 36. (a) | 37. (d) | 38. (c) | 39. (c) | 40. (b) |
| 41. (b) | 42. (d) | 43. (d) | 44. (d) | 45. (a) | 46. (d) | 47. (a) | 48. (c) | 49. (c) | 50. (d) |

Chemistry

- | | | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (c) | 2. (a) | 3. (a) | 4. (a) | 5. (a) | 6. (b) | 7. (c) | 8. (d) | 9. (a) | 10. (a) |
| 11. (b) | 12. (c) | 13. (b) | 14. (c) | 15. (a) | 16. (d) | 17. (b) | 18. (c) | 19. (a) | 20. (b) |
| 21. (*) | 22. (b) | 23. (d) | 24. (d) | 25. (*) | 26. (b) | 27. (d) | 28. (c) | 29. (b) | 30. (d) |
| 31. (b) | 32. (c) | 33. (*) | 34. (b) | 35. (a) | 36. (a) | 37. (a) | 38. (d) | 39. (d) | 40. (b) |
| 41. (b) | 42. (b) | 43. (c) | 44. (a) | 45. (b) | 46. (a) | 47. (b) | 48. (b) | 49. (b) | 50. (d) |

* None of the option is correct.

Biology

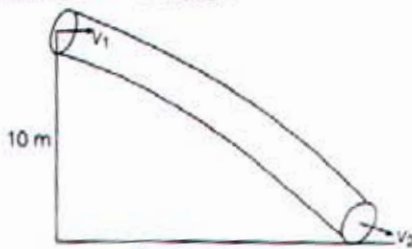
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|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|
| 1. (d) | 2. (a) | 3. (d) | 4. (b) | 5. (b) | 6. (d) | 7. (b) | 8. (d) | 9. (d) | 10. (c) |
| 11. (c) | 12. (d) | 13. (b) | 14. (b) | 15. (b) | 16. (a) | 17. (a) | 18. (d) | 19. (b) | 20. (a) |
| 21. (c) | 22. (b) | 23. (b) | 24. (b) | 25. (d) | 26. (b) | 27. (b) | 28. (b) | 29. (b) | 30. (b) |
| 31. (a) | 32. (d) | 33. (a) | 34. (b) | 35. (b) | 36. (a) | 37. (c) | 38. (a) | 39. (c) | 40. (b) |
| 41. (d) | 42. (a) | 43. (c) | 44. (a) | 45. (d) | 46. (b) | 47. (c) | 48. (c) | 49. (d) | 50. (d) |
| 51. (d) | 52. (b) | 53. (a) | 54. (a) | 55. (a) | 56. (b) | 57. (c) | 58. (b) | 59. (d) | 60. (a) |
| 61. (a) | 62. (d) | 63. (a) | 64. (a) | 65. (d) | 66. (d) | 67. (b) | 68. (c) | 69. (c) | 70. (b) |
| 71. (d) | 72. (c) | 73. (a) | 74. (d) | 75. (d) | 76. (a) | 77. (b) | 78. (b) | 79. (b) | 80. (b) |
| 81. (d) | 82. (b) | 83. (c) | 84. (d) | 85. (b) | 86. (b) | 87. (a) | 88. (d) | 89. (a) | 90. (b) |
| 91. (c) | 92. (c) | 93. (b) | 94. (d) | 95. (c) | 96. (c) | 97. (b) | 98. (a) | 99. (b) | 100. (c) |



Hints & Solutions

Physics

1. From Bernoulli's theorem



$$\rho_1 + \rho gh + \frac{1}{2} \rho v_1^2 = \rho_2 + \frac{1}{2} \rho v_2^2$$

$$15 \times 10^5 + 10^3 \times 10 \times 10 + \frac{1}{2} \times 10^3 \times 25$$

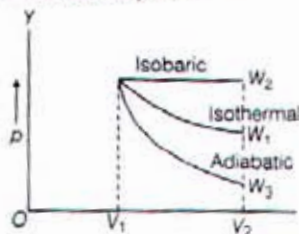
$$= \rho_2 + \frac{1}{2} \times 10^3 \times \frac{25}{4}$$

$$15 \times 10^5 + 10^5 + \frac{25}{2} \times 10^3 = \rho_2 + \frac{25}{8} \times 10^3$$

$$\rho_2 = \frac{25 \times 83 \times 10^3}{8}$$

$$= 259375 \times 10^3 = 2.6 \times 10^5 \text{ Pa}$$

2. Work done is equal to area under the curve on p - V diagram. This is largest for isobaric process and least for adiabatic expansion.



3. Given that

$$n = 1 \text{ mol}$$

$$p_1 = 10 \times 10^5 \text{ Pa}$$

$$p_2 = 0.5 \times 10^5 \text{ Pa}$$

Change in entropy of the gas

$$= \frac{Q}{T} = \frac{W}{T}$$

$$= \frac{nRT \log(p_1/p_2)}{T}$$

$$= nR \log(p_1/p_2)$$

$$= 1 \times 8.31 \times 2.303 \times 0.3010 = 5.76 \text{ J/K}$$

4. From ideal gas law

For container A,

$$n_1 = \frac{p_1 V_1}{RT_1}$$

For container B,

$$n_2 = \frac{p_2 V_2}{RT_2}$$

After opening the valve, x moles of gas stream from container A to container B such that both container equalize at pressure p . Number of moles in container A has changed to $n_1 - x$, i.e.,

$$(n_1 - x) = \frac{p \cdot V_1}{R \cdot T_1}$$

$$\therefore x = n_1 - \frac{p \cdot V_1}{R \cdot T_1} = \frac{(p_1 - p) \cdot V_1}{R \cdot T_1} \quad \dots (i)$$

Number of moles in container B has changed to $n_2 + x$, therefore

$$(n_2 + x) = \frac{p \cdot V_2}{R \cdot T_2}$$

$$\therefore x = \frac{p \cdot V_2}{R \cdot T_2} - n_2 = \frac{(p - p_2) \cdot V_2}{R \cdot T_2} \quad \dots (ii)$$

Equating Eqs. (i) and (ii), we get

$$\frac{(p_1 - p) \cdot V_1}{R \cdot T_1} = \frac{(p - p_2) \cdot V_2}{R \cdot T_2}$$

$$\Rightarrow (p_1 - p) = (p - p_2) \cdot \left(\frac{V_2}{V_1}\right) \cdot \left(\frac{T_1}{T_2}\right)$$

The pressure changes in the two containers are proportional

$$(p_1 - p) = (p - p_2) \cdot K$$

$$\text{with } K = \left(\frac{V_2}{V_1}\right) \cdot \left(\frac{T_1}{T_2}\right) = 4 \left(\frac{300}{400}\right) = 3$$

$$p = \frac{p_1 + p_2 \cdot K}{1 + K} = \frac{5 \times 10^5 + 1 \times 10^5}{1 + 3}$$

$$= \frac{6 \times 10^5}{4} = 1.5 \times 10^5 \text{ Pa}$$

6. Both O_2 and N_2 are diatomic gases. Rotational degree of freedom in both cases is two.

Therefore average rotational kinetic energy per molecule for each of them is $2 \left(\frac{1}{2} KT\right)$ or the ratio

is 1:1



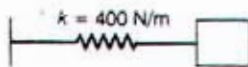
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7. Given that, spring constant $K = 400 \text{ N/m}$

Position $y = 0.100 \text{ m}$

Velocity $v = -15.0 \text{ m/s}$

and acceleration $a = 90 \text{ m/s}^2$



We know that

$$v = \omega \sqrt{A^2 - y^2} \quad \dots (i)$$

and $a = -\omega^2 y \quad \dots (ii)$

From Eq. (ii),

$$90 = \omega^2 \times 0.1$$

$$\Rightarrow \omega = 30$$

How $\omega^2 = \frac{k}{m}$

$$9\omega = \frac{400}{m}$$

$$m = \frac{4}{9} = 0.44 \text{ kg}$$

From Eq (i),

$$15 = \omega \sqrt{A^2 - y^2}$$

$$225 = 900(A^2 - y^2)$$

$$225 = 900A^2 - 900(0.1)^2$$

$$A^2 = \frac{234}{900}$$

$$A = \frac{15}{30} = \frac{1}{2} = 0.5 \text{ m}$$

8. Given that fundamental frequency of open organ pipe (A) = 300 Hz

$$f_1 = 300 \text{ Hz} = \frac{v}{2l_1} \quad \dots (i)$$

Frequency of second harmonic of open organ pipe

$$(A) = \frac{v}{l_1}$$

and frequency of third harmonic of closed organ pipe (B)

$$= \frac{3v}{4l_2}$$

Now according to question

$$\frac{v}{l_1} = \frac{3v}{4l_2}$$

$$\Rightarrow \frac{l_1}{l_2} = \left(\frac{4}{3}\right) \quad \dots (ii)$$

Form Eq. (i), we get

$$300 = \frac{343}{2l_1}$$

$$l_1 = \frac{343}{600} = 52.16 = 57.2 \text{ cm}$$

Now from Eq. (ii), we get

$$l_2 = \frac{3}{4} \times l_1 = \frac{3}{4} \times 57.2$$

$$= 42.9 \text{ cm}$$

9. Given that

$$y = 0.06 \sin\left(\frac{2\pi x}{3}\right) \cos(120\pi t)$$

This is comparing with

$$y = 2a \sin\left(\frac{2\pi x}{\lambda}\right) \cos\left(\frac{2\pi vt}{T}\right)$$

we get

$$\lambda = 3 \text{ m}, v = 60 \text{ Hz}$$

Now $v = v\lambda$

$$= 60 \times 3$$

$$= 180 \text{ m/s}$$

Now

$$v = \sqrt{\left(\frac{T}{\mu}\right)}$$

$$180 = \sqrt{\left(\frac{T}{\mu}\right)}$$

$$T = 180 \times 180 \times \mu$$

$$= 180 \times 180 \times \frac{m}{T}$$

$$= 180 \times 180 \times \frac{3 \times 10^{-2}}{15}$$

$$= 648 \text{ N}$$

- 10.



$$V = \frac{C_1 V_1 + C_2 V_2}{C_1 + C_2}$$

$$= \frac{3.5 \times 6 + 0}{10}$$

$$V = 2.1 \text{ V}$$

$$q_1 = 2.1 \times 3.5$$



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$$q_1 = 7.35 \mu\text{C}$$

$$q_2 = C_2 V$$

$$= 6.5 \times 10^{-6} \times 2.1$$

$$= 13.65 \mu\text{C}$$

and

$$U = \frac{1}{2} C V^2$$

$$= \frac{1}{2} \times 10 (2.1)^2$$

$$= 22.01$$

$$= 22 \mu\text{J}$$

11. Given that

$$F_1 = 0.108 \text{ N}$$

$$r = 0.5 \text{ m}$$

$$F_1 = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}$$

$$0.108 = 9 \times 10^9 \frac{q_1 q_2}{(0.5)^2}$$

$$q_1 q_2 = \frac{0.25 \times 0.108}{9 \times 10^9} = \frac{108 \times 25 \times 10^{-5}}{9 \times 10^9}$$

$$q_1 q_2 = 3 \times 10^{-12} \text{ C}^2 \quad \dots(i)$$

and

$$0.036 = 9 \times 10^9 \frac{\left(\frac{q_1 - q_2}{2}\right)^2}{(0.5)^2}$$

$$\frac{0.036 \times 4 \times 0.25}{9 \times 10^9} = (q_1 - q_2)^2$$

$$\frac{4 \times 4 \times 25 \times 10^{-5}}{10^9} = (q_1 - q_2)^2$$

$$4 \times 10^{-12} = (q_1 - q_2)^2$$

$$2 \times 10^{-6} = q_1 - q_2 \quad \dots(ii)$$

Now

$$(q_1 + q_2)^2 = (q_1 - q_2)^2 + 4 q_1 q_2$$

$$= 4 \times 10^{-12} + 4 \times 3 \times 10^{-12}$$

$$= 16 \times 10^{-12}$$

$$q_1 + q_2 = 4 \times 10^{-6} \quad \dots(iii)$$

From Eqs. (ii) and (iii), we get

$$q_1 = -3 \times 10^{-6} \text{ and } q_2 = 1 \times 10^{-6}$$

12. The electric field inside the sphere

$$E_{\text{inside}} = \frac{\rho r}{3\epsilon_0}$$

but

$$\rho = \frac{q}{\frac{4}{3}\pi a^3}$$

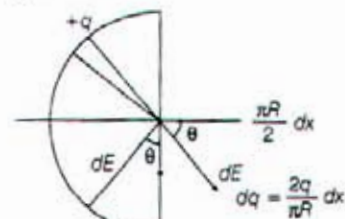
$$E_{\text{inside}} = \frac{q r}{\frac{4}{3}\pi a^3 \times 3\epsilon_0}$$

$$= \frac{1}{4\pi\epsilon_0} \frac{q r}{a^3}$$

The electric field at distances r for $a < r < b$ is not zero. The electric field at distance r for $b < r < c$ is zero and the charge on the inner surface of the spherical shell is $-q$. The charge on the outer surface of the spherical shell is zero.

Hence the option (b) is correct.

13. $E = 2 \int dE \cos\theta$



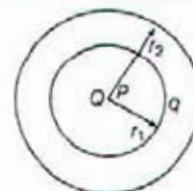
$$E = \frac{2}{4\pi\epsilon_0} \frac{2q}{\pi R^3} \int_0^{\pi/2} \cos\theta \, d\theta$$

$$= \frac{q}{\pi^2 \epsilon_0 R^2}$$

$$= \frac{q}{\epsilon_0 \pi^2 R^2}$$

Perpendicular to the line OP and directed downward.

14. Force at P due to q when the radius of circle is r_1



$$F_1 = \frac{Qq}{4\pi\epsilon_0 r_1^2} \quad \dots(i)$$

Force at P due to q when the radius of circle is r_2

$$F_2 = \frac{1}{4\pi\epsilon_0} \frac{Qq}{r_2^2} \quad \dots(ii)$$

Increase in radius $(r_2 - r_1)$ (distance)

$$\text{Resultant force} = \sqrt{F_1 \times F_2}$$

$$= \frac{1}{4\pi\epsilon_0} \frac{Qq}{r_1 r_2}$$



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∴ Work done

$$W = F \times dr$$

$$= \frac{1}{4\pi\epsilon_0} \frac{Qq}{r^2} \times (r_2 - r_1)$$

$$W = \frac{Qq}{4\pi\epsilon_0} \left(\frac{1}{r_1} - \frac{1}{r_2} \right)$$

15. Given that

$$V = 115 \text{ V}$$

$$l = 10 \text{ m}$$

$$J = 1.4 \times 10^4 \text{ A/m}^2$$

$$r = 0.30 \text{ mm} = 0.3 \times 10^{-3} \text{ m}$$

$$J = \left(\frac{i}{A} \right)$$

$$i = JA$$

and

$$R = \frac{V}{i}$$

$$R = \frac{V}{JA}$$

Now

$$R = \frac{\rho l}{A}$$

$$\frac{V}{JA} = \frac{\rho l}{A}$$

$$\rho = \frac{V}{Jl}$$

$$= \frac{115}{1.4 \times 10^4 \times 10}$$

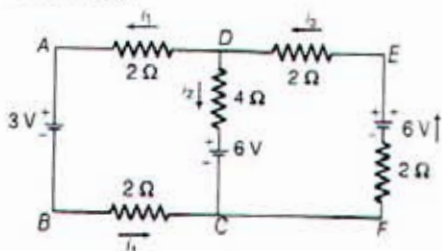
$$= 82.14 \times 10^{-5}$$

$$= 8214 \times 10^{-4} \Omega \cdot \text{m}$$

16. Given that $l_1 = 58 \text{ cm}$, $l_2 = 50 \text{ cm}$, $R = 5$

$$\therefore r = R \left(\frac{l_1}{l_2} - 1 \right) = 5 \left(\frac{58}{50} - 1 \right) = 0.8 \Omega$$

17. Given circuit



In ABCD,

From Kirchoff's law

$$2i_1 + 2i_1 - 4i_2 + 3 - 6 = 0$$

$$4i_1 - 4i_2 = 3 \quad \dots(i)$$

and in CDEF

From Kirchoff's law

$$2i_3 + 4i_2 + 6 - 6 + 2i_3 = 0$$

$$4i_2 + 4i_3 = 0$$

$$i_2 = -i_3$$

∴ (ii)

$$i_1 + i_2 = i_3$$

∴ (iii)

From Eq. (ii), we get

$$i_1 + i_2 = -i_2$$

From Eq. (i),

$$i_1 = -2i_2$$

$$3 = 4(-2i_2) - 4i_1$$

$$3 = -12i_2$$

$$i_2 = -0.25 \text{ A}$$

$$i_1 = -2i_2 = 0.50 \text{ A}$$

and

$$i_3 = -i_2 = 0.25 \text{ A}$$

18. Magnetic field at C is



$$B = \frac{1}{4} \text{ (due to whole circle)}$$

$$= \frac{1}{4} \left(\frac{\mu_0 I}{2R} \right) = \frac{\mu_0 I}{8R}$$

19. Given that $r = 0.20 \text{ m}$, $t = 10 \text{ s}$, $R = 2 \Omega$

$$B = (4.0 \text{ T/s}^2)t^2 + (2.0 \text{ T/s})t + 3.0 \text{ T}$$

$$\frac{dB}{dt} = 8t + 2$$

$$\text{From } E = -\frac{d\Phi}{dt} = -A \frac{dB}{dt}$$

$$E = -\pi r^2 (8t + 2)$$

$$= 3.14 \times 0.2 \times 0.2 \times 82$$

$$= 10.30$$

$$\text{Total } E = 10.30 + 2$$

$$= 12.30 \text{ V}$$

$$I = \frac{E}{R}$$

$$= \frac{12.30}{2.0} = 6.15$$

$$= 6.2 \text{ A}$$

20. A current I flows along the length of an infinity long straight, thin walled pipe then the magnetic field at any point inside the pipe is zero.



21. We know that

$$\begin{aligned} L &= l\omega \\ L &= 2m^2 \times \omega \end{aligned} \quad \dots(i)$$



and

$$\begin{aligned} m &= IA \\ &= \frac{q}{T} \cdot A \\ &= 2q \times l \pi I^2 \\ &= 2q \times \frac{\omega}{2\pi} \times \pi I^2 \\ &= q\omega I^2 \end{aligned} \quad \dots(ii)$$

From Eqs. (i) and (ii), we get

$$\frac{m}{L} = \frac{q\omega I^2}{2m^2 \times \omega} = q/2m$$

22. Given that $C = 1.5 \mu\text{F} = 1.5 \times 10^{-6} \text{F}$
 $V = 60 \text{V}$
 $L = 15 \text{mH} = 15 \times 10^{-3} \text{H}$

As $U = \frac{1}{2} CV^2$

and $U = \frac{1}{2} LI^2$

$$\begin{aligned} \frac{1}{2} LI^2 &= \frac{1}{2} CV^2 \\ I^2 &= \frac{CV^2}{L} = \frac{1.5 \times 10^{-6} \times 60 \times 60}{15 \times 10^{-3}} \\ I &= 0.6 \text{A} \end{aligned}$$

23. Given that

$$R = 200 \Omega, C = 15 \mu\text{F} = 15 \times 10^{-6} \text{F}$$

$$L = 230 \text{mH} = 230 \times 10^{-3} \text{H}$$

and $\varepsilon = 36.0 \sin 120 \pi t$

This is comparing with

$$\begin{aligned} \varepsilon &= \varepsilon_0 \sin \omega t \\ \varepsilon_0 &= 36 \\ \omega &= 120\pi \\ X_L &= \omega L \\ &= 120\pi \times 230 \times 10^{-3} \\ &= 86.664 = 86.66 \\ X_C &= \frac{1}{\omega C} = \frac{1}{120\pi \times 15 \times 10^{-6}} \end{aligned}$$

$$= \frac{10^6}{120 \times 314 \times 15}$$

$$= 176.93 \Omega$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$= \sqrt{40000 + 8148.67}$$

$$= \sqrt{48148.67}$$

$$= 219.42 \Omega$$

$$i = \frac{\varepsilon_0}{Z} = \frac{36}{219.42}$$

$$= 0.164 \text{A}$$

$$= 164 \text{mA}$$

24. Given that

$$Bn = (4.0 \times 10^{-6} \text{T}) \sin [(1.57 \times 10^7 \text{m}^{-1})y + \omega t]$$

This equation comparing with

$$B = B_0 \sin \left[\frac{2\pi V}{\lambda} + \omega t \right], \text{ we get}$$

$$B_0 = 4 \times 10^{-6} \text{T}$$

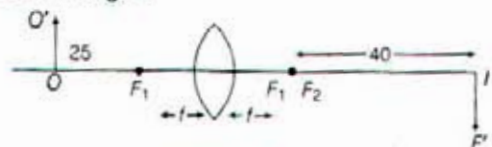
Now, from $i = \frac{CB_0^2}{2\mu_0}$

but $C^2 = \frac{1}{\varepsilon_0 \mu_0}$

$$\therefore i = \frac{1}{2} C^3 \varepsilon_0 B_0^2$$

$$i = 1.9 \text{kW/m}^2$$

25. In the figure



$$u = -(25 + f)$$

$$v = (40 + f)$$

using $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$$\frac{1}{f + 40} + \frac{1}{25 + f} = \frac{1}{f}$$

$$65f + 2f = 1000 + 65f + f^2$$

$$f^2 = 1000$$

$$f = 31.62 \text{cm}$$

$$u = 25 + 31.62$$

$$= 56.62 \text{cm}$$

$$v = 40 + 31.62 = 71.62 \text{cm}$$

$$m = \frac{v}{u} = \frac{71.62}{-56.62} = -1.3$$



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26. Given μ = refractive index of glass = 1.5
 t = thickness of coating, μ' = refractive index of coating

$$= 1.8, \lambda = 648 \times 10^{-9} \text{ m}$$

For constructive interference

$$2\mu t = (2n + 1) \frac{\lambda}{2}$$

$$2 \times 1.8 \times t = \frac{648 \times 10^{-9}}{2}$$

(t to be minimum $n = 0$)

$$t = \frac{648}{2 \times 2 \times 1.8} \times 10^{-9} \text{ m}$$

$$t = \frac{648}{72} \times 10^{-9} \text{ m} = 90 \text{ m}$$

27. Given that

Potential difference $V = 125 \text{ V}$

$$\text{Then, } \lambda = \frac{12375}{V} \text{ \AA}$$

$$= \frac{12375}{125} \text{ \AA}$$

\therefore Energy of electron in eV

$$E = \frac{hc}{\lambda}$$

$$E = \frac{6.6 \times 10^{-34} \times 3 \times 10^8 \times 125 \times 10^{-10}}{12375}$$

$$= 125 \text{ eV}$$

Then the energy of photon = 125 eV

28. From

$$N_1 e^{-\lambda_1 t} = N_2 e^{-\lambda_2 t}$$

$$\frac{N_1}{N_2} = e^{-(\lambda_2 - \lambda_1)t}$$

$$\frac{1}{e} = e^{-(\lambda_2 - \lambda_1)t} \quad \left(\text{Given } \frac{N_1}{N_2} = \frac{1}{e} \right)$$

$$1 = (6\lambda - 3\lambda)t$$

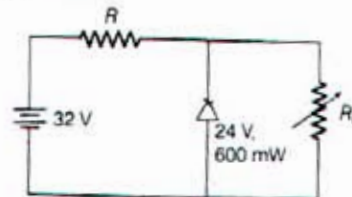
$$t = \frac{1}{3\lambda}$$

- 29.

Property	α -particle	β -particle	γ -ray particle
Ionising	10^4	10^2	1
Power			
Penetrating	1	10^2	10^4
Power			

Hence from the table option (b) is correct.

30. The voltage across R would be equal to
 $32 - 24 = 8 \text{ V}$



Current flow across R ,

$$I = \left(\frac{P}{V} \right) = \frac{600 \times 10^{-3}}{24} = \frac{0.6}{24} \text{ A}$$

Now

$$R = \frac{V}{I}$$

$$= \frac{8}{0.6} \times 24 = 320 \Omega$$

31. Given that

$$i_c = 10 \text{ mA}$$

According to question

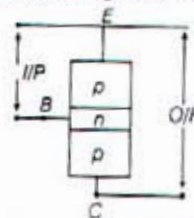
$$i_E \times \frac{90}{100} = 10$$

$$i_E = 11 \text{ mA}$$

Now from $i_E = i_D + i_C$

$$i_D = 1 \text{ mA}$$

32. In the figure, circuit connection (ii) represent the common-emitter configuration of p - n - p transistor



Because in this configuration emitter (E) is common terminal for both input and output.

33. $F = qvB$

$$B = \frac{F}{qv} = \frac{F}{It}$$

$$= \frac{[MLT^{-2}]}{[AT][LT^{-1}]} = [MT^{-2}A^{-1}]$$

$$B = \frac{F}{q} = [MLT^{-3}A^{-1}]$$

$$E \times B = [MLT^{-3}A^{-1}] \times [MT^{-2}A^{-1}]$$

$$= [M^2LT^{-5}A^{-2}]$$



34. Given that

$$y = 4\sqrt{3}m$$

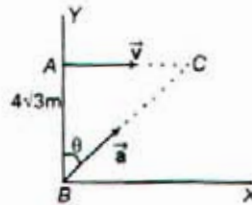
For particle A,

$$v = 2 \text{ m/s}$$

and

For particle B

$$a = 4 \text{ m/s}^2$$



Let particle are collide after 't' sec. distance covered by A in t sec. = $2t$

$$\text{and B, } = \frac{1}{2} \times 4 \times t^2$$

For collision

$$2t = \frac{1}{2} \times 4 \times t^2$$

$$t = 1 \text{ sec.}$$

Velocity of B = $4 \times 1 = 4 \text{ m/s}$

Now, from ΔABC

$$\sin\theta = \frac{2}{4} = \frac{1}{2}$$

$$\theta = 30^\circ$$

35. From figure $AB = 2r$

$$AB = 2 \times 1 = 2 \text{ m}$$

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

$$= \frac{2}{1} = 2 \text{ m/s}$$



36. Let balls collide at time t , they are at same height h
Height of first ball after t seconds

$$= 49t - 0.5(9.8t^2) = 4.9t(10 - t)$$

Height of second ball after t seconds

$$= 98 - \text{downward distance moved by it in } t \text{ seconds}$$

$$= 98 - 0.5(9.8)t^2 = 4.9(20 - t^2)$$

$$\Rightarrow 4.9t(10 - t) = 4.9(20 - t^2)$$

$$\Rightarrow 10t - t^2 = 20 - t^2$$

$$\Rightarrow t = 2 \text{ s}$$

The balls thus collide after 2 s the start of their motion. Their velocities at this instance are

$$\text{Ball 1 : } v_1 = (49 - 9.8 \times 2) = 29.4 \text{ m/s upward}$$

$$\text{Ball 2 : } v_2 = (0 + 9.8 \times 2) = 19.6 \text{ m/s downwards}$$

From conservation of momentum

$$200v = 100 \times 29.4 - 100 \times 19.6$$

$$\Rightarrow v = 4.9 \text{ m/s}$$

37. The tension at A

$$= (m_1 + m_2)(g + a)$$

$$= (2.9 + 1.9 + 2)(9.8 + 2)$$

$$= 50 \text{ N}$$

38. $f = 0.6 \times 10 \times 9.8 \text{ N} = 58.8 \text{ N}$

Since the applied force is greater than f therefore the block will be in motion so, we should consider f_k .

$$f_k = 0.4 \times 10 \times 9.8 \text{ N}$$

$$\text{or } f_k = 4 \times 9.8 \text{ N}$$

This would cause acceleration of 40 kg block

$$\text{acceleration} = \frac{4 \times 9.8}{40} = (0.98) \text{ m/s}^2 = (1) \text{ m/s}^2$$

Acceleration of 10 kg block

$$\frac{58.8}{10} = (5.88) \text{ m/s}^2 = (6) \text{ m/s}^2$$

39. $F = \frac{m(v_1 - v_2)}{t}$

$$= \frac{140 \times 10^{-3}(39 + 39)}{12 \times 10^{-3}}$$

$$= \frac{1400 \times 78}{12}$$

$$= 9100 \text{ N}$$

40. We know that

$$P = \frac{dW}{dt}$$

$$P = (0.20 \times 2)t$$

$$P = 0.4t$$

$$P = 0.4 \times 5 = 2.0 \text{ W}$$

$$P_{\text{ins}} = 0.4 \times 3$$

$$= 1.2 \text{ W}$$

41. Given that

$$m_1 = 2 \text{ kg} \quad m_2 = ?$$

$$u_1 = v \quad v_2 = ?$$

$$v_1 = v/4 \quad v_{\text{cm}} = ?$$

From conservation of momentum

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

$$2v + 0 = 2 \times \frac{v}{4} + m_2v_2$$

$$\frac{3}{2}v = m_2v_2$$

... (i)



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Now, from Newton's law of restitution

$$v_1 - v_2 = e(u_2 - u_1)$$

($\because e = 1$ for elastic collision)

$$\frac{v}{4} - v_2 = -v$$

$$v_2 = \frac{5}{4}v$$

From Eq. (i), we get

$$m_2 = \frac{6}{5}$$

$$= 1.2 \text{ kg}$$

$$v_{\text{cm}} = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2}$$

$$= \frac{2 \times \frac{v}{4} + 1.2 + \frac{5}{4}v}{2 + 1.2}$$

$$= \frac{(0.5 + 1.5)v}{3.2}$$

$$= \frac{5}{8}v$$

42. From figure

Work done (W) = max

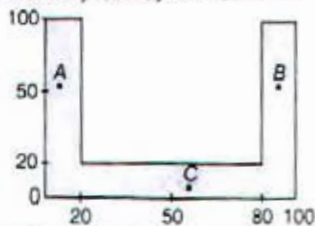
$$W_4 = 2 \left[\frac{1}{2} \times 1 \times 6 + 3 \times 6 \right]$$

$$= 42 \text{ J}$$

$$W_7 = 2 [21 + 3 - 3 - 1 \times 6]$$

$$= 30 \text{ J}$$

43. COM is exactly halfway from other end



Object	Mean	x	y	z
Left bar	m_A	10 mm	50 mm	3 mm
Right bar	m_B	90 mm	50 mm	3 mm
Bottom bar	m_C	50 mm	50 mm	3 mm

$$x_{\text{cm}} = \frac{m_A x_A + m_B x_B + m_C x_C}{m_{\text{sys}}}$$

$$= \frac{m(10) + m(90) + 0.6m(50)}{2.6m}$$

$$= 50 \text{ mm}$$

$$y_{\text{cm}} = \frac{m_A y_A + m_B y_B + m_C y_C}{m_{\text{sys}}}$$

$$= \frac{m(50) + m(50) + 0.6m(10)}{2.6m} = 41 \text{ mm}$$

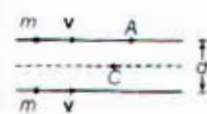
$$z = \frac{m(3 \text{ mm}) + m(3 \text{ mm}) + 0.6m(3 \text{ mm})}{2.6m}$$

$$z = 3 \text{ mm}$$

44. We know that

$$L = mrv = mvd$$

Hence, the magnitude of the total angular momentum of the two-particle system around the point A will be mvd .



Similarly the magnitude of total angular momentum of the system around the point B will be mvd .

The magnitude of the vector sum

$$L = L_1 + L_2 = mvd - mvd = 0$$

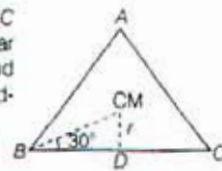
The magnitudes of the angular momentum of the system around C

$$L = mvd \quad (\because d = 0)$$

$$\therefore L = 0$$

45. Moment of inertia of rod BC about an axis perpendicular to plane of triangle ABC and passing through the midpoint of rod BC (i.e., D) is

$$I_1 = \frac{m^2}{12}$$



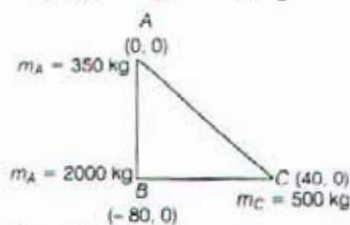
From theorem of parallel axes, moment of inertia of this rod about the asked axis is

$$I_2 = I_1 + Mr^2 = \frac{M^2}{12} + M \left(\frac{2}{\sqrt{3}} \right)^2 = \frac{M^2}{6}$$

\therefore Moment of inertia of all three rod is

$$I = 3I_2 = 3 \left(\frac{M^2}{6} \right) = \frac{M^2}{2}$$

$$46. U = -G \left[\frac{m_A m_B}{r_{AB}} + \frac{m_B m_C}{r_{BC}} + \frac{m_C m_A}{r_{CA}} \right]$$



$$= -67 \times 10^{-11}$$



$$\left[\frac{350 \times 2000}{80 \times 10^{-2}} + \frac{2000 \times 500}{120 \times 10^{-2}} + \frac{350 \times 500}{40 \times 10^{-2}} \right]$$

$$= -6.7 \times 10^{-11} [8750 + 8333.33 + 4375] \times 10^{-2}$$

$$= -6.7 \times 10^{-9} \times 21458.33$$

$$= -143770.81 \times 10^{-9} = -1.43 \times 10^{-4} \text{ J}$$

Hence gravitational potential energy $U = -1.43 \times 10^{-4} \text{ J}$ and its value shall increase if m_g removed.

47. From the given figure

For solid $F_1 = \frac{GMm}{d^2}$

For cavity $F_2 = \frac{\frac{GM}{8}(m)}{\left(d - \frac{R}{2}\right)^2}$

$$= \frac{GMm}{8d^2 \left(1 - \frac{R}{2d}\right)^2}$$

So, resultant force

$$F = F_1 - F_2$$

$$= \frac{GMm}{d^2} - \frac{GMm}{8d^2 \left(1 - \frac{R}{2d}\right)^2}$$

$$= \frac{GMm}{d^2} \left[1 - \frac{1}{8 \left(1 - \frac{R}{2d}\right)^2} \right]$$

48. The elastic energy density stored in wire = Energy stored in unit volume of wire

$$= \frac{1}{2} \times \text{stress} \times \text{strain}$$

$$= \frac{1}{2} \frac{(\text{Stress})^2}{Y} = \frac{S^2}{2Y}$$

49. From given figure

$$\rho_0 + \rho_1 g h_1 = \rho_0 + \rho_w g h_2$$

$$\frac{\rho_1}{\rho_w} = \frac{h_2}{h_1}$$

$$\rho_1 = \frac{h_2}{h_1} \times \rho_w$$

$$= \frac{135 \times 1000}{147.5}$$

$$= 915 \text{ kg/m}^3$$

50. Given that, $\lambda_1 = 300 \text{ nm} = 3 \times 10^{-7} \text{ m}$

$$\lambda_2 = 500 \text{ nm} = 5 \times 10^{-7} \text{ m}$$

We know that

$$P \propto T^4$$

But $T \propto \frac{1}{\lambda}$

So $P \propto \left(\frac{1}{\lambda}\right)^4$

Then $\frac{P_1}{P_2} = \left(\frac{\lambda_2}{\lambda_1}\right)^4 = \left(\frac{5}{3}\right)^4$

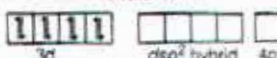
Chemistry

1. In $[\text{Ni}(\text{CN})_4]^{2-}$, nickel is in +2 oxidation state and has electronic configuration $3d^8$.

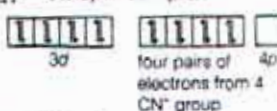
Orbitals of Ni^{2+} ion



dsp^2 hybridised orbitals of Ni^{2+}



$[\text{Ni}(\text{CN})_4]^{2-}$ low spin complex



Therefore, the shape is square planar and the hybridisation involved is dsp^2 .

2. Most of transition metals show variable valencies or different oxidation states because of incomplete

d -subshell. The variable oxidation states are due to the participation of ns and $(n-1)d$ electrons in bonding. $_{23}\text{V}$ shows +2, +3, +4, and +5 oxidation states. $_{27}\text{Co}$ shows +2, +3, +4 oxidation states. Therefore, known oxidation states for both V and Co are +2, +3, +4 and +5.

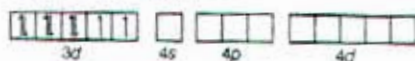
3. Effective magnetic moment (μ_{eff}) is $\mu = \sqrt{n(n+2)}$ where, n = number of unpaired electrons. A single unpaired electron has a magnetic moment of 1.73 Bohr magneton (BM).
4. N_2O nitrous oxide is a colourless gas with pleasant odour and sweet taste. On inhaling in moderate quantity it produces laughing hysteria, hence named as laughing gas.
5. Substances which show permanent magnetism even in the absence of the magnetic field are called ferromagnetic substances, e.g., Fe, Ni, Co, Gd and CrO_2 are ferromagnetic substances.



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6. In $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ complex ion Ni is in +2 oxidation state. It has electronic configuration $3d^8$.

Orbitals of Ni^{2+} ions

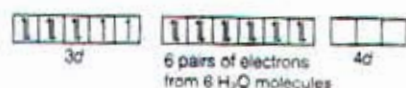


H_2O is a weak field ligand. So, pairing of electrons in d -orbitals does not occur. The complex $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ involves the outer $4d$ -orbitals for hybridisation (sp^3d^2). It is outer orbital complex.

sp^3d^2 hybridised orbitals of Ni^{2+}



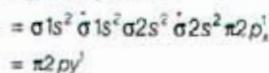
$[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$



7. In case of MgSO_4 hydration energy is higher than the lattice energy. Hydration enthalpies of alkaline earth metal ions decrease with increase in ionic size down the group. Lattice energy also decreases as the size of cation increases. But in case of large size anion such as SO_4^{2-} and the small changes in cation size do not alter the lattice energy, i.e., lattice energies are about the same. For BeSO_4 and MgSO_4 , hydration enthalpies of Be^{2+} and Mg^{2+} ions are higher than that of their lattice enthalpies.

8. Ne_2 molecule does not exist, because it has zero bond order. A positive bond order means a stable molecule while a negative or zero bond order means an unstable molecule.

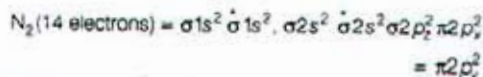
B_2 (10 electrons)



$$\text{Bond order} = \frac{1}{2}(N_b - N_a) = \frac{6 - 4}{2} = 1$$

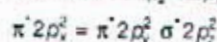
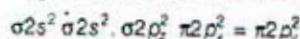
He_2^+ (3 electrons) $= \sigma 1s^2 \sigma^* 1s^1$

$$\text{Bond order} = \frac{1}{2}(N_b - N_a) = \frac{1}{2} \times (2 - 1) = \frac{1}{2} = 0.5$$



$$\text{Bond order} = \frac{1}{2}(10 - 4) = 3$$

Ne_2 (20 electrons) $= \sigma 1s^2 \sigma^* 1s^2,$



$$\text{Bond order} = \frac{1}{2}(10 - 10) = 0$$

Hence, Ne_2 molecule does not exist.

9. Dual nature of electron was first proposed by de-Broglie. He gave the following equation for the wavelength of electron.

$$\lambda = \frac{h}{mv}$$

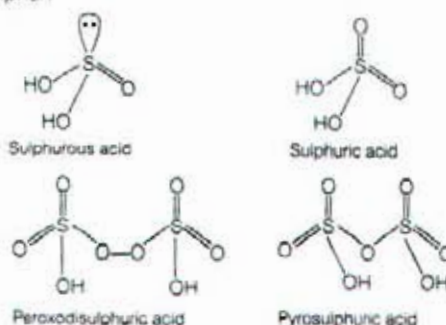
He proposed that all microparticles like electrons, protons, neutrons etc. have dual nature i.e., both wave nature as well as particle nature.

Interference and diffraction support the wave nature of electron.

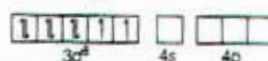
$E = mc^2$ support the particle nature of electron.

$E = h\nu = \frac{hc}{\lambda}$ is de-Broglie equation, it supports both wave nature and particle nature of electron.

10. Sulphurous acid contains a lone pair of electrons on sulphur.

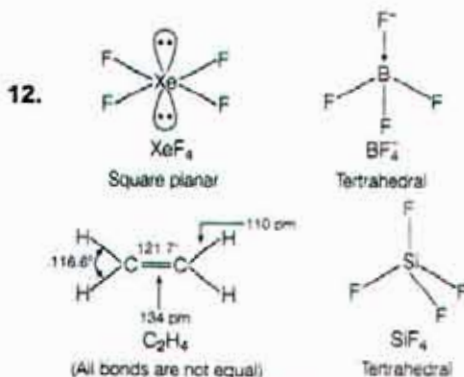


11. In $[\text{NiCl}_4]^{2-}$, Ni is in +2 oxidation state. Since, Cl^- is a weak field ligand, it does not cause pairing of electron. $\text{Ni}^{2+} = 3d^8$



$$\text{Number of unpaired electrons, } n = 2$$

$$\mu = \sqrt{n(n+2)} = \sqrt{2(2+2)} = \sqrt{8} \text{ BM} = 2.82 \text{ BM}$$

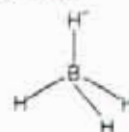


In C₂H₄, carbon-carbon double bond in alkenes consists of one strong sigma (σ) bond and one weak pi (π) bond. In ethene all the bonds are not equal. While in case of remaining species, all the bonds are equal.

13. The correct order of electron gain enthalpy with negative sign of F, Cl, Br, and I is Cl > F > Br > I. Actually halogens have maximum electron gain enthalpy in the corresponding periods and it becomes less negative down the group. However, the negative electron gain enthalpy of fluorine is less than that of chlorine. It is due to the small size of fluorine atom. As a result, there are strong interelectronic repulsions in the relatively small 2p-orbitals of fluorine and thus, the incoming electron does not experience much attraction.
14. Basic character of hydroxides of s-block elements increase with increasing atomic number. However alkaline earth metal hydroxides are less basic than alkali metal hydroxides. Therefore, Li(OH) is the weakest base.
15. Haemoglobin (blood) is the positively charged sol. Gold sols, clay and As₂S₃ are the examples of negatively charged sols.
16. Mass, energy, volume are extensive properties while energy mol⁻¹ is intensive property.
17. Principle of paper chromatography is based on liquid-liquid partition chromatography. In paper chromatography, special quality paper known as chromatography paper contains water trapped in it which acts as the stationary phase. A strip of chromatographic paper spotted at the base with the solution of the mixture is suspended in a suitable solvent for a mixture of solvents. This solvent acts as the mobile phase. The solvent rises up the paper by capillary action and flows over the spot. The paper selectively retains different components according

to their differing partition in the two phases. The paper strip so developed is called as a chromatogram.

18. The shape of BH₄⁻ is tetrahedral because in BH₄⁻, boron is sp³ hybridised.



19. $\Delta T_f = i k_f m$

$$0.197 = i \times 1.86 \times 0.1$$

$$i = \frac{0.197}{1.86 \times 0.1} = 1.059 = 1.06$$

$$\text{In case of dissociation, } \alpha = \frac{i-1}{n-1} = \frac{1.06-1}{2-1} = 0.06 = 6\%$$

20. Elevation in boiling point is colligative property. It depends upon number of ions or molecules or particles.

Glucose and sucrose does not dissociate so $n = 1$ for these solutions while for NaCl, $n = 2$ and for CaCl₂, $n = 3$. 1% solution means 100 g solution contains 1 g solute (glucose or NaCl or sucrose or CaCl₂).

$$w_2 = 1 \text{ g, } w_1 \text{ (solvent)} = 99 \text{ g}$$

$$\Delta T_b = \frac{i \times k_b \times W_2 \times 1000}{M_2 \times W_1}$$

$$\text{For glucose, } \Delta T_b = \frac{1}{180} = 0.0056$$

(because k_b , w_2 , w_1 same for all the cases)

$$\text{For sucrose, } \Delta T_b = \frac{1}{342} = 0.00292$$

$$\text{For NaCl, } \Delta T_b = \frac{2}{58.5} = 0.0342$$

$$\text{For CaCl}_2, \Delta T_b = \frac{3}{111} = 0.0270$$

Hence 1% NaCl solution has the highest boiling point.

21. Percentage of Fe(III) in Fe_{0.93}O_{1.0}

$$\text{Formula Fe}_{0.93}\text{O}_{1.00} \text{ shows that Fe : O} \\ = 0.93 : 1.00 \text{ or } 93 : 100$$

If there are 100 oxygen atoms then Fe atoms = 93

$$\text{Charge on oxide ion} = 100 \times (-2) = -200$$

$$\text{Suppose Fe}^{2+} = x, \text{ then Fe}^{3+} = 93 - x$$

$$\text{Total positive charge} = (2 \times x) + 3(93 - x)$$

$$2x + 279 - 3x = 279 - x$$



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Positive charge = negative charge

$$279 - x = 200$$

$$x = 79 = \text{Fe}^{2+}$$

$$\text{Fe}^{3+} = 93 - 79 = 14$$

$$\% \text{ of Fe}^{3+} = \frac{14 \times 100}{93} = 15.05\%$$

Hence, None of these options is correct.

22. $i = \text{NaCl} = 2$, i for $\text{BaCl}_2 = 3$

$$\text{Hence, } \frac{\Delta T_f (\text{NaCl})}{\Delta T_f (\text{BaCl}_2)} = \frac{2}{3}$$

$$\text{or } T_f (\text{BaCl}_2) = \frac{3}{2} \times 2 = 3^\circ \quad (\Delta T_f \text{ NaCl} = 2)$$

So that T_f for $\text{BaCl}_2 = -3^\circ\text{C}$

23. Suppose number of electrons in an ion = x

$$\begin{aligned} \text{Number of neutrons} &= x + \frac{11.1}{100}x = 1.111x \\ &= 1.111x \end{aligned}$$

Number of electrons in the neutral atom = $x - 1$

\therefore Number of protons = $x - 1$

Mass number = number of neutrons + number of protons

$$\therefore 37 = 1.111x + x - 1 \text{ or } 2.111x = 38 \text{ or } x = 18$$

$$\begin{aligned} \text{Number of protons} &= \text{atomic number} = x - 1 \\ &= 18 - 1 = 17 \end{aligned}$$

Hence, the symbol of the ion will be ${}_{17}^{37}\text{X}^{-1}$

$$24. K_a = \frac{K_w}{K_b} = \frac{10^{-14}}{1.77 \times 10^{-3}} = 5.64 \times 10^{-10}$$

$$25. \Delta G^\circ = -nFE^\circ$$

$$\Delta G^\circ = -2.303 RT \log K_{sp}$$

$$nFE^\circ = 2.303 RT \log K_{sp}$$

$$\text{or } \log K_{sp} = \frac{nFE^\circ}{2.303 RT} = \frac{1 \times 96500 \times 0.295}{2.303 \times 8.314 \times 298}$$

$$\log K_{sp} = 4.989 \text{ or } K_{sp} = 9.750 \times 10^4$$

26. In magnesium, 3s energy band is completely filled. The filled 3s- energy band overlaps an empty 3p- energy band. Due to this, electrons flow under applied electric field from occupied band to unoccupied band. That's why Mg is a conductor.

27. Average energy per molecule of a gas at a given temperature is given by $\frac{3RT}{2N_0}$

$$28. r = k[\text{H}^+]^2$$

$$\text{Exp. (I)} r_1 = k [10^{-2}]^2 \quad (\text{If pH} = 2, \text{ then } [\text{H}^+] = 10^{-2})$$

$$\text{Exp. (II)} 100r_2 = k [10^{-1}]^2$$

$$(\text{If pH} = 1, \text{ then } [\text{H}^+] = 10^{-1})$$

$$\frac{\text{Exp. (II)}}{\text{Exp. (I)}} = \frac{100r_2}{r_1} = \frac{k[0.1]^2}{k[0.01]^2} = \frac{100}{1} = \left[\frac{10}{1}\right]^2 \text{ or } n = 2$$

Order of reaction is 2.

29. (a) $n = 1, l = 0, m = 0, m_s = -\frac{1}{2}$ all the values are according to the rules.

(b) $n = 1, l = 1, m_l = 0, m_s = +\frac{1}{2}$. The value of l can have maximum $(n-1)$ value i.e. 0 (zero) in this case. This set of quantum numbers is not possible.

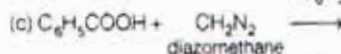
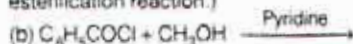
(c) $n = 2, l = 1, m_l = 0, m_s = +1/2$; All the values according to rules

(d) $n = 3, l = 1, m_l = 0, m_s = +1/2$; All the values according to rules.

30. (a) $\text{C}_6\text{H}_5\text{COOH} + \text{CH}_3\text{OH} \xrightarrow{\text{H}^+}$

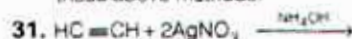


(The reaction is known as Fischer - Speier esterification reaction.)



(Methyl esters can be prepared by treating carboxylic acid with ethereal solution of diazomethane.

Hence, methyl benzoate can be prepared by all these above methods.



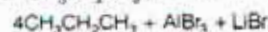
white precipitate (X)

32. Acid anhydride on reaction with primary amines give substituted acid amides e.g.,

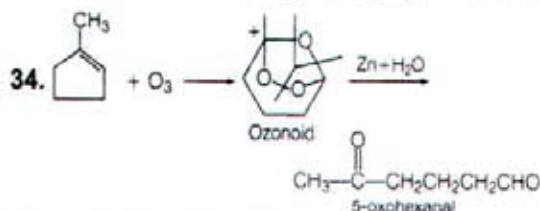
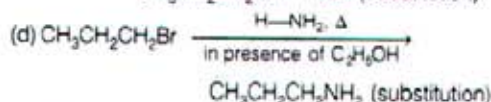
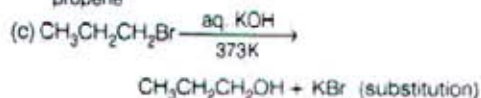
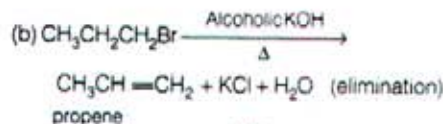


N-ethylacetamide

33. Propane can be made from 1-bromopropane in a single step by reduction.

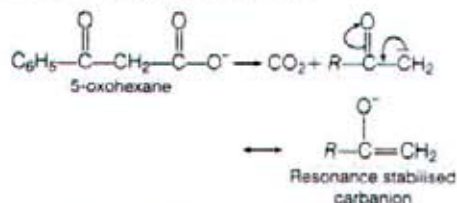


LiAlH_4 is a hydride donor (H^- donor). Note 3° alkyl halides give alkenes. Because they undergo dehydrohalogenation.



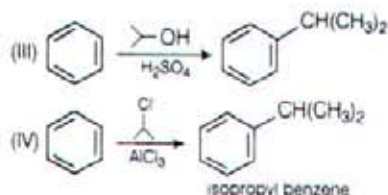
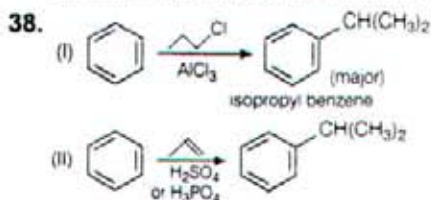
35. Drugs that bind to the receptor site and inhibit its natural function are called antagonists. These are useful when blocking of message is required.

36. If keto group is at β -position then decarboxylation takes place simply by heating. β -keto acid is very reactive in decarboxylation reaction because it produces a highly stable carbanion.

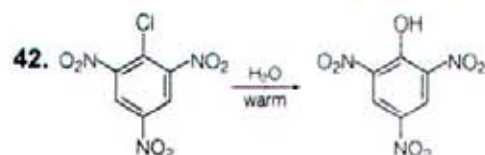
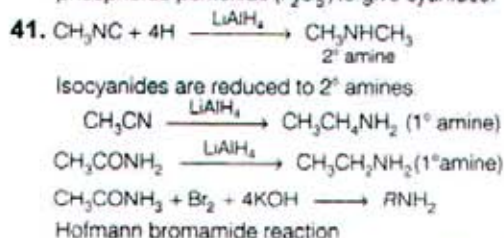
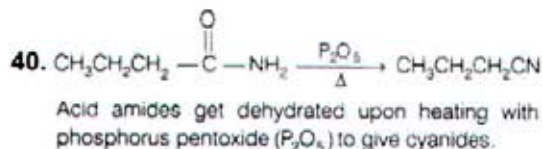
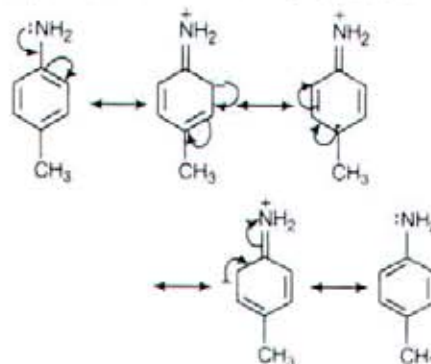


37. Kjeldahl method can not be used for compounds having azo groups ($-\text{N}=\text{N}-$) nitroso ($-\text{NO}$) azoxy compounds ($\begin{matrix} \text{—N—} \\ | \\ \text{O} \end{matrix}$) and nitrogen in the ring (pyridine, quinoline etc.)

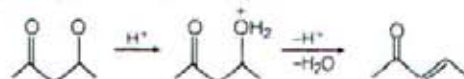
Since, nitrogen in these compounds is not quantitatively converted into ammonium sulphate.



39. In *p*-toluidine, resonance $-\text{NH}_2$ is possible.

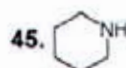
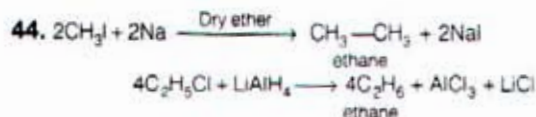


43. β -hydroxy aldehydes or β -hydroxy ketones (i.e. aldol) readily dehydrated under acidic conditions to give α,β unsaturated aldehyde or ketone.



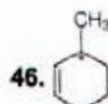


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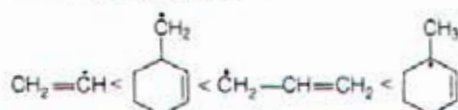
Piperidine is the strongest Brongest base.

It is non-aromatic and state of hybridisation of N-atom is sp^3 hybridised.



is the most stable radical.

Increasing order of their stability is



47. Alkali metal hydroxides are the strongest of all bases and on moving down the group strength of the bases increases. Hence, KOH is the strongest base.

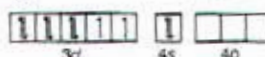
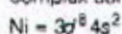
48. Elements belong to second transition series are
 Y Zr Nb Mo Tc Ru Rh Pd Ag Cd

49. Oxidation state of Co in $[\text{Co}(\text{H}_2\text{O})_5\text{Cl}]^{2+}$ is +3.

$$x + (5 \times 0) + (-1) = +2$$

$$x = +3$$

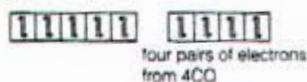
50. In $\text{Ni}(\text{CO})_4$, there is no unpaired electron. It is diamagnetic. Oxidation state of Ni in $[\text{Ni}(\text{CO})_4]$ complex compound is zero.



sp^3 hybridised orbitals of Ni



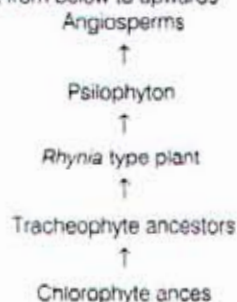
$[\text{Ni}(\text{CO})_4]$



four pairs of electrons
from 4CO

Biology

1. Flowering plant (angiosperm) evolved about 140 million year ago in Coenozoic era. These flowering plants might have originated from psilophytes (primitive vascular plant). The fossil history of plants shows the following procession of plant life through the ages in the following arrangement from below to upwards



2. The drug 'marijuana' also called as marihuana along with bhang, ganja and charas are obtained from hemp plants. e.g., *Cannabis sativa* and *Cannabis indica*. The drug is obtained from dried leaves and flower of the plants *Papaver somniferum* is source of opium, while belladonna is obtained from species *Atropa* in which *A. belladonna* and *A. acuminata* are more important.

3. Black rot of crucifers is caused by bacteria, while late rot of sugarcane, late blight of potato and brown rust of wheat are caused by fungus.

4. Archaeobacteria and methanogens are involved in production of biogas or gobar gas. Some other bacteria involved in degradation process are *Bacillus clostridium*, *Eubacterium*, etc. Biogas is produced during second treatment of sewage by anaerobic degradation of sludge by microbe, which is a mixture of CH_4 (50-70%), CO_2 (25-35%) H_2 (1-5%) N_2 (2-7%) and O_2 (0.0-1%) and rarely H_2S .

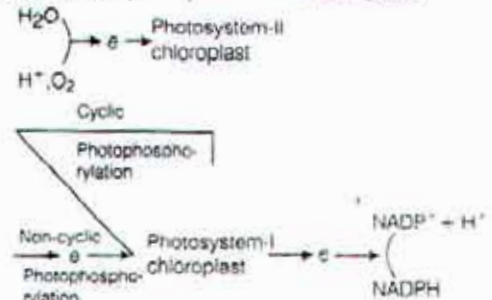
5. The process of rDNA technology involve following process: isolation of DNA molecule, cutting of DNA at specific site, amplification of gene using PCR, insertion of recombinant DNA into host cells obtain foreign gene product then down stream processing. During amplification of gene using PCR *Taq* DNA polymerase isolated from thermophilic bacterium, *Thermus aquaticus* is used between extension (final step) and annealing (joining II step).

6. Professor Ramdeo Misra is regarded as Father of Indian Ecology. The first viable center of ecology was established by this eminent ecologist at department of botany, BHU. He also established a school of ecology sagar (MP).



- Decomposition is most important process in an ecosystem. It is carried out by decomposer or saprotrophs or reducers. In a detritus food chain, detritus (dead organic matter) is broke down by bacteria fungi and Protozoa into simpler forms. These organisms are termed as detritivore (detritus eating). The process is known as fragmentation. These detritivores in turn are eaten by their predators insect larvae, nematodes. Fragmentation is followed leaching, then catabolism, which in turn is followed by humification and mineralisation.
- Montreal Protocol, a landmark international treaty to protect the ozone layer by agreeing to limit the production and use of ozone depleting substance was signed at Montreal in 1987 by 27 industrialised countries.
- An ecologist use the term biodiversity or biological diversity to the variety of life forms and habitats found in defined area. In other words biodiversity can be defined as the variety of species of all living plant and animals and microbes also living in their natural habitats and the ecological complexes of which they are a part.
- Knock knee syndrome occurs due to the pollution of fluorides. The disease is characterised by stiffness and hardness of joints and bones. More than 13 states of India have high concentration of fluoride (more than 1.5 ppm) in ground drinking water.
- The fluid mosaic model of cell membrane was given by SJ Singer and GL Nicholson in 1972. According to the model lipid molecule are arranged in two layers and the protein molecule are located among the lipid molecules.
- Hydroponics or solution culture or soilless culture is cultivation of plant in nutrient solution without soil. In other words the cultivation or growing of plant by placing the roots in nutrient solution is termed as hydroponics. Now-a-days chelating agent (Na-EDTA- disodium salt of ethylene diamintetra acetic acid and DTPA- diethylene triamino penta acetic acid, keep the metal of nutrient solution in soluble state.
- Photochemical reaction or light reaction takes place in grana of chloroplast. According to Arnon, light energy is converted into chemical energy and is stored in ATP. This process is known as photophosphorylation. NADP, 2H is formed as hydrogen donor. Photochemical reaction include two photoacts; photosystem-I and photosystem-II, which are called as cyclic and non-cyclic photophosphorylation respectively. In cyclic photophosphorylation, electron released from

P_{700} return to P_{700} in cyclic manner while in photosystem-II electron released from $P_{680-690}$ does not return, but is passed on to NADP with helps of photosystem-II. During the photoact continued supply of electron is made by oxygen evolving complex (4 manganese ion Mn^{+2} , Mn^{+3} , Mn^{+4} and Mn^{+5}). The complex oxidises two molecule of water to form one molecule of O_2 , $4H^+$ and $4e^-$, i.e., photolysis of water takes place.



- Photorespiration or photosynthetic carbon oxidation, universal in C_3 -plant, involves three cell organelles; chloroplast, peroxysomes and mitochondria. During cycle RUBP is oxidised into phosphoglyceric (molecule) and phosphoglycolic acids. Enzyme phosphatase hydrolyse phosphoglycolic acid into glycolic acid. Chloroplast membrane contain transporter protein for glycolic acid and glycolic acid enters from chloroplast to peroxysomes. Now it strats photosynthetic carbon oxidation. Glycolic acid is oxidised to glyoxylic acid and H_2O_2 and glyoxylic acid is aminated to form amino acid glycine with the help of transaminase.

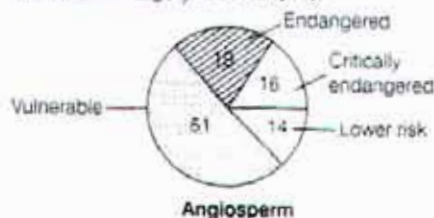
$$\text{Glyoxylic acid} + \text{Glutamic acid} \xrightarrow{\text{transaminase}} \text{Glycine} + \alpha\text{-ketoglutaric acid}$$
 Now glycine enters from peroxysomes to mitochondrion.
- Tricarboxylic acid cycle or citric acid cycle or Krebs' cycle takes place in matrix of mitochondria. Acetyl coenzyme-A is connecting link between cycle and EMP pathway, while oxaloacetate is acceptor molecule. Substrate level phosphorylation takes place during the conversion of succinyl Co-A to succinic acid.

$$\text{Succinyl Co-A} + \text{ADP} + \text{H}_3\text{PO}_4 \xrightarrow[\text{Co-A-synthetase}]{\text{Succinyl}} \text{succinic acid} + \text{ATP} + \text{Co-A}$$
- The aestivation in corolla (petals) of *Calotropis* is valvate. In this type of aestivation petals are arranged in contact on margins without overlapping. Custard apple and *Brassica* also show this type of aestivation in corolla.



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17. The commonly found tissue in pulp of fruit like guava, mango, apple in leaves of plants and lower floral parts is collenchyma. It is a simple permanent tissue, which can manufacture and store food. Normally the tissue provide mechanical strength to soft and tender organs of plant. So, it is also termed as living mechanical tissue. Collenchyma occurs hypodermally in dicots stem and is absent in root and most monocots.
18. According to integration union of conservation of Nature and Natural Resources 2000 Red Data Book around 5621 species of plants and 5490 species of animals are listed as critically endangered vulnerable. The percentage of angiosperm as vulnerable category is about 51%.



19. *Neurospora crassa* is widely studied in experimental genetics. This pink mold is member of Ascomycetes and is known as *Drosophila* of plant kingdom. In this fungus the product of meiosis linearly arranged in an ascus, which help in analysing the individuals.
20. The correct sequence of seral stage in hydrosere or hydrarch is plankton (pioneer community) rooted submerged rooted floating, reed swamp, sedge meadow, woodland then climax forest stage.
21. Charles Robert Darwin (1809-1882) an English naturalist was the most dominant figure among biologist of 19th century. He travelled round the world on the ship HMS Beagle with surviving expedition for five years. (1831-1836). In 1858 he was highly influenced by a short essay written by Wallace another naturalist. The theory of natural selection was announced on July 1st 1958 by both of them in historic meeting of the Linnean Society of London. Darwin explained his theory of evolution in book entitled 'On the origin of species' by means of Natural selection. The book was published on 24th November 1959.
22. Several plant pathogens, like harmful insect and disease causing pest can be controlled by biopesticides, i.e., by the application of their natural parasite and predators. *Trichoderma* fungus (free living) grow in soil and root ecosystem. It is being developed as an effective biocontrol agent of several plant pathogens. While species *Phytophthora* are

- responsible for roots of different parts of a number of plants. Late blight of potato is caused by *Phytophthora infestans*. *Albugo candida* causes white rust of crucifers. *Saccharomyces* is common yeast.
23. Histology is the study of plant and animal tissue. It is science that deal with detailed structure, chemical composition and function of tissues. It is also called as microanatomy. Term histology was coined by Mayer (1819).
24. *Cuscuta* (deodar, amerbel) is total stem parasite, which lack cotyledon but is placed under dicotyledons. Maize is monocot, while mustard and linseed (flax) possess two cotyledons.
25. Acetyl coenzyme-A (acetyl Co-A), two carbon active acetate group can be formed through the process of glycolysis, deamination of amino acids and β -oxidation of fatty acids. As the EMP pathway is the first step of cellular respiration that break down the glucose and related hexose into two molecule of pyruvic acid. Pyruvate undergoes oxidative decarboxylation to produce acetyl Co-A. Excess amino acid are deaminated (removal of $-NH_2$ group) and their organic acid are converted into glucose and other carbohydrates and during metabolism fats are converted into glucose.
26. Blight of beans is caused by bacterium *Xanthomonas phaseoli*, while canker of tomato is caused *Xanthomonas lycopersi*.
27. Fungus *Agaricus* are edible mushroom like *A. campestris* and *A. brunnescens*. However, some other species of mushroom fungi are toxic like toad stools *aspergilli* are good source of citric acid. Soya sauce (shoyu, brown liquid used for seasoning) is prepared from soyabean meal and wheat by mean of *Aspergillus oryzae*. *Saccharomyces* is common yeast and is used in bakery and brewery industry. Some species of *Penicillium*, *P. raquilforti* and *P. comemberti* are used in cheese production.
28. *nigrum* is the species of genus *Solanum*, i.e., *Solanum nigrum* (Vern. makoi), which belong to family-Solanaceae. *Mangifera* is a genus of family-Anacardiaceae, i.e., *Mangifera indica* (mango). *Triticum* is genus of family-Poaceae, i.e., *Triticum aestivum* and *Pisum sativum* (common pea) belong to family-Fabaceae.
29. Mode of nutrition is diverse in Protista. Protists obtain food by both autotrophic and heterotrophic mode of nutrition. Some obtain food from outside through ingestion (phagotrophic, holozoic) absorption from dead organic matter (saprophytic) living host

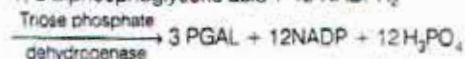
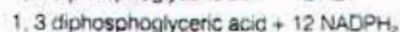
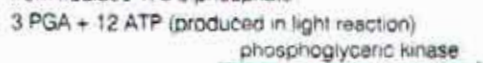


- (parasite) Few protists are mixotrophic, i.e. possess two or more type of nutrition.
30. Katherine Esau, an eminent worker in field of anatomy was borne in Ukraine in 1898.
31. When the margin of thalamus or receptacle grow upward enclosing ovary and getting fused with it. While other flower parts arise above the ovary, i.e., calyx, corolla and stamens appear to be borne on the top of ovary around the base of style, the ovary in this situation is called inferior and flower is termed as epigynous.
32. Seed is fertilised and ripened ovule, consisting a dormant embryo reserve food for its future development and protective covering. The seed which store their food in **endosperm** are called endospermic or endospermous seed or albuminous seed, e.g., castor, rubber, maize, etc. The seeds where food reserve is present in **cotyledons** are called non-endospermic or exalbuminous seeds, e.g., bean, gram, pea, *Sagittaria* and orchids (smallest seed). **Perispermic seeds** contain reserve food in **persistent nucellus**.
33. Maize seed (a endospermic monocot grain is one seeded fruit called caryopsis, because fruit wall (pericarp) is fused with testa embryo of maize seed contain single cotyledon called scutellum and embryo axis with plumule (embryonal shoot) and radicle (embryonal root). The later is adjacent to protective sheath coleorhiza.
34. The word meristem is derived from Greek word *meristos*, which literally mean divided or divisible. It is a simple plant tissue of thin walled embryonic cells, which undergo mitosis forming new cells and tissues. The term meristem was coined by Negali in 1858.
35. Stele hypothesis was given by Van Tiegham and Doulet in 1886. According to hypothesis, the primary structure of root and stem is fundamentally similar which consist cortex as a major part and stele is located in the centre the two parts are separated by endodermis, which is the innermost layer of cortex, while stele is surrounded by pericycle. A stele consists of pericycle, vascular bundle and pith in it centre.
36. During secondary growth the amount of secondary xylem produced is more than the secondary phloem because cambium is more active on inner side. Vascular cambium consists two type of cells; fusiform initial and ray initial. The later form radial system, while the fusiform cells form axial system of secondary vascular tissue, which divide by periclinal division to form component of vascular tissues.
- Now the active cambium cell toward inner side undergo multi plicative division for increasing the diameter of vascular cambium.
37. The movement of cilia and flagella is due to singlet microtubules. A cilium or flagellum possess three parts basal body, basal plate and shaft. The later is hair-like exposed part of flagellum or cilium and consist of sheath and axonemata for descriptive purpose. Axoneme again can be further distinguished into fibrils, matrix, central sheath, radial spokes and linkers. Axoneme contain 11 fibril 9 doublet on periphery and two singlet central (9+2) The two central singlet occur in central region and is covered by a sheath called central sheath.
38. On the basis of structure and reaction, amino acid can be categorised into neutral, acidic and basic amino acids sulphur containing, aromatic, alcoholic, hetero-cycle and amino acids. Neutral amino acids are non-cyclic hydrocarbon chain one amino group and one COOH—groups, i.e., monoamino and monocarboxylic amino acids, e.g. alanine, glycine isoleucine, leucine and valine.
39. Metaphase of mitosis division is best stage measuring size, counting numbers and morphology of chromosomes. Chromosomes are clearly visible during this phase. Each chromosome consists of two chromatids or chromonemata. The two chromatids are joined at one point. This point of attachment of two chromatids is known as kinetochore or centromere, which is one in each chromosome. Since, a onion contain 16 (2n) chromosome. So, the number of centromere will be 16.
40. Apoplastic path for the transport of water in root occur exclusively through intercellular spaces and cell walls. This type of transport does not involve crossing the cell membrane and in continue throughout the plant except casparian strip of endodermis in roots.
41. The source of mineral nutrient is rocks, and soil. Minerals are also added in the soil and sea water by degradation of rocks, which are deposited in from of rocks again and in sea the dissolved minerals are absorbed by zooplankton and phytoplankton whereas, plant absorb mineral along with water from soil.
42. In Hill reaction or chemical dark reaction 12 mole of 3-phosphoglyceric acid (3-phosphoglycerate) is formed by the reaction of RuBP and CO₂ in presence of water through process of carboxylation. Now during second phosphorylation two reducing power (12 ATP and 12 NADPH₂) produced in light



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reaction are used in formation of 3 phosphoglycerate from ribulose 1, 5 biphosphate



43. Population growth curve are the mathematical expression of the growth of a population, which are used to predict the growth rate of population from its beginning till its climax stage i.e., stability. These growth curve may be S-shaped or sigmoid shape or J-shaped. The later J-shaped curve is shown by small population and contain two phases e.g., lag phase and exponential phase and is represented by following exponential equation $\frac{dN}{dt} = rN$

Where, r denote intrinsic rate of natural increases and N is size of population, while dN/dt is rate of change in population size.

The integral form of the above reaction can be derived as

$$W_t = W_0 e^{rt}$$

where, W_t = population density after time t .

W_0 = population density at time 0

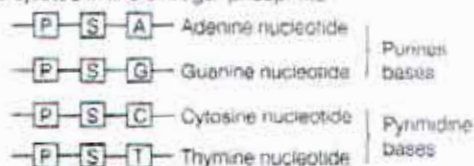
e = the base of natural logarithm

r = intrinsic rate of natural increase.

44. Cytokinins phytohormone cause cell division along with counterpart auxin. These compound were discovered by Skoog and Miller who found that kinetin promoted cell division in tissue culture when present in small amount in presence of auxins, chemically kinetin is derivative of adenine (base of purine) with furfuryl group at sixth position.
45. Vegetative propagation in *Eichhornia* (water hyacinth) takes place by offset, which develop from below a tuft or rosette of leaves, grow for sometime bear a new tuft or rosette of leaves at its tips
46. Ovule, an integumented megasporangium consists of a nucellus invested by one or two integument and funiculus (stalk). The funicle attaches the ovule to placenta, while body of the ovule fused with funicle is called as hilum.
47. Endosperm, a result of triple fusion provide nourishment to developing embryo and is stored for further development as reserve food in some seed. Those seed, which store endosperm as reserve food are called as endospermic seed or albuminous seed.

While in non-endospermic seed or exalbuminous seed endosperm is consumed by developing embryo and food is stored in cotyledons, e.g., pea, groundnut and bean, gram, etc

48. Total four colour tested by Mendel from seven contrasting trait of garden pea. Colour of unripe pod (i.e., green (dominant) yellow (recessive), colour of flower or seed coat. Coloured (dominant) like red and white (recessive).
49. DNA a large molecule, is made up of a long chain of up to two lakhs nucleotide pairs its molecular weight may be between 50,00,000 to 9,00,00,000. Each nucleotides contain a nitrogenous base (pyrimidine or purines) a pentose sugar molecule and a phosphoric acid. Purine are adenine and guanine while pyrimidine are cytosine and thymine. Each nucleotide possess only one of the four bases. These nucleotide are attached with each other in a lever arrangement fashion through their sugar and phosphate molecule is sugar and phosphate form the backbone of DNA double helix, while base are projected in line of sugar phosphate



50. RNA polymerase II occur in nucleoplasm (a part of nucleus). It is a major component of RNA polymerase activity and transcribe mRNA producing gene in eukaryotic organisms it transcribes hnRNA (an initial form of mRNA precursor) which are later on processed into mRNA, while rRNA are transcribed by RNA polymerase-I.
51. The organisms, which produce two kind of gametes are termed as heterogametic organisms. Male heterogamety is found in certain insects (*Drosophila*) and human being. Female heterogamety is has been found in butterflies moth and vertebrates like fish reptiles and birds. Male heterogamety (XX-XY type) female heterogamety (ZZ-ZW type)
52. A voluntary termination of pregnancy before the foetus became viable is termed as medical termination of pregnancy or induced abortion. MTPs are safe during the first trimester of pregnancy, i.e., up to 12 weeks of pregnancy.
53. The site on antigen that are recognised by corresponding binding site of antibodies are antigenic determinants. Antigen-antibody intermolecular force include electrostatic force of attraction, reversible H bonds, hydrophobic bonds and van der Waal force of attraction.



54. T-lymphocytes, highly specialised cells are responsible for cell-mediated immune response. These cells attack directly on pathogens at the site of infection. These cells are morphologically similar but functionally are of four types: T-helper cells, T-killer or cytotoxic cells, T-suppressor cell and T-memory cells.
55. HIV (Human Immuno Deficiency Virus) selectively target functional T-helper cells of T-lymphocytes, which stimulate antibody production by β -cells. This in turn result in lack of natural defence against viral infection.
56. Disease, which is always present at low level in a given population or geographic region is termed as Endemic disease. e.g., common cold, malarial fever, sleeping sickness. Epidemic disease are not restricted to a particular geographical region and affect a large population and occur at large level in a given population group. While pandemic is also a type of epidemic usually affecting a large population over wide geographic region like a continent or world. e.g., SARS, AIDS and Avian influenza, etc.
57. Oral contraceptive or physiological device prevent pregnancy by preventing ovulation. Oral contraceptive (birth control pills) contain synthetic formed progesterone and oestrogen and check ovulation in human female by inhibiting the secretion of follicle stimulating hormone and luteinising hormone, those are necessary for ovulation.
58. Anaphylactic shock is severe form of allergy, which is caused by an antigen of poisonous nature like insect bite, injection of penicillin to a penicillin sensitive person, or by certain allergic food. Histamine released from ruptured mast cells and basophils causes marked dilation of all arteries through out the body and blood capillaries become highly permeable causing loss of large amount of fluid from blood to the tissue which in turn cause drastic fall in blood pressure. If immediately person is not injecting epinephrine, it leads to death.
59. Endangered or threatened animal species are protected from its extinction by *in situ* and *ex situ* conservation. In *ex situ* conservation threatened species are protected in Zoological Park and Botanical Garden, which mean off site conservation providing the natural habitats to threatened species. Wild-Life Sanctuary, Biosphere Reserve and National Park are means of *in situ* conservation, i.e., on site conservation.
60. Population growth are the mathematical expression of the growth of a population, which are used to predict the growth rate of population from its beginning till its climax stage, i.e., stability. These growth curve may be S-shaped or sigmoid shape and J-shaped. The former sigmoid curve is logistic growth curve and is formed of five phase: lag phase, positive acceleration phase, logarithmic phase, negative acceleration phase, stationary phase.
61. Prosthetic group is a type of cofactor of an enzyme which is a non-protein part of holoenzyme. (APO enzyme + CO factor). Prosthetic groups are organic compound (cofactors) which are tightly permanently bound to the apoenzyme, e.g., haem, biotin, peroxidase and catalase that are involved in break down of H_2O_2 .
62. Alcohol has ill effects on all the body organs. Consumption of high doses of alcohol may leads to accumulation of acetaldehyde in liver a toxic compound, which provide energy to synthesise fats from alcohol. So, liver become store house of fats and become hard and dry and liver cells are replaced by fibrous tissues. This condition is known as liver cirrhosis. Alcohol also cause lowering of blood glucose level.
63. Polio myelitis is caused by virus (RNA virus) while other three diseases are caused by bacterian. Diphtheria are caused by *Mycobacterium tuberculosis*, *Treponema pallidum* and *Cornebacterium diphtheria*.
64. Males of draught breed are beast of burden that help in different ways like work in mountainous region (mule) pulling carts, ploughing and transporting. Halikar Nageri and Malvi are such draught breed Halikar, a breed of cattle is found particularly in Karnataka.
65. Inspiratory Reserve Volume + Tidal Volume + expiratory reserve volume will be the same as inspiratory capacity + residual volume as
 $IRV + TV + ERV = \text{Inspiratory Capacity (IC)} + RV$
Tidal volume is approximately 500 mL in a healthy person. Inspiratory reserve volume averages 2500-3000 mL, inspiratory reserve volume averages 1000 mL to 1100 mL, Residual volume is 1100 mL to 1200 mL.
Inspiratory reserve capacity of a person is the total volume of a person can inspire after a normal inspiration and is equal to Tidal Volume (TV) and expiratory reserve volume.
So, $IRV (3000) + TV (500) + 1100 TV + IRV (IC) + RV$
 $4600 = 500 + 3000 + 1100 = 4600$
LHS = RHS



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66. Bile secreted by liver cells, is one of the digestive juice that probably contains no enzyme yet it play an important role in digestion and absorption of fat. This important juice is stored in the gall bladder, which release it small intestine for digestion absorption fat. So, after surged removal of an infected gall bladder, a person must be special careful to restrict dietary intake of fats is she/he should avoid fat diet.
67. Jelly fish (*Aurelia*) is coelenterates. It belongs to class—Scyphozoa of phylum—Coelenterata or Cnidaria. The organism (jelly fish) lack alimentary canals. Gastro-vascular cavity is without stomodeum but endodermal gastric tentacles are present.
68. Most of our cells are surrounded by interstitial fluid. Electron microscopy reveal that a eukaryotic animal cell (animal cell) consists two envelopes system of organisation cytoskeletal structure and membrane bound cell organelles. Animal cells are bathed in a tissue fluid, which is absent in others.
69. In his laboratory experiment, in 1953 Stanley Miller, an American Scientist, created similar condition in laboratory scale. He created electric discharge in a closed flask containing CH_4 , NH_3 and hydrogen and water vapours at 800°C and observed formation of amino acids sugar, nitrogen bases, etc. Methane ammonia and H_2 were taken in 2 : 2 : 1 ratio.
70. Primitive atmosphere was probably non-oxygenic i.e., the earth originally had a strongly reducing atmosphere, which consists of molecular hydrogen (H_2), hydrogen compound of other elements like H_2O vaporous ammonia and methane.
71. Pulse is a direct measure of heart rate. Heart beat consist of systole and diastole, which are 120 mmHg and 80 mmHg is systolic pressure and diastolic pressure.
72. Aschelminthes are pseudocoelomates i.e., false coelom occur between the body wall and digestive region, which is derived from blastocoel and is not lined by peritonium. This false coelom contain pseudomative fluid (hydrolymph).
73. In cockroach the flow of haemolymph is heart → head haemocoel → perivisceral sinus → pericardial sinus → ostia → heart.
Heart in cockroach is neurogenic. Haemocoel (body cavity) is perivisceral cavity filled with colour less blood (haemolymph). When alary muscle contract the dorsal diaphragm became flat and pericardial increases. Blood from perivisceral sinus enter into pericardial sinus through pore of dorsal diaphragm become dome-shaped and blood from pericardial sinus is forced into the heart through valvular ostia then the heart and aorta contract peristaltically. Blood flow from posterior end to anterior end in heart and flow into head sinus through aorta.
74. *Ornithorynchus* (duckbill platypus) is oviparous mammal with a cloaca. *Platypus* and *Echidna* belong to class—Prototheria. *Balaenoptera* is zoological name of blue whale. *Delphinus* is to dolphin and *Pteropus* is flying fox (bat). All of three are viviparous.
75. Metanephros is the functional kidney in mammal birds and reptiles. Metanephros develops from posterior part of mesomere. It is also known as posterior kidney. Archinephros type of kidney is present in larval of hagfish caeullians. Ophisthonephros type (mesonephros) is found in fish and amphibians while pronephros occur only in embryo or larval stage, but modified pronephros (head kidney) is found in adult hagfish and several bony fishes.
76. Torsion is a characteristic of class—Gastropoda of phylum—Mollusca. The body of gastropods is asymmetrical due to torsion.
77. Stratosphere extend between altitude of 16-50 km of atmosphere. Temperature increases with height in this layer of atmosphere. Troposphere (extend up to 16 km from earth surface). In this layer temperature decrease with increase in high. Mesosphere extend between altitude of 50-90 km, in this layer of atmosphere temperature decrease with heights.
78. In tropical region (latitudinal range of 23.5°N to 23.5°S) Species diversity is maximum than temperate region. This richness of species is due to higher rain fall (precipitation) throughout the year which in turn result into higher relative humidity, both condition allow to flourish fauna and flora, i.e., abundant evergreen forest with lower group plant like algae and bryophytes.
79. In a pollutant environment conc. of maximum pollutants will be higher in top consumers, i.e., tertiary consumer harmful pollutant from producer to consumer reach through food chain and at each successive level conc. of pollutant is increased. This accumulation of pollutant is known as biomagnification.
80. Gir Lion Sanctuary was established in 1965 in Gujarat, which cover an area of 1452 square km. The Gir Lion Sanctuary Project was started in 1972. It is running by state and central government.
81. There are about 100 vestigial organs in human being like rudimentary ear muscles (much developed in have elephant and cow) third molar, coccyx



(4-5 coccygeal vertebrae) scalp muscle, vermiform appendix, nictitating membrane, ear pinna muscle is vestigial but ear functional bone in man, olecranon process is related to nervous system.

- 82.** Lichens are considered as best indicators of industrial pollution, which are grown as pollution indicators as they are very sensitive to SO_2 . Some lichens like *Parmelia*, *Usnea* and *Cladonia* as completely destroyed by SO_2 . A rich growth of lichen indicates fresh atmospheric garden pea is another SO_2 pollution indicator.
- 83.** Homologous organ are those organs, which look different and perform different function but have similar origin design and basic structure. e.g., vertebrae of forelimbs (wings of pigeon and foreleg of horse wing of butterfly and wings of pigeon are analogous as they possess different origin but perform same function.
- 84.** Haemophilia-A (absence of antihemophilic globulin and haemophilic- β (due to absence of plasma thromboplastin) is autosomal X-linked recessive trait (genetic disorder) with locus in X_{q28} and related with factor VIII. Some other autosomal recessive traits are albinism, alkaptonuria and sickle-cell anaemia, etc.
- 85.** Genotype Hb^A/Hb^A is normal haemoglobin is no sickling. Hb^S/Hb^S genotype means haemoglobin is only sickling under normal oxygen tension in sickle cell anaemia glutamic acid at 6th position is replaced by valine amino acid. In this disease RBCs show a marked change in their structure attaining a sickle shaped structure.
- 86.** Inhibition of ovulation is caused by progestogen (a combination of progestogen and oestrogen) is oral pills. White progesterone, a steroid is secreted by corpus luteum. It is released under influence of LH of anterior pituitary gland in second half of menstrual cycle. The hormone cause routine temporary change in endometrial lining of uterus and help in ovulation. During pregnancy, it help in implantation of embryo, development of placenta, maintenance of pregnancy and growth of secretory alveoli in mammary glands.
- 87.** 'YAC' refer to yeast artificial colony.
- 88.** Starch is a homopolysaccharides, which is a polymer of α -glucose. It is made up of two component amylose and amylopectin. Amylose is a linear structure consisting of several glucose residues joined only by α , 1-4 glycosidic bonds (contain 200-1000 residues) while amylopectin is straight outer chain with short chain of glucose unit (25-35) linked by α -1,4 glycosidic linkages.
- 89.** Polysaccharides are complex long chains (more than 10) of monosaccharides. The individual subunits of polysaccharides are linked by glycosidic linkages (bonds).
- 90.** Sucrose, the common table sugar or cane sugar is made up of glucose and fructose. Its molecular formula is $\text{C}_{12}\text{H}_{22}\text{O}_{11}$. On hydrolysis sucrose give rise one molecule of glucose and one molecule of fructose.
- $$\text{C}_{12}\text{H}_{22}\text{O}_{11} + \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{C}_6\text{H}_{12}\text{O}_6$$
- Glucose + Fructose
- 91.** Ontogenetically liver and pancreas are endodermal. Some other derivative of endoderm germ layer are, parathyroid, thyroid, gastric and intestinal glands, trachea, bronch and lungs, etc.
- 92.** Transmission of nerve impulses from one neuron to another and at neuromuscular junction is required by an organic compound acetylcholine and Ca^{2+} respectively. Most synapses across these is by means of some chemical mediator. As action potential of depolarisation reaches the presynaptic membrane its voltage gated Ca^{2+} channels open. Ca^{2+} is some 10,000 times more concentrated in synaptic fluid. It therefore, reaches into presynaptic knob. Ca^{2+} induce the synaptic vesicle to reach the presynaptic membrane fuse with it and release the neurotransmitter into synaptic cleft through exocytosis.
- 93.** Kwashiorkor is a protein deficiency disease. Osteomalacia is caused by deficiency of calcium, phosphorus or vitamin-D. It is characterised by spongy bones. Pellagra is caused by vitamin-B₃ (Niacin or nicotinic acid). Rickets is caused by vitamin-D deficiency in children.
- 94.** Lymphocytes are four kinds of agranulocytes of leucocytes of blood. These are the main cells of immune system these are formed by thymus and liver in foetus and by bone marrow and lymph node in adult. After originations they circulate in stream of blood for 1-2 days, migrating to connective tissue, and then form macrophage. These are of two types, i.e., β -lymphocytes and T-lymphocytes. About 75% of circulating lymphocytes are T-lymphocytes.
- 95.** Urea is excretory product of semiterrestrial animal e.g., amphibian and mammals. The excretory product is eliminated by glomerular filtration and tubular secretion, while tubular absorption is associated with absorption of water, glucose, vitamin, amino acids and ions.



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- 96.** The organ of Corti is a receptor organ for hearing. It is part of internal ear, which consists of otolith organ, semicircular canals and cochlear duct.
- The wall of cochlear duct is fused with cochlear bone on the side to form 3 chambers: *scala vestibuli*, *scala media* and *scala tympani*. The floor of *scala media* is called basilar membrane, whereas its ceiling (roof) is Reasner's membrane. The organ of Corti is situated on the basilar membrane in the median canal.
- 97.** On the basis of type of stimulus receptors are mechanoreceptors, chemoreceptors, Thermoreceptors, photoreceptors and electroreceptors. pressure receptor is a type of mechanoreceptor, which is sensitive to deep pressure, e.g., pacinian corpuscles respond to pressure.
- Meissnar corpuscles (dermis) is associated with tangoreceptor (a type of mechanoreceptor). Thermoreceptors (sensitive to change in temperature) are of two types, *caloreceptors*, i.e., organ of Ruffini and *frigidoreceptors* (sensitive to cold) i.e., Bulb of Krause.
- 98.** Between breathing (inspiration and expiration) the intrapleural pressure (pressure inside thin double membrane lung) is approximately 1 mmHg less than atmospheric pressure. In normal respiration, the simultaneous relaxation of inspiratory muscle reduce the volume of thoracic cavity in all direction. As a result the atmospheric pressure inside the lung increase by 3-4 mmHg in normal expiration and 4-6 mmHg in a forced expiration.
- 99.** Nephron is the structural and functional unit of kidney. It is made up of glomerulus and renal tubule. A branch of renal artery from dorsal aorta called afferent arterioles enter into Bowman's capsule and divide into blood capillaries, forming a network called glomerulus. From glomerulus network of efferent arterioles (narrow than afferent arteriole) further form numerous peritubular capillaries in the cortex region, which surrounds the PCT and DCT of nephrons.
- 100.** GnRH (Gonadotropin Releasing Hormone) is secreted by hypothalamus. The hormone GnRH stimulate master gland pituitary to release follicle stimulating hormone and luteinizing hormone. The two hormones responsible for formation of ovulation are released by anterior lobe of pituitary.