disha
Publication Inc

NEET 2017 Solved Paper

This Section is taken from the Book:

ISBN : 9789390511938

This book is available at all leading physical book stores and online book stores

To view complete books visit.

To download complete catalogue click **https://amzn.to/2GXTMyA** or visit **QR.**

NEET - 2017
Solved Paper

Time : 3 hours **MM : 720**

PHYSICS

1. A physical quantity of the dimensions of length that can be formed out of c, G and $\frac{e^2}{4\pi\varepsilon_0}$ is [c is velocity of light, G is universal constant of gravitation and e is charge]

(a) $c^2\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{1/2}$ (b) $\frac{1}{c^2}\left[\frac{e^2}{G4\pi\varepsilon_0}\right]^{1/2}$

(c) $\frac{1}{c}G\frac{e^2}{4\pi\varepsilon_0}$ (d) $\frac{1}{c^2}\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{1/2}$

2. Preeti reached the metro station and found that the escalator was not working. She walked up the stationary escalator in time t_1. On other days, if she remains stationary on the moving escalator, then the escalator takes her up in time t_2. The time taken by her to walk up on the moving escalator will be:

(a) $\frac{t_1t_2}{t_2-t_1}$ (b) $\frac{t_1t_2}{t_2+t_1}$

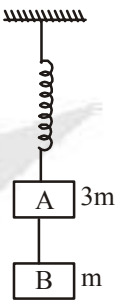
(c) t_1-t_2 (d) $\frac{t_1+t_2}{2}$

3. The x and y coordinates of the particle at any time are $x = 5t - 2t^2$ and $y = 10t$ respectively, where x and **y** are in meters and t in seconds. The acceleration of the particle at $t = 2$s is

(a) 5 m/s^2 (b) –4 m/s^2

(c) –8 m/s^2 (d) 0

4. Two blocks A and B of masses 3 m and m respectively are connected by a massless and inextensible string. The whole system is suspended by a massless spring as shown in figure. The magnitudes of acceleration of A and B immediately after the string is cut, are respectively :



(a) $\frac{g}{3}$, g (b) g, g

(c) $\frac{g}{3}, \frac{g}{3}$ (d) g, $\frac{g}{3}$

5. One end of string of length l is connected to a particle of mass 'm' and the other end is connected to a small peg on a smooth horizontal table. If the particle moves in circle with speed 'v' the net force on the particle (directed towards centre) will be (T represents the tension in the string) :

(a) T $\frac{mv^2}{l}$ (b) T – $\frac{mv^2}{l}$

(c) Zero (d) T

6. Consider a drop of rain water having mass 1 g falling from a height of 1 km. It hits the ground with a speed of 50 m/s. Take 'g' constant with a value 10 m/s^2. The work done by the (i) gravitational force and the (ii) resistive force of air is

(a) (i) 1.25 J (ii) –8.25 J

(b) (i) 100 J (ii) 8.75 J

(c) (i) 10 J (ii) – 8.75 J

(d) (i) – 10 J (ii) –8.25 J

7. Which of the following statements are **correct**?
   (A) Centre of mass of a body always coincides with the centre of gravity of the body
   (B) Centre of mass of a body is the point at which the total gravitational torque on the body is zero
   (C) A couple on a body produce both translational and rotation motion in a body
   (D) Mechanical advantage greater than one means that small effort can be used to lift a large load
   (a) (A) and (B) (b) (B) and (C)
   (c) (C) and (D) (d) (B) and (D)

8. A rope is wound around a hollow cylinder of mass 3 kg and radius 40 cm. What is the angular acceleration of the cylinder if the rope is pulled with a force of 30 N?
   (a) 0.25 rad/s^2 (b) 25 rad/s^2
   (c) 5 m/s^2 (d) 25 m/s^2

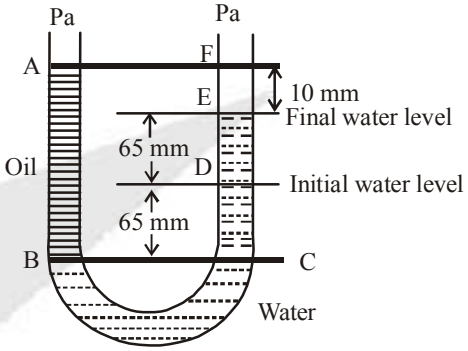
9. Two discs of same moment of inertia rotating about their regular axis passing through centre and perpendicular to the plane of disc with angular velocities ω_1 and ω_2. They are brought into contact face to face coinciding the axis of rotation. The expression for loss of energy during this process is:-
   (a) $\frac{1}{4}I(\omega_1-\omega_2)^2$ (b) $I(\omega_1-\omega_2)^2$
   (c) $\frac{1}{8}(\omega_1-\omega_2)^2$ (d) $\frac{1}{2}I(\omega_1+\omega_2)^2$

10. Two astronauts are floating in gravitation free space after having lost contact with their spaceship. The two will
   (a) move towards each other.
   (b) move away from each other.
   (c) become stationary
   (d) keep floating at the same distance between them.

11. The acceleration due to gravity at a height 1 km above the earth is the same as at a depth *d* below the surface of earth. Then
   (a) $d = 1$ km (b) $d = \frac{3}{2}$ km
   (c) $d = 2$ km (d) $d = \frac{1}{2}$ km

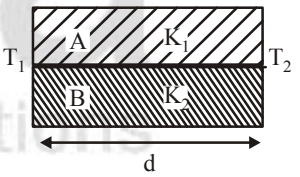
12. The bulk modulus of a spherical object is 'B'. If it is subjected to uniform pressure 'p', the fractional decrease in radius is
   (a) $\frac{B}{3p}$ (b) $\frac{3p}{B}$
   (c) $\frac{p}{3B}$ (d) $\frac{p}{B}$

13. A U tube with both ends open to the atmosphere, is partially filled with water. Oil, which is immiscible with water, is poured into one side until it stands at a distance of 10 mm above the water level on the other side. Meanwhile the water rises by 65 mm from its original level (see diagram). The density of the oil is



   (a) 425 kg m^{-3} (b) 800 kg m^{-3}
   (c) 928 kg m^{-3} (d) 650 kg m^{-3}

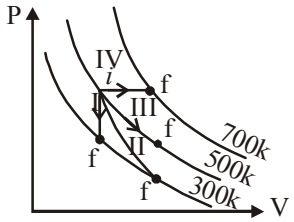
14. Two rods A and B of different materials are welded together as shown in figure. Their thermal conductivities are K_1 and K_2. The thermal conductivity of the composite rod will be :



   (a) $\frac{3(K_1+K_2)}{2}$ (b) K_1+K_2
   (c) $2(K_1+K_2)$ (d) $\frac{K_1+K_2}{2}$

15. A spherical black body with a radius of 12 cm radiates 450 watt power at 500 K. If the radius were halved and the temperature doubled, the power radiated in watt would be :
   (a) 450 (b) 1000
   (c) 1800 (d) 225

16. Thermodynamic processes are indicated in the following diagram :



Match the following

	Column-1		Column-2
P.	Process I	A.	Adiabatic
Q.	Process II	B.	Isobaric
R.	Process III	C.	Isochoric
S.	Process IV	D.	Isothermal

(a) P → C, Q → A, R → D, S → B
(b) P → C, Q → D, R → B, S → A
(c) P → D, Q → B, R → A, S → C
(d) P → A, Q → C, R → D, S → B

17. A carnot engine having an efficiency of $\frac{1}{10}$ as heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is :

(a) 90 J (b) 99 J
(c) 100 J (d) 1 J

18. A gas mixture consists of 2 moles of O_2 and 4 moles of Ar at temperature T. Neglecting all vibrational modes, the total internal energy of the system is :-

(a) 15 RT (b) 9 RT
(c) 11 RT (d) 4 RT

19. A particle executes linear simple harmonic motion with an amplitude of 3 cm. When the particle is at 2 cm from the mean position, the magnitude of its velocity is equal to that of its acceleration. Then its time period in seconds is

(a) $\frac{\sqrt{5}}{2\pi}$ (b) $\frac{4\pi}{\sqrt{5}}$
(c) $\frac{2\pi}{\sqrt{3}}$ (d) $\frac{\sqrt{5}}{\pi}$

20. A spring of force constant k is cut into lengths of ratio 1 : 2 : 3. They are connected in series and the new force constant is k'. Then they are connected in parallel and force constant is k'' . Then k' : k'' is

(a) 1 : 9 (b) 1 : 11
(c) 1 : 14 (d) 1 : 6

21. The two nearest harmonics of a tube closed at one end and open at other end are 220 Hz and 260 Hz. What is the fundamental frequency of the system?

(a) 20 Hz (b) 30 Hz
(c) 40 Hz (d) 10 Hz

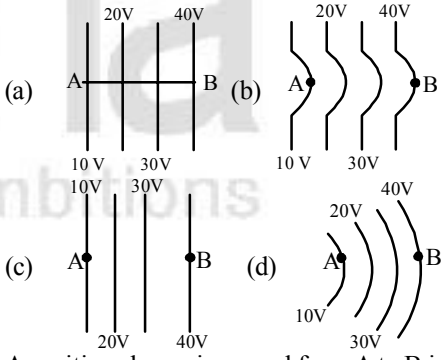
22. Two cars moving in opposite directions approach each other with speed of 22 m/s and 16.5 m/s respectively. The driver of the first car blows a horn having a frequency 400 Hz. The frequency heard by the driver of the second car is [velocity of sound 340 m/s] :

(a) 361 Hz (b) 411 Hz
(c) 448 Hz (d) 350 Hz

23. Suppose the charge of a proton and an electron differ slightly. One of them is – e, the other is (e + Δe). If the net of electrostatic force and gravitational force between two hydrogen atoms placed at a distance d (much greater than atomic size) apart is zero, then Δe is of the order of [Given mass of hydrogen $m_h = 1.67 \times 10^{-27}$ kg]

(a) 10^{-23}C (b) 10^{-37} C
(c) 10^{-47} C (d) 10^{-20} C

24. The diagrams below show regions of equipotentials.



A positive charge is moved from A to B in each diagram.

(a) In all the four cases the work done is the same
(b) Minimum work is required to move q in figure (a)
(c) Maximum work is required to move q in figure (b)
(d) Maximum work is required to move q in figure (c)

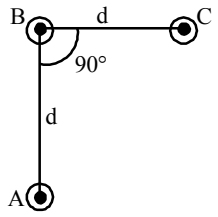
25. A capacitor is charged by a battery. The battery is removed and another identical uncharged capacitor is connected in parallel. The total electrostatic energy of resulting system :
(a) decreases by a factor of 2
(b) remains the same
(c) increases by a factor of 2
(d) increases by a factor of 4

26. The resistance of a wire is 'R' ohm. If it is melted and stretched to 'n' times its original length, its new resistance will be :-
(a) $\frac{R}{n}$ (b) n^2R
(c) $\frac{R}{n^2}$ (d) nR

27. A potentiometer is an accurate and versatile device to make electrical measurements of E.M.F. because the method involves
(a) Potential gradients
(b) A condition of no current flow through the galvanometer
(c) A combination of cells, galvanometer and resistances
(d) Cells

28. A 250-turn rectangular coil of length 2.1 cm and width 1.25 cm carries a current of 85 μA and subjected to magnetic field of strength 0.85 T. Work done for rotating the coil by 180° against the torque is
(a) 4.55 μJ (b) 2.3 μJ
(c) 1.15 μJ (d) 9.1 μJ

29. An arrangement of three parallel straight wires placed perpendicular to plane of paper carrying same current 'I along the same direction is shown in fig. Magnitude of force per unit length on the middle wire 'B' is given by

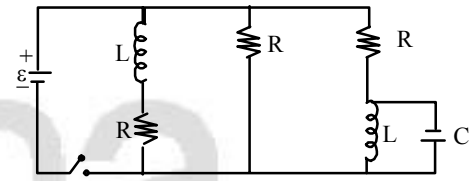


(a) $\frac{2\mu_0 i^2}{\pi d}$ (b) $\frac{\sqrt{2}\mu_0 i^2}{\pi d}$
(c) $\frac{\mu_0 i^2}{\sqrt{2}\pi d}$ (d) $\frac{\mu_0 i^2}{2\pi d}$

30. If θ_1 and θ_2 be the apparent angles of dip observed in two vertical planes at right angles to each other, then the true angle of dip θ is given by :-
(a) $\tan^2\theta = \tan^2\theta_1 + \tan^2\theta_2$
(b) $\cot^2\theta = \cot^2\theta_1 - \cot^2\theta_2$
(c) $\tan^2\theta = \tan^2\theta_1 - \tan^2\theta_2$
(d) $\cot^2\theta = \cot^2\theta_1 + \cot^2\theta_2$

31. A long solenoid of diameter 0.1 m has 2×10^4 turns per meter. At the centre of the solenoid, a coil of 100 turns and radius 0.01 m is placed with its axis coinciding with the solenoid axis. The current in the solenoid reduces at a constant rate to 0A from 4 A in 0.05 s. If the resistance of the coil is $10\pi^2\Omega$. the total charge flowing through the coil during this time is :-
(a) 16 μC (b) 32 μC
(c) 16 π μC (d) 32 π μC

32. Figure shows a circuit that contains three identical resistors with resistance R = 9.0 Ω each, two identical inductors with inductance L = 2.0 mH each, and an ideal battery with emf ε = 18 V. The current 'i' through the battery just after the switch closed is



(a) 0.2 A (b) 2 A
(c) 0 (d) 2 mA

33. In an electromagnetic wave in free space the root mean square value of the electric field is E_{rms} = 6V/m. The peak value of the magnetic field is :-
(a) 2.83×10^{-8} T (b) 0.70×10^{-8} T
(c) 4.23×10^{-8} T (d) 1.41×10^{-8} T

34. A beam of light from a source L is incident normally on a plane mirror fixed at a certain distance x from the source. The beam is reflected back as a spot on a scale placed just above the source I. When the mirror is rotated through a small angle θ, the spot of the light is found to move through a distance y on the scale. The angle θ is given by
(a) $\frac{y}{x}$ (b) $\frac{x}{2y}$
(c) $\frac{x}{y}$ (d) $\frac{y}{2x}$

35. A thin prism having refracting angle 10° is made of glass of refractive index 1.42. This prism is combined with another thin prism of glass of refractive index 1.7. This combination produces dispersion without deviation. The refracting angle of second prism should be

(a) 6° (b) 8°

(c) 10° (d) 4°

36. Young's double slit experment is first performed in air and then in a medium other than air. It is found that 8th bright fringe in the medium lies where 5th dark fringe lies in air. The refractive index of the medium is nearly

(a) 1.59 (b) 1.69

(c) 1.78 (d) 1.25

37. Two Polaroids P_1 and P_2 are placed with their axis perpendicular to each other. Unpolarised light I_0 is incident on P_1. A third polaroid P_3 is kept in between P_1 and P_2 such that its axis makes an angle 45° with that of P_1 . The intensity of transmitted light through P_2 is

(a) $\frac{I_0}{4}$ (b) $\frac{I_0}{8}$

(c) $\frac{I_0}{16}$ (d) $\frac{I_0}{2}$

38. The ratio of resolving powers of an optical microscope for two wavelengths λ_1 = 4000 Å and λ_2 = 6000 Å is

(a) 9 : 4 (b) 3 : 2

(c) 16 : 81 (d) 8 : 27

39. The de-Broglie wavelength of a neutron in thermal equilibrium with heavy water at a temperature T (Kelvin) and mass m, is :-

(a) $\frac{h}{\sqrt{3mkT}}$ (b) $\frac{2h}{\sqrt{3mkT}}$

(c) $\frac{2h}{\sqrt{mkT}}$ (d) $\frac{h}{\sqrt{mkT}}$

40. The photoelectric threshold wavelength of silver is 3250×10^{-10}m. The velocity of the electron ejected from a silver surface by ultraviolet light of wavelength 2536×10^{-10} m is

(Given h = 4.14×10^{-15} eVs and c = 3×10^8 ms^{-1})

(a) $\approx 0.6 \times 10^6$ ms^{-1}

(b) $\approx 61 \times 10^3$ ms^{-1}

(c) $\approx 0.3 \times 10^6$ ms^{-1}

(d) $\approx 6 \times 10^5$ ms^{-1}

41. The ratio of wavelengths of the last line of Balmer series and the last line of Lyman series is :-

(a) 1 (b) 4

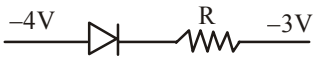
(c) 0.5 (d) 2

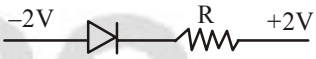
42. Radioactive material 'A' has decay constant '8 λ' and material 'B' has decay constant 'λ'. Initially they have same number of nuclei. After what time, the ratio of number of nuclei of material 'B' to that 'A' will be $\frac{1}{e}$?

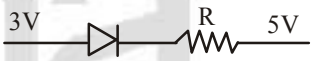
(a) $\frac{1}{7\lambda}$ (b) $\frac{1}{8\lambda}$

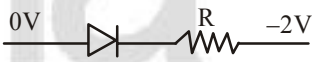
(c) $\frac{1}{9\lambda}$ (d) $\frac{1}{\lambda}$

43. Which one of the following represents forward bias diode ?

(a) 

(b) 

(c) 

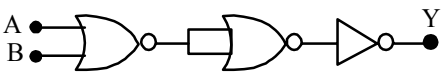
(d) 

44. In a common emitter transistor amplifier the audio signal voltage across the collector is 3V. The resistance of collector is 3 kΩ. If current gain is 100 and the base resistance is 2 kΩ, the voltage and power gain of the amplifier is

(a) 15 and 200 (b) 150 and 15000

(c) 20 and 2000 (d) 200 and 1000

45. The given electrical network is equivalent to :



(a) OR gate (b) NOR gate

(c) NOT gate (d) AND gate

46. Which one is the wrong statement ?
(a) The uncertainty principle is $\Delta E \times \Delta t \geq h/4\pi$
(b) Half filled and fully filled orbitals have greater stability due to greater exchange energy, greater symmetry and more balanced arrangement.
(c) The energy of 2*s* orbital is less than the energy of 2*p* orbital in case of Hydrogen like atoms
(d) de-Broglie's wavelength is given by $\lambda \quad \frac{h}{m\nu}$, where m = mass of the particle, ν = group velocity of the particle

47. The element $Z = 114$ has been discovered recently. It will belong to which of the following family/ group and electronic configuration ?
(a) Carbon family, [Rn] $5f^{14}\,6d^{10}\,7s^2\,7p^2$
(b) Oxygen family, [Rn] $5f^{14}\,6d^{10}\,7s^2\,7p^4$
(c) Nitrogen family, [Rn] $5f^{14}\,6d^{10}\,7s^2\,7p^6$
(d) Halogen family, [Rn] $5f^{14}\,6d^{10}\,7s^2\,7p^5$

48. Which of the following pairs of compounds is isoelectronic and isostructural ?
(a) TeI_2, XeF_2 (b) IBr_2^-, XeF_2
(c) IF_3, XeF_2 (d) $BeCl_2, XeF_2$

49. The species, having bond angles of 120° is :-
(a) ClF_3 (b) NCl_3 (c) BCl_3 (d) PH_3

50. Which of the following pairs of species have the same bond order ?
(a) O_2, NO^+ (b) CN^-, CO
(c) N_2, O_2^- (d) CO, NO

51. A gas is allowed to expand in a well insulated container against a constant external pressure of 2.5 atm from an initial volume of 2.50 L to a final volume of 4.50 L. The change in internal energy ΔU of the gas in joules will be:-
(a) – 500 J (b) – 505 J
(c) + 505 J (d) 1136.25 J

52. For a given reaction, $\Delta H = 35.5$ kJ mol^{-1} and $\Delta S = 83.6$ JK^{-1} mol^{-1}. The reaction is spontaneous at: (Assume that ΔH and ΔS do not vary with temperature)
(a) $T > 425$ K (b) All temperatures
(c) $T > 298$ K (d) $T < 425$ K

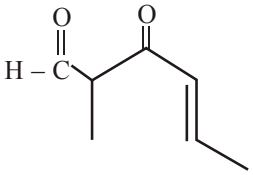
53. The equilibrium constant of the following are :
$N_2 + 3H_2 \rightleftharpoons 2NH_3 \quad K_1$
$N_2 + O_2 \rightleftharpoons 2NO \quad K_2$
$H_2 + \frac{1}{2}O_2 \rightarrow H_2O \quad K_3$
The equilibrium constant (K) of the reaction :
$2NH_3 + \frac{5}{2}O_2 \overset{K}{\rightleftharpoons} 2NO + 3H_2O$, will be;
(a) $K_2K_3^3/K_1$ (b) K_2K_3/K_1
(c) $K_2^3K_3/K_1$ (d) $K_1K_3^3/K_2$

54. A 20 litre container at 400 K contains CO_2(g) at pressure 0.4 atm and an excess of SrO (neglect the volume of solid SrO). The volume of the container is now decreased by moving the movable piston fitted in the container. The maximum volume of the container, when pressure of CO_2 attains its maximum value, will be :
(Given that : $SrCO_3(s) \rightleftharpoons SrO(s) + CO_2(g)$, $Kp = 1.6$ atm)
(a) 10 litre (b) 4 litre
(c) 2 litre (d) 5 litre

55. Concentration of the Ag^+ ions in a saturated solution of $Ag_2C_2O_4$ is 2.2×10^{-4} mol L^{-1}. Solubility product of $Ag_2C_2O_4$ is :-
(a) 2.66×10^{-12} (b) 4.5×10^{-11}
(c) 5.3×10^{-12} (d) 2.42×10^{-8}

56. It is because of inability of ns^2 electrons of the valence shell to participate in bonding that:-
(a) Sn^{2+} is oxidising while Pb^{4+} is reducing
(b) Sn^{2+} and Pb^{2+} are both oxidising and reducing
(c) Sn^{4+} is reducing while Pb^{4+} is oxidising
(d) Sn^{2+} is reducing while Pb^{4+} is oxidising

57. The IUPAC name of the compound is :



(a) 5-formylhex-2-en-3-one
(b) 5-methyl-4-oxohex-2-en-5-al
(c) 3-keto-2-methylhex-5-enal
(d) 3-keto-2-methylhex-4-enal

58. The most suitable method of separation of 1 : 1 mixture of ortho and para-nitrophenols is :
(a) Chromatography (b) Crystallisation
(c) Steam distillation (d) Sublimation

59. The correct statement regarding electrophile is:-
(a) Electrophile is a negatively charged species and can form a bond by accepting a pair of electrons from another electrophile
(b) Electrophiles are generally neutral species and can form a bond by accepting a pair of electrons from a nucleophile
(c) Electrophile can be either neutral or positively charged species and can form a bond by accepting a pair of electrons from a nucleophile
(d) Electrophile is a negatively charged species and can form a bond by accepting a pair of electrons from a nucleophile

60. With respect to the conformers of ethane, which of the following statements is true ?
(a) Bond angle changes but bond length remains same
(b) Both bond angle and bond length change
(c) Both bond angles and bond length remains same
(d) Bond angle remains same but bond length changes

61. Which one is the correct order of acidity ?
(a) $CH \equiv CH > CH_3 - C \equiv CH > CH_2 = CH_2 > CH_3 - CH_3$
(b) $CH \equiv CH > CH_2 = CH_2 > CH_3 - C \equiv CH > CH_3 - CH_3$
(c) $CH_3 - CH_3 > CH_2 = CH_2 > CH_3 - C \equiv CH > CH \equiv CH$
(d) $CH_2 = CH_2 > CH_3 - CH = CH_2 > CH_3 - C \equiv CH > CH \equiv CH$

62. Predict the correct intermediate and product in the following reaction :

$$H_3C - C \equiv CH \xrightarrow[HgSO_4]{H_2O,\ H_2SO_4} \underset{(A)}{\text{Intermediate}} \rightarrow \underset{(B)}{\text{product}}$$

(a) A : $H_3C - \underset{\underset{OH}{|}}{C} = CH$, B : $H_3C - \underset{\underset{SO_4}{|}}{C} = CH_2$

(b) A : $H_3C - \underset{\underset{O}{||}}{C} = CH_3$, B : $H_3C - C \equiv CH$

(c) A : $H_3C - \underset{\underset{OH}{|}}{C} = CH_2$, B : $H_3C - \underset{\underset{O}{||}}{C} = CH_3$

(d) A : $H_3C - \underset{\underset{SO_4}{|}}{C} = CH_2$, B : $H_3C - \underset{\underset{O}{||}}{C} - CH_3$

63. Which of the following is a sink for CO?
(a) Microorganism present in the soil
(b) Oceans
(c) Plants
(d) Haemoglobin

64. If molality of the dilute solutions is doubled, the value of molal depression constant (K_f) will be:-
(a) halved (b) tripled
(c) unchanged (d) doubled

65. Which of the following is dependent on temperature?
(a) Molarity
(b) Mole fraction
(c) Weight percentage
(d) Molality

66. Ionic mobility of which of the following alkali metal ions is lowest when aqueous solution of their salts are put under an electric field ?
(a) K (b) Rb (c) Li (d) Na

67. In the electrochemical cell :-
$Zn\,|\,ZnSO_4(0.01M)\,||\,CuSO_4(1.0\,M)\,|\,Cu$, the emf of this Daniel cell is E_1. When the concentration of $ZnSO_4$ is changed to 1.0M and that of $CuSO_4$ changed to 0.01M, the emf changes to E_2. From the followings, which one is the relationship between E_1 and E_2? (Given, $\frac{RT}{F} = 0.059$)
(a) $E_1 < E_2$ (b) $E_1 > E_2$
(c) $E_2 = 0 \neq E_1$ (d) $E_1 = E_2$

68. Mechanism of a hypothetical reaction $X_2 + Y_2 \rightarrow 2XY$ is given below :
(i) $X_2 \rightarrow X + X$ (fast)
(ii) $X + Y_2 \rightleftharpoons XY + Y$ (slow)
(iii) $X + Y \rightarrow XY$ (fast)
The overall order of the reaction will be :
(a) 2 (b) 0 (c) 1.5 (d) 1

69. A first order reaction has a specific reaction rate of $10^{-2}\,s^{-1}$. How much time will it take for 20 g of the reactant to reduce to 5 g ?
(a) 138.6 sec (b) 346.5 sec
(c) 693.0 sec (d) 238.6 sec

70. Which one of the following statements is not correct?
(a) The value of equilibrium constant is changed in the presence of a catalyst in the reaction at equilibrium
(b) Enzymes catalyse mainly bio-chemical reactions
(c) Coenzymes increase the catalytic activity of enzyme
(d) Catalyst does not initiate any reaction

71. Extraction of gold and silver involves leaching with CN^- ion. Silver is later recovered by
(a) distillation
(b) zone refining
(c) displacement with Zn
(d) liquation

72. In which pair of ions both the species contain S – S bond?
(a) $S_4O_6^{2-}, S_2O_3^{2-}$ (b) $S_2O_7^{2-}, S_2O_8^{2-}$
(c) $S_4O_6^{2-}, S_2O_7^{2-}$ (d) $S_2O_7^{2-}, S_2O_3^{2-}$

73. Match the interhalogen compounds of column-I with the geometry in column II and assign the correct code.

	Column-I		**Column-II**
1.	XX'	(i)	T-shape
2.	XX'_3	(ii)	Pentagonal bipyramidal
3.	XX'_5	(iii)	Linear
4.	XX'_7	(iv)	Square-pyramidal
		(v)	Tetrahedral

Code :

	1	2	3	4
(a)	(iii)	(i)	(iv)	(ii)
(b)	(v)	(iv)	(iii)	(ii)
(c)	(iv)	(iii)	(ii)	(i)
(d)	(iii)	(iv)	(i)	(ii)

74. Name the gas that can readily decolourise acidified $KMnO_4$ solution :
(a) SO_2 (b) NO_2 (c) P_2O_5 (d) CO_2

75. The reason for greater range of oxidation states in actinoids is attributed to :-
(a) actinoid contraction
(b) 5*f*, 6*d* and 7*s* levels having comparable energies
(c) 4*f* and 5*d* levels being close in energies
(d) the redioactive nature of actinoids

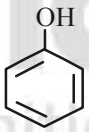
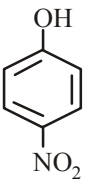
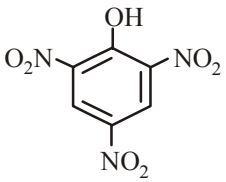
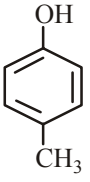
76. The correct order of the stoichiometries of AgCl formed when $AgNO_3$ in excess is treated with the complexes : $CoCl_3.6NH_3$, $CoCl_3.5NH_3$, $CoCl_3.4NH_3$ respectively is :-
(a) 3 AgCl, 1 AgCl, 2 AgCl
(b) 3 AgCl, 2 AgCl, 1 AgCl
(c) 2 AgCl, 3 AgCl, 1 AgCl
(d) 1 AgCl, 3 AgCl, 2 AgCl

77. $HgCl_2$ and I_2 both when dissolved in water containing I^- ions, the pair of species formed is:
(a) HgI_2, I^- (b) HgI_4^{2-}, I_3^-
(c) Hg_2I_2, I^- (d) HgI_2, I_3^-

78. Correct increasing order for the wavelengths of absorption in the visible region the complexes of Co^{3+} is :-
(a) $[Co(H_2O)_6]^{3+}, [Co(en)_3]^{3+}, [Co(NH_3)_6]^{3+}$
(b) $[Co(H_2O)_6]^{3+}, [Co(NH_3)_6]^{3+}, [Co(en)_3]^{3+}$
(c) $[Co(NH_3)_6]^{3+}, [Co(en)_3]^{3+}, [Co(H_2O)_6]^{3+}$
(d) $[Co(en)_3]^{3+}, [Co(NH_3)_6]^{3+}, [Co(H_2O)_6]^{3+}$

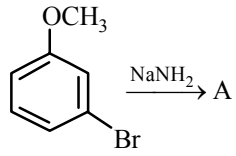
79. Pick out the correct statement with respect to $[Mn(CN)_6]^{3-}$
(a) It is sp^3d^2 hybridised and tetrahedral
(b) It is d^2sp^3 hybridised and octahedral
(c) It is dsp^2 hybridised and square planar
(d) It is sp^3d^2 hybridised and octahedral

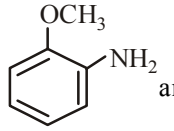
80. An example of a sigma bonded organometallic compound is :
(a) Grignard's reagent (b) Ferrocene
(c) Cobaltocene (d) Ruthenocene

81. Which one is the most acidic compound ?
(a) 
(b) 
(c) 
(d) 

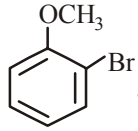
82. The heating of phenyl-methyl ethers with HI produces
(a) Iodobenzene (b) Phenol
(c) Benzene (d) Ethyl chlorides

83. Identify A and predict the type of reaction

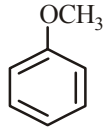


(a) 

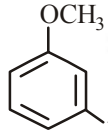
and elimination addition reaction

(b) 

and cine substitution reaction

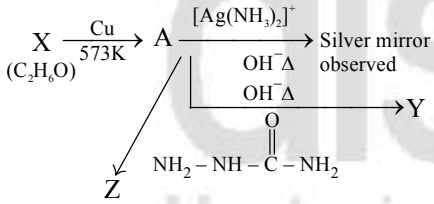
(c) 

and cine substitution reaction

(d) 

and substitution reaction

84. Consider the reactions :-



Identify A, X, Y and Z

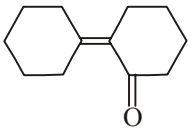
(a) A-Methoxymethane, X-Ethanol, Y-Ethanoic acid, Z-Semicarbazide.

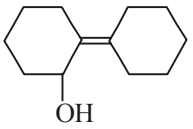
(b) A - Ethanal, X-Ethanol, Y - But - 2-enal, Z-Semicarbazone

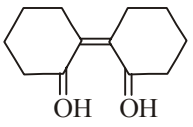
(c) A-Ethanol, X-Acetaldehyde, Y - Butanone, Z-Hydrazone

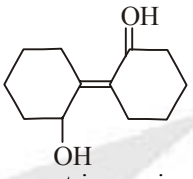
(d) A-Methoxymethane, X-Ethanoic acid, Y-Acetate ion, Z-hydrazine.

85. Of the following, which is the product formed when cyclohexanone undergoes aldol condensation followed by heating ?

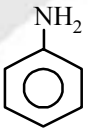
(a) 

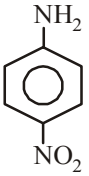
(b) 

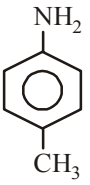
(c) 

(d) 

86. The correct increasing order of basic strength for the following compounds is :

(I) 

(II) 

(III) 

(a) III < I < II (b) III < II < I

(c) II < I < III (d) II < III < I

87. Which of the following reactions is appropriate for converting acetamide to methanamine?

(a) Hoffmann hypobromamide reaction

(b) Stephens reaction

(c) Gabriels phthalimide synthesis

(d) Carbylamine reaction

88. Which of the following statements is not correct :

(a) Ovalbumin is a simple food reserve in egg-white

(b) Blood proteins thrombin and fibrinogen are involved in blood clotting

(c) Denaturation makes the proteins more active

(d) Insulin maintains sugar level in the blood of a human body

89. Mixture of chloroxylenol and terpineol acts as:

(a) antiseptic (b) antipyretic

(c) antibiotic (d) analgesic

90. The heating of phenyl-methyl ethers with HI produces

(a) Iodobenzene (b) Phenol

(c) Benzene (d) Ethyl chlorides

91. Which of the following are found in extreme saline conditions?
(a) Eubacteria (b) Cyanobacteria
(c) Mycobacteria (d) Archaebacteria

92. Which of the following components provides sticky character to the bacterial cell?
(a) Nuclear membrane (b) Plasma membrane
(c) Glycocalyx (d) Cell wall

93. Which among the following are the smallest living cells, known without a definite cell wall, pathogenic to plants as well as animals and can survive without oxygen?
(a) *Pseudomonas* (b) *Mycoplasma*
(c) *Nostoc* (d) *Bacillus*

94. Viroids differ from viruses in having;
(a) DNA molecules without protein coat
(b) RNA molecules with protein coat
(c) RNA molecules without protein coat
(d) DNA molecules with protein coat

95. An example of colonial alga is :
(a) *Volvox* (b) *Ulothrix*
(c) *Spirogyra* (d) *Chlorella*

96. Zygotic meiosis is characteristic of:
(a) *Fucus* (b) *Funaria*
(c) *Chlamydomonas* (d) *Marchantia*

97. Life cycle of *Ectocarpus* and *Fucus* respectively are:
(a) Diplontic, Haplodiplontic
(b) Haplodiplontic, Diplontic
(c) Haplodiplontic, Haplontic
(d) Haplontic, Diplontic

98. Select the mismatch
(a) *Cycas* – Dioecious
(b) *Salvinia* – Heterosporous
(c) *Equisetum* – Homosporous
(d) *Pinus* – Dioecious

99. Double fertilization is exhibited by :
(a) Algae (b) Fungi
(c) Angiosperms (d) Gymnosperms

100. In case of poriferans, the spongocoel is lined with flagellated cells called:
(a) oscula (b) choanocytes
(c) mesenchymal cells (d) ostia

101. An important characteristic that Hemichordates share with Chordates is :
(a) Ventral tubular nerve cord
(b) Pharynx with gill slits
(c) Pharynx without gill slits
(d) Absence of notochord

102. Which among these is the correct combination of aquatic mammals?
(a) Dolphins, Seals, Trygon
(b) Whales, Dolphins, Seals
(c) Trygon, Whales, Seals
(d) Seals, Dolphins, Sharks

103. Plants which produce characteristic pneumatophores and show vivipary belong to:
(a) Halophytes (b) Psammophytes
(c) Hydrophytes (d) Mesophytes

104. In Bougainvillea thorns are the modifications of :
(a) Adventitious root (b) Stem
(c) Leaf (d) Stipules

105. Coconut fruit is a :
(a) Berry (b) Nut
(c) Capsule (d) Drupe

106. The morphological nature of the edible part of coconut is:
(a) Cotyledon (b) Endosperm
(c) Pericarp (d) Perisperm

107. Root hairs develop from the region of :
(a) Elongation (b) root cap
(c) Meristematic activity (d) Maturation

108. Which of the following is made up of dead cells?
(a) Collenchyma (b) Phellem
(c) Phloem (d) Xylem parenchyma

109. Which of the following facilitates opening of stomatal aperture?
(a) Decrease in turgidity of guard cells
(b) Radial orientation of cellulose micro-fibrils in the cell wall of guard cells
(c) Longitudinal orientation of cellulose microfibrils in the cell wall of guard cells
(d) Contraction of outer wall of guard cells

110. The vascular cambium normally gives rise to:
(a) Primary phloem (b) Secondary xylem
(c) Periderm (d) Phelloderm

111. Identify the wrong statement in context of heart-wood:
(a) It is highly durable
(b) It conducts water and minerals efficiently
(c) It comprises dead elements with highly lignified walls
(d) Organic compounds are deposited in it

112. Frog's heart when taken out of the body continues to beat for sometime.
Select the best option from the following statements.
(a) Frog is a poikilotherm.
(b) Frog does not have any coronary circulation.
(c) Heart is "myogenic" in nature.
(d) Heart is autoexcitable
Options:
(a) Only (D) (b) (a) and (B)
(c) (c) and (D) (d) Only (c)

113. Which of the following cell organelles is responsible for extracting energy from carbohydrates to form ATP?
(a) Ribosome (b) Chloroplast
(c) Mitochondrion (d) Lysosome

114. About 98 percent of the mass of every living organism is composed of just six elements including carbon, hydrogen, nitrogen, oxygen and
(a) sulphur and magnesium
(b) magnesium and sodium
(c) calcium and phosphorus
(d) phosphorus and sulphur.

115. Which one of the following statements is correct, with reference to enzymes ?
(a) Holoenzyme = Apoenzyme + Coenzyme
(b) Coenzyme = Apoenzyme + Holoenzyme
(c) Holoenzyme = Coenzyme + Co-factor
(d) Apoenzyme = Holoenzyme + Coenzyme

116. Which of the following are not polymeric?
(a) Proteins (b) Polysaccharides
(c) Lipids (d) Nucleic acids

117. DNA replication in bacteria occurs:
(a) Within nucleolus
(b) Prior to fission
(c) Just before transcription
(d) During S phase

118. Which of the following options gives the correct sequence of events during mitosis?
(a) Condensation → nuclear membrane disassembly → arrangement at equator → centromere division → segregation → telophase
(b) Condensation → crossing over→ nuclear membrane disassembly → segregation → telophase
(c) Condensation → arrangement at equator → centromere division → segregation → telophase
(d) Condensation → nuclear membrane disassembly → crossing over → segregation → telophase

119. Anaphase Promoting Complex (APC) is a protein degradation machinery necessary for proper mitosis of animal cells. If APC is defective in a human cell, which of the following is expected to occur?
(a) Chromosomes will be fragmented
(b) Chromosomes will not segregate
(c) Recombination of chromosome arms will occur
(d) Chromosomes will not condense

120. The water potential of pure water is :
(a) Less than zero
(b) More than zero but less than one
(c) More than one
(d) Zero

121. With reference to factors affecting the rate of photosynthesis, which of the following statements is not correct ?
(a) Increasing atmospheric CO_2 concentration up to 0.05% can enhance CO_2 fixation rate
(b) C_3 plants respond to higher temperatures with enhanced photosynthesis while C_4 plants have much lower temperature optimum
(c) Tomato is a greenhouse crop which can be grown in CO_2 - enriched atmosphere for higher yield
(d) Light saturation for CO_2 fixation occurs at 10% of full sunlight

122. Phosphoenol Pyruvate (PEP) is the primary CO_2 acceptor in:
(a) C_4 plants (b) C_2 plants
(c) C_3 and C_4 plants (d) C_3 plants

123. Which statement is wrong for Krebs' cycle ?
(a) There is one point in the cycle where FAD^+ is reduced to $FADH_2$
(b) During conversion of succinyl CoA to succinic acid, a molecule of GTP is synthesised
(c) The cycle starts with condensation of acetyl group (acetyl CoA) with pyruvic acid to yield citric acid
(d) There are three points in the cycle where NAD^+ is reduced to $NADH + H^+$

124. Fruit and leaf drop at early stages can be prevented by the application of:
(a) Ethylene (b) Auxins
(c) Gibberellic acid (d) Cytokinins

125. Which cells of "Crypts of Lieberkuhn" secrete antibacterial lysozyme ?
(a) Paneth cells (b) Zymogen cells
(c) Kupffer cells (d) Argentaffin cells

126. The hepatic portal vein drains blood to liver from :
(a) Stomach (b) Kidneys
(c) Intestine (d) Heart

127. A baby boy aged two years is admitted to play school and passes through a dental check - up. The dentist observed that the boy had twenty teeth. Which teeth were absent?
(a) Canines (b) Pre-molars
(c) Molars (d) Incisors

128. Which of the following options best represents the enzyme composition of pancreatic juice?
(a) amylase, pepsin, trypsinogen, maltase
(b) peptidase, amylase, pepsin, rennin
(c) lipase, amylase, trypsinogen, procarboxypeptidase
(d) amylase, peptidase, trypsinogen, rennin

129. Lungs are made up of air-filled sacs, the alveoli. They do not collapse even after forceful expiration, because of:
(a) Inspiratory Reserve Volume
(b) Tidal Volume
(c) Expiratory Reserve Volume
(d) Residual Volume

130. Adult human RBCs are enucleated. Which of the following statement(s) is/are **most appropriate** explanation for this feature ?
(1) They do not need to reproduce
(2) They are somatic cells
(3) They do not metabolize
(4) All their internal space is available for oxygen transport
(a) only (1). (b) (1), (3) and (4).
(c) (2) and (3). (d) only (4).

131. Which of the following statements is correct?
(a) The descending limb of loop of Henle is impermeable to water.
(b) The ascending limb of loop of Henle is permeable to water.
(c) The descending limb of loop of Henle is permeable to electrolytes.
(d) The ascending limb of loop of Henle is impermeable to water.

132. The pivot joint between atlas and axis is a type of:
(a) Cartilaginous joint (b) Synovial joint
(c) Saddle joint (d) Fibrous joint

133. Out of 'X' pairs of ribs in humans only 'Y' pairs are true ribs. Select the option that correctly represents values of X and Y and provides their explanation:
(a) X = 12, Y = 5 True ribs are attached dorsally to vertebral column and sternum on the two ends.
(b) X = 24, Y = 7 True ribs are dorsally attached to vertebral column but are free on ventral side.
(c) X = 24, Y = 12 True ribs are dorsally attached to vertebral column but are free on ventral side.
(d) X = 12, Y = 7 True ribs are attached dorsally to vertebral column and ventrally to the sternum.

134. Myelin sheath is produced by :
(a) Astrocytes and Schwann cells
(b) Oligodendrocytes and Osteoclasts
(c) Osteoclasts and Astrocytes
(d) Schwann cells and Oligodendrocytes

135. Receptor sites for neurotransmitters are present on:
(a) Pre-synaptic membrane
(b) Tips of axons
(c) Post-synaptic membrane
(d) Membrane of synaptic vesicles

136. Good vision depends on adequate intake of carotene rich food.
Select the best option from the following statements :
(i) Vitamin A derivatives are formed from carotene
(ii) The photopigments are embedded in the membrane discs of the inner segment
(iii) Retinal is a derivative of Vitamin A
(iv) Retinal is a light absorbing part of all the visual photopigments
Options :
(a) (i), (iii) and (iv) (b) (i) and (iii)
(c) (ii), (iii) and (iv) (d) (i) and (iv)

137. A decrease in blood pressure / volume will not cause the release of :
(a) Atrial natriuretic factor
(b) Aldosterone
(c) ADH
(d) Renin

138. Attractants and rewards are required for:
(a) Entomophily (b) Hydrophily
(c) Cleistogamy (d) Anemophily

139. Flowers which have single ovule in the ovary and are packed into inflorescence are usually pollinated by:
(a) Bee (b) Wind
(c) Bat (d) Water

140. A dioecious flowering plant prevents both :
(a) Autogamy and geitonogamy
(b) Geitonogamy and xenogamy
(c) Cleistogamy and xenogamy
(d) Autogamy and xenogamy

141. Functional megaspore in an angiosperm develops into ?
(a) Endosperm (b) Embryo sac
(c) Embryo (d) Ovule

142. Capacitation occurs in:
(a) Epididymis
(b) Vas deferens
(c) Female reproductive tract
(d) Rete testic

143. The function of copper ions in copper releasing IUD's is :
(a) They inhibit gametogenesis
(b) They make uterus unsuitable for implantation
(c) They inhibit ovulation
(d) They suppress sperm motility and fertilising capacity of sperms

144. In case of a couple where the male is having a very low sperm count, which technique will be suitable for fertilisation ?
(a) Gamete intracytoplasmic fallopian transfer
(b) Artificial Insemination
(c) Intracytoplasmic sperm injection
(d) Intrauterine transfer

145. The genotypes of a husband and wife are I^AI^B and I^Ai. Among the blood types of their children, how many different genotypes and phenotypes are possible?
(a) 3 genotypes ; 4 phenotypes
(b) 4 genotypes ; 3 phenotypes
(c) 4 genotypes ; 4 phenotypes
(d) 3 genotypes ; 3 phenotypes

146. Among the following characters, which one was not considered by Mendel in his experiments on pea ?
(a) Trichomes – Glandular or non-glandular
(b) Seed – Green or Yellow
(c) Pod – Inflated or Constricted
(d) Stem – Tall or Dwarf

147. Which one from those given below is the period for Mendel's hybridisation experiments?
(a) 1840 - 1850 (b) 1857 - 1869
(c) 1870 - 1877 (d) 1856 - 1863

148. Thalassemia and sickle cell anemia are caused due to a problem in globin molecule synthesis. Select the correct statement :
(a) Both are due to a quantitative defect in globin chain synthesis
(b) Thalassemia is due to less synthesis of globin molecules
(c) Sickel cell anemia is due to a quantitative problem of globin molecules
(d) Both are due to a qualitative defect in globin chain synthesis

149. A disease caused by an autosomal primary non-disjunction is :
(a) Klinefelter's Syndrome
(b) Turner's Syndrome
(c) Sickel Cell Anemia
(d) Down's Syndrome

150. The final proof for DNA as the genetic material came from the experiments of:
(a) Hershey and Chase
(b) Avery, Mcleod and McCarty
(c) Hargobind Khorana
(d) Griffith

151. DNA fragments are:
(a) Negatively charged
(b) Neutral
(c) Either positively or negatively charged depending on their size
(d) Positively charged

152. Which of the following RNAs should be most abundant in animal cell?
(a) t-RNA (b) m-RNA
(c) mi-RNA (d) r-RNA

153. The association of histone H1 with a nucleosome indicates:
(a) DNA replication is occurring.
(b) The DNA is condensed into a Chromatin Fibre.
(c) The DNA double helix is exposed.
(d) Transcription is occurring.

154. If there are 999 bases in an RNA that codes for a protein with 333 amino acids, and the base at position 901 is deleted such that the length of the RNA becomes 998 bases, how many codons will be altered?
(a) 11 (b) 33
(c) 333 (d) 1

155. During DNA replication, Okazaki fragments are used to elongate:
(a) The lagging strand towards replication fork.
(b) The leading strand away from replication fork.
(c) The lagging strand away from the replication fork.
(d) The leading strand towards replication fork.

156. Spliceosomes are not found in cells of;
(a) Fungi (b) Animals
(c) Bacteria (d) Plants

157. Which of the following represents order of Horse'?
(a) Perissodactyla (b) Caballus
(c) Ferus (d) Equidae

158. Transplantation of tissues/organs fails often due to non-acceptance by the patient's body. Which type of immune-response is responsible for such rejections?
(a) Cell-mediated immune response
(b) Hormonal immune response
(c) Physiological immune response
(d) Autoimmune response

159. MALT constitutes about _____ percent of the lymphoid tissue in human body.
(a) 20% (b) 70%
(c) 10% (d) 50%

160. Homozygous purelines in cattle can be obtained by:
(a) mating of unrelated individuals of same breed.
(b) mating of individuals of different breed.
(c) mating of individuals of different species.
(d) mating of related individuals of same breed.

161. Which of the following in sewage treatment removes suspended solids?
(a) Secondary treatment (b) Primary treatment
(c) Sludge treatment (d) Tertiary treatment

162. Which of the following is correctly matched for the product produced by them ?
(a) *Methanobacterium* : Lactic acid
(b) *Penicillium notatum* : Acetic acid
(c) *Sacchromyces cerevisiae* : Ethanol
(d) *Acetobacter aceti* : Antibiotics

163. The DNA fragments separated on an agarose gel can be visualised after staining with:
(a) Acetocarmine (b) Aniline blue
(c) Ethidium bromide (d) Bromophenol blue

164. A gene whose expression helps to identify transformed cell is known as :
(a) Vector (b) Plasmid
(c) Structural gene (d) Selectable marker

165. What is the criterion for DNA fragments movement on agarose gel during gel electrophoresis?
(a) The smaller the fragment size, the farther it moves
(b) Positively charged fragments move to farther end
(c) Negatively charged fragments do not move
(d) The larger the fragment size, the farther it moves

166. The process of separation and purification of expressed protein before marketing is called:
(a) Downstream processing
(b) Bioprocessing
(c) Postproduction processing
(d) Upstream processing

167. Presence of plants arranged into well defined vertical layers depending on their height can be seen best in:
(a) Tropical Rain Forest
(b) Grassland
(c) Temperate Forest
(d) Tropical Savannah

168. Asymptote in a logistic growth curve is obtained when :
(a) K = N
(b) K > N
(c) K < N
(d) The value of 'r' approaches zero

169. Mycorrhizae are the example of:
(a) Amensalism (b) Antibiosis
(c) Mutualism (d) Fungistasis

170. Which ecosystem has the maximum biomass?
(a) Grassland ecosystem
(b) Pond ecosystem
(c) Lake ecosystem
(d) Forest ecosystem

171. Alexander Von Humboldt described for the first time:
(a) Laws of limiting factor
(b) Species-Area relationships
(c) Population Growth equation
(d) Ecological Biodiversity

172. Which one of the following statements is not valid for aerosols?
(a) They alter rainfall and monsoon patterns
(b) They cause increased agricultural productivity
(c) They have negative impact on agricultural land
(d) They are harmful to human health

173. Artificial selection to obtain cows yielding higher milk output represents :
(a) Directional as it pushes the mean of the character in one direction
(b) Disruptive as it splits the population into two, one yielding higher output and the other lower output
(c) Stabilizing followed by disruptive as it stabilizes the population to produce higher yielding cows
(d) Stabilizing selection as it stabilizes this character in the population

174. Select the mismatch :
(a) *Rhodospirillum* - Mycorrhiza
(b) *Anabaena* - Nitrogen fixer
(c) *Rhizobium* - Alfalfa
(d) *Frankia* - Alnus

175. Which one of the following is related to Ex-situ conservation of threatened animals and plants ?
(a) Biodiversity hot spots
(b) Amazon rainforest
(c) Himalayan region
(d) Wildlife safari parks

176. A temporary endocrine gland in the human body is:
(a) Corpus cardiacum (b) Corpus luteum
(c) Corpus allatum (d) Pineal gland

177. Match the following sexually transmitted diseases (Column-I) with their causative agent (Column-II) and select the correct option :

	Column-I		Column-II
(A)	Gonorrhea	(i)	HIV
(B)	Syphilis	(ii)	*Neisseria*
(C)	Genital Warts	(iii)	*Treponema*
(D)	AIDS	(iv)	Human papilloma-Virus

	(A)	(B)	(C)	(D)
(a)	(iii)	(iv)	(i)	(ii)
(b)	(iv)	(ii)	(iii)	(i)
(c)	(iv)	(iii)	(ii)	(i)
(d)	(ii)	(iii)	(iv)	(i)

178. Which of the following in sewage treatment removes suspended solids ?
(a) Secondary treatment (b) Primary treatment
(c) Sludge treatment (d) Tertiary treatment

179. Select the correct route for the passage of sperms in male frogs:
(a) Testes → Vasa efferentia → Kidney → Seminal Vesicle → Urinogenital duct → Cloaca
(b) Testes → Vasa efferentia → Bidder's canal → Ureter → Cloaca
(c) Testes → Vasa efferentia → Kidney → Bidder's canal → Urinogenital duct → Cloaca
(d) Testes → Bidder's canal → Kidney → Vasa efferentia → Urinogenital duct → Cloaca

180. GnRH, a hypothalamic hormone, needed in reproduction, acts on:
(a) anterior pituitary gland and stimulates secretion of LH and FSH.
(b) posterior pituitary gland and stimulates secretion of oxytocin and FSH.
(c) posterior pituitary gland and stimulates secretion of LH and relaxin.
(d) anterior pituitary gland and stimulates secretion of LH and oxytocin.

HINTS & SOLUTIONS

PHYSICS

1. (d) Let dimensions of length is related as,

$[L] \quad [c]^x[G]^y\left[\frac{e^2}{4\pi\varepsilon_0}\right]^z$

$\Rightarrow \quad \frac{e^2}{4_{\pi\,\varepsilon\,0}} = [ML^3T^{-2}]$

$[L] = [LT^{-1}]^x\,[M^{-1}L^3T^{-2}]^y[ML^3T^{-2}]^z$

$[L] = [L^{x+3y+3z}\,M^{-y+z}\,T^{-x-2y-2z}]$

Comparing both sides

$-y+z=0 \Rightarrow \quad y=z$ ...(i)

$x+3y+3z=1$ ...(ii)

$-x-4z=0 \qquad (\because\ y=z)$ ...(iii)

From (i), (ii) and (iii)

$z=y=\frac{1}{2},\ x=-2$

Hence, $[L] = c^{-2}\left[G\,\frac{e^2}{4\pi\varepsilon_0}\right]^{1/2}$

2. (b) Let the distance be 'd' time taken by preeti to travel up the stationary escalator = t_1 Velocity of preeti w.r.t. elevator $v_1 = \frac{d}{t_1}$

Since the distance is same let the time taken when preeti stands on the moving escalator = t_2.

Velocity of elevator w.r.t. ground $v_2 \quad \frac{d}{t_2}$

Then net velocity of preeti w.r.t. ground

$v = v_1 + v_2$

$\frac{d}{t} \quad \frac{d}{t_1} \quad \frac{d}{t_2}$

$\frac{1}{t} \quad \frac{1}{t_1} \quad \frac{1}{t_2}$

$\therefore \quad t = \frac{t_1t_2}{(t_1 \quad t_2)}$ (time taken by preeti to walk up on the moving escalator)

3. (b) Given:

$x = 5t - 2t^2 \qquad y = 10t$

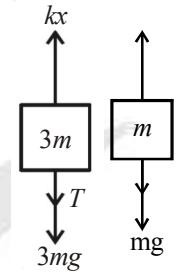
$v_x = \frac{dx}{dt} = 5-4t \qquad v_y = \frac{dy}{dt} \quad 10$

$a_x = \frac{dv_x}{dt} = -4 \qquad a_y = \frac{dv_y}{dt} \quad 0$

$\vec{a} \quad a_x i \quad a_y j \qquad \vec{a} = -4i\ \text{m/s}^2$

Hence, acceleration of particle at (t = 2 s) = –4m/s^2

4. (a) Before cutting the string



$kx = T + 3\,mg$ ...(i)

$T = mg$ ...(ii)

Force an string,

$\Rightarrow \quad kx = 4mg$

After cutting the string T = 0

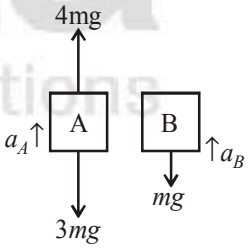
For block A: $3ma_A = 4mg - 3mg$

$a_A = \frac{4mg-3mg}{3m} = \frac{g}{3}$

$a_A = \frac{g}{3}$

For block B: $ma_B = mg$

$a_B = g$



5. (d) Net force on particle in uniform circular motion is centripetal force $\left(\frac{mv^2}{\ell}\right)$ which is provided by tension in string so the net force will be equal to tension *i.e.*, T.

6. (c) From work-energy theorem,

$W_g + W_a = \Delta$ K.E.

or, $mgh + W_a = \frac{1}{2}mv^2 - 0$

$10^{-3} \times 10 \times 10^3 \quad W_a \quad \frac{1}{2} \times 10^{-3} \times (50)^2$

$\Rightarrow \quad W_a = -8.75$ J

which is the work done due to air resistance

Work done due to gravity = mgh

$= 10^{-3} \times 10 \times 10^3 = 10$ J

7. (d) Mechanical advantage, $M.A. = \frac{\text{Load}}{\text{Effort}}$

If $M.A. > 1 \Rightarrow$ Load > Effort

NOTES

Centre of mass may or may not coincide with centre of gravity. Net torque of gravitational pull is zero about centre of mass.

$\tau_g = \Sigma \tau_i = \Sigma r_i \times m_{ig} \quad 0$

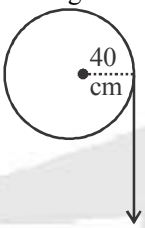
8. (b) Given, mass of cylinder m = 3kg

R = 40 cm = 0.4 m

F = 30 N ; α = ?

As we know, torque $\tau = I\alpha$

$F \times R = MR^2\alpha$



$\alpha \quad \frac{F \times R}{MR^2}$

$\alpha \quad \frac{30 \times (0.4)}{3 \times (0.4)^2}$ or, $\alpha \quad 25 \text{rad/s}^2$

9. (a) Here, $I\omega_1 + I\omega_2 = 2I\omega$

$\Rightarrow \quad \omega = \frac{\omega_1 + \omega_2}{2}$

$(K.E.)_i = \frac{1}{2}I\omega_1^2 + \frac{1}{2}I\omega_2^2$

$(K.E.)_f = \frac{1}{2} \times 2I\omega^2 = I\left(\frac{\omega_1 + \omega_2}{2}\right)^2$

Loss in K.E. $= (K.E)_f - (K.E)_i = \frac{1}{4}I(\omega_1 - \omega_2)^2$

10. (a) Both the astronauts are in the condition of weightlessness. Gravitational force between them pulls towards each other. Hence Astronauts move towards each other under mutual gravitional force.

11. (c)

Above earth surface	Below earth surface
$g_h = g\left(1 - \frac{2h}{R_e}\right)$	$g_d = g\left(1 - \frac{d}{R_e}\right)$

According to question, $g_h = g_d$

$g\left(1 - \frac{2h}{R_e}\right) = g\left(1 - \frac{d}{R_e}\right)$

Clearly,

$d = 2h = 2$ km

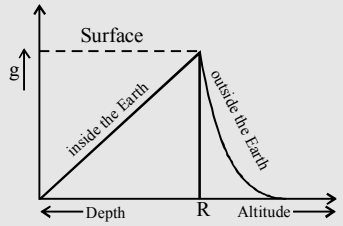
NOTES

Graph of g, R and d:

(i) g at surface of earth is maximum

(ii) g at centre of earth is zero

(iii) g is maximum at poles and minimum at the equator.



12. (c) Bulk modulus is given by

$B = \frac{p}{\left(\frac{\Delta V}{V}\right)}$ or $\frac{\Delta V}{V} \quad \frac{p}{B}$

$3\frac{\Delta R}{R} \quad \frac{p}{B}$ (here, $\frac{\Delta R}{R}$ = fractional decreases in radius)

$\Rightarrow \quad \frac{\Delta R}{R} \quad \frac{p}{3B}$

NOTES

If the object of mass m and radius r is sorrounded by a liquid in a cylindrical container

$\frac{\Delta R}{R} \quad \frac{1}{3}\frac{\Delta V}{V}$ ...(i)

Bulk modulus, $K = -V\frac{\Delta P}{\Delta V}$

$\therefore \quad \frac{\Delta V}{V} \quad \frac{\Delta P}{K} \quad \frac{mg}{AK} \quad \left(\because \Delta P \quad \frac{mg}{A}\right)$

$\therefore \quad \frac{\Delta R}{R} \quad \frac{1}{3}\frac{mg}{AK}$ (Here A = area of object)

13. (c) Here, $h_{oil} \times \rho_{oil} \times g = h_{water} \times \rho_{water} \times g$

$\rho_0 g \times 140 \times 10^{-3} = \rho_w g \times 130 \times 10^{-3}$

$\rho_{oil} = \frac{130}{140} \times 10^3 = 928 \text{kg/m}^3$

$[\because \rho_w = 1 \text{ kgm}^{-3}]$

14. (d) Equivalent thermal conductivity of the composite rod in parallel combination will be,

$$K = \frac{K_1 A(T_1 - T_2)}{d} \quad \frac{K_2 A(T_1 - T_2)}{d}$$

$$\frac{K_{EQ} 2A(T_1 - T_2)}{d} \quad \frac{A(T_1 - T_2)}{d} [K_1 \quad K_2]$$

Hence equivalent thermal conductivities for two rods of equal area is given by

$$K_{EQ} \quad \frac{k_1 \quad k_2}{2}$$

15. (c) Given $r_1 = 12$ cm, $r_2 = 6$ cm
$T_1 = 500$ K and $T_2 = 2 \times 500 = 1000$ K
$P_1 = 450$ watt
Rate of power loss $P \quad r^2T^4$

$$\frac{P_1}{P_2} \quad \frac{r_1^2 T_1^4}{r_2^2 T_2^4}$$

$$P_2 \quad P_1 \frac{r_2^2 T_2^4}{r_1^2 T_1^4}$$

Solving we get, $P_2 = 1800$ watt

16. (a) Process I volume is constant hence, it is isochoric
In process IV, pressure is constant hence, it is isobaric.

17. (a) Given, efficiency of engine, $\eta = \frac{1}{10}$
work done on system $W = 10$J
Coefficient of performance of refrigerator

$$\beta \quad \frac{Q_2}{W} \quad \frac{1 - \eta}{\eta} = \frac{1 - \frac{1}{10}}{\frac{1}{10}} \quad \frac{\frac{9}{10}}{\frac{1}{10}} = 9$$

Energy absorbed from reservoir
$Q_2 = \beta W \qquad Q_2 = 9 \times 10 = 90$ J

NOTES A refrigerator works along the reverse direction of a heat engine.

18. (c) Internal energy of the system is given by

$$U = \frac{f}{2} nRT$$

Degree of freedom
$F_{diatomic} = 5$
$f_{monoatomic} = 3$
and, number of moles
$n(O_2) = 2$
$n(Ar) = 4$

$$U_{total} = \frac{5}{2}(2)RT \quad \frac{3}{2}(4)RT = 11RT$$

19. (b) Given, Amplitude $A = 3$ cm
When particle is at $x = 2$ cm
According to question, magnitude of velocity = acceleration

$$\omega \sqrt{A^2 - x^2} = x\omega^2$$

$$\sqrt{(3)^2 - (2)^2} \quad 2\left(\frac{2\pi}{T}\right)$$

$$\sqrt{5} \quad \frac{4\pi}{T} \Rightarrow \quad T = \frac{4\pi}{\sqrt{5}}$$

20. (b) Let ℓ be the complete length of the spring.
Length when cut in ratio, 1 : 2 : 3 are

$$\frac{\ell}{6}, \frac{\ell}{3} \text{ and } \frac{\ell}{2}$$

$$\text{Spring constant (k)} \quad \frac{1}{\text{length}(\ell)}$$

Spring constant for given segments
$k_1 = 6k$, $k_2 = 3k$ and $k_3 = 2k$
When they are connected **in series**

$$\frac{1}{k'} \quad \frac{1}{6k} \quad \frac{1}{3k} \quad \frac{1}{2k}$$

$$\Rightarrow \quad \frac{1}{k'} \quad \frac{6}{6k}$$

$\therefore$ Force constant $k' = k$
And when they are connected **in parallel**
$k'' = 6k + 3k + 2k$
$\Rightarrow \quad k'' = 11k$
Then the ratios

$$\frac{k'}{k''} \quad \frac{1}{11} \text{ i.e., } k' : k'' = 1 : 11$$

NOTES If a spring of force constant K is divided into n equal parts then spring constant of each part will become nk and if these n parts connected in parallel then $k_{eff} = n^2 k$.

21. (a) Difference in two successive frequencies of closed pipe,

$$\frac{2v}{4l} \Rightarrow \quad 260 - 220 = 40 \text{ Hz}$$

$$\text{or } \frac{2v}{4l} = 40 \text{ Hz}$$

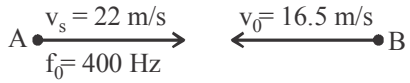
$\Rightarrow \quad \frac{v}{4\ell} \quad 20\text{Hz}$

Which is the fundamental frequency of system of closed organ pipe.

22. (c) As we known from Doppler's Effect

$$f_{apprent} = f_0\left[\frac{v \quad v_0}{v - v_s}\right] = 400\left[\frac{340 \quad 16.5}{340 - 22}\right]$$

$f_{apprent} = 448$ Hz



23. (b) Net charge on one H atom $= {}^{-}e + (e + {}_{\Delta}e) = {}_{\Delta}e$

According to question, the net electrostatic force (F_E) = gravitational force (F_G)

$F_E = F_G$

or $\frac{1}{4\pi\varepsilon_0}\frac{{}_{\Delta}e^2}{d^2} \quad \frac{Gm^2}{d^2}$

$$\Rightarrow \quad {}_{\Delta}e = m\sqrt{\frac{G}{k}} \quad \left(\frac{1}{4\pi\varepsilon_0} \quad k \quad 9\times 10^9\right)$$

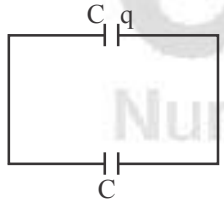
$$= 1.67\times 10^{-27}\sqrt{\frac{6.67\times 10^{-11}}{9\times 10^9}}$$

${}_{\Delta}e = 1.436\times 10^{-37}$ C

24. (a) As the regions are of equipotentials, so Work done $W = q_{\Delta}V$

${}_{\Delta}V$ is same in all the cases hence work - done will also be same in all the cases.

25. (a) When battery is replaced by another uncharged capacitor



As uncharged capacitor is connected parallel

So, $C' = 2C$

and $V_c = \frac{q_1 \quad q_2}{C_1 \quad C_2}$

$$V_c = \frac{q \quad 0}{C \quad C} = \frac{CV}{C \quad C} \qquad [\because q = cv]$$

$\Rightarrow \quad V_c = \frac{V}{2}$

Initial Energy of system, $U_i = \frac{1}{2}CV^2$ … (i)

Final energy of system, $U_f = \frac{1}{2}(2C)\left(\frac{V}{2}\right)^2$

$$= \frac{1}{2}CV^2\left(\frac{1}{2}\right) \qquad \text{…(ii)}$$

From equation (i) and (ii)

$U_f = \frac{1}{2}U_i$

i.e., Total electrostatic energy of resulting system decreases by a factor of 2

26. (b) We know that, $R = \frac{\rho\ell}{A}$

or $R = \frac{\rho\ell^2}{\text{Volume}} \Rightarrow R \quad \ell^2$

According to question $\ell_2 = n\ell_1$

$$\frac{R_2}{R_1} = \frac{n^2 l_1^2}{l_1^2}$$

or, $\frac{R_2}{R_1} \quad n^2$

$\Rightarrow \quad R_2 = n^2 R_1$

27. (b) Reading of potentiometer is accurate because during taking reading it does not draw any current from the circuit.

28. (d) Work done, $W = MB(\cos\theta_1 - \cos\theta_2)$

When it is rotated by angle 180° then

$W = MB(\cos 0° - \cos 180°) = MB(1 + 1)$

$W = 2MB$

$W = 2(NIA)B$

$= 2\times 250\times 85\times 10^{-6}[1.25\times 2.1\times 10^{-4}]\times 85\times 10^{-2}$

$= 9.1\ \mu$J

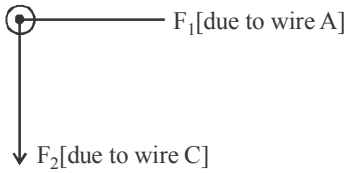
29. (c) Force per unit length between two parallel current carrying conductors,

$F = \frac{\mu_0 i_1 i_2}{2\pi d}$

Since same current flowing through both the wires

$i_i = i_2 = i$

so $F_1 \quad \frac{\mu_0 i^2}{2\pi d} \quad F_2$



$\therefore$ Magnitude of force per unit length on the middle wire 'B'

$$F_{net} = \sqrt{F_1^2 \quad F_2^2} \quad \frac{\mu_0 i^2}{\sqrt{2}\pi d}$$

30. (d) If θ_1 and θ_2 are opparent angles of dip
Let α be the angle which one of the plane make with the magnetic meridian.

$$\tan\theta_1 \quad \frac{v}{H\cos\alpha}$$

$$\text{i.e., } \cos\alpha \quad \frac{v}{H\tan\theta_1} \qquad \ldots(i)$$

$$\tan\theta_2 \quad \frac{v}{H\sin\alpha},$$

$$\text{i.e., } \sin\alpha \quad \frac{v}{H\tan\theta_2} \qquad \ldots(ii)$$

Squaring and adding (i) and (ii), we get

$$\cos^2\alpha + \sin^2\alpha \quad \left(\frac{V}{H}\right)^2\left(\frac{1}{\tan^2\theta_1} \quad \frac{1}{\tan^2\theta_2}\right)$$

$$\text{i.e., } 1 = \frac{V^2}{H^2}[\cot^2\theta_1 + \cot^2\theta_2]$$

$$\text{or} \quad \frac{H^2}{V^2} = \cot^2\theta_1 + \cot^2\theta_2$$

$$\text{i.e., } \cot^2\theta = \cot^2\theta_1 + \cot^2\theta_2$$

31. (b) Given, no. of turns $N = 100$
radius, $r = 0.01$ m
resistance, $R = 10\pi^2\ \Omega$, $n = 2 \times 10^4$
As we know,

$$\varepsilon = -N\frac{d\phi}{dt} \quad \Rightarrow \frac{\varepsilon}{R} = -\frac{N}{R}\frac{d\phi}{dt}$$

$$\Delta I = -\frac{N}{R}\frac{d\phi}{dt} \quad \Rightarrow \frac{\Delta q}{\Delta t} = -\frac{N}{R}\frac{\Delta\phi}{\Delta t}$$

$$\Delta q = -\left[\frac{N}{R}\left(\frac{\Delta\phi}{\Delta t}\right)\right]\Delta t$$

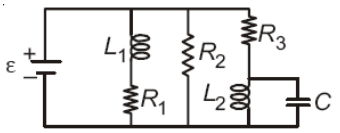
'–' ve sign shows that induced emf opposes the change of flux.

$$\Delta q = \left[\mu_0 nN\pi r^2\left(\frac{\Delta i}{\Delta t}\right)\right]\frac{1}{R}\Delta t \quad \frac{\mu_0 nN\pi r^2\Delta i}{R}$$

$$\Delta q \quad \frac{4\pi\times10^{-7}\times100\times4\times\pi\times(0.01)^2\times2\times10^4}{10\pi^2}$$

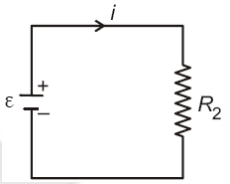
$\Delta q = 32\mu$ C

32. (b)



At $t = 0$, no current flows through R_1 and R_3

$\therefore$



Current through battery just after the switch closed is

$$i \quad \frac{\varepsilon}{R_2} \quad \frac{18}{9} = 2A$$

33. (a) Given, $E_{rms} = 6$ V/m

$$\frac{E_{rms}}{B_{rms}} \quad c$$

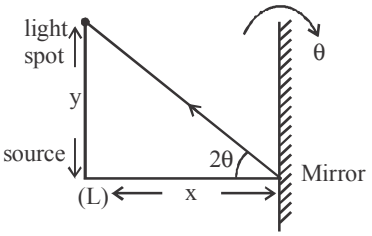
$$\Rightarrow \quad B_{rms} \quad \frac{E_{rms}}{c} \qquad ...(i)$$

$$B_{rms} = \frac{B_0}{\sqrt{2}} \Rightarrow \quad B_0 \quad \sqrt{2}\,B_{rms}$$

$$B_0 = \sqrt{2}\times\frac{E_{rms}}{c} \text{ From equation (i)}$$

$$= \frac{\sqrt{2}\times 6}{3\times 10^8} = 2.83\times10^{-8}\text{ T}$$

34. (d) When mirror is rotated by angle θ reflected ray will be rotated by 2θ.
According to the condition,



$\frac{y}{x} = 2\theta \quad \Rightarrow \quad \theta = \frac{y}{2x}$

35. (a) For dispersion without deviation

$(\mu - 1)A_1 + (\mu' - 1)A_2 \quad 0$

$|(\mu - 1)A_1| = |(\mu' - 1)A_2|$

$(1.42–1) \times 10° = (1.7–1)A_2$

$4.2 = 0.7A_2$

$A_2 = 6°$

NOTES

In case of deviation without dispersion

$\frac{A'}{A'} \quad \frac{\mu_V - \mu_R}{\mu'_V - \mu'_R}$

36. (c) According to question

8th bright fringe in medium = 5th dark fring in air

$Y_{8\text{th bright}} = 8\frac{\lambda D}{\mu d}$

$Y_{5\text{th dark}} = (2 \times 5 - 1)\frac{\lambda D}{2d} \quad \frac{9}{2}\frac{\lambda D}{d}$

$\Rightarrow \quad \frac{9}{2}\frac{\lambda D}{d} \quad 8\frac{\lambda D}{\mu d}$

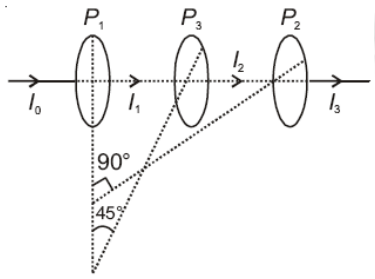
or, refractive index $\mu = \frac{16}{9} \quad 1.78$

NOTES

In YDSE for constructive or bright fringes.

$Y_n = \frac{nD\lambda}{d}$ for nth bright fringe and for destructive or dark fringes. $y_n = (2n - 1)\frac{D\lambda}{2d}$ for nth dark fringe.

37. (b) I.



According to Malus law, $I = I_0\cos^2\theta$

$I_1 = \frac{I_0}{2}$

$I_2 = \frac{I_0}{2}\cos^2 45 \quad = \frac{I_0}{2} \times \frac{1}{2} \quad \frac{I_0}{4}$

$I_3 = \frac{I_0}{4}\cos^2 45 \quad = \frac{I_0}{8}$

38. (b) Resolving power of a microscope $= \frac{2\mu \sin\theta}{\lambda}$

i.e., R $\frac{1}{\lambda}$ or, $\frac{R_1}{R_2} \quad \frac{\lambda_2}{\lambda_1}$

Given that the two wavelengths,

$\lambda_1 \quad 4000Å$ and $\lambda_2 \quad 6000Å$

$\therefore \quad \frac{R_1}{R_2} = \frac{6000Å}{4000Å} \quad \frac{3}{2}$

39. (a) We know that,

de-Broglie wavelength $\lambda = \frac{\hbar}{p} = \frac{h}{\sqrt{2m(KE)}}$

K.E. of thermal neutron $= \frac{3}{2}kT$

$= \frac{h}{\sqrt{2m\left(\frac{3}{2}kT\right)}}$

$\lambda = \frac{h}{\sqrt{3mkT}}$

40. (a, d) Both answers are correct

Given,

$\lambda_0 = 3250 \times 10^{-10}\,m$

$\lambda = 2536 \times 10^{-10}\,m$

$\phi = \frac{hc}{\lambda_0} \quad \frac{4.14 \times 10^{-15} \times 3 \times 10^8}{3250 \times 10^{-10}} \quad 3.82eV$

$h\nu = \frac{hc}{\lambda} \quad \frac{4.14 \times 10^{-15} \times 3 \times 10^8}{2536 \times 10^{-10}} \quad 4.89eV$

According to Einstein's photoelectric equation,

$K_{max} = h\nu - \phi$

$KE_{max} = (4.89–3.82)eV = 1.077\,eV$

$\frac{1}{2}mv^2 = 1.077 \times 1.6 \times 10^{-19}$

$\Rightarrow \quad v = \sqrt{\frac{2 \times 1.077 \times 1.6 \times 10^{-19}}{9.1 \times 10^{-31}}}$

or, $v = 0.6 \times 10^6\,m/s$ or $6 \times 10^5\,m/s$

41. (b) For last line of Balmer series :

$n_1 = 2$ and $n_2 = \infty$

$$\frac{1}{\lambda_B} = RZ^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] = R_1^2\left[\frac{1}{2^2} - \frac{1}{\infty^2}\right]$$

$$\lambda_B \quad \frac{4}{R} \qquad ...(i)$$

For last line of Lyman series : $n_1 = 1$ and $n_2 = \infty$

$$\frac{1}{\lambda_L} = RZ^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] = RZ^2\left[\frac{1}{1^2} - \frac{1}{\infty^2}\right]$$

$$\lambda_L \quad \frac{1}{R} \qquad ...(ii)$$

Dividing equation (i) by (ii)

$$\frac{\lambda_B}{\lambda_L} \quad \frac{\frac{4}{R}}{\frac{1}{R}}$$

Ratio of wavelengths is $\frac{\lambda_B}{\lambda_L} \quad 4$

42. (a) Given, $\lambda_A = 8\lambda$, $\lambda_B = \lambda$

$$N_B = \frac{N_A}{e}$$

$$\Rightarrow \quad N_o e^{-\lambda_B t} \quad N_o \frac{e^{-\lambda_A t}}{e}$$

$$e^{-\lambda t} \quad e^{-8\lambda t} e^{-1}$$

$$e^{-\lambda t} \quad e^{-8\lambda t - 1}$$

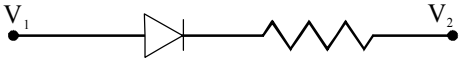
Comparing both side powers

$$-\lambda t = -8\lambda t - 1$$

$$-1 = 7\lambda t$$

$$t = -\frac{1}{7\lambda}$$

The best possible answer is $t = \frac{1}{7\lambda}$

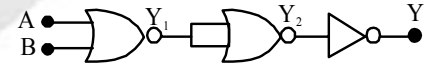
43. (d) 

In forward bias, $V_1 > V_2$ i.e., in figure (d) p-side is at higher potential w.r.t. n-side of p-n junction diode.

44. (b) Given, current gain $\beta = 100$, $R_c = 3k\Omega$, $R_b = 2k\Omega$

Voltage gain $(A_v) = \beta \frac{R_c}{R_b} = 100\left(\frac{3}{2}\right) = 150$

Power gain $= A_v \beta = 150\,(100) = 15000$

45. (b) 

$Y_1 = \overline{A \quad B}$

$Y_2 = \overline{Y_1 \quad Y_1} \quad \overline{Y_1} \quad A \quad B$

$Y = \overline{Y}_2 = \overline{A \quad B}$ i.e. NOR gate

CHEMISTRY

46. (c) For hydrogen like atoms energy of 2*s*-orbital and 2*p*-orbital is equal.

47. (a) After $_{86}Rn$ (Group 18), elements from atomic number 89 to 103 (actinides) are in group 3 $114 = 103 + 11$. Thus, element with atomic number 114 will be in group $(3 + 11)$ or group 14 (carbon family).

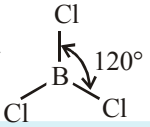
The outer shell configuration of group 14 is ns^2np^2.

Hence, only option (a) is correct.

48. (b) IBr_2^-, XeF_2

Total number of valence electrons are equal in both the species and both the species exhibit linear shape.

49. (c) BCl_3 is trigonal planar and hence the bond angle is 120°.



50. (b) CN^- and CO have same no. of electrons and have same bond order equal to 3.

NOTES

Short cut trick to calculate the bond order:

N_2 has 14 electrons and its bond order is 3. We have to remember this concept that every electron added or subtracted to 14, reduces the bond order by 0.5. For example

CN^- ⇒ no. of electrons = 6 + 7 + 1 = 14

∴ bond order = 3

CO ⇒ no. of electrons = 6 + 8 = 14

∴ bond order = 3

NO ⇒ no. of electrons = 7 + 8 = 15

∴ bond order = 3 – 0.5 = 2.5

NO^+ ⇒ no. of electrons = 7 + 8 – 1 = 14

∴ bond order = 3

O_2^- ⇒ no. of electrons = 8 + 8 + 1 = 17

∴ bond order = 3 – 1.5

Please note that this method will work for any species that have electrons between 10 and 18.

51. (b) The system is in isolated state.

$\because$ For an adiabatic process, $q = 0$

$\therefore \Delta U = q + w$

$\therefore \Delta U = w$

$= -p\Delta V$

$= -2.5 \text{ atm} \times (4.5 - 2.5) \text{ L}$

$= -2.5 \times 2 \text{ L-atm}$

$= -5 \times 101.3 \text{ J}$

$= -506.5 \text{ J} \approx -505 \text{J}$

52. (a) Given ΔH 35.5 kJ mol^{-1}

$\Delta S = 83.6 \text{ JK}^{-1} \text{ mol}^{-1}$

$\because \Delta G = \Delta H - T\Delta S$

For a reaction to be spontaneous, $\Delta G = -\text{ve}$

i.e., $\Delta H < T\Delta S$

$\therefore \quad T > \dfrac{\Delta H}{\Delta S} \quad \dfrac{35.5 \times 10^3 \text{ Jmol}^{-1}}{83.6 \text{ JK}^{-1}}$

So, the given reaction will be spontaneous at $T > 425$ K

53. (a)

(i) $N_2 \quad 3H_2 \rightleftharpoons 2NH_3; K_1 \quad \dfrac{NH_3^{\ 2}}{N_2 \quad H_2^{\ 3}}$

(ii) $N_2 \quad O_2 \rightleftharpoons 2NO; K_2 \quad \dfrac{NO^{\ 2}}{N_2 \quad O_2}$

(iii) $H_2 + \dfrac{1}{2}O_2 \longrightarrow H_2O; K_3 \quad \dfrac{H_2O}{H_2 \quad O_2^{\ 1/2}}$

Applying (II + 3 × III – I) we will get

$2NH_3 \quad \dfrac{5}{2}O_2 \overset{K}{\rightleftharpoons} 2NO \quad 3H_2O;$

$$K = \frac{NO^{\ 2}}{N_2 \quad O_2} \times \frac{H_2O^{\ 3}}{H_2^{\ 3} \times O_2^{\ 3/2}} \Big/ \frac{NH_3^{\ 2}}{N_2 \quad H_2^{\ 3}}$$

$\therefore \quad K = K_2 \times K_3^3 / K_1$

54. (d) Max. pressure of CO_2 = Pressure of CO_2 at equilibrium

For reaction,

$SrCO_3(s) \rightleftharpoons SrO(s) + CO_2(g)$

$K_p = P_{CO_2} = 1.6$ atm = maximum pressure of CO_2 volume of container at this stage.

$$V = \frac{nRT}{P} \qquad \ldots(i)$$

Since container is sealed and reaction was not earlier at equilibrium.

$\therefore \quad n$ = constant.

$$n = \frac{PV}{RT} \quad \frac{0.4 \times 20}{RT} \qquad \ldots(ii)$$

Put equation (ii) in equation (i)

$$V = \left[\frac{0.4 \times 20}{RT}\right]\frac{RT}{1.6} \quad 5L$$

55. (c)

$Ag_2C_2O_4(s) \rightleftharpoons \underset{2s}{2Ag^+} \text{ aq} \quad \underset{s}{C_2O_4^{2-}} \text{ aq}$

$K_{sp} = [Ag^+]^2 [C_2O_4^{2-}]$

$[Ag^+] = 2.2 \times 10^{-4}$ M

Given that:

$\therefore$ Concentration of $C_2O_4^{2-}$ ions,

$$\left[C_2O_4^{2-}\right] \quad \frac{2.2 \times 10^{-4}}{2} \text{M} \quad 1.1 \times 10^{-4} \text{M}$$

$\therefore \quad K_{sp} = (2.2 \times 10^{-4})^2 (1.1 \times 10^{-4})$

$= 5.324 \times 10^{-12}$

56. (d) Due to inert pair effect, Pb(II) is more stable than Pb(IV)

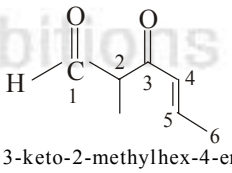
Sn(IV) is more stable than Sn(II)

$\therefore$ Pb(IV) is easily reduced to Pb(II) and can acts as an oxidising agent whereas Sn(II) is easily oxidised to Sn(IV) and can acts as a reducing agent.

NOTES

Inertness of ns^2 electrons of the valence shell to participate in bonding on moving down the group in heavier *p*-block elements is called inert pair effect. It occurs due to poor shielding of the ns^2 electrons of the valence shell by the intervening *d* and *f* electrons.

57. (d)



3-keto-2-methylhex-4-enal

Aldehydes get higher priority over ketone and alkene in numbering of principal carbon chain.

58. (c) The *o*-isomer is steam volatile due to intra-molecular H-bonding. The *p*-isomer is not steam volatile due to intermolecular *H*-bonding or association of molecules. Thus, both can be separated by steam distillation.

59. (c) Electrophite is a electron deficient species and can accpet pair of electrons from nucleophile

60. (c) There is no change in bond angles and bond lengths in the conformations of ethane.

61. (a) Correct order is

$$\underset{\text{Two acidic hydrogens}}{H-C\equiv C-H} > \underset{\text{One acidic hydrogen}}{H_3C-C\equiv C-H} \quad H_2C \quad CH_2 \quad CH_3-CH_3$$

62. (c) Hydration of alkynes give ketones.

$$H_3C-C\equiv CH- \rightarrow \underset{(A)}{H_3C-\overset{OH}{\overset{|}{C}}=CH_2}$$

$$\underset{(B)}{H_3C-\overset{O}{\overset{||}{C}}-CH_3} \xleftarrow{\text{Tautomerism}}$$

63. (a) Microorganisms present in the soil is a sink for CO.

NOTES

Microorganism present in soil convert CO to CO_2, thus it's sink.

64. (c) K_f (molal depression constant) only depends on the nature of the solvent and is independent of the concentration of the solution.

65. (a) Molarity depends on the volume of a solution which can be changed with change in temperature.

66. (c) Li^+ being smallest, has maximum charge density.

$\therefore$ Li^+ is most heavily hydrated among all alkali metal ions. Effective size of Li^+ in aqueous solution is therefore, largest. So, moves slowest under electric field.

67. (b) For cell,
$Zn|ZnSO_4(0.01\ M)\,||\,CuSO_4(1.0\ M)|Cu$

$$E_{cell} \quad E_{cell} - \frac{2.303RT}{nF}\log\frac{Zn^2}{Cu^2}$$

$$\therefore \quad E_1 \quad E_{cell} - \frac{2.303RT}{2\times F}\times\log\frac{0.01}{1}$$

When concentrations are changed for $ZnSO_4$ and $CuSO_4$, we can write

$$E_2 = E^\circ_{cell} - \frac{2.303RT}{2F}\times\log\frac{1}{0.01}$$

$\therefore$ $E_1 > E_2$

68. (c) Overall rate $= k[X][Y_2]$ …(1)
k = rate constant
Assuming step (i) to be reversible, its equilibrium constant,

$$k_{eq} \quad \frac{X^2}{X_2} \Rightarrow X^2 \quad k_{eq}\ X_2\ ;$$

$$X \quad k_{eq}^{\frac{1}{2}}\ X_2^{\frac{1}{2}} \qquad \ldots(2)$$

From eq (1) and (2)

$$\text{Rate} = kk_{eq}^{\frac{1}{2}}\ X_2^{\frac{1}{2}}\ Y_2$$

$$\text{Overall order} = \frac{1}{2} \quad 1 \quad \frac{3}{2} \quad 1.5$$

NOTES

The overall reaction rate depends on the rate of the slowest step.
i.e., Overall rate = Rate of slowest step

69. (a) Half life for a first order reaction,

$$t_{1/2} = \frac{0.693}{K}$$

$$\text{So, } t_{1/2} = \frac{0.693}{10^{-2}}\text{sec}.$$

Also, for the reduction of 20 g of reactant to 5 g, two half lives will be required.

$\therefore$ For 20 g of the reactant to reduce to 5 g, time taken,

$$t = 2\times\frac{0.693}{10^{-2}}\text{sec} = 138.6\text{ sec}.$$

70. (a) A catalyst speeds up both forward and backward reaction with the same rate.
So, equilibrium constant is not affected by the presence of a catalyst at any given temperature.

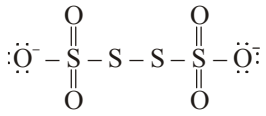
71. (c) Zn being more reactive than Ag and Au, displaces them.

NOTES

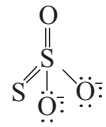
$$4Ag + 8NaCN + 2H_2O + O_2 \xrightarrow{\text{Leaching}} \underset{\text{Soluble Sodium dicyanoargentate (I)}}{4Na[Ag(CN)_2]} + 4NaOH$$

Soluble cyanide compound can be treated with Zn to give metal by displacement.

$$2Na[Ag(CN)_2] + Zn \xrightarrow{\text{Displacement}} Na_2[Zn(CN)_4] + 2Ag\downarrow$$

72. (a) 

$S_4O_6^{2-}$



$S_2O_3^{2-}$

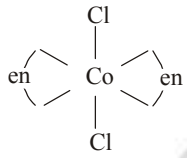
73. (a) $XX' \rightarrow$ Linear (e.g. ClF, BrF)
$XX_3' \rightarrow$ T-Shape (e.g. ClF_3, BrF_3)
$XX_5' \rightarrow$ Square pyramidal (e.g. BrF_5 IF_5)
$XX_7' \rightarrow$ Pentagonal bipyramidal (e.g. IF_7)

74. (a) Potassium permanganate has a purple colour. When sulphur dioxide reacts with potassium permanganate, the solution decolourises.

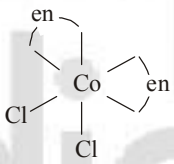
$$5SO_2 + 2KMnO_4 + 2H_2O \rightarrow 2H_2SO_4 + 2MnSO_4 + K_2SO_4$$

75. (b) Minimum or comparable energy gap between 5*f*, 6*d* and 7*s* subshell makes electron excitation easier, hence there is a greater range of oxidation states in actinoids.

76. (a) In the given complex, the CN of Co is 6, and the complex has octahedral geometry.



trans (optically inactive)



cis (optically active)

77. (b) In a solution containing $HgCl_2$, I_2 and I^-, both $HgCl_2$ and I_2 compete for I^-.
Since formation constant of $[HgI_4]^{2-}$ is very large (1.9×10^{30}) as compared with I_3^- ($K_f = 700$).
$\therefore$ I^- will preferentially combine with $HgCl_2$.

$$HgCl_2 + 2I^- \rightarrow \underset{\text{Red ppt}}{HgI_2\downarrow} + 2Cl^-$$

$$HgI_2 + 2I^- \rightarrow \underset{\text{soluble}}{HgI_4^{2-}}$$

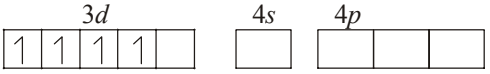
78. (d) The order of strength of ligand is
$en > NH_3 > H_2O$
For strong ligand, the value of Δ_0 for the complex is higher.

Hence, the increasing order of wavelengths of absorption is:

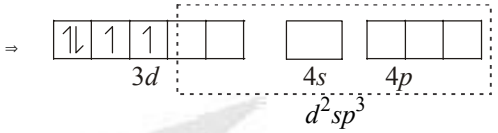
$[Co(en)_3]^{3+} < [Co(NH_3)_6]^{3+} < [Co(H_2O)_6]^{3+}$

NOTES Higher value of Δ_0 means higher stability, which means it will absorb high energy photons. High energy photons have low value of wavelength.

79. (b) In the complex $[Mn(CN)_6]^{3-}$, O.S. of Mn is +3
E.C. of $Mn^{+3} \rightarrow 3d^4$

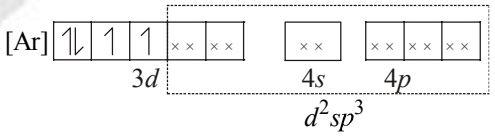


The presence of a strong field ligand CN^- causes pairing of electrons.



As, coordination number of Mn = 6, so it will form an octahedral complex.

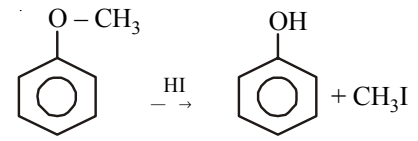
$\therefore$ $[Mn(CN)_6]^{3-}$ =



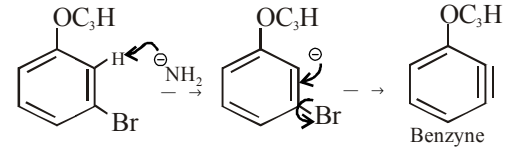
80. (a) Grignard's reagent (RMgX) is a σ-bonded organometallic compound.

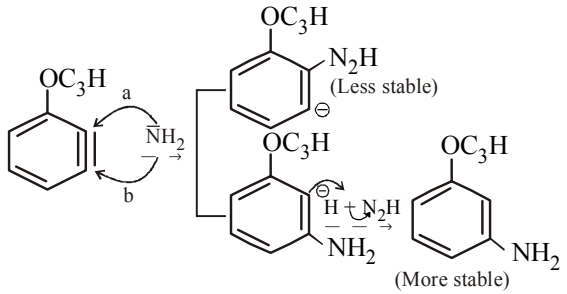
81. (c) Electron withdrawing – NO_2 group has very strong –I and –R effects so, compound 3 will be most acidic.

82. (b) When Ar – O – R ethers are reacted with HI, they are cleaved at weaker O – R bond to give phenol and alkyl iodide.



83. (d)





More stable as –ve charge is close to electron withdrawing group.

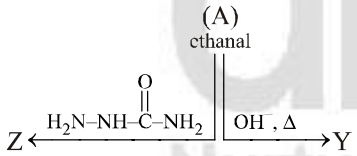
Also, incoming nucleophile gets attached on same 'C' on which 'Br' (Leaving group) was present.

∴ not a cine substitution reaction.

84. (b) Since 'A' gives positive silver mirror test therefore, it must be an aldehyde of α-Hydroxyketone. Also, reaction with OH^- *i.e.*, aldol condensation (by assuming alkali to be dilute) indicates that 'A' is aldehyde as aldol reaction of ketones is reversible and carried out in special apparatus. It indicates that 'A' is an aldehyde.

$$\underset{(X)}{CH_3 - CH_2OH} \xrightarrow[573K]{Cu} \underset{(A)}{CH_3 - CHO}$$

$$\xrightarrow[\Delta]{[Ag(NH_3)_2]OH^-} \text{silver mirror observed}$$



$$\underset{\text{3-Hydroxybutanal}}{CH_3 - \overset{OH}{\overset{|}{C}}H - CH_2 - CHO} \xrightarrow{\Delta}$$

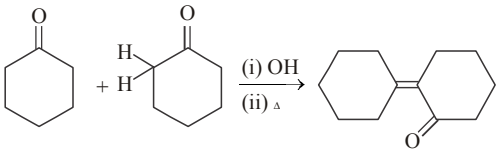
$$\underset{(Y)}{CH_3 - CH = CH - CHO}$$

But-2-enal

$$\underset{(Z)}{CH_3 - CH = N - NH - \overset{O}{\overset{\|}{C}} - NH_2}$$

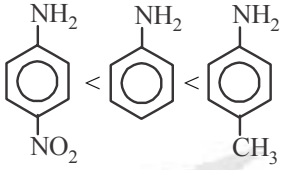
Semicarbazone

85. (a)



86. (c) $-NO_2$ group has strong – R effect and $-CH_3$ shows +R effect.

∴ Order of basic strength is



87. (a) $\underset{\text{acetamide}}{CH_3 - \overset{O}{\overset{\|}{C}} - NH_2} \quad Br_2 \quad 4NaOH \xrightarrow{\Delta}$

$$CH_3 - NH_2 + 2NaBr + Na_2CO_3 + 3H_2O$$

methanamine

It is called Hoffmann Bromamide reaction.

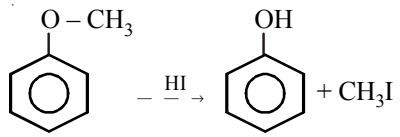
NOTES

Hoffmann bromamide reaction: Reaction of an acid amide with bromine in an aqueous or ethanolic solution of sodium hydroxide to form a primary amine, with one carbon atom less, is known as Hoffmann bromamide reaction.

88. (c) Due to denaturation of proteins, helix get uncoiled and protein loses its biological activity.

89. (a) Dettol is a mixture of chloroxylenol and terpineol which is a very commonly known antiseptic.

90. (b) When Ar – O – R ethers are reacted with HI, they are cleaved at weaker O – R bond to give phenol and alkyl iodide.



91. (d) Archaebacteria are able to survive in harsh conditions due to the presence of branched lipid chain in cell membrane that reduces fluidity of cell membrane.
It includes halophiles which are exclusively found in saline habitats.

NOTES
The halophiles, named after the Greek word for "salt-loving", are extremophiles that thrive in high salt concentrations. While most halophiles are classified into the domain Archaea, there are also bacterial halophiles and some eukaryotic species, such as the alga *Dunaliella salina* and fungus *Wallemia* ichthyophaga.

92. (c) Sticky character of the bacterial wall is due to glycocalyx which is rich in glycoproteins.

NOTES
When on eukaryotic cells the glycocalyx can be a factor used for the recognition of the cell. On bacterial cells, the glycocalyx provides a protective coat from host factors.

93. (b) Mycoplasmas are smallest, prokaryotes lacking cell wall and are pleomorphic in nature. These are pathogenic to both plants and animals.
94. (c) Viroids in nature are sub-viral agents as infectious RNA particles, without protein coat.
95. (a) *Volvox* is a motile colonial fresh water green alga. It forms spherical colonies. It was first observed with a light microscope by Van Leeuwenhoek (1700) within the volvocales.

NOTES
Volvox is autotrophs and contributes to oxygen production. They also serve as a food for various aquatic organisms such as microscopic invertebrates called rotifers.

96. (c) *Chlamydomonas* has haplontic life cycle hence shows zygotic meiosis.
97. (b) *Ectocarpus* exhibits haplodiplontic life cycle while *Fucus* has diplontic life cycle.
98. (d) Pinus is monoecious plant comprising of both male and female cones on same plant.
99. (c) Double fertilisation is a unique feature exhibited only by angiosperms. It involves both syngamy and triple fusion.
100. (b) In poriferans (sponges) choanocytes (collar cells) form lining of spongocoel. Flagella present in collar cells provide circulation to water in water canal system.

NOTES
By cooperatively moving their flagella, choanocytes generate a flow of water through the sponges' pores, into the spongocoel, and out through the osculum.

101. (b) Pharyngeal gill slits are present in hemichordates and in chordates. Notochord is present in chordates only. Ventral tubular nerve cord is present in non-chordates.
102. (b) Sharks and Trygon (sting ray) are the members of cartilaginous fish while Whale, Dolphin and Seals are aquatic mammals belong to class mammalia.
103. (a) Halophytes growing in saline soils show vivipary for seed germination and have pneumatophores for gaseous exchange.

NOTES
Psammophytes are plant that thrives in shifting sands, primarily in deserts. They are marked by a number of adaptations that enable them to exist on wind-blown sands. In such an environment, the plants are often covered with sand, or their root system is exposed.

104. (b) Thorns are hard, pointed straight structures for protection against grazing animal. These are modified stem.
105. (d) Coconut fruit is a drupe. A drupe is a fleshy fruit with thin skin and central stone containing the seed.
106. (b) The edible part of coconut is its endosperm. Coconut has double endosperm, liquid endosperm and cellular.
107. (d) In roots, the root hairs develops from zone of maturation. This zone is differentiated zone thus bearing root hairs.

NOTES
The occurrence of the root hair at the zone of maturation is because it is region from where the root is differentiated into tissue of the primary body. The root hair develop in this region and lives for a day. The root hair develops form the single epidermal cells and help to absorb water from the soil.

108. (b) Cork cambium undergoes periclinal division and cuts off thick walled suberised dead cells towards outside i.e. phellem (cork) and it cuts off thin walled living cells i.e., phelloderm on inner side.

NOTES
A mature cork cell is non-living and has cell walls that are composed of a waxy substance that is highly impermeable to gases and water called suberin. The layer of dead cells formed by the cork cambium provides the internal cells of the plants with extra insulation and protection.

109. (b) Cellulose microfibrils are arranged radially rather than longitudinally which makes easy for the stomata to open.
110. (b) During secondary growth in plants vascular cambium gives rise to secondary xylem and secondary phloem. Phelloderm is formed by cork cambium. Periderm is the corky outer layer formed in secondary thickening.

111. (b) Heartwood is inactive physiologically due to deposition of organic compounds and formation of tyloses so it will not conduct water and minerals..
112. (c) The vertebrates process myogenic heart which is self contractile system or autoexcitable; it will thus keep working outside the body for some time.
113. (c) The site of aerobic oxidation of carbohydrates in cells to generate ATP are mitochondria.
114. (c) Calcium and phosphorus are the remaining elements.
115. (a) Holoenzyme is conjugated enzyme which consists of a protein part called apoenzyme and a non-protein called cofactor. Coenzyme are also organic compounds but their association with apoenzyme is only transient and acts as cofactors.
116. (c) – Nucleic acids are polymers of nucleotides
– Proteins are polymers of amino acids
– Polysaccharides are polymers of monosaccharides
– Lipids are the tri-esters of fatty acids with glycerol.
117. (b) In bacteria DNA replication occurs in cytoplasm prior to fission. Prokaryotes due to their primitive nature do not show well marked S-phase.
118. (a) The correct sequence of events occur during mitosis would be as follows :
(i) DNA condensation occurs so that chromosomes become visible during early to mid-prophase.
(ii) Disassembly of nuclear membrane begins at late prophase or transition to metaphase.
(iii) Chromosomes align at equator during metaphase.
(iv) Centromere division occurs during anaphase forming daughter chromosomes.
(v) During anaphase segregation also occurs in which daughter chromosomes separate and move to opposite poles.
(vi) Telophase finally leads to formation of two daughter nuclei.
119. (b) During anaphase, Anaphase Promoting Complex (APC) is a protein necessary for separation of daughter chromosomes. A defective APC will cause the chromosomes fail to segregate during anaphase.

NOTES

The APC gene provides instructions for making the APC protein, which plays a critical role in several cellular processes. The APC protein acts as a tumor suppressor, which means that it keeps cells from growing and dividing too fast or in an uncontrolled way. People with mutations in the APC gene have familial adenomatous polyposis (FAP) or attenuated FAP (AFAP). You have an increased chance to develop multiple gastrointestinal polyps, colorectal cancer, and possibly other cancers. There are risk management options to detect cancer early or lower the risk to develop cancer.

120. (d) By convention, the water potential of pure water at standard temperature, which is not under any pressure, is taken to be zero. ($\Psi_w = 0$)
121. (b) In C_3 plants photosynthesis decreases at higher temperature due to increased photorespiration. C_4 plants have higher temperature optimum because of the presence of enzyme called pyruvate phosphate dikinase, which is sensitive to low temperature.
122. (a) In the mesophyll cells cytoplasm of C_4 plants like sugarcane, maize, sorghum etc. PEP is 3C compound which serves as primary CO_2 acceptor.
123. (c) Krebs cycle begins with condensation of acetyl CoA (2C) with oxaloacetic acid (4C) to form citric acid (6C).

NOTES

The citric acid cycle is regulated primarily by the concentration of ATP and NADH. The key control points are the enzymes isocitrate dehydrogenase and α-ketoglutarate dehydrogenase. α-Ketoglutarate dehydrogenase is inhibited by succinyl CoA and NADH, the products of the reaction that it catalyzes.

124. (b) Auxins helps to prevent premature leaf and fruit fall.
125. (a) – Kupffer-cells are phagocytic cells present in liver.
– Zymogen cells are enzyme producing cells which are secreted by pancreas.
– Paneth cell secrete lysozyme which acts as anti-bacterial agent, into the lumen of intestine.
– Argentaffin cells are hormone producing cells.
126. (c) In hepatic portal system, hepatic portal vein drains blood to liver from intestine.
127. (b) Total number of teeth in a human child is 20. In primary dentition premolars are absent.
128. (c) Rennin and Pepsin enzymes are present in the gastric juice whereas Maltase is present in the intestinal juice.
129. (d) Volume of air present in lungs after forceful expiration as residual volume prevents the collapsing of alveoli.

NOTES

Atelectasis is a complete or partial collapse of the entire lung or area (lobe) of the lung. It occurs when the tiny air sacs (alveoli) within the lung become deflated or possibly filled with alveolar fluid. Atelectasis is one of the most common breathing (respiratory) complications after surgery.

130. (d) In human RBCs, nucleus get degenerates during maturation and it provide more space for oxygen carrying pigment (haemoglobin). It lacks many cell organelles including mitochondria so respires anaerobically.

131. (d) Descending limb of loop of Henle is permeable to water but impermeable to electrolytes whereas ascending limb is impermeable to water but permeable to electrolytes.

NOTES

The descending loop of Henle receives isotonic (300 mOsm/L) fluid from the proximal convoluted tubule (PCT). Substances reabsorbed in the PCT include urea, water, potassium, sodium, chloride, glucose, amino acids, lactate, phosphate, and bicarbonate.

132. (b) Pivot joint is a type of synovial joint which provide freely movement between atlas and axis vertebrae of vertebral column.

NOTES

The pivot joints (and the other joints) can be affected by such conditions as the following: Ankylosis: The fusion of bones across a joint. It is often a complication of arthritis. Ankylosing spondylitis: A type of inflammatory arthritis that progresses to ankylosis.

133. (d) In human, 12 pairs of ribs are present out of which 7 pairs of ribs (1st to 7th pair) are dorsally attached to vertebral column and ventrally to the sternum.

134. (d) Myelin sheath wrapped around the nerve axon. Oligodendrocytes are neuroglial cells which produce myelin sheath in central nervous system while Schwann cell produces myelin sheath in peripheral nervous system.

NOTES

The demyelinating form of Guillain-Barre syndrome destroys the protective covering of the peripheral nerves (myelin sheath), preventing the nerves from transmitting signals to the brain.

135. (c) Pre-synaptic membrane is involved in the release of neurotransmitter in the chemical synapse. The receptors sites for neurotransmitters are present on post-synaptic membrane of neuron.

136. (a) Carotene is the source of retinal which is involved in formation of rhodopsin of rod cells. Retinal, a derivative of vitamin A, is the light-absorbing part of all visual photopigments. Photopigments are occur entirely on the surface of membrane disc.

137. (a) A decrease in blood pressure / volume stimulates the release of renin, aldosterone, and ADH while increase in blood pressure / volume stimulates the release of Atrial Natriuretic Factor (ANF) secreted by atria of heart, which causes vasodilation and also inhibits RAAS (Renin Angiotensin Aldosterone System) mechanism that decreases the blood volume/pressure.

138. (a) Insect pollinated plants provide rewards as edible pollen grain and nectar as usual rewards. In order to materialize and maximize pollination flowers have developed a set of attributes which are aimed at attracting the pollinators called attractants.

139. (b) Wind pollination or anemophily occurs in flowers which are having a single ovule in each ovary, and numerous flowers packed in an inflorescence. It is a non-directional pollination.

140. (a) Autogamy occurs in bisexual flowers. Geitonogamous flowers are unisexual but present in the same plant. Dioecious condition is observed when unisexual male and female flowers are present on different plants and it prevents both autogamy and geitonogamy.

141. (b) The first cell of female gametophytic generation in angiosperm is megaspore. It undergoes three successive mitotic division to form 8-nucleated and 7-celled embryo sac.

142. (c) Capacitation is increase in fertilising capacity of sperms which occurs in female reproductive tract. It is required to render sperm to fertilize an oocyte.

143. (d) Cu^{2+} interfere in the sperm movement, which suppress the sperm motility and fertilising capacity of sperms.

NOTES

The hormones present in the IUDs prevent pregnancy in two ways as hormonal IUDs make the mucus on cervix thicker and this mucus blocks sperm to fertilize the egg. Whereas the hormones in the IUD can also stop eggs from leaving ovaries (called ovulation), which means there's no egg for a sperm to fertilize.

144. (b) Infertility cases due to inability of the male partner to inseminate the female or due to very low sperm count in the ejaculates, could be corrected by using artificial insemination (AI) technique. In this procedure, semen is injected directly into the vagina or uterus.

145. (b) Husband × Wife

I^AI^B I^Ai

♀ \ ♂	I^A	I^B
I^A	I^AI^A	I^AI^B
i	I^Ai	I^Bi

Number of genotypes = 4
Number of phenotypes = 3
I^AI^A and I^Ai = A
I^AI^B = AB
I^Bi = B

146. (a) During his experiments Mendel have taken seven characters in a pea plant. Among these, nature of trichomes i.e., glandular or non-glandular was not considered by Mendel.

147. (d) According to NCERT, Mendel conducted hybridisation experiments for 7 years on Pea plant between 1856 to 1863 and his data was published in 1865.
148. (b) Thalassemia is a quantitative problem of synthesising very few globin molecules while sickle cell anaemia is a qualitative problem of synthesising an incorrectly functioning globin.
149. (d) Down's syndrome is caused by non-disjunction of 21st chromosome i.e. Trisomy.
150. (a) Hershey and Chase proved that DNA as genetic material. They used bacteriophage for their experiment.
151. (a) DNA fragments are negatively charged because of presence of phosphate group.
152. (d) Ribosomal RNA (rRNA) is most abundant in animal cell. It constitutes 80% of total RNA of the cell.
153. (b) The association of H1 protein indicates the complete formation of nucleosome which requires DNA condensation. The DNA is therefore in condensed form.
154. (b) If deletion happens at 901st position then the remaining 98 bases specifying for 33 codons of amino acids will be altered.
155. (c) Two DNA polymerase molecules simultaneously work at the DNA fork, one on the leading strand and the other on the lagging strand. DNA polymerase synthesizes each Okazaki fragment at lagging strand in 5′-3′ direction. As the replication fork opens further, new Okazaki fragments appear. The first Okazaki fragment appears away from the replication fork and thus the direction of elongation would be away from replication fork.
156. (c) In eukaryotes, spliceosomes are used in removal of introns during post-transcriptional processing of hnRNA. They are absent in prokaryotes.
157. (a) Horse belongs to
Orders - Perissodactyla
Family - Equidae
Genus - *Equus*
Species - *ferus*
Subspecies - *caballus*
158. (a) Cell mediated immune response causes non-acceptance or rejection of graft or transplanted tissues/organs.
Transplant rejection is caused primarily by a cell-mediated immune response to HLA antigens expressed on donor antigen-presenting cells (APCs) transferred along with the transplanted organ. Recognition of donor HLA antigens on the cells of the graft induces vigorous T cell proliferation in the recipient.

NOTES

B cells and anti-HLA antibodies have recently been shown to play an important role in both acute and chronic allograft rejection. The presence of CD20+ B cells and plasma cells infiltrating allograft has been found to correlate with irreversible acute rejection episodes.

159. (d) MALT or Mucosa Associated Lymphoid Tissue constitutes about 50 percent of the lymphoid tissue in human body. It is scattered along mucosal lining in the human body.

NOTES

Mucosa-associated lymphoid tissue (MALT) is scattered along mucosal linings in the human body and constitutes the most extensive component of human lymphoid tissue. These surfaces protect the body from an enormous quantity and variety of antigens.

160. (d) Inbreeding increases homozygosity. So, mating of the related indi viduals of same breed will give homozygous purelines.

NOTES

By inbreeding, individuals are further decreasing genetic variation by increasing homozygosity in the genomes of their offspring. The likelihood of deleterious recessive alleles to pair is significantly higher in a small inbreeding population than in a larger inbreeding population.

161. (b) Primary treatment is a physical process which involves two process, i.e. filtration and sedimentation of big solid waste.
162. (c) *Saccharomyces cerevisiae* commonly know as Brewer's yeast, causes fermentation of carbohydrates and produces ethanol.
163. (c) Ethidium bromide (EtBr) is used to stain the DNA fragments and will appear as orange coloured bands when kept under UV light.

NOTES

Ethidium bromide dye is most commonly used for the detection of DNA/ RNA. It is a DNA intercalating agent, inserting itself into the spaces between the base pairs of the double helix. It possesses UV absorbance maxima at 300 and 360 nm.

164. (d) Selectable markers in recombinant DNA technology, helps in identification and elimination of non-transformants and selectively permits the growth of the transformants.
165. (a) DNA fragments during gel electrophoresis, separate (resolve) according to their size due to sieving effect provided by agarose gel.

NOTES

Loading buffer is used in gel and SDS-PAGE electrophoresis in order to increases the density of the sample. DNA loading buffers contains a coloured dye and a density agent. The density agent serves to enhance the density of the DNA sample allowing the DNA to sink into the bottom of the well. The dye adds visibility to the DNA sample and also serves as a tracking dye allowing the user to monitor the DNA migration during electrophoresis.

166. (a) The various stages of processing that occur after the completion of fermentation or biosynthetic stage which include separation and purification of product called downstream processing.

NOTES

The most important objective in downstream processing is to maximize product recovery and, at the same time, minimize the cost of production.

167. (a) The tropical rain forest have five vertical strata on the basis of plants height i.e., ground vegetation, shrubs, short canopy trees, tall canopy trees and tall emergent trees.

NOTES

The tropical rainforest have hot and wet climate because it is on the equator the sun's rays will always be directly shining on them. Rainforests are wet because the air pressure at the equator is low. Air is sucked in from the oceans which contains moisture.

168. (a) In logistic growth curve, the curve has an upper a symptote known as carrying capacity (K) is obtained when the maximum population size is at $\frac{dN}{dt} = 0$. A population growing in a habitat with limited resources shows logistic growth curve.

For logistic growth,

$$\frac{dN}{dt} = rN\left(\frac{K - N}{K}\right)$$

If K = N then $\frac{K - N}{K} = 0$

$\therefore \quad \frac{dN}{dt} = 0.$

The population reaches asymptote.

NOTES

Carrying capacity is widely used as an indicator of environmental sustainability. It often serves as the basis for sustainable development policies that attempt to balance the needs of today against the resources that will be needed in the future.

169. (c) Mycorrhizae is a symbiotic association between fungi and roots of higher plants.

NOTES

The population interaction is a very important one as it ensures that there is stability in the ecosystem. The two main populations interacting in predation are the predators and the prey. The species diversity in a community is also maintained by the predators. They reduce the intensity of the competition between prey species.

170. (d) Forest ecosystem has the maximum biomass. Some very high productive ecosystem are
– Tropical rain forest
– Coral reef
– Estuaries
– Sugarcane fields

171. (b) Alexander Von Humboldt noticed that within a region species richness increases with the increase in area.

172. (b) Aerosols through its direct or indirect effects on plants can cause various problems in agriculture. However, continuous increase in air pollution may represent a threat to agriculture in the future that is persistent and largely irreversible.

173. (a) Artificial selection to obtain cow yielding higher milk output will shift the peak to one direction, so this represent an example of Directional selection. In stabilizing selection, the organisms with the mean value of the trait are selected. In disruptive selection, both extremes get selected.

174. (a) *Rhodospirillum* is facultative anaerobe and free living nitrogen fixer. Mycorrhiza show symbiotic relationship between fungi and roots of higher plants.

175. (d) Ex-situ conservation is offsite strategy for conservation of biological diversity in zoological park and botanical gardens respectively.

176. (b) Corpus luteum is the temporary endocrine gland formed in the ovary after ovulation. It release hormones like progesterone, oestrogen etc.

177. (d) Gonorrhoea – *Neisseria* (Bacteria)
Syphilis – *Treponema* (Bacteria)
Genital Warts – *Human papilloma virus*
AIDS – HIV (Virus)

178. (b) Primary treatment is a physical process which involves two process, i.e. filtration and sedimentation of big solid waste.

179. (c) In male frog the sperms passage is:
Testes → Vasa efferentia → Kidney → Bidder's canal → Urinogenital duct → Cloaca.

180. (a) GnRH is secreted by hypothalamus which stimulates anterior pituitary gland for the secretion of gonadotropins (FSH and LH).