

SOLVED PAPER

AIIMS - 2010

Time : 3½ Hours

Max. Marks : 200

PHYSICS

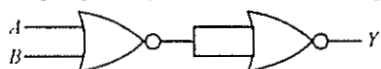
1. Transmission lines transmit a voltage of V volt to our houses from power stations, then the power P supplied by them is proportional to

- (a) $\frac{1}{V}$ (b) V
 (c) V^2 (d) $\frac{1}{V^2}$

2. Whenever a stream of electrons collides with a stream of photons, in this collision, which of the following is not conserved?

- (a) Linear momentum
 (b) Total energy
 (c) No. of photons
 (d) No. of electrons

3. The logic gate represented in following figure is



- (a) OR Gate (b) NOT Gate
 (c) NAND Gate (d) XOR Gate

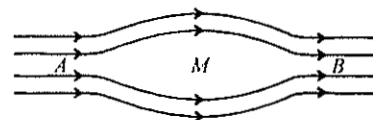
4. For a person near point of vision is 100 cm. Then the power of lens he must wear so as to have normal vision, should be

- (a) +1 D (b) -1 D
 (c) +3 D (d) -3 D

5. Two projectiles of same mass have their maximum kinetic energies in ratio 4 : 1 and ratio of their maximum heights is also 4 : 1 then what is the ratio of their ranges ?

- (a) 2 : 1 (b) 4 : 1
 (c) 8 : 1 (d) 16 : 1

6. An uncharged particle is moving with a velocity of \vec{v} in non-uniform magnetic field as shown.



Velocity \vec{v} would be

- (a) Maximum at A & B
 (b) Minimum at A & B
 (c) Maximum at M (d) Same at all points

7. Which of the following is true regarding diamagnetic substances (symbols have their usual meaning)

- (a) $\mu_r > 1, \chi_m > 1$ (b) $\mu_r > 1, \chi_m < 1$
 (c) $\mu_r < 1, \chi_m < 0$ (d) $\mu_r < 1, \chi_m > 0$

8. What is moment of inertia of a cylinder of radius r , along its height ?

- (a) mr^2 (b) $\frac{mr^2}{2}$
 (c) $\frac{2mr^2}{5}$ (d) $\frac{mr^2}{5}$

9. A uniform string is vibrating with a fundamental frequency ' f '. The new frequency, if radius & length both are doubled would be

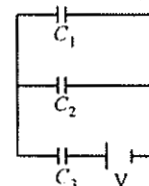
- (a) $2f$ (b) $3f$
 (c) $\frac{f}{4}$ (d) $\frac{f}{3}$

10. Two spherical soap bubbles of radii a and b in vacuum coalesce under isothermal conditions. The resulting bubbles has a radius given by

- (a) $\frac{(a+b)}{2}$ (b) $\frac{ab}{a+b}$
 (c) $\sqrt{a^2+b^2}$ (d) $a+b$

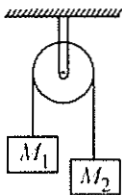
11. What would be the voltage across C_3 ?

- (a) $\frac{(C_1+C_2)V}{C_1+C_2+C_3}$
 (b) $\frac{C_1V}{C_1+C_2+C_3}$



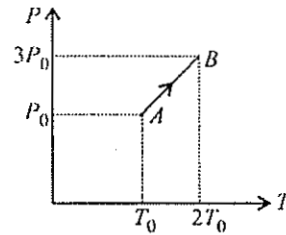
(c) $\frac{C_2V}{C_2 + C_2 + C_3}$
 (d) $\frac{C_3V}{C_1 + C_2 + C_3}$

12. What would be maximum wavelength for Brackett series of hydrogen-spectrum?
 (a) 74583 Å (b) 22790 Å
 (c) 40519 Å (d) 18753 Å
13. What would be the radius of second orbit of He⁺ ion?
 (a) 1.058 Å (b) 3.023 Å
 (c) 2.068 Å (d) 4.458 Å
14. The position of a particle moving in the x - y plane at any time t is given by; $x = (3t^3 - 6t)$ metres; $y = (t^2 - 2t)$ metres. Select the correct statement.
 (a) acceleration is zero at $t = 0$
 (b) velocity is zero at $t = 0$
 (c) velocity is zero at $t = 1$ s
 (d) velocity and acceleration of the particle are never zero.
15. Two masses $M_1 = 5$ kg and $M_2 = 10$ kg are connected at the ends of an inextensible string passing over a frictionless pulley as shown. When the masses are released, then the acceleration of the masses will be

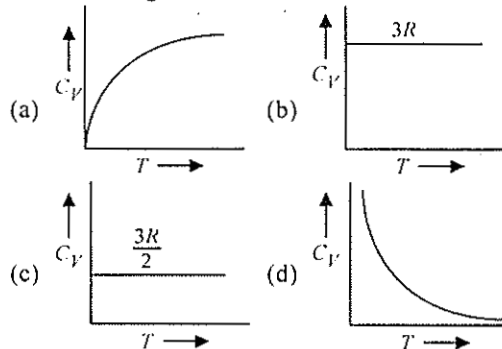


- (a) g (b) $g/2$
 (c) $g/3$ (d) $g/4$
16. A block of mass m is pulled along a horizontal surface by applying a force at an angle θ with the horizontal. If the block travels with a uniform velocity and has a displacement d and the coefficient of friction is μ , then the work done by the applied force is
 (a) $\frac{\mu mgd}{\cos \theta + \mu \sin \theta}$ (b) $\frac{\mu mgd \cos \theta}{\cos \theta + \mu \sin \theta}$
 (c) $\frac{\mu mgd \sin \theta}{\cos \theta + \mu \sin \theta}$ (d) $\frac{\mu mgd \cos \theta}{\cos \theta - \mu \sin \theta}$

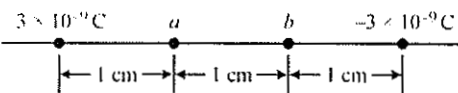
17. Pressure versus temperature graph of an ideal gas is as shown in figure. Density of the gas at point A is ρ_0 . Density at point B will be



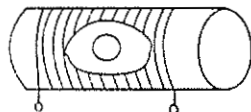
- (a) $\frac{3}{4}\rho_0$ (b) $\frac{3}{2}\rho_0$
 (c) $\frac{4}{3}\rho_0$ (d) $2\rho_0$
18. The latent heat of vaporisation of a substance is always
 (a) greater than its latent heat of fusion
 (b) greater than its latent heat of sublimation
 (c) equal to its latent heat of sublimation
 (d) less than its latent heat of fusion
19. A reversible engine converts one-sixth of the heat input into work. When the temperature of the sink is reduced by 62°C, the efficiency of the engine is doubled. The temperatures of the source and sink are
 (a) 99°C, 37°C (b) 80°C, 37°C
 (c) 95°C, 37°C (d) 90°C, 37°C
20. Graph of specific heat at constant volume for a monoatomic gas is



21. In figure, a particle having mass $m = 5$ g and charge $q' = 2 \times 10^{-9}$ C starts from rest at point a and moves in a straight line to point b . What is its speed v at point b ?



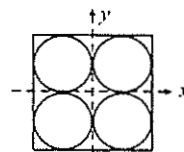
- (a) 2.65 cms^{-1} (b) 3.65 cms^{-1}
 (c) 4.65 cms^{-1} (d) 5.65 cms^{-1}
22. A galvanometer has a current sensitivity of 1 mA per division. A variable shunt is connected across the galvanometer and the combination is put in series with a resistance of 500Ω and cell of internal resistance 1Ω . It gives a deflection of 5 division for shunt of 5 ohm and 20 division for shunt of 25 ohm. The emf of cell is
 (a) 47.1 V (b) 57.1 V
 (c) 67.1 V (d) 77.1 V
23. A circular coil with a cross-sectional area of 4 cm^2 has 10 turns. It is placed at the center of a long solenoid that has 15 turns/cm and a cross-sectional area of 10 cm^2 , as shown in the figure. The axis of the coil coincides with the axis of the solenoid. What is their mutual inductance ?



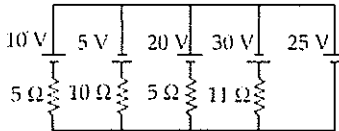
- (a) $7.54 \mu\text{H}$ (b) $8.54 \mu\text{H}$
 (c) $9.54 \mu\text{H}$ (d) $10.54 \mu\text{H}$
24. If K_1 and K_2 are maximum kinetic energies of photoelectrons emitted when lights of wavelengths λ_1 and λ_2 respectively incident on a metallic surface. If $\lambda_1 = 3\lambda_2$, then
 (a) $K_1 > (K_2/3)$ (b) $K_1 < (K_2/3)$
 (c) $K_1 = 2K_2$ (d) $K_2 = 2K_1$
25. Two radioactive substances A and B have decay constants 5λ and λ respectively. At $t = 0$, they have the same number of nuclei. The ratio of number of nuclei of A to those of B will be $(1/e^2)$ after a time
 (a) 4λ (b) 2λ
 (c) $\frac{1}{2\lambda}$ (d) $\frac{1}{4\lambda}$
26. The intensity of gamma radiation from a given source is I . On passing through 36 mm of lead, it is reduced to $I/8$. The thickness of lead which will reduce the intensity to $I/2$ will be

- (a) 18 mm (b) 12 mm
 (c) 6 mm (d) 9 mm

27. An electric charge $10^{-3} \mu\text{C}$ is placed at the origin (0, 0) of (x-y) co-ordinate system. Two points A and B are situated at $(\sqrt{2}, \sqrt{2})$ and (2,0) respectively. The potential difference between the points A and B will be
 (a) 4.5 volt (b) 9 volt
 (c) zero (d) 2 volt
28. If the energy, $E = G^p h^q c^r$, where G is the universal gravitational constant, h is the Planck's constant and c is the velocity of light, then the values of p, q and r are, respectively
 (a) $-1/2, 1/2$ and $5/2$ (b) $1/2, -1/2$ and $-5/2$
 (c) $-1/2, 1/2$ and $3/2$ (d) $1/2, -1/2$ and $-3/2$
29. Four holes of radius R are cut from a thin square plate of side $4R$ and mass M. The moment of inertia of the remaining portion about z-axis is



- (a) $\frac{\pi}{12} MR^2$ (b) $\left(\frac{4}{3} - \frac{\pi}{4}\right) MR^2$
 (c) $\left(\frac{4}{3} - \frac{\pi}{6}\right) MR^2$ (d) $\left(\frac{8}{3} - \frac{10\pi}{16}\right) MR^2$
30. A liquid is kept in a cylindrical vessel which is being rotated about a vertical axis through the centre of the circular base. If the radius of the vessel is r and angular velocity of rotation is ω , then the difference in the heights of the liquid at the centre of the vessel and the edge is
 (a) $\frac{r\omega}{2g}$ (b) $\frac{r^2\omega^2}{2g}$
 (c) $\sqrt{2gr\omega}$ (d) $\frac{\omega^2}{2gr^2}$
31. A block of mass 10 kg is moving in x-direction with a constant speed of 10 m/s. It is subjected to a retarding force $F = 0.1x$ joule/metre during its travel from $x = 20$ m to $x = 30$ m. Its final K.E. will be
 (a) 475 J (b) 450 J
 (c) 275 J (d) 250 J

32. A capillary tube of radius r is immersed in water and water rises in it to a height h . The mass of water in the capillary tube is 5 g. Another capillary tube of radius $2r$ is immersed in water. The mass of water that will rise in this tube is
 (a) 2.5 g (b) 5.0 g
 (c) 10 g (d) 20 g
33. Which of the following pairs does not have same dimensions ?
 (a) impulse and momentum
 (b) moment of inertia and moment of force
 (c) angular momentum and Planck's constant
 (d) work and torque.
34. The wavelength of Lyman series for first number is
 (a) $\frac{4 \times 1.097 \times 10^7}{3}$ m (b) $\frac{3}{4 \times 1.097 \times 10^7}$ m
 (c) $\frac{4}{3 \times 1.097 \times 10^7}$ m (d) $\frac{3}{4} \times 1.097 \times 10^7$ m
35. In the circuit shown, current flowing through 25 V cell is
- 
- (a) 7.2 A (b) 10 A
 (c) 12 A (d) 14.2 A
36. Five sinusoidal waves have the same frequency 500 Hz but their amplitudes are in the ratio $2 : \frac{1}{2} : \frac{1}{2} : 1 : 1$ and their phase angles $0, \frac{\pi}{6}, \frac{\pi}{3}, \frac{\pi}{2}$ and π respectively. The phase angle of resultant wave obtained by the superposition of these five waves is
 (a) 30° (b) 45°
 (c) 60° (d) 90°
37. The second overtone of an open pipe has the same frequency as the first overtone of a closed pipe 2 m long. The length of the open pipe is
 (a) 8 m (b) 4 m
 (c) 2 m (d) 1 m
38. Let T_1 and T_2 be the time periods of springs A and B when mass M is suspended from one end of each

spring. If both springs are taken in series and the same mass M is suspended from the series combination, the time period is T , then

- (a) $T_1 + T_2 + T_3$ (b) $\frac{1}{T} = \frac{1}{T_1} + \frac{1}{T_2}$
 (c) $T^2 = T_1^2 + T_2^2$ (d) $\frac{1}{T^2} = \frac{1}{T_1^2} + \frac{1}{T_2^2}$
39. Alternating current cannot be measured by D.C. ammeter because
 (a) A.C. cannot pass through D.C. ammeter
 (b) A.C. changes direction
 (c) average value of current for complete cycle is zero
 (d) D.C. ammeter will get damaged
40. The core of any transformer is laminated so as to
 (a) reduce the energy loss due to eddy currents
 (b) make it light weight
 (c) make it robust & strong
 (d) increase the secondary voltage

Directions : In the following questions (41-60), a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as :

- (a) If both assertion and reason are true and reason is the correct explanation of assertion
 (b) If both assertion and reason are true but reason is not the correct explanation of assertion
 (c) If assertion is true but reason is false
 (d) If both assertion and reason are false.
41. **Assertion :** Two balls of different masses are thrown vertically upward with same speed. They will pass through their point of projection in the downward direction with the same speed.
Reason : The maximum height and downward velocity attained at the point of projection are independent of the mass of the ball.
42. **Assertion :** In javelin throw, the athlete throws the projectile at an angle slightly more than 45° .
Reason : The maximum range does not depend upon angle of projection.

43. **Assertion** : The apparent weight of a body in an elevator moving with some downward acceleration is less than the actual weight of a body.
Reason : The part of the weight is spent in producing downward acceleration, when body is in elevator.
44. **Assertion** : An electric field is preferred in comparison to magnetic field for detecting the electron beam in a television picture tube.
Reason : Electric field requires low voltage.
45. **Assertion** : A horse has to pull a cart harder during the first few steps of his motion.
Reason : The first few steps are always difficult.
46. **Assertion** : The magnetic poles of earth do not coincide with the geographic poles.
Reason : The discrepancy between the orientation of a compass and true north-south direction is known as magnetic declination.
47. **Assertion** : Electromagnetic waves are transverse in nature
Reason : The electric and magnetic fields of an e.m. wave are perpendicular to each other and also perpendicular to the direction of wave propagation.
48. **Assertion** : A wheel moving down a perfectly frictionless inclined plane will undergo slipping (not rolling motion)
Reason : For perfect rolling motion, work done against friction is zero.
49. **Assertion** : A hollow shaft is found to be stronger than a solid shaft made of same material.
Reason : The torque required to produce a given twist in hollow cylinder is greater than that required to twist a solid cylinder of same size and material.
50. **Assertion** : Water kept in an open vessel will quickly evaporate on the surface of the moon.
Reason : The temperature at the surface of the moon is much higher than boiling point of water.
51. **Assertion** : A pure semiconductor has negative temperature coefficient of resistance.
Reason : On raising the temperature, more charge carriers are released, conductance increases and resistance decreases.
52. **Assertion** : At a fixed temperature, silicon will have a minimum conductivity when it has a smaller acceptor doping.
Reason : The conductivity of an intrinsic semiconductor is slightly higher than that of a lightly doped p -type
53. **Assertion** : Communication in UHF/VHF regions can be established by space wave or tropospheric wave.
Reason : Communication in UHF/VHF regions is limited to line of sight distance.
54. **Assertion** : If objective and eye lenses of a microscope are interchanged then it can work as telescope.
Reason : The objective lens of telescope has small focal length.
55. **Assertion** : If a proton and an α -particle enter a uniform magnetic field perpendicularly with the same speed, the time period of revolution of α -particle is double that of proton.
Reason : In a magnetic field, the period of revolution of a charged particle is directly proportional to the mass of the particle and is inversely proportional to charge of particle.
56. **Assertion** : If momentum of a body increases by 50%, its kinetic energy will increase by 125%.
Reason : Kinetic energy is proportional to square of velocity.

57. **Assertion** : The difference in the value of acceleration due to gravity at pole and equator is proportional to square of angular velocity of earth.

Reason : The value of acceleration due to gravity is minimum at the equator and maximum at the pole.

58. **Assertion** : It is advantageous to transmit electric power at high voltage.

Reason : High voltage implies high current.

59. **Assertion** : X-ray astronomy is possible only from satellites orbiting the earth.

Reason : Efficiency of X-rays telescope is large as compared to any other telescope.

60. **Assertion** : The de Broglie equation has significance for any microscopic or sub-microscopic particles.

Reason : The de Broglie wavelength is inversely proportional to the mass of the object if velocity is constant.

CHEMISTRY

61. Butter is an example of which type of colloid?

- (a) Solid in liquid (b) Liquid in solid
(c) Liquid in liquid (d) Gas in liquid.

62. What are constituents of 'Mischmetal'?

- (a) La, Fe (b) La, Ce
(c) Fe, Ce (d) Ce, Cu

63. For a 1st order reaction if concentration is doubled then rate of reaction becomes

- (a) doubles (b) half
(c) four times (d) remains same.

64. In tetragonal crystal system, which of following is not true?

- (a) All axial lengths and all axial angles are equal.
(b) All three axial lengths are equal.
(c) All three axial angles are equal.
(d) Two axial angles are equal but the third is different.

65. Which of the following is correct?

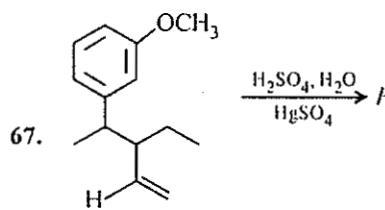
- (a) Ionic radius is proportional to atomic number.
(b) Ionic radius is inversely proportional to atomic mass.

(c) Ionic radius is inversely proportional to effective nuclear charge.

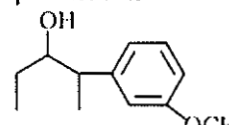
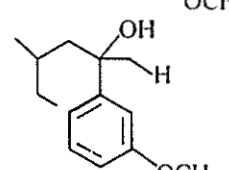
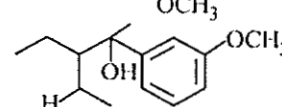
(d) All are correct.

66. The strained tetracyclic alkane is isomerized thermally to the cyclic alkene. The reaction involves

- (a) free radical (b) carbocation
(c) carbanion (d) carbene.



The product P is

- (a) 
(b) 
(c) 
(d) none of these.

68. For a reaction $X \rightarrow Y$, the graph of the product concentration (x) versus time (t) came out to be a straight line passing through the origin. Hence

the graph of $\frac{-d[X]}{dt}$ and time would be

- (a) straight line with a negative slope and an intercept on y-axis
(b) straight line with a positive slope and an intercept on y-axis
(c) a straight line parallel to x-axis
(d) a hyperbola.

69. A factory produces 40 kg of calcium in two hours by electrolysis. How much aluminium can be produced by same current in 2 hours if current efficiency is 50%?

- (a) 22 kg (b) 18 kg
(c) 9 kg (d) 27 kg.

70. Equal weight of CO and CH₄ are mixed together in an empty container at 300 K. The fraction of total pressure exerted by CH₄ is

- (a) $\frac{16}{17}$ (b) $\frac{7}{11}$
 (c) $\frac{8}{9}$ (d) $\frac{5}{16}$

71. Match list I with list II and select the correct answer using the codes given below the lists.

	List I Metal ion		List II Magnetic moment(BM)
A.	Cr ³⁺	1.	$\sqrt{35}$
B.	Fe ²⁺	2.	$\sqrt{30}$
C.	Ni ²⁺	3.	$\sqrt{24}$
D.	Mn ²⁺	4.	$\sqrt{15}$
		5.	$\sqrt{8}$

Codes

- (a) A-1, B-3, C-5, D-4
 (b) A-2, B-3, C-5, D-1
 (c) A-4, B-3, C-5, D-1
 (d) A-4, B-5, C-3, D-1
72. Which of the following reactions does not yield an amine?
- (a) $R-X + NH_3 \longrightarrow$
 (b) $R-CH=NOH + [H] \xrightarrow{Na/C_2H_5OH}$
 (c) $R-CN + H_2O \xrightarrow{H^+}$
 (d) $R-CONH_2 \xrightarrow{LiAlH_4}$
73. The chemical name for melamine is
- (a) 1,3,5-Triamino-2,4,6-triazine
 (b) 2,4,6-Triamino-1,3,5-triazine
 (c) 2-Amino-1,3,5-triazine
 (d) 2,4-Diamino-1,3,5-triazine.
74. Bromine is added to cold dilute aqueous solution of NaOH. The mixture is boiled. Which of the following statements is not true?
- (a) During the reaction bromine is present in four different oxidation states.
 (b) The greatest difference between the various oxidation states of bromine is 5.
 (c) On acidification of the final mixture bromine is formed.
 (d) Disproportionation of bromine occurs during the reaction.

75. A complex PtCl₄.5NH₃ shows a molar conductance of 402 ohm⁻¹ cm² mol⁻¹ in water and precipitates three moles of AgCl with AgNO₃ solution. The formula of the complex is

- (a) [Pt(NH₃)₆]Cl₄ (b) [Pt(NH₃)₄Cl₂]Cl₂
 (c) [Pt(NH₃)₅Cl]Cl₃ (d) [Pt(NH₃)₃Cl₃]Cl.

Electrolyte	KCl	KNO ₃	HCl	NaOAc	NaCl
Λ^∞ (S cm ² mol ⁻¹)	149.9	145.0	426.2	91.0	126.5

76.

Calculate Λ^∞_{HOAC} using appropriate molar conductances of the electrolytes listed above at infinite dilution in H₂O at 25°C.

- (a) 517.2 (b) 552.7
 (c) 390.7 (d) 217.5

77. In the ground state of Cu⁺, the number of shells occupied, subshells occupied, filled orbitals and unpaired electrons respectively are

- (a) 4, 8, 15, 0 (b) 3, 6, 15, 1
 (c) 3, 6, 14, 0 (d) 4, 7, 14, 2

78. Which of the following conditions is not correct for resonating structures?

- (a) The contributing structures must have the same number of unpaired electrons.
 (b) The contributing structures should have similar energies.
 (c) The contributing structures should be so written that unlike charges reside on atoms that are far apart.
 (d) The positive charge should be present on the electropositive element and the negative charge on the electronegative element.

79. CaO and NaCl have the same crystal structure and approximately the same ionic radii. If U is the lattice energy of NaCl, the approximate lattice energy of CaO is

- (a) $U/2$ (b) U
 (c) $2U$ (d) $4U$

80. The phosphate of a metal has the formula $MHPO_4$. The formula of its chloride would be

- (a) MCl (b) MCl_2
 (c) MCl_3 (d) M_2Cl_3

81. Two flasks X and Y have capacity 1L and 2L respectively and each of them contains 1 mole of a gas. The temperatures of the flasks are so adjusted that average speed of molecules in X is

twice as those in *Y*. The pressure in flask *X* would be

- (a) same as that in *Y* (b) half of that in *Y*
(c) twice of that in *Y* (d) 8 times of that in *Y*.

82. Match List I with List II and select the correct answer using the codes given below the lists:

List I		List II	
A.	$\left(\frac{\delta G}{\delta P}\right)_T$	1.	μ_{JT}
B.	$\left(\frac{\delta G}{\delta T}\right)_P$	2.	T
C.	$\left(\frac{\delta H}{\delta S}\right)_P$	3.	$-S$
D.	$\left(\frac{\delta T}{\delta P}\right)_H$	4.	P
		5.	V
A	B	C	D
(a)	5	1	2
(b)	5	3	2
(c)	3	5	2
(d)	5	3	2

83. What is the pH of 0.01 M glycine solution?

For glycine $K_{a_1} = 4.5 \times 10^{-3}$ and $K_{a_2} = 1.7 \times 10^{-10}$ at 298 K.

- (a) 3.0 (b) 10.0
(c) 7.06 (d) 8.2

84. Which of the following sequence contains atomic number of only representative elements?

- (a) 55, 12, 48, 53 (b) 13, 33, 54, 80
(c) 3, 33, 53, 87 (d) 22, 33, 55, 66.

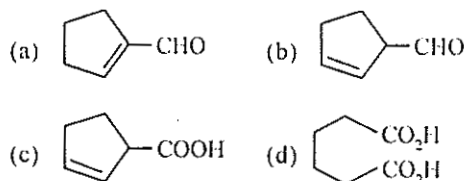
85. 100 cm³ of a given sample of H₂O₂ gives 1000 cm³ of O₂ at S.T.P. The given sample is

- (a) 10% H₂O₂ (b) 90% H₂O₂
(c) 10 volume H₂O₂ (d) 100 volume H₂O₂

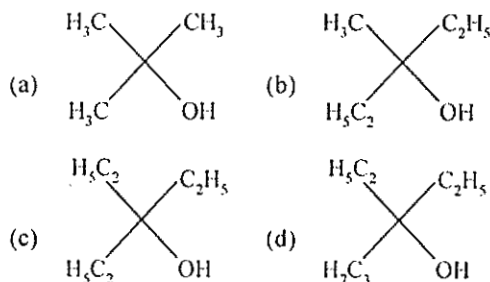
86. Beryllium and aluminium exhibit many properties which are similar. But the two elements differ in

- (a) maximum covalency in compounds
(b) exhibiting amphoteric nature in their oxides
(c) forming covalent halides
(d) forming polymeric hydrides

87. Cyclohexene on ozonolysis followed by reaction with zinc dust and water gives compound *E*. Compound *E* on further treatment with aqueous KOH yields compound *F*. Compound *F* is



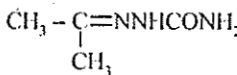
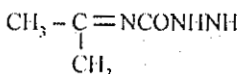
88. Ethyl ester $\xrightarrow[\text{excess}]{\text{CH}_3\text{MgBr}}$ *P*. The product *P* will be



89. The compound which on reaction with aqueous nitrous acid at low temperature produces an oily nitrosoamine is

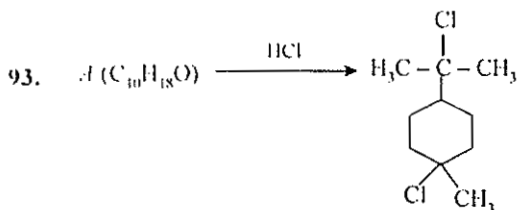
- (a) methyl amine (b) ethyl amine
(c) diethyl amine (d) triethyl amine

90. Compound *A* (molecular formula C₃H₈O) is treated with acidified potassium dichromate to form a product *B* (molecular formula C₃H₆O). *B* forms a shining silver mirror on warming with ammoniacal silver nitrate. *B* when treated with an aqueous solution of H₂NCONHNH₂·HCl and sodium acetate gives a product *C*. Identify the structure of *C*.

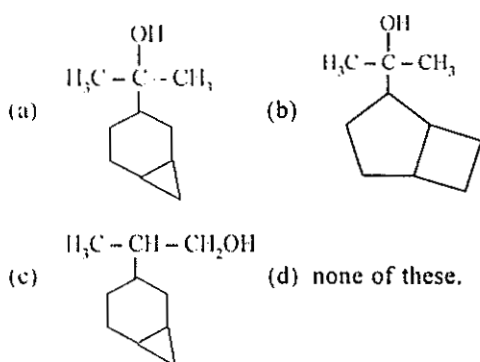
- (a) CH₃CH₂CH = NNHCONH₂
(b) 
(c) 
(d) CH₃CH₂CH = NCONHNH₂

91. Assume that you are travelling at a speed of 90 km/h in a small car with a mass of 1050 kg. If the uncertainty in the velocity of the car is 1% ($\Delta v = 0.9$ km/h), what is the uncertainty (in meters) in the position of the car?

- (a) $\Delta x \geq 1 \times 10^{-35}$ m (b) $\Delta x \geq 2 \times 10^{-37}$ m
 (c) $\Delta x \geq 2 \times 10^{-36}$ m (d) $\Delta x \geq 4 \times 10^{-38}$ m
92. When 25 g of Na_2SO_4 is dissolved in 10^3 kg of solution, its concentration will be
 (a) 2.5 ppm (b) 25 ppm
 (c) 250 ppm (d) 100 ppm

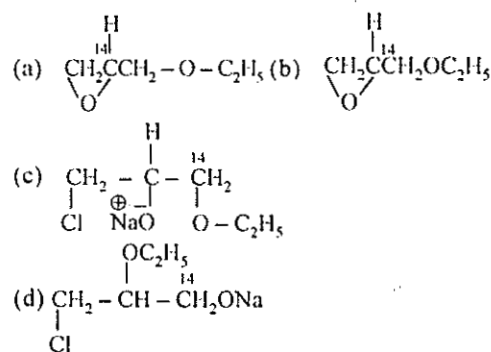
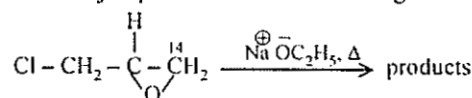


Degree of unsaturation of $A = 2$, it contains no double or triple bonds.

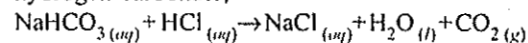


94. The shape and hybridisation of some xenon oxyfluorides are given. Choose the wrong set.
 (a) XeOF_2 - T-Shape - sp^3d
 (b) XeOF_4 - Square pyramidal - sp^3d^2
 (c) XeO_2F_2 - Distorted trigonal bipyramidal - sp^3d
 (d) XeO_3F_2 - Octahedral - sp^3d
95. The standard half-cell reduction potential for $\text{Ag}^+|\text{Ag}$ is 0.7991 V at 25°C . Given the experimental value $K_{sp} = 1.56 \times 10^{-10}$ for AgCl , calculate the standard half-cell reduction potential for the $\text{Ag}|\text{AgCl}$ electrode.
 (a) 0.2192 V (b) -0.2192 V
 (c) -1.2192 V (d) 1.2192 V
96. Which of the following acids will not evolve H_2 gas on reaction with alkali metals?
 (a) hydrazoic acid (b) perxenic acid
 (c) boric acid (d) none of these

97. The major product of the following reaction is



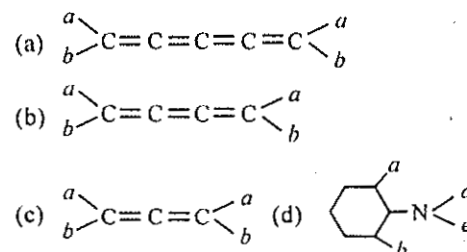
98. Stomach acid, a dilute solution of HCl in water, can be neutralized by reaction with sodium hydrogen carbonate,



How many milliliters of 0.125 M NaHCO_3 solution are needed to neutralize 18.0 mL of 0.100 M HCl ?

- (a) 14.4 mL (b) 12.0 mL
 (c) 14.0 mL (d) 13.2 mL
99. For the electrochemical cell, $M | M^+ || X^- | X$, $E^\circ(M^+|M) = 0.44$ V and $E^\circ(X|X^-) = 0.33$ V. From this data one can deduce that
 (a) $M + X \rightarrow M^+ + X^-$ is the spontaneous reaction
 (b) $M^+ + X^- \rightarrow M + X$ is the spontaneous reaction
 (c) $E_{\text{cell}} = 0.77$ V (d) $E_{\text{cell}} = -0.77$ V

100. Which is optically inactive?



Directions : In the following questions (101-120), a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as :

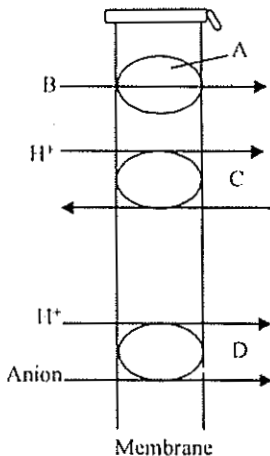
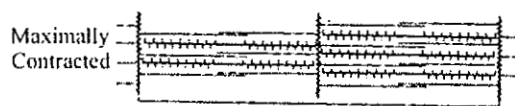
- (a) If both assertion and reason are true and reason is the correct explanation of assertion
 (b) If both assertion and reason are true but reason is not the correct explanation of assertion

- (c) If assertion is true but reason is false
 (d) If both assertion and reason are false.

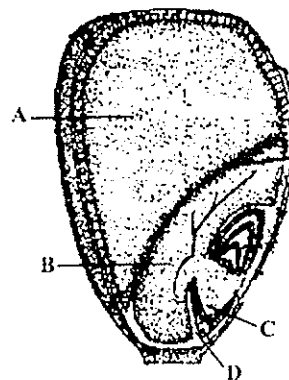
101. **Assertion** : Magnesium is extracted by the electrolysis of fused mixture of $MgCl_2$, $NaCl$ and $CaCl_2$.
Reason : Calcium chloride acts as a reducing agent.
102. **Assertion** : The equilibrium constant is fixed and a characteristic for any given chemical reaction at a specified temperature.
Reason : The composition of the final equilibrium mixture at a particular temperature depends upon the starting amount of reactants.
103. **Assertion** : PCl_5 is covalent in gaseous and liquid states but ionic in solid state.
Reason : PCl_5 in solid state consists of tetrahedral PCl_4^+ cation and octahedral PCl_6^- anion.
104. **Assertion** : Zinc displaces copper from copper sulphate solution.
Reason : The E^\ominus of zinc is -0.76 V and that of copper is $+0.34$ V.
105. **Assertion** : $CH_3-C(=CH-COOH)COOC_2H_5$ is 3-carbethoxy-2-butenic acid.
Reason : Principal functional group gets lowest number followed by double bond or triple bond.
106. **Assertion** : Helium has the highest value of ionisation energy among all the elements known.
Reason : Helium has the highest value of electron affinity among all the elements known.
107. **Assertion** : The nuclear isomers are the atoms with the same atomic number and same mass number, but with different radioactive properties.
Reason : The nucleus in the excited state will evidently have a different half-life as compared to that in the ground state.
108. **Assertion** : Conductivity of silicon increases by doping it with group-15 elements.
Reason : Doping means introduction of small amount of impurities like P, As or Bi into the pure crystal.
109. **Assertion** : The overall order of the reaction is the sum of the exponents of all the reactants in the rate expression.
Reason : There are many higher order reactions.
110. **Assertion** : Transition metals are poor reducing agents.
Reason : Transition metals form numerous alloys with other metals.
111. **Assertion** : Aldol condensation can be catalysed both by acids and bases.
Reason : β -Hydroxy aldehydes or ketones readily undergo acid catalysed dehydration.
112. **Assertion** : The position of an element in periodic table after emission of one α - and two β - particles remains unchanged.
Reason : Emission of one α - and two β -particles give isotope of the element which acquires same position in periodic table.
113. **Assertion** : S.I. unit of atomic mass and molecular mass is kilograms.
Reason : Atomic mass is equal to the mass of 6.023×10^{24} atoms.
114. **Assertion** : Bond energy and bond dissociation energy have identical value for diatomic molecules.
Reason : Greater the bond dissociation energy, less reactive is the bond.
115. **Assertion** : The degree of complex formation in actinides decreases in the order $M^{4+} > MO_2^{2+} > M^{3+} > MO_2^+$.
Reason : Actinides form complexes with π -bonding ligands such as alkyl phosphines and thioethers.
116. **Assertion** : Benzene on heating with conc. H_2SO_4 gives benzenesulphonic acid which when heated with superheated steam under pressure gives benzene.

- Reason** : Sulphonation is a reversible process.
117. **Assertion** : The molality of the solution does not change with change in temperature.
- Reason** : The molality is expressed in units of moles per 1000 g of solvent.
118. **Assertion** : Due to Frenkel defect, density of the crystalline solid decreases.
- Reason** : In Frenkel defect, cation or anion leaves the crystal.
119. **Assertion** : $\left[(en)_2Co \begin{array}{c} \diagup NH \\ \diagdown OH \end{array} Co(en)_2 \right]^{3+}$
- is named as tetrakis (ethylenediamine) μ -hydroxo- μ -imido dicobalt (III) ion.
- Reason** : In naming polynuclear complexes *i.e.*, containing two or more metal atoms joined by bridging ligands, the word μ is added with hyphen before the name of such ligands.
120. **Assertion** : 2,3-Dimethylbut-2-ene is more stable than but-2-ene.
- Reason** : Six hyperconjugation structures can be written for 2, 3-dimethylbut-2-ene while but-2-ene has twelve.

BIOLOGY

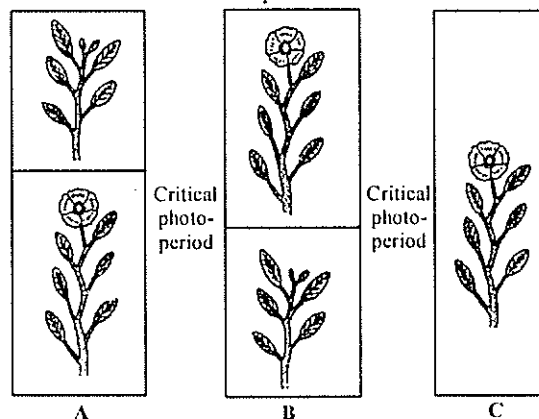
121. Vitamin B₆ is also called
- (a) thiamine (b) pantothenic acid
(c) pyridoxine (d) retinol.
122. Protista differs from monera in having
- (a) cell wall (b) autotrophic nutrition
(c) flagella (d) nuclear membrane
123. What does 'T' stands for in DPT vaccine?
- (a) tuberculosis (b) typhoid
(c) trachoma (d) tetanus
124. Why are vascular bundles closed in monocots?
- (a) xylem and phloem are present
(b) xylem and phloem occur in separate bundles
(c) vascular cambium is present between xylem and phloem
(d) vascular cambium is not present.
125. Who invented electron microscope?
- (a) Janssen (b) Edison
- (c) Knoll & Ruska (d) Landsteiner
126. What do A, B, C, and D represent in the following figure?
- 
- (a) A : carrier protein, B : symport, C : uniport, D : antiport
(b) A : carrier protein, B : uniport, C : antiport, D : symport
(c) A : carrier protein, B : antiport, C : symport, D : uniport
(d) A : carrier protein, B : uniport, C : symport, D : antiport
127. Gametophyte and sporophyte are independent of each other in which of the following groups?
- (a) pteridophytes (b) angiosperms
(c) gymnosperms (d) bryophytes
128. Which of the following is correct?
- (a) paneth cells secrete pepsinogen
(b) parietal cells secrete hydrochloric acid
(c) argentaffin cells secrete mucus
(d) chief cells secrete gastrin
129. Which of the following has highest diversity in India?
- (a) mango (b) dolphin
(c) tiger (d) orchids
130. Which of the following is correct about the given figure?
- 
- Two sarcomeres
- (a) the length of the thick and thin myofilaments has changed.

- (b) length of both anisotropic and isotropic band has changed.
- (c) the myosin cross-bridges move on the surface of actin and the thin and thick myofilaments slide past each other.
- (d) length of the sarcomere remains same.
131. Which of the following disorders are caused due to recessive autosomal mutations?
- (a) Turner's syndrome and sickle cell anaemia
 (b) Edward's syndrome and Down's syndrome
 (c) cystic fibrosis and phenylketonuria
 (d) Alzheimer's disease and Huntington's chorea.
132. What is correct about the movement of substance across the membrane in facilitated diffusion?
- (a) it is an active transport
 (b) it doesn't cause transport of molecules from low concentration to high concentration
 (c) it is insensitive to inhibitors
 (d) it is a very specific transport
133. Which one is correct?
- (a) *Salmonella typhi* and *Haemophilus influenzae* cause pneumonia
 (b) Widal test is done for malaria
 (c) *Entamoeba histolytica* causes amoebiasis
 (d) *Wuchereria* causes enterobiasis.
134. What is the Greek word for ecology?
- (a) ethology (b) oekologie
 (c) synecology (d) hexicology
135. Which of the following is correct regarding genetic code?
- (a) UUU is the initiation codon which also codes for phenylalanine.
 (b) there are 64 triplet codons and only 20 amino acids.
 (c) three random nitrogen bases specify the placement of one amino acid.
 (d) UAA is the nonsense codon which also codes for methionine.
136. The given figure shows L.S of the seed of maize. What do A, B, C and D represent?



- (a) A : endosperm B : scutellum
 C : plumule D : coleoptile
 (b) A : scutellum B : pericarp
 C : radicle D : coleoptile
 (c) A : endosperm B : scutellum
 C : radicle D : coleorrhiza
 (d) A : scutellum B : pericarp
 C : plumule D : coleorrhiza

137. Refer the given figures on photoperiodism and select the correct option.



- (a) no correlation between light period and flowering long light-exposure period short light-exposure period
- (b) long light-exposure period no correlation between light period and flowering short light-exposure period
- (c) short light-exposure period long light-exposure period no correlation between light period and flowering

- (d) no correlation between light period and flowering short light-exposure period long light-exposure period
138. What are Singer and Nicolson known for?
 (a) one-gene-one-enzyme hypothesis
 (b) plasma membrane modifications
 (c) fluid-mosaic model of plasma membrane
 (d) structure of DNA
139. Select the correct statement.
 (a) *Acetobacter aceti* produces citric acid
 (b) *Saccharomyces cerevisiae* is used as clot buster
 (c) *Penicillium notatum* restrict the growth of *Staphylococci*
 (d) methanogens are found in aerobic conditions
140. Which of the following diseases is also called Christmas disease?
 (a) sickle-cell anaemia
 (b) haemoglobinuria
 (c) myocardial infarction
 (d) haemophilia - B
141. Which of the following is correct?
 (a) all fungi are filamentous
 (b) transfer of DNA from one bacteria to another bacteria cannot take place
 (c) virus cannot have both DNA and RNA
 (d) protists reproduce asexually only.
142. Which of the following have porous body and are diploblastic?
 (a) *Aurelia* and *Obelia*
 (b) *Adamsia* and *Euplectella*
 (c) *Leucosolenia* and *Spongilla*
 (d) *Sycon* and *Hydra*
143. CD-4 receptor is associated with
 (a) AIDS (b) cancer
 (c) malaria (d) pneumonia
144. Which one is correct regarding electrocardiograph (ECG)?
 (a) P-wave represents the electrical excitation of the ventricle
 (b) QRS complex represents repolarisation of the ventricles
 (c) T-wave represents repolarisation of the atria
 (d) by counting the number of QRS complexes one can determine the pulse rate.
145. Animals take phosphorus from
 (a) water (b) plants
 (c) rock (d) soil
146. What is the effect of GnRH produced by hypothalamus?
 (a) stimulates the synthesis and secretion of androgens
 (b) stimulates secretion of milk in mammary glands
 (c) stimulates foetal ejection reflex
 (d) stimulates synthesis of carbohydrates from non-carbohydrates in liver.
147. Chemosensitive area of respiratory centre in medulla is affected by
 (a) less CO₂ and H⁺ ions
 (b) less O₂ and H⁺ ions
 (c) excess CO₂ and H⁺ ions
 (d) excess O₂ and H⁺ ions.
148. What do A, B, C and D represent?
-
- (a) infundibulum fertilization myometrium morula
 (b) infundibulum fertilization endometrium blastocyst
 (c) isthmus fertilization myometrium blastocyst
 (d) isthmus fertilization endometrium morula
149. Microvilli of intestinal epithelium are similar in function with
 (a) typhlosole in earthworm
 (b) hepatic caecae in cockroach
 (c) intestinal caecum in earthworm
 (d) Malpighian tubules in cockroach.
150. The type of epithelial cells which line the inner surface of Fallopian tubes, bronchioles and bronchi are known as
 (a) squamous epithelium
 (b) ciliated epithelium
 (c) columnar epithelium
 (d) cubical epithelium.

151. Cyclic photophosphorylation involves
 (a) PS I (b) PS II
 (c) PS I and PS II (d) P_{680}
152. Which animal has the longest gestation period?
 (a) shark (b) walrus
 (c) elephant (d) dog
153. What is a plasmid?
 (a) bacterial, linear, dsDNA
 (b) extrachromosomal linear RNA
 (c) extrachromosomal circular dsDNA
 (d) autonomously replicating circular RNA.
154. The concept of chemical evolution is based on
 (a) interaction of water, air and clay under intense heat
 (b) effect of solar radiation on chemicals
 (c) possible origin of life by combination of chemicals under suitable environmental conditions
 (d) crystallization of chemicals.
155. Which of the following is a correct match between crop, variety and resistance to diseases?
- | Crop | Variety | Resistance to diseases |
|---------------------|----------------|------------------------|
| (a) wheat | hingiri | white rust |
| (b) <i>Brassica</i> | Pusa sadabahar | black rot |
| (c) cowpea | Pusa komal | bacterial blight |
| (d) chilli | Pusa swarnim | chilly mosaic virus |
156. Recombinant DNA technology involves several steps in which initial step is of isolation of the DNA. Which enzymes are used in the process for the break down of fungal cell, plant cell and bacterial cell respectively?
 (a) lysozyme, lipases, trypsin
 (b) chitinase, cellulase, lysozyme
 (c) chitinase, cellulase, trypsin
 (d) trypsin, lipases, cellulase
157. The taxon which includes related species is
 (a) class (b) order
 (c) family (d) genus
158. Match the following columns and select the correct option

Column I	Column II
----------	-----------

- | | |
|----------------------------------|-------------------------|
| (A) <i>Panthera tigris</i> | (i) Mango |
| (B) <i>Mangifera indica</i> | (ii) Common Indian frog |
| (C) <i>Musca domestica</i> | (iii) Cockroach |
| (D) <i>Periplaneta americana</i> | (iv) Tiger |
| (E) <i>Rana tigerina</i> | (v) House fly |
- (a) A - (ii), B - (v), C - (i), D - (iii), E - (iv)
 (b) A - (iv), B - (i), C - (v), D - (iii), E - (ii)
 (c) A - (ii), B - (v), C - (iii), D - (i), E - (iv)
 (d) A - (iv), B - (i), C - (v), D - (ii), E - (iii)
159. Which of the following is correct regarding HIV, hepatitis B, gonorrhoea, trichomoniasis?
 (a) trichomoniasis is a STD whereas other are not
 (b) gonorrhoea is a viral disease whereas others are bacterial
 (c) HIV is a pathogen whereas others are diseases
 (d) Hepatitis B is eradicated completely whereas others are not.
160. The first stable product of Calvin cycle is
 (a) 3-phosphoglycerate
 (b) 1, 3 biphosphoglycerate
 (c) glyceraldehyde - 3 phosphate
 (d) ribulose - 5- phosphate

Directions : In the following questions (161-180), a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as :

- (a) If both assertion and reason are true and reason is the correct explanation of assertion
 (b) If both assertion and reason are true but reason is not the correct explanation of assertion
 (c) If assertion is true but reason is false
 (d) If both assertion and reason are false.
161. Assertion : Adrenaline is called an emergency hormone.
 Reason : It acts on the cells of skeletal, cardiac, smooth muscles, blood vessels and fat cells.
162. Assertion : Cork prevents the loss of water by evaporation.
 Reason : Cork cells contain tannins.
163. Assertion : In cockroach respiratory gases directly comes in contact with the various organs of the body.

- Reason** : Cockroaches do not have respiratory pigment.
164. **Assertion** : Interferons are antiviral proteins.
Reason : Interferons are secreted by virus infected cells.
165. **Assertion** : While on going down the loop of Henle, the filtrate becomes hypotonic.
Reason : The descending limb of loop of Henle is impermeable to both water and electrolytes.
166. **Assertion** : Shrinkage of the protoplast of a cell occurs under the influence of hypertonic solution.
Reason : Hypertonic solution causes plasmolysis.
167. **Assertion** : Inbreeding produces pureline.
Reason : It causes homozygosity.
168. **Assertion** : Parturition is induced by neural signal in maternal pituitary.
Reason : At the end of gestation period, the maternal pituitary release prolactin which causes uterine contractions.
169. **Assertion** : *Commelina* shows cleistogamy.
Reason : This reduces chances of inbreeding.
170. **Assertion** : *Antirrhinum* is a good example to understand incomplete dominance.
Reason : Heterozygotes show characteristics of both the alleles.
171. **Assertion** : Presence of large amounts of nutrients in water body causes excessive growth of planktonic algae.
Reason : It is due to biomagnification.
172. **Assertion** : Bile is essential for the digestion of lipids.
Reason : Bile juice contains enzymes bilirubin and biliverdin.
173. **Assertion** : Emphysema is a chronic disorder in which alveolar walls are damaged.
Reason : Emphysema is closely related to cigarette smoking.
174. **Assertion** : DNA fingerprinting involves identifying differences in specific regions in DNA sequence.
Reason : DNA fingerprinting is the basis of paternity testing.
175. **Assertion** : All pathogens are parasites but all parasites are not pathogens.
Reason : Majority of the parasites confer benefits to the host.
176. **Assertion** : Due to pollution atmospheric concentration of CO₂ is increasing which will be harmful for C₄ plants whereas productive for C₃ plants.
Reason : C₄ plants have greater efficiency for CO₂ as CO₂ is fixed by PEP oxygenase.
177. **Assertion** : Insulin is antagonistic to glucagon.
Reason : It is an anabolic hormone.
178. **Assertion** : Auditory ossicles are small bones present in the cavity of inner ear.
Reason : Auditory ossicles maintain the balance of air pressure between two sides of ear drum.
179. **Assertion** : Pharyngeal nephridia play a role in the conservation of water in the earthworm.
Reason : They help the earthworm in keeping the skin moist for cutaneous respiration.
180. **Assertion** : Pantothenic acid deficiency is probably the most common vitamin deficiency.
Reason : Macrocytic anaemia is a characteristic feature of pantothenic acid deficiency.

GENERAL KNOWLEDGE

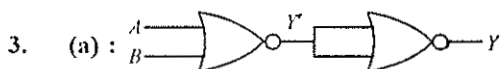
181. Which country has three capitals?
(a) S. Africa (b) Switzerland
(c) Netherland (d) Australia
182. Which is the largest desert in the world?
(a) Atacama (b) Thar
(c) Sahara (d) Kalahri
183. Which is the largest lake in the world?
(a) Caspian sea (b) Wular
(c) Lake superior (d) Baikal

184. Which country has won 'Fifa World Cup' maximum times?
(a) Germany (b) Brazil
(c) France (d) Italy
185. 'World population day' is on
(a) 8th March (b) 21st March
(c) 11th July (d) 3rd October
186. Who invented the stethoscope?
(a) Reni Laennec (b) Hopkins
(c) Louis Pasteur (d) Hausen
187. Which country has largest number of coal reserves?
(a) USA (b) Russia
(c) China (d) India
188. What term is given to the relationship between culture and food?
(a) astronomy (b) agronomy
(c) gastronomy (d) geology
189. One-rupee note bears the signature of the
(a) Governor of Reserve Bank of India
(b) Finance ministry
(c) Secretary, Ministry of Finance
(d) President of India
190. Which one of the following classical dance forms originated in Andhra Pradesh?
(a) bharatnatyam (b) kathakali
(c) kuchipudi (d) odissi
191. On adding salt to water, the boiling point and freezing point of water will
(a) increase
(b) increase and decrease respectively
(c) decrease
(d) decrease and increase respectively.
192. Chocolates can be bad for health because of a high content of
(a) cobalt (b) nickel
(c) zinc (d) lead
193. The novel Coolie is written by
(a) R. K. Narayan (b) Prem Chand
(c) Jainendra Kumar (d) Mulk Raj Anand
194. Beirut is the capital of
(a) Syria (b) Jordan
(c) Lebanon (d) Libya
195. The first month of Saka year is
(a) vaisakh (b) chaitra
(c) jyeshtha (d) paush
196. Chameli Devi Award is given to an outstanding woman who is a
(a) vocalist (b) lawyer
(c) journalist (d) scientist
197. "Olive Branch" is a sign of
(a) war (b) peace
(c) defeat (d) conquest
198. 800 in Roman number is written as
(a) DDCC (b) DDDC
(c) DCCC (d) DCCD.
199. Santosh Trophy is associated with
(a) hockey (b) cricket
(c) badminton (d) football
200. Which river carries maximum quantity of water in the world?
(a) Nile (b) Amazon
(c) Thames (d) Mississippi

SOLUTIONS

PHYSICS

1. (b)
2. (c) : In a photon-particle collision (such as photon-electron), the total energy and total momentum are conserved. However, the number of photons may not be conserved in a collision. The photon may be absorbed or a new photon may be created.



Truth Table of this gate

A	B	Y'	Y
0	0	1	0
1	0	0	1
0	1	0	1
1	1	0	1

$$Y' = \overline{A+B} = \overline{A} \cdot \overline{B}$$

$$\text{and } Y = \overline{Y'} = \overline{\overline{A+B}} = A+B$$

This is the boolean expression for the OR gate.

4. (c) : The power of lens
- $$P = \frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \left[\frac{1}{25} - \frac{1}{\text{N.P.}} \right] \text{ where N.P. = Near point of vision}$$
- $$P = \left[\frac{1}{25} - \frac{1}{100} \right]$$
- $$P = \frac{4-1}{100} = \frac{3}{100 \text{ cm}} = \frac{3}{1 \text{ m}} = 3 \text{ D}$$
5. (b) : The kinetic energy of the projectiles is maximum at the point of release.

The ratio of K.E. of projectiles

$$\frac{\frac{1}{2} m u_1^2}{\frac{1}{2} m u_2^2} = \frac{4}{1}$$

$$\frac{u_1^2}{u_2^2} = \frac{4}{1} \quad \dots (i)$$

The ratio of maximum heights of projectiles

$$\frac{H_1}{H_2} = \frac{4}{1}$$

$$\frac{u_1^2 \sin^2 \theta_1}{2g} = \frac{4}{1}$$

$$\frac{u_1^2 \sin^2 \theta_1}{u_2^2 \sin^2 \theta_2} = \frac{4}{1}$$

$$\frac{4 \sin^2 \theta_1}{1 \sin^2 \theta_2} = \frac{4}{1}$$

(from equation (i))

$$\sin^2 \theta_1 = \sin^2 \theta_2$$

$$\theta_1 = \theta_2$$

Now, ratio of ranges of projectiles

$$\frac{R_1}{R_2} = \frac{u_1^2 \sin 2\theta_1}{u_2^2 \sin 2\theta_2}$$

$$\frac{R_1}{R_2} = \frac{u_1^2 \sin 2\theta_1}{u_2^2 \sin 2\theta_1}$$

($\because \theta_1 = \theta_2$)

$$\frac{R_1}{R_2} = \frac{u_1^2}{u_2^2}, \quad \frac{R_1}{R_2} = \frac{4}{1}$$

6. (d)
7. (c) : Relative magnetic permeability of diamagnetic substances is always less than unity.
i.e. $\mu_r < 1$
 $\mu_r = (1 + \chi_m)$ as $\mu_r < 1$, χ_m is negative.
Hence, susceptibility of diamagnetic substances has a small negative value.
8. (b)
9. (c) : Fundamental frequency of a vibrating string is expressed as

$$f = \frac{1}{2L} \sqrt{\frac{T}{\mu}} = \frac{1}{LD} \sqrt{\frac{T}{\pi \rho}}$$

where, D = diameter of string

ρ = density of the

material of string

As length L and radius are doubled, the new frequency

$$f' = \frac{1}{(2L)(2D)} \sqrt{\frac{T}{\pi \rho}} = \frac{1}{4} f$$

10. (c) : Since the bubbles coalesce in vacuum and there is no change in temperature, hence its surface energy does not change. This means that the surface area remains unchanged. Hence

$$4\pi a^2 + 4\pi b^2 = 4\pi R^2 \text{ or } R = \sqrt{a^2 + b^2}$$

11. (a) : Capacitors C_1 and C_2 are in parallel, their equivalent capacitance is in series with capacitor C_3 . Hence, the equivalent capacitance of the given circuit is

$$C_{eq} = \frac{(C_1 + C_2)C_3}{C_1 + C_2 + C_3}$$

Charge on capacitor C_3 is

$$Q = V C_{eq} \\ = \frac{V(C_1 + C_2)C_3}{C_1 + C_2 + C_3}$$

Voltage across C_3 is

$$= \frac{Q}{C_3} = \frac{V(C_1 + C_2)}{C_1 + C_2 + C_3}$$

12. (c) : For Brackett series, $n_1 = 4, n_2 = 5, 6, 7, \dots$

$$\frac{1}{\lambda} = R \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

where $R = 1.09678 \times 10^7 \text{ m}^{-1}$, called Rydberg's constant.

$$\frac{1}{\lambda} = R \left(\frac{1}{4^2} - \frac{1}{n_2^2} \right)$$

For maximum wavelength, $n_2 = 5$

$$\frac{1}{\lambda_{\max}} = 1.09678 \times 10^7 \left(\frac{1}{4^2} - \frac{1}{5^2} \right)$$

$$\lambda_{\max} = 40519 \text{ \AA}$$

13. (a) : $r = \frac{n^2}{Z} \times 0.529$

For He^+ , $n = 2, Z = 1$

$$r = \frac{4}{2} \times 0.529 \\ = 1.058 \text{ \AA}$$

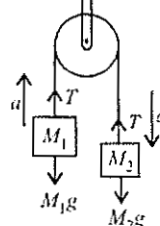
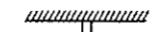
14. (c) : $x = 3t^2 - 6t$; So (velocity) $_x = \frac{dx}{dt} = 6t - 6$;
 $y = t^2 - 2t$

$$\text{So, (velocity)}_y = \frac{dy}{dt} = 2t - 2$$

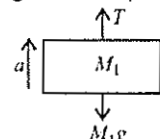
At time $t = 1$,

$$= \frac{dx}{dt} = 6 \times 1 - 6 = 0 \text{ and } \frac{dy}{dt} = 2 \times 1 - 2 = 0.$$

15. (c) : Since $M_2 > M_1$, therefore M_2 moves downwards and M_1 moves upwards with an acceleration a as shown in the figure.



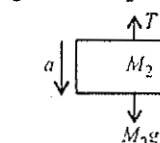
Free body diagram of M_1



The equation of motion for M_1 is

$$T - M_1g = M_1a \quad \dots(i)$$

Free body diagram of M_2



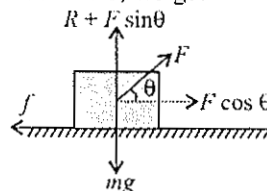
The equation of motion for M_2 is

$$M_2g - T = M_2a \quad \dots(ii)$$

Adding (i) and (ii), we get

$$a = \frac{(M_2 - M_1)g}{M_2 + M_1} = \frac{(10 - 5)g}{(10 + 5)} = \frac{g}{3}$$

16. (b) : Because the block moves with a uniform velocity, the resultant force is zero. Resolving F into horizontal component $F \cos \theta$ and vertical component $F \sin \theta$, we get



$$R + F \sin \theta = mg \text{ or } R = mg - F \sin \theta$$

$$\text{Also } f = \mu R = \mu(mg - F \sin \theta)$$

$$\text{But } F \cos \theta = f$$

$$\text{or } F \cos \theta = \mu(mg - F \sin \theta)$$

$$\text{or } F(\cos \theta + \mu \sin \theta) = \mu mg$$

$$\therefore F = \frac{\mu mg}{\cos \theta + \mu \sin \theta}$$

$$\text{Work } W = Fs \cos \theta$$

$$\therefore W = \frac{\mu mgd \cos \theta}{\cos \theta + \mu \sin \theta}$$

$$(\because s = d)$$

17. (b) : $\rho = \frac{PM}{RT}$ or $\rho \propto \frac{P}{T}$

$$\left(\frac{P}{T}\right)_A = \frac{P_0}{T_0} \quad \text{and} \quad \left(\frac{P}{T}\right)_B = \frac{3}{2} \left(\frac{P_0}{T_0}\right)$$

$$\left(\frac{P}{T}\right)_B = \frac{3}{2} \left(\frac{P}{T}\right)_A$$

$$\therefore \rho_B = \frac{3}{2} \rho_A = \frac{3}{2} \rho_0$$

18. (a)

19. (a) : $\eta_1 = 1 - \frac{T_L}{T_H} = \frac{W}{Q_1} = \frac{1}{6}$

or $5T_H - 6T_L = 0$... (i)

$$\eta_2 = 1 - \frac{T_L - 62}{T_H} = 2\eta_1 = \frac{1}{3} \quad \text{(Given)}$$

$$\Rightarrow 1 - \frac{1}{3} = \frac{T_L - 62}{T_H}$$

or $2T_H - 3T_L = -186$... (ii)

Solving (i) and (ii), we get

$$\therefore T_H = 372 \text{ K} = 99^\circ\text{C}$$

$$T_L = \frac{5}{6} T_H = \frac{5}{6} \times 372 \text{ K} = 310 \text{ K} = 37^\circ\text{C}$$

20. (c) : According to first law of thermodynamics

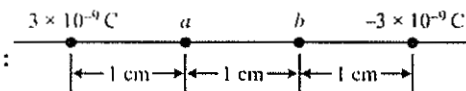
$$\Delta Q = \Delta U + P\Delta V$$

If ΔQ is absorbed at constant volume, $\Delta V = 0$

$$C_V = \left(\frac{\Delta Q}{\Delta T}\right)_V = \left(\frac{\Delta U}{\Delta T}\right)_V = \frac{\Delta U}{\Delta T}$$

for an ideal monoatomic gas

$$\frac{\Delta U}{\Delta T} = \frac{3}{2} R; \quad C_V = \frac{3}{2} R$$

21. (c) : 

According to conservation of energy, we get

$$K_a + U_a = K_b + U_b$$

Here, $K_a = 0$ and the potential energies are

$$U_a = q'V_a \quad \text{and} \quad U_b = q'V_b$$

$$\therefore 0 + q'V_a = \frac{1}{2}mv^2 + q'V_b$$

$$\text{or } v = \sqrt{\frac{2q'(V_a - V_b)}{m}}$$

$$V_a = (9.0 \times 10^9 \text{ Nm}^2\text{C}^{-2})$$

$$\left(\frac{3 \times 10^{-9} \text{ C}}{0.01 \text{ m}} + \frac{-3 \times 10^{-9} \text{ C}}{0.02 \text{ m}}\right) = 1350 \text{ V}$$

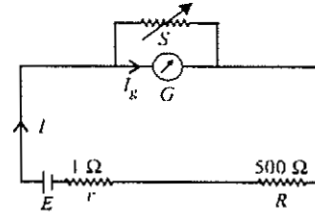
$$V_b = (9.0 \times 10^9 \text{ Nm}^2\text{C}^{-2})$$

$$\left(\frac{3 \times 10^{-9} \text{ C}}{0.02 \text{ m}} + \frac{-3 \times 10^{-9} \text{ C}}{0.01 \text{ m}}\right) = -1350 \text{ V.}$$

$$\therefore v = \sqrt{\frac{2(2 \times 10^{-9} \text{ C})(2700 \text{ V})}{5 \times 10^{-3} \text{ kg}}} = 4.65 \times 10^{-2} \text{ m s}^{-1}$$

$$= 4.65 \text{ cm s}^{-1}$$

22. (a) :



Here, $I = \frac{E}{R+r+\frac{GS}{G+S}}$ and $I_g = \frac{IS}{G+S}$

$$I_g = \frac{E}{(R+r)+\frac{GS}{(G+S)}} \times \frac{S}{(G+S)}$$

$$\therefore I_g = \frac{ES}{(R+r)(G+S)+GS}$$

For $S = 5 \text{ ohm}$, $I_g = 5 \times 10^{-3} \text{ A}$

and for $S = 25 \text{ ohm}$,

$$I_g = 20 \times 10^{-3} \text{ A}$$

Hence, $5 \times 10^{-3} = \frac{E \times 5}{501(G+5)+5G}$... (i)

and $20 \times 10^{-3} = \frac{E \times 25}{501(G+25)+25G}$... (ii)

Dividing and solving,

$$G = 88.2 \Omega$$

From (i), we get

$$E = 10^{-3} [501(88.2+5) + 5 \times 88.2]$$

$$= 47.1 \text{ volt}$$

23. (a) : Let us refer to the coil as circuit 1 and the solenoid as circuit 2. The field in the central region of the solenoid is uniform, so the flux through the coil is

$$\Phi_{12} = B_2 A_1 = (\mu_0 n_2 I_2) A_1$$

where $n_2 = N_2/l = 1500 \text{ turns/m}$. The mutual inductance is

$$M = \frac{N_1 \Phi_{12}}{I_2} = \mu_0 n_2 N_1 A_1$$

$$= (4\pi \times 10^{-7} \text{ T} \cdot \text{m/A})(1500 \text{ m}^{-1})(10)(4 \times 10^{-4} \text{ m}^2)$$

$$= 7.54 \times 10^{-6} \text{ H}$$

24. (b) : $K_1 = \frac{hc}{\lambda_1} - \phi_0$... (i)

$$\text{and } K_2 = \frac{hc}{\lambda_2} - \phi_0 \text{ or } \frac{hc}{\lambda_2} = (K_2 + \phi_0) \dots \text{(ii)}$$

$$\begin{aligned} \therefore K_1 - K_2 &= hc \left[\frac{1}{\lambda_1} - \frac{1}{\lambda_2} \right] \\ &= hc \left[\frac{1}{3\lambda_2} - \frac{1}{\lambda_2} \right] = \frac{2hc}{3\lambda_2} \\ &= -\frac{2}{3}(K_2 + \phi_0) \end{aligned} \quad \text{From (ii)}$$

$$\text{or } K_1 = K_2 - \frac{2}{3}K_2 - \frac{2}{3}\phi_0 = \frac{K_2}{3} - \frac{2}{3}\phi_0$$

$$\text{or } K_1 < \frac{K_2}{3}$$

25. (c) : At $t = 0$, $N = N_0$ for both the substances A and B

$$\therefore N_A = N_0 e^{-\lambda_A t} \text{ and } N_B = N_0 e^{-\lambda_B t}$$

$$\frac{N_A}{N_B} = \frac{e^{-\lambda_A t}}{e^{-\lambda_B t}} = e^{(\lambda_B - \lambda_A)t} = e^{(\lambda - 5\lambda)t}$$

$$= e^{-4\lambda t} = \left(\frac{1}{e}\right)^{4\lambda t}$$

$$\text{As } \frac{N_A}{N_B} = \left(\frac{1}{e}\right)^2 \text{ [According to question]}$$

$$\therefore 4\lambda t = 2$$

$$\text{or } t = \frac{2}{4\lambda} = \frac{1}{2\lambda}$$

26. (b) : $\therefore I = I_0 e^{-kx} \Rightarrow \frac{I}{I_0} = e^{-kx}$

$$\therefore \ln\left(\frac{I}{I_0}\right) = -kx$$

In first case

$$\ln\left(\frac{1}{8}\right) = -k \times 36$$

$$\ln(2^{-3}) = -k \times 36$$

$$\text{or } 3\ln 2 = k \times 36 \quad \dots\dots\dots \text{(i)}$$

$$\text{In second case, } \ln\left(\frac{1}{2}\right) = -k \times x$$

$$\text{or } \ln(2^{-1}) = -kx$$

$$\text{or } \ln 2 = kx \quad \dots\dots\dots \text{(ii)}$$

From (i) and (ii)

$$3 \times (kx) = k \times 36$$

$$\text{or } x = 12 \text{ mm.}$$

27. (c) : $\vec{r}_1 = \sqrt{2}\hat{i} + \sqrt{2}\hat{j}$

$$|\vec{r}_1| = r_1 = \sqrt{(\sqrt{2})^2 + (\sqrt{2})^2} = 2$$

$$\vec{r}_2 = 2\hat{i} + 0\hat{j}$$

$$\text{or } |\vec{r}_2| = r_2 = 2$$

Potential at point A is

$$\begin{aligned} V_A &= \frac{1q}{4\pi\epsilon_0 r_1} \\ &= \frac{1}{4\pi\epsilon_0} \frac{10^{-3} \times 10^{-6}}{2} \end{aligned}$$

Potential at point B is

$$V_B = \frac{1}{4\pi\epsilon_0} \frac{q}{r_2} = \frac{1}{4\pi\epsilon_0} \frac{10^{-3} \times 10^{-6}}{2}$$

$$\therefore V_A - V_B = 0.$$

28. (a) : $E = G^p h^q c^r \dots \text{(i)}$

$$[M^1 L^2 T^{-2}] = [M^{-1} L^3 T^{-2}]^p [ML^2 T^{-1}]^q [LT^{-1}]^r$$

$$= M^{p-q} L^{3p+2q+r} T^{-2p-q-r}$$

Applying principle of homogeneity of dimensions, we get

$$-p + q = 1 \quad \dots \text{(ii)}$$

$$3p + 2q + r = 2 \quad \dots \text{(iii)}$$

$$-2p - q - r = -2 \quad \dots \text{(iv)}$$

$$\text{Add (iii) and (iv), } p + q = 0 \quad \dots \text{(v)}$$

$$\text{Add (ii) and (v), we get } q = \frac{1}{2}$$

$$\text{From (ii), we get } p = q - 1 = \frac{1}{2} - 1 = -\frac{1}{2}$$

$$\text{Put in (iii), we get } -\frac{3}{2} + 1 + r = 2, \quad r = 5/2$$

29. (d) : If M is mass of the square plate before cutting the holes, then mass of portion of each hole,

$$m = \frac{M}{16R^2} \times \pi R^2 = \frac{M\pi}{16}$$

\therefore Moment of inertia of remaining portion about Z axis

$$I = I_{\text{square}} - 4 I_{\text{hole}}$$

$$= \frac{M}{12} (16R^2 + 16R^2) - 4 \left[\frac{mR^2}{2} + m(\sqrt{2}R)^2 \right]$$

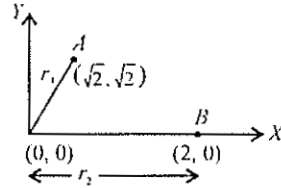
$$= \frac{M}{12} \times 32R^2 - 10mR^2$$

$$= \frac{8}{3} MR^2 - \frac{10}{16} MR^2 \pi$$

$$I = \left(\frac{8}{3} - \frac{10\pi}{16} \right) MR^2.$$

30. (b) : From Bernoulli's theorem,

$$P_A + \frac{1}{2} dv_A^2 + dgh_A = P_B + \frac{1}{2} dv_B^2 + dgh_B$$



Here, $h_A = h_B$

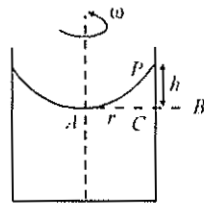
$$\therefore P_A + \frac{1}{2} dv_A^2 = P_B + \frac{1}{2} dv_B^2$$

$$P_A - P_B = \frac{1}{2} d[v_B^2 - v_A^2]$$

Now, $v_A = 0$, $v_B = r\omega$

and $P_A - P_B = h\Delta g$

$$\therefore h\Delta g = \frac{1}{2} dr^2 \omega^2 \text{ or } h = \frac{r^2 \omega^2}{2g}$$



31. (a) : Initial K.E., $E_1 = \frac{1}{2} mv^2$

$$= \frac{1}{2} \times 10 \times (10)^2 = 500 \text{ J}$$

At $x = 20$ m, retarding force,

$$F_1 = 0.1 \times 20 = 2 \text{ N}$$

At $x = 30$ m, retarding force,

$$F_2 = 0.1 \times 30 = 3 \text{ N.}$$

$$\text{Average Retarding Force } F = \frac{F_1 + F_2}{2} = \frac{2+3}{2} = 2.5$$

Work done by retarding force = loss in K.E.

$$= F \times s = 2.5 (30 - 20) = 25 \text{ J}$$

$$\text{Final K.E.} = E_1 - \text{loss in K.E.} = 500 - 25 = 475 \text{ J}$$

32. (c) : $h = \frac{2S \cos \theta}{r \rho g}$

Mass of water in the first tube,

$$m = \pi r^2 h \rho = \pi r^2 \times \left(\frac{2S \cos \theta}{r \rho g} \right) \times \rho$$

$$= \frac{2\pi r S \cos \theta}{g}$$

$$\therefore m \propto r. \text{ Hence, } \frac{m'}{m} = \frac{2r}{r} = 2$$

$$\text{or } m' = 2m = 2 \times 5 \text{ g} = 10 \text{ g.}$$

33. (b) : Impulse = $F \times t$

$$= \frac{m(v_2 - v_1)}{t} \times t = m(v_2 - v_1)$$

= change in momentum

$$\therefore [\text{Impulse}] = [\text{Momentum}]$$

Angular momentum, $L = mvr$

Planck's constant, $[h] = [\text{energy}] \times [\text{time}]$

$$\Rightarrow [F \times r \times \text{time}] = \frac{m(v_2 - v_1)}{t} \times r \times t$$

$$\Rightarrow m(v_2 - v_1) \times r = (\text{change of momentum}) \times r$$

$$\therefore [h] = [L].$$

Work, $W = \vec{F} \cdot \vec{d}$; Torque, $\tau = \vec{r} \times \vec{F}$

$$\therefore [W] = [\tau]$$

Moment of inertia, $I = mr^2 = \text{mass} \times (\text{distance})^2$

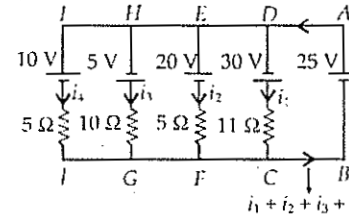
Moment of force, $\tau = \vec{r} \times \vec{F} = \text{distance} \times \text{force}$
 $= \text{distance} \times \frac{\text{change of momentum}}{\text{time}}$

$$\therefore [I] \neq [\tau].$$

Therefore, moment of inertia and moment of force have different dimensions.

34. (a)

35. (c) :



Applying KVL in loop ABCDA, ABFEA, ABGHA and ABJIA, we get

$$30 - i_1 \times 11 = -25 \quad \dots(i)$$

$$20 + i_2 \times 5 = 25 \quad \dots(ii)$$

$$5 - i_3 \times 10 = -25 \quad \dots(iii)$$

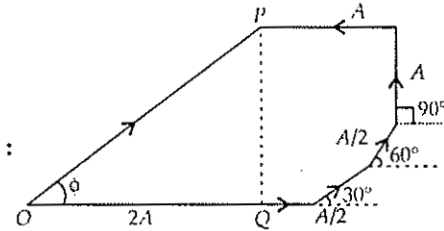
$$10 + i_4 \times 5 = 25 \quad \dots(iv)$$

Solving equations (i), (ii), (iii) and (iv) we get

$$i_1 = 5 \text{ A, } i_2 = 1 \text{ A, } i_3 = 3 \text{ A and } i_4 = 3 \text{ A.}$$

Hence, current flowing through 25 V cell is 12 A.

36. (b) :



$$y_1 = 2A \sin \omega t; \quad y_2 = \frac{A}{2} \sin \left(\omega t + \frac{\pi}{6} \right)$$

$$y_3 = \frac{A}{2} \sin \left(\omega t + \frac{\pi}{3} \right); \quad y_4 = A \sin \left(\omega t + \frac{\pi}{2} \right)$$

$$y_5 = A \sin (\omega t + \pi)$$

$$\text{By phasor diagram, } \tan \phi = \frac{PQ}{OQ} = 1$$

$$\Rightarrow \phi = 45^\circ$$

37. (b) : Let L be the length of the open pipe. The fundamental frequency of the open pipe is given by

$$\nu = \frac{v}{2L}, \quad v = \text{velocity of sound in air}$$

The second overtone of the open pipe has a

$$\text{frequency } 3\nu_c = \frac{3v}{2L_c} \text{ Hz}$$

The length of the closed pipe $L_c = 2 \text{ m}$.

The fundamental frequency of the closed pipe is given by $\nu = \frac{v}{4L}$

The first overtone of the closed pipe has a frequency

$$3\nu_c = \frac{3v}{4L_c} = \frac{3v}{4 \times 2} = \frac{3v}{8} \text{ Hz}$$

$$\text{Now } 3\nu_c = 3\nu_c \text{ or } \frac{3v}{2L_c} = \frac{3v}{8}$$

$$\text{or } 2L_c = 8 \text{ or } L_c = 4 \text{ m}$$

$$38. \text{ (c) : } T_1 = 2\pi \sqrt{\frac{M}{k_1}} \text{ or } k_1 = \frac{4\pi^2 M}{T_1^2}$$

$$\text{and } k_2 = \frac{4\pi^2 M}{T_2^2}$$

$$\text{In series combination, } k_{\text{eff}} = \frac{k_1 k_2}{k_1 + k_2} = \frac{4\pi^2 M}{T_1^2 + T_2^2}$$

$$\therefore T = 2\pi \sqrt{\frac{M}{k_{\text{eff}}}} = \sqrt{T_1^2 + T_2^2}$$

39. (c) : Average value of A.C. for complete cycle is zero. Hence A.C. can not be measured by D.C. ammeter.

40. (a) : The energy loss due to eddy currents is reduced by using laminated core in a transformer.

41. (a) : $h = ut - (1/2)gt^2$ and $v^2 = u^2 - 2gh$
The above equations are independent of mass

42. (d) : If a body is projected from a place above the surface of earth, then for the maximum range, the angle of projection should be less than 45° .

43. (b) : The apparent weight of a body in an elevator moving with downward acceleration a is given by $W' = m(g - a)$

44. (d) : If electric field is used for detecting the electron beam, then very high voltage will have to be applied or very long tube will have to be taken.

45. (c) : In the first few steps, work has to be done against limiting friction and afterwards, work is to be done against dynamic friction, which is smaller than the limiting friction.

46. (a)

47. (a)

48. (b) : Rolling occurs only on account of friction which is a tangential force capable of providing torque when the inclined plane is perfectly smooth. It will simply slip under the effect of its own weight. Once the perfect rolling begins, force of friction becomes zero. Hence, the work done against friction is zero.

49. (a)

50. (a) Water would evaporate quickly because there is no atmosphere on moon, due to which surface temperature of moon is much higher than earth (maximum surface temperature of moon is 123°C).

51. (a)

52. (c) : As conductivity of an intrinsic semiconductor is less than that of a lightly doped p -type

53. (b) : As UHF/VHF waves are not reflected by ionosphere being of higher frequency.

54. (d) : We cannot interchange the objective and eye lenses of a microscope to make a telescope. The reason is that the focal length of lenses in microscope are very small, of the order of mm or a few cm and the difference ($f_o - f_e$) is very small, while the telescope objective have a very large focal length as compared to eye lens of microscope.

55. (a) : The period of a charged particle in a magnetic

$$\text{field is given by } T = \frac{2\pi m}{qB}, \text{ i.e., } T \propto \frac{m}{q}$$

We know that, $m_p = m$, $m_\alpha = 4m$, $q_p = e$, $q_\alpha = 2e$

$$\therefore \frac{T_p}{T_\alpha} = \frac{1}{2} \text{ or } T_\alpha = 2T_p$$

56. (a) : As, $p_2 = p_1 + 50\%$ of $p_1 = (3/2)p_1$

$$\therefore v_2 = (3/2)v_1$$

As, kinetic energy, $K \propto v^2$

$$\therefore K_2 = \frac{9}{4} K_1$$

$$\text{Increase in K.E.} = \frac{(K_2 - K_1) \times 100}{K_1} = 125\%$$

57. (b) : Acceleration due to gravity,

$$g' = g - R_c \omega^2 \cos^2 \lambda$$

$$\text{At equator, } \lambda = 0^\circ, \therefore \cos 0^\circ = 1$$

$$\therefore g_c = g - R_c \omega^2$$

$$\text{At poles, } \lambda = 90^\circ, \therefore \cos 90^\circ = 0 \therefore g_p = g$$

$$\text{Thus, } g_p - g_c = g - g + R_c \omega^2 = R_c \omega^2$$

Also, the value of g is maximum at poles and minimum at equator.

58. (c) : As $P = VI$, hence for the transmission of same power, high voltage implies less current. Therefore heat energy losses ($H = I^2 R t / 4.2$) are minimized if power is transmitted at high voltage.
59. (c) : The earth's atmosphere is transparent to visible light and radio waves, but absorbs X-rays. Therefore X-rays telescope cannot be used on earth surface.

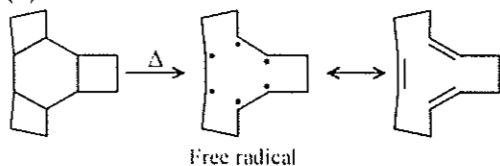
60. (a)

CHEMISTRY

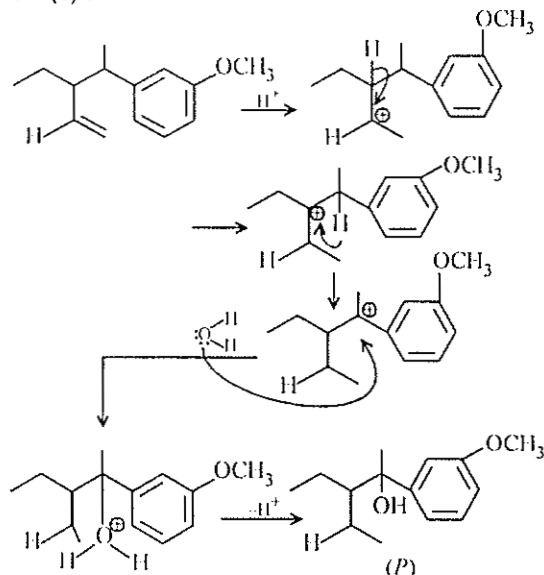
61. (c)
62. (b) : The constituents of Mischmetal is approximately 50% cerium and 25% lanthanum with small amounts of neodymium and praseodymium.
63. (a) : For a first order reaction, rate = $k[A]$, when concentration of A is doubled, the rate becomes double.
64. (c) : In tetragonal system,
 $a = b \neq c$, $\alpha = \beta = \gamma = 90^\circ$

65. (c) : (c) is correct answer because $r_{ionic} \propto \frac{1}{Z_{eff}}$

66. (a) :



67. (c) :



68. (c) : If product concentration is x .

$$\text{For a zero order reaction } \frac{x}{t} = k$$

Thus graph would be a straight line passing through origin. So the given information is for zero order reaction. For a zero order reaction, rate of the reaction is constant. Thus, plot of rate vs time, i.e., $-\frac{d[X]}{dt}$ vs time will be a straight line parallel to x-axis.

69. (c) : $\frac{W_{Ca}}{E_{Ca}} = \frac{W_{Al}}{E_{Al}} \Rightarrow \frac{40}{20} = \frac{W_{Al}}{9} \Rightarrow W_{Al} = 18 \text{ kg}$

As current efficiency is 50% so, $W_{Al} = 9 \text{ kg}$

70. (b) : Let the weight of CO = weight of $\text{CH}_4 = a \text{ g}$

$$\text{Moles of CO} = \frac{a}{28}$$

$$\text{Moles of CH}_4 = \frac{a}{16}$$

$$\text{Total moles} = \frac{a}{28} + \frac{a}{16}$$

$$x_{\text{CH}_4} = \frac{\frac{a}{16}}{\frac{a}{28} + \frac{a}{16}} = \frac{a}{16} \times \frac{28 \times 16}{44a} = \frac{14}{22} = \frac{7}{11}$$

\therefore Fraction of pressure exerted by $\text{CH}_4 = 7/11$.

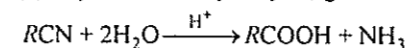
71. (c) : For $\text{Cr}^{3+} = 3d^3$, $\mu = \sqrt{3(3+2)} = \sqrt{15}$ B.M.

For $\text{Fe}^{2+} = 3d^6$, $\mu = \sqrt{4(4+2)} = \sqrt{24}$ B.M.

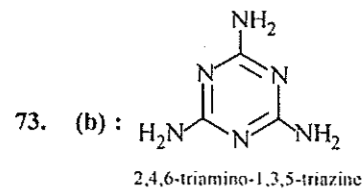
For $\text{Ni}^{2+} = 3d^8$, $\mu = \sqrt{2(2+2)} = \sqrt{8}$ B.M.

For $\text{Mn}^{2+} = 3d^5$, $\mu = \sqrt{5(5+2)} = \sqrt{35}$ B.M.

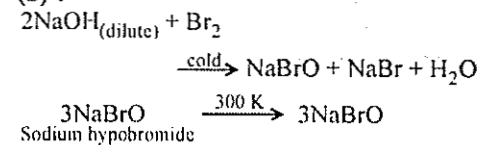
72. (c) : Cyanides, on hydrolysis, give acids



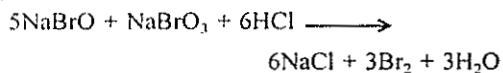
while all other reactions give amines.



74. (b) :



On acidification, the final mixture gives bromine.



Thus, during the reaction, bromine is present in four different oxidation states *i.e.*, zero in Br_2 , +1 in NaBrO , -1 in NaBr and +5 in NaBrO_3 . The greatest difference between various oxidation states of bromine is 6 and not 5. On acidification of the final mixture, Br_2 is formed and disproportionation of Br_2 occurs during the reaction giving BrO^- , Br^- and BrO_3^- ions.

75. (c) : The complex $\text{PtCl}_4 \cdot 5\text{NH}_3$ is designated as $[\text{Pt}(\text{NH}_3)_3\text{Cl}]\text{Cl}_3$ which ionizes to $[\text{Pt}(\text{NH}_3)_3\text{Cl}]^{3+} + 3\text{Cl}^-$ ions. Thus total ions produced are four but three moles of AgCl are produced from 3Cl^- ions with AgNO_3 .

76. (c) : $\Delta_{\text{HOAc}}^\circ = \Delta_{\text{NaOAc}}^\circ + \Delta_{\text{HCl}}^\circ - \Delta_{\text{NaCl}}^\circ$
 $= 91.0 + 426.2 - 126.5 \text{ S cm}^2 \text{ mol}^{-1}$
 $= 390.7 \text{ S cm}^2 \text{ mol}^{-1}$

77. (c) : $\text{Cu}^+ = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$.
 Shells occupied = 3, sub-shells occupied = 6, filled orbitals = 14. Unpaired $e^- = 0$.

78. (c) : There is no restriction that resonating structures should have +ve and -ve charges on atoms that are far apart.

79. (d) : Lattice energy = $-\frac{q_1 q_2}{r^2}$

where q_1 and q_2 are charges on ions and r is the distance between them. Since interionic distances in CaO and NaCl are similar, (larger cation has smaller anion and vice versa) therefore, r is almost the same. Therefore, lattice energy depends only on charge. Since the magnitude of charge on Na^+ and Cl^- ions is unity and that on Ca^{2+} and O^{2-} ions is 2 each, therefore, the lattice energy of CaO is four times the lattice energy of NaCl , *i.e.*, $4U$.

80. (b) : Since the phosphate of a metal is $M\text{HPO}_4$, therefore, metal M must be divalent, *i.e.*, M^{2+} . As a result, the formula of its chloride is $M\text{Cl}_2$.

81. (d) : $P = \frac{1}{3} \frac{nmv^2}{V}$

$$\frac{P_x}{P_y} = \frac{n_x u_x V_y}{n_y u_y V_x} = \frac{(N_0 / 1000)}{(N_0 / 2000)} \times 2 \times \frac{2}{1} = 8$$

82. (d) : From thermodynamics, $dG = VdP - SdT$

At constant T , $dT = 0$ so that $\left(\frac{\delta G}{\delta P}\right)_T = V$

At constant P , $dP = 0$ so that $\left(\frac{\delta G}{\delta T}\right)_P = -S$

Also $\mu_{JT} = \left(\frac{\delta T}{\delta P}\right)_H$

83. (c) : Glycine $\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-$ is more acidic than basic. Instead of K_b value, the second given K_a value is corresponding to the K_b value ($\therefore K_a \times K_b = 10^{-14}$). Hence, overall ionization constant,

$$K = K_{a_1} \times K_{a_2} = 4.5 \times 10^{-3} \times 1.7 \times 10^{-10} \\ = 7.65 \times 10^{-13}$$

$$H^+ = \sqrt{KC} = \sqrt{7.65 \times 10^{-13} \times 0.01} \\ = \sqrt{0.765 \times 10^{-14}} = 0.87 \times 10^{-7} \text{ M} \\ \text{pH} = -\log(0.87 \times 10^{-7}) = 7.06$$

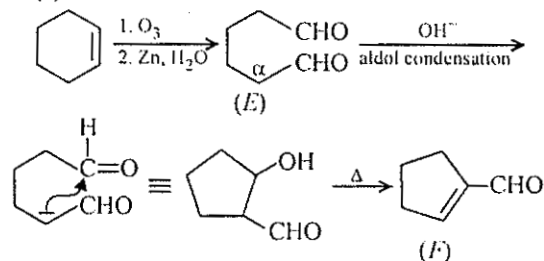
84. (c) : Sequence (c) contains only representative elements.

85. (c) : $2\text{H}_2\text{O}_2 \longrightarrow 2\text{H}_2\text{O} + \text{O}_2$
 100 mL 1000 mL

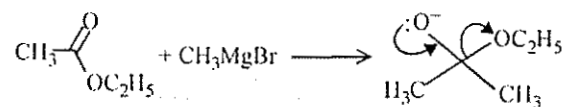
or 1 mL of H_2O_2 will give 10 mL of O_2 at STP
 Thus its volume strength is 10 volume.

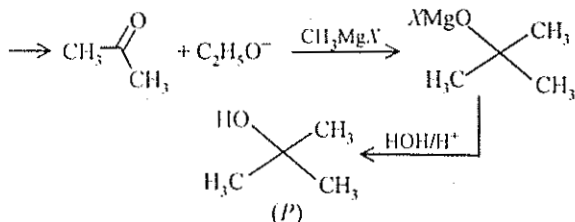
86. (a) : Be exhibits maximum covalency of four whereas Al shows maximum covalency of six.

87. (a) :

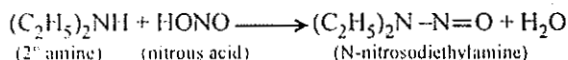


88. (a) :

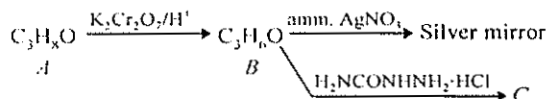




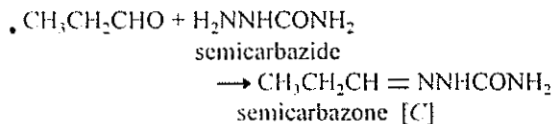
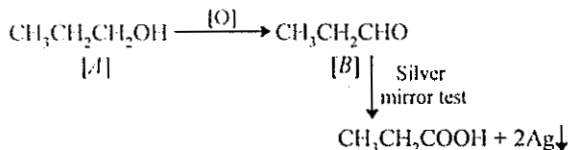
89. (c) : Secondary (2°) amines (aliphatic as well as aromatic) react with nitrous acid (HNO_2) to form N-nitrosoamines.



90. (a) :



Reaction of B indicates that B is an aldehyde thus B should be $\text{C}_2\text{H}_5\text{CHO}$ or $\text{CH}_3\text{CH}_2\text{CHO}$ and therefore C should be $\text{CH}_3\text{CH}_2\text{CH}=\text{NNHCONH}_2$.



$$91. (b) : \Delta x \geq \frac{h}{(4\pi)(m\Delta v)} \\ \Delta x \geq \frac{6.626 \times 10^{-34}}{(4 \times 3.14 \times 1050)(0.9) \left(\frac{1}{3600} \right) \left(\frac{1000}{1} \right)}$$

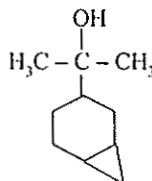
$$\Delta x \geq 2 \times 10^{-17} \text{ m}$$

The uncertainty in the position of the car is far smaller than the uncertainty in the position of an electron in a hydrogen atom ($3 \times 10^{-10} \text{ m}$) and far too small a value to have any measurable consequences.

92. (b) : When a solute is present in very minute amounts (trace quantities), the concentration is expressed in ppm.

$$\begin{aligned} \text{ppm of } A &= \frac{\text{mass of component } A}{\text{total mass of solution}} \times 10^6 \\ &= \frac{0.025}{10^1} \times 10^6 = 25 \text{ ppm} \end{aligned}$$

93. (a) : Degree of unsaturation of $\text{C}_{10}\text{H}_{18}\text{O} = 2$, but it contains no double or triple bond. Hence there are two rings – one six membered as indicated by product and the other three membered which is cleaved by HCl due to strain. Hence A has following structure.



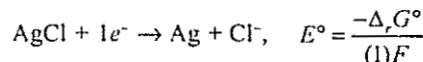
94. (d) : The structure of XeO_3F_2 - $\text{O}=\text{Xe} \begin{array}{l} \text{F} \\ \parallel \\ \text{O} \\ \parallel \\ \text{F} \end{array}$

No. of lone pair of Xe = 0 and no. of bond pair = 5

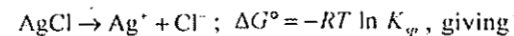
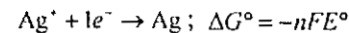
Hybridisation of Xe = sp^3d

Hence, shape of XeO_3F_2 should be trigonal bipyramidal and not octahedral.

95. (a) : For the desired reaction,



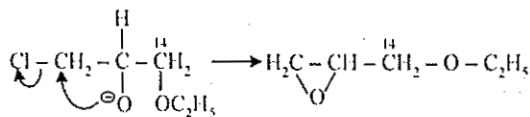
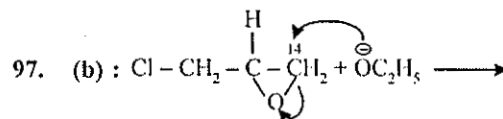
The needed $\Delta_r G^\circ$ can be obtained by adding the values of $\Delta_r G^\circ$ for the reactions



$$\begin{aligned} \Delta_r G^\circ &= -(1 \text{ mol})(9.648 \times 10^4 \text{ J mol}^{-1} \text{ V}^{-1})(0.7991 \text{ V}) \\ &\quad - (8.314 \text{ JK}^{-1} \text{ mol}^{-1})(298 \text{ K}) \ln(1.56 \times 10^{-10}) \\ &= -77.10 \text{ kJ} + 55.95 \text{ kJ} = -21.15 \text{ kJ} \end{aligned}$$

$$\text{The potential is } E^\circ = \frac{-(-21.15)}{(1)(96.485)} = +0.2192 \text{ V}$$

96. (d) : None of these acids evolve H_2 gas with alkali metals.



98. (a) : Given, $M_{\text{HCl}} = 0.1 \text{ M}$, $V_{\text{HCl}} = 18.0 \text{ mL}$
 $M_{\text{NaHCO}_3} = 0.125 \text{ M}$, $V_{\text{NaHCO}_3} = ?$

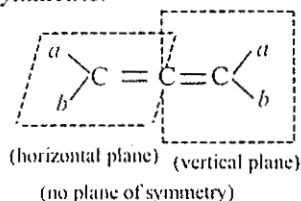
On applying, $M_{\text{HCl}} \times V_{\text{HCl}} = M_{\text{NaHCO}_3} \times V_{\text{NaHCO}_3}$

$$\Rightarrow 0.1 \times 18 = 0.125 \times V_{\text{NaHCO}_3}$$

$$\Rightarrow M_{\text{NaHCO}_3} = 14.4 \text{ mL}$$

Thus, 14.4 mL of the 1.25 M NaHCO_3 solution is needed to neutralise 18.0 mL of the 0.100 M HCl solution.

99. (b) : $M^+ + X^- \rightarrow M + X$ is spontaneous because for the cell represented by $M|M^+ || X^-|X$, the value of E° is positive i.e. $(0.44 - 0.33) \text{ V} = 0.11 \text{ V}$.
100. (b) : Allenes with even number of cumulative double bonds are optically active if both sides are disymmetric.

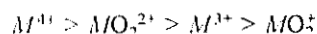


101. (c) : NaCl and CaCl_2 are added to provide conductivity to the electrolyte and also to lower the fusion temperature of anhydrous MgCl_2 .
102. (b) : The equilibrium constant is always fixed and is characteristic of a reaction at specified temperature. However final composition of a reaction mixture at equilibrium at constant temperature depends on the initial concentration of reactants and products.
103. (a) : PCl_5 is trigonal bipyramidal containing sp^3d hybridized P atom in liquid and gaseous states whereas in solid state it consists of tetrahedral PCl_4^+ cation and octahedral PCl_6^- anion.
104. (a)
105. (a) : $\text{CH}_3-\overset{4}{\underset{\text{COOC}_2\text{H}_5}{\text{C}}}-\overset{2}{\text{C}}=\overset{1}{\text{CH}}-\text{COOH}$
- Here since $-\text{COOH}$ is the principal functional group, it gets the lowest number than the secondary functional group (3-carbethoxy). So it is 3-carbethoxy-2-butenic acid.
106. (c) : He contains fully filled $1s^2$ orbital which has more penetrating effect and is very close to the nucleus and hence has higher value of ionisation energy.
107. (a) : The nuclear isomerism in the nuclei of same mass number and same atomic number arises due to different radioactive properties. The reason for

nuclear isomerism is the different energy states of two isomeric nuclei. One may be in the ground state and other in an excited state. The nucleus in the excited state will have different half-life.

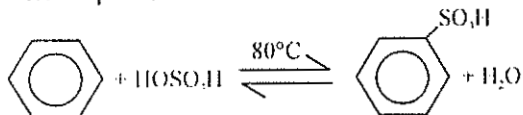
108. (b) : When a silicon crystal is doped with a group-15 elements, such as P, As, Sb or Bi the structure of the crystal lattice is left unchanged but an occasional atom with five valence electrons occupies a site that would normally be occupied by a silicon atom. The foreign atom uses four of its electrons in covalent bonding but the remaining fifth electron becomes delocalised and is thus free to contribute to electrical conduction.
109. (c) : Reactions of higher order are rare because chances for larger number of molecules to come simultaneously for collision are less.
110. (b) : In actual practice transition metals react with acid very slowly and act as poor reducing agents. This is due to the protection of metal as a result of formation of thin oxide protective film. Further, their poor tendency as reducing agent is due to high ionisation energy, high heat of vapourization and low heat of hydration.
111. (b) : Both carbanions (formed in presence of base) and enol form (formed in presence of an acid) act as nucleophiles and hence add on the carbonyl group of aldehydes and ketones to give aldols.
112. (a) : The loss of one α -particle will reduce the mass number by four and atomic number by two. Subsequent two β -emissions will increase the atomic number by two without affecting the mass number. Hence, the new element will be only an isotope of the parent nuclide and hence its position in the periodic table remains unchanged.
113. (d) : Atomic mass and molecular mass are the ratios and have no units.
- $$\text{Mol. mass} = \frac{\text{Wt. of one molecule of the substance}}{\frac{1}{12} \times \text{wt. of one atom of C-12}}$$
114. (b) : Bond dissociation energy is the energy required to break a particular bond in one mole of a gaseous molecule. Bond energy is the average values of dissociation energies of the same type of bond present in the molecule. Bond energy of C-H bond in methane is 99.2 kcal/mol. Thus for polyatomic molecules, average bond energy is taken as the dissociation bond energy.

115. (b) : The higher the charge on the metal ion, smaller is the ionic size and more is the complex forming ability. Thus, the degree of complex formation decreases in the order



The higher tendency of complex formation of MO_2^{2+} as compared to M^{3+} is due to high concentration of charge on metal atom M in MO_2^{2+} .

116. (a) : Sulphonation of benzene is an electrophilic substitution reaction in which SO_3 acts as the electrophile.



117. (a) : Molality does not depend upon volume thus it does not depend on temperature.
118. (d) : In a Frenkel defect an ion leaves its position in the lattice and occupies normally vacant interstitial position.

119. (a) : $\left[(en)_2Co \begin{array}{c} \diagup NH \\ \diagdown OH \end{array} Co(en)_2 \right]^{3+}$ is named as tetrakis (ethylenediammine)- μ -hydroxo- μ -imido dicobalt (III) ion. For more than one bridging group the word μ is repeated before each bridging group.

120. (c) : Greater the number of hyperconjugating structures, greater is the stability of the compound.

BIOLOGY

121. (c) : Vitamin B_6 , also called pyridoxine is widely distributed in cereal grains, yeast, liver, milk, etc. It is a constituent of a coenzyme (pyridoxal phosphate) involved in amino acid metabolism. Deficiency causes retarded growth, dermatitis, convulsions, and other symptoms.
122. (d) : All single-celled eukaryotes are placed under protista. Phylogenetically the kingdom protista acts as a connecting link between the prokaryotic kingdom— Monera and the complex multicellular kingdoms— Fungi, Plantae and Animalia. Being eukaryotes, the protistan cell body contains a well defined nucleus and other membrane-bound organelles. It is surrounded by plasmalemma (cell membrane). Cilia and flagella occur in a number of forms. Nucleus has typical structure—porous nuclear envelope, chromatin, nucleolus and nucleoplasm.
- Monerans lack nuclear membrane.
123. (d) : DPT vaccine is a combined vaccine against diphtheria, whooping cough (pertussis), and tetanus now replaced by the DTaP/IPV/Hib and DTaP/IPV vaccines.
124. (d) : The vascular system consists of complex tissues, the phloem and the xylem. The xylem and phloem together constitute vascular bundles. In dicotyledonous stems, cambium is present between phloem and xylem. Such vascular bundles because of the presence of cambium possess the ability to form secondary xylem and phloem tissues, and hence are called open vascular bundles. In the monocotyledons, the vascular bundles have no cambium present in them. Hence, since they do not form secondary tissues they are referred to as closed.
125. (c)
126. (a)
127. (a) : Bryophytes are nonvascular terrestrial plants of moist habitats in which a multicellular diploid sporophyte lives as a parasite on an independent multicellular haploid gametophyte that develops multicellular jacketed sex organs. Whereas, in pteridophytes, the main plant body is a sporophyte which is differentiated into true root, stem and leaves and gametophyte is small or inconspicuous, it is usually independent.
128. (b) : Parietal cells are present in the epithelium of the gastric glands. They are large and are most numerous on the side walls of the glands. They are also called oxyntic cells as they stain strongly with eosin. They secrete hydrochloric acid and Castle intrinsic factor.
129. (a) : A single species might show high diversity at the genetic level over its distributional range. India has more than 50,000 genetically different strains of rice, and 1,000 varieties of mango.
130. (c)
131. (c) : Gene related human disorders are determined by mutations in single gene. They are transmitted to the offspring as per Mendelian principles. The pattern of inheritance of such Mendelian disorders can be traced in a family by the pedigree analysis. Cystic fibrosis is an abnormal recessive disorder of infants, children and young adults that is due to an

- abnormal recessive autosomal allele present on chromosome 7. In 70% of cases, it is due to deletion of three bases. The disease gets its name from the fibrous cysts that appear in the pancreas. It produces a defective glycoprotein. The defective glycoprotein causes formation of thick mucus in skin, lungs, pancreas, liver and other secretory organs. There is maldigestion of food with high fat content in stool. Liver may undergo cirrhosis.
- Phenylketonuria is an inborn, autosomal, recessive metabolic disorder in which the homozygous recessive individual lacks the enzyme phenylalanine hydroxylase needed to change phenylalanine to tyrosine in liver. It results in hyperphenylalaninemia which is characterised by accumulation and excretion of phenylalanine, phenylpyruvic acid and related compounds. Lack of the enzyme is due to the abnormal autosomal recessive gene on chromosome 12.
132. (d) : In facilitated diffusion special proteins help move substances across membranes along the concentration gradient without expenditure of ATP energy. Facilitated diffusion is very specific, it allows cell to select substances for uptake. It is sensitive to inhibitors which react with protein side chains.
133. (c) : *Entamoeba histolytica* is a protozoan parasite in the large intestine of human which causes amoebiasis (amoebic dysentery). *Streptococcus pneumoniae* and *Haemophilus influenzae* are responsible for the disease pneumonia in humans which infects the alveoli (air filled sacs) of the lungs. *Plasmodium*, a tiny protozoan is responsible for malaria. Typhoid fever could be confirmed by Widal test. *Wuchereria* (*W. bancrofti* and *W. malayi*), the filarial worms cause a slowly developing chronic inflammation of the organs in which they live for many years, usually the lymphatic vessels of the lower limbs and the disease is called elephantiasis or filariasis.
134. (b) : The term ecology was coined by combining two Greek words, *oikos* (meaning 'house' or 'dwelling place') and *logos* (meaning 'the study of') to denote such relationships between the organisms and their environment. Thus, literally, ecology is the study of organisms 'at home'.
135. (b) : There are 64-triplet codons which code for 20 amino acids. This is due to the degeneracy of code as some amino acids are influenced by more than one codon. Only tryptophan and methionine are specified by single codons. All other amino acids are specified by two (e.g., phenylalanine—UUU, UUC) to six (e.g., arginine—CGU, CGC, CGA, CGG, AGA, AGG) codons.
136. (c)
137. (a)
138. (c) : The most recent model of plasma membrane is fluid-mosaic model which was proposed by Singer and Nicolson in 1972. According to this model, the membrane does not have a uniform disposition of lipids and proteins but is instead a mosaic of the two. Further, the membrane is not solid but is quasifluid.
139. (c) : *Penicillium notatum* restrict the growth of *Staphylococci*. *Acetobacter aceti* produces acetic acid. *Saccharomyces cerevisiae* is used for commercial production of ethanol. *Streptococcus* produces streptokinase which is modified by genetic engineering to be used as a 'clot buster' for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack. Bacteria which produce methane are collectively called methanogens, and one such common bacterium is *Methanobacterium*. These bacteria are commonly found in the anaerobic sludge during sewage treatment.
140. (d) : Haemophilia B is due to deficiency of factor IX (Christmas factor). The patient may experience prolonged bleeding following any injury or wound, and in severe cases there is spontaneous bleeding into muscles and joints.
141. (c) : Virus is a nucleoprotein entity which is able to utilize the synthetic machinery of a living cell of another organism for its multiplication which does not involve growth and division. The nucleic acid is either DNA or RNA but never both. DNA containing viruses are called deoxyviruses while RNA containing viruses are termed as riboviruses.
142. (c)
143. (a) : AIDS or acquired immunodeficiency syndrome or acquired immune deficiency

- syndrome (a death warrant) is a serious disease (also called slim disease) caused by a retrovirus HIV (human immunodeficiency virus). It is a set of symptoms and infections resulting from the damage to the human immune system by the virus, that depletes primarily the number of T-lymphocytes (CD-4 T cells or helper T-cells) and renders the patient susceptible to opportunistic infections *i.e.*, infection caused by non-pathogens.
144. (d) : The P-wave represents the electrical excitation (or depolarisation) of the atria, which leads to the contraction of both the atria. The QRS complex represents the depolarisation of the ventricles, which initiates the ventricular contraction. The T-wave represents the return of the ventricles from excited to normal state (repolarisation). So, by counting the number of QRS complexes that occur in a given time period, one can determine the heart beat rate of an individual.
145. (b) : Phosphorus is a major constituent of biological membranes, nucleic acids and cellular energy transfer systems. Many animals also need large quantities of this element to make shells, bones and teeth. The natural reservoir of phosphorus is rock, which contains phosphorus in the form of phosphates. When rocks are weathered, minute amounts of these phosphates dissolve in soil solution and are absorbed by the roots of the plants. Herbivores and other animals obtain this element from plants.
146. (a) : Gonadotropin releasing hormone (GnRH), stimulates the anterior lobe of the pituitary gland to secrete two gonadotropic hormones, follicle stimulating hormone (FSH) and luteinising hormone (LH). In male LH activates the Leydig's (interstitial) cells of the testis to secrete androgens.
147. (c) : Human beings have a significant ability to maintain and moderate the respiratory rhythm to suit the demands of the body tissues. A specialised centre present in the medulla region of the brain called respiratory rhythm centre is primarily responsible for this regulation. A chemosensitive area is situated adjacent to the rhythm centre which is highly sensitive to CO_2 and hydrogen ions. Increase in these substances can activate this centre, which in turn can signal the rhythm centre to make necessary adjustments in the respiratory process by which these substances can be eliminated.
148. (b)
149. (a) : Microvilli increases absorptive surface area. Typhlosolar region in earthworm is the middle region of the intestine in which the mid-dorsal wall of the intestine is thrown into a longitudinal fold which is known as typhlosole. The typhlosole increases the absorptive surface of the intestine.
150. (b) : In ciliated epithelium, the cells bear numerous delicate hair like outgrowths, the cilia, arising from basal granules. This epithelium lines most of the respiratory tract and Fallopian tubes (oviducts). It is also present in tympanic cavity of middle ear and auditory tube (Eustachian tube).
151. (a) : Cyclic photophosphorylation is a process of photophosphorylation in which an electron expelled by the excited photocentre is returned to it after passing through a series of electron carriers. Cyclic photophosphorylation is performed by photosystem I only. The electron is circulated within the photosystem and the phosphorylation occurs due to cyclic flow of electron. The excited electron does not pass on to NADP^+ but is cycled back to the PS I complex through the electron transport chain. The cyclic flow hence, results only in the synthesis of ATP, but not of $\text{NADPH} + \text{H}^+$.
152. (c) : Elephant has the longest gestation period among the given animals. The gestation period of an elephant is 624-641 days.
153. (c) : Plasmid is a structure in bacterial cells consisting of DNA that can exist and replicate independently of the chromosome. These are extrachromosomal circular dsDNA which provide genetic instructions for certain cell activities (*e.g.* resistance to antibiotic drugs). They can be transferred from cell to cell in a bacterial colony. Plasmids are widely used as vectors to produce recombinant DNA for gene cloning.
154. (c) : Concept of chemical evolution refers to origin of life from non living matter. First inorganic compounds and then organic compounds were formed in accordance with ever changing environmental conditions.

155. (c)

Crop	Variety	Resistance to diseases
Wheat	Himgiri	Leaf and stripe rust, hill bunt
Brassica	Pusa swarmim	White rust
Cowpea	Pusa komal	Bacterial blight
Chilli	Pusa sadabahar	Chilly mosaic virus

156. (b) : Processes of recombinant DNA technology involves isolation of DNA of a desired DNA fragment. In order to cut the DNA with restriction enzymes, it needs to be in pure form, free from other macro molecules. The DNA is enclosed within the membranes, we have to break the cell open to release DNA along with other macromolecules such as RNA, proteins, polysaccharides and also lipids. This can be achieved by treating the bacterial cells/plant or animal tissue with enzymes such as lysozyme (bacteria), cellulase (plant cells), chitinase (fungus). The RNA can be removed by treatment with ribonuclease whereas proteins can be removed by treatment with protease.

157. (d) : Genus comprises a group of related species which has more characters in common in comparison to species of other genera. In the other words, genera are aggregates of closely related species. For example, potato and brinjal are two different species but both belong to the genus *Solanum*.

158. (b) : *Panthera tigris* - Tiger
Mangifera indica - Mango
Musca domestica - Housefly
Periplaneta americana - Cockroach
Rana tigrina - Common Indian frog

159. (c)

160. (a) : Calvin pathway occurs in all photosynthetic plants which is CO_2 fixation cycle. Carbon dioxide combines with ribulose-1, 5-biphosphate to produce a transient intermediate compound. The intermediate compound splits up immediately in the presence of water to form the two molecules of 3-phosphoglycerate or PGA. It is the first stable

product of photosynthesis.

161. (b) : Adrenaline (epinephrine) is a hormone produced by the medulla of the adrenal glands, that increases heart activity, improves the power and prolongs the action of muscles, and increases the rate and depth of breathing to prepare the body for 'fright, fight, or flight. It is secreted at the time of emergency. Hence it is also called emergency hormone.

162. (b) : Cork consists of dead and compactly arranged rectangular cells that possess suberised cell walls. The cork cells contain tannins. Hence, they appear brown or dark brown in colour. The cork cells of some plants are filled with air. Cork prevents the loss of water by evaporation. It also protects the interior against entry of harmful micro-organisms, mechanical injury and extremes of temperature. Cork is light, compressible, nonreactive and sufficiently resistant to fire. It is used as stopper for bottles, shock absorption and insulation.

163. (a) : The blood of cockroach, also called as haemolymph is a mobile connective tissue composed of corpuscles and a colourless fluid, the plasma. It does not contain any respiratory pigment and therefore plays no role in respiration.

The respiratory system consists of a network of trachea, that open through 10 pairs of small holes called spiracles present on the lateral side of the body. Thin branching tubes carry oxygen from the air to all the parts. The opening of the spiracles is regulated by the sphincters. Exchange of gases take place at the tracheoles by diffusion.

164. (a) : Virus infected cells secrete proteins known as interferons which protect non infected cells from further viral infection.

165. (d) : The descending limb of loop of Henle is permeable to water but almost impermeable to electrolytes. This concentrates the filtrate as it moves down.

166. (a) : Shrinkage of the protoplast of a cell under the influence of a hypertonic solution is called plasmolysis. Hypertonic solution causes exosmosis or withdrawal of water from cytoplasm and then the central vacuole of cell. The size of cytoplasm as well as central vacuole and hence protoplast

- becomes reduced. The pressure on the wall is simultaneously reduced and the elastic wall contracts causing a reduction in cell size.
167. (a) : Inbreeding refers to the mating of closely related individuals within the same breed for 4-6 generations. Superior males and superior females of the same breed are identified and mated in pairs. The progeny obtained from such matings are evaluated and superior males and females among them are identified for further mating. Inbreeding increases homozygosity. Thus inbreeding is necessary if we want to evolve a pureline in any animal.
168. (d) : The process of delivery of the foetus (childbirth) is called parturition. Parturition is induced by a complex neuroendocrine mechanism. The signals for parturition originate from the fully developed foetus and the placenta which induce mild uterine contractions called foetal ejection reflex. This triggers release of oxytocin from the maternal pituitary. Oxytocin acts on the uterine muscle and causes stronger uterine contractions, which in turn stimulates further secretion of oxytocin. The stimulatory reflex between the uterine contraction and oxytocin secretion continues resulting in stronger and stronger contractions. This leads to expulsion of the baby out of the uterus through the birth canal.
169. (c)
170. (e) : Incomplete dominance is the phenomenon where none of the two contrasting alleles or factors is dominant. The expression of the character in a hybrid or F_1 individual is intermediate or a fine mixture of the expression of the two factors. The inheritance of flower colour in *Antirrhinum* is a good example to understand incomplete dominance. There are two types of flower colour in pure state, red and white. When the two types of plants are crossed, the hybrid or plants of F_1 generation have pink flowers. The pink colour apparently appears due to mixing of red and white colours (incomplete dominance).
171. (e) : Presence of large amounts of nutrients in water causes excessive growth of planktonic (free-floating) algae, called an algal bloom which imparts a distinct colour to the water bodies. Algal blooms cause deterioration of the water quality and fish mortality. Biomagnification refers to increase in concentration of the toxicant at successive trophic levels.
172. (d) : Bile (gall) is a bitter-tasting greenish-yellow alkaline fluid produced by the liver, stored in the gall bladder, and secreted into the duodenum of vertebrates. It assists the digestion and absorption of fats by the action of bile salts, which chemically reduce fatty substances and decrease the surface tension of fat droplets so that they are broken down and emulsified. Bile may also stimulate gut muscle contraction (peristalsis). Bile also contains the bile pigments, bilirubin and biliverdin, which are produced by the breakdown of the blood pigment haemoglobin.
173. (a) : The word "emphysema" means "inflation" or "full of air". Emphysema is an inflation or abnormal distension of the bronchioles or alveolar sacs of the lungs. It causes irreversible distension and loss of elasticity of alveoli. As a result, the alveolar sacs remain filled with air even after expiration. The exhalation becomes more difficult. The lungs remain inflated. Many of the septa between the alveoli are destroyed and much of the elastic tissue of the lungs is replaced by connective tissue. Major causes are cigarette smoking and the inhalation of other smoke or toxic substances over a period of time.
174. (b) : DNA fingerprinting involves identifying differences in some specific regions in DNA sequence called as repetitive DNA, because in these sequences, a small stretch of DNA is repeated many times. These sequences normally do not code for any proteins, but they form a large portion of human genome. These sequences show high degree of polymorphism and form the basis of DNA fingerprinting. As the polymorphisms are inheritable from parents to children, DNA fingerprinting is the basis of paternity testing in case of disputes.
175. (c) : Parasitism is a relationship between two living organisms of different species in which one organism called parasite obtains its food directly from another living organism called host. Majority of the parasites harm the host; they may reduce the survival, growth and reproduction of the host and reduce its population density. Pathogens are disease-causing microorganisms which get benefit by causing harm to host.

organism. Pathogens such as viruses, bacteria, fungi, protozoans, helminths, insects etc., reproduce or multiply inside the host organism and therefore, they get the opportunity to complete the life cycle and spread their population.

176. (c) : CO_2 concentration of the atmosphere is 0.036% or 360 ppm ($360 \mu\text{l} \cdot \text{l}^{-1}$). It is a limiting factor for C_3 as the available CO_2 concentration is lower than the optimum for photosynthesis. Increase in its concentration upto 0.05% increases the rate of photosynthesis in most C_3 plants. When CO_2 concentration is reduced, there comes a point at which illuminated plant parts stop absorbing carbon dioxide from their environment. It is known as CO_2 compensation point or threshold value. At this value CO_2 fixed in photosynthesis is equal to CO_2 evolved in respiration and photorespiration. The value is 25–100 ppm in C_3 plants and 0–10 ppm in C_4 plants. The reason for low compensation value for C_3 plants is the greater efficiency of CO_2 fixation through PEP-carboxylase.
177. (a) : Glucagon stimulates the liver to convert stored glycogen into glucose. Glucagon is also called an "anti-insulin" hormone. Insulin is antagonistic to glucagon. Insulin converts glucose into glycogen in the liver and muscles. It promotes protein synthesis in tissue from amino acids. Insulin reduces catabolism of proteins. It is an anabolic hormone. It increase the synthesis of fat in the adipose tissue from fatty acids. Insulin reduces the breakdown and oxidation of fat.
178. (d) : Auditory ossicles are three small bones present in the middle ear. These three ear ossicles are malleus, the incus and the stapes. These three bones are in the sequence of malleus, incus and stapes and are attached to each other. Their function is to increase the intensity of sound waves. The cavity of middle ear communicates with that of pharynx through the air filled tube called Eustachian tube. The Eustachian tube maintains the balance in the

air pressure between two sides of the ear drum and thus allows it to vibrate freely when sound waves impinge on it.

179. (c) : Pharyngeal nephridia occur in three pairs of bunches in the 4th, 5th and 6th segments lying on each side of the alimentary canal. The ducts of the nephridia of the sixth segment open into the buccal cavity while the ducts from the nephridia bunches of the fourth and fifth segments open into the pharynx. These ducts carry excretory products from the pharyngeal nephridia into the gut. Enteronephric condition is an adaptation for the conservation of water which is absorbed by the inner lining of the alimentary canal. Ectonephric nephridia discharge their contents directly to the outside which help the earthworm in keeping the skin moist for cutaneous respiration only. Integumentary nephridia are ectonephric nephridia while, pharyngeal and septal nephridia are enteronephric.
180. (d) : Pantothenic acid, formerly known as chick anti-dermatitis factor or filtrate factor is widely distributed in nature. It is a surprise to biochemists that despite the involvement of pantothenic acid (as coenzyme A) in a great number of metabolic reactions, its deficiency manifestations have not been reported in humans, presumably because of the wide occurrence of this vitamin in almost all foods and because small amount can be synthesized in the body. Folic acid deficiency is probably the most common vitamin deficiency. The macrocytic anaemia (abnormally large RBC) associated with megaloblastic changes in bone marrow is a characteristic feature of folate deficiency.

GENERAL KNOWLEDGE

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|----------|----------|----------|----------|----------|
| 181. (a) | 182. (c) | 183. (a) | 184. (b) | 185. (c) |
| 186. (a) | 187. (a) | 188. (c) | 189. (c) | 190. (c) |
| 191. (b) | 192. (d) | 193. (d) | 194. (c) | 195. (b) |
| 196. (c) | 197. (b) | 198. (c) | 199. (d) | 200. (b) |



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Use the index for topicwise analysis of
AIIMS paper and refer to these
questions when you are practising MCQs chapterwise.

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