MHT CET 2018 Question Paper with Solution

Maharashtra Common Entrance Test

MHT-CET 2018

General Instructions

- *This question booklet contains 150 Multiple Choice Questions (MCQs).*
  Section-A: *Physics & Chemistry - 50 Questions each and*
  Section-B: *Mathematics - 50 Questions.*
- *Choice and sequence for attempting questions will be as per the convenience of the candidate.*
- *Read each question carefully.*
- *Determine the one correct answer out of the four available options given for each question.*
- *Each question with correct response shall be awarded one (1) mark. There shall be no negative marking.*
- *No mark shall be granted for marking two or more answers of same question, scratching or overwriting.*
- *Duration of paper is 3 Hours.*

SECTION-A

PHYSICS

1. The path length of oscillation of simple pendulum of length 1 meter is 16 cm. Its maximum velocity is ($g = \pi^2$ m/s^2)

(a) 2π cm/s (b) 4π cm/s
(c) 8π cm/s (d) 16π cm/s

2. A vessel completely filled with water has holes 'A' and 'B' at depths 'h' and '3h' from the top respectively. Hole 'A' is a square of side 'L' and 'B' is circle of radius 'r'. The water flowing out per second from both the holes is same. Then 'L' is equal to

(a) $r^{\frac{1}{2}}(\pi)^{\frac{1}{2}}(3)^{\frac{1}{2}}$ (b) $r\cdot(\pi)^{\frac{1}{2}}(3)^{\frac{1}{4}}$

(c) $r\cdot(\pi)^{\frac{1}{2}}(3)^{\frac{1}{4}}$ (d) $r^{\frac{1}{2}}(\pi)^{\frac{1}{3}}(3)^{\frac{1}{2}}$

3. A transistor is used as a common emitter amplifier with a load resistance 2 KΩ. The input resistance is 150 Ω. Base current is changed by 20 μA which results in a change in collector current by 1.5 mA. The voltage gain of the amplifier is

(a) 900 (b) 1000 (c) 1100 (d) 1200

4. A dics has mass 'M' and radius 'R'. How much tangential force should be applied to the rim of the disc so as to rotate with angular velocity 'ω' in times 't' ?

(a) $\frac{MR\omega}{4t}$ (b) $\frac{MR\omega}{2t}$

(c) $\frac{MR\omega}{t}$ (d) $MR\omega t$

5. A circular coil carrying current 'I' has radius 'R' and magnetic field at the centre is 'B'. At what distance from the centre along the axis of the magnetic field will be $\frac{B}{8}$?

(a) $R\sqrt{2}$ (b) $R\sqrt{3}$ (c) 2R (d) 3R

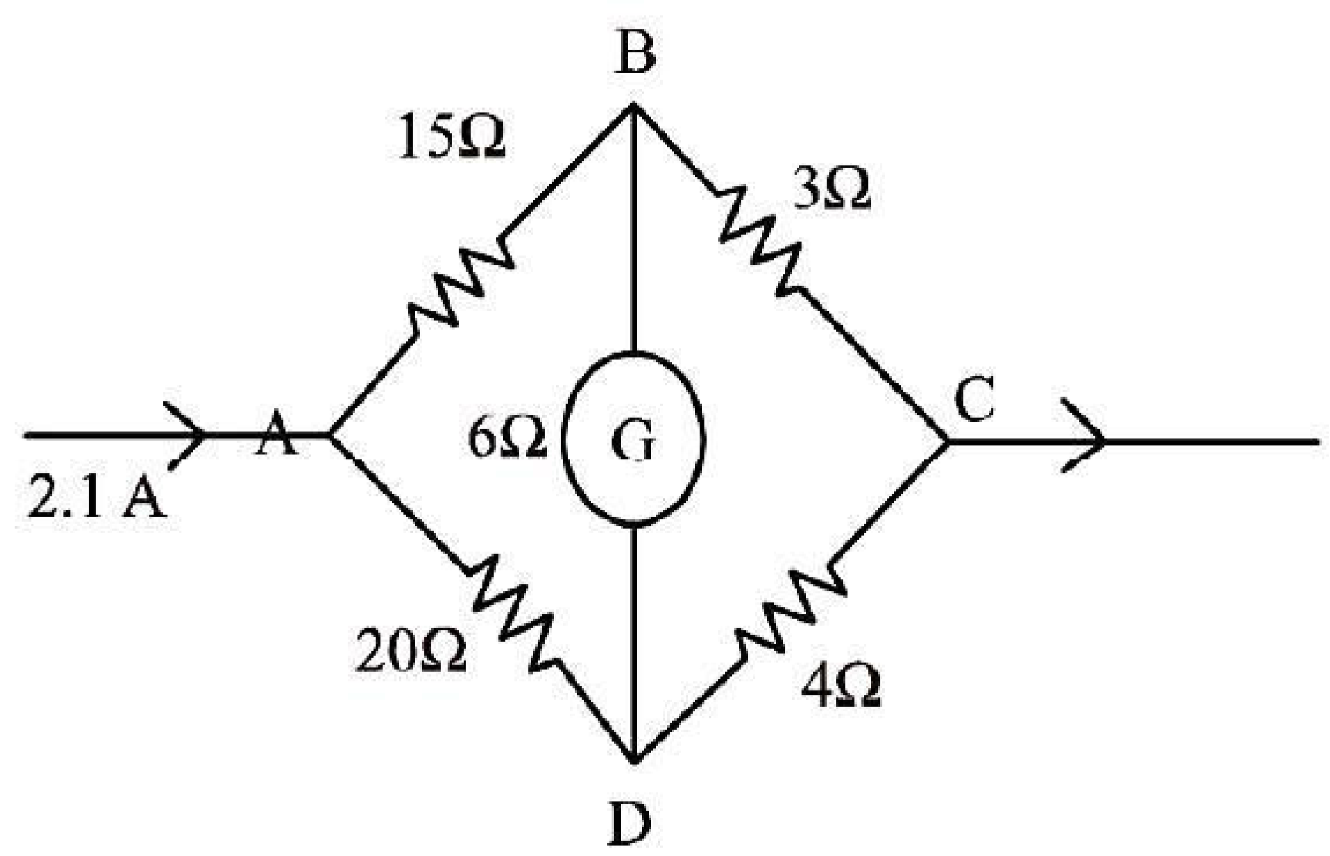
6. Two light waves of intensities 'I_1' and 'I_2' having same frequency pass through same medium at a time in same direction and interface. The sum of the minimum and maximum intensities is

(a) $(I_1 + I_2)$ (b) $2(I_1 + I_2)$
(c) $(\sqrt{I_1} + \sqrt{I_2})$ (d) $(\sqrt{I_1} - \sqrt{I_2})$

7. An alternative voltage $e = 200\sqrt{2}$ sin (100 t) volt is connected to 1 μF capacitor through a.c. ammeter. The reading of ammeter is

(a) 5 mA (b) 10 mA (c) 15 mA (d) 20 mA

8. In the following network, the current flowing through 15Ω resistance is



(a) 0.8 A (b) 1.0 A (c) 1.2 A (d) 1.4 A

9. The angle made by incident ray of light with normal of the reflecting surface is called
(a) glancing angle (b) angle of incidence
(c) angle of deviation (d) angle of refraction

10. In non uniform circular motion, the ratio of tangential to radius acceleration is (r = radius of circle, v = speed of the particle, α = angular acceleration)

(a) $\frac{\alpha^2 r^2}{v}$ (b) $\frac{\alpha^2 r}{v^2}$ (c) $\frac{\alpha r^2}{v^2}$ (d) $\frac{v^2}{r^2 \alpha}$

11. If numerical aperture of a microscope is increased then its
(a) resolving power remains constant
(b) resolving power becomes zero
(c) limit of resolution is decreased
(d) limit of resolution is increased

12. In amplitude modulation
(a) amplitude remains constant but frequency changes
(b) both amplitude and frequency do not change
(c) both amplitude and frequency change
(d) amplitude of the carrier wave changes according to information signal

13. If M_Z = magnetization of a paramagnetic sample, B = external magnetic field, T = absolute temperature, C = curie constant then according to Curie's law in Magnetism, the correct relation is

(a) $M_z = \frac{T}{CB}$ (b) $M_z = \frac{CB}{T}$

(c) $C = \frac{M_z B}{T}$ (d) $C = \frac{T^2}{M_z B}$

14. An electron of stationary hydrogen atom jumps from 4^{th} energy level to ground level. The velocity that the photon acquired as a result of electron transition will be (h = Planck's constant, R = Rydberg's constant, m = mass of photon)

(a) $\frac{9Rh}{16m}$ (b) $\frac{11hR}{16m}$

(c) $\frac{13hR}{16m}$ (d) $\frac{15hR}{16m}$

15. A metal wire of density 'ρ' floats on water surface horizontally. If it is **NOT** to sink in water then maximum radius of wire is proportional to (T = surface of water, g = gravitational acceleration)

(a) $\sqrt{\frac{T}{\pi \rho g}}$ (b) $\sqrt{\frac{\pi \rho g}{T}}$

(c) $\frac{T}{\pi \rho g}$ (d) $\frac{\pi \rho g}{T}$

16. A sphere of mass 'm' moving with velocity 'v' collides head-on another sphere of same mass which is at rest. The ratio of final velocity of second sphere to the initial velocity of the first sphere is (e is coefficient of restitution and collision is inelastic)

(a) $\frac{e-1}{2}$ (b) $\frac{e}{2}$ (c) $\frac{e+1}{2}$ (d) e

17. For a particle performing linear S.H.M., its average speed over one oscillation is (a = amplitude of S.H.M., n = frequency of oscillation)
(a) 2 an (b) 4 an (c) 6 an (d) 8 an

18. An ideal transformer converts 220 V a.c. to 3.3 kV a.c. to transmit a power of 4.4 kW. If primary coil has 600 turns, then alternating current in secondary coil is

(a) $\frac{1}{3}$A (b) $\frac{4}{3}$A (c) $\frac{5}{3}$A (d) $\frac{7}{3}$A

19. A conducing wire has length 'L_1' and diameter 'd_1'. After stretching the same wire length becomes 'L_2' and diameter 'd_2' The ratio of resistances before and after stretching is

(a) $d_2^4 : d_1^4$ (b) $d_1^4 : d_2^4$

(c) $d_2^2 : d_1^2$ (d) $d_1^2 : d_2^2$

20. The molar specific heat of an ideal gas at constant pressure and constant volume is 'C_p' and 'C_V' respectively. If 'R' is the universal gas constant and the ratio of 'C_p' to 'C_v' is 'γ' then C_V =

(a) $\frac{1-\gamma}{1+\gamma}$ (b) $\frac{1+\gamma}{1-\gamma}$ (c) $\frac{\gamma-1}{R}$ (d) $\frac{R}{\gamma-1}$

21. In a capillary tube having area cross-section 'A' water rises to a height 'h'. If cross-sectional area is reduced to $\frac{A}{9}$, the rise of water in the capillary tube is

(a) 4h (b) 3h (c) 2h (d) h

22. With forward biased mode, the p-n junction diode

(a) is one in which width of depletion layer increases
(b) is one in which potential barrier increases
(c) acts as closed switch
(d) acts as open switch

23. An alternating electric field of frequency 'v' is applied across the dees (radius R) of a cyclotron to accelerate protons (mass m). The operating magnetic field 'B' used and K.E. of the proton beam produced by it are respectively (e = charge on proton)

(a) $\frac{2\pi mv}{e}, 2\pi^2 m v^2 R^2$

(b) $\frac{2\pi^2 mv}{e^2}, 4\pi^2 m v^2 R^2$

(c) $\frac{\pi mv}{e}, \pi^2 m v^2 R^2$

(d) $\frac{2\pi^2 m^2 v^2}{e}, 2\pi^2 m v^2 R^2$

24. A ray of light is incident normally on a glass slab of thickness 5 cm and refractive index 1.6. The time taken to travel by a from source of slab is same as to travel through glass slab. The distance of source from the surface is

(a) 4 cm (b) 8 cm (c) 12 cm (d) 16 cm

25. A string is vibrating in its fifth overtone between two rigid supports 2.4 m apart. The distance between successive node and antinode is

(a) 0.1 m (b) 0.2 m (c) 0.6 m (d) 0.8 m

26. If $\vec{A}=3\hat{i}-2\hat{j}+\hat{k}, \vec{B}=\hat{i}-3\hat{j}+5\hat{k}$ and $\vec{C}=2\hat{i}+\hat{j}-4\hat{k}$ form a right angled triangle then out of the following which one is satisfied ?

(a) $\vec{A}=\vec{B}+\vec{C}$ and $A^2=B^2+C^2$

(b) $\vec{A}=\vec{B}+\vec{C}$ and $B^2=A^2+C^2$

(c) $\vec{B}=\vec{A}+\vec{C}$ and $B^2=A^2+C^2$

(d) $\vec{B}=\vec{A}+\vec{C}$ and $A^2=B^2+C^2$

27. A square frame ABCD is formed by four identical rods each of mass 'm' and length 'ℓ'. This frame is in X-Y plane such that side AB coincides with X-axis and side AD along Y-axis. The moment of inertia of the frame about X-axis is

(a) $\frac{5ml^2}{3}$ (b) $\frac{2ml^2}{3}$ (c) $\frac{4ml^2}{3}$ (d) $\frac{ml^2}{12}$

28. A unit vector is represented as $(0.8\hat{i}+b\hat{j}+0.4\hat{k})$. Hence the value of 'b' must be

(a) 0.4 (b) $\sqrt{0.6}$ (c) 0.2 (d) $\sqrt{0.2}$

29. Magnetic susceptibility for a paramagnetic and diamagnetic materials is respectively

(a) small, positive and small, positive
(b) large, positive and small, negative
(c) small, positive and small, negative
(d) large, negative and large, positive

30. A mass is suspended from a vertical spring which is executing S.H.M. of frequency 5 Hz. The spring is unstretched at the highest point of oscillation. Maximum speed of the mass is [acceleration due to gravity g = 10 m/s^2]

(a) 2π m/s (b) π m/s

(c) $\frac{1}{2\pi}$ m/s (d) $\frac{1}{\pi}$ m/s

31. The moment of inertia of a ring about an axis passing through the centre and perpendicular to its plane is 'I'. It is rotating with angular velocity 'ω'. Another identical ring is gently placed on it so that their centres coincide. If both the rings are rotating about the same axis then loss in kinetic energy is

(a) $\frac{I\omega^2}{2}$ (b) $\frac{I\omega^2}{4}$ (c) $\frac{I\omega^2}{6}$ (d) $\frac{I\omega^2}{8}$

32. A bomb at rest explodes into 3 parts of same mass. The momentum of two parts is $-3P\hat{i}$ and $2P\hat{j}$ respectively. The magnitude of momentum of the third part is

(a) P (b) 5P (c) 11 P (d) $\sqrt{13}$ P

33. In a photocell, frequency of incident radiation is increased by keeping other factors constant ($v > v_0$), the stopping potential
(a) decreases
(b) increases
(c) becomes zero
(d) first decreases and then increase

34. A mass attached to one end of a string crosses top-most point on a vertical circle with critical speed. Its centripetal acceleration when string becomes horizontal will be (g = gravitational acceleration)
(a) g (b) 3g (c) 4g (d) 6g

35. The expression for electric field intensity at a point outside uniformly charged thin plane sheet is (d is the distance of point from plane sheet)
(a) independent of d
(b) directly proportional to $\sqrt{d}$
(c) directly proportional to d
(d) directly proportional to $\frac{1}{\sqrt{d}}$

36. When source of sound moves towards a stationary observer, the wavelength of sound received by him
(a) decrease while frequency increase
(b) remains the same whereas frequency increases
(c) increases and frequency also increases
(d) decreases while frequency remains the same

37. The deflection in galvanometer falls to $\left(\frac{1}{4}\right)^{th}$ when it is shunted by 3Ω. If additional shunt of 2Ω is connected to earlier shunt, the deflection in galvanometer falls to

(a) $\frac{1}{2}$ (b) $\left(\frac{1}{3}\right)^{th}$

(c) $\left(\frac{1}{4}\right)^{th}$ (d) $\left(\frac{1}{8.5}\right)^{th}$

38. A body is thrown from the surface of the earth with velocity 'u' m/s. The maximum height in m above the surface of the earth upto which it will reach is (R = radius of earth, g = acceleration due to gravity)

(a) $\frac{u^2R}{2gR-u^2}$ (b) $\frac{2u^2R}{gR-u^2}$

(c) $\frac{u^2R^2}{2gR^2-u^2}$ (d) $\frac{u^2R}{gR-u^2}$

39. A series combination of N_1 capacitors (each of capacity C_1) is charged to potential difference '3V'. Another parallel combination of N_2 capacitors (each of capacity C_2) is charged to potential difference 'V'. The total energy stored in both the combinations is same. The value of C_1 in terms of C_2 is

(a) $\frac{C_2N_1N_2}{9}$ (b) $\frac{C_2N_1^2N_2^2}{9}$

(c) $\frac{C_2N_1}{9N_2}$ (d) $\frac{C_2N_2}{9N_1}$

40. Heat energy is incident on the surface at the rate of 1000 J/min. If coefficient of absorption is 0.8 and coefficient of reflection is 0.1 then heat energy transmitted by the surface in 5 minutes is

(a) 100 J (b) 500 J (c) 700 J (d) 900 J

41. Two metal wires 'P' and 'Q' of same length and material are stretched by same load. Their masses are in the ratio $m_1 : m_2$. The ratio of elongation of wire 'P' to that of 'Q' is

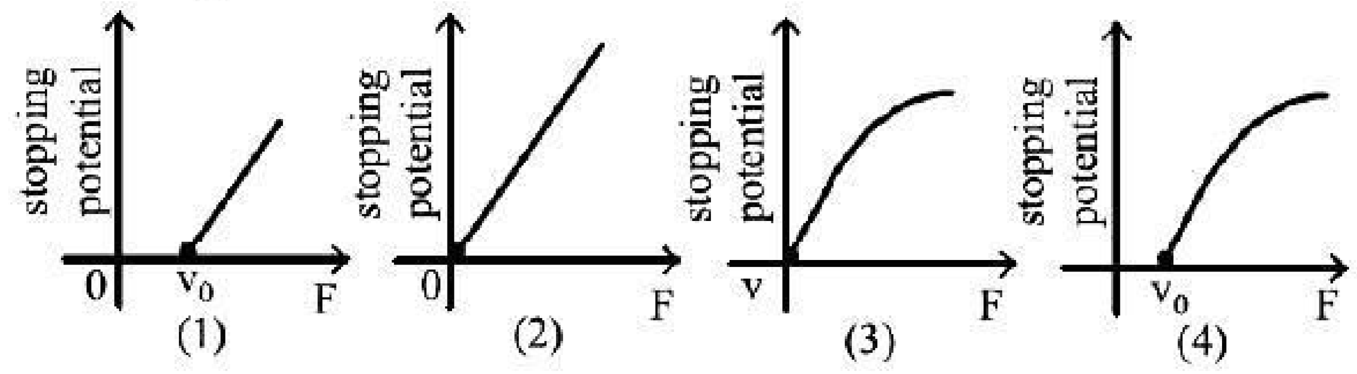
(a) $m_1^2 : m_2^2$ (b) $m_2^2 : m_1^2$

(c) $m_2 : m_1$ (d) $m_1 : m_2$

42. Let $x = \left[\frac{a^2b^2}{c}\right]$ be the physical quantity. If the percentage error in the measurement of physical quantities a, b and c is 2, 3 and 4 percent respectively then percentage error in the measurement of x is

(a) 7% (b) 14% (c) 21% (d) 28%

43. Following graphs show the variation of stopping potential corresponding to the frequency of incident radiation (F) for a given metal. The correct variation is shown in graph
(v_0 = Threshold frequency)



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

44. In compound microscope, the focal length and aperture of the objective used is respectively
(a) large and large (b) large and small
(c) short and large (d) short and small

45. The energy of an electron having de-Broglie wavelength 'λ' is (h = Plank's constant, m = mass of electron)

(a) $\frac{h}{2m\lambda}$ (b) $\frac{h^2}{2m\lambda^2}$

(c) $\frac{h^2}{2m^2\lambda^2}$ (d) $\frac{h^2}{2m^2\lambda}$

46. 'n' number of waves are produced on a string in 0.5 second. Now the tension in the string is doubled (Assume length and radius constant), the number of waves produced in 0.5 second for the same harmonic will be

(a) n (b) $\sqrt{2}$ n (c) $\frac{n}{\sqrt{2}}$ (d) $\frac{n}{\sqrt{5}}$

47. The increase in energy of a metal bar of length 'L' and cross-sectional area 'A' when compressed with a load 'M' along its length is (Y = Young's modulus of the material of metal bar)

(a) $\frac{FL}{2AY}$ (b) $\frac{F^2L}{2AY}$

(c) $\frac{FL}{AY}$ (d) $\frac{F^2L^2}{2AY}$

48. The ratio of magnetic fields due to a bar magnet at the two axial points P_1 and P_2 which are separated from each other by 10 cm is 25 : 2. Points P_1 is situated at 10 cm from the centre of the magnet. Magnetic length of the bar magnet is (Points P_1 and P_2 are on the same side of magnet and distance of P_2 from the centre is greater than distance of P_1 from the centre of magnet)
(a) 5 cm (b) 10 cm (c) 15 cm (d) 20 cm

49. A satellite is revolving in a circular orbit at a height 'h' above the surface of the earth of radius 'R'. The speed of the satellite in its orbit is one-fourth the escape velocity from the surface of the earth. The relation between 'h' and 'R' is
(a) h = 2R (b) h = 3R (c) h = 5R (d) h = 7R

50. A pipe closed at one end has length 83 cm. The number of possible natural oscillations of air column whose frequencies lie below 1000 Hz are (velocity of sound in air = 332 m/s)
(a) 3 (b) 4 (c) 5 (d) 6

CHEMISTRY

51. A certain reaction occurs in two steps as
(i) $2SO_2(g) + 2NO_2(g) \rightarrow 2SO_3(g) + 2NO(g)$
(ii) $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$
In the reaction
(a) $NO_2(g)$ is intermediate
(b) NO(g) is intermediate
(c) NO(g) is catalyst
(d) $O_2(g)$ is intermediate

52. Which among the following equations represents the first law of thermodynamics under isobaric conditions ?
(a) $\Delta U = q_p - P_{ex}.\Delta V$ (b) $q_v = \Delta U$
(c) $\Delta U = W$ (d) $W = -q$

53. During galvanization of iron, which metal is used for coating iron surface ?
(a) Copper (b) Zinc
(c) Nickel (d) Tin

54. Formation of PCl_3 is explained on the basis of what hybridisation of phosphorus atom ?
(a) sp^2 (b) sp^3
(c) sp^3d (d) sp^3d^2

55. Identify the element that forms amphoteric oxide.
(a) Copper (b) Zinc
(c) Calcium (d) Sulphur

56. Identify the product 'C' in the following reaction.
Aniline

$$\text{Aniline} \xrightarrow[\text{Pyridine}]{(CH_3CH)_2O} A \xrightarrow[CH_3COOH]{Br_2} B \xrightarrow{H^+ \text{ or } OH^-} C$$

(a) Acetanilide
(b) $p-$Bromoacetanilide
(c) $p-$Bromoaniline
(d) $o-$Bromoaniline

57. Identify the functional group that has electron donating inductive effect.
(a) $-COOH$ (b) $-CN$
(c) $-CH_3$ (d) $-NO_2$

58. Which among the following metals crystallise as a simple cube ?
(a) Polonium (b) Iron
(c) Copper (d) Gold

59. Which among the following oxoacids of phosphorus shows a tendency of disproportionation ?
(a) Phosphinic acid (H_3PO_2)
(b) Orthophosphoric acid (H_3PO_4)
(c) Phosphonic acid (H_3PO_3)
(d) Pyrophosphoric acid ($H_4P_2O_7$)

60. What is the oxidation number of gold in the complex $[AuCl_4]^{1-}$?
(a) +4 (b) +3 (c) +2 (d) +1

61. Which symbol replaces the unit of atomic mass, amu ?
(a) u (b) A (c) M (d) n

62. Which of the following compounds reacts immediately with Lucas reagent ?
(a) CH_3CH_2OH
(b) $CH_3CH_2CH_2OH$
(c) $CH_3-\underset{\underset{OH}{|}}{CH}-CH_3$
(d) $CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{OH}{|}}{C}}-CH_3$

63. What is the catalyst used for oxidation of SO_2 to SO_3 in lead chamber process for manufacturer of sulphuric acid ?
(a) Nitric oxide (b) Nitrous oxide
(c) Potassium iodide (d) Dilute HCl

64. The number of moles of electrons passed when current of 2 A is passed through a solution of electrolyte for 20 minutes is
(a) 4.1×10^{-4} mol e^- (b) 1.24×10^{-2} mol e^-
(c) 2.487×10^{-2} mol e^- (d) 2.487×10^{-1} mol e^-

65. The molarity of urea (molar mass 60 g mol^{-1}) solution by dissolving 15 g of urea in 500 cm^3 of water is
(a) 2 mol dm^{-3} (b) 0.5 mol dm^{-3}
(c) 0.125 mol dm^{-3} (d) 0.0005 mol dm^{-3}

66. Which carbon atom of deoxy Ribose sugar in DNA does **NOT** contain $-\overset{|}{\underset{|}{C}}-OH$ bond ?
(a) C_5 (b) C_3 (c) C_2 (d) C_1

67. Which of the following carboxylic acids is most reactive towards esterification ?
(a) $(CH_3)_3CCOOH$
(b) $(CH_3)_2CHCOOH$
(c) CH_3CH_2COOH
(d) $(C_2H_5)_2)CHCOOH$

68. Molarity is
(a) the number of moles of solute present in 1 dm^3 volume of solution
(b) the number of moles of solute dissolved in 1 kg of solvent
(c) the number of moles of solute dissolved in 1 kg of solution
(d) the number of moles of solute dissolved in 100 dm^3 volume of solution

69. Which of the followings is a tricarboxylic acid ?
(a) Citric acid (b) Malonic acid
(c) Succinic acid (d) Malic acid

70. What is the number of donor atoms in dimethylglyoximato ligand ?
(a) 1 (b) 2 (c) 3 (d) 4

71. In which substance does nitrogen exhibit the lowest oxidation state ?
(a) nitrogen gas (b) ammonia
(c) nitrous oxide (d) nitric oxide

72. Which of the following is most reactive towards addition reaction of hydrogen cyanide to form corresponding cyanohydrin ?
(a) Acetone (b) Formaldehyde
(c) Acetaldehyde (d) Diethylketone

73. The most basic hydroxide from following is
(a) $Pr(OH)_3$ (Z = 59) (b) $Sm(OH)_3$ (Z = 62)
(c) $Ho(OH)_3$ (Z = 67) (d) $La(OH)_3$ (Z = 57)

74. What is the SI unit of density ?
(a) g cm^{-3} (b) g m^{-3}
(c) kg m^{-3} (d) kg cm^{-3}

75. Which of the following compounds does **NOT** undergo haloform reaction ?
(a) $CH_3-\underset{\underset{OH}{|}}{CH}-CH_3$ (b) $CH_3-\underset{\underset{O}{||}}{C}-CH_3$
(c) $C_2H_5-\underset{\underset{OH}{|}}{CH}-C_2H_5$ (d) $CH_3-\underset{\underset{O}{||}}{C}-C_2H_5$

76. Two moles of an idea gas are allowed to expand from a volume of 10 dm^3 to $2m^3$ at 300 K against a pressure of 101.325 KPa. Calculate the work done.
(a) −201.6kJ (b) 13.22 kJ
(c) −810.6 J (d) −18.96 kJ

77. In which among the following solids, Schottky defect is **NOT** observed ?
(a) ZnS (b) NaCl (c) KCl (d) CsCl

78. What are the products of auto-photolysis of water ?
(a) H_2 and O_2 (b) Steam
(c) H_3O^+ and OH^- (d) Hydrogen peroxide

79. Bauxite, the ore of aluminium, is purified by which process ?

(a) Hoope's process (b) Hall's process
(c) Mond's process (d) Liquation process

80. Phenol in presence of sodium hydroxide reacts with chloroform to form salicylaldehyde. The reaction is known as

(a) Kolbe's reaction
(b) Reimer-Tiemann reaction
(c) Stephen reaction
(d) Etard reaction

81. Which among the following elements of group-2 exhibits anomalous properties ?

(a) Be (b) Mg (c) Ca (d) Ba

82. Excess of ammonia with sodium hypochloride solution in the presence of glue or gelatine gives

(a) $NaNH_2$ (b) NH_2NH_2
(c) N_2 (d) NH_4Cl

83. What is the density of solution of sulphuric acid used as an electrolyte in lead accumulator ?

(a) $1.5\ g\ mL^{-1}$ (b) $1.2\ g\ mL^{-1}$
(c) $1.8\ g\ mL^{-1}$ (d) $2.0\ g\ mL^{-1}$

84. Which of the following polymers is used to manufacture clothes for firefighters ?

(a) Thiokol (b) Kevlar
(c) Nomex (d) Dynel

85. Which elements is obtained in the pure form by van Arkel method ?

(a) Aluminium (b) Titanium
(c) Silicon (d) Nickel

86. Which of the following is **NOT** a tranquilizer ?

(a) Meprobamate (b) Equanil
(c) Chlordiazepoxide (d) Bromopheniramine

87. Conversion of hexane into benzene involves the reaction of

(a) hydration (b) hydrolysis
(c) hydrogenation (d) dehydrogenation

88. The element that does **NOT** exhibit allotropy is

(a) phosphorus (b) arsenic
(c) antimony (d) bismuth

89. Which of the following reactions is used to prepare aryl fluorides from diazonium salts and fluoroboric acid ?

(a) Sandmeyer reaction
(b) Balz-Schiemann reaction
(c) Gattermann reaction
(d) Swarts reaction

90. The correct relation between elevation of boiling point and mass of solute is

(a) $M_2 = \dfrac{K_b \cdot W_2}{\Delta T_b \cdot W_1}$ (b) $M_2 = \dfrac{K_b \cdot W_1}{\Delta T_b \cdot W_2}$

(c) $M_2 = \dfrac{\Delta T_b \cdot K_b}{W_1 \cdot W_2}$ (d) $M_2 = \dfrac{\Delta T_b \cdot W_1}{K_b \cdot W_2}$

91. Which among the group – 15 elements does **NOT** exists as tetra atomic molecule ?

(a) Nitrogen (b) Phosphorus
(c) Arsenic (d) Antimony

92. Identify the monosaccharide containing only one asymmetric carbon atom in its molecule.

(a) Ribulose (b) Ribose
(c) Erythrose (d) Glyceraldehyde

93. Identify the oxidation states of titanium (Z = 22) and copper (Z = 29) in their colourless compounds.

(a) Ti^{3+}, Cu^{2+} (b) Ti^{2+}, Cu^{2+}
(c) Ti^{4+}, Cu^{1+} (d) Ti^{4+}, Cu^{2+}

94. Arenes on treatments with chlorine in presence of ferric chloride as a catalyst undergo what type of reaction ?

(a) Electrophilic substitution
(b) Nucleophilic substitution
(c) Electrophilic addition
(d) Nucleophilic addition

95. In case of R, S configuration the group having highest priority is

(a) $-NO_2$ (b) $-NH_2$ (c) $-CN$ (d) $-OH$

96. Lactic acid and glycollic acid are the monomers used for preparation of polymer

(a) Nylon-2 nylon-6 (b) Dextron
(c) PHBV (d) Buna-N

97. What is the geometry of water molecule ?

(a) distorted tetrahedral
(b) tetrahedral
(c) trigonal planer
(d) diagonal

98. With which halogen the reactions, of alkanes are explosive ?

(a) Fluorine (b) Chlorine
(c) Bromine (d) Iodine

99. Calculate the work done during combustion of 0.138 kg of ethanol, $C_2H_5OH(1)$ at 300 K. Given : $R = 8.314\ Jk^{-1}\ mol^{-1}$ molar mass of ethanol = 46 $g\ mol^{-1}$.

(a) −7482 J (b) 7482 J
(c) −2494 J (d) 2494 J

100. Slope of the straight line obtained by plotting $\log_{10}k$ against represents what term ?

(a) $-E_a$ (b) $-2.303\ E_a/R$
(c) $-E_a/2.303\ R$ (d) $-E_a/R$

SECTION-B

MATHEMATICS

1. If $\int_0^K \frac{dx}{2+18x^2} = \frac{\pi}{24}$, then the value of K is

(a) 3 (b) 4 (c) $\frac{1}{3}$ (d) $\frac{1}{4}$

2. The cartesian co-ordinates of the point on the parabola $y^2 = -16x$, whose parameter is $\frac{1}{2}$, are

(a) $(-2, 4)$ (b) $(4, -1)$
(c) $(-1, -4)$ (d) $(-1, 4)$

3. $\int \frac{1}{\sin x . \cos^2 x} dx =$

(a) $\sec x + \log|\sec x + \tan x| + c$
(b) $\sec x . \tan x + c$
(d) $\sec x + \log|\sec x - \tan x| + c$
(c) $\sec x + \log|\operatorname{cosec} x - \cot x| + c$

4. If $\log_{10}\left(\frac{x^3 - y^3}{x^3 + y^3}\right) = 2$ then $\frac{dy}{dx} =$

(a) $\frac{x}{y}$ (b) $-\frac{y}{x}$
(c) $-\frac{x}{y}$ (d) $\frac{y}{x}$

5. If $f : R - \{2\} \to R$ is a function defined by $f(x) = \frac{x^2 - 4}{x - 2}$, then its range is

(a) R (b) R−{2}
(c) R−{4} (d) R−{−2,2}

6. If $f(x) = x^2 + \alpha$ for $x >$ $0 = 2\sqrt{x^2+1} + \beta$ for $x < 0$) is continuous at $x = 0$ and $f\left(\frac{1}{2}\right) = 2$ then $\alpha^2 + \beta^2$ is

(a) 3 (b) $\frac{8}{25}$ (c) $\frac{25}{8}$ (d) $\frac{1}{3}$

7. If $y = (\tan^{-1} x)^2$ then $(x^2+1)^2 \frac{d^2y}{dx^2} + 2x\left(x^2+1\right)\frac{dy}{dx} =$

(a) 4 (b) 2 (c) 1 (d) 0

8. The line $5x + y - 1 = 0$ coincides with one of the lines given by $5x^2 + xy - kx - 2y + 2 = 0$ then the value of k is

(a) −11 (b) 31 (c) 11 (d) −31

9. If $A = \begin{bmatrix} 1 & 2 & 3 \\ -1 & 1 & 2 \\ 1 & 2 & 4 \end{bmatrix}$ then $(A^2 - 5A)A^{-1} =$

(a) $\begin{bmatrix} 4 & 2 & 3 \\ -1 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} -4 & 2 & 3 \\ -1 & -4 & 2 \\ 1 & 2 & -1 \end{bmatrix}$

(c) $\begin{bmatrix} -4 & -1 & 1 \\ 2 & -4 & 2 \\ 3 & 2 & -1 \end{bmatrix}$ (d) $\begin{bmatrix} -1 & -2 & 1 \\ 4 & -2 & -3 \\ 1 & 4 & -2 \end{bmatrix}$

10. The equation of line passing through (3, −1, 2) and perpendicular to the lines

$\vec{r} = \left(\hat{i} + \hat{j} - \hat{k}\right) + \lambda\left(2\hat{i} - 2\hat{j} + \hat{k}\right)$ and

$\vec{r} = \left(2\hat{i} + \hat{j} - 3\hat{k}\right) + \mu\left(\hat{i} - 2\hat{j} + 2\hat{k}\right)$ is

(a) $\frac{x+3}{2} = \frac{y+1}{3} = \frac{z-2}{2}$

(b) $\frac{x-3}{3} = \frac{y+1}{2} = \frac{z-2}{2}$

(c) $\frac{x-3}{2} = \frac{y+1}{3} = \frac{z-2}{2}$

(d) $\frac{x-3}{2} = \frac{y+1}{2} = \frac{z-2}{3}$

11. Lettrs in the word HULULULU are rearrnged. The Probability of all three L being together is

(a) $\frac{3}{20}$ (b) $\frac{2}{5}$ (c) $\frac{3}{28}$ (d) $\frac{5}{23}$

12. The sum of the first 10 terms of the series 9 + 99 + 999 +..., is

(a) $\frac{9}{8}\left(9^{10} - 1\right)$ (b) $\frac{100}{9}\left(10^9 - 1\right)$

(c) $10^9 - 1$ (d) $\frac{100}{9}\left(10^{10} - 1\right)$

13. If A, B, C are the angles of Δ ABC then cotA.cotB + cotB. cotC + cotC + cotA =

(a) 0 (b) 1 (c) 2 (d) −1

14. If $\int \frac{dx}{\sqrt{16 - 9x^2}} = A \sin^{-1}(Bx) + C$ then $A + B =$

(a) $\frac{9}{4}$ (b) $\frac{19}{4}$ (c) $\frac{3}{4}$ (d) $\frac{13}{12}$

15. $\int e^x \left[\frac{2+\sin 2x}{1+\cos 2x}\right] dx =$

(a) $e^x \tan x + c$ (b) $e^x \tan x + c$
(c) $2e^x \tan x + c$ (d) $e^x \tan 2x + c$

16. A coin is tossed three times. If X denotes the absolute difference beween the number of heads and the number of tails then $P(X = 1) =$

(a) $\frac{1}{2}$ (b) $\frac{2}{3}$ (c) $\frac{1}{6}$ (d) $\frac{3}{4}$

17. If $2\sin\left(\theta+\frac{\pi}{3}\right) = \cos\left(\theta-\frac{\pi}{6}\right)$, then $\tan\theta$, =

(a) $\sqrt{3}$ (b) $-\frac{1}{\sqrt{3}}$ (c) $\frac{1}{\sqrt{3}}$ (d) $-\sqrt{3}$

18. The area of the region bounded by $x^2 = 4y$, $y = 1$, $y = 4$ and the y-axis lying in the first quadrant is square units.

(a) $\frac{22}{3}$ (b) $\frac{28}{3}$ (c) 30 (d) $\frac{21}{4}$

19. If $f(x) = \frac{e^{x^2} - \cos x}{x^2}$, for $x \neq 0$ is continuous at $x = 0$, then value of (0) is

(a) $\frac{2}{3}$ (b) $\frac{5}{2}$ (c) 1 (d) $\frac{3}{2}$

20. The maximum value of $2x + y$ subject to $3x + 5y \leq 26$ and $5x + 3y \leq 30$, $x \geq 0$, $y \geq 0$ is

(a) 12 (b) 11.5 (c) 10 (d) 17.33

21. If $\vec{a}, \vec{b}, \vec{c}$ are mutually perpendicular vectors having magnitudes 1, 2, 3 respectively, then $\left[\vec{a}+\vec{b}+\vec{c} \;\; \vec{b}-\vec{a} \;\; \vec{c}\right] =$

(a) 0 (b) 6 (c) 12 (d) 18

22. If points P(4,5, x), Q(3, y, 4) and R(5, 8, 0) are collinear, then the value of $x + y$ is

(a) -4 (b) 3 (c) 5 (d) 4

23. If the slope of one the lines given by $ax^2 + 2hxy + by^2 = 0$ is two times the other then

(a) $8h^2 = 9ab$ (b) $8h^2 = 9ab^2$
(c) $8h = 9ab$ (d) $8h = 9ab^2$

24. The equation of the line passing through the point (–3,1) and bisecting the angle between co-ordinate axes is

(a) $x + y + 2 = 0$ (b) $-x + y + 2 = 0$
(c) $x - y + 4 = 0$ (d) $2x + y + 5 = 0$

25. The negation of the statement : "Getting above 95% marks is necessary condition for Hema to get the admission in good college".

(a) Hema gets above 95% marks but she does not get the admission in good college
(b) Hema does not get above 95% marks and she gets admission in good college
(c) If Hema does not get above 95% marks then she will not get the admission in good college
(d) Hema does not get above 95% marks or she gets the admission in good college

26. $\cos 1^\circ . \cos 2^\circ . \cos 3^\circ \ldots \cos 179^\circ =$

(a) 0 (b) 1 (c) $-\frac{1}{2}$ (d) -1

27. If planes $x - cy - bz = 0$, $cx - y + az = 0$ and $bx + ay - z = 0$ pass through a straight line then $a^2 + b^2 + c^2 =$

(a) $1 - abc$ (b) $abc - 1$
(c) $1 - 2abc$ (d) $2abc - 1$

28. The point of intersection of line represented by $x^2 - y^2 + 3y - 2 = 0$ is

(a) $(1, 0)$ (b) $(0, 2)$
(c) $\left(-\frac{1}{2}, \frac{3}{2}\right)$ (d) $\left(\frac{1}{2}, \frac{1}{2}\right)$

29. A die is rolled. If X denotes the number of positive divisors of the outcome then the range of the random variable X is

(a) $\{1, 2, 3\}$ (b) $\{1, 2, 3, 4\}$
(c) $\{1, 2, 3, 4, 5, 6\}$ (d) $\{1, 3, 5\}$

30. A die is thrown four times. The probability of getting perfect square in at least one throw is

(a) $\frac{16}{81}$ (b) $\frac{65}{81}$ (c) $\frac{23}{81}$ (d) $\frac{58}{81}$

31. $\int_0^{\pi/4} x.\sec^2 x \, dx =$

(a) $\frac{\pi}{4} + \log\sqrt{2}$ (b) $\frac{\pi}{4} - \log\sqrt{2}$

(c) $1 + \log\sqrt{2}$ (d) $1 - \frac{1}{2}\log 2$

32. In Δ ABC, with usual notations, if a, b, c are in A.P. Then $a\cos^2\left(\frac{C}{2}\right) + c\cos^2\left(\frac{A}{2}\right) =$

(a) $3\frac{a}{2}$ (b) $3\frac{c}{2}$ (c) $3\frac{b}{2}$ (d) $\frac{3abc}{2}$

33. If $x = e^\theta (\sin\theta - \cos\theta)$, $y = e^\theta (\sin\theta + \cos\theta)$ then $\frac{dy}{dx}$ at $\theta = \frac{\pi}{4}$ is

(a) 1 (b) 0 (c) $\frac{1}{\sqrt{2}}$ (d) $\sqrt{2}$

34. The number of solutions of $\sin x + \sin 3x + \sin 5x = 0$ in the interval $\left[\frac{\pi}{2}, 3\frac{\pi}{2}\right]$ is

(a) 2 (b) 3 (c) 4 (d) 5

35. If $\tan^{-1} 2x + \tan^{-1} 3x = \frac{\pi}{4}$, then x =

(a) –1 (b) $\frac{1}{3}$ (c) $\frac{1}{6}$ (d) $\frac{1}{2}$

36. Matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 1 & 5 \\ 2 & 4 & 7 \end{bmatrix}$ then the value of $a_{31} A_{31} + a_{32} A_{32} + a_{33} A_{33}$ is

(a) 1 (b) 13 (c) –1 (d) –13

37. The contrapositive of the statement : "If the weather is fine then my friends will come and we go for a picnic."

(a) The weather is fine but my friends will not come or we do not go for a picnic
(b) If my friends do not come or we do not go for picnic then weather will not be fine
(c) If the weather is not fine then my friends will not come or we do not go a picnic
(d) The weather is not fine but friends will come and we go for a picnic

38. If $f(x) = \frac{x}{x^2+1}$ is increasing function then the value of x lies in

(a) R (b) $(-\infty, -1)$
(c) $(1, \infty)$ (d) $(-1, 1)$

39. If $X = \{4^n - 3n - 1 : n \in N\}$ and $Y = \{9n - 1\} : n \in N\}$, then $X \cap Y =$

(a) X (b) Y (c) ϕ (d) {0}

40. The statement pattern $P \wedge (\sim p \wedge q)$ is

(a) a tautology
(b) a contradiction
(c) equivalent to $p \wedge q$
(d) equivalent to $p \vee q$

41. If the line y = 4x – 5 touches to the curve $y^2 = ax^3 + b$ at the point (2, 3) then 7a + 2b =

(a) 0 (b) 1 (c) –1 (d) 2

42. The sides of a rectangle are given by $x = \pm a$ and $y = \pm b$. The equation of the circle passing through the vertices of the rectangle is

(a) $x^2 + y^2 = a^2$
(b) $x^2 + y^2 = a^2 + b^2$
(c) $x^2 + y^2 = a^2 - b^2$
(d) $(x - (a)^2 + (Y - (b)^2 = a^2 + b^2$

43· The minimum value of the function f(x) = xlogx is

(a) $-\frac{1}{e}$ (b) – e (c) $\frac{1}{e}$ (d) e

44. If $X \sim B(n, p)$ with n = 10, p = 0.4 then $E(X^2) =$

(a) 4 (b) 2.4 (c) 3.6 (d) 18.4

45. The general solution of differential equation $\frac{dx}{dy} = \cos(x + y)$ is

(a) $\tan\left(\frac{x+y}{2}\right) = y + c$

(b) $\tan\left(\frac{x+y}{2}\right) = x + c$

(c) $\cot\left(\frac{x+y}{2}\right) = y + c$

(d) $\cot\left(\frac{x+y}{2}\right) = x + c$

46. If planes $\vec{r}.\left(p\hat{i} - \hat{j} + 2\hat{k}\right) + 3 = 0$ and $\vec{r}.\left(2\hat{i} - p\hat{j} - \hat{k}\right) - 5 = 0$ include angle $\frac{\pi}{3}$ then the value of p is

(a) 1, –3 (b) –1, –3
(c) –3 (d) 3

47. The order of the differential equation of all parabolas, whose latus rectum is 4a and axis parallel to the x-axis, is

(a) one (b) four (c) three (d) two

48. If lines $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{4}$ and $x - 3 = \frac{y-k}{2} = z$ intersect then the value of k is

(a) $\frac{9}{2}$ (b) $\frac{1}{2}$ (c) $\frac{5}{2}$ (d) $\frac{7}{2}$

49. If a line makes angles 120° and 60° with the positive directions of X and Z axes respectively then the angle made by the line with positive Y-axis is

(a) 150° (b) 60° (c) 135° (d) 120°

50. L and M are two points with position vectors $2\vec{a} - \vec{b}$ and $\vec{a} + 2\vec{b}$ respectively. The position vector of the point N which divides the line segment LM in the ratio 2 : 1 extenally is

(a) $3\vec{b}$ (b) $4\vec{b}$
(c) $5\vec{b}$ (d) $3\vec{a} + 4\vec{b}$

ANSWER KEYS & SOLUTIONS

(MHT-CET 2018)

Answer KEYS

SECTION-A

PHYSICS

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

CHEMISTRY

51	(b)	**56**	(c)	**61**	(a)	**66**	(c)	**71**	(c)	**76**	(a)	**81**	(a)	**86**	(d)	**91**	(a)	**96**	(b)
52	(a)	**57**	(c)	**62**	(d)	**67**	(c)	**72**	(b)	**77**	(a)	**82**	(b)	**87**	(d)	**92**	(d)	**97**	(a)
53	(b)	**58**	(a)	**63**	(a)	**68**	(d)	**73**	(d)	**78**	(c)	**83**	(b)	**88**	(d)	**93**	(c)	**98**	(a)
54	(b)	**59**	(c)	**64**	(c)	**69**	(a)	**74**	(c)	**79**	(b)	**84**	(c)	**89**	(b)	**94**	(c)	**99**	(b)
55	(b)	**60**	(b)	**65**	(b)	**70**	(b)	**75**	(c)	**80**	(b)	**85**	(b)	**90**	(a)	**95**	(d)	**100**	(c)

SECTION-B

MATHEMATICS

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

SECTION-A

PHYSICS

1. (c) Given : Path length = 16 *cm*

$\therefore$ Amplitude $a = \frac{16}{2} = 8\ cm$

Time period $T = 2\pi\sqrt{\frac{l}{g}}$

$= 2\pi\sqrt{\frac{1}{\pi^2}} = 2\pi \times \frac{1}{\pi} = 2s$

Maximum velocity $V_{max} = a\omega$

$= a \times \frac{2\pi}{T} = 8 \times \frac{2\pi}{2} = 8\pi\ cm/s$

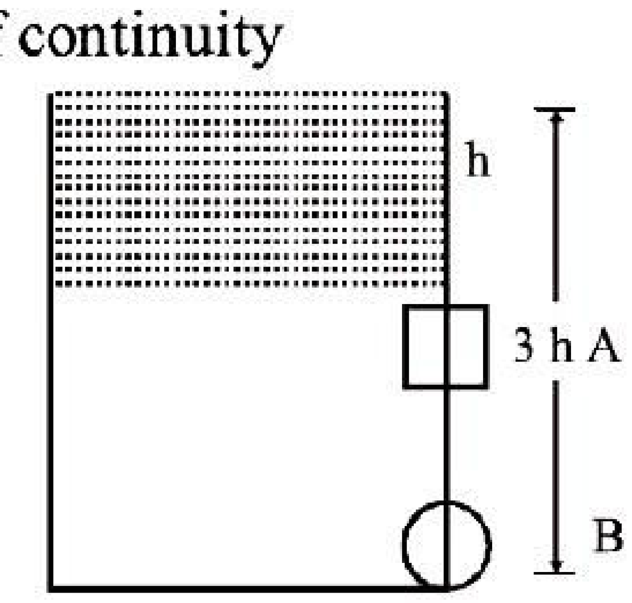
2. (c) Using equation of continuity

$A_1V_1 = A_2V_2$

$L^2\sqrt{2gh} = \pi r^2\sqrt{6gh}$

$L^4 gh = \pi^2 r^4 6gh$

$\therefore\quad L = (\pi)^{\frac{1}{2}}(r)(3)^{\frac{1}{4}}$



3. **(b)** Voltage gain = $\frac{V_o}{V_i} = \frac{R_o \times I_c}{R_i \times I_B}$

$= \frac{2000 \times 1.5 \times 10^{-3}}{150 \times 20 \times 10^{-6}} = \frac{3}{3000 \times 10^{-6}} = 1000$

4. **(b)** Torque, $\tau = I\alpha$

$F \times R = \frac{MR^2}{2} \times \frac{\omega}{t}$

$\therefore$ Tangential force, $F = \frac{MR\omega}{2t}$

5. **(b)** $B_{centre} = \frac{\mu_0 \eta I}{R}$

Let at a distance x from the centre, magnetic field becomes $\frac{B}{8}$

$\frac{B}{8} = \frac{\mu_0 \eta I R^2}{(R^2 + x^2)^{3/2}}$

$\Rightarrow \frac{\mu_0 \eta I}{8R} = \frac{\mu_0 \eta I R^2}{(R^2 + x^2)^{3/2}}$

or, $8R^3 = (R^2 + x^2)^{3/2}$

$\Rightarrow 2R = (R^2 + x^2)^{1/2}$ ... (i)

or $4R^2 = R^2 + x^2$ [from squarring both sides of equation (i)]

$\Rightarrow 3R^2 = x^2$

$\therefore x = \sqrt{3R^2} = \sqrt{3}R$

6. **(b)** $I_{max} = (a_1 + a_2)^2$ and $I_{min} = (a_1 - a_2)^2$

$I_{max} + I_{min} = a_1^2 + a_2^2 + a_1^2 + a_2^2$

$= 2(a_1^2 + a_2^2) = 2(I_1 + I_2)$

7. **(d)** Alternating voltage, $e = e_0 \sin \omega t$

From question,

$e_0 = 200\sqrt{2}V, \ \omega = 100$

$I_{rms} = \frac{v_{rms}}{X_c} = \frac{V_0 \omega C}{\sqrt{2}}$

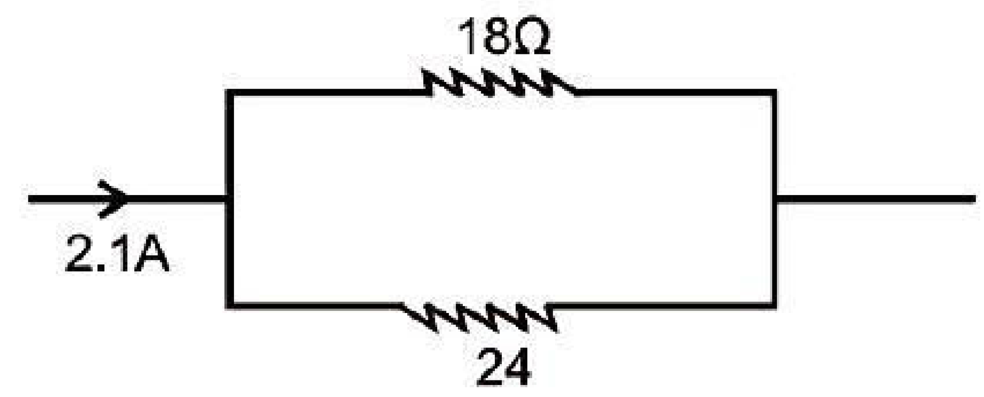
$= \frac{200\sqrt{2} \times 100 \times 10^{-6}}{\sqrt{2}}$

$= 2 \times 10^{-2} = 20mA$

8. **(c)** $I = I_1 + I_2 = 2.1\,A$

$18I_1 = 24I_2$

$\Rightarrow 3I_1 = 4I_2 = 4(2.1 - I_1)$



or, $7I_1 = 8.4$

$\therefore I_1 = \frac{8.4}{7} = 1.2\,A$

9. **(b)**

10. **(c)** Tangential acceleration = αr

Radial acceleration = $\frac{v^2}{r}$

$\therefore$ Ratio = $\frac{\alpha r}{v^2/r} = \frac{\alpha r^2}{v^2}$

11. **(c)** $d = \frac{\lambda}{2\mu \sin\alpha} = \frac{\lambda}{2N.A}$

N.A. limit of resolution is decrease (c).

12. **(d)** In amplitude modulaion amplitude of the carrier wave changes according to information signal.

13. **(b)** Magnetisation of a paramagnetic $M_z = \frac{M_{ext}}{V}$

$M_z = \frac{CB}{T}$ ... (Paranmagnetic)

14. **(d)** $\frac{1}{\lambda} = R\left(\frac{1}{\eta_1} - \frac{1}{\eta_2}\right)$

$\frac{1}{\lambda} = R\left[\frac{1}{1} - \frac{1}{16}\right] = \frac{15 - R}{16} \quad \therefore \lambda = \frac{16}{15R}$

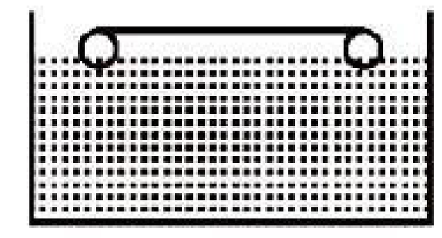
$P = \frac{h}{\lambda}$ or, $mv = \frac{h}{\lambda} \quad \therefore v \ \frac{h}{m\lambda} = \frac{15hR}{m16}$

15. **(a)** Suspension tension, $T = \frac{f}{\ell}$

$mg = T.l$

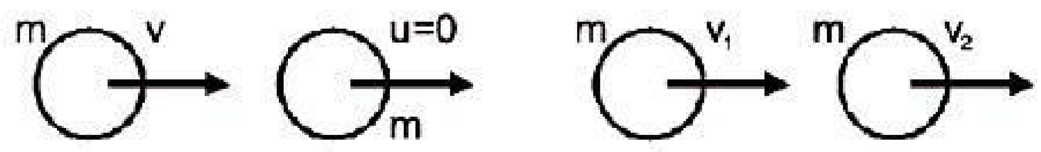
$\pi r^2 \rho g = Tl$

$r^2 = \frac{T}{\pi \rho g}$



$r = \sqrt{\frac{T}{\pi \rho g}}$

16. **(c)** Before collision After collision



$mV + 0 = mV_1 + mV_2$

$V_1 + V_2 = V$

$e = \dfrac{V_2 - V_1}{u_1 - u_2}$ $e = \dfrac{V_2 - V_1}{V - 0}$

Coefficient of restitution, e

$eV = V_2 - V_1$

$eV + V = 2V_2 \Rightarrow V_2 = \dfrac{V(e+1)}{2}$

$\therefore$ Ratio, $\dfrac{V_2}{V} = \dfrac{e+1}{2}$

17. **(b)** Distance travelled in one oscillation = 4a

Average velocity = $\dfrac{total\ distance}{Time}$

$= \dfrac{4a}{T} = 4an\ [\therefore\ n = \dfrac{1}{T}]$

18. **(b)** Given : $V_{in} = 220$ V; $V_{out} = 3.3 \times 10^3 V$

Power, $P = 4.4\ kW$ and no. of turns in secondary coil, $N_P = 600$

$P = V_{in} \times I_{in} \Rightarrow I_{in} = \dfrac{4.4 \times 1000}{220}$

$= \dfrac{44 \times 10}{22} = 20A$; $\dfrac{e_s}{e_p} = \dfrac{I_p}{I_s}$

$I_S = I_P = \dfrac{e_p}{e_s} = \dfrac{20 \times 220}{3.3 \times 1000} = \dfrac{44}{33} = \dfrac{4}{3}A$

19. **(c)** Using, $R = f\dfrac{\ell}{A}$

$$\frac{R_1}{R_2} = \frac{L_1}{L_2} \times \frac{A_2}{l_2} = \frac{L_1}{L_2} \times \frac{\frac{\pi d_2^2}{4}}{\frac{\pi d_1^2}{4}}$$

$\therefore$ Ratio $\dfrac{R_1}{R_2} = \dfrac{d_2^2}{d_1^2}$

20. **(d)** $C_P - C_V = R$, $\dfrac{C_P}{C_V} = \gamma \Rightarrow C_P = \gamma C_V$

$\gamma C_V - C_V = R \Longrightarrow C_V(r-1) = R$

$\therefore C_V = \dfrac{R}{(\gamma - 1)}$

21. **(b)** From Jurin's law, $h \propto \dfrac{1}{r}$ or, rh = constant

$r_1 h_1 = r_2 h_2$ $A_1 = \pi r_1^2$

$\dfrac{r_1}{r_2} = \dfrac{h_2}{h_1}$ $A_2 = \pi r_2^2$

$3 = \dfrac{h_2}{h_1} = \dfrac{h_2}{h_1}$ $\dfrac{\pi r_1^2}{9} = \pi r_2^2$

$h_2 = 3h_1 = 3h$ $\dfrac{r_1^2}{r_2^2} = 9 \Rightarrow \dfrac{r_1}{r_2} = 3h$

22. **(c)** P-N junction diode with forward biosed mode.

23. **(a)** Time period, $T = 1/V = \dfrac{2\pi m}{eB}$

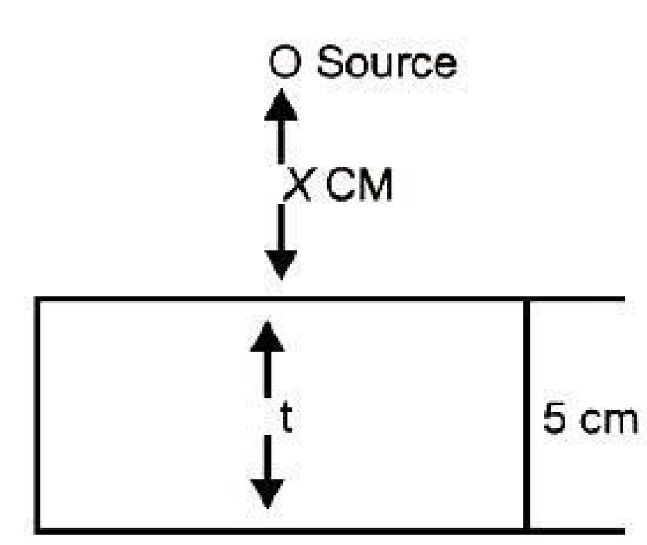
$\Rightarrow B = \dfrac{2\pi m}{e} v$

$R = \dfrac{mv}{eB} = \dfrac{P}{eB}$ $[\because F = \dfrac{mv^2}{R} = eB]$

$P = eBR = e \times \dfrac{2\pi mv^2}{2m} = 2\pi mvR$

$K.E = \dfrac{P^2}{2m} = \dfrac{(2\pi mvR)^2}{2m} = 2\pi^2 mv^2 R^2$

24. **(b)** According to question,



Let 'x' be the distance of source from the surface of glass slab

time taken to travel light, from source to surface of the glass slab, (t_1) = time taken to travel in glass slab (t_2)

$t_1 = \dfrac{x}{3\times10^8}$ and, $t_2 = \dfrac{5}{\dfrac{3\times10^8}{1.6}}$

[$\because$ Velocity of light in glass medium, $= \dfrac{C}{M}$]

$\therefore \dfrac{x}{3\times10^8} = \dfrac{5}{\dfrac{3\times10^8}{1.6}}$

or, $x = 5 \times 1.6 = 8.0$ cm

25. (b) Fifth overtone, $2.4 = 6n$

$A = 0.4\,m = \dfrac{\lambda}{2} \Rightarrow \lambda = 0.8$

$\therefore$ Distance between successive node and antinode,

$\dfrac{\lambda}{4} = \dfrac{0.8}{4} = 0.2\,m$

26. (c) Here, $|A| = \sqrt{9+4+1} = \sqrt{14}$

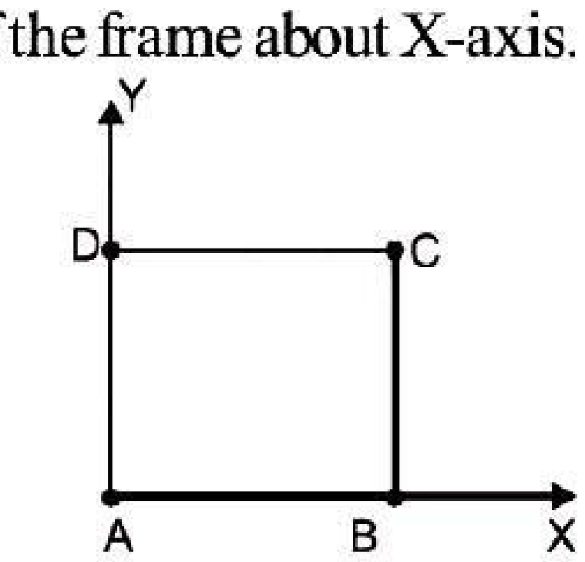
$|B| = \sqrt{1+9+25} = \sqrt{35}$

$|C| = \sqrt{4+1+16} = \sqrt{21}$

Clearly, $\vec{B} = \vec{A} + \vec{C}$ and $B^2 = A^2 + C^2$

27. (a) Moment of inertia of the frame about X-axis.

$\dfrac{ml^2}{3} + \dfrac{ml^2}{3} + ml^2$



$I = \dfrac{5}{3}ml^2$

28. (d) Magnitude of unit vector = 1

$\sqrt{(0.8)^2 + (b)^2 + (0.4)^2} = 1$

$\Rightarrow \sqrt{64 + b^2 + 0.16} = 1 \Rightarrow \sqrt{0.80 + b^2} = 1$

$\Rightarrow 0.8 + b^2 = 1 \Rightarrow b^2 = 0.2 \therefore b = \sqrt{0.2}$

29. (c) (Relation between magnetic permeability and susceptibility)

$B = (1 + X)H$

X = for paramagnetic positive and small

X' = for diamagnetic negative and small

30. (d) Time period, $T = 2\pi\sqrt{\dfrac{m}{k}}$

and, frequency, $n = \dfrac{1}{T} = \dfrac{1}{2\pi}\sqrt{\dfrac{k}{m}}$

$25 = \dfrac{1}{4\pi^2}\dfrac{k}{m} \Rightarrow k = 100\,\pi^2 m$

$kA = mg \Rightarrow A = \dfrac{mg}{k}$

$V_{max} = \omega A = \dfrac{2\pi}{T}A = 2\pi nA$

$= \dfrac{2\pi 5\times mg}{k} = \dfrac{10\pi\times m\times10}{100\pi^2 m} = \dfrac{1}{\pi}$

31. (b) Conservation of angular momentum,

$I_1\omega_1 = I_2\omega_2$

or, $I\omega = 2I\omega_1 \Rightarrow \omega_1 = \dfrac{\omega}{2}$

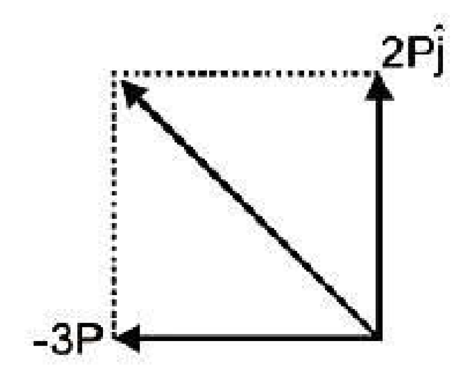
Original $KE = 2\dfrac{1}{2}I\omega^2$

New $KE = 2\dfrac{1}{2}I\omega_1^2 = \dfrac{1}{2}2I\left(\dfrac{\omega}{2}\right)^2 = \dfrac{I\omega^2}{4}$

Change in $KE = \dfrac{1}{2}I\omega^2 - \dfrac{I\omega^2}{4} = \dfrac{I\omega^2}{4}$

32. (d) Magnitude of momentum of the 3rd part.

$\sqrt{9P^2 + 4P^2} = \sqrt{13}\,P$



33. (b) In the photocell, stopping potential directly proportional to frequency of incident radiation.

34. (b) Speed at top most point, $v = \sqrt{3rg}$

Centripetal acceleration, $a_c = \dfrac{v^2}{T} = \dfrac{3rg}{r} = 3g$

35. (a) Electric field intensity at a point outside a uniformly charged thin plane sheet $= \dfrac{\sigma}{2\varepsilon_0}$

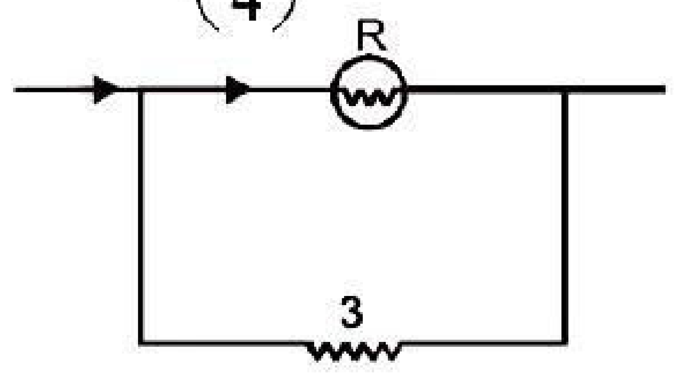
So it is independent of d

36. (a) Apparent frequency,

$n_a = n\left[\dfrac{v}{v - v_s}\right]$ *i.e.*, frequency increase

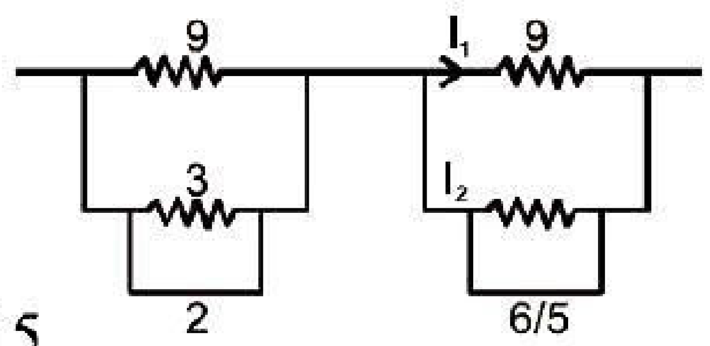
As frequency increases, so wevelength decreases.

37. (d) According to question, the deflection in galvanometer falls to $\left(\frac{1}{4}\right)^{th}$ when it is shunted by 3Ω.



$\therefore I - \frac{I}{4} = \frac{3I}{4}$

$\frac{R}{4} = \frac{3I}{4} \times 3$



$\Rightarrow R = 9\,\Omega$

$I - I_1 = I_2$

$9I_1 = \frac{6}{5}I_2 \Rightarrow \frac{15}{2}I_1 = I_2$

$I = I_1 + \frac{15}{2}I_1 = \frac{17}{2}I_1$ or, $I_2 = \frac{2I}{17} = \frac{I}{8.5}$

38. (a) Let 'h' be the height of the body above the surface of the earth.

$$\frac{GMm}{R} + \frac{1}{2}mu^2 = 0 + -\frac{GMm}{R+h}$$

$$\frac{GM}{R+h} = \frac{Gm}{R} - \frac{u^2}{2}$$

$$\frac{GM}{(R+h)} = \frac{2Gm - Ru^2}{2R}$$

$$\frac{R+h}{GM} = \frac{2R}{2GM - Ru^2}$$

$$h = \frac{2GMR}{2GM - Ru^2} - R$$

$$= \frac{2GMR - 2GMR + R^2u^2}{2GM - Ru^2}$$

$$= \frac{R^2u^2}{2GM - Ru^2} = \frac{Ru^2}{2gR - u^2}$$

39. (a) N_1 number of cap acitors each of capacity, C_1 charged to potential difference, 3V are in series.

$$\therefore C_{eq} = \frac{C_1}{N_1};\ V = 3V$$

$$E = \frac{1}{2}CV^2 = \frac{1}{2}\frac{C_1}{N_1}9V^2$$

N_2 number of capacitors each of capacity, C_2 charged to potential difference, V are in parallel,

$\therefore C_{eq} = N_2C_2;\ V = V$

$$E = \frac{1}{2}CV^2 = \frac{1}{2}C_2N_2V^2$$

From question, total energy stored in both the combination is same.

$$\therefore \frac{9}{2}\frac{C_1}{N_1}V^2 = \frac{C_2N_2V^2}{2} \Rightarrow C_1 = C_2\frac{N_2N_1}{9}$$

40. (b) Heat energy incident on the surface,

$Q_i = 1000\,J/m$

Coefficient of absorption, $a = 0.8$ coefficient of reflection, $r = 0.1$ Heat energy transmitted in 5 minutes, $Q_t = ?$

$\because 1 = r + a + t \Rightarrow t = 1 - 0.1 - 0.8 = 0.1$

$Q_t = Q_i \times t \times T$ (t = cofficient of transmitance)

$Q_t = 0.1 \times 1000 \times 5 = 500\,J$

41. (c) $Y = \frac{Fl}{A\Delta l},\ \Delta l = \frac{Fl}{YA}$

$m = \rho V = \rho \times A \times l$

$$A \propto m\ \frac{\Delta lP}{\Delta lQ} = \frac{A_2}{A_1} = \frac{m_2}{m_1}$$

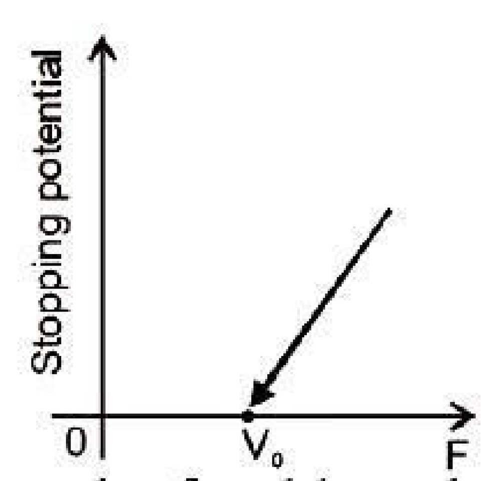
42. (b) Percentage error in the measurement of x

$$\frac{\Delta x}{x} = 2\frac{\Delta a}{a} + 2\frac{\Delta b}{b} + \frac{\Delta c}{c}$$

$= 2 \times 2 + 2 \times 3 + 4$

$= 4 + 6 + 4 = 14\%$

43. (a) The variation of stopping potential corresponding to the frequency of incident radiation (F) as shown below.



44. (b) In compound microscope, the focal length and aperture of the objective used is respectively large and small.

45. (b) de-Broglie wavelength

$$\lambda = \frac{h}{p}\ \frac{h}{\sqrt{2mK.E}}$$

$$\text{or, } \lambda^2 = \frac{h^2}{2m(K.E)}$$

$$\therefore K.E. = \frac{h^2}{2m\lambda^2}$$

46. **(b)** Frequency of waves produced in string when tension in string T,

$$n=\frac{1}{2L}\sqrt{\frac{T}{m}}$$

When tension in string is doubled i.e., $2T$.

$$n'=\frac{1}{2L}\sqrt{\frac{2T}{m}}=\sqrt{2}\frac{1}{2L}\sqrt{\frac{T}{m}}$$

Clearly, $n'=\sqrt{2}n$

47. **(b)** $\because Y=\frac{FL}{Al}\quad \therefore l\frac{FL}{AY}$

Work done / increase in energy

$$=\frac{YAL^2}{2L}=\frac{F^2L}{2AY}$$

48. **(a)** According to question,

$$\frac{B_1}{B_2}=\frac{25}{2}\Rightarrow\frac{\frac{\mu_0}{4\pi}\frac{M\,d_1}{\left(d_1^2-l^2\right)^2}}{\frac{\mu_0}{4\pi}\frac{M\,d_2}{\left(d_2^2-l^2\right)}}=\frac{25}{2}$$

$$\frac{d_1}{d_2}\times\frac{\left(d_2^2-l^2\right)^2}{\left(d_1^2-l^2\right)^2}=\frac{25}{2}$$

$d_1=10$ cm, $d_2=20$ cm

$$\frac{10}{20}\times\left(\frac{20^2-l^2}{10^2-l^2}\right)=\frac{25}{2}$$

$400-l^2=5(100-l^2)$

$4l^2=100\Rightarrow l^2=25$ or, $l=5$ cm

49. **(d)** According to question, speed of satellite in its orbit.

$$v_c=\frac{1}{4}v_e.$$

(v_e = escape speed)

$$\sqrt{\frac{GM}{R+h}}=\frac{1}{4}\sqrt{\frac{2GM}{(R)}};\ \sqrt{\frac{GM}{(R+h)}}=\frac{1}{16}\times\frac{2Gm}{(R)}$$

$R+h=8(R)$

$R+h=8R$

$7R=h$

50. **(c)** In case of closed organ pipe, fundamental frequency

$$n\frac{V}{4L}=\frac{332}{4\times83\times10^{-2}}$$

or, $n=100$ Hz

Hence frequency of overtones $n_1 : n_2 : n_3 :$ ------- = 1 : 3 : 3 i.e., 100, 300, 500, 700 and 900 Hz

So number of possible natural oscillations of air column whose frequencies lie below 1000 are 5.

CHEMISTRY

51. **(b)**

52. **(a)** $\Delta U=q+W$

According to first law of thermodynamics

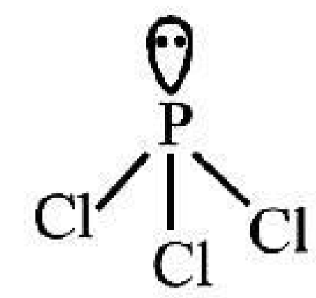
$=q+(-P_{ex}.\Delta V)$ $(\because W=-P_{ex}.\Delta V)$

$\Delta U=q_p-P_{ex}.\Delta V$

53. **(b)** Zinc is used for coating iron surface. Because zinc get oxidized first when comes in contact with moisture and hence iron suface is protected from corosion.

54. **(b)** PCl_3 - has 3 sigma bond and 1 tone pair.

$3+1=4$



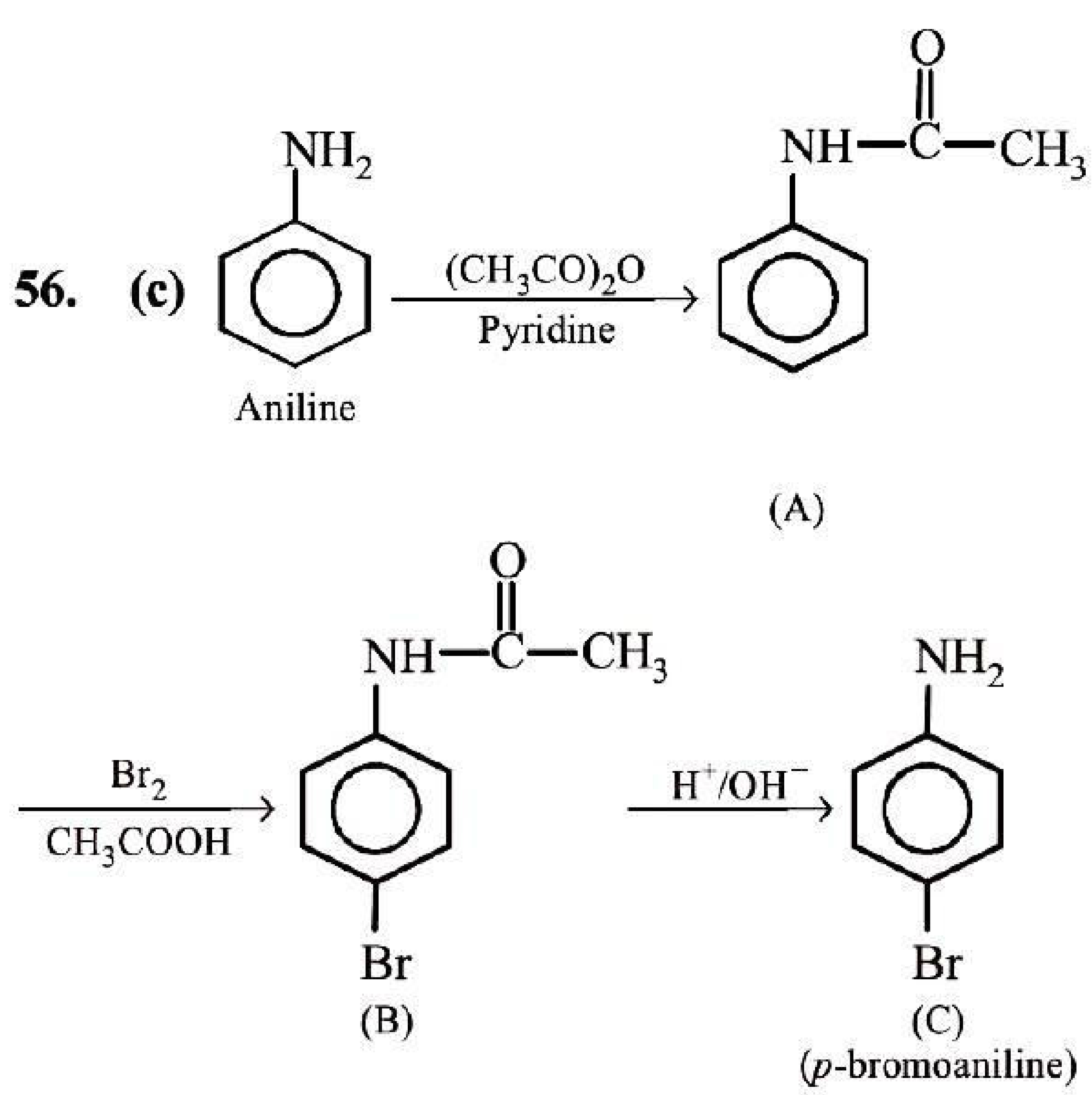
Hence, hybridization = sp^3

55. **(b)** Zn forms amphoteric oxide ZnO

$ZnO+2HCl\longrightarrow 2nCl_2+H_2O$ (acid)

$ZnO+2NaOH\longrightarrow Na_2ZnO_2+H_2O$ (Base)

56. **(c)**



57. **(c)** $-CH_3$ is electron donating group which shows + I effect.

58. **(a)**

59. **(c)** $\underset{\text{(phosphonic acid)}}{4H_3PO_3} \longrightarrow 3H_3PO_4 + PH_3$

$H_3PO_3 \longrightarrow H_3PO_4\ \text{(oxidation)}$

$H_3PO_3 \longrightarrow PH_3\ \text{(reduction)}$

60. **(b)** In $[AuCl_4]^{1-}$ Let the oxidation number of Au = x

$x + 4(-1) = -1$

$x - 4 = -1$

$x = -1 + 4$

$x = +3$

61. **(a)**

62. **(d)**

$$CH_3-\underset{OH}{\overset{CH_3}{\overset{|}{\underset{|}{C}}}}-CH_3$$

3° alcohol reacts with lucas reagent (HCl + anhydrous $ZnCl_2$) immediately & gives two separate layers.

63. **(a)** Nitric oxide

64. **(c)** Moles of electron

$$= \frac{\text{Charge}}{F} = \frac{\text{Current} \times \text{Time}}{96500}$$

$$\frac{2 \times 20 \times 60}{96500} = 0.02487$$

or 2.487×10^{-2} mol e^-

65. **(b)** $\text{Molarity} = \dfrac{\text{No. of moles of solute}}{\text{Volume of solution in (L)}}$

Urea (molar mass) = 60 g/mol

$$\text{molarity} = \frac{15 \times 1000}{60 \times 500} = \frac{15}{6 \times 5} = \frac{1}{2}$$

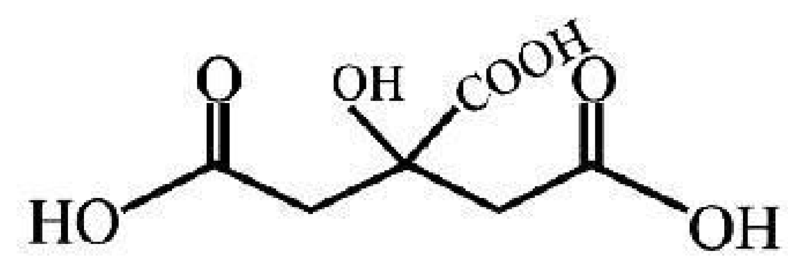
$= 0.5$ mol dm^{-3}

66. **(c)** C_2

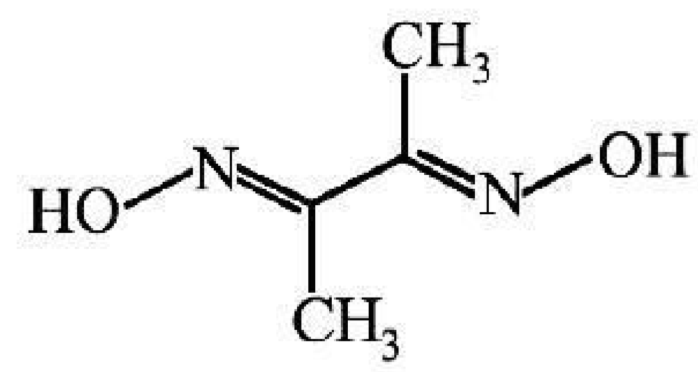
67. **(c)** CH_3CH_2COOH is most reactive towards esterification as bulkier group near the site of reaction, slows down esterification.

68. **(d)** $\text{Molarity} = \dfrac{\text{No. of moles of solute}}{\text{Vol. of Solution in } dm^3}$

69. **(a)** Citric acid is a tricarboxylic acid.



70. **(b)** No. of donor atom = 2



71. **(c)** Nitrous oxide (N_2O) has the lowest oxidation state (zero) as it is a neutral molecule.

72. **(b)** Formaldehyde is most reactive towards addition reaction.

73. **(d)** $La(OH)_3 (Z = 57)$ is the most basic hydroxide due to lanthanide contration.

74. **(c)** kg m^{-3}

75. **(c)** $C_2H_5-\underset{OH}{\underset{|}{CH}}-C_2H_5$

Because haloform is given by compound containing

$$CH_3-\overset{O}{\overset{\|}{C}}-\text{group or } R-\underset{OH}{\underset{|}{CH}}-CH_3 \text{ only}$$

76. **(a)** Work done is as :-

$W = -PdV$

$W = -P(V_2 - V_1)$

$V_1 = 10\ dm^3 = 10^{-2} m^3$

$V_2 = 2m^3$

$P = 101.325 \times 10^3$ pa

$W = -101.325 \times 10^3 (1.99)$

$= -201.6$ kJ

77. **(a)** ZnS because it shows Frenkel defect.

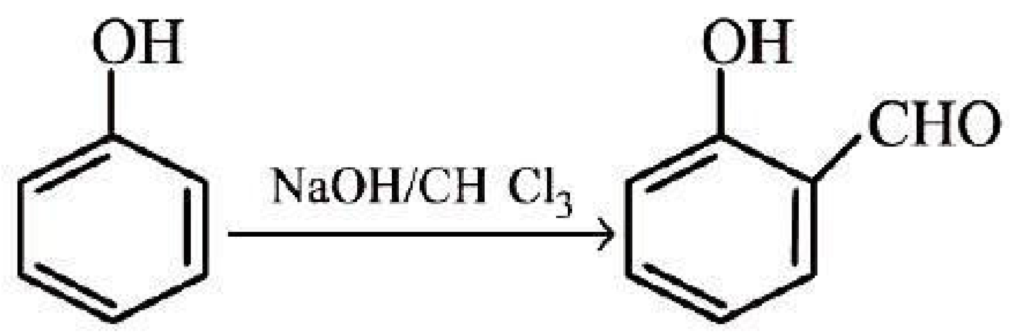
78. **(c)** Autophotolysis of water is as :-

$H_2O \rightleftharpoons H^+ + OH^-$

$H_2O + H^+ \rightarrow H_3O^+$

$2H_2O \rightarrow H_3O^+ + OH^-$

79. **(b)** Hall's process is used to purify the ore of aluminium.

80. **(b)** 

This reaction is known as Reimer-Tiemann reaction

81. **(a)** Be-belongs to second period which exhibits anomalous properties.

82. **(b)** $\underset{\text{(Excess)}}{NH_3} + NaOCl \longrightarrow \underset{\text{(Hydrazine)}}{NH_2 - NH_2} + NaCl + H_2O$

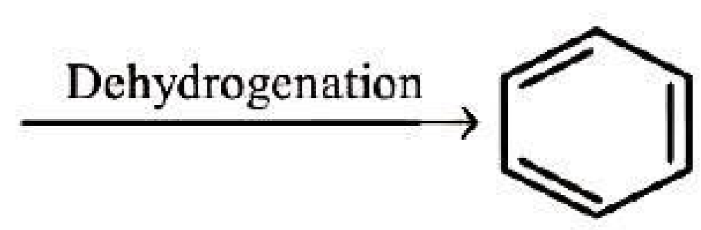
83. **(b)** $1.2\ g\ mL^{-1}$

84. **(c)** Nomex is used to manufacture clothes for firefighters.

85. **(b)** Titanium is obtained in pure form by Van Arkel method.

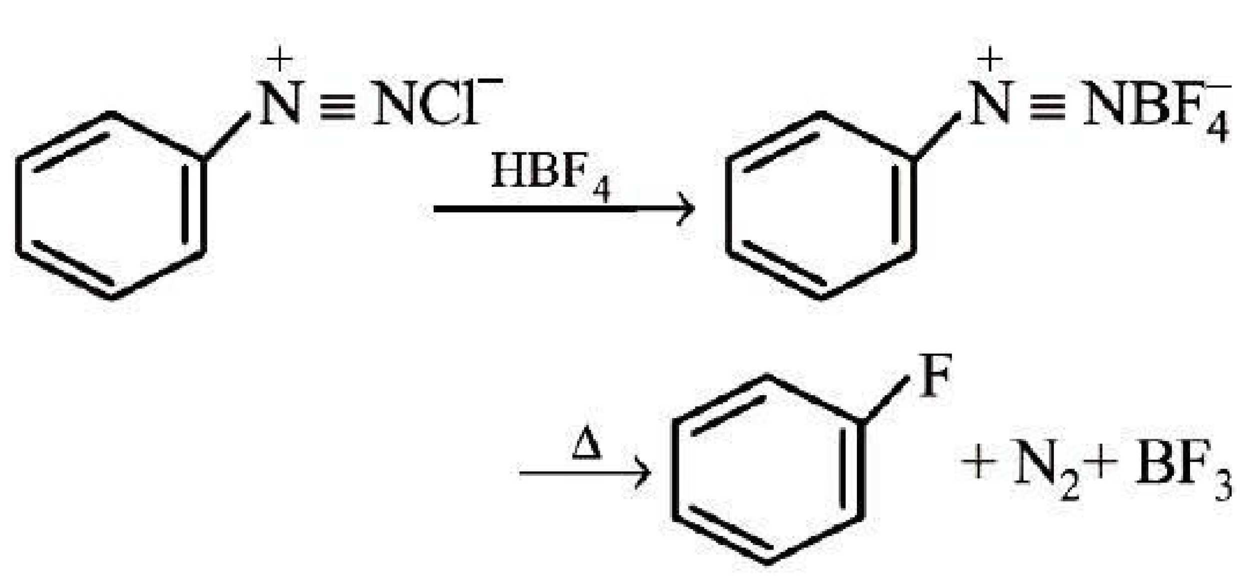
86. **(d)** Bromopheniramine is an Antihistamine.

87. **(d)** $\underset{\text{Hexane}}{CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3}$



88. **(d)** Bismuth does not exhibit allotrophy.

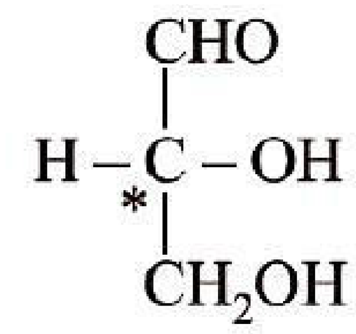
89. **(b)** In Balz-Schiemann reaction aryl fluoride is prepared from diazonium salts and fluoroboric acid.



90. **(a)** $\Delta T_b = \dfrac{K_b \times W_2 \times 1000}{W_1 \times M_2}$

$M_2 = \dfrac{K_b \times W_2}{\Delta T_b \times W_1}$

91. **(a)** Nitrogen exists as N_2 (diatomic molecule), not as tetra atomic molecule.

92. **(d)** 

glyceraldehyde

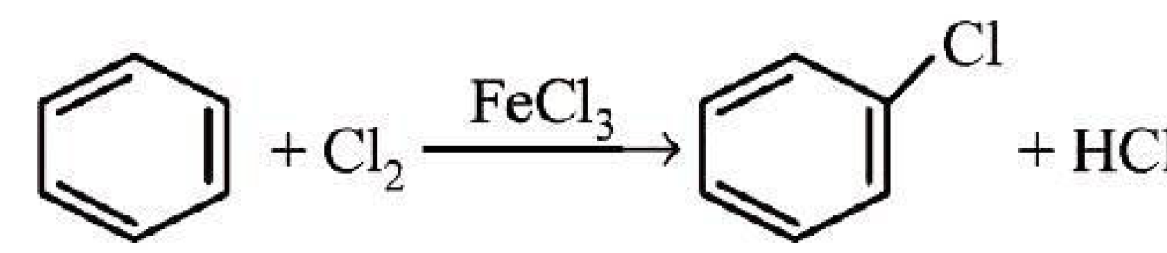
asymmetric carbon atom

93. **(c)** Ti^{4+}, Cu^{1+} are colourless compound

Ti : [Ar] $4s^2 3d^2$ Cu : [Ar] $4s^1 3d^{10}$

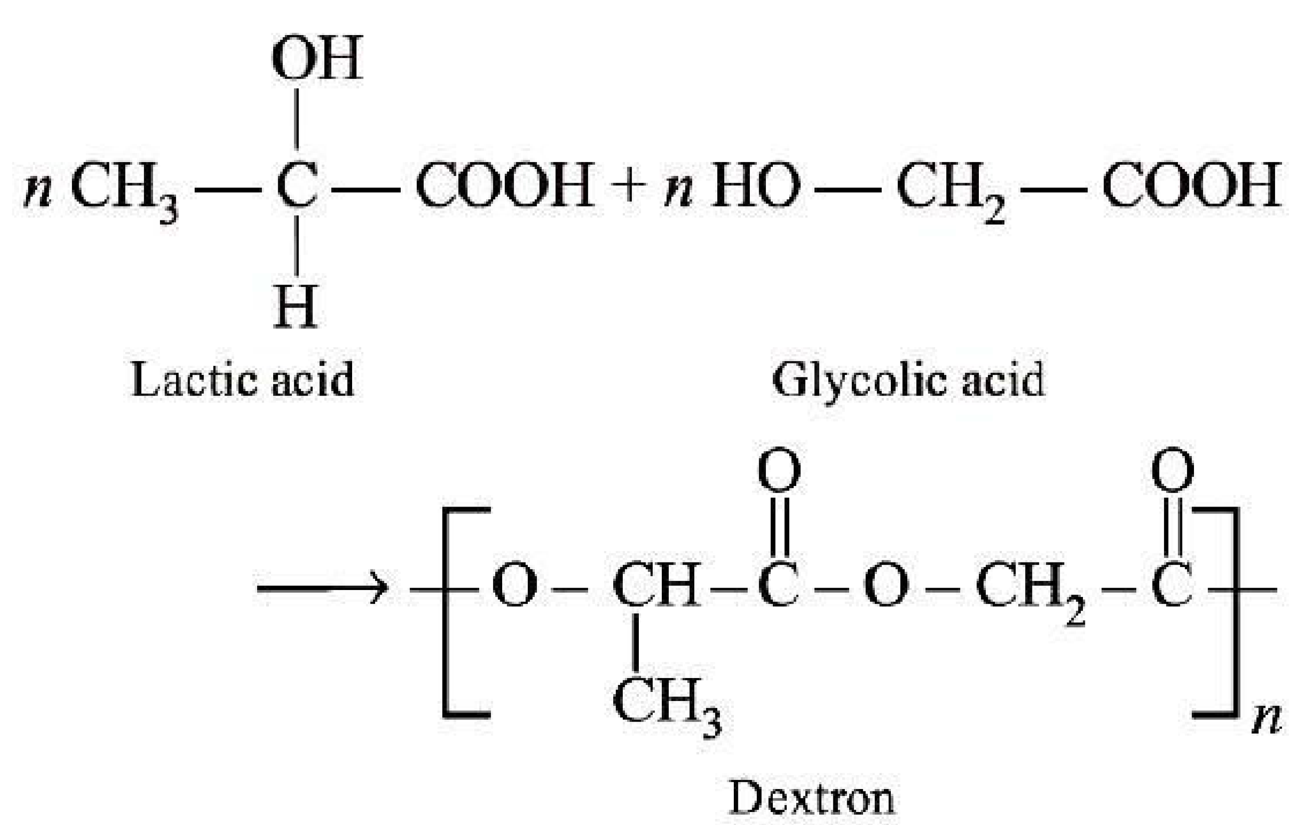
Ti^{4+} : [Ar] $4s^0\ 3d^0$ Cu^{1+} : [Ar] $4s^0\ 3d^{10}$

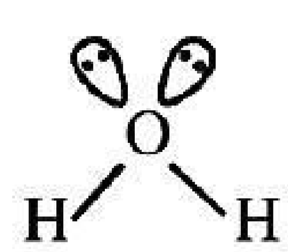
94. **(c)** It is an Electrophillic addition reaction.



95. **(d)** – OH Atomic mass of oxygen is more than that of C & N.

96. **(b)** Dextron



97. **(a)** 

Distorted tetrahedral

98. **(a)** Fluorine

$\underset{\text{(alkane)}}{R - H} + F_2 \xrightarrow{\text{dark}} R - F + HF$

(highly exothermic)

99. **(b)** Combustion of ethanol is as :-

$$\underset{1}{C_2H_5OH} + \underset{3}{3O_2} \longrightarrow \underset{2}{2CO_2} + \underset{3}{3H_2O}$$

0.138 kg = 138/46 = 3 mole

138 g

$3C_2H_5OH(l) + 9O_2(g) \rightarrow 6CO_2(g) + 9H_2O(l)$

$\Delta n = 6 - 9 = -3$

Work = – ΔnRT

$= -(-3) \times 8.314 \times 300 = 7482\ J$

100. **(c)** Acc to Arrhenius equation.

$$K = Ae^{-E_a/RT}$$

$$\ln k = \ln A - \frac{E_a}{RT}$$

$$\log k = \log A - \frac{E_a}{2.303\,R} \times \frac{1}{T}$$

$$y = mx + C$$

$$y = \log k;\ x = \frac{1}{T};\ \text{Slope} = \frac{-E_a}{2.303\,R}$$

$$m = \frac{-E_a}{2.303\,R}$$

SECTION-B

MATHEMATICS

1. **(c)** Here, $\int_0^k \frac{dx}{2+18x^2} = \frac{\pi}{24}$

$$\Rightarrow \frac{\pi}{24} = \frac{1}{18}\int_0^k \frac{dx}{\left(\frac{1}{9}\right)+x^2} = \frac{1}{18}\int_0^k \frac{dx}{\left(\frac{1}{3}\right)^2 + x^2}$$

$$\Rightarrow \frac{\pi}{24} = \frac{1}{18} \times \frac{1}{\left(\frac{1}{3}\right)} \tan^{-1}\left[\frac{x}{\left(\frac{1}{3}\right)}\right]_0^k$$

$$\Rightarrow \frac{\pi}{24} = \frac{3}{18}\tan^{-1}[3x]_0^k = \frac{1}{6}\left[\tan^{-1}3k - \tan^{-1}0\right]$$

$$\Rightarrow \frac{\pi}{24} = \frac{1}{6}\left[\tan^{-1}3k - 0\right]$$

$$\therefore \frac{6\pi}{24} = \tan^{-1}3k \Rightarrow \tan\frac{\pi}{4} = 3k$$

$$\Rightarrow 1 = 3K \Rightarrow K = \frac{1}{3}$$

2. **(d)** $\because y^2 = -16x$

Comparing it with $y^2 = -4ax$

$\therefore\ a = 4$

Parametric equations are

$x = -at^2,\ y = 2at$

or $x = -4\left(\frac{1}{2}\right)^2, y = 2(4)\left(\frac{1}{2}\right)$

or $x = -1, y = 4$

3. **(d)** $\int \frac{dx}{\sin x \cos^2 x} = \int \frac{\sin^2 x + \cos^2 x}{\sin x \cos^2 x} dx$

$$= \int \frac{\sin x}{\cos^2 x} dx + \int \frac{dx}{\sin x} = \int \tan x \sec x + \int \operatorname{cosec} x\ dx$$

$$= \sec x + \log|\operatorname{cosec} x - \cot x| + c$$

4. **(d)** Since, $\log_{10}\left(\frac{x^3 - y^3}{x^3 + y^3}\right) = 2$

$\therefore\ \log(x^3 - y^3) - \log(x^3 + y^3) = 2$

$\Rightarrow\ \log(x^3 - y^3) = 2 + \log(x^3 + y^3)$

Differentiating b/s w.r.t. x

$$\Rightarrow \frac{1}{x^3 - y^3}\left[3x^2 - 3y^2\frac{dy}{dx}\right] = \frac{1}{x^3 + y^3}\left[3x^2 + 3y^2\frac{dy}{dx}\right]$$

$$\Rightarrow \frac{3x^2}{x^3 - y^3} - \frac{3y^2}{x^3 - y^3}\frac{dy}{dx} = \frac{3x^2}{x^3 + y^3} + \frac{3y^2}{x^3 + y^3}\frac{dy}{dx}$$

$$\Rightarrow \frac{3x^2}{x^3 - y^3} - \frac{3x^2}{x^3 + y^3} = \left[\frac{3y^2}{x^3 + y^3} + \frac{3y^2}{x^3 - y^3}\right]\frac{dy}{dx}$$

$$\Rightarrow 3x^2\left[\frac{1}{x^3 - y^3} - \frac{1}{x^3 + y^3}\right] = 3y^2\left[\frac{1}{x^3 + y^3} + \frac{1}{x^3 - y^3}\right]\frac{dy}{dx}$$

$$\Rightarrow 3x^2\left[\frac{2y^3}{(x^3 - y^3)(x^3 + y^3)}\right] = 3y^2\left[\frac{2x^3}{(x^3 + y^3)(x^3 - y^3)}\right]\frac{dy}{dx}$$

$$\Rightarrow \frac{y}{x} = \frac{dy}{dx}$$

5. **(a)** Here $f(x) = \frac{x^2 - 4}{x - 2} = \frac{(x - 2(x + 2)}{(x - 2)} = x + 2$

$\therefore$ Range is R

6. **(c)** $f(x) = \begin{cases} x^2 + \alpha & \text{if } x \geq 0 \\ 2\sqrt{x^2+1} + \beta & \text{if } x < 0 \end{cases}$

is continuous at x = 0

$\therefore f(0) = \lim_{x \to 0^-} f(x)$

$\Rightarrow \quad 0 + \alpha = \lim_{x \to 0^-} 2\sqrt{x^2+1} + \beta$

$\Rightarrow \quad \alpha = 2 + \beta \Rightarrow \alpha - \beta = 2$

$f\left(\frac{1}{2}\right) = \left(\frac{1}{2}\right)^2 + \alpha = 2 \Rightarrow \alpha = 2 - \frac{1}{4} = \frac{7}{4}$

$\therefore \beta = \frac{7}{4} - 2 = \frac{-1}{4}$

$\therefore \alpha^2 + \beta^2 = \left(\frac{7}{4}\right)^2 + \left(\frac{-1}{4}\right)^2 = \frac{49+1}{16} = \frac{50}{16} = \frac{25}{8}$

7. **(b)** Since, $y = (\tan^{-1}x)^2$

$\Rightarrow \frac{dy}{dx} = \frac{2\tan^{-1}x}{1+x^2}$

$\Rightarrow \left(1+x^2\right)\frac{dy}{dx} = 2\tan^{-1}x = 2\sqrt{y}$

$\Rightarrow \left(1+x^2\right)^2\left(\frac{dy}{dx}\right)^2 = 4y$

Again differentiating b/s with respect to x, we get:

$$2\left(1+x^2\right)(2x)\left(\frac{dy}{dx}\right)^2 + 2\left(\frac{dy}{dx}\right)\frac{d^2y}{dx^2}\left(1+x^2\right)^2 = 4\frac{dy}{dx}$$

$$\Rightarrow 4x\left(1+x^2\right)\left(\frac{dy}{dx}\right)^2 + 2\left(1+x^2\right)^2\left(\frac{dy}{dx}\right)\frac{d^2y}{dx^2} = 4\frac{dy}{dx}$$

$$\Rightarrow 4x\left(1+x^2\right)\frac{dy}{dx} + 2\left(1+x^2\right)^2\frac{d^2y}{dx^2} = 4$$

$$\Rightarrow \left(x^2+1\right)^2\frac{d^2y}{dx^2} + 2x\left(1+x^2\right)\frac{dy}{dx} = 2$$

8. **(c)** $5x + y - 1 = 0$ coincides
$5x^2 + xy - kx - 2y + 2 = 0$

$\therefore a = 5, b = 0, h = \frac{1}{2}, g = -\frac{k}{2}, f = -1, c = 2$

If the above equation represents a pair of straight lines, then

$$\begin{vmatrix} a & h & g \\ h & b & f \\ g & f & c \end{vmatrix} = 0 \Rightarrow \begin{vmatrix} 5 & \frac{1}{2} & -\frac{k}{2} \\ \frac{1}{2} & 0 & -1 \\ -\frac{k}{2} & -1 & 2 \end{vmatrix} = 0$$

$$\therefore 5(0-1) - \frac{1}{2}\left(1 - \frac{k}{2}\right) - \frac{k}{2}\left(\frac{-1}{2} - 0\right) = 0$$

$$\therefore -5 - \frac{1}{2} + \frac{k}{4} + \frac{k}{4} = 0 \Rightarrow \frac{k}{2} = \frac{11}{2} \Rightarrow k = 11$$

9. **(b)** $(A^2 - 5A)A^{-1} = A^2A^{-1} - 5AA^{-1} = A.AA^{-1} - 5I$
$= A - 5I$

$$= \begin{bmatrix} 1 & 2 & 3 \\ -1 & 1 & 2 \\ 1 & 2 & 4 \end{bmatrix} - \begin{bmatrix} 5 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 5 \end{bmatrix}$$

$$= \begin{bmatrix} -4 & 2 & 3 \\ -1 & -4 & 2 \\ 1 & 2 & -1 \end{bmatrix}$$

10. **(c)** Let a, b, c be d. rs of desired line which is also perpendicular to the given lines.
$\therefore 2a - 2b + c = 0$
$a - 2b + 2c = 0$

$$\Rightarrow \frac{a}{\begin{vmatrix} -2 & 1 \\ -2 & 2 \end{vmatrix}} = \frac{-b}{\begin{vmatrix} 2 & 1 \\ 1 & 2 \end{vmatrix}} = \frac{c}{\begin{vmatrix} 2 & -2 \\ 1 & -2 \end{vmatrix}}$$

$$\Rightarrow \frac{a}{-4+2} = \frac{-b}{4-1} = \frac{c}{-4+2}$$

$$\Rightarrow \frac{a}{-2} = \frac{b}{-3} = \frac{c}{-2}$$

$\therefore$ direction ratios are $< -2, -3, -2 >$
Hence equation of desired line is

$$\frac{x-3}{-2} = \frac{y+1}{-3} = \frac{z-2}{-2} \text{ or } \frac{x-3}{2} = \frac{y+1}{3} = \frac{z-2}{2}$$

11. **(c)** The word HULULULU contains 4U, 3L & 1H. Consider 3L together i.e. we have to arrange 6 units which contains 4U.
Hence number of possible arrangements

$= \frac{6!}{4!} = 6 \times 5 = 30$

Number of ways of arranging all letters of given word $= \frac{8!}{3!4!} = \frac{8 \times 7 \times 6 \times 5}{3 \times 2} = 8 \times 7 \times 5$

Hence required probability $= \frac{30}{8 \times 7 \times 5} = \frac{6}{8 \times 7} = \frac{3}{28}$

12. **(b)** $9 + 99 + 999 + ...$ upto 10 terms
$= (10-1) + (100-1) + (1000-1) + ...$ upto 10 terms
$= (10 + 100 + 1000 + ...$ upto 10 terms$)$ $-(1+1+...$ upto 10 times$)$

$$= \frac{10\left[(10)^{10} - 1\right]}{10-1} - 10$$

$$= \frac{10(10^{10}-1)}{9} - 10 = \frac{10^{11} - 10 - 90}{9}$$

$$= \frac{10^{11} - 100}{9} = \frac{100(10^9 - 1)}{9}$$

13. **(b)** We know that if $A + B + C = \pi$, then
$\tan A + \tan B + \tan C = \tan A \tan B \tan C$

$$\Rightarrow \frac{1}{\tan B \tan C} + \frac{1}{\tan A \tan C} + \frac{1}{\tan A \tan B} = 1$$

$\Rightarrow \cot B \cot C + \cot A \cot C + \cot A \cot B = 1$

14. **(d)** $\int \frac{dx}{\sqrt{16 - 9x^2}} = \frac{1}{3}\int \frac{dx}{\sqrt{\left(\frac{16}{9}\right) - x^2}} = \frac{1}{3}\int \frac{dx}{\sqrt{\left(\frac{4}{3}\right)^2 - x^2}}$

$$= \frac{1}{3}\sin^{-1}\left[\frac{x}{\left(\frac{4}{3}\right)}\right] + C \ \therefore\ A = \frac{1}{3} \text{ and } B = \frac{3}{4}$$

$$\therefore\ A + B = \frac{1}{3} + \frac{3}{4} = \frac{13}{12}$$

15. **(a)** $\int e^x\left[\frac{2 + \sin 2x}{1 + \cos 2x}\right]dx = \int e^x\left[\frac{2(1 + \sin x \cos x)}{2\cos^2 x}\right]$

$$= \int e^x\left[\sec^2 x + \tan x\right]dx = e^x \tan x + c$$

16. **(d)** A coin is tossed 3 times.
$\therefore$ possibilities are
HHH $\rightarrow X = 3 - 0 = 3$
TTT $\rightarrow X = 3 - 0 = 3$
HHT $\rightarrow X = 2 - 1 = 1$
HTH $\rightarrow X = 2 - 1 = 1$
THH $\rightarrow X = 2 - 1 = 1$
HTT $\rightarrow X = 2 - 1 = 1$
TTH $\rightarrow X = 2 - 1 = 1$
THT $\rightarrow X = 2 - 1 = 1$

$\therefore P(X = 1) = \frac{6}{8} = \frac{3}{4}$

17. **(d)** $2\sin\left(\theta + \frac{\pi}{3}\right) = \cos\left(\theta - \frac{\pi}{6}\right)$

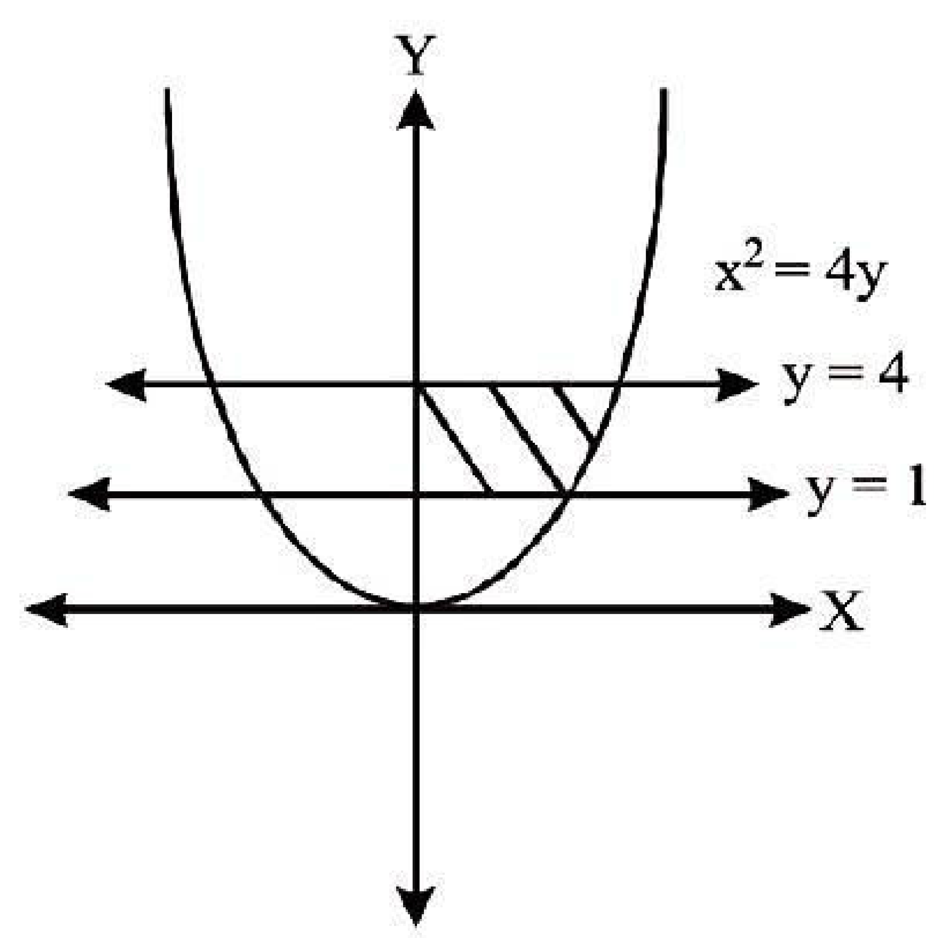
$$\Rightarrow 2\left[\sin\theta\cos\frac{\pi}{3} + \cos\theta\sin\frac{\pi}{3}\right] = \cos\theta\cos\frac{\pi}{6} + \sin\theta\sin\frac{\pi}{6}$$

$$\Rightarrow 2\left[\frac{\sin\theta}{2} + \cos\theta\left(\frac{\sqrt{3}}{2}\right)\right] = \cos\theta\left(\frac{\sqrt{3}}{2}\right) + \sin\theta\left(\frac{1}{2}\right)$$

$$\Rightarrow \sin\theta + \sqrt{3}\cos\theta = \frac{\sqrt{3}}{2}\cos\theta + \frac{1}{2}\sin\theta$$

$$\Rightarrow \frac{1}{2}\sin\theta = \frac{-\sqrt{3}}{2}\cos\theta \Rightarrow \tan\theta = -\sqrt{3}$$

18. **(b)**



We have $x^2 = 4y \Rightarrow x = 2\sqrt{y}$

$\therefore$ area between $x = 2\sqrt{y}$, $y = 1$ & $y = 4$

$$= \int_1^4 2\sqrt{y}\,dy = 2\left[\frac{y^{3/2}}{3/2}\right]_1^4$$

$$= 2\left(\frac{2}{3}\right)\left[y\sqrt{y}\right]_1^4 = \frac{4}{3}(8-1) = \frac{28}{3}$$

19. **(d)** $f(x)=\dfrac{e^{x^2}-\cos x}{x^2}$

Since f(x) is continuous at x = 0

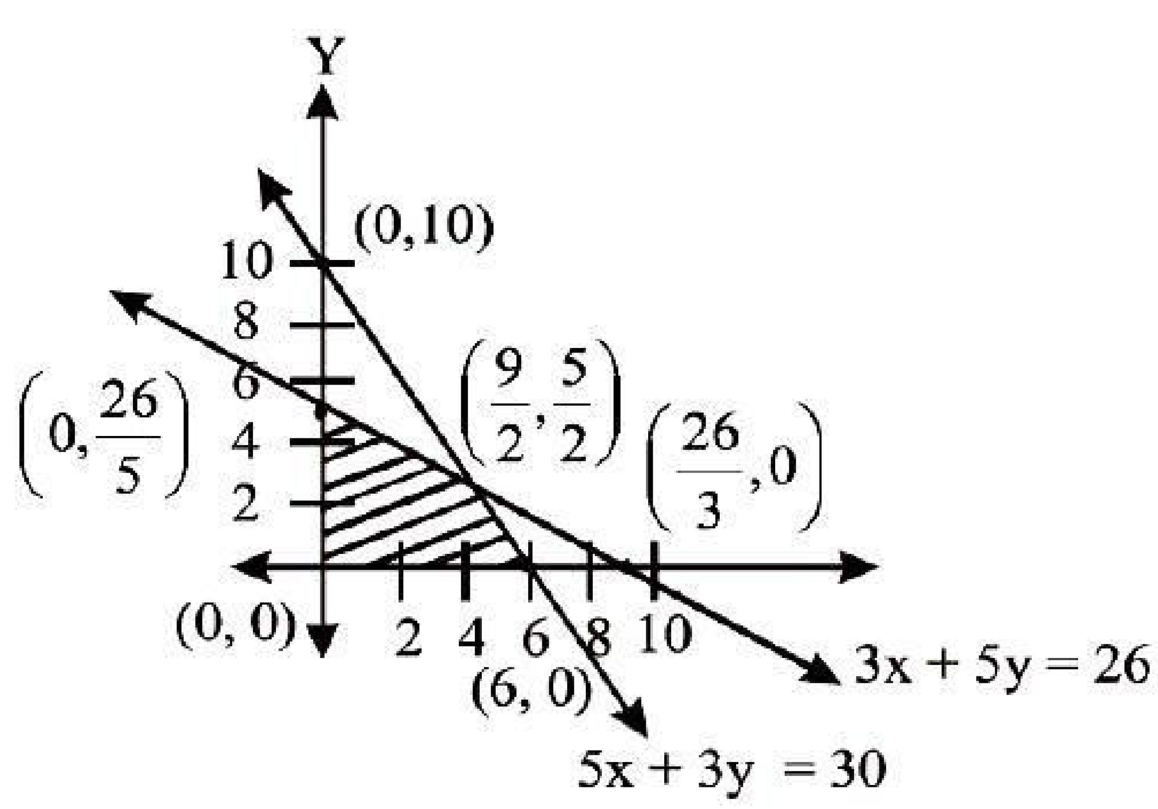
$\Rightarrow f(0)=\lim\limits_{x\to 0} f(x)$

$\Rightarrow f(0)=\lim\limits_{x\to 0}\dfrac{\left(e^{x^2}-1\right)-(\cos x-1)}{x^2}$

$\Rightarrow f(0)=\lim\limits_{x\to 0}\dfrac{e^{x^2}-1}{x^2}-\lim\limits_{x\to 0}\dfrac{-2\sin^2\frac{x}{2}}{x^2}$

$\Rightarrow f(0)=1+2\lim\limits_{x\to 0}\left[\dfrac{\sin\frac{x}{2}}{\frac{x}{2}}\right]^2\times\dfrac{1}{4}=1+\dfrac{2}{4}=\dfrac{3}{2}$

20. **(a)**



Corner Points	**Value of z = 2x + y**
(0, 0)	$z=0$
(6, 0)	$z=2(6)+0=12$
$\left(\frac{9}{2},\frac{5}{2}\right)$	$z=2\left(\frac{9}{2}\right)+\frac{5}{2}=11.5$
$\left(0,\frac{26}{5}\right)$	$z=2(0)+\frac{26}{5}=5.2$

21. **(c)** $|\vec{a}|=1,\ |\vec{b}|=2,\ |\vec{c}|=3$

$\vec{a}.\vec{b}=\vec{b}.\vec{c}=\vec{a}.\vec{c}=0$

Now, $\left[\vec{a}+\vec{b}+\vec{c}\ \ \vec{b}-\vec{a}\ \ \vec{c}\right]$

$=(\vec{a}+\vec{b}+\vec{c}).\left[(\vec{b}-\vec{a})\times\vec{c}\right]=(\vec{a}+\vec{b}+\vec{c}).\left(\vec{b}\times\vec{c}-\vec{a}\times\vec{c}\right)$

$=\left[\vec{a}\ \vec{b}\ \vec{c}\right]-\left[\vec{b}\ \vec{a}\ \vec{c}\right]=2\left[\vec{a}\ \vec{b}\ \vec{c}\right]=2\vec{a}.(\vec{b}\times\vec{c})$

$=2|\vec{a}|.|\vec{b}\times\vec{c}|\cos 0^\circ$ $\left(\because \vec{a}\ \&\ (\vec{b}\times\vec{c})\text{ are parallel}\right)$

$=2|\vec{a}|\cdot|\vec{b}\times\vec{c}|=2|\vec{a}||\vec{b}||\vec{c}|\sin 90^\circ$

$=2(1)(2)(3)=12$

22. **(d)** $\overrightarrow{PQ}=(-1,\ y-5,\ 4-x)$

$\overrightarrow{QR}=(2,\ 8-y,\ -4)$

$\because$ P, Q, R are collinear

$\therefore \dfrac{-1}{2}=\dfrac{y-5}{8-y}=\dfrac{4-x}{-4}$

$\Rightarrow -8+y=2y-10\ \&\ 4=8-2x$

$\Rightarrow y=2\ \&\ x=2$

$\therefore \boxed{x+y=4}$

23. **(a)** $\because ax^2+2hxy+2by^2=0$

Let the slope of one line is m.

In slope of other line = 2m.

We know that

$m+2m=\dfrac{-2h}{b}\ \&\ m\times 2m=\dfrac{a}{b}.$

$\Rightarrow 3m=\dfrac{-2h}{b}\ \&\ 2m^2=\dfrac{a}{b}.$

$\Rightarrow m=\dfrac{-2h}{b}\ \Rightarrow m^2=\dfrac{4h^2}{9b^2}.$

$\therefore 2\left(\dfrac{4h^2}{9b^2}\right)=\dfrac{a}{b}.\ \Rightarrow 8h^2=9ab$

24. **(a)** $y-1=(-1)(x+3)\Rightarrow x+y+z=0$

25. **(b)** p : Hema gets the admission in good college

q : Hema gets 95% marks

$\therefore$ given statement can be written as :

$p\rightarrow q$

$\therefore$ its negation is $p\wedge\sim q$

26. **(a)** $\cos 1^\circ\cos 2^\circ\cos 3^\circ.......\cos 179^\circ=0$

Since $\cos 90^\circ=0$

$\therefore$ required product = 0

27. **(c)** Planes $x - cy - bz = 0$

$$cx - y + az = 0$$
$$bx + ay - z = 0$$

Since the given planes pass through a straight line.

$\therefore$ planes are concurrent

$$\begin{vmatrix} 1 & -c & -b \\ c & -1 & a \\ b & a & -1 \end{vmatrix} = 0$$

$1(1 - a^2) + c(-c - ab) - b(ac + b) = 0$

$1 - a^2 - c^2 - abc - abc - b^2 = 0$

$a^2 + b^2 + c^2 + 2abc = 1$

$a^2 + b^2 + c^2 = 1 - 2abc$

28. **(c)** $x^2 - y^2 + x + 3y - 2 = 0$

Comparing the above equation with

$ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$

we get

$a = 1, h = 0, b = -1,\ g = \frac{1}{2},\ f = \frac{3}{2}, c = -2$

$\therefore$ req. point of intersection is:

$$\left(\frac{hf - bg}{ab - h^2}, \frac{gh - af}{ab - h^2}\right)$$

$$\equiv \left(\frac{0 + \frac{1}{2}}{-1}, \frac{0 - \frac{3}{2}}{-1}\right) \equiv \left(-\frac{1}{2}, \frac{3}{2}\right)$$

29. **(b)** When we get 1, number of positive divisors are 1

When we get 2, number of positive divisors are 2

When we get 3, number of positive divisors are 2

When we get 4, number of positive divisors are 3

When we get 5, number of positive divisors are 2

When we get 6, number of positive divisors are 4

Hence range of random variable X is $\{1, 2, 3, 4\}$

30. **(b)** P (getting perfect square in atleast one throw) = 1 – P (not getting perfect square in any throw)

$$= 1 - \left(\frac{4}{6} \times \frac{4}{6} \times \frac{4}{6} \times \frac{4}{6}\right)$$

$$= 1 - \left(\frac{2}{3}\right)^4 = 1 - \frac{16}{81} = \frac{65}{81}$$

31. **(b)** $\int_0^{\pi/4} x \sec^2 x \, dx$

$$= \left[x \int \sec^2 x \, dx\right]_0^{\pi/4} - \int_0^{\pi/4} \left[\frac{d}{dx} x \int \sec^2 x \, dx\right] dx$$

$$= [x.\tan x]_0^{\pi/4} - \int_0^{\pi/4} [\tan x] dx$$

$$= [x.\tan x]_0^{\pi/4} - [\log|\sec x|]_0^{\pi/4}$$

$$= \left[\frac{\pi}{4} - 0\right] - \left[\log\left|\sec\frac{\pi}{4}\right| - \log|\sec 0|\right]$$

$$= \frac{\pi}{4} - \left[\log\sqrt{2} - \log 1\right]$$

$$= \frac{\pi}{4} - \log\sqrt{2}$$

32. **(c)** $\because$ a, b, c are in A.P.

$\therefore 2b = a + c$ ....(i)

Now, $a\cos^2\left(\frac{C}{2}\right) + c\cos^2\left(\frac{A}{2}\right)$

$$= a\frac{[1 + \cos C]}{2} + c\frac{[1 + \cos A]}{2}$$

$$= \frac{a + c + a\cos C + C\cos A}{2}$$

$$= \frac{a + c + b}{2} \qquad [\because b = a\cos C + c\cos A]$$

$$= \frac{2b + b}{2} = \frac{3b}{2} \qquad \text{[Using equation (i)]}$$

33. **(a)** $x = e^{\theta}(\sin\theta - \cos\theta)$ & $y = e^{\theta}(\sin\theta + \cos\theta)$

$$\therefore \frac{dx}{d\theta} = e^{\theta}(\cos\theta + \sin\theta) + (\sin\theta - \cos\theta)e^{\theta}$$

$$= e^{\theta}[2\sin\theta]$$

$$\& \frac{dy}{d\theta} = e^{\theta}(\cos\theta - \sin\theta) + (\sin\theta + \cos\theta)e^{\theta} = e^{\theta}[2\cos\theta]$$

$$\therefore \frac{dy}{dx} = \frac{dy/d\theta}{dx/d\theta} = \frac{e^{\theta}[2\cos\theta]}{e^{\theta}[2\sin\theta]}$$

$$\Rightarrow \frac{dy}{dx} = \cot\theta$$

$$\Rightarrow \left.\frac{dy}{dx}\right|_{\theta=\frac{\pi}{4}} = \cot\frac{\pi}{4} = 1$$

34. **(b)** $\sin x + \sin 3x + \sin 5x = 0$

$\sin 5x + \sin x + \sin 3x = 0$

$2\sin 3x.\cos 2x + \sin 3x = 0$

$\therefore \sin 3x\,[2\cos 2x + 1] = 0$

$\therefore \sin 3x = 0$ or $2\cos 2x + 1 = 0$

$\Rightarrow \sin 3x = \sin n\pi$

$\Rightarrow 3x = n\pi$

$$\Rightarrow x = \frac{n\pi}{3}$$

also $2\cos 2x = -1$

$\Rightarrow \cos 2x = -1/2$

$\Rightarrow \cos 2x = -\cos\pi/3$

$\cos 2x = \cos(\pi - \pi/3)$

$$\Rightarrow \cos 2x = \cos\frac{2\pi}{3}$$

$$\Rightarrow 2x = 2n\pi \pm \frac{2\pi}{3}$$

$$x = \frac{n\pi}{3},\ x = n\pi \pm \frac{\pi}{3}$$

$x \in \left[\frac{\pi}{2}, \frac{3\pi}{2}\right]$ gives

$$x = \pi, \frac{2\pi}{3} \& \frac{4\pi}{3}$$

35. **(c)** $\tan^{-1}2x + \tan^{-1}3x = \frac{\pi}{4}$

$$\Rightarrow \tan^{-1}\left(\frac{2x+3x}{1-6x^2}\right) = \frac{\pi}{4}$$

$$\Rightarrow \frac{5x}{1-6x^2} = \tan\frac{\pi}{4}$$

$$\Rightarrow \frac{5x}{1-6x^2} = 1$$

$\Rightarrow 5x = 1 - 6x^2$

$\Rightarrow 6x^2 + 5x - 1 = 0$

$\Rightarrow 6x^2 + 6x - x - 1 = 0$

$\Rightarrow 6x(x+1) - 1(x+1) = 0$

$\Rightarrow (x+1)(6x-1) = 0$

$\therefore x = -1,\ x = \frac{1}{6}$

When $x = \frac{1}{6}$, given equation is satisfied.

When $x = -1$, we get sum of two negative angles, hence discarded.

$\therefore x = \frac{1}{6}$

36. **(c)** Here $A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 1 & 5 \\ 2 & 4 & 7 \end{bmatrix}$

we know that,

$a_{31}A_{31} + a_{32}A_{32} + a_{33}A_{33} = |A|$

$= +1(7-20) - 2(7-10) + 3(4-2)$

$= -13 + 6 + 6 = -1$

37. **(b)** p = The weather is fine

q = My friends will come and we go for a picnic.

$\therefore$ given statement can be written as : $p \rightarrow q$

$\therefore$ its contrapositive is : $\sim q \rightarrow \sim p$

i.e. If my friends do not come or we do not go for picnic, then weather will not be fine.

38. **(d)** $f(x) = \frac{x}{x^2+1}$

$$\Rightarrow f'(x) = \frac{(x^2+1)(1) - (x)(2x)}{(x^2+1)^2}$$

$$\Rightarrow f'(x) = \frac{1-x^2}{(x^2+1)^2}$$

$\because f(x)$ is increasing function.

$\therefore f'(x) > 0$

$$\Rightarrow \frac{1-x^2}{\left(x^2+1\right)^2} > 0$$

Here $x^2 + 1 \neq 0$, $\quad x^2 \neq -1$

$1 - x^2 > 0$, $\quad x^2 < 1$

$x \in (-1, 1)$

39. **(a)** $X = 4^n - 3n - 1 \quad n \in N$

$\& \; Y = 9(n-1) \quad n \in N$

$\Rightarrow \; X = \{0, 9, 54, 243, ...\}$

$\& \; Y = \{0, 9, 18, 27, 36, 45, 54, ...\}$

$\therefore X \cap Y = X$

40. **(b)** $p \wedge (\sim p \wedge q)$

$= (p \wedge \sim p) \wedge q$ ....(Associative law)

$= F \wedge q$ ....(Compliment law)

$= F$ ....(Identity law)

41. **(a)** Line $y = 4x - 5 \to$ slope of line $m = 4$ ...(i)

curve $y^2 = ax^3 + b$

$\therefore$ differentiating w.r.t. 'x'

$$2y\frac{dy}{dx} = 3ax^2$$

$$\frac{dy}{dx} = \frac{3ax^2}{2y} = \text{slope of tangent}$$

$$\therefore \left.\frac{dy}{dx}\right|_{(2,3)} = \frac{3a \times 4}{2 \times 3} = 2a \quad ...(ii)$$

$\therefore$ from (i) and (ii), we get

$4 = 2a \Rightarrow a = 2$

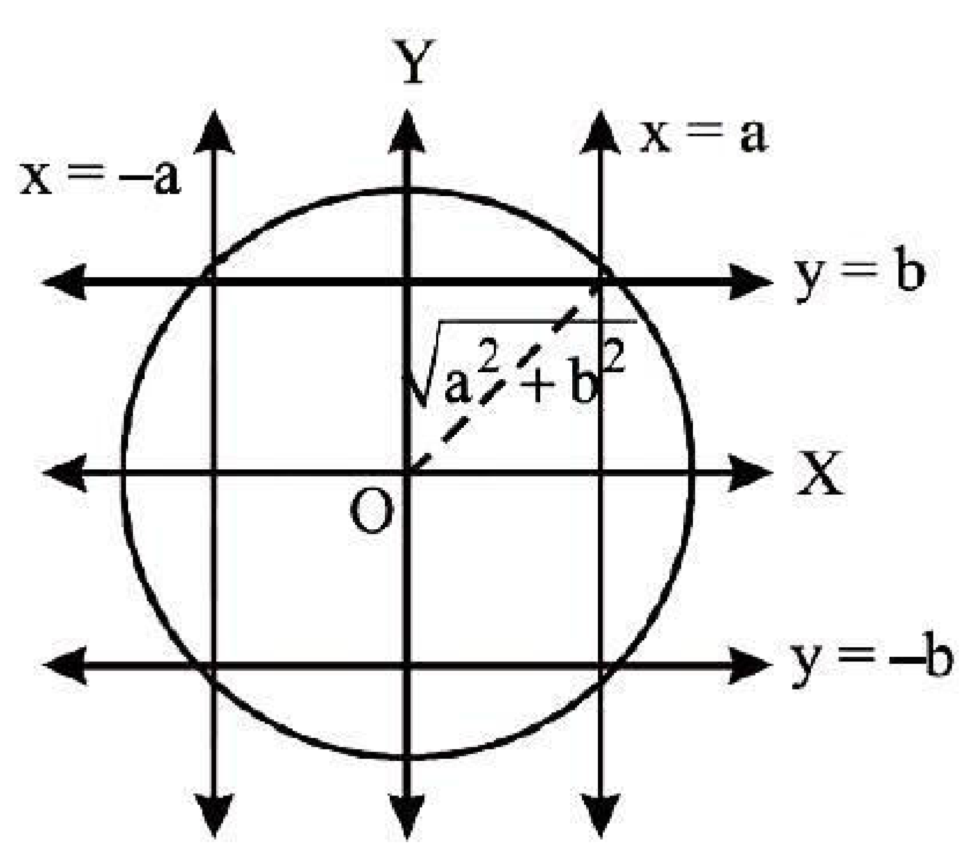
Since, (2, 3) is a point on the curve : $y^2 = ax^3 + b$.

$\therefore (3)^2 = 2(2)^3 + b$

$\Rightarrow b = -7$

$\therefore 7a + 2b = 7 \times 2 + 2(-7) = 0$

42. **(b)**



Centre $= (0, 0)$ & radius $= r = \sqrt{a^2 + b^2}$

$\therefore$ equation of circle

$x^2 + y^2 = a^2 + b^2$

43. **(a)** $f(x) = x \log x$

$\therefore f'(x) = 1 + \log x$

For minimum value

$f'(x) = 0 \Rightarrow 1 + \log x = 0$

$$\Rightarrow \log x = -1 \Rightarrow x = \frac{1}{e}$$

$$\text{min value} = f\left(\frac{1}{e}\right) = \frac{1}{e}.\log\left(\frac{1}{e}\right)$$

$$= \frac{1}{e}(\log 1 - \log e) = \frac{1}{e}(0-1) = -\frac{1}{e}$$

44. **(d)** $n = 10, p = 0.4, q = 0.6$

$\because E(x) = np = 4$

$\& \; V(x) = npq = 10(0.4)(0.6) = 2.4$

Now, $V(x) = E(x^2) - [E(x)]^2$

$\Rightarrow 2.4 = E(x^2) - (4)^2$

$\Rightarrow E(x^2) = 18.4$

45. **(a)** $\dfrac{dx}{dy} = \cos(x + y)$

$$\Rightarrow \frac{dy}{dx} = \frac{1}{\cos(x+y)}$$

Put $x + y = V$

Differentiating w.r.t. 'x'

$$1 + \frac{dy}{dx} = \frac{dV}{dx}$$

$$\Rightarrow \frac{dy}{dx} = \frac{dV}{dx} - 1$$

$$\Rightarrow \frac{dV}{dx} - 1 = \frac{1}{\cos V}$$

$$\Rightarrow \frac{dV}{dx} = \frac{1}{\cos V} + 1$$

$$\Rightarrow \frac{dV}{dx} = \frac{1 + \cos V}{\cos V}$$

$$\Rightarrow \frac{\cos V}{(1 + \cos V)} dV = dx$$

Integrate both sides, we get :

$$\int \frac{(1 + \cos V) - 1}{1 + \cos V} dV = \int dx$$

$$\Rightarrow \int \left[1 - \frac{1}{2\cos^2 \frac{V}{2}}\right] dV = \int dx$$

$$\Rightarrow V-\frac{1}{2}\frac{\tan\frac{V}{2}}{\frac{1}{2}}=x+C_1$$

$$\Rightarrow x+y-\tan\left(\frac{x+y}{2}\right)=x+C_1$$

$$\Rightarrow \tan\left(\frac{x+y}{2}\right)=y+C \qquad [\because C=-C_1]$$

46. **(d)** We have $\vec{r}.\left(p\hat{i}-\hat{j}+2\hat{k}\right)+3=0$ and

$\vec{r}.\left(2\hat{i}-p\hat{j}-\hat{k}\right)-5=0$

Since angle between them is $\frac{\pi}{3}$.

$$\therefore \cos\theta=\left|\frac{\vec{n}_1.\vec{n}_2}{|\vec{n}_1|.|\vec{n}_2|}\right|$$

$$\Rightarrow \cos\frac{\pi}{3}=\frac{\left(p\hat{i}-\hat{j}+2\hat{k}\right).\left(2\hat{i}-p\hat{j}-\hat{k}\right)}{\sqrt{(p)^2+(-1)^2+(2)^2}\sqrt{(2)^2+(-p)^2+(-1)^2}}$$

$$\Rightarrow \frac{1}{2}=\frac{2p+p-2}{\left(\sqrt{p^2+5}\right)\left(\sqrt{p^2+5}\right)}\Rightarrow \frac{1}{2}=\frac{3p-2}{\left(p^2+5\right)}$$

$\Rightarrow p^2+5=6p-4\Rightarrow p^2-6p+9=0$
$\Rightarrow (p-3)^2=0\Rightarrow p=3$

47. **(d)** Equation of parabola whose axis is parallel to X axis and latus rectum is 4a
$(y-k)^2=4a(x-h)$
(where h & k are arbitrary constants)
differentiating b/s, we get
$2(y-k)y'=4ax$ ....(i)
again differentiating b/s, we get.

$$(y-k)y''+y'^2=2a$$

$$\Rightarrow \frac{2ax}{y'}.y''+y'^2=2a \qquad \text{from (i)}$$

$\Rightarrow 2axy''+y'^3=2ay'$
$\Rightarrow$ order 2.

48. **(a)** Points on the given lines are respectively (1, –1, 1) and (3, k, 0) and their direction ratios are respectively 2, 3, 4 and 1, 2, 1
Since lines intersect, then lines are coplanar

$$\therefore \begin{vmatrix} x_2-x_1 & y_2-y_1 & z_2-z_1 \\ a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \end{vmatrix}=0$$

$$\therefore \begin{vmatrix} 2 & k+1 & -1 \\ 2 & 3 & 4 \\ 1 & 2 & 1 \end{vmatrix}=0$$

$\therefore 2(-5)-(k+1)(-2)-1(1)=0$
$-11+2k+2=0$

$$k=\frac{9}{2}$$

49. **(c)** Let cos α, cos β & cos γ are the direction cosines of the line. We know that
$\cos^2\alpha+\cos^2\beta+\cos^2\gamma=1$
$\Rightarrow (\cos 120°)^2+\cos^2\beta+(\cos 60°)^2=1$

$$\Rightarrow \left(-\frac{1}{2}\right)^2+\cos^2\beta+\left(\frac{1}{2}\right)^2=1$$

$$\Rightarrow \cos^2\beta=1-\frac{1}{2}=\frac{1}{2}\Rightarrow \cos\beta=\pm\frac{1}{\sqrt{2}}$$

$\Rightarrow \beta=135°$

50. **(c)** We have $L\equiv(2,-1)$ and $M\equiv(1,2)$ and is divided by N in ratio 2 : 1 externally.

$$\therefore N\equiv\frac{(2)(1)-(2)(1)}{2-1},\frac{(2)(2)-(1)(-1)}{2-1}$$

i.e. $N\equiv\left(0,\frac{5}{1}\right)$ i.e. $N\equiv(0,5)$

$\therefore$ position vector of point N is $5\vec{b}$