MHT-CET 2019

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. A sotne of mass 1 kg is tied to a string of length 2 m long and is rotated at constant speed of 40 ms^{-1} in a vertical circle. The ratio of the tension at the top and the bottom is [Take $g = 10\ ms^{-2}$]

(a) $\frac{81}{79}$ (b) $\frac{79}{81}$

(c) $\frac{19}{12}$ (d) $\frac{12}{19}$

2. Two coils have a mutual inductance of 0.01 H. The current in the first coil changes according to equation $I = 5 \sin 200\pi t$. The maximum value of e.m.f. induced in the second coil is

(a) 10π volt (b) 0.1π volt

(c) π volt (d) 0.01π volt

3. The radius of the earth and the radius of orbit around the sun are 6371 km and 149×10^6 km respectively. The order of magnitude of the diameter of the orbit is greater than that of earth by

(a) 10^3 (b) 10^2

(c) 10^4 (d) 10^5

4. Two open pipes of different lengths and of same diameter in which the air column vibrates with fundamental frequencies 'n_1' and 'n_2' respectively. When both pipes are joined to form a single pipe, its fundamental frequency will be

(a) $\frac{n_1+n_2}{n_1 n_2}$ (b) $\frac{n_1 n_2}{2n_2+n_1}$

(c) $\frac{2n_1+n_2}{n_1 n_2}$ (d) $\frac{n_1 n_2}{n_1+n_2}$

5. If 'C_p' and C_v are molar specific heats of an ideal gas at constant pressure and volume respectively, 'γ' is ratio of two specific heats and 'R' is univeral gas constant then 'C_p' is equal to

(a) $\frac{R\gamma}{\gamma-1}$ (b) γR

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

6. In a series LCR circuit $R = 300\ \Omega$, $L = 0.9$ H, $C = 2\ \mu F$, $\omega = 1000$ rad/s. The impedance of the circuit is

(a) $500\ \Omega$ (b) $1300\ \Omega$

(c) $400\ \Omega$ (d) $900\ \Omega$

7. The quantity which *does not* vary periodically for a particle performing S.H.M. is
(a) acceleration (b) total energy
(c) displacement (d) velocity

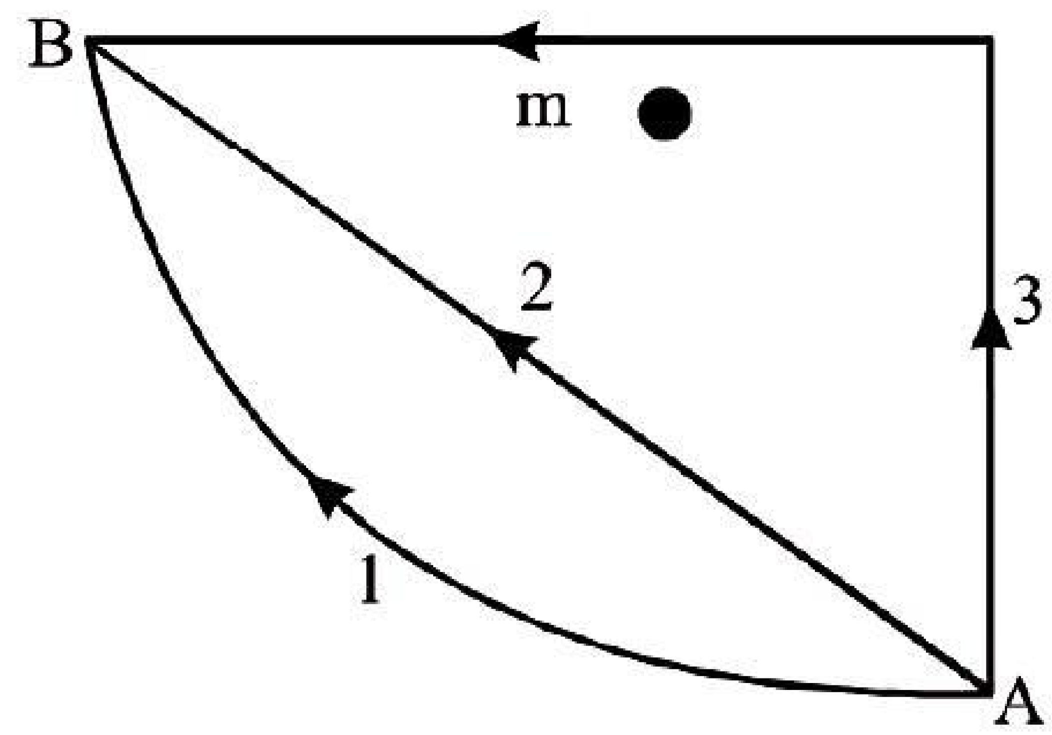
8. Which of the following combinations of 7 identical capacitors each of 2 μF gives a resultant capacitance of $\frac{10}{11}$ μF?
(a) 3 in parallel and 4 in series
(b) 2 in parallel and 5 in series
(c) 4 in parallel and 3 in series
(d) 5 in parallel and 2 in series

9. Bohr model is applied to a particle of mass '*m*' and charge '*q*' moving in a plane under the influence of a transverse magnetic field 'B'. The energy of the charged particle in the n^{th} level will be (h = Planck's constant)
(a) $\frac{2nhqB}{\pi m}$ (b) $\frac{nhqB}{2\pi m}$
(c) $\frac{nhqB}{4\pi m}$ (d) $\frac{nhqB}{\pi m}$

10. In moving coil galvanometer, strong horse shoe magnet of concave shaped pole pieces is used to
(a) increase space for rotation of coil
(b) reduce weight of galvanometer
(c) produce magnetic field which is parallel to plane of coil at any position
(d) make magnetic induction weak at the centre

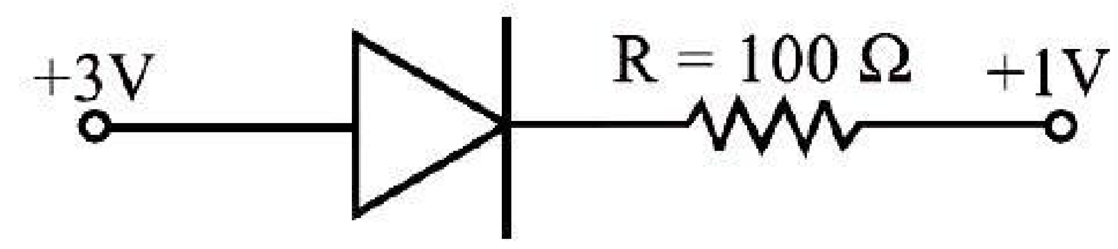
11. Two identical wires of substances 'P' and 'Q' are subjected to equal stretching force along the length. If the elongation of 'Q' is more than that of 'P', then
(a) both P and Q are equally elastic
(b) P is more elastic than Q
(c) P is plastic and Q is elastic
(d) Q is more elastic than P

12. If W_1, W_2 and W_3 represent the work done in moving a particle from A to B along three different paths 1, 2 and 3 (as shown in fig.) in the gravitational field of the point mass '*m*'. Find the correct relation between 'W_1', 'W_2' and 'W_3'



(a) $W_1 < W_3 < W_2$ (b) $W_1 < W_2 < W_3$
(c) $W_1 = W_2 = W_3$ (d) $W_1 > W_3 > W_2$

13. Assuming that the junction diode is ideal, the current in the arrangement shown in figure is



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

14. The equation of simple harmonic progressive wave is given by $Y = a \sin 2\pi (bt - cx)$
The maximum particle velocity will be twice the wave velocity if
(a) $c = \pi a$ (b) $c = \frac{1}{2\pi a}$
(c) $c = \frac{1}{\pi a}$ (d) $c = 2\pi a$

15. In fundamental mode, the time required for the sound wave to reach upto the closed end of a pipe filled with air is 't' second. The frequency of vibration of air column is
(a) $(2t)^{-1}$ (b) $4(t)^{-1}$
(c) $2(t)^{-1}$ (d) $(4t)^{-1}$

16. Two small drops of mercury each of radius 'R' coalesce to form a large single drop. The ratio of the total surface energies before and after the change is
(a) $2^{2/3} : 1$ (b) $\sqrt{2} : 1$
(c) $2^{1/3} : 1$ (d) $2 : 1$

17. If radius of the solid sphere is doubled by keeping its mass constant, the ratio of their moment of inertia about any of its diameter is
(a) 1 : 8 (b) 2 : 5
(c) 2 : 3 (d) 1 : 4

18. For a metallic wire, the ratio of voltage to corresponding current is
(a) independent of temperature
(b) increases with rise in temperature
(c) increases or decreases with rise in temperature depending upon the metal
(d) decreases with rise in temperature

19. A soap bubble in vacuum has a radius of 3 cm and another soap bubble in vacuum has a radius of 4 cm. If the two bubbles coalesce under isothermal condition, then the radius of the new bubble is
(a) 2.3 cm (b) 4.5 cm
(c) 5 cm (d) 7 cm

20. Two parallel conductors carrying unequal currents in the same direction
(a) neither attract nor repel each other
(b) repel each other
(c) attract each other
(d) will have rotational motion

21. A layer of atmosphere that reflects medium frequency radio waves which is ineffective during night, is
(a) F layer (b) E layer
(c) stratosphere (d) thermosphere

22. A transverse wave is propagating on the string. The linear density of a vibrating string is 10^{-3} kg/m. The equation of the wave is $y = 0.05 \sin(x + 15t)$ where x and y are in metre and time in second. The tension in the string is
(a) 0.2 N (b) 0.250 N
(c) 0.225 N (d) 0.325 N

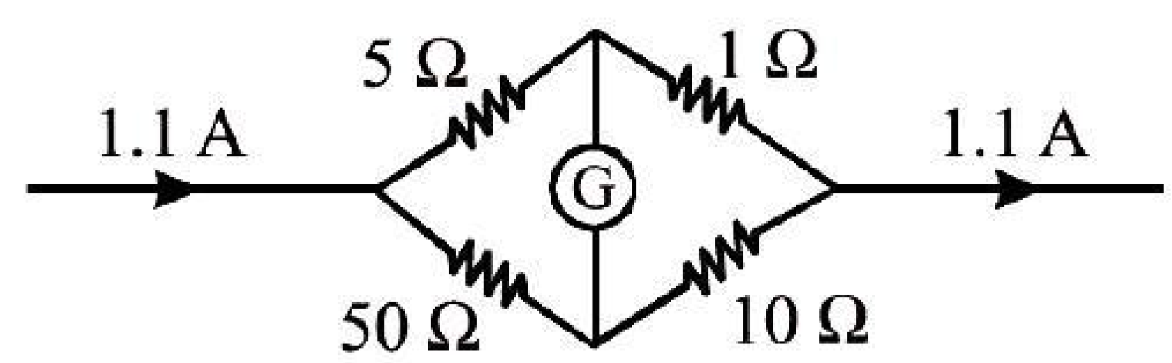
23. The kinetic energy of a revolving satellite (mass m) at a height equal to thrice the radius of the earth (R) is
(a) $\frac{mgR}{8}$ (b) $\frac{mgR}{16}$
(c) $\frac{mgR}{2}$ (d) $\frac{mgR}{4}$

24. A particle executes the simple hormonic motion with an amplitude 'A'. The distance travelled by it in one periodic time is
(a) $\frac{A}{2}$ (b) A
(c) 2 A (d) 4 A

25. A galvanometer has resistance of 100 Ω and a current of 10 mA produces full scale deflection in it. The resistance to be connected to it in series, to get a voltmeter of range 50 volt is
(a) 3900 Ω (b) 4000 Ω
(c) 4600 Ω (d) 4900 Ω

26. The angle made by orbital angular momentum of electron with the direction of the orbital magnetic moment is
(a) 120° (b) 60°
(c) 180° (d) 90°

27. The current in 1 Ω resistor in the following circuit is



(a) 1 A (b) 0.5 A
(c) 1.1 A (d) 0.8 A

28. The wavelength of the first line in Balmer series in the hydrogen spectrum is 'λ'. What is the wavelength of the second line in the same series?
(a) $\frac{20}{27}\lambda$ (b) $\frac{3}{16}\lambda$
(c) $\frac{5}{36}\lambda$ (d) $\frac{3}{4}\lambda$

29. Work done in stretching a wire through 1 mm is 2J. What amount of work will be done for elongating another wire of same material, with half the length and double the radius of cross section, by 1 mm?
(a) 1.2 J (b) 4 J
(c) 8 J (d) 16 J

30. The resultant $\vec{R}$ of $\vec{P}$ and $\vec{Q}$ is perpendicular to $\vec{P}$. Also $|\vec{P}| = |\vec{R}|$. The angle between $\vec{P}$ and $\vec{Q}$ is [tan45° = 1]

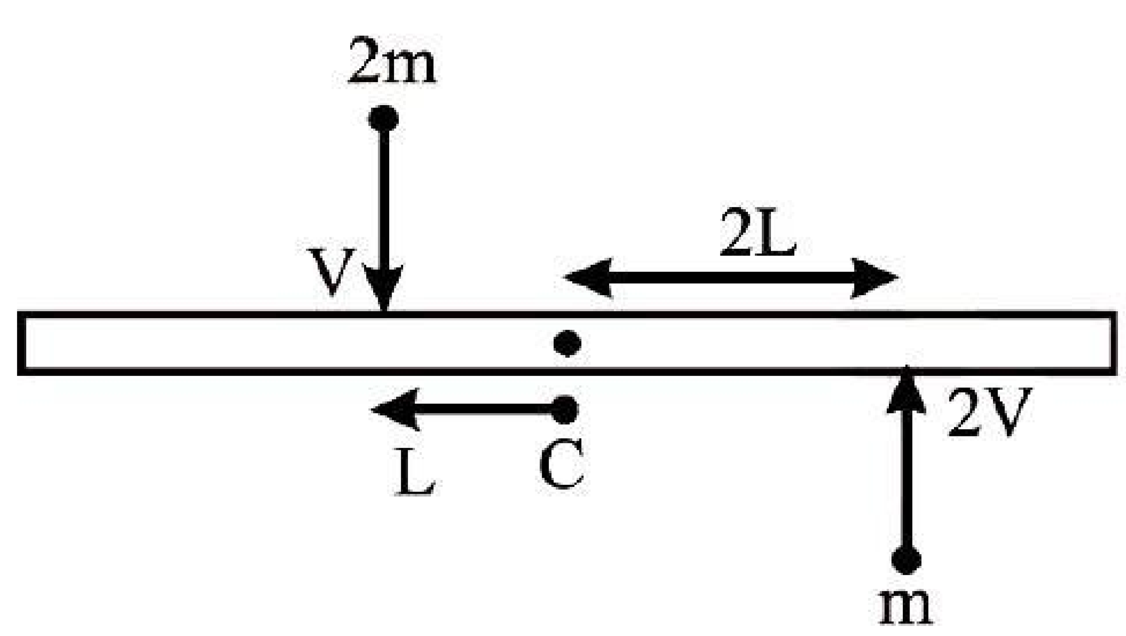
(a) $\frac{6\pi}{4}$ (b) $\frac{7\pi}{4}$

(c) $\frac{\pi}{4}$ (d) $\frac{3\pi}{4}$

31. A telescope has large diameter of the objective. Then its resolving power is

(a) independent of the diameter of the objective
(b) low
(c) zero
(d) high

32. A uniform rod of length '6L' and mass '8m' is pivoted at its centre 'C'. Two masses 'm' and '2m' with speed 2v, v as shown strikes the rod and stick to the rod. Initially the rod is at rest. Due to impact, if it rotates with angular velocity 'w_1' then 'w' will be



(a) $\frac{v}{4\,L}$ (b) Zero

(c) $\frac{8\,v}{6\,L}$ (d) $\frac{11\,v}{3\,L}$

33. If $\sqrt{A^2+B^2}$ represents the magnitude of resultant of two vectors $(\vec{A}+\vec{B})$ and $(\vec{A}-\vec{B})$, then the angle between two vectors is

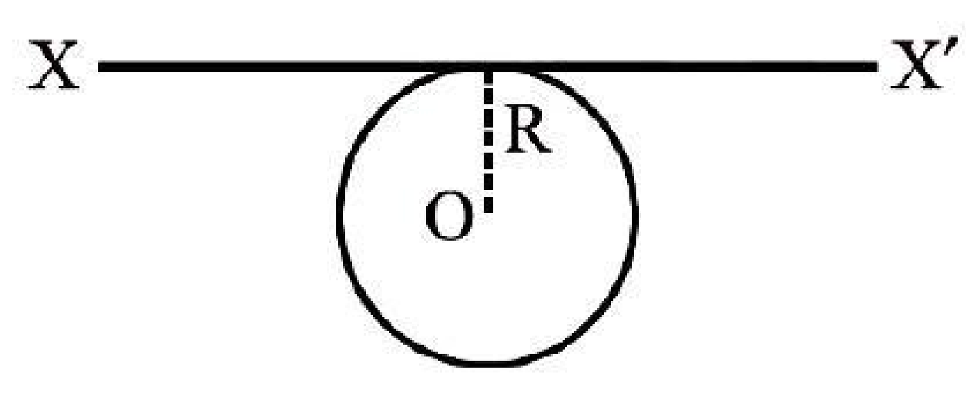
(a) $\cos^{-1}\left[\frac{2(A^2-B^2)}{(A^2+B^2)}\right]$

(b) $\cos^{-1}\left[-\frac{A^2-B^2}{A^2B^2}\right]$

(c) $\cos^{-1}\left[-\frac{(A^2+B^2)}{2(A^2-B^2)}\right]$

(d) $\cos^{-1}\left[-\frac{(A^2-B^2)}{A^2+B^2}\right]$

34. A thin metal wire of length 'L' and uniform linear mass density 'Q' is bent into a circular coil with 'o' as centre. The moment of inertia of a coil about the axis XX′ is



(a) $\frac{3QL^3}{8\pi^2}$ (b) $\frac{QL^3}{4\pi^2}$

(c) $\frac{3QL^2}{4\pi^2}$ (d) $\frac{QL^3}{8\pi^2}$

35. The dimensions of torque are same as that of

(a) moment of force (b) pressure
(c) acceleration (d) impulse

36. For transistor, the current ratio 'β_{dc}' is defined as the ratio of

(a) collector current to emitter current
(b) collector current to base current
(c) base current to collector current
(d) emitter current to collector current

37. A clock pendulum having coefficient of linear expansion $\alpha = 9 \times 10^{-7}$/°C has a period of 0.5 s at 20°C. If the clock is used in a climate where the temperature is 30°C, how much time does the clock lose in each oscillation? (g = constant)

(a) 2.5×10^{-7} s (b) 5×10^{-7} s
(c) 1.125×10^{-6} s (d) 2.25×10^{-6} s

38. Two capillary tubes of different diameters are dipped in water. The rise of water is

(a) zero in both the tube
(b) same in both the tube
(c) more in the tube of larger diameter
(d) more in the tube of smaller diameter

39. A thin hollow prism of refracting angle 3°, filled with water gives a deviation of 1°. The refractive index of water is

(a) 1.59 (b) 1.33
(c) 1.46 (d) 1.51

40. A body is projected vertically from the surface of the earth of radius 'R' with velocity equal to half of the escape velocity. The maximum height reached by the body is

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

41. In biprism experiment, the distance between source and eyepiece is 1.2 m, the distance between two virtual sources is 0.84 mm. Then the wavelength of light used if eyepiece is to be moved transversely through a distance of 2.799 cm to shift 30 fringes is

(a) 6533 Å (b) 6537 Å
(c) 6535 Å (d) 6351 Å

42. When photons of energy hv fall on metal plate of work function 'W_0', photoelectrons of maximum kinetic energy 'K' are ejected. If the frequency of the radiation is doubled, the maximum kinetic energy of the ejected photoelectrons will be

(a) $K+W_0$ (b) $K+hv$
(c) K (d) 2K

43. If a star emitting yellow light is accelerated towards earth, then to an observer on earth it will appear

(a) becoming orange
(b) shining yellow
(c) gradually changing to blue
(d) gradually changing to red

44. The magnitude of magnetic induction at a point on the axis at a large distance (r) from the centre of circular coil of 'n' turns, and area 'A' carrying current (I) is given by

(a) $B_{axis} = \frac{\mu_0}{4\pi} \cdot \frac{nA}{Ir^3}$ (b) $B_{axis} = \frac{\mu_0}{4\pi} \cdot \frac{2nIA}{r^3}$
(c) $B_{axis} = \frac{\mu_0}{4\pi} \cdot \frac{2nI}{Ar^3}$ (d) $B_{axis} = \frac{\mu_0}{4\pi} \cdot \frac{nIA}{r^3}$

45. A metal sphere of radius 'R' and density 'e_1' is dropped in a liquid of density 'σ' moves with terminal velocity 'V'. Another metal sphere of same radius and density 'e_2' is dropped in the same liquid, its terminal velocity will be

(a) $V\left[\frac{(e_2+\sigma)}{(e_1+\sigma)}\right]$ (b) $V\left[\frac{(e_1+\sigma)}{(e_2+\sigma)}\right]$
(c) $V\left[\frac{(e_2-\sigma)}{(e_1-\sigma)}\right]$ (d) $V\left[\frac{(e_1-\sigma)}{(e_2-\sigma)}\right]$

46. If α is the coefficient of performance of a refrigerator and 'Q_1' is heat released to the hot reservoir, then the heat extracted from the cold reservoir 'Q_2' is

(a) $\frac{\alpha Q_1}{\alpha-1}$ (b) $\frac{\alpha-1}{\alpha}Q_1$
(c) $\frac{\alpha Q_1}{1+\alpha}$ (d) $\frac{1+\alpha}{\alpha}Q_1$

47. The real force 'F' acting on a particle of mass 'm' performing circular motion acts along the radius of circle 'r' and is directed towards the centre of circle. The square root of magnitude of such force is (T = periodic time)

(a) $\frac{2\pi}{T}\sqrt{mr}$ (b) $\frac{Tmr}{4\pi}$
(c) $\frac{2\pi T}{\sqrt{mr}}$ (d) $\frac{T^2 mr}{4\pi}$

48. Dimensions of Gyromagnetic ratio are

(a) $[L^1M^0T^1I^1]$ (b) $[L^0M^{-1}T^1I^1]$
(c) $[L^1M^0T^0I^{-1}]$ (d) $[L^{-1}M^0T^1I^1]$

49. The maximum velocity of the photoelectron emitted by the metal surface is 'V'. Charge and mass of the photoelectron is denoted by 'e' and 'm' respectively. The stopping potential in volt is

(a) $\frac{V^2}{2\left(\frac{m}{e}\right)}$ (b) $\frac{V^2}{2\left(\frac{e}{m}\right)}$
(c) $\frac{V^2}{\left(\frac{e}{m}\right)}$ (d) $\frac{V^2}{\left(\frac{m}{e}\right)}$

50. The equiconvex lens has a focal length 'f'. If the lens is cut along the line perpendicular to principal axis and passing through the pole, what will be the focal length of any half part?

(a) $\frac{f}{2}$ (b) $2f$

(c) $\frac{3f}{2}$ (d) f

CHEMISTRY

51. Which of following methods is used to separate wolframite and stannic oxide present in cassiterite?

(a) Hydraulic washing using Wilfley table
(b) Froth flotation
(c) Hydraulic classifier
(d) Magnetic separation

52. In the reaction, $MnO_4^{-1}(aq.) + Br^{-1}(aq.) \rightarrow MnO_2(s) + BrO_3^{-1}(aq.)$, the correct change in oxidation number of the species involved is

(a) Br^{+5} to Br^{-1} (b) Mn^{+7} to Mn^{+2}
(c) Mn^{+7} to Mn^{+3} (d) Br^{-1} to Br^{+5}

53. How many isoprene units are present in abscisic acid?

(a) Three (b) Two
(c) Four (d) Five

54. Action of hydrogen iodide on anisole gives,

(a) phenol and iodomethane
(b) iodobenzene and methanol
(c) phenol and methanol
(d) iodobenzene and iodomethane

55. Which among the following compounds is used to decaffeinate coffee?

(a) Iodoform
(b) Carbon tetrachloride
(c) Methylene dichloride
(d) Chloroform

56. Which complex among the following gives a white precipitate on treatment with an aqueous solution of barium chloride?

(a) $[Pt(NH_3)_4Br_2]Cl_2$
(b) $[Co(NH_3)_5SO_4]NO_2$
(c) $[Co(NH_3)_5NO_2]SO_4$
(d) $[Pt(NH_3)_4Cl_2]Br_2$

57. When CuSO4 solution in water is treated with concentrated HCl it turns

(a) Violet (b) Yellow
(c) Purple (d) Green

58. Which of the following polymer is used in paints?

(a) Gutta percha (b) Melamine
(c) Buna-S (d) Novolac

59. Three moles of an ideal gas are expanded isothermally from a volume of 300 cm^3 to 2.5 L at 300 K against a pressure of 1.9 atm. The work done in joules is

(a) –423.56 J (b) +423.56 J
(c) –4.18 J (d) +4.8 J

60. Which among the following is used in the treatment of cancer?

(a) cis-$[Pt(en)_2Cl_2]$
(b) cis-$[PtCl_2(NH_3)_2]$
(c) trans-$[Pt(en)_2Cl_2]$
(d) trans-$[Pt(NH_3)_2Cl_2]$

61. Which among the following pairs of compounds in **NOT** isomorphous?

(a) $NaNO_3$ and $CaCO_3$
(b) K_2SO_4 and K_2SeO_4
(c) NaCl and KCl
(d) NaF and MgO

62. Which among the following compounds is used as selective weed killer?

(a) Picric acid
(b) 2, 4-dichlorophenoxy acetic acid
(c) 2, 4, 6-trichlorophenoxy acetic acid
(d) Salol

63. Calculate the difference between heat of combustion of carbon monoxide gas at constant pressure and at constant volume at 27°C? ($R = 2 Cal\ K^{-1}\ mol^{-1}$)

(a) 54 cal (b) –600 cal
(c) –300 cal (d) 27 cal

64. The conductivity of an electrolytic solution decreases on dilution due to

(a) decrease in number of ions per unit volume
(b) increase in ionic mobility of ions
(c) increase in percentage ionisation
(d) increase in number of ions per unit volume

65. Identify B in the following reaction,

$$\text{Acetaldoxime} \xrightarrow[\text{Alcohol}]{\text{Na}} A \xrightarrow[\text{HCl}]{\text{NaNO}_2} B + H_2O + N_2\uparrow$$

(a) $CH_3CH_2CH_2OH$ (b) C_2H_5OH
(c) C_2H_5Cl (d) $C_2H_5NH_2$

66. Which among the following solids shows Frenkel defect?

(a) NaCl (b) CsCl
(c) KCl (d) AgCl

67. A cold drink bottle contains 200 mL liquid in which CO_2 is 0.1 molar. Considering CO_2 as an ideal gas the volume of the dissolved CO_2 at S.T.P. is

(a) 22.4 L (b) 0.224 L
(c) 2.24 L (d) 0.448 L

68. In the reaction,

$$2n\,\text{R-X} \xrightarrow[\text{Dry ether}]{+2n\,\text{Na}} \text{product}$$

The product obtained is

(a) $2n$ Alkene (b) n Soldium halide
(c) n Alchol (d) n Alkane

69. The bacteriostatic antibiotic from the following is

(a) Tetracycline (b) Aminoglycosides
(c) Penicillin (d) Ofloxacin

70. Nitroalkanes are obtained in laboratory from primary or secondary alkyl halides by the action of

(a) $AgNO_2$ (b) $NaNO_3$
(c) $AgNO_3$ (d) HNO_3

71. Which of following bonds has maximum bond length?

(a) C – O (b) C – H
(c) C – C (d) C – N

72. Which of the following sets of components form homogeneous mixture?

(a) Phenol + Water
(b) Sugar + Benzene
(c) Silver chloride + Water
(d) Ethyl alcohol + Water

73. Which among the following compounds in crystalline form is used for making Nicol's prism?

(a) $CaSO_4$ (b) Na_2AlF_6
(c) $CaCO_3$ (d) Al_2O_3

74. Two electroytic cells are connected in series containing $CuSO_4$ solution and molten $AlCl_3$. If in electrolysis 0.4 moles of 'Cu' are deposited on cathode of first cell. The number of moles of 'Al' deposited on cathode of the second cell is

(a) 0.6 moles (b) 0.27 moles
(c) 0.18 moles (d) 0.4 moles

75. Mandelonitrile is obtained by the reaction between hydrogen cyanide and

(a) Propionaldehyde (b) Benzaldehyde
(c) Acetaldehyde (d) Acetone

76. The ionic charges on chromate ion and dichromate ion respectively is

(a) –2, –2 (b) –3, –2
(c) –2, –4 (d) –4, –2

77. In the reaction,

$$C_6H_5COCH_3 \xrightarrow[\text{Zn-Hg/conc. HCl}]{[H]} X$$

X is

(a) toluene (b) methylbenzene
(c) benzylalcohol (d) ethylbenzene

78. What is the percentage of carbon in urea? (At mass C = 12, H = 1, N = 14, O = 16)

(a) 20% (b) 26.6%
(c) 6.67% (d) 46.0%

79. α-butylene when subjected to hydroboration oxidation reaction, yields

(a) iso-butyl alcohol (b) sec-butyl alcohol
(c) n-butyl alcohol (d) tert-butyl alcohol

80. Calculate Vant Hoff factor for 0.2 m aqueous solution of KCl which freezes at –0.680°C. (K_f = 1.86 K kg mol^{-1})

(a) 3.72 (b) 1.83
(c) 6.8 (d) 1.86

81. Which among the following sets of compounds is used as raw material for the preparation of sodium carbonate by solvay process?

(a) NaOH, HCl, CO_2
(b) NH_4Cl, H_2O, NaCl
(c) NaCl, NH_3, $Ca(OH)_2$
(d) NaCl, $CaCO_3$, H_2SO_4

82. What is the H-S-H bond angle is H_2S?

(a) 104.5° (b) 92.1°
(c) 91° (d) 90°

83. 'K' is Henry's constant and has the unit

(a) atm mol^{-1} dm^3

(b) mol^{-1} dm^3 atm^{-1}

(c) atm mol dm^{-3}

(d) mol dm^{-3} atm^{-1}

84. For the conversion of oxygen to ozone in the atmosphere, nitric oxide in gaseous phase acts as

(a) enzyme catalyst

(b) Inhibitor

(c) homogeneous catalyst

(d) heterogeneous catalyst

85. Which among the following group 15 elements does not exhibit allotropy?

(a) N (b) As

(c) Sb (d) Bi

86. Which among the following oxides of nitrogen is called nitrogen sesquioxide?

(a) NO_2 (b) N_2O_3

(c) N_2O_4 (d) N_2O_5

87. For the elementary reaction $2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$, identify the correct among the following relations

(a) $\frac{-d[SO_{2(g)}]}{dt} = \frac{-d[O_{2(g)}]}{dt}$

(b) $+\frac{1}{2}\frac{d[SO_{3(g)}]}{dt} = \frac{d[SO_{2(g)}]}{dt}$

(c) $\frac{+d[SO_{3(g)}]}{dt} = \frac{-2d[O_{2(g)}]}{dt}$

(d) $\frac{+d[SO_{2(g)}]}{dt} = \frac{-d[O_{2(g)}]}{dt}$

88. For a process, entropy change of a system is expressed as

(a) H-TS (b) $\frac{q_{rev}}{T}$

(c) $\frac{T}{q_{rev}}$ (d) $q_{rev} \times T$

89. Which among the following is NOT a semi-synthetic polymer.

(a) Terylene

(b) Viscose-Rayon

(c) Cupra-ammonium silk

(d) Acetate Rayon

90. Basesemerization is used in the extraction of

(a) Iron (b) Copper

(c) Aluminium (d) Zinc

91. Which among the following reaction is an example of a zero order reaction?

(a) $C_{12}H_{22}O_{11(aq.)} + H_2O_{(l)} \rightarrow C_6H_{12}O_{6(aq.)} + C_6H_{12}O_{6(aq.)}$

(b) $2NH_{3(g)} \xrightarrow{Pt} N_{2(g)} + 3H_2$

(c) $2H_2O_{2(l)} \rightarrow 2H_2O_{(l)} + O_{2(g)}$

(d) $H_{2(g)} + I_{2(g)} \rightarrow 2HI_{(g)}$

92. The resistance of $\frac{1}{10}$ M solution is 2.5×10^3 ohm. What is the molar conductivity of solution? (cell constant = 1.25 cm^{-1})

(a) 3.5 ohm^{-1} cm^2 mol^{-1}

(b) 5.0 ohm^{-1} cm^2 mol^{-1}

(c) 2.5 ohm^{-1} cm^2 mol^{-1}

(d) 2.0 ohm^{-1} cm^2 mol^{-1}

93. If the Vant Hoff factor for 0.1 M $Ba(NO_3)_2$ solution is 2.74, the degree of dissociaion is

(a) 0.87 (b) 0.74

(c) 0.91 (d) 87

94. What happens when ionic hydrides of S-block elements in molten state are electrolysed?

(a) Hydride ion migrates at cathode

(b) Dihydrogen is liberated at cathode

(c) Hydride ion reforms metal hydride

(d) Dihydrogen is liberated at anode

95. Which of following is NOT a property of red phosphorus?

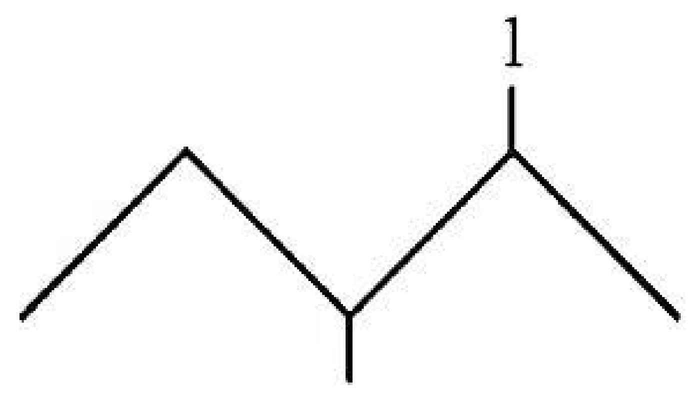
(a) Insoluble in carbon disulphide

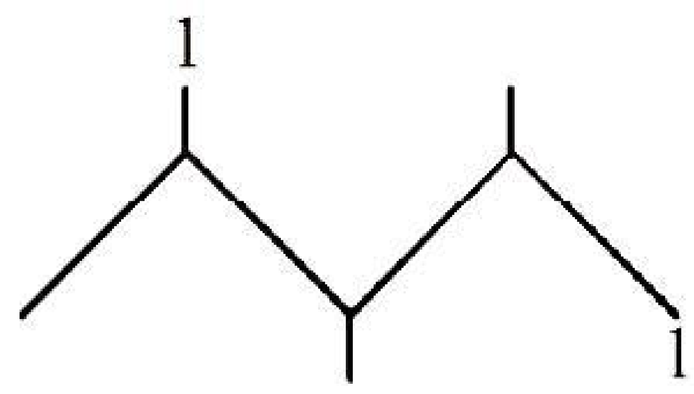
(b) It does not show chemiluminescence by action of air

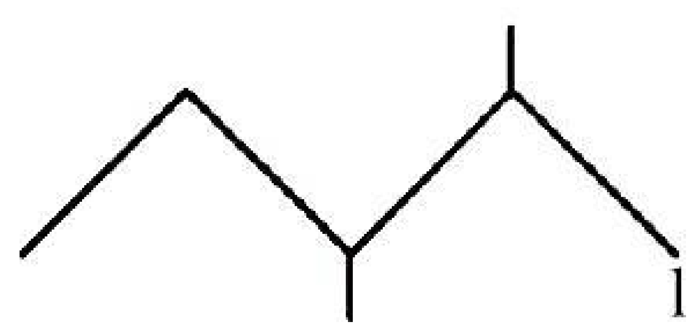
(c) If forms phosphine when treated with hot sodium hydroxide solution

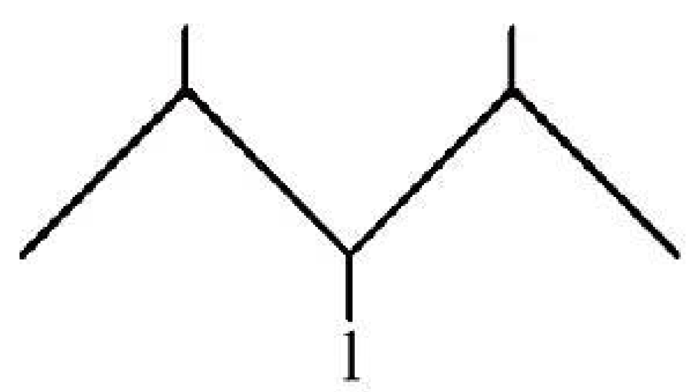
(d) It is non-poisonous

96. The bond line formula of 1-iodo –2, 3-dimethyl pentane is

(a) 

(b) 

(c) 

(d) 

97. When propene reacts with HCl in presence of peroxide, the product is

(a) 1-chloro propane
(b) 1, 1-dichloro propane
(c) 2-chloro propane
(d) 1, 2-dichloro propane

98. Which hydride among the following is strongest reducing agent?

(a) AsH_3
(b) BiH_3
(c) PH_3
(d) SbH_3

99. Which of the following is NOT an antiseptic compound?

(a) Boric acid
(b) Iodoform
(c) Hydrogen peroxide
(d) Potassium sulphite

100. β-pleated sheets of polypeptide chains are present in

(a) Secondary structure
(b) Primary structure
(c) Tertiary structure
(d) Quaternary structure

SECTION-B

MATHEMATICS

1. If $P(x_1, y_1)$ is a point on the hyperbola $x^2 - y^2 = a^2$, then SP.S'P = ...

(a) $\frac{x_1^2 - y_1^2}{a^2}$ (b) $\frac{x_1^2 + y_1^2}{a^2}$
(c) $x_1^2 - y_1^2$ (d) $x_1^2 + y_1^2$

2. If $f(x) = \cos^{-1}\left[\frac{1-(\log x)^2}{1+(\log x)^2}\right]$, then $f'(e) =$ ....

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

3. The order of the differential equation of all circles whose radius is 4, is ....

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

4. If $A = \begin{bmatrix} x & 1 \\ 1 & 0 \end{bmatrix}$ and $A = A^{-1}$, then $x =$ ....

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

5. Which of the following function is not continuous at $x = 0$?

(a) $f(x)\begin{cases} f(x) = (1+2x)^{1/x}, & x \neq 0 \\ = e^2, & x = 0 \end{cases}$

(b) $f(x)\begin{cases} = \sin x - \cos x, & x \neq 0 \\ = -1, & x = 0 \end{cases}$

(c) $f(x)\begin{cases} = \frac{e^{1/x} - 1}{e^{1/x} + 1}, & x \neq 0 \\ = -1, & x = 0 \end{cases}$

(d) $f(x)\begin{cases} = \frac{e^{5x} - e^{2x}}{\sin 3x}, & x \neq 0 \\ = 1, & x = 0 \end{cases}$

6. It is observed that 25% of the cases related to child labour reported to the police station are solved. If 6 new cases are reported, then the probability that atleast 5 of them will be solved is ....

(a) $\left(\frac{1}{4}\right)^6$ (b) $\frac{19}{1024}$

(c) $\frac{19}{2048}$ (d) $\frac{19}{4096}$

7. For a G.P., if $S_n = \frac{4^n - 3^n}{3^n}$, then $t_2 =$ ....

(a) $\frac{1}{9}$ (b) $\frac{2}{9}$

(c) $\frac{7}{9}$ (d) $\frac{4}{9}$

8. The area of the region bounded by the curve $y = 2x - x^2$ and the line $y = x$ is .... square units

(a) $\frac{1}{6}$ (b) $\frac{1}{2}$

(c) $\frac{1}{3}$ (d) $\frac{7}{6}$

9. The general solution of $x\frac{dy}{dx} = y - x\tan\left(\frac{y}{x}\right)$ is ....

(a) $x^2 \sin\left(\frac{x}{y}\right) = c$ (b) $x \sin\left(\frac{x}{y}\right) = c$

(c) $x \sin\left(\frac{y}{x}\right) = c$ (d) $x^2 \sin\left(\frac{y}{x}\right) = c$

10. The statement pattern

$(p \wedge q) \wedge [\sim r \vee (p \wedge q)] \vee (\sim p \wedge q)$

is equivalent to ....

(a) r (b) q

(c) $p \wedge q$ (d) p

11. A bag contains 6 white and 4 black balls. Two balls are drawn at random. The probability that they are of the same colour is ....

(a) $\frac{5}{7}$ (b) $\frac{1}{7}$

(c) $\frac{7}{15}$ (d) $\frac{1}{15}$

12. $\int \frac{\cos x + x\sin x}{x^2 + x\cos x} dx =$ ....

(a) $\log\left|\frac{x\sin x}{x + \cos x}\right| + c$

(b) $\log\left|\frac{x}{x + \cos x}\right| + c$

(c) $\log|\cos x + x\sin x| + c$

(d) $\log|x^2 + x\cos x| + c$

13. A stone is dropped into a pond. Waves in the form of circles are generated and radius of outermost ripple increases at the rate of 5 cm/sec. The area increased after 2 seconds is ....

(a) 100π cm^2/sec (b) 40 cm^2/sec

(c) 50 cm^2/sec (d) 25 cm^2/sec

14. If $f(x) = 3x - 2$ and $g(x) = x^2$, then $fog(x) =$ ....

(a) $3x^2 - 2$ (b) $3x^2 + 2$

(c) $3x - 2$ (d) $2 - 3x^2$

15. Which of the following is NOT equivalent to $p \to q$.

(a) p only if q

(b) q is necessary for p

(c) q only if p

(d) p is sufficient for q

16. The value of $\int_{-3}^{3}(ax^5 + bx^3 + cx + k)dx$, where a, b, c, k are constants, depends only on ....

(a) a, b and c (b) k

(c) a and b (d) a and k

17. The general solution of the differential equation of all circles having centre at A(–1, 2) is ....

(a) $x^2 + y^2 + x - 2y + c = 0$

(b) $x^2 + y^2 - 2x + 4y + c = 0$

(c) $x^2 + y^2 - x + 2y + c = 0$

(d) $x^2 + y^2 + 2x - 4y + c = 0$

18. If A is non-singular matrix such that (A–2I) (A–4I) = 0 then $A + 8A^{-1} =$ ....

(a) I (b) 0

(c) 3 I (d) 6 I

19. If G(3, –5, r) is centroid of triangle ABC where A(7, –8, 1), B(p, q, 5) and C(q + 1, 5p, 0) are vertices of a triangle then values of p, q, r are respectively ....

(a) 6, 5, 4 (b) –4, 5, 4
(c) –3, 4, 3 (d) –2, 3, 2

20. $\int \frac{1}{(x^2+1)^2}dx =$ ....

(a) $\tan^{-1} x - \frac{1}{2x(x^2+1)} + c$

(b) $\frac{1}{2}\tan^{-1} x + \frac{x}{2(x^2+1)} + c$

(c) $\tan^{-1} x + \frac{x}{x^2+1} + c$

(d) $\tan^{-1} x + \frac{1}{2(x^2+1)} + c$

21. If $\theta = \frac{17\pi}{3}$ then $\tan\theta - \cot\theta =$ ....

(a) $\frac{1}{2\sqrt{3}}$ (b) $\frac{-1}{2\sqrt{3}}$

(c) $\frac{2}{\sqrt{3}}$ (d) $-\frac{2}{\sqrt{3}}$

22. Derivative of $\log_e^2(\log x)$ with respect to x is ....

(a) $\frac{2}{x\log x}$ (b) $\frac{1}{x\log x}$

(c) $\frac{1}{x\log x^2}$ (d) $\frac{2}{\log x}$

23. In Δ ABC; with usual notations, if $\cos A = \frac{\sin B}{\sin C}$, then the triangle is ....

(a) Acute angled triangle
(b) Equilateral triangle
(c) Obtuse angled triangle
(d) Right angled triangle

24. For a G.P, if $(m+n)^{th}$ term is p and $(m-n)^{th}$ term is q, then m^{th} term is ....

(a) pq (b) $\sqrt{pq}$

(c) $\frac{p}{q}$ (d) $\frac{q}{p}$

25. A random variable X has following probability distribution

X = x	1	2	3	4	5	6
P(X = x)	K	3K	5K	7K	8K	K

Then $P(2 \le x < 5) =$ ....

(a) $\frac{3}{5}$ (b) $\frac{7}{25}$

(c) $\frac{23}{25}$ (d) $\frac{24}{25}$

26. The equation of normal to the curve $y = \log_e x$ at the point P(1, 0) is ....

(a) $2x + y = 2$ (b) $x - 2y = 1$
(c) $x - y = 1$ (d) $x + y = 1$

27. The values of x in $\left(0, \frac{\pi}{2}\right)$ satisfying the equation $\sin x \cos x = \frac{1}{4}$ are ....

(a) $\frac{\pi}{6}, \frac{\pi}{12}$ (b) $\frac{\pi}{12}, \frac{5\pi}{12}$

(c) $\frac{\pi}{8}, \frac{3\pi}{8}$ (d) $\frac{\pi}{8}, \frac{\pi}{4}$

28. If $\vec{a} + \vec{b}, \vec{b} + \vec{c}$ and $\vec{c} + \vec{a}$ are coterminous edges of a parallelopiped then its volume is ....

(a) $3[\vec{a}\ \vec{c}\ \vec{b}]$ (b) 0

(c) $2[\vec{a}\ \vec{b}\ \vec{c}]$ (d) $4[\vec{b}\ \vec{a}\ \vec{c}]$

29. If the c.d.f. (cumulative distribution function) is given by $F(x) = \frac{x-25}{10}$, then $P(27 \le x \le 33) =$ ......

(a) $\frac{3}{5}$ (b) $\frac{3}{10}$

(c) $\frac{1}{5}$ (d) $\frac{1}{10}$

30. The joint equation of pair of straight lines passing through origin and having slopes $(1+\sqrt{2})$ and $\left(\frac{1}{1+\sqrt{2}}\right)$ is ....

(a) $x^2 - 2\sqrt{2}xy + y^2 = 0$

(b) $x^2 - 2\sqrt{2}xy - y^2 = 0$

(c) $x^2 + 2xy - y^2 = 0$

(d) $x^2 + 2xy + y^2 = 0$

31. The angle between lines $\frac{x-2}{2} = \frac{y-3}{-2} = \frac{z-5}{1}$ and $\frac{x-2}{1} = \frac{y-3}{2} = \frac{z-5}{2}$ is ....

(a) 30° (b) 60°
(c) 45° (d) 90°

32. If the line passes through the points P(6, –1, 2), Q(8, –7, 2λ) and R(5, 2, 4) then value of λ is ....

(a) –3 (b) 0
(c) –1 (d) 2

33. The equivalent form of the statement $\sim(p \to \sim q)$ is ....

(a) $p \wedge q$ (b) $p \wedge \sim q$
(c) $p \vee \sim q$ (d) $\sim p \vee q$

34. If $A = \{x \in R : x^2 - 5|x| + 6 = 0\}$, then $n(A) =$ ....

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

35. If the function $f(x) = \frac{\log(1+ax) - \log(1-bx)}{x}$, $x \neq 0$ is continuous at $x = 0$ then, $f(0) =$ ......

(a) $\log a - \log b$ (b) $a + b$
(c) $\log a + \log b$ (d) $a - b$

36. The coordinates of the foot of perpendicular drawn from origin to the plane $2x - y + 5z - 3 = 0$ are ....

(a) $\left(\frac{2}{\sqrt{30}}, \frac{-1}{\sqrt{30}}, \frac{5}{\sqrt{30}}\right)$ (b) (2, –1, 5)

(c) $\left(\frac{2}{3}, \frac{-1}{3}, \frac{5}{3}\right)$ (d) $\left(\frac{1}{5}, \frac{-1}{10}, \frac{1}{2}\right)$

37. $\int \frac{\sqrt{x^2 - a^2}}{x} dx =$ ....

(a) $\sqrt{x^2 - a^2} - a\cos^{-1}\left(\frac{a}{x}\right) + c$

(b) $x\sqrt{x^2 - a^2} - \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right) + c$

(c) $\sqrt{x^2 - a^2} + a\sec^{-1}\left(\frac{x}{a}\right) + c$

(d) $\sqrt{x^2 - a^2} + \frac{1}{x}\sec^{-1}(x) + c$

38. The maximum value of $z = 9x + 11y$ subject to $3x + 2y \leq 12, 2x + 3y \leq 12, x \geq 0, y \geq 0$ is ....

(a) 44 (b) 54
(c) 36 (d) 48

39. $\int_0^4 \frac{1}{1+\sqrt{x}} dx =$ ....

(a) $\log\left(\frac{e^4}{6}\right)$ (b) $\log\left(\frac{e^4}{3}\right)$

(c) $\log\left(\frac{e^4}{9}\right)$ (d) $\log\left(\frac{e^3}{4}\right)$

40. The number of solutions of $\sin^2\theta = \frac{1}{2}$ in$[0, \pi]$ is ....

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

41. If $\vec{p}$, $\vec{q}$ and $\vec{r}$ are nonzero, noncoplanar vectors then $[\vec{p}+\vec{q}-\vec{r} \;\; \vec{p}-\vec{q} \;\; \vec{q}-\vec{r}] =$ ....

(a) $3[\vec{p}\;\vec{q}\;\vec{r}]$ (b) 0

(c) $[\vec{p}\;\vec{q}\;\vec{r}]$ (d) $2[\vec{p}\;\vec{q}\;\vec{r}]$

42. Which of the following equation has no solution?

(a) $\sec\theta = 23$ (b) $\cos\theta = \sqrt{2}$

(c) $\tan\theta = 2019$ (d) $\sin\theta = -\frac{1}{5}$

43. The minimum value of $z = 10x + 25y$ subject to $0 \leq x \leq 3, 0 \leq y \leq 3, x + y \geq 5$ is ....

(a) 80 (b) 95
(c) 105 (d) 30

44. If $f(x) = 3x^3 - 9x^2 - 27x + 15$, then the maximum value of $f(x)$ is ....

(a) –66 (b) 30

(c) –30 (d) 66

45. The equationof the plane passing through the point (–1, 2, 1) and perpendicular to the line joining the points (–3, 1, 2) and (2, 3, 4) is ....

(a) $\bar{r}.(5\hat{i} + 2\hat{j} + 2\hat{k}) = 1$

(b) $\bar{r}.(5\hat{i} + 2\hat{j} + 2\hat{k}) = -1$

(c) $\bar{r}.(5\hat{i} - 2\hat{j} + 2\hat{k}) = -5$

(d) $\bar{r}.(5\hat{i} - 2\hat{j} - 2\hat{k}) = 1$

46. If the lengths of the transverse axis and the latus rectum of a hyperbola are 6 and $\frac{8}{3}$ respectively, then the equation of the hyperbola is ....

(a) $4x^2 - 9y^2 = 72$ (b) $4x^2 - 9y^2 = 36$

(c) $9x^2 - 4y^2 = 72$ (d) $9x^2 - 4y^2 = 36$

47. The value of

$\tan^{-1}\frac{1}{3} + \tan^{-1}\frac{1}{5} + \tan^{-1}\frac{1}{7} + \tan^{-1}\frac{1}{8}$ is ....

(a) $\frac{11\pi}{5}$ (b) $\frac{\pi}{4}$

(c) π (d) $\frac{3\pi}{4}$

48. The joint equation of the lines passing through the origin and trisecting the first quadrant is ....

(a) $\sqrt{3}x^2 - 4xy + \sqrt{3}y^2 = 0$

(b) $x^2 + \sqrt{3}xy - y^2 = 0$

(c) $3x^2 - y^2 = 0$

(d) $x^2 - \sqrt{3}xy - y^2 = 0$

49. If P(2, 2), Q(–2, 4) and R(3, 4) are the vertices of ΔPQR then the eqution of the median through vertex R is ....

(a) $x + 3y + 9 = 0$ (b) $x - 3y + 9 = 0$

(c) $x - 3y - 9 = 0$ (d) $x + 3y - 9 = 0$

50. If $x = \sqrt{a^{\sin^{-1} t}}$, $y = \sqrt{a^{\cos^{-1} t}}$, then $\frac{dy}{dx} = ...$

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

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

ANSWER KEYS & SOLUTIONS

(MHT-CET 2019)

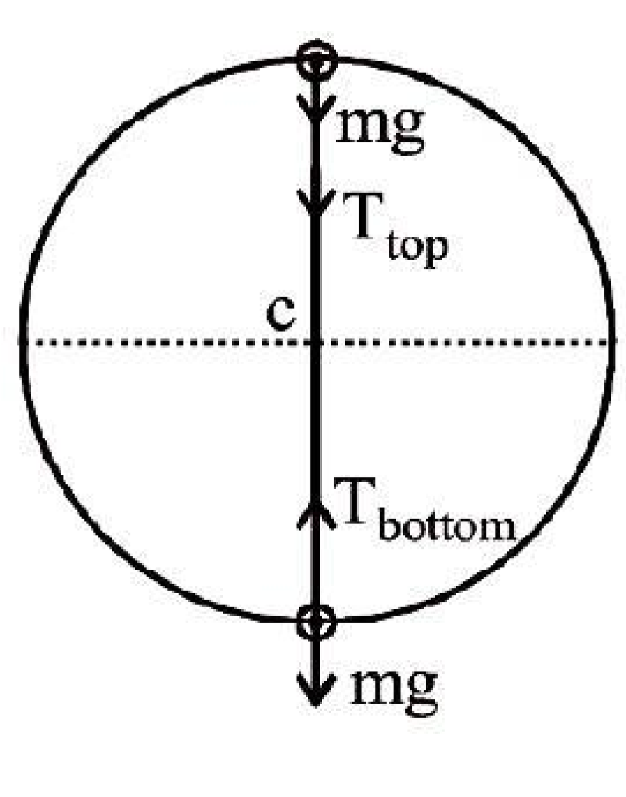
Answer KEYS

SECTION-A																			
PHYSICS																			
1	(b)	**6**	(a)	**11**	(b)	**16**	(c)	**21**	(b)	**26**	(c)	**31**	(d)	**36**	(b)	**41**	(None)	**46**	(c)
2	(a)	**7**	(b)	**12**	(c)	**17**	(d)	**22**	(c)	**27**	(a)	**32**	(None)	**37**	(d)	**42**	(b)	**47**	(a)
3	(c)	**8**	(d)	**13**	(c)	**18**	(b)	**23**	(a)	**28**	(a)	**33**	(c)	**38**	(d)	**43**	(c)	**48**	(b)
4	(d)	**9**	(c)	**14**	(c)	**19**	(c)	**24**	(d)	**29**	(d)	**34**	(a)	**39**	(b)	**44**	(b)	**49**	(b)
5	(a)	**10**	(c)	**15**	(d)	**20**	(c)	**25**	(d)	**30**	(d)	**35**	(a)	**40**	(b)	**45**	(c)	**50**	(b)
CHEMISTRY																			
51	(d)	**56**	(c)	**61**	(c)	**66**	(d)	**71**	(b)	**76**	(a)	**81**	(c)	**86**	(b)	**91**	(b)	**96**	(c)
52	(d)	**57**	(b)	**62**	(b)	**67**	(d)	**72**	(d)	**77**	(d)	**82**	(b)	**87**	(c)	**92**	(b)	**97**	(c)
53	(a)	**58**	(d)	**63**	(c)	**68**	(d)	**73**	(c)	**78**	(a)	**83**	(d)	**88**	(a)	**93**	(a)	**98**	(b)
54	(a)	**59**	(a)	**64**	(a)	**69**	(a)	**74**	(b)	**79**	(c)	**84**	(c)	**89**	(a)	**94**	(d)	**99**	(d)
55	(c)	**60**	(b)	**65**	(b)	**70**	(a)	**75**	(b)	**80**	(b)	**85**	(d)	**90**	(b)	**95**	(c)	**100**	(a)
SECTION-B																			
MATHEMATICS																			
1	(d)	**6**	(d)	**11**	(c)	**16**	(b)	**21**	(d)	**26**	(d)	**31**	(d)	**36**	(d)	**41**	(c)	**46**	(b)
2	(*)	**7**	(d)	**12**	(b)	**17**	(d)	**22**	(c)	**27**	(b)	**32**	(c)	**37**	(a)	**42**	(b)	**47**	(b)
3	(b)	**8**	(a)	**13**	(a)	**18**	(d)	**23**	(d)	**28**	(c)	**33**	(a)	**38**	(d)	**43**	(a)	**48**	(a)
4	(a)	**9**	(c)	**14**	(a)	**19**	(d)	**24**	(b)	**29**	(a)	**34**	(d)	**39**	(c)	**44**	(b)	**49**	(b)
5	(c)	**10**	(b)	**15**	(c)	**20**	(b)	**25**	(a)	**30**	(a)	**35**	(b)	**40**	(c)	**45**	(a)	**50**	(a)

SECTION-A

PHYSICS

1. **(b)** $T_{top} = \frac{mv^2}{r} - mg$ ...(i)



$T_{bottom} = \frac{mv^2}{r} + mg$ ...(ii)

Solving (i) and (ii) we get :

$$\frac{T_{top}}{T_{bottom}} = \frac{v^2 - rg}{v^2 + rg} = \frac{79}{81}$$

2. **(a)** $\varepsilon = -M\frac{di}{dt} = -M\frac{d}{dt}(5\sin 200\pi t)$

$= -M \times 5 \times 200\pi \cos(200\pi t)$

$|\varepsilon|_{max} = 10\pi$ volt

3. **(c)**

4. **(d)** $v = n\lambda$ [for open pipe in fundamental mode $\lambda = 2l$, where l is the length of the pipe]

So, $v = n_1(2l_1) = n_2(2l_2) = n_3\,2(l_1 + l_2)$

$$\Rightarrow \frac{1}{n_3} = \frac{1}{n_1} + \frac{1}{n_2} \quad \Rightarrow n_3 = \frac{n_1 n_2}{n_1 + n_2}$$

5. **(a)** $C_p - C_v = R$ ...(i)

$$\frac{C_p}{C_v} = \gamma \qquad \text{...(ii)}$$

Solving (i) and (ii)

We get : $C_p = \dfrac{R\gamma}{\gamma - 1}$

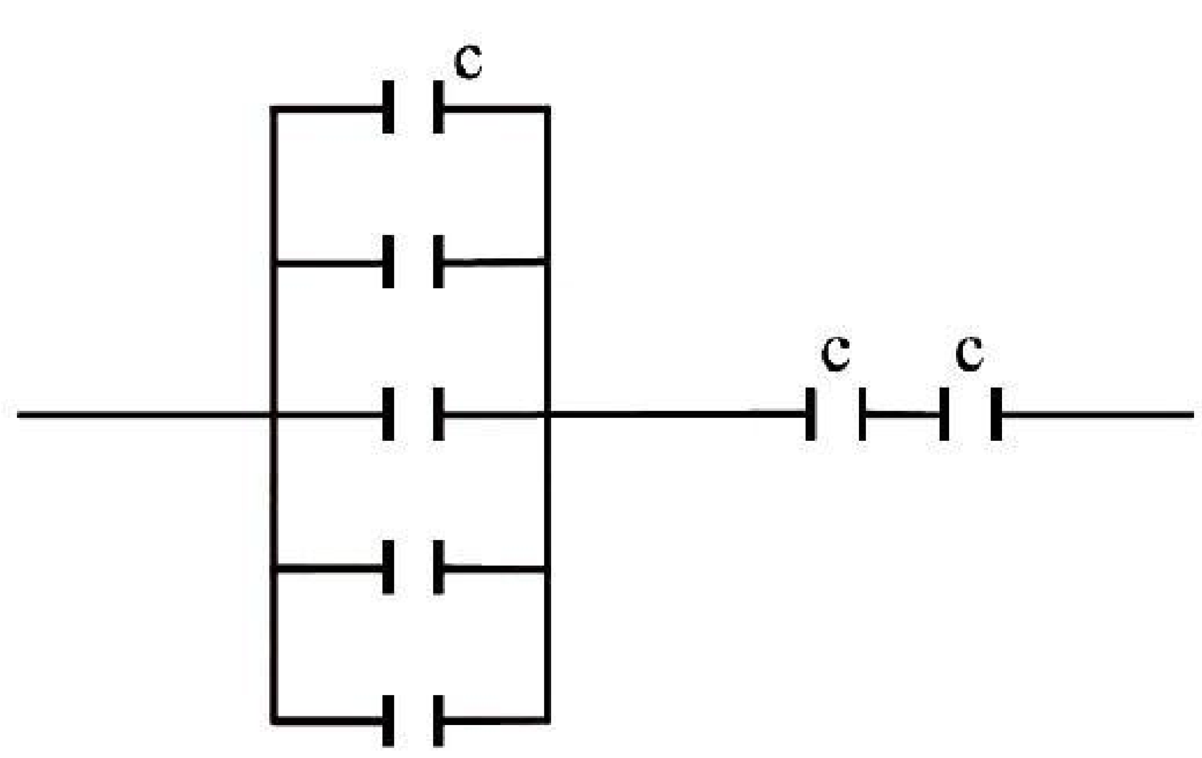
6. **(a)** $z = \sqrt{R^2 + \left(\omega L - \dfrac{1}{\omega c}\right)^2}$

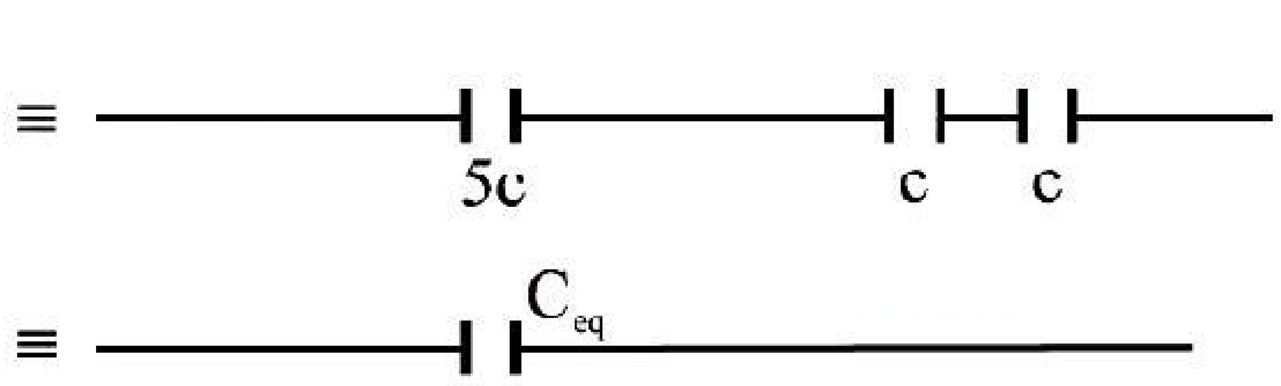
Putting $R = 300\ \Omega$, $L = 0.9H$, $C = 2 \times 10^{-6}F$ and $\omega = 1000$ rad/s

We get : $z = 500\ \Omega$

7. **(b)**

8. **(d)**





$$= C_{eq} = \frac{1}{\left(\frac{1}{5c} + \frac{1}{c} + \frac{1}{c}\right)} = \frac{5c}{1+5+5}$$

$$= \frac{5c}{11} = \frac{5 \times 2\,\mu F}{11} = \frac{10}{11}\mu F$$

9. **(c)** $q\,v\,B = \dfrac{mv^2}{r}$ ...(i)

$$m\,v\,r = \frac{nh}{2\pi} \qquad \text{...(ii)}$$

$$K.E. = \frac{1}{2}mv^2 \qquad \text{...(iii)}$$

Solving (i), (ii) and (iii) we get:

$$K.E. = \frac{1}{2}rqvB$$

$$= \frac{1}{2} \times qB \times \frac{nh}{2\pi m} = \frac{nhqB}{4\pi m}$$

10. **(c)**

11. **(b)** $Y \alpha \dfrac{1}{\Delta l}$

12. **(c)**

13. **(c)** $i = \dfrac{3v - 1v}{100\Omega} = \dfrac{2}{100}\ A = 20mA$

14. **(c)** Particle velocity

$$v_1 = \frac{dY}{dt} = a\,2\pi b \cos 2\pi(bt - cx)$$

So, $V_1 max = a \times 2\pi \times b = 2\pi ab$

wave velocity $v_2 = \dfrac{\omega}{K} = \dfrac{2\pi b}{2\pi c} = \dfrac{b}{c}$

Now, $\dfrac{v_1 max}{v_2} = \dfrac{2\pi ab}{b/c} \quad \Rightarrow \quad 2 = 2\pi ac$

$$\Rightarrow \quad c = \frac{1}{\pi a}$$

15. **(d)** For fundamental mode

let time period be T, then

So, $t = \frac{T}{4}$

$\Rightarrow \quad T = 4t$

$\Rightarrow \quad \frac{1}{T} = (4t)^{-1}$

$\Rightarrow \quad \upsilon = (4t)^{-1}$

16. **(c)** R_{big} single drop $= 2^{\frac{1}{3}}\ r_{small\ drop}$

$U = T \times A$

So, $\frac{U_{initially}}{U_{finally}} = \frac{2 \times T \times 4\pi r^2}{T \times 4\pi R^2}$

$= \frac{2r^2}{\left(2^{1/3} r\right)^2} = 2^{\left(1 - \frac{2}{3}\right)} = 2^{1/3} : 1$

17. **(d)** $I = \frac{2}{5} mr^2$

$\Rightarrow \quad I \propto r^2 \quad \Rightarrow \quad I_1 : I_2$

$= r_1^2 : (2r_1)^2 = 1 : 4 \qquad [\text{as } r_2 = 2r_1]$

18. **(b)** $R = \frac{V}{I}$ and for conductor R increases with increase in temperature.

19. **(c)** $r^2 = r_1^2 + r_2^2$

$r = \sqrt{3^2 + 4^2}$

$= 5$ cm

20. **(c)** Parallel currents in the same direction attract each other.

21. **(b)**

22. **(c)** as $y = 0.05 \sin(x + 15t)$

so, $v = \frac{\omega}{K} = \frac{15}{1}$

Now $v = \sqrt{\frac{F}{\mu}}$

$\Rightarrow F = v^2 \mu = (15)^2 \times (10^{-3}) = 0.225$ N

[Here F = tension force and $\mu = 10^{-3}$ kg/m]

23. **(a)** $\frac{mv^2}{r} = \frac{GmM}{r^2}$

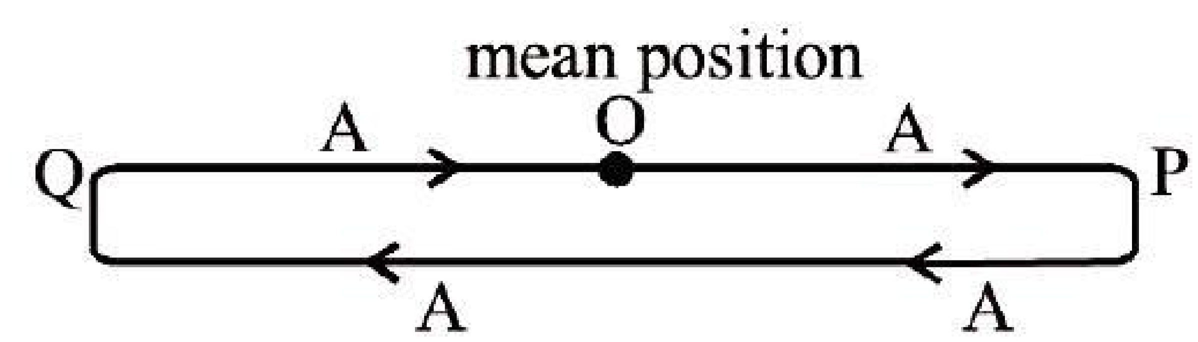
$\Rightarrow v^2 = \frac{GM}{r} \quad \Rightarrow v = \sqrt{\frac{GM}{r}}$

Now, Kinetic energy $= \frac{1}{2} mv^2$

$\frac{1}{2} m \frac{GM}{r} = \frac{1}{2} \frac{mGM}{(3R + R)} = \frac{1}{8} mgR$

$\left[\text{As} \quad g = \frac{GM}{R^2}\right]$

24. **(d)**



in one time period total distance travelled $= A + A + A + A = 4A$

[as in each quarter starting from mean position it travelles A distance as shown]

25. **(d)** $i(Rg + R) = 50$

$iRg + iR = 50$

$\Rightarrow \quad R = \frac{50}{10 \times 10^{-3}} - 100 = 4900\,\Omega$

26. **(c)**

27. **(a)** Given circuit forms wheat stone bridge :

so, $i_1 (5 + 1)\,\Omega = i_2 (50 + 10)\,\Omega$

$\Rightarrow \quad i_1 = 10 i_2 \qquad$ ...(i)

also $\quad i_1 + i_2 = 1.1$ A $\qquad$ ...(ii)

Solving (i) and (ii) we get i_1 = IA which passes through 1Ω resistor

28. **(a)** $\frac{1}{\lambda} = K\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$\Rightarrow \quad \frac{1}{\lambda_1} = K\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$

[for first line of Balmer series $n_1 = 2$ and $n_2 = 3$]

also $\frac{1}{\lambda_2} = K\left(\frac{1}{2^2} - \frac{1}{4^2}\right)$

[for second line in Balmer series $n_1 = 2$ and $n_2 = 4$]

so, $\frac{\lambda_2}{\lambda_1} = \frac{20}{27} \Rightarrow \lambda_2 = \frac{20}{27}\lambda_1 = \frac{20}{27}\lambda$

29. **(d)** Work done in streatching a wire

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

$= \frac{1}{2} \times Y \times (\Delta l)^2 \times \frac{\pi r^2}{l}$

so, $\frac{w_2}{w_1} = \left(\frac{r_2}{r_1}\right)^2 \times \left(\frac{l_1}{l_2}\right)$

$\Rightarrow w_2 = 8w_1 = 16J$

30. **(d)**

31. **(d)** Resolving power $\propto$, d

Resolving power of a telescope is proportional to the diameter.

32. **(None)**

33. **(c)**

34. **(a)** $I = \frac{3MR^2}{2} = \frac{3}{8\pi^2}.Q.L^3$

35. **(a)** Torque = Force × distance

Moment of force = Force × distance

So, Moment of force and torque have same dimension.

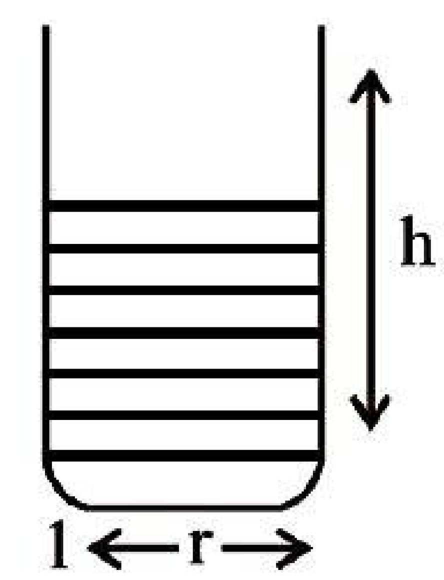
36. **(b)** $\beta_{dc} = \frac{I_C}{I_B}$

$= \frac{\text{Collector current}}{\text{Base current}}$

37. **(d)** $\Delta T = \frac{1}{2}T\alpha\theta$

$= \frac{1}{2} \times 9 \times 10^{-7} \times 10 \times 0.5$

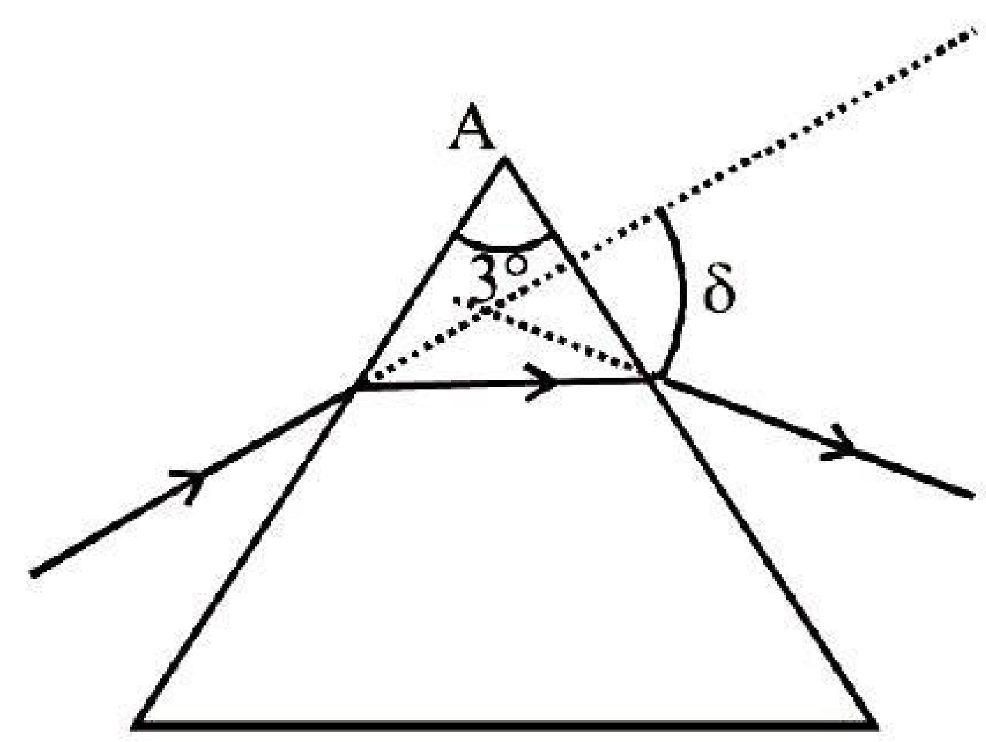
38. **(d)**



Height in the capillary

$h = \frac{2s\cos\theta}{\rho gr} \quad \therefore \quad h \propto \frac{1}{r}$

39. **(b)**



Angular deviation $\delta = (\mu - 1)A$

$\therefore 1 = (\mu - 1)3$

$\therefore \mu = 1 + \frac{1}{3}$

$= 1.33$

40. **(b)** Using conservation of energy

Total mechanical energy at surface = total mechanical energy at height h

Using this, we have

$\frac{1}{R} - \frac{1}{r} = \frac{1}{4R}$

$\therefore \frac{1}{r} = \frac{1}{R} - \frac{1}{4R}$

$= \frac{1}{R}.\frac{3}{4}$

$\therefore r = 4/3R$

$\therefore h = R/3$

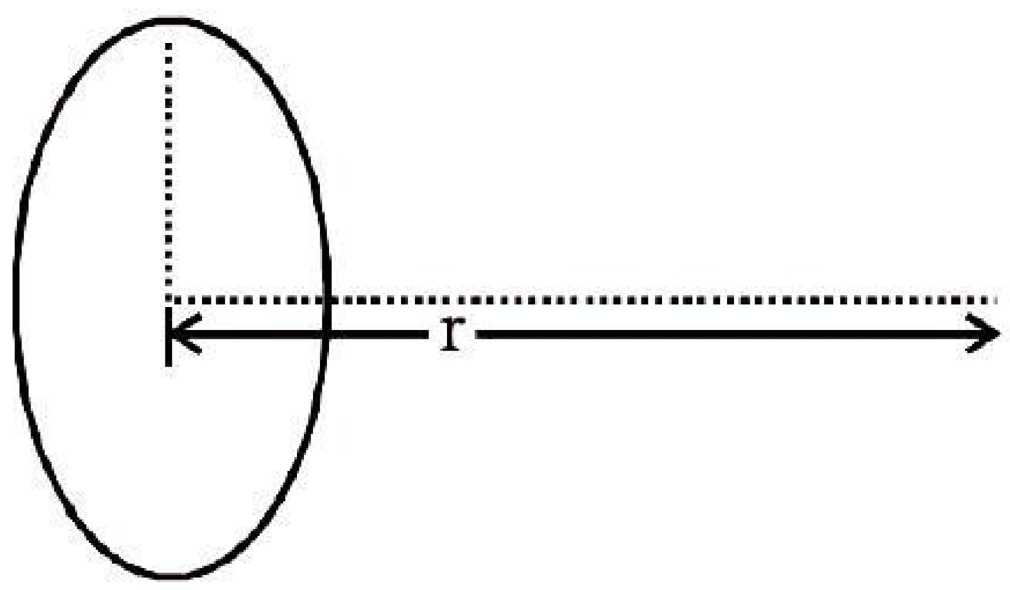
41. **(None)**

42. **(b)** $K_{max} = h\upsilon - \varphi$

$\therefore K_2 = 2h\upsilon - Wn = k + h\upsilon$

43. **(c)** From Doppler's effect. We know that frequency increases.

44. **(b)**



$$B_{axis} = \frac{\mu_0}{4\pi}\frac{2}{r^3}NIA$$

45. **(c)** Terminal velocity $v \propto \rho_s - \rho_l$

$$\therefore \frac{v_2}{v_1} = \frac{e_2 - \sigma}{e_1 - \sigma}$$

$$\therefore v_2 = \left[\frac{e_2 - \sigma}{e_1 - \sigma}\right] v$$

46. **(c)** $\alpha = \frac{Q_2}{Q_1 - Q_2}$

$$\therefore \frac{1}{\alpha} = \frac{Q_1 - Q_2}{Q_2}$$

$$= \frac{Q_1}{Q_2} - 1$$

$$\therefore \frac{Q_1}{Q_2} = 1 + \frac{1}{\alpha}$$

$$= \frac{\alpha + 1}{\alpha}$$

$$\therefore Q_2 = \frac{\alpha}{\alpha + 1}.Q_1$$

47. **(a)** $F = m\omega^2 r$

$$= mr\frac{4\pi^2}{T^2}$$

$$\therefore \sqrt{F} = \sqrt{mr}.\frac{2\pi}{T}$$

48. **(b)**

49. **(b)** $K_{max} = \frac{hc}{\lambda} - \varphi$

$$\therefore Vs = \frac{1}{2}\frac{mv^2}{e} = \frac{v^2}{2\frac{e}{m}}$$

50. **(b)** Focal length of new lens = 2 × focal length of convex lens.

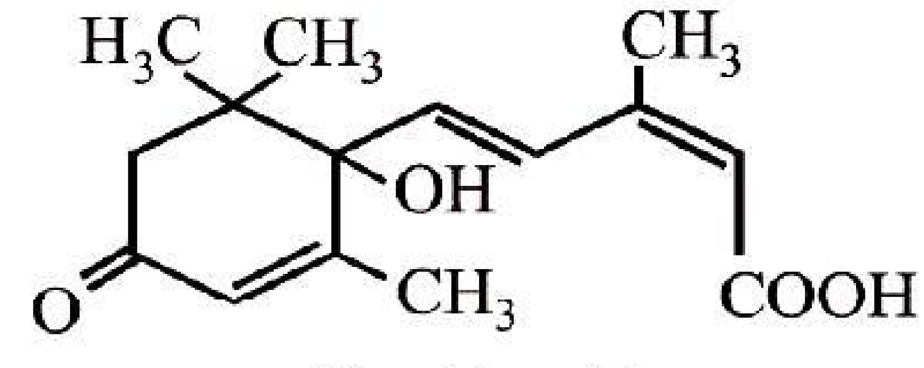
CHEMISTRY

51. **(d)** Wolframite is magnetic in nature whereas stannic oxide is non-magnetic in nature. Hence they can be separated by magnetic seperation method.

52. **(d)** $\overset{+7}{Mn}O_4^- + Br^- \longrightarrow \overset{+4}{Mn}O_2 + \overset{+5}{Br}O_3^-$

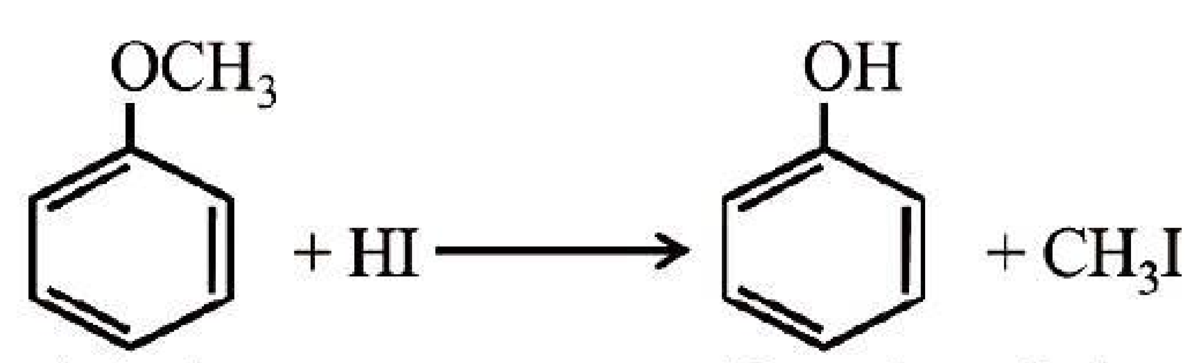
Hence (d) is correct option.

53. **(a)** Abscisic acid (molecular formula ($C_{15}H_{20}O_4$) composed of three isoprene residues and having a cyclohexene ring with keto and one hydroxyl group and a side chain with terminal carboxylic group in its structure.



Abscisic acid

54. **(a)**



Anisole Phenol Iodomethane

55. (c) The decaffeination process includes soaking green coffee in hot water and then some of solvent or activated carbon is used to extract the caffeine. The solvent typically used are methylene dichloride or ethyl acetate.

56. (c) $[Co(NH_3)_5NO_2]SO_4 + BaCl_2 \rightarrow [Co(NH_3)_5NO_2]Cl_2 + \underset{\text{(White ppt)}}{BaSO_4}$

The precipitate of barium sulphate is white in colour.

57. (b) When concentrated HCl is added to a very diluted solution of $CuSO_4$, the pale blue solution slowly turns greenish yellow on the formation of copper chloride complex.

$$\underset{\text{(Pale blue)}}{[Cu(H_2O)_6]^{2+}} + 4Cl^- \longrightarrow \underset{\text{(Yellow)}}{[CuCl_4]^{2-}} + 6H_2O$$

58. (d) Novolac polymer is used in paints.

59. (a) Given, n = 3 moles, $v_1 = 0.3L$, $v_2 = 2.5L$, $P_{ext} = 1.9$ atm

Workdone in isothermal process, $w = -P_{ex}dv$

$\therefore w = -1.9 \times (2.5 - 0.3)$

$w = -4.18L$ atm

$w = -4.18L\text{ atm} \times 101.325\ JL^{-1}\ atm^{-1}$

$= -423.54J$

60. (b) *cis*-platin is used in the treatment of cancer.

61. (c) NaCl and KCl have same atomic ratio, similar molecular formula and similar chemical properties but different crystal structure. Thus NaCl and KCl are not isomorphous.

62. (b) 2, 4-dichlorophenoxy acetic acid is the active ingredient in many products as an herbicide to kill weeds on land and in the water.

63. (c) $CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$

$\Delta H = \Delta U + \Delta n_g RT$

$\Delta H - \Delta U = \Delta n_g RT$

$\Delta n_g = 1 - 1 + \frac{1}{2} = -\frac{1}{2}$

$\therefore \Delta H - \Delta U = -\frac{1}{2} \times 2 \times 300$

$= -300cal$

64. (a) Conductivity decreases with decrease in concentration as the number of ions per unit volume that carries the current in a solution decreases on dilution.

65. (b)

$$\underset{\text{Acetaldoxime}}{CH_3 - CH = N - OH} \xrightarrow[\text{alcohol}]{\text{Na}} \underset{\text{(A)}}{CH_3CH_2NH_2}$$

$$\xrightarrow[\text{HCl}]{NaNO_2} \underset{\text{(B)}}{CH_3CH_2OH} + H_2O + N_2$$

66. (d) Frenkel defect is found in AgCl because there is a large difference between the size of Ag^+ and Cl^-. Hence the cation Ag^+ occupy the interstitial site by leaving a corresponding number of normal lattice site vacant.

67. (d) 0.1 molar $\approx$ 0.1 mol is present in 1L

Given volume = 200 mL $\approx$ 0.2L

No. of mole in 0.2 L liquid

$= \frac{2}{1} \times 0.1$

$= 0.02$ mol of CO_2

$V = 0.02 \times 22.4 = 0.448L$

68. (d) The given reaction is an example of Wurtz reaction which is used in preparation of alkanes.

69. (a) Bacteriostatic antibiotics limit the growth of bacteria by interfering with bacterial protein production, DNA replication or other aspects of bacterial cellular metabolism. This group includes tetracyclines.

70. (a) Alkyl halides react with silver nitrite in ethanolic solution to give nitro compounds.

$R - X + AgNO_2 \longrightarrow RNO_2 + AgI$

71. (b) Bond length order for the given options is,

$C - H > C - C > C - N \approx C - O$

72. **(d)** Ethyl alcohol and water, after mixing, can very easily become a homogeneous mixture, because the two liquids are miscible, soluble in all proportions. The dipoles on the ethanol and water molecules cause the formation of hydrogen bonds between the molecules.

73. **(c)** Nicol's prism is a type of polarizer, an optical device made from calcite crystal. Calcite is a carbonate mineral and the most stable polymorph of calcium carbonate.

74. **(b)** Applying Faraday's second law of electrolysis

$$\frac{\text{wt. of Cu}}{\text{wt. of Al}} = \frac{E_W \text{ of Cu}}{E_W \text{ of Al}}$$

$$E_W \text{ of Cu} = \frac{\text{Atomic wt}}{\text{n factor}} = \frac{63.5}{2}$$

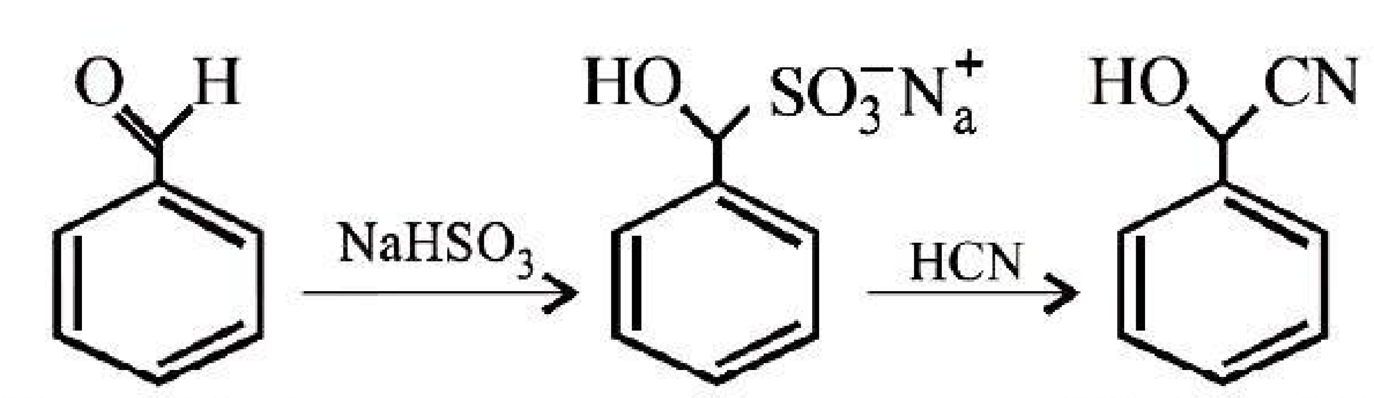
$$E_W \text{ of Al} = \frac{27}{3}$$

$$\therefore \frac{0.4 \times 63.5}{\text{wt of Al}} = \frac{31.75}{9}$$

wt of Al = 7.2 g

$$\text{wt of Al in moles} = \frac{7.2}{27} = 0.27 \text{ mol}$$

75. **(b)**



Benzaldehyde Mandelonitrile

76. **(a)** $K_2CrO_4 \longrightarrow 2K^+ + CrO_4^{2-}$

$K_2Cr_2O_7 \longrightarrow 2K^+ + Cr_2O_7^{2-}$

Both ions contain – 2 charge.

77. **(d)**

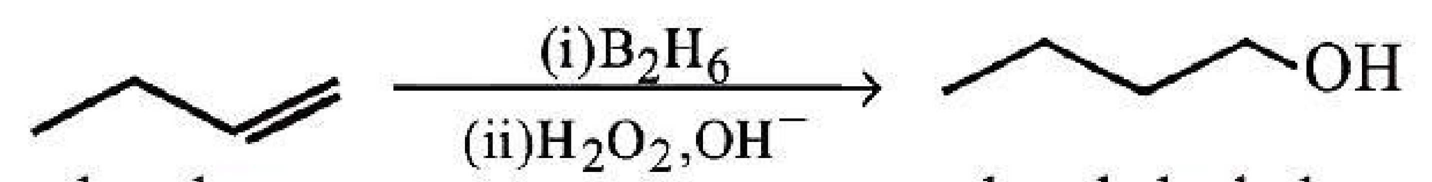
$$C_6H_5COCH_3 \xrightarrow[\text{Zn-Hg/conc. HCl}]{[H]} C_6H_5CH_2CH_3$$

Acetophenone Clemmensen reduction Ethylbenzene

78. **(a)** Molar mass of urea ($NH_2CO\,NH_2$)
$= 28 + 4 + 12 + 16 = 60$ g/mol.
60g urea contains 12g C.

$$\therefore \text{ 100g urea contains } \frac{12}{60} \times 100 = 20\% \text{ C}$$

79. **(c)**



α-butylene n-butyl alcohol

80. **(b)** $T_f = i.K_f m$

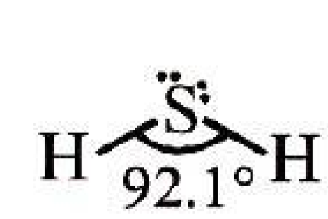
Given, $T_f = T_f^\circ - T_f$
$= 0 - (-0.680)$
$= +0.680°C$
$m = 0.2$
$K_f = 1.86$

Thus, $0.680 = i \times 0.2 \times 1.86$

$$i = \frac{0.680}{0.2 \times 1.86} = 1.83$$

81. **(c)** $NaCl, NH_3, Ca(OH)_2$
$Ca(OH)_2$ is used for the regeneration of ammonia
$2NH_4Cl(aq) + Ca(OH)_2\,(aq/s) \rightarrow CaCl_2(aq) + 2NH_3(g) + 2H_2O(l)$

82. **(b)**



83. **(d)** mol dm^{-3} atm^{-1}

84. **(c)** Nitric oxide (pollutant) act as an homogeneous catalyst in the conversion of oxygen to ozone, since at very high concentration in air it converts into NO_2 which generate free oxygen atom.

85. **(d)** Bi does not exhibit allotropy.

86. **(b)** Nitrogen sesquioxide is N_2O_3.

87. **(c)** $$\frac{-1}{2}\frac{d[SO_2]}{dt}=\frac{-d[O_2]}{dt}=\frac{1}{2}\frac{d[SO_3]}{dt}$$

$$\therefore \quad \frac{d[SO_3]}{dt}=\frac{-2d[O_2]}{dt}$$

88. **(a)** $\Delta s=\frac{q_{rev}}{T}$

89. **(a)** Terylene is a synthetic polymer which is formed by the interaction of ethylene glycol and terephthalic acid.

90. **(b)** Copper

91. **(b)** The decomposition of ammonia on platinum surface is a zero order reaction.

92. **(b)** Resistance (R) = 2.5×10^3 ohm

$$\text{Conductivity }(\kappa)=\frac{\text{Cell constant}}{\text{Resistance}}$$

$$\text{Conductivity }(\kappa)=\frac{1.25\text{cm}^{-1}}{2.5\times10^3\text{ohm}}$$

$$=5\times10^{-4}\text{ohm}^{-1}\text{cm}^{-1}$$

$$\text{Molar conductivity }(\Lambda_m)=\frac{\kappa}{C}\times1000$$

$$\Lambda_m=\frac{5\times10^{-4}\text{ohm}^{-1}\text{cm}^{-1}}{0.1\text{ mol cm}^{-3}}\times1000$$

$$\Lambda_m=5\text{ ohm}^{-1}\text{ cm}^2\text{ mol}^{-1}$$

93. **(a)** $Ba(NO_3)_2 \longrightarrow Ba^{2+}+2NO_3^-$

n mol	0	0
n-nα	nα	2nα

Total moles of particles

$$=n-n\alpha+n\alpha+2n\alpha=n(1+2\alpha)$$

$$\text{Vant Haff factor }(i)=\frac{n(1+2\alpha)}{n}$$

$$2.74-\frac{n(1+2\alpha)}{n}-1+2\alpha$$

$$\alpha=\frac{2.74-1}{2}=0.87$$

94. **(d)** Ionic hydrides of S-block elements, in molten state, liberate dihydrogen gas at anode on electrolysis.

$$2H^-(\text{melt})\xrightarrow{\text{anode}}H_2(g)+2e^-$$

95. **(c)** Phosphine is formed by heating white phosphorous with conc. NaOH solution.

96. **(c)** $CH_3-CH_2-CH(CH_3)-CH(CH_3)-CH_2I$

1-Iodo-2, 3-dimethylpentane

97. **(c)**

$$CH_3-CH=CH_2+HCl\xrightarrow{\text{Peroxide}}CH_3-\underset{}{CH(Cl)}-CH_3$$

Propene 2-Chloropropane

98. **(b)** As we move down the group, M-H bond dissociation enthalpy of hydrides decreases. Therefore, reducing property of metal hydrides increases in the order as follows,

$PH_3 < AsH_3 < SbH_3 < BiH_3$

99. **(d)** Potassium sulphite is not an antiseptic.

100. **(a)** Secondary structure of protein refers to the shape in which a long polypeptide chain can exist. They are found to exist in two different types of structures viz. α-helix and β-pleated sheet structure.

SECTION-B

MATHEMATICS

1. **(d)** $\because$ P(x_1, y_1) lie on $x^2 - y^2 = a^2$.

then; $x_1^2 - y_1^2 = a^2$

$\Rightarrow x_1^2 - a^2 = y_1^2$ ... (i)

$\because x^2 - y^2 = a^2$ is an equation of rectangular hyperbola.

$\therefore e = \sqrt{2}$

$SP = ex_1 - a = \sqrt{2}x_1 - a$

$S'P = ex_1 + a = \sqrt{2}\,x_1 - a$

$\therefore$ SP. S'P $= e^2x_1^2 - a^2 = 2x_1^2 - a^2$

$= x_1^2 + x_1^2 - a^2 = x_1^2 + y_1^2$ (from (i))

2. **(*)** $f(x) = \cos^{-1}\left[\dfrac{1-(\log x)^2}{1+(\log x)^2}\right]$

Let $1 + (\log x)^2 = u$

$\Rightarrow 1 - (\log x)^2 = 2 - u$

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

$$\Rightarrow f'(u) = \left(\frac{\left(\frac{2}{u^2}\right)}{\sqrt{1-\left(\frac{2}{u}-1\right)^2}}\right) = \frac{1}{u\sqrt{u-1}}$$

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

$$= \frac{1}{\log x\left(1+(\log x)^2\right)}$$

$$\Rightarrow f'(e) = \frac{1}{\log e(1+(\log e)^2)} = \frac{1}{2}$$

3. **(b)** Equation of family of circles whose radius is 4 is :

$(x-a)^2 + (y-b)^2 = 16$ ... (i)

(where a & b are arbitrary constant)

Differentiating we get:

$2(x-a) + 2(y-b)y_1$ ... (ii)

$\left(y_1 = \dfrac{dy}{dx}\right)$

Again differentiating we get :

$1 + y_1 \cdot y_1 + (y-b)y_2 = 0$ $\left(y_2 = \dfrac{d^2y}{dx^2}\right)$

$\Rightarrow 1 + y_1^2 + (y-b)y_2 = 0$

$\Rightarrow (y-b)y_2 = -\left(1+y_1^2\right)$

$$\Rightarrow y - b = -\frac{\left(1+y_1^2\right)}{y_2} \quad \text{... (iii)}$$

from (ii) we get:

$x - a = -(y-b)y_1$

$\therefore$ from (i), we get:

$(y-b)^2y_1^2 + (y-b)^2 = 16$

$\Rightarrow (y-b)^2 - (1+y_1^2) = 16$

$$\Rightarrow \left(\frac{(1+y_1^2)^2}{y_2^2}\right)\left(1+y_1^2\right) = 16 \quad \text{(from (iii))}$$

$\Rightarrow (1+y_1^2)^3 = 16y_2^2$

$$\Rightarrow \left[1+\left(\frac{dy}{dx}\right)^2\right]^3 = 16\left[\frac{d^2y}{dx^2}\right]^2$$

$\therefore$ Order = 2 & degree = 2

4. **(a)** $A = \begin{bmatrix} x & 1 \\ 1 & 0 \end{bmatrix}$

$|A| = 0 - 1 = -1$

$\therefore A^{-1} = -1\begin{bmatrix} 0 & -1 \\ -1 & x \end{bmatrix}$

$\because = A = A^{-1} \Rightarrow x = 0$

5. **(c)**

(a) $\lim\limits_{n\to 0} f(x) = \lim\limits_{n\to 0}(1+2x)^{1/x} = e^2$

$\& f(0) = e^2$

$\therefore$ Continuous at $x = 0$

(b) $\lim\limits_{n\to 0} f(x) = \lim\limits_{n\to 0}(\sin x - \cos x) = 0 - 1 = -1$

$\& f(0) = -1$

$\therefore$ Continuous at $x = 0$

(c) $\lim\limits_{n\to 0} f(x) = \lim\limits_{n\to 0} \dfrac{e^{1/x} - 1}{e^{1/x} + 1}$

$$= \lim_{n\to 0} \frac{e^{1/x}\left[1 - \frac{1}{e^{1/x}}\right]}{e^{1/x}\left[1 + \frac{1}{e^{1/x}}\right]}$$

$= \dfrac{(1-0)}{(1+0)} = 1 \;\& f(0) = -1$

$\therefore$ not continuous at $x = 0$

(d) $\lim\limits_{n\to 0} f(x) = \lim\limits_{n\to 0} \dfrac{e^{5x} - e^{2x}}{\sin 3x}$ $\quad \left(\dfrac{0}{0}\right)$

is using L' Hospital's rule :

$= \lim\limits_{n\to 0} \dfrac{5e^{5x} - 2e^{2x}}{3\cos x} = \dfrac{5(1) - 2(1)}{3} = \dfrac{3}{3} = 1$

$\therefore \& f(0) = 1$

$\therefore$ Continuous at $x = 0$

6. **(d)**

7. **(d)** $S_n = \dfrac{4^n - 3^n}{3^n}$ $\qquad S_1 = \dfrac{4-3}{3} = \dfrac{1}{3}$

$S_2 = \dfrac{4^2 - 3^2}{3^2} = \dfrac{16-9}{9} = \dfrac{7}{9}$

$\therefore t_2 = S_2 - S_1 = \dfrac{7}{9} - \dfrac{1}{3} = \dfrac{7-3}{9} = \dfrac{4}{9}$

8. **(a)** Given curves are $y = 2x - x^2$

$\& y = x$

From the above equations we get,

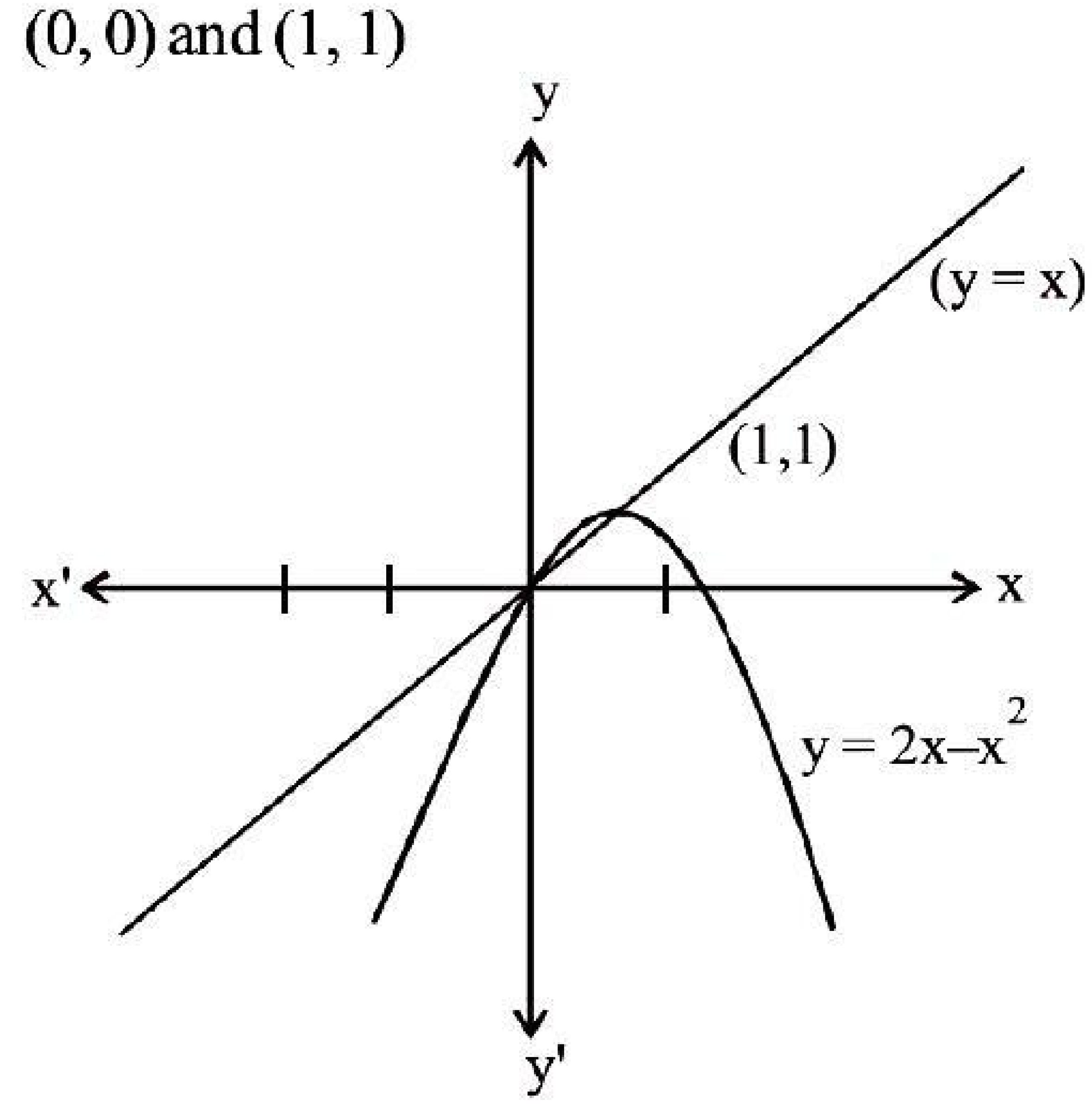
$x = 2x - x^2$

$\Rightarrow x^2 - x = 0$

$\Rightarrow x(x-1) = 0 \Rightarrow x = 0, 1$

$\Rightarrow y = 0, 1$ (respectively)

$\therefore$ intersecting points of the two curves are (0, 0) and (1, 1)



$\therefore$ required area $= \int\limits_0^1 (2x - x^2)dx - \int\limits_0^1 x \cdot dx$

$= \left[\dfrac{2x^2}{2} - \dfrac{x^3}{3}\right]_0^1 - \left[\dfrac{x^2}{2}\right]_0^1$

$= \left[1 - \dfrac{1}{3}\right] - \left[\dfrac{1}{2}\right]$

$= \dfrac{2}{3} - \dfrac{1}{2} = \dfrac{1}{6}$ sq. units.

9. **(c)** Given : $x\frac{dy}{dx} = y - x\tan\left(\frac{y}{x}\right)$

$$\Rightarrow \frac{dy}{dx} = \frac{y}{x} - \tan\left(\frac{y}{x}\right) \quad \text{... (i)}$$

Put $\frac{y}{x} = v \Rightarrow y = xv = \frac{dy}{dx} = v + x\frac{dv}{dx}.$

$$\Rightarrow x\frac{dv}{dx} + v = v - \tan v \quad \text{[from (i)]}$$

$$\Rightarrow x\frac{dv}{dx} = -\tan v$$

$$\Rightarrow \frac{dv}{\tan v} - -\frac{dx}{x}$$

$$\Rightarrow \cot v\, dv = -\frac{dx}{x}$$

Integrating we get :

ln (sin$v$) = –ln (xc)

$$\Rightarrow \ln(\sin v) = \ln\left(\frac{c_1}{x}\right).$$

$$\Rightarrow \sin v = \frac{c_1}{x} \Rightarrow x\sin v = \frac{y}{x} = c_1.$$

10. **(b)**

p	q	r	~r	~p	p ∧ q	~p ∧ q	~r ∨ (p ∧ q)	(p ∧ q) ∧ [~ r ∨ (p ∧ q)]	(p ∧ q) ∧ [~ r ∨ (p ∧ q)] ∨ (~ p ∧ q)
T	T	T	F	F	T	F	T	T	T
T	T	F	T	F	T	F	T	T	T
T	F	T	F	F	F	F	F	F	F
T	F	F	T	F	F	F	T	F	F
F	T	T	F	T	F	T	F	F	T
F	T	F	T	T	F	T	T	F	T
F	F	T	F	T	F	F	F	F	F
F	F	F	T	T	F	F	T	F	F

∴ (p ∧ q) ∧ [~ r ∨ (p ∧ q)] ∨ (~ p ∧ q) ≡ q

11. **(c)** Total number of balls = 10.

No. of ways of drawing 2 balls out of 10 = $^{10}C_2 = 45$

No. of ways of drawing 2 white balls out of 6 $= {}^6C_2 = 15.$

No. of ways of drawing 2 balck balls out of 4 $= {}^4C_2 = 6.$

∴ required probability $= \frac{15+6}{45} = \frac{21}{45} = \frac{7}{15}.$

12. **(b)** Let $I = \int \frac{\cos x + x\sin x}{x^2 + x\cos x}dx$

$$= \int \frac{(x+\cos x) - x(1-\sin x)}{x(x+\cos)}dx.$$

$$= \int\left[\frac{1}{x} - \frac{(1-\sin x)}{(x+\cos x)}\right]dx.$$

Put $f(x) = x + \cos x \Rightarrow f'(x) = 1 - \sin x.$

$$\Rightarrow I = \int\left[\frac{1}{x} - \frac{f'(x)}{f(x)}\right]dx.$$

$= \log|x| - \log|f(x)| + c$

$= \log\left|\dfrac{x}{x+\cos x}\right| + c.$

13. **(a)** Radius increases at the rate of 5 cm/sec.

$\therefore$ radius after 2 seconds = 10 cm.

Now, Area $(A) = \pi r^2$ $\quad (r = \text{radius})$

$\Rightarrow \dfrac{dA}{dt} = 2\pi r.\dfrac{dr}{dt}.$

$\therefore$ after 2 seconds.

$\dfrac{dA}{dt} = 2\pi(10)(5) = 100\pi \text{cm}^2/\text{sec}.$

14. **(a)** $f(x) = 3x - 2$ and $g(x) = x^2$.

$\Rightarrow f[g(x)] = 3(x^2) - 2 = 3x^2 - 2.$

15. **(c)** "q only if p " is not equivalent " $p \to q$".

16. **(b)** $\displaystyle\int_{-3}^{3} (ax^5 + bx^3 + cx + k)dx$

$= \left[\dfrac{ax^6}{6} + \dfrac{bx^4}{4} + \dfrac{cx^2}{2} + kx\right]_{-3}^{3}$

$= \left[\dfrac{a(3)^6}{6} + \dfrac{b(3)^4}{4} + \dfrac{c(3)^2}{2} + k(3)\right]$

$- \left[\dfrac{a(-3)^6}{6} + \dfrac{b(-3)^4}{4} + \dfrac{c(-3)^2}{2} + k(-3)\right]$

$= \dfrac{3^6 a}{6} + \dfrac{3^4 b}{4} + \dfrac{a}{2}c + 3k$

$- \dfrac{3^6 a}{6} - \dfrac{3^4 b}{4} - \dfrac{a}{2}c + 3k$

$= 6k.$

$\therefore$ given integral depends only on k.

17. **(d)** Equation of all circles having centre at $(-1, 2)$ is :

$(x-(-1))^2 + (y-2)^2 = r^2$ $\quad (r = \text{radius}).$

$\Rightarrow (x+1)^2 + (y-2)^2 = r^2$

$\Rightarrow x^2 + 1 + 2x + y^2 + 4 - 4y = r^2.$

$\Rightarrow x^2 + y^2 + 2x - 4y + 5 - r^2 = 0.$

$\Rightarrow x^2 + y^2 + 2x - 4y + c = 0,$

where $(c = 5 - r^2)$.

Above equation is the required solution.

18. **(d)** $\because (A - 2I)(A - 4I) = 0$

$\Rightarrow A^2 - 4A - 2A + 8I = 0$

$\Rightarrow A^2 - 6A + 8I = 0$

Multiply A^{-1} both sides we get :

$A^{-1}.A.A - 6A^{-1}.A + 8A^{-1}.I = A^{-1}.0$

$\Rightarrow IA - 6I + 8A^{-1} = 0$

$\Rightarrow A - 6I + 8A^{-1} = 0$

$\Rightarrow A + 8A^{-1} = 6I.$

19. **(d)** Here; $\dfrac{7+p+q+1}{3} = 3 \Rightarrow p + q = 1$ ...(i)

$\dfrac{-8+q+5p}{3} = -5 \Rightarrow 5p + q = -7$ ....(ii)

and $\dfrac{1+5+0}{3} = r \Rightarrow r = 2$

Subtract (ii) form (i), we get:

$p + q - 5p - q = 1 + 7$

$\Rightarrow -4p = 8 \Rightarrow p = -2.$

from (1) we get,

$-2 + q = 1 \Rightarrow \text{q} = 3.$

$\therefore p = -2, q = 3 \;\&\; r = 2.$

20. **(b)** let $I = \displaystyle\int \dfrac{1}{(x^2+1)^2}dx$

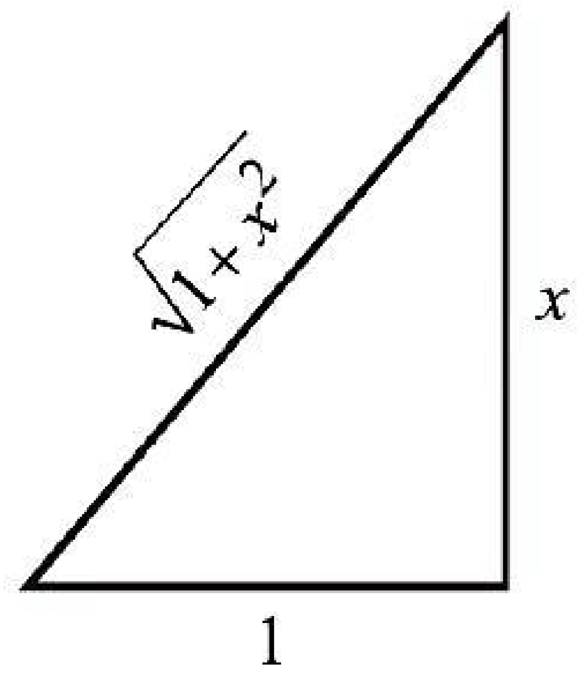
Put $x = \tan\theta \Rightarrow dx = \sec^2\theta \, d\theta$.

$\Rightarrow I = \displaystyle\int \dfrac{\sec^2\theta \, d\theta}{(\tan^2\theta + 1)^2} = \int \dfrac{\sec^2\theta}{\sec^4\theta}d\theta$

$\Rightarrow I = \displaystyle\int \cos^2\theta \, d\theta = \dfrac{1}{2}\int(\cos 2\theta + 1)d\theta$

$\Rightarrow I = \dfrac{1}{4}\sin 2\theta + \dfrac{\theta}{2} + c.$ ...(1)

$\because \tan\theta = x$



$\Rightarrow \sin\theta = \dfrac{x}{\sqrt{1+x^2}}$ & $\cos\theta = \dfrac{1}{\sqrt{1+x^2}}$.

$\Rightarrow \sin 2\theta = 2\sin\theta\cos\theta = \dfrac{2x}{(1+x^2)}$.

$\therefore\ I = \dfrac{1}{2}.\dfrac{x}{(1+x^2)} + \dfrac{1}{2}\tan^{-1}x + c.$

21. (d) $\because\ \theta = \dfrac{17\pi}{3} = 6\pi - \dfrac{\pi}{3}$.

$\therefore \tan\theta - \cot\theta = \tan\left(6\pi - \dfrac{\pi}{3}\right) - \cot\left(6\pi - \dfrac{\pi}{3}\right)$

$= -\tan\dfrac{\pi}{3} + \cot\dfrac{\pi}{3}$.

$= -\sqrt{3} + \dfrac{1}{\sqrt{3}} = \dfrac{-3+1}{\sqrt{3}} = \dfrac{-2}{\sqrt{3}}$

22. (c) Let $y = \log_{e^2}(\log x)$

$= \dfrac{\log(\log x)}{\log e^2} = \dfrac{\log(\log x)}{2}$.

$\Rightarrow \dfrac{dy}{dx} = \dfrac{1}{2}.\dfrac{1}{\log x}\dfrac{d}{dx}(\log x)$

$= \dfrac{1}{2\log x}.\dfrac{1}{x} = \dfrac{1}{2x\log x} = \dfrac{1}{x\log x^2}$

23. (d) $\because\ \cos A - \dfrac{\sin B}{\sin C}$

$\Rightarrow \cos A \sin C = \sin B.$

$\Rightarrow \cos A \sin C = \sin(\pi - (A + C))$

$(\because A + B + C = \pi).$

$\Rightarrow \cos A \sin C = \sin(A + C)$

$\Rightarrow \cos A \sin C = \sin A \cos C + \cos A \sin C$

$\Rightarrow \sin A \cos C = 0$

$\Rightarrow$ Either $\sin A = 0$ or $\cos C = 0$.

For $\sin A = 0$, $A = 0°$ (not possible)

For $\cos C = 0$, $C = 90°$

$\therefore\ \Delta ABC$ is right angled triangle.

24. (b) Let a is the first term & r is the common ratio.

$\therefore\ p = ar^{m+n-1}$ & $q = ar^{m-n-1}$

$\Rightarrow pq = a^2r^{m+n-1}r^{m-n-1}$

$\Rightarrow pq = a^2r^{2m-2} = (ar^{m-1})^2$

$\Rightarrow \sqrt{pq} = ar^{m-1} = m^{\text{th}}$ term.

25. (a)

$X = x$	1	2	3	4	5	6
$P(X = x)$	k	$3k$	$5k$	$7k$	$8k$	k

$\because \sum_{x=1}^{6} P(X) = 1$

$\Rightarrow k + 3k + 5k + 7k + 8k + k = 1 \Rightarrow k = \dfrac{1}{25}$

$\therefore\ P(2 \le x < 5) = P(2) + P(3) + P(4)$

$= 3k + 5k + 7k = 15 \times \dfrac{1}{25} = \dfrac{3}{5}$.

26. (d) $\because\ y = \log_e x \Rightarrow \dfrac{dy}{dx} = \dfrac{1}{x}$.

$\Rightarrow \left.\dfrac{dy}{dx}\right)_{(1,0)} = 1.$

$\therefore$ equation of normal is :

$(y - 0) = -1\,(x - 1)$

$\Rightarrow y = -x + 1 \Rightarrow x + y = 1.$

27. **(b)** $\because$ $\sin x\cos x=\frac{1}{4}\Rightarrow 2\sin x\cos x=\frac{1}{2}$

$\Rightarrow \sin 2x=\frac{1}{2}$ Þ $\quad 2x=n\pi+(-1)^n\frac{\pi}{6},\ n\in I.$

For $n=0,\ x=\frac{\pi}{12}.$

For $n=1,\ x=\frac{5\pi}{12}.$

$\therefore$ x has only 2 values is $\left(0,\frac{\pi}{2}\right).$

28. **(c)** $\because$ $\vec{a}+\vec{b},\vec{b}+\vec{c}$ and $\vec{c}+\vec{a}$ are coterminous edges of a parallelopiped.

Then, its volume $(v)=\left[\vec{a}+\vec{b}\quad \vec{b}+\vec{c}\quad \vec{c}+\vec{a}\right]$

We know, scalar triple product

$[\vec{a}\,\vec{b}\,\vec{c}]=\vec{a}.(\vec{b}\times\vec{c})\equiv(\vec{a}\times\vec{b}).\vec{c}$

Consider $[\vec{a}+\vec{b}\quad \vec{b}+\vec{c}\quad \vec{c}+\vec{a}]$

$=(\vec{a}+\vec{b})\,.\,\{(\vec{b}+\vec{c})\times(\vec{c}+\vec{a})\}$

$=(\vec{a}+\vec{b}).\{(\vec{b}\times\vec{c})+(\vec{b}\times\vec{a})+(\vec{c}\times\vec{c})+(\vec{c}\times\vec{a})\}$

$=(\vec{a}+\vec{b})\,.\,\{(\vec{b}\times\vec{c})+(\vec{b}\times\vec{a})+(\vec{c}\times\vec{a})\}$ $\quad(\because\vec{c}\times\vec{c}=0)$

$=\vec{a}\,.\,(\vec{b}\times\vec{c})+\vec{a}\,.(\vec{b}\times\vec{a})+\vec{a}\,.(\vec{c}\times\vec{a})+\vec{b}\,.(\vec{b}\times\vec{c})+\vec{b}\,.(\vec{b}\times\vec{a})+\vec{b}\,.(\vec{c}\times\vec{a})$

$=[\vec{a}\,\vec{b}\,\vec{c}]+[\vec{a}\,\vec{b}\,\vec{a}]+[\vec{a}\,\vec{c}\,\vec{a}]+[\vec{b}\,\vec{b}\,\vec{c}]+[\vec{b}\,\vec{b}\,\vec{a}]+[\vec{b}\,\vec{c}\,\vec{a}]$

$=[\vec{a}\,\vec{b}\,\vec{c}]+[\vec{b}\ \vec{c}\ \vec{a}]=2\,[\vec{a}\ \vec{b}\ \vec{c}]$

29. **(a)**

30. **(a)** Equations of lines are :

$(x-0)=(1+\sqrt{2})(y-0)$ & $(x-0)$

$=\left(\frac{1}{1+\sqrt{2}}\right)(y-0)$

or $x=y(1+\sqrt{2})$ & $x=\frac{y}{1+\sqrt{2}}\times\frac{1-\sqrt{2}}{1-\sqrt{2}}$

or $x-y(1+\sqrt{2})=0$ & $x+y\,(1-\sqrt{2})=0$

$\therefore$ joint equation is :

$\left[x-y(1+\sqrt{2})\right]\left[x+y(1-\sqrt{2})\right]=0$

$\Rightarrow x^2+xy(1-\sqrt{2})-xy(1+\sqrt{2})-y^2(1-(\sqrt{2})^2)=0$

$\Rightarrow x^2+xy-xy\sqrt{2}-xy-xy\sqrt{2}-y^2(-1)=0$

$\Rightarrow x^2-2\sqrt{2}xy+y^2=0$.

31. **(d)** Angle beween the lines :

$\frac{x-x_1}{a_1}=\frac{y-y_1}{b_1}=\frac{z-z_1}{c_1}$

and $\frac{x-x_2}{a_2}=\frac{y-y_2}{b_2}=\frac{z-z_2}{c_2}$.

is :

$$\cos\theta=\left|\frac{a_1a_2+b_1b_2+c_1c_2}{\sqrt{a_1^2+b_1^2+c_1^2}\sqrt{a_2^2+b_2^2+c_2^2}}\right|$$

$\therefore$ angle between two given lines is :

$$\cos q=\left|\frac{(2)(1)+(-2)(2)+(1)(2)}{\sqrt{4+4+1}\sqrt{1+4+4}}\right|$$

$$=\left|\frac{2-4+2}{9}\right|$$

$\Rightarrow\cos\theta=0\Rightarrow\theta=90°.$

32. (c) Here the given three points P (6, –1, 2), Q(8, –7, 2λ) and R (5, 2, 4) are collinear.

we know that if three points (x_1, y_1, z_1), (x_2, y_2, z_2) and (x_3, y_3, z_3) are collinear, then

$$\frac{x_1-x_2}{x_2-x_3}=\frac{y_1-y_2}{y_2-y_3}=\frac{z_1-z_2}{z_2-z_3}.$$

$$\therefore \frac{6-8}{8-5}=\frac{-1+7}{-7-2}=\frac{2-2\lambda}{2\lambda-4}$$

$$\Rightarrow \frac{-2}{3}=\frac{2-2\lambda}{2\lambda-4}\Rightarrow -4\lambda+8=6-6\lambda$$

$$\Rightarrow 2\lambda=-2 \Rightarrow \lambda=-1.$$

33. (a) $\sim(p\to\sim q)=p\wedge\sim(\sim q)=p\wedge q$

34. (d) $x^2-5|x|+6=0.$

If $x<0$, then $|x|=-x$

$\therefore x^2+5x+6=0$

$\Rightarrow x^2+3x+2x+6=0$

$\Rightarrow x(x+3)+2(x+3)=0$

$\Rightarrow (x+3)(x+2)=0$

$\Rightarrow x=-3, -2.$

If $x>0$, then $|x|=x$

$\therefore x^2-5x+6=0$

$\Rightarrow x^2-3x-2x+6=0$

$\Rightarrow x(x-3)-2(x-3)=0$

$\Rightarrow (x-2)(x-3)=0$

$\Rightarrow x=2, 3.$

$\therefore n(A)=4.$

35. (b)

$$\lim_{x\to 0} f(x)=\lim_{x\to 0}\frac{\log(1+ax)-\log(1-bx)}{x}\left(\frac{0}{0}\right)$$

$$=\lim_{x\to 0}\frac{\frac{a}{1+ax}+\frac{b}{1-bx}}{1} \text{ (Using L' Hospital's Rule)}$$

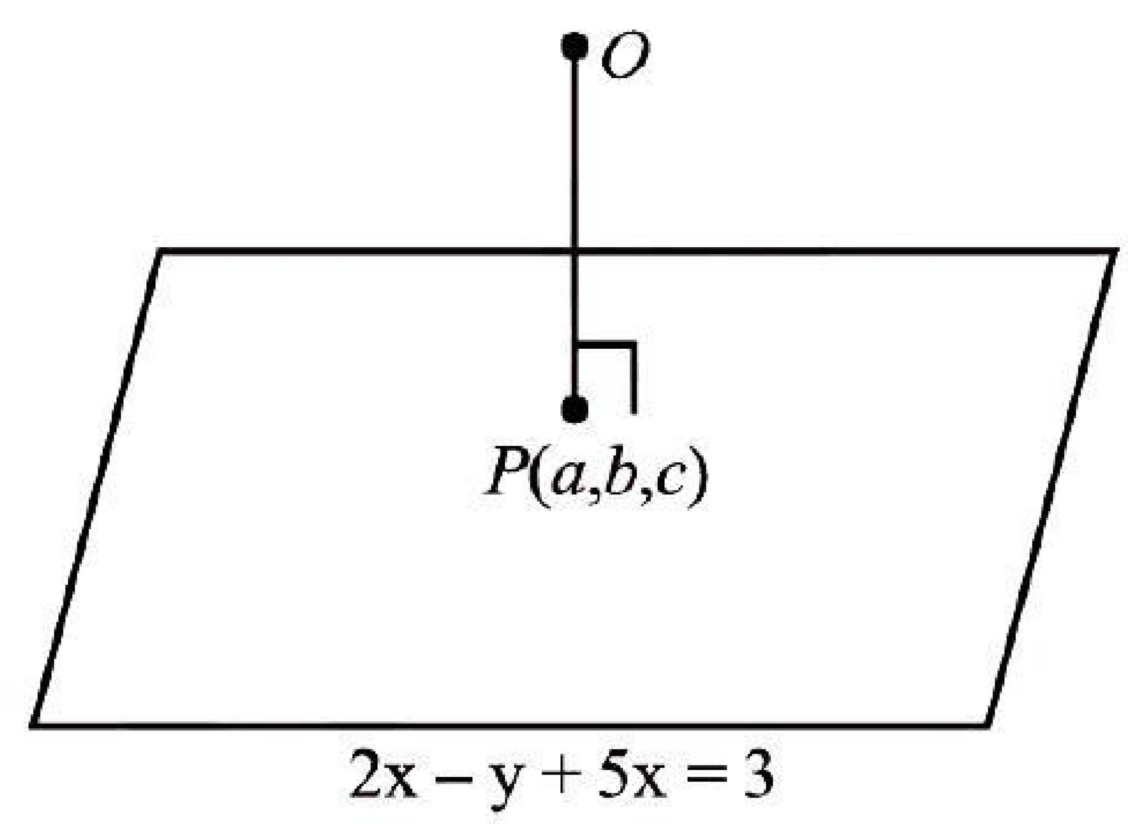
$$=\frac{a}{1+0}+\frac{b}{1-0}=a+b.$$

$\because$ $f(x)$ is continuous at $x=0$.

$$\therefore f(0)=\lim_{x\to 0} f(x)=a+b.$$

36. (d) let the co-ordinates of foot of perpendicular from the orgin (0) to the plane $2x-y+5x=3$ is $P(a, b, c)$.

$\therefore$ direction ratios of OP are $<a, b, c>$ which is also the direction ratios of normal to the given plane.



$$\therefore \frac{a}{2}=\frac{b}{-1}=\frac{c}{5}=k.$$

$\Rightarrow a=2k, b=-k, c=5k.$

$\because P(a, b, c)$ passes the given plane

$\therefore 2(2k)-(-k)+5(5k)=3$

$\Rightarrow 4k+k+25k=3$

$$\Rightarrow k=\frac{3}{30}=\frac{1}{10}.$$

$$\therefore a=\frac{2}{10}=\frac{1}{5};\ b=-\frac{1}{10} \text{ and } c=\frac{5}{10}=\frac{1}{2}.$$

37. (a) Let $I=\int\frac{\sqrt{x^2-a^2}}{x}dx$

Put $x=a\sec\theta \Rightarrow dx=a\sec\theta\tan\theta\, d\theta$

$$\Rightarrow I=\int\frac{\sqrt{a^2(\sec^2\theta-1)}}{a\sec\theta}.\,a\sec\theta\tan\theta\, d\theta$$

$$=\int a\tan^2\theta.d\theta=a\int(\sec^2\theta-1)d\theta$$

$$=a(\tan\theta-\theta)+c \quad (\because \int\sec^2 x\, dx=\tan x).$$

$$=a\sqrt{\sec^2\theta-a}-a\theta+c$$

$$= a\sqrt{\left(\frac{x^2}{a^2}\right) - a} - a\sec^{-1}\left(\frac{x}{a}\right) + c.$$

$$\left(\because\ \sec\theta = \frac{x}{a}\right)$$

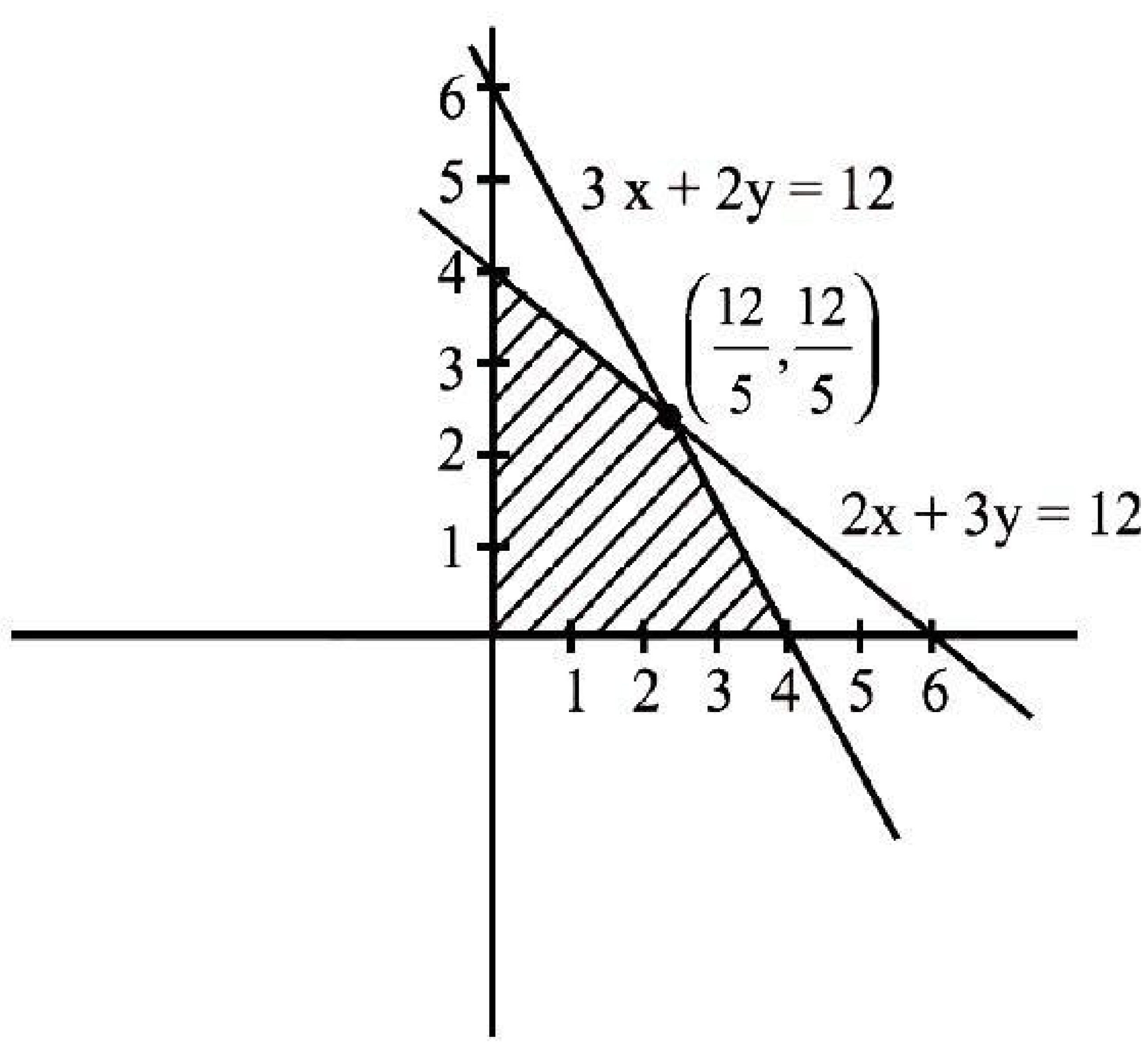
$$= \sqrt{x^2 - a^2} - a\ \sec{-1}\left(\frac{x}{a}\right) + c.$$

$$= \sqrt{x^2 - a^2} - a\cos{-1}\left(\frac{a}{x}\right) + c.$$

38. (d) $\because$ $3x+2y$ £ 12 or $\frac{x}{4}+\frac{y}{6}$ £ 1

$2x+3y$ £ 12 or $\frac{x}{6}+\frac{y}{4}$ £ 1.

and x ³ 0 , y ³ 0



$\therefore$ Corner points are : (0, 0), (0, 4),(4, 0) and $\left(\frac{12}{5}, \frac{12}{5}\right)$.

$\because z = 9x + 11y.$

At (0, 0) , $z = 0$.

At (0, 4) , $z = 44$.

At (4, 0) , $z = 36$.

At $\left(\frac{12}{5}, \frac{12}{5}\right), z = \frac{108+132}{5} = \frac{240}{5} = 48.$

$\therefore$ maximum value of z is 48.

39. (c) Let $I = \int_0^4 \frac{1}{1+\sqrt{x}}\,dx$

put $u = \sqrt{x} \Rightarrow u^2 = x \Rightarrow 2u\,du = dx.$

when $x = 0$, $u = 0$ & when $x = 4$, $u = 2$.

$$\Rightarrow I = \int_0^2 \frac{1}{1+u} 2u\,du.$$

$$= 2\int_0^2 \frac{u}{1+u}\,du$$

put $1 + u = w \Rightarrow du = dw.$

when $u = 0$, $w = 1$ & when $u = 2$, $w = 3$

$$\Rightarrow I = 2\int_0^3 \frac{w-1}{w}\,dw = 2\int_1^3 \left(1 - \frac{1}{w}\right) dw$$

$$= 2\left[w - \log w\right]_1^3$$

$= 2[3 - \log 3] - 2\,[1 - \log 1]$

$= 6 - 2\log 3 - 2 = 4 - 2\log 3$

$$= 4\log e - \log 3^2 = \log e^4 - \log 9 = \log\left(\frac{e^4}{9}\right)$$

40. (c) $\because \sin^2$q $= \frac{1}{2}$

$$\Rightarrow \sin^2\theta = \left(\frac{1}{\sqrt{2}}\right)^2$$

$$\Rightarrow \sin^2\theta = \sin^2\left(\frac{\pi}{4}\right).$$

$$\Rightarrow \theta = n\pi \pm \frac{\pi}{4},\ n \in I.$$

$\therefore$ in $[0, \pi]$, there are only two solutions i.e; $\frac{\pi}{4}$ and $\frac{3\pi}{4}$.

41. (c) $[\vec{p}+\vec{q}-\vec{r} \quad \vec{p}-\vec{q} \quad \vec{q}-\vec{r}]$

$=(\vec{p}+\vec{q}-\vec{r}).[(\vec{p}-\vec{q})\times(\vec{q}-\vec{r})]$.

$=(\vec{p}+\vec{q}-\vec{r}).[\vec{p}\times\vec{q}-\vec{p}\times\vec{r}-\vec{q}\times\vec{q}+\vec{q}\times\vec{r}]$

$=[\vec{p}+\vec{q}-\vec{r}].[\vec{p}\times\vec{q}-\vec{p}\times\vec{r}+\vec{q}\times\vec{r}] \quad (\because \vec{a}\times\vec{a}=0)$

$=[\vec{p}\ \vec{p}\ \vec{q}]-[\vec{p}\ \vec{p}\ \vec{r}]+[\vec{p}\ \vec{q}\ \vec{r}]+[\vec{q}\ \vec{p}\ \vec{q}]-[\vec{q}\ \vec{p}\ \vec{r}]$

$+[\vec{q}\ \vec{q}\ \vec{r}]-[\vec{r}\ \vec{p}\ \vec{q}]+[\vec{r}\ \vec{p}\ \vec{r}]-[\vec{r}\ \vec{q}\ \vec{r}]$

$=0-0+[\vec{p}\vec{q}\vec{r}]-0-[\vec{q}\ \vec{p}\ \vec{r}]+0-[\vec{r}\ \vec{p}\ \vec{q}]+0-0$

$[\because [\vec{a}\ \vec{a}\ \vec{b}]=0]$

$=[\vec{p}\ \vec{q}\ \vec{r}]+[\vec{p}\ \vec{q}\ \vec{r}]-[\vec{p}\ \vec{q}\ \vec{r}]$

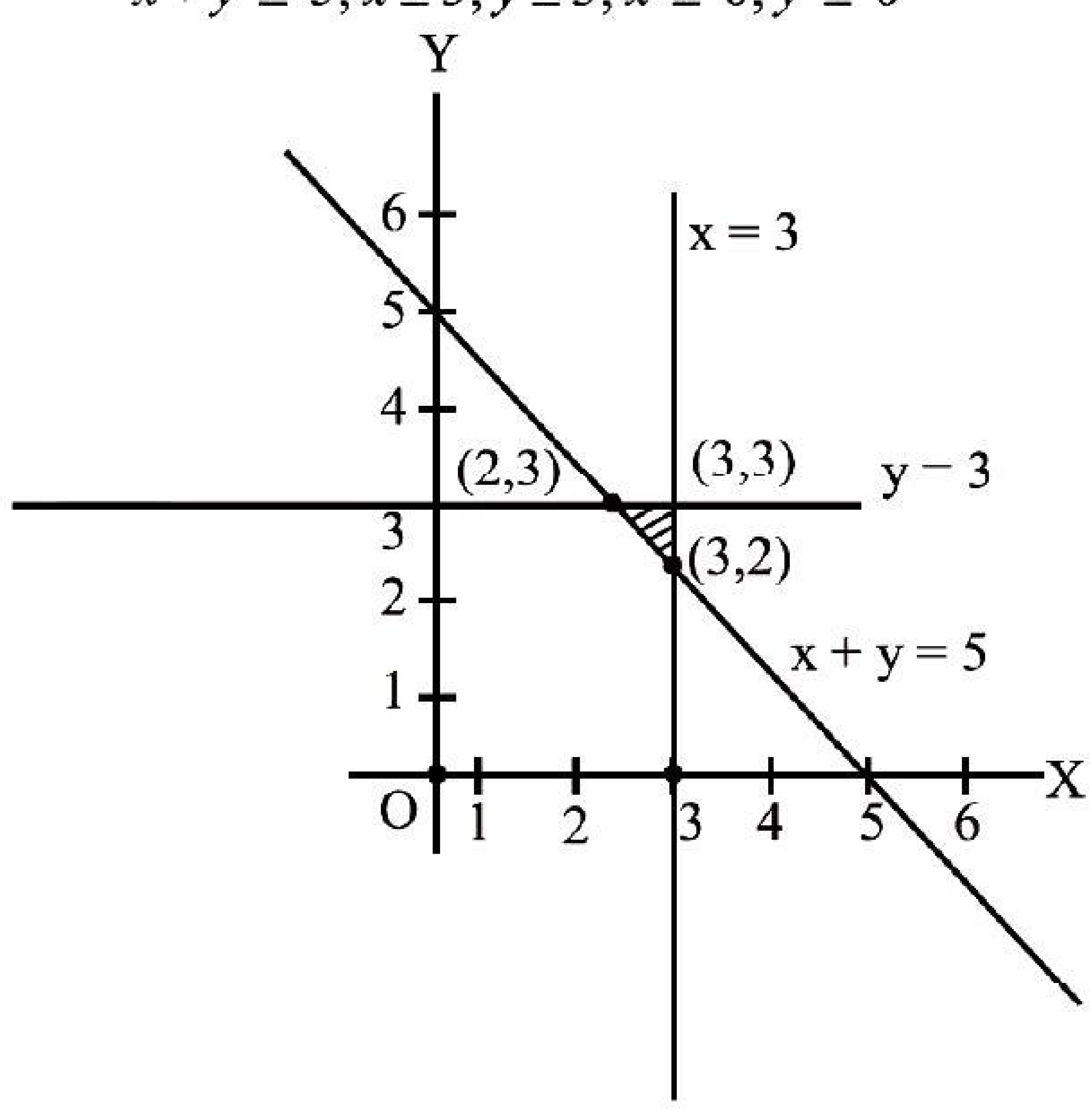
$\because [\vec{a}\ \vec{b}\ \vec{c}]=[\vec{b}\ \vec{c}\ \vec{a}]=-[\vec{b}\ \vec{a}\ \vec{c}]$

$=[\vec{p}\ \vec{q}\ \vec{r}]$.

42. (b) $\cos\theta=\sqrt{2}$ has no solution, since value of $\cos\theta$ lies in $[-1, 1]$

43. (a) $z=10x+25y$ subject to :

$x+y \geq 5; x \leq 3; y \leq 3; x \geq 0; y \geq 0$



$\therefore$ Corner points of the bounded region are : $(3, 2), (2, 3)$ & $(3, 3)$

$z=10x+25y$.

At $(3, 2), z=30+50=80$ (Minimum).

At $(2, 3), z=20+75=95$

At $(3, 3), z=30+75=105$.

44. (b) $f(x)=3x^3-9x^2-27x+15$.

$f'(x)=9x^2-18x-27$.

For maxima or minima :

$f'(x)=0 \Rightarrow 9x^2-18x-27=0$.

$\Rightarrow x^2-2x-3=0$

$\Rightarrow x^2-3x+x-3=0$

$\Rightarrow x(x-3)+1(x-3)=0$

$\Rightarrow x=-1, 3$.

$f''(x)=18x-18$.

$f''(-1)=-18-18=-36<0$

$f''(3)=18(3)-18=36>0$.

$\therefore f(x)$ has maximum value at $x=-1$.

& max. value $=3(-1)^3-9(-1)^2-27(-1)+15$

$=-3-9+27+15=30$.

45. (a) We know that equation of plane passing through a point with position vector $\vec{a}$ and normal to the vector $\vec{r}$ is :

$(\vec{r}-\vec{a})\cdot n=0$

$\because$ the plane passes through $(-1, 2, 1)$

$\therefore \vec{a}=-\hat{i}+2\hat{j}+\hat{k}$

Also plane is perpendicular to the line containing $(-3, 1, 2)$ and $(2, 3, 4)$

$\therefore \vec{n}=5\hat{i}+2\hat{j}+2\hat{k}$

$\therefore$ required equation is :

$[\vec{r}-(-\hat{i}+2\hat{j}+\hat{k})].(5\hat{i}+2\hat{j}+2\hat{k})=0$

$\Rightarrow \vec{r}.(5\hat{i}+2\hat{j}+2\hat{k})$

$-[(-\hat{i}+2\hat{j}+\hat{k}).(5\hat{i}+2\hat{j}+2\hat{k})]=0$

$\Rightarrow \vec{r}.(5\hat{i}+2\hat{j}+2\hat{k})-[-5+4+2]=0$

$\Rightarrow \vec{r}.(5\hat{i}+2\hat{j}+2\hat{k})=1$

46. (b) For $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$

Length of transverse axis $=2a=6 \Rightarrow a=3$

and length of latus rectum $=\frac{2b^2}{a}=\frac{8}{3}$

$\Rightarrow \frac{2b^2}{3}=\frac{8}{3} \Rightarrow b^2=4$

$\therefore$ equation of hyperbola is :

$\frac{x^2}{9}-\frac{y^2}{4}=1$

$\Rightarrow 4x^2-9y^2=36$

47. (b) $\because \tan^{-1}+\tan^{-1}y=\tan^{-1}\left(\frac{x+y}{1-xy}\right)$, if $xy<1$.

$\therefore \tan^{-1}\frac{1}{3}+\tan^{-1}\frac{1}{5}+\tan^{-1}\frac{1}{7}+\tan^{-1}\frac{1}{8}$

$=\tan^{-1}\left[\frac{\frac{1}{3}+\frac{1}{5}}{1-\frac{1}{15}}\right]+\tan^{-1}\left[\frac{\frac{1}{7}+\frac{1}{8}}{1-\frac{1}{56}}\right]$

$=\tan^{-1}\left[\frac{\frac{5+3}{15}}{\frac{14}{15}}\right]+\tan^{-1}\left[\frac{\frac{7+8}{56}}{\frac{55}{56}}\right]$

$=\tan^{-1}\frac{8}{14}+\tan^{-1}\frac{15}{55}$

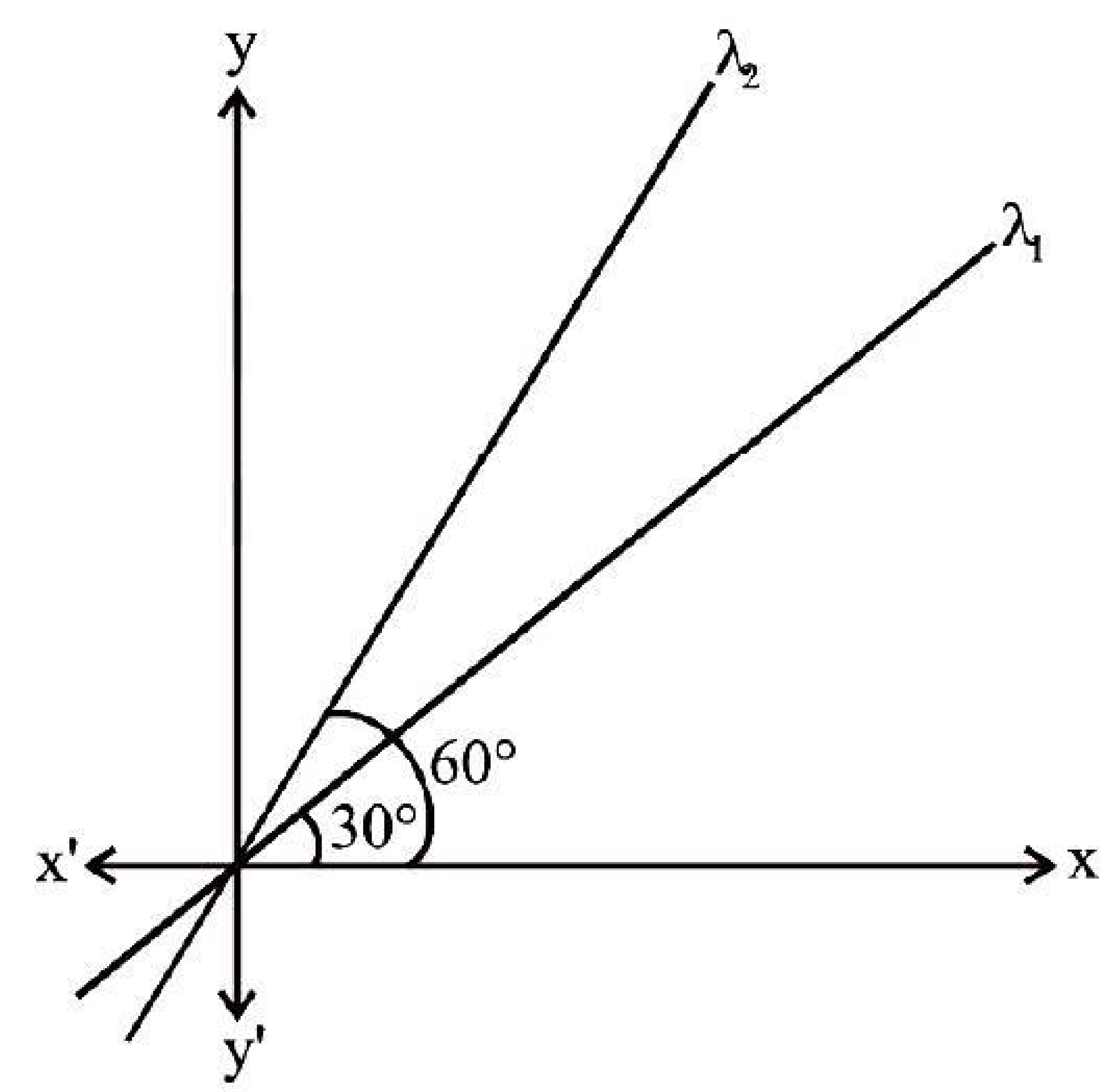
$=\tan^{-1}\frac{4}{7}+\tan^{-1}\frac{3}{11}$

$=\tan^{-1}\left[\frac{\frac{4}{7}+\frac{3}{11}}{1-\frac{12}{77}}\right]=\tan^{-1}\left[\frac{\frac{44+21}{77}}{\frac{65}{77}}\right]$

$=\tan^{-1}\left(\frac{65}{65}\right)$

$=\tan^{-1}(1)=\frac{\pi}{4}$

48. (a) Let ℓ_1 and ℓ_2 are the two lines, which trisects the first quadrant (as shown in the figure)



slope of $\ell_1=\tan 30°=\frac{1}{\sqrt{3}}$

and slope of $\ell_2=\tan 60°=\sqrt{3}$

$\therefore$ equation of ℓ_1 is :

$x=\frac{y}{\sqrt{3}}$ ($\because \ell_1$ passes through centre)

& equation of ℓ_2 is :

$x=\sqrt{3}y$ ($\because \ell_2$ passes through centre)

$\therefore$ joint equation is :

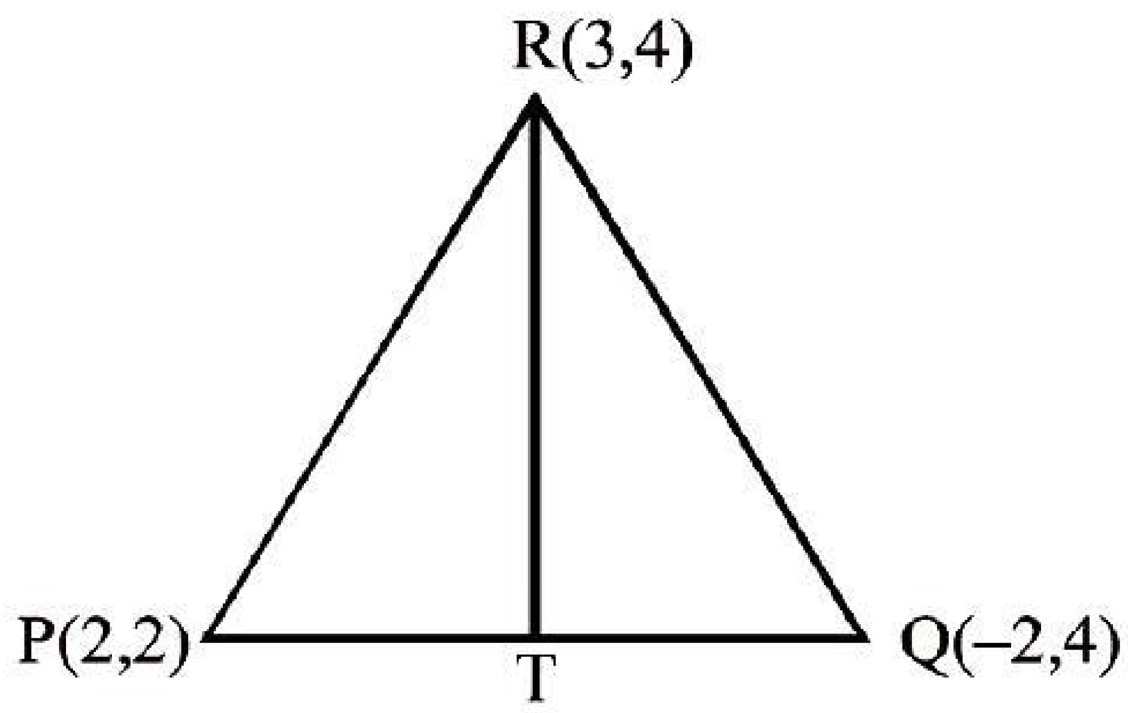
$\left(x-\frac{y}{\sqrt{3}}\right)(x-\sqrt{3}y)=0$

$x^2-\sqrt{3}xy-\frac{xy}{\sqrt{3}}+y^2=0$

$$\Rightarrow \frac{\sqrt{3}x^2 - 3xy - xy + \sqrt{3}y^2}{\sqrt{3}} = 0$$

$$\Rightarrow \sqrt{3}x^2 - 4xy + \sqrt{3}y^2 = 0$$

49. (b) From figure it is clear that T is the mid point of PQ



$\therefore$ co-ordinates of $T \equiv \left(\frac{2-2}{2}, \frac{2+4}{2}\right)$

$\equiv (0,3)$.

Equation of RT is $(y-4) = \left(\frac{3-4}{0-3}\right)(x-3)$

or $(y-4) = \frac{1}{3}(x-3)$ or $3y - 12 = x - 3$

or $x - 3y + 9 = 0$.

50. (a) $x = \sqrt{a^{\sin^{-1} t}}$

$$\Rightarrow \frac{dx}{dt} = \frac{1}{2\sqrt{a^{\sin^{-1} t}}} \cdot \frac{a^{\sin^{-1} t} \log a}{\sqrt{1-t^2}} = \frac{\log a}{2} \frac{\sqrt{a^{\sin^{-1} t}}}{\sqrt{1-t^2}}.$$

and $y = \sqrt{a^{\cos^{-1} t}}$

$$\Rightarrow \frac{dy}{dt} = \frac{1}{2\sqrt{a^{\cos^{-1} t}}} \cdot \frac{a^{\cos^{-1} t} \log a}{\left(-\sqrt{1-t^2}\right)} = \frac{-\log a}{2} \frac{\sqrt{a^{\cos^{-1} t}}}{\sqrt{1-t^2}}.$$

$$\therefore \frac{dy}{dt} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{-\log a}{2} \frac{y}{\sqrt{1-t^2}} \times \frac{2}{\log a} \frac{\sqrt{1-t^2}}{x} = \frac{-y}{x}.$$