MHT CET 2023 PCM May 13 Shift 2 Question Paper

Conducted by the State Common Entrance Test Cell, Maharashtra

Time Allowed: 180 Minutes **Total Questions: 150** **Maximum Marks: 200**

General Instructions

(i) This **PCM** paper is from **MHT CET 2023**, conducted by the **State Common Entrance Test Cell, Maharashtra**.

(ii) Answer all **150 multiple choice questions**: **50 Physics**, **50 Chemistry** and **50 Mathematics**.

(iii) Each question offers **four choices**, with **one correct answer**.

(iv) Allow **90 minutes for Physics and Chemistry together**, followed by **90 minutes for Mathematics**. The first group closes before the second opens.

(v) Correct answers earn **1 mark in Physics and Chemistry** and **2 marks in Mathematics**.

(vi) There is **no negative marking**. Unanswered questions score zero.

1. A sample of oxygen gas and a sample of hydrogen gas both have the same mass, same volume and the same pressure. The ratio of their absolute temperature is

(A) 1 : 4 (B) 4 : 1

(C) 1 : 16 (D) 16 : 1

2. If two planets have their radii in the ratio $x : y$ and densities in the ratio $m : n$, then the acceleration due to gravity on them are in the ratio

(A) $\frac{ny}{mx}$ (B) $\frac{my}{nx}$

(C) $\frac{nx}{my}$ (D) $\frac{mx}{ny}$

3. An excited hydrogen atom emits a photon of wavelength λ in returning to ground state. The quantum number n of the excited state is ($R =$ Rydberg's constant)

(A) $\sqrt{\lambda R(\lambda R - 1)}$ (B) $\sqrt{\frac{\lambda R}{(\lambda R - 1)}}$

(C) $\sqrt{\frac{(\lambda R - 1)}{\lambda R}}$ (D) $\sqrt{\frac{1}{\lambda R(\lambda R - 1)}}$

4. There is hole of area A at the bottom of a cylindrical vessel. Water is filled to a height h and water flows out in t second. If water is filled to a height $4h$, it will flow out in time (in second)

(A) t (B) $4t$

(C) $2t$ (D) $t/4$

5. The number of turns in the primary and the secondary of a transformer are 1000 and 3000 , respectively. If 80 V AC is applied to the primary coil of the transformer, then the potential difference per turn of the secondary coil would be

(A) 240 V (B) 2400 V

(C) 0.24 V (D) 0.08 V

6. The ratio of magnetic field at the centre of the current carrying circular loop and magnetic moment is X. When both the current and radius are doubled, then the ratio will be

(A) $2X$ (B) $\frac{X}{2}$

(C) $\frac{X}{4}$ (D) $\frac{X}{8}$

7. Light of wavelength $5000\,\mathring{A}$ is incident normally on a slit. The first minimum of the diffraction pattern is observed to lie at a distance of 5 mm from the central maximum on a screen placed at a distance of 2 m from the slit. The width of the slit is

(A) 2 cm (B) 0.2 cm

(C) 0.02 cm (D) 0.01 cm

8. When two tuning forks are sounded together, 5 beats per second are heard. One of the forks is in unison with 0.97 m length of sonometer wire and the other is in unison with 0.96 m length of the same wire. The frequencies of the two tuning forks are

(A) 383 Hz, 388 Hz (B) 475 Hz, 480 Hz

(C) 388 Hz, 39z Hz (D) 480 Hz, 485 Hz

9. The work done in rotating a dipole placed parallel to the electric field through 180° is W. So, the work done in rotating it through 60° is $\left(\cos 0^\circ = 1, \cos 60^\circ = \frac{1}{2}, \cos 180^\circ = -1\right)$

(A) $4W$ (B) 3 W

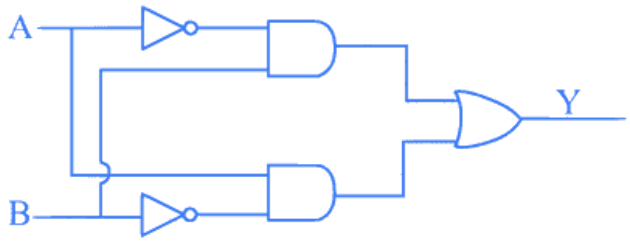
(C) $W/2$ (D) $W/4$

10. When an electron is excited from its 4 th orbit to 5 th stationary orbit, the change in the angular momentum of electron is approximately. (Planck's constant $= h = 6.63 \times 10^{-34}$ J − s)

(A) 2×10^{-34} J − s (B) 6.63×10^{-34} J − s

(C) 1×10^{-34} J − s (D) 3.14×10^{-34} J − s

11. The Boolean expression for the following combination is



(A) $(A + \bar{B}) \cdot (A + B)$ (B) $(A \cdot \bar{B}) + (\overline{A} \cdot B)$

(C) $(\overline{A} \cdot B) + (A \cdot \overline{B})$ (D) $(\overline{A} + B) \cdot (A + \overline{B})$

12. Under the influence of force F_1 the body oscillates with a period T_1 and due to another force F_2 body oscillates with period T_2. If both forces acts simultaneously, then the resultant period is (consider displacement is same in all three cases)

(A) $T = \sqrt{\frac{T_1^2+T_2^2}{T_1^2T_2^2}}$ (B) $T = \sqrt{\frac{T_1^2T_2^2}{T_1^2+T_2^2}}$

(C) $T = \sqrt{\frac{T_1^2}{T_2^2}}$ (D) $T = \sqrt{T_1^2+T_2^2}$

13. The internal energy of a monoatomic ideal gas molecule is

(A) partly kinetic and partly potential (B) totally kinetic

(C) totally potential (D) Neither kinetic nor potential

14. A gas at pressure p_0 is contained in a vessel. If the masses of all the molecules are halved and their velocities are doubled, then the resulting pressure would be equal to

(A) $4p_0$ (B) $2p_0$

(C) p_0 (D) $p_0/2$

15. The equation of a progressive wave is

$$Y = a\sin 2\pi\left(nt - \frac{x}{5}\right)$$

. The ratio of maximum particle velocity to wave velocity is

(A) $\frac{\pi a}{5}$ (B) $\frac{2\pi a}{5}$

(C) $\frac{3\pi a}{5}$ (D) $\frac{4\pi a}{5}$

16. For an adiabatic process, which one of the following is wrong statement?

(A) Equation of state is $pV^\gamma =$ constant (B) There is exchange of heat with surrounding

(C) All the work is utilised to change the internal energy of the system (D) Temperature of the system changes i.e. $\Delta T \neq 0$

17. A mine is located at depth $R/3$ below earth's surface. The acceleration due to gravity at that depth in mine is ($R =$ radius of earth, $g =$ acceleration due to gravity)

(A) g (B) $3g$

(C) $\frac{2g}{3}$ (D) $\frac{g}{3}$

18. A 10 m long wire of resistance 20Ω is connected in series with a battery of emf 3 V (negligible internal resistance) and a resistance of 10Ω. The potential gradient along the wire is

(A) 3 V/m (B) 0.1 V/m

(C) 0.2 V/m (D) 0.3 V/m

19. A group of lamps having total power rating of 1000 W is supplied by an AC voltage of $E = 200\sin(310t + 60^\circ)$, the rms value of current flowing through the circuit is

(A) 10 A (B) $5\sqrt{2}$ A

(C) 20 A (D) $10\sqrt{2}$ A

20. At a particular angular frequency, the reactance of capacitor and that of inductor is same. If the angular frequency is doubled, the ratio of the reactance of the capacitor to that of the inductor will be

(A) 1/4 (B) 1/2

(C) 2 (D) 4

21. A metal disc of radius R rotates with an angular velocity ω about an axis perpendicular to its plane passing through its centre in a magnetic field of induction B acting perpendicular to the plane of the disc. The magnitude of induced emf between the rim and axis of the disc is

(A) πBR^2 (B) $\frac{2\pi^2BR^2}{\omega}$

(C) $\pi BR^2\omega$ (D) $\frac{BR^2\omega}{2}$

22. A mass M is suspended from a light spring. An additional mass M_1 added extends the spring further by a distance x. Now, the combined mass will oscillate on the spring with period $T =$

(A) $2\pi[(\frac{M_1g}{x(M+M_1)})]^{\frac{1}{2}}$ (B) $2\pi[\frac{(M+M_1)x}{M_1g}]^{\frac{1}{2}}$

(C) $(\frac{\pi}{2})[(\frac{M_1g}{x(M+M_1)})]^{\frac{1}{2}}$ (D) $2\pi[(\frac{M+M_1}{M_1gx})]^{\frac{1}{2}}$

23. The path difference between two identical light waves at a point Q on the screen is 3μm. If wavelength of the waves is $5000\,\overset{o}{\text{A}}$, then at point Q there is

(A) 3rd dark band (B) 4th bright band

(C) 5th dark band (D) 6 th bright band

24. If the maximum efficiency of a full wave rectifier is $x\%$ and that of half-wave rectifier is $y\%$, then the relation between x and y is

(A) $x = y$ (B) $x = 2y$

(C) $y = 2x$ (D) $y = 4x$

25. Two bodies A and B start from the same point at the same instant and move along a straight line. body A moves with uniform acceleration a and body B moves with uniform velocity v. They meet after time t. The value of t is

(A) $\frac{2v}{a}$ (B) $\frac{a}{2v}$

(C) $\frac{v}{2a}$ (D) $\sqrt{\frac{v}{a}}$

26. A small steel ball is dropped from a height of 1.5 m into a glycerine jar. The ball reaches the bottom of the jar 1.5 s after it was dropped. If the retardation is 2.66 m/s^2, the height of the glycerine in the jar is about (acceleration due to gravity $g = 9.8\ m/s^2$)

(A) 7.0 m (B) 7.5 m

(C) 5.5 m (D) 3.2 m

27. In a parallel plate capacitor with air between the plates, the distance d between the plates is changed and the space is filled with dielectric constant 8. The capacity of the capacitor is increased 16 times, the distance between the plates is

(A) 2d (B) 4d

(C) d/2 (D) d/4

28. A ray of light passes through an equilateral prism such that the angle of incidence (i) is equal to angle of emergence (e). The angle of emergence is equal to $\left(\frac{3}{4}\right)$ th the angle of prism. The angle of deviation is

(A) 20° (B) 30°

(C) 39° (D) 45°

29. The radii of curvature of both the surfaces of a convex lens of focal length f and power P are equal. One of the surfaces is made by plane grinding. The new focal length and focal power of the lens is

(A) $\frac{2}{3}f, \frac{2}{3}P$ (B) $\sqrt{\frac{2}{f}}, \sqrt{\frac{P}{2}}$

(C) $\frac{f}{2}, 2P$ (D) $2f, \frac{P}{2}$

30. A spring balance is attached to the ceiling of a lift. A man hangs his bag on the spring and the spring balance reads 49 N, when the lift is stationary. If the lift moves downward with an acceleration of 5 m/s^2, the reading of the spring balance will be $\left(g = 9.8\ m/s^2\right)$

(A) 15 N (B) 24 N

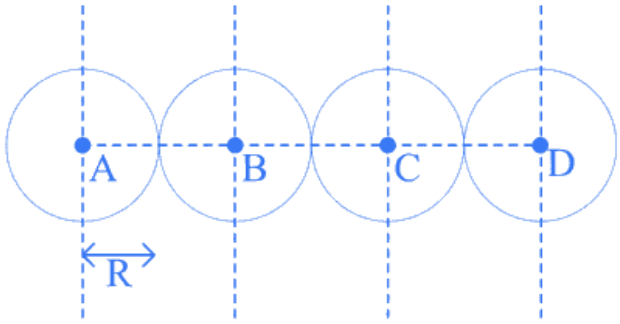
(C) 49 N (D) 74 N

31. In a L-R circuit the inductive reactance is equal to the resistance R in the circuit. An emf $E = E_0 \cos \omega t$ is applied to the circuit. The power consumed in the circuit is

(A) $\frac{E_0^2}{\sqrt{2}R}$ (B) $\frac{E_0^2}{4R}$

(C) $\frac{E_0^2}{2R}$ (D) $\frac{E_0^2}{8R}$

32. Four identical uniform solid spheres each of same mass M and radius R are placed touching each other as shown in figure with centres $A, B, C, D. I_A, I_B, I_C, I_D$ are the moment of inertia of these spheres respectively about an axis passing through centre and perpendicular to the plane, then



(A) $I_A > I_B > I_C > I_D$ (B) $I_D > I_C > I_B > I_A$

(C) $I_A = I_D > I_B = I_C$ (D) $I_A = I_D < I_B = I_C$

33. A transverse wave strike against a wall,

(A) its phase changes by 180° but velocity does not change

(B) its phase does not change but velocity changes

(C) its velocity changes and phase changes by 180°

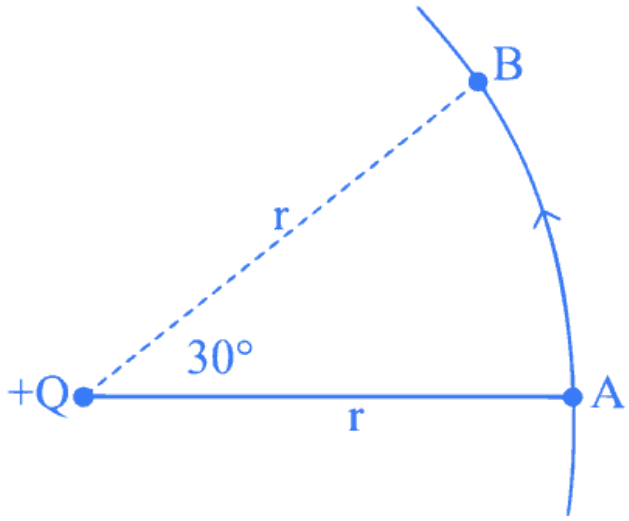
(D) nothing can be predicted about changes in its velocity and phase

34. A circular current carrying coil has radius R. The magnetic induction at the centre of the coil is B_C. The magnetic induction of the coil at a distance $\sqrt{3}R$ from the centre along the axis is B_A. The ratio $B_A : B_C$ is

(A) 1 : 3 (B) 1 : 8

(C) 8 : 1 (D) 27 : 1

35. In the electric field due to a charge Q, a charge q moves from point A to B. The work done is ($\varepsilon_0 =$ permittivity of vacuum)



(A) $\frac{1}{4\pi\epsilon_0}\frac{Qq}{r^2}$ (B) $\frac{1}{4\pi\epsilon_0}\frac{Qq}{r} \times \frac{\pi}{6}$

(C) $\frac{1}{4\pi\epsilon_0}\frac{Qq}{r}$ (D) Zero

36. Of the two slits producing interference in Young's experiment, one is covered with glass so that light intensity passing is reduced to 50%. Which of the following is correct?

(A) Intensity of fringes remains unaltered.

(B) Intensity of bright fringe decreases and that of dark fringe increases.

(C) Intensity of bright fringe increases and that of dark fringe decreases.

(D) Intensity of both bright and dark fringes decreases.

37. Magnetic shielding is done by surrounding the instrument to be protected from magnetic field by

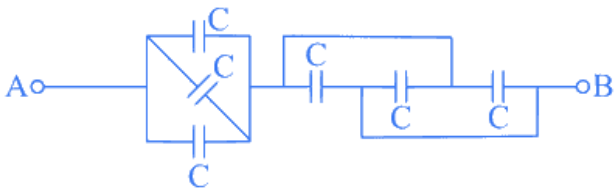
(A) soft ferromagnetic substance soft iron.

(B) diamagnetic substance fine copper gauge.

(C) paramagnetic substance aluminium.

(D) paramagnetic material tantalum.

38. In the given figure, the equivalent capacitance between points A and B is



(A) 1.5 C (B) 2 C

(C) 3 C (D) 6 C

39. If work done in blowing a soap bubble of volume V is W, then the work done in blowing the bubble of volume 2 V from same soap solution is

(A) $W/2$ (B) $\sqrt{2}$ W

(C) $(2)^{1/3}W$ (D) $(4)^{1/3}W$

40. Which one of the following is based on convection?

(A) Heating of a copper utensil

(B) Heating a room by heater

(C) Heating of iron rod

(D) Heat transferred from sun to earth

41. A simple spring has length l and force constant K. It is cut in to two springs of length l_1 and l_2 such that

$$l_1 = nl_2$$

(n is an integer). The force constant of spring of length l_1 is

(A) $K(1+n)$ (B) $\frac{K(n+1)}{n}$

(C) K (D) $\frac{K}{(n+1)}$

42. A closed pipe and an open pipe have their first overtone equal in frequency. Then, the lengths of these pipe are in the ratio

(A) 1 : 2 (B) 2 : 3

(C) 3 : 4 (D) 4 : 5

43. A conductor 10 cm long is moves with a speed 1 m/s perpendicular to a field of strength 1000 A/m. The emf induced in the conductor is (Given : $\mu_0 = 4\pi \times 10^{-7}$ Wb/Am)

(A) π mV (B) 2π mV

(C) $40\pi\mu$ V (D) $4\pi\mu$ V

44. Dual nature of light is exhibited by

(A) diffraction as well as photoelectric effect (B) diffraction as well as reflection

(C) refraction as well as interference (D) photoelectric effect

45. A carnot engine operates with source at 227°C and sink at 27°C. If the source supplies 50 kJ of heat energy, the work done by the engine is

(A) 2 kJ (B) 5 kJ

(C) 10 kJ (D) 20 kJ

46. Doping of a semiconductor (with small impurity atoms) generally changes the resistivity as follows.

(A) Decreases (B) Does not change

(C) May increase or decrease depending on the dopant (D) Increase

47. A stone is projected at angle θ with velocity u . If it executes nearly a circular motion at its maximum point for short time, then the radius of the circular path will be ($g =$ acceleration due to gravity)

(A) $\frac{u^2}{g}$ (B) $\frac{u^2\cos^2\theta}{g}$

(C) $\frac{u^2\sin^2\theta}{g}$ (D) $\frac{u^2\cos^2\theta}{2g}$

48. When radiations of wavelength λ is incident on a metallic surface the stopping potential required is 4.8 V. If same surface is illuminated with radiations of double the wavelength, then required stopping potential becomes 1.6 V, then the value of threshold wavelength for the surface is

(A) 2λ (B) 4λ

(C) 6λ (D) 8λ

49. A thin uniform rod AB of mass m and length l is hinged at one end A to the ground level. Initially the rod stands vertically and is allowed to fall freely to the ground in the vertical plane. The angular velocity of the rod when its end B strikes the ground is ($g =$ acceleration due to gravity)

(A) $\sqrt{\frac{g}{l}}$ (B) $\sqrt{\frac{mg}{l}}$

(C) $\sqrt{\frac{3g}{l}}$ (D) $\sqrt{\frac{mg}{3l}}$

50. Only 4% of the total current in the circuit passes through a galvanometer. If the resistance of the galvanometer is G, then the shunt resistance connected to the galvanometer is

(A) $\frac{G}{25}$ (B) $\frac{G}{24}$

(C) 24G (D) 25G

51. What is the pH of solution containing $4.62 \times 10^{-4} MH^{+}$ ions?

(A) 8.62
(B) 4.64
(C) 5.66
(D) 3.34

52. Which of the following is vinylic alcohol?

(A) Prop-2-en-1-ol
(B) But-2-en-2-ol
(C) But-3-en-2-ol
(D) 2-methylbut-3-en-2-ol

53. Which among the following is benzylic halide?

(A) $C_6H_5 - CH_2 - X$
(B) $C_6H_5 - X$
(C) $C_6H_5 - CH = CH - X$
(D) $C_6H_5 - CH_2 - CH_2 - X$

54. Which among the following is a simple ketone?

(A) Acetophenone
(B) Butanone
(C) Benzophenone
(D) Pentan-2-one

55. Identify glycosidic linkage present in maltose.

(A) $\beta - 1,4$
(B) $\alpha - 1,6$
(C) $\beta - 1,6$
(D) $\alpha - 1,4$

56. Which statement from following about nano-material is NOT correct?

(A) As the particle size decreases the total surface area of particles increases.
(B) Nano-material based catalysts exhibit increased catalytic activities.
(C) Nano-sized Cu and Pd clusters have very less hardness than bulk metal.
(D) Carbon nano-tube can act as electrical conductor.

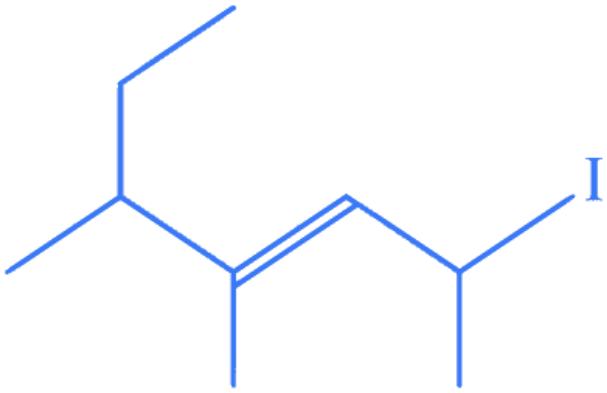
57. Which from following species is NOT a monodentate ligand?

(A) CN^{-}
(B) $H_2N(CH_2)_2NH_2$
(C) OH^{-}
(D) Cl^{-}

58. Two moles of an ideal gas expand freely and isothermally from 5 dm^3 to 50 dm^3. What is the value of ΔH ?

(A) Zero kJ
(B) 20 kJ
(C) 100 kJ
(D) 150 kJ

59. What is IUPAC name of following compound?



(A) 1-iodo-1,3,4-trimethylhex-2-ene
(B) 2-iodo-4,5-dimethylhept-3-ene
(C) 2-iodo-5-ethyl-4-methylhex-3-ene
(D) 1-iodo-4-ethyl-1,3-dimethylpent-2-ene

60. What is the molecular formula of an alkane if it exhibits three structural isomers?

(A) C_3H_8
(B) C_4H_{10}
(C) C_5H_{12}
(D) C_6H_{14}

61. What is the bond order in N_2^{+}?

(A) 0
(B) 1
(C) 2
(D) 2.5

62. Identify alkaline earth metal from following.

(A) Rb
(B) Sr
(C) Fr
(D) Cs

63. What is the molality of solution of a non-volatile solute having boiling point elevation 7.15 K and molal elevation constant 2.75 K kg mol^{-1} ?

(A) 3.2 m
(B) 2.0 m
(C) 2.6 m
(D) 3.8 m

64. Which from following statements about rate constant is NOT true?

(A) It is independent of concentration.
(B) It varies with temperature.
(C) It is equal to rate of reaction at unit concentration of reactants.
(D) It's unit is independent of order of reaction.

65. Identify 'B' in the following conversions

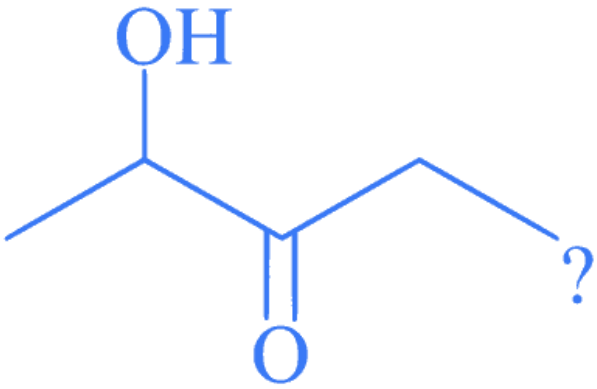
$$CH_3Br \xrightarrow{KCN} A \xrightarrow{Na/C_2H_5OH} B$$

(A) CH_3CN
(B) $CH_3OC_2H_5$
(C) CH_3ONa
(D) $CH_3CH_2NH_2$

66. Find the radius of metal atom in bcc unit cell having edge length 450 pm.

(A) 225.04 pm
(B) 194.85 pm
(C) 159.08 pm
(D) 90.05 pm

67. Which from following statements is true for the molecule



(A) $-OH$ is considered as principal functional group.
(B) Molecular formula of this compound is $C_4H_9O_2$.
(C) $-OH$ is attached with sp^2 hybrid carbon.
(D) IUPAC name of this compound is 2-hydroxypentan-3-one.

68. Which among the following salt solution in water is acidic in nature?

(A) $CuCl_2$
(B) NH_4CN
(C) KCN
(D) CH_3COONa

69. Which among the following is intensive and extensive properties respectively?

(A) Boiling point and heat capacity
(B) Heat capacity and boiling point
(C) Internal energy and pressure
(D) Heat capacity and surface tension

70. Which of the following compounds has lowest boiling point?

(A) Chloromethane
(B) Fluoromethane
(C) Iodomethane
(D) Bromomethane

71. Which of the following statements is NOT true about polymorphism?

(A) The existence of substance in more than one crystalline form.
(B) Polymorphism occuring in element is called allotropy.
(C) Polymorphic forms of a substance are formed under different conditions.
(D) The crystal shape of polymorphic substances is identical to each other.

72. Which from the following expression represents molar conductivity of an electrolyte A_2B_3 type?

(A) $2\lambda^0_{A^{+++}} + 3\lambda^0_{B^{--}}$
(B) $3\lambda^0_{A^{+++}} + 2\lambda^0_{B^{--}}$
(C) $2\lambda^\circ_{A^{+++}} + \lambda^\circ_{B^{--}}$
(D) $\lambda^\circ_{A^{+++}} + 3\lambda^\circ_{B^{--}}$

73. Which of the following electromagnetic radiations possesses lowest energy?

(A) Radio waves
(B) Microwaves
(C) Infrared
(D) Ultraviolet

74. Which among the following is an example of branched chain polymer?

(A) High density polythene
(B) Low density polythene
(C) Bakelite
(D) Melamine

75. For the reaction,

$CH_3Br(aq) + OH^-(aq) \longrightarrow CH_3OH(aq) + Br^-(aq)$,

The rate law is rate

$$= k\left[CH_3Br\right]\left[OH^-\right]$$

. What is change in rate of reaction if concentration of both reactants is doubled?

(A) Rate increases by factor 2

(B) Rate increases by factor 4

(C) Rate remains same

(D) Rate decreases by factor 2

76. For the reaction, $2A + 2B \longrightarrow 2C + D$, the rate law is expressed as rate

$$= k[A]^2[B]$$

. Calculate the rate constant if rate of reaction is 0.24 mol dm^{-3} s^{-1}.

[[A]

$$= 0.5M$$

and

$$[B] = 0.2M$$

]

(A) 4.8 mol^{-2} dm^6 s^{-1}

(B) 9.6 mol^{-2} dm^6 s^{-1}

(C) 12.1 mol^{-2} dm^6 s^{-1}

(D) 14.4 mol^{-2} dm^6 s^{-1}

77. What is the molar conductivity of 0.005 M NaI solution if it's conductivity is $6.065 \times 10^{-4} \Omega^{-1}$ cm^{-1} ?

(A) $121.3\Omega^{-1}$ cm^2 mol^{-1}

(B) $115.1\Omega^{-1}$ cm^2 mol^{-1}

(C) $126.5\Omega^{-1}$ cm^2 mol^{-1}

(D) $131.2\Omega^{-1}$ cm^2 mol^{-1}

78. Which of the following is not a disaccharide?

(A) Sucrose

(B) Maltose

(C) Lactose

(D) Raffinose

79. Which from following is a correct decreasing order of ionisation enthalpy for different elements?

(A) Ar > Ne > S > Cl

(B) Ne > Ar > Cl > S

(C) Ne > S > Cl > Ar

(D) Cl > S > Ne > Ar

80. Which among the following salts exhibits inverse relation between it's solubility and temperature?

(A) NaBr

(B) $NaNO_3$

(C) KNO_3

(D) Na_2SO_4

81. Which from following series of elements is correctly arranged according to their decreasing order of ionisation enthalpy (IE_1) ?

(A) Zn > Fe > Cr > Sc

(B) Cr > Fe > Zn > Sc

(C) Sc > Fe > Cr > Zn

(D) Cr > Zn > Sc > Fe

82. Identify the product formed by the action of H_2(g) with CO(g) in presence of Ni ?

(A) Methane and water

(B) Methyl alcohol

(C) Acetaldehyde

(D) Ethylene oxide

83. Calculate E° cell for following.

$$Zn(s)\left|Zn^{++}(1M)\right\|Pb^{++}(1M)\left|Pb(s)\right.$$

if

$$E^\circ_{Zn} = -0.763 \text{ V}$$

and

$$E^\circ_{Pb} = -0.126 \text{ V}$$

(A) 0.637 V

(B) −0.530 V

(C) −0.889 V

(D) 0.789 V

84. Which from following elements exhibits usual tendency to undergo reduction?

(A) Mg

(B) Ni

(C) O

(D) Cu

85. According to reaction,

$Mg(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g) \uparrow$.

Calculate the mass of Mg required to liberate 4.48 dm^3 H_2 at STP?

(Molar mass of

$$Mg = 24 \text{ g mol}^{-1}$$

)

(A) 12 g

(B) 4.8 g

(C) 6 g

(D) 2.4 g

86. A closed container contains mixture of non-reacting gases A and B. Partial pressure of A and B are 4.5 bar and 5.5 bar respectively. Find mole fractions of A and B respectively?

(A) 0.035 and 0.065

(B) 0.055 and 0.045

(C) 0.45 and 0.55

(D) 0.55 and 0.45

87. Which from following compounds is obtained when toluene is treated with CrO_2Cl_2 in presence of CS_2 followed by acid hydrolysis?

(A) Chlorobenzene

(B) Benzal chloride

(C) Benzaldehyde

(D) Benzoic acid

88. Which of the following is NOT prepared by the action of Grignard's reagent on methanal?

(A) Ethanol

(B) Propan-1-ol

(C) Propan-2-ol

(D) Butan-1-ol

89. What is the number of elements present in each series of transition element?

(A) 8 (B) 10

(C) 14 (D) 24

90. Which of the following is Wolf-Kishner reduction?

(A) $\mathrm{RCOCl} \xrightarrow[\mathrm{Pd\text{–}BaSO_4}]{\mathrm{H_2}} \mathrm{R{-}CHO + HCl}$

(B) $\mathrm{RCN} \xrightarrow[\mathrm{H_3O^+}]{\mathrm{SnCl_2,\ HCl}} \mathrm{RCHO + NH_4Cl}$

(C) $\mathrm{RCHO} \xrightarrow[\Delta]{\mathrm{Zn-Hg,\ conc.\ HCl}} \mathrm{R{-}CH_3 + H_2O}$

(D) $\mathrm{RCOR} \xrightarrow[\mathrm{(ii)\ KOH,\ HO(CH_2)_2OH}]{\mathrm{(i)\ H_2N\text{–}NH_2,\ \Delta}} \mathrm{R{-}CH_2{-}R + N_2}$

91. Calculate the wave number of photon emitted during transition from the orbit of

$$n = 3$$

to

$$n = 2$$

in hydrogen atom

$$\left(R_H = 109677\ \mathrm{cm^{-1}}\right)$$

.

(A) 15354.8 $\mathrm{cm^{-1}}$ (B) 82257.8 $\mathrm{cm^{-1}}$

(C) 30515.4 $\mathrm{cm^{-1}}$ (D) 41128.5 $\mathrm{cm^{-1}}$

92. What is the molar concentration of acetic acid if value of it's, dissociation constant is 1.8×10^{-5} and degree of dissociation is 0.02 ?

(A) 4.6×10^{-3} M (B) 4.5×10^{-2} M

(C) 4.0×10^{-4} M (D) 3.6×10^{-2} M

93. An ideal gas absorbs 210 J of heat and undergoes expansion from 3 L to 6 L against a constant external pressure of 10^5 Pa. What is the value of ΔU ?

(A) 310 J (B) -90 J

(C) -210 J (D) 190 J

94. What is the molecular formula of *p*-toluidine?

(A) $C_8H_{10}N_2$ (B) C_7H_9N

(C) $C_{10}H_{14}N_2$ (D) $C_{10}H_{14}N$

95. If 0.01 m aqueous solution of an electrolyte freezes at -0.056 K. Calculate van't Hoff factor for an electrolyte (cryoscopic constant of water

$$= 1.86\ \mathrm{K\ kg\ mol^{-1}}$$

)

(A) 1.30 (B) 2.33

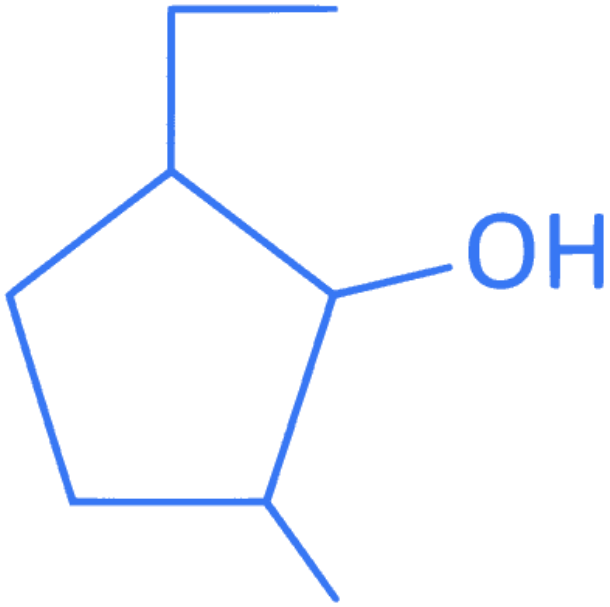
(C) 3.00 (D) 4.11

96. Which element from following does NOT belong to chalcogen family?

(A) At (B) Po

(C) Se (D) Te

97. What is IUPAC name of following compound?



(A) 2-ethyl-3-methylcyclopentanol

(B) 2-methyl-3-ethylcyclopentanol

(C) 1-methyl-3-ethylcyclopentan-2-ol

(D) 2-ethyl-5-methylcyclopentanol

98. Identify the monomers used to prepare novolac.

(A) Isoprene (B) 1,3-butadiene

(C) Phenol and formaldehyde (D) Melamine

99. Calculate the volume of unit cell if an element having molar mass 180 g $\mathrm{mol^{-1}}$ forms fcc unit cell.

$$\left[\rho \cdot N_A = 120 \times 10^{21}\ \mathrm{g\ cm^{-3}\ mol^{-1}}\right]$$

(A) 6.00×10^{-21} $\mathrm{cm^3}$ (B) 5.00×10^{-21} $\mathrm{cm^3}$

(C) 4.00×10^{-21} $\mathrm{cm^3}$ (D) 7.00×10^{-21} $\mathrm{cm^3}$

100. Identify homoleptic complex from following.

(A) $[Co(NH_3)_6]^{3+}$ (B) $[Co(NH_3)_4Cl_2]^{+}$

(C) $[Pt(NH_3)_2Cl_2]$ (D) $[Co(NH_3)_5Cl]SO_4$

101. If
$$xdy = y(dx + ydy), y(1) = 1, y(x) > 0$$
, then $y(-3)$ is

(A) 1 (B) 2
(C) 3 (D) 4

102. Slope of the tangent to the curve
$$y = 2e^x \sin\left(\frac{\pi}{4} - \frac{x}{2}\right)\cos\left(\frac{\pi}{4} - \frac{x}{2}\right)$$
, where $0 \le x \le 2\pi$ is minimum at
$x =$

(A) 0 (B) π
(C) 2π (D) 1

103. If the vectors
$$p\hat{\mathbf{i}} + \hat{\mathbf{j}} + \hat{\mathbf{k}}, \hat{\mathbf{i}} + q\hat{\mathbf{j}} + \hat{\mathbf{k}}$$
and $\hat{\mathbf{i}} + \hat{\mathbf{j}} + r\hat{\mathbf{k}} (p \ne q \ne r \ne 1)$ are coplanar, then the value of $pqr - (p + q + r)$ is

(A) -2 (B) 2
(C) 0 (D) -1

104. A tetrahedron has vertices at $P(2, 1, 3), Q(-1, 1, 2), R(1, 2, 1)$ and $O(0, 0, 0)$, then angle between the faces OPQ and PQR is

(A) $\cos^{-1}\left(\frac{5}{7\sqrt{59}}\right)$ (B) $\cos^{-1}\left(\frac{\sqrt{25}}{\sqrt{59}\cdot\sqrt{35}}\right)$
(C) $\cos^{-1}\left(\frac{5}{413}\right)$ (D) $\cos^{-1}\left(\frac{25}{\sqrt{59}\sqrt{35}}\right)$

105. Two dice are rolled. If both dice have six faces numbered $1, 2, 3, 5, 7, 11$, then the probability that the sum of the numbers on upper most face is prime, is

(A) 1/4 (B) 3/4
(C) 1/9 (D) 2/7

106. The domain of the definition of the function $y(x)$ is given by the equation
$$2^x + 2^y = 2$$
is

(A) $0 < x \le 1$ (B) $0 \le x \le 1$
(C) $-\infty < x \le 0$ (D) $-\infty < x < 1$

107. If
$$\mathbf{a} = \frac{1}{\sqrt{10}}(3\hat{\mathbf{i}} + \hat{\mathbf{k}}), \mathbf{b} = \frac{1}{7}(2\hat{\mathbf{i}} + 3\hat{\mathbf{j}} - 6\hat{\mathbf{k}})$$
, then the value of $(2\mathbf{a} - \mathbf{b}) \cdot [(\mathbf{a} \times \mathbf{b}) \times (\mathbf{a} + 2\mathbf{b})]$ is

(A) -3 (B) 5
(C) 3 (D) -5

108.
$$y = \frac{\sqrt[3]{1+3x}\ \sqrt[4]{1+4x}\ \sqrt[5]{1+5x}}{\sqrt[7]{1+7x}\ \sqrt[8]{1+8x}}$$
. Then, $\frac{dy}{dx}$ at $x = 0$
is

(A) 3 (B) -1
(C) 1 (D) 2

109. Five students are selected from n students such that the ratio of number of ways in which 2 particular students are selected to the number of ways 2 particular students not selected is 2 : 3. Then, the value of n is

(A) 5 (B) 6
(C) 11 (D) not possible

110. If
$$\int \frac{\log\left(t + \sqrt{1+t^2}\ \right)}{\sqrt{1+t^2}} dt = \frac{1}{2}[g(t)]^2 + c$$
, (where c is a constant of integration), then $g(2)$ is

(A) $\frac{1}{\sqrt{5}}\log(2 + \sqrt{5})$ (B) $\frac{1}{2}\log(2 + \sqrt{5})$
(C) $2\log(2 + \sqrt{5})$ (D) $\log(2 + \sqrt{5})$

111. If
$$A = \begin{bmatrix} 1 & \tan x \\ -\tan x & 1 \end{bmatrix}$$
, then
$$A^T \cdot A^{-1} =$$

(A) $\begin{bmatrix} -\cos 2x & \sin 2x \\ -\sin 2x & \cos 2x \end{bmatrix}$

(B) $\begin{bmatrix} \cos 2x & -\sin 2x \\ \sin 2x & \cos 2x \end{bmatrix}$

(C) $\begin{bmatrix} \cos 2x & \sin 2x \\ -\sin 2x & \cos 2x \end{bmatrix}$

(D) $\begin{bmatrix} \cos 2x & -\sin 2x \\ -\sin 2x & \cos 2x \end{bmatrix}$

112.
$$\mathbf{a} = 2\hat{\mathbf{i}} + 3\hat{\mathbf{j}} + 4\hat{\mathbf{k}}, \mathbf{b} = \hat{\mathbf{i}} - 2\hat{\mathbf{j}} + \hat{\mathbf{k}}, \mathbf{c} = \hat{\mathbf{i}} + \hat{\mathbf{j}} - \hat{\mathbf{k}}$$
are three vectors. For a vector $\mathbf{r}$ with
$$\mathbf{r} \times \mathbf{a} = \mathbf{b}$$
and
$$\mathbf{r} \cdot \mathbf{c} = 3, |\mathbf{r}|$$
is

(A) $\sqrt{55}$ (B) $\sqrt{138}$
(C) $\sqrt{155}$ (D) $\sqrt{170}$

113. Let PQR be a right angled isosceles triangle, right angled at $Q(2,1)$. If the equation of the line PR is

$$2x + y = 3$$

, then the combined equation representing the pair of lines PQ and QR is

(A) $3x^2 + 8xy - 3y^2 - 20x - 10y + 25 = 0$

(B) $3x^2 - 8xy - 3y^2 - 20x - 10y - 25 = 0$

(C) $3x^2 + 8xy - 3y^2 + 20x + 10y + 25 = 0$

(D) $3x^2 - 8xy - 3y^2 + 20x + 10y - 25 = 0$

114. If a curve

$$y = a\sqrt{x} + bx$$

passes through the point $(1,2)$ and the area bounded by the curve, line

$$x = 4$$

and X-axis is 8 sq units, then

(A) $a = 3, b = -1$ (B) $a = 3, b = 1$

(C) $a = -3, b = 1$ (D) $a = -3, b = -1$

115. A plane is parallel to two lines whose direction ratios are $2, 0, -2$ and $-2, 2, 0$ and it contains the point $(2,2,2)$. If it cuts coordinate axes at A, B, C, then the volume of the tetrahedron $OABC$ (in cubic units) is

(A) 216 (B) 6

(C) 36 (D) 9

116. If q is false and $p \wedge q \leftrightarrow r$ is true, then ..... is a tautology.

(A) $p \vee r$ (B) $(p \wedge r) \rightarrow p \vee r$

(C) $(p \vee r) \rightarrow p \wedge r$ (D) $p \wedge r$

117. Negation of contrapositive of statement pattern $(p \vee \sim q) \rightarrow (p \wedge \sim q)$ is

(A) $(\sim p \wedge q) \vee (p \wedge \sim q)$

(B) $(\sim p \vee q) \wedge (p \vee \sim q)$

(C) $(p \wedge \sim q) \vee (\sim p \wedge \sim q)$

(D) $(\sim p \vee \sim q) \wedge (p \vee q)$

118. The value of

$$\tan\left(\sin^{-1}\left(\frac{3}{5}\right) + \tan^{-1}\left(\frac{2}{3}\right)\right)$$

is

(A) 6/17 (B) 17/6

(C) 16/7 (D) 7/16

119. Variance of first $2n$ natural numbers is

(A) $\frac{4n^2+1}{12}$ (B) $\frac{(2n-1)^2}{12}$

(C) $\frac{n^2}{3} - 1$ (D) $\frac{4n^2-1}{12}$

120.

$$\int \frac{x-3}{(x-1)^3} e^x dx =$$

(A) $e^x(\frac{1}{(x-1)^2}) + c$, where c is constant of integration

(B) $e^x(\frac{1}{x+1}) + c$, where c is constant of integration

(C) $e^x((x-1)^2) + c$, where c is constant of integration

(D) $e^x((x-1)^3) + c$, where c is constant of integration

121. If $\mathbf{a}, \mathbf{b}, \mathbf{c}$ are non-coplanar unit vectors such that

$$\mathbf{a} \times (\mathbf{b} \times \mathbf{c}) = \frac{\mathbf{b} + \mathbf{c}}{\sqrt{2}}$$

, then the angle between $\mathbf{a}$ and $\mathbf{b}$ is

(A) $3\pi/4$ (B) $\pi/4$

(C) $\pi/2$ (D) π

122.

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

(A) $2\log(x + \sin\frac{x}{2}) + c$, where c is constant of integration

(B) $\frac{1}{2}\log(x + \sin\frac{x}{2}) + c$, where c is constant of integration

(C) $4\log(x + \sin\frac{x}{2}) + c$, where c is constant of integration

(D) $\log(x + \sin\frac{x}{2}) + c$, where c is constant of integration

123. In $\triangle ABC$, with usual notations, if

$$\frac{b+c}{11} = \frac{c+a}{12} = \frac{a+b}{13}$$

, then the value of $\cos A + \cos B + \cos C$ is

(A) 17/35 (B) 51/35

(C) 5/7 (D) 19/35

124. If slope of the tangent to the curve

$$xy + ax + by = 0$$

at the point $(1,1)$ on it is 2, then the value of $3a + b$ is

(A) 3 (B) 1

(C) 2 (D) -1

125. If $(3x+2)-(5y-3)i$ and $(6x+3)+(2y-4)i$ are conjugates of each other, then the value of

$$\frac{x-y}{x+y}$$

is (where $i=\sqrt{-1}\ , x, y \in R$)

(A) -1 (B) 0

(C) 1 (D) 2

126. If

$$\left(\tan^{-1}x\right)^2+\left(\cot^{-1}x\right)^2=\frac{5\pi^2}{8}$$

, then the value of x is

(A) -2 (B) -1

(C) 1 (D) 2

127. The solution of

$$(1+xy)ydx+(1-xy)xdy=0$$

is

(A) $\log(\frac{x}{y})+\frac{1}{xy}=k$, where k is constant of integration

(B) $\log(\frac{x}{y})=\frac{1}{xy}+k$, where k is constant of integration

(C) $\log(\frac{x}{y})+xy=k$, where k is constant of integration

(D) $\log(\frac{x}{y})=xy+k$, where k is constant of integration

128. The integral

$$\int_{\pi/6}^{\pi/3}\sec^{\frac{2}{3}}x\,\mathrm{cosec}^{\frac{4}{3}}x\,dx$$

is equal to

(A) $3^{\frac{5}{6}}-3^{\frac{2}{3}}$ (B) $3^{\frac{7}{6}}-3^{\frac{5}{6}}$

(C) $3^{\frac{5}{3}}-3^{\frac{1}{3}}$ (D) $3^{\frac{4}{3}}-3^{\frac{1}{3}}$

129.

$$\lim_{x\to 0}\frac{\sqrt{1+x\sin x}-\sqrt{\cos x}}{\tan^2\frac{x}{2}}=$$

(A) 1 (B) 2

(C) 3 (D) -1

130. $A(1,-3), B(4,3)$ are two points on the curve

$$y=x-\frac{4}{x}$$

. The points on the curve, the tangents at which are parallel to the chord AB, are

(A) $(1,2),(-1,-2)$ (B) $(2,0),(-2,0)$

(C) $(0,2),(1,-2)$ (D) $(3,2),(-3,1)$

131. Let $f: R \to R$ be a function such that $f(x)=x^3+x^2f'(1)+xf''(2)+f'''(3), x \in R$, then $f(2)$ equals

(A) 30 (B) -2

(C) -4 (D) 8

132. A radioactive substance, with initial mass m_0, has a half-life of h days. Then, its initial decay rate is given by

(A) $\frac{m_0}{h}\log 2$ (B) $m_0 h\log 2$

(C) $-\frac{m_0}{h}\log 2$ (D) $-m_0 h\log\cdot 2$

133. The abscissae of two points A and B are the roots of the equation

$$x^2+2ax-b^2=0$$

and their ordinates are roots of the equation

$$y^2+2py-q^2=0$$

. Then, the equation of the circle with AB as diameter is given by

(A) $x^2+y^2-2ax-2py+(b^2+q^2)=0$

(B) $x^2+y^2-2ax-2py-(b^2+q^2)=0$

(C) $x^2+y^2+2ax+2py+(b^2+q^2)=0$

(D) $x^2+y^2+2ax+2py-(b^2+q^2)=0$

134. The incentre of the $\triangle ABC$, whose vertices are $A(0,2,1), B(-2,0,0)$ and $C(-2,0,2)$, is

(A) $(-\frac{3}{2},\frac{1}{2},1)$ (B) $(\frac{3}{2},\frac{1}{2},1)$

(C) $(-\frac{3}{2},-\frac{1}{2},-1)$ (D) $(\frac{3}{2},-\frac{1}{2},-1)$

135. The acute angle between the line joining the points $(2,1,-3),(-3,1,7)$ and a line parallel to

$$\frac{x-1}{3}=\frac{y}{4}=\frac{z+3}{5}$$

through the point $(-1,0,4)$ is

(A) $\cos^{-1}(\frac{1}{\sqrt{10}})$ (B) $\cos^{-1}(\frac{5}{7\sqrt{10}})$

(C) $\cos^{-1}(\frac{7}{5\sqrt{10}})$ (D) $\cos^{-1}(\frac{3}{5\sqrt{10}})$

136. A random variable X has the probability distribution

$X=x$	1	2	3	4	5	6	7	8
$P(X=x)$	0.15	0.23	0.12	0.20	0.08	0.10	0.05	0.07

For the events

$$E=\{X$$

is a prime number $\}$ and

$$F=\{x<5\}, P(EUF)$$

is

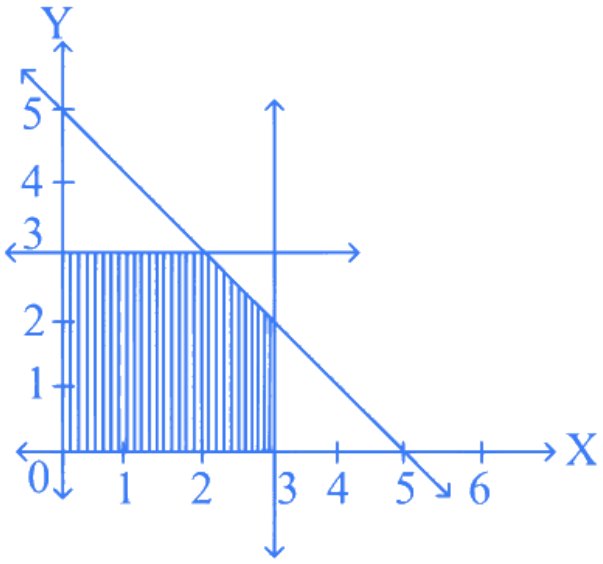
(A) 0.63 (B) 0.75

(C) 0.83 (D) 0.90

137. The shaded area in the given figure is a solution set for some system of inequations. The maximum value of the function

$$z = 10x + 25y$$

subject to the linear constraints given by the system is



(A) 80 (B) 100

(C) 95 (D) 105

138. The foot of the perpendicular from the point $(1, 2, 3)$ on the line

$$\mathbf{r} = (6\hat{\mathbf{i}} + 7\hat{\mathbf{j}} + 7\hat{\mathbf{k}}) + \lambda(3\hat{\mathbf{i}} + 2\hat{\mathbf{j}} - 2\hat{\mathbf{k}})$$

has the coordinates

(A) $(3, 5, 9)$ (B) $(5, -3, 9)$

(C) $(3, -5, -9)$ (D) $(5, -9, 3)$

139. Water is running in a hemispherical bowl of radius 180 cm at the rate of 108 cubic decimeters per minute. How fast the water level is rising when depth of the water level in the bowl is 120 cm ? (1 decimeter $= 10$ m)

(A) 16πcm/sec (B) $\frac{16}{\pi}$cm/sec

(C) $\frac{1}{16\pi}$cm/sec (D) $\frac{\pi}{16}$ cm/sec

140. The solution of

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

in $(0, \pi/2)$ are

(A) $\frac{\pi}{4}, \frac{\pi}{10}$ (B) $\frac{\pi}{6}, \frac{\pi}{3}$

(C) $\frac{\pi}{4}, \frac{\pi}{12}$ (D) $\frac{\pi}{8}, \frac{\pi}{16}$

141. If

$$(1 + \sqrt{1+x}\,)\tan x = 1 + \sqrt{1-x}$$

, then $\sin 4x$ is

(A) x (B) $-x$

(C) $4x$ (D) $-4x$

142. If the sum of the mean and the variance of a binomial distribution for 5 trials is 1.8 , then the value of p is

(A) 0.4 (B) 0.8

(C) 0.18 (D) 0.2

143. If

$$I = \int \frac{e^x}{e^{4x} + e^{2x} + 1} dx$$

and

$$J = \int \frac{e^{-x}}{e^{-4x} + e^{-2x} + 1} dx$$

, then for any arbitrary constant C, than the value of $J - I$ equals

(A) $\frac{1}{2}\log|(\frac{e^{4x} - e^{2x} + 1}{e^{4x} + e^{2x} + 1})| + C$

(B) $\frac{1}{2}\log|(\frac{e^{2x} + e^{x} + 1}{e^{2x} - e^{x} + 1})| + C$

(C) $\frac{1}{2}\log|(\frac{e^{2x} - e^{x} + 1}{e^{2x} + e^{x} + 1})| + C$

(D) $\frac{1}{2}\log|(\frac{e^{4x} + e^{2x} + 1}{e^{4x} - e^{2x} + 1})| + C$

144. The principal value of $\sin^{-1}(\sin(3\pi/4))$ is

(A) $\pi/4$ (B) $-\pi/4$

(C) $3\pi/4$ (D) $5\pi/4$

145. If

$$x = \log_e\left(\frac{\cos\frac{y}{2} - \sin\frac{y}{2}}{\cos\frac{y}{2} + \sin\frac{y}{2}}\right), \tan\frac{y}{2} = \sqrt{\frac{1-t}{1+t}}$$

Then,

$$\left(y_1\right)_{t\,=\,1/2}$$

has the value

(A) $1/2$ (B) $-1/2$

(C) $1/4$ (D) $-1/4$

146. The c.d.f. $F(x)$ associated with p.d.f. $f(x)$

$$f(x) = \begin{cases} 12x^2(1-x), & \text{if } 0 < x < 1 \\ 0; & \text{otherwise} \end{cases}$$

is

(A) $F(x) = 4x^3 + 3x^4$ (B) $F(x) = 4x^3 - 3x^4$

(C) $F(x) = -4x^3 - 3x^4$ (D) $F(x) = -4x^3 + 3x^4$

147. If $f(x)$ is continuous on its domain $[-2, 2]$, where

$$f(x) = \begin{cases} \frac{\sin ax}{x} + 3 & , \text{ for } -2 \le x < 0 \\ 2x + 7 & , \text{ for } 0 \le x \le 1 \\ \sqrt{x^2 + 8} - b & , \text{ for } 1 < x \le 2 \end{cases}$$

then the value of $2a + 3b$ is

(A) -12 (B) -10

(C) 10 (D) 12

148. PS is the median of the triangle with vertices at $P(2, 2), Q(6, -1)$ and $R(7, 3)$, then the intercepts on the coordinate axes of the line passing through point $(1, -1)$ and parallel to PS are respectively

(A) $\frac{7}{2}, \frac{-7}{9}$ (B) $\frac{2}{7}, \frac{9}{7}$

(C) $\frac{-7}{2}, \frac{-7}{9}$ (D) $-2, -9$

149. If Rolle's theorem holds for the function

$$f(x) = x^3 + bx^2 + ax + 5$$

on $[1, 3]$ with

$$c = 2 + \frac{1}{\sqrt{3}}$$

, then the values of a and b respectively are

(A) $-11, -6$ (B) $11, 6$

(C) $11, -6$ (D) $6, 11$

150. The distance of the point $(1, 6, 2)$ from the point of intersection of the line

$$\frac{x-2}{3} = \frac{y+1}{4} = \frac{z-2}{12}$$

and the plane

$$x - y + z = 16$$

is

(A) 11 units (B) 12 units

(C) 13 units (D) 14 units

- End of Question Paper -