MHT CET 2023 PCM May 14 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. The power factor of an R-L circuit is $\frac{1}{\sqrt{2}}$. If the frequency of AC is doubled the power factor will now be

(A) $\frac{1}{\sqrt{3}}$ (B) $\frac{1}{\sqrt{5}}$

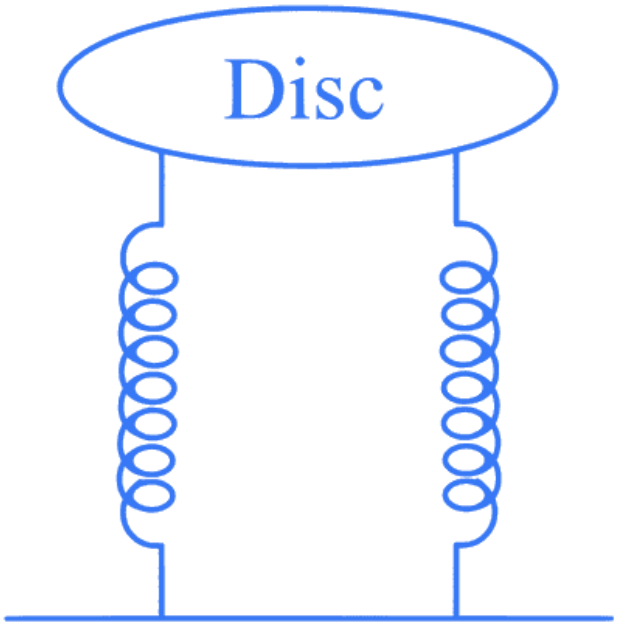
(C) $\frac{1}{\sqrt{7}}$ (D) $\frac{1}{\sqrt{11}}$

2. Ratio of longest wavelength corresponding to Lyman and Balmer series in hydrogen spectrum is

(A) $\frac{7}{29}$ (B) $\frac{9}{31}$

(C) $\frac{5}{27}$ (D) $\frac{3}{23}$

3. A uniform circular disc of mass 12 kg is held by two identical springs. When the disc is slightly pressed down and released, it executes S.H.M. of period 2 second. The force constant of each spring is (nearly) (Take $\pi^2 = 10$)



(A) 230 Nm^{-1} (B) 120 Nm^{-1}

(C) 60 Nm^{-1} (D) 30 Nm^{-1}

4. A charge 17.7×10^{-4}C is distributed uniformly over a large sheet of area 200 m^2. The electric field intensity at a distance 20 cm from it in air will be $\left[\varepsilon_0 = 8.85 \times 10^{-12} C^2/Nm^2\right]$

(A) 5×10^5 N/C (B) 6×10^5 N/C

(C) 7×10^5 N/C (D) 8×10^5 N/C

5. Sound waves of frequency 600 Hz fall normally on a perfectly reflecting wall. The shortest distance from the wall at which all particles will have maximum amplitude of vibration is (speed of sound $= 300\ ms^{-1}$)

(A) $\frac{1}{4}$ m (B) $\frac{1}{8}$ m

(C) $\frac{3}{8}$ m (D) $\frac{7}{8}$ m

6. A long solenoid has 1500 turns. When a current of 3.5 A flows through it, the magnetic flux linked with each turn of solenoid is 2.8×10^{-3} weber. The self-inductance of solenoid is

(A) 1.2 H (B) 2.4 H

(C) 3.6 H (D) 6 H

7. A metal rod cools at the rate of 4°C/min whon its temperature is 90°C and the rate of 1°C/min when its temperature is 30°C. The temperature of the surrounding is

(A) 20°C (B) 15°C

(C) 10°C (D) 5°C

8. On replacing a thin film of mica of thickness 12×10^{-5} cm in the path of one of the interfering beams in Young's double slit experiment using monochromatic light, the fringe pattern shifts through a distance equal to the width of bright fringe. If $\lambda = 6 \times 10^{-5}$ cm, the refractive index of mica is

(A) 1.1 (B) 1.3

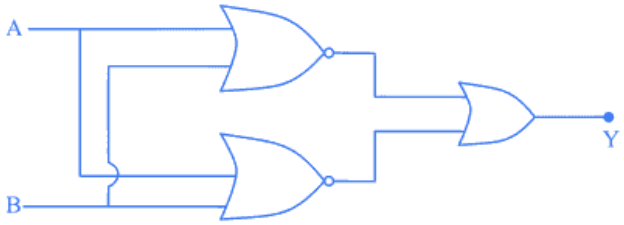
(C) 1.5 (D) 1.4

9. In the hysteresis curve the value of magnetization (B) which will be present in a substance when value of magnetizing force (H) is made zero (H = 0) is called as

(A) coercivity (B) retentivity

(C) domain (D) saturation

10. The output of following combination is same as that of



(A) AND gate (B) OR gate
(C) NAND gate (D) NOR gate

11. A parallel plate capacitor with air medium between the plates has a capacitance of 10μF. The area of capacitor is divided into two equal halves and filled with two media (as shown in figure) having dielectric constant

$$K_1 = 2$$

and

$$K_2 = 4$$

. The capacitance of the system will be



(A) 10 μF (B) 20 μF
(C) 30 μF (D) 40 μF

12. Refractive index of a glass convex lens is 1.5. The radius of curvature of each of the two surfaces of the lens is 20 cm. The ratio of the power of the lens when immersed in a liquid of refractive index 1.25 to that when placed in air is

(A) 2 : 3 (B) 2 : 5
(C) 3 : 5 (D) 5 : 2

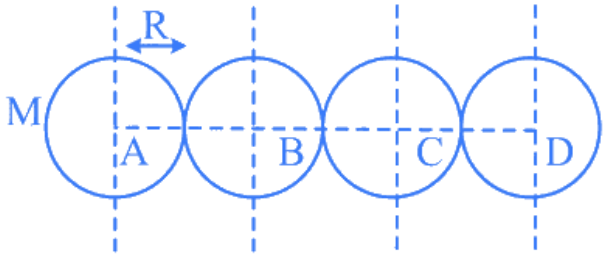
13. Earth is assumed to be a sphere of radius R. If 'g_ϕ' is value of effective acceleration due to gravity at latitude 30° and 'g' is the value at equator, then the value of $|g - g_\phi|$ is (ω is angular velocity of rotation of earth,

$$\cos 30^\circ = \frac{\sqrt{3}}{2}$$

)

(A) $\frac{1}{4}\omega^2$R (B) $\frac{3}{4}\omega^2$R
(C) ω^2R (D) $\frac{1}{2}\omega^2$R

14. 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 and I_D are the moment of inertia of these spheres respectively about an axis passing through centre and perpendicular to the plane. The difference in I_A, and I_B is

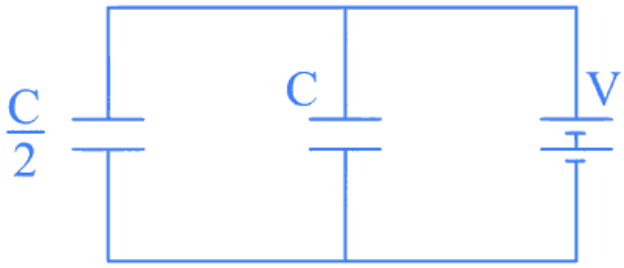


(A) 24 MR^2 (B) 32 MR^2
(C) 56 MR^2 (D) 80 MR^2

15. Two condensers one of capacity

$$\frac{C}{2}$$

and other capacity C are connected to a battery of voltage V as shown. The work done in charging fully both the condensers is



(A) $\frac{1}{2}$ CV^2 (B) $\frac{3}{4}$ CV^2
(C) $\frac{3}{2}$ CV^2 (D) 2 CV^2

16. When two light waves each of amplitude 'A' and having a phase difference of

$$\frac{\pi}{2}$$

superimposed then the amplitude of resultant wave is

(A) $\frac{A}{\sqrt{2}}$ (B) 2 A
(C) $\sqrt{2}$ A (D) $\frac{A}{2}$

17. In an n-p-n transistor, the collector current is 28 mA. If 80% of electrons reach the collector, its base current in mA is

(A) 35 (B) 24
(C) 14 (D) 7

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18. A light spring is suspended with mass m_1 at its lower end and its upper end fixed to a rigid support. The mass is pulled down a short distance and then released. The period of oscillation is T second. When a mass m_2 is added to m_1 and the system is made to oscillate, the period is found to be

$$\frac{3}{2}T$$

. The ratio $m_1 : m_2$ is

(A) 2 : 3 (B) 3 : 4

(C) 4 : 5 (D) 5 : 6

19. The molecular mass of a gas having r.m.s. speed four times as that of another gas having molecular mass 32 is

(A) 2 (B) 4

(C) 16 (D) 32

20. The position 'x' of a particle varies with a time as

$$x = at^2 - bt^3$$

where 'a' and 'b' are constants. The acceleration of the particle will be zero at

(A) $\frac{2a}{3b}$ (B) $\frac{a}{b}$

(C) $\frac{a}{3b}$ (D) zero

21. When the conductivity of a semiconductor is only due to the breaking of the covalent bonds, the semiconductor is called

(A) donor (B) intrinsic

(C) acceptor (D) extrinsic

22. A coil having effective area A, is held with its plane normal to magnetic field of induction B. The magnetic induction is quickly reduced by 25% of its initial value in 2 second. Then the e.m.f. induced across the coil will be

(A) $\frac{AB}{8}$ (B) $\frac{AB}{2}$

(C) $\frac{3AB}{4}$ (D) $\frac{3AB}{8}$

23. At constant temperature, increasing the pressure of a gas by 5% its volume will decrease by

(A) 5% (B) 5.26%

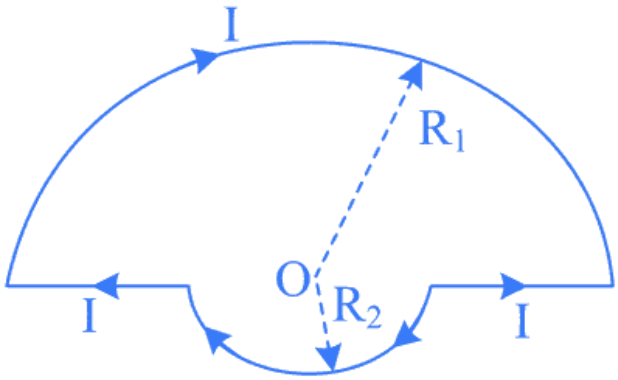
(C) 4.20% (D) 4.70%

24. Half life of radio-active element is 1600 years. The fraction of sample remains undecayed after 6400 years will be

(A) $\frac{1}{16}$ (B) $\frac{1}{4}$

(C) $\frac{1}{8}$ (D) $\frac{1}{24}$

25. Figure shows two semicircular loops of radii R_1 and R_2 carrying current I. The magnetic field at the common centre 'O' is



(A) $\frac{\mu_0 I}{4}(\frac{1}{R_1} + \frac{1}{R_2})$ (B) $\frac{\mu_0 I}{4}(\frac{1}{R_1} - \frac{1}{R_2})$

(C) $\frac{\mu_0 I}{2\pi}(\frac{1}{R_1} + \frac{1}{R_2})$ (D) $\frac{\mu_0 I}{2\pi}(\frac{1}{R_1} - \frac{1}{R_2})$

26. When radiation of wavelength 'λ' is incident on a metallic surface, the stopping potential is 4.8 V. If the surface is illuminated with radiation of double the wavelength then the stopping potential becomes 1.6 V. The threshold wavelength for the surface is

(A) 2λ (B) 4λ

(C) 6λ (D) 8λ

27. A long wire is bent into a circular coil of one turn and then into a circular coil of smaller radius having n turns. If the same current passes in both the cases, the ratio of magnetic fields produced at the centre for one turn to that of n turns is

(A) 1 : n (B) n : 1

(C) $1 : n^2$ (D) $n^2 : 1$

28. When moving coil galvanometer (MCG) is converted into a voltmeter, the series resistance is 'n' times the resistance of galvanometer. How many times that of MCG the voltmeter is now capable of measuring voltage?

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

(C) $n + 1$ (D) $n - 1$

29. The self induction (L) produced by solenoid of length 'l' having 'N' number of turns and cross sectional area 'A' is given by the formula ($\phi =$ magnetic flux, $\mu_0 =$ permeability of vacuum)

(A) $L = N\varrho$ (B) $L = \mu_0 NAl$

(C) $L = \frac{\mu_0 N^2 A}{l}$ (D) $L = \frac{\mu_0 NA}{l}$

30. A wire PQ has length 4.8 m and mass 0.06 kg . Another wire QR has length 2.56 m and mass 0.2 kg. Both wires have same radii and are joined as a single wire. This wire is under tension of 80 N. A wave pulse of amplitude 3.5 cm is sent along the wire PQ from end P. the time taken by the wave pulse to travel along the wire from point P to R is ?

(A) 0.1 s (B) 0.12 s
(C) 0.14 s (D) 0.16 s

31. When a monochromatic ray of light is passed through an equilateral glass prism, it is found that the refracted ray in glass is parallel to the base of the prism. If 'i' and 'e' denote the angles of incidence and emergence respectively, then

(A) $i > e$ (B) $i < e$
(C) $i = e$ (D) $i + e = 90^\circ$

32. A solid cylinder and a solid sphere having same mass and same radius roll down on the same inclined plane. The ratio of the acceleration of the cylinder 'a_c' to that of sphere 'a_s' is

(A) $\frac{11}{15}$ (B) $\frac{13}{14}$
(C) $\frac{15}{14}$ (D) $\frac{14}{15}$

33. An alternating voltage

$$E = 200\sqrt{2}\ \sin(100t)$$

volt is connected to a $1\mu f$ capacitor through an a.c. ammeter. The reading of the ammeter shall

(A) 10 mA (B) 20 mA
(C) 40 mA (D) 80 mA

34. A sonometer wire 49 cm long is in unison with a tuning fork of frequency 'n'. If the length of the wire is decreased by 1 cm and it is vibrated with the same tuning fork, 6 beats are heard per second. The value of 'n' is

(A) 256 Hz (B) 288 Hz
(C) 320 Hz (D) 384 Hz

35. Two spherical soap bubbles of radii 'a' and 'b' in vacuum coalesce under isothermal conditions. The resulting bubble has a radius equal to

(A) $a + b$ (B) $\frac{a+b}{2}$
(C) $\sqrt{a^2 + b^2}$ (D) $\frac{a+b}{ab}$

36. A mass 'M' is moving with constant velocity parallel to X-axis. Its angular momentum with respect to the origin is

(A) constant (B) zero
(C) decreasing (D) increasing

37. A block of mass 'M' rests on a piston executing S.H.M. of period one second. The amplitude of oscillations, so that the mass is separated from the piston, is (acceleration due to gravity,

$$g = 10\ ms^{-2}, \pi^2 = 10$$

)

(A) 0.25 m (B) 0.5 m
(C) 1 m (D) ∞

38. A machine gun fires bullets of mass 30 g with velocity of 1000 m/s. The man holding the gun can exert a maximum force of 300 N on it. How many bullets can he fire per second at most?

(A) 3 (B) 6
(C) 10 (D) 9

39. The temperature of a gas is measure of

(A) the average kinetic energy of gas molecules. (B) the average potential energy of gas molecules.
(C) the average distance between the molecules of a gas (D) the size of the molecules of a gas

40. A body (mass m) starts its motion from rest from a point distant

$$R_0\,(R_0 > R)$$

from the centre of the earth. The velocity acquired by the body when it reaches the surface of earth will be (

$$G =$$

universal constant of gravitation,

$$M =$$

mass of earth, R = radius of earth)

(A) $2GM(\frac{1}{R} - \frac{1}{R_0})$ (B) $[2GM(\frac{1}{R} - \frac{1}{R_0})]^{\frac{1}{2}}$
(C) $GM(\frac{1}{R} - \frac{1}{R_0})$ (D) $2GM[(\frac{1}{R} - \frac{1}{R_0})]^{\frac{1}{2}}$

41. An ideal refrigerator has freezer at a temperature of -13°C. The coefficient of performance of the engine is 5. The temperature of the air (to which heat is rejected) is

(A) 320°C (B) 39°C
(C) 325 K (D) 325°C

42. 1000 small water drops of equal size combine to form a big drop. The ratio of final surface energy to the total initial surface energy is

(A) 10 : 1 (B) 1 : 10

(C) 1000 : 1 (D) 1 : 1000

43. It is easier to spray water to which soap is added because addition of soap to water

(A) decreases surface tension of water (B) increases surface tension of water.

(C) makes surface tension of water zero. (D) increases its density.

44. What will be the phase difference between virtual voltage and virtual current when current in the circuit is wattless?

(A) 60° (B) 45°

(C) 90° (D) 180°

45. Two wavelengths of sodium light 590 nm and 596 nm are used one after another to study diffraction due to single slit of aperture 2×10^{-6} m. The distance between the slit and the screen is 1.5 m. The separation between the positions of first maximum of the diffraction pattern obtained in the two cases is

(A) 5.5 mm (B) 5.75 mm

(C) 6.25 mm (D) 6.75 mm

46. A coil having an inductance of

$$\frac{1}{\pi}\text{H}$$

is connected in series with a resistance of 300Ω. If 20 V from a 200 Hz source are impressed across the combination, the value of the phase angle between the voltage and the current is

(A) $\tan^{-1}(\frac{5}{4})$ (B) $\tan_{-1}(\frac{4}{5})$

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

47. The pressure and density of a diatomic gas

$$\left(\gamma = \frac{7}{5}\right)$$

changes adiabatically from (P, ρ) to (P', ρ'). If

$$\frac{\rho'}{\rho} = 32$$

then

$$\frac{\text{P}'}{\text{P}}$$

should be

(A) $\frac{1}{128}$ (B) 128

(C) 32 (D) 64

48. A source of sound is moving towards a stationary observer with

$$\left(\frac{1}{10}\right)^{\text{th}}$$

the of the speed of sound. The ratio of apparent to real frequency is

(A) 10 : 9 (B) 11 : 10

(C) $(11)^2 : (10)^2$ (D) $(9)^2 : (10)^2$

49. If E_a and E_q represent the electric field intensity due to a short dipole at a point on its axial line and on the equatorial line at the same distance 'r' from the centre of the dipole, then

(A) $\text{E}_\text{a} = \text{E}_\text{q}$ (B) $\text{E}_\text{a} = \frac{1}{2}\text{E}_\text{q}$

(C) $\text{E}_\text{a} = \frac{1}{\sqrt{2}}\text{E}_\text{q}$ (D) $\text{E}_\text{a} = 2\text{E}_\text{q}$

50. In potentiometer experiment, the balancing length is 8 m when two cells E_1 and E_2 are joined in series. When two cells are connected in opposition the balancing length is 4 m. The ratio of the e.m.f. of the two cells

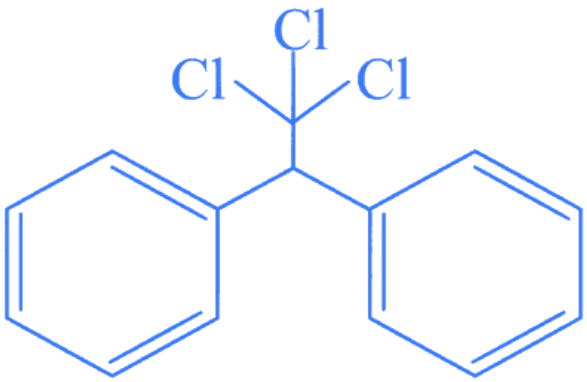
$$\left(\frac{E_1}{E_2}\right)$$

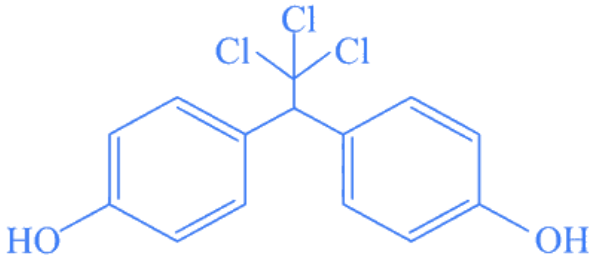
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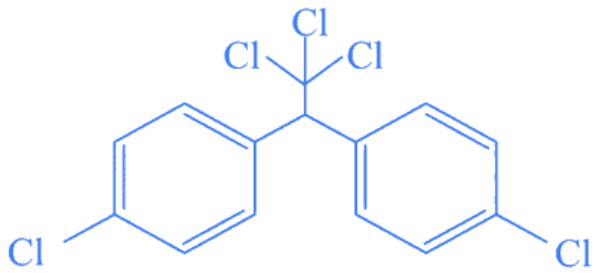
(A) 1 : 2 (B) 2 : 1

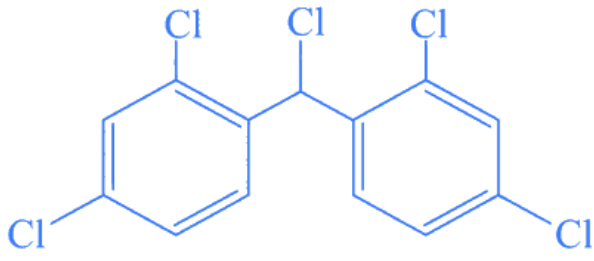
(C) 1 : 3 (D) 3 : 1

51. Which of the following is a structural formula of DDT?

(A) 

(B) 

(C) 

(D) 

52. Which among the following is haloalkyne?

(A) Chloroethyne (B) 3-Chlorobut-1-yne
(C) 1-Chloropent-2-yne (D) 4-Chloropent-2-yne

53. What type of peptide is the glycylalanine?

(A) Dipeptide (B) Tripeptide
(C) Tetrapeptide (D) Pentapeptide

54. What is Henry's law constant of a gas if solubility of gas in water at 25°C is 0.028 mol dm^{-3} ? [Partial pressure of gas = 0.346 bar]

(A) 0.081 mol $dm^{-3}bar^{-1}$
(B) 0.075 mol $dm^{-3}bar^{-1}$
(C) 0.093 mol $dm^{-3}bar^{-1}$
(D) 0.049 mol $dm^{-3}bar^{-1}$

55. Calculate the rate constant of the first order reaction if 80% of the reactant decomposes in 60 minutes.

(A) 2.68×10^{-2} $minute^{-1}$ (B) 5.36×10^{-2} $minute^{-1}$
(C) 1.34×10^{-2} $minute^{-1}$ (D) 8.1×10^{-2} $minute^{-1}$

56. Which from following polymers is classified fibres depending on inter molecular forces?

(A) Vulcanized rubber (B) Buna-S
(C) Terylene (D) Polystyrene

57. Calculate the frequency if wavelength is 750 nm.

(A) 2×10^{14} Hz (B) 4×10^{14} Hz
(C) 6×10^{15} Hz (D) 8×10^{15} Hz

58. Calculate the edge length of bcc unit cell if radius of metal atom is 227 pm.

(A) 4.54×10^{-8} cm (B) 5.24×10^{-8} cm
(C) 6.42×10^{-8} cm (D) 1.135×10^{-8} cm

59. Identify the compound 'A' in the following sequence of reactions.

$$A \xrightarrow[\text{Dryether}]{C_2H_3MgBr} B \xrightarrow{H_3O^+} \text{3-Methylpentan-3-ol}$$

(A) Propanal (B) Propanone
(C) Butanal (D) Butanone

60. A solution of nonvolatile solute is obtained by dissolving 15 g in 200 mL water has depression in freezing point 0.75 K. Calculate the molar mass of solute if cryoscopic constant of water is 1.86 K kg mol^{-1}.

(A) 160 g mol^{-1} (B) 172 g mol^{-1}
(C) 186 g mol^{-1} (D) 198 g mol^{-1}

61. For a reaction $A + B \rightarrow$ products ΔH is $-84.2\,kJ$ and ΔS is $-200\,J\,K^{-1}$. Calculate the highest value of temperature so that the reaction will proceed in forward direction.

(A) 421 K (B) 237 K

(C) 168 K (D) 273 K

62. The solubility product of $PbCl_2$ at 298 K is 3.2×10^{-5}. What is its solubility in $moldm^{-3}$?

(A) 8×10^{-6} (B) 2×10^{-2}

(C) 5.6×10^{-3} (D) 5.0×10^{-2}

63. Which among the following elements does NOT exhibit ferromagnetic properties?

(A) Cr (B) Fe

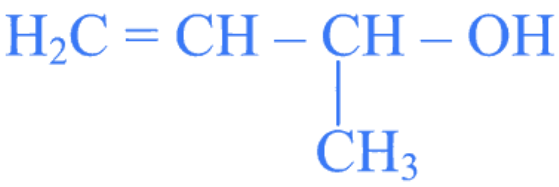
(C) Co (D) Ni

64. Which of the following is a secondary allylic alcohol?

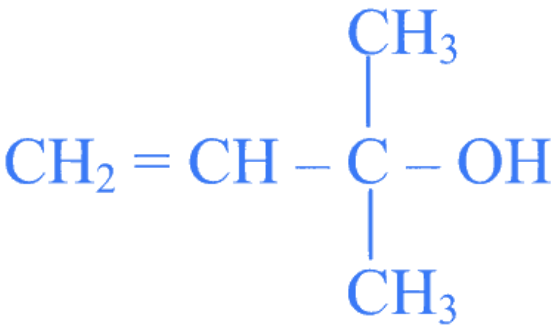
(A) $H_2C = CH - CH_2 - OH$

(B) $CH_3 - CH = CH - CH_2 - OH$

(C)



(D)



65. Which from following elements is in liquid state at room temperature?

(A) Se (B) Br

(C) I (D) S

66. Identify major product formed in the following reaction.

3-Bromo-2-methylpentane $\xrightarrow[\Delta]{\text{Alc.KOH}}$ Major product

(A) 2-Methylpentan-3-ol (B) 2-Methylpent-2-ene

(C) 4-Methylpent-3-ene (D) 4-Methylpentan-3-ol

67. What is molecular formula of cyclohexylamine?

(A) C_6H_8N (B) $C_6H_{10}N$

(C) $C_6H_{12}N$ (D) $C_6H_{13}N$

68. Identify $base_2$ for following equation according to Bronsted-Lowry theory.

$$HCl_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + Cl^-_{(aq)}$$

(A) $H_3O^+_{(aq)}$ (B) $H_2O_{(l)}$

(C) $Cl^-_{(aq)}$ (D) $HCl_{(aq)}$

69. Which of the following is Clemmensen reduction?

(A) $RCOCl \xrightarrow[Pd - BaSO_4]{H_2} RCHO + HCl$

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

(C) $RCHO \xrightarrow[\Delta]{Zn - Hg,\ Conc.\ HCl} RCH_3 + H_2O$

(D) $RCOR \xrightarrow[\Delta]{\substack{i)\ H_2N - NH_2 \\ ii)\ KOH, HO - CH_2 - CH_2 - OH}} R - CH_2 - R$

70. Which of the following gases is readily adsorbed by solid adsorbent?

(A) Cl_2 (B) N_2

(C) O_2 (D) H_2

71. Which from following is an example of two dimensional nanostructures?

(A) Nanoparticles (B) Thin films

(C) Quantum dots (D) Nanowires

72. A conductivity cell containing 0.001 M $AgNO_3$ solution develops resistance 6530ohm at 25°C. Calculate the electrical conductivity of solution at same temperature if the cell constant is $0.653\ cm^{-1}$.

(A) $1.3 \times 10^{-4}\Omega^{-1}\ cm^{-1}$

(B) $1.5 \times 10^{-4}\Omega^{-1}\ cm^{-1}$

(C) $1.7 \times 10^{-4}\Omega^{-1}\ cm^{-1}$

(D) $1.0 \times 10^{-4}\Omega^{-1}\ cm^{-1}$

73. What is the number of sp^3 hybrid carbon atoms in

$$HO(CH_2)_3CH(CH_3)CH(CH_3)_2$$

?

(A) Five (B) Two
(C) Eight (D) Four

74. Which from following thermodynamic properties is a path function?

(A) Internal energy (B) Work
(C) Entropy (D) Enthalpy

75. Which among the following species is reduced by tin easily?

(A) Iodine (B) Iron
(C) Zinc (D) Sodium

76. Which from following combinations is an example for construction of n-type semiconductor?

(A) Si doped with B (B) Si doped with P
(C) Si doped with Ga (D) Si doped with In

77. Calculate the density of metal having molar mass 210 g mol^{-1} that forms simple cubic unit cell.

$$\left(a^3 \cdot N_A = 21.5\ cm^3\ mol^{-1}\right)$$

(A) 9.77 g cm^{-3} (B) 7.15 g cm^{-3}
(C) 8.12 g cm^{-3} (D) 6.94 g cm^{-3}

78. Which element from following rapidly loses its luster in air and tarnishes?

(A) Ba (B) Be
(C) K (D) Mg

79. A neon-dioxygen mixture contains 64 g O_2 and 160 g Ne. If the total pressure is 25 bar, calculate the partial pressure of dioxygen.

(A) 5 bar (B) 7.5 bar
(C) 10 bar (D) 20 bar

80. Identify anionic sphere complex from following.

(A) Hexaamminecobalt(III) chloride
(B) Potassium hexacyanoferrate(II)
(C) Tetraamminedichlorocobalt(III) ion
(D) Pentaamminechlorocobalt(III) sulphate

81. What is the number of moles of ethane obtained from $2n$ moles of bromomethane using $2n$ moles of sodium atoms in dry ether medium?

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

82. Calculate E^0_{cell} for

$$Cd_{(s)}\left|Cd^{++}_{(1M)}\right|\left|Ag^{+}_{(1M)}\right|Ag_{(s)}$$

.

$$\left[E^0_{Cd} = -0.403\ V; E^0_{Ag} = 0.799\ V\ \right]$$

(A) 1.202 V (B) −1.202 V
(C) 0.396 V (D) −0.396 V

83. Find the number of unpaired electrons for copper in ground state configuration.

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

84. Identify the element having highest ionization enthalpy.

(A) Ti (B) Sc
(C) Zn (D) Ni

85. What is the oxidation number of Pt in $PtCl_6^{2-}$?

(A) +6 (B) +4
(C) −6 (D) −4

86. What is the value of rate constant for first order reaction if slope for the graph of rate versus concentration is 2.5×10^{-3} ?

(A) 2.5×10^{-3} $time^{-1}$ (B) 5.0×10^{-3} $time^{-1}$
(C) 7.5×10^{-3} $time^{-1}$ (D) 1.25×10^{-3} $time^{-1}$

87. An organic monobasic acid has dissociation constant 2.25×10^{-6}. What is percent dissociation in its 0.01 M solution?

(A) 1.5% (B) 15%
(C) 5% (D) 0.5%

88. Which of the following pair of compounds demonstrates the law of multiple proportions?

(A) CH_4, CCl_4 (B) BF_3, NH_3
(C) CO, CO_2 (D) NO_2, CO_2

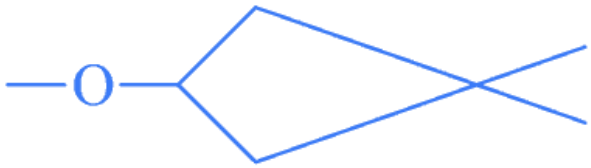
89. Which of the following amines on heating with chloroform generate foul smelling product?

(A) Ethanamine (B) Ethylmethylamine
(C) Ethyldimethylamine (D) Diethylmethylamine

90. The rate law for the reaction $A + B \rightarrow$ product is rate $= k[A][B]$. When will the rate of reaction increase by factor two?

(A) [A] and [B] both are doubled
(B) [A] is doubled and [B] is kept constant
(C) [B] is doubled and [A] is halved
(D) [A] is kept constant [B] is halved

91. What is IUPAC name of following compound?



(A) 1-Methoxy-3,3-dimethylcyclobutane
(B) 3-Methoxy-1,1-dimethylcyclobutane
(C) 3,3-Dimethylcyclobutoxymethane
(D) 1-Methoxy-3-isopropylbutane

92. Identify substrate 'A' in the following reaction.

$$2nA \xrightarrow{\text{Dimethyl cadmium}} 2n \text{ Propanone} + n \text{ Cadmium chloride}$$

(A) Ethyl chloride
(B) Ethylene dichloride
(C) Ethanoyl chloride
(D) Ethylidene dichloride

93. Which of the following is NOT a basic amino acid?

(A) Proline
(B) Lysine
(C) Arginine
(D) Histidine

94. Calculate the PV type of work for the following reaction at 1 bar pressure.

$$\underset{(150\,mL)}{C3H6(g)} + \underset{(150\,mL)}{HCl(g)} \longrightarrow \underset{(150\,mL)}{C3H7Cl(g)}$$

(A) 5.2 J
(B) 10.21 J
(C) 15.00 J
(D) 18.2 J

95. Which among the following is NOT dicarboxylic acid?

(A) Malonic acid
(B) Caproic acid
(C) Glutaric acid
(D) Succinic acid

96. Identify the element having positive electron gain enthalpy.

(A) Ne
(B) I
(C) S
(D) O

97. Identify the use of HDP from following.

(A) Insulation of electric cables
(B) Manufacture of toys
(C) Submarine cable insulation
(D) Producing extruded films

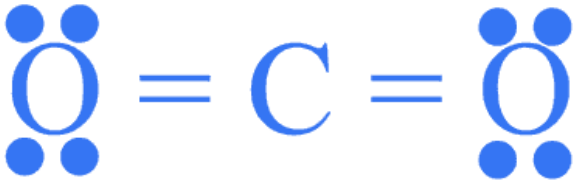
98. Which coordination complex from following contains neutral ligand?

(A) Pentacarbonyl iron(0)
(B) Trioxalatocobaltate(III) ion
(C) Sodium hexanitrocobaltate(III)
(D) Tetracyanonickelate(II) ion

99. What type of following solutions is the gasoline?

(A) Liquid as solute and liquid as solvent
(B) Liquid as solute and solid as solvent
(C) Solid as solute and liquid as solvent
(D) Gas as solute and liquid as solvent

100. What is formal charge on carbon in the following Lewis structure?



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

101. Let $z \in C$ with

$$\text{Im}(z) = 10$$

and it satisfies

$$\frac{2z-n}{2z+n} = 2i-1, i = \sqrt{-1}$$

for some natural number n, then

(A) n = 20 and Re(z) = −10

(B) n = 40 and Re(z) = −10

(C) n = 40 and Re(z) = 10

(D) n = 20 and Re(z) = 10

102. Let

$$\bar{a} = 2\hat{i} + \hat{j} - 2\hat{k}$$

and

$$\bar{b} = \hat{i} + \hat{j}$$

. If $\bar{c}$ is a vector such that

$$\bar{a} \cdot \bar{c} = |\bar{c}|, |\bar{c} - \bar{a}| = 2\sqrt{2}$$

and the angle between $\bar{a} \times \bar{b}$ and $\bar{c}$ is

$$\frac{2\pi}{3}$$

, then

$$|(\bar{a} \times \bar{b}) \times \bar{c}| =$$

(A) $\frac{\sqrt{3}}{2}$

(B) $\frac{3\sqrt{3}}{2}$

(C) $3\sqrt{3}$

(D) $4\sqrt{3}$

103. If both mean and variance of 50 observations $x_1, x_2, \ldots, x_{50}$ are equal to 16 and 256 respectively, then mean of $(x_1-5)^2, (x_2-5)^2, \ldots\ldots, (x_{50}-5)^2$ is

(A) 357

(B) 367

(C) 377

(D) 387

104. If the statement p ↔ (q → p) is false, then true statement/statement pattern is

(A) p

(B) p → (p∨ ∼ q)

(C) p ∧ (∼ p ∧ q)

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

105. If

$$|\bar{a}| = 2, |\bar{b}| = 3, |\bar{c}| = 5$$

and each of the angles between the vectors $\bar{a}$ and $\bar{b}, \bar{b}$ and $\bar{c}$, $\bar{c}$ and $\bar{a}$ is 60°, then the value of $|\bar{a} + \bar{b} + \bar{c}|$ is

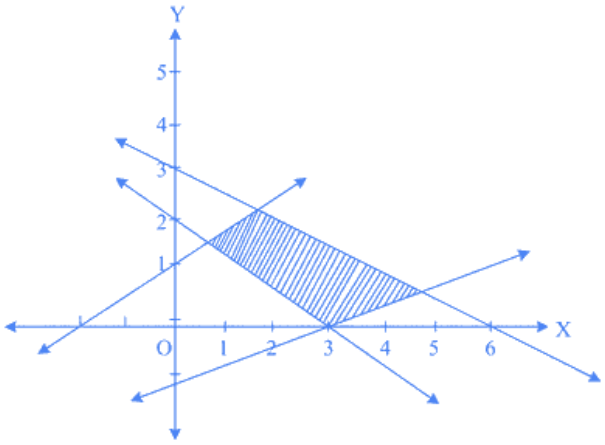
(A) $\sqrt{69}$

(B) $\sqrt{70}$

(C) $\sqrt{80}$

(D) $\sqrt{39}$

106. The shaded region in the following figure represents the solution set for a certain linear programming problem. Then linear constraints for this region are given by



(A) $2x + 3y \geq 6, -x + 2y \geq 2, 3x + 6y \leq 18, x - 3y \geq 3, x \geq 0, y \geq 0$

(B) $2x + 3y \geq 6, -x + 2y \leq 2, x - 3y \leq 3x + 2y \geq 18, x \geq 0, y \geq 0$

(C) $2x + 3y \leq 6, -x + 2y \geq 2, 3x + 6y \leq 18, x - 3y \leq 3, x \geq 0, y \geq 0$

(D) $2x + 3y \geq 6, 3x + 6y \leq 18, x - 3y \leq 3, -x + 2y \leq 2, x \geq 0, y \geq 0$

107. The function f defined on

$$\left(-\frac{1}{3}, \frac{1}{3}\right)$$

by

$$f(x) = \begin{cases} \frac{1}{x}\log\left(\frac{1+3x}{1-2x}\right) & , \quad x \neq 0 \\ k & , \quad x = 0 \end{cases}$$

is continuous at

$$x = 0$$

, then k is

(A) 6

(B) 1

(C) 5

(D) −5

108. The mirror image of P(2, 4, −1) in the plane

$$x - y + 2z - 2 = 0$$

is (a, b, c), then the value of $a + b + c$ is

(A) 4

(B) 5

(C) 7

(D) 9

109. If the slope of the tangent of the curve at any point is equal to $-y + e^{-x}$, then the equation of the curve passing through origin is

(A) $y + xe^x = 0$ (B) $ye^x + x = 0$

(C) $ye^x - x = 0$ (D) $y - xe^x = 0$

110. If

$$A = \begin{bmatrix} 1 & -1 \\ 2 & -1 \end{bmatrix}, B = \begin{bmatrix} 1 & 1 \\ 4 & -1 \end{bmatrix}$$

, then $(A + B)^{-1}$ is

(A) $\begin{bmatrix} \frac{-1}{2} & 0 \\ \frac{-3}{2} & \frac{1}{2} \end{bmatrix}$ (B) $\begin{bmatrix} \frac{1}{2} & 0 \\ \frac{3}{2} & \frac{-1}{2} \end{bmatrix}$

(C) $\begin{bmatrix} \frac{1}{2} & 0 \\ \frac{-3}{2} & \frac{1}{2} \end{bmatrix}$ (D) $\begin{bmatrix} \frac{1}{2} & 0 \\ \frac{3}{2} & \frac{1}{2} \end{bmatrix}$

111. The function

$$f(x) = x^3 - 6x^2 + 9x + 2$$

has maximum value when x is

(A) 1 (B) 2

(C) 3 (D) 6

112. If

$$I_n = \int_0^{\frac{\pi}{4}} \tan^n \theta d\theta$$

, then

$$I_{12} + I_{10} =$$

(A) $\frac{1}{8}$ (B) $\frac{1}{12}$

(C) $\frac{1}{11}$ (D) $\frac{1}{10}$

113. The centre of the circle whose radius is 3 units and touching internally the circle

$$x^2 + y^2 - 4x - 6y - 12 = 0$$

at the point $(-1, -1)$ is

(A) $(\frac{4}{5}, \frac{7}{5})$ (B) $(\frac{4}{5}, \frac{-7}{5})$

(C) $(\frac{-4}{5}, \frac{-7}{5})$ (D) $(\frac{-4}{5}, \frac{7}{5})$

114. A fair die with numbers 1 to 6 on their faces is thrown. Let X denote the number of factors of the number, on the uppermost face, then the probability distribution of X is

(A)

X = x	1	2	3	4
P(X = x)	$\frac{1}{6}$	$\frac{1}{2}$	$\frac{1}{6}$	$\frac{1}{6}$

(B)

X = x	1	2	3	4
P(X = x)	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{2}$

(C)

X = x	1	2	3	4
P(X = x)	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$

(D)

X = x	1	2	3	4
P(X = x)	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{2}$	$\frac{1}{6}$

115. Let $\overline{u}, \overline{v}$ and $\overline{w}$ be the vectors such that

$$|u| = 1; |\overline{v}| = 2; |\overline{w}| = 3$$

. If the projection of $\bar{v}$ along $\bar{u}$ is equal to that of $\overline{w}$ along $\overline{u}$ and $\overline{v}, \overline{w}$ are perpendicular to each other, then $|\bar{u} - \bar{v} + \bar{w}|$ is equal to

(A) 2 (B) $\sqrt{7}$

(C) $\sqrt{14}$ (D) 14

116. If

$$y = 4x - 5$$

is a tangent to the curve

$$y^2 = px^3 + q$$

at $(2, 3)$, then $p - q$ is

(A) -5 (B) 5

(C) 9 (D) -9

117. If

$$x = \sqrt{e^{\sin^{-1} t}}$$

and

$$y = \sqrt{e^{\cos^{-1} t}}$$

, then

$$\frac{d^2y}{dx^2}$$

is

(A) $\frac{-y}{x^2}$ (B) $\frac{y^2}{2x^2}$

(C) $\frac{2y}{x^2}$ (D) $\frac{-2y}{x^2}$

118. If

$$\sum_{r=1}^{50} \tan^{-1} \frac{1}{2r^2} = p$$

then $\tan p$ is

(A) $\frac{100}{101}$ (B) $\frac{51}{50}$

(C) $\frac{50}{51}$ (D) $\frac{101}{102}$

119. The value of

$$\int e^x\left(\frac{x^2+4x+4}{(x+4)^2}\right)dx$$

is :

(A) $e^x(\frac{x}{x+4})+c$, where c is a constant of integration.

(B) $e^x(\frac{4}{x+4})+c$, where c is a constant of integration.

(C) $e^x(\frac{x}{(x+4)^2})+c$, where c is a constant of integration.

(D) $e^x(\frac{4}{(x+4)^2})+c$, where c is a constant of integration.

120. The diagonal of a square is changing at the rate of 0.5 cm/sec. Then the rate of change of area when the area is 400 cm^2 is equal to

(A) $20\sqrt{2}\ cm^2/sec$

(B) $10\sqrt{2}\ cm^2/sec$

(C) $\frac{1}{10\sqrt{2}}\ cm^2/sec$

(D) $\frac{10}{\sqrt{2}}\ cm^2/sec$

121. Let

$$\bar{a}=\hat{i}+2\hat{j}-\hat{k}$$

and

$$\bar{b}=\hat{i}+\hat{j}-\hat{k}$$

be two vectors. If $\bar{c}$ is a vector such that

$$\bar{b}\times\bar{c}=\bar{b}\times\bar{a}$$

and

$$c\cdot a=0$$

, then $\bar{c}\cdot\bar{b}$ is

(A) $\frac{1}{2}$

(B) $\frac{3}{2}$

(C) $\frac{-3}{2}$

(D) $\frac{-1}{2}$

122. Let $P\equiv(-3,0), Q\equiv(0,0)$ and $R\equiv(3,3\sqrt{3})$ be three points. Then the equation of the bisector of the angle PQR is

(A) $\frac{\sqrt{3}}{2}x+y=0$

(B) $x+\sqrt{3}y=0$

(C) $\sqrt{3}x+y=0$

(D) $x+\frac{\sqrt{3}}{2}y=0$

123. If in a regular polygon, the number of diagonals are 54, then the number of sides of the polygon are

(A) 10

(B) 12

(C) 9

(D) 6

124. Let x_0 be the point of local minima of

$$f(x)=a\cdot(b\times c)$$

where

$$a=x\hat{i}-2\hat{j}+3\hat{k}, b=-2\hat{i}+x\hat{j}-\hat{k},$$

$$c=7\hat{i}-2\hat{j}+x\hat{k}$$

, then value of $\bar{a}\cdot\bar{b}$ at

$$x=x_0$$

is

(A) 15

(B) -15

(C) 12

(D) -12

125. If a body cools from 80°C to 50°C in the room temperature of 25°C in 30 minutes, then the temperature of the body after 1 hour is

(A) 31.36°C

(B) 32.25°C

(C) 36.36°C

(D) 33.25°C

126. If

$$f(a)=2, f'(a)=1, g(a)=-1, g'(a)=2$$

, then as x approaches a,

$$\frac{g(x)f(a)-g(a)f(x)}{(x-a)}$$

approaches

(A) 3

(B) 5

(C) 0

(D) 2

127. The differential equation representing the family of curves

$$y^2=2c(x+\sqrt{c}\ )$$

, where c is a positive parameter, is of

(A) order 1, degree 4

(B) order 2, degree 3

(C) order 2, degree 4

(D) order 1, degree 3

128. If

$$\cos^{-1}x-\cos^{-1}\frac{y}{3}=\alpha$$

, where $-1\le x\le 1$, $-3\le y\le 3, x\le\frac{y}{3}$, then for all $x, y, 9x^2-6xy\cos\alpha+y^2$ is equal to

(A) $\sin^2\alpha$

(B) $3\sin^2\alpha$

(C) $9\sin^2\alpha$

(D) $\frac{4}{9}\sin^2\alpha$

129. In a triangle ABC, $m\angle A, m\angle B, m\angle C$ are in A.P. and lengths of two larger sides are 10 units, 9 units respectively, then the length (in units) of the third side is

(A) $5+\sqrt{6}$

(B) $\sqrt{5}-1$

(C) $\sqrt{6}+1$

(D) $\sqrt{5}+1$

130. The value of

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

is

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

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

131. The p.m.f. of a random variable X is

$$P(x)=\begin{cases}\frac{2x}{n(n+1)}, & x=1,2,3,\ \ldots\ n\\ 0, & \text{otherwise}\end{cases}$$

, then E(X) is

(A) $\frac{n+1}{6}$ (B) $\frac{2n+1}{6}$

(C) $\frac{n+1}{3}$ (D) $\frac{2n+1}{3}$

132. If the lines

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

and

$$\frac{x-3}{1}=\frac{y-\frac{9}{2}}{2}=\frac{z}{1}$$

intersect, then the value of k is

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

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

133. If

$$|\vec{a}|=\sqrt{3}\ ;|\vec{b}|=5;\vec{b}\cdot\vec{c}=10$$

, angle between $\vec{b}$ and $\vec{c}$ is

$$\frac{\pi}{3},$$

a

is perpendicular to $\vec{b}\times\vec{c}$. Then the value of $|\vec{a}\times(\vec{b}\times\vec{c})|$ is

(A) 20 (B) 30

(C) 60 (D) 40

134. If

$$\int\frac{x^2}{\sqrt{1-x}}dx=p\sqrt{1-x}\left(3x^2+4x+8\right)+c$$

where c is a constant of integration, then the value of p is

(A) $\frac{-2}{15}$ (B) $\frac{2}{15}$

(C) $\frac{4}{15}$ (D) $\frac{-4}{15}$

135. The centroid of the triangle formed by the lines

$$x+3y=10$$

and

$$6x^2+xy-y^2=0$$

is

(A) $(\frac{1}{3},\frac{-7}{3})$ (B) $(\frac{-1}{3},\frac{-7}{3})$

(C) $(\frac{-1}{3},\frac{7}{3})$ (D) $(\frac{1}{3},\frac{7}{3})$

136. The statement

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

is equivalent to

(A) $\sim$ r (B) p

(C) $\sim$ q (D) q

137. If

$$f(x)=\frac{2x-3}{3x-4},x\neq\frac{4}{3}$$

, then the value of $f^{-1}(x)$ is

(A) $\frac{4x-3}{3x-2}$ (B) $\frac{3x-2}{4x+3}$

(C) $\frac{3x-4}{4x-2}$ (D) $\frac{2x+3}{4x-3}$

138. If

$$f'(x)=\sin(\log x)$$

and

$$y=f\left(\frac{2x+3}{3-2x}\right)$$

, then

$$\frac{dy}{dx}$$

at

$$x=1$$

is

(A) 6sin(log5) (B) 5sin(log6)

(C) 12sin(log5) (D) 5sin(log12)

139. The area bounded by the curve

$$y=|x-2|,x=1,x=3$$

and X-axis is

(A) 3 sq. units (B) 2 sq. units

(C) 1 sq. units (D) 4 sq. units

140.

$$\int\frac{dx}{\cot^2x-1}=\frac{1}{A}\log|\sec 2x+\tan 2x|-\frac{x}{B}+c$$

, (where c is constant of integration), then

$$A+B=$$

(A) -6 (B) 6

(C) -5 (D) 5

141. There are 6 positive and 8 negative numbers. From these four numbers are chosen at random and multiplied. Then the probability, that the product is a negative number, is

(A) $\frac{496}{1001}$ (B) $\frac{505}{1001}$

(C) $\frac{490}{1001}$ (D) $\frac{504}{1001}$

142. If

$$a\cos 2\theta + b\sin 2\theta = c$$

has α and β as its roots, then the value of $\tan\alpha + \tan\beta$ is

(A) $\frac{2b}{c+a}$ (B) $\frac{2a}{b+c}$

(C) $\frac{b}{c+a}$ (D) $\frac{a}{b+c}$

143. A lot of 100 bulbs contains 10 defective bulbs. Five bulbs are selected at random from the lot and are sent to retail store. Then the probability that the store will receive at most one defective bulb is

(A) $\frac{7}{5}(\frac{9}{10})^4$ (B) $\frac{7}{5}(\frac{9}{10})^5$

(C) $\frac{6}{5}(\frac{9}{10})^4$ (D) $\frac{6}{5}(\frac{9}{10})^5$

144. Given

$$0 \le x \le \frac{1}{2}$$

, then the value of

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

is

(A) 1 (B) $\sqrt{3}$

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

145. A vector parallel to the line of intersection of the planes

$$\overline{r}\cdot(3\hat{i} - \hat{j} + \hat{k}) = 1$$

and

$$\overline{r}\cdot(\hat{i} + 4\hat{j} - 2\hat{k}) = 2$$

is

(A) $-2\hat{i} + 7\hat{j} + 13\hat{k}$ (B) $2\hat{i} - 7\hat{j} + 13\hat{k}$

(C) $-\hat{i} + 4\hat{j} + 7\hat{k}$ (D) $\hat{\mathrm{i}} - 4\hat{\mathrm{j}} + 7\hat{\mathrm{k}}$

146. The length of the perpendicular drawn from the point $(1, 2, 3)$ to the line

$$\frac{x-6}{3} = \frac{y-7}{2} = \frac{z-7}{-2}$$

is

(A) 4 units (B) 5 units

(C) 6 units (D) 7 units

147. If

$$I = \int \frac{dx}{\sin(x-a)\sin(x-b)}$$

, then I is given by

(A) $\frac{1}{\sin(b-a)}\log|\sin(x-a)\sin(x-b)| + c$, where c is a constant of integration.

(B) $\log|\frac{\sin(x-a)}{\sin(x-b)}| + c$, where c is a constant of integration.

(C) $\frac{1}{\sin(b-a)}\log|\frac{\sin(x-a)}{\sin(x-b)}| + c$, where c is a constant of integration.

(D) $\frac{1}{\sin(b-a)}\log|\frac{\sin(x-b)}{\sin(x-a)}| + c$, where c is a constant of integration.

148. Let $P(x)$ be a polynomial of degree 2, with

$$P(2) = -1, P'(2) = 0, P''(2) = 2$$

, then $P(1.001)$ is

(A) 0.002 (B) -0.002

(C) 0.004 (D) -0.004

149. If

$$y = \sqrt{(x-\sin x) + \sqrt{(x-\sin x) + \sqrt{(x-\sin x)\ldots}}}$$

, then

$$\frac{dy}{dx} =$$

(A) $\frac{1-\cos x}{2y-1}$ (B) $\frac{1+\cos x}{2y-1}$

(C) $\frac{1-\cos x}{2y+1}$ (D) $\frac{1-\sin x}{2y-1}$

150. Let

$$f(x) = 5 - |x-2|$$

and

$$g(x) = |x+1|, x \in R$$

If $f(x)$ attains maximum value at α and $g(x)$ attains minimum value at β, then

$$\lim_{x \to -\alpha\beta} \frac{(x-1)(x^2-5x+6)}{x^2-6x+8}$$

is equal to

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

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

- End of Question Paper -