MHT CET 2023 PCM May 12 Shift 1 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 uniform string is vibrating with a fundamental frequency 'n'. If radius and length of string both are doubled keeping tension constant then the new frequency of vibration is

(A) 2n (B) 3n

(C) $\frac{n}{4}$ (D) $\frac{n}{3}$

2. Let γ_1 be the ratio of molar specific heat at constant pressure and molar specific heat at constant volume of a monoatomic gas and γ_2 be the similar ratio of diatomic gas. Considering the diatomic gas molecule as a rigid rotator, the ratio

$$\frac{\gamma_2}{\gamma_1}$$

is

(A) $\frac{37}{21}$ (B) $\frac{27}{35}$

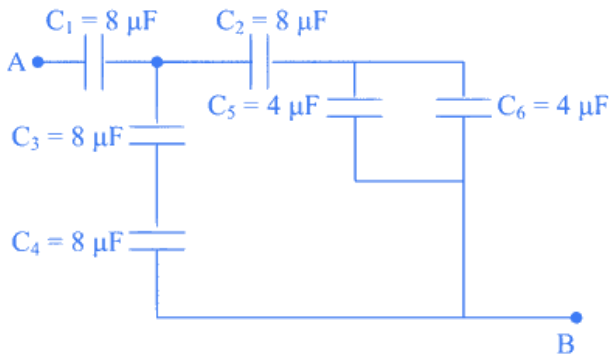
(C) $\frac{21}{25}$ (D) $\frac{35}{27}$

3. A railway track is banked for a speed ',v' by elevating outer rail by a height 'h' above the inner rail. The distance between two rails is 'd' then the radius of curvature of track is (g = gravitational acceleration)

(A) $\frac{v^2 d}{gh}$ (B) $\frac{2v^2}{gdh}$

(C) $\frac{gd}{2v^2h}$ (D) $\frac{v^2}{2ghd}$

4. In the given capacitive network the resultant capacitance between point A and B is



(A) 8 μF (B) 4 μF

(C) 2 μF (D) 16 μF

5. In Young's double slit experiment the intensities at two points, for the path difference

$$\frac{\lambda}{4}$$

and

$$\frac{\lambda}{3}$$

(λ = wavelength of light used) are I_1 and I_2 respectively. If I_0 denotes the intensity produced by each one of the individual slits then

$$\frac{I_1 + I_2}{I_0}$$

is equal to

$$\left(\cos 60^\circ = 0.5, \cos 45^\circ = \frac{1}{\sqrt{2}}\right)$$

(A) 1 (B) 2

(C) 3 (D) 4

6. A simple pendulum performs simple harmonic motion about

$$x = 0$$

with an amplitude 'a' and time period 'T'. The speed of the pendulum at

$$x = \frac{a}{2}$$

is

(A) $\frac{\pi a}{T}$ (B) $\frac{3\pi^2 a}{T}$

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

7. The molar specific heat of an ideal gas at constant pressure and constant volume is C_p and C_v respectively. If R is universal gas constant and

$$\gamma = \frac{C_p}{C_v}$$

then

C_v =

(A) $\frac{1-\gamma}{1+\gamma}$ (B) $\frac{1+\gamma}{1-\gamma}$

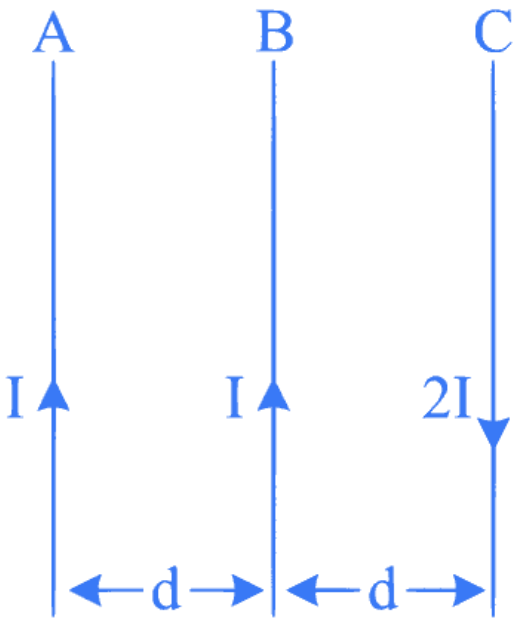
(C) $\frac{\gamma-1}{R}$ (D) $\frac{R}{\gamma-1}$

8. Resistance of a potentiometer wire is 2Ω/m. A cell of e.m.f. 1.5 V balances at 300 cm. The current through the wire is

(A) 2.5 mA (B) 7.5 mA

(C) 250 mA (D) 750 mA

9. A, B and C are three parallel conductors of equal lengths and carry currents I, I and 2I respectively as shown in figure. Distance AB and BC is same as 'd'. If 'F_1' is the force exerted by B on A and F_2 is the force exerted by C on A, then



(A) $F_1 = F_2$ (B) $F_1 = -F_2$

(C) $F_1 = 2F_2$ (D) $F_1 = \frac{1}{2} F_2$

10. Two electric dipoles of moment P and 27P are placed on a line with their centres 24 cm apart. Their dipole moments are in opposite direction. At which point the electric field will be zero between the dipoles from the centre of dipole of moment P?

(A) 6 cm (B) 8 cm

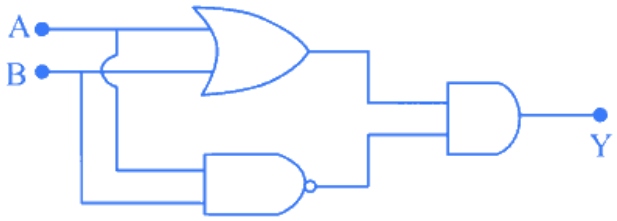
(C) 10 cm (D) 12 cm

11. Converging or diverging ability of a lens or mirror is called

(A) focal power (B) focal length

(C) magnifying power (D) linear magnification

12. The following logic gate combination is equivalent to



(A) NAND gate (B) OR gate

(C) XOR gate (D) NOT gate

13. Radiations of two photons having energies twice and five times the work function of metal are incident successively on metal surface. The ratio of the maximum velocity of photo electrons emitted in the two cases will be

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

(C) 1 : 3 (D) 1 : 4

14. Time period of simple pendulum on earth's surface is 'T'. Its time period becomes 'xT' when taken to a height R (equal to earth's radius) above the earth's surface. Then the value of 'x' will be

(A) 4 (B) 2

(C) $\frac{1}{2}$ (D) $\frac{1}{4}$

15. Consider a soap film on a rectangular frame of wire of area $3 \times 3\ \text{cm}^2$. If the area of the soap film is increased to $5 \times 5\ \text{cm}^2$, the work done in the process will be (surface tension of soap solution is $2.5 \times 10^{-2}\ \text{N/m}$)

(A) 9×10^{-6} J (B) 16×10^{-6} J

(C) 40×10^{-6} J (D) 80×10^{-6} J

16. In Lyman series, series limit of wavelength is λ_1. The wavelength of first line of Lyman series is λ_2 and in Balmer series, the series limit of wavelength is λ_3. Then the relation between λ_1, λ_2 and λ_3 is

(A) $\lambda_1 = \lambda_2 + \lambda_3$ (B) $\lambda_2 = \lambda_1 + \lambda_3$

(C) $\frac{1}{\lambda_1} = \frac{1}{\lambda_2} - \frac{1}{\lambda_3}$ (D) $\frac{1}{\lambda_1} - \frac{1}{\lambda_2} = \frac{1}{\lambda_3}$

17. The magnetic moment of a current (I) carrying circular coil of radius 'r' and number of turns 'n' depends on

(A) n only (B) I only

(C) r only (D) n, I and r

18. A spherical drop of liquid splits into 1000 identical spherical drops. If 'E_1' is the surface energy of the original drop and 'E_2' is the total surface energy of the resulting drops, then

$$\frac{E_1}{E_2} = \frac{x}{10}$$

. Then value of 'x' is

(A) 9 (B) 7

(C) 3 (D) 1

19. The displacement of two sinusoidal waves is given by the equation

$$y_1 = 8\sin(20x - 30t)$$

$$y_2 = 8\sin(25x - 40t)$$

then the phase difference between the waves after time

$$t = 2\text{ s}$$

and distance

$$x = 5\text{ cm}$$

will be

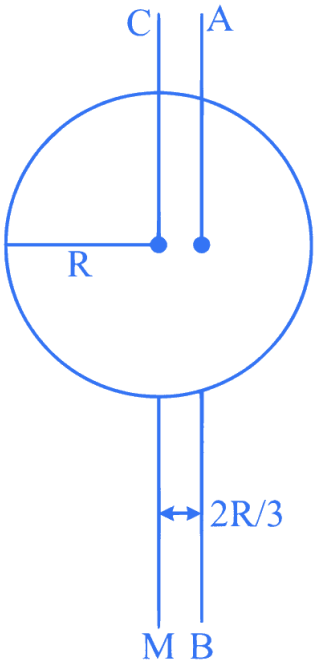
(A) 2 radian (B) 3 radian

(C) 4 radian (D) 5 radian

20. I_1 is the moment of inertia of a circular disc about an axis passing through its centre and perpendicular to the plane of disc. I_2 is its moment of inertia about an axis AB perpendicular to plane and parallel to axis CM at a distance

$$\frac{2R}{3}$$

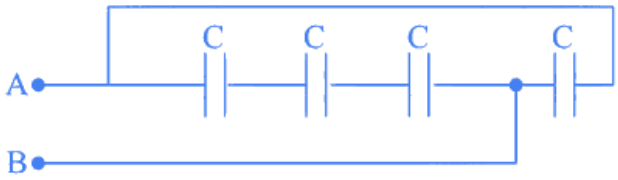
from centre. The ratio of I_1 and I_2 is $x : 17$. The value of 'x' is (R = radius of the disc)



(A) 9 (B) 12

(C) 15 (D) 17

21. The equivalent capacity between terminal A and B is



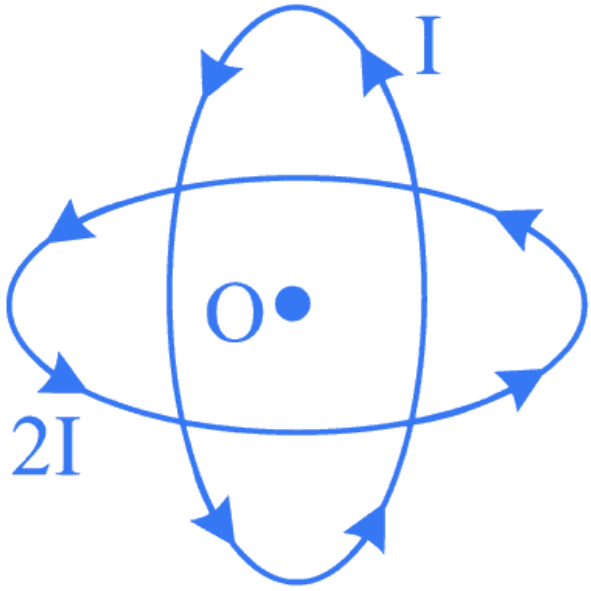
(A) $\frac{C}{4}$ (B) $\frac{3C}{4}$

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

22. Two similar coils each of radius R are lying concentrically with their planes at right angles to each other. The current flowing in them are I and 2I. The resultant magnetic field of induction at the centre will be

$$(\mu_0 =$$

Permeability of vacuum)



(A) $\frac{\mu_0 I}{2R}$ (B) $\frac{\mu_0 I}{R}$

(C) $\frac{3\mu_0 I}{2R}$ (D) $\frac{\sqrt{5}\mu_0 I}{2R}$

23. The logic gate combination circuit shown in the figure performs the logic function of



(A) AND gate (B) NAND gate

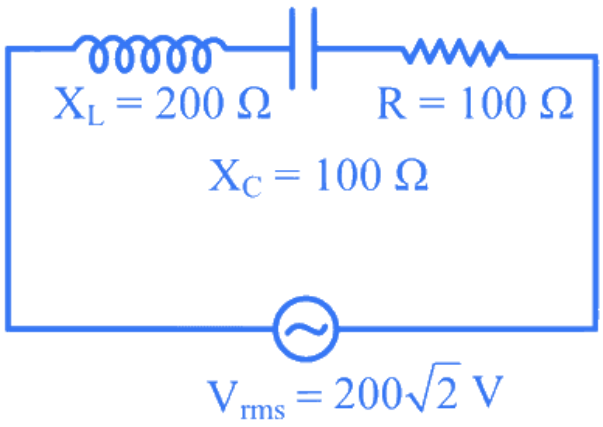
(C) OR gate (D) XOR gate

24. Two sounding sources send waves at certain temperature in air of wavelength 50 cm and 50.5 cm respectively. The frequency of sources differ by 6 Hz. The velocity of sound in air at same temperature is

(A) 300 m/s (B) 303 m/s

(C) 313 m/s (D) 330 m/s

25. In the given circuit, r.m.s. value of current through the resistor R is



(A) 2 A (B) 0.5 A

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

26. A particle of mass 'm' moving east ward with a speed 'v' collides with another particle of same mass moving north-ward with same speed 'v'. The two particles coalesce after collision. The new particle of mass '2 m' will move in north east direction with a speed (in m/s)

(A) V (B) 2 V

(C) $\frac{V}{2}$ (D) $\frac{V}{\sqrt{2}}$

27. The height at which the weight of the body becomes

$$\left(\frac{1}{9}\right)^{th}$$

its weight on the surface of earth is

(R = radius of earth)

(A) 8R (B) 4R

(C) 3R (D) 2R

28. A single turn current loop in the shape of a right angle triangle with side 5 cm, 12 cm, 13 cm is carrying a current of 2 A. The loop is in a uniform magnetic field of magnitude 0.75 T whose direction is parallel to the current in the 13 cm side of the loop. The magnitude of the magnetic force on the 5 cm side will be

$$\frac{x}{130}\ N$$

. The value of 'x' is

(A) 4 (B) 9

(C) 12 (D) 15

29. 41 tuning forks are arranged in increasing order of frequency such that each produces 5 beats/second with next tuning fork. If frequency of last tuning fork is double that of frequency of first fork. Then frequency of first and last fork is

(A) 400, 200 Hz (B) 200, 400 Hz

(C) 100, 200 Hz (D) 205, 410 Hz

30. In two separate setups for Biprism experiment using same wavelength, fringes of equal width are obtained. If ratio of slit separation is 2 : 3 then the ratio of the distance between the slit and screen in the two setups is

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

(C) 4 : 9 (D) 9 : 4

31. A composite slab consists of two materials having coefficient of thermal conductivity K and 2 K, thickness x and 4x respectively. The temperature of the two outer surfaces of a composite slab are T_2 and

$$T_1 (\ T_2 > T_1)$$

. The rate of heat transfer through the slab in a steady state is

$$\left[\frac{A(T_2 - T_1)K}{x}\right] \cdot f$$

where 'f' is equal to

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

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

32. A black sphere has radius 'R' whose rate of radiation is 'E' at temperature 'T'. If radius is made $R/3$ and temperature '$3T$', the rate of radiation will be

(A) E (B) 3E

(C) 6E (D) 9E

33. The potential on the plates of capacitor are $+20$ V and -20 V. The charge on the plate is 40C. The capacitance of the capacitor is

(A) 2 F (B) 1 F

(C) 4 F (D) 0.5 F

34. A thin uniform circular disc of mass 'M' and radius 'R' is rotating with angular velocity 'ω', in a horizontal plane about an axis passing through its centre and perpendicular to its plane. Another disc of same radius but of mass

$$\left(\frac{M}{2}\right)$$

is placed gently on the first disc co-axially. The new angular velocity will be

(A) $\frac{2}{3}\omega$ (B) $\frac{4}{5}\omega$

(C) $\frac{5}{4}\omega$ (D) $\frac{3}{2}\omega$

35. A gas at normal temperature is suddenly compressed to one-fourth of its original volume. If

$$\frac{C_p}{C_v} = \gamma = 1.5$$

, then the increase in its temperature is

(A) 273 K (B) 373 K

(C) 473 K (D) 573 K

36. When light of wavelength λ is incident on a photosensitive surface the stopping potential is 'V '. When light of wavelength 3λ is incident on same surface the stopping potential is

$$\frac{V}{6}$$

. Then the threshold wavelength for the surface is

(A) 2λ (B) 3λ

(C) 4λ (D) 5λ

37. One of the necessary condition for total internal reflection to take place is

(

$$i =$$

angle of incidence,

$$i_c =$$

critical angle)

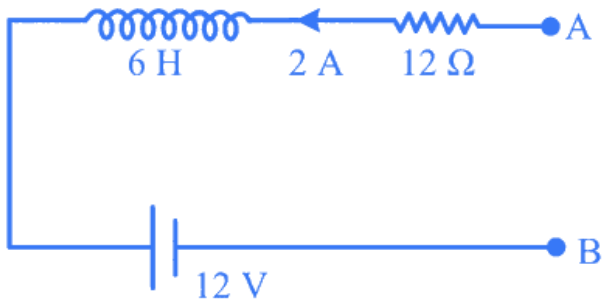
(A) $i < i_c$ (B) $i = i_c$

(C) $i = \frac{\pi^e}{2}$ (D) $i > i_c$

38. In the given circuit, if

$$\frac{dI}{dt} = -1 \text{ A/s}$$

then the value of $(V_A - V_B)$ at this instance will be



(A) 30 V (B) 24 V

(C) 18 V (D) 9 V

39. An inductor of 0.5 mH, a capacitor of 20 μF and a resistance of 20Ω are connected in series with a 220 V a.c. source. If the current is in phase with the e.m.f. the maximum current in the circuit is $\sqrt{x}A$. The value of 'x' is

(A) 44 (B) 82

(C) 146 (D) 242

40. The wavelength of radiation emitted is 'λ_0' when an electron jumps from the second excited state to the first excited state of hydrogen atom. If the electron jumps from the third excited state to the second orbit of the hydrogen atom, the wavelength of the radiation emitted will be

$$\frac{20}{x}\lambda_0$$

. The value of x is

(A) 3 (B) 9

(C) 13 (D) 27

41. Two particles having mass 'M' and 'm' are moving in a circular path with radius 'R' and 'r' respectively. The time period for both the particles is same. The ratio of angular velocity of the first particle to the second particle will be

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

(C) 2 : 3 (D) 3 : 4

42. The excess pressure inside a first spherical drop of water is three times that of second spherical drop of water. Then the ratio of mass of first spherical drop to that of second spherical drop is

(A) 1 : 3 (B) 1 : 6

(C) 1 : 9 (D) 1 : 27

43. When forward bias is applied to a p-n junction, then what happens to the potential barrier (V_B) and the width (X) of the depletion region?

(A) V_B increase, X decreases
(B) V_B decreases, X increase
(C) V_B increase, X increase
(D) V_B decreases, X decreases

44. Two inductors of 60 mH each are joined in parallel. The current passing through this combination is 2.2 A. The energy stored in this combination of inductors in joule is

(A) 0.0333
(B) 0.0667
(C) 0.0726
(D) 0.0984

45. A beam of light is incident on a glass plate at an angle of 60°. The reflected ray is polarized. If angle of incidence is 45° then angle of refraction is

(A) $\sin^{-1}(\frac{1}{\sqrt{6}})$
(B) $\sin^{-1}(\frac{1}{\sqrt{3}})$
(C) $\sin^{-1}(\sqrt{\frac{3}{2}})$
(D) $\cos^{-1}(\sqrt{\frac{3}{2}})$

46. Consider a light planet revolving around a massive star in a circular orbit of radius 'r' with time period 'T'. If the gravitational force of attraction between the planet and the star is proportional to

$$r^{\frac{7}{2}}$$

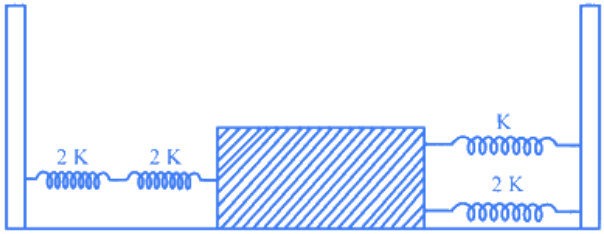
, then T^2 is proportional to

(A) $r^{9/2}$
(B) $r^{7/2}$
(C) $r^{5/2}$
(D) $r^{3/2}$

47. A potentiometer wire has length of 5 m and resistance of 16Ω. The driving cell has an e.m.f. of 5 V and an internal resistance of 4Ω. When the two cells of e.m.f.s 1.3 V and 1.1 V are connected so as to assist each other and then oppose each other, the balancing lengths are respectively

(A) 3 m, 0.25 m
(B) 0.25 m, 3 m
(C) 2.5 m, 0.3 m
(D) 0.3 m, 2.5 m

48. Four massless springs whose force constants are 2 K, 2 K, K and 2 K respectively are attached to a mass M kept on a frictionless plane as shown in figure, If mass M is displaced in horizontal direction then frequency of oscillating system is



(A) $\frac{1}{2\pi}\sqrt{\frac{K}{4M}}$
(B) $\frac{1}{2\pi}\sqrt{\frac{4K}{M}}$
(C) $\frac{1}{2\pi}\sqrt{\frac{K}{7M}}$
(D) $\frac{1}{2\pi}\sqrt{\frac{7K}{M}}$

49. About black body radiation, which of the following is the wrong statement?

(A) For all wavelengths, intensity is same.
(B) For shorter wavelengths, intensity is more.
(C) For longer wavelengths, intensity is less.
(D) All wavelengths are emitted by a black body.

50. Two coils have a mutual inductance of 0.004 H. The current changes in the first coil according to equation

$$I = I_0 \sin \omega t$$

, where

$$I_0 = 10 \text{ A}$$

and

$$\omega = 50\,\pi \text{ rad s}^{-1}$$

. The maximum value of e.m.f. in the second coil in volt is

(A) 5π
(B) 4π
(C) 2.5π
(D) 2π

51. Find [OH] if a monoacidic base is 3% ionised in its 0.04 M solution.

(A) 3.1×10^{-2} mol L^{-1} (B) 4.5×10^{-3} mol L^{-1}

(C) 9.0×10^{-2} mol L^{-1} (D) 1.2×10^{-3} mol L^{-1}

52. Calculate ΔG° for the reaction

$$Mg_{(s)} + Sn^{++}_{(aq)} \longrightarrow Mg^{++}_{(aq)} + Sn_{(s)}$$

if E^{0}_{cell} is 2.23 V.

(A) -430.4 kJ (B) 215.2 kJ

(C) 645.6 kJ (D) -860.8 kJ

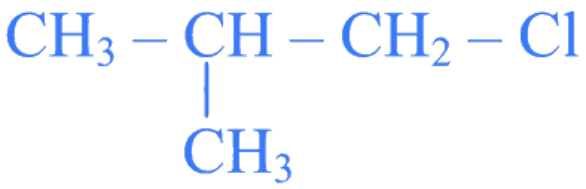
53. If lattice enthalpy and hydration enthalpy of KCl are 699 kJ mol^{-1} and -681.8 kJ mol^{-1} respectively. What is the enthalpy of solution of KCl ?

(A) 8.20 kJ mol^{-1} (B) 10.25 kJ mol^{-1}

(C) 13.80 kJ mol^{-1} (D) 17.20 kJ mol^{-1}

54. Which of the following compounds does NOT undergo Williamson's synthesis?

(A) $C_2H_5 - Cl$



(B)

(C) $C_6H_5 - Cl$

(D) $CH_3 - CH_2 - CH_2 - Cl$

55. What is the expression for solubility product of silver chromate if it's solubility is expressed as S mol L^{-1} ?

(A) $2\ S^2$ (B) $3\ S^3$

(C) $4\ S^3$ (D) $27\ S^4$

56. Which from following is a non-ferrous alloy?

(A) Nickel steel (B) Chromium steel

(C) Stainless steel (D) Brass

57. What are the number of octahedral and tetrahedral voids in 0.3 mole substance respectively if it forms hcp structure?

(A) 1.8066×10^{23} and 3.6132×10^{23} (B) 3.6132×10^{23} and 1.8066×10^{23}

(C) 6.022×10^{23} and 12.044×10^{23} (D) 12.044×10^{23} and 6.022×10^{23}

58. Calculate the molar mass of an element having density 7.8 g cm^{-3} that forms bcc unit cell.

$$\left[a^3 \cdot N_A = 16.2\ cm^3\ mol^{-1}\right]$$

(A) 63.18 g mol^{-1} (B) 61.23 g mol^{-1}

(C) 59.31 g mol^{-1} (D) 65.61 g mol^{-1}

59. Which among the following compounds exhibits +2 oxidation state of oxygen?

(A) H_2O (B) SO_2

(C) OF_2 (D) H_2O_2

60. Identify substrate A in the following reaction.

$$A + AgOH \xrightarrow[ii)\ \Delta]{i)\ moist\ Ag_2O} CH_3CH_2\ N$$

$$(CH_3)_2 + CH_2 = CH_2$$

(A) Diethyldimethyl ammonium halide (B) Ethyltrimethyl ammonium halide

(C) Diethyldimethyl ammonium hydroxide (D) Ethyltrimethyl ammonium hydroxide

61. What volume of $CO_{2(g)}$ at STP is obtained by complete combustion of 6 g carbon?

(A) 22.4 dm^3 (B) 11.2 dm^3

(C) 5.6 dm^3 (D) 2.24 dm^3

62. Identify the chiral molecule from the following.

(A) 2-Iodopropane (B) 2-Iodo-2-methylbutane

(C) 2-lodo-3-methylbutane (D) 3-Iodopentane

63. Calculate the time needed for reactant to decompose 99.9% if rate constant of first order reaction is 0.576 $minute^{-1}$.

(A) 8 minutes (B) 12 minutes

(C) 16 minutes (D) 20 minutes

64. What is the number of moles of sp^3 hybrid carbon atoms in one mole of 2-Methylbut-2-ene?

(A) Four (B) Three

(C) Two (D) One

65. Identify major product A in following reaction.

3-Bromo-2-methylpentane $\xrightarrow[\Delta]{\text{alc.KOH}}$ A

(A) 2-Methylpentan-3-ol
(B) 2-Methylpent-2-ene
(C) 4-Methylpent-3-ene
(D) 4-Methylpentan-3-ol

66. For reaction,

$$CO_{(g)} + \frac{1}{2}O_{2(g)} \longrightarrow CO_{2(g)}$$

Which of the following equations is CORRECT at constant T and P ?

(A) $\Delta H < \Delta U$
(B) $\Delta H > \Delta U$
(C) $\Delta H = \Delta U$
(D) $\Delta H = 0$

67. Identify the example of zero-dimensional nanostructure from following.

(A) Nanotubes
(B) Fibres
(C) Thin films
(D) Quantum dots

68. What is pH of solution containing 50 mL each of 0.1 M sodium acetate and 0.01 M acetic acid?

$$\left(pK_a CH_3COOH = 4.50\right)$$

(A) 2.5
(B) 3.5
(C) 4.5
(D) 5.5

69. Calculate amount of methane formed by liberation of 149.6 kJ of heat using following equation.

$$C_{(s)} + 2H_{2(g)} \longrightarrow CH_{4(g)} \quad \Delta H = -74.8 \text{ kJ/mol}$$

(A) 16 g
(B) 24 g
(C) 32 g
(D) 48 g

70. Which from following polymers is used to obtain tyre cords?

(A) Nylon 6
(B) Polyacrylonitrile
(C) Bakelite
(D) Terylene

71. Electrolytic cells containing Zn and Al salt solutions are connected in series. If 6.5 g of Zn is deposited in one cell calculate mass of Al deposited in second cell (molar mass : $Zn = 65, Al = 27$) by passing definite quantity of electricity?

(A) 2.4 g
(B) 2.1 g
(C) 2.7 g
(D) 1.8 g

72. What type of glycosidic linkages are present in cellulose?

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

73. Calculate the rate constant of first order reaction if half life of reaction is 40 minutes.

(A) 1.733×10^{-2} minute^{-1}
(B) 1.951×10^{-2} minute^{-1}
(C) 1.423×10^{-2} minute^{-1}
(D) 1.256×10^{-2} minute^{-1}

74. Identify product 'B' in following sequence of reactions.

2n Propanone $\xrightarrow{Ba(OH)_2}$ A $\xrightarrow[-H_2O]{\Delta}$ nB

(A) 4-Hydroxy-4-methylpentan-2-one
(B) 2-Methylpentan-3-one
(C) 2-Methylpent-2-en-4-one
(D) 4-Methylpent-3-en-2-one

75. Identify rate law expression for $2NO_{(g)} + Cl_{2(g)} \rightarrow 2NOCl_{(g)}$ if the reaction is second order in NO and first order in Cl_2.

(A) Rate $= k[NO]^2[Cl_2]$
(B) Rate $= k[NO][Cl_2]$
(C) Rate $= k[NO]^2$
(D) Rate $= k[Cl_2]$

76. Which among the following solutions has minimum boiling point elevation?

(A) 0.1 m NaCl
(B) 0.2 m KNO_3
(C) 0.1 m Na_2SO_4
(D) 0.05 m $CaCl_2$

77. Calculate osmotic pressure of solution of 0.025 mole glucose in 100 mL water at 300 K.

$$\left[R = 0.082 \text{ atmdmmol}^{-1} \text{ K}^{-1}\right]$$

(A) 1.54 atm
(B) 2.05 atm
(C) 6.15 atm
(D) 3.08 atm

78. Which from following is a neutral ligand?

(A) Aqua
(B) Sulphato
(C) Carbonato
(D) Bromo

79. How many isomers of $C_4H_{11}N$ are tertiary amines?

(A) One
(B) Two
(C) Three
(D) Four

80. Which element from following exhibits diagonal relationship with Mg ?

(A) Be (B) Li

(C) Na (D) B

81. Identify the good conductor of electricity from following band gap energy values of solids.

Solid	E gap
A	5.47 eV
B	0.0 eV
C	1.12 eV
D	0.67 eV

(A) A (B) B

(C) C (D) D

82. Identify the product obtained when ethoxybenzene reacts with hot and concentrated HI.

(A) Ethyl iodide and Phenol (B) Ethyl alcohol and Phenol

(C) Ethyl alcohol and Iodobenzene (D) Ethyl iodide and Iodobenzene

83. Identify thermosetting polymer from following

(A) Urea formaldehyde resin (B) Polythene

(C) Polystyrene (D) Polyvinyls

84. Which from following phenomena is inversely proportional with adsorption?

(A) Critical temperature of gas (B) Surface area of adsorbent

(C) Temperature of process (D) Pressure of gas

85. Calculate the frequency of blue light having wavelength 440 nm.

(A) 6.82×10^{14} Hz (B) 7.5×10^{14} Hz

(C) 4.0×10^{14} Hz (D) 5.26×10^{14} Hz

86. Which from following elements is NOT radioactive?

(A) At (B) Po

(C) Rn (D) Ar

87. Which from following is strongest reducing agent?

(A) K (B) Al

(C) Mg (D) Ag

88. What is the numerical value of spin only magnetic moment of copper in +2 state?

(A) 0.0 (B) 1.73

(C) 2.78 (D) 4.4

89. Identify the element having highest density from following.

(A) O (B) S

(C) Se (D) Te

90. What is the shape of AB_4E type of molecule according to VSEPR?

(A) See saw (B) Bent

(C) Trigonal pyramidal (D) T shape

91. The molecular formula of hexachlorobenzene is

(A) $C_6H_6Cl_6$ (B) C_6Cl_6

(C) C_6H_5Cl (D) C_6H_6Cl

92. What is the value of specific rotation exhibited by fructose molecule?

(A) $+52.7^\circ$ (B) -92.4°

(C) $+66.5^\circ$ (D) -40.3°

93. Which of the following reactions is Rosenmund reduction?

(A) $R-\underset{\underset{O}{\|}}{C}-Cl \xrightarrow[Pd\text{-}BaSO_4]{H_2} R-CHO + HCl$

(B) $R-CN \xrightarrow[H_2O]{SnCl_2,HCl} R-CHO + NH_4Cl$

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

(D) $R-\underset{\underset{O}{\|}}{C}-R \xrightarrow[ii)\ KOH,\ HO-CH_2-CH_2-OH]{i)\ H_2N-NH_2,\ \Delta} R-CH_2-R$

94. Which from following complexes contains only anionic ligands?

(A) Tetraamminedibromoplatinum (IV) bromide

(B) Potassium trioxalatoaluminate (III)

(C) Pentaaquaisothiocyanatoiron (III) ion

(D) Pentaammineaquacobalt (III) iodide

95. A hot air balloon has volume of 2000 dm^3 at 99°C. What is the new volume if air in balloon cools to 80°C ?

(A) 2428.9 dm^3 (B) 2656.9 dm^3

(C) 2814.9 dm^3 (D) 1897.8 dm^3

96. Identify the product obtained in following reaction.

n

$$CH_3MgI + H_2O \xrightarrow{\text{dry ether}}$$

product

(A) n MgI and n CH_4 (B) $\frac{n}{2}C_2H_6$

(C) n CH_3OH and n MgI (D) n CH_4 and n MgI(OH)

97. Which of following pairs is an example of isoelectronic species?

(A) $O^{--}; Na^{+}$ (B) $O^{--}; F$

(C) $K; Ca^{++}$ (D) $Ar; Al^{+3}$

98. Which from following compounds is obtained when anisole is heated with dilute sulfuric acid?

(A) Phenol and ethanol (B) Phenol and methanol

(C) Pyrogallol and methanol (D) Phloroglucinol and ethanol

99. Calculate molality of solution of a non-volatile solute having boiling point elevation 1.89 K if boiling point elevation constant of solvent is 3.15 K kg mol^{-1}.

(A) 0.4 m (B) 0.8 m

(C) 0.6 m (D) 0.3 m

100. What type of following phenomena does the Cannizzaro reaction exhibit?

(A) Nucleophilic addition (B) Elimination

(C) Disproportionation (D) Decomposition

101. If $\overline{a}, \overline{b}, \overline{c}$ are three vectors,

$$|a| = 2, |b| = 4, |c| = 1, |\overline{b} \times \overline{c}| = \sqrt{15}$$

and

$$\overline{b} = 2\overline{c} + \lambda\overline{a}$$

, then the value of λ is

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

(C) 1 (D) 4

102. The centroid of tetrahedron with vertices at $A(-1, 2, 3), B(3, -2, 1), C(2, 1, 3)$ and $D(-1, -2, 4)$ is

(A) $(\frac{3}{4}, \frac{-1}{4}, \frac{11}{4})$ (B) $(\frac{5}{4}, \frac{-3}{4}, \frac{7}{4})$

(C) $(\frac{-3}{4}, \frac{-1}{4}, \frac{11}{4})$ (D) $(\frac{-5}{4}, \frac{-3}{4}, \frac{-7}{4})$

103. Two adjacent sides of a parallelogram ABCD are given by

$$AB = 2\hat{i} + 10\hat{j} + 11\hat{k}$$

and

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

. The side AD is rotated by an acute angle α in the plane of parallelogram so that AD becomes AD′. If AD′ makes a right angle with side AB, then the cosine of the angle α is given by

(A) $\frac{8}{9}$ (B) $\frac{\sqrt{17}}{9}$

(C) $\frac{1}{9}$ (D) $\frac{4\sqrt{5}}{9}$

104. The values of a and b, so that the function

$$f(x) = \begin{cases} x + a\sqrt{2}\sin x, 0 \le x \le \frac{\pi}{4} \\ 2x\cot x + b, \frac{\pi}{4} \le x \le \frac{\pi}{2} \\ a\cos 2x - b\sin x, \frac{\pi}{2} < x \le \pi \end{cases}$$

is continuous for $0 \le x \le \pi$, are respectively given by

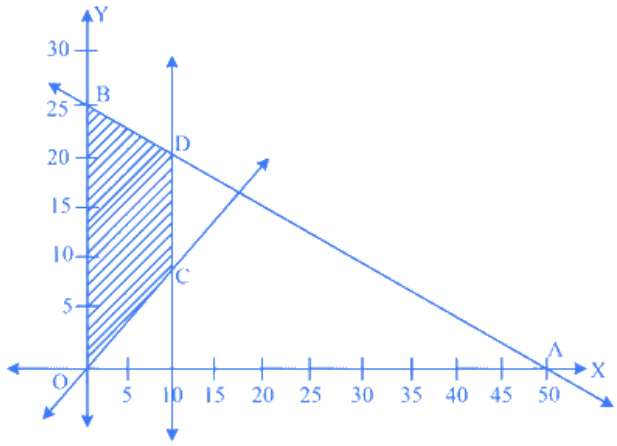
(A) $-\frac{\pi}{12}, \frac{\pi}{6}$ (B) $-\frac{\pi}{6}, -\frac{\pi}{12}$

(C) $\frac{\pi}{6}, \frac{\pi}{12}$ (D) $\frac{\pi}{6}, -\frac{\pi}{12}$

105. For a feasible region OCDBO given below, the maximum value of the objective function

$$z = 3x + 4y$$

is



(A) 70 (B) 100

(C) 110 (D) 130

106. If

$$g(x) = 1 + \sqrt{x}$$

and

$$f(g(x)) = 3 + 2\sqrt{x} + x$$

then $f(f(x))$ is

(A) $x^2 + 4x + 6$ (B) $x^4 + x^2 + 6$

(C) $x^2 + x + 6$ (D) $x^4 + 4x^2 + 6$

107. The approximate value of $\sin(60°0'10'')$ is (given that

$$\sqrt{3} = 1.732, 1° = 0.0175°$$

)

(A) 0.08660243 (B) 0.0008660243

(C) 0.8660243 (D) 0.008660243

108. The decay rate of radio active material at any time t is proportional to its mass at that time. The mass is 27 grams when

$$t = 0$$

. After three hours it was found that 8 grams are left. Then the substance left after one more hour is

(A) $\frac{27}{8}$ grams (B) $\frac{81}{4}$ grams

(C) $\frac{16}{3}$ grams (D) $\frac{16}{9}$ grams

109. The derivative of $f(\tan x)$ w.r.t. $g(\sec x)$ at

$$x = \frac{\pi}{4}$$

where

$$f'(1) = 2$$

and

$$g'(\sqrt{2}) = 4$$

is

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

(C) 1 (D) 0

110. The p.m.f of random variate X is

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

Then

$$E(X) =$$

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

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

111. The angle between the tangents to the curves

$$y = 2x^2$$

and

$$x = 2y^2$$

at $(1,1)$ is

(A) $\tan^{-1}(\frac{15}{8})$ (B) $\tan^{-1}(\frac{7}{8})$

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

112. If the area of the triangle with vertices $(1,2,0)$, $(1,0,2)$ and $(0,x,1)$ is $\sqrt{6}$ square units, then the value of x is

(A) 1 (B) 2

(C) 3 (D) 4

113. An experiment succeeds twice as often as it fails. Then the probability, that in the next 6 trials there will be atleast 4 successes, is

(A) $\frac{1}{729}$ (B) $\frac{496}{729}$

(C) $\frac{233}{729}$ (D) $\frac{491}{729}$

114. The co-ordinates of the points on the line

$$2x - y = 5$$

which are the distance of 1 unit from the line

$$3x + 4y = 5$$

are

(A) $(\frac{30}{11}, \frac{-5}{11}), (\frac{20}{11}, \frac{15}{11})$ (B) $(\frac{-30}{11}, \frac{5}{11}), (\frac{-20}{11}, \frac{15}{11})$

(C) $(\frac{30}{11}, \frac{5}{11}), (\frac{20}{11}, \frac{-15}{11})$ (D) $(\frac{-30}{11}, \frac{5}{11}), (\frac{-20}{11}, \frac{-15}{11})$

115. If

$$x = \text{cosec}\left(\tan^{-1}\left(\cos\left(\cot^{-1}\left(\sec\left(\sin^{-1} a\right)\right)\right)\right)\right), a \in [0,1]$$

(A) $x^2 - a^2 = 3$ (B) $x^2 + a^2 = 3$

(C) $x^2 - a^2 = 2$ (D) $x^2 + a^2 = 2$

116. Let $\overline{A}$ be a vector parallel to line of intersection of planes P_1 and P_2 through origin. P_1 is parallel to the vectors $2\hat{j} + 3\hat{k}$ and $4\hat{j} - 3\hat{k}$ and P_2 is parallel to $\hat{j} - \hat{k}$ and $3\hat{i} + 3\hat{j}$, then the angle between $\bar{A}$ and $2\hat{i} + \hat{j} - 2\hat{k}$ is

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

(C) $\frac{\pi}{6}$ (D) $\frac{3\pi}{4}$

117.

$$\int \frac{\text{cosec}\, x dx}{\cos^2\left(1 + \log\tan\frac{x}{2}\right)} =$$

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

(B) $\tan(1 + \log(\tan x)) + c$, where c is constant of integration

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

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

118. If the variance of the numbers $-1, 0, 1, k$ is 5, where

$$k > 0$$

, then k is equal to

(A) $2\sqrt{\frac{10}{3}}$ (B) $2\sqrt{6}$

(C) $4\sqrt{\frac{5}{3}}$ (D) $\sqrt{6}$

119. The differential equation

$$\cos(x + y)dy = dx$$

has the general solution given by

(A) $y = \sin(x + y) + c$, where c is a constant.

(B) $y = \tan(x + y) + c$, where c is a constant

(C) $y = \tan(\frac{x+y}{2}) + c$, where c is a constant

(D) $y = \frac{1}{2}\tan(x + y) + c$, where c is a constant

120. The area of the region bounded by the curves

$$y = e^x, y = \log x$$

and lines

$$x = 1, x = 2$$

is

(A) $(e-1)^2$ sq. units

(B) $(e^2 - e + 1)$ sq. units

(C) $(e^2 - e + 1 - 2\log 2)$ sq. units

(D) $(e^2 + e - 2\log 2)$ sq. units

121. If

$$x = -1$$

and

$$x = 2$$

are extreme points of

$$f(x) = \alpha \log x + \beta x^2 + x, \alpha$$

and β are constants, then the value of $\alpha^2 + 2\beta$ is

(A) -3 (B) 3

(C) $\frac{3}{2}$ (D) 5

122. A plane is parallel to two lines whose direction ratios are $1, 0, -1$ and $-1, 1, 0$ and it contains the point $(1, 1, 1)$. If it cuts the co-ordinate axes at A, B, C, then the volume of the tetrahedron OABC (in cubic units) is

(A) $\frac{9}{4}$ (B) $\frac{9}{2}$

(C) 9 (D) 27

123. The function

$$f(x) = \sin^4 x + \cos^4 x$$

is increasing in

(A) $0 < x < \frac{\pi}{8}$ (B) $\frac{\pi}{4} < x < \frac{\pi}{2}$

(C) $\frac{3\pi}{8} < x < \frac{5\pi}{8}$ (D) $\frac{5\pi}{8} < x < \frac{3\pi}{4}$

124. If

$$a > 0$$

and

$$z = \frac{(1+i)^2}{a+i}, (i = \sqrt{-1}\ )$$

has magnitude

$$\frac{2}{\sqrt{5}}$$

, then $\bar{z}$ is equal to

(A) $-\frac{2}{5} + \frac{4}{5}i$ (B) $\frac{2}{5} - \frac{4}{5}i$

(C) $-\frac{2}{5} - \frac{4}{5}i$ (D) $\frac{2}{5} + \frac{4}{5}i$

125. The integral

$$\int \frac{\sin^2 x \cos^2 x}{\left(\sin^5 x + \cos^3 x \sin^2 x + \sin^3 x \cos^2 x + \cos^5 x\right)^2} dx$$

is equal to

(A) $\frac{1}{3(1+\tan^3 x)} + c$, where c is a constant of integration.

(B) $\frac{-1}{3(1+\tan^3 x)} + c$, where c is a constant of integration.

(C) $\frac{1}{1+\cot^3 x} + c$, where c is a constant of integration.

(D) $\frac{-1}{1+\cos^3 x} + c$, where c is a constant of integration.

126. The equation of the plane through $(-1, 1, 2)$ whose normal makes equal acute angles with co-ordinate axes is

(A) $x + y + z - 3 = 0$ (B) $x + y + z - 2 = 0$

(C) $x + y - z - 2 = 0$ (D) $x - y + z - 3 = 0$

127. If T_n denotes the number of triangles which can be formed using the vertices of regular polygon of n sides and

$$T_{n+1} - T_n = 21$$

, then

$$n =$$

(A) 5 (B) 7

(C) 6 (D) 4

128. Two cards are drawn successively with replacement from a well shuffled pack of 52 cards. Then the probability distribution of number of jacks is

(A)

$X = x$	0	1	2
$P(X = x)$	$\frac{144}{169}$	$\frac{24}{169}$	$\frac{1}{169}$

(B)

$X = x$	0	1	2
$P(X = x)$	$\frac{1}{169}$	$\frac{144}{169}$	$\frac{24}{169}$

(C)

$X = x$	0	1	2
$P(X = x)$	$\frac{24}{169}$	$\frac{1}{169}$	$\frac{144}{169}$

(D)

$X = x$	0	1	2
$P(X = x)$	$\frac{144}{169}$	$\frac{1}{169}$	$\frac{24}{169}$

129. If
$$\tan\theta = \frac{\sin\alpha - \cos\alpha}{\sin\alpha + \cos\alpha}, 0 \le \alpha \le \frac{\pi}{2}$$
, then the value of $\cos 2\theta$ is

(A) $\cos 2\alpha$ (B) $\sin\alpha$

(C) $\cos\alpha$ (D) $\sin 2\alpha$

130. The solution set of
$$8\cos^2\theta + 14\cos\theta + 5 = 0$$
, in the interval $[0, 2\pi]$, is

(A) $\{\frac{\pi}{3}, \frac{2\pi}{3}\}$ (B) $\{\frac{\pi}{3}, \frac{4\pi}{3}\}$

(C) $\{\frac{2\pi}{3}, \frac{4\pi}{3}\}$ (D) $\{\frac{2\pi}{3}, \frac{5\pi}{3}\}$

131. A ladder 5 meters long rests against a vertical wall. If its top slides downwards at the rate of 10 cm/s, then the angle between the ladder and the floor is decreasing at the rate of _____ rad./s when it's lower end is 4 m away from the wall.

(A) -0.1 (B) -0.025

(C) 0.1 (D) 0.025

132. If
$$\frac{dy}{dx} = y + 3$$
and
$$y(0) = 2$$
, then
$$y(\log 2) =$$

(A) 5 (B) 7

(C) 13 (D) -2

133.
$$\text{If } \log(x + y) = 2xy, \text{ then } \frac{dy}{dx} \text{ at } x = 0 \text{ is}$$

(A) 1 (B) -1

(C) 2 (D) -2

134. If general solution of
$$\cos^2\theta - 2\sin\theta + \frac{1}{4} = 0$$
is
$$\theta = \frac{n\pi}{A} + (-1)^n\frac{\pi}{B}, n \in Z$$
, then $A + B$ has the

(A) 7 (B) 6

(C) 1 (D) -7

135. $\overline{u}, \overline{v}, \overline{w}$ are three vectors such that
$$|u| = 1, |\overline{v}| = 2, |\overline{w}| = 3$$
. If the projection of $\bar{v}$ along $\bar{u}$ is equal to projection of $\bar{w}$ along $\bar{u}$ and $\bar{v}, \bar{w}$ are perpendicular to each other, then
$$|\bar{u} - \bar{v} + \bar{w}| =$$

(A) 4 (B) $\sqrt{7}$

(C) $\sqrt{14}$ (D) 2

136. The distance of the point $P(-2, 4, -5)$ from the line
$$\frac{x+3}{3} = \frac{y-4}{5} = \frac{z+8}{6}$$
is

(A) $\frac{\sqrt{37}}{10}$ (B) $\sqrt{\frac{37}{10}}$

(C) $\frac{37}{\sqrt{10}}$ (D) $\frac{37}{10}$

137. A and B are independent events with
$$P(A) = \frac{1}{4}$$
and
$$P(A \cup B) = 2P(B) - P(A)$$
, then $P(B)$ is

(A) $\frac{1}{4}$ (B) $\frac{3}{5}$

(C) $\frac{2}{3}$ (D) $\frac{2}{5}$

138.
$$\int \frac{x^2+1}{x(x^2-1)}dx =$$

(A) $\log x(x^2 - 1) + c$, where c is a constant of integration.

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

(C) $\log(x^2 - 1) + c$, where c is a constant of integration.

(D) $\log(\frac{x^2+1}{x}) + c$, where c is a constant of integration.

139. If the matrix
$$A = \begin{bmatrix} 1 & 2 \\ -5 & 1 \end{bmatrix}$$
and
$$A^{-1} = xA + yI$$
, when I is a unit matrix of order 2 , then the value of $2x + 3y$ is

(A) $\frac{8}{11}$ (B) $\frac{4}{11}$

(C) $\frac{-8}{11}$ (D) $\frac{-4}{11}$

140. The inverse of the statement "If the surface area increase, then the pressure decreases.", is

(A) If the surface area does not increase, then the pressure does not decrease.

(B) If the pressure decreases, then the surface area increases.

(C) If the pressure does not decreases, then the surface area does not increase.

(D) If the surface area does not increase, then the pressure decreases.

141. In a triangle, the sum of lengths of two sides is x and the product of the lengths of the same two sides is y. If

$$x^2 - c^2 = y$$

, where c is the length of the third side of the triangle, then the circumradius of the triangle is

(A) $\frac{c}{3}$

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

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

(D) $\frac{y}{\sqrt{3}}$

142. The contrapositive of "If x and y are integers such that xy is odd, then both x and y are odd" is

(A) If both x and y are odd integers, then xy is odd.

(B) If both x and y are even integers, then xy is even.

(C) If x or y is an odd integer, then xy is odd.

(D) If both x and y are not odd integers, then the product xy is not odd.

143.

$$y = (1+x)\left(1+x^2\right)\left(1+x^4\right) \ldots \ldots \ldots \left(1+x^{2n}\right)$$

, then the value of

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

at

$$x = 0$$

is

(A) 0

(B) -1

(C) 1

(D) 2

144.

$$\lim_{x \to 0} \frac{\cos 7x^\circ - \cos 2x^\circ}{x^2}$$

is

(A) $\frac{-45}{2}\pi^2$

(B) $\frac{-45}{2}\pi$

(C) $\frac{-\pi^2}{1440}$

(D) $\frac{-\pi^2}{2880}$

145.

$$\int_0^4 |2x-5|dx =$$

(A) $\frac{13}{2}$

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

(C) $\frac{17}{4}$

(D) $\frac{17}{2}$

146. If λ is the perpendicular distance of a point P on the circle

$$x^2 + y^2 + 2x + 2y - 3 = 0$$

, from the line

$$2x + y + 13 = 0$$

, then maximum possible value of λ is

(A) $2\sqrt{5}$

(B) $3\sqrt{5}$

(C) $4\sqrt{5}$

(D) $\sqrt{5}$

147. If the line

$$\frac{1-x}{3} = \frac{7y-14}{2p} = \frac{z-3}{2}$$

and

$$\frac{7-7x}{3p} = \frac{y-5}{1} = \frac{6-z}{5}$$

are at right angles, then

$$p =$$

(A) $\frac{70}{11}$

(B) $\frac{11}{70}$

(C) $\frac{-70}{11}$

(D) $\frac{-11}{70}$

148. The value of $\sin\left(\cot^{-1} x\right)$ is

(A) $\frac{1}{\sqrt{1+x^2}}$

(B) $\sqrt{1+x^2}$

(C) $\frac{1}{x\sqrt{1+x^2}}$

(D) $x\sqrt{1+x^2}$

149. If

$$\int \cos^{\frac{3}{5}} x \cdot \sin^3 x dx = \frac{-1}{m}\cos^m x + \frac{1}{n}\cos^n x + c$$

, (where c is the constant of integration), then

$$(m, n) =$$

(A) $(\frac{18}{5}, \frac{8}{5})$

(B) $(\frac{-8}{5}, \frac{18}{5})$

(C) $(\frac{8}{5}, \frac{18}{5})$

(D) $(\frac{-18}{5}, \frac{-8}{5})$

150. Let PQR be a right angled isosceles triangle, right angled at P$(2,1)$. If the equation of the line QR is

$$2x + y = 3$$

, then the equation representing the pair of lines PQ and PR is

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

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

(C) $3x^2 - 3y^2 + 8xy + 10x + 15y + 20 = 0$

(D) $3x^2 - 3y^2 - 8xy - 10x - 15y - 20 = 0$

- End of Question Paper -