MHT CET 2023 PCM May 13 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. Select the 'WRONG' statement out of the following.

(A) Electromagnetic waves do not require any medium for their propagation.

(B) Electromagnetic waves can travel through vacuum with speed of light

(C) Material medium is necessary for propagation of electromagnetic waves.

(D) Electromagnetic waves are transverse in nature.

2. Two cells E_1 and E_2 having equal EMF 'E' and internal resistances r_1 and

$$r_2 (r_1 > r_2)$$

respectively are connected in series. This combination is connected to an external resistance 'R'. It is observed that the potential difference across the cell E_1 becomes zero. The value of 'R' will be

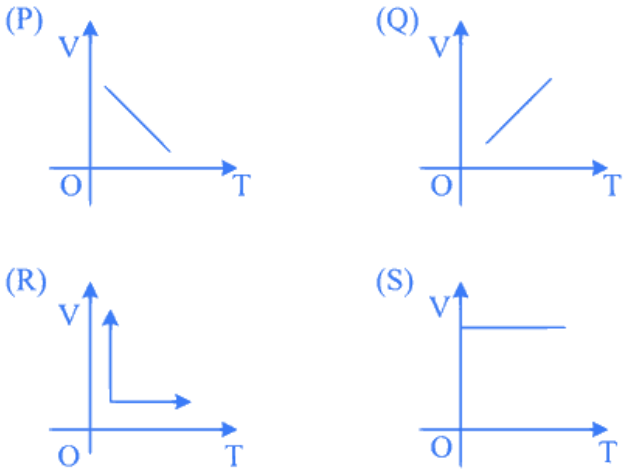
(A) $r_1 - r_2$

(B) $r_1 + r_2$

(C) $\frac{r_1 - r_2}{2}$

(D) $\frac{r_1 + r_2}{2}$

3. Which one of the following represents correctly the variation of volume (V) of an ideal gas with temperature (T) under constant pressure conditions?



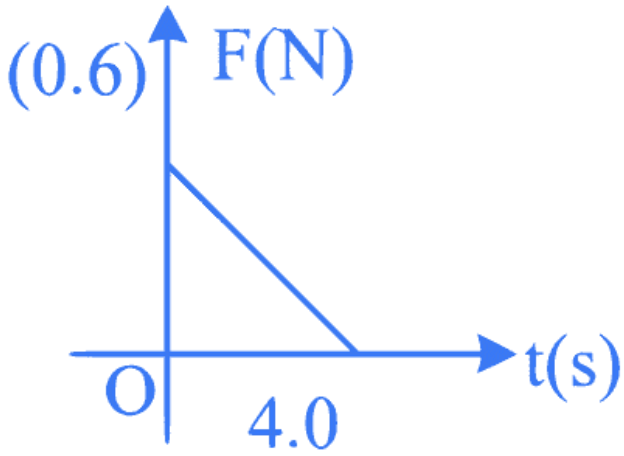
(A) P

(B) Q

(C) R

(D) S

4. Using variation of force and time given below, final velocity of a particle of mass 2 kg moving with initial velocity 6 m/s will be



(A) 10 m/s

(B) 5 m/s

(C) 12 m/s

(D) 0 m/s

5. dQ is the heat energy supplied to an ideal gas under isochoric conditions. If dU and dW denote the change in internal energy and the work done respectively then

(A) dQ = dW

(B) dQ > dU

(C) dQ < dU

(D) dQ = dU

6. A black body at temperature 127°C radiates heat at the rate of 5 cal/cm^2 s. At a temperature 927°C, its rate of emission in units of cal/cm^2 s will be

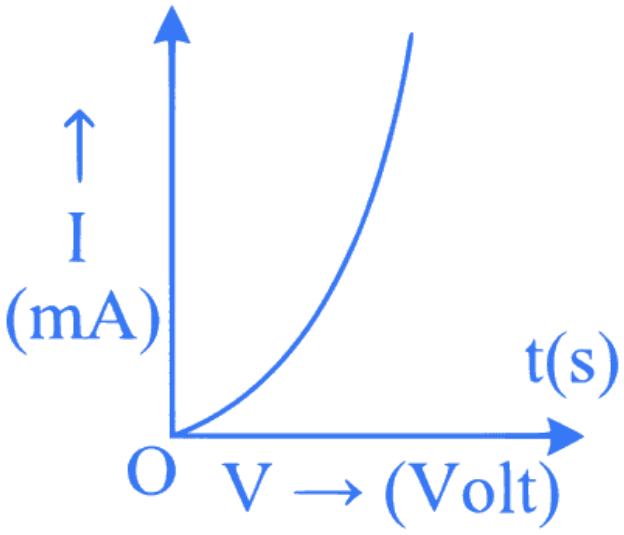
(A) 405

(B) 35

(C) 45

(D) 350

7. The following graph represents



(A) forward bias characteristics of a solar cell
(B) reverse bias characteristics of a Zener diode
(C) reverse bias characteristics of a photodiode
(D) forward bias characteristics of a LED

8. A rigid body rotates with an angular momentum L. If its rotational kinetic energy is made four times, its angular momentum will become

(A) 4 L
(B) 16 L
(C) $\sqrt{2}$ L
(D) 2 L

9. A radioactive sample has half-life of 5 years. The percentage of fraction decayed in 10 years will be

(A) 25%
(B) 50%
(C) 75%
(D) 100%

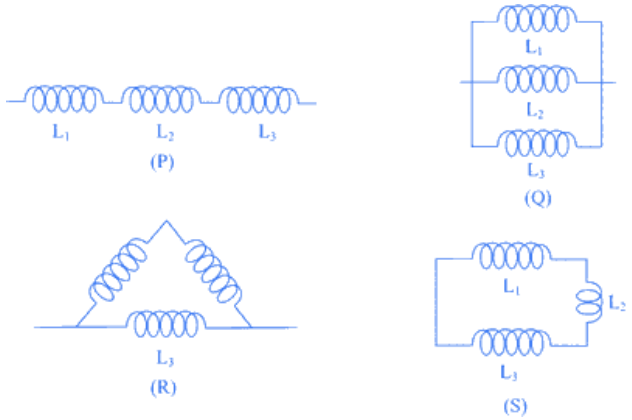
10. Three coils of inductance

$$L_1 = 2H, L_2 = 3H$$

and

$$L_3 = 6H$$

are connected such that they are separated from each other. To obtain the effective inductance of 1 henry, out of the following combinations as shown in figure, the correct one is



(A) S
(B) P
(C) R
(D) Q

11. A Carnot engine has the same efficiency between (i) 100 K and 600 K and (ii) TK and 960 K . The temperature T in kelvin of the sink is

(A) 120
(B) 160
(C) 240
(D) 320

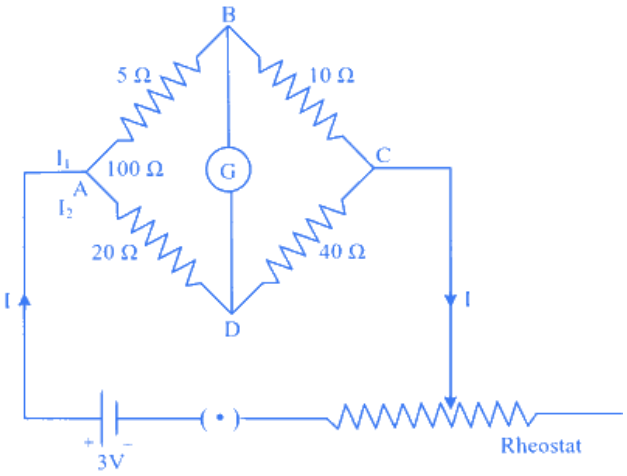
12. For which of the following substances, the magnetic susceptibility is independent of temperature?

(A) Diamagnetic only.
(B) Paramagnetic only.
(C) Ferromagnetic only.
(D) Diamagnetic and paramagnetic both.

13. When a light of wavelength 300 nm fall on a photoelectric emitter, photo electrons are emitted. For another emitter light of wavelength 600 nm is just sufficient for liberating photoelectrons. The ratio of the work function of the two emitters is

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

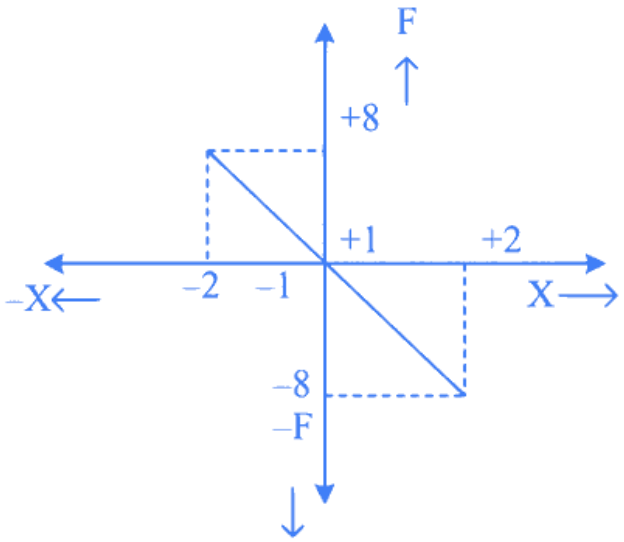
14. In a given meter bridge, the current flowing through 40Ω resistor is



(A) $I_2 + I_g$ (B) I_g

(C) $I_2 - I_g$ (D) I_2

15. A body of mass 0.04 kg executes simple harmonic motion (SHM) about $x = 0$ under the influence of force F as shown in graph. The period of



(A) 2πs (B) 0.2πs

(C) π s (D) $\frac{\pi}{2}$ s

16. A large number of water droplets each of radius 't' combine to form a large drop of Radius 'R'. If the surface tension of water is 'T' & mechanical equivalent of heat is 'J' then the rise in temperature due to this is

(A) $\frac{2\,T}{rJ}$ (B) $\frac{3\,T}{RJ}$

(C) $\frac{3T}{J}(\frac{1}{r} - \frac{1}{R})$ (D) $\frac{2\,T}{J}(\frac{1}{r} - \frac{1}{R})$

17. In resonance tube, first and second resonance are obtained at depths 22.7 cm and 70.2 cm respectively. The third resonance will be obtained at a depth

(A) 117.7 cm (B) 92.9 cm

(C) 115.5 cm (D) 113.5 cm

18. Twenty seven droplets of water each of radius 0.1 mm merge to form a single drop then the energy released is

(A) 1.6×10^{-3} J (B) 1.6 J

(C) 1600 J (D) 1.6×10^{-7} J

19. If two inputs of a NAND gate are shorted, the resulting gate is

(A) an OR gate (B) an AND gate

(C) a NOT gate (D) a NOR gate

20. Venturimeter is used to

(A) measure liquid pressure. (B) measure liquid density.

(C) measure rate of flow of liquids. (D) measure surface tension.

21. Which of the following statements is 'WRONG' for the conductors?

(A) In static situation, the interior of conductor can have no charge. (B) The net electrostatic field is zero in the interior of a conductor.

(C) The electrostatic field just outside the surface of charged conductor must be tangential to the surface at any point. (D) The electrostatic potential is constant within and on the surface of a conductor.

22. A circular coil of radius 'r' and number of turns ' n ' carries a current 'I'. The magnetic fields at a small distance 'h' along the axis of the coil (B_a) and at the centre of the coil (B_c) are measured. The relation between B_c and B_a is

(A) $B_c = B_a(1 + \frac{h^2}{r^2})$ (B) $B_c = B_a(1 + \frac{h^2}{r^2})^{\frac{1}{2}}$

(C) $B_c = B_a(1 + \frac{h^2}{r^2})^{\frac{3}{2}}$ (D) $B_c = B_a(1 + \frac{h^2}{r^2})^{-\frac{3}{2}}$

23. A spherical surface of radius of curvature 'R' separates air from glass of refractive index 1.5. The centre of curvature is in the glass. A point object P placed in air forms a real image Q in the glass. The line PQ cuts the surface at point 'O' and

$$PO = OQ = x$$

. Hence the distance 'x' is equal to

(A) 1.5 R (B) 2 R

(C) 3 R (D) 5 R

24. The rotational kinetic energy and translational kinetic energy of a rolling body are same, the body is

(A) disc (B) sphere

(C) cylinder (D) ring

25. Two concentric circular coils A and B have radii 20 cm and 10 cm respectively lie in the same plane. The current in coil A is 0.5 A in anticlockwise direction. The current in coil B so that net field at the common centre is zero, is

(A) 0.5 A in anticlockwise direction (B) 0.25 A in anticlockwise direction.

(C) 0.25 A in clockwise direction. (D) 0.125 A in clockwise direction.

26. A charged spherical conductor of radius 'R' is connected momentarily to another uncharged spherical conductor of radius 'r' by means of a thin conducting wire, then the ratio of the surface charge density of the first to the second conductor is

(A) $R : r^2$ (B) $R : r$

(C) $r : R$ (D) $1 : 1$

27. The magnet is moved towards the coil with speed 'V'. The induced e.m.f. in the coil is 'e'. The magnet and the coil move away from one another each moving with speed 'V'. The induced e.m.f. in the coil is



(A) e (B) 2e

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

28. A uniform wire 20 m long and weighing 50 N hangs vertically. The speed of the wave at mid point of the wire is (acceleration due to gravity $= g = 10\ ms^{-2}$)

(A) $4\ ms^{-1}$ (B) $10\sqrt{2}\ ms^{-1}$

(C) $10\ ms^{-1}$ (D) Zero ms^{-1}

29. A large number of bullets are fired in all directions with same speed 'U'. The maximum area on the ground on which the bullets will spread is

(A) $\frac{\pi u^2}{g}$ (B) $\frac{\pi u^4}{g^2}$

(C) $\frac{\pi^2 u^4}{g^2}$ (D) $\frac{\pi^2 u^2}{g^2}$

30. A transformer has 20 turns in the primary and 100 turns in the secondary coil. An ac voltage of

$$V_{in} = 600 \sin 314t$$

is applied to primary terminal of transformer. Then maximum value of secondary output voltage obtained in volt is

(A) 600 (B) 300

(C) 3000 (D) 6000

31. On increasing the reverse bias to a large value in a P-N junction diode, current

(A) increase slowly. (B) remains fixed.

(C) suddenly increases. (D) decreases slowly.

32. For an ideal gas the density of the gas is ρ_0 when temperature and pressure of the gas are T_0 and P_0 respectively. When the temperature of the gas is 2 T_0, its pressure will be $3P_0$. The new density will be

(A) $\frac{3}{2}\rho_0$ (B) $\frac{4}{3}\rho_0$

(C) $\frac{3}{4}\rho_0$ (D) $\frac{2}{3}\rho_0$

33. The temperature gradient in a rod of length 75 cm is 40°C/m. If the temperature of cooler end of the rod is 10°C, then the temperature of hotter end is

(A) 50°C (B) 40°C

(C) 35°C (D) 25°C

34. In an oscillating LC circuit, the maximum charge on the capacitor is 'Q'. When the energy is stored equally between the electric and magnetic fields, the charge on the capacitor becomes

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

(C) $\frac{Q}{\sqrt{2}}$ (D) $\frac{Q}{\sqrt{3}}$

35. A body of mass 'm' is raised through a height above the earth's surface so that the increase in potential energy is

$$\frac{mgR}{5}$$

. The height to which the body is raised is (R = radius of earth, g = acceleration due to gravity)

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

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

36. With increase in frequency of a.c. supply, the impedance of an L-C-R series circuit

(A) remains constant. (B) increases.

(C) decreases. (D) decreases at first, becomes minimum and then increases.

37. A passenger is sitting in a train which is moving fast. The engine of the train blows a whistle of frequency 'n'. If the apparent frequency of sound heard by the passenger is 'f' then

(A) $f = n$ (B) $f > n$

(C) $f < n$ (D) $f \leq n$

38. If the magnitude of intensity of electric field at a distance 'r_1' on an axial line and at a distance 'r_2' on an equatorial line due to a given short dipole are equal, then $r_1 : r_2$, is

(A) $\sqrt[2]{3} : 1$ (B) $\sqrt{2} : 1$

(C) $1 : 2$ (D) $1 : \sqrt[2]{3}$

39. In an a.c. circuit the instantaneous current and emf are represented as

$$I = I_0, \sin[\omega t - \pi/6]$$

and

$$E = E_0 \sin[\omega t + \pi/3]$$

respectively. The voltage leads the current by

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

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

40. In a biprism experiment, monochromatic light of wavelength 'λ' is used. The distance between two coherent sources 'd' is kept constant. If the distance between slit and eyepiece 'D' is varied as

$$D_1, D_2, D_3 \& D_4$$

and corresponding measured fringe widths are Z_1, Z_2, Z_3 and Z_4 then

(A) $Z_1D_1 = Z_2D_2 = Z_3D_3 = Z_4D_4$

(B) $\frac{Z_1}{D_1} = \frac{Z_2}{D_2} = \frac{Z_3}{D_3} = \frac{Z_4}{D_4}$

(C) $D_1\sqrt{Z_1} = D_2\sqrt{Z_2} = D_3\sqrt{Z_3} = D_4\sqrt{Z_4}$

(D) $Z_1\sqrt{D_1} = Z_2\sqrt{D_2} = Z_3\sqrt{D_3} = Z_4\sqrt{D_4}$

41. Three charges each of value $+q$ are placed at the corners of an isosceles triangle ABC of sides AB and AC each equal to 2a. The mid points of AB and AC are D and E respectively. The work done in taking a charge Q from D to E is (ε_0 = permittivity of free space)

(A) Zero (B) $\frac{3qQ}{4\pi\epsilon_0 a}$

(C) $\frac{qQ}{8\pi\epsilon_0 a}$ (D) $\frac{3qQ}{8\pi\epsilon_0 a}$

42. Light of frequency 1.5 times the threshold frequency is incident on photosensitive material. If the frequency is halved and intensity is doubled, the photocurrent becomes

(A) quadrupled (B) double

(C) half (D) zero

43. A solid cylinder of mass 3 kg is rolling on a horizontal surface with velocity 4 m/s. It collides with a horizontal spring whose one end is fixed to rigid support. The force constant of material of spring is 200 N/m. The maximum compression produced in the spring will be (assume collision between cylinder & spring be elastic)

(A) 0.7 m (B) 0.2 m

(C) 0.5 m (D) 0.6 m

44. Which one of the following statements is Wrong?

(A) A body can have zero velocity and still be accelerated.

(B) A body can have a constant velocity and still have a varying speed.

(C) A body can have a constant speed and still have a varying velocity.

(D) The direction of the velocity of a body can change when its acceleration is constant.

45. The fundamental frequency of a sonometer wir carrying a block of mass 'M' and density 'ρ' is 'n' Hz. When the block is completely immerse in a liquid of density 'σ' then the new frequency will be

(A) $\mathrm{n}[\frac{\rho-\sigma}{\rho}]^{\frac{1}{2}}$ (B) $\mathrm{n}[\frac{\rho-\sigma}{\sigma}]^{\frac{1}{2}}$

(C) $\mathrm{n}[\frac{\rho}{\rho-\sigma}]^{\frac{1}{2}}$ (D) $n[\frac{\sigma}{\rho-\sigma}]^{\frac{1}{2}}$

46. A simple pendulum has a time period 'T' in air. Its time period when it is completely immersed in a liquid of density one eighth the density of the material of bob is

(A) $(\sqrt{\frac{7}{8}})\mathrm{T}$ (B) $(\sqrt{\frac{5}{8}})\mathrm{T}$

(C) $(\sqrt{\frac{3}{8}})\mathrm{T}$ (D) $(\sqrt{\frac{8}{7}})\mathrm{T}$

47. Array of light is incident at an angle of incidence 'i' on one surface of a prism of small angle A and emerges normally from the other surface. If the refractive index of the material of the prism is 'μ', then the angle of incidence is equal to

(A) $\frac{\mathrm{A}}{2\mu}$ (B) $\frac{\mathrm{A}\mu}{2}$

(C) $\mathrm{A}\mu$ (D) $\frac{\mathrm{A}}{\mu}$

48. An isotope of the original nucleus can be formed in a radioactive decay, with the emission of following particles.

(A) one α and one β (B) one α and two β

(C) one α and four β (D) four α and one β

49. If two identical spherical bodies of same material and dimensions are kept in contact, the gravitational force between them is proportional to R^{X}, where x is non zero integer [Given : R is radius of each spherical body]

(A) -4 (B) 4

(C) 2 (D) -2

50. A and B are two interfering sources where A is ahead in phase by 54° relative to B. The observation is taken from point P such that PB $-$ PA $=$ 2.5 λ. Then the phase difference between the waves from A and B reaching point P is (in rad)

(A) 3.5π (B) 5.3π

(C) 4.3π (D) 5.8π

51. Identify cationic sphere complex from following.

(A) Tetraaminecopper(II) ion

(B) Tetracyanonickelate(II) ion

(C) Trioxalatocobaltate(III) ion

(D) Triamminetrinitrocobalt(III)

52. Identify substrate 'A' in the following conversion.

$$A + \underset{\text{(excess)}}{CH_3I} \xrightarrow{\Delta} C_2H_5(CH_3)_3\overset{+}{N}I^-$$

(A) $C_2H_5NO_2$ (B) C_2H_5CN

(C) $C_2H_5NH_2$ (D) CH_3CONH_2

53. Identify FALSE statement regarding adsorption from following.

(A) It takes place due to unbalanced forces acting on the surface of solid or liquid.

(B) During adsorption surface energy of adsorbent increases.

(C) It is caused by van der Waals forces.

(D) It is an exothermic process.

54. Find the rate of formation of $NO_{2(g)}$ in the following reaction.

$$2\,N_2O_{5(g)} \rightarrow 4NO_{2(g)} + O_{2(g)}$$

$$\left[\frac{-d[N_2O_5]}{dt} = 0.02 \text{ mol dm}^{-3}\right]$$

(A) 0.01 mol dm^{-3} (B) 0.02 mol dm^{-3}

(C) 0.03 mol dm^{-3} (D) 0.04 mol dm^{-3}

55. Which from following properties is exhibited by group 2 elements?

(A) Act as inert elements in +1 state.

(B) Form MH_2 type hydrides with hydrogen on heating.

(C) Elements at the top in the group catch fire when kept on water.

(D) Reducing power of these elements is more than group I elements.

56. Calculate the rate constant of the first order reaction if 20% of the reactant decomposes in 15 minutes.

(A) 1.488×10^{-2} minute^{-1} (B) 1.881×10^{-2} minute^{-1}

(C) 1.984×10^{-2} minute^{-1} (D) 1.18×10^{-2} minute^{-1}

57. Which from following methods of structural formula representation uses conventionally a point for front carbon and a circle around it for rear carbon?

(A) Andiron formula (B) Condensed formula

(C) Newman projection formula (D) Fisher projection formula

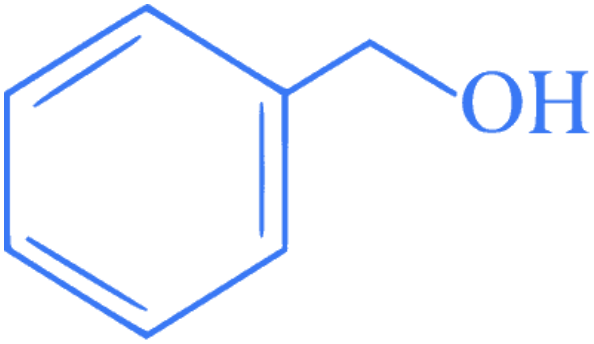
58. Identify substrate 'A' in the following sequence of reactions.

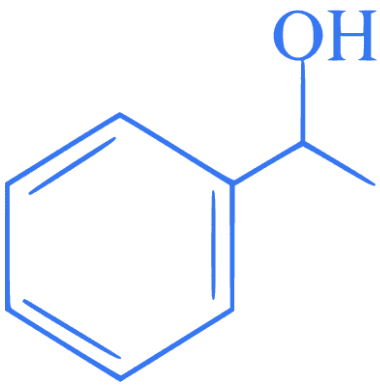
A $\xrightarrow[\Delta]{SOCl_2}$ B $\xrightarrow[C_2H_5Cl]{Na/ether}$ 2-Methylbutane

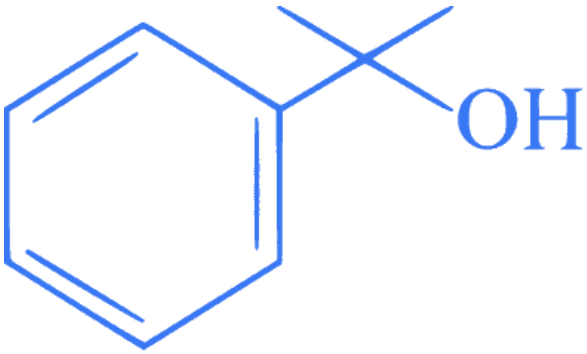
(A) Propan-1-ol (B) Propan-2-ol

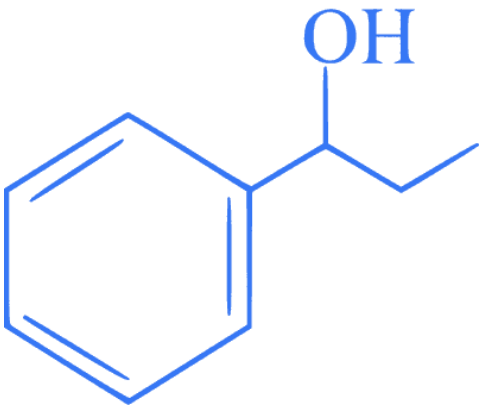
(C) 2-Chloropropane (D) Butan-2-ol

59. Which of the following is tertiary benzylic alcohol?

(A) 

(B) 

(C) 

(D) 

60. Which among the following is a feature of S_N1 mechanism?

(A) Single step mechanism
(B) Only backside attack of nucleophile
(C) Transition state contains pentacoordinate carbon
(D) Formation of planar carbocation intermediate

61. The volume of a gas is 4 dm^3 at 0°C. Calculate new volume at constant pressure when the temperature is increased by 10°C.

(A) 2.07 dm^3
(B) 3.21 dm^3
(C) 4.14 dm^3
(D) 6.54 dm^3

62. Which following reagent is used in Etard reaction?

(A) Chromium chloride
(B) Chromyl chloride
(C) Chromium oxide
(D) Chromic acid

63. Which of the following processes exhibits increase in internal energy?

(A) Adiabatic compression of gas.
(B) Adiabatic expansion of gas.
(C) Isothermal expansion of gas.
(D) Isothermal compression of gas.

64. Calculate E^0_{cell} if the equilibrium constant for following reaction is 1.2×10^6.

$$2Cu^{+}_{(aq)} \longrightarrow Cu^{++}_{(aq)} + Cu_{(s)}$$

(A) 0.36 V
(B) −0.36 V
(C) −0.18 V
(D) 0.18 V

65. Which from following alloys is used to make statues?

(A) Nichrome
(B) Stainless steel
(C) Bronze
(D) Cupra-nickel

66. Which of the following molecules does NOT obey octet rule?

(A) CCl_4
(B) Cl_2
(C) O_2
(D) BeF_2

67. Calculate van't Hoff factor of K_2SO_4 if 0.1 m aqueous solution of K_2SO_4 freezes at −0.43°C and cryoscopic constant of water is 1.86 K kg mol^{-1}.

(A) 2.3
(B) 2.7
(C) 3.1
(D) 3.5

68. Find the radius of fourth orbit of hydrogen atom if its radius of first orbit is R pm.

(A) R pm
(B) 4 R pm
(C) 9 R pm
(D) 16 R pm

69. Which noble gas element from following exhibits highest number of different oxidation states?

(A) Xe
(B) Kr
(C) Ar
(D) Ne

70. Which among the following is a pair of monocarboxylic acids?

(A) Malonic acid and propionic acid
(B) Valeric acid and succinic acid
(C) Acetic acid and adipic acid
(D) Butyric acid and caproic acid

71. Identify the overall oxidation reaction that occurs in lead storage cell during discharge.

(A) $Pb^{++}_{(aq)} + SO^{--}_{4(aq)} \longrightarrow PbSO_{4(s)}$

(B) $PbSO_{4(s)} + 2H_2O_{(f)} \longrightarrow PbO_{2(B)} + 4H^{+}_{(aq)} + SO^{--}_{4(aq)} + 2e^{-}$

(C) $Pb_{(s)} + SO^{--}_{4(aq)} \longrightarrow PbSO_{4(s)} + 2e^{-}$

(D) $PbSO_{4(s)} + 2e^{-} \longrightarrow Pb_{(s)} + SO^{--}_{4(aq)}$

72. What is the change in oxidation number of selenium in the following redox reaction?

$SeO^{2-}_{3((a))} + Cl_{2(g)} + 2OH^{-} \longrightarrow SeO^{2-}_{4((a))} + 2Cl^{-}_{((a))} + H_2O$

(A) +2 to −2
(B) −2 to +2
(C) +4 to +6
(D) +3 to +4

73. A buffer solution is prepared by mixing equimolar acetic acid and sodium acetate. If 'K_d' of acetic acid is 1.78×10^{-5}, find the pH of buffer solution.

(A) 4.75
(B) 8.9
(C) 9.4
(D) 2.6

74. What is the number of moles of nascent hydrogen required to prepare 1 mole of methane from iodomethane?

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

75. Which from following metal has hcp crystal structure?

(A) Cu
(B) Zn
(C) Ag
(D) Po

76. One mole of an ideal gas performs 900 J of work on surrounding. If internal energy increases by 625 J, find the value of ΔH.

(A) −275 J
(B) 200 J
(C) −150 J
(D) 525 J

77. Which of the following temperature values in Fahrenheit (°F) is equal to 50°C ?

(A) 90°F
(B) 100°F
(C) 110°F
(D) 122°F

78. Which from following formulae is of trioxalatocobaltate(III) ion?

(A) $[Co_3(C_2O_4)]^{3-}$
(B) $[Co(C_2O_4)_3]^{3+}$
(C) $[Co_3(C_2O_4)]^{3+}$
(D) $[Co(C_2O_4)_3]^{3-}$

79. Which of the following pair of nuclides is an example of isotones?

(A) $^{35}_{17}Cl, ^{37}_{17}Cl$
(B) $^{40}_{18}Ar, ^{40}_{19}K$
(C) $^{13}_{6}C, ^{11}_{5}B$
(D) $^{12}_{6}C, ^{11}_{5}B$

80. Identify FALSE statement from following.

(A) Boiling point of sulfur is lower than oxygen.
(B) Ionization enthalpy of group 16 elements gradually decreases from top to bottom.
(C) Group 16 elements have lower ionization enthalpy than group 15 elements in corresponding periods.
(D) Oxygen has highest electronegativity next to fluorine amongst all the elements.

81. What is IUPAC name of crotonyl alcohol?

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

82. A solution of 5.6 g non-volatile solute in 50 g solvent has elevation in boiling point 1.75 K. What is the molar mass of solute $\left(K_b = 3\ K\ kg\ mol^{-1}\right)$?

(A) 192 g mol^{-1}
(B) 200 g mol^{-1}
(C) 184 g mol^{-1}
(D) 176 g mol^{-1}

83. What is the common name of benzene-1,3-diol?

(A) Catechol (B) Resorcinol

(C) Quinol (D) Pyrogallol

84. Identify the CORRECT decreasing order of basic strength of compounds from following.

(A) $CH_3NH_2 > (CH_3)_2NH > C_6H_5NH_2 > NH_3$

(B) $(CH_3)_2NH > CH_3NH_2 > NH_3 > C_6H_5NH_2$

(C) $NH_3 > CH_3NH_2 > (CH_3)_2NH > C_6H_5NH_2$

(D) $C_6H_5NH_2 > (CH_3)_2NH > CH_3NH_2 > NH_3$

85. Calculate the work done in the following reaction at 300 K and at constant pressure.

$$\left(R = 8.314\ J\ K^{-1}\ mol^{-1}\right)$$

$$4HCl_{(g)} + O_{2(g)} \rightarrow 2Cl_{2(g)} + 2H_2O_{(g)}$$

(A) -7482 J (B) -4988 J

(C) 2494 J (D) 3200 J

86. The solubility product of $Mg(OH)_2$ is 1.8×10^{-11} at 298 K. What is its solubility in mol dm^{-3} ?

(A) 1.650×10^{-4} (B) 2.120×10^{-4}

(C) 3.184×10^{-4} (D) 4.550×10^{-4}

87. If K_{sp} is solubility product of $Al(OH)_3$, its solubility is expressed by formula,

(A) $\frac{4}{K_{sp}}\sqrt{3}$ (B) $\frac{K_{sp}}{4}\sqrt{3}$

(C) $\frac{K_{sp}}{27}\sqrt{4}$ (D) $\sqrt[27]{K_{sp} \times 4}$

88. Which from following is the slope of the graph of $[A]_t$ versus time for zero order reaction?

(A) $-k$ (B) k

(C) $\frac{k}{2.303}$ (D) $\frac{-k}{2.303}$

89. Which from following statements is NOT true about natural rubber?

(A) It is a linear polymer.

(B) In this polymer chain has coiled structure.

(C) In this polymer chains are held together by weak van der Waals forces.

(D) It is obtained from chloroprene.

90. What is the molal elevation constant if one gram mole of a nonvolatile solute is dissolved in 1 kg of ethyl acetate?

$$\left(\Delta T_b = x\ K\right)$$

(A) x K kg mol^{-1} (B) $\frac{x}{2}$ K kg mol^{-1}

(C) $2x$ K kg mol^{-1} (D) $3x$ K kg mol^{-1}

91. Which from following elements exhibits ferromagnetic properties?

(A) Mn (B) Co

(C) Zn (D) Sc

92. Which of the following is NOT a globular protein?

(A) Insulin (B) Egg albumin

(C) Serum albumin (D) Keratin

93. Calculate the time required in second to deposit 6.35 g copper from its salt solution by passing 5 ampere current. [Molar mass of

$$Cu = 63.5\ g\ mol^{-1}$$

]

(A) 3600 (B) 3700

(C) 3860 (D) 4000

94. Which from following nanomaterial has one dimension less than 100 nm ?

(A) Fibres (B) Nanoparticles

(C) Thin films (D) Microcapsules

95. Which among the following compounds has highest boiling point?

(A) Propanone (B) Ethanoic acid

(C) Propan-1-ol (D) Propanal

96. Calculate the radius of metal atom in bcc unit cell having edge length 287 pm.

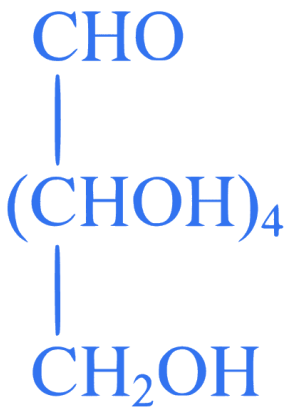
(A) 124.27 pm (B) 143.51 pm

(C) 101.45 pm (D) 57.4 pm

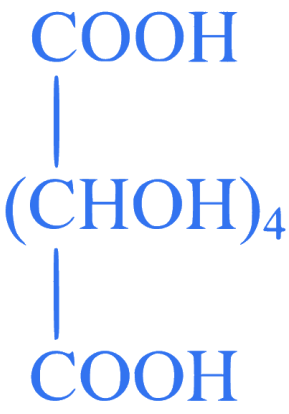
97. Identify A in the following reaction.

$$C_6H_{12}O_6 \xrightarrow[\text{dil. } HNO_3]{(O)} A$$

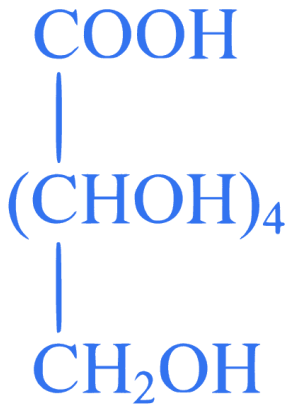
(A)



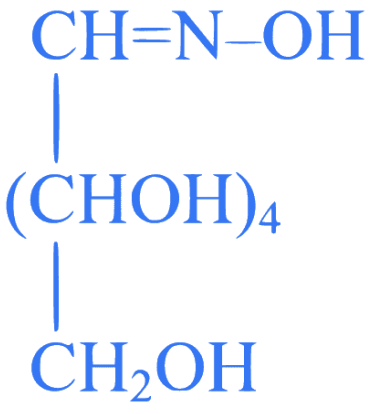
(B)



(C)



(D)



98. Which of the following is formed when propene is heated with chlorine at high temperature?

(A) 1,2-Dichloropropane
(B) 1-Chloropropane
(C) 2-Chloropropane
(D) 3-Chloropropene

99. Identify the monomer used to prepare Teflon.

(A) C_2H_4
(B) C_2H_3N
(C) $CONH_2$ and CH_2O
(D) C_2F_4

100. Calculate the number of atoms present in unit cell if an element having molar mass 23 g mol^{-1} and density 0.96 g cm^{-3}.

$[a^3 \cdot N_A = 48\ cm^3\ mol^{-1}]$

(A) 1
(B) 2
(C) 4
(D) 6

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101. If
$$f(x) = x^3 + bx^2 + cx + d$$
and
$$0 < b^2 < c$$
, then in $(-\infty, \infty)$

(A) $f(x)$ has a local maxima.
(B) $f(x)$ is strictly increasing function.
(C) $f(x)$ is bounded.
(D) $f(x)$ is strictly decreasing function.

102. Differentiation of
$$\tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$$
w.r.t.
$$\cos^{-1}\left(\sqrt{\frac{1+\sqrt{1+x^2}}{2\sqrt{1+x^2}}}\right)$$
is

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

103. The function
$$f(t) = \frac{1}{t^2 + t - 2}$$
where
$$t = \frac{1}{x-1}$$
is discontinuous at

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

104. A random variable X has the following probability distribution

X = x	0	1	2
P(X = x)	$\frac{4k-10}{k^2}$	5k − 1	$3k^3$

then P(X < 2) is

(A) $\frac{2}{9}$
(B) $\frac{5}{9}$
(C) $\frac{8}{9}$
(D) $\frac{4}{9}$

105. If
$$I = \int \frac{2x-7}{\sqrt{3x-2}}\,dx$$
, then I is given by

(A) $\frac{106}{27}(3x-2)^{\frac{3}{2}} + c$, where c is a constant of integration.
(B) $\frac{98}{27}(3x-2)^{\frac{3}{2}} + c$, where c is a constant of integration.
(C) $\frac{4}{27}(3x-2)^{\frac{3}{2}} - \frac{34}{9}(3x-2)^{\frac{1}{2}} + c$, where c is a constant of integration.
(D) $\frac{4}{27}(3x-2)^{\frac{3}{2}} + \frac{34}{9}(3x-2)^{\frac{1}{2}} + c$, where c is a constant of integration

106. Let X be random variable having Binomial distribution $B(7, p)$. If
$$P[X = 3] = 5P[X = 4]$$
, then variance of X is

(A) $\frac{7}{6}$
(B) $\frac{35}{36}$
(C) $\frac{77}{36}$
(D) $\frac{1}{36}$

107. The scalar product of vectors
$$a = \hat{i} + 2\hat{j} + \hat{k}$$
and a unit vector along the sum of vectors
$$\bar{b} = 2\hat{i} - 4\hat{j} + 5\hat{k}$$
and
$$\bar{c} = \lambda\hat{i} + 2\hat{j} - 3\hat{k}$$
is one, then the value of λ is

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

108.
$$\int \frac{\log(x^2+a^2)}{x^2}dx =$$

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

109. The parametric equations of the curve
$$x^2 + y^2 + ax + by = 0$$
are

(A) $x = \frac{a}{2} + \sqrt{\frac{a^2+b^2}{4}}\cos\theta, y = \frac{b}{2} + \sqrt{\frac{a^2+b^2}{4}}\sin\theta$

(B) $x = \frac{a}{2} - \sqrt{\frac{a^2+b^2}{4}}\cos\theta, y = \frac{b}{2} - \sqrt{\frac{a^2+b^2}{4}}\sin\theta$

(C) $x = -\frac{a}{2} + \sqrt{\frac{a^2+b^2}{4}}\cos\theta, y = -\frac{b}{2} + \sqrt{\frac{a^2+b^2}{4}}\sin\theta$

(D) $x = -\frac{a}{2} - \sqrt{\frac{a^2+b^2}{4}}\cos\theta, y = -\frac{b}{2} - \sqrt{\frac{a^2+b^2}{4}}\sin\theta$

110. The sides of a triangle are three consecutive natural numbers and its largest angle is twice the smallest one, then the sides of the triangle (in units) are

(A) 3, 4, 5 (B) 4, 5, 6

(C) 5, 6, 7 (D) 2, 3, 4

111. x, y, z are in G.P. and $\tan^{-1}x, \tan^{-1}y, \tan^{-1}z$ are in A.P, then

(A) $6x = 4y = 3z$ (B) $2x = 3y = 6z$

(C) $6x = 3y = 2z$ (D) $x = y = z$

112. In $\triangle ABC$ with usual notation,
$$\frac{\cos A}{a} = \frac{\cos B}{b} = \frac{\cos C}{c}$$
and
$$a = \frac{1}{\sqrt{6}}$$
, then the area of triangle is _____ sq. units.

(A) $\frac{1}{8}$ (B) $\frac{1}{24\sqrt{3}}$

(C) $\frac{1}{24}$ (D) $\frac{1}{8\sqrt{3}}$

113. If $\hat{a}$ and $\hat{b}$ are unit vectors and
$$c = \hat{b} - (\hat{a} \times c)$$
, then minimum value of $[\hat{a}\hat{b}\bar{c}]$ is

(A) 0 (B) $\frac{1}{2}$

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

114. Angles of a triangle are in the ratio $4 : 1 : 1$. Then the ratio of its greatest side to its perimeter is

(A) $3 : (2 + \sqrt{3})$ (B) $\sqrt{3} : (2 + \sqrt{3})$

(C) $\sqrt{3} : (2 - \sqrt{3})$ (D) $1 : (2 + \sqrt{3})$

115. If a continuous random variable X has probability density function $f(x)$ given by
$$f(x) = \begin{cases} ax & , \text{if } 0 \le x < 1 \\ a & , \text{if } 1 \le x < 2 \\ 3a - ax & , \text{if } 2 \le x \le 3 \\ 0 & , \text{otherwise} \end{cases}$$
,
then a has the value

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

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

116. The value of
$$\cos(18^\circ - A) \cdot \cos(18^\circ + A) - \cos(72^\circ - A)\cos(72^\circ + A)$$ is

(A) $\cos72^\circ$ (B) $\sin54^\circ$

(C) $\sin18^\circ$ (D) $\cos54^\circ$

117. If
$$\int x^5 e^{-4x^3}\,dx = \frac{1}{48}e^{-4x^3}f(x) + c$$
, where c is a constant of integration, then $f(x)$ is given by

(A) $4x^3 + 1$ (B) $-4x^3 - 1$

(C) $-2x^3 - 1$ (D) $-2x^3 + 1$

118. The solution of the differential equation
$$e^{-x}(y+1)dy + (\cos^2 x - \sin 2x)y\,dx = 0$$
at
$$x = 0$$
,
$$y = 1$$
is

(A) $(y+1) + e^x\cos^2 x = 2$

(B) $y + \log y = e^x\cos^2 x$

(C) $\log(y+1) + e^x\cos^2 x = 1$

(D) $y + \log y + e^x\cos^2 x = 2$

119. If
$$A = \begin{bmatrix} 1 & 2 & 3 \\ -1 & 1 & 2 \\ 1 & 2 & 4 \end{bmatrix}$$
and A_{ij} is a cofactor of a_{ij} then the value of $a_{21}A_{21} + a_{22}A_{22} + a_{23}A_{23}$ is

(A) 0 (B) -2

(C) 4 (D) 3

120. Rate of increase of bacteria in a culture is proportional to the number of bacteria present at that instant and it is found that the number doubles in 6 hours. The number of bacteria becomes _____ times at the end of 18 hours.

(A) 9 (B) 6
(C) 8 (D) 3

121. The slope of the normal to the curve

$$x = \sqrt{t}$$

and

$$y = t - \frac{1}{\sqrt{t}}$$

at

$$t = 4$$

is

(A) $\frac{-17}{4}$ (B) $\frac{4}{17}$
(C) $\frac{-4}{17}$ (D) $\frac{17}{4}$

122. If

$$3f(x) - f\left(\frac{1}{x}\right) = 8\log_2 x^3, x > 0$$

, then $f(2), f(4), f(8)$ are in

(A) A.P. (B) G.P.
(C) H.P. (D) Arithmetico Geometric Progression

123. If the angle between the lines given by $x^2 - 3xy + \lambda y^2 + 3x - 5y + 2 = 0; \lambda \geq 0$ is

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

, then the value of λ is

(A) 1 (B) 2
(C) $\frac{9}{4}$ (D) -1

124. A line drawn from the point A(1, 3, 2) parallel to the line

$$\frac{x}{2} = \frac{y}{4} = \frac{z}{1}$$

, intersects the plane

$$3x + y + 2z = 5$$

in point B, then co-ordinates of point B are

(A) $(\frac{1}{6}, \frac{4}{3}, \frac{19}{12})$ (B) $(-\frac{1}{6}, -\frac{4}{3}, \frac{19}{12})$
(C) $(\frac{1}{6}, \frac{4}{3}, -\frac{19}{12})$ (D) $(-\frac{1}{6}, -\frac{4}{3}, -\frac{19}{12})$

125. The value of

$$\frac{i^{248} + i^{246} + i^{244} + i^{242} + i^{240}}{i^{249} + i^{247} + i^{245} + i^{243} + i^{241}}, (i = \sqrt{-1})$$

is

(A) i (B) 1
(C) -1 (D) $-i$

126. If

$$f(x) = \int \frac{x^2\, dx}{(1 + x^2)\left(1 + \sqrt{1 + x^2}\right)}$$

and

$$f(0) = 0$$

, then $f(1)$ is

(A) $\log(1 + \sqrt{2})$ (B) $\log(1 + \sqrt{2}) - \frac{\pi}{4}$
(C) $\log(1 + \sqrt{2}) + \frac{\pi}{4}$ (D) $\log(1 - \sqrt{2})$

127. A line L_1 passes through the point, whose p. v. (position vector) $3\hat{i}$, is parallel to the vector $-\hat{i} + \hat{j} + \hat{k}$. Another line L_2 passes through the point having p.v. $\hat{i} + \hat{j}$ is parallel to vector $\hat{i} + \hat{k}$, then the point of intersection of lines L_1 and L_2 has p.v.

(A) $2\hat{i} + 2\hat{j} + \hat{k}$ (B) $2\hat{i} + \hat{j} + \hat{k}$
(C) $2\hat{i} - \hat{j} - \hat{k}$ (D) $2\hat{i} - 2\hat{j} + \hat{k}$

128. If

$$y = \tan^{-1}\left(\frac{4\sin 2x}{\cos 2x - 6\sin^2 x}\right)$$

, then

$$\left(\frac{dy}{dx}\right)$$

at

$$x = 0$$

is

(A) 3 (B) 5
(C) 8 (D) 1

129. The expression $(p \wedge \sim q) \vee q \vee (\sim p \wedge q)$ is equivalent to

(A) $\sim p \vee q$ (B) $p \wedge q$
(C) $p \vee q$ (D) $p \vee \sim q$

130. The raw data $x_1, x_2, \ldots\ldots, x_n$ is an A.P. with common difference d and first term $0, \bar{x}$ and σ^2 are mean and variance of

$$x_i, i = 1,2, \ \ldots \ \ldots n$$

, then σ^2 is

(A) $\frac{(n^2+1)d^2}{24}$ (B) $\frac{(n^2-1)d^2}{24}$
(C) $\frac{(n^2+1)d^2}{12}$ (D) $\frac{(n^2-1)d^2}{12}$

131. The particular solution of differential equation

$$e^{\frac{dy}{dx}} = (x+1), y(0) = 3$$

is

(A) $y = x\log x - x + 2$

(B) $y = (x+1)\log(x+1) - x + 3$

(C) $y = (x+1)\log(x+1) + x - 3$

(D) $y = x\log x + x - 2$

132. A card is drawn at random from a well shuffled pack of 52 cards. The probability that it is black card or face card is

(A) $\frac{3}{13}$ (B) $\frac{5}{13}$

(C) $\frac{6}{13}$ (D) $\frac{8}{13}$

133. If

$$\bar{a} = 2\hat{i} + 3\hat{j} - 4\hat{k}$$

and

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

, then the projection of $\bar{b}$ in the direction of $\bar{a}$ is

(A) $\frac{1}{\sqrt{29}}$ (B) $\frac{2}{\sqrt{3}}$

(C) $\frac{5}{\sqrt{3}}$ (D) $\frac{3}{\sqrt{29}}$

134. If

$$f(x) = \begin{cases} e^{\cos x}\sin x & , \text{ for } |x| \le 2 \\ 2, & \text{otherwise} \end{cases}$$

, then

$$\int_{-2}^{3} f(x)dx$$

is equal to

(A) 0 (B) 2

(C) 1 (D) 3

135. The equation of the line passing through the point $(-1, 3, -2)$ and perpendicular to each of the lines

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

and

$$\frac{x+2}{-3} = \frac{y-1}{2} = \frac{z+1}{5}$$

is

(A) $\frac{x+1}{2} = \frac{y-3}{7} = \frac{z+2}{4}$ (B) $\frac{x+1}{2} = \frac{y-3}{-7} = \frac{z+2}{4}$

(C) $\frac{x-1}{2} = \frac{y+3}{-7} = \frac{z+2}{4}$ (D) $\frac{x-1}{2} = \frac{y+3}{7} = \frac{z-2}{4}$

136. Let $f : R \to R$ be a function such that

$$f(x) = x^3 + x^2 f'(1) + x f''(2) + 6, x \in R$$

, then $f(2)$ is

(A) 30 (B) -4

(C) -2 (D) 8

137. If $A(1, 4, 2)$ and $C(5, -7, 1)$ are two vertices of triangle ABC and

$$G\left(\frac{4}{3}, 0, \frac{-2}{3}\right)$$

is centroid of the triangle ABC, then the mid point of side BC is

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

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

138. The base of an equilateral triangle is represented by the equation

$$2x - y - 1 = 0$$

and its vertex is $(1, 2)$, then the length (in units) of the side of the triangle is

(A) $\sqrt{\frac{20}{3}}$ (B) $\frac{2}{\sqrt{15}}$

(C) $\sqrt{\frac{8}{15}}$ (D) $\sqrt{\frac{15}{2}}$

139. Five persons A, B, C, D and E are seated in a circular arrangement. If each of them is given a cap of one of the three colours red, blue and green, then the number of ways of distributing the caps such that the persons seated in adjacent seats get different coloured caps, is

(A) 30 (B) 15

(C) 60 (D) 40

140. The distance of the point $(-1, -5, -10)$ from the point of intersection of the line

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

and the plane

$$x - y + z = 5$$

is

(A) 13 units. (B) 12 units.

(C) 5 units. (D) 16 units.

141. Negation of inverse of the following statement pattern $(p \wedge q) \to (p \vee \sim q)$ is

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

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

142. If

$$f(x) = 3x^{10} - 7x^8 + 5x^6 - 21x^3 + 3x^2 - 7$$

, then

$$\lim_{\alpha \to 0} \frac{f(1-\alpha) - f(1)}{\alpha^3 + 3\alpha} =$$

(A) $\frac{53}{3}$ (B) $\frac{-53}{3}$

(C) $\frac{52}{3}$ (D) $\frac{-52}{3}$

143. The area (in sq. units) of the region bounded by curves

$$y = 3x + 1, y = 4x + 1$$

and

$$x = 3$$

is

(A) $\frac{7}{2}$ (B) $\frac{9}{5}$

(C) $\frac{9}{2}$ (D) $\frac{7}{5}$

144. Values of c as per Rolle's theorem for

$$f(x) = \sin x + \cos x + 6$$

on $[0, 2\pi]$ are

(A) $\frac{\pi}{3}, \frac{5\pi}{3}$ (B) $\frac{\pi}{6}, \frac{5\pi}{6}$

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

145. A vector $\bar{a}$ has components 1 and $2p$ with respect to a rectangular Cartesian system. This system is rotated through a certain angle about origin in the counter clock wise sense. If, with respect to the new system, $\bar{a}$ has components 1 and $(p+1)$, then

(A) $\mathrm{p} = 1$ or $\mathrm{p} = \frac{1}{3}$ (B) $\mathrm{p} = -1$ or $\mathrm{p} = \frac{-1}{3}$

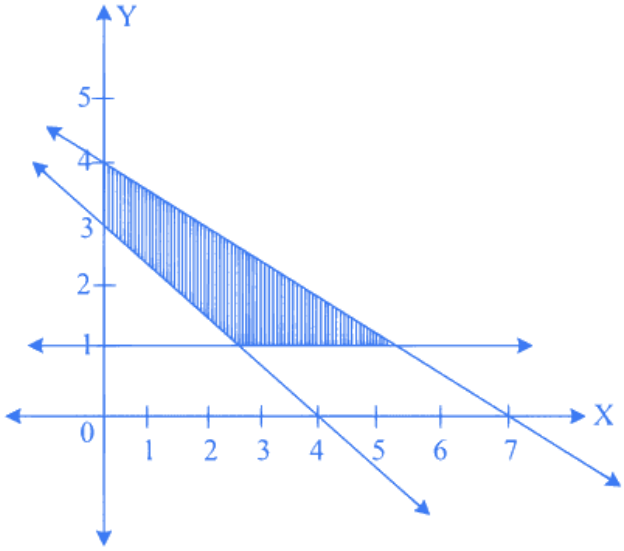
(C) $\mathrm{p} = \frac{-1}{3}$ or $\mathrm{p} = 1$ (D) $\mathrm{p} = \frac{1}{3}$ or $\mathrm{p} = -1$

146. A line is drawn through the point $(1, 2)$ to meet the co-ordinate axes at P and Q such that it forms a $\triangle$OPQ, where O is the origin. If the area of $\triangle$OPQ is least, then the slope of the line PQ is

(A) -2 (B) 2

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

147. If feasible region is as shown in the figure, then related inequalities are



(A) $3x + 4y \geq 12, 4x + 7y \leq 28, y \leq 1, x \geq 0, y \geq 0$

(B) $3x + 4y \geq 12, 4x + 7y \leq 28, y \geq 1, x \geq 0, y \geq 0$

(C) $3x + 4y \leq 12, 4x + 7y \leq 28, y \leq 1, x \geq 0, y \geq 0$

(D) $3x + 4y \leq 12, 4x + 7y \geq 28, y \geq 1, x \geq 0, y \geq 0$

148. The general solution of the equation

$$3\sec^2\theta = 2\,\mathrm{cosec}\,\theta$$

is

(A) $\mathrm{n}\pi + \frac{\pi}{4}, \mathrm{n} \in \mathrm{Z}$

(B) $2\mathrm{n}\pi + (-1)^{\mathrm{n}}\frac{\pi}{12}, \mathrm{n} \in \mathrm{Z}$

(C) $\mathrm{n}\pi + (-1)^{\mathrm{n}}\frac{\pi}{6}, \mathrm{n} \in \mathrm{Z}$

(D) $\mathrm{n}\pi + (-1)^{\mathrm{n}}\frac{\pi}{3}, \mathrm{n} \in \mathrm{Z}$

149. A right circular cone has height 9 cm and radius of base 5 cm. It is inverted and water is poured into it. If at any instant, the water level rises at the rate

$$\frac{\pi}{\mathrm{A}}\mathrm{cm/sec}$$

. where A is area of the water surface at that instant, then cone is completely filled in

(A) 70 sec. (B) 75 sec.

(C) 72 sec. (D) 77 sec.

150. If θ is angle between the vectors $\bar{a}$ and $\bar{b}$ where

$$|\bar{a}| = 4, |\bar{b}| = 3$$

and

$$\theta \in \left(\frac{\pi}{4}, \frac{\pi}{3}\right)$$

, then $|(\bar{a} - \bar{b}) \times (\bar{a} + \bar{b})|^2 + 4(\bar{a} \cdot \bar{b})^2$ has the value

(A) 576 (B) 24

(C) 144 (D) 12

- End of Question Paper -