MHT CET 2022 PCM Aug 8 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 2022**, 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 particle of mass 10 g moves along a circle of radius 6.4 cm with a constant tangential acceleration. If the kinetic energy of the particle becomes 8×10^{-4} J by the end of the second revolution after the beginning of the motion, the magnitude of the tangential acceleration is

(A) 0.6 m/s (B) 0.4 m/s
(C) 0.1 m/s (D) 0.3 m/s

2. A particle is moving along a circular path with constant speed and centripetal acceleration a. If the speed is doubled, the ratio of its acceleration after and before the change is

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

3. A string of length ' L ' fixed at one end carries a mass ' m ' at the other end. The string makes $\frac{3}{\pi}$ r.p.s. around the vertical axis through fixed end. The tension in the string is

(A) 72 mL (B) 18 mL
(C) 9 mL (D) 36 mL

4. A solid sphere has mass ' M ' and radius ' R '. Its moment of inertia about a parallel axis passing through a point at a distance $\frac{R}{2}$ from its centre is

(A) $\frac{8MR^2}{11}$ (B) $\frac{11MR^2}{18}$
(C) $\frac{7MR^2}{10}$ (D) $\frac{13MR^2}{20}$

5. An uniform rod AB of mass m and length l is at rest on a smooth horizontal surface. An impulse P applied to the end B. The time taken by the rod to turn through a right angle is

(A) $\frac{\pi}{12}\frac{m\ell}{P}$ (B) $2\pi\frac{m\ell}{P}$
(C) $2\frac{\pi P}{m\ell}$ (D) $\frac{\pi P}{m\ell}$

6. The depth below the earth's surface at which the acceleration due to gravity ' g ' becomes $\frac{g}{n}$ is (R = radius of the earth, n is an integer, $n > 1$)

(A) $\frac{R(n+1)}{n}$ (B) $\frac{R(n-1)}{n}$
(C) $\frac{Rn}{(n+1)}$ (D) $\frac{R}{n}$

7. Binding energy of a revolving satellite at height ' h ' is 3.5×10^8 J. Its potential energy is

(A) -3.5×10^8 J (B) -7×10^8 J
(C) 7×10^8 J (D) 3.5×10^8 J

8. Due to surface tension, the excess pressure inside a smaller drop is 9 units. If 27 smaller drops of same liquid combine then the excess pressure inside the bigger drop is

(A) 18 units (B) 9 units
(C) 6 units (D) 3 units

9. When a liquid of density ' ρ ' flows through a tube of diameter ' d ' with critical velocity ' V ' then the Reynolds number is ($\eta =$ coefficient of viscosity of liquid)

(A) $\frac{\eta\rho}{Vd}$ (B) $\frac{Vd}{\rho\eta}$
(C) $\frac{Vpd}{\eta}$ (D) $\frac{V\eta d}{\eta}$

10. Two glass plates of area 10^{-2} m^2 have 10 cm thick water film between them. The surface tension of water is 70×10^{-3} N/m. The force required to separate two glass plates from each other is

(A) 14 N (B) 17 N
(C) 28 N (D) 30 N

11. Two bodies A and B radiate maximum energy with wavelength difference 4μm. The absolute temperature of body A is 3 times that of B. The wavelength at which body B radiates maximum energy is:

(A) $2\mu m$ (B) $4\mu m$
(C) $6\mu m$ (D) $12\mu m$

12. Two metal rods P and Q have same length and same temperature difference between their ends. Their thermal conductivities are K_1 and K_2, also cross-sectional areas A_1 and A_2 respectively. If the rate of flow of heat through rod Q is three times that in rod P, then

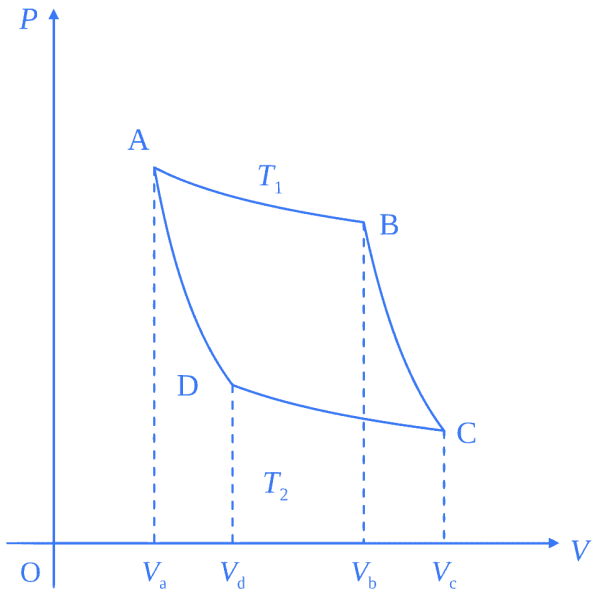
(A) $K_1 A_1 = 3 K_2 A_2$ (B) $3 K_1 A_1 = K_2 A_2$
(C) $3 K_1 A_1 = 2 K_2 A_2$ (D) $2 K_1 A_1 = 3 K_2 A_2$

13. A star (P) behaves like a perfectly black body emitting radiant energy at temperature ' T '. Another star (Q) also behaves like perfectly black body emitting radiant energy at temperature ' $T/4$ ' and has radius eight times the radius of star (P). The ratio of radiant energy emitted by (P) to that by (Q) is

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

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

14. In the P-V diagram shown, there are two adiabatic parts of the same gas intersecting two isothermals at T_1 and T_2. The ratio $\left(\frac{V_b}{V_a}\right)$ is equal to



(A) $\left(\frac{V_c}{V_d}\right)^2$ (B) $\left(\frac{V_c}{V_d}\right)$

(C) $\frac{1}{2}\left(\frac{V_c}{V_d}\right)$ (D) $2\left(\frac{V_c}{V_d}\right)$

15. In which thermodynamic process, the change in internal energy ' ΔU ', heat supplied ' Q ' and the work done in expansion ' W ' are all non-zero?

(A) Adiabatic (B) Isobaric

(C) Isothermal (D) Isochoric

16. According to kinetic theory of gases, when two molecules of a gas collide with each other then

(A) kinetic energy is conserved but momentum is not conserved.

(B) momentum is conserved but kinetic energy is not conserved.

(C) neither kinetic energy nor momentum is conserved.

(D) both momentum and kinetic energy are conserved.

17. The instantaneous displacement of particle in S.H.M is $x = A\cos\left(\omega t + \frac{\pi}{4}\right)$. The time at which the velocity is maximum for the first time is

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

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

18. A particle executing linear S.H.M has period 3 second and amplitude 6 cm. The time required by it to travel a distance of 3 cm from positive extreme position is $\left[\sin 30^\circ = \cos 60^\circ = \frac{1}{2},\ \sin 60^\circ = \cos 30^\circ = \frac{\sqrt{3}}{2}\right]$

(A) 2s (B) 3s

(C) 4s (D) 0.5s

19. A small wooden cube is placed on a plank. The plank performs a vertical S.H.M of frequency $\frac{3}{\pi}$Hz. The maximum amplitude of the plank so that the wooden block does not leave the plank is [take $g = 10\ \text{m/s}^2$]

(A) $\frac{7}{12}$ m (B) $\frac{5}{2}m$

(C) $\frac{5}{18}$ m (D) $\frac{11}{18}$ m

20. A cylindrical tube open at both ends, has a vibrating air column of fundamental frequency ' f ' in air. The tube is dipped vertically in water so that half of its is in water. The fundamental frequency of the vibrating air column is now

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

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

21. In fundamental mode, the time required for the sound wave to each upto the closed end of a pipe filled with air is ' t ' second. The frequency of vibration of air column is

(A) $\frac{2}{t}$ (B) $\frac{0.5}{t}$

(C) $\frac{1}{t}$ (D) $\frac{0.25}{t}$

22. In a stationary wave all particles

(A) vibrate in S.H.M of different periods and different amplitudes.

(B) vibrate in S.H.M of same period and amplitude.

(C) except at nodes vibrate in S.H.M of same period but of different amplitudes.

(D) except at nodes vibrate in S.H.M of same period and same amplitude.

23. An engine sounding a whistle of frequency 1152 Hz is receding from a stationary observer at 72 km/ hour. If velocity of sound in air is 340 m/s, then the frequency of note heard by the observer is

(A) 612 Hz

(B) 1088 Hz

(C) 1224 Hz

(D) 544 Hz

24. Assume that an electric field $E = 20x^2\hat{i}$ exists in space. If V_0 is the potential at the origin and V_A is the potential at $x = 3$ m then, the potential difference $V_A - V_0$ in volts is

(A) -80

(B) -220

(C) -180

(D) -120

25. Two parallel plates separated by ' d ' mm are kept at potential difference of ' V ' volt. A particle of mass ' m ' and charge ' q ' enters in it with some velocity. The acceleration of the particle will be

(A) $\frac{q}{dmV}$

(B) $\frac{qm}{Vd}$

(C) $\frac{qd}{Vm}$

(D) $\frac{qV}{dm}$

26. There are two metallic spheres of same radii but one is solid and other is hollow then

(A) they can be charged equally (maximum).

(B) solid sphere can be given more charge.

(C) hollow sphere can be given more charge.

(D) solid sphere can be charged double to hollow sphere.

27. If the charge on the capacitor is increased by 2 coulombs, the energy stored in it increase by 21%. the original charge on the capacitor is

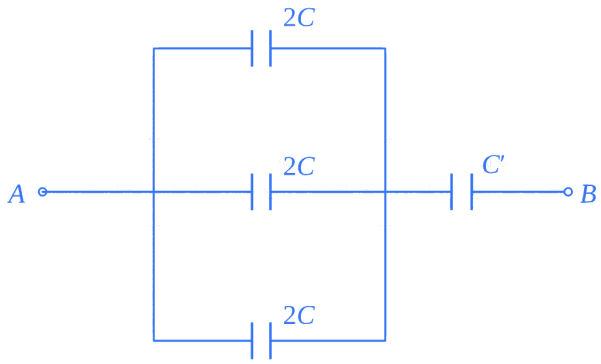
(A) 10 C

(B) 15 C

(C) 20 C

(D) 5 C

28. If the equivalent capacitance between A and B of the combination of capacitors shown in figure is 3C, the capacitor C′ 'is equal to



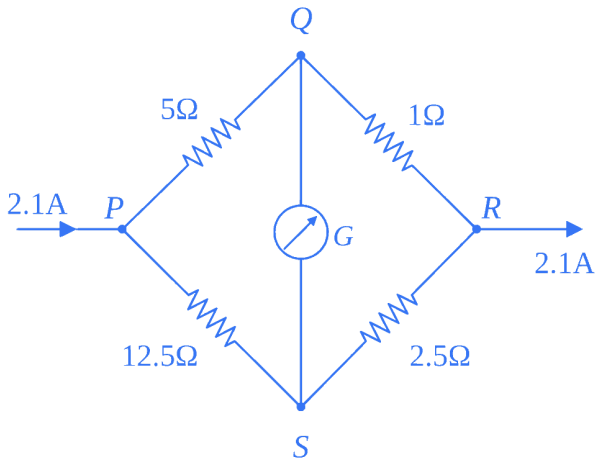
(A) 5C

(B) 4C

(C) 7C

(D) 6C

29. The current through 1Ω resistance in the following circuit is



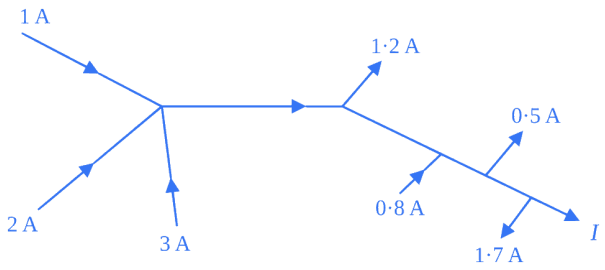
(A) 0.6 A

(B) 1.5 A

(C) 0.1 A

(D) 0.5 A

30. In the following electrical network, the value of ' I ' is



(A) 3.4 A
(B) 4.3 A
(C) 5.8 A
(D) 1.9 A

31. A charged particle moves through a magnetic field perpendicular to its direction. Then

(A) both momentum and kinetic energy of the particle are changed
(B) its momentum changes but its kinetic energy remains constant
(C) its kinetic energy changes but momentum remains constant
(D) both momentum and kinetic energy of the particle remains constant

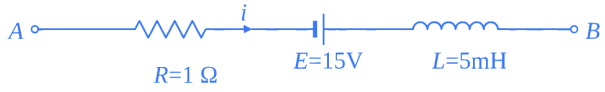
32. The magnetic moment product in a sample of 2 gram is $8 \times 10^{-7} \mathrm{Am}^2$. If its density is $4\ \mathrm{g/cm}^3$ then the magnetization of the sample in Am^{-1} is

(A) 1.6
(B) 1.8
(C) 1.2
(D) 1.4

33. Whenever a magnet is moved towards or away from a conducting coil, and e.m.f is induced, the magnitude of which is independent of

(A) the speed with which the magnet is moved.
(B) the resistance of the coil.
(C) the strength of magnetic field.
(D) the number of turns of the coil.

34. The network shown in the figure is part of complete circuit. If at a certain instant the current i is 5 A and is decreasing at the rate of 10^3 A/s, then $V_B - V_A$ is



(A) 15V
(B) 10V
(C) 5V
(D) 20V

35. The frequency for which a 5μF capacitor has a reactance of $\frac{1}{1000}\Omega$ is given by

(A) $\frac{1}{1000}$ Hz
(B) 1000 Hz
(C) $\frac{100}{\pi}$MHz
(D) $\frac{1000}{\pi}$Hz

36. A transformer works on the principle of

(A) magnetic effect of electric current
(B) self-induction
(C) heat transfer
(D) mutual induction

37. In the circuit shown, the AC source has voltage $V = 20\ \cos(\omega t)$ volt with $\omega = 2000\mathrm{rad/s}$. The magnitude of amplitude current will be nearly



(A) $\sqrt{5}$ A
(B) 3.3 A
(C) 2 A
(D) $\frac{2}{\sqrt{5}}$ A

38. A 10Ω resistance, 5mH coil and 10μF capacitor are joined in series. When alternating current source of suitable frequency is joined to this combination, the circuit resonates. If the resistance is halved, the resonant frequency is

(A) quadrupled.
(B) halved.
(C) doubled.
(D) remains unchanged.

39. For occurring total internal reflection, which one of the following is correct statement? (i = angle incidence, i_C = critical angle).

(A) Ray travels from denser medium to rarer medium and $i > i_C$.
(B) Ray travels from rarer medium to denser medium and $i < i_C$.
(C) Ray travels from rarer medium to denser medium and $i < i_C$.
(D) Ray travels from denser medium to rarer medium and $i < i_C$.

40. A ray of light is incident normally on a glass slab of thickness 5 cm and refractive index 1.6. The time taken to travel by a ray from source to surface of slab is same as to travel through glass slab. The distance of source from the surface is

(A) 12 cm (B) 24 cm

(C) 5 cm (D) 8 cm

41. The Young's double slit experiment, angular width of fringes is 0.20 radians for sodium light of wavelength 5890Å. If the complete system is dipped in water, then the angular width of fringes will be [Refractive index of water $= \frac{4}{3}$]

(A) 0.30° (B) 0.15°

(C) 0.11° (D) 0.22°

42. In biprism experiment, the 4^{th} dark band is formed opposite to one of the slits. The wavelength of light used is (D = distance between source and screen, d = distance between the slits)

(A) $\frac{\mathrm{d}^2}{9\mathrm{D}}$ (B) $\frac{d^2}{11D}$

(C) $\frac{d^2}{14D}$ (D) $\frac{\mathrm{d}^2}{7\mathrm{D}}$

43. A parallel beam of light of wavelength ' λ ' is incident normally on a narrow slit. A diffraction pattern is formed on a screen placed perpendicular to the direction of incident beam. At the second minimum of the diffraction pattern, the phase difference between the ray coming from the two edges of slit is

(A) 3π (B) 4π

(C) $\pi\lambda$ (D) 2π

44. Photoelectric emission takes place from a certain metal at threshold frequency ' v '. If the radiation of frequency ' $2v$ ' is incident on the metal plate, the maximum velocity of the emitted photoelectron will be (m = mass of electron, h = Planck's constant)

(A) $\sqrt{\frac{2\mathrm{hv}}{\mathrm{m}}}$ (B) $\sqrt{\frac{\mathrm{hv}}{2\,\mathrm{m}}}$

(C) $\sqrt{\frac{\mathrm{hv}}{3\,\mathrm{m}}}$ (D) $\sqrt{\frac{\mathrm{hv}}{\mathrm{m}}}$

45. According to de-Broglie hypothesis if an electron of mass ' m ' is accelerated by potential difference ' V ' then associated wavelength is ' λ '. When a proton of mass ' M ' is accelerated through potential difference ' 9 V ' then the wavelength associated with it is

(A) $\frac{\lambda}{3}\sqrt{\frac{M}{m}}$ (B) $\frac{\lambda}{3}\sqrt{\frac{\mathrm{m}}{\mathrm{M}}}$

(C) $\frac{\lambda}{6}\sqrt{\frac{m}{M}}$ (D) $\frac{\lambda}{6}\sqrt{\frac{M}{m}}$

46. The potential energy of the orbital electron in the ground state of hydrogen atoms is $-\mathrm{E}$. What is the kinetic energy?

(A) 4E (B) $\frac{E}{4}$

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

47. If an electron in hydrogen atom jumps from 3^{rd} orbit to 2^{nd} orbit, it emits a photon of wavelength ' λ '. When it jumps from 4^{th} orbit to 3^{rd} orbit, the corresponding wavelength of the photon will be

(A) $\frac{20}{13}\lambda$ (B) $\frac{20}{7}\lambda$

(C) $\frac{9}{16}\lambda$ (D) $\frac{16}{25}\lambda$

48. At room temperature, a p-type semiconductor has

(A) equal number of free electrons and holes.

(B) large number of free electrons and few holes.

(C) large number of holes and few electrons.

(D) no electrons or holes.

49. The Boolean expression for two-input Ex-OR gate is (A, B are inputs, Y is output)

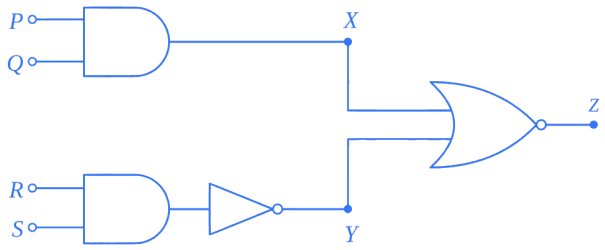
(A) $Y = (\bar{A} + B) \cdot (A + \bar{B})$

(B) $\mathrm{Y} = (\mathrm{A},\, \mathrm{B}) + (\overline{\mathrm{A}} + \overline{\mathrm{B}})$

(C) $\mathrm{Y} = (\overline{\mathrm{A}} \cdot \mathrm{B}) + (\mathrm{A} \cdot \overline{\mathrm{B}})$

(D) $\mathrm{Y} = (\mathrm{A} \cdot \mathrm{B}) + (\overline{\mathrm{A}} + \mathrm{B})$

50. A combination of logic gates is as shown in figure. ' P ', ' Q ', ' R ' and ' S ' are the inputs and ' X ', ' Y ' and ' Z ' are outputs. When inputs P and R are 'low' and Q and S are 'high', the outputs X, Y and Z are respectively



(A) 0,1,0
(B) 0,1,1
(C) 1,0,0
(D) 1,1,1

51. What is the volume occupied by 2 g of helium gas at STP? (molar mass of helium gas $= 4\ \text{g mol}^{-1}$)

(A) 5.6dm^3 (B) 22.4dm^3

(C) 11.2dm^3 (D) 2.0dm^3

52. What is the number of nucleons present in an atom having 29 electrons and 34 neutrons in it?

(A) 29 (B) 34

(C) 05 (D) 63

53. The molecule in which central atom does NOT undergo sp^3 hybridisation is

(A) NH_3 (B) H_2O

(C) CH_4 (D) BF_3

54. Which of the following molecules has bond order greater than one?

(A) F_2 (B) H_2

(C) Li_2 (D) N_2

55. Which of the following is a correct relation for Gay-Lussac's law?

(A) $P \propto T$ (at constant volume) (B) $V \propto n$ (at constant temperature and pressure)

(C) $P \propto \frac{1}{V}$ (at constant temperature) (D) $V \propto T$ (at constant pressure)

56. Calculate the change in enthalpy in a chemical reaction when work done is -800 J and increase in internal energy is 600 J.

(A) -1400 J (B) -240 J

(C) -200 J (D) -680 J

57. For the combustion of one mole acetic acid, work done at 298 K is

(A) -2.0 J (B) -1.5 J

(C) 2.0 J (D) 0.0 J

58. Calculate bond enthalpy of $H-Cl$ bond from following reaction. $H_2(g) + Cl_2(g) \rightarrow 2HCl(g), \Delta_r H^\circ = -185$ kJ (Given bond enthalpies of $H-H$, $Cl-Cl$ bonds are 435.0 kJ mol^{-1} and 244 kJ mol^{-1} respectively)

(A) 340 kJ (B) 432 kJ

(C) 370 kJ (D) 864 kJ

59. A weak monobasic acid dissociates to 0.001% in its 0.01M solution. What is its dissociation constant?

(A) 1×10^{-6} (B) 1×10^{-8}

(C) 1×10^{-3} (D) 1×10^{-12}

60. Why the pH of aqueous solution of copper sulphate is less than 7 ?

(A) It is a salt of strong acid and weak base. (B) It is a salt of weak acid and weak base.

(C) It is salt of strong acid and strong base. (D) It is a salt of weak acid and strong base.

61. A buffer solution is prepared by mixing 0.1MHCN and 0.2MNaCN What is the pH of buffer solution if pKa of HCN is 9.3? ($\log 2 = 0.3010$)

(A) 4.2 (B) 2.0

(C) 9.60 (D) 6.15

62. Identify correct statement for following reaction.

$3Br_2 + 6CO_3^{2-} + 3H_2O \rightarrow 5Br^- + BrO_3^- + 6HCO_3^-$

(A) Bromine is neither reduced nor oxidised (B) Bromine is oxidised and carbonate is reduced

(C) Bromine is reduced and water is oxidised (D) Bromine is both reduced and oxidised

63. Which among the following elements exhibits diagonal relationship with Li ?

(A) Al (B) B

(C) Na (D) Mg

64. Which among the following compounds has chiral carbon atom?

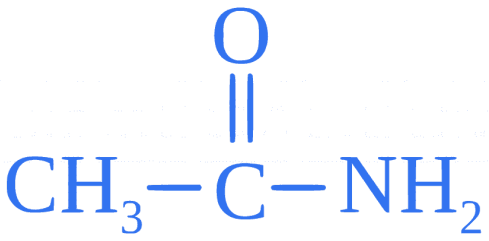
(A) $CH_3CH(Cl)CH_2CH_3$

(B) $(CH_3CH_2)_2CHCl$

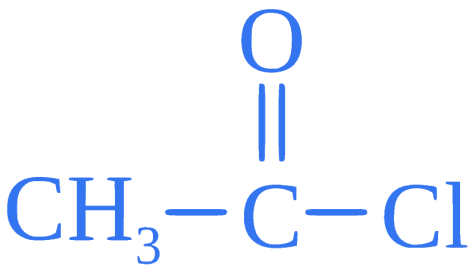
(C) $(CH_3)_2 - CHCl$

(D) $(CH_3)_2 - CHCl$

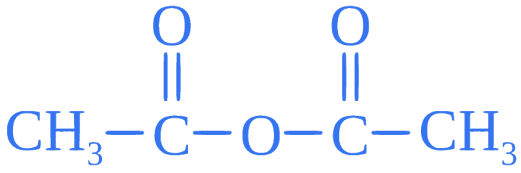
65. Identify acetyl chloride from the following compounds.



(A)



(B)



(C)

(D) CCl_3COOH

66. Which among the following examples of halogen derivatives does NOT correctly match with its type of compound?

(A) Halo alkane : Methyl chloride

(B) Allylic halide : 1-chloroethene

(C) Haloarene : Chlorobenzene

(D) Benzylic halide : Benzyl chloride

67. Which among the following reagents is used for the conversion of alkanes into an alcohol?

(A) $KMnO_4/H_2O_2$

(B) B_2H_6/H_2O_2

(C) H_2/Ni

(D) aqueous NaOH

68. Identify meta directing group from following.

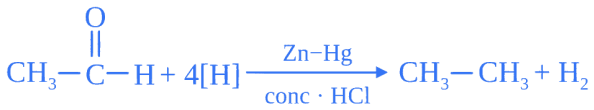
(A) $-Br$

(B) $-SO_3H$

(C) $-CH_3$

(D) $-OH$

69. The reaction



is called as

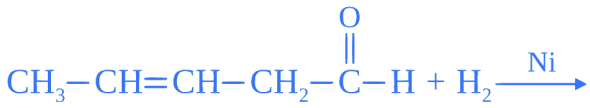
(A) Clemmensen reduction

(B) Wolff-Kishner reduction

(C) Aldol condensation

(D) Cannizzaro reaction

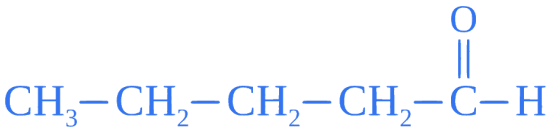
70. Identify the product Y in the following reaction.



(A) $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - OH$

(B) $CH_3 - CH_2 - CH_2 - CH_2 - CH_3$

(C)



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

71. Calculate the molar mass of metal having density 7.8 g cm^{-3} and crystallized to form bcc structure with edge length 288pm.

(A) 120.0 g mol^{-1}

(B) 86.2 g mol^{-1}

(C) 108.1 g mol^{-1}

(D) 56.1 g mol^{-1}

72. What is the edge length of simple cubic unit cell if radius of atom is 174pm ?

(A) 174pm

(B) 492pm

(C) 348 pm

(D) 402pm

73. Identify the type of unit cell containing single particle.

(A) Body centred cubic (B) Base centred cubic
(C) Face centred cubic (D) Simple cubic

74. Which among the following equations represents relation between cryoscopic constant, depression in freezing point and molality?

(A) $K_f = \frac{m}{\Delta T_f}$ (B) $K_f = \Delta T_f \times m$
(C) $K_f = \frac{\Delta T_f}{m}$ (D) $K_f = \frac{1}{\Delta T_f \times m}$

75. Calculate the amount of solute dissolved in 612 grams of water at $30^\circ C$ if molar mass of solute is $342\ g\ mol^{-1}$ (Relative vapour pressure lowering is 0.025 and molar mass of water $18\ g\ mol^{-1}$)

(A) 142.5 gram (B) 270.6 gram
(C) 240.2 gram (D) 290.7 gram

76. What is the molar mass of solute if a solution is prepared by dissolving 4.5 gram solute in $3dm^3$ water having osmotic pressure 0.25 atm at 300 K ? $\left(R = 0.0821 dm^3\ atm\ K\ K^{-1}\ mol^{-1}\right)$

(A) $148\ g\ mol^{-1}$ (B) $160\ g\ mol^{-1}$
(C) $172\ g\ mol^{-1}$ (D) $136\ g\ mol^{-1}$

77. In a certain electrolysis experiment, 0.650 g of zinc is deposited in a cell having $ZnSO_4$ solution. Calculate mass of Cu deposited in other cell having $CuSO_4$ solution arranged in series with first cell ? (molar mass of $Zn = 65$, $Cu = 63.5\ g\ mol^{-1}$)

(A) 0.635 g (B) 6.35 g
(C) 0.317 g (D) 3.17 g

78. Identify representation of standard hydrogen electrode?

(A) $H^+_{aq} \left| \begin{matrix} H_2 \\ 1_M \end{matrix} \right| Pt, [H^+]$

(B) $H^+(1M)|H_2(\ g)1\ atm|Pt$

(C) $H_{2(\ g)}|H^+_{aq}|Pt, H^+$

(D) $Pt, [H^+]H_2\ g_{g)}P_2|H^+|H^+(1\ m)$

79. Molar conductivity of $0.01 M CH_3COOH$ is $19.5 \Omega^{-1}\ cm^2\ mol^{-1}$. Calculate its degree of dissociation if molar conductivity at zero concentration is $390 \Omega^{-1}\ cm^2\ mol^{-1}$?

(A) 0.05 (B) 0.2
(C) 0.08 (D) 0.6

80. Calculate the half-life period of first order reaction if rate constant of the reaction is $0.02\ min^{-1}$.

(A) 34.65 min (B) 45.6 min
(C) 40.2 min (D) 30.5 min

81. What is order of reaction if unit of rate constant is s^{-1} ?

(A) 3 (B) 2
(C) 0 (D) 1

82. For a reaction, $2\ A + B \rightarrow 2C$, rate of disappearance of A is $0.076\ moldm^{-3}\ s^{-1}$. What is the rate of disappearance of B ?

(A) $0.152\ moldm^{-3}\ s^{-1}$ (B) $0.114\ moldm^{-3}\ s^{-1}$
(C) $0.038\ moldm^{-3}\ s^{-1}$ (D) $0.076\ moldm^{-3}\ s^{-1}$

83. Which among following is a zero-dimensional nanostructure?

(A) Nano rods (B) Nanaowires
(C) Nanoparticles (D) Thin flims

84. Which of the following conversions is carried out by using charcoal catalyst?

(A) $SO_2(g) + Cl_2(g) \rightarrow SO_2Cl_2(l)$

(B) $4HCl + O_2 \rightarrow 2Cl_2 + 2H_2O$

(C) $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

(D) $2ZnS(s) + 3O_2(g) \rightarrow 2ZnO(s) + 2SO_2(g)$

85. What is effect of pressure on extent of adsorption?

(A) Increase as pressure increases continuously
(B) Increases at start as pressure increase and then remains constant
(C) Decrease as pressure increase
(D) No change in extent of adsorption if pressure increase or decreases

86. Which of following interhalogen compounds is NOT obtained by action of fluorine with bromine? $(X = Br, X' = F)$

(A) XX'_5 (B) XX'_3
(C) XX' (D) XX'_7

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87. Which among the following elements do not have any electron in f− sub shell either in expected or in observed state electronic configuration?

(A) $Lu(Z = 71)$ (B) $La(Z = 57)$

(C) $Eu(Z = 63)$ (D) $Nd(Z = 60)$

88. Which from following alloys is used to construct marine condenser tubes of ships?

(A) Titanium alloys (B) Nichrome

(C) Bronze (D) Cupro-Nickle

89. How many unpaired electrons are present in cobalt ion in +3 oxidation state prior to hybridization in $[CoF_6]^{3+}$ complex ion?

(A) zero (B) 3

(C) 4 (D) 2

90. What type of geometry and magnetic nature is present in a complex $[NiCl_4]^{2-?}$

(A) Square planar, diamagnetic (B) Square planar, Paramagnetic

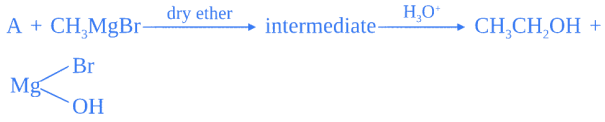
(C) Tetrahedral, Paramagnetic (D) Tetrahedral, diamagnetic

91. What product is obtained when alkyl halides react with metallic sodium in presence of dry ether?

(A) Alkenes with same number of carbon atoms as in alkyl halide. (B) Alkynes with same number of carbon atoms as in alkyl halide.

(C) Alkanes with same number of carbon atoms as in alkyl halide. (D) Alkanes with double the number of carbon atoms as in alkyl halide.

92. Identify the compound A in the following reaction.



(A) Acetic acid (B) Acetaldehyde

(C) Formaldehyde (D) Acetone

93. Identify the product of following reaction.

$$CH_3 - CH = CH - CH_2 - C \equiv N \xrightarrow[H_3O^+]{\text{DIBAL} - H} \text{Product}$$

(A) Pent-3-enoic acid (B) Pentanal

(C) Pent-3-enal (D) Pentanoic acid

94. What is the source of L-Lactic acid from the following?

(A) Curd (B) Tamarind

(C) Vinegar (D) Lemon

95. Which among the following molecules has lowest p^{Kb} value?

(A) $CH_3CH_2NH_2$ (B) $(CH_3CH_2)_3\ N$

(C) $(CH_3CH_2)_2NH$ (D) CH_3NH_2

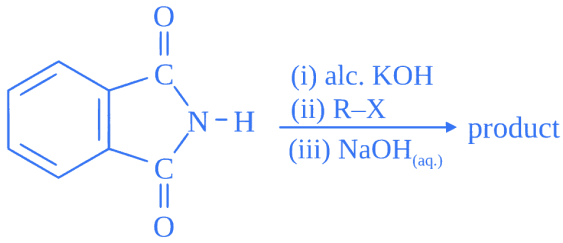
96. Identify the Gabriel phthalimide synthesis reaction from the reactants and reagents used in it.

(A) $R - C \equiv N + [H] \xrightarrow[\text{ether}]{LiAlH_4}$ product

(B) $R - CO - NH_2 + [H] \xrightarrow[\text{ether}]{LiAlH_4}$ product

(C) $R - CO - NH_2 + Br_2 + 4NaOH_{(aq.)} \xrightarrow{\Delta}$ product

(D)



97. What is the total number of essential amino acids?

(A) 8 (B) 5

(C) 12 (D) 10

98. Which among the following enzymes converts glucose to fructose?

(A) Proteases (B) Lipase

(C) Amylase (D) Glucose isomerase

99. Which of the following polymers is used to obtain hose pipes for transport of gasoline?

(A) PVC (B) Neoprene

(C) Buna-s (D) Buna-N

100. Which from following polymers is used to obtain electrical and telecommunication hardware?

(A) Buna-N
(B) Polycarbonate
(C) Thermocol
(D) Polyacrylamide

101. For a suitable chosen real constant a, let the function $f : R - \{-a\} \to R$ be defined by $f(x) = \frac{a-x}{a+x}$. Further, suppose that for any real number $x \neq -a$ and $f(x) \neq -a, (fof)(x) = x$. Then, $f\left(-\frac{1}{2}\right)$ is equal to

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

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

102. $\text{Cos}^2 48^\circ - \sin^2 12^\circ =$ _____ ,if $\sin 18^\circ = \frac{\sqrt{5}-1}{4}$

(A) $\frac{\sqrt{5}-1}{8}$ (B) $\frac{\sqrt{5}}{8} + 1$

(C) $\frac{\sqrt{5}}{8} - 1$ (D) $\frac{\sqrt{5}+1}{8}$

103. $\tan\left\{\frac{1}{2}\cos^{-1}\frac{\sqrt{5}}{3}\right\}$ has the value

(A) $\frac{\sqrt{5}}{6}$ (B) $\frac{\sqrt{5}}{6}$

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

104. If $x = -2 - \sqrt{3}i$, where $i = \sqrt{-1}$, then the value of $2x^4 + 5x^3 + 7x^2 - x + 41$ is

(A) 6 (B) -6

(C) 75 (D) -76

105. There are 6 periods in each working day of a school. The number of ways one can arrange 5 subjects such that each is allowed at least one period, is

(A) 3600 (B) 725

(C) 720 (D) 5

106. The Centroid of the triangle formed by the lines $6x^2 + xy - y^2 = 0$ and $x + 3y - 10 = 0$ is

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

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

107. The co-ordinates of point on the line $x + y + 3 = 0$, whose distance from the line $x + 2y + 2 = 0$ is $\sqrt{5}$ units, are

(A) (-1,-4) (B) (1,-4)

(C) (-1,4) (D) (1,4)

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

109. $\lim_{x\to 0} \frac{\sin\left(\pi\cos^2 x\right)}{x^2}$ is equal to

(A) $-\pi$ (B) π

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

110. The negation of $\sim s \vee (\sim r \vee s)$ is equivalent to

(A) $s \wedge r$ (B) $\sim r \wedge s$

(C) $s \wedge (r \wedge \sim s)$ (D) $s \wedge (r \vee \sim s)$

111. The statement pattern $\sim (p \leftrightarrow \sim q)$ is

(A) equivalent to $(\sim p) \leftrightarrow q$ (B) a tautology

(C) a fallacy (D) equivalent to $(p \leftrightarrow q)$

112. Consider the following three statements P : 11 is a prime number. Q: 7 is a factor of 176 . R : LCM of 3 and 7 is 21 . Then, the truth value of which one of the following statement is true?

(A) $P \vee (\sim Q \wedge R)$ (B) $(\sim P) \wedge (\sim Q \wedge R)$

(C) $(P \wedge Q) \vee (\sim R)$ (D) $(\sim P) \vee (Q \wedge R)$

113. If both mean and the standard deviation of 50 observations $x_1, x_2, \ldots, x_{50}$ are equal to 16 , then mean of $(x_1 - 5)^2, (x_2 - 5)^2, \ldots\ldots, (x_{50} - 5)^2$ is

(A) 378 (B) 377

(C) 357 (D) 397

114. If $\tan^{-1} 2x + \tan^{-1} 3x = \frac{\pi}{4}$, then value of x is

(A) $\frac{1}{6}$ (B) $-\frac{1}{6}$

(C) 1 (D) $\frac{5}{6}$

115. $\tan^{-1} 2 + \tan^{-1} 3 =$

(A) $\frac{5\pi}{4}$ (B) $\frac{\pi}{4}$

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

116. If $\tan^{-1}\sqrt{x^2+x} + \sin^{-1}\sqrt{x^2+x+1} = \frac{\pi}{2}$, then the value of x is

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

(C) 1 (D) 0

117. If $A = \begin{bmatrix} 2 & 3 \\ -4 & 1 \end{bmatrix}$, then adj $(3A^2 + 12A)$ is equal to

(A) $\begin{bmatrix} -21 & 63 \\ 84 & 0 \end{bmatrix}$ (B) $\begin{bmatrix} 21 & 63 \\ 84 & 0 \end{bmatrix}$

(C) $\begin{bmatrix} 21 & -63 \\ 84 & 0 \end{bmatrix}$ (D) $\begin{bmatrix} -21 & -63 \\ 84 & 0 \end{bmatrix}$

118. If $A = [a_{ij}]_{3\times 3} = \begin{bmatrix} 3 & 2 & 4 \\ 1 & 4 & 1 \\ 2 & 6 & 3 \end{bmatrix}$ and A_{ij} is a co-factor of a_{ij}, then the value of $a_{21}A_{21} + a_{22}A_{22} + a_{23}A_{23}$ is equal to

(A) 18 (B) 8

(C) -8 (D) 0

119. Let $f : R \to R$ be a function defined as $f(x) = \begin{cases} 5 & , \text{ if } x \le 1 \\ a + bx & , \text{ if } 1 < x < 3 \\ b + 5x & , \text{ if } 3 \le x < 5 \\ 30 & , \text{ if } x \ge 5 \end{cases}$ | then f is

(A) continuous if $a = 5$ and $b = 5$.

(B) continuous if $a = -5$ and $b = 10$.

(C) not continuous for any values of a and b.

(D) continuous is $a = 0$ and $b = 5$.

120. If $f(x) = \sin^{-1}\left(\frac{2x}{1+x^2}\right) + \cos^{-1}\left(\frac{1-x^2}{1+x^2}\right), x \in (1, \infty)$, then $f'(x)$

(A) $\frac{-4}{1+x^2}$ (B) 0

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

121. $\frac{d}{dx}\left(\log\sqrt{\frac{1+\sin x}{1-\sin x}}\right) =$

(A) $\cos^2 x$ (B) $\sec^2 x$

(C) $\cos x$ (D) $\sec x$

122. If $y = \tan^{-1}\left(\frac{5x+1}{3-x-6x^2}\right)$, then $\frac{dy}{dx} =$

(A) $\frac{3}{9x^2+12x+5} + \frac{1}{2x^2-2x+1}$

(B) $\frac{1}{9x^2+12x+5} + \frac{1}{4x^2-4x+2}$

(C) $\frac{1}{9x^2+12x+5} - \frac{1}{4x^2-4x+2}$

(D) $\frac{3}{9x^2+12x+5} - \frac{1}{2x^2-2x+1}$

123. Derivative of $\sin^{-1}\left(\frac{2x}{1+x^2}\right)$ w.r.t. $\tan^{-1} x, -1 < x < 1$ is

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

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

124. The tangent to the curve $y = x^3 + ax - b$ at the point $(1, -5)$ is perpendicular to the line $y - x + 4 = 0$, then which one of the following points lies on the curve?

(A) (2,-2) (B) (-2,2)

(C) (-2,1) (D) (2,-1)

125. Let AD and BC be two vertical poles at A and B respectively on a horizontal ground. If $AD = 8$ m, $BC = 11$ m and $AB = 10$ m, then the distance (in meters) of point M on AB from the point A such that $MD^2 + MC^2$ is minimum, is

(A) 8 (B) 5

(C) 4 (D) 7

126. On the interval $[0, 1]$, the function $x^{25}(1-x)^{75}$ takes its maximum value at the point

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

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

127. The value of $\int \frac{2x^3-1}{x^4+x}\,dx$ is equal to (where C is a constant of integration.)

(A) $\frac{1}{2}\log\frac{(x^3+1)^2}{x^3} + C$ (B) $\log\frac{(x^3+1)}{x} + C$

(C) $\log\left(\frac{x^3+1}{x^2}\right) + C$ (D) $\frac{1}{2}\log\frac{(x^3+1)}{x^2} + C$

128. The integral $\int \frac{\sin^2 x \cos^2 x dx}{(\sin^5 x + \cos^3 x \sin^2 x + \sin^3 x \cos^2 x + \cos^5 x)^2}$ is equal to (where C is a constant of integration).

(A) $\frac{1}{3(1+\tan^3 x)} + C$ (B) $\frac{-1}{3(1+\tan^3 x)} + C$

(C) $\frac{-1}{1+\cot^3 x} + C$ (D) $\frac{1}{1+\cot^3 x} + C$

129. $\int \sin\sqrt{x}\,dx = \ldots + C$ (where C is a constant of integration.)

(A) $2(-\sqrt{x}\cos\sqrt{x} + \sin\sqrt{x})$

(B) $2(-\cos\sqrt{x} + \sin\sqrt{x})$

(C) $2(\cos\sqrt{x} + \sqrt{x}\sin\sqrt{x})$

(D) $2(\sqrt{x}\cos\sqrt{x} + \sin\sqrt{x})$

130. If $\int \frac{\sqrt{1-x^2}}{x^4}\,dx = A(x)\left(\sqrt{1-x^2}\right)^m + C$ for a suitable chosen integer m and a function $A(x)$, where C is a constant of integration, then $(A(x))^m$ equals

(A) $-\frac{1}{27x^9}$ (B) $\frac{1}{9x^4}$

(C) $\frac{1}{27x^6}$ (D) $-\frac{1}{3x^3}$

131. If $g(x) = \int_0^x \cos^4 t\,dt$, then $g(x+\pi)$ equals

(A) $g(x) + g(\pi)$ (B) $g(x) - g(\pi)$

(C) $\frac{g(x)}{g(\pi)}$ (D) $g(x)\cdot g(\pi)$

132. $\int_0^{\pi/4} \sqrt{1-\sin 2x}dx =$

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

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

133. $\int_0^1 |5x-3|dx =$

(A) $\frac{23}{10}$ (B) $\frac{13}{10}$

(C) $\frac{31}{10}$ (D) $\frac{1}{2}$

134. There are (in square units) of the region bounded by the parabola $y = x^2+2$ and the lines $y = x+1, x = 0$ and $x = 3$ is

(A) $\frac{15}{4}$ (B) $\frac{15}{2}$

(C) $\frac{21}{2}$ (D) $\frac{17}{4}$

135. The equation of the curve passing through the point $(0,-2)$ given that at any point (x,y) on the curve, the product of the slope of its tangent and y-co-ordinate of the point is equal to the x-co-ordinate of the point, is

(A) $y^2+x^2=4$ (B) $y^2-x^2=4$

(C) $2y^2+x^2=8$ (D) $4y^2+3x^2=16$

136. General solution of the differential equation $x\cos y\,dy = (xe^x\log x + e^x)dx$ is (where C is a constant of integration.)

(A) $\sin y = e^x\log x + C$ (B) $\sin y = e^x + C\log x$

(C) $\sin y = Ce^x + \log x$ (D) $e^x\sin y = \log x + C$

137. The solution of the differential equation $e^{\left(\frac{dy}{dx}\right)} = x+1; y(0)=5, x\in(-1,\infty)$

(A) $(x-1)\log(x+1) - x - 5 = y$

(B) $(x+1)\log(x+1) + x + 5 = y$

(C) $(x-1)\log(x+1) + x - 5 = y$

(D) $(x+1)\log(x+1) - x + 5 = y$

138. For non-zero vectors $\bar{a},\bar{b},\bar{c}, |(\bar{a}\times\bar{b})\cdot\bar{c}| = |\bar{a}||\bar{b}||\bar{c}|$ holds and only if

(A) $\bar{b}\cdot\bar{c}=0, \bar{c}\cdot\bar{a}=0$

(B) $\bar{c}\cdot\bar{a}=0, \bar{a}\cdot\bar{b}=0$

(C) $\bar{a}\cdot\bar{b} = \bar{b}\cdot\bar{c} = \bar{c}\cdot\bar{a} = 0$

(D) $\bar{a}\times\bar{b}=0, \bar{b}\times\bar{c}=0$

139. Let $\vec{u},\vec{v}$ and $\vec{w}$ be vectors such that $\vec{u}+\vec{v}+\vec{w}=\vec{0}$. If $|\vec{u}|=3$, $|\vec{v}|=4$ and $|\vec{w}|=5$, then the value of $\vec{u}\cdot\vec{v}+\vec{v}\cdot\vec{w}+\vec{w}\cdot\vec{u}$ is

(A) 0 (B) -25

(C) 47 (D) 25

140. If $\bar{a}$ and $\bar{b}$ are vectors such that $|\bar{a}+\bar{b}| = \sqrt{29}$ and $\bar{a}\times(2\hat{i}+3\hat{j}+4\hat{k}) = (2\hat{i}+3\hat{j}+4\hat{k})\times\bar{b}$, then a possible value of $(\bar{a}+\bar{b})\cdot(-7\hat{i}+2\hat{j}+3\hat{k})$ is

(A) 4 (B) 0

(C) 1 (D) 8

141. The value of a, so that the volume of parallelepiped formed by $\hat{i}+a\hat{j}+\hat{k}, \hat{j}+a\hat{k}$ and $a\hat{i}+\hat{k}$ becomes minimum is

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

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

142. If the vector $\bar{a} = 2\hat{i}+2\hat{j}+3\hat{k}, \bar{b} = -\hat{i}+2\hat{j}+\hat{k}$ and $\bar{c} = 3\hat{i}+\hat{j}$ are such that $(\bar{a}+\lambda\bar{b})$ is perpendicular to $\bar{c}$, then the value of λ is

(A) -8 (B) 10

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

143. The foot of the perpendicular drawn from the origin to the plane is $(4,-2,-5)$. Hence, the equation of the plane is

(A) $4x-2y+5z=-5$

(B) $4x-2y-5z=45$

(C) $4x+2y-5z=37$

(D) $4x+2y+5z+13=0$

144. Then foot of the perpendicular from the point $(0, 2, 3)$ on the line $\frac{x+3}{5} = \frac{y-1}{2} = \frac{z+4}{3}$

(A) (2,3,1) (B) (2,3,-1)

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

145. The value of k, such that $\frac{x-4}{1} = \frac{y-2}{1} = \frac{z-k}{2}$ lies on the plane $2x - 4y + z = 7$, is

(A) no real value (B) 4

(C) -7 (D) 7

146. The line $\frac{x-1}{3} = \frac{y+1}{2} = \frac{z-1}{5}$ and $\frac{x+2}{4} = \frac{y-1}{3} = \frac{z+1}{-2}$

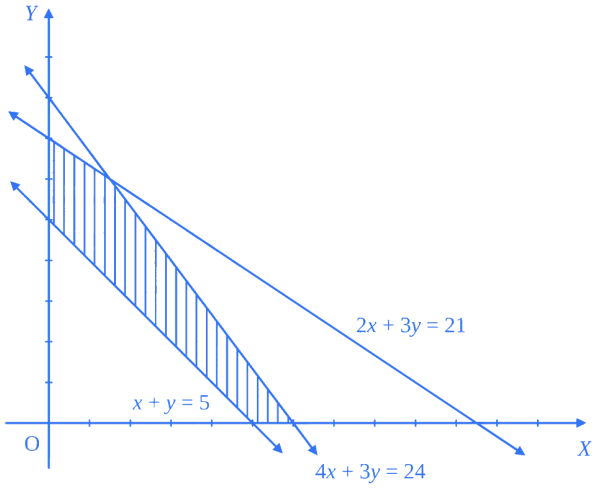
(A) intersect each other and point of intersection is $(4, 3, -2)$.

(B) do not intersect.

(C) intersect each other and point of intersection is $(3, 2, 5)$.

(D) intersect each other and point of intersection is $(-2, -1, -1)$

147. The function to be maximized is given by $Z = 2x + y$. The feasible region for this function Z is the shaded region given below. The maximum value of Z is _____ and occurs at the point _____.



(A) $10, (5, 0)$ (B) $12, (6, 0)$

(C) $9, (1.5, 6)$ (D) $21, (0.5, 0)$

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

(A)

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

(B)

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

(C)

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

(D)

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

149. For a Binomial variate x, mean is 2 and variance is 1 , Then odds in favor of $X = 0$ are

(A) 4:1 (B) 15:1

(C) 1:15 (D) 1:4

150. The probability that at least one of the events A and B occurs is 0.6 . If A and B occur simultaneously with probability 0.2 , then $P(A') + P(B')$ is equal to

(A) 0.8 (B) 0.4

(C) 1.4 (D) 1.2

- End of Question Paper -