MHT CET 2025 PCM Apr 20 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 2025**, 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.

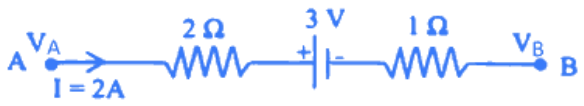
1. In hydrogen spectrum, the ratio of wavelengths of the last line of Lyman series and that of the last line of Balmer series is

(A) 1 (B) 0.5
(C) 0.25 (D) 0.2

2. For a perfectly black body, coefficient of emission is

(A) zero. (B) unity.
(C) less than one (non-zero). (D) infinity.

3. The potential difference $(V_A - V_B)$ between the points A and B in the given figure is



(A) 6 V (B) -3 V
(C) 9 V (D) 3 V

4. Which one of the following person is in an inertial frame of reference?

(A) A person (man) in a train which is slowing down to stop. (B) A person (child) revolving in a merry-go-round.
(C) A person (driver) in a bus which is moving with constant velocity. (D) A person (pilot) in an aeroplane which is taking off.

5. Two discs A and B of same material and thickness have radii R and $3R$ respectively. Their moments of inertia about their axis will be in the ratio

(A) 3 : 1 (B) 1 : 9
(C) 1 : 81 (D) 1 : 27

6. When an observer moves towards a stationary source with velocity ' V_1 ', the apparent frequency of emitted note is ' F_1 '. When observer moves away from stationary source with velocity ' V_1 ' the apparent frequency is ' F_2 '. If ' v ' is velocity of sound in air and $\frac{F_1}{F_2} = 2$, then $\frac{V}{V_1}$ is equal to

(A) 6 (B) 5
(C) 3 (D) 4

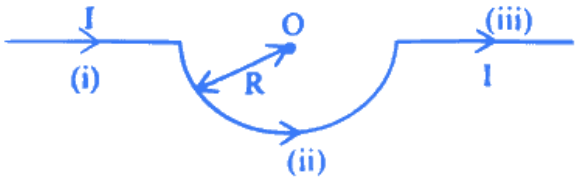
7. For the following reaction, the particle ' x ' is $_6C^{11} \longrightarrow {}_5B^{11} + \beta^+ + X$

(A) proton (B) neutrino
(C) anti neutrino (D) neutron

8. In fundamental mode, the time required for the sound wave to reach up to closed end of a pipe filled with air is ' t ' second. The frequency of vibration of air column is (Neglect end correction)

(A) $(4t)^{-1}$ (B) $(2t)^{-1}$
(C) $4t$ (D) $2t$

9. A wire has three different sections as shown in figure. The magnitude of the magnetic field produced at the centre ' O ' of the semicircle by three sections together is ($\mu_0 =$ permiability of free space)



(A) $\frac{\mu_0 I}{4R}$ (B) $\frac{\mu_0 I}{2R}$
(C) $\frac{\mu_0 I}{4\pi R}$ (D) $\frac{\mu_0 I}{2\pi R}$

10. A student measures time for 20 oscillations of a simple pendulum as 30 s, 32 s, 35 s and 35 s . If the minimum division in the measuring clock is 1 s , then correct mean time (in second) is

(A) (33 ± 2) (B) (32 ± 3)
(C) (33 ± 3) (D) (32 ± 2)

11. Light of wavelength ' λ ' falls on a metal having work function $\frac{hc}{\lambda_0}$. Photoelectric effect will take place only if (λ_0 is the threshold wavelength)

(A) $\lambda \geq \lambda_0$ (B) $\lambda \geq 2\lambda_0$
(C) $\lambda \leq \lambda_0$ (D) $\lambda = 4\lambda_0$

12. For a particle moving in a circle with constant angular speed, which of the following statements is 'false'?

(A) The velocity vector is tangent to the circle.
(B) The acceleration vector is tangent to the circle.
(C) The velocity and acceleration vectors are perpendicular to each other.
(D) The acceleration vector points to the centre of the circle.

13. In Young's double slit experiment, the distance between screen and aperture is 1 m . The slit width is 2 mm . Light of 6000 $\mathring{A}$ is used. If a thin glass plate ($\mu = 1.5$) of thickness 0.04 mm is placed over one of the slits, then there will be a lateral displacement of the fringes by

(A) 0.5 cm
(B) 1 cm
(C) 1.5 cm
(D) 2 cm

14. For an ideal diode, in forward and reverse biased condition the resistance is respectively

(A) infinite, zero.
(B) infinite, infinite.
(C) zero, zero.
(D) zero, infinite.

15. In Young's double slit experiment, when light of wavelength 600 nm is used, 18 fringes are observed on the screen. If the wavelength of light is changed to 400 nm , the number of fringes observed on the screen is

(A) 12
(B) 27
(C) 22
(D) 24

16. If $\vec{A} = \hat{i} + \hat{j} + 3\hat{k}, \vec{B} = -\hat{i} + \hat{j} + 4\hat{k}$ and $\vec{C} = 2\hat{i} - 2\hat{j} - 8\hat{k}$, then the angle between the vectors $\overrightarrow{P} = \overrightarrow{A} + \overrightarrow{B} + \overrightarrow{C}$ and $\overrightarrow{Q} = (\overrightarrow{A} \times \overrightarrow{B})$ is (in degree)

(A) 0°
(B) 45°
(C) 90°
(D) 60°

17. A coil of self-inductance L is connected in series with a bulb and an a. c. source. Brightness of the bulb decreases when

(A) an iron rod is inserted in the coil.
(B) frequency of a.c. source is decreased.
(C) number of turns in the coil is reduced.
(D) a capacitance of reactance $(X_C - X_L)$ is included in the same circuit.

18. The period of S. H.M. of a particle is 16 second. The phase difference between the positions at $t = 2$ s and $t = 4$ s will be

(A) π
(B) $\frac{\pi}{2}$
(C) $\frac{\pi}{4}$
(D) $\frac{\pi}{8}$

19. A body cools from 60°C to 40°C in 6 minutes. After next 6 minutes its temperature will be (Temperature of the surroundings is 10°C)

(A) 24°C
(B) 28°C
(C) 18°C
(D) 32°C

20. A parallel beam of light is incident normally on a plane surface absorbing 50% of the light and reflecting the rest. If the incident beam carries 90 W of power, the force exerted by it on the surface is (C = velocity of light in air $= 3 \times 10^8$ m/s)

(A) 4.5×10^{-7} N
(B) 1.5×10^{-7} N
(C) 3×10^{-7} N
(D) 9×10^{-7} N

21. A tyre of a vehicle is filled with air having pressure 270 kPa at 27°C. The air pressure in the tyre when the temperature increases to 37°C is

(A) 282 kPa
(B) 270 kPa
(C) 265 kPa
(D) 279 kPa

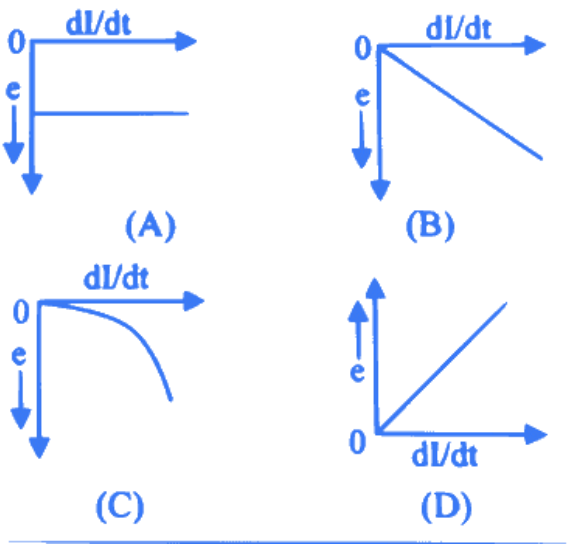
22. A 20Ω resistance, 10 mH inductance coil and 15μ F capacitor are joined in series. When a suitable frequency alternating current source is joined to this combination, the circuit resonates. If the resistance is made $\frac{1}{3}$rd, the resonant frequency

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

23. If the period of a oscillation of mass ' m ' suspended from a spring is 2 s , then the period of suspended mass ' 4 m ' with the same spring will be

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

24. The current flowing through an inductor of selfinductance L is continuously increasing at constant rate. The variation of induced e.m.f. (e) verses dI/dt is shown graphically by figure



(A) B (B) A
(C) D (D) C

25. Three point charges $+Q, +2Q$ and q are placed at the vertices of an equilateral triangle. The value of charge q in terms of Q, so that electrical potential energy of the system is zero, is given by

(A) $q = \frac{1}{3}Q$ (B) $q = \frac{2}{3}Q$
(C) $q = -\frac{2}{3}Q$ (D) $q = -\frac{3}{2}Q$

26. The surface energy of a liquid drop is ' V '. It is sprayed into 1000 equal droplets. The surface energy of all the droplets is

(A) V (B) 10 V
(C) 100 V (D) 1000 V

27. When an n-p-n junction transistor is used as an amplifier in common emitter mode,

(A) the base emitter junction is reverse biased.
(B) the input impedance is high and the output impedance is low.
(C) input signal is applied between the base and emitter and the output is obtained between collector and emitter.
(D) the input voltage and the output voltage are in phase.

28. The average force applied on the walls of a closed container depends as T^x where T is the temperature of an ideal gas. The value of x is

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

29. A hollow cylinder has a charge of ' q ' C within it. If ϕ is the electric flux associated with the curved surface B, the flux linked with the plane surface A will be



(A) $\frac{\varrho}{3}$ (B) $\frac{q}{\epsilon_0} - \varrho$
(C) $\frac{q}{3\epsilon_0}$ (D) $\frac{1}{2}(\frac{q}{\epsilon_0} - \varrho)$

30. A diatomic gas $\left(\gamma = \frac{7}{5}\right)$ is compressed adiabatically to volume $\frac{V_0}{32}$, where V_0 is its initial volume. The initial temperature of the gas is T_i in kelvin and the final temperature is xT_i in kelvin. The value of x is

(A) 5 (B) 4
(C) 3 (D) 2

31. The coefficient of mutual induction is 2 H and induced e.m.f. across secondary is 2 kV . Current in the primary is reduced from 6 A to 3 A . The time required for the change of current is

(A) 4×10^{-3} s (B) 6×10^{-3} s
(C) 2×10^{-3} s (D) 3×10^{-3} s

32. A liquid drop having surface energy E is spread into 729 droplets of same size. The final surface energy of the droplets is

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

33. A body is projected vertically from earth's surface with $\left(\frac{1}{3}\right)^{rd}$ of escape velocity. The maximum height reached by the body is (R = radius of earth)

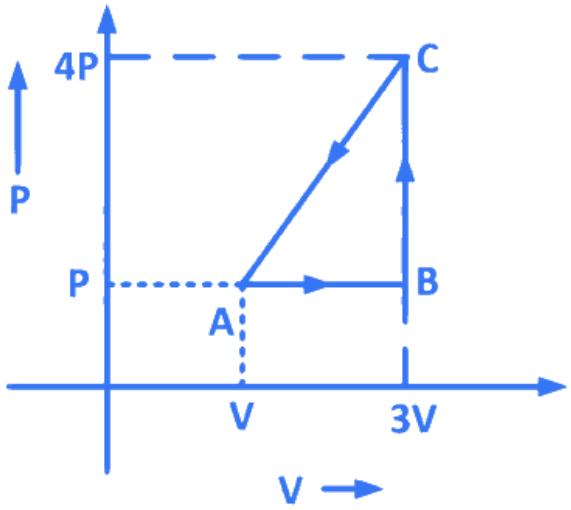
(A) $\frac{R}{4}$ (B) $\frac{R}{8}$
(C) $\frac{R}{9}$ (D) $\frac{R}{6}$

34. Two planar concentric rings of metal wire having radii r_1 and r_2 $(r_1 > r_2)$ are placed in air. The current I is flowing through the coil of larger radius. The mutual inductance between the coils is given by (μ_0 = permeability of free space)

(A) $\frac{\mu_0 \pi r_1^2}{2r_2}$ (B) $\frac{\mu_0 \pi r_2^2}{2r_1}$

(C) $\frac{\mu_0 \pi (r_1+r_2)^2}{2r_1}$ (D) $\frac{\mu_0 \pi (r_1-r_2)^2}{2r_2}$

35. The work done by a gas as it is taken in a cyclic process (shown in graph) is



(A) 2 pv (B) -2 pv

(C) 3 pv (D) -3 pv

36. A conducting sphere of radius ' R ' is given a charge ' Q ' uniformly. The electric field and the electric potential at the centre of the sphere are respectively [ε_0 = permittivity of free space]

(A) zero and $\frac{Q}{4\pi\epsilon_0 R}$ (B) $\frac{Q}{4\pi\epsilon_0 R^2}$ and zero

(C) $\frac{Q}{4\pi\epsilon_0 R}$ and $\frac{Q}{4\pi\epsilon_0 R^2}$ (D) zero and zero

37. An inclined plane makes an angle 30° with the horizontal. A solid sphere rolling down an inclined plane from rest without slipping has linear acceleration (g = acceleration due gravity) ($\sin 30^\circ = 0.5$)

(A) $\frac{5g}{7}$ (B) $\frac{5g}{14}$

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

38. Two pipes of lengths L_1 and L_2, open at both ends are joined in series. If ' f_1 ' and ' f_2 ' are the fundamental frequencies of two pipes, then the fundamental frequency of series combination will be (neglect end correction)

(A) $\frac{f_1 f_2}{f_1 - f_2}$ (B) $f_1 + f_2$

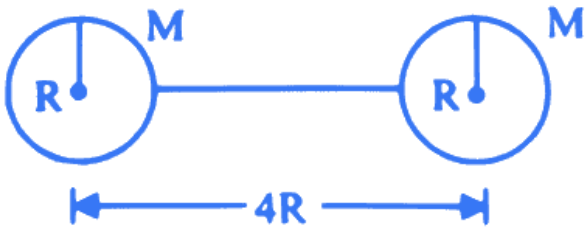
(C) $\frac{f_1 f_2}{f_1 + f_2}$ (D) $\sqrt{f_1^2 + f_2^2}$

39. A long wire carrying a steady current is bent into a circle of single turn. The magnetic field at the centre of the coil is ' B '. If it is bent into a circular loop of radius ' r_1 ' having ' n ' turns, the magnetic field at the centre of the coil for same current is

(A) $\frac{B}{n^2}$ (B) $\frac{B}{n}$

(C) $n^2 B$ (D) nB

40. Two spheres each of mass M and radius R are connected with a massless rod of length 4 R . The moment of inertia of the system about an axis passing through the centre of one of the spheres and perpendicular to the rod will be



(A) $\frac{21}{5}MR^2$ (B) $\frac{84}{5}MR^2$

(C) $\frac{42}{5}MR^2$ (D) $\frac{5}{21}MR^2$

41. In Young's double slit experiment, for the nth dark fringe ($n = 1, 2, 3 \ldots$) the phase difference of the interfering waves in radian will be

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

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

42. A water drop of $0.01\ cm^3$ is squeezed between two glass plates and spreads in to area of $10\ cm^2$. If surface tension of water is 70 dyne /cm then the normal force required to separate glass plates from each other will be

(A) 12 N (B) 14 N

(C) 16 N (D) 28 N

43. A null point is obtained at 200 cm on potentiometer wire when cell in secondary circuit is shunted by 5Ω. When a resistance of 15Ω is used for shunting, null point moves to 300 cm . The internal resistance of the cell is

(A) 3Ω (B) 4Ω

(C) 5Ω (D) 6Ω

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44. A resistance of 200Ω and an inductor of $\frac{1}{2\pi}$H are connected in series to a.c. voltage of 40 V and 100 Hz frequency. The phase angle between the voltage and current is

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

(C) $\tan^{-1}(1/3)$ (D) $\tan^{-1}(0.5)$

45. A wire of length L , diameter ' d ' density of material ' e ' is under tension ' T ', having fundamental frequency of vibration n_A. Another wire of length 2 L , tension 2 T , density 2 e and diameter 3 d has fundamental frequency of vibration n_B. The ratio $n_B : n_A$ is

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

(C) 1 : 6 (D) 1 : 8

46. ' n ' small spherical drops of same size which are charged to ' V ' volt each coalesce to form a single big drop. The potential of the big drop is

(A) $\frac{V}{n}$ (B) $n \cdot V$

(C) $n^{1/3} \cdot V$ (D) $n^{2/3} \cdot V$

47. In a transistor (common emitter configuration) the ratio of power gain to voltage gain is (α and β are current ratios)

(A) $\frac{\beta}{\alpha}$ (B) $\alpha\beta$

(C) α (D) β

48. A particle oscillates in straight line simple harmonically with period 8 second and amplitude $4\sqrt{2}$ m. Particle starts from mean position. The ratio of the distance travelled by it in 1^{st} second of its motion to that in 2^{nd} second is $\left(\sin 45^\circ = 1/\sqrt{2}, \sin\frac{\pi}{2} = 1\right)$

(A) 1 : 8 (B) 1 : 4

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

49. The length of the compound microscope is 15 cm . The magnifying power for relaxed eye is 25 . If the focal length of eye lens is 6 cm then the object distance for objective lens will be

(A) 1.3 cm (B) 1.5 cm

(C) 1.7 cm (D) 1.9 cm

50. The magnetic susceptibility of iron is 5499 . The relative permeability of iron will be

(A) 5500×10^7 (B) 5500×10^{-7}

(C) 5500 (D) 5501

51. Solubility of $Ca_3(PO_4)_2$ is ' S ' $moldm^{-3}$. Find solubility product.

(A) S^5 (B) $108\ S^5$

(C) $54\ S^5$ (D) $12\ S^5$

52. Which from following reagents is used in Gatterman-Koch formylation of arene?

(A) $AlH(i-Bu)_2$ (B) CO, HCl (anhyd. $AlCl_3$)

(C) $CrO_2Cl_2(CS_2)$ (D) $DIBAI-H$

53. Which of the following species acts as reducing agent during working of hydrogen-oxygen fuel cell?

(A) H_2 (B) O_2

(C) H^+ (D) NaOH

54. The rate constant for a first order reaction is $0.58\ s^{-1}$ at 300 K and $0.026\ s^{-1}$ at 290 K .
What is the energy of activation?
$\left(R = 8.314\ J\ K^{-1}\ mol^{-1}\right)$

(A) 124.48 kJ (B) 224.55 kJ

(C) 348.18 kJ (D) 513.21 kJ

55. The reaction of propane with bromine in presence of UV light predominantly forms

(A) 1-Bromopropane (B) 2-Bromopropane

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

56. Which of the following pair of compounds on heating gives butanenitrile?

(A) Propanol and alcoholic KCN (B) Butanol and alcoholic KCN

(C) n -Butylchloride and alcoholic KCN (D) n -Propylchloride and alcoholic KCN

57. Standard potential (E°) of $Zn^{+2}_{(aq)} + 2e^- \longrightarrow Zn_{(s)}$ is -0.76 V .
What is standard potential of reaction $2Zn_{(s)} \longrightarrow 2Zn^{+2}_{(aq)} + 4e^-$?

(A) -1.52 V (B) +1.52 V

(C) -0.76 V (D) +0.76 V

58. Identify the ligands present in cisplatin.

(A) Cl^- and CN^- (B) NH_3 and Cl^-

(C) NH_3 and H_2O (D) Cl^- and H_2O

59. Identify false statement from the following about fluorine.

(A) It is highly electronegative element. (B) It exhibits only -1 oxidation state.

(C) It has high bond dissociation enthalpy among all halogens. (D) It forms only one oxoacid.

60. Which from following process involves zero work done?

(A) Isobaric expansion of gas. (B) Adiabatic compression of gas.

(C) Isothermal expansion of gas. (D) Free expansion of gas.

61. Calculate the constant external pressure required to expand 2 moles of an ideal gas from volume $15dm^3$ to $20dm^3$ if amount of work done is -600 J .

(A) 1.2 bar (B) 1.5 bar

(C) 1.8 bar (D) 2.1 bar

62. Which from following tests confirms presence of aldehydic group in glucose?

(A) Formation of oxime when reacted with NH_2OH. (B) Formation of gluconic acid when reacted with Br_2 water.

(C) Formation of saccharic acid when glucose and gluconic acid treated with dil. HNO_3. (D) Formation of penta acetate when treated with acetic anhydride.

63. Which metal in following compounds is not present in fractional oxidation state?

(A) Fe_3O_4 (B) Mn_3O_4

(C) Pb_3O_4 (D) $Na_2\ S_4O_6$

64. Which among the following is NOT dicarboxylic acid?

(A) Adipic acid (B) Glutaric acid

(C) Valeric acid (D) Malonic acid

65. Identify the substrate ' X ' in the following reaction.

$$X + \underset{(air)}{O_2} \xrightarrow[\text{ii) dil HCl } \Delta]{\text{i) Co-naphenate 423 K}} \text{Phenol} + \text{Acetone}$$

(A) Chlorobenzene
(B) Benzene sulphonic acid
(C) Benzenamine
(D) Isopropyl benzene

66. Identify the monomers use to prepare glyptal.

(A) β-Hydroxy butyric acid and β-hydroxy valeric acid
(B) Ethylene glycol and phenol
(C) Ethylene glycol and terephthalic acid
(D) Ethylene glycol and phtalic acid

67. Identify the product ' Z ' in the following series of reactions.

$$\text{Ethanol} \xrightarrow[\Delta]{SOCl_2} X \xrightarrow[\text{Dry ether}]{Mg} Y \xrightarrow{NH_3} Z$$

(A) Ethyl chloride
(B) Ethyl magnesium chloride
(C) Ethyl amine
(D) Ethane

68. Calculate the enthalpy of vaporisation of ethanol if 11.5 g of ethanol is completely vaporised by supplying 11.8 kJ of heat.

(A) 21.7 kJ mol^{-1}
(B) 47.2 kJ mol^{-1}
(C) 65.1 kJ mol^{-1}
(D) 39.0 kJ mol^{-1}

69. Identify the reagent involved in Sandmeyer reaction.

(A) CuCN/KCN
(B) Cu (Powder) /HBr
(C) H_3PO_3
(D) CH_3CH_2OH

70. The solubility of AgBr is 7.1×10^{-7} $moldm^{-3}$. Calculate its solubility product at the same temperature.

(A) 7.08×10^{-13}
(B) 3.67×10^{-13}
(C) 5.89×10^{-13}
(D) 5.04×10^{-13}

71. Identify the product ' B ' in the following sequence of reactions.

$$\text{Methylpropanoate} \xrightarrow[\text{dil. NaOH}]{\Delta} A \xrightarrow[\text{Conc. HCl}]{H^+} B$$

(A) sodium propanoate
(B) propanone
(C) propanal
(D) propanoic acid

72. Which from following functional groups has highest priority order for naming the poly functional compound?

(A) -CN
(B) $-CONH_2$
(C) $-C \equiv C-$
(D) $-NH_2$

73. Identify the product ' X ' formed in the following reaction,
Sodium ethoxide + Isopropyl chloride$\longrightarrow$ X+ Ethanol + Sodium chloride

(A) 1-Ethoxypropane
(B) 2-Ethoxypropane
(C) Propene
(D) Propane

74. Which among the following is NOT benzylic halide?

(A) Bromophenylmethane
(B) 1-Bromo-1-phenylethane
(C) 2-Bromo-2-phenylpropane
(D) 1-Bromo-2-phenylbutane

75. If compressibility factor of real gas is 1.05 at STP. What is molar volume of real gas?

(A) $22.40dm^3$
(B) $21.33dm^3$
(C) $23.52dm^3$
(D) $23.05dm^3$

76. Identify the type of defect from following in stainless steel.

(A) Substitutional impurity defect
(B) Interstitial impurity defect
(C) Metal excess defect
(D) Frenkel defect

77. Which from following is a lanthanoid element?

(A) Er
(B) Am
(C) Np
(D) Lr

78. Which from following formulae is used to obtain value of E^r_{cell} for a reaction taking place in Dry cell?

(A) $\frac{-\Delta G^\circ}{F}$
(B) $\frac{-\Delta G^\circ}{2F}$
(C) $\frac{-\Delta G^\circ}{3F}$
(D) $\frac{-\Delta G^\circ}{4F}$

79. Which of the following solutions exhibits highest freezing point depression?

(A) 0.1 m NaCl
(B) 0.05 m$MgSO_4$
(C) 1 m$AlPO_4$
(D) 0.05 m$Al_2(SO_4)_3$

80. Calculate the energy associated with third orbit of He^{+}.

(A) -4.8×10^{-19} J (B) -1.45×10^{-19} J

(C) -19.36×10^{-19} J (D) -9.69×10^{-19} J

81. What is the pH of buffer solution formed by mixing 0.01 M acetic acid and 0.05 M sodium acetate? ($pK_a = 4.7447$)

(A) 2.80 (B) 3.00

(C) 5.44 (D) 6.5

82. Identify the geometry of TeF_4 molecule from the following.

(A) Linear (B) Tetrahedral

(C) Trigonal bipyramidal (D) Trigonal

83. Which of the following set of elements is present in apatite?

(A) Mg, P and S (B) Ca, P and O

(C) Al, Mg and P (D) Ca, S and O

84. Which of the following is not negatively charged sol?

(A) $As_2 S_3$ (B) Haemoglobin

(C) Clay (D) Congo Red

85. The rate constant for the reaction, $2\,N_2O_{5(g)} \rightarrow 2\,N_2O_{4(g)} + O_{2(g)}$ is $4.98 \times 10^{-4}\ s^{-1}$. What is the order of reaction?

(A) 2 (B) 1

(C) Zero (D) 3

86. Identify thermoplastic polymer from following.

(A) Polyvinyl (B) Bakelite

(C) Terylene (D) Neoprene

87. What is the number of unpaired electrons in Ti in +3 state?

(A) 4 (B) 3

(C) 1 (D) Zero

88. Calculate the total number of tetrahedral and octahedral voids formed in 0.6 mol of a compound if it forms hcp structure.

(A) 3.613×10^{24} (B) 7.226×10^{24}

(C) 1.084×10^{24} (D) 2.913×10^{24}

89. Calculate the concentration of dissolved gas in water at 25°C if partial pressure of gas at same temperature is 0.15 atm .

$$\left[K_H = 0.15\ moldm^{-3}\ atm^{-1}\right]$$

(A) 0.0261 M (B) 0.0182 M

(C) 0.0293 M (D) 0.0225 M

90. Which from following is an essential amino acid?

(A) Tyrosine (B) Serine

(C) Histidine (D) Glycine

91. What is the mass in grams of 0.25 mol water?

(A) 1.5 g (B) 2.5 g

(C) 4.5 g (D) 3.5 g

92. Which from following statements is correct regarding a detergent sodium lauryl sulphate?

(A) It is anionic detergent and is used in toothpaste.

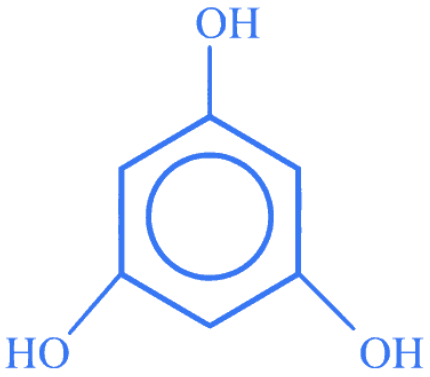
(B) It is cationic detergent and is used as household detergent.

(C) It is cationic detergent and is used as hair conditioner.

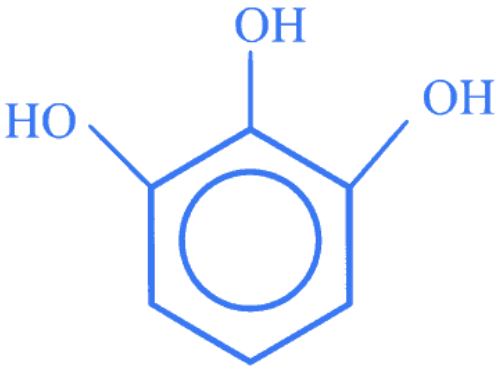
(D) It is an ether and used as liquid detergent.

93. Identify the structural formula of phloroglucinol.

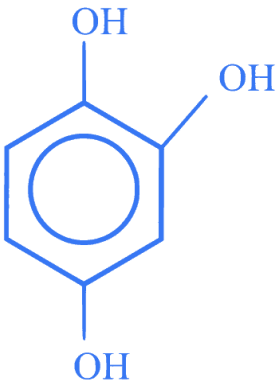
(A)



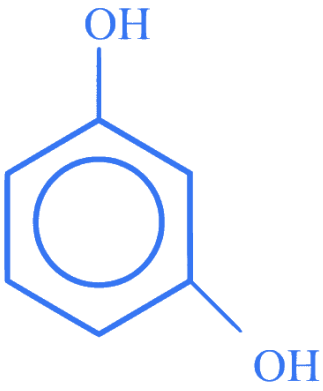
(B)



(C)



(D)



94. Which of the following equations is correct regarding rate of disappearance of reactant and appearance of product for

$$N_{2(g)} + 3H_{2(g)} \longrightarrow 2NH_{3(g)}$$

(A) $3\frac{d[N_2]}{dt} = \frac{1}{2}\frac{d[N_2]}{dt}$ (B) $\frac{1}{2}\frac{d[N_2]}{dt} = \frac{1}{3}\frac{d[H_2]}{dt}$

(C) $2\frac{d[NH_3]}{dt} = 3\frac{d[H_2]}{dt}$ (D) $3\frac{d[NH_3]}{dt} = -2\frac{d[H_2]}{dt}$

95. If salicylic acid (138 u) reacts with acetic anhydride (102 u) to from aspirin (180 u) calculate \% atom economy.

(A) 25% (B) 50%

(C) 65% (D) 75%

96. Identify a molecule having highest number of lone pair of electrons in valence shell of central atom.

(A) NH_3 (B) SF_4

(C) ICl_3 (D) PCl_3

97. Which among the following compounds has lowest boiling point?

(A) $(C_2H_5)_2NH$ (B) $C_2H_5\ N(CH_3)_2$

(C) $n - C_4H_9OH$ (D) C_2H_5COOH

98. Calculate the molar mass of an element if it forms fcc unit cell structure [mass of unit cell $= 1.8 \times 10^{-22}$ g, $N_A = 6.022 \times 10^{23}\ mol^{-1}$]

(A) 27.0 g mol^{-1} (B) 24.4 g mol^{-1}

(C) 21.0 g mol^{-1} (D) 30.2 g mol^{-1}

99. Calculate the osmotic pressure of 0.03 mole of non electrolyte solute dissolved in $0.1 dm^3$ of water at 300 K. $\left[R = 0.0821 dm^3\ atm\ mol^{-1}\ K^{-1}\right]$

(A) 7.4 atm (B) 6.4 atm

(C) 8.0 atm (D) 5.6 atm

100. Identify the correct decreasing order of stability of complexes formed by divalent metal ions with same ligand.

(A) $Cu^{2+} > Mn^{2+} > Cd^{2+}$

(B) $Cd^{2+} > Mn^{2+} > Cu^{2+}$

(C) $Mn^{2+} > Cd^{2+} > Cu^{2+}$

(D) $Cu^{2+} > Cd^{2+} > Mn^{2+}$

101. The general solution of $x(x-1)\frac{dy}{dx} = x^3(2x-1) + (x-2)y$ is

(A) $y(x-1) = x^3 + c(x-1)$, where c is the constant of integration.

(B) $y = x^3(x-1) + c$, where c is the constant of integration.

(C) $y(x-1) = x^3(x-1) + cx^2$, where c is the constant of integration.

(D) $y(x-1) = x^3(x-1) + c$, where c is the constant of integration.

102. The direction cosines of the line $x - y + 2z = 5$ and $3x + y + z = 6$ are

(A) $\frac{-3}{5\sqrt{2}}, \frac{5}{5\sqrt{2}}, \frac{4}{5\sqrt{2}}$ (B) $\frac{3}{5\sqrt{2}}, \frac{-5}{5\sqrt{2}}, \frac{4}{5\sqrt{2}}$

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

103. 20 is divided into two parts so that the product of the cube of one part and the square of the other part is maximum, then these two parts are

(A) 15,5 (B) 16,4

(C) 12,8 (D) 14,6

104. The acute angle between the diagonals of a parallelogram whose vertices are $A(2,-1)$, $B(0,2), C(2,3)$ and $D(4,0)$ is

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

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

105. The shortest distance between the line $y - x = 1$ and the curve $x = y^2$ is

(A) $\frac{3\sqrt{2}}{8}$ (B) $\frac{2\sqrt{3}}{8}$

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

106. The equation of the circle passing through the point $(1,1)$ and having two diameters along the pair of lines $x^2 - y^2 - 2x + 4y - 3 = 0$ is

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

(B) $(x-3)^2 + (y-1)^2 = 4$

(C) $(x-1)^2 + (y-2)^2 = 1$

(D) $(x+1)^2 + (y+2)^2 = 1$

107.

$$\int \sin^5 x \, dx =$$

(A) $\cos x + \frac{2}{3}\cos^3 x - \frac{\cos^5 x}{5} + c$, where c is the constant of integration

(B) $\cos x + \frac{2}{3}\cos^3 x + \frac{\cos^5 x}{5} + c$, where c is the constant of integration

(C) $-(\cos x - \frac{2}{3}\cos^3 x + \frac{\cos^5 x}{5} + c)$, where c is the constant of integration

(D) $\cos x - \frac{2}{3}\cos^3 x + \frac{\cos^5 x}{5} + c$, where c is the constant of integration

108. If the angle between the planes $x - 2y + 3z - 5 = 0$ and $x + \alpha y + 2z + 7 = 0$ is $\cos^{-1}\left(\frac{1}{14}\right)$ then the difference between the values of α is

(A) $\frac{12}{11}$ (B) $\frac{62}{55}$

(C) $\frac{31}{11}$ (D) $\frac{8}{5}$

109. If the shortest distance between the lines $\frac{x-k}{2} = \frac{y-4}{3} = \frac{z-3}{4}$ and $\frac{x-2}{4} = \frac{y-4}{6} = \frac{z-7}{8}$ is $\frac{13}{\sqrt{29}}$, then k =

(A) 1 (B) -1

(C) 2 (D) -2

110. The acute angle between the lines $x = -2 + 2t, y = 3 - 4t, z = -4 + t$ and $x = -2 - t, y = 3 + 2t, z = -4 + 3t$ is

(A) $\cos^{-1}(\frac{1}{\sqrt{6}})$ (B) $\cos^{-1}(\frac{1}{\sqrt{5}})$

(C) $\sin^{-1}(\frac{2}{\sqrt{5}})$. (D) $\cos^{-1}(\frac{2}{\sqrt{6}})$

111. If the curves $y^2 = 6x$ and $9x^2 + by^2 = 16$ intersect each other at right angles, then the value of b is

(A) 4 (B) $\frac{7}{2}$

(C) 6 (D) $\frac{9}{2}$

112. The value of $\sqrt{3}\cot 20^\circ - 4\cos 20^\circ$ is equal to

(A) 1 (B) -1

(C) 0 (D) $\frac{1}{2}$

113. Let $\bar{a}$ and $\bar{b}$ be two vectors such that $|\bar{a}| = 1, |\bar{b}| = 4, \bar{a} \cdot \bar{b} = 2$. If $\bar{c} = (2\bar{a} \times \bar{b}) - 3\bar{b}$, then the angle between $\bar{b}$ and $\bar{c}$ is

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

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

114. If $\bar{a}, \bar{b}, \bar{c}, \bar{d}$ are unit vectors such that $\bar{a} \cdot \bar{b} = \frac{1}{2}, \bar{c} \cdot \bar{d} = \frac{1}{2}$ and the angle between $\bar{a} \times \bar{b}$ and $\bar{c} \times \bar{d}$ is $\frac{\pi}{6}$, then the value of $|[\bar{a}\bar{b}\bar{d}]\bar{c} - [\bar{a}\bar{b}\bar{c}]\bar{d}| =$

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

(C) $\frac{3}{8}$ (D) 2

115. If $\bar{a} = 4\hat{i} + 3\hat{j} + \hat{k}, \bar{b} = \hat{i} - 2\hat{j} + 2\hat{k}$ then $\bar{a} \times (\bar{a} \times (\bar{a} \times (\bar{a} \times \bar{b}))) =$

(A) $676\bar{a}$ (B) $676\,\bar{b}$

(C) $625\bar{a}$ (D) $625\,\bar{b}$

116. If X is a binomial variable with range $\{0, 1, 2, 3, 4\}$ and $P(X = 3) = 3P(X = 4)$ then the parameter 'p' of the binomial distribution is

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

(C) $\frac{1}{3}$ (D) $\frac{4}{7}$

117. If a statement q has truth value False and $(p \wedge q) \leftrightarrow r$ has truth value True then which of the following has truth value true?

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

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

118. The logically equivalent statement of $(\sim p \wedge q) \vee (\sim p \wedge \sim q) \vee (p \wedge \sim q)$ is

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

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

119. Two cards are drawn simultaneously from a well shuffled pack of 52 cards. If X is the random variable of getting queens, then the value of $2E(X) + 3E\left(X^2\right)$ for the number of queens is

(A) $\frac{132}{221}$ (B) $\frac{108}{221}$

(C) $\frac{176}{221}$ (D) $\frac{68}{221}$

120. A random variable X has the following probability distribution

X :	0	1	2	3	4
P(X) :	k	2k	4k	2k	k

then the value of $P(1 \leqslant X < 4 \mid X \leqslant 2) =$

(A) $\frac{5}{6}$ (B) $\frac{6}{7}$

(C) $\frac{7}{8}$ (D) $\frac{8}{9}$

121. The area of the region bounded by $\frac{x^2}{9} + \frac{y^2}{4} = 1$ and the line $\frac{x}{3} + \frac{y}{2} = 1$ is

(A) $\frac{1}{2}(\pi - 2)$ sq. units (B) $\frac{3}{2}(\pi - 2)$ sq. units

(C) $\frac{5}{4}(\pi - 2)$ sq. units (D) $\frac{2}{3}(\pi - 2)$ sq. units

122. If $f(x) = \begin{cases} mx + 1, & x \leqslant \frac{\pi}{2} \\ \sin x + n, & x > \frac{\pi}{2} \end{cases}$, is continuous at $x = \frac{\pi}{2}, (m, n \in \mathbb{Z})$ then

(A) $m = 1, n = 0$ (B) $m = \frac{n\pi}{2}$

(C) $m = n = \frac{\pi}{2}$ (D) $n = \frac{m\pi}{2}$

123.

$$\int_{-2}^{2} |x^2 - x - 2| dx =$$

(A) $\frac{17}{3}$ (B) $\frac{19}{3}$

(C) 19 (D) 17

124.

$$\lim_{x \to 0} \frac{e^{\tan x} - e^x}{\tan x - x} =$$

(A) 1 (B) 0

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

125. The area of the triangle formed by the lines joining the vertex of the parabola $x^2 = 20y$ to the end of its latus rectum is

(A) 100 sq. units (B) 40 sq. units

(C) 20 sq. units (D) 50 sq. units

126. The value of $\int_{-1}^{1} \left(\sqrt{1 + x + x^2} - \sqrt{1 - x + x^2}\right) dx$ is

(A) -1 (B) 1

(C) 0 (D) 2

127. If two numbers p and q are chosen randomly from the set $\{1, 2, 3, 4\}$, one by one, with replacement, then the probability of getting $p^2 \geq 4q$ is

(A) $\frac{1}{4}$ (B) $\frac{7}{16}$

(C) $\frac{1}{2}$ (D) $\frac{9}{16}$

128. The function defined by $f(x) = \frac{2x+3}{3x+4}, x \neq -\frac{4}{3}$ is

(A) only one one (B) only onto

(C) onto for $y \neq \frac{2}{3}$ and one-one (D) neither one-one nor onto

129. The equation $|z+1-i| = |z-1+i|$ represents a (where z is a complex number)

(A) Straight line passing through the origin and the first and third quadrant.

(B) Straight line passing through the origin and the second and fourth quadrant.

(C) Straight line passing through the point $(1,-1)$ and having slope -1 .

(D) Straight line passing through the point $(2,1)$ and having slope $\frac{1}{2}$.

130. If $\int \frac{2x+3}{(x-1)(x^2+1)}dx$
$= \log_e\left\{(x-1)^{\frac{5}{2}}\left(x^2+1\right)^a\right\} - \frac{1}{2}\tan^{-1}x + A$
where A is an arbitrary constant, then the value of a is

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

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

131. The money invested in a company is compounded continuously. ₹ 400 invested today becomes ₹ 800 in 6 years, then at the end of 33 years, it will become .. $(\sqrt{2} = 1.4142)$

(A) 9050.88 (B) 18101.76

(C) 6788.16 (D) 12067.84

132. If $\overline{a}$ and $\overline{b}$ are unit vectors and θ is the angle between them, then $\overline{a}+\overline{b}$ is a unit vector when θ is

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

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

133. A regular polygon has 20 sides. The number of triangles that can be drawn by using the vertices but not using the sides are

(A) 1140 (B) 800

(C) 340 (D) 20

134.
$$\int \frac{dx}{2+\cos x} =$$

(A) $2\tan^{-1}(\frac{1}{\sqrt{3}}\tan\frac{x}{2}) + c$, where c is the constant of integration

(B) $\frac{2}{\sqrt{3}}\tan^{-1}(\frac{1}{\sqrt{3}}\tan\frac{x}{2}) + c$, where c is the constant of integration

(C) $\frac{1}{\sqrt{3}}\tan^{-1}(\frac{1}{\sqrt{3}}\tan\frac{x}{2}) + c$, where c is the constant of integration

(D) $\sqrt{3}\tan^{-1}(\frac{1}{\sqrt{3}}\tan\frac{x}{2}) + c$, where c is the constant of integration

135. If $A+B = \frac{\pi}{2}$ then the maximum value of $\cos A \cdot \cos B$ is

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

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

136. The magnitude of a vector which is orthogonal to the vector $\hat{i}+\hat{j}+\hat{k}$ and is coplanar with the vectors $\hat{i}+\hat{j}+2\hat{k}$ and $\hat{i}+2\hat{j}+\hat{k}$ is

(A) $\sqrt{2}$ (B) $4\sqrt{2}$

(C) 4 (D) $2\sqrt{3}$

137. The distance between the lines represented by the equation $4x^2+4xy+y^2-6x-3y-4=0$ is

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

(C) $\sqrt{5}$ units (D) 5 units

138. If $y = x^x + x^{\frac{1}{x}}$, then $\frac{dy}{dx}$ is equal to

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

(B) $(x^x + x^{\frac{1}{x}})[1+\log x + \frac{1}{x^2}(1-\log x)]$

(C) $(x^x + x^{\frac{1}{x}})[(1+\log x) - \frac{1}{x^2}(1-\log x)]$

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

139. If the plane $\frac{x}{3}+\frac{y}{2}-\frac{z}{4}=1$ cuts the co-ordinate axes at points A, B and C , then the area of the triangle ABC is

(A) $\frac{\sqrt{61}}{2}$ sq. units (B) $2\sqrt{61}$ sq. units

(C) $\sqrt{61}$ sq. units (D) $3\sqrt{61}$ sq. units

140. If $\tan^{-1}\left(\frac{x}{2}\right) + \tan^{-1}\left(\frac{y}{2}\right) + \tan^{-1}\left(\frac{z}{2}\right) = \frac{\pi}{2}$ then $xy+yz+zx =$

(A) 0 (B) 2

(C) -1 (D) 4

141. In a triangle ABC , with usual notations if $\frac{2\cos A}{a} + \frac{\cos B}{b} + \frac{2\cos C}{c} = \frac{a}{bc} + \frac{b}{ca}$ then $\angle A =$

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

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

142. If $f(1)=1, f'(1)=3$, then the derivative of $f(f(f(x))) + (f(x))^2$ at $x=1$ is

(A) 9 (B) 12

(C) 15 (D) 33

143. If $y = \log_e x^3 + 3\sin^{-1}x + kx^2$ and $y'\left(\frac{1}{2}\right) = 2\sqrt{3}$, then $k =$

(A) 6 (B) -6

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

144. In a triangle ABC with usual notations, if a, b, c are in arithmetic progression, then, $\tan\frac{A}{2}\cdot\tan\frac{C}{2}=$

(A) 3 (B) $\frac{1}{13}$

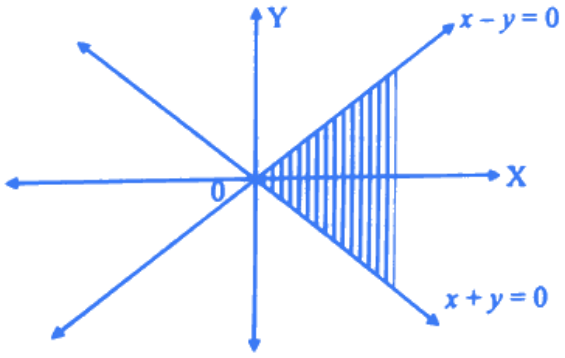
(C) -3 (D) $\frac{1}{3}$

145. If $\tan 3\theta=\cot\theta$, then $\theta=$

(A) $\frac{(2n+1)\pi}{8}, n\in\mathbb{Z}$ (B) $\frac{(2n+1)\pi}{4}, n\in\mathbb{Z}$

(C) $\frac{(n+2)\pi}{3}, n\in\mathbb{Z}$ (D) $n\pi, n\in\mathbb{Z}$

146. The shaded region in the following figure represents a solution set of



(A) $x-y\geq 0, x+y\geq 0$

(B) $x-y\leq 0, x+y\geq 0$

(C) $x-y\geq 0, x+y\leq 0$

(D) $x-y\leq 0, x+y\leq 0$

147. With usual notations, in a triangle ABC, if θ is any real number, then $a\cos(B-\theta)+b\cos(A+\theta)$ is

(A) $a\cos\theta$ (B) $b\cos\theta$

(C) $\cos\theta$ (D) $c\cos\theta$

148. If $A=\begin{bmatrix}1 & \tan x\\ -\tan x & 1\end{bmatrix}$, then $A^TA^{-1}=$

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

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

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

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

149. The sum of the degree and order of the differential equation $\sqrt{\frac{d^2y}{dx^2}}=\sqrt[5]{\frac{dy}{dx}-5}$ is

(A) 1 (B) 3

(C) 5 (D) 7

150. The differential equation whose solution represents the family $x^2y=4e^x+c$, where c is an arbitrary constant, is

(A) $x\frac{dy}{dx}+xy=0$

(B) $x^2\frac{dy}{dx}+(2x-xy)=0$

(C) $x\frac{dy}{dx}+(x-2)y=0$

(D) $x^2\frac{dy}{dx}+2xy-4e^x=0$

- End of Question Paper -