VITEEE 2023 Question Paper with Solutions

Time Allowed :2 hours 30 minutes	**Maximum Marks :**125	**Total questions :**125

General Instructions

Read the following instructions very carefully and strictly follow them :

1. This question paper contains 125 questions. All questions are compulsory.
2. There are 5 sections in the question paper- Mathematics, Physics, Chemistry, Aptitude, English.
3. There are 35 questions each in Chemistry and Physics, 40 questions in Mathematics, 10 question of Aptitude, and 5 questions of English.
4. 1 mark will be given for each correct answer. There is no negative marking. No marks will be deducted for any wrong response selected by candidates.

1 Physics

1. Light of wavelength λ_A and λ_B falls on two identical metal plates A and B respectively. The maximum kinetic energy of photoelectrons is K_A and K_B respectively. Given that $\lambda_A = 2\lambda_B$, which one of the following relations is true?

(A) $K_A < \frac{K_B}{2}$

(B) $2K_A = K_B$

(C) $K_A = 2K_B$

(D) $K_A > 2K_B$

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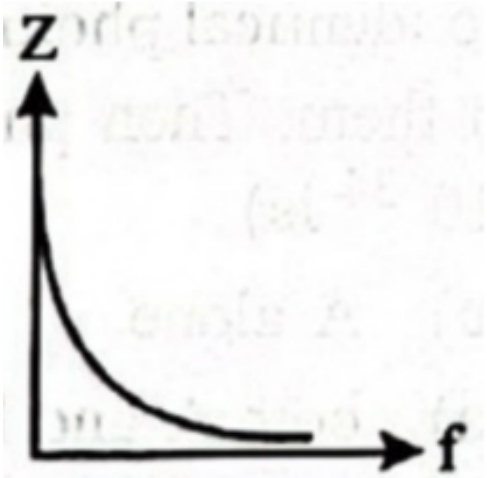
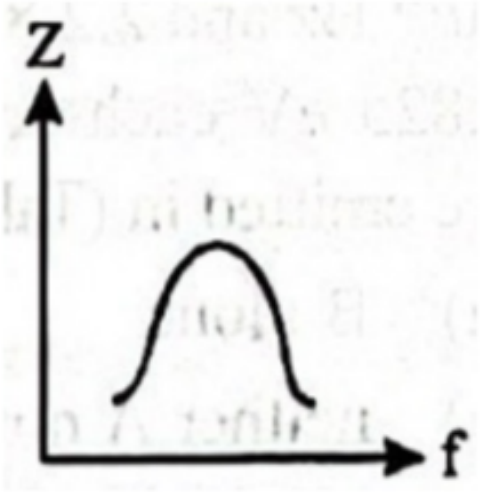
2. Which one of the following curves represents the variation of impedance (Z) with frequency f in a series LCR circuit?

(A)



(B)



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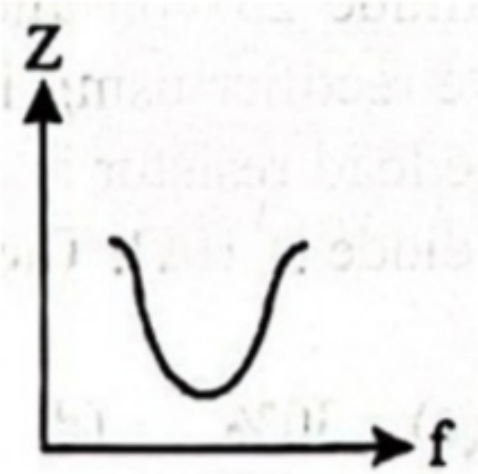
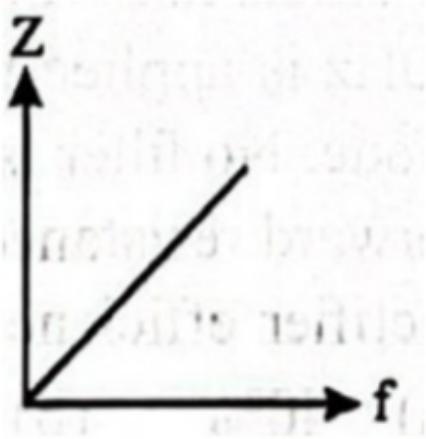


(D)



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3. A Carnot engine takes 3×10^6 cal of heat from a reservoir at $627°C$, and gives it to a sink at $27°C$. The work done by the engine is:

(A) 4.2×10^6 J

(B) 8.4×10^6 J

(C) 16.8×10^6 J

(D) 0

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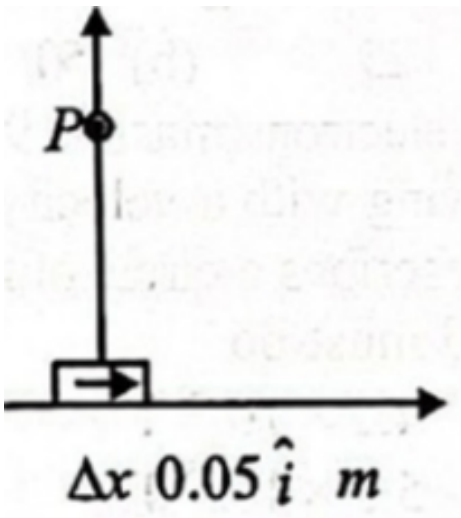
4. An element of 0.05 m is placed at the origin, carrying a large current of $10A$. The magnetic field at a perpendicular distance of 1 m is:



(A) 4.5×10^{-8} T

(B) 5.5×10^{-8} T

(C) 5.0×10^{-8} T

(D) 7.5×10^{-8} T

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5. A sinusoidal voltage of amplitude 25 V and frequency 50 Hz is applied to a half-wave rectifier using a P-N junction diode. No filter is used, and the load resistor is 1000Ω. The forward resistance R_f of the ideal diode is 10Ω. The percentage rectifier efficiency is:

(A) 40%

(B) 20%

(C) 30%

(D) 15%

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6. A flask contains a monoatomic and a diatomic gas in the ratio of $4:1$ by mass at a temperature of $300K$. The ratio of average kinetic energy per molecule of the two gases is:

(A) $1:1$

(B) $2:1$

(C) $4:1$

(D) $1:4$

---

7. The potential energy of a particle $U(x)$ executing simple harmonic motion is given by:

(A) $U(x) = \frac{k}{2}(x-a)^2$

(B) $U(x) = k_1 x + k_2 x^2 + k_3 x^3$

(C) $U(x) = Ae^{-bx}$

(D) $U(x) =$ a constant

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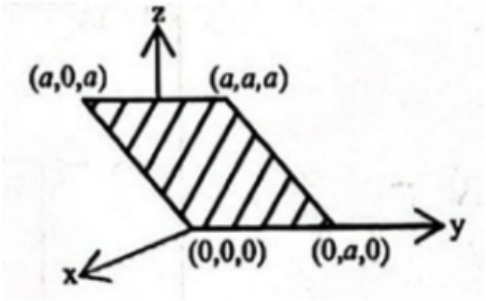
8. Consider an electric field $\mathbf{E} = E_0\hat{x}$, where E_0 is a constant. The flux through the shaded area (as shown in the figure) due to this field is:



(A) $2E_0a^2$

(B) $\sqrt{2}E_0a^2$

(C) E_0a^2

(D) $\frac{E_0a^2}{\sqrt{2}}$

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9. The equation of a wave on a string of linear mass density 0.04 kg/m is given by:

$$y = 0.02 \sin 2\pi \left(\frac{t}{0.04} - \frac{x}{0.50}\right)$$

The tension in the string is:

(A) $4.0N$

(B) $12.5N$

(C) $0.5N$

(D) $6.25N$

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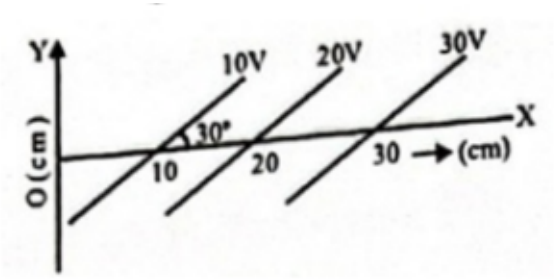
10. Equipotential surfaces are shown in the figure. The electric field strength will be:



(A) 100 V/m along X-axis

(B) 100 V/m along Y-axis

(C) 200 V/m at an angle $120°$ with X-axis

(D) 50 V/m at an angle $120°$ with X-axis

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11. Water falls from a 40 m high dam at the rate of 9×10^4 kg per hour. Fifty percent of gravitational potential energy can be converted into electrical energy. The number of $100W$ lamps that can be lit is:

(A) 25

(B) 50

(C) 100

(D) 18

---

12. An electron (mass = 9×10^{-31} kg, charge = 1.6×10^{-19} C) moving with a velocity of 10^6 m/s enters a magnetic field. If it describes a circle of radius 0.1 m, then the strength of the magnetic field must be:

(A) 4.5×10^{-5} T

(B) 1.4×10^{-5} T

(C) 5.5×10^{-5} T

(D) 2.6×10^{-5} T

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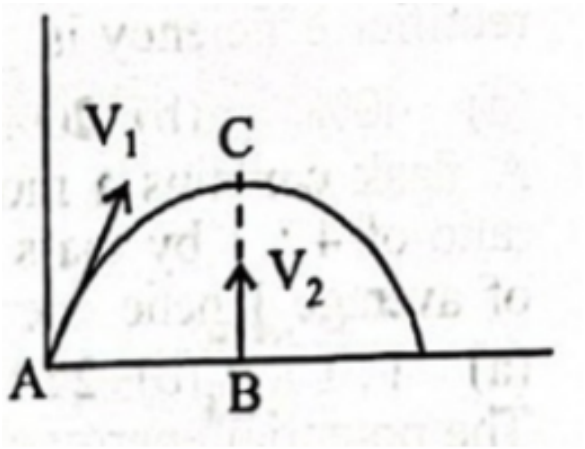
13. If V_1 is the velocity of a body projected from point A and V_2 is the velocity of a body projected from point B, which is vertically below the highest point C, and if both the bodies collide, then:



(A) $V_1 = \frac{1}{2}V_2$

(B) $V_2 = \frac{1}{2}V_1$

(C) $V_1 = V_2$

(D) $V_1 = 3V_2$

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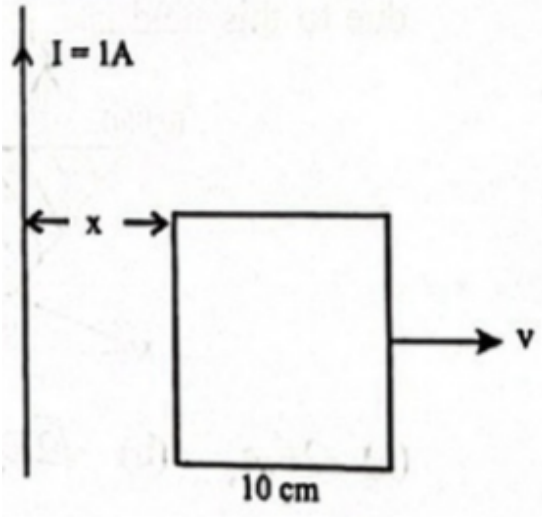
14. A square frame of side 10 cm and a long straight wire carrying current $1A$ are in the plane of the paper. Starting from close to the wire, the frame moves towards the right with a constant speed of 10 m/s (see figure). The induced EMF at the time the left arm of the frame is at $x = 10$ cm from the wire is:



(A) $2\mu V$

(B) $1\mu V$

(C) $0.75\mu V$

(D) $0.5\mu V$

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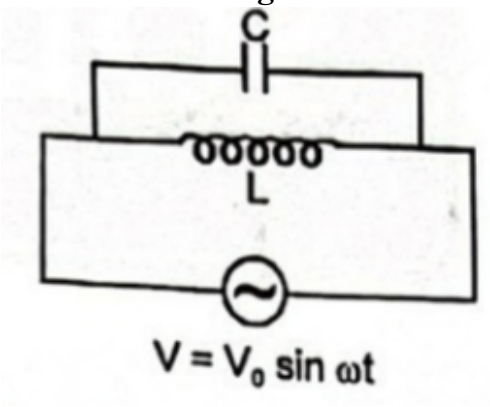
15. For the circuit shown in the figure, the current through the inductor is $0.9A$ while the current through the condenser is $0.4A$. Then:



(A) Current drawn from source $I = 1.13A$

(B) $\omega = \frac{1}{1.5LC}$

(C) $I = 0.5A$

(D) $I = 0.6A$

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16. The ozone layer in the atmosphere absorbs:

(A) Only the radio waves

(B) Only the visible light

(C) Only the γ-rays

(D) X-rays and ultraviolet rays

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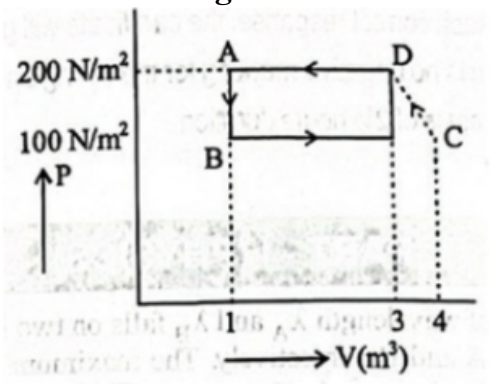
17. The P-V diagram of a diatomic ideal gas system undergoing a cyclic process is shown in the figure. The work done during the adiabatic process CD is (Use $\gamma = 1.4$):



(A) $-500J$

(B) $200J$

(C) $-400J$

(D) $400J$

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18. In YDSE, how many maximas can be obtained on a screen, including central maxima, on both sides of the central fringe if $\lambda = 3000$ Å, $d = 5000$ Å?

(A) 2

(B) 5

(C) 3

(D) 1

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19. A and B are two metals with threshold frequencies 1.8×10^{14} Hz and 2.2×10^{14} Hz. Two identical photons of energy 0.825 eV each are incident on them. Then photoelectrons are emitted in (Take $h = 6.6 \times 10^{-34}$ Js):

(A) B alone

(B) A alone

(C) Neither A nor B

(D) Both A and B

---

20. A sinusoidal voltage of amplitude 25 V and frequency 50 Hz is applied to a half-wave rectifier using a P-N junction diode. No filter is used, and the load resistor is 1000Ω. The forward resistance R_f of the ideal diode is 10Ω. The percentage rectifier efficiency is:

(A) 40%

(B) 20%

(C) 30%

(D) 15%

---

21. The force between two short bar magnets with magnetic moments M_1 and M_2 whose centers are r meters apart is 8 N when their axes are in the same line. If the separation is increased to $2r$, the force between them is reduced to:

(A) $4N$

(B) $2N$

(C) $1N$

(D) $0.5N$

---

22. In a Rutherford scattering experiment, when a projectile of charge Z_1 and mass M_1 approaches a target nucleus of charge Z_2 and mass M_2, the distance of closest approach is r_0. The energy of the projectile is:

(A) Directly proportional to $Z_1 Z_2$

(B) Inversely proportional to Z_1

(C) Directly proportional to mass M_1

(D) Directly proportional to $M_1 \times M_2$

---

23. What will be the maximum speed of a car on a road turn of radius 30m if the coefficient of friction between the tyres and the road is 0.4? (Take $g = 9.8$ m/s^2)

(A) 10.84 m/s

(B) 9.84 m/s

(C) 8.84 m/s

(D) 6.84 m/s

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24. A person aiming to reach the exactly opposite point on the bank of a stream is swimming with speed of 0.5 m/s at an angle of 120° with the direction of flow of water. The speed of water in the stream is:

(A) 1 m/s

(B) 0.5 m/s

(C) 0.25 m/s

(D) 0.433 m/s

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25. A car moves at a speed of 20 m/s on a banked track and describes an arc of a circle of radius $40\sqrt{3}$ m. The angle of banking is: (Take $g = 10$ m/s^2)

(A) 25°

(B) 60°

(C) 45°

(D) 30°

26. A force $\mathbf{F} = \alpha\hat{i} + 3\hat{j} + 6\hat{k}$ is acting at a point $\mathbf{r} = 2\hat{i} - 6\hat{j} - 12\hat{k}$. The value of α for which angular momentum about the origin is conserved is:

(A) 2

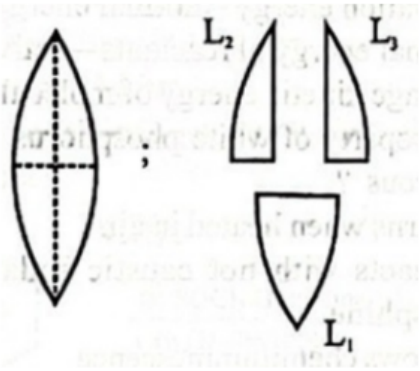
(B) 0

(C) 1

(D) -1

---

27. A convex lens has power P. It is cut into two halves along its principal axis. Further, one piece (out of the two halves) is cut into two halves perpendicular to the principal axis (as shown in figure). Choose the incorrect option for the reported pieces.



(A) Power of $L_1 = \frac{P}{2}$

(B) Power of $L_2 = \frac{P}{2}$

(C) Power of $L_3 = \frac{P}{2}$

(D) Power of $L_1 = P$

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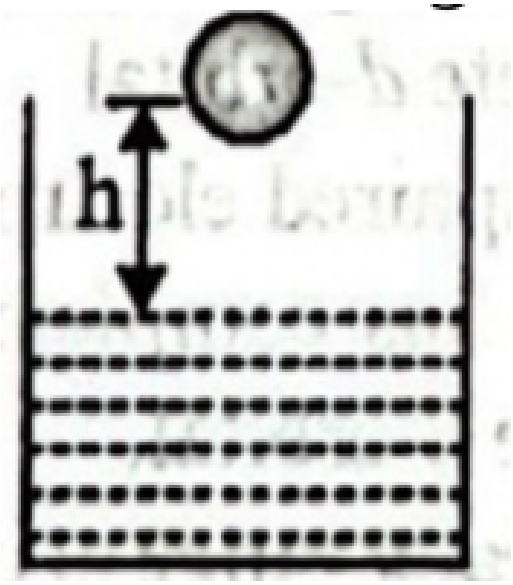
28. A ball of radius r and density ρ falls freely under gravity through a distance h before entering water. The velocity of the ball does not change even on entering water. If the viscosity of water is η, the value of h is given by:



(A) $\frac{2}{9}\frac{r^2(1-\rho)}{\eta g}$

(B) $\frac{2}{81}\frac{r^2(\rho-1)}{\eta g}$

(C) $\frac{2}{81}\frac{r^4(\rho-1)}{\eta^2 g}$

(D) $\frac{2}{9}\frac{r^4(\rho-1)}{\eta^2 g}$

---

29. The pressure inside a tyre is 4 times that of the atmosphere. If the tyre bursts suddenly at temperature $300K$, what will be the new temperature?

(A) $300(4)^{7/2}$

(B) $300(4)^{2/7}$

(C) $300(2)^{7/2}$

(D) $300(4)^{-27}$

---

30. A parallel plate air capacitor of capacitance C is connected to a cell of emf V and then disconnected from it. A dielectric slab of dielectric constant K, which can just fill the air gap of the capacitor, is now inserted in it. Which of the following is incorrect?

(A) The energy stored in the capacitor decreases K times.

(B) The change in energy stored is $\frac{1}{2}CV^2(1-\frac{1}{K})$.

(C) The charge on the capacitor is not conserved.

(D) The potential difference between the plates decreases K times.

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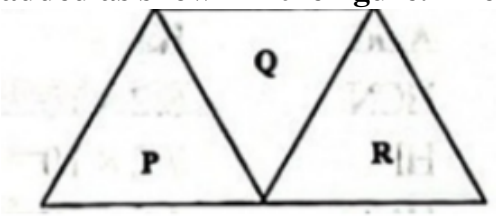
31. A given ray of light suffers minimum deviation in an equilateral prism P.

Additional prisms Q and R of identical shape and of the same material as P are now added as shown in the figure. The ray will now suffer:



(A) Greater deviation

(B) No deviation

(C) Same deviation as before

(D) Total internal reflection

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32. If m is magnetic moment and B is the magnetic field, then the torque is given by:

(A) $\vec{m}\vec{B}$

(B) $\frac{\vec{m}}{\vec{B}}$

(C) $\vec{m} \times \vec{B}$

(D) $|\vec{m}||\vec{B}|$

---

33. An α-particle of 10 MeV collides head-on with a copper nucleus ($Z = 29$) and is deflected back. The minimum distance of approach between the centers of the two is:

(A) 8.4×10^{-15} cm

(B) 8.4×10^{-15} m

(C) 4.2×10^{-15} m

(D) 4.2×10^{-15} cm

---

34. A planet in a distant solar system is 10 times more massive than Earth and its radius is 10 times smaller. Given that the escape velocity from Earth's surface is 11 km/s, the escape velocity from the planet's surface would be:

(A) 1.1 km/s

(B) 11 km/s

(C) 110 km/s

(D) 0.11 km/s

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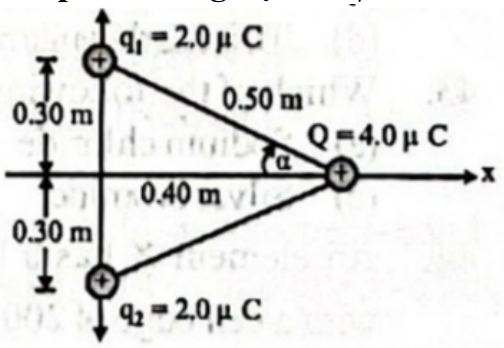
35. In the given figure, two equal positive point charges $q_1 = q_2 = 2.0\mu C$ interact with a third point charge $Q = 4.0\mu C$. The magnitude and direction of the net force on Q is:



(A) $0.23N$ in the $+x$-direction

(B) $0.46N$ in the $+x$-direction

(C) $0.23N$ in the $-x$-direction

(D) $0.46N$ in the $-x$-direction

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2 Chemistry

36. Which of the following sets of quantum numbers is correct for an electron in a 4f orbital?

(A) $n = 4,\ l = 3,\ m = +1,\ s = +\frac{1}{2}$

(B) $n = 4,\ l = 4,\ m = -4,\ s = -\frac{1}{2}$

(C) $n = 4,\ l = 3,\ m = +4,\ s = +\frac{1}{2}$

(D) $n = 3,\ l = 2,\ m = -2,\ s = +\frac{1}{2}$

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37. Arrange the following in increasing order of ionic radii: $C^{4-}, N^{3-}, F^{-}, O^{2-}$.

(A) $C^{4-} < N^{3-} < O^{2-} < F^{-}$

(B) $N^{3-} < C^{4-} < O^{2-} < F^{-}$

(C) $F^{-} < O^{2-} < N^{3-} < C^{4-}$

(D) $O^{2-} < F^{-} < N^{3-} < C^{4-}$

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38. The bond dissociation energies of $X_2, Y_2,$ and XY are in the ratio of 1:0.5:1. If ΔH for the formation of XY is -200 kJ mol^{-1}, what is the bond dissociation energy of X_2?

(A) 200 kJ mol^{-1}

(B) 100 kJ mol^{-1}

(C) 400 kJ mol^{-1}

(D) 800 kJ mol^{-1}

---

39. Values of dissociation constant K_a are given as follows:

Acid	K_a
HCN	6.2×10^{-10}
HF	7.2×10^{-4}
HNO_2	4.0×10^{-4}

Correct order of increasing base strength of the conjugate bases CN^-, F^- and NO_2^- is:

(A) $F^- < CN^- < NO_2^-$

(B) $NO_2^- < CN^- < F^-$

(C) $F^- < NO_2^- < CN^-$

(D) $NO_2^- < F^- < CN^-$

---

40. The product(s) formed when diborane (B_2H_6) is hydrolyzed is/are:

(A) B_2O_3 and H_3BO_3

(B) B_2O_3 only

(C) H_3BO_3 and H_2

(D) H_3BO_3 only

---

41. The compounds $CH_3CH = CHCH_3$ and $CH_3CH_2CH = CH_2$:

(A) are tautomers

(B) are position isomers

(C) contain the same number of sp^3-sp^3, sp^3-sp^2, and sp^2-sp^2 carbon-carbon bonds

(D) are chain isomers

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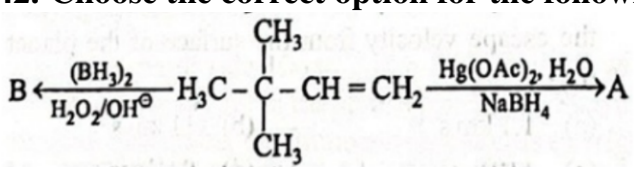
42. Choose the correct option for the following reactions.



(A) A and B are both Markovnikov addition products.

(B) A is Markovnikov product and B is anti-Markovnikov product.

(C) A and B are both anti-Markovnikov products.

(D) B is Markovnikov and A is anti-Markovnikov product.

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43. Which of the following exhibits Frenkel defects?

(A) Sodium chloride

(B) Silver bromide

(C) Graphite

(D) Diamond

---

44. An element X has a body-centred cubic (bcc) structure with a cell edge of 200 pm. The density of the element is 5 g cm^{-3}. The number of atoms present in 300g of the element X is:

Given: Avogadro Constant, $N_A = 6.0 \times 10^{23}$ mol^{-1}.

(A) $5N_A$

(B) $6N_A$

(C) $15N_A$

(D) $25N_A$

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45. On passing current through two cells, connected in series, containing solutions of $AgNO_3$ and $CuSO_4$, 0.18 g of Ag is deposited. The amount of Cu deposited is:

(A) 0.529 g

(B) 10.623 g

(C) 0.0529 g

(D) 1.2708 g

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46. The limiting molar conductivities of HCl, CH_3COONa, and $NaCl$ are respectively 425, 90, and 125 mho cm^2 mol^{-1} at 25°C. The molar conductivity of 0.1M CH_3COOH solution is 7.8 mho cm^2 mol^{-1} at the same temperature. The degree of dissociation of 0.1M acetic acid solution at the same temperature is:

(A) 0.10

(B) 0.02

(C) 0.15

(D) 0.03

---

47. The rate law for a reaction between the substances A and B is given by:

$$\text{Rate} = k[A]^m[B]^n$$

On doubling the concentration of A and halving the concentration of B, the ratio of the new rate to the earlier rate of the reaction will be:

(A) $(m + n)$

(B) $(n - m)$

(C) $2^{(n-m)}$

(D) $\frac{1}{2^{(m+n)}}$

---

48. In a reaction, the threshold energy is equal to:

(A) Activation energy + normal energy of reactants

(B) Activation energy - normal energy of reactants

(C) Normal energy of reactants - activation energy

(D) Average kinetic energy of molecules of reactants

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49. Which property of white phosphorus is common to red phosphorus?

(A) It burns when heated in air.

(B) It reacts with hot caustic soda solution to give phosphine.

(C) It shows chemiluminescence.

(D) It is soluble in carbon disulphide.

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50. XeO_4 **molecule is tetrahedral having:**

(A) Two $p\pi - d\pi$ bonds

(B) One $p\pi - d\pi$ bond

(C) Four $p\pi - d\pi$ bonds

(D) Three $p\pi - d\pi$ bonds

51. Cuprous ion is colourless while cupric ion is coloured because:

(A) Both have half-filled p- and d-orbitals.

(B) Cuprous ion has an incomplete d-orbital and cupric ion has a complete d-orbital.

(C) Both have unpaired electrons in the d-orbitals.

(D) Cuprous ion has a complete d-orbital and cupric ion has an incomplete d-orbital.

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52. The reason for the greater range of oxidation states in actinoids is attributed to:

(A) Actinoid contraction

(B) $5f, 6d$ and $7s$ levels having comparable energies

(C) $4f$ and $5d$ levels being close in energies

(D) The radioactive nature of actinoids

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53. The geometry and magnetic behaviour of the complex $[Ni(CO)_4]$ are:

(A) Square planar geometry and diamagnetic

(B) Tetrahedral geometry and diamagnetic

(C) Tetrahedral geometry and paramagnetic

(D) Square planar geometry and paramagnetic

---

54. Indicate the complex ion which shows geometrical isomerism.

(A) $[Cr(H_2O)_4Cl_2]^+$

(B) $[Pt(NH_3)_3Cl]_2^-$

(C) $[Co(NH_3)_6]^{3+}$

(D) $[Co(CN)(NC)]^{3-}$

---

55. Reaction of $C_6H_5CH_2Br$ with aqueous sodium hydroxide follows:

(A) SN1 mechanism

(B) SN2 mechanism

(C) Any of the above two depending upon the temperature of reaction

(D) Saytzeff rule

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56. What is the correct order of reactivity of alcohols in the following reaction?

$$R - OH + HCl \rightarrow R - Cl + H_2O$$

(A) $1^\circ > 2^\circ > 3^\circ$

(B) $3^\circ > 2^\circ > 1^\circ$

(C) $1^\circ < 2^\circ < 3^\circ$

(D) $3^\circ > 1^\circ > 2^\circ$

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57. Which of the following cannot be made by using Williamson's synthesis?

(A) Methoxybenzene

(B) Benzyl p-nitrophenyl ether

(C) Methyl tertiary butyl ether

(D) Di-tert-butyl ether

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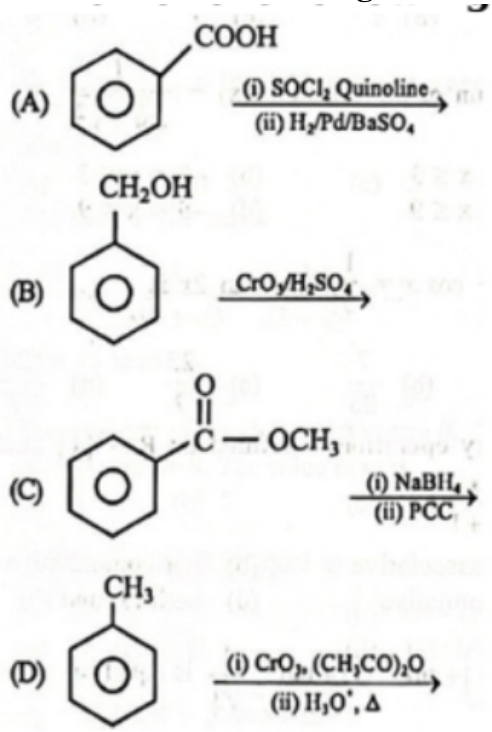
58. Which of the following reactions will yield benzaldehyde as a product?



Choose the correct answer from the following options:

A. (B) and (C)

B. (C) and (D)

C. (A) and (D)

D. (A) and (C)

---

59. In Clemmensen reduction, carbonyl compounds are treated with:

(A) Zinc amalgam + HCl

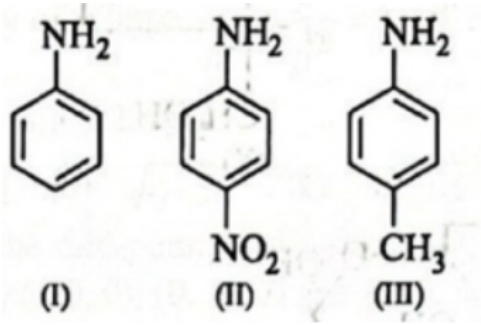
(B) Sodium amalgam + HCl

(C) Zinc amalgam + Nitric acid

(D) Sodium amalgam + HNO_3

---

60. The correct increasing order of basic strength for the following compounds is:



(A) $II < III < I$

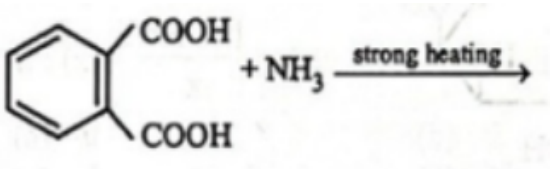
(B) $III < I < II$

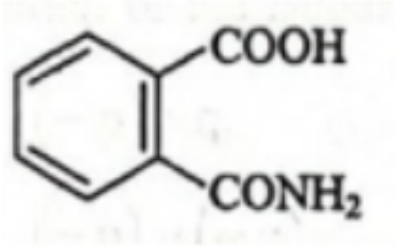
(C) $III < II < I$

(D) $II < I < III$

---

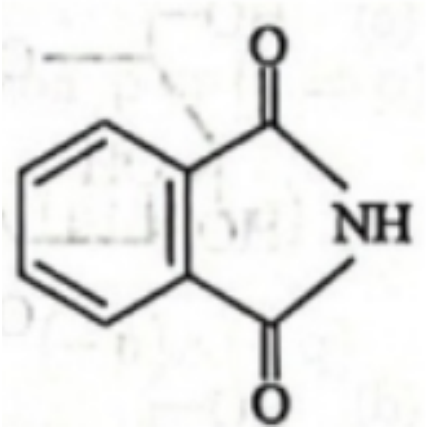
61. The major product of the following reaction is:



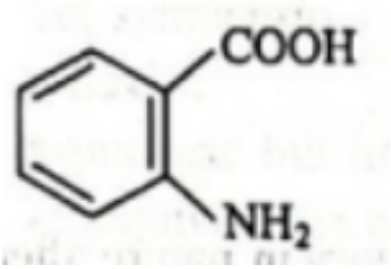


(A)

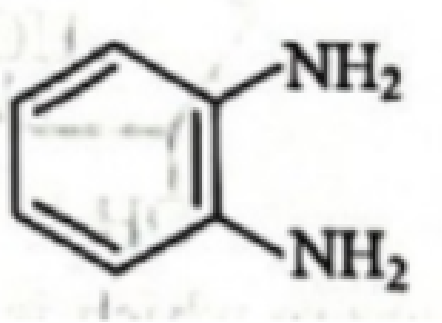
(B)



(C)



(D)



---

62. Blister copper is:

(A) Impure Cu

(B) Cu alloy

(C) Pure Cu

(D) Cu having 1% impurity

---

63. P_A **and** P_B **are the vapor pressures of pure liquid components A and B, respectively, in an ideal binary solution. If** X_A **represents the mole fraction of component A, the total pressure of the solution will be:**

(A) $P_A + X_A(P_B - P_A)$

(B) $P_B + X_A(P_B - P_A)$

(C) $P_A + X_A(P_A - P_B)$

(D) $P_B + X_A(P_A - P_B)$

---

64. Which of the following complexes shows sp^3d^2 hybridization?

(A) $[Cr(NO_2)_6]^{3-}$

(B) $[Fe(CN)_6]^{4-}$

(C) $[CoF_6]^{3-}$

(D) $[Ni(CO)_4]$

---

65. 2-Pentene contains:

(A) 15 σ- and one π-bond

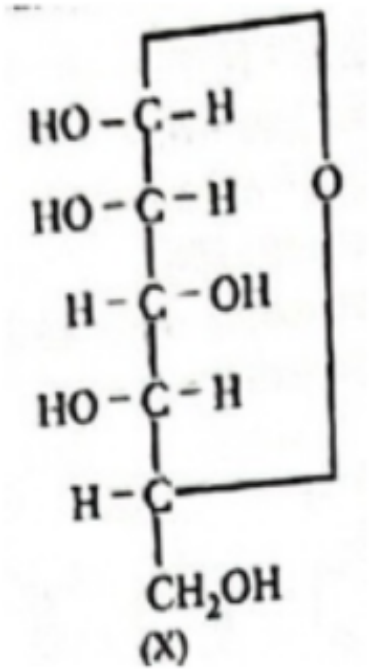
(B) 14 σ- and one π-bond

(C) 15 σ- and two π-bonds

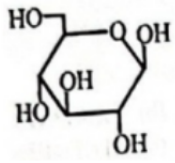
(D) 14 σ- and two π-bonds

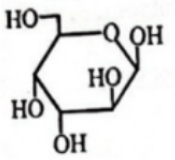
---

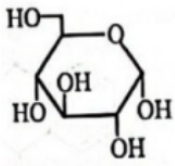
66. For the below-given cyclic hemiacetal (X), the correct pyranose structure is:

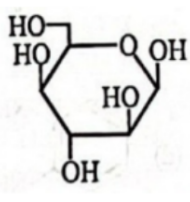


(X)

(A) 

(B) 

(C) 

(D) 

---

67. Sucrose, which is dextrorotatory in nature, after hydrolysis gives glucose and fructose, among which:

(i) Glucose is laevorotatory and fructose is dextrorotatory.

(ii) Glucose is dextrorotatory and fructose is laevorotatory.

(iii) The mixture is laevorotatory.

(iv) Both are dextrorotatory.

(A) (i) and (iii)

(B) (iii) and (iv)

(C) (ii) and (iii)

(D) (iii) only

---

68. The Allyl cyanide molecule contains:

(A) 9 sigma bonds, 4 pi bonds, and no lone pair

(B) 9 sigma bonds, 3 pi bonds, and one lone pair

(C) 8 sigma bonds, 5 pi bonds, and one lone pair

(D) 8 sigma bonds, 3 pi bonds, and two lone pairs

69. Which of the following pairs of compounds is isoelectronic and isostructural?

(A) TeI_2, XeF_2

(B) IBr_2^-, XeF_2

(C) IF_5, XeF_5

(D) $BeCl_2, XeF_2$

---

70. In which case does the change in entropy (ΔS) become negative?

(A) Evaporation of water

(B) Expansion of a gas at constant temperature

(C) Sublimation of solid to gas

(D) $2H(g) \rightarrow H_2(g)$

---

3 Mathematics

71. The argument of the complex number

$$\left(\frac{i}{2} - \frac{2}{i}\right)$$

is equal to:

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

(B) $\frac{3\pi}{4}$

(C) $\frac{\pi}{12}$

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

---

72. The lines

$$p(p^2+1)x - y + q = 0 \quad \text{and} \quad (p^2+1)^2x + (p^2+1)y + 2q = 0$$

are perpendicular to a common line for:

(A) Exactly one value of p

(B) Exactly two values of p

(C) More than two values of p

(D) No value of p

---

73. The probability that a card drawn from a pack of 52 cards will be a diamond or a king is:

(A) $\frac{1}{52}$

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

(C) $\frac{4}{13}$

(D) $\frac{1}{13}$

---

74. If $n(A) = 4$ and $n(B) = 7$, then the difference between the maximum and minimum value of $n(A \cup B)$ is:

(A) 1

(B) 2

(C) 3

(D) 4

---

75. The domain of the function

$$f(x) = \frac{1}{\sqrt{9 - x^2}}$$

is:

(A) $-3 \leq x \leq 3$

(B) $-3 < x < 3$

(C) $-9 \leq x \leq 9$

(D) $-9 < x < 9$

---

76. If

$$\sin x + \cos x = \frac{1}{5}$$

then $\tan 2x$ is:

(A) $\frac{25}{17}$

(B) $\frac{7}{25}$

(C) $\sqrt{\frac{25}{7}}$

(D) $\frac{24}{7}$

77. For the binary operation defined on $\mathbb{R} - \{1\}$ such that:

$$ab = \frac{a}{b+1}$$

which of the following is true?

(A) Not associative

(B) Commutative

(C) Not commutative

(D) Both (A) and (B)

---

78. Evaluate:

$$\cos^{-1}\frac{1}{2} + \sin^{-1}(1) + \tan^{-1}\frac{1}{\sqrt{3}}$$

(A) π

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

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

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

---

79. If

$$A = \begin{bmatrix} 1 & -1 \\ 2 & -1 \end{bmatrix}, \quad B = \begin{bmatrix} x & 1 \\ y & -1 \end{bmatrix}$$

and

$$(A+B)^2 = A^2 + B^2$$

then $x + y$ is:

(A) 2

(B) 3

(C) 4

(D) 5

---

80. The determinant of the matrix:

$$\begin{bmatrix} -a^2 & ab & ac \\ ab & -b^2 & bc \\ ac & bc & -c^2 \end{bmatrix}$$

is:

(A) 0

(B) abc

(C) $4a^2b^2c^2$

(D) None of these

---

81. If

$$A = \begin{bmatrix} \alpha & \beta \\ \gamma & \alpha \end{bmatrix}$$

then $\text{Adj}(A)$ **is equal to:**

(A) $\begin{bmatrix} \delta & -\gamma \\ -\beta & \alpha \end{bmatrix}$

(B) $\begin{bmatrix} \delta & -\beta \\ -\gamma & \alpha \end{bmatrix}$

(C) $\begin{bmatrix} -\delta & \beta \\ \gamma & -\alpha \end{bmatrix}$

(D) $\begin{bmatrix} -\delta & -\beta \\ \gamma & \alpha \end{bmatrix}$

---

82. If

$$\left| \frac{\sec(x-y)}{\sec(x+y)} \right| = a$$

then $\frac{dy}{dx}$ **is:**

(A) $-\frac{y}{x}$

(B) $\frac{x}{y}$

(C) $-\frac{x}{y}$

(D) $\frac{y}{x}$

---

83. The number of nonzero terms in the expansion of

$$(1 + 3\sqrt{2}x)^9 + (1 - 3\sqrt{2}x)^9$$

is:

(A) 2

(B) 3

(C) 4

(D) 5

---

84. If

$$\frac{a^n + b^n}{a^{n-1} + b^{n-1}}$$

is the arithmetic mean (A.M.) between a and b, then the value of n is:

(A) 1

(B) 2

(C) 3

(D) 4

---

85. The sum of the series

$$\frac{1}{1+\sqrt{2}} + \frac{1}{\sqrt{2}+\sqrt{3}} + \frac{1}{\sqrt{3}+\sqrt{4}} + \dots$$

up to 15 terms is:

(A) 1

(B) 2

(C) 3

(D) 4

---

86. The equation of the circle with centre (0,2) and radius 2 is

$$x^2 + y^2 - my = 0.$$

The value of m is:

(A) 1

(B) 2

(C) 4

(D) 3

---

87. The integral

$$\int x^n(1+\log x)\,dx$$

is equal to:

(A) $x^n + C$

(B) $x^{2x} + C$

(C) $x^n \log x + C$

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

---

88. Evaluate the definite integral:

$$I = \int_0^{\frac{\pi}{2}} (\sqrt{\tan x} + \sqrt{\cot x})dx$$

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

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

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

(D) $\sqrt{2}\pi$

---

89. The area of the region bounded by the ellipse

$$\frac{x^2}{16} + \frac{y^2}{9} = 1$$

is:

(A) 12π

(B) 3π

(C) 24π

(D) π

---

90. If the vertex of a parabola is $(2, -1)$ and the equation of its directrix is

$$4x - 3y = 21,$$

then the length of its latus rectum is:

(A) 2

(B) 8

(C) 12

(D) 16

---

91. Eccentricity of ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

if it passes through point (9, 5) and (12, 4) is:

(A) $\sqrt{\frac{3}{4}}$

(B) $\sqrt{\frac{4}{5}}$

(C) $\sqrt{\frac{5}{6}}$

(D) $\sqrt{\frac{6}{7}}$

---

92. In $\triangle ABC$ the mid-point of the sides AB, BC and CA are respectively $(1, 0, 0), (0, m, 0)$ and $(0, 0, n)$.

(A) 8

(B) 16

(C) 9

(D) 25

---

93. If

$$f(x) = \frac{x + |x|}{x}$$

then the value of

$$\lim_{x \to 0} f(x)$$

is:

(A) 0

(B) 2

(C) Does not exist

(D) None of these

---

94. Negation of the Boolean expression

$$p \Leftrightarrow (q \Rightarrow p)$$

is:

(A) $\sim p \wedge q$

(B) $p \wedge \sim q$

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

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

---

95. If

$$R = \{(x, y) : x \text{ is exactly 7cm taller than } y\}$$

then R is:

(A) Not symmetric

(B) Reflexive

(C) Symmetric but not transitive

(D) An equivalence relation

---

96. The particular solution of

$$\log \frac{dy}{dx} = 3x + 4y, \quad y(0) = 0$$

is:

(A) $e^{3x} + 3e^{-4y} = 4$

(B) $4e^{3x} - 3e^{-4y} = 3$

(C) $3e^{3x} + 4e^{4y} = 7$

(D) $4e^{3x} + 3e^{-4y} = 7$

---

97. The general solution of the differential equation given by:

$$\tan^{-1} x + \tan^{-1} y = c$$

(A) $\frac{dy}{dx} = \frac{1+y^2}{1+x^2}$

(B) $\frac{dy}{dx} = \frac{1+x^2}{1+y^2}$

(C) $(1 + x^2)dy + (1 + y^2)dx = 0$

(D) $(1 + x^2)dx + (1 + y^2)dy = 0$

---

98. If $|\mathrm{a}| = 3$, $|\mathrm{b}| = 4$, then the value of λ for which $\mathrm{a} + \lambda\mathrm{b}$ is perpendicular to $\mathrm{a} - \lambda\mathrm{b}$ is:

(A) $\frac{9}{16}$

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

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

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

---

99. The area of the parallelogram whose diagonals are

$$\mathbf{d_1} = \frac{3}{2}\hat{i} + \frac{1}{2}\hat{j} - \hat{k}, \quad \mathbf{d_2} = 2\hat{i} - 6\hat{j} + 8\hat{k}$$

is:

(A) $5\sqrt{3}$

(B) $5\sqrt{2}$

(C) $25\sqrt{3}$

(D) $25\sqrt{2}$

---

100. Bag P contains 6 red and 4 blue balls, and Bag Q contains 5 red and 6 blue balls. A ball is transferred from Bag P to Bag Q, and then a ball is drawn from Bag Q. **What is the probability that the ball drawn is blue?**

(A) $\frac{7}{15}$

(B) $\frac{8}{15}$

(C) $\frac{4}{19}$

(D) $\frac{8}{19}$

---

101. The mean and variance of a random variable X having binomial distribution are 4 and 2, respectively. Find $P(X = 1)$.

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

(B) $\frac{1}{32}$

(C) $\frac{1}{16}$

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

---

102. Evaluate:

$$\tan(\cos^{-1}\frac{4}{5}) + \tan^{-1}\frac{2}{3}$$

(A) $\frac{6}{17}$

(B) $\frac{7}{16}$

(C) $\frac{16}{7}$

(D) None of these

---

103. If the function

$$f(x) = \begin{cases} 1, & x \leq 2 \\ ax + b, & 2 < x < 4 \\ 7, & x \geq 4 \end{cases}$$

is continuous at $x = 2$ and $x = 4$, then the values of a and b are:

(A) $a = 3, b = -5$

(B) $a = -5, b = 3$

(C) $a = -3, b = 5$

(D) $a = 5, b = -3$

---

104. The derivative of

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

with respect to

$$\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$$

is equal to:

(A) 1

(B) -1

(C) 2

(D) None of these

---

105. The number of distinct real roots of the equation:

$$x^7 - 7x - 2 = 0$$

is:

(A) 5

(B) 7

(C) 1

(D) 3

---

106. The minimum value of the function

$$y = x^4 - 2x^2 + 1$$

in the interval $\left[\frac{1}{2}, 2\right]$ is:

(A) 0

(B) 2

(C) 8

(D) 9

---

107. Evaluate the integral:

$$I = \int \frac{\sin^2 x - \cos^2 x}{\sin^2 x \cos^2 x} dx$$

(A) $\tan x + \cot x + C$

(B) $\csc x + \sec x + C$

(C) $\tan x + \sec x + C$

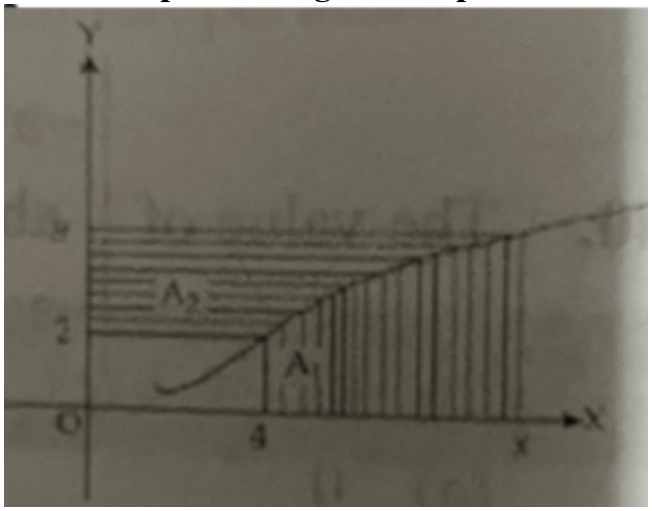
(D) $\tan x + \csc x + C$

---

108. Consider a curve $y = y(x)$ in the first quadrant as shown in the figure. Let the area A_1 be twice the area A_2. The normal to the curve perpendicular to the line

$$2x - 12y = 15$$

does NOT pass through which point?



(A) $(6, 21)$

(B) $(8, 9)$

(C) $(10, -4)$

(D) $(12, -15)$

---

109. The shortest distance between the lines $x = y + 2 = 6z - 6$ and $x + 1 = 2y = -12z$ is:

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

(B) 2

(C) 1

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

---

110. The angle between the two lines:

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

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

is:

(A) $\cos^{-1}\frac{1}{9}$

(B) $\cos^{-1}\frac{4}{9}$

(C) $\cos^{-1}\frac{2}{9}$

(D) $\cos^{-1}\frac{3}{9}$

---

4 Aptitude

111. What is the approximate percentage increase in the production of Monopoly from 1993 to 1995?

(A) 10

(B) 20

(C) 30

(D) 25

---

112. For which toy category has there been a continuous increase in production over the years?

(A) Ludo

(B) Chess

(C) Monopoly

(D) Carrom

---

113. What is the percentage drop in the production of Ludo from 1992 to 1994?

(A) 30

(B) 50

(C) 20

(D) 10

---

114. Find the missing number in the sequence:

$$285, 253, 221, 189, ?$$

(A) 150

(B) 182

(C) 157

(D) 156

---

115. In a certain code language, PRESENTATION is written as ENESTAITPRON. How would INTELLIGENCE be written in that code?

(A) TETGLLTNENCE

(B) LUENLINTETG

(C) LLKKTGTEEBTB

(D) LLTEIGENINCE

---

116. Ram moves from a point X to 20 metres towards North. Then he moves 40 metres towards West. Then he moves 20 metres North. Then he moves 40 metres towards East and then 10 metres towards right and he reaches a point Y. Find the distance and direction of Y from X?

(A) 30 metres, North

(B) 40 metres, North

(C) 30 metres, South

(D) 40 metres, South

---

117. If the 5th date of a month is Tuesday, what date will be 3 days after the 3rd Friday in the month?

(A) 17

(B) 22

(C) 19

(D) 18

---

118. Statements:

I. Some cats are dogs.

II. No dog is a toy.

Conclusions:

I. Some dogs are cats.

II. Some toys are cats.

III. Some cats are not toys.

IV. All toys are cats.

(A) Only Conclusions I and either II or III.

(B) Only Conclusions II and III follow.

(C) Only Conclusions I and II follow.

(D) Only Conclusion I follows.

---

119. How is H related to B?

Statements:

I. H is married to P. P is the mother of T. T is married to D. D is the father of B.

II. B is the daughter of T. T is the sister of N. H is the father of N.

(A) Statement I alone is sufficient.

(B) Statement II alone is sufficient.

(C) Either statement I or II is sufficient.

(D) Both statements together are necessary.

---

120. Among five persons D, E, F, G, H, each having different heights, who is the second tallest?

Statements:

I. D is taller than only G and E. F is not the tallest.

II. H is taller than F. G is taller than E but shorter than D.

(A) If the data in Statement I alone are sufficient to answer the question, while the data in Statement II alone are not sufficient.

(B) If the data in Statement II alone are sufficient to answer the question, while the data in Statement I alone are not sufficient.

(C) If the data in Statement I alone or in Statement II alone are sufficient to answer the question.

(D) If the data in both the Statements I and II together are not sufficient.

(E) If the data in both the Statements I and II together are necessary to answer the question.

---

5 English

121. If someone else's opinion makes us angry, it means that

(A) we are subconsciously aware of having no good reason for becoming angry

(B) there may be good reasons for his opinion but we are not consciously aware of them

(C) our own opinion is not based on good reason and we know this subconsciously

(D) we are not consciously aware of any reason for our own opinion

---

122. "Your own contrary conviction" refers to

(A) the fact that you feel pity rather than anger

(B) the opinion that two and two are four and that Iceland is a long way from the Equator

(C) the opinion that two and two are five and that Iceland is on the Equator

(D) the fact that you know so little about arithmetic or geography

---

123. Conviction means

(A) persuasion

(B) disbelief

(C) strong belief

(D) ignorance

---

124. The writer says if someone maintains that two and two are five, you feel pity because you

(A) have sympathy

(B) don't agree with him

(C) want to help the person

(D) feel sorry for his ignorance

---

125. The second sentence in the passage

(A) builds up the argument of the first sentence by restating it from the opposite point of view

(B) makes the main point which has only been introduced by the first sentence

(C) simply adds a further point to the argument already stated in the first sentence

(D) illustrates the point made in the first sentence
