Physics

1. A spherical convex surface of power 5 D separates object and image space of refractive indices 1.0 and 4/3, respectively. The radius of curvature of the surface is.

(a) 20 cm (b) 1 cm
(c) 4 cm (d) 5 cm

2. In Young's double slit experiment, light of wavelength λ passes through the double slit and forms interference fringes on a screen 1.2 m away. If the difference between 3rd order maximum and 3rd order minimum is 0.18 cm and the slits are 0.02 cm apart, then λ is.

(a) 1200 nm (b) 450 nm
(c) 600 nm (d) 300 nm

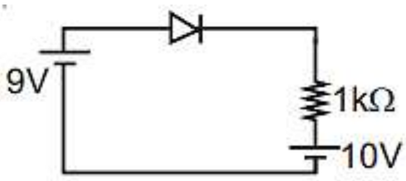
3. A 12.5 eV electron beam is used to bombard gaseous hydrogen at ground state. The energy level upto which the hydrogen atoms would be excited is.

(a) 2 (b) 3
(c) 4 (d) 1

4. Let r, v, E be the radius of orbit, speed of electron and total energy of electron respectively in H -atom. Which of the following quantities according to Bohr theory, is proportional to the quantum number n ?

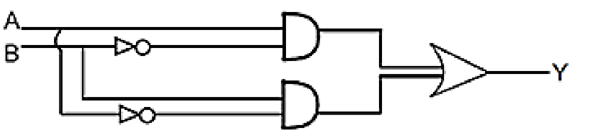
(a) Vr (b) rE
(c) $\frac{r}{E}$ (d) $\frac{r}{v}$

5. What is the value of current through the diode in the circuit given?



(a) Zero (b) 1 mA
(c) 19 mA (d) 9 mA

6. For the given logic circuit, the output Y for inputs $(A=0, B=1)$ and $(A=0, B=0)$ respectively are.

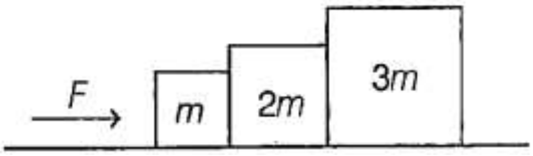


(a) 0,0 (b) 0,1
(c) 1,0 (d) 1,1

7. From dimensional analysis, the Rydberg constant can be expressed in terms of electric charge (e), mass (m) and Planck constant (h) a [consider $\frac{1}{4\pi\varepsilon_0} \equiv 1$ unit].

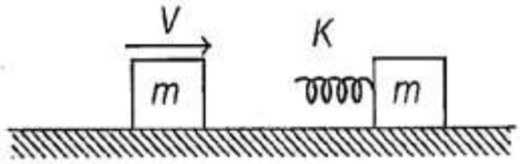
(a) $\frac{h^2}{me^2}$ (b) $\frac{me^4}{h^2}$
(c) $\frac{m^2e^4}{h^2}$ (d) $\frac{me^2}{h}$

8. Three blocks are pushed with a force F across a frictionless table as shown in figure above. Let N_1 be the contact force between the left two blocks and N_2 be the contact force between the right two blocks. Then,



(a) $F > N_1 > N_2$ (b) $F > N_2 > N_1$
(c) $F > N_1 = N_2$ (d) $F = N_1 = N_2$

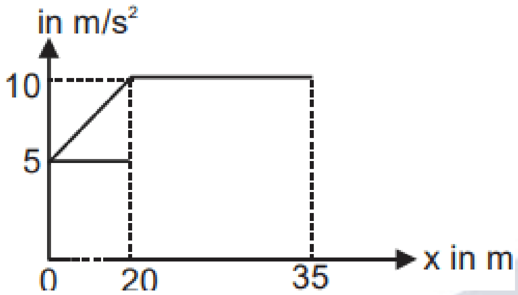
9. A block of mass m slides with speed v on a frictionless table towards another stationary block of mass m. A massless spring with spring constant k is attached to the second block as shown in figure. The maximum distance, the spring gets compressed through is.



(a) $\sqrt{\frac{m}{k}}v$ (b) $\sqrt{\frac{m}{2k}}v$

(c) $\sqrt{\frac{k}{m}}v$ (d) $\sqrt{\frac{k}{2m}}v$

10. The acceleration versus distance graph for a particle moving with initial velocity 5 m/s is shown in the figure. The velocity of the particle at $x = 35$ m will be



(a) 20.62 m/s (b) 20 m/s

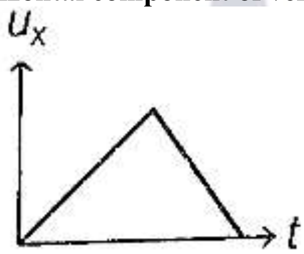
(c) 25 m/s (d) 50 m/s

11. A simple pendulum, consisting of a small ball of mass m attached to a massless string hanging vertically from the ceiling is oscillating with an amplitude such that $T_{max} = 2T_{min}$, where T_{max} and T_{min} are the maximum and minimum tension in the string, respectively. The value of maximum tension T_{max} in the string is.

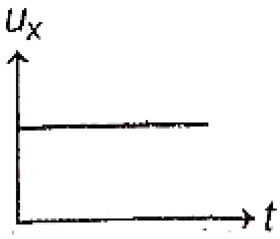
(a) $\frac{3mg}{2}$ (b) mg

(c) $\frac{3mg}{4}$ (d) 3 mg

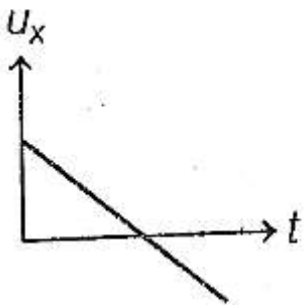
12. In case of projectile motion, which one of the following figures represent variation of horizontal component of velocity (u_x) with time t ? (Assume that air resistance is negligible)



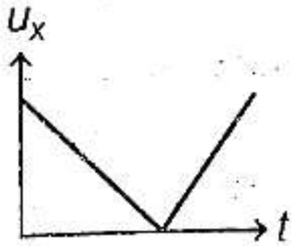
(a)



(b)



(c)

(d) 

13. A uniform thin rod of length L, mass m is lying on a smooth horizontal table. A horizontal impulse P is suddenly applied perpendicular to the rod at one end. The total energy of the rod after the impulse is.

(a) $\frac{P^2}{m}$ (b) $\frac{7P^2}{8m}$

(c) $\frac{13P^2}{2m}$ (d) $\frac{2P^2}{m}$

14. Centre of mass (CM) of three particles of masses 1 kg, 2 kg and 3 kg lies at the point $(1,2,3)$ and CM of another system of particles of 3 kg and 2 kg lies at the point $(-1,3,-2)$. Where should we put a particle of mass 5 kg , so that the CM of entire system lies at the CM of the first system?

(a) (3,1,8) (b) (0,0,0)

(c) (1,3,2) (d) $(-1,2,3)$

15. A body of density 12×10^3 kg/m^3 is dropped from rest from a height 1 m into a liquid to density 2.4×10^3 kg/m^3. Neglecting all dissipative effects, the maximum depth to which the body sinks before returning to float on the surface is.

(a) 0.1 m (b) 1 m

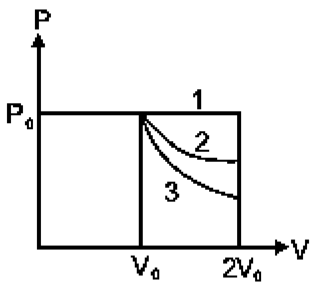
(c) 0.01 m (d) 2 m

16. Two solid spheres S_1 and S_2 of same uniform density fall from rest under gravity in a viscous medium and after sometime, reach terminal velocities v_1 and v_2, respectively. If ratio of masses $\frac{m_1}{m_2} = 8$, then $\frac{v_1}{v_2}$ will be equal to.

(a) 2 (b) 4

(c) $\frac{1}{2}$ (d) $\frac{1}{4}$

17. In the given figure, 1 represents isobaric, 2 represents isothermal and 3 represents adiabatic processes of an ideal gas. If ΔU_1, ΔU_2 and ΔU_3 be the changes in internal energy in these processes respectively, then



(a) $\Delta U_1 < \Delta U_2 < \Delta U_3$

(b) $\Delta U_1 > \Delta U_3 < \Delta U_2$

(c) $\Delta U_1 = \Delta U_2 > \Delta U_3$

(d) $\Delta U_1 > \Delta U_2 > \Delta U_3$

18. If pressure of real gas O_2 in a container is given by $p = \frac{RT}{2V-b} - \frac{a}{4b^2}$, then the mass of the gas in the container is.

(a) 32 g (b) 16 g

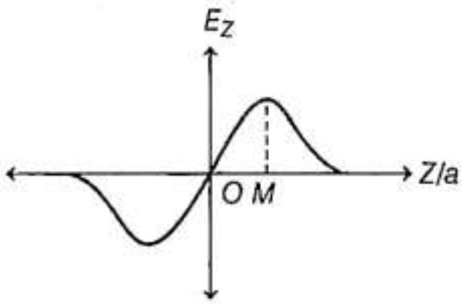
(c) 4 g (d) 64 g

19. 300 g of water at 25°C is added to 100 g of ice at 0°C. The final temperature of the mixture Is.

(a) 12.5°C (b) 0°C

(c) 25°C (d) 50°C

20. The variation of electric field along the Z-axis due to a uniformly charged circular ring of radius a in XY-plane as shown in the figure.The value of coordinate M will be.



(a) $\frac{1}{2}$ (b) $\sqrt{2}$

(c) 1 (d) $\frac{1}{\sqrt{2}}$

21. A metal sphere of radius R carrying charge q is surrounded by a thick concentric metal shell of inner and outer radii a and b, respectively. The net charge on the shell is zero.The potential at the centre of the sphere, when the outer surface of the shell is grounded will be.

(a) $\frac{q}{4\pi\varepsilon_0}\left(\frac{1}{a}-\frac{1}{b}\right)$ (b) $\frac{q}{4\pi\varepsilon_0}\frac{1}{a}$

(c) $\frac{q}{4\pi\varepsilon_0}\left(\frac{1}{R}-\frac{1}{a}\right)$ (d) $\frac{q}{4\pi\varepsilon_0}\frac{1}{R}$

22. Three infinite plane sheets carrying uniform charge densities $-\sigma, 2\sigma, 4\sigma$ are placed parallel to XZ-plane at $Y = a, 3a, 4a$, respectively. The electric field at the point $(0, 2a, 0)$ is.

(a) $\frac{5\sigma}{2\varepsilon_0}\hat{\mathbf{j}}$ (b) $-\frac{7\sigma}{2\varepsilon_0}\hat{\mathbf{j}}$

(c) $\frac{\sigma}{2\varepsilon_0}\hat{\mathbf{j}}$ (d) $\frac{5\sigma}{-2\varepsilon_0}\hat{\mathbf{j}}$

23. Two point charges $+q_1$ and $+q_2$ are placed a finite distance d apart. It is desired to put a third charge q_3 in between these two charges, so that q_3 is in equilibrium. This is.

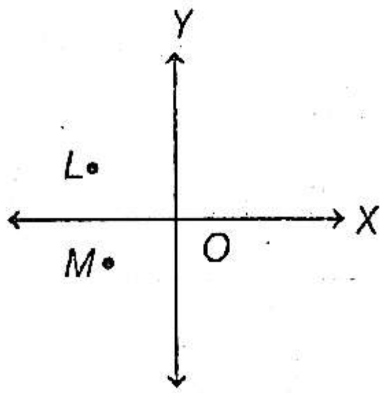
(a) possible only, if q_3 is negative

(b) possible only, if q_3 is positive

(c) possible irrespective of the sign of q_3

(d) Not possible at all

24. Consider two infinitely long wires parallel to Z-axis carrying same current I in the positive z-direction. One wire passes through the point L at coordinates $(-1, +1)$ and the other wire passes through the point M at coordinates $(-1, -1)$. The resultant magnetic field at the origin O will be.



(a) $\frac{\mu_0 l}{2\sqrt{2}\pi}\hat{\mathbf{j}}$ (b) $\frac{\mu_0 I}{2\pi}\hat{\mathbf{j}}$

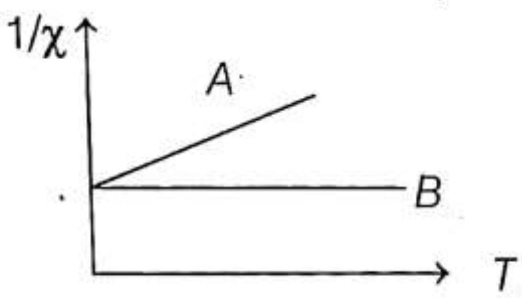
(c) $\frac{\mu_0 l}{2\sqrt{2}\pi}\hat{\mathbf{i}}$ (d) $\frac{\mu_0 I}{4\pi}\hat{\mathbf{i}}$

25. A thin charged rod is bent into the shape of a small circle of radius R, the charge per unit length of the rod being λ. The circle is rotated about its axis with a time period T and it is found the magnetic field at a distance d away $(d \gg R)$ from the centre and on the axis, varies as R^m/d^n. The values of m and n respectively are

(a) $m = 2, n = 2$

(b) $m=2, n=3$
(c) $m=3, n=2$
(d) $m=3, n=3$

26. For two types of magnetic materials A and B, variation of $1/\chi$ (χ : susceptibility) versus temperature T is shown in the figure. Then,

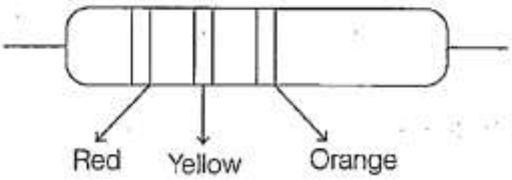


(a) A is diamagnetic and B is paramagnetic
(b) A is ferromagnetic and B diamagnetic
(c) A is paramagnetic and B is ferromagnetic
(d) A is paramagnetic and B is diamagnetic

27. The rms value of potential difference V shown in the figure is.

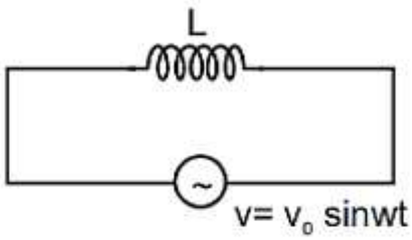
(a) $\frac{V_0}{2}$ (b) V_0
(c) $\frac{V_0}{\sqrt{3}}$ (d) $\frac{V_0}{\sqrt{2}}$

28. The carbon resistor with colour code is shown in the figure. There is no fourth band in the resistor. The value of the resistance is.



(a) $24 \mathrm{M}\Omega \pm 20\%$
(b) $14 \mathrm{k}\Omega \pm 5\%$
(c) $24 \mathrm{k}\Omega \pm 20\%$
(d) $34 \mathrm{k}\Omega \pm 10\%$

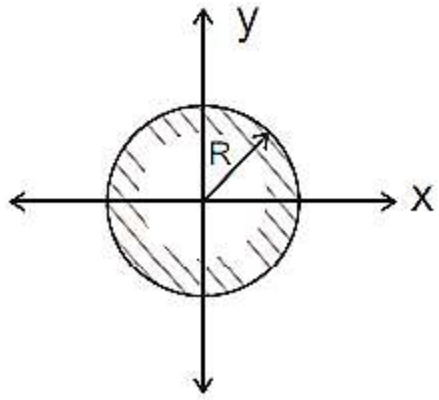
29. Consider a pure inductive AC circuit as shown in the figure. If the average power consumed is P, Then.



(a) $P>0$ (b) $P<0$
(c) $P=0$ (d) P is infinite

30. The cross-section of a reflecting surface is represented by the equation $x^2+y^2=R^2$ as

shown in the figure. A ray travelling in the positive x-direction is directed toward positive y-direction after reflection from the surface at point M. The coordinate of the point M on the reflecting surface is.'



(a) $\left(\frac{R}{\sqrt{2}}, \frac{R}{\sqrt{2}}\right)$' (b) $\left(-\frac{R}{2}, -\frac{R}{2}\right)$
(c) $\left(-\frac{R}{\sqrt{2}}, \frac{R}{\sqrt{2}}\right)$ (d) $\left(\frac{R}{\sqrt{2}}, -\frac{R}{\sqrt{2}}\right)$

31. For a plane electromagnetic wave, the electric field is given by
$E = 90\sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t)\hat{k}$ V/m. The corresponding magnetic field B will be.
(a) $B = 3 \times 10^{-7}\sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t)\hat{\imath}T$
(b) $B = 3 \times 10^{-7}\sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t)\hat{\jmath}T$
(c) $B = 27 \times 10^{9}\sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t)\hat{\jmath}T$
(d) $B = 3 \times 10^{-7}\sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t)\hat{k} \cdot T$

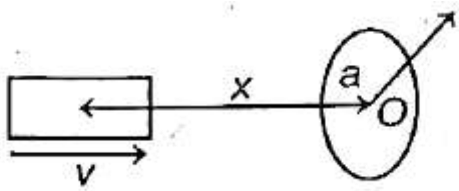
32. Two metal wires of identical dimensions are connected in series. If σ_1 and σ_2 are the electrical conductivities of the metal wires respectively, the effective conductivity of the combination is.
(a) $\sigma_1 + \sigma_2$ (b) $\frac{\sigma_1\sigma_2}{\sigma_1+\sigma_2}$
(c) $\frac{2\sigma_1\sigma_2}{\sigma_1+\sigma_2}$ (d) $\frac{\sigma_1+\sigma_2}{2\sigma_1\sigma_2}$

33. A uniform rod of length L pivoted at one end P is freely rotated in a horizontal plane with an angular velocity ω about a vertical axis passing through P. If the temperature of the system is increased by ΔT, angular velocity becomes $\frac{\omega}{2}$. If coefficient of linear expansion of the rod is $\alpha(\alpha \ll 1)$, then ΔT will be.
(a) $\frac{1}{\alpha}$ (b) $\frac{1}{2\alpha}$
(c) $\frac{1}{4\alpha}$ (d) α

34. An ideal gas of molar mass M is contained in a very tall vertical cylindrical column in the uniform gravitational field. Assuming the gas temperature to be T, the height at which the center of gravity of the gas is located is ($R \rightarrow$ universal gas constant).
(a) $\frac{RT}{g}$ (b) $\frac{RT}{Mg}$
(c) MgR (d) RTg

35. Under isothermal conditions, two soap bubbles of radii a and b coalesce to form a single bubble of radius c. If the external pressure is p, then surface tension of the bubbles is.
(a) $\frac{p(c^3-a^3+b^3)}{4(a^2+b^2-c^2)}$ (b) $\frac{p(c^3-a^3-b^3)}{4(a^2+b^2-c^2)}$
(c) $\frac{p(c^2+a^3-b^2)}{4(a^3+b^3-c^3)}$ (d) $\frac{p(a^3+b^3-c^3)}{4(a^2+b^2-c^2)}$

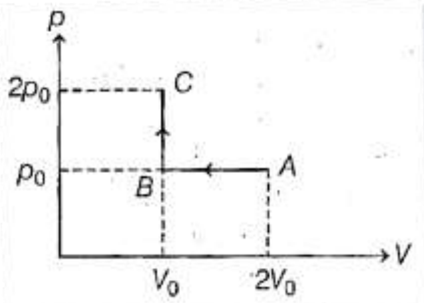
36. A small bar magnet of dipole moment M is moving with speed v along x-direction towards a small closed circular conducting loop of radius a with its centre O at $x = 0$ (see figure). Assume $x \gg a$ and the coil has a resistance R. Then, which of the following statement(s) is/are true?



(a) Magnetic field at the center O of the circular coil due to the bar magnet is $\frac{M}{x^3}$.
(b) Induced emf is proportional to $\frac{1}{x^4}$.
(c) The magnetic moment μ due to induced current in the coil is proportional to a^4.
(d) The heat produced is proportional to $\frac{1}{x^6}$.

37. Electric field component of an EM radiation varies with time as $E = a(\cos \omega_0 t + \sin \omega t \cos \omega_0 t)$, where a is a constant and $\omega = 10^{15}\ s^{-1}$, $\omega_0 = 5 \times 10^{15}\ s^{-1}$. This radiation falls on a metal whose stopping potential is -2 eV . Then, which of the following statement(s) is/are true? ($h = 6.62 \times 10^{-34}$ J-s)
(a) For light of frequency ω, photoelectric effect is not possible.
(b) Stopping potential versus frequency graph will be a straight line.
(c) The work function of the mutual is -2 eV .
(d). The maximum kinetic energy of the photoelectrons is -2 eV .

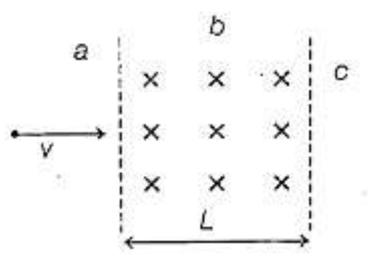
38. Consider the $p - V$ diagram for 1 mole of an ideal monatomic gas shown in the figure. Which of the following statement(s) is/are true?



(a) The change in internal energy for the whole process is zero.
(b) Heat is rejected during the process.
(c) Change in internal energy for process $A \rightarrow B$ is $-\frac{3}{2} p_0 V_0$.
(d) Work done by the gas during the entire process is $2p_0 V_0$.

39. The potential energy of a particle of mass 0.02 kg moving along X-axis is given by $V = Ax(x-4)$J, where x is in metre and A is a constant. Which of the following statement(s) is/are correct?
(a) The particle is acted upon by a constant force.
(b) The particle executes simple harmonic motion.
(c) The speed of the particle is maximum at $x = 2$ m.
(d) The period of oscillation of the particle is $\frac{\pi}{5}$ s.

40. A particle of mass m and charge q moving with velocity v enters region $-b$ from region- a along the normal to the boundary as shown in the figure. Region- b has a uniform magnetic field B perpendicular to the plane of the paper. Also, region- b has length L.
Choose the correct statement.



(a) The particle enters region- c only if $v > \frac{qLB}{m}$.
(b) The particle enters region- c only if $v < \frac{qLB}{m}$.

(c) Path of the particle is a circle in region-b.
(d) Time spent in region- b is independent of velocity v.

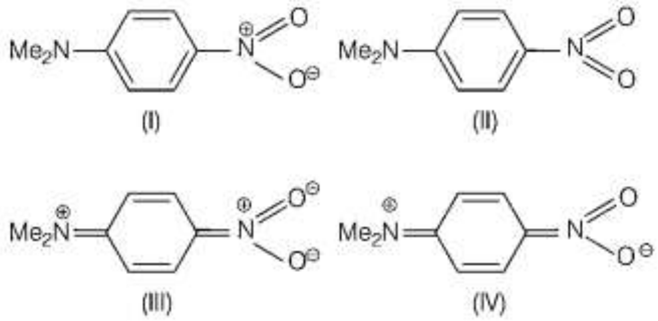
Chemistry

41. The exact order of boiling points of the compounds n-pentane, isopentane, butanone and 1-butanol is.
(a) n-pentane < isopentane < butanone < 1-butanol
(b) isopentane < n-pentane < butanone < 1-butanol
(c) butanone < n-pentane < isopentane < 1-butanol
(d) 1-butanol < butanone < n-pentane < isopentane

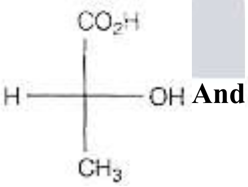
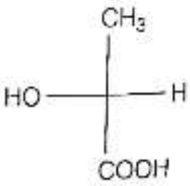
42. The maximum number of atoms that can be in one plane in the molecule p-nitrobenzonitrile are.
(a) 6 (b) 12
(c) 13 (d) 15

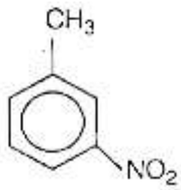
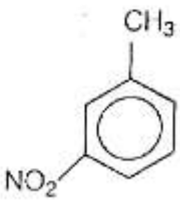
43. Cyclo [18] carbon is an allotrope of carbon with molecular formula C_{18}. It is a ring of 18 carbon atoms, connected by single and triple bonds. The total number of triple bonds present in this cyclocarbon are.
(a) 9 (b) 10
(c) 12 (d) 6

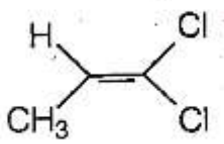
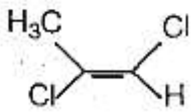
44. p-nitro- N, N-dimethylaniline cannot be represented by the resonating structures.



(a) I and II (b) II and IV
(c) I and III (d) III and IV

45. 1.  **And** 

2.  **And** 

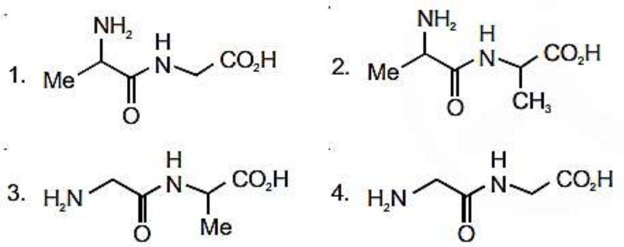
3.  **And** 

The relationship between the pair of compounds shown above are respectively
(a) homomer (identical), enantiomer and constitutional isomer
(b) enantiomer, enantiomer and diastereomer
(c) homomer (identical), homomer (identical) and constitutional isomer
(d) enantiomer, homomer (identical) and geometrical isomer

46. The exact order of acidity of the compounds p-nitrophenol, acetic acid, acetylene and ethanol is.

(a) p-nitrophenol < acetic acid < acetylene < ethanol
(b) acetic acid < p-nitrophenol < acetylene < ethanol
(c) acetylene < p-nitrophenol < ethanol < acetic acid
(d) acetylene < ethanol < p-nitrophenol < acetic acid

47. The dipeptides which may be obtained from the amino acids glycine and alanine are.

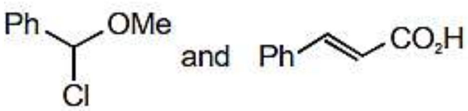


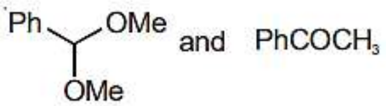
(a) Only 1 (b) Only 2
(c) Both 1 and 2 (d) All of them

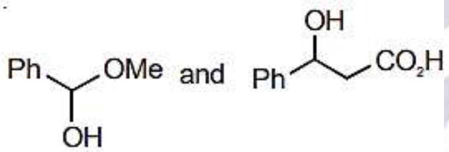
48. Benzaldehyde + methanol

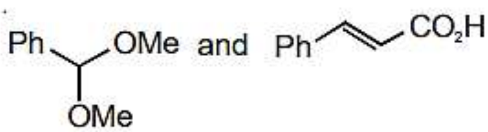
$$\xrightarrow[\text{HCl}]{\text{dry}} A \xrightarrow[2.(CH_3CO)_2O,\ CH_3COONa]{1.\ \text{dil. HCl}} B$$

The compounds A and B above are respectively.

(a) 

(b) 

(c) 

(d) 

49. For a spontaneous reaction at all temperatures which of the following is correct?
(a) Both ΔH and ΔS are positive
(b) ΔH is positive and ΔS is negative
(c) ΔH is negative and ΔS is positive
(d) Both ΔH and ΔS are negative

50. A given amount of Fe^{2+} is oxidised by x mol of MnO_4^- in acidic medium. The number of moles of $Cr_2O_7^{2-}$ required to oxidise the same amount of Fe^{2+} in acidic medium is.
(a) x (b) $0.83x$
(c) $2.0x$ (d) $1.2x$

51. An element crystallises in a body centered cubic lattice. The edge length of the unit cell is 200 pm and the density of the element is 5.0 g cm^{-3}. Calculate the number of atoms in 100 g of this element.
(a) 2.5×10^{23} (b) 2.5×10^{24}
(c) 5.0×10^{23} (d) 5.0×10^{24}

52. Molecular velocities of two gases at the same temperature (T) are u_1 and u_2. Their masses are m_1 and m_2 respectively. Which of the following expressions is correct at temperature T ?
(a) $\frac{m_1}{u_1^2} = \frac{m_2}{u_2^2}$ (b) $m_1u_1 = m_2u_2$
(c) $\frac{m_1}{u_1} = \frac{m_2}{u_2}$ (d) $m_1u_1^2 = m_2u_2^2$

53. **When 20 g of naphthoic acid $(C_{11}H_8O_2)$ is dissolved in 50 g of benzene, a freezing point depression of 2 K is observed. The van't Hoff factor (i) is $[K_f = 1.72 \text{ K kg mol}^{-1}]$.**
(a) 0.5 (b) 1.0
(c) 2.0 (d) 3.0

54. **The equilibrium constant for the reaction $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ is 4×10^{-4} at 2000 K. In presence of a catalyst the equilibrium is attained 10 times faster. Therefore, the equilibrium constant, in presence of the catalyst at 2000 K is.**
(a) 4×10^{-4} (b) 4×10^{-3}
(c) 4×10^{-5} (d) 2.5×10^{-4}

55. **Under the same reaction conditions, initial concentration of 1.386 moldm^{-3} of a substance becomes half in 40 s and 20 s through first-order and zero-order kinetics respectively. Ratio $\left(\frac{k_1}{k_0}\right)$ of the rate constants for first-order (k_1) and zero-order (k_0) of the reactions is.**
(a) $0.5 \text{ mol}^{-1}\text{dm}^3$ (b) 0.5 moldm^{-3}
(c) 1.0 moldm^{-3} (d) $2.0 \text{ mol}^{-1}\text{dm}^3$

56. **Which of the following solutions will have highest conductivity?**
(a) $0.1 M CH_3COOH$ (b) 0.1 M NaCl
(c) $0.1 M KNO_3$ (d) 0.1 M HCl

57. Indicate the products (X) and (Y) in the following reactions
$Na_2S + nS(n = 1-8) \longrightarrow (X)$
$Na_2SO_3 + S \longrightarrow (Y)$

	(X)	(Y)
(a)	$Na_2S_2O_3$	Na_2S_2
(b)	$Na_2S_{(n+1)}$	$Na_2S_2O_3$
(c)	Na_2S_n	$Na_2S_2O_3$
(d)	Na_2S_5	$Na_2S_2O_4$

58. 2.5 mL 0.4 M weak monoacidic base ($K_b = 1 \times 10^{-12}$ at 25°C) is titrated with 2/15M HCl in water at 25°C. The concentration of H^+ at equivalence point is ($K_w = 1 \times 10^{-14}$, at 25°C).
(a) 3.7×10^{-13}M (b) 32×10^{-7}M
(c) 32×10^{-2}M (d) 2.7×10^{-2}M

59. Solubility products (K_{sp}) of the salts of types MX, MX_2 and M_3X at temperature T are $4.0 \times 10^{-8}, 3.2 \times 10^{-14}$ and 2.7×10^{-15} respectively. Solubilities (in moldm^{-3}) of the salts at temperature T are in the order.
(a) $MX > MX_2 > M_3X$
(b) $M_3X > MX_2 > MX$
(c) $MX_2 > M_3X > MX$
(d) $MX > M_3X > MX_2$

60. The reduction potential of hydrogen half-cell:will be negative if.
(a) $p(H_2) = 1$ atm and $[H^+] = 1.0$M
(b) $p(H_2) = 1$ atm and $[H^+] = 2.0$M
(c) $p(H_2) = 2$ atm and $[H^+] = 1.0$M
(d) $p(H_2) = 2$ atm and $[H^+] = 2.0$M

61. A saturated solution of $BaSO_4$ at 25°C is 4×10^{-5}M. The solubility of $BaSO_4$ in 0.1 M Na_2SO_4 at this temperature will be.
(a) 1.6×10^{-9}M (b) 1.6×10^{-8}M
(c) 4×10^{-6}M (d) 4×10^{-4}M

62. A solution is made by a concentrated solution of $Co(NO_3)_2$ with a concentrated solution of $NaNO_2$ is 50% acetic acid. A solution of a salt containing metal M is added to the mixture, when a yellow precipitate is formed. Metal' M' is.

(a) magnesium (b) sodium
(c) potassium (d) zinc

63. Extraction of a metal (M) from its sulphide ore (M_2S) involves the following chemical reactions

$$2M_2S + 3O_2 \xrightarrow{\text{Heat}} 2M_2O + 2SO_2 \uparrow$$

$$M_2S + 2M_2O \xrightarrow{\text{Heat}} 6M + SO_2 \uparrow$$

(a) Zn (b) Cu
(c) Fe (d) Ca

64. The white precipitate (Y), obtained on passing colourless and odourless.gas (X) through an ammoniacal solution of NaCl, loses about 37% of its weight on heating and a white residue (Z) of basic nature is left. Identify (X), (Y) and (Z) from following sets.

	(X)	(Y)	(Z)
(a)	N_2	$(NH_4)_2CO_3$	NH_4Cl
(b)	O_2	$NaNH_4CO_3$	$NaHCO_3$
(c)	CO_2	NH_4HCO_3	$(NH_4)_2CO_3$
(d)	CO_2	$NaHCO_3$	Na_2CO_3

65. Which structure has delocalized π-electrons?
(a) O_3 (b) CO
(c) HCN (d) O_3 and HCN

66. The H_3O^+ ions has the following shape.
(a) tetrahedral (b) pyramidal
(c) triangular planar (d) "T" shaped

67. For the reaction $^{14}N(\alpha, p)\,^{17}O$, 1.16MeV (Mass equivalent $= 0.00124$amu) of energy is absorbed. Mass on the reactant side is 18.00567 amu and proton mass $= 1.00782$ amu. The atomic mass of ^{17}O will be.
(a) 17.0044 amu (b) 16.9991 amu
(c) 17.0114 amu (d) 16.9966 amu

68. A solution of $NaNO_3$, when treated with a mixture of Zn dust and ' A ' yields ammonia. A' can be
(a) caustic soda
(b) dilute sulphuric acid
(c) concentrated sulphuric acid
(d) sodium carbonate

69. Indicate the number of unpaired electrons in $K_3[Fe(CN)_6]$ and $K_4[Fe(CN)_6]$.
$K_3[Fe(CN)_6]$ $K_4[Fe(CN)_6]$
(a) 1 (b) 5 6
(c) 6 5 (d) 0 1

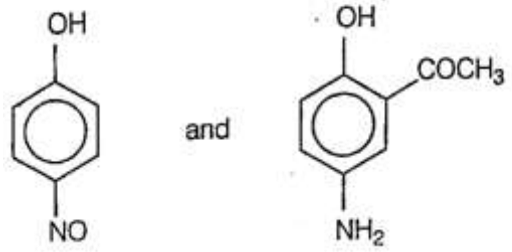
70. Which of the following compounds have magnetic moment identical with. $[Cr(H_2O)_6]^{3+}$?
(a) $[Cu(H_2O)_6]^{2+}$ (b) $[Mn(H_2O)_6]^{3+}$
(c) $[Fe(H_2O)_6]^{3+}$ (d) $[Mn(H_2O)_6]^{3+}$

71. Among the following chlorides the compounds which will be hydrolysed most easily and most slowly in aqueous NaOH solution are respectively:
1.Methoxymethyl chloride
2.Benzyl chloride
3.Neopentyl chloride
4.Propyl chloride
(a) 1 and 3 (b) 2 and 3
(c) 2 and 4 (d) 3 and 1

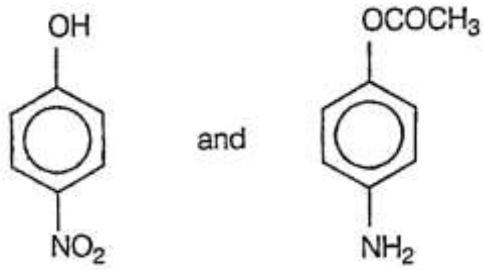
72. The products X and Y which are formed in the following sequence of reactions are

respectively.

$$\text{Phenol} \xrightarrow{\text{dil. } HNO_3} X \xrightarrow[2.\ (CH_3CO)_2O(1\text{ equiv.})]{1.Zn/HCl,\Delta} Y$$



(a)



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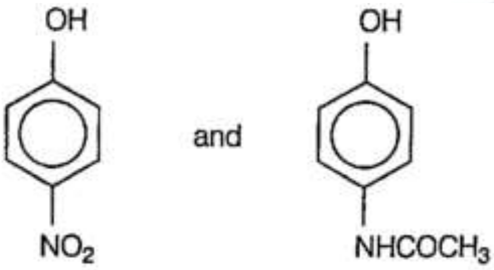

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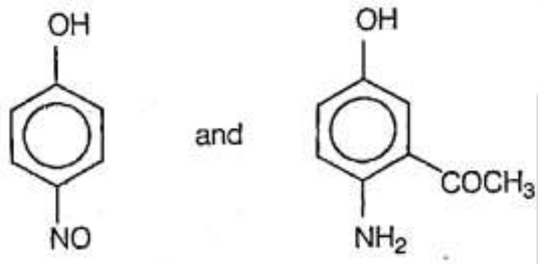


(d)

73. The atomic masses of helium and neon are 4.0 and 20.0 amu respectively. The value of the de-Broglie wavelength of helium gas at -73°C is M times the de-Broglie wavelength of neon at 727°C. The value of M is.

(a) 5 (b) 25

(c) $\frac{1}{5}$ (d) $\frac{1}{25}$

74. The mole fraction of a solute in a binary solution is 0.1 at 298 K , molarity of this solution is same as its molality. Density of this solution at 298 K is 2.0 g cm^{-3}. The ratio of molecular weights of the solute and the solvent ($M_{\text{solute}} / M_{\text{solvent}}$) is.

(a) 9 (b) $\frac{1}{9}$

(c) 4.5 (d) $\frac{1}{4.5}$

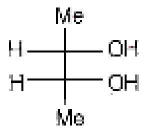
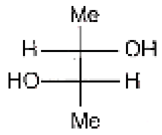
75. 5.75 mg of sodium vapour is converted to sodium ion. If the ionisation energy of sodium is 490 kJ mol^{-1} and atomic weight is 23 units, the amount of energy needed for this conversion will be.

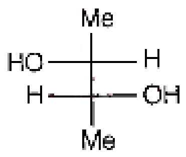
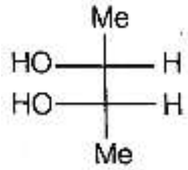
(a) 1.96 kJ (b) 1960 kJ

(c) 122.5 kJ (d) 0.1225 kJ

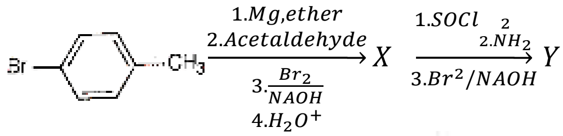
76. The product(s) in the following sequence of reactions will be

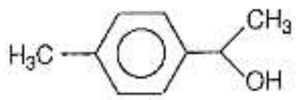
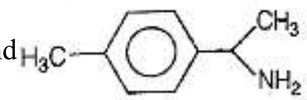
$$Me - C \equiv C - Me \xrightarrow[2.\ \text{dil.alkaline } KMnO_4]{\frac{1.\ Na}{NH_3\ (liq.)}\ \text{ethanol, } -33^{\circ}C} \textbf{Product(s).}$$

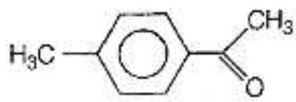
(a)  (b) 

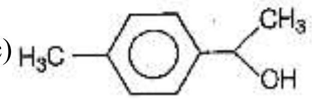
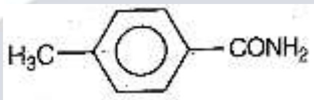
(c)  (d) 

77. The compounds X and Y are respectively.



(a)  And 

(b)  And 

(c)  And 

(d)  And 

78. Aqueous solution of HNO_3, KOH, CH_3COOH and CH_3COONa of identical concentration are provided. The pair(s) of solutions which form a buffer upon mixing is (are).

(a) HNO_3 and CH_3COOH

(b) KOH and CH_3COONa

(c) HNO_3 and CH_3COONa

(d) CH_3COOH and CH_3COONa

79. Reaction of silver nitrate solution with phosphorus acid produces

(a) silver phosphite (b) phosphoric acid

(c) metallic silver (d) silver phosphate

80. N_2H_4 and H_2O_2 show similarity in.

(a) density

(b) reducing nature

(c) oxidising nature

(d) hybridisation of central atoms

Mathematics

81. If $I = \lim_{x\to 0} \sin\left(\frac{e^x - x - 1 - \frac{x^2}{2}}{x^2}\right)$, then limit.

(a) does not exist

(b) exists and equals 1

(c) exists and equals 0

(d) exists and equals $\frac{1}{2}$

82. Let $f: R \to R$ be such that $f(0) = 0$ and $|f'(x)| \leq 5$ for all x. Then $f(1)$ is in.

(a) $(5,6)$ (b) $[-5,5]$

(c) $(-\infty,-5) \cup (5,\infty)$ (d) $[-4,4]$

83. If $\int \frac{\sin 2x}{(a+b\cos x)^2} dx$

$$= \alpha\left[\log_e |a + b\cos x| + \frac{a}{a + b\cos x}\right] + c$$

then α is equal to

(a) $\frac{2}{b^2}$ (b) $\frac{2}{a^2}$

(c) $-\frac{2}{b^2}$ (d) $-\frac{2}{a^2}$

84. Let $g(x)=\int_x^{2x}\frac{f(t)}{t}dt$ where $x>0$ and f be continuous function and $f(2x)=f(x)$, then

(a) $g(x)$ is strictly increasing function
(b) $g(x)$ is strictly decreasing function
(c) $g(x)$ is constant function
(d) $g(x)$ is not derivable function

85. $\int_1^3 \frac{|x-1|}{|x-2|+|x-3|}dx$ is equal to.

(a) $1+\frac{4}{3}\log_e 3$ (b) $1+\frac{3}{4}\log_e 3$

(c) $1-\frac{4}{3}\log_e 3$ (d) $1-\frac{3}{4}\log_e 3$

86. The value of the integral $\int_{-1/2}^{1/2}\left\{\left(\frac{x+1}{x-1}\right)^2+\left(\frac{x-1}{x+1}\right)^2-2\right\}^{1/2}dx$ is equal to.

(a) $\log_e\left(\frac{4}{3}\right)$ (b) $4\log_e\left(\frac{3}{4}\right)$

(c) $4\log_e\left(\frac{4}{3}\right)$ (d) $\log_e\left(\frac{3}{4}\right)$

87. If $\int_{\log_e 2}^{x}(e^x-1)^{-1}dx=\log_e\frac{3}{2}$ then the value of x is.

(a) 1 (b) e^2

(c) $\log 4$ (d) $\frac{1}{e}$

88. The normal to a curve at $P(x,y)$ meets the X-axis at G. If the distance of G from the origin is twice the abscissa of P then the curve is.

(a) a parabola (b) a circle

(c) a hyperbola (d) an ellipse

89. The differential equation of all the ellipses centred at the origin and have axes as the co-ordinate axes is.

(a) $y^2+xy^2-yy'=0$
(b) $xyy''+xy'^2-yy'=0$
(c) $yy'+xy'^2-xy'=0$
(d) $x^2y'+xy''-3y=0$

where $y'\equiv\frac{dy}{dx}, y''\equiv\frac{d^2y}{dx^2}$

90. If $x\frac{dy}{dx}+y=\frac{xf(xy)}{f'(xy)}$, then $|f(xy)|$ is equal to

(a) $ke^{x^2/2}$ (b) $ke^{y^2/2}$

(c) ke^{x^2} (d) ke^{y^2}

91. The straight the through the origin which divides the area formed by the curves $y=2x-x^2, y=0$ and $x=1$ into two equal halves is.

(a) $y=x$ (b) $y=2x$

(c) $y=\frac{3}{2}x$ (d) $y=\frac{2}{3}x$

92. The value of $\int_0^5 \max\{x^2,6x-8\}dx$ is.

(a) 72 (b) 125

(c) 43 (d) 69

93. A bulb is placed at the center of a circular track of radius 10 m . A vertical wall is erected touching the track at a point P. A man is running along the track with a speed of 10 m/sec. Starting from P the speed with which his shadow is running along the wall when he is at an angular distance of 60° from P is.

(a) 30 m/sec (b) 40 m/sec

(c) 60 m/sec (d) 80 m/sec

94. Two particles A and B move from rest along a straight line with constant accelerations f

and f' respectively. If A takes m sec. more than that of B and describes n units more than that of B in acquiring the same velocity, then.
(a) $(f+f')m^2 = ff'n$
(b) $(f-ff')m^2 = ff'n$
(c) $(f'-f)n = \frac{1}{2}f'm^2$
(d) $\frac{1}{2}(f+f')m = f'n^2$

95.Let α, β, γ be three non-zero vectors which are pairwise non-collinear. If $\alpha + 3\beta$ is collinear with γ and $\beta + 2\gamma$ is collinear with α, then $\alpha + 3\beta + 6\gamma$ is.
(a) γ (b) 0
(c) $\alpha + \gamma$ (d) α

96.Let $f: R \to R$ be given by $f(x) = |x^2 - 1|, x \in R$. Then
(a) f has a local minimum at $x = \pm 1$ but no local maximum.
(b) f has a local minimum at $x = 0$ but no local minimum.
(c) f has a local minima at $x = \pm 1$ and a local maxima at $x = 0$.
(d) f has neither a local maxima nor a local minima at any point.

97.Let a, b, c be real numbers, each greater than 1, such that $\frac{2}{3}\log_b a + \frac{3}{5}\log_c b + \frac{5}{2}\log_a c = 3$.If the value of b is 9 , then the value of ' a ' must be.
(a) $\sqrt[3]{81}$ (b) $\frac{27}{2}$
(c) 18 (d) 27

98. Consider the real valued function $h: \{0, 1, 2, 100\} \to R$ such that $h(0) = 5, h(100) = 20$ and satisfying $h(p) = \frac{1}{2}\{h(p+1) + h(p-1)\}$ for every $p = 1, 2 \ldots \ldots 99$. Then the value of $h(l)$ is.
(a) 5.15 (b) 5.5
(c) 6 (d) 6.15

99.If $|z| = 1$ and $z \neq \pm 1$, then all the points representing $\frac{z}{1-z^2}$ lie on.
(a) a line not passing through the origin
(b) the line $y = x$
(c) the X-axis
(d) the Y-axis

100. Let C denote the set of all complex numbers. Define $A = \{(z, w) \mid z, w \in C \text{ and } |z| = |w|\}$, $B = \{z, w) \mid z, w \in C \text{ and } z^2 = w^2\}$. Then.
(a) $A = B$ (b) $A \subset B$
(c) $B \subset A$ (d) $A \cap B = \varphi$

101. Let α, β be the roots of the equation $x^2 - 6x - 2 = 0$ with $\alpha > \beta$. If $a_n = \alpha^n - \beta^n$ for $n \geq 1$, then the value of $\frac{a_{10} - 2a_8}{2a_0}$ is.
(a) 1 (b) 2
(c) 3 (d) 4

102. For $x \in R, x \neq -1$, if
$(1+x)^{2016} + x(1+x)^{2015} + x^2(1+x)^{2014} + \cdots . + x^{2016} = \sum_{i=0}^{2016} a_i \cdot x^i$, then a_{17} is equal to.
(a) $\frac{2016!}{17!1999!}$ (b) $\frac{2016!}{16!}$
(c) $\frac{2017!}{2000!}$ (d) $\frac{2017!}{17!2000!}$

103. Five letter words, having distinct letters, are to be constructed using the letters of the word 'EQUATION' so that each word contains exactly three vowels and two consonants. How many of them have all the vowels together?
(a) 3600 (b) 1800
(c) 1080 (d) 900

104. What is the number of ways in which an examiner can assign 10 marks to 4 questions, giving not less than 2 marks to any question?
(a) 4 (b) 6
(c) 10 (d) 16

105. The digit in the unit's place of the number $1! + 2! + 3! + \cdots . +99$!is.

(a) 3 (b) 0
(c) 1 (d) 7

106. If M is a 3×3 matrix such that $(0,1,2)\ M = (100), (3,45)M = (0,1,0)$, then (678) M is equal to.

(a) $(2 \quad 1 \quad -2)$ (b) $(0 \quad 0 \quad 1)$
(c) $(-1 \quad 2 \quad 0)$ (d) $(9 \quad 10 \quad 8)$

107. Let $A = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos t & \sin t \\ 0 & -\sin t & \cos t \end{pmatrix}$

Let $\lambda_1, \lambda_2, \lambda_3$ be the roots of $\det(A - \lambda I_3) = 0$, where I_3 denotes the identity matrix. If $\lambda_1 + \lambda_2 + \lambda_3 = \sqrt{2} + 1$, then the set of possible values of $t, -\pi \le t < \pi$ is.

(a) a void set (b) $\left\{\frac{\pi}{4}\right\}$
(c) $\left\{-\frac{\pi}{4}, \frac{\pi}{4}\right\}$ (d) $\left\{-\frac{\pi}{3}, \frac{\pi}{3}\right\}$

108. Let A and B two non singular skew symmetric matrices such that $AB = BA$, then $A^2B^2(A^TB)^{-1}(AB^{-1})^T$ is equal to.

(a) A^2 (b) $-B^2$
(c) $-A^2$ (d) AB

109. If $a_n > 0$) be the n^{th} term of a G.P. then

$\begin{vmatrix} \log a_n & \log a_{n+1} & \log a_{n+2} \\ \log a_{n+3} & \log a_{n+4} & \log a_{n+5} \\ \log a_{n+6} & \log a_{n+7} & \log a_{n+8} \end{vmatrix}$ is equal to

(a) 1 (b) 2
(c) -2 (d) 0

110. Let A, B, C be three non-void subsets of set S. Let $(A \cap C) \cup (B \cap C') = \phi$ where C' denote the complement of set C in S. Then.

(a) $A \cap B = \phi$ (b) $A \cap B \ne \phi$
(c) $A \cap C = A$ (d) $A \cup C = A$

111. Let T and U be the set of all orthogonal matrices of order 3 over R and the set of all non-singular matrices of order 3 over R respectively. Let $A = \{-1, 0, 1\}$, then.

(a) there exists bijective mapping between A and T, U.
(b) there does not exist bijective mapping between A and T, U.
(c) there exists bijective mapping between A and T but not between A and U.
(d) there exists bijective mapping between A and U but not between A and T.

112. Four persons A, B, C and D throw and unbiased die, turn by turn, in succession till one gets an even number and win the game. What is the probability that A wins the game if A begins?

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$
(c) $\frac{7}{15}$ (d) $\frac{8}{15}$

113. The mean and variance of a binomial distribution are 4 and 2 respectively. Then the probability of exactly two successes is.

(a) $\frac{7}{64}$ (b) $\frac{21}{128}$
(c) $\frac{7}{32}$ (d) $\frac{9}{32}$

114. Let $S_n = \cot^{-1} 2 + \cot^{-1} 8 + \cot^{-1} 18 + \cot^{-1} 32 + \cdots$ to n^{th} term. Then $\lim_{n\to\infty} S_n$ is.

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{4}$
(c) $\frac{\pi}{6}$ (d) $\frac{\pi}{8}$

115. If $a > 0, b > 0$ then the maximum area of the parallelogram whose three vertices are $O(0,0), A(a\cos\theta, b\sin\theta)$ and $B(a\cos\theta, -b\sin\theta)$ is.

(a) ab when $\theta = \frac{\pi}{4}$ (b) 3ab when $\theta = \frac{\pi}{4}$
(c) ab when $\theta = -\frac{\pi}{2}$ (d) $2ab$

116. Let A be the fixed point $(0,4)$ and B be a moving point on X-axis. Let M be the midpoint of

AB and let the perpendicular bisector of AB meets the Y-axis at R. The locus of the midpoint P of MR is.
(a) $y + x^2 = 2$
(b) $x^2 + (y-2)^2 = \frac{1}{4}$
(c) $(y-2)^2 - x^2 = \frac{1}{4}$
(d) $x^2 + y^2 = 16$

117. A moving line intersects the lines $x + y = 0$ and $x - y = 0$ at the points A, B respectively such that the area of the triangle with vertices $(0,0), A$ and B has a constant area C. The locus of the mid-point AB is given by the equation.
(a) $(x^2 + y^2)^2 = C^2$
(b) $(x^2 - y^2)^2 = C^2$
(c) $(x + y)^2 = C^2$
(d) $(x - y)^2 = C^2$

118. The locus of the vertices of the family of parabolas $6y = 2a^3x^2 + 3a^2x - 12a$ is.
(a) $xy = \frac{105}{64}$ (b) $xy = \frac{64}{105}$
(c) $xy = \frac{35}{16}$ (d) $xy = \frac{16}{35}$

119. A ray of light along $x + \sqrt{3}y = \sqrt{3}$ gets reflected upon reaching X-axis, the equation of the reflected ray is.
(a) $y = x + \sqrt{3}$
(b) $\sqrt{3}y = x - \sqrt{3}$
(c) $y = \sqrt{3}x - \sqrt{3}$
(d) $\sqrt{3}y = x - 1$

120. Two tangents to the circle $x^2 + y^2 = 4$ at the points A and B meet at $M(-4, 0)$. The area of the quadrilateral $MAOB$, where O is the origin is.
(a) $4\sqrt{3}$ sq units (b) $2\sqrt{3}$ sq units
(c) $\sqrt{3}$ sq units (d) $3\sqrt{3}$ sq units

121. From a point $(d, 0)$ three normals are drawn to the parabola $y^2 = x$, then.
(a) $d = \frac{1}{2}$ (b) $d > \frac{1}{2}$
(c) $d < \frac{1}{2}$ (d) $d = \frac{1}{3}$

122. If from a point $P(a, b, c)$, perpendicular PA and PB are drawn to YZ and ZX-planes respectively, then the equation of the plane OAB is
(a) $bcx + cay + abz = 0$
(b) $bcx + cay - abz = 0$
(c) $bcx - cay + abz = 0$
(d) $bcx - cay - abz = 0$

123. The co-ordinate of a point on the auxiliary circle of the ellipse $x^2 + 2y^2 = 4$ corresponding to the point on the ellipse whose eccentric angle is $60°$ will be
(a) $(\sqrt{3}, 1)$ (b) $(1, \sqrt{3})$
(c) $(1,1)$ (d) $(1,2)$

124. The locus of the center of a variable circle which always touches two given circles externally Is.
(a) an ellipse (b) a hyperbola
(c) a parabola (d) a circle

125. A line with positive direction cosines passes through the point $P(2, -1, 2)$ and makes equa angle with co-ordinate axes. The line meets the plane $2x + y + z = 9$ at point Q. The lengt of the line segment PQ equals.
(a) 1 unit (b) $\sqrt{2}$ unit
(c) $\sqrt{3}$ unit (d) 2 unit

126. For $y = \sin^{-1}\left\{\frac{5x+12\sqrt{1-x^2}}{13}\right\}; |x| \le 1$, if $a(1-x^2)y_2 + bxy_1 = 0$ then $(a, b) =$

(a) (2,1) (b) $(1,-1)$
(c) $(-1,1)$ (d) (1,2)

127. $f(x)$ **is real valued function such that** $2f(x)+3f(-x)=15-4x$ **for all** $x \in R$**. Then** $f(2)=$
(a) -15 (b) 22
(c) 11 (d) 0

128. Consider the functions $f_1(x)=x, f_2(x)=2+\log_e x, x>0$**. The graphs of the functions intersect**
(a) once in $(0,1)$ but never in $(1,\infty)$
(b) once in $(0,1)$ and once in (e^2,∞)
(c) once in $(0,1)$ and once in (e,e^2)
(d) more than twice in $(0,\infty)$

129. The equation $6^x+8^x=10^x$ **has**
(a) no real root.
(b) infinitely many rational roots
(c) exactly one real root
(d) two distinct real roots

130. Let $f: D \rightarrow R$ **where** $D=[-0,1] \cup [2,4]$ **be defined by**
$f(x)=\begin{cases} x, & \text{if } x \in [0,1] \\ 4-x, & \text{if } x \in [2,4] \end{cases}$ **Then,**
(a) Rolle's theorem is applicable to f in D.
(b) Rolle's theorem is not applicable to f in D.
(c) there exists $\xi \in D$ for which $f'(\xi)=0$ but Rolle's theorem is not applicable.
(d) f is not continuous in D.

131. Let $f(x)$ **be continuous periodic function with period** T**. Let** $I=\int_a^{a+T} f(x)dx$**. Then**
(a) I is linear function in ' a '
(b) I does not depend on ' a '
(c) $0<1<a^2+1$ where / depends on ' a '
(d) / is quadratic function in ' a '

132. If $b=\int_0^1 \frac{e^t}{t+1}dt$**, then** $\int_{a-1}^{a} \frac{e^{-t}}{t-a-1}$ **is.**
(a) be^a (b) be^{-a}
(c) $-be^{-a}$ (d) $-be^a$

133. The differential of $f(x)=\log_e(1+e^{10x})-\tan^{-1}(e^{5x})$ **at** $x=0$ **and for** $dx=0.2$ **is**
(a) 0.5 (b) 0.3
(c) -02 (d) -0.5

134. Given that $f: S \rightarrow R$ **is said to have a fixed point at** c **of** S **if** $f(c)=c$**.**
Let $f:[1,\infty) \rightarrow R$ **be defined by** $f(x)=1+\sqrt{x}$**. Then**
(a) f has no fixed point in $[1,\infty)$
(b) f has unique fixed point in $[1,\infty)$
(c) f has to fixed points in $[1,\infty)$
(d) f has infinitely many fixed points in $[1,\infty)$

135. The $\lim_{x\to\infty}\left(\frac{3x-1}{3x+1}\right)^{4x}$ **equals.**
(a) 1 (b) 0
(c) $e^{-8/3}$ (d) $e^{-4/9}$

136. The area bounded by the parabolas $y=4x^2, y=\frac{x^2}{9}$ **and the straight line** $y=2$ **is**
(a) $\frac{20\sqrt{2}}{3}$ sq. unit (b) $10\sqrt{5}$ sq. unit
(c) $\frac{10\sqrt{3}}{7}$ sq. unit (d) $10\sqrt{2}$ sq. unit

137. If $a(\alpha \times \beta)+b(\beta \times \gamma)+c(\gamma \times \alpha)=0$**, where** a, b, c **are non-zero scalars, then the vectors**

α, β, γ are.

(a) parallel (b) non-coplanar
(c) coplanar (d) mutually perpendicular

138. If the tangent at the point P with co-ordinates (h, k) on the curve $y^2 = 2x^3$ is perpendicular to the straight line $4x = 3y$, then

(a) $(h, k) = (0,0)$ only
(b) $(h, k) = \left(\frac{1}{8}, -\frac{1}{16}\right)$ only
(c) $(h, k) = (0,0)$ or $\left(\frac{1}{8}, \frac{1}{16}\right)$
(d) no such point P exists

139. The co-efficient of $a^3 b^4 c^5$ in the expansion of $(bc + ca + ab)^6$ is

(a) $\frac{12!}{3!4!5!}$ (b) $\frac{6!}{3!}$
(c) 33 (d) $3\left(\frac{6!}{3!3!}\right)$

140. Three unequal positive numbers a, b, c are such that a, b, c are in G.P. while $\log\left(\frac{5c}{2a}\right), \log\left(\frac{7b}{5c}\right), \log\left(\frac{2a}{7b}\right)$ are in A.P. Then a, b, c are the lengths of the sides of.

(a) an isosceles triangle
(b) an equilateral triangle
(c) a scalene triangle
(d) a right-angled triangle

141. The determinant $\begin{vmatrix} a^2+10 & ab & ac \\ ab & b^2+10 & bc \\ ac & bc & c^2+10 \end{vmatrix}$ is

(a) divisible by 10 but not by 100
(b) divisible by 100
(c) not divisible by 100
(d) not divisible by 10

142. Let R be the real line. Let the relations S and T or R be defined by $S = \{(x, y): y = x + 1, 0 < x < 2\}, T = \{(x, y): x - y$ is an integer $\}$. Then

(a) both S and T are equivalence relations on R
(b) T is an equivalence on R but S is not
(c) neither S nor T is an equivalence relation on R
(d) S is an equivalence relation on R but T is not

143. The plane $\ell x + my = 0$ is rotated about its line of intersection with the plane $z = 0$ through an angle α. The equation changes to.

(a) $\ell x + my \pm \tan\alpha\sqrt{\ell^2 + m^2} = 0$
(b) $\ell x + my \pm z\tan\alpha\sqrt{\ell^2 + m^2 + 1} = 0$
(c) $\ell x + my \pm z\tan\alpha\sqrt{\ell^2 + 1} = 0$
(d) $\ell x + my \pm z\tan\alpha\sqrt{\ell^2 + m^2} = 0$

144. The points of intersection of two ellipses $x^2 + 2y^2 - 6x - 12y + 20 = 0$ and $2x^2 + y^2 - 10x - 6y + 15 = 0$ lie on a circle.
The centre of the circle is.

(a) $(8,3)$ (b) $(8,1)$
(c) $\left(\frac{8}{3}, 3\right)$ (d) $(3,8)$

145. Let $I = \int_{\pi/4}^{\pi/3} \frac{\sin x}{x} dx$. Then

(a) $\frac{\sqrt{3}}{8} \le 1 \le \frac{\sqrt{2}}{6}$ (b) $\frac{\sqrt{3}}{2\pi} \le 1 \le \frac{2\sqrt{3}}{\pi}$
(c) $\frac{\sqrt{3}}{9} \le 1 \le \frac{\sqrt{2}}{16}$ (d) $\pi \le 1 \le \frac{4\pi}{3}$

146. If $|z + i| - |z - 1| = |z| - 2 = 0$ for a complex number z, then z is equal to

(a) $\sqrt{2}(1 + i)$ (b) $\sqrt{2}(1 - i)$
(c) $\sqrt{2}(-1 + i)$ (d) $\sqrt{2}(-1 - i)$

147. $\begin{vmatrix} x & 3x+2 & 2x-1 \\ 2x-1 & 4x & 3x+1 \\ 7x-2 & 17x+6 & 12x-1 \end{vmatrix} = 0$ **is true for.**

(a) only one value of x
(b) only two value of x
(c) only three values of x
(d) infinitely many value of x

148. The remainder when $7^{7^{7^{7}}}$ (22 time 7) is divided by 48 is.

(a) 21 (b) 7
(c) 47 (d) 1

149. Whichever of the following is/are correct?

(a) To evaluate $l_1 = \int_{-2}^{2} \frac{dx}{4+x^2}$, it is possible to $x = \frac{1}{t}$
(b) To evaluate $I_2 = \int_0^1 \sqrt{(x^2+1)}dx$, it is possible to put $x = \sec t$
(c) To evaluate $I_2 = \int_0^1 \sqrt{(x^2+1)}dx$, it is not possible to put $x = \operatorname{cosec}\theta$
(d) To evaluate I_1, it is not possible to put $x = \frac{1}{t}$

150. A plane meets the co-ordinate axes at the points A, B, C respectively such a way that the centroid of $\triangle ABC$ is $(1, r, r^2)$ for some real r. If the plane passes through the point $(5, 5, -12)$ then $r =$

(a) $\frac{3}{2}$ (b) 4
(c) -4 (d) $-\frac{3}{2}$

151. Let P be a variable point on a circle C and Q be a fixed point outside C. If R is the midpoint of the line segment PQ, then locus of R is.

(a) a circle
(b) a circle and a pair of straight lines
(c) a rectangular hyperbola
(d) a pair of straight lines

152. $\lim\limits_{n\to\infty} \left\{ \frac{\sqrt{n}}{\sqrt{(n^3)}} + \frac{\sqrt{n}}{\sqrt{(n+4)^3}} + \frac{\sqrt{n}}{\sqrt{(n+8)^3}} + \cdots . + \frac{\sqrt{n}}{\sqrt{[n+4(n-1)]^3}} \right\}$ **is.**

(a) $\frac{5-\sqrt{5}}{10}$ (b) $\frac{5+\sqrt{5}}{10}$
(c) $\frac{2+\sqrt{3}}{2}$ (d) $\frac{2-\sqrt{3}}{2}$

153. Let $f(x) = \begin{cases} 0, & \text{if} \quad -1 \le x < 0 \\ 1, & \text{if} \quad x = 0 \\ 2, & \text{if} \quad 0 < x \le 1 \end{cases}$ **and let $F(x) = \int_{-1}^{x} f(t)dt, -1 \le x \le 1$, then**

(a) F is continuous function in $[-1,1]$
(b) F is discontinuous function in $[-1,1]$
(c) $F'(x)$ exists at $x = 0$
(d) $F'(x)$ does not exist at $x = 0$

154. The greatest and least value of $f(x) = \tan^{-1} x - \frac{1}{2}\ln x$ on $\left[\frac{1}{\sqrt{3}}, \sqrt{3}\right]$ are.

(a) $f_{\min} = \sqrt{3} - 1$
(b) $f_{\max} = \frac{\pi}{6} + \frac{1}{4}\ln 3$
(c) $f_{\min} = \frac{\pi}{3} - \frac{1}{4}\ln 3$
(d) $f_{\max} = \frac{\pi}{12} + \ln 5$

155. Let f and g be periodic functions with the periods T_1 and T_2 respectively. Then $f + g$ is.

(a) periodic with period $T_1 + T_2$
(b) non-periodic
(c) periodic with the period T_1
(d) periodic when $T_1 = T_2$