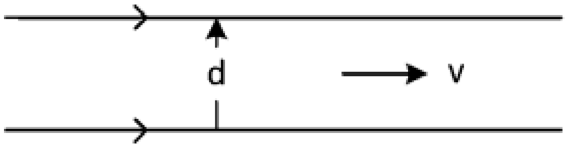
Physics

1. Two infinite line-charges parallel to each other are moving with a constant velocity v in the same direction as shown in the figure below.

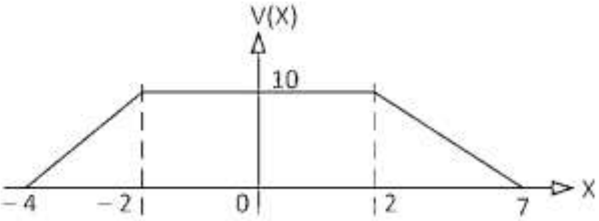


The separation between two line-charges is d. The magnetic attraction balances the electric repulsion when, [$c =$ speed of light in free space].

(a) $v = \sqrt{2}c$ (b) $v = \frac{c}{\sqrt{2}}$

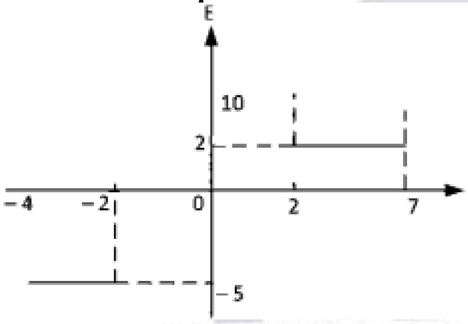
(c) $v = c$ (d) $v = \frac{c}{2}$

2. The electric potential for an electric field directed parallel to X-axis is shown in the figure.

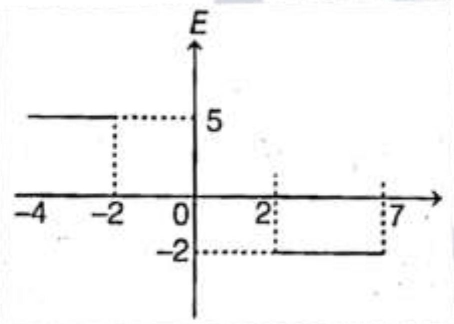


Choose the correct plot of electric field strength.

(a)



(b)



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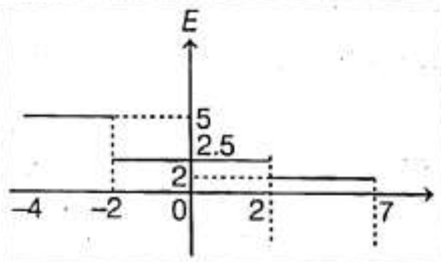

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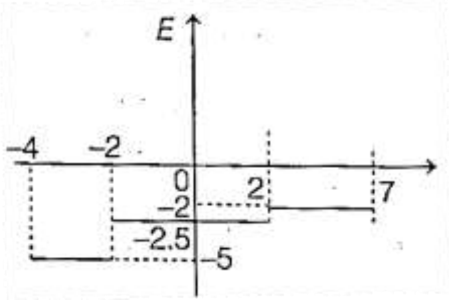


3. An electron revolves around the nucleus in a circular path with angular momentum L. A uniform magnetic field B is applied perpendicular to the plane of its orbit. If the electron experiences a torque T, then

(a) T||L
(b) T is anti-parallel to L
(c) $\mathbf{T} \cdot \mathbf{L} = 0$
(d) Angle between T and L is 45°

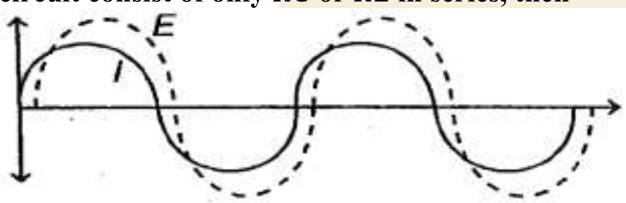
4. A straight wire is placed in a magnetic field that varies with distance x from origin as $B = B_0\left(2-\frac{x}{a}\right)\hat{k}$. Ends of wire are at $(a, 0)$ and $(2a, 0)$ and it carries a current I. If force on wire is $F = IB_0\left(\frac{ka}{2}\right)\hat{j}$, then value of k is.

(a) 1 (b) 5
(c) -1 (d) $\frac{1}{2}$

5. In a closed circuit, there is only a coil of inductance L and resistance 100Ω. The coil is situated in a uniform magnetic field. All on a sudden, the magnetic flux linked with the circuit changes by 5 Wb . What amount of charge will flow in the circuit as a result?

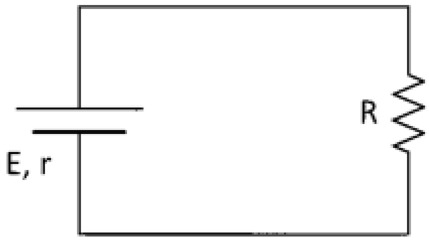
(a) 500 C
(b) 0.05 C
(c) 20 C
(d) Value of L is to be known to find the charge flown

6. When an AC source of emf E with frequency $\omega = 100\text{rad/s}$ is connected across a circuit, the phase difference between E and current I in the circuit is observed to be $\frac{\pi}{4}$ as shown in the figure. If the circuit consist of only RC or RL in series, then



(a) $R = 1\text{k}\Omega, C = 5\mu$ F
(b) $R = 1\text{k}\Omega, L = 10\text{H}$
(c) $R = 1\text{k}\Omega, L = 1\text{H}$
(d) $R = 1\text{k}\Omega, C = 10\mu$ F

7. A battery of emf E and internal resistance r is connected with an external resistance R as shown in the figure. The battery will act as a constant voltage source, if



(a) $r \ll R$
(b) $r \gg R$
(c) $r = R$
(d) It will never act as a constant voltage source

8. If the kinetic energies of an electron, an alpha particle and a proton having same de-Broglie wavelengths are $\varepsilon_1, \varepsilon_2$ and ε_3 respectively, then.
(a) $\varepsilon_1 > \varepsilon_3 > \varepsilon_2$
(b) $\varepsilon_1 = \varepsilon_2 = \varepsilon_3$
(c) $\varepsilon_1 < \varepsilon_3 < \varepsilon_2$
(d) $\varepsilon_1 > \varepsilon_2 > \varepsilon_3$

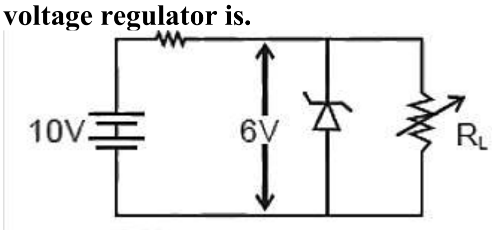
9. In a Young's double slit experiment, the intensity of light at a point on the screen where the path difference between the interfering waves is λ, (λ being the wavelength of light used) is 1 . The intensity at a point where the path difference is $\lambda/4$ will be (assume two waves have same amplitude)
(a) zero (b) 1
(c) $\frac{1}{2}$ (d) $\frac{1}{4}$

10. In Young's double slit experiment with a monochromatic light, maximum intensity is 4 times the minimum intensity in the interference pattern. What is the ratio of the intensities of the two interfering waves?
(a) 1/9 (b) 1/3
(c) 1/16 (d) 1/2

11. The human eye has an approximate angular resolution of $\theta = 5.8 \times 10^{-4}$ rad and typical photo printer prints a minimum of 300 dpi (dots per inch, 1 inch = 2.54 cm). At what minimal distance d should a printed page be held, so that one does not see the individual dots?
(a) 20.32 cm (b) 29.50 cm
(c) 14.59 cm (d) 6.85 cm

12. Suppose in a hypothetical world the angular momentum is quantized to be even integral multiples of $\frac{h}{2\pi}$. The largest possible wavelength emitted by hydrogen atoms in visible range in a world according to Bohr's model will be.
(Consider $hc = 1242\text{MeV} - \text{nm}$)
(a) 153 nm (b) 409 nm
(c) 121 nm (d) 487 nm

13. A Zener diode having breakdown voltage $V_Z = 6$ V is used in a voltage regulator circuit as shown in the figure. The minimum current required to pass through the Zener to act as a voltage regulator is 10 mA and maximum allowed current through Zener is 40 mA . The maximum value of R_S for Zener to act as a voltage regulator is.



(a) 100Ω (b) 400Ω
(c) 0.4Ω (d) 950Ω

14. The expression $\bar{A}(A+B)+(B+AA)(A+\bar{B})$ simplifies to.
(a) $A+B$ (b) AB
(c) $\overline{A+B}$ (d) $\bar{A}+\bar{B}$

15. Given, the percentage error in the measurements of A, B, C and D are respectively,

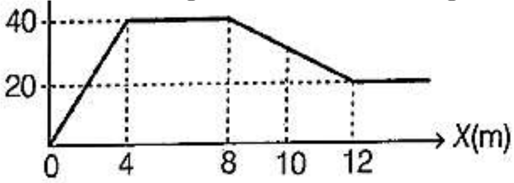
4%2%, 3% and 1%. The relative error in $Z = \frac{A^4 B^{\frac{1}{3}}}{C D^{\frac{3}{2}}}$ is.

(a) $\frac{127}{2}\%$ (b) $\frac{127}{5}\%$
(c) $\frac{127}{6}\%$ (d) $\frac{127}{7}\%$

16. The entropy S of a black hole can be written as $S = \beta k_B A$, where k_B is the Boltzmann constant and A is the area of the black hole. Then, β has dimension of.

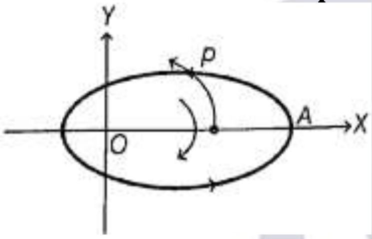
(a) $[L^2]$ (b) $[ML^2 T^{-1}]$
(c) $[L^{-2}]$ (d) Dimensionless

17. The kinetic energy (E_k) of a particle moving along X-axis varies with its position (x) as shown in the figure. The force acting on the particle at $x = 10$ m is.



(a) $5\hat{i}$N (b) zero
(c) $97.5\hat{i}$ N (d) $-5\hat{i}$N

18. A particle is moving in an elliptical orbit as shown in figure. If p, L and r denote the linear momentum, angular momentum and position vector of the particle (from focus O) respectively at a point A, then the direction of $\alpha = \mathbf{p} \times \mathbf{L}$ is along.



(a) + ve X-axis (b) - ve X-axis
(c) + ve Y-axis (d) - ve Y-axis

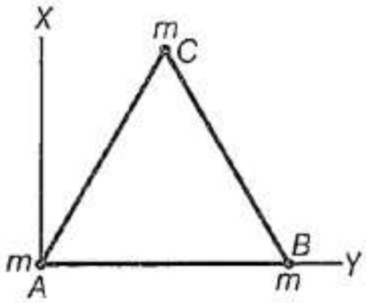
19. A particle is subjected to two simple harmonic motions in the same direction having equal amplitudes and equal frequency. If the resultant amplitude is equal to the amplitude of the individual motion, the phase difference (δ) between the two motions is.

(a) $\delta = \frac{\pi}{3}$ (b) $\delta = \frac{2\pi}{3}$
(c) $\delta = \pi$ (d) $\delta = \frac{\pi}{2}$

20. A body of mass m is thrown with velocity u from the origin of a co-ordinate axes at an angle θ with the horizon. The magnitude of the angular momentum of the particle about the origin at time t when it is at the maximum height of the trajectory is proportional to.

(a) u (b) u^2
(c) u^3 (d) independent of u

21. Three particles, each of mass m grams situated at the vertices of an equilateral $\triangle ABC$ of side a cm (as shown in the figure). The moment of inertia of the system about a line AX perpendicular to AB and in the plane of ABC in $\mathrm{g-cm^2}$ units will be.



(a) $2ma^2$ (b) $\frac{3}{2}ma^2$
(c) $\frac{3}{4}ma^2$ (d) $\frac{5}{4}ma^2$

22. A body of mass m is thrown vertically upward with speed $\sqrt{3}v_e$, where v_e is the escape velocity of a body from earth surface. The final velocity of the body is.

(a) zero (b) $2v_\theta$
(c) $\sqrt{3}v_e$ (d) $\sqrt{2}v_e$

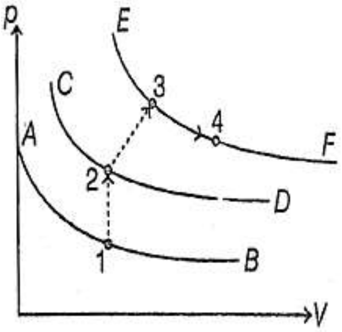
23. If a string, suspended from the ceiling is given a downward force F_1, its length becomes L_1, its length is L_2, if the downward force is F_2. What is its actual length?

(a) $\frac{L_1+L_2}{2}$ (b) $\sqrt{L_1L_2}$
(c) $\frac{F_2L_1+F_1L_2}{F_2+F_1}$ (d) $\frac{F_2L_1-F_1L_2}{F_2-F_1}$

24. 27 drops of mercury coalese to form a bigger drop. What is the relative increase in surface energy?

(a) $\frac{3}{2}$ (b) $\frac{2}{3}$
(c) $-\frac{2}{3}$ (d) 8

25. Certain amount of an ideal gas is taken from its initial state 1 to final state 4 through the paths $1 \rightarrow 2 \rightarrow 3 \rightarrow 4$ as shown in figure. AB, CD, EF are all isotherms. If v_p is the most probable speed of the molecules. Then,

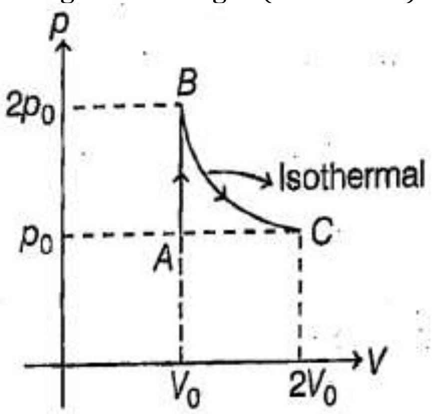


(a) v_p at 3 $= v_p$ at 4 $> v_p$ at 2 $> v_p$ at 1
(b) v_p at 3 $> v_p$ at 1 $> v_p$ at 2 $> v_p$ at 4
(c) v_p at 3 $> v_p$ at 2 $> v_p$ at 4 $> v_p$ at 1
(d) v_p at 2 $= v_p$ at 3 $> v_p$ at 1 $> v_p$ at 4

26. Consider a thermodynamic process, where internal energy $U = Ap^2V$ (A = constant). If the process is performed adiabatically, then.

(a) $Ap^2(V+1) =$ constant
(b) $(Ap+1)^2V =$ constant
(c) $(Ap+1)V^2 =$ constant
(d) $\frac{V}{(Ap+1)^2} =$ constant

27. One mole of a diatomic ideal gas undergoes a process shown in $p-V$ diagram. The total heat given to the gas ($\ln 2 = 0.7$) is.

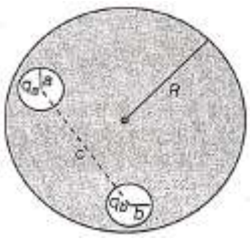


(a) $2.5p_0V_0$ (b) $3.9p_0V_0$
(c) $1.1p_0V_0$ (d) $1.4p_0V_0$

28. **Two charges, each equal to $-q$ are kept at $(-a, 0)$ and $(a, 0)$. A charge q is placed at the origin. If q is given a small displacement along y-direction, the force acting on q is proportional to.**

(a) y (b) $-y$
(c) $\frac{1}{y}$ (d) $-\frac{1}{y}$

29.



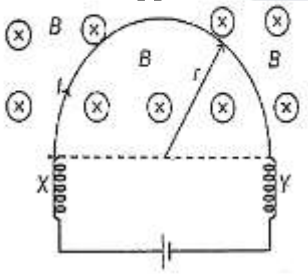
A neutral conducting solid sphere of radius R has two spherical cavities of radius a and b as shown in the figure above. Centre to centre distance between two cavities is c. q_a and q_b charges are placed at the centres of cavities, respectively. The force between q_a and q_b is.

(a) $\frac{1}{4\pi\varepsilon_0} \cdot \frac{q_a q_b}{c^2}$ (b) $\frac{1}{4\pi\varepsilon_0} q_a q_b \left(\frac{1}{a^2} + \frac{1}{b^2}\right)$
(c) zero (d) Insufficient data

30. Consider two concentric conducting sphere of radii R and $2R$, respectively. The inner sphere is given a charge $+Q$. The other sphere is grounded. The potential at $r = \frac{3R}{2}$ is.

(a) $\frac{1}{4\pi\varepsilon_0}\frac{Q}{6R}$ (b) zero
(c) $\frac{1}{4\pi\varepsilon_0}\frac{2Q}{3R}$ (d) $\frac{1}{4\pi\varepsilon_0}\frac{Q}{R}$

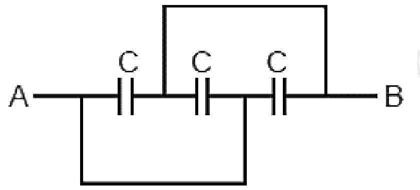
31. A horizontal semi-circular wire of radius r is connected to battery through two similar springs X and Y to an electric cell, which sends current I through it. A vertically downward uniform magnetic field B is applied on the wire, as shown in the figure.



What is the force acting on each spring?

(a) $2\pi rBI$ (b) $\frac{1}{2}\pi rBI$
(c) B/r (d) $2B/r$

32. Find the equivalent capacitance between A and B of the following arrangement.



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

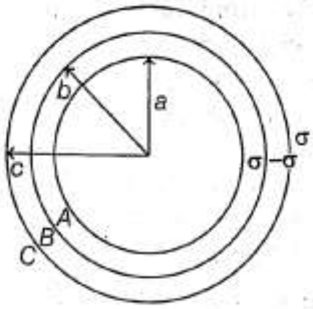
33. **A golf ball of mass 50 gm placed on a tee, is struck by a golf-club. The speed of the golf ball**

as it leaves the tee is $100 \mathrm{~m/s}$, the time of contact on the ball is 0.02 s . If the force decreases to zero linearly with time, then the force at the beginning of the contact is.

(a) 100 N (b) 200 N

(c) 250 N (d) 500 N

34. Three concentric metallic shells A, B and C of radii a, b and $c(a<b<c)$ have surface charge densities $+\sigma,-\sigma$ and $+\sigma$, respectively. The potential of shell B is.



(a) $(a+b+c) \frac{\sigma}{\varepsilon_0}$ (b) $\frac{\sigma C}{\varepsilon_0}$

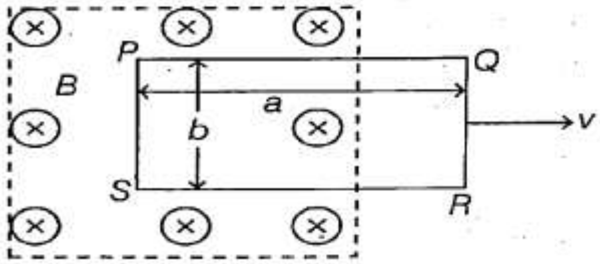
(c) $\left(\frac{a^2}{c}-\frac{b^2}{c}+c\right) \frac{\sigma}{\varepsilon_0}$ (d) $\left(\frac{a^2}{b}-b+c\right) \frac{\sigma}{\varepsilon_0}$

35. One mole of an ideal monoatomic gas expands along the polytrope $pV^3=$ constant from V_1 to V_2 at a constant pressure p_1. The temperature during the process is such that molar specific heat $C_V=\frac{3R}{2}$. The total heat absorbed during the process can be expressed as.

(a) $p_1 V_1\left(\frac{V_1^2}{V_2^2}+1\right)$ (b) $p_1 V_1\left(\frac{V_1^2}{V_2^2}-1\right)$

(c) $p_1 V_1\left(\frac{V_1^3}{V_2^2}-1\right)$ (d) $p_1 V_1\left(\frac{V_1}{V_2^2}-1\right)$

36. As shown in figure, a rectangular loop of length a and width b and made of a conducting material of uniform cross-section is kept in a horizontal plane, where a uniform magnetic field of intensity B is acting vertically downward. Resistance per unit length of the loop is $\lambda \Omega/\mathrm{m}$. If the loop is pulled with uniform velocity v in horizontal direction, which of the following statement is/are true?



(a) Current in the loop $I=\frac{Bbv}{\lambda(2b+2a)}$.

(b) Current will be in clockwise direction, looking from the top.

(c) $V_p-V_S=V_Q-V_R$, where V is the potential.

(d) There cannot be any induction in part SR.

37. A sample of hydrogen atom in its ground state is radiated with photons of 10.2 eV energies. The radiation from the sample is absorbed by excited ionised He^+. Then, which of the following statement/s is/are true?

(a) He^+ electron moves from $n=2$ to $n=4$.

(b) In the He^+ emission spectra, there will be 6 lines.

(c) Smallest wavelength of He^+ spectrum is obtained when transition taken place from $n=4$ to $n=3$.

(d) He^+ electron moves from $n=2$ to $n=3$.

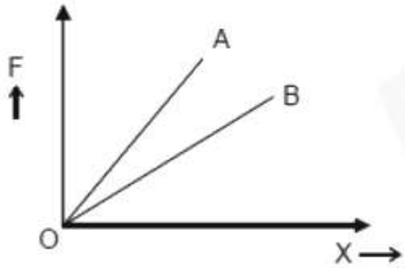
38. A particle is moving in $x-y$ plane according to $\mathbf{r}=b\cos \omega t \hat{\imath}+b\sin \omega t \hat{\jmath}$, where ω is constant. Which of the following statement(s) is/are true?

(a) $\frac{E}{\omega}$ is a constant, where E is the total energy of the particle.

(b) The trajectory of the particle in $x-y$ plane is a circle.

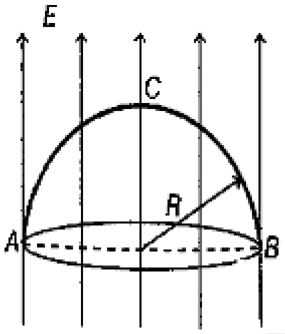
(c) In $a_x - a_y$ plane, trajectory of the particle is an ellipse (a_x, a_y denotes the components of acceleration)
(d) $a = \omega^2 v$

39. Two wires A and B of same length are made of same material. Load (F) versus elongation (x) graph for these two wires is shown in the figure. Then, which of the following statement(s) is/are true?



(a) The cross-sectional area of A is greater than that of B.
(b) Young's modulus of A is greater than Young's modulus of B.
(c) The cross-sectional area of B is greater than that of A.
(d) Young's modulus of both A and B are same.

40. A hemisphere of radius R is placed in a uniform electric field E, so that its axis is parallel to the field. Which of the following statement(s) is/are true?



(a) Flux through the curved surface of hemisphere is $\pi R^2 E$.
(b) Flux through the circular surface of hemisphere is $\pi R^2 E$.
(c) Total flux enclosed is zero.
(d) Work done in moving a point charge q from A to B via the path ACB depends upon R.

Chemistry

41. A sample of $MgCO_3$ is dissolved in dil. HCl and the solution is neutralised with ammonia and buffered with NH_4Cl/NH_4OH. Disodium hydrogen phosphate reagent is added to the resulting solution. A white precipitate is formed. What is the formula of the precipitate?
(a) $Mg_3(PO_4)_2$ (b) $Mg(NH_4)PO_4$
(c) $MgHPO_4$ (d) $Mg_2P_2O_7$

42. $XeF_2, NO_2, HCN, ClO_2, CO_2$
Identify the non-linear molecule-pair from the above mentioned molecules.
(a) XeF_2, ClO_2 (b) CO_2, NO_2
(c) HCN, NO_2 (d) ClO_2, NO_2

43. The number of atoms in body centred and face centred cubic unit cell respectively are.
(a) 2 and 4 (b) 4 and 3
(c) 1 and 2 (d) 4 and 6

44. The number of unpaired electrons in Mn^{2+} ion is.
(a) 2 (b) 3
(c) 5 (d) 6

45. The average speed of H_2 at T_1 K is equal to that of O_2 at T_2 K. The ratio $T_1 : T_2$ is.
(a) $1:6$ (b) $16:1$
(c) $1:4$ (d) $1:1$

46. Sodium nitroprusside is.
(a) $Na_4[Fe(CN)_5NO_2]$
(b) $Na_2[Fe(CN)_5NO]$

(c) $Na_3[Fe(CN)_5NO]$
(d) $Na_4[Fe(CN)_5NO_3]$

47. Choose the correct statement for the $[Ni(CN)_4]^{2-}$ complex ion (Atomic number of Ni = 28).
(a) The complex is square planar and paramagnetic.
(b) The complex is tetrahedral and diamagnetic.
(c) The complex is square planar and diamagnetic.
(d) The complex is tetrahedral and paramagnetic.

48. The boiling point of the water is higher than liquid HF. The reason is that
(a) hydrogen bonds are stronger in water
(b) hydrogen bonds are stronger in HF
(c) hydrogen bonds are larger in number in HF
(d) hydrogen bonds are larger in number in water

49. The metal-pair that can produce nascent hydrogen in alkaline medium is.
(a) Zn, Al (b) Fe, Ni
(c) Al, Mg (d) Mg, Zn

50. The correct bond order of B − F bond in BF_3 molecule is.
(a) 1 (b) $1\frac{1}{2}$
(c) 2 (d) $1\frac{1}{3}$

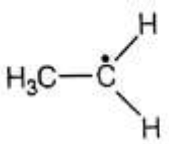
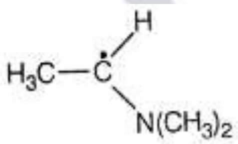
51. Which of the following is radioactive?
(a) Hydrogen (b) Deuterium
(c) Tritium (d) None of the above

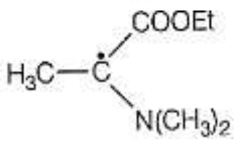
52. The correct order of acidity of the following hydra acids is.
(a) $HF > HCl > HBr > HI$
(b) $HF < HCl < HBr < HI$
(c) $HF < HCl > HBr > HI$
(d) $HF > HCl < HBr > HI$

53. To a solution of colourless sodium salt, a solution of lead nitrate was added to have a white precipitate which dissolves in warm water and reprecipitates on cooling. Which of the following acid radical is present in the salt?
(a) Cl^- (b) SO_4^{2-}
(c) S^{2-} (d) NO_3^-

54. Oxidation states of Cr in $K_2Cr_2O_7$ and CrO_5 are, respectively
(a) +6, +5q (b) +6, +10
(c) +6 + 6 (d) None of the above

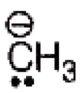
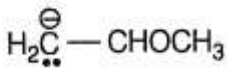
55. The correct order of relative stability for the given free radicals is.

(i)  (ii) 

(iii) 

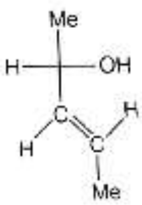
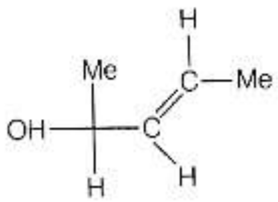
(a) II > I > III (b) II > III > I
(c) III > I > II (d) II > II > I

56. Hybridisation of the negative carbons in (1) and (2) are.

(i)  (ii) 

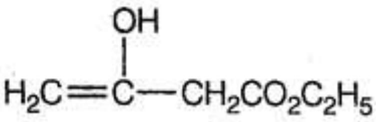
(a) sp^2 and sp^3 (b) sp^3 and sp^2
(c) both sp^2 (d) both sp^3

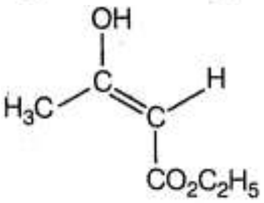
57. The correct relationship between molecules I and II is.

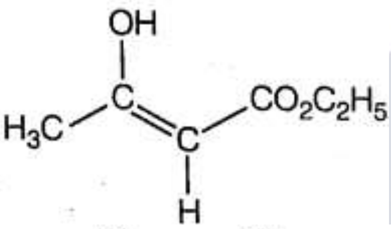
(I)  **(II)** 

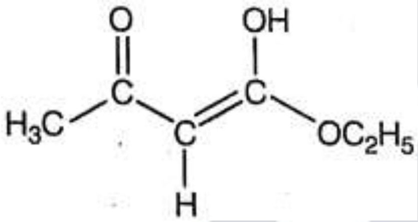
(a) enantiomer (b) homomer
(c) diastereomer (d) constitutional isomer

58. The enol form in which ethyl-3-oxobutanoate exists is.

(a) 

(b) 

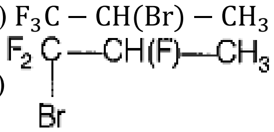
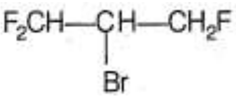
(c) 

(d) 

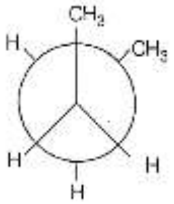
59. How many monobrominated product(s) (including stereoisomers) would form in the free radical bromination of n-butane?
(a) 2 (b) 1
(c) 3 (d) 4

60. What is the correct order of acidity of salicylic acid, 4-hydroxybenzoic acid, and 2, 6-dihydroxybenzoic acid?
(a) 2, 6-dihydroxybenzoic acid > Salicylic acid > 4-hydroxybenzoic acid
(b) 2, 6-dihydroxybenzoic acid > 4-hydroxybenzoic acid > salicylic acid
(c) Salicylic acid > 2, 6-dihydroxybenzoic acid > 4-hydroxybenzoic acid
(d) Salicylic acid > 4-hydroxybenzoic acid > 2, 6-dihydroxybenzoic acid

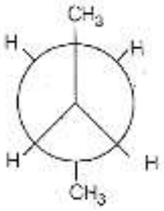
61. How much solid oxalic acid (molecular weight $= 126$) has to be weighed to prepare 100 mL exactly 0.1 N oxalic acid solution in water?
(a) 1.26 g (b) 0.126 g
(c) 0.63 g (d) 0.063 g

62. The major product of the following reaction is.
$\mathbf{F_3C - CH = CH_2 + HBr \longrightarrow}$
(a) $F_3C - CH_2 - CH_2Br$
(b) $F_3C - CH(Br) - CH_3$
(c) 
(d) 

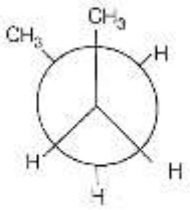
63. The correct order of relative stability of the given conformers of n-butane is.



(I)



(II)



(III)

(a) II $>$ I $=$ III (b) II $>$ III $>$ I
(c) II $>$ I $>$ III (d) I $=$ III $>$ II

64. $C_6H_6(l) + \frac{15}{2} O_2(g) \longrightarrow 6CO_2(g) + 3H_2O(l)$

Benzene burns in oxygen according to the above equation. What is the volume of oxygen (at STP) needed for complete combustion of 39 g of liquid benzene?

(a) 11.2 L (b) 22.4 L
(c) 84 L (d) 168 L

65. Avogadro's law is valid for.

(a) all gases
(b) ideal gas
(c) van der Waals' gas
(d) real gas

66. A metal (M) forms two oxides. The ratio M: O (by weight) in the two oxides are 25: 4 and 25: 6. The minimum value of atomic mass of M is.

(a) 50 (b) 100
(c) 150 (d) 200

67. The de-Broglie wavelength (λ) for electron (e), proton (p) and He^{2+} ion (α) are in the following order. Speed of e, p and α are the same.

(a) $\alpha > p > e$ (b) $e > p > \alpha$
(c) $e > \alpha > p$ (d) $\alpha < p > e$

68. 1 mL of water has 25 drops. Let N_0 be the Avogadro number. What is the number of molecules present in 1 drop of water?
(Density of water = 1 g/mL)

(a) $\frac{0.02}{9} N_0$ (b) $\frac{18}{25} N_0$
(c) $\frac{25}{18} N_0$ (d) $\frac{0.04}{25} N_0$

69. In Bohr model of atom, radius of hydrogen atom in ground state is r_1 and radius of He^+ ion in ground state is r_2. Which of the following is correct?

(a) $\frac{r_1}{r_2} = 4$ (b) $\frac{r_1}{r_2} = \frac{1}{2}$
(c) $\frac{r_2}{r_1} = \frac{1}{4}$ (d) $\frac{r_2}{r_1} = \frac{1}{2}$

70. Which one of the following is the correct set of four quantum numbers (n, l, m, s) ?

(a) $\left(3,0,-1,+\frac{1}{2}\right)$ (b) $\left(4,3,-2,-\frac{1}{2}\right)$
(c) $\left(3,1,-2,-\frac{1}{2}\right)$ (d) $\left(4,2,-3,+\frac{1}{2}\right)$

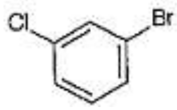
71. Let $(C_{rms})_{H_2}$ is the r.m.s. speed of H_2 at 150 K . At what temperature, the most probable speed of helium [$(C_{mp})_{He}$] will be half of $(C_{rms})_{H_2}$?

(a) 75 K (b) 112.5 K
(c) 225 K (d) 900 K

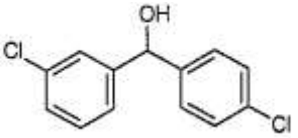
72. The correct pair of electron affinity order is.

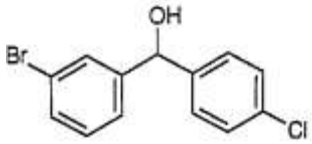
(a) $O > S, F > Cl$
(b) $O < S, Cl > F$
(c) $S > O, F > Cl$
(d) $S < O, Cl > F$

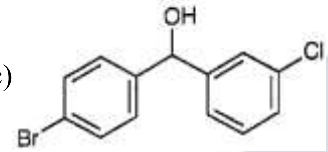
73. The product of the following reaction is.

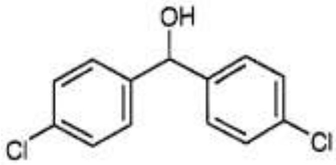


$$\xrightarrow[\substack{\text{4-chlorobenzaldehyde} \\ \text{aq.}NH_4Cl}]{MgEt_2O(\text{dry})}$$

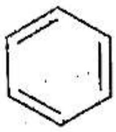
(a) 

(b) 

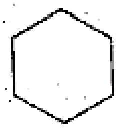
(c) 

(d) 

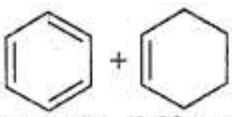
74. The product of the following hydrogenation reaction is.

 $+H_2$ (1eqv.) $\xrightarrow[\textit{High temperature and Pressure}]{\text{Catalyst}}$

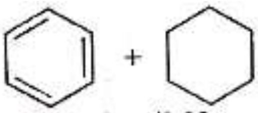
(1 eqv.)

(a) 

(1 eqv.)

(b) 

(0.33 eqv.) (0.66 eqv.)

(c) 

(0.66 eqv.) (0.33 eqv.)

(d) 

(1 eqv.)

75. Pick the correct statement.

(a) Relative lowering of vapour pressure is independent of T.
(b) Osmotic pressure always depends on the nature of solute.
(c) Elevation of boiling point is independent of nature of the solvent:
(d) Lowering of freezing point is proportional to the molar concentration of solute.

76. During the preparation of NH_3 in Haber's process, the promoter(s) used is/are

(a) PtO_2 (b) Mo
(c) Mix of Al_2O_3 and K_2O (d) Fe and Mn

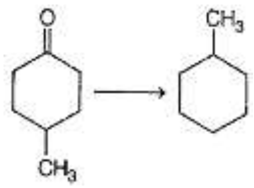
77. The correct statement(s) about B_2H_6 is/are

(a) all B atoms are sp^3 hybridised.
(b) it is paramagnetic
(c) it contains $3C-4e^-$ bonding
(d) there are two types of H present

78. Which of the following would produce enantiomeric products when reacted with methyl magnesium iodide?

(a) Benzaldehyde (b) Propiophenone
(c) Acetone (d) Acetaldehyde

79.



The above conversion can be carried out by,

(a) $Zn-Hg/$ conc. HCl
(b) i. H_2NNH_2 ii. NaOH in ethylene glycol, Δ
(c) i. $HSCH_2CH_2SH/H^{\oplus}$ ii. H_2/Ni
(d) bromine water

80. Which of the statement are incorrect?

(a) pH of a solution of salt of strong acid and weak base is less than 7.
(b) pH of solution of a weak acid and weak base is basic, if $K_b < K_a$.
(c) pH of an aqueous solution of 10^{-8}MHCl is 8 .
(d) Conjugate acid of NH_2^- is NH_3.

Mathematics

81. The values of a, b, c for which the function $f(x)=\begin{cases}\frac{\sin(a+1)x+\sin x}{x}, & x<0\\ c, & x=0\\ \frac{(x+bx^2)^{1/2}-x^{1/2}}{bx^{1/2}}, & x>0\end{cases}$ is continuous at $x=0$, are

(a) $a=\frac{3}{2}, b=-\frac{3}{2}, c=\frac{1}{2}$
(b) $a=-\frac{3}{2}, c=\frac{3}{2}$, b is arbitrary non-zero real number
(c) $a=-\frac{5}{2}, b=-\frac{3}{2}, c=\frac{3}{2}$
(d) $a=-2, b\in R-\{0\}, c=0$

82. Domain of $y=\sqrt{\log_{10}\frac{3x-x^2}{2}}$ is.

(a) $x<1$ (b) $2<x$
(c) $1\le x\le 2$ (d) $2<x<3$

83. Let $f(x)=a_0+a_1|x|+a_2|x|^2+a_3|x|^3$, where a_0, a_1, a_2, a_3 are real constants. Then, $f(x)$ is differentiable at $x=0$.

(a) whatever be a_0, a_1, a_2, a_3
(b) for no values of a_0, a_1, a_2, a_3
(c) only if $a_1=0$
(d) only if $a_1=0, a_3=0$

84. If $y=e^{\tan^{-1}x}$, then

(a) $(1+x^2)y_2+(2x-1)y_1=0$
(b) $(1+x^2)y_2+2xy=0$
(c) $(1-x^2)y_2-y_1=0$
(d) $(1+x^2)y_2+3xy_1+4y=0$

85. $\lim_{x\to 0}\left(\frac{1}{x}\ln\sqrt{\frac{1+x}{1-x}}\right)$ **is.**

(a) ½ (b) 0
(c) 1 (d) does not exist

86. Let $f:[a,b]\to R$ be continuous in $[a,b]$, differentiable in (a,b) and $f(a)=0=f(b)$. Then,
(a) there exists at least one point $c\in(a,b)$ for which $f'(c)=f(c)$
(b) $f'(x)=f(x)$ does not hold at any point of (a,b)
(c) at every point of $(a,b), f'(x)>f(x)$
(d) at every point of $(a,b), f'(x)<f(x)$

87. $I=\int\cos(\ln x)dx$. Then, I is equal to
(a) $\frac{x}{2}\{\cos(\ln x)+\sin(\ln x)\}+c$
(b) $x^2\{\cos(\ln x)-\sin(\ln x)\}+c$
(c) $x^2\sin(\ln x)+c$
(d) $x\cos(\ln x)+c$
(c denotes constant of integration)

88. Let f be derivable in $[0,1]$, then
(a) there exists $c\in(0,1)$ such that
$$\int_0^c f(x)dx=(1-c)f(c)$$
(b) there does not exist any point $d\in(0,1)$ for which
$$\int_0^d f(x)dx=(1-d)f(d)$$
(c) $\int_0^c f(x)dx$ does not exist, for any $c\in(0,1)$
(d) $\int_0^c f(x)dx$ is independent of $c, c\in(0,1)$

89. Let $\int\frac{x^{1/2}}{\sqrt{1-x^3}}dx=\frac{2}{3}g(f(x))+c$, then
(a) $f(x)=\sqrt{x}, g(x)=x^{3/2}$
(b) $f(x)=x^{3/2}, g(x)=\sin^{-1}x$
(c) $f(x)=\sqrt{x}, g(x)=\sin^{-1}x$
(d) $f(x)=\sin^{-1}x, g(x)=x^{3/2}$

90. The value of $\int_0^{\pi/2}\frac{(\cos x)^{\sin x}}{(\cos x)^{\sin x}+(\sin x)^{\cos x}}dx$ is.
(a) $\frac{\pi}{4}$ (b) 0
(c) $\frac{\pi}{2}$ (d) $\frac{1}{2}$

91. Let $\lim_{\varepsilon\to 0^+}\int_\varepsilon^x\frac{bt\cos 4t-a\sin 4t}{t^2}dt=\frac{a\sin 4x}{x}-1, \left(0<x<\frac{\pi}{4}\right)$. Then, a and b are given by
(a) $a=2, b=2$ (b) $a=\frac{1}{4}, b=1$
(c) $a=-1, b=4$ (d) $a=2, b=4$

92. Let $f(x)=\int_{\sin x}^{\cos x}e^{-t^2}dt$. Then, $f'\left(\frac{\pi}{4}\right)$ equals.
(a) $\sqrt{\frac{1}{e}}$ (b) $-\sqrt{\frac{2}{e}}$
(c) $\sqrt{\frac{2}{e}}$ (d) $-\sqrt{\frac{1}{e}}$

93. If $x\frac{dy}{dx}+y=x\frac{f(xy)}{f'(xy)}$, then $|f(xy)|$ is equal to.
(a) $ce^{x^2/2}$ (b) ce^{x^2}
(c) ce^{2x^2} (d) $ce^{x^2/3}$

where, c is the constant of integration.

94.A curve passes through the point $(3,2)$ for which the segment of the tangent line contained between the coordinate axes is bisected at the point of contact. The equation of the curve is.

(a) $y=x^2-7$

(b) $x=\frac{y^2}{2}+2$

(c) $xy=6$

(d) $x^2+y^2-5x+7y+11=0$

95.The solution of $\cos y\frac{dy}{dx}=e^{x+\sin y}+x^2e^{\sin y}$ is $f(x)+e^{-\sin y}=C$ (C is arbitrary real constant), where $f(x)$ is equal to.

(a) $e^x+\frac{1}{2}x^3$ (b) $e^{-x}+\frac{1}{3}x^3$

(c) $e^{-x}+\frac{1}{2}x^3$ (d) $e^x+\frac{1}{3}x^3$

96.The point of contact of the tangent to the parabola $y^2=9x$ which passes through the point $(4,10)$ and makes an angle θ with the positive side of the axis of the parabola where $\tan\theta>2$, is.

(a) $\left(\frac{4}{9},2\right)$ (b) $(4,6)$

(c) $(4,5)$ (d) $\left(\frac{1}{4},\frac{1}{6}\right)$

97.Let $f(x)=(x-2)^{17}(x+5)^{24}$. Then,

(a) f does not have a critical point at $x=2$

(b) f has a minimum at $x=2$

(c) f has neither a maximum nor a minimum at $x=2$

(d) f has a maximum at $x=2$

98. If $\mathbf{a}=\hat{\mathbf{i}}+\hat{\mathbf{j}}-\hat{\mathbf{k}}, \mathbf{b}=\hat{\mathbf{i}}-\hat{\mathbf{j}}+\hat{\mathbf{k}}$ and $\vec{\mathbf{c}}$ is unit vector perpendicular to a and coplanar with a and b, then unit vector d perpendicular to both a and c is.

(a) $\pm\frac{1}{\sqrt{6}}(2\hat{\mathbf{i}}-\hat{\mathbf{j}}+\hat{\mathbf{k}})$ (b) $\pm\frac{1}{\sqrt{2}}(\hat{\mathbf{j}}+\hat{\mathbf{k}})$

(c) $\pm\frac{1}{\sqrt{6}}(\hat{\mathbf{i}}-2\hat{\mathbf{j}}+\hat{\mathbf{k}})$ (d) $\pm\frac{1}{\sqrt{2}}(\hat{\mathbf{j}}-\hat{\mathbf{k}})$

99.If the equation of one tangent to the circle with center at $(2,-1)$ from the origin is $3x+y=0$, then the equation of the other tangent through the origin is.

(a) $3x-y=0$ (b) $x+3y=0$

(c) $x-3y=0$. (d) $x+2y=0$

100. Area of the figure bounded by the parabola $y^2+8x=16$ and $y^2-24x=48$ is.

(a) $\frac{11}{9}$ sq units (b) $\frac{32}{3}\sqrt{6}$ sq units

(c) $\frac{16}{3}$ sq units (d) $\frac{24}{5}$ sq units

101. A particle moving in a straight line starts from rest and the acceleration at any time t is $a-kt^2$, where a and k are positive constants. The maximum velocity attained by the particle is.

(a) $\frac{2}{3}\sqrt{\frac{a^3}{k}}$ (b) $\frac{1}{3}\sqrt{\frac{a^3}{k}}$

(c) $\sqrt{\frac{a^3}{k}}$ (d) $2\sqrt{\frac{a^3}{k}}$

102. If a,b,c are in GP and $\log a-\log 2b, \log 2b-\log 3c, \log 3c-\log a$ are in AP, then a,b,c are the lengths of the sides of a triangle which is.

(a) acute angled (b) obtuse angled

(c) right angled (d) equilateral

103. Let $a_n=\left(1^2+2^2+\cdots.n^2\right)^n$ and $b_n=n^n(n!)$. Then,

(a) $a_n<b_n,\forall n$

(b) $a_n>b_n,\forall n$

(c) $a_n=b_n$ for infinitely many n

(d) $a_n<b_n$ if n is even and $a_n>b_n$ if n is odd

104. The number of zeroes at the end of 100 ! is.

(a) 21 (b) 22
(c) 23 (d) 24

105. **If $|z-25i| \leq 15$, then Maximum $\arg(z)$ − Minimum $\arg(z)$ is equal to.**

(a) $2\cos^{-1}\left(\frac{3}{5}\right)$

(b) $2\cos^{-1}\left(\frac{4}{5}\right)$

(c) $\frac{\pi}{2}+\cos^{-1}\left(\frac{3}{5}\right)$

(d) $\sin^{-1}\left(\frac{3}{5}\right)-\cos^{-1}\left(\frac{3}{5}\right)$

(arg z is the principal value of argument of z).

106. **If $z=x-iy$ and $z^{1/3}=p+iq(x,y,p,q \in R)$, then $\frac{\left(\frac{x}{p}+\frac{y}{q}\right)}{(p^2+q^2)}$ is equal to.**

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

107. **If a, b are odd integers, then the roots of the equation $2ax^2+(2a+b)x+b=0, a \neq 0$ are.**

(a) rational (b) irrational
(c) non-real (d) equal

108. **There are n white and n black balls marked 1 , 2, 3, ... n. The number of ways in which we can arrange these balls in a row so that neighbouring balls are of different colours is.**

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

109. **Let $f(n)=2^{n+1}, g(n)=1+(n+1)2^n$ for all $n \in N$. Then,**

(a) $f(n)>g(n)$
(b) $f(n)<g(n)$
(c) $f(n)$ and $g(n)$ are not comparable
(d) $f(n)>g(n)$ if n is even and $f(n)<g(n)$ if n is odd

110. **A is a set containing n elements. P and Q are two subsets of A. Then, the number of ways of choosing P and Q so that $P \cap Q=\phi$ is.**

(a) $2^{2n-2n}C_n$ (b) 2^n
(c) 3^n-1 (d) 3^n

111. **Under which of the following condition(s) does(do) the system of equations**

$\begin{bmatrix} 1 & 2 & 4 \\ 2 & 1 & 2 \\ 1 & 2 & (a-4) \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix}=\begin{bmatrix} 6 \\ 4 \\ a \end{bmatrix}$ **possesses (posses) unique solution?**

(a) $\forall a \in R$
(b) $a=8$
(c) for all integral values of a
(d) $a \neq 8$

112. **If $\Delta(x)=\begin{vmatrix} x-2 & (x-1)^2 & x^3 \\ x-1 & x^2 & (x+1)^3 \\ x & (x+1)^2 & (x+2)^3 \end{vmatrix}$, then coefficient of x in $\Delta(x)$ is.**

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

113. **If $p=\begin{bmatrix} 1 & \alpha & 3 \\ 1 & 3 & 3 \\ 2 & 4 & 4 \end{bmatrix}$ is the adjoint of the 3×3 matrix A and $\det A=4$, then α is equal to.**

(a) 4 (b) 11
(c) 5 (d) 0

114. **If $A=\begin{bmatrix} 1 & 1 \\ 0 & i \end{bmatrix}$ and $A^{2018}=\begin{bmatrix} a & b \\ c & d \end{bmatrix}$, then $(a+d)$ equals**

(a) $1+i$ (b) 0
(c) 2 (d) 2018

115. Let S, T, U be three non-void sets and $f: S \to T, g: T \to U$ and composed mapping $g \cdot f: S \to U$ be defined. Let $g \cdot f$ be injective mapping. Then,

(a) f, g both are injective
(b) neither f nor g is injective
(c) f is obviously injective
(d) g is obviously injective

116. For the mapping $f: R - \{1\} \to R - \{2\}$, given by $f(x) = \frac{2x}{x-1}$, which of the following is correct?

(a) f is one-one but not onto
(b) f is onto but not one-one
(c) f is neither one-one nor onto
(d) f is both one-one and onto

117. A, B, C are mutually exclusive events such that $P(A) = \frac{3x+1}{3}, P(B) = \frac{1-x}{4}$ and $P(C) = \frac{1-2x}{2}$. Then, the set of possible values of x are in.

(a) $[0,1]$ (b) $\left[\frac{1}{3}, \frac{1}{2}\right]$
(c) $\left[\frac{1}{3}, \frac{2}{3}\right]$ (d) $\left[\frac{1}{3}, \frac{13}{3}\right]$

118. A determinant is chosen at random from the set of all determinants of order 2 with elements 0 or 1 only. The probability that the determinant chosen is non-zero is.

(a) $\frac{3}{16}$ (b) $\frac{3}{8}$
(c) $\frac{1}{4}$ (d) $\frac{5}{8}$

119. If $(\cot\alpha_1)(\cot\alpha_2)\dots(\cot\alpha_n) = 1, 0 < \alpha_1, \alpha_2, \dots . \alpha_n < \pi/2$, then the maximum value of $(\cos\alpha_1)(\cos\alpha_2)\dots(\cos\alpha_n)$ is given by

(a) $\frac{1}{2^{n/2}}$ (b) $\frac{1}{2^n}$
(c) $\frac{1}{2n}$ (d) 1

120. If the algebraic sum of the distances from the points $(2,0)$, $(0,2)$ and $(1,1)$ to a variable straight line be zero, then the line passes through fixed point.

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

121. The side AB of $\triangle ABC$ is fixed and is of length $2a$ units. The vertex moves in the plane such that the vertical angle is always constant and is α. Let X-axis be along AB and the origin be at A. Then, the locus of the vertex is.

(a) $x^2 + y^2 + 2ax\sin\alpha + a^2\cos\alpha = 0$
(b) $x^2 + y^2 - 2ax - 2ay\cot\alpha = 0$
(c) $x^2 + y^2 - 2ax\cos\alpha - a^2 = 0$
(d) $x^2 + y^2 - ax\sin\alpha - ay\cos\alpha = 0$

122. If the sum of the distances of a point from two perpendicular lines in a plane is 1 unit, then its locus is

(a) a square (b) a circle
(c) a straight line (d) two intersecting lines

123. A line passes through the point $(-1,1)$ and makes an angle $\sin^{-1}\left(\frac{3}{5}\right)$ in the positive direction of X-axis. If this line meets the curve $x^2 = 4y - 9$ at A and B, then $|AB|$ is equal to.

(a) $\frac{4}{5}$ unit (b) $\frac{5}{4}$ units
(c) $\frac{3}{5}$ unit (d) $\frac{5}{3}$ units

124. Two circles
$S_1 = px^2 + py^2 + 2g'x + 2f'y + d = 0$ and
$S_2 = x^2 + y^2 + 2gx + 2fy + d' = 0$ have a common chord PQ. The equation of PQ is.

(a) $S_1 - S_2 = 0$ (b) $S_1 + S_2 = 0$
(c) $S_1 - pS_2 = 0$ (d) $S_1 + pS_2 = 0$

125. **Let $P(3\sec\theta, 2\tan\theta)$ and $Q(3\sec\phi, 2\tan\phi)$ be two points on $\frac{x^2}{9}-\frac{y^2}{4}=1$ such that $\theta+\phi=\frac{\pi}{2}, 0<\theta,\phi<\frac{\pi}{2}$. Then, the ordinate of the point of intersection of the normal at P and Q is.**

(a) $\frac{13}{2}$ (b) $-\frac{13}{2}$

(c) $\frac{5}{2}$ (d) $-\frac{5}{2}$

126. **Let P be a point on $(2,0)$ and Q be a variable point on $(y-6)^2=2(x-4)$. Then, the locus of mid-point of PQ is.**

(a) $y^2+x+6y+12=0$

(b) $y^2-x+6y+12=0$

(c) $y^2+x-6y+12=0$

(d) $y^2-x-6y+12=0$

127. **AB is a chord of a parabola $y^2=4ax, (a>0)$ with vertex $A. BC$ is drawn perpendicular to AB meeting the axis at C. The projection of BC on the axis of the parabola is.**

(a) a unit (b) $2a$ units

(c) $8a$ units (d) $4a$ units

128. **AB is a variable chord of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$. If AB subtends a right angle at the origin O, then $\frac{1}{OA^2}+\frac{1}{OB^2}$ equals.**

(a) $\frac{1}{a^2}+\frac{1}{b^2}$ (b) $\frac{1}{a^2}-\frac{1}{b^2}$

(c) a^2+b^2 (d) a^2-b^2

129. **The equation of the plane through the intersection of the planes $x+y+z=1$ and $2x+3y-z+4=0$ and parallel to the X-axis is.**

(a) $y+3z+6=0$

(b) $y+3z-6=0$

(c) $y-3z+6=0$

(d) $y-3z-6=0$

130. **The line $x-2y+4z+4=0, x+y+z-8=0$ intersect the plane $x-y+2z+1=0$ at the Point.**

(a) $(-2,5,1)$ (b) $(2,-5,1)$

(c) $(2,5,-1)$ (d) $(2,5,1)$

131. **If I is the greatest of**

$$I_1=\int_0^1 e^{-x}\cos^2 x\,dx, I_2=\int_0^1 e^{-x^2}\cos^2 x\,dx,$$

$$I_3=\int_0^1 e^{-x^2}dx, I_4=\int_0^1 e^{-x^2/2}dx, \text{ then}$$

(a) $I=I_1$ (b) $I=I_2$

(c) $I=I_3$ (d) $I=I_4$

132. **$\lim_{x\to\infty}\left(\frac{x^2+1}{x+1}-ax-b\right), (a,b\in R)=0$. Then,**

(a) $a=0, b=1$ (b) $a=1, b=-1$

(c) $a=-1, b=1$ (d) $a=0, b=0$

133. **If the transformation $z=\log\tan\frac{x}{2}$ reduces the differential equation $\frac{d^2y}{dx^2}+\cot x\frac{dy}{dx}+4y\text{cosec}^2 x=0$ into the form $\frac{d^2y}{dz^2}+ky=0$, then k is equal to.**

(a) -4 (b) 4

(c) 2 (d) -2

134. **From the point $(-1,-6)$, two tangents are drawn to $y^2=4x$. Then, the angle between the two tangents is.**

(a) $\pi/3$ (b) $\pi/4$

(c) $\pi/6$ (d) $\pi/2$

135. **If α is a unit vector, $\beta=\hat{\imath}+\hat{\jmath}-\hat{k}, \gamma=\hat{\imath}+\hat{k}$, then the maximum value of $[\alpha\beta\gamma]$ is.**

(a) 3 (b) $\sqrt{3}$

(c) 2 (d) $\sqrt{6}$

136. The maximum value of $f(x)=e^{\sin x}+e^{\cos x}; x\in R$ is.

(a) $2e$ (b) $2\sqrt{e}$

(c) $2e^{1/\sqrt{2}}$ (d) $2e^{-1/\sqrt{2}}$

137. A straight line meets the coordinate axes at A and B. A circle is circumscribed about the $\triangle OAB, O$ being the origin. If m and n are the distances of the tangent to the circle at the origin from the points A and B respectively, the diameter of the circle is.

(a) $m(m+n)$ (b) $m+n$

(c) $n(m+n)$ (d) $\frac{1}{2}(m+n)$

138. Let the tangent and normal at any point $P(at^2, 2at), (a>0)$, on the parabola $y^2=4ax$ meet the axis of the parabola at T and G respectively. Then, the radius of the circle through P, T and G is.

(a) $a(1+t^2)$ (b) $(1+t^2)$

(c) $a(1-t^2)$ (d) $(1-t^2)$

139. The value of a for which the sum of the squares of the roots of the equation $x^2 -= (a-2)x-a-1=0$ assumes the least value is.

(a) 0 (b) 1

(c) 2 (d) 3

140. If x satisfies the inequality $\log_{25} x^2+(\log_5 x)^2<2$, then x belongs to.

(a) $\left(\frac{1}{5},5\right)$ (b) $\left(\frac{1}{25},5\right)$

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

141. The solution of $\det(A-\lambda I_2)=0$ be 4 and 8 and $A=\begin{bmatrix}2 & 3\\ x & y\end{bmatrix}$. Then,

(a) $x=4, y=10$

(b) $x=5, y=8$

(c) $x=3, y=9$

(d) $x=-4, y=10$

(I_2 is identity matrix of order 2)

142. If P_1P_2 and P_3P_4 are two focal chords of the parabola $y^2=4ax$ then the chords P_1P_3 and P_2P_4 intersect on the.

(a) directrix of the parabola

(b) axis of the parabola

(c) latusrectum of the parabola

(d) Y-axis

143. $f: X\to R, X=\{x \mid 0<x<1\}$ is defined as $f(x)=\frac{2x-1}{1-|2x-1|}$. Then,

(a) f is only injective

(b) f is only surjective

(c) f is bijective

(d) f is neither injective nor surjective

144. Let f be a non-negative function defined in $[0,\pi/2]$, f' exists and be continuous for all x and $\int_0^x \sqrt{1-(f'(t))^2}dt=\int_0^x f(t)dt$ and $f(0)=0$.Then,

(a) $f\left(\frac{1}{2}\right)<\frac{1}{2}$ and $f\left(\frac{1}{3}\right)>\frac{1}{3}$

(b) $f\left(\frac{1}{2}\right)>\frac{1}{2}$ and $f\left(\frac{1}{3}\right)<\frac{1}{3}$

(c) $f\left(\frac{4}{3}\right)<\frac{4}{3}$ and $f\left(\frac{2}{3}\right)<\frac{2}{3}$

(d) $f\left(\frac{4}{3}\right)>\frac{4}{3}$ and $f\left(\frac{2}{3}\right)>\frac{2}{3}$

145. PQ is a double ordinate of the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ such that $\triangle OPQ$ is an equilateral triangle, O being the centre of the hyperbola. Then, the eccentricity e of the hyperbola satisfies.

(a) $1<e<\frac{2}{\sqrt{3}}$ (b) $e=\frac{2}{\sqrt{3}}$

(c) $e=2\sqrt{3}$ (d) $e>\frac{2}{\sqrt{3}}$

146. From a balloon rising vertically with uniform velocity $v\mathrm{ft/sec}$ a piece of stone is let go. The height of the balloon above the ground when the stone reaches the ground after 4 sec is [$g = 32\mathrm{ft/sec}^2$]
(a) 220 ft (b) 240 ft
(c) 256 ft (d) 260 ft

147. Let $f(x) = x^2 + x\sin x - \cos x$. Then,
(a) $f(x) = 0$ has at least one real root
(b) $f(x) = 0$ has no real root
(c) $f(x) = 0$ has at least one positive root
(d) $f(x) = 0$ has at least one negative root

148. Let z_1 and z_2 be two non-zero complex numbers. Then,
(a) Principal value of $\arg(z_1 z_2)$ may not be equal to Principal value of $\arg z_1$ + Principal value of $\arg z_2$
(b) Principal value of $\arg(z_1 z_2)$ = Principal value of $\arg z_1$ + Principal value of $\arg z_2$
(c) Principal value of $\arg(z_1/z_2)$ = Principal value of $\arg z_1$ − Principal value of $\arg z_2$
(d) Principal value of $\arg(z_1/z_2)$ may not be $\arg z_1 - \arg z_2$

149. Let $\Delta = \begin{vmatrix} \sin\theta\cos\phi & \sin\theta\sin\phi & \cos\theta \\ \cos\theta\cos\phi & \cos\theta\sin\phi & -\sin\theta \\ -\sin\theta\sin\phi & \sin\theta\cos\phi & 0 \end{vmatrix}$. Then,
(a) Δ is independent of θ
(b) Δ is independent of ϕ
(c) Δ is a constant
(d) $\left(\frac{d\Delta}{d\theta}\right)_{\theta=\frac{\pi}{2}} = 0$

150. Let R and S be two equivalence relations on a non-void set A. Then,
(a) $R \cup S$ is equivalence relation
(b) $R \cap S$ is equivalence relation
(c) $R \cap S$ is not equivalence relation
(d) $R \cup S$ is not equivalence relation

151. Chords of an ellipse are drawn through the positive end of the minor axis. Their mid-point lies on.
(a) a circle (b) a parabola
(c) an ellipse (d) a hyperbola

152. Consider the equation $y - y_1 = m(x - x_1)$. If m and x_1 are fixed and different lines are drawn for different values of y_1, then.
(a) the lines will pass through a fixed point
(b) there will be a set of parallel lines
(c) all lines intersect the line $x = x_1$
(d) all lines will be parallel to the line $y = x_1$

153. Let $p(x)$ be a polynomial with real coefficients, $p(0) = 1$ and $p'(x) > 0$ for all $x \in R$. Then,
(a) $p(x)$ has at least two real roots
(b) $p(x)$ has only one positive real root
(c) $p(x)$ may have negative real root
(d) $p(x)$ has infinitely many real roots

154. Twenty metres of wire is available to fence off a flower bed in the form of a circular sector. What must the radius of the circle be, if the area of the flower bed be greatest?
(a) 10 m (b) 4 m
(c) 5 m (d) 6 m

155. The line $y = x + 5$ touches
(a) the parabola $y^2 = 20x$
(b) the ellipse $9x^2 + 16y^2 = 144$.
(c) the hyperbola $\frac{x^2}{29} - \frac{y^2}{4} = 1$
(d) the circle $x^2 + y^2 = 25$