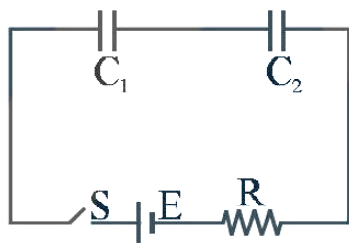


PHYSICS

- Two moles of helium are mixed with a mole of hydrogen. If $\frac{C_p}{C_v} = \frac{3}{2}$ for the mixture, then the value of n is: -
 (a) 1 (b) 2
 (c) 3 (d) $3/2$
- Both the nucleus and the atom of some element are in their respective first excited states. They get de-excited by emitting photons of wavelengths λ_N, λ_A respectively. The ratio $\frac{\lambda_N}{\lambda_A}$ is closest to:
 (a) 10 (b) 10^{-6}
 (c) 10^{-1} (d) 10^{-10}
- In the following circuit, the switch S is closed at $t = 0$. The charge on the capacitor C_1 as a function of time will be given by:

$$\left(C_{eq} = \frac{C_1 C_2}{C_1 + C_2} \right)$$

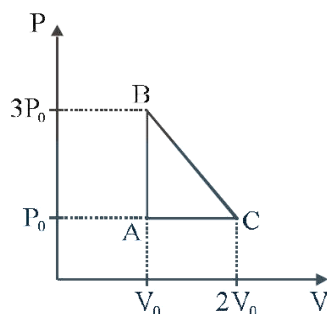


- $E_{eq} E [1 - \exp(-t/RC_{eq})]$
 - $C_1 E [1 - \exp(-tR/C_1)]$
 - $C_{eq} E \exp(-t/RC_{eq})$
 - $C_2 E [1 - \exp(-t/RC_2)]$
- A carrier wave of peak voltage 14 V is used for transmitting a message signal. The peak voltage of modulating signal given to achieve a modulation index of 80% will be :
 (a) 22.4 V (b) 11.2 V
 (c) 7 V (d) 28 V
 - A charge q is spread uniformly over an insulated loop of radius r . If it is rotated with an angular velocity ω with respect to normal axis then the magnetic moment of the loop is :-
 (a) $\frac{1}{2} q \omega r^2$ (b) $q \omega r^2$
 (c) $\frac{3}{2} q \omega r^2$ (d) $\frac{4}{3} q \omega r^2$
 - Suppose that the angular velocity of rotation of earth is increased. Then, as a consequence:
 (a) There will be no change in weight anywhere on the earth
 (b) Weight of the object, everywhere on the earth, will increase
 (c) Except at poles, weight of the object on the earth will decrease
 (d) Weight of the object, everywhere on the earth, will decrease
 - The percentage errors in quantities P, Q, R and S are 0.5%, 1% and 1.5% respectively in the measurement of a physical quantity $A = \frac{P^3 Q^2}{\sqrt{RS}}$.

The maximum percentage error in the value of A will be:

- 6.5%
- 8.5%
- 6.0%
- 7.5%

8. One mole of an ideal monoatomic gas is taken along the path ABCA as shown in the PV diagram. The maximum temperature attained by the gas along the path BC is given by:



- (a) $\frac{5 P_0 V_0}{8 \frac{R}{25 P_0 V_0}}$ (b) $\frac{25 P_0 V_0}{8 \frac{R}{25 P_0 V_0}}$
 (c) $\frac{25 P_0 V_0}{4 R}$ (d) $\frac{25 P_0 V_0}{16 R}$
9. At some instant, a radioactive sample S_1 having an activity $5\mu\text{Ci}$ has twice the number of nuclei as another sample S_2 which has an activity of $10\mu\text{Ci}$. The half lives of S_1 and S_2 are:
- (a) 20 years and 10 years, respectively
 (b) 10 years and 20 years, respectively
 (c) 20 years and 5 years, respectively
 (d) 5 years and 20 years, respectively
10. A heating element has a resistance of 100 W at room temperature. When it is connected to a supply of 220 V, a steady current of 2 A passes in it and temperature is 500°C more than room temperature. What is the temperature coefficient of resistance of the heating element :-
- (a) $1 \times 10^{-4}^\circ\text{C}^{-1}$ (b) $2 \times 10^{-4}^\circ\text{C}^{-1}$
 (c) $0.5 \times 10^{-4}^\circ\text{C}^{-1}$ (d) $5 \times 10^{-4}^\circ\text{C}^{-1}$
11. An oscillator mass M is at rest in its equilibrium position in a potential $V = \frac{1}{2}k(x - X)^2$. A particle of mass m comes from right with speed u and collides completely inelastically with M and sticks to it. This process repeats every time the oscillator crosses its equilibrium position. The amplitude of oscillations after 13 collisions is:
- ($M = 10, m = 5, u = 1, k = 1$)
- (a) $\frac{1}{\sqrt{3}}$ (b) $\frac{2}{3}$
 (c) $\sqrt{\frac{3}{5}}$ (d) $\frac{1}{2}$
12. The de-Broglie wavelength (λ_B) associated with the electron orbiting in the second excited state of hydrogen atom is related to that in the ground state (λ_G) by :
- (a) $\lambda_B = \lambda_G/3$ (b) $\lambda_B = 3\lambda_G$
 (c) $\lambda_B = \lambda_G/2$ (d) $\lambda_B = 2\lambda_G$
13. In a circuit for finding the resistance of a galvanometer by half deflection method, a 6 V battery and a high resistance of 11k Ω are used. The figure of merit of the galvanometer is 60 $\mu\text{A}/\text{division}$. In the absence of shunt resistance, the galvanometer produces a deflection of $\theta = 9$ divisions when current flows in the circuit. The value of the shunt resistance that can cause the deflection of $\theta/2$, is closest to:
- (a) 55 Ω (b) 110 Ω
 (c) 220 Ω (d) 550 Ω

14. Two particles of the same mass m are moving in circular orbits because of force, given by

$$F(r) = \frac{-16}{r} - r^3$$

The first particle is at a distance $r = 1$, and the second, at $r = 4$. The best estimate for the ratio of kinetic energies of the first and the second particle is closest to:

- (a) 6×10^{-2} (b) 10^{-1}
(c) 3×10^{-3} (d) 6×10^2

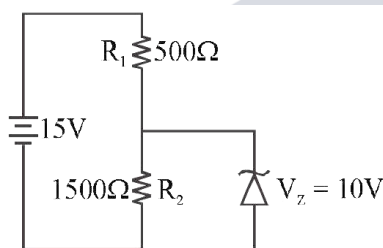
15. Two sitar strings, A and B , playing the note 'Dha' are slightly out of tune and produce beats of frequency 5 Hz. The tension of the string B is slightly increased and the beat frequency is found to decrease by 3 Hz. If the frequency of A is 425 Hz, the original frequency of B is:

- (a) 428 Hz (b) 430 Hz
(c) 420 Hz (d) 422 Hz

16. A body of mass m starts moving from rest along x -axis so that its velocity varies as $v = a\sqrt{s}$ where a is a constant and s is the distance covered by the body. The total work done by all the forces acting on the body in the first t seconds after the start of the motion is:

- (a) $\frac{1}{4}ma^4t^2$ (b) $4man^4t^2$
(c) $\frac{1}{8}ma^4t^2$ (d) $8mat^4t^2$

17. In the given circuit, the current through zener diode is :-



- (a) 6.7 mA (b) 3.3 mA
(c) 2.5 mA (d) 5.5 mA

18. The relative uncertainty in the period of a satellite orbiting around the earth is 10^{-2} . If the relative uncertainty in the radius of the orbit is negligible, the relative uncertainty in the mass of the earth is:

- (a) 6×10^{-2} (b) 10^{-2}
(c) 2×10^{-2} (d) 3×10^{-2}

19. A power transmission lines feeds input power at 2300 V to a step-down transformer with its primary windings having 4000 turns, giving the output power at 230 V. If the current in the primary of the transformer is 5 A, and its efficiency is 90%, the output current would be:

- (a) 50 A (b) 25 A
(c) 45 A (d) 20 A

20. A particle executes simple harmonic motion and is located at $x = a, b$ and c at times $t_0, 2t_0$ and $3t_0$ respectively. The frequency of the oscillation is:

- (a) $\frac{1}{2\pi t_0} \cos^{-1} \left(\frac{a+b}{2c} \right)$ (b) $\frac{1}{2\pi t_0} \cos^{-1} \left(\frac{2a+3c}{2} \right)$
(c) $\frac{1}{2\pi t_0} \cos^{-1} \left(\frac{a+2b}{3c} \right)$ (d) $\frac{1}{2\pi t_0} \cos^{-1} \left(\frac{a+c}{2b} \right)$

21. A small soap bubble of radius 4 cm is trapped inside another bubble of radius 6 cm without any contact. Let P_2 be the pressure inside the inner bubble and P_0 , the pressure outside the outer bubble. Radius of another bubble with pressure difference $P_2 - P_0$ between its inside the outside would be:

- (a) 12 cm (b) 4.8 cm
(c) 2.4 cm (d) 6 cm

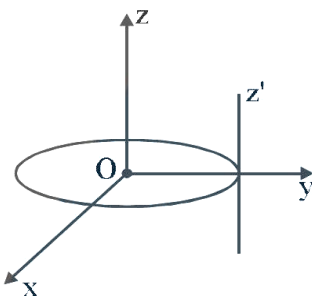
22. A ray of light is incident at an angle of 60° on one face of a prism of angle 30° . The emergent ray of light makes an angle of 30° with incident ray. The angle made by the emergent ray with second face of prism will be:

- (a) 0° (b) 45°
(c) 90° (d) 30°

23. A coil of cross-sectional area A having n turns is placed in a uniform magnetic field B . When it is rotated with an angular velocity ω , the maximum e.m.f. induced in the coil will be:

- (a) $\frac{3}{2}nBA$ (b) $nBA\omega$
(c) $3nBA\omega$ (d) $\frac{1}{2}nBA\omega$

24. A thin circular disk is in the xy plane as shown in the figure. The ratio of its moment of inertia about z and z' axes will be:-



- (a) 1:4 (b) 1:3
(c) 1:2 (d) 1:5

25. Unpolarized light of intensity I is incident on a system of two polarizers, A followed by B. The intensity of emergent light is $I/2$. If a third polarizer C is placed between A and B, the intensity of emergent light is reduced to $I/3$. The angle between the polarizers A and C is θ . Then-

- (a) $\cos \theta = \left(\frac{1}{3}\right)^{1/2}$ (b) $\cos \theta = \left(\frac{2}{3}\right)^{1/4}$
(c) $\cos \theta = \left(\frac{2}{3}\right)^{1/2}$ (d) $\cos \theta = \left(\frac{1}{3}\right)^{1/4}$

26. Let $\vec{A} = (\hat{i} + \hat{j})$ and, $\vec{B}(2\hat{i} - \hat{j})$. The magnitude of a coplanar vector $\vec{C}$ such that $\vec{A} \cdot \vec{C} = \vec{B} \cdot \vec{C} = \vec{A} \cdot \vec{B}$, is given by :

- (a) $\sqrt{\frac{20}{9}}$ (b) $\sqrt{\frac{5}{9}}$
(c) $\sqrt{\frac{9}{12}}$ (d) $\sqrt{\frac{10}{9}}$

27. Two identical conducting spheres A and B, carry equal charge. They are separated by a distance much larger than their diameters, and the force between them is F . A third identical conducting sphere, C, is uncharged. Sphere C is first touched to A, then to B, and then removed. As a result, the force between A and B would be equal to:

- (a) $\frac{3F}{8}$ (b) $\frac{F}{2}$
(c) $\frac{3F}{4}$ (d) F

28. A plane electromagnetic wave of wavelength 1 has an intensity I . It is propagating along the positive Y -direction. The allowed expressions for the electric and magnetic fields are given by :

(a) $\vec{E} = \sqrt{\frac{1}{\epsilon_0 c}} \cos \left[\frac{2\pi}{\lambda} (y - ct) \right] \hat{k}; \vec{B} = \frac{1}{c} E \hat{k}$

(b) $\vec{E} = \sqrt{\frac{21}{\epsilon_0 c}} \cos \left[\frac{2\pi}{\lambda} (y + ct) \right] \hat{k}; \vec{B} = \frac{1}{c} E \hat{i}$

(c) $\vec{E} = \sqrt{\frac{21}{\epsilon_0 c}} \cos \left[\frac{2\pi}{\lambda} (y - ct) \right] \hat{k}; \vec{B} = +\frac{1}{c} E \hat{i}$

(d) $\vec{E} = \sqrt{\frac{1}{\epsilon_0 c}} \cos \left[\frac{2\pi}{\lambda} (y - ct) \right] \hat{k}; \vec{B} = \frac{1}{c} E \hat{i}$

29. The end correction of a resonance column is 1 cm. If the shortest length resonating with the tuning fork is 10 cm, the next resonating length should be:

(a) 36 cm (b) 40 cm

(c) 28 cm (d) 32 cm

30. A galvanometer with its coil resistance 25Ω requires a current of 1 mA for its full deflection. In order to construct an ammeter to read up to a current of 2 A, the approximate value of the shunt resistance should be:

(a) $1.25 \times 10^{-3}\Omega$ (b) $1.25 \times 10^{-2}\Omega$

(c) $2.5 \times 10^{-3}\Omega$ (d) $2.5 \times 10^{-2}\Omega$

CHEMISTRY

31. In the extraction of copper from its sulphide ore, metal is finally obtained by the oxidation of cuprous sulphide with:-

(a) CO (b) Cu_2O

(c) Fe_2O_3 (d) SO_2

32. Among the following, the incorrect statement is:-

(a) Cellulose and amylose has 1, 4-glycosidic linkage.

(b) Lactose contains β -D-galactose and β -D-glucose.

(c) Maltose and lactose has 1, 4-glycosidic linkage.

(d) Sucrose and amylose has 1,2-glycosidic linkage.

33. For which of the following processes, ΔS is negative?

(a) $\text{C (diamond)} \rightarrow \text{C (graphite)}$

(b) $\text{N}_2(\text{g}, 273 \text{ K}) \rightarrow \text{N}_2(\text{g}, 300 \text{ K})$

(c) $\text{H}_2(\text{g}) \rightarrow 2\text{H}(\text{g})$

(d) $\text{N}_2(\text{g}, 1 \text{ atm}) \rightarrow \text{N}_2(\text{g}, 5 \text{ atm})$

34. The correct match between items of List-I and List-II is :-

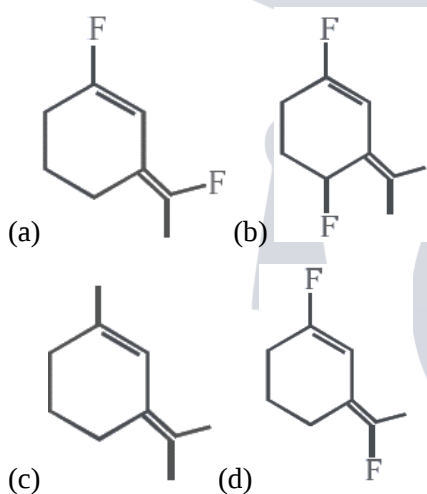
	List-I		List-II
(A)	Phenelzine	(P)	Pyrimidine
(B)	Chloroxylenol	(Q)	Furan
(C)	Uracil	(R)	Hydrazine
(D)	Ranitidine	(S)	Phenol

- (a) (A)-(S), (B)-(R), (C)-(P), (D)-(Q)
 (b) (A)-(R), (B)-(S), (C)-(P), (D)-(Q)
 (c) (A)-(S), (B)-(R), (C)-(Q), (D)-(P)
 (d) (A)-(R), (B)-(S), (C)-(Q), (D)-(P)

35. For standardizing NaOH solution, which of the following is used as a primary standard?

- (a) Oxalic acid (b) Ferrous Ammonium Sulfate
 (c) Sodium tetraborate (d) dil. HCl

36. The most polar compound among the following is:



37. The incorrect statement is :

- (a) Ferric ion gives blood red colour with potassium thiocyanate.
 (b) Cu^{2+} and Ni^{2+} ions give black precipitate with H_2S in presence of HCl solution.
 (c) Cu^{2+} salts give red coloured borax bead test in reducing flame.
 (d) Cu^{2+} ion gives chocolate coloured precipitate with potassium ferrocyanide solution.

38. An unknown chlorohydrocarbon has 3.55% of chlorine. If each molecule of the hydrocarbon has one chlorine atom only; chlorine atoms present in 1 g of chlorohydrocarbon are:

(Atomic wt. of Cl = 35.5u; Avogadro constant = $6.023 \times 10^{23} \text{ mol}^{-1}$)

- (a) 6.023×10^{21} (b) 6.023×10^{23}
 (c) 6.023×10^{20} (d) 6.023×10^9

39. At 320 K, a gas A_2 is 20% dissociated to $A(g)$. The standard free energy change at 320 K and 1 atm in Jmol^{-1} is approximately:

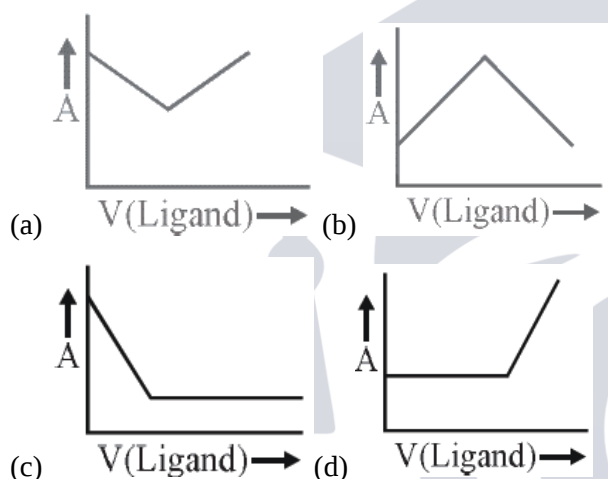
($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$; $\ln 2 = 0.693$; $\ln 3 = 1.098$)

- (a) 4281 (b) 4763
(c) 2068 (d) 1844

40. Which of the following complexes will show geometrical isomerism?

- (a) Potassium amminetrichloroplatinate (II)
(b) Aquachlorobis (ethylenediamine) cobalt (II) chloride
(c) Potassium tris(oxalato) chromate (III)
(d) Pentaquachlorochromium(III) chloride

41. In a complexometric titration of metal ion with ligand M (Metal ion) + L (Ligand) $\rightarrow$ C (Complex) end point is estimated spectrophotometrically (through light absorption). If ' M ' and ' C ' do not absorb light and only ' L ' absorbs, then the titration plot between absorbed light (A) versus volume of ligand ' L ' (v) would look like:



42. Which one of the following is not a property of physical adsorption?

- (a) Unilayer adsorption occurs
(b) Greater the surface area, more the adsorption
(c) Lower the temperature, more the adsorption
(d) Higher the pressure, more the adsorption

43. If 50% of a reaction occurs in 100 second and 75% of the reaction occurs in 200 second, the order of this reaction is:

- (a) 1 (b) 2
(c) Zero (d) 3

44. When 9.65 ampere current was passed for 1.0 hour into nitrobenzene in acidic medium, the amount of p-aminophenol produced is-

- (a) 10.9 g (b) 98.1 g
(c) 109.0 g (d) 9.81 g

45. The mass of a non-volatile, non-electrolyte solute (molar mass = 50 g mol^{-1}) needed to be dissolved in 114 g octane to reduce its vapour pressure to 75%, is :-

- (a) 50 g (b) 37.5 g
(c) 75 g (d) 150 g

46. Among the oxides of nitrogen : N_2O_3 , N_2O_4 and N_2O_5 ; the molecule(s) having nitrogen-nitrogen bond is/are :-

- (a) N_2O_3 and N_2O_5 (b) N_2O_4 and N_2O_5
(c) N_2O_3 and N_2O_4 (d) Only N_2O_5

47. In Wilkinson's catalyst, the hybridization of central metal ion and its shape are respectively:

- (a) dsp^2 , square planar (b) $sp^3 d$, trigonal bipyramidal
(c) sp^3 , tetrahedral (d) d^2s^3 , octahedral

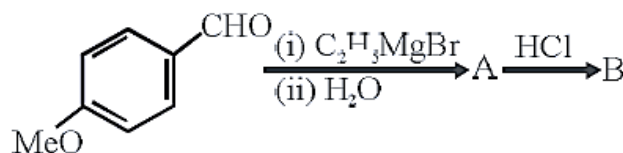
48. A group 13 element 'X' reacts with chlorine gas to produce a compound XCl_3 . XCl_3 is electron deficient and easily reacts with NH_3 to form $Cl_3X \leftarrow NH_3$ adduct; however, XCl_3 does not dimerize. X is :

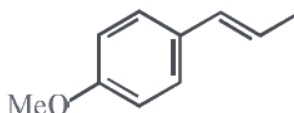
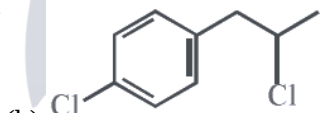
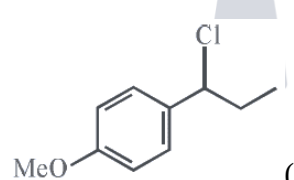
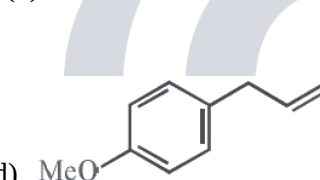
- (a) Ga (b) Al
(c) In (d) B

49. The incorrect geometry is represented by:-

- (a) BF_3 - trigonal planar (b) NF_3 - trigonal planar
(c) AsF_5 - trigonal bipyramidal (d) H_2O - bent

50. The major product B formed in the following reaction sequence is:



- (a)  (b) 
(c)  (d) 

51. Assuming ideal gas behaviour, the ratio of density of ammonia to that of hydrogen chloride at same temperature and pressure is:

(Atomic wt. of Cl = 35.5u)

- (a) 0.64 (b) 1.64
(c) 1.46 (d) 0.46

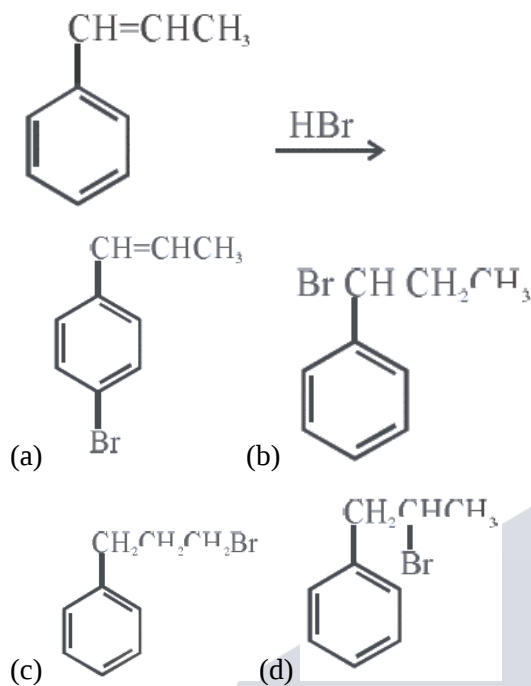
52. The gas phase reaction $2NO_2(g) \rightarrow N_2O_4(g)$ is an exothermic reaction. The decomposition of N_2O_4 , in equilibrium mixture of $NO_2(g)$ and $N_2O_4(g)$, can be increased by:-

- (a) Addition of an inert gas at constant volume.
(b) Increasing the pressure.
(c) Lowering the temperature.
(d) Addition of an inert gas at constant pressure.

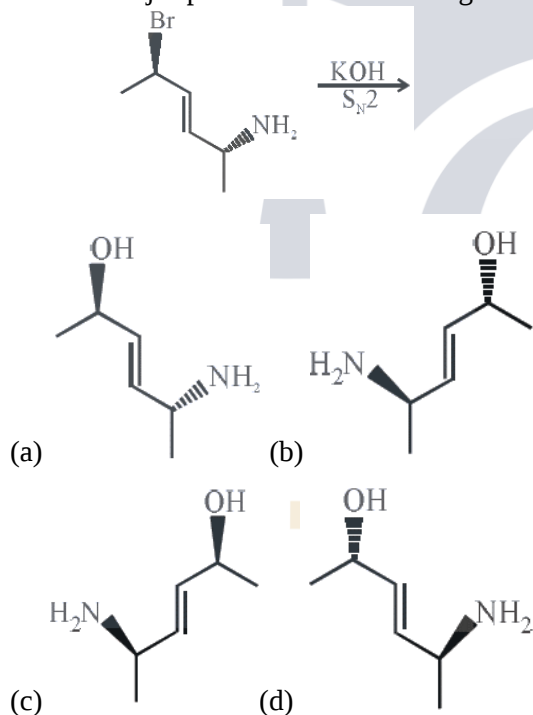
53. Which of the following conversions involves change in both shape and hybridization ?

- (a) $\text{BF}_3 \rightarrow \text{BF}_4^-$ (b) $\text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+$
 (c) $\text{CH}_4 \rightarrow \text{C}_2\text{H}_6$ (d) $\text{NH}_3 \rightarrow \text{NH}_4^+$

54. The major product of the following reaction is:



55. The major product of the following reaction is:



56. Which of the following statements is false?

- (a) Photon has momentum as well as wavelength.
 (b) Splitting of spectral lines in electrical field is called Stark effect.
 (c) Frequency of emitted radiation from a black body goes from a lower wavelength to higher wavelength as the temperature increases.
 (d) Rydberg constant has unit of energy.

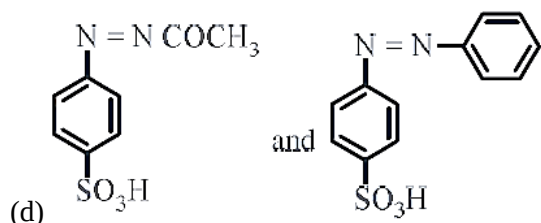
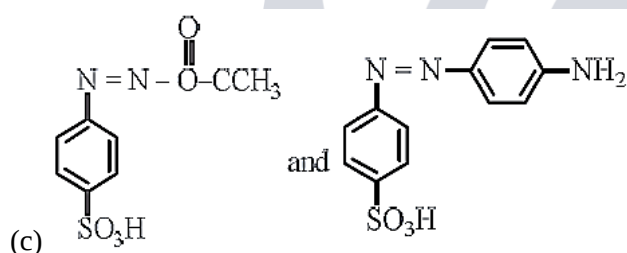
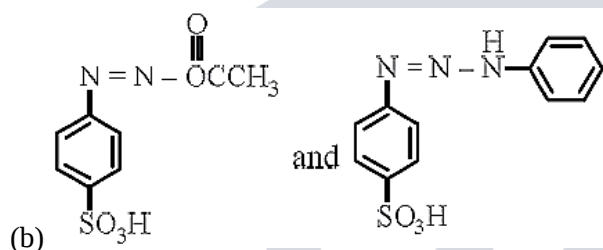
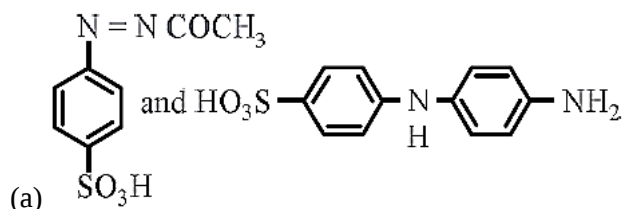
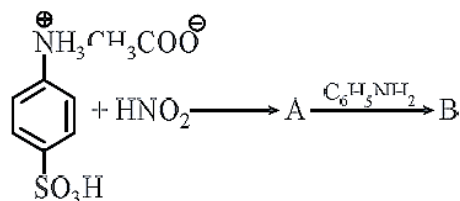
57. Which of the following compounds will most readily be dehydrated to give alkene under acidic condition?

- (a) 4-Hydroxypentan-2-one (b) 2-Hydroxycyclopentanone
(c) 3-Hydroxypentan-2-one (d) 1-Pentanol

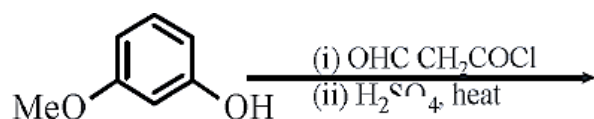
58. When XO_2 is fused with an alkali metal hydroxide in presence of an oxidizing agent such as KNO_3 ; a dark green product is formed which disproportionates in acidic solution to afford a dark purple solution. X is:

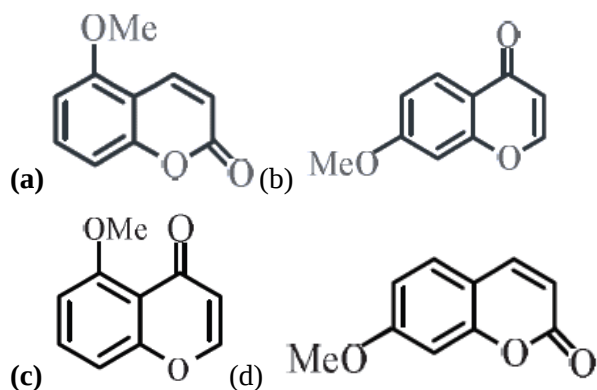
- (a) Ti (b) Cr
(c) V (d) Mn

59. Products A and B formed in the following reactions are respectively:



60. The major product of the following reaction is:





MATHEMATICS

61. Let A, B and C be three events, which are pair-wise independent and $\bar{E}$ denotes the complement of an event E . If $P(A \cap B \cap C) = 0$ and $P(C) > 0$, then $P[(\bar{A} \cap \bar{B}) | C]$ is equal to :
- (a) $P(A) + P(\bar{B})$ (b) $P(\bar{A}) - P(\bar{B})$
 (c) $P(\bar{A}) - P(B)$ (d) $P(\bar{A}) + P(\bar{B})$
62. Let P be a point on the parabola, $x^2 = 4y$. If the distance of P from the centre of the circle, $x^2 + y^2 + 6x + 8 = 0$ is minimum, then the equation of the tangent to the parabola at P , is :
- (a) $x + 4y - 2 = 0$ (b) $x + y + 1 = 0$
 (c) $x - y + 3 = 0$ (d) $x + 2y = 0$
63. If the angle between the lines, $\frac{x}{2} = \frac{y}{2} = \frac{z}{1}$ and $\frac{5-x}{-2} = \frac{7y-14}{p} = \frac{z-3}{4}$ is $\cos^{-1}\left(\frac{2}{3}\right)$, then p is equal to :
- (a) $-\frac{4}{7}$ (b) $\frac{7}{2}$
 (c) $-\frac{7}{4}$ (d) $\frac{2}{7}$
64. If $f(x) = \int_0^x t(\sin x - \sin t) dt$ then:
- (a) $f'''(x) + f'(x) = \cos x - 2x \sin x$
 (b) $f'''(x) + f''(x) - f'(x) = \cos x$
 (c) $f'''(x) - f''(x) = \cos x - 2x \sin x$
 (d) $f'''(x) + f''(x) = \sin x$
65. The coefficient of x^2 in the expansion of the product $(2 - x^2) \cdot ((1 + 2x + 3x^2)^6 + (1 - 4x^2)^6)$ is :
- (a) 155 (b) 106
 (c) 108 (d) 107
66. If the length of the latus rectum of an ellipse is 4 units and the distance between a focus and its nearest vertex on the major axis is $\frac{3}{2}$ units, then its eccentricity is :
- (a) $\frac{1}{3}$ (b) $\frac{2}{3}$
 (c) $\frac{1}{9}$ (d) $\frac{1}{2}$
67. Two different families A and B are blessed with equal number of children. There are 3 tickets to be distributed amongst the children of these families so that no child gets more than one ticket. If the probability that all the tickets go to the children of the family B is $\frac{1}{12}$, then the number of children in each family is:
- (a) 3 (b) 5
 (c) 4 (d) 6
68. The number of values of k for which the system of linear equations,

$$(k+2)x + 10y = k$$

$$kx + (k+3)y = k-1$$

has no solution is :

- (a) infinitely many (b) 1
(c) 2 (d) 3

69. The least positive integer n for which $\left(\frac{1+i\sqrt{3}}{1-i\sqrt{3}}\right)^n = 1$, is:

- (a) 3 (b) 5
(c) 2 (d) 6

70. If the function f defined as $f(x) = \frac{1}{x} - \frac{k-1}{e^{2x}-1}$, $x \neq 0$, is continuous at $x = 0$, then the ordered pair $(k, f(0))$ is equal to :

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

71. If a circle C , whose radius is 3, touches externally the circle, $x^2 + y^2 + 2x - 4y - 4 = 0$ at the point (2, 2), then the length of the intercept cut by this circle C , on the x -axis is equal to:

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

72. If

$$\int \frac{\tan x}{1+\tan x+\tan^2 x} dx = x - \frac{K}{\sqrt{A}} \tan^{-1} \left(\frac{K \tan x + 1}{\sqrt{A}} \right) + C,$$

(C is a constant of integration), then the ordered pair (K, A) is equal to :

- (a) (-2,3) (b) (-2,1)
(c) (2,1) (d) (2,3)

73. If $x = \sqrt{2 \operatorname{cosec}^{-1} t}$ and $y = \sqrt{2 \sec^{-1} t}$ ($|t| \geq 1$), then $\frac{dy}{dx}$ is equal to :

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

74. Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 1 & 1 & 1 \end{bmatrix}$ and $B = A^{20}$. Then the sum of the elements of the first column of B is:

- (a) 211 (b) 251
(c) 231 (d) 210

75. The locus of the point of intersection of the lines, $\sqrt{2}x - y + 4\sqrt{2}k = 0$ and $\sqrt{2}kx + ky - 4\sqrt{2} = 0$ (k is any non-zero real parameter), is:

- (a) a hyperbola with length of its transverse axis $8\sqrt{2}$
(b) a hyperbola whose eccentricity is $\sqrt{3}$.
(c) an ellipse whose eccentricity is $\frac{1}{\sqrt{3}}$.
(d) an ellipse with length of its major axis $8\sqrt{2}$

76. A man on the top of a vertical tower observes a car moving at a uniform speed towards the tower on a horizontal road. If it takes 18 min. for the angle of depression of the car to change from 30° to 45° ; then after this, the time taken (in min.) by the car to reach the foot of the tower, is :

- (a) $9(1 + \sqrt{3})$ (b) $18(\sqrt{3} - 1)$
(c) $\frac{9}{2}(\sqrt{3} - 1)$ (d) $18(1 + \sqrt{3})$

77. Let p, q and r be real numbers ($p \neq q, r \neq 0$), such that the roots of the equation $\frac{1}{x+p} + \frac{1}{x+q} = \frac{1}{r}$ are equal in magnitude but opposite in sign, then the sum of squares of these roots is equal to :
- (a) $p^2 + q^2$ (b) $2(p^2 + q^2)$
 (c) $p^2 + q^2 + r^2$ (d) $\frac{p^2+q^2}{2}$
78. The mean and the standard deviation(s.d.) of five observations are 9 and 0, respectively. If one of the observations is changed such that the mean of the new set of five observations becomes 10. then their s.d. is:
- (a) 0 (b) 1
 (c) 4 (d) 2
79. Let M and m be respectively the absolute maximum and the absolute minimum value of the function, $f(x) = 2x^3 - 9x^2 + 12x + 5$ in the interval $[0, 3]$. Then $M - m$ is equal to :
- (a) 5 (b) 1
 (c) 4 (d) 9
80. If $p \rightarrow (\sim p \vee \sim q)$ is false, then the truth values of p and q are respectively
- (a) F, F (b) F, T
 (c) T, T (d) T, F
81. The sum of the first 20 terms of the series $1 + \frac{3}{2} + \frac{7}{4} + \frac{15}{8} + \frac{31}{16} + \dots$, is:
- (a) $39 + \frac{1}{2^{19}}$ (b) $39 + \frac{1}{2^{20}}$
 (c) $38 + \frac{1}{2^{20}}$ (d) $38 + \frac{1}{2^{19}}$
82. The differential equation representing the family of ellipses having foci either on the x-axis or on the y-axis, centre at the origin and passing through the point $(0, 3)$ is:
- (a) $x + yy'' = 0$ (b) $xyy' - y^2 + 9 = 0$
 (c) $xyy'' + x(y')^2 - yy' = 0$ (d) $xyy' + y^2 - 9 = 0$
83. $\lim_{x \rightarrow 0} \frac{(27+x)^{1/3} - 3}{9 - (27+x)^{2/3}}$ equals:
- (a) $-\frac{1}{3}$ (b) $\frac{1}{6}$
 (c) $-\frac{1}{6}$ (d) $\frac{1}{3}$
84. The number of numbers between 2,000 and 5,000 that can be formed with the digits 0, 1, 2, 3, 4 (repetition of digits is not allowed) and are multiple of 3 is :-
- (a) 36 (b) 48
 (c) 24 (d) 30
85. Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{c} = \hat{j} - \hat{k}$ and a vector $\vec{b}$ be such that $\vec{a} \times \vec{b} = \vec{c}$ and $\vec{a} \cdot \vec{b} = 3$. Then $|\vec{b}|$ equals:
- (a) $\sqrt{\frac{11}{3}}$ (b) $\frac{11}{\sqrt{3}}$
 (c) $\frac{\sqrt{11}}{3}$ (d) $\frac{11}{3}$
86. If the area of the region bounded by the curves, $y = x^2$, $y = \frac{1}{x}$ and the lines $y = 0$ and $x = t$ ($t > 1$) is 1 sq. unit, then t is equal to:
- (a) $\frac{4}{3}$ (b) $e^{\frac{3}{2}}$
 (c) $\frac{3}{2}$ (d) $e^{\frac{2}{3}}$
87. Let N denote the set of all-natural numbers. Define two binary relations on N as $R_1 = \{(x, y) \in N \times N : 2x + y = 10\}$ and $R_2 = \{(x, y) \in N \times N : x + 2y = 10\}$. Then:
- (a) Both R_1 and R_2 are symmetric relations
 (b) Range of R_1 is $\{2, 4, 8\}$
 (c) Both R_1 and R_2 are transitive relations.

(d) Range of R_2 is $\{1, 2, 3, 4\}$

88. Let $\frac{1}{x_1}, \frac{1}{x_2}, \dots, \frac{1}{x_n}$ ($x_i \neq 0$ for $i = 1, 2, \dots, n$) be in A.P. such that $x_1 = 4$ and $x_{21} = 20$. If n is the least positive integer for which $x_n > 50$, then $\sum_{i=1}^n \left(\frac{1}{x_i}\right)$ is equal to :

(a) $\frac{1}{8}$ (b) 3

(c) $\frac{13}{8}$ (d) $\frac{13}{4}$

89. If an angle A of a $\triangle ABC$ satisfies $5\cos A + 3 = 0$, then the roots of the quadratic equation, $9x^2 + 27x + 20 = 0$ are :

(a) $\sin A, \sec A$ (b) $\sec A, \cot A$

(c) $\sec A, \tan A$ (d) $\tan A, \cos A$

90. The sum of the intercepts on the coordinate axes of the plane passing through the point $(-2, -2, 2)$ and containing the line joining the points $(1, -1, 2)$ and $(1, 1, 1)$, is

(a) 4 (b) -4

(c) 12 (d) -8

