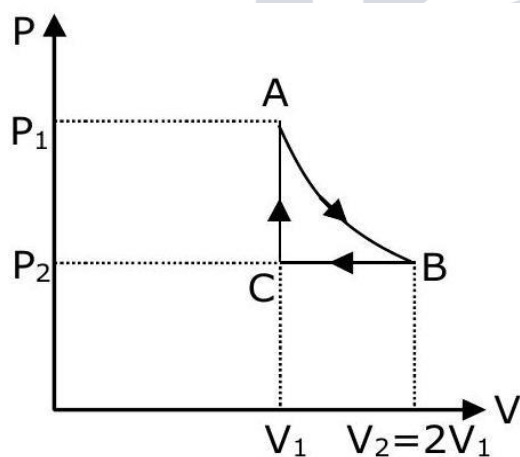


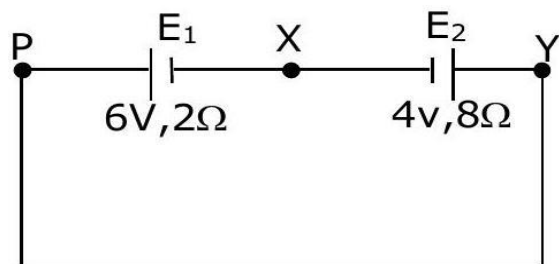
PART-I PHYSICS

SECTION-A

- Four identical particles of equal masses 1 kg made to move along the circumference of a circle of radius 1 m under the action of their own mutual gravitational attraction. The speed of each particle will be -
 (a) $\frac{\sqrt{(1+2\sqrt{2})G}}{2}$ (b) $\sqrt{G(1+2\sqrt{2})}$
 (c) $\sqrt{\frac{G}{2}(2\sqrt{2}-1)}$ (d) $\sqrt{\frac{G}{2}(1+2\sqrt{2})}$
- Consider two satellites S_1 and S_2 with periods of revolution 1hr. and 8hr. respectively revolving around a planet in circular orbits. The ratio of angular velocity of satellite S_1 to the angular velocity of satellite S_2 is -
 (a) 8:1 (b) 1:8
 (c) 2:1 (d) 1:4
- n mole of a perfect gas undergoes a cyclic process ABCA (see figure) consisting of the following processes -
 A $\rightarrow$ B : Isothermal expansion at temperature T so that the volume is doubled from V_1 to $V_2 = 2V_1$ and pressure changes from P_1 to P_2 .
 B $\rightarrow$ C : Isobaric compression at pressure P_2 to initial volume V_1 .
 C $\rightarrow$ A : Isochoric change leading to change of pressure from P_2 to P_1 .
 Total workdone in the complete cycle ABCA is -



- 0 (b) $nRT \left(\ln 2 + \frac{1}{2} \right)$
 - $nRT \ln 2$ (d) $nRT \left(\ln 2 - \frac{1}{2} \right)$
- Two equal capacitors are first connected in series and then in parallel. The ratio of the equivalent capacities in the two cases will be -
 (a) 2:1 (b) 1:4
 (c) 4:1 (d) 1:2
 - A cell E_1 of emf 6 V and internal resistance 2Ω is connected with another cell E_2 of emf 4 V and internal resistance 8Ω (as shown in the figure). The potential difference across points X and Y is -



- (a) 3.6 V (b) 10.0 V
(c) 5.6 V (d) 2.0 V

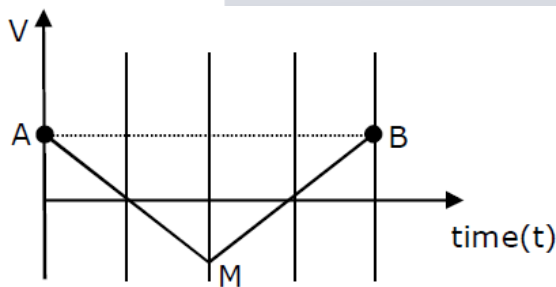
6. If Y , K and η are the values of Young's modulus, bulk modulus and modulus of rigidity of any material respectively. Choose the correct relation for these parameters.

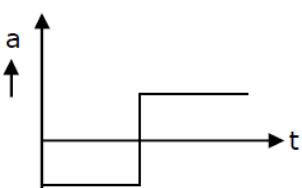
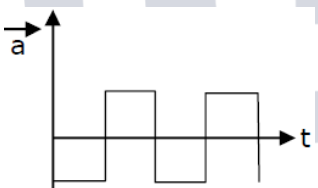
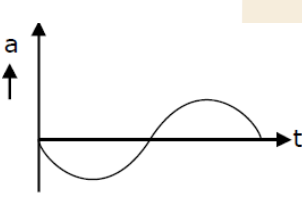
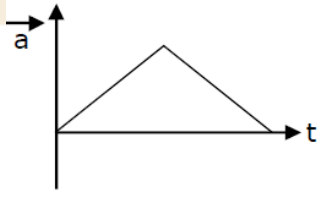
- (a) $K = \frac{Y\eta}{9\eta - 3Y} N/m^2$ (b) $\eta = \frac{3YK}{9K + Y} N/m^2$
(c) $Y = \frac{9K\eta}{3K - \eta} N/m^2$ (d) $Y = \frac{9K\eta}{2\eta + 3K} N/m^2$

7. Two stars of masses m and $2m$ at a distance d rotate about their common centre of mass in free space. The period of revolution is -

- (a) $2\pi \sqrt{\frac{d^3}{3Gm}}$ (b) $\frac{1}{2\pi} \sqrt{\frac{3Gm}{d^3}}$
(c) $\frac{1}{2\pi} \sqrt{\frac{d^3}{3Gm}}$ (d) $2\pi \sqrt{\frac{3Gm}{d^3}}$

8. If the velocity-time graph has the shape AMB , what would be the shape of the corresponding acceleration-time graph?



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

9. Given below are two statements:

Statement - I: Two photons having equal linear momenta have equal wavelengths.

Statement-II: If the wavelength of photon is decreased, then the momentum and energy of a photon will also decrease.

In the light of the above statements, choose the correct answer from the options given below.

- (a) Statement-I is false but Statement-II is true

- (b) Both Statement-I and Statement-II are true
 (c) Both Statement-I and Statement-II are false
 (d) Statement-I is true but Statement-II is false

10. A current through a wire depends on time as $i = \alpha_0 t + \beta t^2$

where $\alpha_0 = 20 \text{ A/s}$ and $\beta = 8 \text{ As}^{-2}$. Find the charge crossed through a section of the wire in 15 s.

- (a) 2100C (b) 260C
 (c) 2250C (d) 11250C

11. match List I with List II

List-I

- (A) Isothermal
 (B) Isochoric
 (C) Adiabatic
 (D) Isobaric

List-II

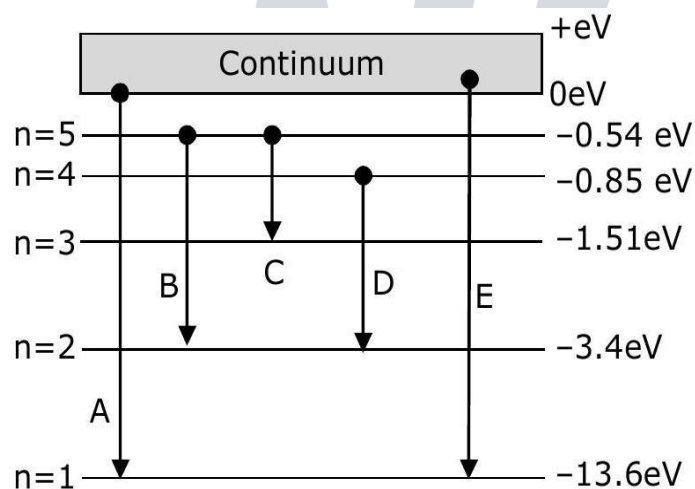
- (i) Pressure constant
 (ii) Temperature constant
 (iii) Volume constant
 (iv) Heat content is constant

Choose the correct answer from the options given below -

- (a) (A) - (ii), (B) - (iv), (C) - (iii), (D) - (i)
 (b) (A) - (ii), (B) - (iii), (C) - (iv), (D) - (i)
 (c) (A) - (i), (B) - (iii), (C) - (ii), (D) - (iv)
 (d) (A) - (iii), (B) - (ii), (C) - (i), (D) - (iv)

12. In the given figure, the energy levels of hydrogen atom have been shown along with some transitions marked A, B, C, D and E.

The transitions A, B and C respectively represents -



- (a) The series limit of Lyman series, third member of balmer series and second member of paschen series
 (b) The first member of the Lyman series, third member of Balmer series and second member of paschen series
 (c) The ionization potential of hydrogen, second member of Balmer series and third member of Paschen series
 (d) The series limit of Lyman series, second memebr of Balmer series and second member of Paschen series.

13. The focal length f is related to the radius of curvature r of the spherical convex mirror by -

- (a) $f = r$ (b) $f = -\frac{1}{2}r$
(c) $f = +\frac{1}{2}r$ (d) $f = -r$

14. Moment of inertia (M.I.) of four bodies, having same mass and radius, are reported as $I_1 = \text{M.I. of thin circular ring about its diameter,}$

$I_2 = \text{M.I. of circular disc about an axis perpendicular to disc and going through the centre,}$

$I_3 = \text{M.I. of solid cylinder about its axis and}$

$I_4 = \text{M.I. of solid sphere about its diameter.}$

Then :-

- (a) $I_1 = I_2 = I_3 < I_4$ (b) $I_1 + I_2 = I_3 + \frac{5}{2}I_4$
(c) $I_1 + I_3 < I_2 + I_4$ (d) $I_1 = I_2 = I_3 > I_4$

15. The work done by a gas molecule in an isolated system is given by, $w = \alpha\beta^2 e^{-\frac{x^2}{\alpha kT}}$, where x is the displacement, k is the Boltzmann constant and T is the temperature. α and β are constants. Then the dimensions of β will be -

- (a) $[M^0LT^0]$ (b) $[M^2LT^2]$
(c) $[MLT^{-2}]$ (d) $[ML^2 T^{-2}]$

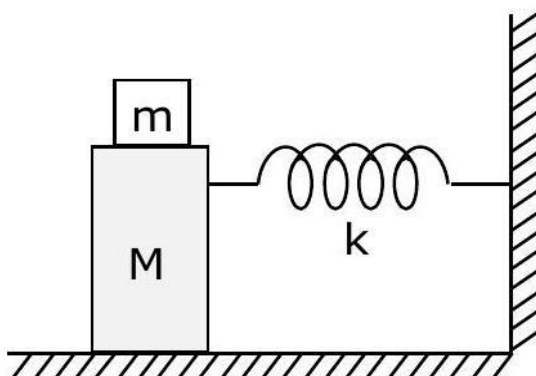
16. If an emitter current is changed by 4 mA, the collector current changes by 3.5 mA. The value of β will be -

- (a) 7 (b) 0.875
(c) 0.5 (d) 3.5

17. In a Young's double slit experiment, the width of the one of the slit is three times the other slit. The amplitude of the light coming from a slit is proportional to the slit-width. Find the ratio of the maximum to the minimum intensity in the interference pattern.

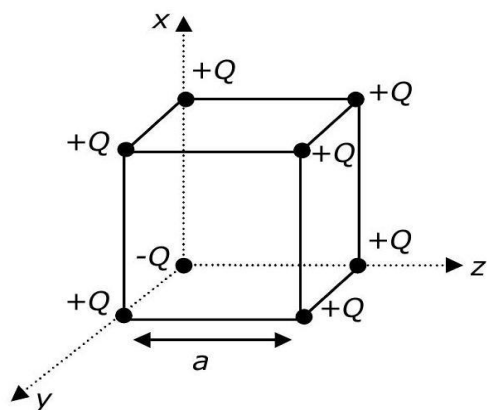
- (a) 4 : 1 (b) 2 : 1
(c) 3 : 1 (d) 1 : 4

18. In the given figure, a mass M is attached to a horizontal spring which is fixed on one side to a rigid support. The spring constant of the spring is k . The mass oscillates on a frictionless surface with time period T and amplitude A . When the mass is in equilibrium position, as shown in the figure, another mass m is gently fixed upon it. The new amplitude of oscillation will be -



- (a) $A\sqrt{\frac{M}{M+m}}$ (b) $A\sqrt{\frac{M}{M-m}}$
(c) $A\sqrt{\frac{M-m}{M}}$ (d) $A\sqrt{\frac{M+m}{M}}$

19. A cube of side ' a ' has point charges $+Q$ located at each of its vertices except at the origin where the charge is $-Q$. The electric field at the centre of cube is:



- (a) $\frac{2Q}{3\sqrt{3}\pi\epsilon_0 a^2} (\hat{x} + \hat{y} + \hat{z})$ (b) $\frac{Q}{3\sqrt{3}\pi\epsilon_0 a^2} (\hat{x} + \hat{y} + \hat{z})$
(c) $\frac{-2Q}{3\sqrt{3}\pi\epsilon_0 a^2} (\hat{x} + \hat{y} + \hat{z})$ (d) $\frac{-Q}{3\sqrt{3}\pi\epsilon_0 a^2} (\hat{x} + \hat{y} + \hat{z})$

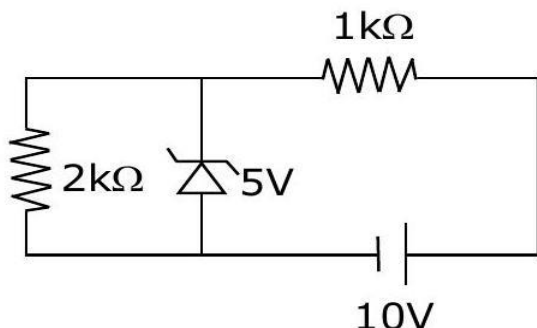
20. Each side of a box made of metal sheet in cubic shape is ' a ' at room temperature ' T ', the coefficient of linear expansion of the metal sheet is ' α '. The metal sheet is heated uniformly, by a small temperature ΔT , so that its new temperature is $T + \Delta T$. Calculate the increase in the volume of the metal box-

- (a) $\frac{4}{3}\pi a^3 \alpha \Delta T$ (b) $4\pi a^3 \alpha \Delta T$
(c) $3a^3 \alpha \Delta T$ (d) $4a^3 \alpha \Delta T$

SECTION-B

21. A resonance circuit having inductance and resistance $2 \times 10^{-4} \text{H}$ and 6.28Ω respectively oscillates at 10MHz frequency. The value of quality factor of this resonator is $[\pi = 3.14]$
22. A ball with a speed of 9 m/s collides with another identical ball at rest. After the collision, the direction of each ball makes an angle of 30° with the original direction. The ratio of velocities of the balls after collision is $x:y$, where x is
23. An audio signal $v_m = 20\sin 2\pi(1500t)$ amplitude modulates a carrier $v_c = 80\sin 2\pi(100,000t)$. The value of percent modulation is
24. The coefficient of static friction between a wooden block of mass 0.5 kg and a vertical rough wall is 0.2 . The magnitude of horizontal force that should be applied on the block to keep it adhere to the wall will be N. $[g = 10 \text{ ms}^{-2}]$
25. An inclined plane is bent in such a way that the vertical cross-section is given by $y = \frac{x^2}{4}$ where y is in vertical and x in horizontal direction. If the upper surface of this curved plane is rough with coefficient of friction $\mu = 0.5$, the maximum height in cm at which a stationary block will not slip downward is cm.
26. An electromagnetic wave of frequency 5GHz, is travelling in a medium whose relative electric permittivity and relative magnetic permeability both are 2 . Its velocity in this medium is $\times 10^7 \text{ m/s}$.
27. A hydraulic press can lift 100 kg when a mass ' m ' is placed on the smaller piston. It can lift kg when the diameter of the larger piston is increased by 4 times and that of the smaller piston is decreased by 4 times keeping the same mass ' m ' on the smaller piston.
28. A common transistor radio set requires 12 V (D.C.) for its operation. The D.C. source is constructed by using a transformer and a rectifier circuit, which are operated at 220 V (A.C.) on standard domestic A.C. supply. The number of turns of secondary coil are 24, then the number of turns of primary are

29. An unpolarized light beam is incident on the polarizer of a polarization experiment and the intensity of light beam emerging from the analyzer is measured as 100 Lumens. Now, if the analyzer is rotated around the horizontal axis (direction of light) by 30° in clockwise direction, the intensity of emerging light will be Lumens.
30. In connection with the circuit drawn below, the value of current flowing through $2\text{k}\Omega$ resistor is $\times 10^{-4}$ A.

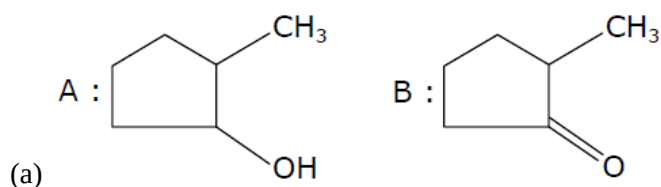


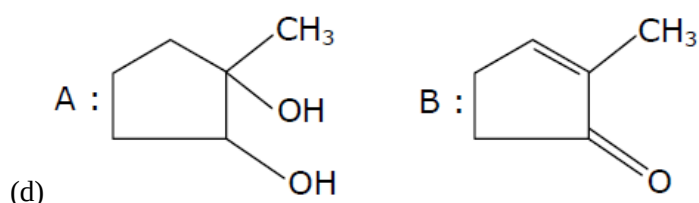
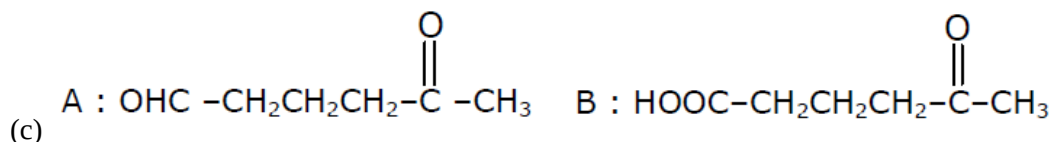
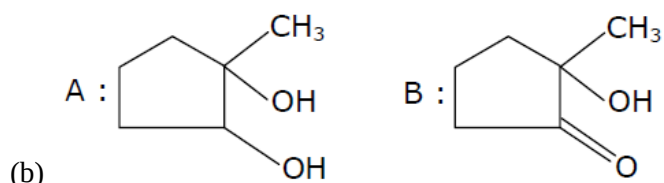
PART-II CHEMISTRY

SECTION - A

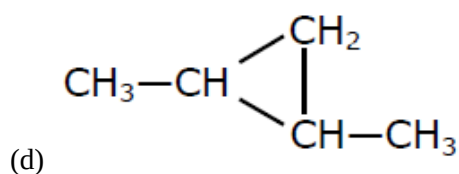
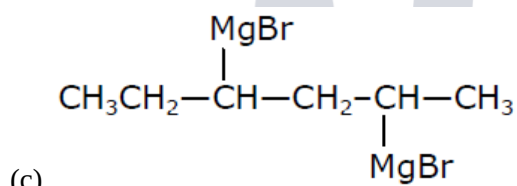
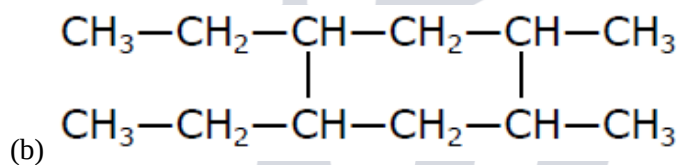
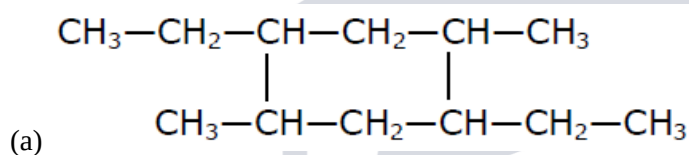
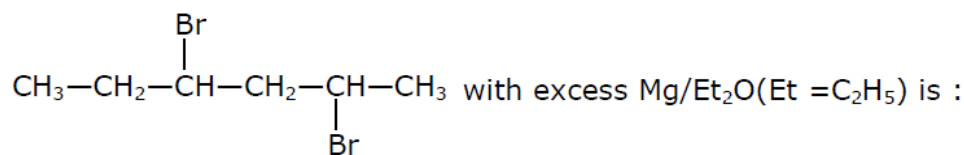
31. The gas released during anaerobic degradation of vegetation may lead to:
- Global warming and cancer
 - Acid rain
 - Corrosion of metals
 - Ozone hole
32. Out of the following, which type of interaction is responsible for the stabilisation α -helix structure of proteins?
- Ionic bonding
 - Hydrogen bonding
 - vander Waals forces
 - Covalent bonding
33. Which of the following are isostructural pairs?
- SO_4^{2-} and CrO_4^{2-}
 - SiCl_4 and TiCl_4
 - NH_3 and NO_3^-
 - BCl_3 and BrCl_3
- A and C only
 - A and B only
 - B and C only
 - C and D only

34. Identify products A and B.





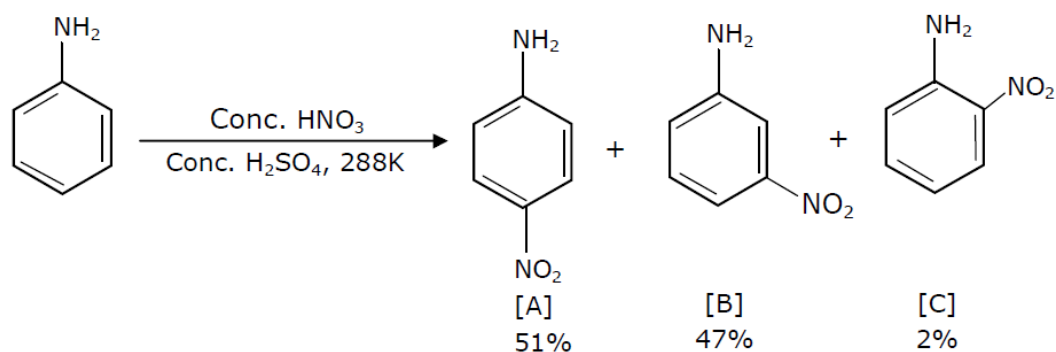
35. The product formed in the first step of the reaction of



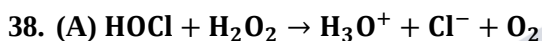
36. The electrode potential of M^{2+}/M of 3 d - series elements shows positive value for:

- (a) Zn (b) Co
(c) Fe (d) Cu

37. In the following reaction the reason why meta-nitro product also formed is:



- (a) Formation of anilinium ion
- (b) $-\text{NO}_2$ substitution always takes place at meta-position
- (c) low temperature
- (d) $-\text{NH}_2$ group is highly meta-directive



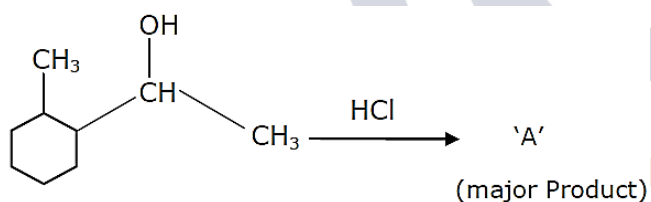
Choose the correct option.

- (a) H_2O_2 act as oxidizing and reducing agent respectively in equations (A) and (B).
- (b) H_2O_2 acts as oxidizing agent in equations (A) and (B).
- (c) H_2O_2 acts as reducing agent in equations (A) and (B).
- (d) H_2O_2 acts as reducing and oxidising agent respectively in equation (A) and (B).

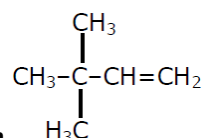
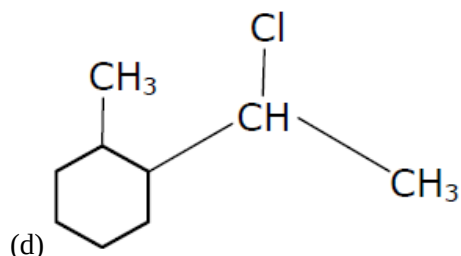
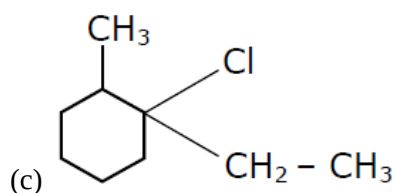
39. Which of the following ore is concentrated using group 1 cyanide salt?

- (a) Sphalerite (b) Siderite
- (c) Malachite (d) Calamine

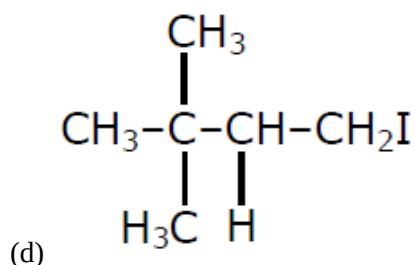
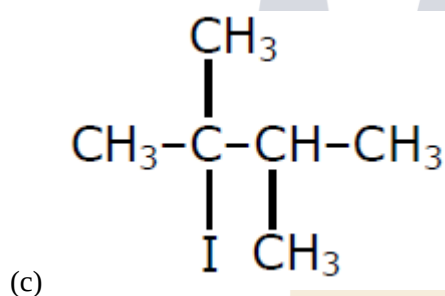
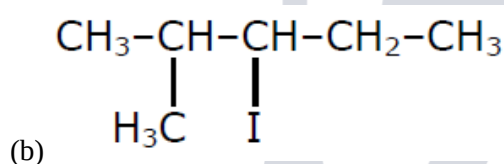
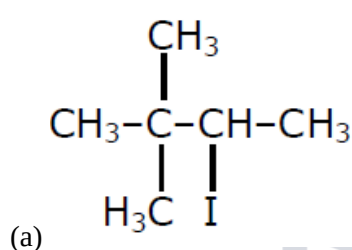
40. Which is the final product (major) 'A' in the given reaction?



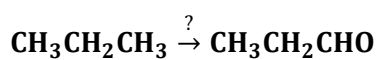
- (a) CC1(CCCC(CC1)C)C=C
- (b) CC1(CCCC(CC1)C)C(=C)C



41. What is the major product formed by HI on reaction with



42. Which of the following reagent is used for the following reaction?



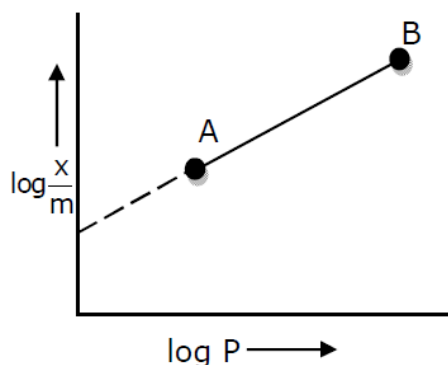
(a) Potassium permanganate

(b) Molybdenum oxide

(c) Copper at high temperature and pressure

(d) Manganese acetate

43. In Freundlich adsorption isotherm, slope of AB line is:



(a) $\frac{1}{n}$ with $\left(\frac{1}{n} = 0 \text{ to } 1\right)$

(b) $\log \frac{1}{n}$ with $(n < 1)$

(c) $\log n$ with $(n > 1)$

(d) n with $(n, 0.1 \text{ to } 0.5)$

44. The major components in "Gun Metal" are:

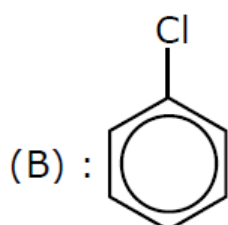
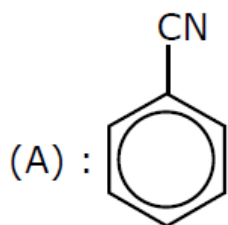
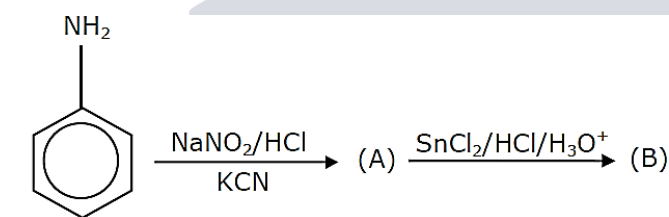
(a) Al, Cu, Mg and Mn

(b) Cu, Sn and Zn

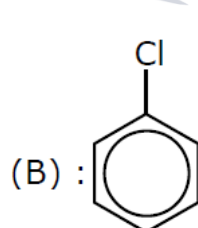
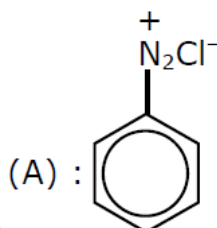
(c) Cu, Zn and Ni

(d) Cu, Ni and Fe

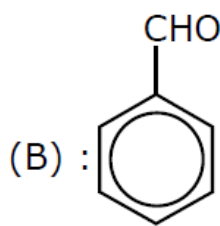
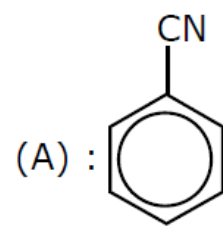
45. 'A' and 'B' in the following reactions are:



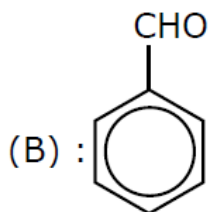
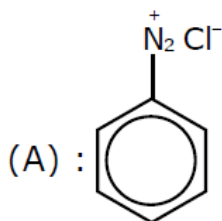
(a)



(b)

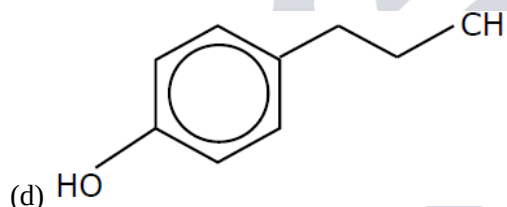
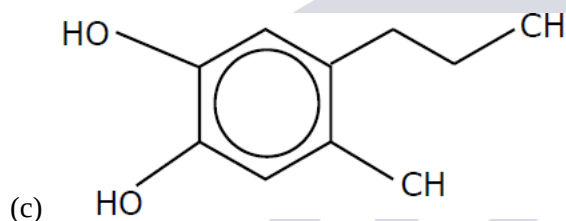
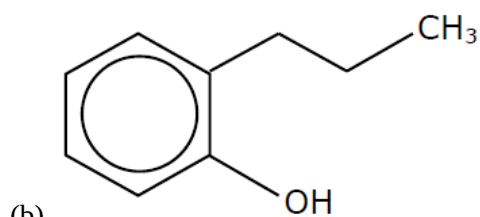
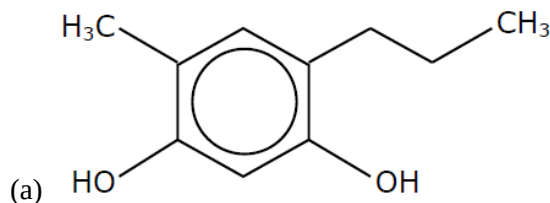


(c)



(d)

46. Which of the following compound gives pink colour on reaction with phthalic anhydride in conc. H_2SO_4 followed by treatment with NaOH ?



47. Consider the elements Mg, Al, S, P and Si, the correct increasing order of their first ionization enthalpy is:

(a) $Al < Mg < Si < S < P$

(b) $Al < Mg < S < Si < P$

(c) $Mg < Al < Si < S < P$

(d) $Mg < Al < Si < P < S$

48. Given below are two statements:

Statement I : Colourless cupric metaborate is reduced to cuprous metaborate in a luminous flame.

Statement II : Cuprous metaborate is obtained by heating boric anhydride and copper sulphate in a non-luminous flame.

In the light of the above statements, choose the most appropriate answer from the options given below.

(a) Statement I is false but statement II is true.

(b) Statement I is true but Statement II is false.

(c) Both Statement I and Statement II are true.

(d) Both Statement I and Statement II are false.

49. Al_2O_3 was leached with alkali to get X. The solution of X on passing of gas Y, forms Z. X, Y and Z respectively are:

- (a) $X = \text{Na}[\text{Al}(\text{OH})_4]$, $Y = \text{CO}_2$, $Z = \text{Al}_2\text{O}_3 \cdot \text{XH}_2\text{O}$
 (b) $X = \text{Na}[\text{Al}(\text{OH})_4]$, $Y = \text{SO}_2$, $Z = \text{Al}_2\text{O}_3$
 (c) $X = \text{Al}(\text{OH})_3$, $Y = \text{SO}_2$, $Z = \text{Al}_2\text{O}_3 \cdot \text{XH}_2\text{O}$
 (d) $X = \text{Al}(\text{OH})_3$, $Y = \text{CO}_2$, $Z = \text{Al}_2\text{O}_3$

50. Match List I with List II.

List I

(Monomer Unit)

(A) Caprolactum

(B) 2-Chloro-1,3-butadiene

(C) Isoprene

(D) Acrylonitrile

List II

(Polymer)

(i) Natural rubber

(ii) Buna-N

(iii) Nylon 6

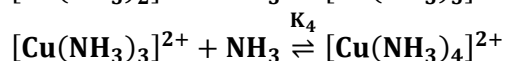
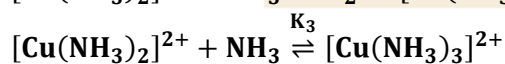
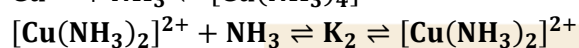
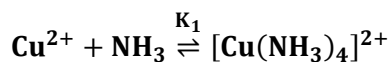
(iv) Neoprene

Choose the correct answer from the options given below:

- (a) (A) $\rightarrow$ (iii), (B) $\rightarrow$ (iv), (C) $\rightarrow$ (i), (D) $\rightarrow$ (ii)
 (b) (A) $\rightarrow$ (i), (B) $\rightarrow$ (ii), (C) $\rightarrow$ (iii), (D) $\rightarrow$ (iv)
 (c) (A) $\rightarrow$ (ii), (B) $\rightarrow$ (i), (C) $\rightarrow$ (iv), (D) $\rightarrow$ (iii)
 (d) (A) $\rightarrow$ (iv), (B) $\rightarrow$ (iii), (C) $\rightarrow$ (ii), (D) $\rightarrow$ (i)

SECTION - B

51. The stepwise formation of $[\text{Cu}(\text{NH}_3)]^{2+}$ is given below:



The value of stability constants K_1 , K_2 , K_3 and K_4 are 10^4 , 1.58×10^2 , 5×10^2 and 10^2 respectively. The overall equilibrium constants for dissociation of $[\text{Cu}(\text{NH}_3)_4]^{2+}$ is $x \times 10^{-12}$. The value of x is (Rounded off to the nearest integer)

52. At 1990 K and 1 atm pressure, there are equal number of Cl_2 molecules and Cl atoms in the reaction mixture. The value of K_p for the reaction $\text{Cl}_{2(g)} \rightleftharpoons 2\text{Cl}_{(g)}$ under the above conditions is $x \times 10^{-1}$. The value of x is . (Rounded off to the nearest integer)

53. 4.5 g of compound A (MW = 90) was used to make 250 mL of its aqueous solution. The molarity of the solution in M is $x \times 10^{-1}$. The value of x is . (Rounded off to the nearest integer)
54. The coordination number of an atom in a body-centered cubic structure is [Assume that the lattice is made up of atoms]
55. Number of amphoteric compounds among the following is
 (a) BeO (b) BaO
 (c) Be(OH)₂ (d) Sr(OH)₂
56. When 9.45 g of ClCH₂COOH is added to 500 mL of water, its freezing point drops by 0.5°C. The dissociation constant of ClCH₂COOH is $x \times 10^{-3}$. The value of x is . (Rounded off to the nearest integer) [K_f(H₂O) = 1.86 K kg mol⁻¹]
57. A proton and a Li³⁺ nucleus are accelerated by the same potential. If λ_{Li} and λ_{p} denote the de Broglie wavelengths of Li³⁺ and proton respectively, then the value of $\frac{\lambda_{\text{Li}}}{\lambda_{\text{p}}}$ is $x \times 10^{-1}$. The value of x is . [Rounded off to the nearest integer] [Mass of Li³⁺ = 8.3 mass of proton]
58. Gaseous cyclobutene isomerizes to butadiene in a first order process which has a 'k' value of $3.3 \times 10^{-4} \text{ s}^{-1}$ at 153°C. The time in minutes it takes for the isomerization to proceed 40% to completion at this temperature is . (Rounded off to the nearest integer)
59. For the reaction A_(g) → B_(g), the value of the equilibrium constant at 300 K and 1 atm is equal to 100.0. The value of $\Delta_r G$ for the reaction at 300 K and 1 atm in Jmol⁻¹ is $-xR$, where x is (Rounded off to the nearest integer)
60. The reaction of sulphur in alkaline medium is given below:
 $\text{S}_{8(\text{s})} + a\text{OH}^{-}_{(\text{aq})} \rightarrow b\text{S}^{2-}_{(\text{aq})} + c\text{S}_2\text{O}^{2-}_{3(\text{aq})} + d\text{H}_2\text{O}_{(\ell)}$
 The values of 'a' is . (Integer answer)

PART-III MATHEMATICS

SECTION-A

61. The locus of the mid-point of the line segment joining the focus of the parabola $y^2 = 4ax$ to a moving point of the parabola, is another parabola whose directrix is: .
 (a) $x = a$ (b) $x = 0$
 (c) $x = -\frac{a}{2}$ (d) $x = \frac{a}{2}$
62. A scientific committee is to be formed from 6 Indians and 8 foreigners, which includes at least 2 Indians and double the number of foreigners as Indians. Then the number of ways, the committee can be formed is:
 (a) 560 (b) 1050
 (c) 1625 (d) 575
63. The equation of the plane passing through the point (1, 2, -3) and perpendicular to the planes $3x + y - 2z = 5$ and $2x - 5y - z = 7$, is:
 (a) $3x - 10y - 2z + 11 = 0$
 (b) $6x - 5y - 2z - 2 = 0$
 (c) $11x + y + 17z + 38 = 0$
 (d) $6x - 5y + 2z + 10 = 0$
64. A man is walking on a straight line. The arithmetic mean of the reciprocals of the intercepts of this line on the coordinate axes is $\frac{1}{4}$. Three stones A, B and C are placed at the points (1, 1),

(2, 2) and (4, 4) respectively. Then which of these stones is/are on the path of the man?

- (a) B only (b) A only
(c) All the three (d) C only

65. The statement among the following that is a tautology is:

- (a) $A \wedge (A \vee B)$ (b) $B \rightarrow [A \wedge (A \rightarrow B)]$
(c) $A \vee (A \wedge B)$ (d) $[A \wedge (A \rightarrow B)] \rightarrow B$

66. Let $f: R \rightarrow R$ be defined as $f(x) = 2x - 1$ and $g: R - \{1\} \rightarrow R$ be defined as $g(x) = \frac{x-\frac{1}{2}}{x-1}$.

Then the composition function $f(g(x))$ is:

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

67. If $f: R \rightarrow R$ is a function defined by $f(x) = [x - 1] \cos\left(\frac{2x-1}{2}\pi\right)$, where $[.]$ denotes the greatest integer function, then f is :

- (a) discontinuous only at $x = 1$
(b) discontinuous at all integral values of x except at $x = 1$
(c) continuous only at $x = 1$
(d) continuous for every real x

68. The function $f(x) = \frac{4x^3-3x^2}{6} - 2\sin x + (2x-1)\cos x$:

- (a) increases in $\left[\frac{1}{2}, \infty\right)$ (b) decreases $\left(-\infty, \frac{1}{2}\right]$
(c) increases in $\left(-\infty, \frac{1}{2}\right]$ (d) decreases $\left[\frac{1}{2}, \infty\right)$

69. The distance of the point (1, 1, 9) from the point of intersection of the line $\frac{x-3}{1} = \frac{y-4}{2} = \frac{z-5}{2}$ and the plane $x + y + z = 17$ is:

- (a) $\sqrt{38}$ (b) $19\sqrt{2}$
(c) $2\sqrt{19}$ (d) 38

70. $\lim_{x \rightarrow 0} \frac{\int_0^{x^2} (\sin \sqrt{t}) dt}{x^3}$ is equal to:

- (a) $\frac{2}{3}$ (b) 0
(c) $\frac{1}{15}$ (d) $\frac{3}{2}$

71. Two vertical poles are 150 m apart and the height of one is three times that of the other. If from the middle point of the line joining their feet, an observer finds the angles of elevation of their tops to be complementary, then the height of the shorter pole (in meters) is:

- (a) 25 (b) $20\sqrt{3}$
(c) 30 (d) $25\sqrt{3}$

72. If the tangent to the curve $y = x^3$ at the point $P(t, t^3)$ meets the curve again at Q , then the ordinate of the point which divides PQ internally in the ratio 1: 2 is :

- (a) $-2t^3$ (b) $-t^3$
(c) 0 (d) $2t^3$

73. The area (in sq. units) of the part of the circle $x^2 + y^2 = 36$, which is outside the parabola $y^2 = 9x$, is:

- (a) $24\pi + 3\sqrt{3}$ (b) $12\pi + 3\sqrt{3}$
(c) $12\pi - 3\sqrt{3}$ (d) $24\pi - 3\sqrt{3}$

74. If $\int \frac{\cos x - \sin x}{\sqrt{8 - \sin 2x}} dx = a \sin^{-1} \left(\frac{\sin x + \cos x}{b} \right) + c$, where c is a constant of integration, then the ordered pair (a, b) is equal to :
- (a) $(1, -3)$ (b) $(1, 3)$
(c) $(-1, 3)$ (d) $(3, 1)$
75. The population $P = P(t)$ at time ' t ' of a certain species follows the differential equation $\frac{dP}{dt} = 0.5P - 450$. If $P(0) = 850$, then the time at which population becomes zero is :
- (a) $\frac{1}{2} \log_e 18$ (b) $2 \log_e 18$
(c) $\log_e 9$ (d) $\log_e 18$
76. The value of ${}^{15}C_1 + 2 \cdot {}^{15}C_2 - 3 \cdot {}^{15}C_3 + \dots - 15 \cdot {}^{15}C_{15} + {}^{14}C_1 + {}^{14}C_3 + {}^{14}C_5 + \dots + {}^{14}C_{11}$ is:
- (a) 2^{14} (b) $2^{13} - 13$
(c) $2^{16} - 1$ (d) $2^{13} - 14$
77. An ordinary dice is rolled for a certain number of times. If the probability of getting an odd number 2 times is equal to the probability of getting an even number 3 times, then the probability of getting an odd number for odd number of times is :
- (a) $\frac{3}{16}$ (b) $\frac{1}{2}$
(c) $\frac{5}{16}$ (d) $\frac{1}{32}$
78. Let p and q be two positive number such that $p + q = 2$ and $p^4 + q^4 = 272$. Then p and q are roots of the equation :
- (a) $x^2 - 2x + 2 = 0$ (b) $x^2 - 2x + 8 = 0$
(c) $x^2 - 2x + 136 = 0$ (d) $x^2 - 2x + 16 = 0$
79. If $e^{(\cos^2 x + \cos^4 x + \cos^6 x + \dots) \log_e 2}$ satisfies the equation $t^2 - 9t + 8 = 0$, then the value of $\frac{2 \sin x}{\sin x + \sqrt{3} \cos x} \left(0 < x < \frac{\pi}{2} \right)$ is :
- (a) $\frac{3}{2}$ (b) $2\sqrt{3}$
(c) $\frac{1}{2}$ (d) $\sqrt{3}$
80. The system of linear equations
- $$3x - 2y - kz = 10$$
- $$2x - 4y - 2z = 6$$
- $$x + 2y - z = 5m$$
- is inconsistent if:
- (a) $k = 3, m = \frac{4}{5}$ (b) $k \neq 3, m \in R$
(c) $k \neq 3, m \neq \frac{4}{5}$ (d) $k = 3, m \neq \frac{4}{5}$

Section - B

81. Let $P = \begin{bmatrix} 3 & -1 & -2 \\ 2 & 0 & \alpha \\ 3 & -5 & 0 \end{bmatrix}$, where $\alpha \in R$. Suppose $Q = [q_{ij}]$ is a matrix satisfying $PQ = k_3$ for some non-zero $k \in R$. If $q_{23} = -\frac{k}{8}$ and $|Q| = \frac{k^2}{2}$, then $\alpha^2 + k^2$ is equal to
82. Let $B_i (i = 1, 2, 3)$ be three independent events in a sample space. The probability that only B_1 occur is α , only B_2 occurs is β and only B_3 occurs is γ . Let p be the probability that none of the events B_i occurs and these 4 probabilities satisfy the equations $(\alpha - 2\beta)p = \alpha\beta$ and $(\beta - 3\gamma)p = 2\beta\gamma$ (All the probabilities are assumed to lie in the interval $(0, 1)$). Then $\frac{P(B_1)}{P(B_3)}$ is equal to

83. The minimum value of α for which the equation $\frac{4}{\sin x} + \frac{1}{1-\sin x} = \alpha$ has at least one solution in $\left(0, \frac{\pi}{2}\right)$ is
84. If one of the diameters of the circle $x^2 + y^2 - 2x - 6y + 6 = 0$ is a chord of another circle 'C' whose center is at $(2, 1)$, then its radius is
85. $\lim_{x \rightarrow \infty} \tan \left\{ \sum_{r=1}^n \tan^{-1} \left(\frac{1}{1+r+r^2} \right) \right\}$ is equal to
86. If $\int_{-a}^a (|x| + |x-2|) dx = 22$, $(a > 2)$ and $[x]$ denotes the greatest integer $\leq x$, then $\int_a^{-a} (x + [x]) dx$ is equal to
87. Let three vectors $\vec{a}, \vec{b}$ and $\vec{c}$ be such that $\vec{c}$ is coplanar with $\vec{a}$ and $\vec{b}$, $\vec{a} \cdot \vec{c} = 7$ and $\vec{b}$ is perpendicular to $\vec{c}$, where $\vec{a} = -\hat{i} + \hat{j} + \hat{k}$ and $\vec{b} = 2\hat{i} + \hat{k}$, then the value of $2\vec{a} + \vec{b} + \vec{c}$ is
88. Let $A = \{n \in N : n \text{ is a 3-digit number}\}$
 $B = \{9k + 2 : k \in N\}$
 and
 $C = \{9k + \ell : k \in N\}$ for some $\ell (0 < \ell < 9)$
 If the sum of all the elements of the set $A \cap (B \cup C)$ is 274×400 , then ℓ is equal to
89. If the least and the largest real values of α , for which the equation $z + \alpha|z-1| + 2i = 0$ ($z \in C$ and $i = \sqrt{-1}$) has a solution, are p and q respectively; then $4(p^2 + q^2)$ is equal to
90. Let M be any 3×3 matrix with entries from the set $\{0, 1, 2\}$. The maximum number of such matrices, for which the sum of diagonal elements of $M^T M$ is seven, is