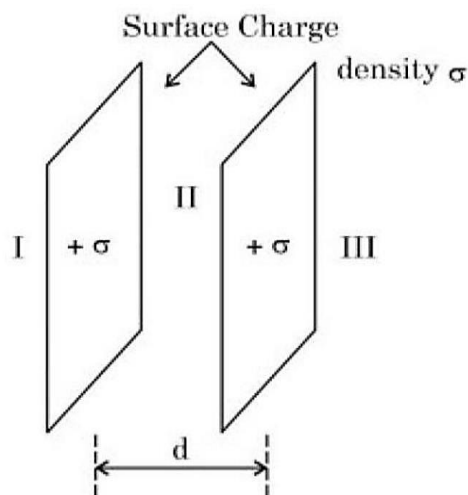


PART-I PHYSICS

SECTION-A

- A child stands on the edge of the cliff 10 m above the ground and throws a stone horizontally with an initial speed of 5 ms^{-1} . Neglecting the air resistance, the speed with which the stone hits the ground will be ms^{-1} (given, $g = 10 \text{ ms}^{-2}$).
(a) 15 (b) 20
(c) 30 (d) 25
- Let σ be the uniform surface charge density of two infinite thin plane sheets shown in figure. Then the electric fields in three different region E_I , E_{II} and E_{III} are:



- $\vec{E}_I = \frac{2\sigma}{\epsilon_0} \hat{n}$, $\vec{E}_{II} = 0$, $\vec{E}_{III} = \frac{2\sigma}{\epsilon_0} \hat{n}$
- $\vec{E}_I = \frac{\sigma}{2\epsilon_0} \hat{n}$, $\vec{E}_{II} = 0$, $\vec{E}_{III} = \frac{\sigma}{2\epsilon_0} \hat{n}$
- $\vec{E}_I = -\frac{\sigma}{\epsilon_0} \hat{n}$, $\vec{E}_{II} = 0$, $\vec{E}_{III} = \frac{\sigma}{\epsilon_0} \hat{n}$
- $\vec{E}_I = 0$, $\vec{E}_{II} = \frac{\sigma}{\epsilon_0} \hat{n}$, $E_{III} = 0$

- A mercury drop of radius 10^{-3} m is broken into 125 equal size droplets.

Surface tension of mercury is 0.45 Nm^{-1} . The gain in surface energy is:

- $28 \times 10^{-5} \text{ J}$
- $17.5 \times 10^{-5} \text{ J}$
- $5 \times 10^{-5} \text{ J}$
- $2.26 \times 10^{-5} \text{ J}$

- If earth has a mass nine times and radius twice to that of a planet P. Then $\frac{v_e}{3} \sqrt{x} \text{ ms}^{-1}$ will be the minimum velocity required by a rocket to pull out of gravitational force of P, where v_e is escape velocity on earth. The value of x is

- 1
- 3
- 18
- 2

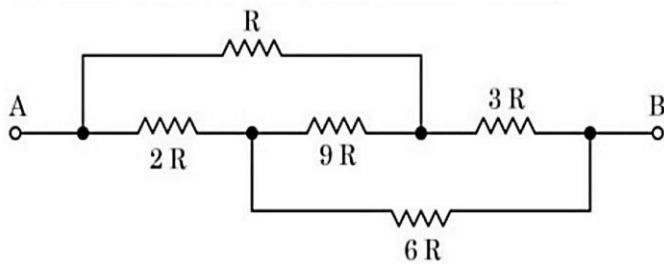
- A sample of gas at temperature T is adiabatically expanded to double its volume. The work done by the gas in the process is (given, $\gamma = \frac{3}{2}$) :

- $W = \frac{T}{R} [\sqrt{2} - 2]$
- $W = RT [2 - \sqrt{2}]$
- $W = TR [\sqrt{2} - 2]$
- $W = \frac{R}{T} [2 - \sqrt{2}]$

- $(P + \frac{a}{V^2})(V - b) = RT$ represents the equation of state of some gases. Where P is the pressure, V is the volume, T is the temperature and a, b, R are the constants. The physical quantity, which has dimensional formula as that of $\frac{b^2}{a}$, will be:

- Compressibility
- Energy density
- Modulus of rigidity
- Bulk modulus

7. The equivalent resistance between A and B of the network shown in figure:



- (a) $\frac{8}{3}R$ (b) $21R$
(c) $14R$ (d) $11\frac{2}{3}R$

8. Match List I with List II:

List I	List II
A. AC generator	I. Presence of both L and C
B. Transformer	II. Electromagnetic Induction
C. Resonance phenomenon to occur	III. Quality factor
D. Sharpness of resonance	IV. Mutual Induction

Choose the correct answer from the options given below:

- (a) A-IV, B-III, C-I, D-II (b) A-IV, B-II, C-I, D-III
(c) A-II, B-IV, C-I, D-III (d) A-II, B-I, C-III, D-IV

9. An object moves with speed v_1 , v_2 and v_3 along a line segment AB, BC and CD respectively as shown in figure. Where $AB = BC$ and $AD = 3AB$, then average speed of the object will be:



- (a) $\frac{(v_1+v_2+v_3)}{3v_1v_2v_3}$ (b) $\frac{(v_1+v_2+v_3)}{3}$
(c) $\frac{3v_1v_2v_3}{(v_1v_2+v_2v_3+v_3v_1)}$ (d) $\frac{v_1v_2v_3}{3(v_1v_2+v_2v_3+v_3v_1)}$

10. 'n' polarizing sheets are arranged such that each makes an angle 45° with the preceding sheet. An unpolarized light of intensity I is incident into this arrangement. The output intensity is found to be $I/64$. The value of n will be:

- (a) 4 (b) 3
(c) 5 (d) 6

11. Match List I with List II:

List I	List II
--------	---------

(A) Microwaves	(I) Radioactive decay of the nucleus
(B) Gamma rays	(II) Rapid acceleration and deceleration of electron in aerials
(C) Radio waves	(III) Inner shell electrons
(D) X-rays	(IV) Klystron valve

Choose the correct answer from the options given below:

- (a) A-I, B-III, C-IV, D-II (b) A-IV, B-I, C-II, D-III
(c) A-IV, B-III, C-II, D-I (d) A-I, B-II, C-III, D-IV

12. A proton moving with one tenth of velocity of light has a certain de Broglie wavelength of λ . An alpha particle having certain kinetic energy has the same de-Broglie wavelength λ . The ratio of kinetic energy of proton and that of alpha particle is:

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

13. A block of mass 5 kg is placed at rest on a table of rough surface. Now, if a force of 30 N is applied in the direction parallel to surface of the table, the block slides through a distance of 50 m in an interval of time 10 s. Coefficient of kinetic friction is (given, $g = 10 \text{ ms}^{-2}$):

- (a) 0.60 (b) 0.25
(c) 0.75 (d) 0.50

14. Given below are two statements:

Statement I: Acceleration due to gravity is different at different places on the surface of earth.

Statement II: Acceleration due to gravity increases as we go down below the earth's surface.

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

15. Which of the following frequencies does not belong to FM broadcast?

- (a) 64MHz (b) 89MHz
(c) 99MHz (d) 106MHz

16. The mass of proton, neutron and helium nucleus are respectively 1.0073u, 1.0087u and 4.0015u. The binding energy of helium nucleus is:

- (a) 28.4MeV (b) 56.8MeV
(c) 14.2MeV (d) 7.1MeV

17. A steel wire with mass per unit length $7.0 \times 10^{-3} \text{ kg m}^{-1}$ is under tension of 70 N. The speed of transverse waves in the wire will be:

- (a) 100 m/s (b) 10 m/s
(c) 50 m/s (d) $200\pi \text{ m/s}$

18. Match List I with List II:

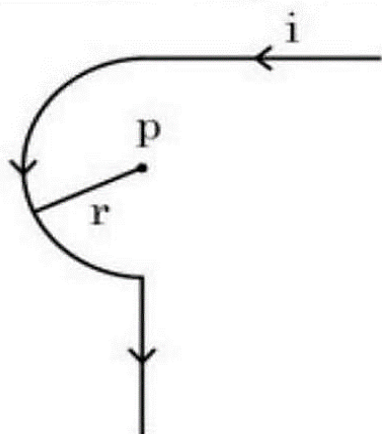
List I	List II
--------	---------

A. Intrinsic semiconductor	I. Fermi-level near the valence band
B. n-type semiconductor	II. Fermi-level in the middle of valence and conduction band
C. p-type semiconductor	III. Fermi-level near the conduction band
D. Metals	IV. Fermi-level inside the conduction band

Choose the correct answer from the options given below:

- (a) A-II, B-III, C-I, D-IV (b) A-I, B-II, C-III, D-IV
(c) A-II, B-I, C-III, D-IV (d) A-III, B-I, C-II, D-IV

19. Find the magnetic field at the point P in figure. The curved portion is a semicircle connected to two long straight wires.



- (a) $\frac{\mu_0 i}{2r} \left(1 + \frac{2}{\pi}\right)$ (b) $\frac{\mu_0 i}{2r} \left(\frac{1}{2} + \frac{1}{2\pi}\right)$
(c) $\frac{\mu_0 i}{2r} \left(1 + \frac{1}{\pi}\right)$ (d) $\frac{\mu_0 i}{2r} \left(\frac{1}{2} + \frac{1}{\pi}\right)$

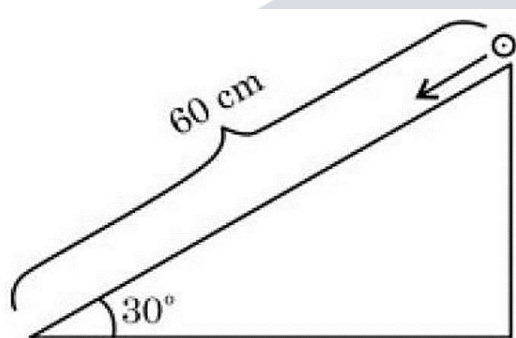
20. The average kinetic energy of a molecule of the gas is

- (a) proportional to absolute temperature
(b) proportional to pressure
(c) proportional to volume
(d) dependent on the nature of the gas

SECTION - B

21. A small particle moves to position $5\hat{i} - 2\hat{j} + \hat{k}$ from its initial position $2\hat{i} + 3\hat{j} - 4\hat{k}$ under the action of force $5\hat{i} + 2\hat{j} + 7\hat{k}$ N. The value of work done will be ____ J.
22. A certain pressure 'P' is applied to 1 litre of water and 2 litre of a liquid separately. Water gets compressed to 0.01% whereas the liquid gets compressed to 0.03%. The ratio of Bulk modulus of water to that of the liquid is $\frac{3}{x}$. The value of x is

23. A light of energy 12.75 eV is incident on a hydrogen atom in its ground state. The atom absorbs the radiation and reaches to one of its excited states. The angular momentum of the atom in the excited state is $\frac{x}{\pi} \times 10^{-17}$ eVs. The value of x is ____ (use $h = 4.14 \times 10^{-15}$ eVs, $c = 3 \times 10^8$ ms⁻¹).
24. A charge particle of 2 μ C accelerated by a potential difference of 100 V enters a region of uniform magnetic field of magnitude 4 mT at right angle to the direction of field. The charge particle completes semicircle of radius 3 cm inside magnetic field. The mass of the charge particle is ____ $\times 10^{-18}$ kg.
25. The amplitude of a particle executing SHM is 3 cm. The displacement at which its kinetic energy will be 25% more than the potential energy is: ____ cm.
26. In an experiment to find emf of a cell using potentiometer, the length of null point for a cell of emf 1.5 V is found to be 60 cm. If this cell is replaced by another cell of emf E, the length-of null point increases by 40 cm. The value of E is $\frac{x}{10}$ V. The value of x is ____
27. A thin cylindrical rod of length 10 cm is placed horizontally on the principle axis of a concave mirror of focal length 20 cm. The rod is placed in a such a way that mid point of the rod is at 40 cm from the pole of mirror. The length of the image formed by the mirror will be $\frac{x}{3}$ cm. The value of x is ____
28. A solid cylinder is released from rest from the top of an inclined plane of inclination 30° and length 60 cm. If the cylinder rolls without slipping, its speed upon reaching the bottom of the inclined ____ plane is ms⁻¹. (Given $g = 10$ ms⁻²)



29. A series LCR circuit is connected to an ac source of 220 V, 50 Hz. The circuit contain a resistance $R = 100 \Omega$ and an inductor of inductive reactance $X_L = 79.6 \Omega$. The capacitance of the capacitor needed to maximize the average rate at which energy is supplied will be ____ μ F.
30. Two equal positive point charges are separated by a distance 2a. The distance of a point from the centre of the line joining two charges on the equatorial line (perpendicular bisector) at which force experienced by a test charge q_0 becomes maximum is $\frac{a}{\sqrt{x}}$. The value of x is ____

PART-II CHEMISTRY

SECTION - A

31. A solution of FeCl_3 when treated with $\text{K}_4[\text{Fe}(\text{CN})_6]$ gives a prussian blue precipitate due to the formation of
 (a) $\text{K}[\text{Fe}_2(\text{CN})_6]$ (b) $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$
 (c) $\text{Fe}[\text{Fe}(\text{CN})_6]$ (d) $\text{Fe}_3[\text{Fe}(\text{CN})_6]_2$
32. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

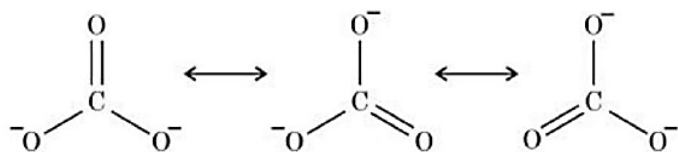
Assertion A: Hydrogen is an environment friendly fuel.

Reason R: Atomic number of hydrogen is 1 and it is a very light element.

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

- (a) A is true but R is false
- (b) A is false but R is true
- (c) Both A and R are true and R is the correct explanation of A
- (d) Both A and R are true but R is NOT the correct explanation of A

33. Resonance in carbonate ion (CO_3^{2-}) is



Which of the following is true?

- (a) All these structures are in dynamic equilibrium with each other.
- (b) It is possible to identify each structure individually by some physical or chemical method.
- (c) Each structure exists for equal amount of time.
- (d) CO_3^{2-} has a single structure i.e., resonance hybrid of the above three structures.

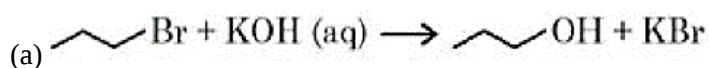
34. Match List I with List II

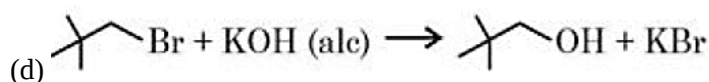
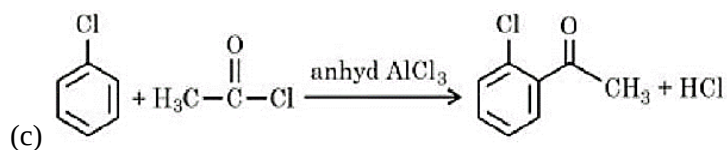
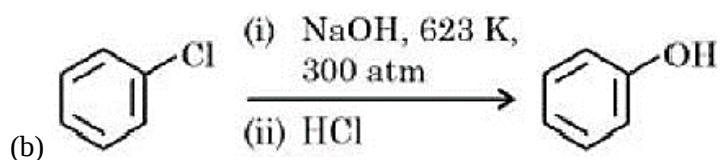
List I	List II
(A) Tranquilizers	(I) Anti blood clotting
(B) Aspirin	(II) Salvarsan
(C) Antibiotic	(III) antidepressant drugs
(D) Antiseptic	(IV) soframycin

Choose the correct answer from the options given below:

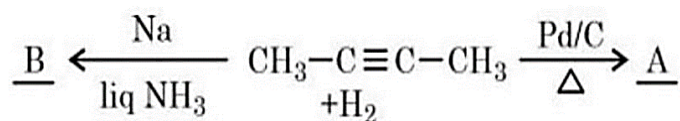
- (a) (A) -IV, (B) - II, (C) - I, (D) - III
- (b) (A) - II, (B) - I, (C) - III, (D) - IV
- (c) (A) - III, (B) - I, (C) - II, (D) - IV
- (d) (A) - II, (B) -IV, (C) - I, (D) - III

35. Identify the incorrect option from the following:





36. But-2-yne is reacted separately with one mole of Hydrogen as shown below:



A. A is more soluble than B.

B. The boiling point & melting point of A are higher and lower than B respectively.

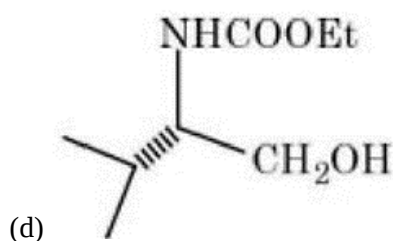
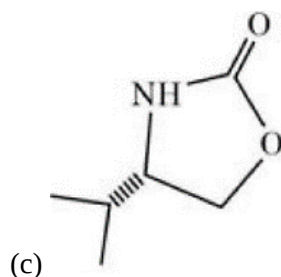
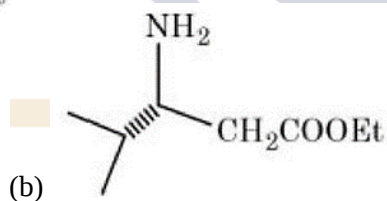
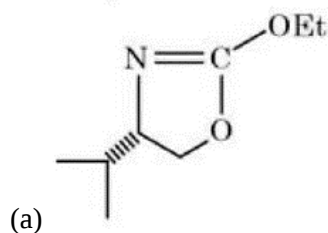
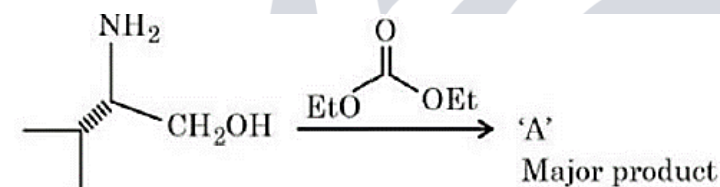
C. A is more polar than B because dipole moment of A is zero.

D. Br₂ adds easily to B than A.

Identify the incorrect statements from the options given below:

- (a) B, C & D only (b) A and B only
(c) A, C & D only (d) B and C only

37. In the following reaction, 'A' is



38. Highest oxidation state of Mn is exhibited in Mn₂O₇. The correct statements about Mn₂O₇ are

(A) Mn is tetrahedrally surrounded by oxygen atoms.

(B) Mn is octahedrally surrounded by oxygen atoms.

(C) Contains Mn-O-Mn bridge.

(D) Contains Mn-Mn bond.

Choose the correct answer from the options given below:

- (a) A and Conly (b) A and D only
(c) B and C only (d) B and D only

39. Match List I with List II

	List I	List II
(A)	Slaked lime	(I) NaOH
(B)	Dead burnt plaster	(II) $\text{Ca}(\text{OH})_2$
(C)	Caustic soda	(III) $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
(D)	Washing soda	(IV) CaSO_4

Choose the correct answer from the options given below:

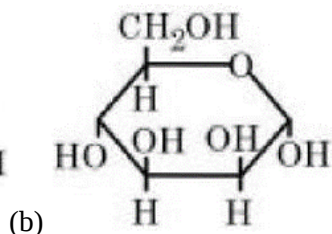
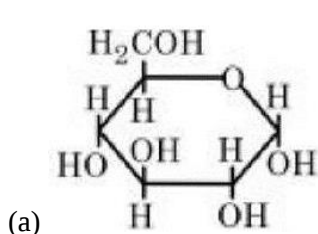
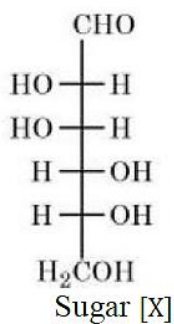
(a) (A) - III, (B) - IV, (C) - II, (D) - I

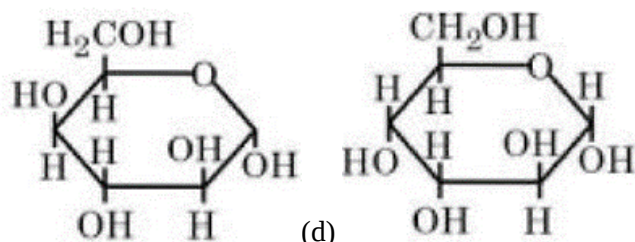
(b) (A) - III, (B) - II, (C) - IV, (D) - I

(c) (A) - I, (B) - IV, (C) - II, (D) - III

(d) (A) - II, (B) - IV, (C) - I, (D) - III

40. The correct representation in six membered pyranose form for the following sugar [X] is





41. Which of the following complex will show largest splitting of d-orbitals?

- (a) $[\text{FeF}_6]^{3-}$ (b) $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$
 (c) $[\text{Fe}(\text{CN})_6]^{3-}$ (d) $[\text{Fe}(\text{NH}_3)_6]^{3+}$

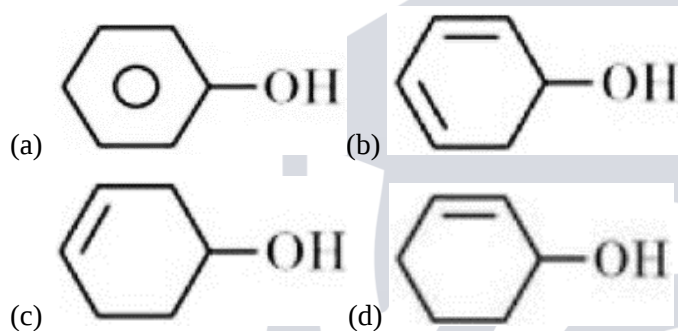
42. Which of the following are the example of double salt?

- (A) $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
 (B) $\text{CuSO}_4 \cdot 4\text{NH}_3\text{H}_2\text{O}$
 (C) $\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$
 (D) $\text{Fe}(\text{CN})_2 \cdot 4\text{KCN}$

Choose the correct answer

- (a) B and D only (b) A and C only
 (c) A and B only (d) A, B and D only

43. Decreasing order of dehydration of the following alcohols is



44. Given below are two statements:

Statement I: Chlorine can easily combine with oxygen to form oxides; and the product has a tendency to explode.

Statement II: Chemical reactivity of an element can be determined by its reaction with oxygen and halogens.

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

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

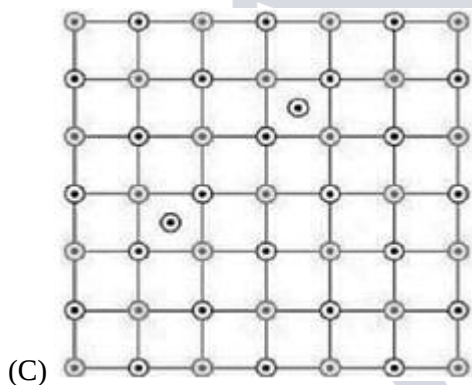
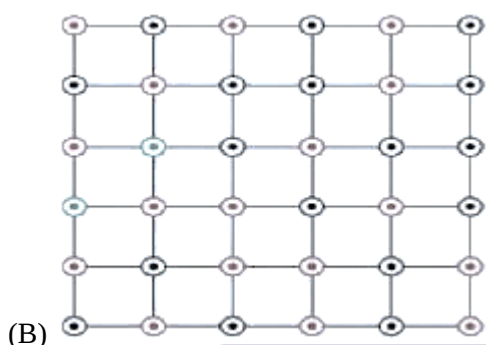
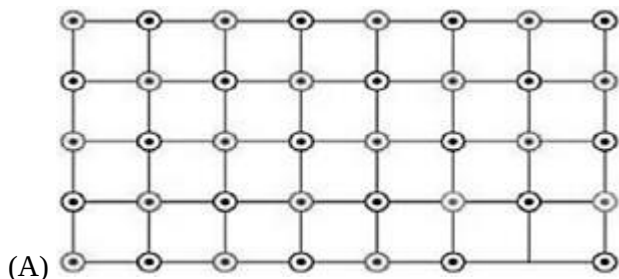
45. Choose the correct statement(s):

- (A) Beryllium oxide is purely acidic in nature.
 (B) Beryllium carbonate is kept in the atmosphere of CO_2 .
 (C) Beryllium sulphate is readily soluble in water.
 (D) Beryllium shows anomalous behavior.

Choose the correct answer from the options given below:

- (a) B, C and D only (b) A only
(c) A, B and C only (d) A and B only

46. Which of the following represents the lattice structure of $A_{0.95}O$ containing A^{2+} , A^{3+} and O^{2-} ions? $\odot$
 $A^{2+} \odot A^{3+} \odot O^{2-}$



- (a) A only (b) B and C only
(c) A and B only (d) B only

47. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

Assertion A: In an Ellingham diagram, the oxidation of carbon to carbon monoxide shows a negative slope with respect to temperature.

Reason R: CO tends to get decomposed at higher temperature.

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

- (a) Both A and R are correct but R is NOT the correct explanation of A
(b) Both A and R are correct and R is the correct explanation of A
(c) A is correct but R is not correct
(d) A is not correct but R is correct

48. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R

Assertion A: Amongst He, Ne, Ar and Kr; 1 g of activated charcoal adsorbs more of Kr.

Reason R: The critical volume V_c ($\text{cm}^3 \text{mol}^{-1}$) and critical pressure P_c (atm) is highest for Krypton but the compressibility factor at critical point Z_c is lowest for Krypton.

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

- (a) A is true but R is false
- (b) Both A and R are true and R is the correct explanation of A
- (c) A is false but R is true
- (d) Both A and R are true but R is NOT the correct explanation of A

49. Match List I with List II

	List I	List II
	Test	Functional group / Class of Compound
(A)	Molisch's Test	(I) Peptide
(B)	Biuret Test	(II) Carbohydrate
(C)	Carbylamine Test	(III) Primary amine
(D)	Schiff's Test	(IV) Aldehyde

Choose the correct answer from the options given below:

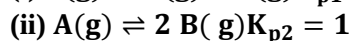
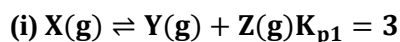
- (a) (A) - III, (B) - IV, (C) - I, (D) - II
- (b) (A) - II, (B) - I, (C) - III, (D) - IV
- (c) (A) - III, (B) - IV, (C) - II, (D) - I
- (d) (A) - I, (B) - II, (C) - III, (D) - IV

50. How can photochemical smog be controlled?

- (a) By using catalytic convertors in the automobiles/industry.
- (b) By complete combustion of fuel.
- (c) By using tall chimneys.
- (d) By using catalyst.

SECTION-B

51.



If the degree of dissociation and initial concentration of both the reactants $X(g)$ and $A(g)$ are equal, then the ratio of the total pressure at equilibrium $\left(\frac{p_1}{p_2}\right)$ is equal to $x:1$. The value of x is ____ (Nearest integer)

52. Electrons in a cathode ray tube have been emitted with a velocity of 1000 m s^{-1} . The number of following statements which is/are true about the emitted radiation is

Given: $h = 6 \times 10^{-34} \text{ Js}$, $m_e = 9 \times 10^{-31} \text{ kg}$.

- (A) The deBroglie wavelength of the electron emitted is 666.67 nm.
- (B) The characteristic of electrons emitted depend upon the material of the electrodes of the cathode ray tube.
- (C) The cathode rays start from cathode and move towards anode.
- (D) The nature of the emitted electrons depends on the nature of the gas present in cathode ray tube.

53. A and B are two substances undergoing radioactive decay in a container.

The half-life of A is 15 min and that of B is 5 min. If the initial concentration of B is 4 times that of A and they both start decaying at the same time, how much time will it take for the concentration of both of them to be same? ____ min.

54. Sum of oxidation states of bromine in bromic acid and perbromic acid is

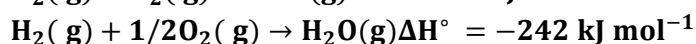
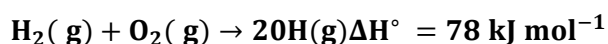
55. 25 mL of an aqueous solution of KCl was found to require 20 mL of 1 M AgNO_3 solution when titrated using K_2CrO_4 as an indicator. What is the depression in freezing point of KCl solutions of the given concentration? ____ (Nearest integer).

(Given: $K_f = 2.0 \text{ K kg mol}^{-1}$)

Assume 1) 100% ionization and

2) density of the aqueous solution as 1 g mL^{-1}

56. At 25°C , the enthalpy of the following processes are given:



What would be the value of X for the following reaction?
(Nearest integer)



57. At what pH, given half cell $\text{MnO}_4^- (0.1\text{M}) \mid \text{Mn}^{2+} (0.001\text{M})$ will have electrode potential of 1.282 V ?
(Nearest Integer)

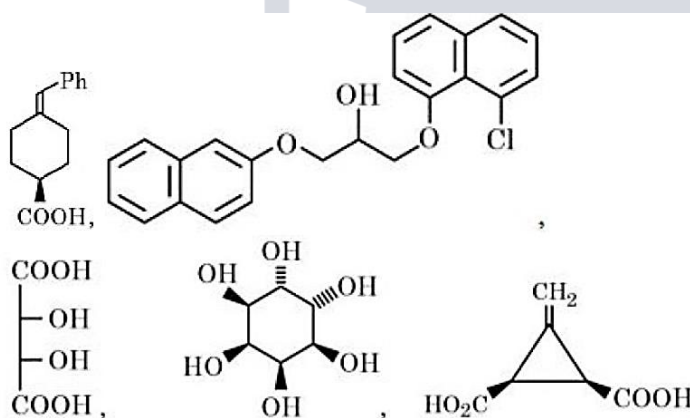
Given $E^\circ_{\text{MnO}_4^-/\text{Mn}^{2+}} = 1.54 \text{ V}$, $\frac{2.303RT}{F} = 0.059 \text{ V}$

58. The density of 3M solution of NaCl is 1.0 g mL^{-1} . Molality of the solution is $\times 10^{-2} \text{ m}$.
(Nearest integer). Given: Molar mass of Na and Cl is 23 and 35.5 g mol^{-1} respectively.

59. Number of isomeric compounds with molecular formula

$\text{C}_9\text{H}_{10}\text{O}$ which (i) do not dissolve in NaOH (ii) do not dissolve in HCl. (iii) do not give orange precipitate with 2,4DNP (iv) on hydrogenation give identical compound with molecular formula $\text{C}_9\text{H}_{12}\text{O}$ is

60. The total number of chiral compound/s from the following is



PART-III MATHEMATICS

SECTION A

61. If $y = y(x)$ is the solution curve of the differential equation $\frac{dy}{dx} + y \tan x = x \sec x$, $0 \leq x \leq \frac{\pi}{3}$, $y(0) = 1$, then

$y\left(\frac{\pi}{6}\right)$ is equal to

- (a) $\frac{\pi}{12} - \frac{\sqrt{3}}{2} \log_e \left(\frac{2\sqrt{3}}{e} \right)$ (b) $\frac{\pi}{12} - \frac{\sqrt{3}}{2} \log_e \left(\frac{2}{e\sqrt{3}} \right)$
(c) $\frac{\pi}{12} + \frac{\sqrt{3}}{2} \log_e \left(\frac{2}{e\sqrt{3}} \right)$ (d) $\frac{\pi}{12} + \frac{\sqrt{3}}{2} \log_e \left(\frac{2\sqrt{3}}{e} \right)$

62. Let R be a relation on $\mathbb{R}$, given by

Then R is

$R = \{(a, b) : 3a - 3b + \sqrt{7} \text{ is an irrational number} \}$

- (a) an equivalence relation
- (b) reflexive and symmetric but not transitive
- (c) reflexive but neither symmetric nor transitive
- (d) reflexive and transitive but not symmetric

63. For a triangle ABC, the value of $\cos 2A + \cos 2B + \cos 2C$ is least. If its inradius is 3 and incentre is M, then which of the following is NOT correct?

- (a) perimeter of $\triangle ABC$ is $18\sqrt{3}$
- (b) $\sin 2A + \sin 2B + \sin 2C = \sin A + \sin B + \sin C$
- (c) $\overrightarrow{MA} \cdot \overrightarrow{MB} = -18$
- (d) area of $\triangle ABC$ is $\frac{27\sqrt{3}}{2}$

64. Let S be the set of all solutions of the equation $\cos^{-1}(2x) - 2\cos^{-1}(\sqrt{1-x^2}) = \pi, x \in \left[-\frac{1}{2}, \frac{1}{2}\right]$. Then

$\sum_{x \in S} 2\sin^{-1}(x^2 - 1)$ is equal to

- (a) $\pi - 2\sin^{-1}\left(\frac{\sqrt{3}}{4}\right)$
- (b) $\pi - \sin^{-1}\left(\frac{\sqrt{3}}{4}\right)$
- (c) $\frac{-2\pi}{3}$
- (d) None of these

65. Let S denote the set of all real values of λ such that the system of equations

$$\lambda x + y + z = 1$$

$$x + \lambda y + z = 1$$

$$x + y + \lambda z = 1$$

is inconsistent, then $\sum_{\lambda \in S} (|\lambda|^2 + |\lambda|)$ is equal to

- (a) 4
- (b) 12
- (c) 6
- (d) 2

66. In a binomial distribution $B(n, p)$, the sum and the product of the mean and the variance are 5 and 6 respectively, then $6(n + p - q)$ is equal to

- (a) 52
- (b) 50
- (c) 51
- (d) 53

67. The combined equation of the two lines $ax + by + c = 0$ and $a'x + b'y + c' = 0$ can be written as $(ax + by + c)(a'x + b'y + c') = 0$.

The equation of the angle bisectors of the lines represented by the equation

$$2x^2 + xy - 3y^2 = 0 \text{ is}$$

- (a) $x^2 - y^2 - 10xy = 0$
- (b) $x^2 - y^2 + 10xy = 0$
- (c) $3x^2 + 5xy + 2y^2 = 0$
- (d) $3x^2 + xy - 2y^2 = 0$

68. The area enclosed by the closed curve C given by the differential equation $\frac{dy}{dx} + \frac{x+a}{y-2} = 0, y(a) = 0$ is 4π . Let P and Q be the points of intersection of the curve C and the y-axis. If normals at P and Q on the curve C intersect x-axis at points R and S respectively, then the length of the line segment RS is

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

69. The value of

$$\frac{1}{1!50!} + \frac{1}{3!48!} + \frac{1}{5!46!} + \dots + \frac{1}{49!2!} + \frac{1}{51!1!} \text{ is:}$$

- (a) $\frac{2^{50}}{51!}$ (b) $\frac{2^{51}}{50!}$
(c) $\frac{2^{50}}{50!}$ (d) $\frac{2^{51}}{51!}$

70. The mean and variance of 5 observations are 5 and 8 respectively. If 3 observations are 1, 3, 5 then the sum of cubes of the remaining two observations is

- (a) 1216 (b) 1072
(c) 1456 (d) 1792

71. The sum to 10 terms of the series

$$\frac{1}{1+1^2+1^4} + \frac{2}{1+2^2+2^4} + \frac{3}{1+3^2+3^4} + \dots \text{ is}$$

- (a) $\frac{55}{111}$ (b) $\frac{56}{111}$
(c) $\frac{58}{111}$ (d) $\frac{59}{111}$

72. The shortest distance between the lines

$$\frac{x-5}{1} = \frac{y-2}{2} = \frac{z-4}{-3} \text{ and } \frac{x+3}{1} = \frac{y+5}{4} = \frac{z-1}{-5} \text{ is}$$

- (a) $5\sqrt{3}$ (b) $7\sqrt{3}$
(c) $6\sqrt{3}$ (d) $4\sqrt{3}$

73. $\lim_{n \rightarrow \infty} \left[\frac{1}{1+n} + \frac{1}{2+n} + \frac{1}{3+n} + \dots + \frac{1}{2n} \right]$ is equal to

- (a) $\log_e 2$ (b) $\log_e \left(\frac{3}{2} \right)$
(c) $\log_e \left(\frac{2}{3} \right)$ (d) 0

74. Let the image of the point P(2, -1, 3) in the plane $x + 2y - z = 0$ be Q. Then the distance of the plane $3x + 2y + z + 29 = 0$ from the point Q is

- (a) $\frac{24\sqrt{2}}{7}$ (b) $2\sqrt{14}$
(c) $3\sqrt{14}$ (d) $\frac{22\sqrt{2}}{7}$

75. Let $f(x) = 2x + \tan^{-1} x$ and $g(x) = \log_e (\sqrt{1+x^2} + x)$, $x \in [0, 3]$.

Then

- (a) $\min f'(x) = 1 + \max g'(x)$
(b) $\max f(x) > \max g(x)$
(c) there exist $0 < x_1 < x_2 < 3$ such that $f(x) < g(x)$, $\forall x \in (x_1, x_2)$
(d) there exists $\hat{x} \in [0, 3]$ such that $f'(\hat{x}) < g'(\hat{x})$

76. If the ortho centre of the triangle, whose vertices are (1, 2), (2, 3) and (3, 1) is (α, β) , then the quadratic equation whose roots are $\alpha + 4\beta$ and $4\alpha + \beta$, is

- (a) $x^2 - 20x + 99 = 0$
(b) $x^2 - 19x + 90 = 0$

(c) $x^2 - 22x + 120 = 0$

(d) $x^2 - 18x + 80 = 0$

77. Let $S = \{x: x \in \mathbb{R} \text{ and } (\sqrt{3} + \sqrt{2})^{x^2-4} + (\sqrt{3} - \sqrt{2})^{x^2-4} = 10\}$

Then $n(S)$ is equal to

(a) 4 (b) 0

(c) 6 (d) 2

78. If the center and radius of the circle $\left|\frac{z-2}{z-3}\right| = 2$ are respectively (α, β) and γ . then $3(\alpha + \beta + \gamma)$ is equal to

(a) 11 (b) 12

(c) 9 (d) 10

79. Let $f(x) = \begin{vmatrix} 1 + \sin^2 x & \cos^2 x & \sin 2x \\ \sin^2 x & 1 + \cos^2 x & \sin 2x \\ \sin^2 x & \cos^2 x & 1 + \sin 2x \end{vmatrix}$, $x \in \left[\frac{\pi}{6}, \frac{\pi}{3}\right]$. If α and β respectively are the maximum and the minimum values of f , then

(a) $\alpha^2 + \beta^2 = \frac{9}{2}$ (b) $\beta^2 - 2\sqrt{\alpha} = \frac{19}{4}$

(c) $\alpha^2 - \beta^2 = 4\sqrt{3}$ (d) $\beta^2 + 2\sqrt{\alpha} = \frac{19}{4}$

80. The negation of the expression $q \vee ((\sim q) \wedge p)$ is equivalent to

(a) $(\sim p) \vee (\sim q)$ (b) $p \wedge (\sim q)$

(c) $(\sim p) \vee q$ (d) $(\sim p) \wedge (\sim q)$

SECTION B

81. Let $\vec{v} = \alpha\hat{i} + 2\hat{j} - 3\hat{k}$, $\vec{w} = 2\alpha\hat{i} + \hat{j} - \hat{k}$ and $\vec{u}$ be a vector such that $|\vec{u}| = \alpha > 0$. If the minimum value of the scalar triple product $[\vec{u}\vec{v}\vec{w}]$ is $-\alpha\sqrt{3401}$, and $|\vec{u} \cdot \hat{i}|^2 = \frac{m}{n}$ where m and n are coprime natural numbers, then $m + n$ is equal to

82. The number of words, with or without meaning, that can be formed using all the letters of the word ASSASSINATION so that the vowels occur together, is

83. The remainder, when $19^{200} + 23^{200}$ is divided by 49, is

84. The number of 3-digit numbers, that are divisible by either 2 or 3 but not divisible by 7, is

85. Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be a differentiable function such that $f'(x) + f(x) = \int_0^2 f(t)dt$. If $f(0) = e^{-2}$, then $2f(0) - f(b)$ is equal to

86. If $f(x) = x^2 + g'(1)x + g''(2)$ and $g(x) = f(1)x^2 + xf'(x) + f''(x)$, then the value of $f(4) - g(4)$ is equal to

87. Let A be the area bounded by the curve $y = x|x - 3|$, the x -axis and the ordinates $x = -1$ and $x = 2$. Then $12A$ is equal to

88. If $\int_0^1 (x^{21} + x^{14} + x^7)(2x^{14} + 3x^7 + 6)^{1/7} dx = \frac{1}{l} (11)^{m/n}$ where $l, m, n \in \mathbb{N}$, m and n are coprime then $l + m + n$ is equal to

89. Let $a_1 = 8, a_2, a_3, \dots, a_n$ be an A.P. If the sum of its first four terms is 50 and the sum of its last four terms is 170, then the product of its middle two terms is

90. $A(2, 6, 2), B(-4, 0, \lambda), C(2, 3, -1)$ and $D(4, 5, 0), |\lambda| \leq 5$ are the vertices of a quadrilateral ABCD. If its area is 18 square units, then $5 - 6\lambda$ is equal to