JEE Main 1 Feb 2023(First Shift)

Total Time: 180

Total Marks: 300.0

Physics

Q.No.1: 'n' polarizing sheets are arranged such that each makes an angle 45° with the preceeding sheet. An unpolarized light of intensity I is incident into this arrangement. The output intensity is found to be $\frac{I}{64}$. The value of n will be

   A. 3
   B. 4
   C. 6
   D. 5

Marks:[4.00]

Q.No.2: 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, $g = 10$ ms^{-2})

   A. 0.50
   B. 0.60
   C. 0.75
   D. 0.25

Marks:[4.00]

Q.No.3: 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

Marks:[4.00]

Q.No.4: Match List I with List II:

	List I		List II
A.	Intrinsic semiconductor	I.	Fermi-level near the valance band
B.	n-type semiconductor	II.	Fermi-level in the middle of the 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

Marks:[4.00]

Q.No.5: $\left(P + \frac{a}{V^2}\right)(V - b) = RT$ 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

A. Compressibility

B. Energy density

C. Modulus of rigidity

D. Bulk modulus

Marks:[4.00]

Q.No.6: Find the magnetic field at the point P in figure. The curved portion is a semicircle connected to two long straight wires.
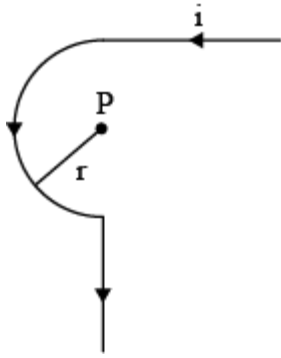
A. $\frac{\mu_0 i}{2r}\left(1 + \frac{2}{\pi}\right)$

B. $\frac{\mu_0 i}{2r}\left(1 + \frac{1}{\pi}\right)$

C. $\frac{\mu_0 i}{2r}\left(\frac{1}{2} + \frac{1}{2\pi}\right)$

D. $\frac{\mu_0 i}{2r}\left(\frac{1}{2} + \frac{1}{\pi}\right)$

Marks:[4.00]

Q.No.7: A steel wire with mass per unit length 7.0×10^{-3} kg m^{-1} is under tension of 70 N. The speed of transverse waves in the wire will be

A. 200п m/s

B. 100 m/s

C. 50 m/s

D. 10 m/s

Marks:[4.00]

Q.No.8: A sample of gas at temperature T is adiabatically expanded to double its volume. The work done by the gas in the process is $\left(\text{given, } \gamma = \frac{3}{2}\right)$

A. $W = \frac{T}{R}\left[\sqrt{2} - 2\right]$

B. $W = RT\left[\sqrt{2} - 2\right]$

C. $W = TR\left[\sqrt{2} - 2\right]$

D. $W = \frac{R}{T}\left[2 - \sqrt{2}\right]$

Marks:[4.00]

Q.No.9: The average kinetic energy of a molecule of the gas is

A. dependent on the nature of the gas

B. proportional to volume

C. proportional to absolute temperature

D. proportional to pressure

4.00]

Marks:[4.00]

Q.No.10: 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 resonance	IV	Mutual Induction

Choose the correct answer from the options given below
  A. A-II, B-I, C-III, D-IV
  B. A-II, B-IV, C-I, D-III
  C. A-IV, B-II, C-I, D-III
  D. A-IV, B-III, C-I, D-II

Marks:[4.00]

Q.No.11: Which of the following frequencies does not belong to FM broadcast.
  A. 99 MHz
  B. 64 MHz
  C. 89 Mhz
  D. 106 MHz

Marks:[4.00]

Q.No.12: If earth has a mass nine times and radius twice to that of a planet P. Then $\frac{v_e}{3}\sqrt{x}ms^{-1}$ will be the minimum velocity required by a rocket to pull out of gravitational force of, P, where v_e is is escape velocity on earth. The value of *x* is
  A. 2
  B. 18
  C. 1
  D. 3

Marks:[4.00]

Q.No.13: The mass of proton, neutron and helium nucleus are respectively 1.0073*u*, 1.0087*u* and 4.0015*u*. The binding energy of helium nucleus is
  A. 56.8 MeV
  B. 28.4 MeV
  C. 7.1 MeV

D. 14.2 MeV

Q.No.14: 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-Brogle wavelength λ. The ratio of kinetic energy of proton and that of alpha particle is

   A. 1 : 4

   B. 1 : 2

   C. 2 : 1

   D. 4 : 1

Q.No.15: 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

   A. 17.5×10^{-5} J

   B. 28×10^{-5} J

   C. 5×10^{-5} J

   D. 2.26×10^{-5} J

Q.No.16: Match List I with List II:

List I	List II
A. Microwaves	I. Radio active 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-II, C-III, D-IV

   B. A-IV, B-I, C-II, D-III

   C. A-IV, B-III, C-II, D-I

   D. A-I, B-III, C-IV, D-II

Q.No.17: The equivalent resistance between A and B of the network shown in figure:
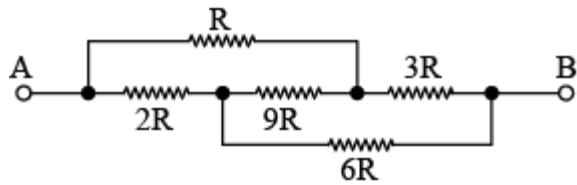
A. $\frac{8}{3}R$

B. $21R$

C. $14R$

D. $11\frac{2}{3}R$

**Q.No.18:** 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, $g = 10$ ms^{-2}).

    A. 15

    B. 25

    C. 30

    D. 20

Q.No.19: 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 :
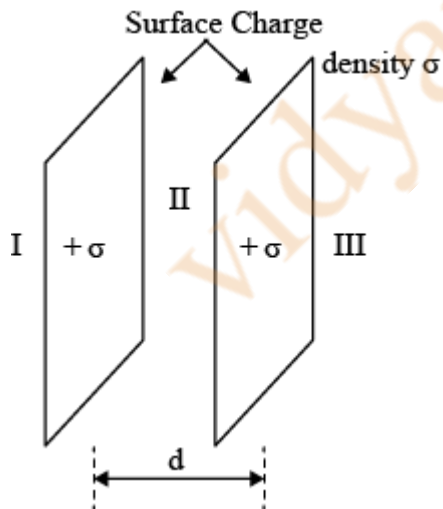
A. $\vec{E}_I = 0, \vec{E}_{II} = \frac{\sigma}{\epsilon_0}\hat{n},\ E_{III} = 0$

B. $\vec{E}_I = -\frac{\sigma}{\epsilon_0}\hat{n},\ E_{II} = 0, \vec{E}_{IIi} = \frac{\sigma}{\epsilon_0}\hat{n}$

C. $\vec{E}_I = -\frac{2\sigma}{\epsilon_0}\hat{n},\ \vec{E}_{II} = 0, \vec{E}_{IIi} = \frac{2\sigma}{\epsilon_0}\hat{n}$

D. $\vec{E}_I = -\frac{\sigma}{2\in_0}\hat{n}, \ \vec{E}_{II} = 0, \vec{E}_{IIi} = \frac{2\sigma}{2\in_0}\hat{n}$

Marks:[4.00]

Q.No.20: 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:

Fig.

A. $\frac{v_1 v_2 v_3}{3(v_1 v_2 + v_2 v_3 + v_3 v_1)}$

B. $\frac{(v_1 + v_2 + v_3)}{3}$

C. $\frac{3v_1 v_2 v_3}{(v_1 v_2 + v_2 v_3 + v_3 v_1)}$

D. $\frac{(v_1 + v_2 + v_3)}{3v_1 v_2 v_3}$

Marks:[4.00]

Q.No.21: 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

_____.

Marks:[4.00]

Q.No.22: 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.

Marks:[4.00]

Q.No.23: 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 bulk modulus of water to that of the liquid is $\frac{3}{x}$. The value of x is _____.

Marks:[4.00]

Q.No.24: 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})

Marks:[4.00]

Q.No.25: 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 $\frac{x}{m} \times 10^{-17}$ eVs. The value of x is _____ (use h = 4.14 × 10^{-15} eVs, c = 3 × 10^8 ms^{-1}). **Marks:[4.00]**

Q.No.26: 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. **Marks:[4.00]**

Q.No.27: A series LCR circuit is connected to an ac source of 220 V, 50 Hz. The circuit contain a resistance R = 100 Ω and an inductor of inductive reactance X_L = 79.6 Ω. The capacitance of the capacitor needed to maximize the average rate at which energy is supplied will be _____ µF. **Marks:[4.00]**

Q.No.28: 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 _____. **Marks:[4.00]**

Q.No.29: A charge particle of 2 µC 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.

Marks:[4.00]

Q.No.30: 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 _____.

Marks:[4.00]

Chemistry

Q.No.31: 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.
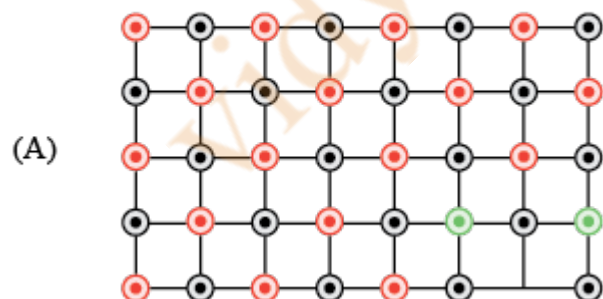In the light of the above statements, choose the **correct** answer from the options given below
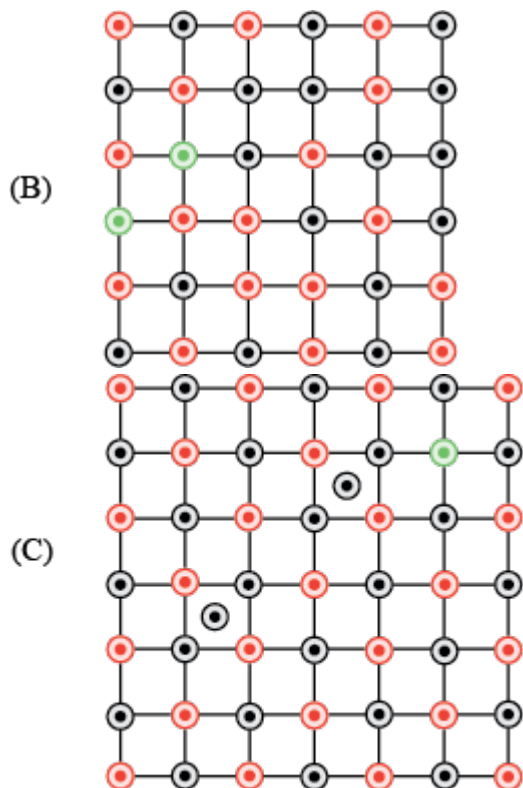
    A. Statement I is true but Statement II is false

    B. Both the Statements I and II are true

    C. Statement I is false but Statement II is true

    D. Both the Statements I and II are false

Marks:[4.00]

Q.No.32: Which of the following represents the lattice structure of $A_{0.95}O$ containing A^{2+}, A^{3+} and O^{2-} ions?

(A)

(B)

(C)

   A. A only
   B. A and B only
   C. B only
   D. B and C only

Marks:[4.00]

Q.No.33: 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 very light element.
In the light of the above statements, choose the **correct** answer from the options given below

   A. Both **A** and **R** are true and **R** is the correct explanation of **A**
   B. **A** is true but **R** is false
   C. Both **A** and **R** are true but **R** is **NOT** the correct explanation of **A**
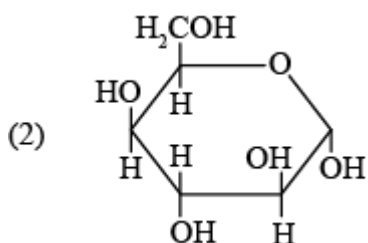   **D.** **A** is false but **R** is true

Marks:[4.00]

Q.No.34: The correct representation in six membered pyranose form for the following sugar [X] is
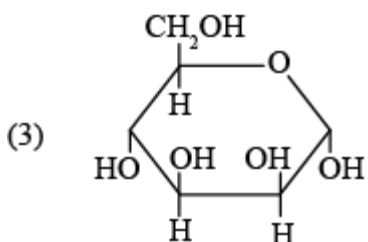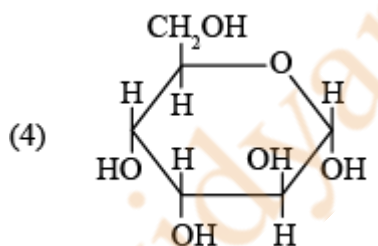
CHO
HO—H
HO—H
H—OH
H—OH
H₂COH

Sugar [X]

A.

(1)

B.

(2)

C.

(3)

D.

(4)
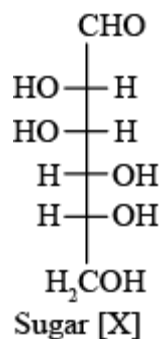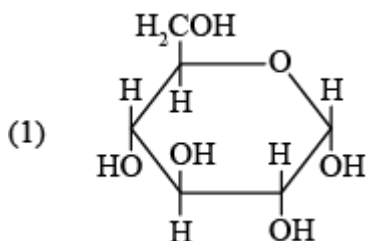
Marks:[4.00]

Q.No.35: 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)	Soframicine

Choose the correct answer from the options given below:

   A. (A) – II, (B) – IV, (C) – I, (D) – III

   B. (A) – II, (B) – I, (C) – III, (D) – IV

C. (A) – IV, (B) – II, (C) – I, (D) – III

D. (A) – III, (B) – I, (C) – II, (D) – IV

Marks:[4.00]

Q.No.36: 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. **A** is not correct but **R** is correct

B. **A** is correct but **R** is not correct

C. Both **A** and **R** are correct but **R** is **NOT** the correct explanation of A

D. Both **A** and **R** are correct and **R** is the correct explanation of **A**

Marks:[4.00]

Q.No.37: Match List I with List II

	List I		List II
	Test		**Functional group/Class of compound**
(A)	Molish'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(II), D(I)

B. A(I), B(II), C(III), D(IV)

C. A(II), B(I), C(III), D(IV)

D. A(III), B(IV), C(I), D(II)

Marks:[4.00]

Q.No.38: A solution of $FeCl_3$ when treated with $K_4[Fe(CN)_6]$ gives a prussian blue precipitate due to the formation of

A. $Fe_3[Fe(CN)_6]_2$

B. $Fe_4[Fe(CN)_6]_3$

C. $Fe[Fe(CN)_6]$

D. $K[Fe_2(CN)_6]$

Marks:[4.00]

Q.No.39: 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; 1g of activated charcoal adsorbs more of Kr.

Reason R: The critical volume V_c(cm^3 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. Both **A** and **R** are true but **R** is **NOT** the correct explanation of **A**

B. **A** is true but **R** is false

C. **A** is false but **R** is true

D. Both **A** and **R** are true and **R** is the correct explanation of **A**

Marks:[4.00]

Q.No.40: Which of the following complex will show largest splitting of d-orbitals?

A. $[Fe(C_2O_4)_3]^{3-}$

B. $[FeF_6]^{3-}$

C. $[Fe(CN)_6]^{3-}$

D. $[Fe(NH_3)_6]^{3+}$

Marks:[4.00]

Q.No.41: Which of the following are the example of double salt?

(A) $FeSO_4.(NH_4)_2SO_4.6H_2O$

(B) $CuSO_4.4NH_3.H_2O$

(C) $K_2SO_4.Al_2(SO_4)_3.24H_2O$

(D) $Fe(CN)_2.4KCN$

Choose the correct answer

A. B and D only

B. A and C only

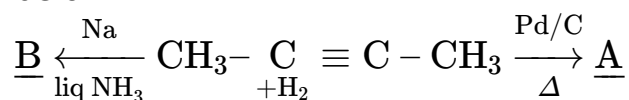C. A, B and D only

D. A and B only

Marks:[4.00]

Q.No.42: How can photochemical smog be controlled?

A. By complete combustion of fuel.

B. By using catalyst.

C. By using catalytic convertors in the automobiles/industry.

D. By using tall chimneys.

Marks:[4.00]

Q.No.43: But-2-yne is reacted separately with one mole of Hydrogen as shown below

$$\underline{B} \xleftarrow[\text{liq NH}_3]{\text{Na}} CH_3 - \underset{+H_2}{C} \equiv C - CH_3 \xrightarrow[\Delta]{\text{Pd/C}} \underline{A}$$

(A) A is more than 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) Br$_2$ adds easily to B than A.

Identify the incorrect statements from the option given below

   A. A, C & D only

   B. B, C & D only

   C. B and C only

   D. A and B only

Marks:[4.00]

Q.No.44: 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 behaviour.

Choose the correct answer from the options given below:

   A. A, B & C only

   B. A only

   C. A and B only

   D. B, C and D only

Marks:[4.00]

Q.No.45: Highest oxidation state of Mn is exhibited in Mn$_2$O$_7$.
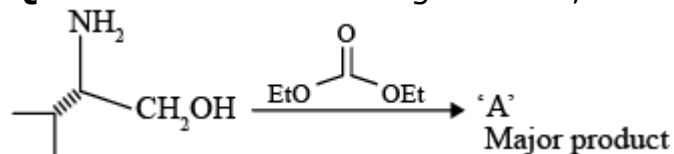
The correct statements about Mn$_2$O$_7$ are

(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 below:

   A. A and C only

   B. B and C only

   C. A and D only

   D. B and D only

Marks:[4.00]

Q.No.46: In the following reaction, 'A' is

A.

(1)

B.

(2)

C.

(3)

D.

(4)

Marks:[4.00]

Q.No.47: Match **List-I** with **List-II**

	List-I		List-II
A.	Slaked lime	I.	NaOH
B.	Dead burnt plaster	II.	$Ca(OH)_2$
C.	Caustic soda	III.	$Na_2CO_3.10H_2O$
D.	Washing soda	IV.	$CaSO_4$

Choose the **correct** answer from the options given below.

   A. A – II, B – IV, C – I, D – III

   B. A – III, B – IV, C – II, D – I

   C. A – III, B – II, C – IV, D – I

   D. A – I, B – IV, C – II, D – III

Marks:[4.00]

Q.No.48: Identify the incorrect option from the following.

A. (1) $\text{>}\hspace{-2pt}\text{Br} + \text{KOH(alc)} \longrightarrow \text{>}\hspace{-2pt}\text{OH} + \text{KBr}$

B. (2)

$\text{C}_6\text{H}_5\text{Cl} \xrightarrow[\text{(ii) HCl}]{\text{(i) NaOH, 623 K, 300 atm}} \text{C}_6\text{H}_5\text{OH}$

C. (3) $\text{Br} + \text{KOH (aq)} \longrightarrow \text{OH} + \text{KBr}$

D. (4)

$\text{C}_6\text{H}_4\text{Cl} + \text{H}_3\text{C}-\overset{\text{O}}{\underset{\|}{\text{C}}}-\text{Cl} \xrightarrow{\text{anhyd AlCl}_3} \text{(ortho-Cl-C}_6\text{H}_4\text{-COCH}_3\text{)} + \text{HCl}$
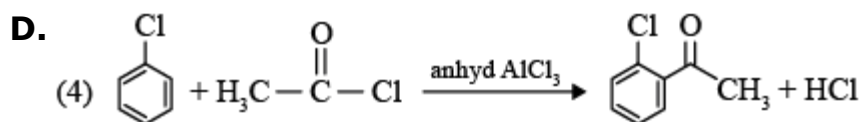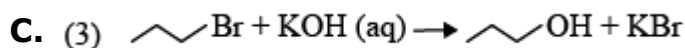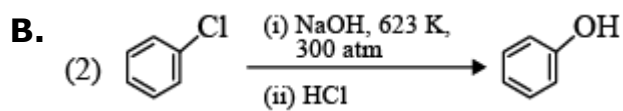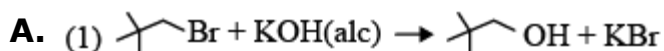
Marks:[4.00]

Q.No.49: Decreasing order of dehydration of the following alcohols is

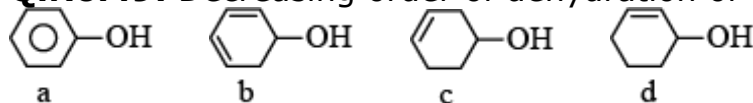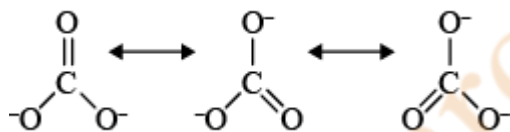
a   b   c   d

   A. b > a > d > c
   B. a > d > b > c
   C. b > d > c > a
   D. d > b > c > a

Marks:[4.00]

Q.No.50: Resonance in carbonate ion $\left(CO_3^{2-}\right)$ is

Which of the following is true?
   A. CO_3^{2-} has a single structure i.e., resonance hybrid of the above three structures.
   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. All these structures are in dynamic equilibrium with each other.

Marks:[4.00]

Q.No.51: Sum of oxidation states of bromine in bromic acid and perbromic acid is _____.   **Marks:[4.00]**

Q.No.52: Number of isomeric compounds with molecular formula $C_9H_{10}O$ which (i) do not dissolve in NaOH (ii) do not dissolve in HCl. (iii) do not give

orange precipitate with 2, 4-DNP (iv) on hydrogenation give identical compound with molecular formula $C_9H_{12}O$ is _____. **Marks:[4.00]**

Q.No.53: 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 solution of the given concentration? _____ (Nearest integer).

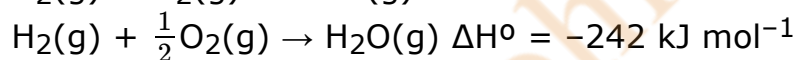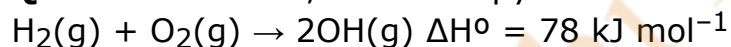(Given: K_f = 2.0 K kg mol^{-1})

Assume (1) 100% ionization and

(2) Density of the aqueous solution as 1 g mL^{-1} **Marks:[4.00]**

Q.No.54: 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. **Marks:[4.00]**

Q.No.55: At 25°C, the enthalpy of the following processes are given

$H_2(g) + O_2(g) \rightarrow 2OH(g)$ ΔH^o = 78 kJ mol^{-1}

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g)$ ΔH^o = −242 kJ mol^{-1}

$H_2(g) \rightarrow 2H(g)$ ΔH^o = 436 kJ mol^{-1}

$\frac{1}{2}O_2(g) \rightarrow O(g)$ ΔH^o = 249 kJ mol^{-1}

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

$H_2O(g) \rightarrow H(g) + OH(g)$ ΔH^o = X kJ mol^{-1}

Marks:[4.00]

Q.No.56: The density of 3 M solution of NaCl is 1.0 g mL^{-1}. Molatity of the solution is _____ × 10^{-2} m. (Nearest integer).

Given: Molar mass of Na and Cl is 23 and 35.5 g mol^{-1} respectively.
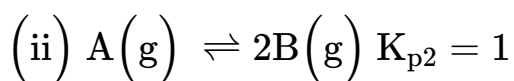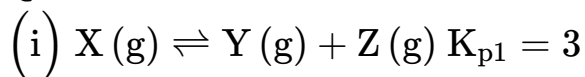
Marks:[4.00]

Q.No.57: 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 <u>true</u> about the emitted radiation is _____.

Given : h = 6 × 10^{-34} J s, m_e = 9 × 10^{-31} kg.

(A) The de Broglie 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. **Marks:[4.00]**

Q.No.58:

$$\left(i\right) X\left(g\right) \rightleftharpoons Y\left(g\right) + Z\left(g\right)\ K_{p1} = 3$$

$$\left(ii\right) A\left(g\right) \rightleftharpoons 2B\left(g\right)\ K_{p2} = 1$$

If the degree of dissociation and initial concentration of both the reactants X(g) and A(g) are equal, then the ration 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) **Marks:[4.00]**

Q.No.59: At what pH, given half cell $MnO_4^-\ (0.1\ M)\big|\ Mn^{2+}\ (0.001\ M)$ will have electrode potential of 1.282 V? _____ (Nearest Integer)

Given $E^{\circ}_{MnO_4^-\,|\,Mn^{2+}} = 1.54V,\ \dfrac{2.303\,RT}{F} = 0.059V$ **Marks:[4.00]**

Q.No.60: The total number of chiral compound/s from the following is _____.
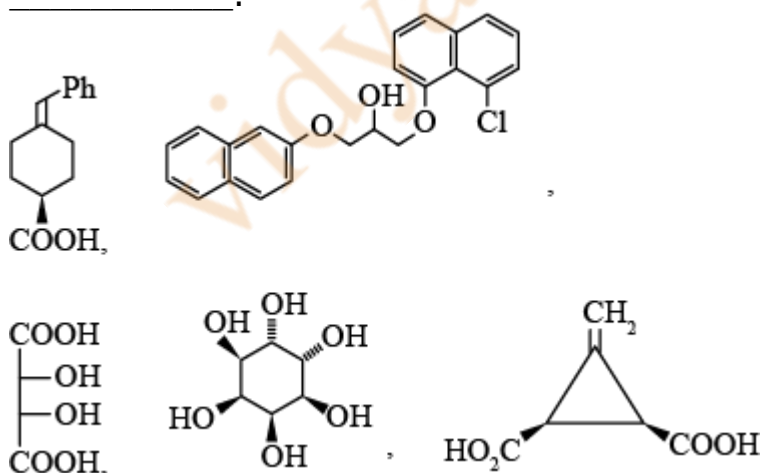
Marks:[4.00]

Mathematics

Q.No.61: If the orthocentre of the triangle, whose vertices are (1, 2), (2, 3) and (3, 1) is (α, β), then the quadratic equation whose roots are α + 4β and 4α

+ β, is

   A. $x^2 - 20x + 99 = 0$

   B. $x^2 - 19x + 90 = 0$

   C. $x^2 - 22x + 120 = 0$

   D. $x^2 - 18x + 99 = 0$

<div align="right">

Marks:[4.00]

</div>

Q.No.62: 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. 1456

   B. 1216

   C. 1792

   D. 1072

<div align="right">

Marks:[4.00]

</div>

Q.No.63: If the centre and radius of the circle $\left|\frac{z-2}{z-3}\right| = 2$ are respectively (α, β) and γ, then 3(α + β + γ) is equal to

   A. 10

   B. 12

   C. 11

   D. 9

<div align="right">

Marks:[4.00]

</div>

Q.No.64: If $y = y(x)$ is the solution curve of the differential equation $\frac{dy}{dx} + y$ tan$x = x$ sec x, $0 \leq 0 \leq \frac{\pi}{3}$, $y\left(0\right) = 1$, 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. $\frac{\pi}{12} + \frac{\sqrt{3}}{2}\log_e\left(\frac{2\sqrt{3}}{e}\right)$

   D. $\frac{\pi}{12} - \frac{\sqrt{3}}{2}\log_e\left(\frac{2}{e\sqrt{3}}\right)$

<div align="right">

Marks:[4.00]

</div>

Q.No.65: The sum to 10 terms of the series
$\frac{1}{1+1^2+1^4} + \frac{2}{1+2^2+2^4} + \frac{3}{1+3^2+3^4}+\ldots$ is

A. $\frac{58}{111}$

B. $\frac{59}{111}$

C. $\frac{55}{111}$

D. $\frac{56}{111}$

Marks:[4.00]

Q.No.66: 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 $2x^2 + xy - 3y^2 = 0$ is

A. $3x^2 + 5xy + 2y^2 = 0$

B. $x^2 - y^2 + 10xy = 0$

C. $3x^2 + xy + 2y^2 = 0$

D. $x^2 - y^2 - 10xy = 0$

Marks:[4.00]

Q.No.67: 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. $\frac{-2\pi}{3}$

B. 0

C. $\pi - \sin^{-1}\left(\frac{\sqrt{3}}{4}\right)$

D. $\pi - 2\sin^{-1}\left(\frac{\sqrt{3}}{4}\right)$

Marks:[4.00]

Q.No.68: The value of
$$\frac{1}{1!50!} + \frac{1}{3!48!} + \frac{1}{5!46!} + \ldots + \frac{1}{49!2!} + \frac{1}{5!1!} \text{ is :}$$

    A. $\dfrac{2^{50}}{51!}$

    B. $\dfrac{2^{51}}{51!}$

    C. $\dfrac{2^{50}}{50!}$

    D. $\dfrac{2^{51}}{50!}$

Marks:[4.00]

Q.No.69: 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 $\sum_{\lambda \in S} \left(|\lambda|^2 + |\lambda| \right)$ is equal to

    A. 4

    B. 2

    C. 6

    D. 12

Marks:[4.00]

Q.No.70: For a triangle ABC, the value of cos2A + cos2B + cos2C is least. If its inradius is 3 and incentre is M, then which of the following is NOT correct?

    A. $\overrightarrow{MA} \cdot \overrightarrow{MB} = -18$

    B. perimeter of ΔABC is $18\sqrt{3}$

    C. area of ΔABC is $\dfrac{27\sqrt{3}}{2}$

    D. sin2A + sin2B + sin2C = sinA + sinB + sinC

Marks:[4.00]

Q.No.71: Let $f\left(x\right) = \begin{vmatrix} 1+\sin^2 x & \cos^2 x & \sin 2x \\ \sin^2 x & 1+\cos^2 x & \sin 2x \\ \sin^2 x & \cos^2 x & 1+\sin 2x \end{vmatrix}$, $x \in \left[\frac{\pi}{6}, \frac{\pi}{3}\right]$. If
α and β respectively are the maximm and the minimum values of f, then

    A. $\beta^2 + 2\sqrt{\alpha} = \frac{19}{4}$

B. $\alpha^2 + \beta^2 = \frac{9}{2}$

C. $\alpha^2 - \beta^2 = 4\sqrt{3}$

D. $\beta^2 - 2\sqrt{\alpha} = \frac{19}{4}$

Marks:[4.00]

Q.No.72: The area enclosed by the closed curve C given by the differential equation $\frac{dy}{dx} + \frac{x+a}{y-2} = 0$, $y\left(1\right) = 0$ is 4п.

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. $\frac{2\sqrt{3}}{3}$

C. $2\sqrt{3}$

D. $\frac{4\sqrt{3}}{3}$

Marks:[4.00]

Q.No.73: Let $f(x) = 2x + \tan^{-1} x$ and $g\left(x\right) = \log_e\left(\sqrt{1+x^2} + x\right)$, $x \in \left[0, 3\right]$. Then

A. min $f'(x) = 1 +$ max g'(x)

B. there exist $0 < x_1 < x_2 < 3$ such that $f(x) < g(x)$, $\forall\ x \in (x_1, x_2)$

C. there exists $\widehat{x} \in [0, 3]$ such that $f'(\widehat{x}) < g'(\widehat{x})$

D. max $f(x) >$ max $g(x)$

Marks:[4.00]

Q.No.74: 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. 53

D. 51

Marks:[4.00]

Q.No.75: The shortest distance between the lines $\frac{x-5}{1} = \frac{y-2}{2} = \frac{z-4}{-3}$ and $\frac{x+3}{1} = \frac{y+5}{4} = \frac{z-1}{-5}$ is

A. $5\sqrt{3}$

B. $6\sqrt{3}$

C. $4\sqrt{3}$

D. $7\sqrt{3}$

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Marks:[4.00]

</div>

Q.No.76: $\lim\limits_{n\to\infty} \left[\frac{1}{1+n} + \frac{1}{2+n} + \frac{1}{3+n} + \ldots + \frac{1}{2n} \right]$ is equal to

A. 0

B. $\log_e \left(\frac{3}{2} \right)$

C. $\log_e 2$

D. $\log_e \left(\frac{2}{3} \right)$

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Marks:[4.00]

</div>

Q.No.77: Let R be a relation on $\mathbb{R}$, given by
$R = \left\{ a,\, b \right) \; : \; 3a - 3b + \sqrt{7} \; \text{is an irrational number} \right\}$. Then R is

A. reflexive but neither symmetric nor transitive

B. an equivalence relation

C. reflexive and symmetric but not transitive

D. reflexive and transitive but not symmetric

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Marks:[4.00]

</div>

Q.No.78: The negation of the expression $q \vee ((\sim q) \wedge p)$ is equivalent to

A. $p \wedge (\sim q)$

B. $(\sim p) \vee (\sim q)$

C. $(\sim p) \vee q$

D. $(\sim p) \wedge (\sim q)$

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Marks:[4.00]

</div>

Q.No.79: Let $S = \left\{ \begin{array}{l} x \; : \; x \in \mathbb{R} \text{ and } \left(\sqrt{3} + \sqrt{2}\right) x^{2-4} \\ \qquad + \left(\sqrt{3} - \sqrt{2}\right)^{x^{2-4}} = 10 \end{array} \right\}$. Then $n(S)$ is equal to

A. 2

B. 4

C. 0

D. 6

Q.No.80: 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. $2\sqrt{14}$

B. $\frac{22\sqrt{2}}{7}$

C. $\frac{24\sqrt{2}}{7}$

D. $3\sqrt{14}$

Q.No.81: $A(2, 6, 2)$, $B(-4, 0, \wedge)$, $C(2, 3, -1)$ and $D(4, 5, 0)$, $|\wedge|\leq 5$ are the vertices of a quadrilateral $ABCD$. If its area is 18 square units, then $5 - 6\wedge$ is equal to _____.

Q.No.82: 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 _____.

Q.No.83: The number of words, with or without meaning, that can be formed using all the letters of word ASSASSINATION so that vowels occur together, is _____.

Q.No.84: Let $\vec{v} = a\hat{i} + 2\hat{j} - 3\hat{k}$, $\vec{w} = 2a\hat{i} + \hat{j} - \hat{k}$ and $\vec{u}$ be a vector such that $\left|\vec{u}\right| = a > 0$. If the minimum value of the scalar triple product $\left[\vec{u}, \vec{v}, \vec{w}\right]$ is $-\alpha\sqrt{3401}$, and $\left|\vec{u}.\hat{i}\right| = \frac{m}{n}$ where m and n are coprime natural numbers, then $m + n$ is equal to

Q.No.85: Let a_1 = 8, a_2, a_3, ..., 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 _____. **Marks:[4.00]**

Q.No.86: If $\int_0^1 \left(x^{21} + x^{14} + x^7\right) \left(2x^{14} + 3x^7 + 6\right)^{\frac{1}{7}} dx = \frac{1}{I}\left(11\right)^{\frac{m}{n}}$ where I, m, $n \in \mathbb{N}$, m and n are coprime then $I + m + n$ is equal to _____. **Marks:[4.00]**

Q.No.87: Let : $f : \mathbb{R} \to \mathbb{R}$ be a differentiable function such that $f'(x) + f(x) = \int_0^2 f\left(t\right) dt$. If $f(0) = e^{-2}$, then $2f(0) - f(2)$ is equal to _____ **Marks:[4.00]**

Q.No.88: 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 _____. **Marks:[4.00]**

Q.No.89: The number of 3-digit numbers, that are divisible by either 2 or 3 but not divisible by 7, is _____. **Marks:[4.00]**

Q.No.90: The remainder, when $19^{200} + 23^{200}$ is divided by 49, is _____ **Marks:[4.00]**