

**Q1.**  $P + \frac{a}{V^2}V - b = RT$  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 :

- (1) Bulk modulus (2) Modulus of rigidity  
(3) Compressibility (4) Energy density

**Q2.** 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  $AD = 3 AB$ , then average speed of the object will be :



- (1)  $\frac{v_1 + v_2 + v_3}{3}$  (2)  $\frac{v_1 v_2 v_3}{3v_1 v_2 + v_2 v_3 + v_3 v_1}$   
(3)  $\frac{3v_1 v_2 v_3}{v_1 v_2 + v_2 v_3 + v_3 v_1}$  (4)  $\frac{v_1 + v_2 + v_3}{3v_1 v_2 v_3}$

**Q3.** A child stands on the edge of the cliff 10 m above the ground and throws a stone horizontally with an initial speed of  $5 \text{ m s}^{-1}$ . Neglecting the air resistance, the speed with which the stone hits the ground will be \_\_\_\_\_  $\text{m s}^{-1}$  (given,  $g = 10 \text{ m s}^{-2}$ ).

- (1) 20 (2) 15  
(3) 30 (4) 25

**Q4.** 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,  $g = 10 \text{ m s}^{-2}$ ):

- (1) 0.60 (2) 0.75  
(3) 0.50 (4) 0.25

**Q5.** If earth has a mass nine times and radius twice to the 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) 2 (2) 3  
(3) 18 (4) 1

**Q6.** 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

- (1) Both Statement I and Statement II are true (2) Both Statement I and Statement II are false  
(3) Statement I is true but Statement II is false (4) Statement I is false but Statement II is true

**Q7.** A mercury drop of radius  $10^{-3} \text{ m}$  is broken into 125 equal size droplets. Surface tension of mercury is  $0.45 \text{ N m}^{-1}$ . The gain in surface energy is:

- (1)  $2.26 \times 10^{-5} \text{ J}$  (2)  $28 \times 10^{-5} \text{ J}$   
(3)  $17.5 \times 10^{-5} \text{ J}$  (4)  $5 \times 10^{-5} \text{ J}$

**Q8.** 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, (given  $\gamma = \frac{3}{2}$ ) :

(1)  $W = TR\sqrt{2} - 2$

(2)  $W = \frac{T}{R}\sqrt{2} - 2$

(3)  $W = \frac{R}{T}2 - \sqrt{2}$

(4)  $W = RT2 - \sqrt{2}$

**Q9.** The average kinetic energy of a molecule of the gas is

(1) proportional to absolute temperature

(2) proportional to volume

(3) proportional to pressure

(4) dependent on the nature of the gas

**Q10.** 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:

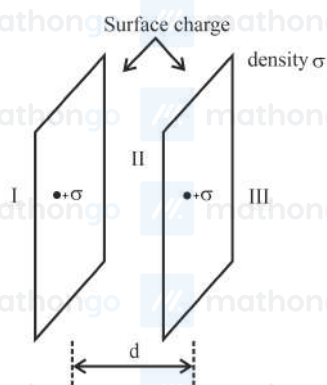
(1)  $200\pi \text{ m s}^{-1}$

(2)  $100 \text{ m s}^{-1}$

(3)  $10 \text{ m s}^{-1}$

(4)  $50 \text{ m s}^{-1}$

**Q11.** Let  $\sigma$  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  $E_{III}$



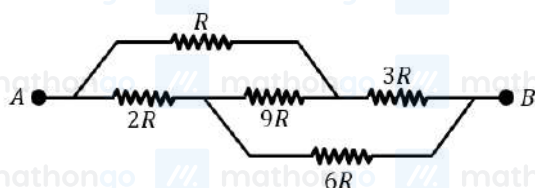
(1)  $\vec{E}_I = \frac{2\sigma}{\epsilon_0}\hat{n}, \vec{E}_{II} = 0, \vec{E}_{III} = \frac{2\sigma}{\epsilon_0}\hat{n}$

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

(3)  $\vec{E}_I = \frac{\sigma}{2\epsilon_0}\hat{n}, \vec{E}_{II} = 0, \vec{E}_{III} = \frac{\sigma}{2\epsilon_0}\hat{n}$

(4)  $\vec{E}_I = \frac{\sigma}{\epsilon_0}\hat{n}, \vec{E}_{II} = 0, \vec{E}_{III} = \frac{\sigma}{\epsilon_0}\hat{n}$

**Q12.** The equivalent resistance between A and B of the network shown in figure:



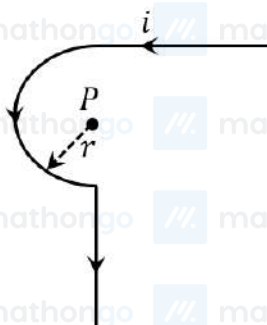
(1)  $11\frac{2R}{3}$

(2)  $14 R$

(3)  $21 R$

(4)  $\frac{8}{3} R$

**Q13.** Find the magnetic field at the point P in figure. The curved portion is a semicircle connected to two long straight wires.



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

$$(3) \frac{\mu_0 i}{2r} \left( \frac{1}{2} + \frac{1}{\pi} \right)$$

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

$$(4) \frac{\mu_0 i}{2r} \left( \frac{1}{2} + \frac{1}{\pi} \right)$$

**Q14.** Match the List-I with List-II.

**List I**

- A AC generator
- B Transformer
- C Resonance phenomenon to occur
- D Sharpness of resonance

**List II**

- I Presence of both L and C
- II Electromagnetic Induction
- III Quality factor
- IV Mutual Inductance

Choose the correct answer from the options given below:

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

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

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

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

**Q15.** Match the List-I with List-II:

**List I**

**List II**

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

Choose the correct answer from the options given below:

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

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

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

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

**Q16.** 'n' polarizing sheets are arranged such that each makes an angle  $45^\circ$  with the proceeding 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:

(1) 3

(2) 6

(3) 5

(4) 4

**Q17.** A proton moving with one tenth of velocity of light has a certain de Broglie wavelength of  $\lambda$ . An alpha particle having certain kinetic energy has the same de-Broglie wavelength  $\lambda$ . The ratio of kinetic energy of proton and that of alpha particle is :

(1) 2 : 1

(2) 4 : 1

(3) 1 : 2

(4) 1 : 4

**Q18.** The mass of proton, neutron and helium nucleus are respectively  $1.0073 \text{ u}$ ,  $1.0087 \text{ u}$  and  $4.0015 \text{ u}$ .

The binding energy of helium nucleus is:

- (1)  $14.2 \text{ MeV}$  (2)  $28.4 \text{ MeV}$   
 (3)  $56.8 \text{ MeV}$  (4)  $7.1 \text{ MeV}$

**Q19.** Match the List I with List II

**List I**

A Intrinsic Semiconductor

B n-type semiconductor

C p-type semiconductor

D Metals

**List II**

I Fermi-level near valence band

II Fermi-level at middle of valence and conduction band

III Fermi-level near conduction band

IV Fermi-level inside conduction band

Choose the correct answer from the options given below:

- (1) (A)  $\rightarrow$  I, (B)  $\rightarrow$  II, (C)  $\rightarrow$  III, (D)  $\rightarrow$  IV (2) (A)  $\rightarrow$  II, (B)  $\rightarrow$  I, (C)  $\rightarrow$  III, (D)  $\rightarrow$  IV  
 (3) (A)  $\rightarrow$  II, (B)  $\rightarrow$  III, (C)  $\rightarrow$  I, (D)  $\rightarrow$  IV (4) (A)  $\rightarrow$  III, (B)  $\rightarrow$  I, (C)  $\rightarrow$  II, (D)  $\rightarrow$  IV

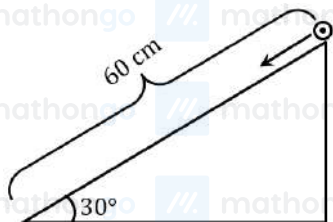
**Q20.** Which of the following frequencies does not belong to FM broadcast.

- (1)  $106 \text{ MHz}$  (2)  $64 \text{ MHz}$   
 (3)  $99 \text{ MHz}$  (4)  $89 \text{ MHz}$

**Q21.** 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  $5\hat{i} + 2\hat{j} + 7\hat{k} \text{ N}$ . The value of work done will be \_\_\_\_\_ J.

**Q22.** A solid cylinder is released from rest from the top of an inclined plane of inclination  $30^\circ$  and length  $60 \text{ cm}$ . If the cylinder rolls without slipping, its speed upon reaching the bottom of the inclined plane is \_\_\_\_\_  $\text{m s}^{-1}$ .

(Given  $g = 10 \text{ m s}^{-2}$ )



**Q23.** 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 \_\_\_\_\_.

**Q24.** The amplitude of a particle executing SHM is  $3 \text{ cm}$ . The displacement at which its kinetic energy will be  $25\%$  more than the potential energy is: \_\_\_\_\_  $\text{cm}$ .

**Q25.** 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 \_\_\_\_\_.

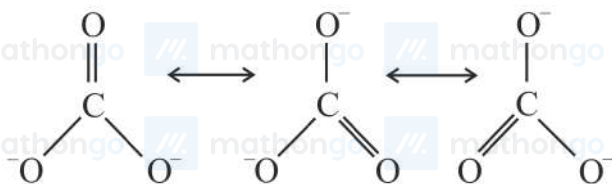
- Q26.** In an experiment to find emf of a cell using potentiometer, the length of null point for a cell of emf 1.5 V is found to be 60 cm. If this cell is replaced by another cell of emf  $E$ , the length-of null point increases by 40 cm. The value of  $E$  is  $\frac{x}{10}$  V. The value of  $x$  is \_\_\_\_\_.
- Q27.** A charge particle of 2  $\mu\text{C}$  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.
- Q28.** 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 \_\_\_\_\_  $\mu\text{F}$ .
- Q29.** 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 \_\_\_\_\_.
- Q30.** 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,  $c = 3 \times 10^8 \text{ m s}^{-1}$ )
- Q31.** 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  
 (1) A is true but R is false  
 (2) Both A and R are true but R is NOT the correct explanation of A  
 (3) A is false but R is true  
 (4) Both A and R are true and R is the correct explanation of A
- Q32.** Match List I with 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) $\text{CaSO}_4$                                      |
- Choose the correct answer form the options given below:
- |  |  |
|--|--|
| (1) (A) - I, (B) - IV, (C) - II, (D) - III | (2) (A) - III, (B) - IV, (C) - II, (D) - I |
| (3) (A) - II, (B) - IV, (C) - I, (D) - III | (4) (A) - III, (B) - II, (C) -IV, (D) -I   |
- Q33.** Choose the correct statement(s):
- Beryllium oxide is purely acidic in nature.
  - Beryllium carbonate is kept in the atmosphere of  $\text{CO}_2$ .
  - Beryllium sulphate is readily soluble in water.
  - Beryllium shows anomalous behavior.
- Choose the correct answer from the options given below:

(1) A, B and C only

(3) A and B only

(2) B, C and D only

(4) A only

Q34. Resonance in carbonate ion  $\text{CO}_3^{2-}$  is

Which of the following is true?

(1) It is possible to identify each structure

individually by some physical or chemical method.

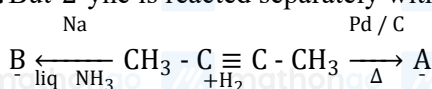
(2) All these structures are in dynamic equilibrium

with each other.

(3) Each structure exists for equal amount of time.

(4)  $\text{CO}_3^{2-}$  has a single structure i.e., resonance hybrid of the above three structures.

Q35. But-2-yne is reacted separately with one mole of Hydrogen as shown below:



Identify the incorrect statements from the options given below:

A. A is more soluble than B.

B. The boiling point &amp; 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.  $\text{Br}_2$  adds easily to B than A.

(1) B and C only

(2) B, C and D only

(3) A, C and D only

(4) A and B only

Q36. How can photochemical smog be controlled?

(1) By using tall chimneys

(2) By complete combustion of fuel

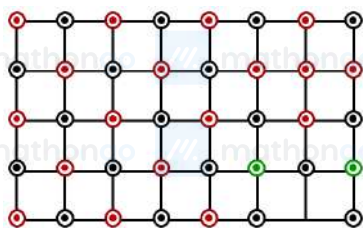
(3) By using catalytic converters in the automobiles/industry

(4) By using catalyst

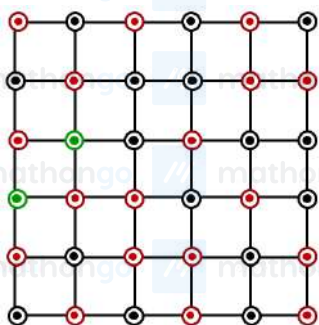
Q37. Which of the following represents the lattice structure of  $\text{A}_{0.95}\text{O}$  containing  $\text{A}^{2+}$ ,  $\text{A}^{3+}$  and  $\text{O}^{2-}$  ions?

●  $\text{A}^{2+}$ 
●  $\text{A}^{3+}$ 
●  $\text{O}^{2-}$

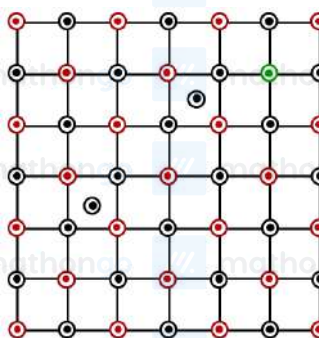
A.



B.



C.



(1) B and C only

(2) B only

(3) A and B only

(4) A only

**Q38.** 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.

(1) A is true but R is false

(2) A is false but R is true

(3) Both A and R are true but R is NOT the correct

(4) Both A and R are true and R is the correct

explanation of A

explanation A

**Q39.** 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

(1) Both A and R are correct and R is the correct

(2) A is not correct but R is correct

explanation of A

(3) Both A and R are correct but R is NOT the

(4) A is correct but R is not correct

correct explanation of A

**Q40.** 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

- (1) Both the statements I and II are true  
(2) Statement I is true but Statement II is false  
(3) Statement I is false but Statement II is true  
(4) Both the Statements I and II are false

**Q41.** A solution of  $\text{FeCl}_3$  when treated with  $\text{K}_4\text{Fe}(\text{CN})_6$  gives a prussian blue precipitate due to the formation of

- (1)  $\text{KFe}_2(\text{CN})_6$   
(2)  $\text{FeFe}(\text{CN})_6$   
(3)  $\text{Fe}_3\text{Fe}(\text{CN})_{62}$   
(4)  $\text{Fe}_4\text{Fe}(\text{CN})_{63}$

**Q42.** Highest oxidation state of Mn is exhibited in  $\text{Mn}_2\text{O}_7$ . The correct statements about  $\text{Mn}_2\text{O}_7$  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 given below

- (1) A and C only  
(2) A and D only  
(3) B and D only  
(4) B and C only

**Q43.** Which of the following complex will show largest splitting of d-orbitals?

- (1)  $\text{FeC}_2\text{O}_4^{3-}$   
(2)  $\text{FeF}_6^{3-}$   
(3)  $\text{Fe}(\text{CN})_6^{3-}$   
(4)  $\text{FeNH}_3^{3+}$

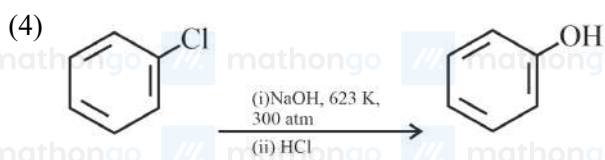
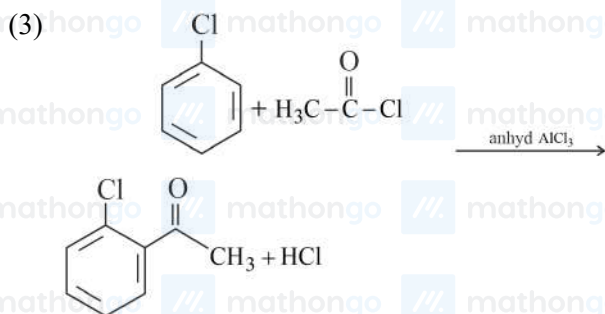
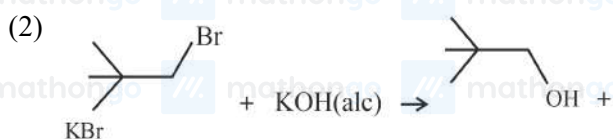
**Q44.** Which of the following are the example of double salt?

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

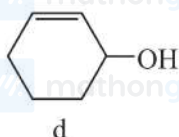
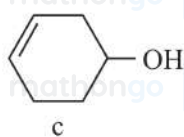
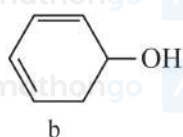
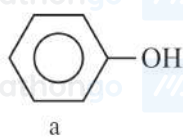
Choose the correct answer.

- (1) A and C only  
(2) A and B only  
(3) A, B and D only  
(4) B and D only

**Q45.** Identify the incorrect option from the following:



Q46. Decreasing order of dehydration of the following alcohols is



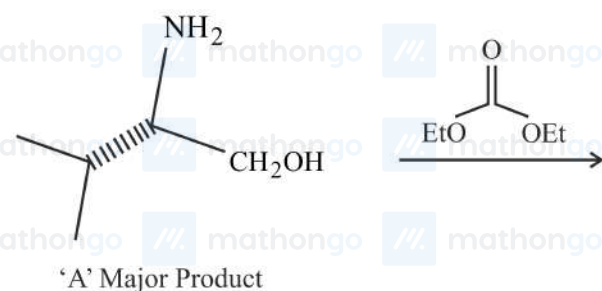
(1)  $a > d > b > c$

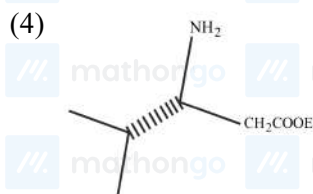
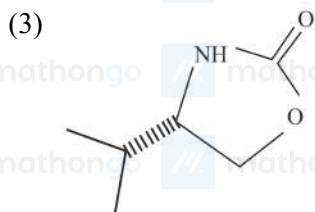
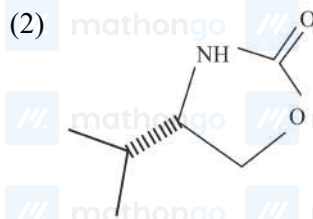
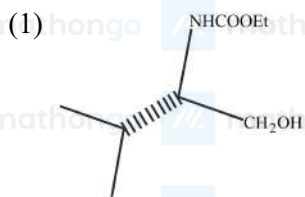
(3)  $b > a > d > c$

(2)  $b > d > c > a$

(4)  $d > b > c > a$

Q47. In the following reaction, 'A' is





**Q48.** 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:

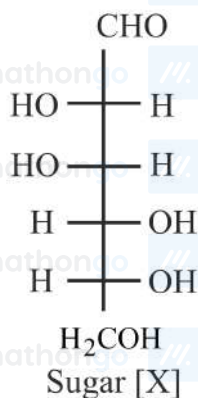
(1) (A)–IV, (B)–II, (C)–I, (D)–III

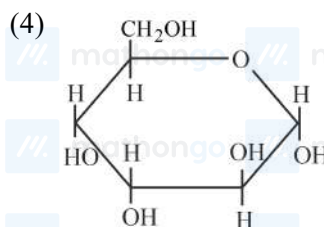
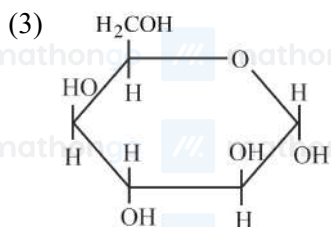
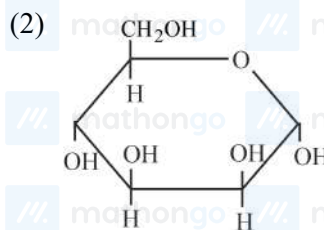
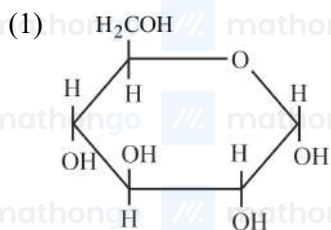
(2) (A)–II, (B)–I, (C)–III, (D)–IV

(3) (A)–III, (B)–I, (C)–II, (D)–IV

(4) (A)–II, (B)–IV, (C)–I, (D)–III

**Q49.** The correct representation in six membered pyranose form for the following sugar [X] is





**Q50.** Match List I and List II

List I

Test

- (A) Molisch's Test
- (B) Biuret Test
- (C) Carbylamine Test
- (D) Schiff's Test

List II

- Functional group /  
Class of Compound
- (I) Peptide
  - (II) Carbohydrate
  - (III) Primary amine
  - (IV) Aldehyde

Choose the correct answer from the options given below:

- (1) (A) - I, (B) - II, (C) - III, (D) - IV
- (2) (A) - III, (B) - IV, (C) - I, (D) - II
- (3) (A) - II, (B) - I, (C) - III, (D) - IV
- (4) (A) - III, (B) - IV, (C) - II, (D) - I

**Q51.** The density of 3M solution of NaCl is  $1.0 \text{ g mL}^{-1}$ . Molality of the solution is  $\text{_____} \times 10^{-2} \text{ m}$  (Nearest integer).

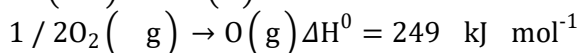
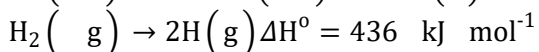
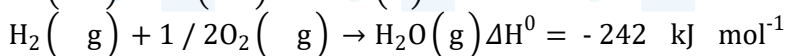
Given: Molar mass of Na and Cl is 23 and  $35.5 \text{ g mol}^{-1}$  respectively.

**Q52.** Electrons in a cathode ray tube have been emitted with a velocity of  $1000 \text{ ms}^{-1}$ . The number of following statements which is/are true about the emitted radiation is

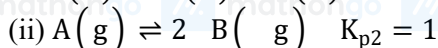
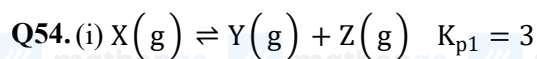
Given :  $h = 6 \times 10^{-34} \text{ Js}$ ,  $m_e = 9 \times 10^{-31} \text{ kg}$

- (A) The deBroglie wavelength of the electron emitted is  $666.67 \text{ nm}$
- (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..

**Q53.** At  $25^\circ\text{C}$ , the enthalpy of the following processes are given:

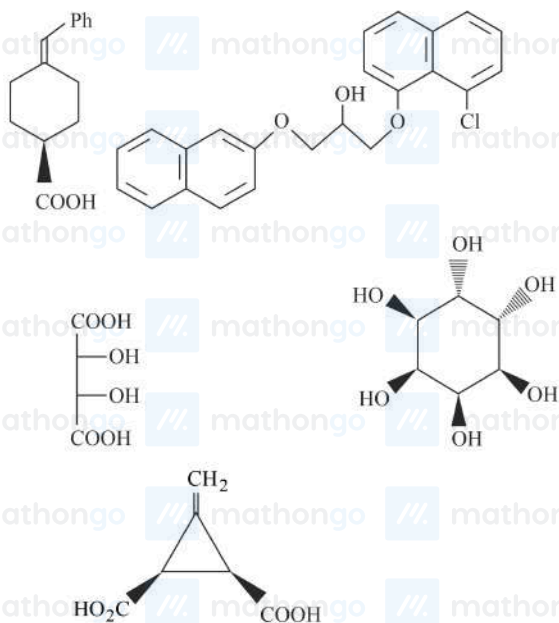


What would be the value of X for the following reaction? (Nearest integer)



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

Q55. The total number of chiral compound/s from the following is



Q56. 25 mL of an aqueous solution of KCl was found to require 20 mL of 1M  $\text{AgNO}_3$  solution when titrated using  $\text{K}_2\text{CrO}_4$  as an indicator. What is the depression in freezing point of KCl solution of the given concentration? (Nearest integer).

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

Assume

- 1) 100% ionization and
- 2) density of the aqueous solution as  $1 \text{ g mL}^{-1}$

Q57. 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  $E^\circ_{\text{MnO}_4^- / \text{Mn}^{2+}} = 1.54 \text{ V}$ ,  $\frac{2.303RT}{F} = 0.059 \text{ V}$

Q58. 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.

Q59. Sum of oxidation states of bromine in bromic acid and perbromic acid is

**Q60.** 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

**Q61.** 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  $nS$  is equal to

- (1) 2
- (2) 4
- (3) 6
- (4) 0

**Q62.** If the center and radius of the circle  $\frac{z-2}{z-3} = 2$  are respectively  $\alpha, \beta$  and  $\gamma$ , then  $3\alpha + \beta + \gamma$  is equal to

- (1) 11
- (2) 9
- (3) 10
- (4) 12

**Q63.** The sum to 10 terms of the series

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

- (1)  $\frac{111}{59}$
- (2)  $\frac{55}{111}$
- (3)  $\frac{56}{111}$
- (4)  $\frac{58}{111}$

**Q64.** The value of

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

- (1)  $\frac{2^{50}}{50!}$
- (2)  $\frac{2^{50}}{51!}$
- (3)  $\frac{2^{51}}{51!}$
- (4)  $\frac{2^{51}}{50!}$

**Q65.** The combined equation of the two lines  $ax + by + c = 0$  and  $a'x + b'y + c' = 0$  can be written as  $ax + by + ca'x + b'y + c' = 0$ . The equation of the angle bisectors of the lines represented by the equation  $2x^2 + xy - 3y^2 = 0$  is

- (1)  $3x^2 + 5xy + 2y^2 = 0$
- (2)  $x^2 - y^2 + 10xy = 0$
- (3)  $3x^2 + xy - 2y^2 = 0$
- (4)  $x^2 - y^2 - 10xy = 0$

**Q66.** If the orthocentre of the triangle, whose vertices are 1, 2, 2, 3 and 3, 1 is  $\alpha, \beta$ , then the quadratic equation whose roots are  $\alpha + 4\beta$  and  $4\alpha + \beta$ , is

- (1)  $x^2 - 19x + 90 = 0$
- (2)  $x^2 - 18x + 80 = 0$
- (3)  $x^2 - 22x + 120 = 0$
- (4)  $x^2 - 20x + 99 = 0$

**Q67.** The negation of the expression  $q \vee ((\sim q) \wedge p)$  is equivalent to

- (1)  $(\sim p) \wedge (\sim q)$
- (2)  $p \wedge (\sim q)$
- (3)  $(\sim p) \vee (\sim q)$
- (4)  $(\sim p) \vee q$

**Q68.** 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

- (1) 1072
- (2) 1792
- (3) 1216
- (4) 1456

**Q69.** 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?

(1) Perimeter of  $\Delta ABC$  is  $18\sqrt{3}$

(3)  $\vec{MA} \cdot \vec{MB} = -18$

(2)  $\sin 2A + \sin 2B + \sin 2C = \sin A + \sin B + \sin C$

(4) area of  $\Delta ABC$  is  $\frac{27\sqrt{3}}{2}$

**Q70.** Let  $R$  be a relation on  $\mathbb{R}$ , given by  $R = \{a, b: 3a - 3b + \sqrt{7} \text{ is an irrational number}\}$ . Then  $R$  is

(1) Reflexive but neither symmetric nor transitive

(3) Reflexive and symmetric but not transitive

(2) Reflexive and transitive but not symmetric

(4) An equivalence relation

**Q71.** Let  $S$  denote the set of all real values of  $\lambda$  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

(1) 2

(3) 4

(2) 12

(4) 6

**Q72.** Let  $S$  be the set of all solutions of the equation  $\cos^{-1} 2x - 2\cos^{-1} \sqrt{1-x^2} = \pi, x \in [-\frac{1}{2}, \frac{1}{2}]$ . Then  $\sum_{x \in S} 2\sin^{-1} x^2 - 1$  is equal to

(1) 0

(3)  $\pi - \sin^{-1} \frac{\sqrt{3}}{4}$

(2)  $\frac{-2\pi}{3}$

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

**Q73.** Let  $f(x) = 2x + \tan^{-1} x$  and  $g(x) = \log_e \sqrt{1+x^2} + x, x \in [0, 3]$ . Then

(1) There exists  $x \in [0, 3]$  such that  $f'(x) < g'(x)$

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

(2)  $\max f(x) > \max g(x)$

(4)  $\min f'(x) = 1 + \max g'(x)$

**Q74.** Let  $f(x) = \frac{1 + \sin^2 x}{\sin^2 x} \cdot \frac{\cos^2 x}{1 + \cos^2 x} \cdot \frac{\sin 2x}{\sin 2x}, x \in [\frac{\pi}{6}, \frac{\pi}{3}]$ . If  $\alpha$  and  $\beta$  respectively are the maximum and the minimum values of  $f$ , then

(1)  $\beta^2 - 2\sqrt{\alpha} = \frac{19}{4}$

(3)  $\alpha^2 - \beta^2 = 4\sqrt{3}$

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

(4)  $\alpha^2 + \beta^2 = \frac{9}{2}$

**Q75.**  $\lim_{n \rightarrow \infty} \frac{1}{1+n} + \frac{1}{2+n} + \frac{1}{3+n} + \dots + \frac{1}{2n}$  is equal to :-

(1) 0

(3)  $\log_e \frac{3}{2}$

(2)  $\log_e 2$

(4)  $\log_e \frac{2}{3}$

**Q76.** The area enclosed by the closed curve  $C$  given by the differential equation  $\frac{dy}{dx} + \frac{x+a}{y-2} = 0, y1 = 0$  is  $4\pi$ . 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

(1)  $2\sqrt{3}$

(3) 2

(2)  $\frac{2\sqrt{3}}{3}$

(4)  $\frac{4\sqrt{3}}{3}$

Q77. If  $y = yx$  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  $y^{\frac{\pi}{6}}$  is equal to

(1)  $\frac{\pi}{12} - \frac{\sqrt{3}}{2} \log_e \frac{2}{e^{\sqrt{3}}}$   
 (3)  $\frac{\pi}{12} - \frac{\sqrt{3}}{2} \log_e \frac{2\sqrt{3}}{e}$

(2)  $\frac{\pi}{12} + \frac{\sqrt{3}}{2} \log_e \frac{2\sqrt{3}}{e}$   
 (4)  $\frac{\pi}{12} + \frac{\sqrt{3}}{2} \log_e \frac{2}{e^{\sqrt{3}}}$

Q78. 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

(1)  $\frac{22\sqrt{2}}{7}$

(2)  $\frac{24\sqrt{2}}{7}$

(3)  $2\sqrt{14}$

(4)  $3\sqrt{14}$

Q79. 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

(1)  $7\sqrt{3}$

(2)  $5\sqrt{3}$

(3)  $6\sqrt{3}$

(4)  $4\sqrt{3}$

Q80. In a binomial distribution  $B(n, p)$ , the sum and product of the mean & variance are 5 and 6 respectively, then find  $6(n + p - q)$  is equal to :-

(1) 51

(2) 52

(3) 53

(4) 50

Q81. 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 \_\_\_\_\_.

Q82. 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 \_\_\_\_\_.

Q83. The number of 3-digit numbers, that are divisible by either 2 or 3 but not divisible by 7 is \_\_\_\_\_.

Q84. The remainder when  $19^{200} + 23^{200}$  is divided by 49, is \_\_\_\_\_.

Q85. If  $fx = x^2 + g'1x + g''2$  and  $gx = f1x^2 + xf'x + f''x$ , then the value of  $f4 - g4$  is equal to \_\_\_\_\_.

Q86. If  $\int_0^1 x^{2l} + x^{14} + x^{72} 2x^{14} + 3x^7 + 6^{1/7} dx = \frac{1}{l} 11^{m/n}$  where  $l, m, n \in \mathbb{N}$ ,  $m$  and  $n$  are co-prime then  $l + m + n$  is equal to \_\_\_\_\_.

Q87. Let  $A$  be the area bounded by the curve  $y = xx - 3$ , the  $x$ -axis and the ordinates  $x = -1$  and  $x = 2$ . Then  $12A$  is equal to \_\_\_\_\_.

Q88. Let  $f: \mathbb{R} \rightarrow \mathbb{R}$  be a differentiable function such that  $f'x + fx = \int_0^2 ftdt$ . If  $f0 = e^{-2}$ , then  $2f0 - f2$  is equal to \_\_\_\_\_.

Q89. Let  $\vec{v} = \hat{a}\hat{i} + 2\hat{j} - 3\hat{k}$ ,  $\vec{w} = 2\hat{a}\hat{i} + \hat{j} - \hat{k}$ , and  $\vec{u}$  be a vector such that  $\vec{u} = \alpha \vec{v}$ ,  $\alpha > 0$ . If the minimum value of the scalar triple product  $\vec{u} \cdot \vec{v} \cdot \vec{w}$  is  $-\alpha\sqrt{3401}$ , and  $\vec{u} \cdot \hat{i} = \frac{m}{n}$  where  $m$  and  $n$  are coprime natural numbers, then  $m + n$  is equal to \_\_\_\_\_.

Q90.  $A(2, 6)$ ,  $B(2, -4)$ ,  $C(3, -1)$  and  $D(4, 5)$  are the vertices of a quadrilateral  $ABCD$ . If its area is 18 square units, then  $5 - 6\lambda$  is equal to \_\_\_\_\_.

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## ANSWER KEYS

1. (3)	2. (3)	3. (2)	4. (3)	5. (1)	6. (3)	7. (1)	8. (4)
9. (1)	10. (2)	11. (4)	12. (4)	13. (3)	14. (3)	15. (2)	16. (2)
17. (2)	18. (2)	19. (3)	20. (2)	21. (40)	22. (2)	23. (1)	24. (2)
25. (2)	26. (25)	27. (144)	28. (40)	29. (32)	30. (828)	31. (2)	32. (3)
33. (2)	34. (4)	35. (2)	36. (3)	37. (4)	38. (1)	39. (4)	40. (1)
41. (4)	42. (1)	43. (3)	44. (1)	45. (2)	46. (2)	47. (2)	48. (3)
49. (2)	50. (3)	51. (364)	52. (2)	53. (499)	54. (12)	55. (2)	56. (3)
57. (3)	58. (15)	59. (12)	60. (2)	61. (2)	62. (4)	63. (2)	64. (2)
65. (4)	66. (4)	67. (1)	68. (1)	69. (4)	70. (1)	71. (4)	72. (1)
73. (2)	74. (1)	75. (2)	76. (4)	77. (1)	78. (4)	79. (3)	80. (2)
81. (50400)	82. (754)	83. (514)	84. (29)	85. (14)	86. (63)	87. (62)	88. (1)
89. (3501)	90. (11)						

**Q1.**  $P + \frac{a}{V^2}V - b = RT$  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 :

- (1) Bulk modulus (2) Modulus of rigidity  
(3) Compressibility (4) Energy density

**Q2.** 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  $AD = 3 AB$ , then average speed of the object will be :



- (1)  $\frac{v_1 + v_2 + v_3}{3}$  (2)  $\frac{v_1 v_2 v_3}{3v_1 v_2 + v_2 v_3 + v_3 v_1}$   
(3)  $\frac{3v_1 v_2 v_3}{v_1 v_2 + v_2 v_3 + v_3 v_1}$  (4)  $\frac{v_1 + v_2 + v_3}{3v_1 v_2 v_3}$

**Q3.** A child stands on the edge of the cliff 10 m above the ground and throws a stone horizontally with an initial speed of  $5 \text{ m s}^{-1}$ . Neglecting the air resistance, the speed with which the stone hits the ground will be \_\_\_\_\_  $\text{m s}^{-1}$  (given,  $g = 10 \text{ m s}^{-2}$ ).

- (1) 20 (2) 15  
(3) 30 (4) 25

**Q4.** 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,  $g = 10 \text{ m s}^{-2}$ ):

- (1) 0.60 (2) 0.75  
(3) 0.50 (4) 0.25

**Q5.** If earth has a mass nine times and radius twice to the 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) 2 (2) 3  
(3) 18 (4) 1

**Q6.** 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

- (1) Both Statement I and Statement II are true (2) Both Statement I and Statement II are false  
(3) Statement I is true but Statement II is false (4) Statement I is false but Statement II is true

**Q7.** A mercury drop of radius  $10^{-3} \text{ m}$  is broken into 125 equal size droplets. Surface tension of mercury is  $0.45 \text{ N m}^{-1}$ . The gain in surface energy is:

- (1)  $2.26 \times 10^{-5} \text{ J}$  (2)  $28 \times 10^{-5} \text{ J}$   
(3)  $17.5 \times 10^{-5} \text{ J}$  (4)  $5 \times 10^{-5} \text{ J}$

**Q8.** 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, (given  $\gamma = \frac{3}{2}$ ) :

(1)  $W = TR\sqrt{2} - 2$

(2)  $W = \frac{T}{R}\sqrt{2} - 2$

(3)  $W = \frac{R}{T}2 - \sqrt{2}$

(4)  $W = RT2 - \sqrt{2}$

**Q9.** The average kinetic energy of a molecule of the gas is

(1) proportional to absolute temperature

(2) proportional to volume

(3) proportional to pressure

(4) dependent on the nature of the gas

**Q10.** 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:

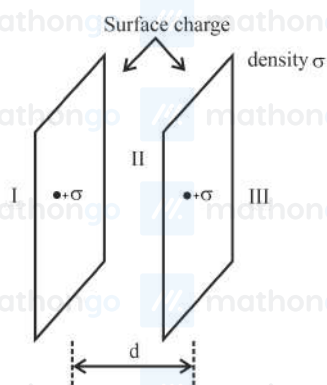
(1)  $200\pi \text{ m s}^{-1}$

(2)  $100 \text{ m s}^{-1}$

(3)  $10 \text{ m s}^{-1}$

(4)  $50 \text{ m s}^{-1}$

**Q11.** Let  $\sigma$  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  $E_{III}$



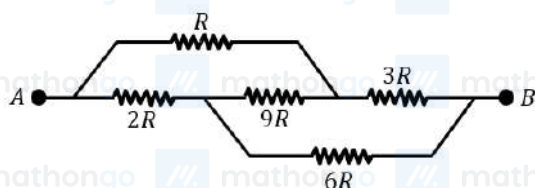
(1)  $\vec{E}_I = \frac{2\sigma}{\epsilon_0}\hat{n}, \vec{E}_{II} = 0, \vec{E}_{III} = \frac{2\sigma}{\epsilon_0}\hat{n}$

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

(3)  $\vec{E}_I = \frac{\sigma}{2\epsilon_0}\hat{n}, \vec{E}_{II} = 0, \vec{E}_{III} = \frac{\sigma}{2\epsilon_0}\hat{n}$

(4)  $\vec{E}_I = \frac{\sigma}{\epsilon_0}\hat{n}, \vec{E}_{II} = 0, \vec{E}_{III} = \frac{\sigma}{\epsilon_0}\hat{n}$

**Q12.** The equivalent resistance between A and B of the network shown in figure:



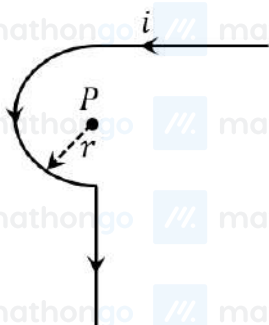
(1)  $11\frac{2R}{3}$

(2)  $14 R$

(3)  $21 R$

(4)  $\frac{8}{3} R$

**Q13.** Find the magnetic field at the point P in figure. The curved portion is a semicircle connected to two long straight wires.



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

$$(3) \frac{\mu_0 i}{2r} \left( \frac{1}{2} + \frac{1}{2\pi} \right)$$

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

$$(4) \frac{\mu_0 i}{2r} \left( \frac{1}{2} + \frac{1}{\pi} \right)$$

**Q14.** Match the List-I with List-II.

**List I**

- A AC generator
- B Transformer
- C Resonance phenomenon to occur
- D Sharpness of resonance

**List II**

- I Presence of both L and C
- II Electromagnetic Induction
- III Quality factor
- IV Mutual Inductance

Choose the correct answer from the options given below:

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

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

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

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

**Q15.** Match the 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:

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

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

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

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

**Q16.** 'n' polarizing sheets are arranged such that each makes an angle  $45^\circ$  with the proceeding 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:

(1) 3

(2) 6

(3) 5

(4) 4

**Q17.** A proton moving with one tenth of velocity of light has a certain de Broglie wavelength of  $\lambda$ . An alpha particle having certain kinetic energy has the same de-Broglie wavelength  $\lambda$ . The ratio of kinetic energy of proton and that of alpha particle is :

(1) 2 : 1

(2) 4 : 1

(3) 1 : 2

(4) 1 : 4

**Q18.** The mass of proton, neutron and helium nucleus are respectively  $1.0073 \text{ u}$ ,  $1.0087 \text{ u}$  and  $4.0015 \text{ u}$ .

The binding energy of helium nucleus is:

- (1)  $14.2 \text{ MeV}$  (2)  $28.4 \text{ MeV}$   
 (3)  $56.8 \text{ MeV}$  (4)  $7.1 \text{ MeV}$

**Q19.** Match the List I with List II

**List I**

A Intrinsic Semiconductor

B n-type semiconductor

C p-type semiconductor

D Metals

**List II**

I Fermi-level near valence band

II Fermi-level at middle of valence and conduction band

III Fermi-level near conduction band

IV Fermi-level inside conduction band

Choose the correct answer from the options given below:

- (1) (A)  $\rightarrow$  I, (B)  $\rightarrow$  II, (C)  $\rightarrow$  III, (D)  $\rightarrow$  IV (2) (A)  $\rightarrow$  II, (B)  $\rightarrow$  I, (C)  $\rightarrow$  III, (D)  $\rightarrow$  IV  
 (3) (A)  $\rightarrow$  II, (B)  $\rightarrow$  III, (C)  $\rightarrow$  I, (D)  $\rightarrow$  IV (4) (A)  $\rightarrow$  III, (B)  $\rightarrow$  I, (C)  $\rightarrow$  II, (D)  $\rightarrow$  IV

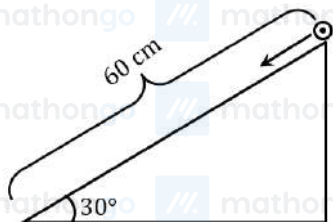
**Q20.** Which of the following frequencies does not belong to FM broadcast.

- (1)  $106 \text{ MHz}$  (2)  $64 \text{ MHz}$   
 (3)  $99 \text{ MHz}$  (4)  $89 \text{ MHz}$

**Q21.** 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  $5\hat{i} + 2\hat{j} + 7\hat{k} \text{ N}$ . The value of work done will be \_\_\_\_\_ J.

**Q22.** A solid cylinder is released from rest from the top of an inclined plane of inclination  $30^\circ$  and length  $60 \text{ cm}$ . If the cylinder rolls without slipping, its speed upon reaching the bottom of the inclined plane is \_\_\_\_\_  $\text{m s}^{-1}$ .

(Given  $g = 10 \text{ m s}^{-2}$ )



**Q23.** 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 \_\_\_\_\_.

**Q24.** The amplitude of a particle executing SHM is  $3 \text{ cm}$ . The displacement at which its kinetic energy will be 25% more than the potential energy is: \_\_\_\_\_ cm.

**Q25.** 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 \_\_\_\_\_.

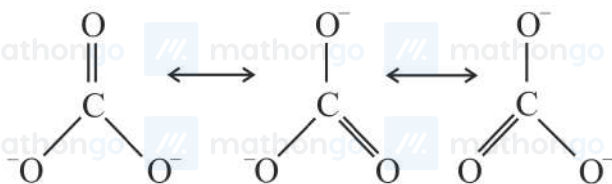
- Q26.** In an experiment to find emf of a cell using potentiometer, the length of null point for a cell of emf 1.5 V is found to be 60 cm. If this cell is replaced by another cell of emf  $E$ , the length-of null point increases by 40 cm. The value of  $E$  is  $\frac{x}{10}$  V. The value of  $x$  is \_\_\_\_\_.
- Q27.** A charge particle of 2  $\mu\text{C}$  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.
- Q28.** 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 \_\_\_\_\_  $\mu\text{F}$ .
- Q29.** 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 \_\_\_\_\_.
- Q30.** 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,  $c = 3 \times 10^8 \text{ m s}^{-1}$ )
- Q31.** 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  
 (1) A is true but R is false  
 (2) Both A and R are true but R is NOT the correct explanation of A  
 (3) A is false but R is true  
 (4) Both A and R are true and R is the correct explanation of A
- Q32.** Match List I with 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) $\text{CaSO}_4$                                      |
- Choose the correct answer form the options given below:
- |  |  |
|--|--|
| (1) (A) - I, (B) - IV, (C) - II, (D) - III | (2) (A) - III, (B) - IV, (C) - II, (D) - I |
| (3) (A) - II, (B) - IV, (C) - I, (D) - III | (4) (A) - III, (B) - II, (C) -IV, (D) -I   |
- Q33.** Choose the correct statement(s):
- Beryllium oxide is purely acidic in nature.
  - Beryllium carbonate is kept in the atmosphere of  $\text{CO}_2$ .
  - Beryllium sulphate is readily soluble in water.
  - Beryllium shows anomalous behavior.
- Choose the correct answer from the options given below:

(1) A, B and C only

(3) A and B only

(2) B, C and D only

(4) A only

Q34. Resonance in carbonate ion  $\text{CO}_3^{2-}$  is

Which of the following is true?

(1) It is possible to identify each structure

individually by some physical or chemical method.

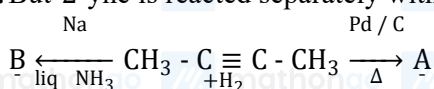
(2) All these structures are in dynamic equilibrium

with each other.

(3) Each structure exists for equal amount of time.

(4)  $\text{CO}_3^{2-}$  has a single structure i.e., resonance hybrid of the above three structures.

Q35. But-2-yne is reacted separately with one mole of Hydrogen as shown below:



Identify the incorrect statements from the options given below:

A. A is more soluble than B.

B. The boiling point &amp; 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.  $\text{Br}_2$  adds easily to B than A.

(1) B and C only

(2) B, C and D only

(3) A, C and D only

(4) A and B only

Q36. How can photochemical smog be controlled?

(1) By using tall chimneys

(2) By complete combustion of fuel

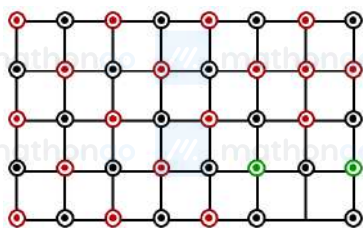
(3) By using catalytic converters in the automobiles/industry

(4) By using catalyst

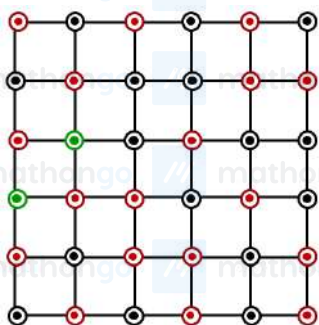
Q37. Which of the following represents the lattice structure of  $\text{A}_{0.95}\text{O}$  containing  $\text{A}^{2+}$ ,  $\text{A}^{3+}$  and  $\text{O}^{2-}$  ions?

●  $\text{A}^{2+}$ 
●  $\text{A}^{3+}$ 
●  $\text{O}^{2-}$

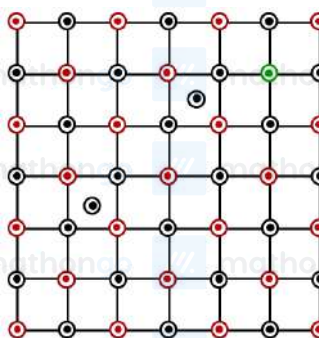
A.



B.



C.



(1) B and C only

(2) B only

(3) A and B only

(4) A only

**Q38.** 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.

(1) A is true but R is false

(2) A is false but R is true

(3) Both A and R are true but R is NOT the correct

(4) Both A and R are true and R is the correct

explanation of A

explanation A

**Q39.** 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

(1) Both A and R are correct and R is the correct

(2) A is not correct but R is correct

explanation of A

(3) Both A and R are correct but R is NOT the

(4) A is correct but R is not correct

correct explanation of A

**Q40.** 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

- (1) Both the statements I and II are true  
(2) Statement I is true but Statement II is false  
(3) Statement I is false but Statement II is true  
(4) Both the Statements I and II are false

**Q41.** A solution of  $\text{FeCl}_3$  when treated with  $\text{K}_4\text{Fe}(\text{CN})_6$  gives a prussian blue precipitate due to the formation of

- (1)  $\text{KFe}_2(\text{CN})_6$   
(2)  $\text{FeFe}(\text{CN})_6$   
(3)  $\text{Fe}_3\text{Fe}(\text{CN})_{62}$   
(4)  $\text{Fe}_4\text{Fe}(\text{CN})_{63}$

**Q42.** Highest oxidation state of Mn is exhibited in  $\text{Mn}_2\text{O}_7$ . The correct statements about  $\text{Mn}_2\text{O}_7$  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 given below

- (1) A and C only  
(2) A and D only  
(3) B and D only  
(4) B and C only

**Q43.** Which of the following complex will show largest splitting of d-orbitals?

- (1)  $\text{FeC}_2\text{O}_4^{3-}$   
(2)  $\text{FeF}_6^{3-}$   
(3)  $\text{Fe}(\text{CN})_6^{3-}$   
(4)  $\text{FeNH}_3^{3+}$

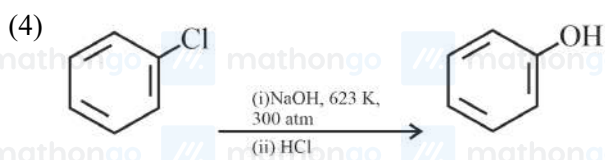
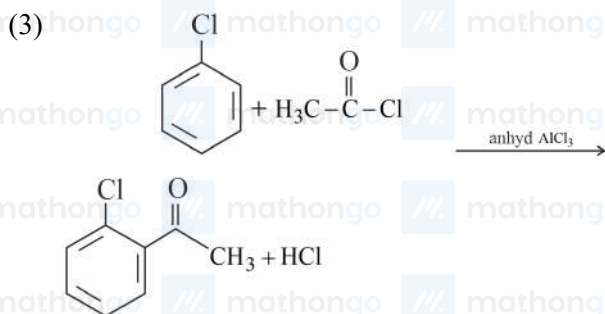
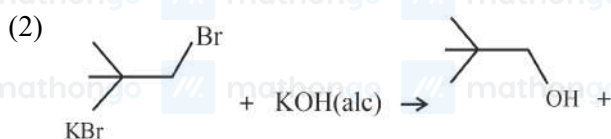
**Q44.** Which of the following are the example of double salt?

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

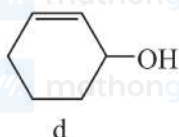
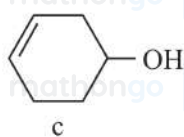
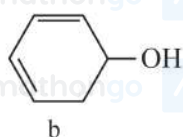
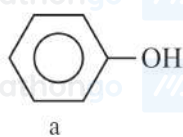
Choose the correct answer.

- (1) A and C only  
(2) A and B only  
(3) A, B and D only  
(4) B and D only

**Q45.** Identify the incorrect option from the following:



Q46. Decreasing order of dehydration of the following alcohols is



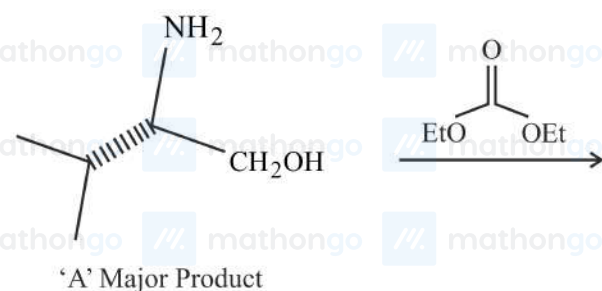
(1)  $a > d > b > c$

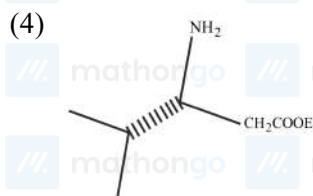
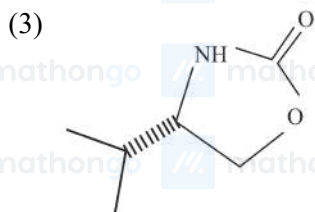
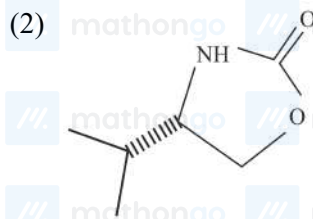
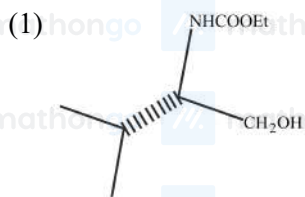
(3)  $b > a > d > c$

(2)  $b > d > c > a$

(4)  $d > b > c > a$

Q47. In the following reaction, 'A' is





**Q48.** Match List I with List II

**List I**

**List II**

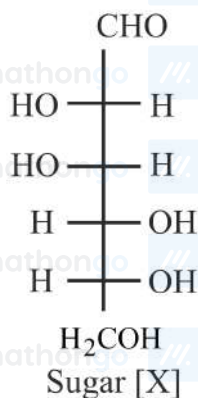
- |                   |                            |
|-------------------|----------------------------|
| (A) Tranquilizers | (I) Anti blood clotting    |
| (B) Aspirin       | (II) Salvarsan             |
| (C) Antibiotic    | (III) Antidepressant drugs |
| (D) Antiseptic    | (IV) Soframicine           |

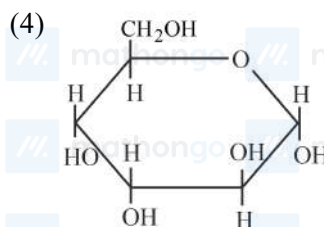
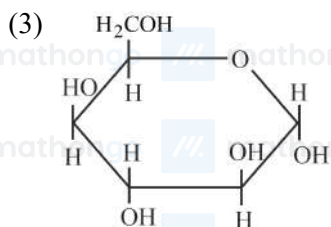
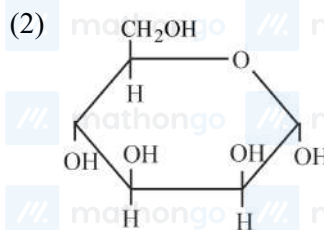
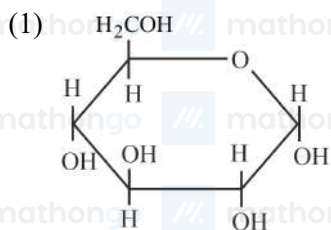
Choose the correct answer from the options given below:

- (1) (A)–IV, (B)–II, (C)–I, (D)–III  
 (3) (A)–III, (B)–I, (C)–II, (D)–IV

- (2) (A)–II, (B)–I, (C)–III, (D)–IV  
 (4) (A)–II, (B)–IV, (C)–I, (D)–III

**Q49.** The correct representation in six membered pyranose form for the following sugar [X] is





**Q50.** Match List I and List II

List I

Test

- (A) Molisch's Test
- (B) Biuret Test
- (C) Carbylamine Test
- (D) Schiff's Test

List II

- Functional group /  
Class of Compound
- (I) Peptide
  - (II) Carbohydrate
  - (III) Primary amine
  - (IV) Aldehyde

Choose the correct answer from the options given below:

- (1) (A) - I, (B) - II, (C) - III, (D) - IV
- (2) (A) - III, (B) - IV, (C) - I, (D) - II
- (3) (A) - II, (B) - I, (C) - III, (D) - IV
- (4) (A) - III, (B) - IV, (C) - II, (D) - I

**Q51.** The density of 3M solution of NaCl is  $1.0 \text{ g mL}^{-1}$ . Molality of the solution is  $\text{_____} \times 10^{-2} \text{ m}$  (Nearest integer).

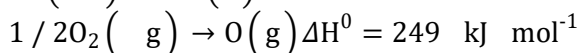
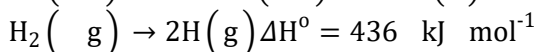
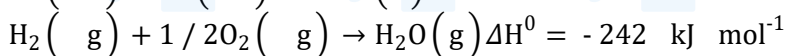
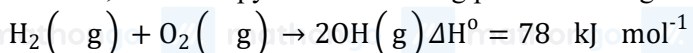
Given: Molar mass of Na and Cl is 23 and  $35.5 \text{ g mol}^{-1}$  respectively.

**Q52.** Electrons in a cathode ray tube have been emitted with a velocity of  $1000 \text{ ms}^{-1}$ . The number of following statements which is/are true about the emitted radiation is

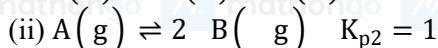
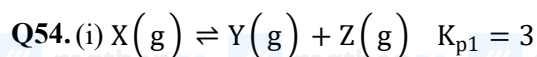
Given :  $h = 6 \times 10^{-34} \text{ Js}$ ,  $m_e = 9 \times 10^{-31} \text{ kg}$

- (A) The deBroglie wavelength of the electron emitted is  $666.67 \text{ nm}$
- (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..

**Q53.** At  $25^\circ\text{C}$ , the enthalpy of the following processes are given:

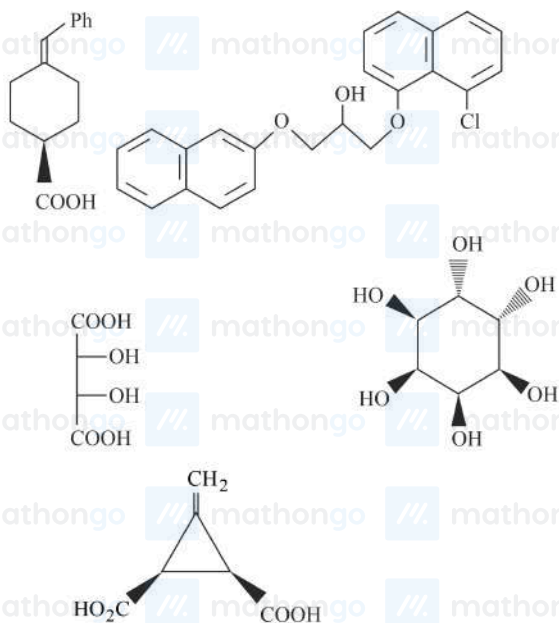


What would be the value of X for the following reaction? (Nearest integer)



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

Q55. The total number of chiral compound/s from the following is



Q56. 25 mL of an aqueous solution of KCl was found to require 20 mL of 1M  $\text{AgNO}_3$  solution when titrated using  $\text{K}_2\text{CrO}_4$  as an indicator. What is the depression in freezing point of KCl solution of the given concentration? (Nearest integer).

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

Assume

- 1) 100% ionization and
- 2) density of the aqueous solution as  $1 \text{ g mL}^{-1}$

Q57. 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  $E^\circ_{\text{MnO}_4^- / \text{Mn}^{2+}} = 1.54 \text{ V}$ ,  $\frac{2.303RT}{F} = 0.059 \text{ V}$

Q58. 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.

Q59. Sum of oxidation states of bromine in bromic acid and perbromic acid is

**Q60.** 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

**Q61.** 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  $nS$  is equal to

- (1) 2
- (2) 4
- (3) 6
- (4) 0

**Q62.** If the center and radius of the circle  $\frac{z-2}{z-3} = 2$  are respectively  $\alpha, \beta$  and  $\gamma$ , then  $3\alpha + \beta + \gamma$  is equal to

- (1) 11
- (2) 9
- (3) 10
- (4) 12

**Q63.** The sum to 10 terms of the series

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

- (1)  $\frac{111}{56}$
- (2)  $\frac{55}{111}$
- (3)  $\frac{56}{111}$
- (4)  $\frac{58}{111}$

**Q64.** The value of

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

- (1)  $\frac{2^{50}}{50!}$
- (2)  $\frac{2^{50}}{51!}$
- (3)  $\frac{2^{51}}{51!}$
- (4)  $\frac{2^{51}}{50!}$

**Q65.** The combined equation of the two lines  $ax + by + c = 0$  and  $a'x + b'y + c' = 0$  can be written as  $ax + by + ca'x + b'y + c' = 0$ . The equation of the angle bisectors of the lines represented by the equation  $2x^2 + xy - 3y^2 = 0$  is

- (1)  $3x^2 + 5xy + 2y^2 = 0$
- (2)  $x^2 - y^2 + 10xy = 0$
- (3)  $3x^2 + xy - 2y^2 = 0$
- (4)  $x^2 - y^2 - 10xy = 0$

**Q66.** If the orthocentre of the triangle, whose vertices are 1, 2, 2, 3 and 3, 1 is  $\alpha, \beta$ , then the quadratic equation whose roots are  $\alpha + 4\beta$  and  $4\alpha + \beta$ , is

- (1)  $x^2 - 19x + 90 = 0$
- (2)  $x^2 - 18x + 80 = 0$
- (3)  $x^2 - 22x + 120 = 0$
- (4)  $x^2 - 20x + 99 = 0$

**Q67.** The negation of the expression  $q \vee ((\sim q) \wedge p)$  is equivalent to

- (1)  $(\sim p) \wedge (\sim q)$
- (2)  $p \wedge (\sim q)$
- (3)  $(\sim p) \vee (\sim q)$
- (4)  $(\sim p) \vee q$

**Q68.** 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

- (1) 1072
- (2) 1792
- (3) 1216
- (4) 1456

**Q69.** 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?

(1) Perimeter of  $\Delta ABC$  is  $18\sqrt{3}$

(3)  $\vec{MA} \cdot \vec{MB} = -18$

(2)  $\sin 2A + \sin 2B + \sin 2C = \sin A + \sin B + \sin C$

(4) area of  $\Delta ABC$  is  $\frac{27\sqrt{3}}{2}$

**Q70.** Let  $R$  be a relation on  $\mathbb{R}$ , given by  $R = \{a, b: 3a - 3b + \sqrt{7} \text{ is an irrational number}\}$ . Then  $R$  is

(1) Reflexive but neither symmetric nor transitive

(3) Reflexive and symmetric but not transitive

(2) Reflexive and transitive but not symmetric

(4) An equivalence relation

**Q71.** Let  $S$  denote the set of all real values of  $\lambda$  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

(1) 2

(3) 4

(2) 12

(4) 6

**Q72.** Let  $S$  be the set of all solutions of the equation  $\cos^{-1} 2x - 2\cos^{-1} \sqrt{1-x^2} = \pi$ ,  $x \in [-\frac{1}{2}, \frac{1}{2}]$ . Then  $\sum_{x \in S} 2\sin^{-1} x^2 - 1$  is equal to

(1) 0

(3)  $\pi - \sin^{-1} \frac{\sqrt{3}}{4}$

(2)  $-\frac{2\pi}{3}$

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

**Q73.** Let  $f(x) = 2x + \tan^{-1} x$  and  $g(x) = \log_e \sqrt{1+x^2} + x$ ,  $x \in [0, 3]$ . Then

(1) There exists  $x \in [0, 3]$  such that  $f'(x) < g'(x)$

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

(2)  $\max f(x) > \max g(x)$

(4)  $\min f'(x) = 1 + \max g'(x)$

**Q74.** Let  $f(x) = \frac{1 + \sin^2 x}{\sin^2 x} \cdot \frac{\cos^2 x}{1 + \cos^2 x} \cdot \frac{\sin 2x}{\sin 2x}$ ,  $x \in [\frac{\pi}{6}, \frac{\pi}{3}]$ . If  $\alpha$  and  $\beta$  respectively are the maximum and the minimum values of  $f$ , then

(1)  $\beta^2 - 2\sqrt{\alpha} = \frac{19}{4}$

(3)  $\alpha^2 - \beta^2 = 4\sqrt{3}$

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

(4)  $\alpha^2 + \beta^2 = \frac{9}{2}$

**Q75.**  $\lim_{n \rightarrow \infty} \frac{1}{1+n} + \frac{1}{2+n} + \frac{1}{3+n} + \dots + \frac{1}{2n}$  is equal to :-

(1) 0

(3)  $\log_e \frac{3}{2}$

(2)  $\log_e 2$

(4)  $\log_e \frac{2}{3}$

**Q76.** The area enclosed by the closed curve  $C$  given by the differential equation  $\frac{dy}{dx} + \frac{x+a}{y-2} = 0$ ,  $y_1 = 0$  is  $4\pi$ . 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

(1)  $2\sqrt{3}$

(3) 2

(2)  $\frac{2\sqrt{3}}{3}$

(4)  $\frac{4\sqrt{3}}{3}$

Q77. If  $y = yx$  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  $y^{\frac{\pi}{6}}$  is equal to

(1)  $\frac{\pi}{12} - \frac{\sqrt{3}}{2} \log_e \frac{2}{e^{\sqrt{3}}}$   
 (3)  $\frac{\pi}{12} - \frac{\sqrt{3}}{2} \log_e \frac{2\sqrt{3}}{e}$

(2)  $\frac{\pi}{12} + \frac{\sqrt{3}}{2} \log_e \frac{2\sqrt{3}}{e}$   
 (4)  $\frac{\pi}{12} + \frac{\sqrt{3}}{2} \log_e \frac{2}{e^{\sqrt{3}}}$

Q78. 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

(1)  $\frac{22\sqrt{2}}{7}$

(2)  $\frac{24\sqrt{2}}{7}$

(3)  $2\sqrt{14}$

(4)  $3\sqrt{14}$

Q79. 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

(1)  $7\sqrt{3}$

(2)  $5\sqrt{3}$

(3)  $6\sqrt{3}$

(4)  $4\sqrt{3}$

Q80. In a binomial distribution  $B(n, p)$ , the sum and product of the mean & variance are 5 and 6 respectively, then find  $6(n + p - q)$  is equal to :-

(1) 51

(2) 52

(3) 53

(4) 50

Q81. 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 \_\_\_\_\_.

Q82. 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 \_\_\_\_\_.

Q83. The number of 3-digit numbers, that are divisible by either 2 or 3 but not divisible by 7 is \_\_\_\_\_.

Q84. The remainder when  $19^{200} + 23^{200}$  is divided by 49, is \_\_\_\_\_.

Q85. If  $fx = x^2 + g'1x + g''2$  and  $gx = f1x^2 + xf'x + f''x$ , then the value of  $f4 - g4$  is equal to \_\_\_\_\_.

Q86. If  $\int_0^1 x^{2l} + x^{14} + x^{72} 2x^{14} + 3x^7 + 6^{1/7} dx = \frac{1}{l} 11^{m/n}$  where  $l, m, n \in \mathbb{N}$ ,  $m$  and  $n$  are co-prime then  $l + m + n$  is equal to \_\_\_\_\_.

Q87. Let  $A$  be the area bounded by the curve  $y = xx - 3$ , the  $x$ -axis and the ordinates  $x = -1$  and  $x = 2$ . Then  $12A$  is equal to \_\_\_\_\_.

Q88. Let  $f: \mathbb{R} \rightarrow \mathbb{R}$  be a differentiable function such that  $f'x + fx = \int_0^2 ftdt$ . If  $f0 = e^{-2}$ , then  $2f0 - f2$  is equal to \_\_\_\_\_.

Q89. Let  $\vec{v} = \hat{a}\hat{i} + 2\hat{j} - 3\hat{k}$ ,  $\vec{w} = 2\hat{a}\hat{i} + \hat{j} - \hat{k}$ , and  $\vec{u}$  be a vector such that  $\vec{u} = \alpha \hat{i}$ ,  $\alpha > 0$ . If the minimum value of the scalar triple product  $\vec{u} \cdot \vec{v} \cdot \vec{w}$  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 \_\_\_\_\_.

Q90.  $A(2, 6)$ ,  $B(2, -4)$ ,  $C(3, -1)$  and  $D(4, 5)$  are the vertices of a quadrilateral  $ABCD$ . If its area is 18 square units, then  $5 - 6\lambda$  is equal to \_\_\_\_\_.

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## ANSWER KEYS

1. (3)	2. (3)	3. (2)	4. (3)	5. (1)	6. (3)	7. (1)	8. (4)
9. (1)	10. (2)	11. (4)	12. (4)	13. (3)	14. (3)	15. (2)	16. (2)
17. (2)	18. (2)	19. (3)	20. (2)	21. (40)	22. (2)	23. (1)	24. (2)
25. (2)	26. (25)	27. (144)	28. (40)	29. (32)	30. (828)	31. (2)	32. (3)
33. (2)	34. (4)	35. (2)	36. (3)	37. (4)	38. (1)	39. (4)	40. (1)
41. (4)	42. (1)	43. (3)	44. (1)	45. (2)	46. (2)	47. (2)	48. (3)
49. (2)	50. (3)	51. (364)	52. (2)	53. (499)	54. (12)	55. (2)	56. (3)
57. (3)	58. (15)	59. (12)	60. (2)	61. (2)	62. (4)	63. (2)	64. (2)
65. (4)	66. (4)	67. (1)	68. (1)	69. (4)	70. (1)	71. (4)	72. (1)
73. (2)	74. (1)	75. (2)	76. (4)	77. (1)	78. (4)	79. (3)	80. (2)
81. (50400)	82. (754)	83. (514)	84. (29)	85. (14)	86. (63)	87. (62)	88. (1)
89. (3501)	90. (11)						

Q1. If the velocity of light  $c$ , universal gravitational constant  $G$  and planck's constant  $h$  are chosen as fundamental quantities. The dimensions of mass in the new system is:

(1)  $[h^{\frac{1}{2}}c^{\frac{1}{2}}G^1]$

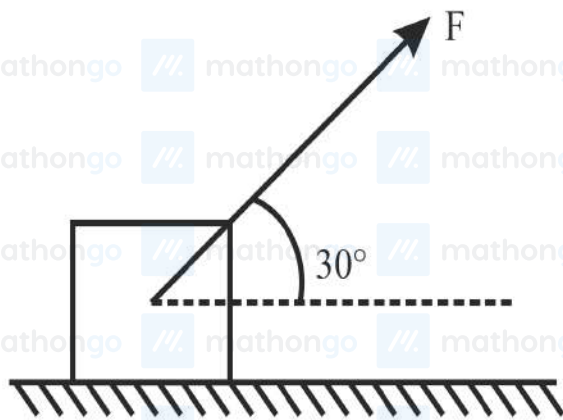
(2)  $h^1c^1G^{-1}$

(3)  $[h^{-\frac{1}{2}}c^{\frac{1}{2}}G^{\frac{1}{2}}]$

(4)  $[h^{\frac{1}{2}}c^{\frac{1}{2}}G^{-\frac{1}{2}}]$

Q2. For a train engine moving with speed of  $20 \text{ ms}^{-1}$ , the driver must apply brakes at a distance of 500 m before the station for the train to come to rest at the station. If the brakes were applied at half of this distance, the train engine would cross the station with speed  $\sqrt{x} \text{ ms}^{-1}$ . The value of  $x$  is \_\_\_\_\_. (Assuming same retardation is produced by brakes)

Q3. As shown in the figure a block of mass 10 kg lying on a horizontal surface is pulled by a force  $F$  acting at an angle  $30^\circ$ , with horizontal. For  $\mu_s = 0.25$ , the block will just start to move for the value of  $F$ : [Given  $g = 10 \text{ m} \cdot \text{s}^{-2}$ ]



(1)  $33.3 \text{ N}$

(2)  $25.2 \text{ N}$

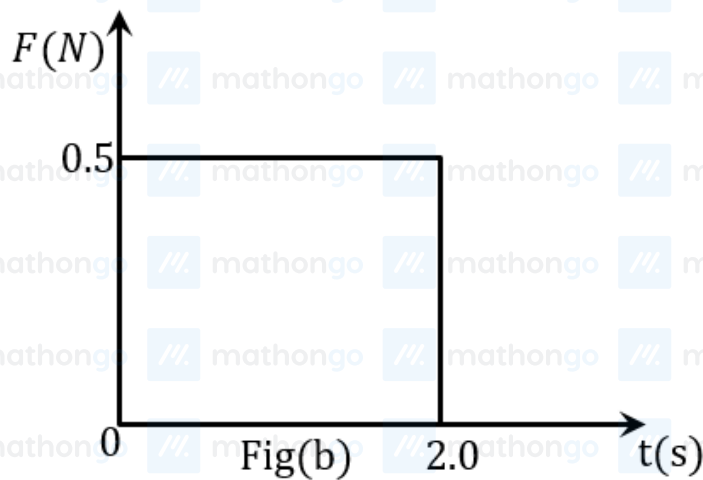
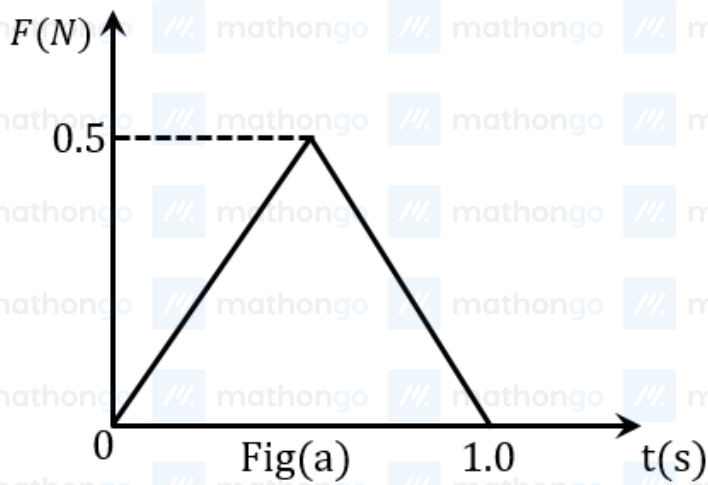
(3)  $20 \text{ N}$

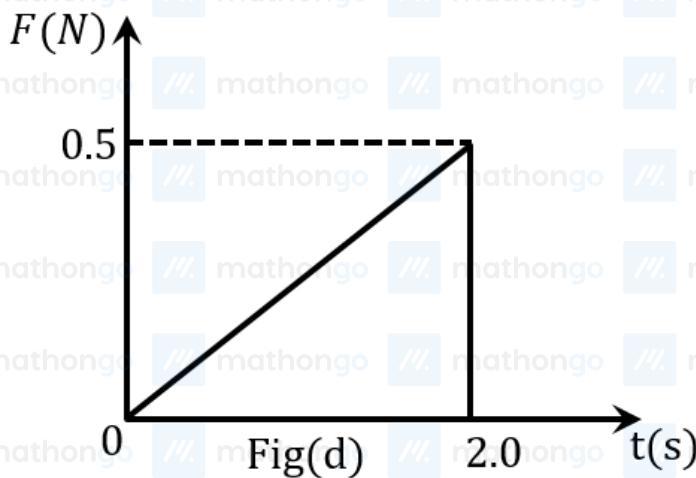
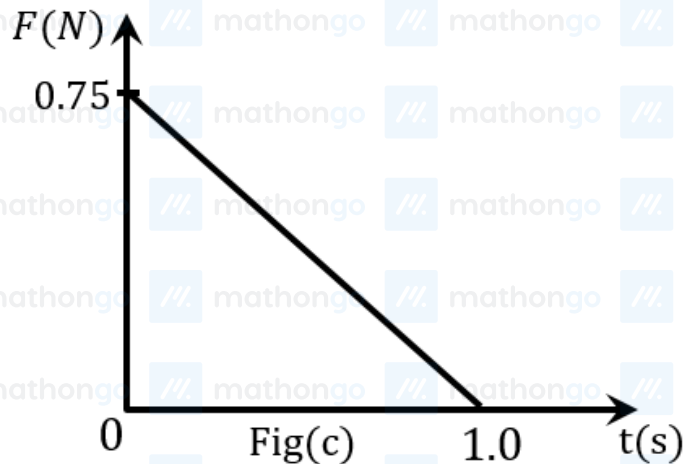
(4)  $35.7 \text{ N}$

Q4. A block is fastened to a horizontal spring. The block is pulled to a distance  $x = 10 \text{ cm}$  from its equilibrium position (at  $x = 0$ ) on a frictionless surface from rest. The energy of the block at  $x = 5 \text{ cm}$  is  $0.25 \text{ J}$ . The spring constant of the spring is \_\_\_\_\_  $\text{N m}^{-1}$ .

Q5. A force  $F = (5 + 3y^2)$  acts on a particle in the  $y$ -direction, where  $F$  is newton and  $y$  is in meter. The work done by the force during a displacement from  $y = 2 \text{ m}$  to  $y = 5 \text{ m}$  is \_\_\_\_\_ J.

Q6. Figures (a), (b), (c) and (d) show variation of force with time.





The impulse is highest in figure.

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

**Q7.** Moment of inertia of a disc of mass  $M$  and radius ' $R$ ' about any of its diameter is  $\frac{MR^2}{4}$ . The moment of inertia of this disc about an axis normal to the disc and passing through a point on its edge will be,  $\frac{x}{2}MR^2$ . The value of  $x$  is \_\_\_\_\_.

**Q8.** The escape velocities of two planets  $A$  and  $B$  are in the ratio  $1 : 2$ . If the ratio of their radii respectively is  $1 : 3$ , then the ratio of acceleration due to gravity of planet  $A$  to the acceleration of gravity of planet  $B$  will be:

- (1)  $\frac{4}{3}$  (2)  $\frac{3}{2}$   
(3)  $\frac{2}{3}$  (4)  $\frac{3}{4}$

**Q9.** For a body projected at an angle with the horizontal from the ground, choose the correct statement

- (1) Gravitational potential energy is maximum at the highest point. (2) The horizontal component of velocity is zero at highest point.  
(3) The vertical component of momentum is maximum at the highest point. (4) The kinetic energy (K.E.) is zero at the highest point of projectile motion.

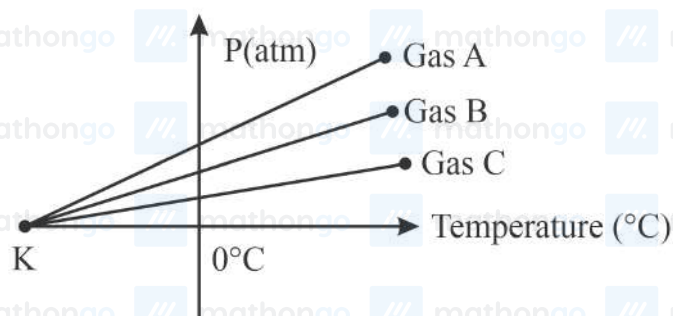
**Q10.** The Young's modulus of a steel wire of length 6 m and cross-sectional area  $3 \text{ mm}^2$ , is  $2 \times 10^{11} \text{ N/m}^2$ . The wire is suspended from its support on a given planet. A block of mass 4 kg is attached to the free end of the

wire. The acceleration due to gravity on the planet is  $\frac{1}{4}$  of its value on the earth. The elongation of wire is  
(Take  $g$  on the earth =  $10 \text{ m/s}^2$ ):

- (1)  $1 \text{ cm}$  (2)  $1 \text{ mm}$   
(3)  $0.1 \text{ mm}$  (4)  $0.1 \text{ cm}$

**Q11.** The surface of water in a water tank of cross section area  $750 \text{ cm}^2$  on the top of a house is  $h \text{ m}$ . above the tap level. The speed of water coming out through the tap of cross section area  $500 \text{ mm}^2$  is  $30 \text{ cm s}^{-1}$ . At that instant,  $\frac{dh}{dt}$  is  $x \times 10^{-3} \text{ m s}^{-1}$ . The value of  $x$  will be \_\_\_\_\_.

**Q12.** For three low density gases  $A, B, C$  pressure versus temperature graphs are plotted while keeping them at constant volume, as shown in the figure



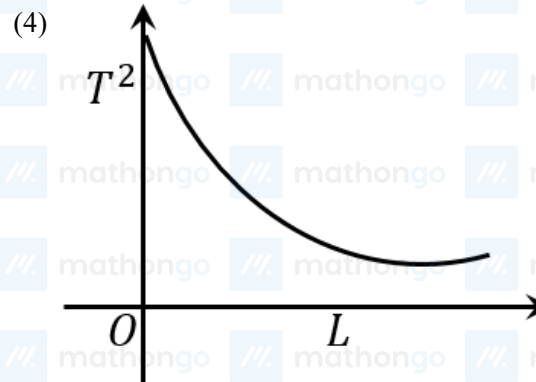
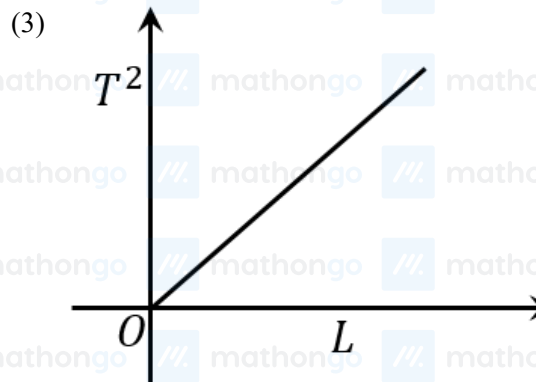
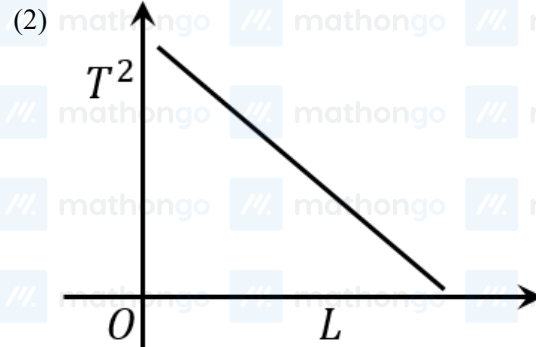
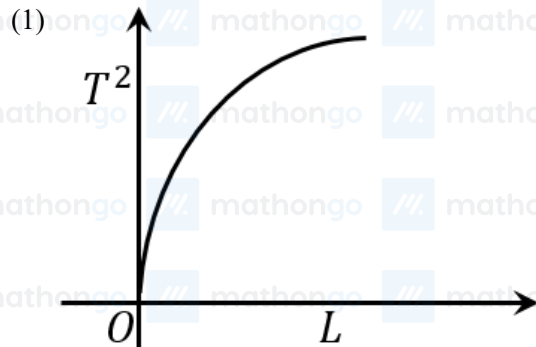
The temperature corresponding to the point  $K$  is:

- (1)  $-273^\circ \text{C}$  (2)  $-100^\circ \text{C}$   
(3)  $-373^\circ \text{C}$  (4)  $-40^\circ \text{C}$

**Q13.** A Carnot engine operating between two reservoirs has efficiency  $\frac{1}{3}$ . When the temperature of cold reservoir raised by  $x$ , its efficiency decreases to  $\frac{1}{6}$ . The value of  $x$ , if the temperature of hot reservoir is  $99^\circ \text{C}$ , will be

- (1)  $16.5 \text{ K}$  (2)  $33 \text{ K}$   
(3)  $66 \text{ K}$  (4)  $62 \text{ K}$

**Q14.** Choose the correct length ( $L$ ) versus square of time period ( $T_2$ ) graph for a simple pendulum executing simple harmonic motion.



**Q15.** A cubical volume is bounded by the surfaces  $x = 0$ ,  $x = a$ ,  $y = 0$ ,  $y = a$ ,  $z = 0$ ,  $z = a$ . The electric field in the region is given by  $\vec{E} = E_0 x \hat{i}$ . Where  $E_0 = 4 \times 10^4 \text{ NC}^{-1} \text{ m}^{-1}$ . If  $a = 2 \text{ cm}$ , the charge contained in the cubical volume is  $Q \times 10^{-14} \text{ C}$ . The value of  $Q$  is \_\_\_\_\_.  
(Take  $\epsilon_0 = 9 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$ )

**Q16.** Given below are two statements : One is labelled as Assertion A and the other is labelled as Reason R.

**Assertion A :** Two metallic spheres are charged to the same potential. One of them is hollow and another is solid, and both have the same radii. Solid sphere will have lower charge than the hollow one.

**Reason R :** Capacitance of metallic spheres depend on the radii of spheres.

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

- |                              |   |
|------------------------------|---|
| (1) A is false but R is true | (2) Both A and R are true and R is the correct explanation of A     |
| (3) A is true but R is false | (4) Both A and R are true but R is not the correct explanation of A |

**Q17.** Given below are two statements : One is labelled as Assertion A and the other is labelled as Reason R.

**Assertion A :** For measuring the potential difference across a resistance of  $600 \Omega$ , the voltmeter with resistance  $1000 \Omega$  will be preferred over voltmeter with resistance  $4000 \Omega$ .

**Reason R :** Voltmeter with higher resistance will draw smaller current than voltmeter with lower resistance.

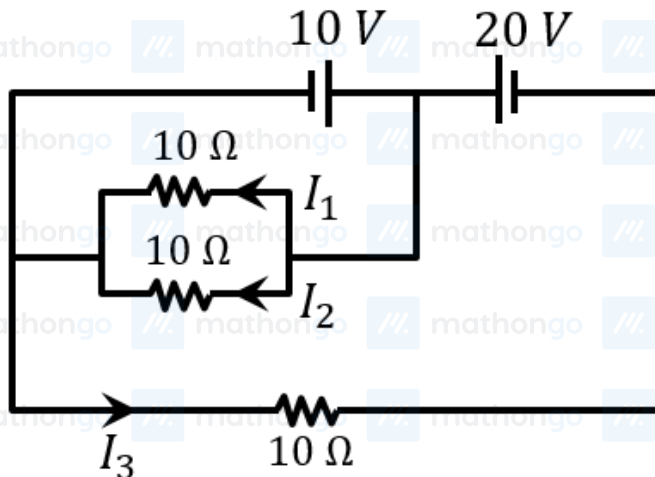
In the light of the above statements, choose the most appropriate answer from the options given below

- |  |  |
|--|--|
| (1) A is not correct but R is correct                                  | (2) Both A and R are correct and R is the correct explanation of A |
| (3) Both A and R are correct but R is not the correct explanation of A | (4) A is correct but R is not correct                              |

**Q18.** Equivalent resistance between the adjacent corners of a regular  $n$ -sided polygon of uniform wire of resistance  $R$  would be :

- (1)  $\frac{(n-1)R}{n^2}$  (2)  $\frac{(n-1)R}{(2n-1)}$   
 (3)  $\frac{n^2R}{n-1}$  (4)  $\frac{(n-1)R}{n}$

**Q19.** In the given circuit the value of  $\left| \frac{I_1 + I_3}{I_2} \right|$  is:



**Q20.** A coil is placed in magnetic field such that plane of coil is perpendicular to the direction of magnetic field. The magnetic flux through a coil can be changed:

- A. By changing the magnitude of the magnetic field within the coil.  
 B. By changing the area of coil within the magnetic field.  
 C. By changing the angle between the direction of magnetic field and the plane of the coil.  
 D. By reversing the magnetic field direction abruptly without changing its magnitude.

Choose the most appropriate answer from the options given below:

- (1) A and B only (2) A, B and C only  
 (3) A, B and D only (4) A and C only

**Q21.** As shown in the figure, a long straight conductor with semicircular arc of radius  $\frac{\pi}{10} \text{ m}$  is carrying current  $I = 3 \text{ A}$ . The magnitude of the magnetic field at the center  $O$  of the arc is: (The permeability of the vacuum  $= 4\pi \times 10^{-7} \text{ NA}^{-2}$ )



- (1)  $6 \mu\text{T}$  (2)  $1 \mu\text{T}$   
 (3)  $4 \mu\text{T}$  (4)  $3 \mu\text{T}$

**Q22.** A square shaped coil of area  $70 \text{ cm}^2$  having 600 turns rotates in a magnetic field of  $0.4 \text{ Wb m}^{-2}$ , about an axis which is parallel to one of the side of the coil and perpendicular to the direction of field. If the coil

completes 500 revolution in a minute, the instantaneous emf when the plane of the coil is inclined at  $60^\circ$  with the field, will be \_\_\_\_\_ V.

(Take  $\pi = \frac{22}{7}$ )

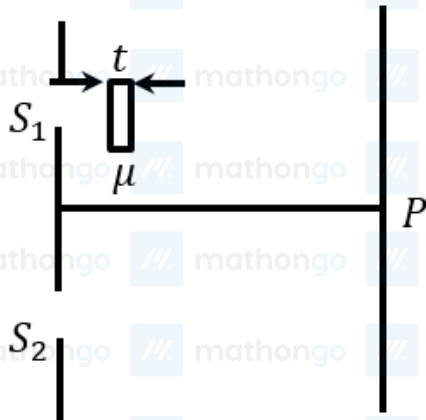
**Q23.** The ratio of average electric energy density and total average energy density of electromagnetic wave is:

- (1) 2 (2) 1  
(3) 3 (4)  $\frac{1}{2}$

**Q24.** Two objects *A* and *B* are placed at 15 cm and 25 cm from the pole in front of a concave mirror having radius of curvature 40 cm. The distance between images formed by the mirror is:

- (1) 40 cm (2) 60 cm  
(3) 160 cm (4) 100 cm

**Q25.** As shown in the figure, in Young's double slit experiment, a thin plate of thickness  $t = 10 \mu\text{m}$  and refractive index  $\mu = 1.2$  is inserted in front of slit  $S_1$ . The experiment is conducted in air ( $\mu = 1$ ) and uses a monochromatic light of wavelength  $\lambda = 500 \text{ nm}$ . Due to the insertion of the plate, central maxima is shifted by a distance of  $x\beta_0$ .  $\beta_0$  is the fringe-width before the insertion of the plate. The value of the  $x$  is \_\_\_\_\_.



**Q26.** The threshold frequency of metal is  $f_0$ . When the light of frequency  $2f_0$  is incident on the metal plate, the maximum velocity of photoelectron is  $v_1$ . When the frequency of incident radiation is increased to  $5f_0$ , the maximum velocity of photoelectrons emitted is  $v_2$ . The ratio of  $v_1$  to  $v_2$  is:

- (1)  $\frac{v_1}{v_2} = \frac{1}{2}$  (2)  $\frac{v_1}{v_2} = \frac{1}{8}$   
(3)  $\frac{v_1}{v_2} = \frac{1}{16}$  (4)  $\frac{v_1}{v_2} = \frac{1}{4}$

**Q27.** An electron of a hydrogen like atom, having  $Z = 4$ , jumps from  $4^{\text{th}}$  energy state to  $2^{\text{nd}}$  energy state, The energy released in this process, will be: (Given  $Rch = 13.6 \text{ eV}$ )

Where  $R$  = Rydberg

constant  $c$  = Speed of light in vacuum

$h$  = Planck's constant

- (1)  $13.6 \text{ eV}$  (2)  $10.5 \text{ eV}$   
(3)  $3.4 \text{ eV}$  (4)  $40.8 \text{ eV}$

**Q28.** Nucleus *a* having  $Z = 17$  and equal number of protons and neutrons has 1.2 MeV binding energy per nucleon. Another nucleus *B* of  $Z = 12$  has total 26 nucleons and 1.8 MeV binding energy per nucleons. The

difference of binding energy of  $B$  and  $A$  will be \_\_\_\_\_ MeV.

**Q29.** Choose the correct statement about Zener diode:

- (1) It works as a voltage regulator in reverse bias and (2) It works as a voltage regulator in both forward and reverse bias  
 behaves like simple p-n junction diode in forward bias  
 (3) It works as a voltage regulator only in forward bias (4) It works as a voltage regulator in forward bias and behaves like simple p-n junction diode in reverse bias

**Q30.** In an amplitude modulation, a modulating signal having amplitude of  $X$  V is superimposed with a carrier signal of amplitude  $Y$  V in first case. Then, in second case, the same modulating signal is superimposed with different carrier signal of amplitude  $2Y$  V. The ratio of modulation index in the two case respectively will be :

- (1) 1 : 2 (2) 1 : 1  
 (3) 2 : 1 (4) 4 : 1

**Q31.** The molality of a 10%(v/V) solution of di-bromine solution in  $\text{CCl}_4$  (carbon tetrachloride) is  $x$  '.  $x =$  \_\_\_\_\_  $\times 10^{-2}$  M. (Nearest integer)

[Given : molar mass of  $\text{Br}_2 = 160 \text{ g mol}^{-1}$

atomic mass of C = 12  $\text{g mol}^{-1}$

atomic mass of Cl = 35.5  $\text{g mol}^{-1}$

density of dibromine = 3.2  $\text{g cm}^{-3}$

density of  $\text{CCl}_4 = 1.6 \text{ g cm}^{-3}$ ]

**Q32.** Which one of the following sets of ions represents a collection of isoelectronic species?

(Given : Atomic Number : F : 9, Cl : 17, Na = 11

Mg = 12, Al = 13, K = 19, Ca = 20, Sc = 21)

- (1)  $(\text{Li}^+, \text{Na}^+, \text{Mg}^{2+}, \text{Ca}^{2+})$  (2)  $(\text{Ba}^{2+}, \text{Sr}^{2+}, \text{K}^+, \text{Ca}^{2+})$   
 (3)  $(\text{N}^{3-}, \text{O}^{2-}, \text{F}^-, \text{S}^{2-})$  (4)  $(\text{K}^+, \text{Cl}^-, \text{Ca}^{2+}, \text{Sc}^{3+})$

**Q33.** For electron gain enthalpies of the elements denoted as  $\Delta_{\text{eg}}H$ , the incorrect option is :

- (1)  $\Delta_{\text{eg}}H(\text{Cl}) < \Delta_{\text{eg}}H(\text{F})$  (2)  $\Delta_{\text{eg}}H(\text{Se}) < \Delta_{\text{eg}}H(\text{S})$   
 (3)  $\Delta_{\text{eg}}H(\text{I}) < \Delta_{\text{eg}}H(\text{At})$  (4)  $\Delta_{\text{eg}}H(\text{Te}) < \Delta_{\text{eg}}H(\text{Po})$

**Q34.** 0.3 g of ethane undergoes combustion at  $27^\circ\text{C}$  in a bomb calorimeter. The temperature of calorimeter system (including the water) is found to rise by  $0.5^\circ\text{C}$ . The heat evolved during combustion of ethane at constant pressure is  $\text{kJ mol}^{-1}$ .

(Nearest integer)

[Given : The heat capacity of the calorimeter system is  $20 \text{ kJ K}^{-1}$ ,  $R = 8.3 \text{ JK}^{-1} \text{ mol}^{-1}$ .

Assume ideal gas behaviour.

Assume ideal gas behaviour.

Atomic mass of C and H are 12 and 1  $\text{g mol}^{-1}$  respectively]

**Q35.** The effect of addition of helium gas to the following reaction in equilibrium state at constant volume, is :



- (1) the equilibrium will shift in the forward direction and more of  $\text{Cl}_2$  and  $\text{PCl}_3$  gases will be produced.  
(2) the equilibrium will go backward due to suppression of dissociation of  $\text{PCl}_5$ .  
(3) helium will deactivate  $\text{PCl}_5$  and reaction will stop.  
(4) addition of helium will not affect the equilibrium.

**Q36.** Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

**Assertion (A) :** An aqueous solution of  $\text{KOH}$  when for volumetric analysis, its concentration should be checked before the use.

**Reason (R) :** On aging,  $\text{KOH}$  solution absorbs atmospheric  $\text{CO}_2$ .

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

- (1) (A) is not correct but (R) is correct  
(2) Both (A) and (R) are correct but (R) is not the correct explanation of (A)  
(3) Both (A) and (R) are correct and (R) is the correct explanation of (A)  
(4) (A) is correct but (R) is not correct

**Q37.** O – O bond length in  $\text{H}_2\text{O}_2$  is X than the O – O bond length in  $\text{F}_2\text{O}_2$ . The O – H bond length in  $\text{H}_2\text{O}_2$  is Y than that of the O – F bond in  $\text{F}_2\text{O}_2$ . Choose the correct option for X and Y from the given below.

- (1) X- shorter, Y- shorter  
(2) X-shorter, Y-longer  
(3) X-longer, Y-longer  
(4) X-longer, Y - shorter

**Q38.** The starting material for convenient preparation of deuterated hydrogen peroxide ( $\text{D}_2\text{O}_2$ ) in laboratory is:

- (1)  $\text{K}_2\text{S}_2\text{O}_8$   
(2) 2-ethylanthraquinol  
(3)  $\text{BaO}_2$   
(4)  $\text{BaO}$

**Q39.** Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

**Assertion (A):** Gypsum is used for making fireproof wall boards.

**Reason (R):** Gypsum is unstable at high temperatures.

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

- (1) Both (A) and (R) are correct but (R) is not the correct explanation of (A).  
(2) (A) is correct but (R) is not correct.  
(3) (A) is not correct but (R) is correct.  
(4) Both (A) and (R) are correct and (R) is the correct explanation of (A).

**Q40.** The correct order of bond enthalpy ( $\text{kJ mol}^{-1}$ ) is:

- (1)  $\text{Si} - \text{Si} > \text{C} - \text{C} > \text{Sn} - \text{Sn} > \text{Ge} - \text{Ge}$   
(2)  $\text{Si} - \text{Si} > \text{C} - \text{C} > \text{Ge} - \text{Ge} > \text{Sn} - \text{Sn}$   
(3)  $\text{C} - \text{C} > \text{Si} - \text{Si} > \text{Sn} - \text{Sn} > \text{Ge} - \text{Ge}$   
(4)  $\text{C} - \text{C} > \text{Si} - \text{Si} > \text{Ge} - \text{Ge} > \text{Sn} - \text{Sn}$

**Q41.** Given below are two statements:

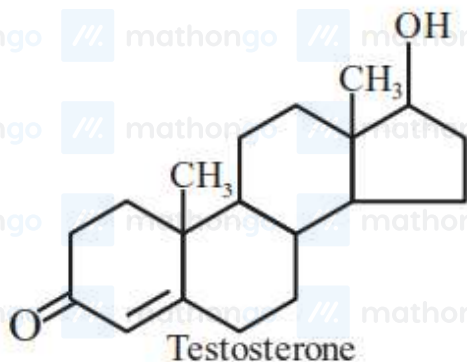
Statement I: Sulphanilic acid gives esterification test for carboxyl group.

Statement II: Sulphanilic acid gives red colour in Lassaigne's test for extra element detection.

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

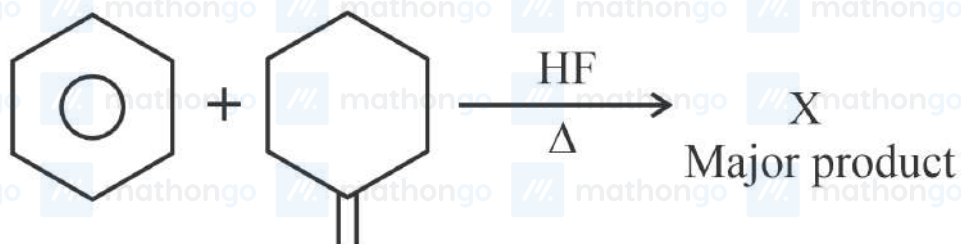
- (1) Statement I is correct but Statement II is incorrect.
- (2) Both Statement I and Statement II are incorrect
- (3) Both Statement I and Statement II are correct
- (4) Statement I is incorrect but Statement II is correct.

Q42. Testosterone, which is a steroidal hormone, has the following structure.



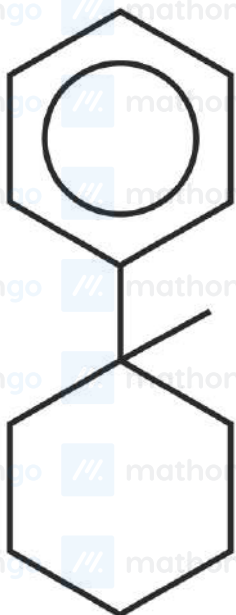
The total number of asymmetric carbon atom/s in testosterone is \_\_\_\_\_.

Q43.

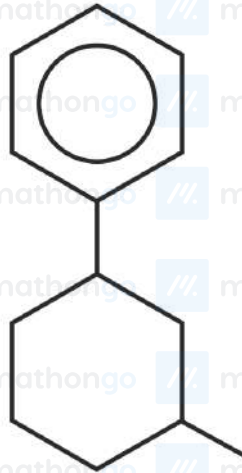


'X' is:

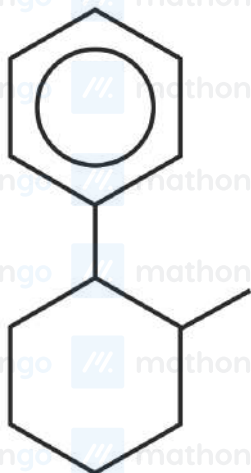
(1)



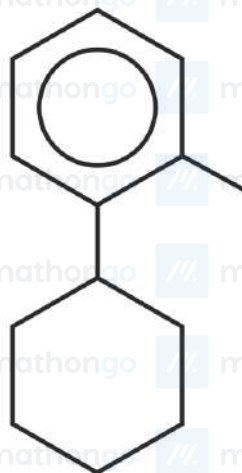
(2)



(3)



(4)



**Q44.** The industrial activity held least responsible for global warming is :

- (1) manufacturing of cement                      (2) steel manufacturing  
(3) Electricity generation in thermal power plants.                      (4) Industrial production of urea

**Q45.** A metal M crystallizes into two lattices :- face centred cubic (fcc) and body centred cubic (bcc) with unit cell edge length of 2.0 and 2.5 Å respectively. The ratio of densities of lattices fcc to bcc for the metal M is \_\_\_\_\_ (Nearest integer)

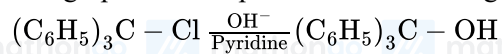
**Q46.** 20% of acetic acid is dissociated when its 5 g is added to 500 mL of water. The depression in freezing point of such water is  $\text{_____} \times 10^{-3}^{\circ}\text{C}$ . Atomic mass of C, H and O are 12, 1 and 16 a.m.u. respectively.  
[Given : Molal depression constant and density of water are  $1.86 \text{ K kg mol}^{-1}$  and  $1 \text{ g cm}^{-3}$  respectively.]

**Q47.**  $1 \times 10^{-5} \text{ M AgNO}_3$  is added to 1 L of saturated solution of AgBr. The conductivity of this solution at 298 K is  $\text{_____} \times 10^{-8} \text{ S m}^{-1}$ .

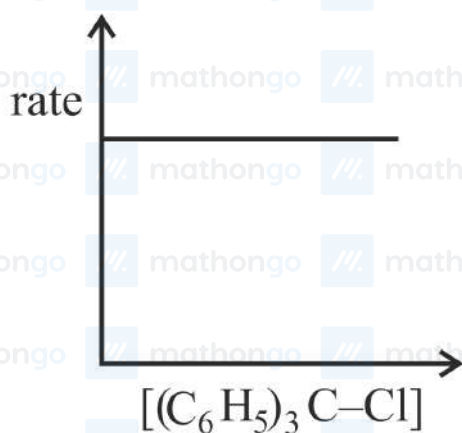
[Given :  $K_{\text{sp}}(\text{AgBr}) = 4.9 \times 10^{-13}$  at 298 K  
 $\lambda_{\text{Ag}^+}^0 = 6 \times 10^{-3} \text{ Sm}^2 \text{ mol}^{-1}$

$$\left[ \begin{array}{l} \lambda_{\text{Br}^-}^0 = 8 \times 10^{-3} \text{ Sm}^2 \text{ mol}^{-1} \\ \lambda_{\text{NO}_3^-}^0 = 7 \times 10^{-3} \text{ Sm}^2 \text{ mol}^{-1} \end{array} \right]$$

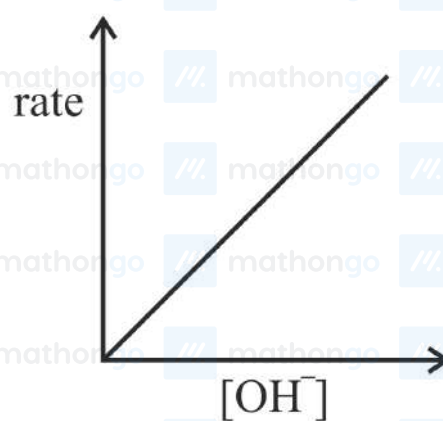
Q48. The graph which represents the following reaction is:



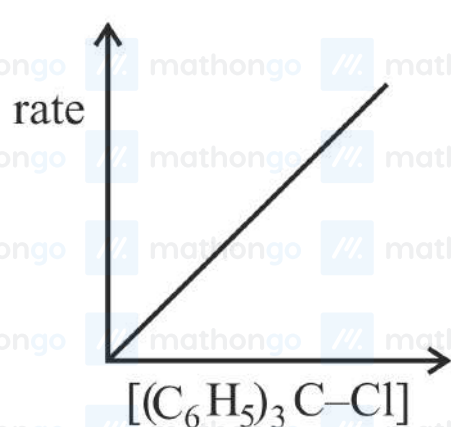
(1)



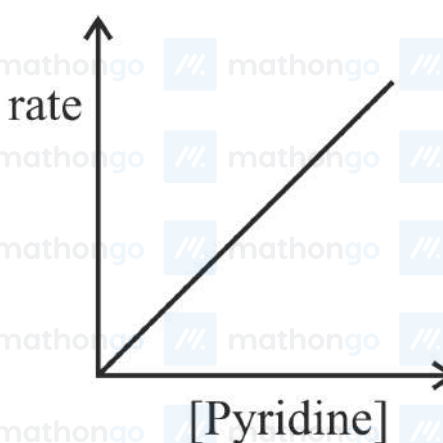
(2)



(3)



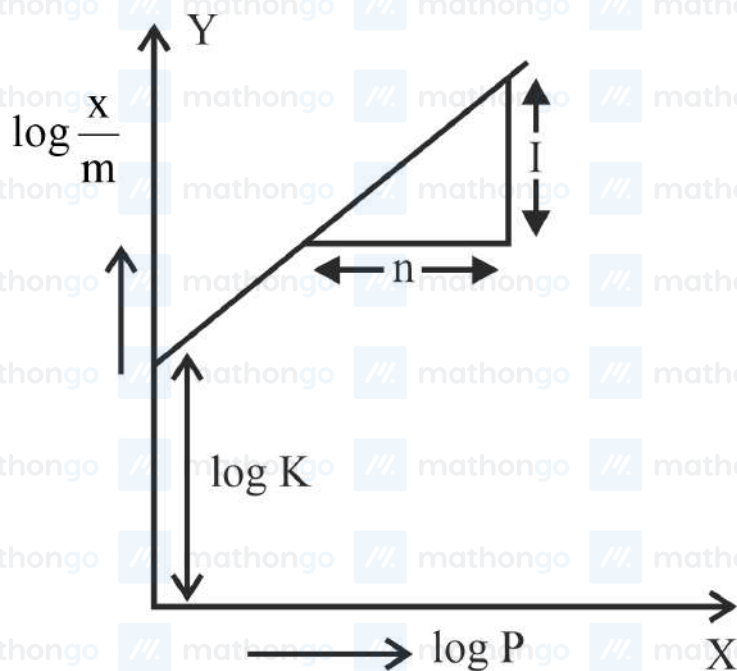
(4)



Q49.  $\text{A} \rightarrow \text{B}$

The above reaction is of zero order. Half life of this reaction is 50 min. The time taken for the concentration of A to reduce to one-fourth of its initial value is min. (Nearest integer)

Q50. In figure, a straight line is given for Freundlich Adsorption ( $y = 3x + 2.505$ ). The value of  $\frac{1}{n}$  and  $\log K$  are respectively.



(1) 0.3 and  $\log 2.505$

(3) 3 and 2.505

(2) 0.3 and 0.7033

(4) 3 and 0.7033

**Q51.** Among following compounds, the number of those present in copper matte is

A.  $\text{CuCO}_3$

B.  $\text{Cu}_2\text{S}$

C.  $\text{Cu}_2\text{O}$

D.  $\text{FeO}$

**Q52.** Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) :  $\text{Cu}^{2+}$  in water is more stable than  $\text{Cu}^+$ .

Reason (R) : Enthalpy of hydration for  $\text{Cu}^{2+}$  is much less than that of  $\text{Cu}^+$ .

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

(1) Both (A) and (R) are correct and (R) is the correct explanation of (A).

(3) (A) is not correct but (R) is correct.

(2) (A) is correct but (R) is not correct.

(4) Both (A) and (R) are correct but (R) is not the correct explanation of (A).

**Q53.** Which element is not present in Nessler's reagent?

(1) Mercury

(3) Iodine

(2) Potassium

(4) Oxygen

**Q54.** The complex cation which has two isomers is:

(1)  $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$

(3)  $[\text{Co}(\text{NH}_3)_5\text{NO}_2]^{2+}$

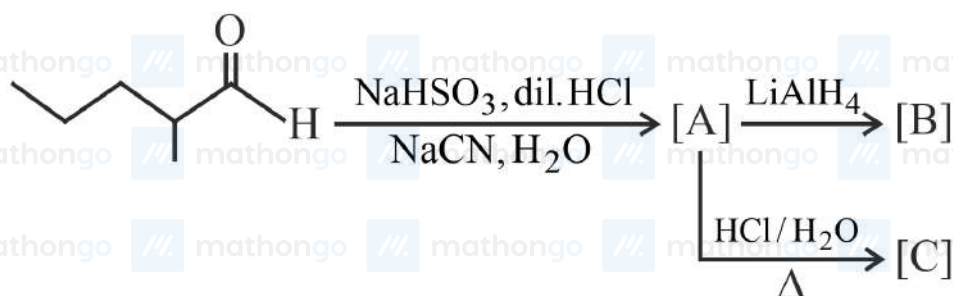
(2)  $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+}$

(4)  $[\text{Co}(\text{NH}_3)_5\text{Cl}]^+$

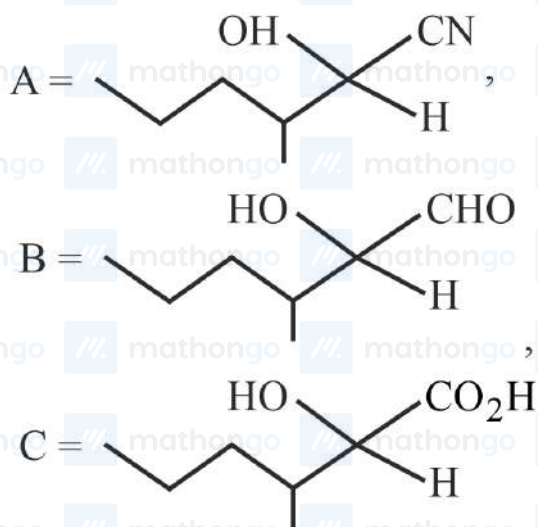
**Q55.** The spin only magnetic moment of  $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$  complexes is B. M. (Nearest integer)

(Given atomic number of Mn = 25)

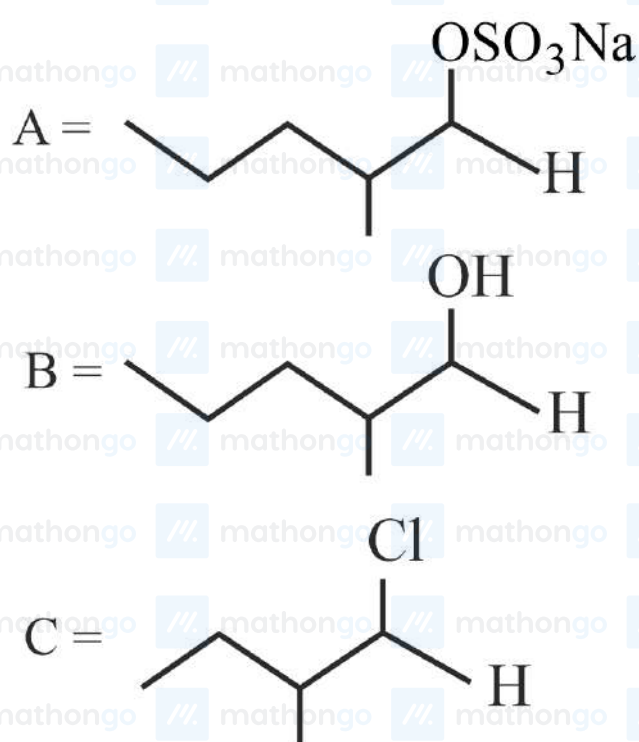
Q56. The structures of major products A, B and C in the following reaction are sequence.



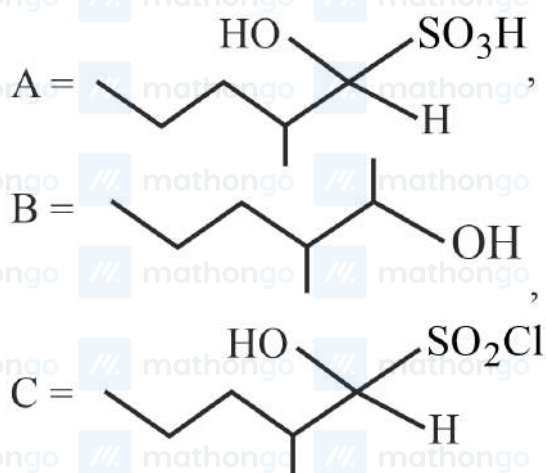
(1)



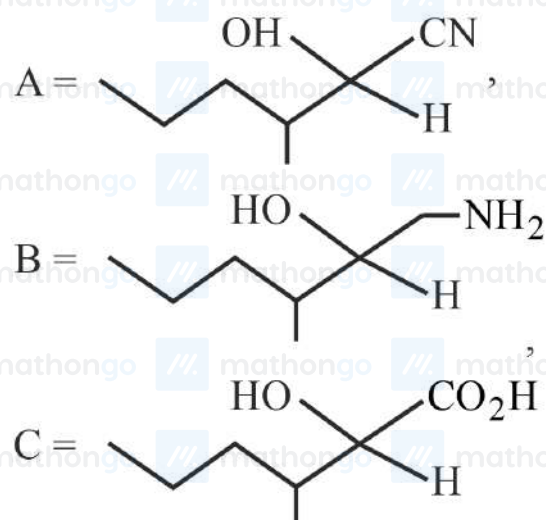
(2)



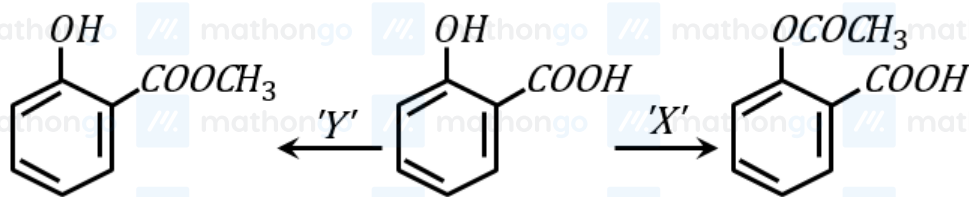
(3)



(4)



Q57. In a reaction



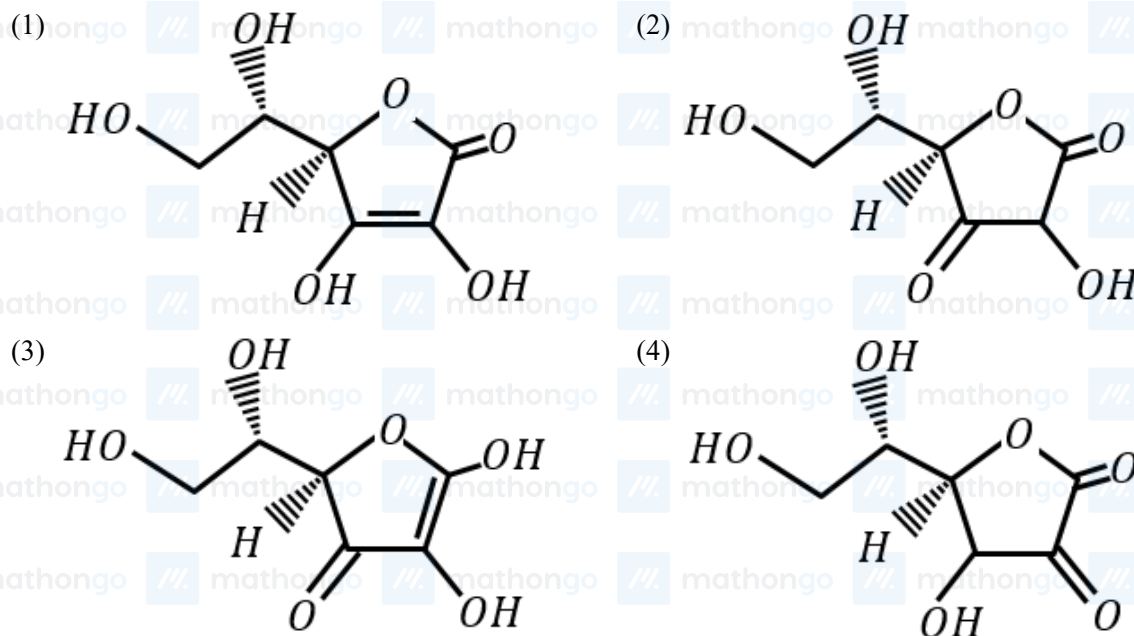
reagents 'X' and 'Y' respectively are:

- (1)  $(\text{CH}_3\text{CO})_2\text{O}/\text{H}^+$  and  $\text{CH}_3\text{OH}/\text{H}^+$ ,  $\Delta$       (2)  $(\text{CH}_3\text{CO})_2\text{O}/\text{H}^+$  and  $(\text{CH}_3\text{CO})_2\text{O}/\text{H}^+$   
 (3)  $\text{CH}_3\text{OH}/\text{H}^+$ ,  $\Delta$  and  $\text{CH}_3\text{OH}/\text{H}^+$ ,  $\Delta$       (4)  $\text{CH}_3\text{OH}/\text{H}^+$ ,  $\Delta$  and  $(\text{CH}_3\text{CO})_2\text{O}/\text{H}^+$

**Q58.** Among the following, the number of tranquilizer/s is/are

- A. Chloroliazepoxide  
 B. Veronal  
 C. Valium  
 D. Salvarsan

**Q59.** All structures given below are of vitamin C. Most stable of them is:



**Q60.** Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

**Assertion (A):**  $\alpha$ -halocarboxylic acid on reaction with dil.  $\text{NH}_3$  gives good yield of  $\alpha$ -amino carboxylic acid whereas the yield of amines is very low when prepared from alkyl halides.

**Reason (R):** Amino acids exist in zwitter ion form in aqueous medium.

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

- (1) Both (A) and (R) are correct and (R) is the correct explanation of (A).      (2) Both (A) and (R) are correct but (R) is not the correct explanation of (A).  
 (3) (A) is correct but (R) is not correct.      (4) (A) is not correct but (R) is correct.

**Q61.** The number of integral values of  $k$ , for which one root of the equation  $2x^2 - 8x + k = 0$  lies in the interval  $(1, 2)$  and its other root lies in the interval  $(2, 3)$ , is :

- (1) 2  
(3) 1
- (2) 0  
(4) 3

**Q62.** Let  $a, b$  be two real numbers such that  $ab < 0$ . If the complex number  $\frac{1+ai}{b+i}$  is of unit modulus and  $a + ib$  lies on the circle  $|z - 1| = |2z|$ , then a possible value of  $\frac{1+[a]}{4b}$ , where  $[t]$  is greatest integer function, is :

- (1) 0  
(3) 1
- (2) -1  
(4)  $\frac{1}{2}$

**Q63.** Number of integral solutions to the equation  $x + y + z = 21$ , where  $x \geq 1, y \geq 3, z \geq 4$ , is equal to \_\_\_\_\_.

**Q64.** The total number of six digit numbers, formed using the digits 4, 5, 9 only and divisible by 6, is \_\_\_\_\_.

**Q65.** The sum  $\sum_{n=1}^{\infty} \frac{2n^2+3n+4}{(2n)!}$  is equal to :

- (1)  $\frac{11e}{2} + \frac{7}{2e}$   
(3)  $\frac{11e}{2} + \frac{7}{2e} - 4$
- (2)  $\frac{13e}{4} + \frac{5}{4e} - 4$   
(4)  $\frac{13e}{4} + \frac{5}{4e}$

**Q66.** The sum of the common terms of the following three arithmetic progressions.

3, 7, 11, 15, ..... , 399

2, 5, 8, 11, ..... 359 and

2, 7, 12, 17, ..... , 197, is equal to \_\_\_\_\_.

**Q67.** If the term without  $x$  in the expansion of  $\left(x^{\frac{2}{3}} + \frac{\alpha}{x^3}\right)^{22}$  is 7315, then  $|\alpha|$  is equal to \_\_\_\_\_.

**Q68.** Let the sixth term in the binomial expansion of  $\left(\sqrt{2^{\log_2(10-3^x)}} + \sqrt[5]{2^{(x-2)\log_2 3}}\right)^m$  powers of  $2^{(x-2)\log_2 3}$ , be 21.

If the binomial coefficients of the second, third and fourth terms in the expansion are respectively the first, third and fifth terms of an A.P., then the sum of the squares of all possible values of  $x$  is \_\_\_\_\_.

**Q69.** If the  $x$ -intercept of a focal chord of the parabola  $y^2 = 8x + 4y + 4$  is 3, then the length of this chord is equal to \_\_\_\_\_.

**Q70.** The line  $x = 8$  is the directrix of the ellipse  $E : \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  with the corresponding focus  $(2, 0)$ . If the tangent to  $E$  at the point  $P$  in the first quadrant passes through the point  $(0, 4\sqrt{3})$  and intersects the  $x$ -axis at  $Q$ , then  $(3PQ)^2$  is equal to \_\_\_\_\_.

**Q71.** Let  $P(x_0, y_0)$  be the point on the hyperbola  $3x^2 - 4y^2 = 36$ , which is nearest to the line  $3x + 2y = 1$ . Then  $\sqrt{2}(y_0 - x_0)$  is equal to :

- (1) -3  
(3) -9
- (2) 9  
(4) 3

**Q72.** Which of the following statements is a tautology?

- (1)  $p \rightarrow (p \wedge (p \rightarrow q))$   
(3)  $(p \wedge (p \rightarrow q)) \rightarrow \sim q$
- (2)  $(p \wedge q) \rightarrow (\sim(p) \rightarrow q)$   
(4)  $p \vee (p \wedge q)$

**Q73.** Let  $9 = x_1 < x_2 < \dots < x_7$  be in an A.P. with common difference  $d$ . If the standard deviation of  $x_1, x_2, \dots, x_7$  is 4 and the mean is  $\bar{x}$ , then  $\bar{x} + x_6$  is equal to :

(1)  $18\left(1 + \frac{1}{\sqrt{3}}\right)$

(2) 34

(3)  $2\left(9 + \frac{8}{\sqrt{7}}\right)$

(4) 25

**Q74.** Let  $P(S)$  denote the power set of  $S = \{1, 2, 3, \dots, 10\}$ . Define the relations  $R_1$  and  $R_2$  on  $P(S)$  as  $AR_1B$  if  $(A \cap B^c) \cup (B \cap A^c) = \phi$  and  $AR_2B$  if  $A \cup B^c = B \cup A^c, \forall A, B \in P(S)$ . Then :

(1) both  $R_1$  and  $R_2$  are equivalence relations(2) only  $R_1$  is an equivalence relation(3) only  $R_2$  is an equivalence relation(4) both  $R_1$  and  $R_2$  are not equivalence relations

**Q75.** If  $A = \frac{1}{2} \begin{bmatrix} 1 & \sqrt{3} \\ -\sqrt{3} & 1 \end{bmatrix}$  then,

(1)  $A^{30} - A^{25} = 2I$

(2)  $A^{30} + A^{25} + A = I$

(3)  $A^{30} + A^{25} - A = I$

(4)  $A^{30} = A^{25}$

**Q76.** For the system of linear equations  $ax + y + z = 1, x + ay + z = 1, x + y + az = \beta$ , which one of the following statements is NOT correct?

(1) It has infinitely many solutions if  $\alpha = 2$  and  $\beta = -1$ (2) It has no solution if  $\alpha = -2$  and  $\beta = 1$ (3)  $x + y + z = \frac{3}{4}$  if  $\alpha = 2$  and  $\beta = 1$ (4) It has infinitely many solutions if  $\alpha = 1$  and  $\beta = 1$ 

**Q77.** Let  $S = \left\{x \in R : 0 < x < 1 \text{ and } 2 \tan^{-1}\left(\frac{1-x}{1+x}\right) = \cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)\right\}$ . If  $n(S)$  denotes the number of elements in  $S$  then :

(1)  $n(S) = 2$  and only one element in  $S$  is less than  $\frac{1}{2}$ (2)  $n(S) = 1$  and the element in  $S$  is more than  $\frac{1}{2}$ (3)  $n(S) = 1$  and the element in  $S$  is less than  $\frac{1}{2}$ (4)  $n(S) = 0$ 

**Q78.** Let  $f : R - \{0, 1\} \rightarrow R$  be a function such that  $f(x) + f\left(\frac{1}{1-x}\right) = 1 + x$ . Then  $f(2)$  is equal to :

(1)  $\frac{9}{2}$

(2)  $\frac{9}{4}$

(3)  $\frac{7}{4}$

(4)  $\frac{7}{3}$

**Q79.** If  $y(x) = x^x, x > 0$ , then  $y''(2) - 2y'(2)$  is equal to :

(1)  $8 \log_e 2 - 2$

(2)  $4 \log_e 2 + 2$

(3)  $4(\log_e 2)^2 - 2$

(4)  $4(\log_e 2)^2 + 2$

**Q80.** The sum of the absolute maximum and minimum values of the function  $f(x) = |x^2 - 5x + 6| - 3x + 2$  in the interval  $[-1, 3]$  is equal to :

(1) 10

(2) 12

(3) 13

(4) 24

**Q81.** The value of the integral  $\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} \frac{x + \frac{\pi}{4}}{2 - \cos 2x} dx$  is :

(1)  $\frac{\pi^2}{6}$

(2)  $\frac{\pi^2}{12\sqrt{3}}$

(3)  $\frac{\pi^2}{3\sqrt{3}}$

(4)  $\frac{\pi^2}{6\sqrt{3}}$

**Q82.** If  $\int_0^\pi \frac{5^{\cos x} (1 + \cos x \cos 3x + \cos^2 x + \cos^3 x \cos 3x) dx}{1 + 5^{\cos x}} = \frac{k\pi}{16}$ , then  $k$  is equal to \_\_\_\_\_.

Q83. The area of the region given by  $\{(x, y) : xy \leq 8, 1 \leq y \leq x^2\}$  is :

(1)  $8 \log_e 2 - \frac{13}{3}$

(2)  $16 \log_e 2 - \frac{14}{3}$

(3)  $8 \log_e 2 + \frac{7}{6}$

(4)  $16 \log_e 2 + \frac{7}{3}$

Q84. Let  $\alpha x = \exp(x^\beta y^\gamma)$  be the solution of the differential equation  $2x^2 y dy - (1 - xy^2) dx = 0$ ,  $x > 0, y(2) = \sqrt{\log_e 2}$ . Then  $\alpha + \beta - \gamma$  equals :

(1) 1

(2) -1

(3) 0

(4) 3

Q85. Let  $\vec{a} = 5\hat{i} - \hat{j} - 3\hat{k}$  and  $\vec{b} = \hat{i} + 3\hat{j} + 5\hat{k}$  be two vectors. Then which one of the following statements is TRUE?

(1) Projection of  $\vec{a}$  on  $\vec{b}$  is  $\frac{-13}{\sqrt{35}}$  and the direction of the projection vector is opposite to the direction of  $\vec{b}$

(2) Projection of  $\vec{a}$  on  $\vec{b}$  is  $\frac{-17}{\sqrt{35}}$  and the direction of the projection vector is opposite to the direction of  $\vec{b}$

(3) Projection of  $\vec{a}$  on  $\vec{b}$  is  $\frac{17}{\sqrt{35}}$  and the direction of the projection vector is opposite to the direction of  $\vec{b}$

(4) Projection of  $\vec{a}$  on  $\vec{b}$  is  $\frac{13}{\sqrt{35}}$  and the direction of the projection vector is opposite to the direction of  $\vec{a}$

Q86. Let  $\vec{a} = 2\hat{i} - 7\hat{j} + 5\hat{k}$ ,  $\vec{b} = \hat{i} + \hat{k}$  and  $\vec{c} = \hat{i} + 2\hat{j} - 3\hat{k}$  be three given vectors. If  $\vec{r}$  is a vector such that  $\vec{r} \times \vec{a} = \vec{c} \times \vec{a}$  and  $\vec{r} \cdot \vec{b} = 0$ , then  $|\vec{r}|$  is equal to:

(1)  $\frac{11}{7}\sqrt{2}$

(2)  $\frac{11}{7}$

(3)  $\frac{11}{5}\sqrt{2}$

(4)  $\frac{\sqrt{914}}{7}$

Q87. Let the plane  $P$  pass through the intersection of the planes  $2x + 3y - z = 2$  and  $x + 2y + 3z = 6$ , and be perpendicular to the plane  $2x + y - z + 1 = 0$ . If  $d$  is the distance of  $P$  from the point  $(-7, 1, 1)$ , then  $d^2$  is equal to :

(1)  $\frac{250}{83}$

(2)  $\frac{15}{53}$

(3)  $\frac{25}{83}$

(4)  $\frac{250}{82}$

Q88. Let  $\alpha x + \beta y + \gamma z = 1$  be the equation of a plane passing through the point  $(3, -2, 5)$  and perpendicular to the line joining the points  $(1, 2, 3)$  and  $(-2, 3, 5)$ . Then the value of  $\alpha \beta \gamma$  is equal to \_\_\_\_\_.

Q89. The point of intersection  $C$  of the plane  $8x + y + 2z = 0$  and the line joining the points  $A(-3, -6, 1)$  and  $B(2, 4, -3)$  divides the line segment  $AB$  internally in the ratio  $k : 1$ . If  $a, b, c$  ( $|a|, |b|, |c|$  are coprime) are the direction ratios of the perpendicular from the point  $C$  on the line  $\frac{1-x}{1} = \frac{y+4}{2} = \frac{z+2}{3}$ , then  $|a + b + c|$  is equal to \_\_\_\_\_.

Q90. Two dice are thrown independently. Let  $A$  be the event that the number appeared on the 1<sup>st</sup> die is less than the number appeared on the 2<sup>nd</sup> die,  $B$  be the event that the number appeared on the 1<sup>st</sup> die is even and that on the second die is odd, and  $C$  be the event that the number appeared on the 1<sup>st</sup> die is odd and that on the 2<sup>nd</sup> is even. Then

(1) The number of favourable cases of the event  $(A \cup B) \cap C$  is 6

(3) The number of favourable cases of the events  $A$ ,  $B$  and  $C$  are 15, 6 and 6 respectively

(2)  $A$  and  $B$  are mutually exclusive

(4)  $B$  and  $C$  are independent

## ANSWER KEYS

1. (4)	2. (2)	3. (2)	4. (4)	5. (1)	6. (3)	7. (1)	8. (4)
9. (3)	10. (1)	11. (1)	12. (1)	13. (2)	14. (4)	15. (4)	16. (3)
17. (1)	18. (4)	19. (1)	20. (3)	21. (200)	22. (67)	23. (132)	24. (3)
25. (2)	26. (288)	27. (2)	28. (44)	29. (4)	30. (6)	31. (4)	32. (2)
33. (4)	34. (3)	35. (4)	36. (1)	37. (1)	38. (4)	39. (4)	40. (1)
41. (4)	42. (3)	43. (3)	44. (1)	45. (4)	46. (3)	47. (4)	48. (1)
49. (1)	50. (2)	51. (139)	52. (1006)	53. (6)	54. (4)	55. (372)	56. (13039)
57. (75)	58. (1)	59. (6)	60. (3)	61. (3)	62. (1)	63. (2)	64. (3)
65. (2)	66. (2)	67. (1)	68. (3)	69. (1)	70. (3)	71. (2)	72. (3)
73. (1)	74. (4)	75. (2)	76. (1)	77. (1)	78. (1)	79. (1)	80. (1)
81. (105)	82. (81)	83. (321)	84. (1)	85. (4)	86. (16)	87. (39)	88. (13)
89. (6)	90. (10)						

**Q1.** Match List I with List II

List I

- A. Torque  
B. Stress  
C. Pressure gradient  
D. Coefficient of viscosity

List II

- I.  $M L^{-2} T^{-2}$   
II.  $M L^2 T^{-2}$   
III.  $M L^{-1} T^{-1}$   
IV.  $M L^{-1} T^{-2}$

Choose the correct answer from the options given below :

- (1) A-II, B-I, C-IV, D-III  
(2) A-IV, B-II, C-III, D-I  
(3) A-II, B-IV, C-I, D-III  
(4) A-III, B-IV, C-I, D-II

**Q2.** Given below are two statements:

**Statement I:** Area under velocity-time graph gives the distance travelled by the body in a given time.

**Statement II:** Area under acceleration-time graph is equal to the change in velocity in the given time.

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

- (1) Both Statement I and Statement II are true  
(2) Both Statement I and Statement II are false  
(3) Statement I is correct but Statement II is false  
(4) Statement I is incorrect but Statement II is true

**Q3.** The trajectory of projectile, projected from the ground is given by  $y = x - \frac{x^2}{20}$ . Where  $x$  and  $y$  are measured in meter. The maximum height attained by the projectile will be.

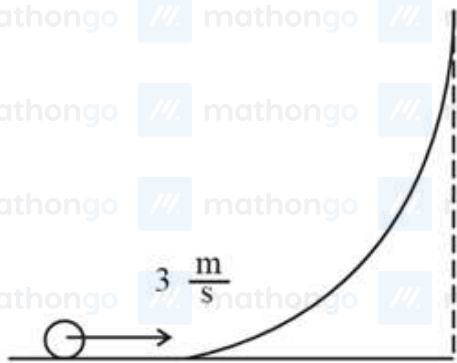
- (1) 200 m  
(2) 10 m  
(3) 5 m  
(4)  $10\sqrt{2}$  m

**Q4.** A bullet of mass 0.1 kg moving horizontally with speed  $400 \text{ m s}^{-1}$  hits a wooden block of mass 3.9 kg kept on a horizontal rough surface. The bullet gets embedded into the block and moves 20 m before coming to rest. The coefficient of friction between the block and the surface is \_\_\_\_\_.

- (1) 0.90  
(2) 0.50  
(3) 0.65  
(4) 0.25

**Q5.** A body of mass 5 kg is moving with a momentum of  $10 \text{ kg m s}^{-1}$ . Now a force of 2 N acts on the body in the direction of its motion for 5 s. The increase in the Kinetic energy of the body is \_\_\_\_\_ J.

**Q6.** A hollow spherical ball of uniform density rolls up a curved surface with an initial velocity  $3 \text{ m s}^{-1}$  (as shown in figure). Maximum height with respect to the initial position covered by it will be \_\_\_\_\_ cm (take,  $g = 10 \text{ m s}^{-2}$ )



**Q7.** The orbital angular momentum of a satellite is  $L$ , when it is revolving in a circular orbit at height  $h$  from earth surface. If the distance of satellite from the earth centre is increased by eight times to its initial value, then the new angular momentum will be

- (1)  $8L$  (2)  $9L$   
(3)  $4L$  (4)  $3L$

**Q8.** The acceleration due to gravity at height  $h$  above the earth if  $h \ll R$  (Radius of earth) is given by

- (1)  $g' = g\left(1 - \frac{h^2}{2R^2}\right)$  (2)  $g' = g\left(1 - \frac{h}{2R}\right)$   
(3)  $g' = g\left(1 - \frac{2h}{R}\right)$  (4)  $g' = g\left(1 - \frac{2h^2}{R^2}\right)$

**Q9.** A hydraulic automobile lift is designed to lift vehicles of mass  $5000 \text{ kg}$ . The area of cross section of the cylinder carrying load is  $250 \text{ cm}^2$ . The maximum pressure the smaller piston would have to bear is [Assume  $g = 10 \text{ m s}^{-2}$ ]

- (1)  $20 \times 10^6 \text{ Pa}$  (2)  $2 \times 10^5 \text{ Pa}$   
(3)  $200 \times 10^6 \text{ Pa}$  (4)  $2 \times 10^6 \text{ Pa}$

**Q10.** A steel rod of length  $1 \text{ m}$  and cross-sectional area  $10^{-4} \text{ m}^2$  is heated from  $0^\circ \text{C}$  to  $200^\circ \text{C}$  without being allowed to extend or bend. The compressive tension produced in the rod is  $\underline{\hspace{1cm}} \times 10^4 \text{ N}$ . (Given Young's modulus of steel  $= 2 \times 10^{11} \text{ N m}^{-2}$ , coefficient of linear expansion  $= 10^{-5} \text{ K}^{-1}$ )

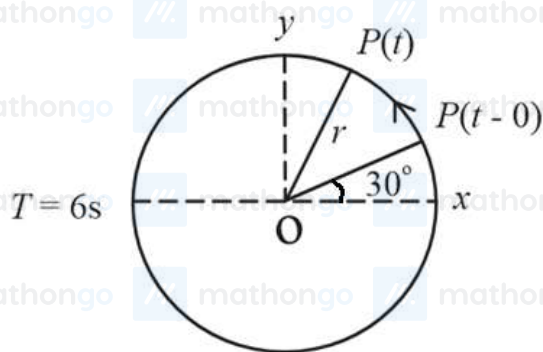
**Q11.** Work done by a Carnot engine operating between temperatures  $127^\circ \text{C}$  and  $27^\circ \text{C}$  is  $2 \text{ kJ}$ . The amount of heat transferred to the engine by the reservoir is:

- (1)  $8 \text{ kJ}$  (2)  $2.67 \text{ kJ}$   
(3)  $2 \text{ kJ}$  (4)  $4 \text{ kJ}$

**Q12.** The temperature at which the kinetic energy of oxygen molecules becomes double than its value at  $27^\circ \text{C}$  is

- (1)  $927^\circ \text{C}$  (2)  $327^\circ \text{C}$   
(3)  $1227^\circ \text{C}$  (4)  $627^\circ \text{C}$

**Q13.** For particle  $P$  revolving round the centre  $O$  with radius of circular path  $r$  and regular velocity  $\omega$ , as shown in below figure, the projection of  $OP$  on the  $x$ -axis at time  $t$  is



(1)  $x(t) = r \cos(\omega t - \frac{\pi}{6})$

(2)  $x(t) = r \cos(\omega t + \frac{\pi}{6})$

(3)  $x(t) = r \sin(\omega t + \frac{\pi}{6})$

(4)  $x(t) = r \cos(\omega t)$

**Q14.** A guitar string of length 90 cm vibrates with a fundamental frequency of 120 Hz. The length of the string producing a fundamental of 180 Hz will be \_\_\_\_\_ cm

**Q15.** Electric potential at a point  $P$  due to a point charge of  $5 \times 10^{-9}$  C is 50 V. The distance of  $P$  from the point charge is:

(Assume,  $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$ )

(1) 9 cm

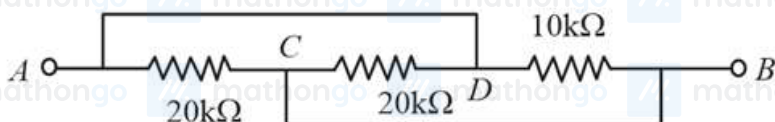
(2) 3 cm

(3) 0.9 cm

(4) 90 cm

**Q16.** A 600 pF capacitor is charged by 200 V supply. It is then disconnected from the supply and is connected to another uncharged 600 pF capacitor. Electrostatic energy lost in the process is \_\_\_\_\_  $\mu\text{J}$ .

**Q17.** The equivalent resistance between A and B as shown in figure is:



(1) 10 k $\Omega$

(2) 5 k $\Omega$

(3) 20 k $\Omega$

(4) 30 k $\Omega$

**Q18.** The number density of free electrons in copper is nearly  $8 \times 10^{28} \text{ m}^{-3}$ . A copper wire has its area of cross-section =  $2 \times 10^{-6} \text{ m}^2$  and is carrying a current of 3.2 A. The drift speed of the electrons is \_\_\_\_\_  $\times 10^{-6} \text{ m s}^{-1}$ .

**Q19.** Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**.

**Assertion A :** Electromagnets are made of soft iron.

**Reason R :** Soft iron has high permeability and low retentivity.

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

(1) **A** is not correct but **R** is correct

(2) **A** is correct but **R** is not correct

(3) Both **A** and **R** are correct and **R** is the correct

(4) Both **A** and **R** are correct but **R** is NOT the

explanation of **A**

correct explanation of **A**

**Q20.** The ratio of magnetic field at the centre of a current carrying coil of radius  $r$  to the magnetic field at distance  $r$  from the centre of coil on its axis is  $\sqrt{x} : 1$ . The value of  $x$  is \_\_\_\_\_.

**Q21.** An emf of 0.08 V is induced in a metal rod of length 10 cm held normal to a uniform magnetic field of 0.4 T, when move with a velocity of:

(1)  $0.5 \text{ m s}^{-1}$

(2)  $20 \text{ m s}^{-1}$

(3)  $3.2 \text{ m s}^{-1}$

(4)  $2 \text{ m s}^{-1}$

**Q22.** A series combination of resistor of resistance  $100 \Omega$  inductor of inductance 1 H and capacitor of capacitance  $6.25 \mu\text{F}$  is connected to an ac source. The quality factor of the circuit will be \_\_\_\_\_.

**Q23.** The waves emitted when a metal target is bombarded with high energy electrons are

(1) Microwaves

(2) Infrared rays

(3) X-rays

(4) Radio Waves

**Q24.** Two transparent media having refractive indices 1.0 and 1.5 are separated by a spherical refracting surface of radius of curvature 30 cm. The centre of curvature of surface is towards denser medium and a point object is placed on the principal axis in rarer medium at a distance of 15 cm from the pole of the surface. The distance of image from the pole of the surface is cm.

**Q25.** The width of fringe is 2 mm on the screen in a double slit experiment for the light of wavelength of 400 nm.

The width of the fringe for the light of wavelength 600 nm will be:

(1) 4 mm

(2) 2 mm

(3) 1.33 mm

(4) 3 mm

**Q26.** In photoelectric effect

A. The photocurrent is proportional to the intensity of the incident radiation.

B. Maximum kinetic energy with which photoelectrons are emitted depends on the intensity of incident light.

C. Max K.E. with which photoelectrons are emitted depends on the frequency of incident light.

D. The emission of photoelectrons require a minimum threshold intensity of incident radiation.

E. Max K.E. of the photoelectrons is independent of the frequency of the incident light.

Choose the correct answer from the options given below:

(1) A and B only

(2) A and E only

(3) A and C only

(4) B and C only

**Q27.** The ratio of wavelength of spectral lines  $H_\alpha$  and  $H_\beta$  in the Balmer series is  $\frac{x}{20}$ . The value of  $x$  is \_\_\_\_\_.

**Q28.** A radio active material is reduced to  $\frac{1}{8}$  of its original amount in 3 days. If  $8 \times 10^{-3}$  kg of the material is left after 5 days the initial amount of the material is

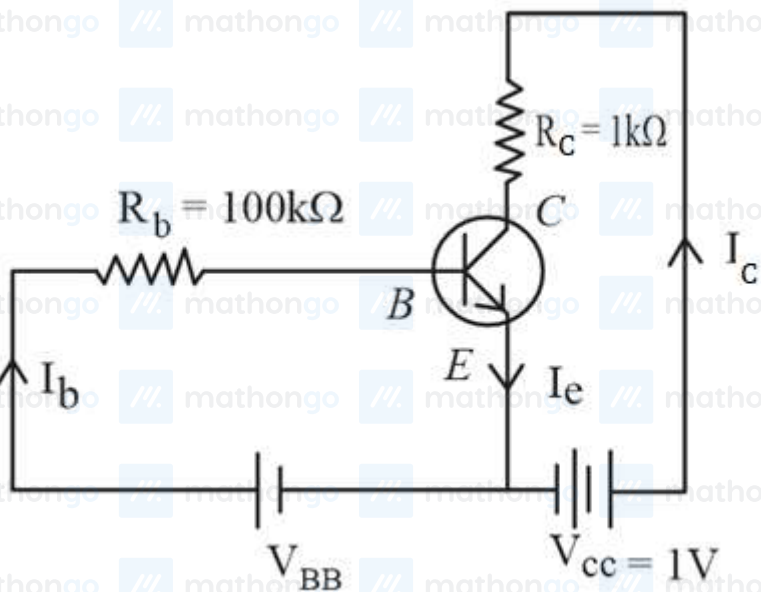
(1) 40 g

(2) 32 g

(3) 64 g

(4) 256 g

**Q29.** For a given transistor amplifier circuit in CE configuration  $V_{CC} = 1 \text{ V}$ ,  $R_C = 1 \text{ k}\Omega$ ,  $R_b = 100 \text{ k}\Omega$  and  $\beta = 100$ . Value of base current  $I_b$  is



(1)  $I_b = 1.0 \mu\text{A}$

(3)  $I_b = 100 \mu\text{A}$

(2)  $I_b = 0.1 \mu\text{A}$

(4)  $I_b = 10 \mu\text{A}$

**Q30.** The power radiated from a linear antenna of length  $l$  is proportional to

(Given,  $\lambda$  = Wavelength of wave):

(1)  $\frac{l}{\lambda}$

(3)  $\frac{l}{\lambda^2}$

(2)  $\left(\frac{l}{\lambda}\right)^2$

(4)  $\frac{l^2}{\lambda}$

**Q31.** Which of the following have same number of significant figures?

(A) 0.00253

(B) 1.0003

(C) 15.0

(D) 163

Choose the correct answer from the options given below

(1) A, B and C only

(3) B and C only

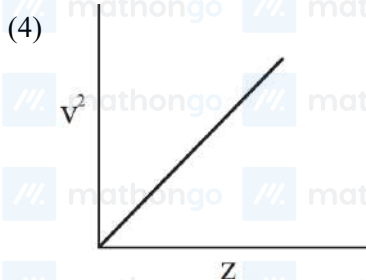
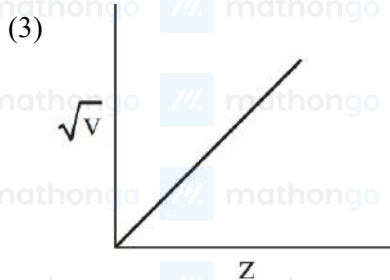
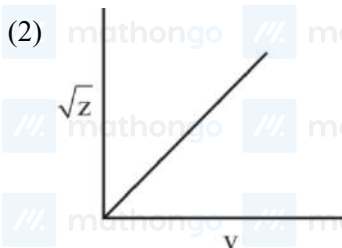
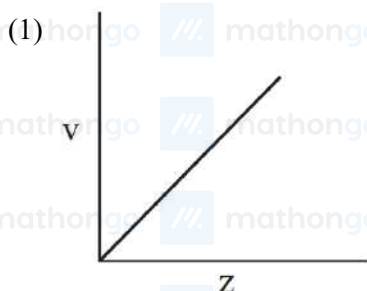
(2) C and D only

(4) A, C and D only

**Q32.** Henry Moseley studied characteristic X-ray spectra of elements. The graph which represents his observation correctly is

Given  $\nu$  = Frequency of X-ray emitted

$Z$  = Atomic number



**Q33.** The number of atomic orbitals from the following having 5 radial nodes is

7s, 7p, 6s, 8p, 8d

**Q34.** The number of species from the following carrying a single lone pair on central atom Xenon is

$\text{XeF}_5^+$ ,  $\text{XeO}_3$ ,  $\text{XeO}_2 \text{ F}_2$ ,  $\text{XeF}_5^-$ ,  $\text{XeO}_3 \text{ F}_2$ ,  $\text{XeOF}_4$ ,  $\text{XeF}_4$

**Q35.** Arrange the following gases in increasing order of van der Waals constant  $a$ /

(A) Ar

(B)  $\text{CH}_4$

(C)  $\text{H}_2\text{O}$

(D)  $\text{C}_6\text{H}_6$

Choose the correct option from the following.

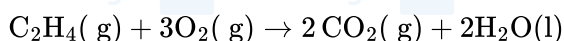
(1) D, C, B and A

(2) B, C, D and A

(3) C, D, B and A

(4) A, B, C and D

**Q36.** For complete combustion of ethene,



the amount of heat produced as measured in bomb calorimeter is  $1406 \text{ kJ mol}^{-1}$  at 300 K. The minimum value of  $T\Delta S$  needed to reach equilibrium is (–) kJ. (Nearest integer)

Given:  $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$

**Q37.** The incorrect statements from the following is:

A. The electrical work that a reaction can perform at constant pressure and temperature is equal to the reaction Gibbs energy.

B.  $E_{\text{cell}}^\circ$  is dependent on the pressure.

C.  $\frac{dE_{\text{cell}}}{dT} = \frac{\Delta_r S^\circ}{nF}$

D. A cell is operating reversibly if the cell potential is exactly balanced by an opposing source of potential difference.

**Q38.** Given below are two statements:

**Statement-I :** Methyl orange is a weak acid.

**Statement-II :** The benzenoid form of methyl orange is more intense/deeply coloured than the quinonoid form.

In the light of the above statement, choose the most appropriate answer from the options given below:

(1) Both **Statement-I** and **Statement-II** are incorrect (2) **Statement-I** is incorrect but **Statement-II** is

correct

(3) Both **Statement-I** and **Statement-II** are correct (4) **Statement-I** is correct but **Statement-II** is

incorrect

**Q39.** The solubility product of  $\text{BaSO}_4$  is  $1 \times 10^{-10}$  at 298 K. The solubility of  $\text{BaSO}_4$  in 0.1M  $\text{K}_2\text{SO}_4(\text{aq})$  solution is  $\text{-----} \times 10^{-9} \text{ g L}^{-1}$  (nearest integer).

Given: Molar mass of  $\text{BaSO}_4$  is  $233 \text{ g mol}^{-1}$

**Q40.** Given below are two statements:

**Statement I :** In redox titration, the indicators used are sensitive to change in pH of the solution.

**Statement II :** In acid-base titration, the indicators used are sensitive to change in oxidation potential.

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

(1) **Statement I** is correct but **Statement II** is incorrect (2) Both **Statement I** and **Statement II** are incorrect

(3) **Statement I** is incorrect but **Statement II** is correct (4) Both **Statement I** and **Statement II** are correct

**Q41.** Which of the following can reduce decomposition of  $\text{H}_2\text{O}_2$  on exposure to light

- (1) Urea (2) Alkali  
(3) Glass containers (4) Dust

**Q42.** For a good quality cement, the ratio of lime to the total of the oxides of Si, Al and Fe should be as close as to

- (1) 4 (2) 1  
(3) 2 (4) 3

**Q43.** Given below are two statements: One is labelled as

Assertion **A** and the other is labelled as Reason **R**

Assertion **A**: Sodium is about 30 times as abundant as potassium in the oceans.

Reason **R**: Potassium is bigger in size than sodium.

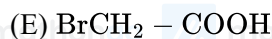
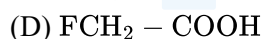
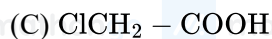
In the light of the above statements, choose the correct answer from the options given below

(1) Both **A** and **R** are true and **R** is the correct explanation of **A** (2) **A** is true but **R** is false

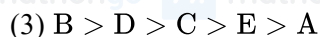
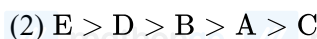
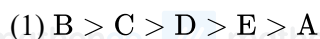
(3) Both **A** and **R** are true but **R** is NOT the correct explanation of **A** (4) Both **A** and **R** are false

**Q44.** The descending order of acidity for the following carboxylic acid is-

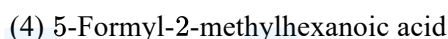
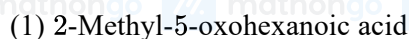
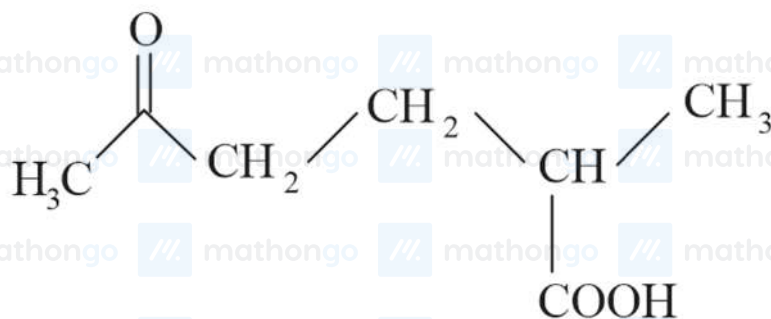
- (A)  $\text{CH}_3\text{COOH}$   
(B)  $\text{F}_3\text{C} - \text{COOH}$



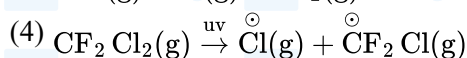
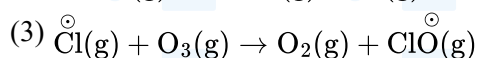
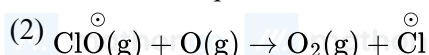
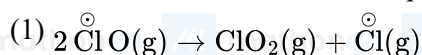
Choose the correct answer from the options given below:



**Q45.** The correct IUPAC nomenclature for the following compound is:

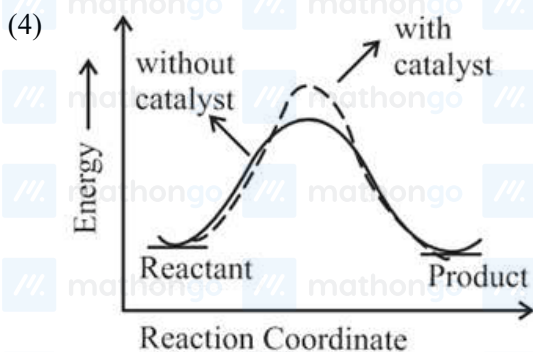
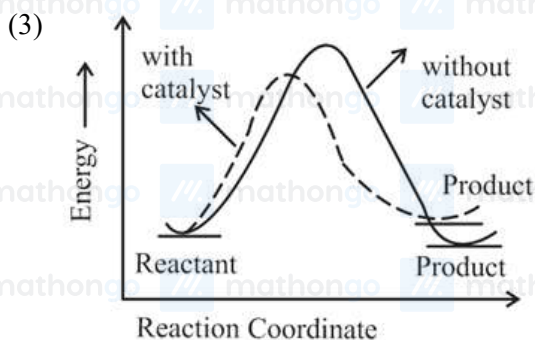
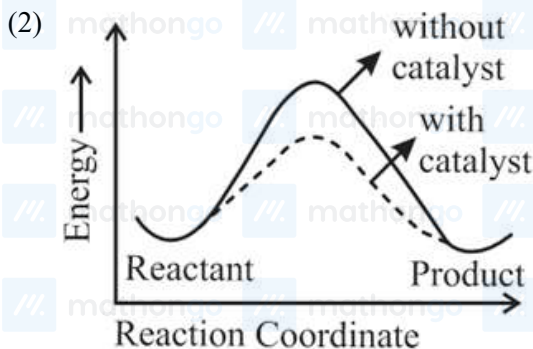
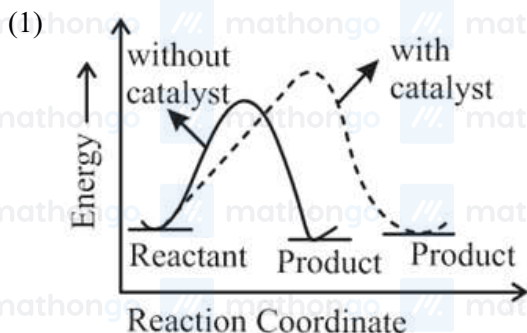


**Q46.** Which of these reactions is not a part of breakdown of ozone in stratosphere?



**Q47.** If the boiling points of two solvents X and Y (having same molecular weights) are in the ratio 2: 1 and their enthalpy of vaporizations are in the ratio 1 : 2, then the boiling point elevation constant of X is m times the boiling point elevation constant of Y. The value of m is (nearest integer).

**Q48.** The correct reaction profile diagram for a positive catalyst reaction.



**Q49.** The statement/s which are true about antagonists from the following is/are:

- A. They bind to the receptor site.
- B. Get transferred inside the cell for their action.
- C. Inhibit the natural communication of the body.
- D. Mimic the natural messenger.

Choose the correct answer from the options given below:

- (1) B only
- (2) A, C and D
- (3) A and C
- (4) A and B

**Q50.** Coagulating value of the electrolytes  $\text{AlCl}_3$  and  $\text{NaCl}$  for  $\text{As}_2\text{S}_3$  are 0.09 and 50.04 respectively. The coagulating power of  $\text{AlCl}_3$  is  $x$  times the coagulating power of  $\text{NaCl}$ . The value of  $x$  is

**Q51.** In Hall-Heroult process, the following is used for reducing  $\text{Al}_2\text{O}_3$  :-

- (1) Magnesium
- (2)  $\text{Na}_3\text{AlF}_6$
- (3) Graphite
- (4)  $\text{CaF}_2$

**Q52.** The ratio of sigma and  $\pi$  bonds present in pyrophosphoric acid is

**Q53.** Match List-I with List-II

**LIST-I**

**Coordination Complex**

- A.  $[\text{Cr}(\text{CN})_6]^{3-}$
- B.  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
- C.  $[\text{Co}(\text{NH}_3)_6]^{3+}$

**LIST-II**

**Number of unpaired electrons**

- I. 0
- II. 3
- III. 2

D.  $[\text{Ni}(\text{NH}_3)_6]^{2+}$  IV. 4

Choose the correct answer from the options given below:

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

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

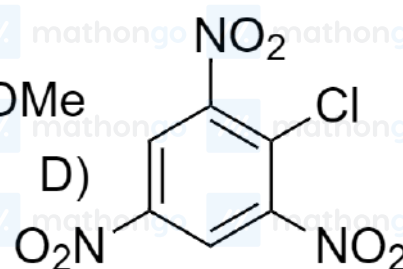
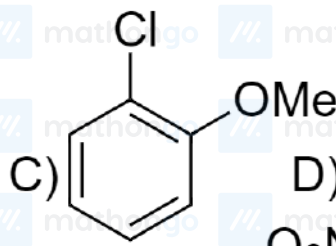
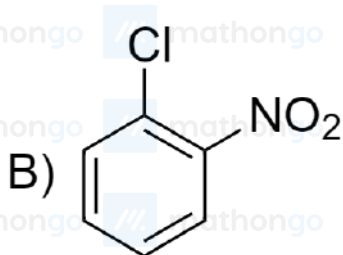
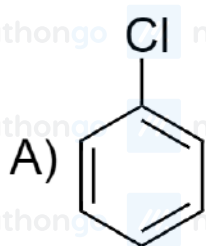
(3) A-II, B-I, C-IV, D-III

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

**Q54.** The observed magnetic moment of the complex  $[\text{Mn}(\text{NCS})_6]^{x-}$  is 6.06 BM. The numerical value of x is

**Q55.** The sum of oxidation state of the metals in  $\text{Fe}(\text{CO})_5$ ,  $\text{VO}^{2+}$  and  $\text{WO}_3$  is

**Q56.** The correct order of reactivity of following haloarenes towards nucleophilic substitution with aqueous NaOH is:



Choose the correct answer from the options given below:

(1) A > B > D > C

(2) C > A > D > B

(3) D > C > B > A

(4) D > B > A > C

**Q57.** A compound /X/ when treated with phthalic anhydride in presence of concentrated  $\text{H}_2\text{SO}_4$  yields /Y/. /Y/ is used as an acid/base indicator. /X/ and /Y/ are respectively

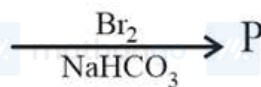
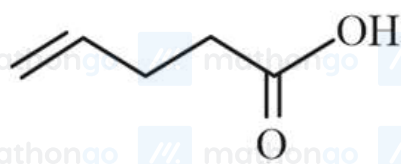
(1) Anisole, methyl orange

(2) Salicylaldehyde, Phenolphthalein

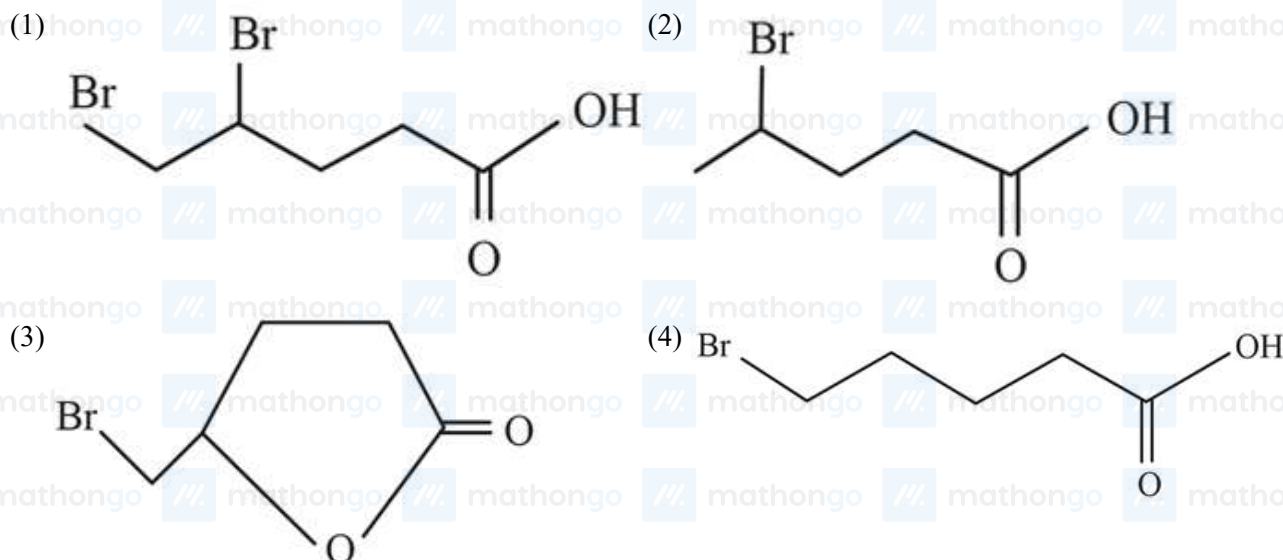
(3) Toluidine, Phenolphthalein

(4) Carboic acid, Phenolphthalein

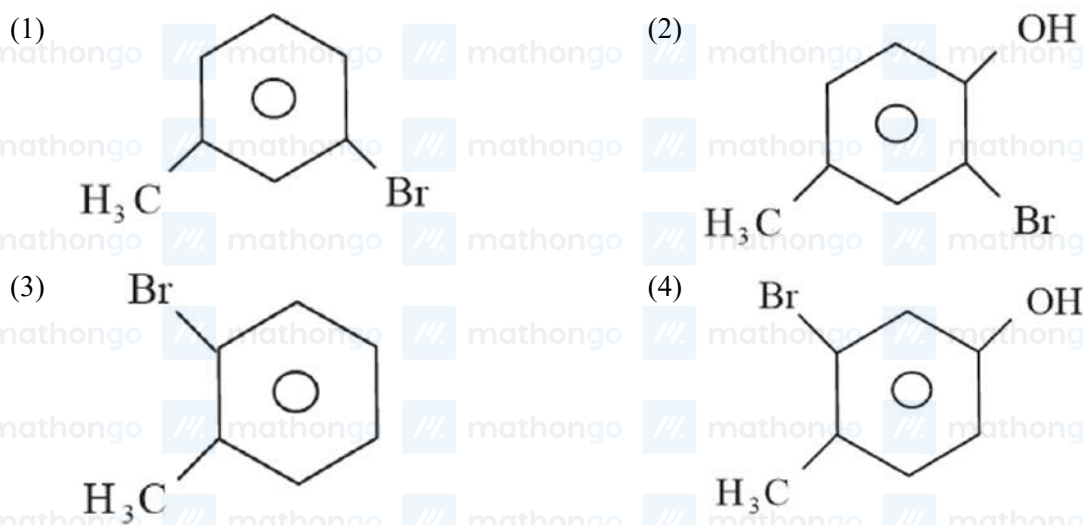
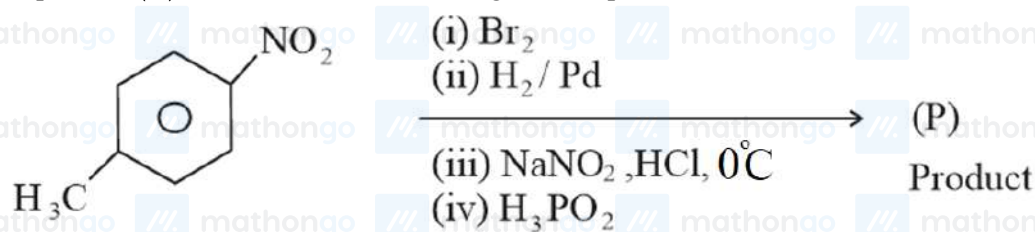
**Q58.** Major product /P/ formed in the following reaction is



Major product



Q59. The product (P) formed from the following multistep reaction is:



Q60. Match List I with List II

## List I

Natural amino acid

- (A) Glutamic acid  
(B) Glutamine  
(C) Tyrosine

## List II

One Letter Code

- (I) Q  
(II) W  
(III) E

(D) Tryptophan

(IV) Y

Choose the correct answer from the options given below:

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

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

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

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

**Q61.** Let  $m$  and  $n$  be the numbers of real roots of the quadratic equations  $x^2 - 12x + [x] + 31 = 0$  and  $x^2 - 5|x + 2| - 4 = 0$  respectively, where  $[x]$  denotes the greatest integer  $\leq x$ . Then  $m^2 + mn + n^2$  is equal to

**Q62.** Let  $A = \{\theta \in (0, 2\pi) : \frac{1+2i\sin\theta}{1-i\sin\theta} \text{ is purely imaginary}\}$  Then the sum of the elements in  $A$  is

(1)  $4\pi$ (2)  $3\pi$ (3)  $\pi$ (4)  $2\pi$ 

**Q63.** If the number of words, with or without meaning, which can be made using all the letters of the word MATHEMATICS in which  $C$  and  $S$  do not come together, is  $(6!)k$  then  $k$  is equal to

(1) 2835

(2) 5670

(3) 1890

(4) 945

**Q64.** Let  $a_n$  be  $n^{\text{th}}$  term of the series  $5 + 8 + 14 + 23 + 35 + 50 + \dots$  and  $S_n = \sum_{k=1}^n a_k$ . Then  $S_{30} - a_{40}$  is equal to

(1) 11310

(2) 11260

(3) 11290

(4) 11280

**Q65.** Let  $0 < z < y < x$  be three real numbers such that  $\frac{1}{x}, \frac{1}{y}, \frac{1}{z}$  are in an arithmetic progression and  $x, \sqrt{2}y, z$  are in a geometric progression. If  $xy + yz + zx = \frac{3}{\sqrt{2}}xyz$ , then  $3(x + y + z)^2$  is equal to

**Q66.** The absolute difference of the coefficients of  $x^{10}$  and  $x^7$  in the expansion of  $(2x^2 + \frac{1}{2x})^{11}$  is equal to

(1)  $13^3 - 13$ (2)  $11^3 - 11$ (3)  $10^3 - 10$ (4)  $12^3 - 12$ 

**Q67.**  $25^{190} - 19^{190} - 8^{190} + 2^{190}$  is divisible by

(1) neither 14 nor 34

(2) 14 but not by 34

(3) 34 but not by 14

(4) both 14 and 34

**Q68.** The value of  $36(4 \cos^2 9^\circ - 1)(4 \cos^2 27^\circ - 1)(4 \cos^2 81^\circ - 1)(4 \cos^2 243^\circ - 1)$  is

(1) 54

(2) 18

(3) 27

(4) 36

**Q69.** Let  $A(0, 1)$ ,  $B(1, 1)$  and  $C(1, 0)$  be the mid-points of the sides of a triangle with incentre at the point  $D$ . If the focus of the parabola  $y^2 = 4ax$  passing through  $D$  is  $(\alpha + \beta\sqrt{2}, 0)$ , where  $\alpha$  and  $\beta$  are rational numbers, then  $\frac{\alpha}{\beta^2}$  is equal to

(1) 8

(2) 12

(3) 6

(4)  $\frac{9}{2}$

**Q70.** Let  $O$  be the origin and  $OP$  and  $OQ$  be the tangents to the circle  $x^2 + y^2 - 6x + 4y + 8 = 0$  at the points  $P$  and  $Q$  on it. If the circumcircle of the triangle  $OPQ$  passes through the point  $(\alpha, \frac{1}{2})$ , then a value of  $\alpha$  is

- (1)  $\frac{3}{2}$  (2)  $-\frac{1}{2}$   
(3)  $\frac{5}{2}$  (4) 1

**Q71.** The ordinates of the points  $P$  and  $Q$  on the parabola with focus  $(3, 0)$  and directrix  $x = -3$  are in the ratio  $3 : 1$ . If  $R(\alpha, \beta)$  is the point of intersection of the tangents to the parabola at  $P$  and  $Q$ , then  $\frac{\beta^2}{\alpha}$  is equal to

**Q72.** If  $\alpha > \beta > 0$  are the roots of the equation  $ax^2 + bx + 1 = 0$ , and

$$\lim_{x \rightarrow \frac{1}{\alpha}} \left( \frac{1 - \cos(x^2 + bx + a)}{2(1 - \alpha x)^2} \right)^{\frac{1}{2}} = \frac{1}{k} \left( \frac{1}{\beta} - \frac{1}{\alpha} \right), \text{ then } k \text{ is equal to}$$

- (1)  $2\beta$  (2)  $\alpha$   
(3)  $2\alpha$  (4)  $\beta$

**Q73.** The negation of  $(p \wedge (-q)) \vee (-p)$  is equivalent to

- (1)  $p \wedge (-q)$  (2)  $p \wedge q$   
(3)  $p \vee (q \vee (-p))$  (4)  $p \wedge (q \wedge (-p))$

**Q74.** Let the mean and variance of 12 observations be  $\frac{9}{2}$  and 4 respectively. Later on, it was observed that two observations were considered as 9 and 10 instead of 7 and 14 respectively. If the correct variance is  $\frac{m}{n}$ , where  $m$  and  $n$  are coprime, then  $m + n$  is equal to

- (1) 315 (2) 316  
(3) 314 (4) 317

**Q75.** Let  $A = \{1, 2, 3, 4, 5, 6, 7\}$ . Then the relation  $R = \{(x, y) \in A \times A : x + y = 7\}$  is

- (1) an equivalence relation (2) symmetric but neither reflexive nor transitive  
(3) transitive but neither symmetric nor reflexive (4) reflexive but neither symmetric nor transitive

**Q76.** If  $A = \begin{bmatrix} 1 & 5 \\ \lambda & 10 \end{bmatrix}$ ,  $A^{-1} = \alpha A + \beta I$  and  $\alpha + \beta = -2$ , then  $4\alpha^2 + \beta^2 + \lambda^2$  is equal to :

- (1) 12 (2) 19  
(3) 14 (4) 10

**Q77.** Let  $S$  be the set of all values of  $\theta \in [-\pi, \pi]$  for which the system of linear equations

$$x + y + \sqrt{3}z = 0$$

$$-x + (\tan \theta)y + \sqrt{7}z = 0$$

$$x + y + (\tan \theta)z = 0$$

has non-trivial solution. Then  $\frac{120}{\pi} \sum_{\theta \in S} \theta$  is equal to

- (1) 20 (2) 40  
(3) 30 (4) 10

**Q78.** If domain of the function  $\log_e \left( \frac{6x^2 + 5x + 1}{2x - 1} \right) + \cos^{-1} \left( \frac{2x^2 - 3x + 4}{3x - 5} \right)$  is  $(\alpha, \beta) \cup (\gamma, \delta)$ , then  $18(\alpha^2 + \beta^2 + \gamma^2 + \delta^2)$  is equal to

**Q79.** Let  $R = \{a, b, c, d, e\}$  and  $S = \{1, 2, 3, 4\}$ . Total number of onto functions  $f : R \rightarrow S$  such that  $f(a) \neq 1$ , is equal to \_\_\_\_\_.

**Q80.** Let  $k$  and  $m$  be positive real numbers such that the function  $f(x) = \begin{cases} 3x^2 + k\sqrt{x+1}, & 0 < x < 1 \\ mx^2 + k^2, & x \geq 1 \end{cases}$  is differentiable for all  $x > 0$ . Then  $\frac{8f'(8)}{f'(\frac{1}{8})}$  is equal to

**Q81.** The integral  $\int \left( \left( \frac{x}{2} \right)^x + \left( \frac{2}{x} \right)^x \right) \log_2 x \, dx$  is equal to

- (1)  $\left( \frac{x}{2} \right)^x + \left( \frac{2}{x} \right)^x + C$  (2)  $\left( \frac{x}{2} \right)^x - \left( \frac{2}{x} \right)^x + C$   
 (3)  $\left( \frac{x}{2} \right)^x \log_2 \left( \frac{x}{2} \right) + C$  (4)  $\left( \frac{x}{2} \right)^x \log_2 \left( \frac{2}{x} \right) + C$

**Q82.** Let  $[t]$  denote the greatest integer function. If

$$\int_0^{2.4} [x^2] dx = \alpha + \beta\sqrt{2} + \gamma\sqrt{3} + \delta\sqrt{5}, \text{ then } \alpha + \beta + \gamma + \delta \text{ is equal to}$$

**Q83.** Let the area enclosed by the lines  $x + y = 2$ ,  $y = 0$ ,  $x = 0$  and the curve  $f(x) = \min\{x^2 + \frac{3}{4}, 1 + [x]\}$  where  $[x]$  denotes the greatest integer  $\leq x$ , be  $A$ . Then the value of  $12A$  is

**Q84.** Let the solution curve  $x = x(y)$ ,  $0 < y < \frac{\pi}{2}$ , of the differential equation

$$(\log_e(\cos y))^2 \cos y \, dx - (1 + 3x \log_e(\cos y)) \sin y \, dy = 0 \text{ satisfy } x\left(\frac{\pi}{3}\right) = \frac{1}{2 \log_e 2}. \text{ If } x\left(\frac{\pi}{6}\right) = \frac{1}{\log_e m - \log_e n},$$

where  $m$  and  $n$  are coprime, then  $mn$  is equal to

**Q85.** Let the vectors  $\vec{u}_1 = \hat{i} + \hat{j} + \hat{a}\hat{k}$ ,  $\vec{u}_2 = \hat{i} + \hat{b}\hat{j} + \hat{k}$ , and  $\vec{u}_3 = \hat{c}\hat{i} + \hat{j} + \hat{k}$  be coplanar. If the vectors  $\vec{v}_1 = (a+b)\hat{i} + c\hat{j} + \hat{c}\hat{k}$ ,  $\vec{v}_2 = a\hat{i} + (b+c)\hat{j} + \hat{a}\hat{k}$  and  $\vec{v}_3 = b\hat{i} + b\hat{j} + (c+a)\hat{k}$  are also coplanar, then  $6(a+b+c)$  is equal to

- (1) 0 (2) 4  
 (3) 12 (4) 6

**Q86.** The area of the quadrilateral  $ABCD$  with vertices  $A(2, 1, 1)$ ,  $B(1, 2, 5)$ ,  $C(-2, -3, 5)$  and  $D(1, -6, -7)$  is equal to

- (1) 48 (2)  $8\sqrt{38}$   
 (3) 54 (4)  $9\sqrt{38}$

**Q87.** For  $a, b \in \mathbb{Z}$  and  $|a - b| \leq 10$ , let the angle between the plane  $P : ax + y - z = b$  and the line

$$L : x - 1 = a - y = z + 1 \text{ be } \cos^{-1}\left(\frac{1}{3}\right). \text{ If the distance of the point } (6, -6, 4) \text{ from the plane } P \text{ is } 3\sqrt{6}, \text{ then } a^4 + b^2 \text{ is equal to}$$

- (1) 32 (2) 85  
 (3) 25 (4) 48

**Q88.** Let  $P$  be the plane passing through the line  $\frac{x-1}{1} = \frac{y-2}{-3} = \frac{z+5}{7}$  and the point  $(2, 4, -3)$ . If the image of the point  $(-1, 3, 4)$  in the plane  $P$  is  $(\alpha, \beta, \gamma)$ , then  $\alpha + \beta + \gamma$  is equal to

- (1) 10 (2) 12  
 (3) 9 (4) 11

**Q89.** Let  $P_1$  be the plane  $3x - y - 7z = 11$  and  $P_2$  be the plane passing through the points  $(2, -1, 0)$ ,  $(2, 0, -1)$ , and  $(5, 1, 1)$ . If the foot of the perpendicular drawn from the point  $(7, 4, -1)$  on the line of intersection of the

planes  $P_1$  and  $P_2$  is  $(\alpha, \beta, \gamma)$ , then  $\alpha + \beta + \gamma$  is equal to

**Q90.** If the probability that the random variable  $X$  takes values  $x$  is given by  $P(X = x) = k(x + 1)3^{-x}$ ,  $x = 0, 1, 2, 3, \dots$ , where  $k$  is a constant, then  $P(X \geq 2)$  is equal to

(1)  $\frac{7}{27}$   
(3)  $\frac{11}{18}$

(2)  $\frac{7}{18}$   
(4)  $\frac{20}{27}$

## ANSWER KEYS

1. (3)	2. (4)	3. (3)	4. (4)	5. (4)	6. (3)	7. (4)	8. (1)
9. (2)	10. (2)	11. (4)	12. (2)	13. (3)	14. (4)	15. (3)	16. (4)
17. (3)	18. (4)	19. (4)	20. (2)	21. (30)	22. (75)	23. (4)	24. (60)
25. (6)	26. (125)	27. (8)	28. (4)	29. (30)	30. (27)	31. (4)	32. (3)
33. (4)	34. (4)	35. (2)	36. (1)	37. (3)	38. (3)	39. (3)	40. (1)
41. (1)	42. (2)	43. (3)	44. (3)	45. (1)	46. (4)	47. (4)	48. (3)
49. (3)	50. (3)	51. (3)	52. (4)	53. (1411)	54. (1)	55. (233)	56. (8)
57. (556)	58. (6)	59. (4)	60. (10)	61. (1)	62. (2)	63. (3)	64. (4)
65. (3)	66. (4)	67. (1)	68. (3)	69. (3)	70. (2)	71. (4)	72. (2)
73. (3)	74. (1)	75. (1)	76. (3)	77. (2)	78. (1)	79. (1)	80. (1)
81. (9)	82. (150)	83. (16)	84. (20)	85. (180)	86. (309)	87. (6)	88. (17)
89. (12)	90. (11)						

**Q1.** Three forces  $F_1 = 10 \text{ N}$ ,  $F_2 = 8 \text{ N}$ ,  $F_3 = 6 \text{ N}$  are acting on a particle of mass  $5 \text{ kg}$ . The forces  $F_2$  and  $F_3$  are applied perpendicularly so that particle remains at rest. If the force  $F_1$  is removed, then the acceleration of the particle is

- (1)  $7 \text{ m s}^{-2}$  (2)  $0.5 \text{ m s}^{-2}$   
(3)  $4.8 \text{ m s}^{-2}$  (4)  $2 \text{ m s}^{-2}$

**Q2.** Match List I with List II

List-I

- A Spring constant  
B Angular speed  
C Angular momentum  
D Moment of Inertia

List-II

- I  $[T^{-1}]$   
II  $[MT^{-2}]$   
III  $[ML^2]$   
IV  $[ML^2T^{-1}]$

Choose the correct answer from the options given below:

- (1) A-I, B-III, C-II, D-IV (2) A-IV, B-I, C-III, D-II  
(3) A-II, B-I, C-IV, D-III (4) A-II, B-III, C-I, D-IV

**Q3.** A ball is thrown vertically upward with an initial velocity of  $150 \text{ m s}^{-1}$ . The ratio of velocity after  $3 \text{ s}$  and  $5 \text{ s}$  is

- $\frac{x+1}{x}$ . The value of  $x$  is \_\_\_\_\_. {take,  $g = 10 \text{ m s}^{-2}$ }  
(1) 10 (2)  $-5$   
(3) 6 (4) 5

**Q4.** Given below are two statements:

**Statement I :** A truck and a car moving with same kinetic energy are brought to rest by applying breaks which provide equal retarding forces. Both come to rest in equal distance.

**Statement II :** A car moving towards east takes a turn and moves towards north, the speed remains unchanged. The acceleration of the car is zero.

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

- (1) Statement I is correct but statement II is incorrect (2) Statement I is incorrect but statement II is correct  
(3) Both statement I and Statement II are correct (4) Both statement I and statement II are incorrect

**Q5.** To maintain a speed of  $80 \text{ km h}^{-1}$  by a bus of mass  $500 \text{ kg}$  on a plane rough road for  $4 \text{ km}$  distance, the work done by the engine of the bus will be \_\_\_\_ kJ. [The coefficient of friction between tyre of bus and road is  $0.04$ ]

**Q6.** For rolling spherical shell, the ratio of rotational kinetic energy and total kinetic energy is  $\frac{x}{5}$ . The value of  $x$  is \_\_\_\_.

**Q7.** Two satellites  $A$  and  $B$  move round the earth in the same orbit. The mass of  $A$  is twice the mass of  $B$ . The quantity which is same for the two satellites will be

- (1) Speed (2) Kinetic energy  
(3) Total energy (4) Potential energy

**Q8.** The ratio of escape velocity of a planet to the escape velocity of earth will be:-

Given: Mass of the planet is 16 times mass of earth and radius of the planet is 4 times the radius of earth.

(1) 4 : 1

(3) 1 :  $\sqrt{2}$

(2) 1 : 4

(4) 2 : 1

**Q9.** 64 identical drops each charged upto potential of 10 mV are combined to form a bigger drop. The potential of the bigger drop will be \_\_\_\_\_ mV.

**Q10.** Glycerin of density  $1.25 \times 10^3 \text{ kg m}^{-3}$  is flowing through the conical section of pipe. The area of cross-section of the pipe at its ends are  $10 \text{ cm}^2$  and  $5 \text{ cm}^2$  and pressure drop across its length is  $3 \text{ N m}^{-2}$ . The rate of flow of glycerine through the pipe is  $x \times 10^{-5} \text{ m}^3 \text{ s}^{-1}$ . The value of  $x$  is \_\_\_\_\_.

**Q11.** A body cools from  $80^\circ\text{C}$  to  $60^\circ$  in 5 minutes. The temperature for the surrounding is  $20^\circ\text{C}$ . The time it takes to cool from  $60^\circ\text{C}$  to  $40^\circ\text{C}$  is

(1) 450 s

(3) 500 s

(2) 420 s

(4)  $\frac{25}{3} \text{ s}$

**Q12.** An engine operating between the boiling and freezing points of water will have

A. Efficiency more than 27%.

B. Efficiency less than the efficiency of a Carnot engine operating between the same two temperatures.

C. Efficiency equal to 27%.

D. Efficiency less than 27%.

Choose the correct answer from the options given below

(1) B, C and D only

(3) B and D only

(2) A and B only

(4) B and C only

**Q13.** If the r.m.s speed of chlorine molecule is  $490 \text{ m s}^{-1}$  at  $27^\circ\text{C}$ , the r.m.s speed of argon molecules at the same temperature will be (Atomic mass of argon = 39.9 u, molecular mass of chlorine = 70.9 u)

(1)  $551.7 \text{ m s}^{-1}$

(3)  $451.7 \text{ m s}^{-1}$

(2)  $651.7 \text{ m s}^{-1}$

(4)  $751.7 \text{ m s}^{-1}$

**Q14.** A particle is executing simple harmonic motion (SHM). The ratio of potential energy and kinetic energy of the particle when its displacement is half of its amplitude will be

(1) 1 : 1

(3) 2 : 1

(2) 1 : 3

(4) 1 : 4

**Q15.** For a certain organ pipe, the first three resonance frequencies are in the ratio of 1 : 3 : 5 respectively. If the frequency of fifth harmonic is 405 Hz and the speed of sound in air is  $324 \text{ m s}^{-1}$  the length of the organ pipe is \_\_\_\_\_ m.

**Q16.** Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**.

**Assertion A :** If an electric dipole of dipole moment  $30 \times 10^{-5} \text{ C m}$  is enclosed by a closed surface, the net flux coming out of the surface will be zero.

**Reason R :** Electric dipole consists of two equal and opposite charges.

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

(1) Both A and R are true and R is the correct explanation of A

(3) A is true but R is false

(2) A is false but R is true

(4) Both A and R are true and R is NOT the correct explanation of A

**Q17.** A wire of resistance  $160\ \Omega$  is melted and drawn in a wire of one-fourth of its length. The new resistance of the wire will be

(1)  $16\ \Omega$

(3)  $640\ \Omega$

(2)  $10\ \Omega$

(4)  $40\ \Omega$

**Q18.** The current flowing through a conductor connected across a source is  $2\ \text{A}$  and  $1.2\ \text{A}$  at  $0^\circ\text{C}$  and  $100^\circ\text{C}$  respectively. The current flowing through the conductor at  $50^\circ\text{C}$  will be  $\frac{\quad}{\quad} \times 10^2\ \text{mA}$ .

**Q19.** Given below are two statements:

**Statement I :** The diamagnetic property depends on temperature.

**Statement II :** The induced magnetic dipole moment in a diamagnetic sample is always opposite to the magnetising field.

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

(1) Both Statement I and Statement II are False

(3) Statement I is correct but Statement II is false

(2) Statement I is incorrect but Statement II is true

(4) Both Statement I and Statement II are true

**Q20.** A compass needle oscillates 20 times per minute at a place where the dip is  $30^\circ$  and 30 times per minute where the dip is  $60^\circ$ . The ratio of total magnetic field due to the earth at two places respectively is  $\frac{4}{\sqrt{x}}$ . The value of  $x$  is

**Q21.** A conducting circular loop is placed in a uniform magnetic field of  $0.4\ \text{T}$  with its plane perpendicular to the field. Somehow, the radius of the loop starts expanding at a constant rate of  $1\ \text{mm s}^{-1}$ . The magnitude of induced emf in the loop at an instant when the radius of the loop is  $2\ \text{cm}$  will be  $\frac{\quad}{\quad}\ \mu\text{V}$ .

**Q22.** Given below are two statements:

**Statement I :** When the frequency of an AC source in a series LCR circuit increases, the current in the circuit first increases, attains a maximum value and then decreases.

**Statement II :** In a series LCR circuit, the value of power factor at resonance is one.

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

(1) Statement I is incorrect but Statement II is true

(3) Both Statement I and Statement II are true

(2) Both Statement I and Statement II are false

(4) Statement I is correct but Statement II is false

**Q23.** Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**

**Assertion A :** EM waves used for optical communication have longer wavelengths than that of microwave, employed in Radar technology.

**Reason R :** Infrared EM waves are more energetic than microwaves, (used in Radar)

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

- (1) Both A and R are true but R is NOT the correct explanation of A
- (2) A is false but R is true
- (3) A is true but R is false
- (4) Both A and R are true and R is the correct explanation of A

**Q24.** An ice cube has a bubble inside. When viewed from one side the apparent distance of the bubble is 12 cm.

When viewed from the opposite side, the apparent distance of the bubble is observed as 4 cm. If the side of the ice cube is 24 cm, the refractive index of the ice cube is

- (1)  $\frac{3}{2}$
- (2)  $\frac{2}{3}$
- (3)  $\frac{6}{5}$
- (4)  $\frac{4}{3}$

**Q25.** Two convex lenses of focal length 20 cm each are placed coaxially with a separation of 60 cm between them. The image of the distant object formed by the combination is at \_\_\_\_\_ cm from the first lens.

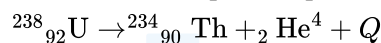
**Q26.** A proton and an  $\alpha$ -particle are accelerated from rest by 2 V and 4 V potentials, respectively. The ratio of their de-Broglie wavelength is :

- (1) 8 : 1
- (2) 2 : 1
- (3) 4 : 1
- (4) 16 : 1

**Q27.** A 12.5 eV electron beam is used to bombard gaseous hydrogen at room temperature. The number of spectral lines emitted will be:

- (1) 1
- (2) 4
- (3) 2
- (4) 3

**Q28.** A common example of alpha decay is



Given:

$${}^{238}_{92}\text{U} = 238.05060 \text{ u}$$

$${}^{234}_{90}\text{Th} = 234.04360 \text{ u}$$

$${}^4_2\text{He} = 4.00260 \text{ u and } 1 \text{ u} = 931.5 \frac{\text{MeV}}{c^2}$$

The energy released ( $Q$ ) during the alpha decay of  ${}^{238}_{92}\text{U}$  is \_\_\_\_\_ MeV.

**Q29.** In an n-p-n common emitter (CE) transistor the collector current changes from 5 mA to 16 mA for the change in base current from 100  $\mu\text{A}$  and 200  $\mu\text{A}$ , respectively. The current gain of transistor is \_\_\_\_\_.

- (1) 110
- (2) 210
- (3) 0.9
- (4) 9

**Q30.** The amplitude of  $15 \sin(1000 \pi t)$  is modulated by  $10 \sin(4 \pi t)$  signal. The amplitude modulated signal contains frequencies of

- A. 500 Hz
- B. 2 Hz
- C. 250 Hz
- D. 498 Hz
- E. 502 Hz

Choose the correct answer from the options given below

(1) A and B only

(3) A and D only

(2) A and C only

(4) A, D and E only

**Q31.** A metal chloride contains 55.0% of chlorine by weight. 100 mL vapours of the metal chloride at STP weigh 0.57 g. The molecular formula of the metal chloride is

(Given: Atomic mass of chlorine is 35.5 u)

(1)  $\text{MCl}_4$ (2)  $\text{MCl}_3$ (3)  $\text{MCl}_2$ (4)  $\text{MCl}$ 

**Q32.** Given below are two statement : one is labelled as Assertion A and the other is labelled as Reason R

Assertion A : 5f electron can participate in bonding to a far greater extent than 4f electrons

Reason R : 5f orbitals are not as buried as 4f orbitals

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

(1) A is false but R is true

(2) Both A and R are true and R is the correct explanation of A

(3) A is true but R is false

(4) Both A and R are true but R is NOT the correct explanation of A

**Q33.** Values of work function ( $W_0$ ) for a few metals are given below

Metal	Li	Na	K	Mg	Cu	Ag
$\frac{W_0}{\text{eV}}$	2.42	2.3	2.25	3.7	4.8	4.3

The number of metals which will show photoelectric effect when light of wavelength 400 nm falls on it is \_\_\_\_\_

Given:  $h = 6.6 \times 10^{-34} \text{ J s}$  $c = 3 \times 10^8 \text{ ms}^{-1}$  $e = 1.6 \times 10^{-19} \text{ C}$ 

**Q34.** The bond order and magnetic property of acetylide ion are same as that of

(1)  $\text{O}_2^+$ (2)  $\text{N}_2^+$ (3)  $\text{NO}^+$ (4)  $\text{O}_2^-$ 

**Q35.** Given below are two statements:

Statement I:  $\text{SbCl}_5$  is more covalent than  $\text{SbCl}_3$ 

Statement II: The higher oxides of halogens also tend to be more stable than the lower ones.

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

(1) Statement I is incorrect but statement II is correct (2) Both Statement I and Statement II are incorrect

(3) Both Statement I and Statement II are correct (4) Statement I is correct but statement II is incorrect

**Q36.** At 600 K, the root mean square (rms) speed of gas X (molar mass = 40) is equal to the most probable speed of gas Y at 90 K. The molar mass of the gas Y is \_\_\_\_\_  $\text{g mol}^{-1}$ . (Nearest integer)

**Q37.** One mole of an ideal gas at 350 K is in a 2.0 L vessel of thermally conducting walls, which are in contact with the surroundings. It undergoes isothermal reversible expansion from 2.0 L to 3.0 L against a constant pressure of 4 atm. The change in entropy of the surroundings ( $\Delta S$ ) is \_\_\_\_\_  $\text{J K}^{-1}$  (Nearest integer)

Given:  $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ .

**Q38.** An analyst wants to convert 1 L HCl of pH = 1 to a solution of HCl of pH = 2. The volume of water needed to do this dilution is \_\_\_\_\_ mL. (Nearest integer)

**Q39.** Match List I with List II

List I	
Type of Hydride	
A	Electron deficient hydride
B	Electron rich hydride
C	Electron precise hydride
D	Saline hydride

List II	
Example	
I	MgH <sub>2</sub>
II	HF
III	B <sub>2</sub> H <sub>6</sub>
IV	CH <sub>4</sub>

Choose the correct answer from the options given below :

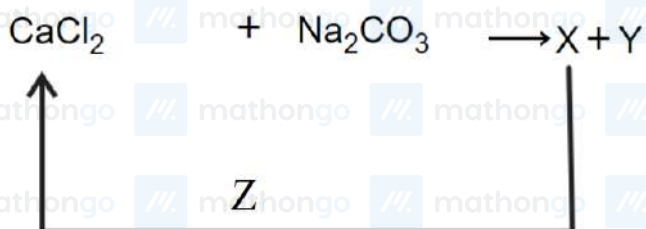
(1) A-III, B-II, C-IV, D-I

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

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

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

**Q40.** In the given reaction cycle



X, Y and Z respectively are

(1) X – CaCO<sub>3</sub>, Y – NaCl, Z – KCl

(2) X – CaCO<sub>3</sub>, Y – NaCl, Z – HCl

(3) X – CaO, Y – NaCl + CO<sub>2</sub>, Z – NaCl

(4) X – CaO, Y – NaCl + CO<sub>2</sub>, Z – KCl

**Q41.** The density of alkali metals is in the order

(1) K < Cs < Na < Rb

(2) Na < Rb < K < Cs

(3) Na < K < Cs < Rb

(4) K < Na < Rb < Cs

**Q42.** Given below are two statements:

Statement I: Boron is extremely hard indicating its high lattice energy.

Statement II: Boron has highest melting and boiling point compared to its other group members.

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

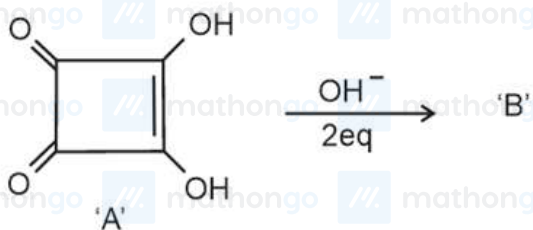
(1) Both Statement I and Statement II are incorrect

(2) Statement I is correct but Statement II is incorrect

(3) Both statement I and Statement II are correct

(4) Statement I is incorrect but Statement II is correct

**Q43.** Correct statements for the given reaction are:

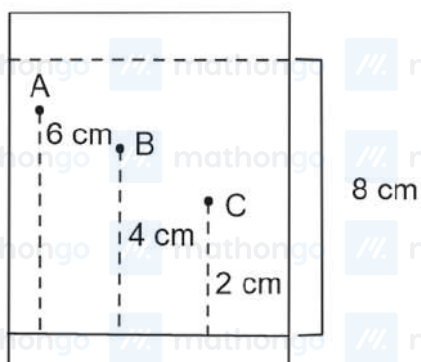


- A. Compound 'B' is aromatic  
 B. The completion of above reaction is very slow  
 C. 'A' shows tautomerism  
 D. The bond lengths of C – C in compound B are found to be same

Choose the correct answer from the options given below.

- (1) B, C and D only  
 (2) A, B and C only  
 (3) A, C and D only  
 (4) A, B and D only

**Q44.** Three organic compounds A, B and C were allowed to run in thin layer chromatography using hexane and gave the following result (see figure). The  $R_f$  value of the most polar compound is  $\times 10^{-2}$



**Q45.** 2 – hexene  $\xrightarrow[\text{(ii) H}_2\text{O}]{\text{(i) O}_3}$  Products

The two products formed in above reaction are

- (1) Butanal and acetaldehyde  
 (2) Butanoic acid and acetaldehyde  
 (3) Butanal and acetic acid  
 (4) Butanoic acid and acetic acid

**Q46.** Match List I with List II

List I

- A Nitrogen oxides in air  
 B Methane in air  
 C Carbon dioxide  
 D Phosphate fertilisers in water

List II

- I Eutrophication  
 II pH of rain water becomes 5.6  
 III Global warming  
 IV Acid rain

Choose the correct answer from the options given below :

- (1) A-II, B-III, C-I, D-IV  
 (2) A-I, B-II, C-III, D-IV  
 (3) A-IV, B-III, C-II, D-I  
 (4) A-IV, B-II, C-III, D-I

**Q47.** 80 mole percent of  $\text{MgCl}_2$  is dissociated in aqueous solution. The vapour pressure of 1.0 molal aqueous solution of  $\text{MgCl}_2$  at  $38^\circ\text{C}$  is \_\_\_\_\_ mm Hg. (Nearest integer)

Given: Vapour pressure of water at  $38^\circ\text{C}$  is 50 mm Hg

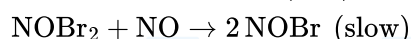
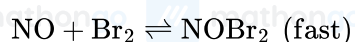
**Q48.** For lead storage battery pick the correct statements

- A. During charging of battery,  $\text{PbSO}_4$  on anode is converted into  $\text{PbO}_2$
- B. During charging of battery,  $\text{PbSO}_4$  on cathode is converted into  $\text{PbO}_2$
- C. Lead storage battery consists of grid of lead packed with  $\text{PbO}_2$  as anode
- D. Lead storage battery has ~38% solution of sulphuric acid as an electrolyte

Choose the correct answer from the options given below:

- (1) A, B, D only
- (2) B, C, D only
- (3) B, C only
- (4) B, D only

**Q49.** The reaction  $2\text{NO} + \text{Br}_2 \rightarrow 2\text{NOBr}$  takes place through the mechanism given below



The overall order of the reaction is \_\_\_\_\_.

**Q50.** Four gases, A, B, C and D have critical temperatures 5.3, 33.2, 126.0 and 154.3K respectively

For their adsorption on a fixed amount of charcoal, the correct order is :

- (1)  $\text{C} > \text{D} > \text{B} > \text{A}$
- (2)  $\text{C} > \text{B} > \text{D} > \text{A}$
- (3)  $\text{D} > \text{C} > \text{B} > \text{A}$
- (4)  $\text{D} > \text{C} > \text{A} > \text{B}$

**Q51.** Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

Assertion A: In the Ellingham diagram, a sharp change in slope of the line is observed from  $\text{Mg} \rightarrow \text{MgO}$  at  $\sim 1120^\circ\text{C}$

Reason R: There is a large change of entropy associated with the change of state

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

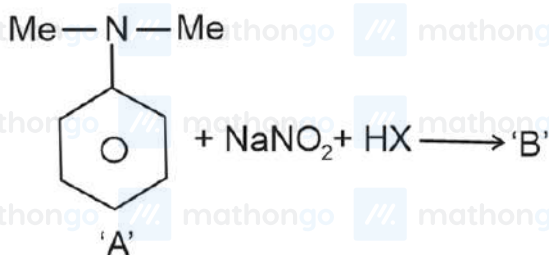
- (1) Both A and R are true but R is NOT the correct explanation of A
- (2) A is false but R is true

explanation of A

- (3) Both A and R are true and R is the correct explanation of A
- (4) A is true but R is false

explanation of A

**Q52.** The incorrect statement regarding the reaction given below is



- (1) The product 'B' formed in the above reaction is p
- (2) 'B' is N-nitroso ammonium compound

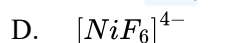
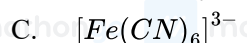
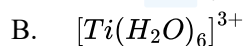
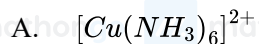
-nitroso compound at low temperature

- (3) The reaction occurs at low temperature

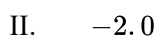
- (4) The electrophile involved in the reaction is  $\text{NO}^+$

Q53. Match List I with List II

List I Complex



List II  $CFSE (\Delta_0)$



Choose the correct answer from the options given below:

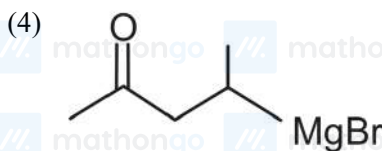
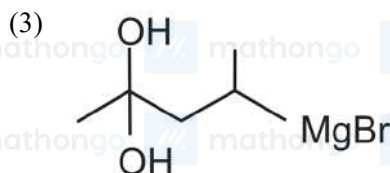
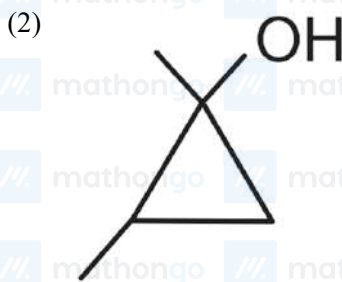
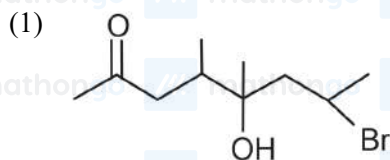
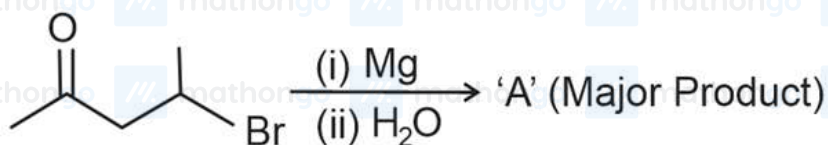
(1) A(III), B(IV), C(I), D(II)

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

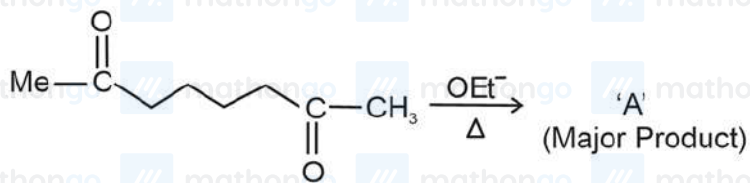
(3) A(I), B(II), C(IV), D(III)

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

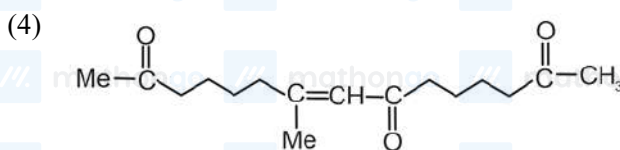
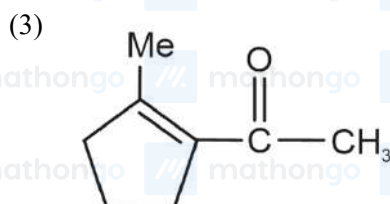
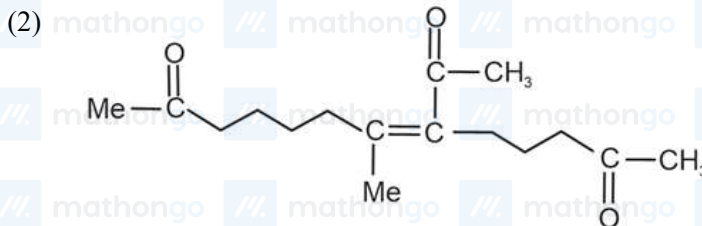
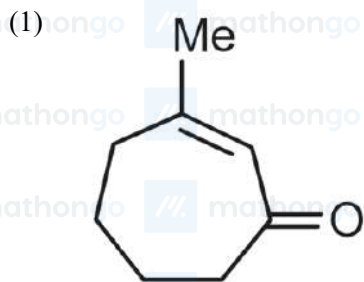
Q54. In the following reaction



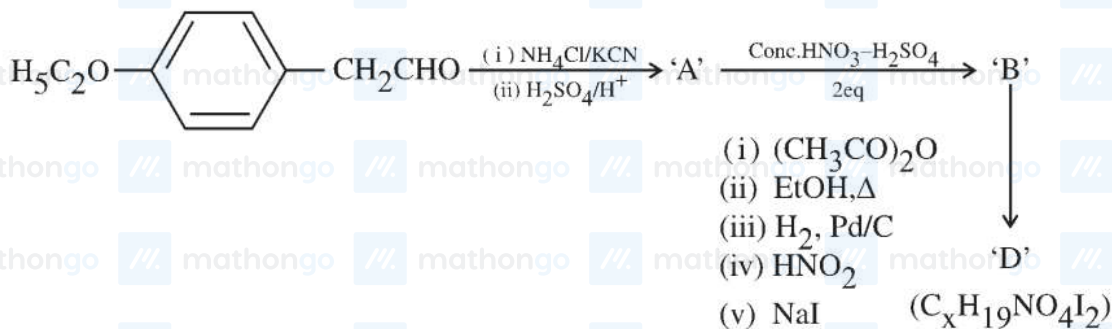
Q55.



A in the above reaction is :



Q56.



The value of x in compound 'D' is \_\_\_\_\_

Q57. The mass of  $\text{NH}_3$  produced when 131.8 kg of cyclohexane carbaldehyde undergoes Tollen's test is \_\_\_\_\_ kg.

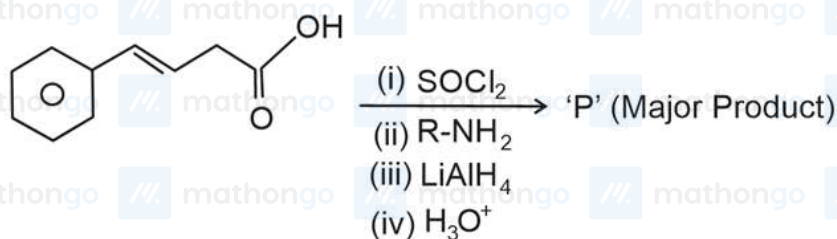
(Nearest Integer)

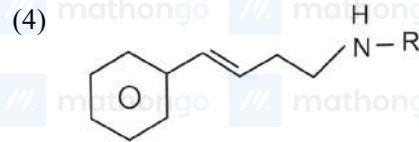
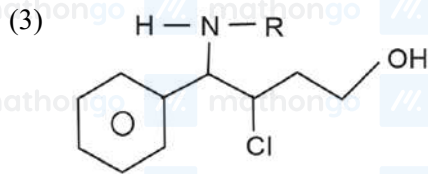
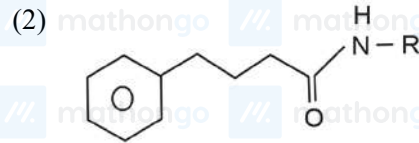
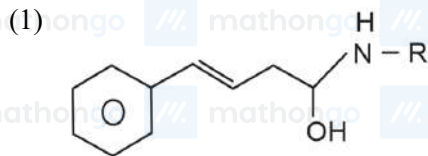
Molar mass of C = 12 g/mol

N = 14 g/mol

O = 16 g/mol

Q58. The major product 'P' formed in the following sequence of reactions is





**Q59.** Match List I with List II

List I

(Example)

A 2-chloro-1, 3-butadiene

B Nylon 2-nylon 6

C Polyacrylonitrile

D Dacron

List II

(Type)

I Biodegradable polymer

II Synthetic Rubber

III Polyester

IV Addition Polymer

Choose the correct answer from the options given below:

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

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

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

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

**Q60.** In an oligopeptide named Alanylglycylphenyl alanyl isoleucine, the number of  $sp^2$  hybridised carbons is \_\_\_\_\_.

**Q61.** Let  $\alpha, \beta$  be the roots of the quadratic equation  $x^2 + \sqrt{6}x + 3 = 0$ . Then  $\frac{\alpha^{23} + \beta^{23} + \alpha^{14} + \beta^{14}}{\alpha^{15} + \beta^{15} + \alpha^{10} + \beta^{10}}$  is equal to

(1) 81

(2) 9

(3) 72

(4) 729

**Q62.** Let  $C$  be the circle in the complex plane with centre  $z_0 = \frac{1}{2}(1 + 3i)$  and radius  $r = 1$ . Let  $z_1 = 1 + i$  and the complex number  $z_2$  be outside circle  $C$  such that  $|z_1 - z_0||z_2 - z_0| = 1$ . If  $z_0, z_1$  and  $z_2$  are collinear, then the smaller value of  $|z_2|^2$  is equal to

(1)  $\frac{5}{2}$

(2)  $\frac{7}{2}$

(3)  $\frac{13}{2}$

(4)  $\frac{3}{2}$

**Q63.** The number of five-digit numbers, greater than 40000 and divisible by 5, which can be formed using the digits 0, 1, 3, 5, 7 and 9 without repetition, is equal to

(1) 132

(2) 120

(3) 72

(4) 96

**Q64.** Let the digits  $a, b, c$  be in A.P. Nine-digit numbers are to be formed using each of these three digits thrice such that three consecutive digits are in A.P. at least once. How many such numbers can be formed?

**Q65.** Let  $\langle a_n \rangle$  be a sequence such that  $a_1 + a_2 + \dots + a_n = \frac{n^2 + 3n}{(n+1)(n+2)}$ . If  $28 \sum_{k=1}^{10} \frac{1}{a_k} = p_1 p_2 p_3 \dots p_m$ , where  $p_1, p_2, \dots, p_m$  are the first  $m$  prime numbers, then  $m$  is equal to

(1) 5

(3) 6

(2) 8

(4) 7

Q66. If  $\frac{1}{n+1} {}^nC_n + \frac{1}{n} {}^nC_{n-1} + \dots + \frac{1}{2} {}^nC_1 + {}^nC_0 = \frac{1023}{10}$  then  $n$  is equal to

(1) 9

(3) 7

(2) 8

(4) 6

Q67. The sum, of the coefficients of the first 50 terms in the binomial expansion of  $(1-x)^{100}$ , is equal to

(1)  ${}^{101}C_{50}$ (3)  $-{}^{101}C_{50}$ (2)  ${}^{99}C_{49}$ (4)  $-{}^{99}C_{49}$ 

Q68. If the point  $\left(\alpha, \frac{7\sqrt{3}}{3}\right)$  lies on the curve traced by the mid-points of the line segments of the lines  $x \cos \theta + y \sin \theta = 7$ ,  $\theta \in \left(0, \frac{\pi}{2}\right)$  between the co-ordinates axes, then  $\alpha$  is equal to

(1)  $-7$ (3)  $7\sqrt{3}$ (2)  $-7\sqrt{3}$ 

(4) 7

Q69. In a triangle  $ABC$ , if  $\cos A + 2 \cos B + \cos C = 2$  and the lengths of the sides opposite to the angles  $A$  and  $C$  are 3 and 7 respectively, then  $\cos A - \cos C$  is equal to

(1)  $\frac{9}{7}$ (3)  $\frac{5}{7}$ (2)  $\frac{10}{7}$ (4)  $\frac{3}{7}$ 

Q70. Two circles in the first quadrant of radii  $r_1$  and  $r_2$  touch the coordinate axes. Each of them cuts off an intercept of 2 units with the line  $x + y = 2$ . Then  $r_1^2 + r_2^2 - r_1 r_2$  is equal to \_\_\_\_.

Q71. Let  $P\left(\frac{2\sqrt{3}}{\sqrt{7}}, \frac{6}{\sqrt{7}}\right)$ ,  $Q$ ,  $R$  and  $S$  be four points on the ellipse  $9x^2 + 4y^2 = 36$ . Let  $PQ$  and  $RS$  be mutually perpendicular and pass through the origin. If  $\frac{1}{(PQ)^2} + \frac{1}{(RS)^2} = \frac{p}{q}$ , where  $p$  and  $q$  are coprime, then  $p + q$  is equal to

(1) 147

(3) 137

(2) 143

(4) 157

Q72. Among the two statements

$(S_1) : (p \Rightarrow q) \wedge (p \wedge (\neg q))$  is a contradiction and  $(S_2) : (p \wedge q) \vee ((\neg p) \wedge q) \vee (p \wedge (\neg q)) \vee ((\neg p) \wedge (\neg q))$  is a tautology

(1) only  $(S_2)$  is true

(3) both are false

(2) only  $(S_1)$  is true

(4) both are true

Q73. Let the positive numbers  $a_1, a_2, a_3, a_4$  and  $a_5$  be in a G.P. Let their mean and variance be  $\frac{31}{10}$  and  $\frac{m}{n}$  respectively, where  $m$  and  $n$  are co-prime. If the mean of their reciprocals is  $\frac{31}{10}$  and  $a_3 + a_4 + a_5 = 14$ , then  $m + n$  is equal to \_\_\_\_\_.

Q74. The number of relations, on the set  $\{1, 2, 3\}$  containing  $(1, 2)$  and  $(2, 3)$  which are reflexive and transitive but not symmetric, is \_\_\_\_\_.

Q75. Let  $A = \begin{bmatrix} 1 & \frac{1}{51} \\ 0 & 1 \end{bmatrix}$ . If  $B = \begin{bmatrix} 1 & 2 \\ -1 & -1 \end{bmatrix} A \begin{bmatrix} -1 & -2 \\ 1 & 1 \end{bmatrix}$ , then the sum of all the elements of the matrix  $\sum_{n=1}^{50} B^n$  is equal to

(1) 75

(3) 50

(2) 125

(4) 100

Q76.

Let  $D_k = \begin{vmatrix} 1 & 2k & 2k-1 \\ n & n^2+n+2 & n^2 \\ n & n^2+n & n^2+n+2 \end{vmatrix}$ . If  $\sum_{k=1}^n D_k = 96$ , then  $n$  is equal to \_\_\_\_\_.

Q77. Let  $D$  be the domain of the function  $f(x) = \sin^{-1}\left(\log_{3x}\left(\frac{6+2\log_3 x}{-5x}\right)\right)$ . If the range of the function  $g : D \rightarrow \mathbb{R}$  defined by  $g(x) = x - [x]$ , ( $[x]$  is the greatest integer function), is  $(\alpha, \beta)$ , then  $\alpha^2 + \frac{5}{\beta}$  is equal to

(1) 135

(3) 46

(2) 45

(4) 136

Q78. Let  $[x]$  be the greatest integer  $\leq x$ . Then the number of points in the interval  $(-2, 1)$  where the function  $f(x) = |[x]| + \sqrt{x - [x]}$  is discontinuous, is \_\_\_\_\_.

Q79. If the total maximum value of the function  $f(x) = \left(\frac{\sqrt{3e}}{2\sin x}\right)^{\sin^2 x}$ ,  $x \in (0, \frac{\pi}{2})$ , is  $\frac{k}{e}$ , then  $\left(\frac{k}{e}\right)^8 + \frac{k^8}{e^5} + k^8$  is equal to

(1)  $e^3 + e^6 + e^{11}$ (3)  $e^3 + e^6 + e^{10}$ (2)  $e^5 + e^6 + e^{11}$ (4)  $e^3 + e^5 + e^{11}$ 

Q80. Let  $I(x) = \int \sqrt{\frac{x+7}{x}} dx$  and  $I(9) = 12 + 7 \log_e 7$ . If  $I(1) = \alpha + 7 \log_e (1 + 2\sqrt{2})$ , then  $\alpha^4$  is equal to \_\_\_\_\_.

Q81. If  $\int_{-0.15}^{0.15} |100x^2 - 1| dx = \frac{k}{3000}$ , then  $k$  is equal to \_\_\_\_\_.

Q82. The area of the region enclosed by the curve  $y = x^3$  and its tangent at the point  $(-1, -1)$  is

(1)  $\frac{19}{4}$ (3)  $\frac{31}{4}$ (2)  $\frac{23}{4}$ (4)  $\frac{27}{4}$ 

Q83. Let  $y = y(x)$ ,  $y > 0$ , be a solution curve of the differential equation  $(1 + x^2)dy = y(x - y)dx$ . If  $y(0) = 1$  and  $y(2\sqrt{2}) = \beta$ , then

(1)  $e^{3\beta-1} = e(3 + 2\sqrt{2})$ (3)  $e^{\beta-1} = e^{-2}(3 + 2\sqrt{2})$ (2)  $e^{3\beta-1} = e(5 + \sqrt{2})$ (4)  $e^{\beta-1} = e^{-2}(5 + \sqrt{2})$ 

Q84. Let  $a, b, c$  be three distinct real numbers, none equal to one. If the vectors  $a\hat{i} + \hat{j} + \hat{k}$ ,  $\hat{i} + b\hat{j} + \hat{k}$  and  $\hat{i} + \hat{j} + c\hat{k}$  are coplanar, then  $\frac{1}{1-a} + \frac{1}{1-b} + \frac{1}{1-c}$  is equal to

(1) 2

(3) -2

(2) -1

(4) 1

Q85. Let  $\lambda \in \mathbb{Z}$ ,  $\vec{a} = \lambda\hat{i} + \hat{j} - \hat{k}$  and  $\vec{b} = 3\hat{i} - \hat{j} + 2\hat{k}$ . Let  $\vec{c}$  be a vector such that  $(\vec{a} + \vec{b} + \vec{c}) \times \vec{c} = \vec{0}$ ,  $\vec{a} \cdot \vec{c} = -17$  and  $\vec{b} \cdot \vec{c} = -20$ . Then  $|\vec{c} \times (\lambda\hat{i} + \hat{j} + \hat{k})|^2$  is equal to

(1) 46

(3) 62

(2) 53

(4) 49

Q86. Let the plane  $x + 3y + 2z + 6 = 0$  meet the co-ordinate axes at the points  $A, B, C$ . If the orthocenter of the triangle  $ABC$  is  $(\alpha, \beta, \frac{6}{7})$ , then  $98(\alpha + \beta)^2$  is equal to \_\_\_\_\_.

Q87. Let the lines  $L_1 : \frac{x+5}{3} = \frac{y+4}{1} = \frac{z-\alpha}{-2}$  and  $L_2 : 3x + 2y + z - 2 = 0 = x - 3y + 2z - 13$  be coplanar. If the point  $P(a, b, c)$  on  $L_1$  is nearest to the point  $Q(-4, -3, 2)$ , then  $|a| + |b| + |c|$  is equal to

(1) 12

(2) 14

(3) 8

(4) 10

Q88. Let the plane  $P : 4x - y + z = 10$  be rotated by an angle  $\frac{\pi}{2}$  about its line of intersection with the plane  $x + y - z = 4$ . If  $\alpha$  is the distance of the point  $(2, 3, -4)$  from the new position of the plane  $P$ , then  $35\alpha$  is equal to

(1) 85

(2) 105

(3) 126

(4) 90

Q89. Two dice  $A$  and  $B$  are rolled. Let the numbers obtained on  $A$  and  $B$  be  $\alpha$  and  $\beta$  respectively. If the variance of  $\alpha - \beta$  is  $\frac{p}{q}$ , where  $p$  and  $q$  are co-prime, then the sum of the positive divisors of  $p$  is equal to

(1) 72

(2) 36

(3) 48

(4) 31

Q90. A fair  $n$  ( $n > 1$ ) faces die is rolled repeatedly until a number less than  $n$  appears. If the mean of the number of tosses required is  $\frac{n}{9}$ , then  $n$  is equal to

## ANSWER KEYS

1. (4)	2. (3)	3. (4)	4. (1)	5. (1)	6. (4)	7. (3)	8. (3)
9. (2)	10. (2)	11. (1)	12. (2)	13. (2)	14. (3)	15. (2)	16. (1)
17. (3)	18. (4)	19. (1)	20. (4)	21. (784)	22. (2)	23. (160)	24. (4)
25. (1)	26. (15)	27. (243)	28. (50)	29. (100)	30. (4)	31. (3)	32. (2)
33. (3)	34. (3)	35. (1)	36. (2)	37. (4)	38. (3)	39. (3)	40. (4)
41. (3)	42. (4)	43. (3)	44. (3)	45. (2)	46. (2)	47. (2)	48. (3)
49. (4)	50. (2)	51. (3)	52. (4)	53. (3)	54. (9000)	55. (25)	56. (48)
57. (3)	58. (15)	59. (60)	60. (10)	61. (1)	62. (1)	63. (2)	64. (3)
65. (1)	66. (4)	67. (4)	68. (2)	69. (4)	70. (4)	71. (4)	72. (1)
73. (1)	74. (4)	75. (1)	76. (4)	77. (1)	78. (4)	79. (3)	80. (3)
81. (1260)	82. (7)	83. (211)	84. (4)	85. (6)	86. (2)	87. (64)	88. (575)
89. (288)	90. (10)						

**Q1.** Electric field in a certain region is given by  $\vec{E} = \frac{A}{x^2} \hat{i} + \frac{B}{y^3} \hat{j}$ . The SI unit of  $A$  and  $B$  are :

(1)  $\text{N m}^3 \text{C}^{-1}$ ;  $\text{N m}^2 \text{C}^{-1}$

(2)  $\text{N m}^2 \text{C}^{-1}$ ;  $\text{N m}^3 \text{C}^{-1}$

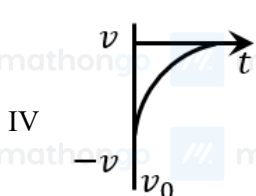
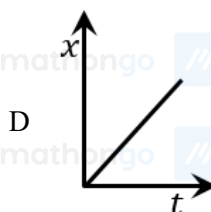
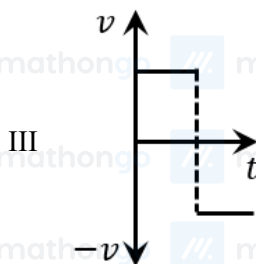
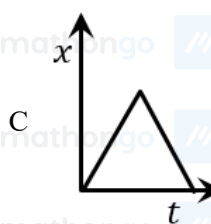
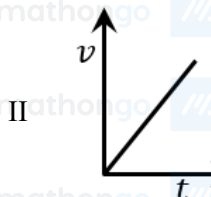
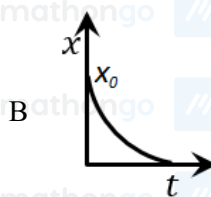
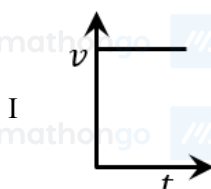
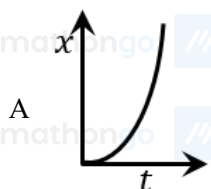
(3)  $\text{N m}^3 \text{C}$ ;  $\text{N m}^2 \text{C}$

(4)  $\text{N m}^2 \text{C}$ ;  $\text{N m}^3 \text{C}$

**Q2.** Match Column-I with Column-II :

**Column-I (x-t graphs)**

**Column-II (v-t graphs)**



Choose the correct answer from the options given below:

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

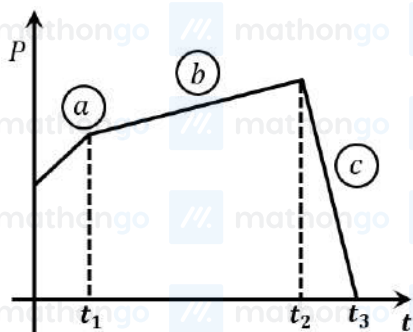
(2) A- I. B-II, C-III, D-IV

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

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

**Q3.** The figure represents the momentum time ( $p - t$ ) curve for a particle moving along an axis under the influence of the force. Identify the regions on the graph where the magnitude of the force is maximum and minimum respectively ?

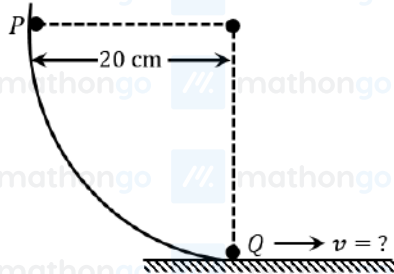
If  $t_3 - t_2 < t_1$



- (1) c and a  
(3) c and b

- (2) b and c  
(4) a and b

**Q4.** As per the given figure, a small ball  $P$  slides down the quadrant of a circle and hits the other ball  $Q$  of equal mass which is initially at rest. Neglecting the effect of friction and assume the collision to be elastic, the velocity of ball  $Q$  after collision will be : ( $g = 10 \text{ m s}^{-2}$ )



- (1) 0  
(3)  $2 \text{ m s}^{-1}$

- (2)  $0.25 \text{ m s}^{-1}$   
(4)  $4 \text{ m s}^{-1}$

**Q5.** A ball of mass  $200 \text{ g}$  rests on a vertical post of height  $20 \text{ m}$ . A bullet of mass  $10 \text{ g}$ , travelling in horizontal direction, hits the centre of the ball. After collision both travel independently. The ball hits the ground at a distance  $30 \text{ m}$  and the bullet at a distance of  $120 \text{ m}$  from the foot of the post. The value of initial velocity of the bullet will be (if  $g = 10 \text{ m s}^{-2}$ ) :

- (1)  $120 \text{ m s}^{-1}$   
(3)  $400 \text{ m s}^{-1}$

- (2)  $60 \text{ m s}^{-1}$   
(4)  $360 \text{ m s}^{-1}$

**Q6.** If the gravitational field in the space is given as  $-\frac{K}{r^2}$ . Taking the reference point to be at  $r = 2 \text{ cm}$  with gravitational potential  $V = 10 \text{ J kg}^{-1}$ . Find the gravitational potentials at  $r = 3 \text{ cm}$  in SI unit (Given, that  $K = 6 \text{ J cm kg}^{-1}$ )

- (1) 9  
(3) 12

- (2) 11  
(4) 10

**Q7.** Choose the correct relationship between Poisson ratio  $\sigma$ , bulk modulus ( $K$ ) and modulus of rigidity  $\eta$  of a given solid object:

- (1)  $\sigma = \frac{3K - 2\eta}{6K + 2\eta}$   
(3)  $\sigma = \frac{3K + 2\eta}{6K + 2\eta}$

- (2)  $\sigma = \frac{6K + 2\eta}{3K - 2\eta}$   
(4)  $\sigma = \frac{6K - 2\eta}{3K - 2\eta}$

**Q8.** The height of liquid column raised in a capillary tube of certain radius when dipped in liquid  $A$  vertically is,  $5 \text{ cm}$ . If the tube is dipped in a similar manner in another liquid  $B$  of surface tension and density double the

values of liquid A, the height of liquid column raised in liquid B would be \_\_\_\_\_ m.

- (1) 0.20 (2) 0.5  
(3) 0.05 (4) 0.10

**Q9.** Heat is given to an ideal gas in an isothermal process.

- A. Internal energy of the gas will decrease.  
B. Internal energy of the gas will increase.  
C. Internal energy of the gas will not change.  
D. The gas will do positive work.  
E. The gas will do negative work.

Choose the correct answer from the options given below :

- (1) A and E only (2) B and D only  
(3) C and E only (4) C and D only

**Q10.** The pressure ( $P$ ) and temperature ( $T$ ) relationship of an ideal gas obeys the equation  $PT^2 = \text{constant}$ . The volume expansion coefficient of the gas will be :

- (1)  $3T^2$  (2)  $\frac{3}{T^2}$   
(3)  $\frac{3}{T^3}$  (4)  $\frac{3}{T}$

**Q11.** Two isolated metallic solid spheres of radii  $R$  and  $2R$  are charged such that both have same charge density  $\sigma$ .

The spheres are then connected by a thin conducting wire. If the new charge density of the bigger sphere is  $\sigma'$ .

The ratio  $\frac{\sigma'}{\sigma}$  is :

- (1)  $\frac{9}{4}$  (2)  $\frac{4}{3}$   
(3)  $\frac{3}{5}$  (4)  $\frac{5}{6}$

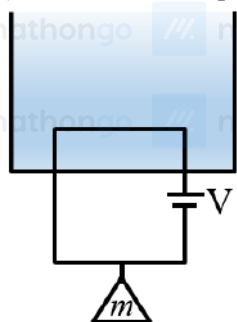
**Q12.** The charge flowing in a conductor changes with time as  $Qt = \alpha t - \beta t^2 + \gamma t^3$ , where  $\alpha$ ,  $\beta$  and  $\gamma$  are constants.

Minimum value of current is:

- (1)  $\alpha - \frac{3\beta^2}{\gamma}$  (2)  $\alpha - \frac{\gamma^2}{3\beta}$   
(3)  $\beta - \frac{\alpha^2}{3\gamma}$  (4)  $\alpha - \frac{\beta^2}{3\gamma}$

**Q13.** A massless square loop, of wire of resistance  $10 \Omega$ , supporting a mass of  $1 \text{ g}$ , hangs vertically with one of its sides in a uniform magnetic field of  $10^3 \text{ G}$ , directed outwards in the shaded region. A dc voltage  $V$  is applied to the loop. For what value of  $V$ , the magnetic force will exactly balance the weight of the supporting mass of  $1 \text{ g}$ ?

(If sides of the loop =  $10 \text{ cm}$ ,  $g = 10 \text{ m s}^{-2}$ )



- (1)  $\frac{1}{10}$  V (2) 100 V  
(3) 1 V (4) 10 V

**Q14.** The magnetic moments associated with two closely wound circular coils  $A$  and  $B$  of radius  $r_A = 10$  cm and  $r_B = 20$  cm respectively are equal if: (Where  $N_A$ ,  $I_A$  and  $N_B$ ,  $I_B$  are number of turn and current of  $A$  and  $B$  respectively)

- (1)  $2N_AI_A = N_BI_B$  (2)  $N_A = 2N_B$   
(3)  $N_AI_A = 4N_BI_B$  (4)  $4N_AI_A = N_BI_B$

**Q15.** In a series  $LR$  circuit with  $X_L = R$ , power factor is  $P_1$ . If a capacitor of capacitance  $C$  with  $X_C = X_L$  is added to the circuit the power factor becomes  $P_2$ . The ratio of  $P_1$  to  $P_2$  will be :

- (1) 1:3 (2)  $1:\sqrt{2}$   
(3) 1:1 (4) 1:2

**Q16.** A person has been using spectacles of power -1.0 diopter for distant vision and a separate reading glass of power 2.0 diopters. What is the least distance of distinct vision for this person:

- (1) 10 cm (2) 40 cm  
(3) 30 cm (4) 50 cm

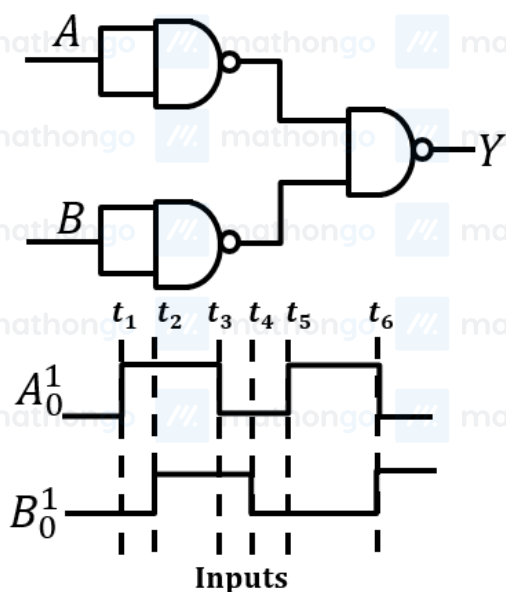
**Q17.** A small object at rest, absorbs a light pulse of power 20 mW and duration 300 ns. Assuming speed of light as  $3 \times 10^8$  m s<sup>-1</sup>. The momentum of the object becomes equal to :

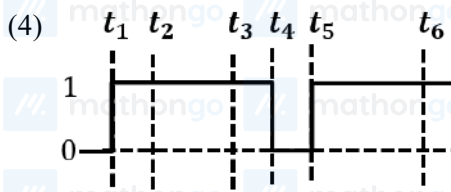
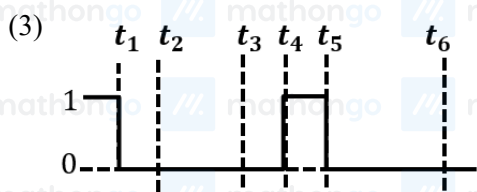
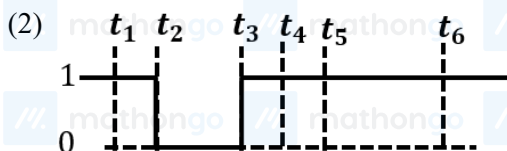
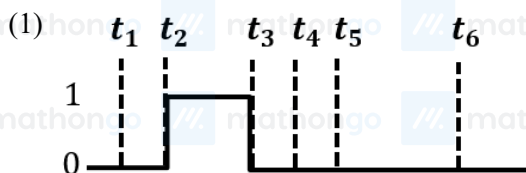
- (1)  $0.5 \times 10^{-17}$  kg m s<sup>-1</sup> (2)  $2 \times 10^{-17}$  kg m s<sup>-1</sup>  
(3)  $3 \times 10^{-17}$  kg m s<sup>-1</sup> (4)  $1 \times 10^{-17}$  kg m s<sup>-1</sup>

**Q18.** Speed of an electron in Bohr's 7<sup>th</sup> orbit for Hydrogen atom is  $3.6 \times 10^6$  m s<sup>-1</sup>. The corresponding speed of the electron in 3<sup>rd</sup> orbit, in m s<sup>-1</sup> is :

- (1)  $1.8 \times 10^6$  (2)  $7.5 \times 10^6$   
(3)  $3.6 \times 10^6$  (4)  $8.4 \times 10^6$

**Q19.** The output waveform of the given logical circuit for the following inputs  $A$  and  $B$  as shown below, is





**Q20.** A sinusoidal carrier voltage is amplitude modulated. The resultant amplitude modulated wave has maximum and minimum amplitude of 120 V and 80 V respectively. The amplitude of each side band is :

- (1) 15 V                      (2) 10 V  
(3) 20 V                      (4) 5 V

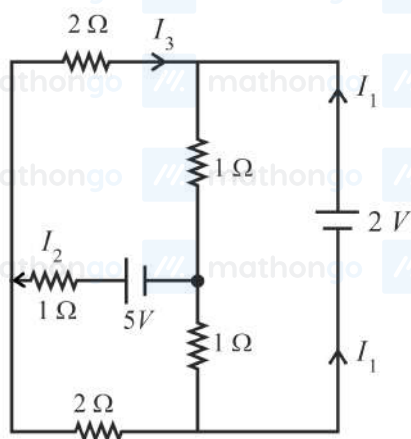
**Q21.** A horse rider covers half the distance with  $5 \text{ m s}^{-1}$  speed. The remaining part of the distance was travelled with speed  $10 \text{ m s}^{-1}$  for half the time and with speed  $15 \text{ m s}^{-1}$  for other half of the time. The mean speed of the rider averaged over the whole time of motion is  $\frac{x}{7} \text{ m s}^{-1}$ . The value of  $x$  is \_\_\_\_\_.

**Q22.** A thin uniform rod of length 2 m, cross sectional area  $A$  and density  $d$  is rotated about an axis passing through the centre and perpendicular to its length with angular velocity  $\omega$ . If value of  $\omega$  in terms of its rotational kinetic energy  $E$  is  $\sqrt{\frac{\alpha E}{Ad}}$ , then the value of  $\alpha$  is \_\_\_\_\_.

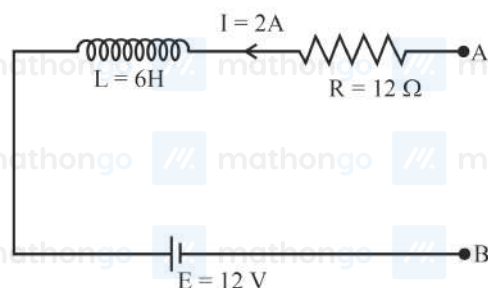
**Q23.** The general displacement of a simple harmonic oscillator is  $x = A \sin \omega t$ . Let  $T$  be its time period. The slope of its potential energy ( $U$ ) – time ( $t$ ) curve will be maximum when  $t = \frac{T}{\beta}$ . The value of  $\beta$  is \_\_\_\_\_.

**Q24.** A capacitor of capacitance  $900 \mu\text{F}$  is charged by a 100 V battery. The capacitor is disconnected from the battery and connected to another uncharged identical capacitor such that one plate of uncharged capacitor connected to positive plate and another plate of uncharged capacitor connected to negative plate of the charged capacitor. The loss of energy in this process is measured as  $x \times 10^{-2} \text{ J}$ . The value of  $x$  is \_\_\_\_\_.

**Q25.** In the following circuit, the magnitude of current  $I_1$ , is \_\_\_\_\_ A.

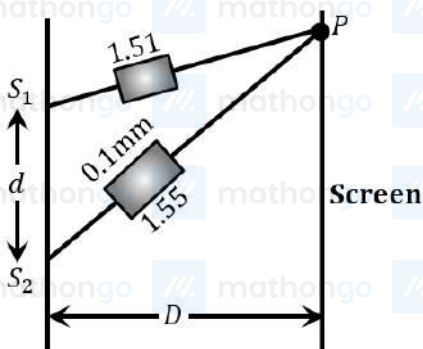


Q26. As per the given figure, if  $\frac{dI}{dt} = -1 \text{ A s}^{-1}$ , then the value of  $V_{AB}$  at this instant will be \_\_\_\_\_ V.



Q27. In an experiment for estimating the value of focal length of converging mirror, image of an object placed at 40 cm from the pole of the mirror is formed at distance 120 cm from the pole of the mirror. These distances are measured with a modified scale in which there are 20 small divisions in 1 cm. The value of error in measurement of focal length of the mirror is  $\frac{1}{K}$  cm. The value of  $K$  is \_\_\_\_\_.

Q28. In Young's double slit experiment, two slits  $S_1$  and  $S_2$  are  $d$  distance apart and the separation from slits to screen is  $D$  (as shown in figure). Now if two transparent slabs of equal thickness 0.1 mm but refractive index 1.51 and 1.55 are introduced in the path of beam  $\lambda = 4000 \text{ Å}$  from  $S_1$  and  $S_2$  respectively. The central bright fringe spot will shift by \_\_\_\_\_ number of fringes.



Q29. A point source of light is placed at the centre of curvature of a hemispherical surface. The source emits a power of 24 W. The radius of curvature of hemisphere is 10 cm and the inner surface is completely reflecting. The force on the hemisphere due to the light falling on it is \_\_\_\_\_  $\times 10^{-8}$  N.

Q30. In a screw gauge, there are 100 divisions on the circular scale and the main scale moves by 0.5 mm on a complete rotation of the circular scale. The zero of circular scale lies 6 divisions below the line of graduation when two studs are brought in contact with each other. When a wire is placed between the studs, 4 linear scale divisions are clearly visible while 46<sup>th</sup> division the circular scale coincide with the reference line. The diameter of the wire is \_\_\_\_\_  $\times 10^{-2}$  mm.

Q31. Match List - I with List - II

LIST-I

(Atomic number)

(A) 37

(B) 78

LIST-II

(Block of periodic table)

I. p-block

II. d-block

- (C) 52 III. f-block  
(D) 65 IV. s-block

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

- (1) A - II, B - IV, C - I, D - III  
(2) A - I, B - III, C - IV, D - II  
(3) A - IV, B - III, C - II, D - I  
(4) A - IV, B - II, C - I, D - III

**Q32.** For  $\text{OF}_2$  molecule consider the following:

- (A) Number of lone pairs on oxygen is 2.  
(B)  $\text{FOF}$  angle is less than  $104.5^\circ$ .  
(C) Oxidation state of O is -2.  
(D) Molecule is bent 'V' shaped.  
(E) Molecular geometry is linear.

**Correct** options are:

- (1) C, D, E only  
(2) B, E, A only  
(3) A, C, D only  
(4) A, B, D only

**Q33.** Match List I with List II

List I (molecules/ions)	List II (No. of lone pairs of $e^-$ on central atom)
----------------------------	--

- |                      |          |
|----------------------|----------|
| (A) $\text{IF}_7$    | I. Three |
| (B) $\text{ICl}_4^-$ | II. One  |
| (C) $\text{XeF}_6$   | III. Two |
| (D) $\text{XeF}_2$   | IV. Zero |

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

- (1) A - II, B - III, C - IV, D - I  
(2) A - IV, B - III, C - II, D - I  
(3) A - II, B - I, C - IV, D - III  
(4) A - IV, B - I, C - II, D - III

**Q34.** The alkaline earth metal sulphate(s) which are readily soluble in water is/are:

- (A)  $\text{BeSO}_4$   
(B)  $\text{MgSO}_4$   
(C)  $\text{CaSO}_4$   
(D)  $\text{SrSO}_4$   
(E)  $\text{BaSO}_4$

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

- (1) A only  
(2) B only  
(3) A and B  
(4) B and C

**Q35.** Lithium aluminium hydride can be prepared from the reaction of

- (1)  $\text{LiCl}$  and  $\text{Al}_2\text{H}_6$   
(2)  $\text{LiH}$  and  $\text{Al}_2\text{Cl}_6$   
(3)  $\text{LiCl}$ ,  $\text{Al}$  and  $\text{H}_2$   
(4)  $\text{LiH}$  and  $\text{AlOH}_3$

**Q36.** Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

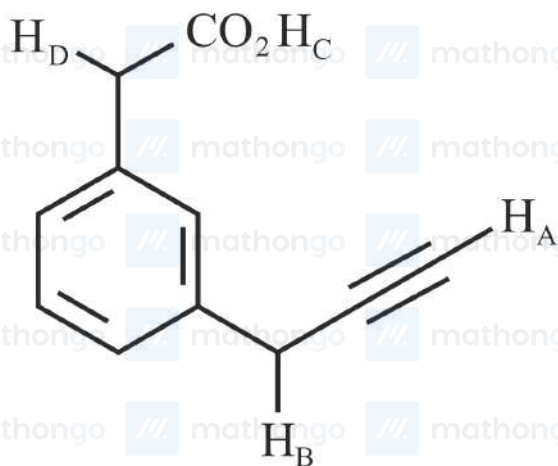
**Assertion (A):** In expensive scientific instruments, silica gel is kept in watch-glasses or in semipermeable membrane bags.

**Reason (R):** Silica gel adsorbs moisture from air via adsorption, thus protects the instrument from water corrosion (rusting) and / or prevents malfunctioning.

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

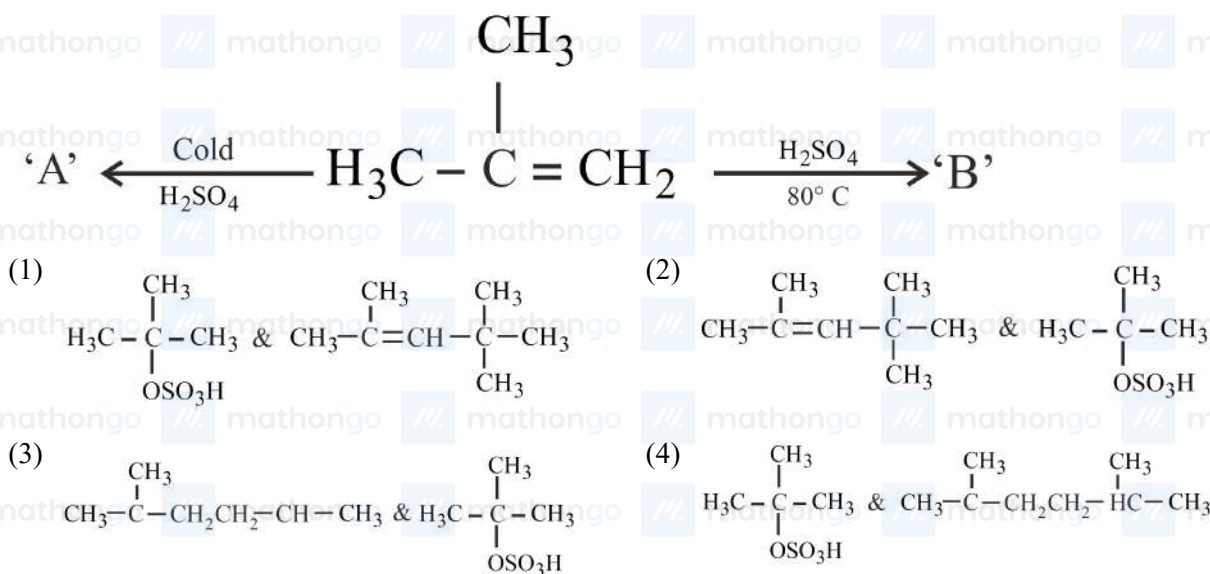
- (1) (A) is false but (R) is true (2) (A) is true but (R) is false  
(3) Both (A) and (R) are true and (R) is the correct explanation of (A) (4) Both (A) and (R) are true but (R) is not the correct explanation of (A)

**Q37.** What is the correct order of acidity of the protons marked A – D in the given compounds?



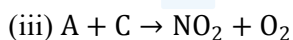
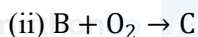
- (1)  $H_C > H_D > H_B > H_A$  (2)  $H_C > H_D > H_A > H_B$   
(3)  $H_D > H_C > H_B > H_A$  (4)  $H_C > H_A > H_D > H_B$

**Q38.** The major products 'A' and 'B', respectively, are

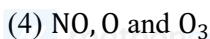
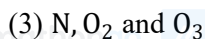
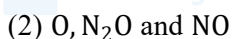
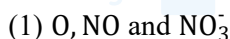
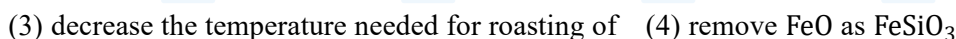
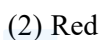
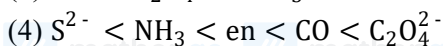
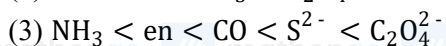
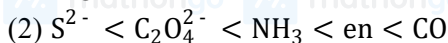
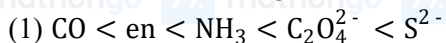
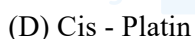
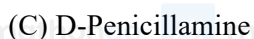


**Q39.** Formation of photochemical smog involves the following reaction in which A, B and C are respectively.

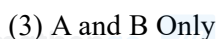
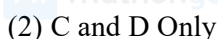
- (i)  $\text{NO}_2 \xrightarrow{h\nu} \text{A} + \text{B}$



Choose the correct answer from the options given below:

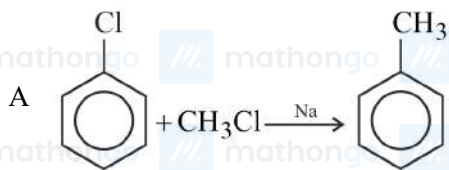
**Q40.** In the extraction of copper, its sulphide ore is heated in a reverberatory furnace after mixing with silica to:**Q41.** During the qualitative analysis of  $SO_3^{2-}$  using dilute  $H_2SO_4$ ,  $SO_2$  gas is evolved which turns  $K_2Cr_2O_7$  solution (acidified with dilute  $H_2SO_4$ ):**Q42.** Which of the following is correct order of ligand field strength?**Q43.** To inhibit the growth of tumours, identify the compounds used from the following:

Choose the correct answer from the option given below:

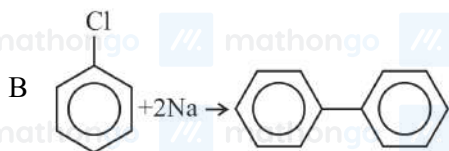
**Q44.** Match List I with List II

List I

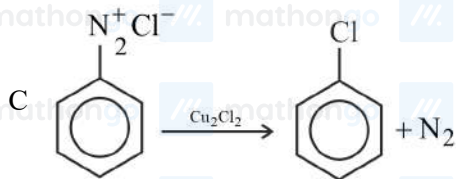
List II



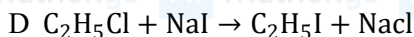
I Fittig reaction



II Wurtz Fittig reaction



III Finkelstein reaction



IV Sandmeyer reaction

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

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

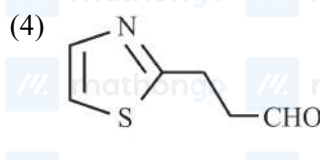
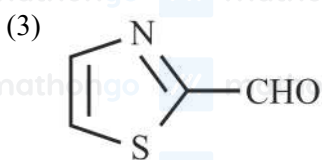
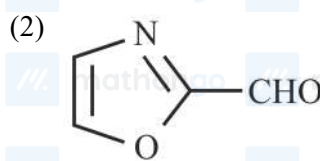
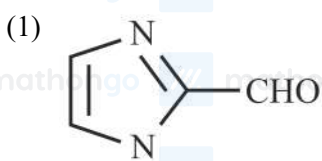
(3) A-IV, B-II, C-III, D-I

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

**Q45.** Which of the following compounds would give the following set of qualitative analysis?

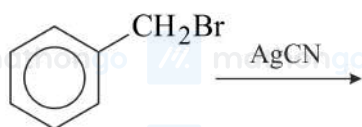
(i) Fehling's Test: Positive

(ii) Na fusion extract upon treatment with sodium nitroprusside gives a blood red colour but not prussian blue.

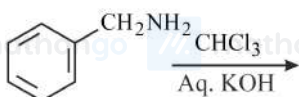


**Q46.** Benzyl isocyanide can be obtained by:

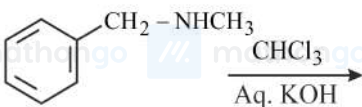
(A)



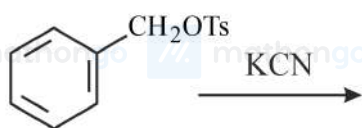
(B)



(C)



(D)



Choose the correct answer from the options given below:

(1) A and D

(3) A and B

(2) Only B

(4) B and C

**Q47.** Caprolactam when heated at high temperature in presence of water, gives

(1) Teflon

(3) Nylon 6, 6

(2) Dacron

(4) Nylon 6

**Q48.** Amongst the following compounds, which one is an antacid?

(1) Ranitidine

(3) Terfenadine

(2) Meprobamate

(4) Brompheniramine

**Q49.** In the wet tests for identification of various cations by precipitation, which transition element cation doesn't belong to group IV in qualitative inorganic analysis?

(1)  $\text{Fe}^{3+}$ (3)  $\text{Co}^{2+}$ (2)  $\text{Zn}^{2+}$ (4)  $\text{Ni}^{2+}$ 

**Q50.** Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

**Assertion (A):** Ketoses give Seliwanoff's test faster than Aldoses.

**Reason (R):** Ketoses undergo  $\beta$ -elimination followed by formation of furfural.

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

(1) (A) is false but (R) is true

(3) (A) is true but (R) is false

(2) Both (A) and (R) are true and (R) is the correct

(4) Both (A) and (R) are true but (R) is not the correct explanation of (A)

**Q51.** The energy of one mole of photons of radiation of frequency  $2 \times 10^{12}$  Hz in  $\text{J mol}^{-1}$  is \_\_\_\_.

(Nearest integer)

(Given:  $h = 6.626 \times 10^{-34}$  Js  $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$ )

**Q52.** When 2 litre of ideal gas expands isothermally into vacuum to a total volume of 6 litre, the change in internal energy is \_\_\_\_ J. (Nearest integer)

**Q53.** 600mL of 0.01M HCl is mixed with 400mL of 0.01M  $\text{H}_2\text{SO}_4$ . The pH of the mixture is  $\times 10^{-2}$ .

(Nearest integer)

[Given  $\log 2 = 0.30$ ,  $\log 3 = 0.48$ ,  $\log 5 = 0.69$ ,  $\log 7 = 0.84$ ,  $\log 11 = 1.04$ ]

**Q54.** A 300mL bottle of soft drink has 0.2M  $\text{CO}_2$  dissolved in it. Assuming  $\text{CO}_2$  behaves as an ideal gas, the volume of the dissolved  $\text{CO}_2$  at STP is \_\_\_\_ mL. (Nearest integer)

Given: At STP, molar volume of an ideal gas is  $22.7 \text{ L mol}^{-1}$ 

**Q55.** A solution containing 2 g of a non-volatile solute in 20 g of water boils at 373.52 K. The molecular mass of the solute is \_\_\_\_  $\text{g mol}^{-1}$ . (Nearest integer)

Given, water boils at 373 K,  $K_b$  for water =  $0.52 \text{ K kg mol}^{-1}$ 

**Q56.** Some amount of dichloromethane  $\text{CH}_2\text{Cl}_2$  is added to 671.141mL of chloroform  $\text{CHCl}_3$  to prepare  $2.6 \times 10^{-3} \text{ M}$  solution of  $\text{CH}_2\text{Cl}_2$  in DCM. The concentration of DCM is \_\_\_\_ ppm (by mass).

Given: Atomic mass : C = 12; H: 1; Cl = 35.5 density of  $\text{CHCl}_3 = 1.49 \text{ g cm}^{-3}$

**Q57.** Consider the cell



When the potential of the cell is 0.712 V at 298 K, the ratio  $\text{Fe}^{2+} / \text{Fe}^{3+}$  is (Nearest integer)

$$\text{Given: } \text{Fe}^{3+} + \text{e}^- = \text{Fe}^{2+}, E^\circ \text{Fe}^{3+}, \text{Fe}^{2+} \mid \text{Pt} = 0.771 \frac{2.303RT}{F} = 0.06 \text{ V}$$

**Q58.** If compound A reacts with B following first order kinetics with rate constant  $2.011 \times 10^{-3} \text{ s}^{-1}$ . The time taken by A (in seconds) to reduce from 7 g to 2 g will be \_\_\_\_\_. (Nearest Integer)

$\log 5 = 0.698, \log 7 = 0.845, \log 2 = 0.301$

**Q59.** The number of electrons involved in the reduction of permanganate to manganese dioxide in acidic medium is \_\_\_\_\_.

**Q60.** A trisubstituted compound 'A',  $\text{C}_{10}\text{H}_{12}\text{O}_2$  gives neutral  $\text{FeCl}_3$  test positive. Treatment of compound 'A' with NaOH and  $\text{CH}_3\text{Br}$  gives  $\text{C}_{11}\text{H}_{14}\text{O}_2$ , with hydroiodic acid gives methyl iodide and with hot conc. NaOH gives a compound B,  $\text{C}_{10}\text{H}_{12}\text{O}_2$ . Compound 'A' also decolorises alkaline  $\text{KMnO}_4$ . The number of  $\pi$  bond/s present in the compound 'A' is \_\_\_\_\_.

**Q61.** If the solution of the equation  $\log_{\cos x} \cot x + 4 \log_{\sin x} \tan x = 1$ ,  $x \in 0, \frac{\pi}{2}$  is  $\sin^{-1} \frac{\alpha + \sqrt{\beta}}{2}$ , where  $\alpha, \beta$  are integers, then  $\alpha + \beta$  is equal to:

- (1) 3 (2) 5  
(3) 6 (4) 4

**Q62.** If  $a_n = \frac{-2}{4n^2 - 16n + 15}$ , then  $a_1 + a_2 + \dots + a_{25}$  is equal to:

- (1)  $\frac{51}{141}$  (2)  $\frac{49}{138}$   
(3)  $\frac{144}{50}$  (4)  $\frac{52}{147}$

**Q63.** If the coefficient of  $x^{15}$  in the expansion of  $ax^3 + \frac{1}{bx^3}$  is equal to the coefficient of  $x^{-15}$  in the expansion of  $ax^{\frac{1}{3}} - \frac{1}{bx^3}$ , where  $a$  and  $b$  are positive real numbers, then for each such ordered pair  $a, b$ :

- (1)  $a = b$  (2)  $ab = 1$   
(3)  $a = 3b$  (4)  $ab = 3$

**Q64.** The coefficient of  $x^{301}$  in  $1 + x^{500} + x + x^{499} + x^2 + x^{498} + \dots + x^{500}$  is:

- (1)  ${}^{501}C_{302}$  (2)  ${}^{500}C_{301}$   
(3)  ${}^{500}C_{300}$  (4)  ${}^{501}C_{200}$

**Q65.** If  $\tan 15^\circ + \frac{1}{\tan 75^\circ} + \frac{1}{\tan 105^\circ} + \tan 195^\circ = 2a$ , then the value of  $a + \frac{1}{a}$  is :

- (1) 4 (2)  $4 - 2\sqrt{3}$   
(3) 2 (4)  $5 - \frac{3}{2}\sqrt{3}$

**Q66.** A straight line cuts off the intercepts  $\text{OA} = a$  and  $\text{OB} = b$  on the positive directions of  $x$ -axis and  $y$ -axis respectively. If the perpendicular from origin  $O$  to this line makes an angle of  $\frac{\pi}{6}$  with positive direction of  $y$ -axis and the

area of  $\triangle OAB$  is  $\frac{98}{3\sqrt{3}}$ , then  $a^2 - b^2$  is equal to:

- (1)  $\frac{392}{3}$  (2) 196  
(3)  $\frac{196}{3}$  (4) 98

**Q67.** Let  $y = x + 2$ ,  $4y = 3x + 6$  and  $3y = 4x + 1$  be three tangent lines to the circle  $(x - h)^2 + (y - k)^2 = r^2$ . Then  $h + k$  is equal to :

- (1) 5 (2)  $5(1 + \sqrt{2})$   
(3) 6 (4)  $5\sqrt{2}$

**Q68.** If  $P(h, k)$  be point on the parabola  $x = 4y^2$ , which is nearest to the point  $Q(0, 33)$ , then the distance of  $P$  from the directrix of the parabola  $y^2 = 4(x + y)$  is equal to:

- (1) 2 (2) 4  
(3) 8 (4) 6

**Q69.** Among the statements:

- $S1: p \vee q \Rightarrow r \Leftrightarrow p \Rightarrow r$   
 $S2: p \vee q \Rightarrow r \Leftrightarrow p \Rightarrow r \vee q \Rightarrow r$

- (1) Only  $(S1)$  is a tautology (2) Neither  $(S1)$  nor  $(S2)$  is a tautology  
(3) Only  $(S2)$  is a tautology (4) Both  $(S1)$  and  $(S2)$  are tautologies

**Q70.** The minimum number of elements that must be added to the relation  $R = (a, b), (b, c)$  on the set  $\{a, b, c\}$  so that it becomes symmetric and transitive is:

- (1) 4 (2) 7  
(3) 5 (4) 3

**Q71.** Let  $A = \begin{pmatrix} m & n \\ p & q \end{pmatrix}$ ,  $d = A \neq 0$  and  $A - d \text{ Adj } A = 0$ . Then

- (1)  $1 + d^2 = m + q^2$  (2)  $1 + d^2 = m + q^2$   
(3)  $1 + d^2 = m^2 + q^2$  (4)  $1 + d^2 = m^2 + q^2$

**Q72.** Let the system of linear equations

$$\begin{aligned} x + y + kz &= 2 \\ 2x + 3y - z &= 1 \\ 3x + 4y + 2z &= k \end{aligned}$$

have infinitely many solutions. Then the system

$$k + 1 \quad x + 2k - 1 \quad y = 7$$

$2k + 1x + k + 5y = 10$  has :

- (1) infinitely many solutions (2) unique solution satisfying  $x - y = 1$   
(3) no solution (4) unique solution satisfying  $x + y = 1$

**Q73.** Suppose  $f: R \rightarrow 0, \infty$  be a differentiable function such that  $5fx + y = fx \cdot fy$ ,  $\forall x, y \in R$ , If  $f^3 = 320$ , then  $\sum_{n=0}^5 fn$  is equal to:

- (1) 6875 (2) 6575  
(3) 6825 (4) 6528

**Q74.** The number of points on the curve  $y = 54x^5 - 135x^4 - 70x^3 + 180x^2 + 210x$  at which the normal lines are parallel to  $x + 90y + 2 = 0$  is:

- (1) 2 (2) 3  
(3) 4 (4) 0

**Q75.** If  $[t]$  denotes the greatest integer  $\leq t$ , then the value of  $\frac{3e-1}{e} \int_1^2 x^2 e^{x+x^3} dx$  is :

- (1)  $e^9 - e$  (2)  $e^8 - e$   
(3)  $e^7 - 1$  (4)  $e^8 - 1$

**Q76.** Let the solution curve  $y = y(x)$  of the differential equation  $\frac{dy}{dx} - \frac{3x^5 \tan^{-1} x^3}{1+x^6} y = 2x \exp \frac{x^3 - \tan^{-1} x^3}{\sqrt{(1+x)^6}}$  pass through

the origin. Then  $y(1)$  is equal to:

- (1)  $\exp \frac{4-\pi}{4\sqrt{2}}$  (2)  $\exp \frac{\pi-4}{4\sqrt{2}}$   
(3)  $\exp \frac{1-\pi}{4\sqrt{2}}$  (4)  $\exp \frac{4+\pi}{4\sqrt{2}}$

**Q77.** If  $\vec{a}$ ,  $\vec{b}$ ,  $\vec{c}$  are three non-zero vectors and  $\hat{n}$  is a unit vector perpendicular to  $\vec{c}$  such that  $\vec{a} = \alpha \vec{b} - \hat{n}$ ,  $\alpha \neq 0$  and  $\vec{b} \cdot \vec{c} = 12$ , then  $\vec{c} \times \vec{a} \times \vec{b}$  is equal to:

- (1) 15 (2) 9  
(3) 12 (4) 6

**Q78.** The line  $l_1$  passes through the point 2, 6, 2 and is perpendicular to the plane  $2x + y - 2z = 10$ . Then the shortest distance between the line  $l_1$  and the line  $\frac{x+1}{2} = \frac{y+4}{3} = \frac{z}{2}$  is:

- (1) 7 (2)  $\frac{19}{3}$   
(3)  $\frac{19}{2}$  (4) 9

**Q79.** Let a unit vector  $\vec{OP}$  make angle  $\alpha, \beta, \gamma$  with the positive directions of the co-ordinate axes OX, OY, OZ respectively, where  $\beta \in (0, \frac{\pi}{2})$ .  $\vec{OP}$  is perpendicular to the plane through points 1, 2, 3, 2, 3, 4 and 1, 5, 7, then which one of the following is true ?

- (1)  $\alpha \in (\frac{\pi}{2}, \pi)$  and  $\gamma \in (\frac{\pi}{2}, \pi)$  (2)  $\alpha \in (0, \frac{\pi}{2})$  and  $\gamma \in (0, \frac{\pi}{2})$   
(3)  $\alpha \in (\frac{\pi}{2}, \pi)$  and  $\gamma \in (0, \frac{\pi}{2})$  (4)  $\alpha \in (0, \frac{\pi}{2})$  and  $\gamma \in (\frac{\pi}{2}, \pi)$

**Q80.** If an unbiased die, marked with -2, -1, 0, 1, 2, 3 on its faces is thrown five times, then the probability that the product of the outcomes is positive, is :

- (1)  $\frac{881}{2592}$  (2)  $\frac{521}{2592}$   
(3)  $\frac{440}{2592}$  (4)  $\frac{27}{288}$

**Q81.** Let  $z = 1 + i$  and  $z_1 = \frac{1 + iz}{\bar{z}(1-z) + \frac{1}{z}}$ . Then  $\frac{12}{\pi} \arg z_1$  is equal to

**Q82.** Number of 4-digit numbers (the repetition of digits is allowed) which are made using the digits 1, 2, 3 and 5, and are divisible by 15, is equal to

**Q83.**  $\sum_{n=0}^{\infty} \frac{n^3((2n)!) + (2n-1)(n!)}{(n!)((2n)!) } = ae + \frac{b}{e} + c$  where  $a, b, c \in \mathbb{Z}$  and  $e = \sum_{n=0}^{\infty} \frac{1}{n!}$ . Then  $a^2 - b + c$  is equal to \_\_\_\_\_

**Q84.** The mean and variance of 7 observations are 8 and 16 respectively. If one observation 14 is omitted,  $a$  and  $b$  are respectively mean and variance of remaining 6 observation, then  $a + 3b - 5$  is equal to \_\_\_\_\_

**Q85.** Let  $S = \{1, 2, 3, 4, 5, 6\}$ . Then the number of oneone functions  $f: S \rightarrow P(S)$ , where  $P(S)$  denote the power set of  $S$ , such that  $f(n) \subset f(m)$  where  $n < m$  is \_\_\_\_\_

**Q86.** Let  $f^1 x = \frac{3x+2}{2x+3}, x \in \mathbb{R} - \frac{3}{2}$ . For  $n \geq 2$ , define  $f^n x = f^1 \circ f^{n-1} x$ . If  $f^5 x = \frac{ax+b}{bx+a}$ ,  $\gcd a, b = 1$ , then  $a + b$  is equal to \_\_\_\_\_

**Q87.**  $\lim_{x \rightarrow 0} \frac{48}{x^4} \int_0^x \frac{t^3}{t^6 + 1} dt$  is equal to \_\_\_\_\_

**Q88.** Let  $\alpha$  be the area of the larger region bounded by the curve  $y^2 = 8x$  and the lines  $y = x$  and  $x = 2$ , which lies in the first quadrant. Then the value of  $3\alpha$  is equal to \_\_\_\_\_

**Q89.** If the equation of the plane passing through the point  $(1, 1, 2)$  and perpendicular to the line  $x - 3y + 2z - 1 = 0 = 4x - y + z$  is  $Ax + By + Cz = 1$ , then  $140(C - B + A)$  is equal to \_\_\_\_\_

**Q90.** If  $\lambda_1 < \lambda_2$  are two values of  $\lambda$  such that the angle between the planes  $P_1: \vec{r} \cdot (3\hat{i} - 5\hat{j} + \hat{k}) = 7$  and  $P_2: \vec{r} \cdot (\lambda\hat{i} + \hat{j} - 3\hat{k}) = 9$  is  $\sin^{-1} \frac{2\sqrt{6}}{5}$ , then the square of the length of perpendicular from the point  $38\lambda_1, 10\lambda_2, 2$  to the plane  $P_1$  is \_\_\_\_\_

## ANSWER KEYS

1. (2)	2. (1)	3. (3)	4. (3)	5. (4)	6. (2)	7. (1)	8. (3)
9. (4)	10. (4)	11. (4)	12. (4)	13. (4)	14. (3)	15. (2)	16. (4)
17. (2)	18. (4)	19. (4)	20. (2)	21. (50)	22. (3)	23. (8)	24. (225)
25. (2)	26. (30)	27. (32)	28. (10)	29. (4)	30. (220)	31. (4)	32. (4)
33. (2)	34. (3)	35. (2)	36. (3)	37. (2)	38. (1)	39. (4)	40. (4)
41. (3)	42. (2)	43. (1)	44. (4)	45. (4)	46. (3)	47. (4)	48. (1)
49. (1)	50. (3)	51. (798)	52. (0)	53. (186)	54. (1362)	55. (100)	56. (148)
57. (10)	58. (623)	59. (3)	60. (4)	61. (4)	62. (3)	63. (2)	64. (4)
65. (1)	66. (1)	67. (1)	68. (4)	69. (2)	70. (2)	71. (1)	72. (4)
73. (3)	74. (3)	75. (2)	76. (1)	77. (3)	78. (4)	79. (1)	80. (2)
81. (9)	82. (21)	83. (26)	84. (37)	85. (3240)	86. (3125)	87. (12)	88. (22)
89. (15)	90. (315)						