

(1001CJA101021240038)



CLASSROOM CONTACT PROGRAMME
(Academic Session : 2024 - 2025)

Test Pattern

JEE(Main)
FULL SYLLABUS
15-01-2025

JEE(Main+Advanced) : ENTHUSIAST & LEADER COURSE (SCORE-I)

Time : 3 Hours

PAPER (OPTIONAL)

Maximum Marks : 300

IMPORTANT NOTE : Students having 8 digits **Form No.** must fill two zero before their Form No. in OMR. For example, if your **Form No.** is 12345678, then you have to fill **0012345678**.

READ THE INSTRUCTIONS CAREFULLY

Important Instructions :

1. Immediately fill in the form number on this page of the Test Booklet with Blue/Black Ball Point Pen. Use of pencil is strictly prohibited.
2. The candidates should not write their Form Number anywhere else (except in the specified space) on the Test Booklet/Answer Sheet.
3. The Test Booklet consists of **75** questions.
4. There are **three** parts in the question paper 1,2,3 consisting of **Physics, Chemistry and Mathematics** having **25 questions** in each subject and each subject having **Two sections**.
 - (i) Section-I contains 20 multiple choice questions with **only one correct** option.
Marking scheme : +4 for correct answer, 0 if not attempted and -1 in all other cases.
 - (ii) Section-II contains 05 **Numerical Value Type** questions.
Marking scheme : +4 for correct answer, 0 if not attempted and -1 in all other cases.
5. No candidate is allowed to carry any textual material, printed or written, bits of papers, mobile phone any electronic device etc, except the Identity Card inside the examination hall/room.
6. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
7. On completion of the test, the candidate must hand over the Answer Sheet to the invigilator on duty in the Room/Hall. **However, the candidate are allowed to take away this Test Booklet with them.**
8. **Do not fold or make any stray marks on the Answer Sheet.**
9. **Take $g = 10 \text{ m/s}^2$ unless otherwise stated.**

Name of the Candidate (in Capitals) _____

Form Number : in figures _____

: in words _____

Centre of Examination (in Capitals) : _____

Candidate's Signature : _____ Invigilator's Signature : _____

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SECTION-I : (Maximum Marks: 80)

This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

Full Marks : +4 If correct answer is selected.

Zero Marks : 0 If none of the option is selected.

Negative Marks : -1 If wrong option is selected.

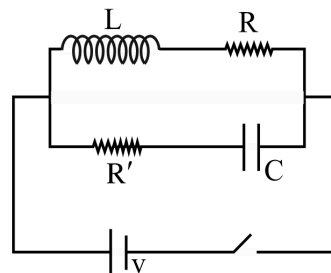
1. In a half wave rectifier the average output voltage in a cycle is V , then in a full wave rectifier with same peak output voltage, the rms voltage in a cycle will be :-

- (A) $\frac{\pi V}{\sqrt{2}}$
 (B) $\frac{\pi V}{2}$
 (C) $\frac{\pi V}{2\sqrt{2}}$
 (D) $\sqrt{2}\pi V$

2. The α -decay of a certain nucleus X^{230} is followed by emission of two groups of α -particles - one group having α -particles of kinetic energy 6.8 MeV while the other having α -particles of kinetic energy 5.2 MeV. Following the emission of these particles the daughter nuclei are found in ground and excited states. The energy of gamma photon emitted is :-

- (A) 1.43 MeV
 (B) 1.53 MeV
 (C) 1.63 MeV
 (D) 1.73 MeV

3. At $t = 0$, switch is closed. Current through cell is found to be independent of time. Then



- (A) $R' = 2R$ and $R = \sqrt{\frac{L}{2C}}$
 (B) $R' = 2R$ and $R = \sqrt{\frac{L}{C}}$
 (C) $R' = R$ and $R = \sqrt{\frac{L}{2C}}$
 (D) $R' = R$ and $R = \sqrt{\frac{L}{C}}$

- 4.

	Column-I		Column-II
(A)	Diverging lens	(P)	Focal length does not change on dipping in water.
(B)	Converging lens	(Q)	Always forms a virtual, erect and diminished image of a real object.
(C)	Concave mirror	(R)	Can form virtual, erect and magnified image of a real object.
(D)	Convex mirror	(S)	Can form real, inverted and diminished image of a real object.

- (A) A-RS, B-PRS, C-PQ, D-Q
 (B) A-Q, B-RS, C-PQ, D-PRS
 (C) A-Q, B-RS, C-PRS, D-PQ
 (D) A-RS, B-Q, C-PRS, D-PQ

5. An electron with initial kinetic energy of 100eV is accelerated through a potential difference of 50V such that its speed increases. Now the de-Broglie wavelength of electron becomes:

(A) 1\AA (B) $\sqrt{1.5}\text{\AA}$
(C) $\sqrt{3}\text{\AA}$ (D) 12.27\AA

6. An electromagnetic wave of frequency 1×10^{14} Hz is propagating along z-axis. The amplitude of electric field is 4 V/m. If $\epsilon_0 = 8.8 \times 10^{-12} \text{ C}^2/\text{N} - \text{m}^2$, then average energy density of electric field will be :

(A) $35.2 \times 10^{-10} \text{ J/m}^3$
(B) $35.2 \times 10^{-11} \text{ J/m}^3$
(C) $35.2 \times 10^{-12} \text{ J/m}^3$
(D) $35.2 \times 10^{-13} \text{ J/m}^3$

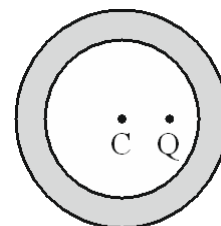
7. A spherical drop of radius r and density n is falling in air with terminal velocity. The density of air is n_0 and its coefficient of viscosity μ . The power developed by gravity is

(A) $\frac{\pi r^5 n}{\mu} (n - n_0) g^2$
(B) $\frac{\pi r^5}{2\mu} n (n - n_0)$
(C) $\frac{27}{8\mu} r^5 n (n - n_0) g^2$
(D) $\frac{8\pi r^5}{27\mu} n (n - n_0) g^2$

8. Find distance of a planet from sun if its period of revolution is $3\sqrt{3}$ years. The distance between sun and earth is $1.5 \times 10^8 \text{ km}$.

(A) $4.5 \times 10^8 \text{ km}$ (B) $3.0 \times 10^8 \text{ km}$
(C) $4.5 \times 10^8 \text{ m}$ (D) $6.0 \times 10^7 \text{ m}$

9. Electric force acting on a point charge $+Q$ placed inside a thin metallic uncharged spherical shell, but not at its centre (as shown in figure) is



(A) Zero
(B) directed in rightward direction
(C) directed in leftward direction
(D) direction can't be determined

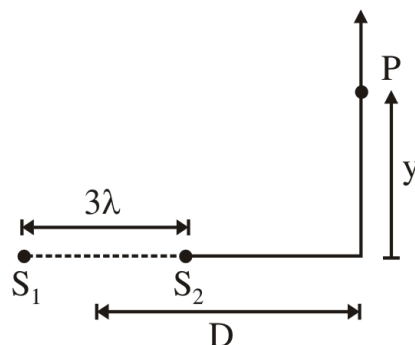
10. One mole of Argon undergoes a process given by $PV^{3/2} = \text{constant}$. If heat obtained by gas is Q and molar specific heat in the process in C , then which of the following is correct if temperature of gas changes by -26K ? ($R \rightarrow$ gas constant)

(A) $C = 0.5 R$, $Q = 13R$
(B) $C = -0.5 R$, $Q = 15R$
(C) $C = -0.5 R$, $Q = 13R$
(D) $C = 0$, $Q = 13R$

11. An open organ pipe of length ℓ is vibrating in its third overtone with maximum pressure amplitude is P_0 . The pressure amplitude at a distance $\frac{\ell}{16}$ from one end is (neglect end correction)

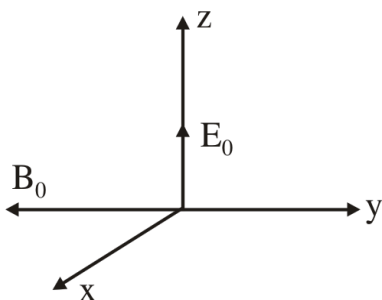
(A) $\frac{P_0}{2}$ (B) $\frac{P_0}{\sqrt{2}}$
(C) $\frac{\sqrt{3}P_0}{2}$ (D) 0

12. A whistle of frequency 1300 Hz is dropped from a height $H = 505$ m above the ground. At the same time a detector is projected upward with velocity 50 m/s along the same line. If velocity of sound is 300 m/s, frequency of sound detected by detector after $t = 5$ sec is $[g = 10 \text{ m/s}^2]$
- (A) 1600 Hz
(B) 1500 Hz
(C) 1700 Hz
(D) 1800 Hz
13. A body of mass 'm', suspended by a string of length ' ℓ_1 ' is given a minimum velocity at its bottom to complete vertical loop successfully. At its highest point it collides elastically with another bob of same mass suspended by light rod of length ℓ_2 , which is initially at rest. If the second bob will also just be able to complete the vertical loop, then $\frac{\ell_1}{\ell_2}$ is :-
- (A) 5 (B) 4
(C) 3 (D) 2
14. The work function of a metal is 3 eV and wavelength of subjected radiation to the metal is 275 nm. Then the de-Broglie's wavelength (in Å) of photoelectrons emitted by the metal is nearly (Given : $hc = 1240 \text{ eV} - \text{nm}$)
- (A) 1.5
(B) 1
(C) 10
(D) 100
15. Suppose the price of a radioactive substance is directly proportional to the activity of radioactive sample. If initial price of radioactive sample ($t_{1/2} = 6$ months) is Rs 4096, then price of radioactive sample after 5 years will be :
- (A) Rs 4
(B) Rs 8
(C) Rs 16
(D) Rs 4096
16. Figure shows two coherent microwave sources S_1 and S_2 emitting waves of wavelength λ and separated by a distance 3λ . The minimum non-zero value of y for point P to be an intensity maximum is ($D \gg \lambda$)



- (A) D
(B) $\sqrt{3}D$
(C) $\frac{\sqrt{5}}{2}D$
(D) None of these

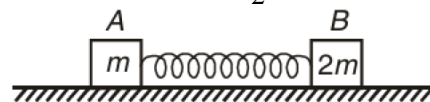
17. A particle of mass m and charge q is released from rest at the origin as shown in figure. The speed of the particle when it has travelled a distance d along the z axis is given by:



- (A) $\sqrt{\frac{2qE_0d}{m}}$
 (B) $\sqrt{\frac{E_0d}{B_0}}$
 (C) $\sqrt{\frac{m}{qE_0d}}$
 (D) $\sqrt{\frac{2m}{qE_0d}}$
18. The current density J inside a long, solid cylindrical wire of radius a is along central axis and its magnitude varies linearly with r as $J = J_0 \frac{r}{a}$. The magnetic field at $r = \frac{a}{2}$ is:

- (A) $\frac{\mu_0 J_0 a}{3}$
 (B) $\frac{\mu_0 J_0 a}{6}$
 (C) $\frac{\mu_0 J_0 a}{9}$
 (D) $\frac{\mu_0 J_0 a}{12}$

19. In the given figure mass of block A is m and that of B is $2m$. They are attached at the ends of a spring and kept on a smooth horizontal surface. Now, the spring is compressed by x_0 and released. Find displacement of block B by the time compression of the spring is reduced to $\frac{x_0}{2}$:



- (A) $\left(\frac{x_0}{3}\right)$
 (B) $\left(\frac{x_0}{2}\right)$
 (C) $\left(\frac{x_0}{6}\right)$
 (D) $\left(\frac{x_0}{4}\right)$
20. **Statement-1** : A conducting sphere cannot be charged beyond a definite potential.
 and
Statement-2 : Dielectric strength of the medium surrounding conductor does not allow infinite charge.
- (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
 (B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
 (C) Statement-1 is True, Statement-2 is False.
 (D) Statement-1 is False, Statement-2 is True.

SECTION-II : (Maximum Marks: 20)

This section contains 05 questions.

The answer to each question is a **Numerical Value**.

For each question, enter the correct integer value (In case of non-integer value, the answer should be rounded off to the nearest Integer).

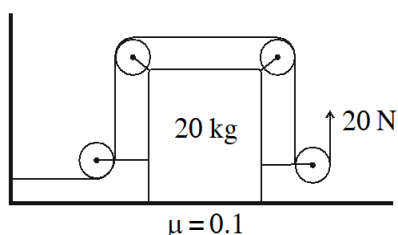
Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If correct answer is entered.

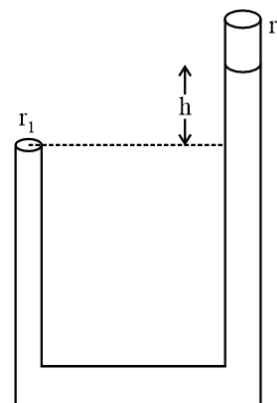
Zero Marks : 0 If the question is unanswered.

Negative Marks : -1 If wrong answer is entered.

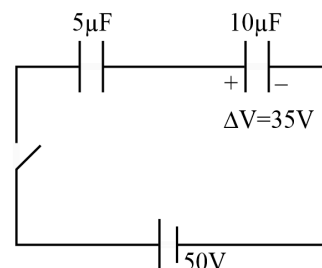
- In optical bench experiment index error is +1 cm and -1 cm between object needle and lens, lens and image needle respectively. Observed values of u and v are 9 cm and 17 cm. The focal length of lens is $\frac{x}{13}$ cm, then find the value of x .
- For the situation shown in the figure determine the acceleration (cm/s^2) of the block. ($g = 10 \text{ m/s}^2$)



- Figure shows two connected capillary tubes of radii r_1 and r_2 respectively. Water is slowly poured into the right tube. Contact angle of water is 0° , T is its surface tension, ρ is density of water. 'h' indicates the height difference between the water levels in the tubes when it is about to flow out of the left tube. Find h (in mm).
Take $r_1 = 0.1 \text{ mm}$, $r_2 = 0.2 \text{ mm}$, $T = 0.075 \text{ N/m}$,
 $\rho = 10^3 \text{ kg/m}^3$, $g = 10 \text{ m/s}^2$



- A cord of length 64 km is used to connect a 100 kg astronaut to spaceship whose mass is much larger than that of the astronaut. Assume that the spaceship is orbiting near earth surface. Assume that the spaceship and the astronaut fall on a straight line from the earth centre. The radius of the earth is 6400 km. If tension in the cord is X newton, then find the value of $1000 X$ (take acceleration due to gravity on the surface of earth as 10 m/s^2).
- A $10 \mu\text{F}$ capacitor is charged to 35 volt. It is next connected in series with an uncharged $5.00 \mu\text{F}$ capacitor. The combination is finally connected across a 50V battery as shown. Find new potential difference (in volt) across $5 \mu\text{F}$ capacitor



SECTION-I : (Maximum Marks: 80)

This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

Full Marks : +4 If correct answer is selected.

Zero Marks : 0 If none of the option is selected.

Negative Marks : -1 If wrong option is selected.

- Consider four solutions given below :
 Solution A : 0.1 mole urea dissolved in 1000 mL water.
 Solution B : 0.01 mole glucose dissolved in 100 mL water.
 Solution C : 0.1 mole NaCl dissolved in 1000 mL water.
 Solution D : 0.01 mole CaCl_2 dissolved in 100 mL water.
 Which solution will have highest osmotic pressure at 27°C ? (Consider complete dissociation of electrolytes in the solution and ignore change in volume on dissolving solute in solvent.)
 (A) Solution A (B) Solution B
 (C) Solution C (D) Solution D
- A saturated aqueous solution of $\text{Fe}(\text{OH})_3$ has a conductivity of $7.5 \times 10^{-4} \text{ Sm}^{-1}$. What is the solubility of $\text{Fe}(\text{OH})_3$ in a 0.5 molar solution of NaOH ?
 (Given that limiting equivalent conductivities are
 $\lambda_{\text{eq}}^\circ = 1.4 \times 10^{-2} \text{ Sm}^2 \text{eq}^{-1}$ for FeCl_3 ,
 $\lambda_{\text{eq}}^\circ = 1.1 \times 10^{-2} \text{ Sm}^2 \text{eq}^{-1}$ for NaCl,
 $\lambda_{\text{eq}}^\circ = 2.2 \times 10^{-2} \text{ Sm}^2 \text{eq}^{-1}$ for NaOH)
 (A) $2.16 \times 10^{-19} \text{ mol L}^{-1}$
 (B) $2.16 \times 10^{-17} \text{ mol L}^{-1}$
 (C) $2.16 \times 10^{-20} \text{ mol L}^{-1}$
 (D) $2.16 \times 10^{-18} \text{ mol L}^{-1}$

- Given below are two statements.

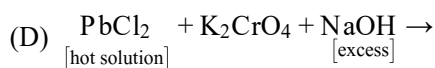
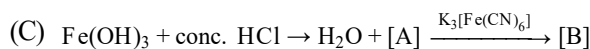
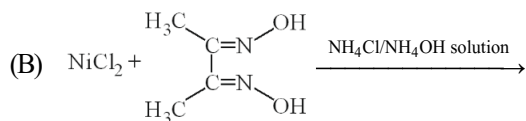
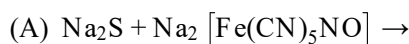
Statement-1: Rate of all chemical reactions (both exothermic and endothermic reactions) increases on increasing the temperature.

Statement-2: On increasing temperature, the rate constant of exothermic reaction decreases whereas endothermic reaction increases.

- Both statement-1 and statement-2 are true.
 - Statement-1 is true but statement-2 is false.
 - Both statement-1 and statement-2 are false.
 - Statement-1 is false but statement-2 is true.
- N_2 and H_2 react to form NH_3 according to the reaction $\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3$. What is the mass of NH_3 formed when 2 mole of N_2 completely react with excess amount of H_2 ?
 (A) 34 g (B) 68 g (C) 17 g (D) 86 g
 - The frequency of certain line of the Lyman series ($n_2 = 4$ to $n_1 = 1$) of the atomic spectrum of hydrogen can not satisfy the following conditions.
 (A) It is the sum of the frequencies of a Lyman line and a Balmer line.
 (B) It is the sum of the frequencies of a certain Lyman line, a Balmer line and a Brackett line.
 (C) It is the sum of the frequencies of a Lyman line, a Balmer line and a Paschen line.
 (D) It is the sum of the frequencies of a Lyman and a Paschen line.

6. Select the correct statement for the reversible reaction $A(g) \rightleftharpoons B(g)$. Assuming constant P and T conditions :
- (A) The reaction proceeds in both direction spontaneously as the reaction in both direction proceeds with decrease in standard free energy (G°).
- (B) $\Delta_r G^\circ$ must be zero for the reversible reaction at equilibrium point.
- (C) At equilibrium, Gibbs free energy of the reaction mixture must be zero.
- (D) At equilibrium, Gibbs free energy of the reaction mixture becomes minimum.
7. 0.5 moles of NaOH is added to 2 litre of solution containing 0.2 M HCl and 0.25 M HCN. pH of resulting solution is $[K_a(\text{HCN}) = 10^{-10}]$, $[\log 2 = 0.3]$
- (A) 9.4 (B) 9.7
(C) 10.3 (D) 4.6
8. Which of the following statements is correct ?
- (A) Potassium ferricyanide obeys EAN rule and it give orange ppt. with AgNO_3 .
- (B) Cyanocobalamin is used to treat pernicious anaemia factor and it give blue bead in borax bead test.
- (C) VBT can distinguish between weak and strong ligands accurately.
- (D) $[\text{Co}(\text{EDTA})]^-$ contain five 5-membered ring and it is optically inactive.
9. Which of the following is true ?
- (A) Amongst noble gases, addition of electron is the easiest for Rn.
- (B) First electron gain enthalpy is endothermic for element having configuration $[\text{Ne}]3s^2 3p^3$.
- (C) Amongst Li^- , Be^- , B^- , C^- , the least stable is Be^- .
- (D) First electron gain enthalpy is less exothermic for Te than O.
10. Choose the incorrect statement.
- (A) $\text{Ti}^{+2}(\text{aq})$ can liberate hydrogen gas from 1M dilute acid
- (B) $E^\circ_{\text{Sc}^{+3}/\text{Sc}}$ is low due to stability of Sc^{3+} .
- (C) $E^\circ_{\text{Ni}^{+2}/\text{Ni}}$ is more negative than expected value due to low ionization energy.
- (D) Low value for $E^\circ_{\text{Fe}^{+3}/\text{Fe}^{+2}}$ attributed to extra stability of Fe^{+3} .
11. Which of the following options is correct -
- (A) Lanthanoid contraction is greater from element to element than actinoid contraction.
- (B) Lanthanoids can achieve higher oxidation state more easily as compare to actinoid.
- (C) Pr^{+3} , Er^{+3} , Ce^{+4} ions produces colourless aquated ion.
- (D) On reaction with boiling water actinide gives a mixture of oxide & hydride.

12. In which of the following reactions a coloured precipitate will be obtained in aqueous solution.

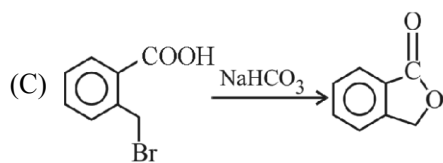
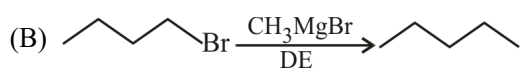
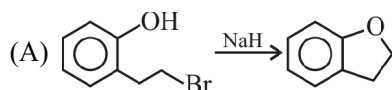


13. **Assertion** : Bonding molecular orbital is formed from constructive interference while antibonding molecular orbital form from destructive interference of atomic orbitals.

Reason : In constructive interference same phase overlap takes place while in destructive interference opposite phase overlap take place.

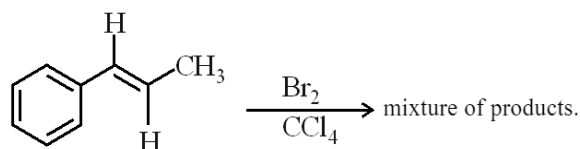
- (A) Both Assertion and Reason are correct
(B) Assertion is incorrect and Reason is correct.
(C) Assertion is correct but Reason is incorrect
(D) Both Assertion and Reason are incorrect

14. Which of the following is correct?



(D) All of them

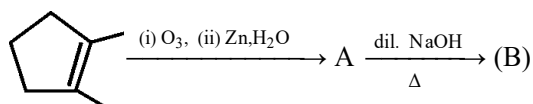
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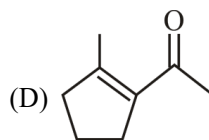
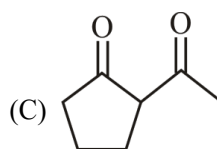
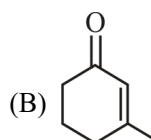
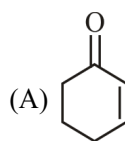
Correct statement about the mixture and products formed is

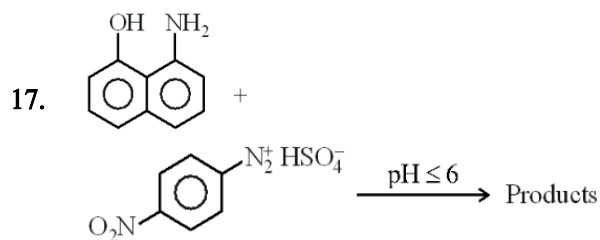
- (A) The mixture will be optically inactive due to formation of a meso compound.
(B) One enantiomeric pair will be formed as the major product due to anti addition.
(C) In the major product benzene ring has at least one -Br as substituent.
(D) Free radical is present as intermediate.

16.

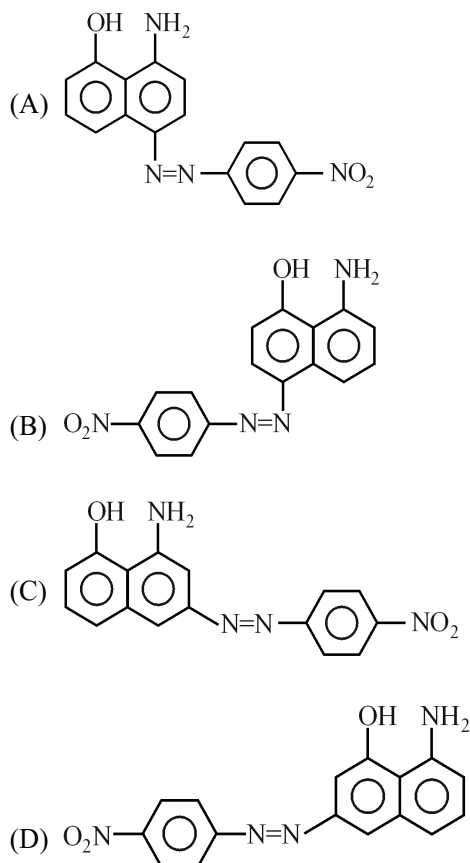


Major product (B) is :





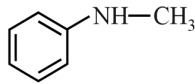
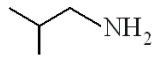

Which of the following product will have highest percentage in the product mixture?



18. Which of the following statement is not correct for isoelectronic point (pI) ?

- (A) Solubility of an amino acid is at its minimum at pI.
 (B) Aspartic acid has a lower pI than glycine.
 (C) Amino acid exist with no charge at pI
 (D) Basic amino acid exist in cationic form at pH = 7

19. Consider the following amines :

- (a) $\text{CH}_3\text{CH}_2 - \text{NH}_2$ (b) $\text{CH}_3 - \text{NH} - \text{CH}_3$
 (c) $(\text{C}_2\text{H}_5)_3\text{N}$ (d) PhNH_2
 (e)  (f) 
 (g) 

Find (X + Y + Z) where

X = No. of amines give foul smelling poisonous gas when treated with CHCl_3/KOH .

Y = No. of amines produce oily yellow coloured nitroso compound when treated with aq. HNO_2

Z = No. of amines after reacting with $\text{Ph-SO}_2\text{Cl}$, the product will be soluble in aq. KOH .

- (A) 3 (B) 6 (C) 9 (D) 12

20. How many of the following pairs can be differentiated with both acidic $\text{K}_2\text{Cr}_2\text{O}_7$ and aqueous NaOI .

- (i) $\text{CH}_3\text{CH}_2\text{OH}$ and $\text{CH}_3 - \overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}} - \text{OH}$
 (ii) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ and $\text{CH}_3\text{CH}_2\text{OH}$
 (iii) CH_3CHO and CH_3COCH_3
 (iv) CH_3COCH_3 and HCOOH
 (v) $\text{CH}_3\text{CH}_2\text{OH}$ and CH_3COCH_3
 (vi) $\text{CH}_3 - \underset{\text{OH}}{\text{CH}} - \text{CH}_3$ and CH_3COCH_3
 (vii) $\text{CH}_3 - \underset{\text{OH}}{\text{CH}} - \text{CH}_3$ and $\text{CH}_3 - \overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}} - \text{OH}$
 (viii) CH_3CHO and $\text{CH}_3 - \overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}} - \text{OH}$
- (A) 2 (B) 4 (C) 6 (D) 8

SECTION-II : (Maximum Marks: 20)

This section contains 05 questions.

The answer to each question is a **Numerical Value**.

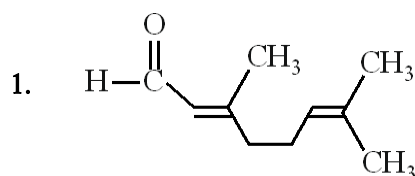
For each question, enter the correct integer value (In case of non-integer value, the answer should be rounded off to the nearest Integer).

Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If correct answer is entered.

Zero Marks : 0 If the question is unanswered.

Negative Marks : -1 If wrong answer is entered.



If IUPAC name of the above compound is

A, B-dimethylocta - C, D - dienal

What is value of (A + B + C + D)?

2. Let E_{cell} for $\text{Zn} \left| \text{ZnSO}_4 (0.1 \text{ M}) \right| \left| \text{HCl} (1 \text{ M}) \right| \text{H}_2 (1 \text{ bar}) \left| \text{Pt} \right.$ be E_1 and E_{cell} for the same cell after addition of 36 g NaOH per litre of electrolyte to the cathode compartment be E_2 . Then $100 \times |E_2 - E_1|$ is nearly [Atomic mass : Na = 23]

3. How many of the following (A to G) will give a silver mirror with Tollen's reagent?

- (i) D-Glucose
- (ii) D-Fructose
- (iii) D-Mannose
- (iv) D-Galactose
- (v) Sucrose
- (vi) Maltose
- (vii) Lactose

4. In which of the following reactions paramagnetic gas will form as one of the product.

- (i) $\text{Ag}_2\text{O}_{(s)} \xrightarrow{\Delta}$
- (ii) $\text{KClO}_{3(s)} \xrightarrow[\text{MnO}_2]{\Delta}$
- (iii) $\text{Pb}_3\text{O}_{4(s)} \xrightarrow{\Delta}$
- (iv) $\text{Pt} + \text{HNO}_3 + 3\text{HCl} \rightarrow$
- (v) $\text{KMnO}_4 \xrightarrow{\Delta}$
- (vi) $\text{NaNO}_{2(s)} + \text{dil. H}_2\text{SO}_4 \xrightarrow{\Delta}$

5. $\text{NaNO}_2 +$ $+ 1\text{-Naphthyl amine} \rightarrow \text{Red azodye (x)}$
- Number of nitrogen atoms present in one molecule of X is

SECTION-I : (Maximum Marks: 80)

This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

Full Marks : +4 If correct answer is selected.

Zero Marks : 0 If none of the option is selected.

Negative Marks : -1 If wrong option is selected.

- One diagonal of a square is the portion of the line $37x + 73y = 2701$, intercepted between the coordinate axes and L_1, L_2 are the lengths of the perpendiculars drawn from the vertices of the other diagonal on the y-axis, then $\left(\frac{L_1 + L_2}{2}\right)$ is equal to
(A) 55
(B) 18
(C) 36.5
(D) 18.5
- Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a real valued function such that $f(x) = \begin{cases} -x^3 - 5x + 50, & x \leq 0 \\ -3x e^x + \lambda & x > 0 \end{cases}$ be a surjective function, then the number of integral values of λ in $[0, 100]$ is equal to
(A) 101
(B) 50
(C) 51
(D) 100

- Let PQ be any chord of the circle $x^2 + y^2 = 36$ which subtends an angle of 90° at the point $A(3, 4)$, then
Assertion (A) : The locus of the mid point of PQ is a circle whose centre is $(3, 2)$.
Reason (R) : Equation of the chord of the circle $S = 0$, which is bisected at $P(x_1, y_1)$ is $T = S_1$.
(A) Both **A** and **R** are correct and **R** is the correct explanation of **A**
(B) Both **A** and **R** are correct but **R** is **NOT** the correct explanation of **A**
(C) **A** is correct but **R** is not correct
(D) **A** is not correct but **R** is correct
- If sum of the coefficients in the expansion of $(2x + 3y - 2z)^n$ is 2187 then the coefficient of x^6 in the expansion of $(1 + 2x^3)^{n-1} (1 - x)^{-3}$ is equal to
(A) 228
(B) 170
(C) 198
(D) 208
- The value of the expression $\sum_{n=1}^{\infty} \tan^{-1} \left(\frac{1}{2^n + 2^{1-n}} \right)$ is equals to λ then the value of $\sin^{-1}(\sin 3\lambda)$ is equal to
(A) $\frac{\pi}{2}$
(B) $\frac{\pi}{4}$
(C) $\frac{\pi}{6}$
(D) $\frac{\pi}{3}$

6. Let $\vec{a}, \vec{b}, \vec{c}$ are three vectors of which every pair is non collinear, and the vectors $\vec{a} + 3\vec{b}$ and $2\vec{b} + 3\vec{c}$ are collinear with \vec{c} and \vec{a} respectively. If $\vec{b} \cdot \vec{b} = 1$, then the value of $|2\vec{a} + 3\vec{b} + 9\vec{c}|$ is equal to

(A) 2 (B) 4 (C) 5 (D) 3

7. Let a tetrahedron ABCD whose vertex A is at origin and B, C lies on line $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z}{-1}$ such that vertices A, B & C form an equilateral triangle. Vertex D lies on $(x-1)^2 + (y-5)^2 + z^2 \leq 0$. Then the volume of tetrahedron ABCD is equal to

(A) $\frac{11}{32}\sqrt{3}$
 (B) $\frac{5}{16}\sqrt{3}$
 (C) $\frac{1}{18}\sqrt{15}$
 (D) $\frac{7}{36}\sqrt{15}$

8. Two cards from a pack of 52 cards are lost, from the remaining cards of pack, two cards are drawn and are found to be both Ace. Then the probability of the lost card being at least one Ace is equal to

(A) $\frac{97}{1225}$
 (B) $\frac{31}{196}$
 (C) $\frac{51}{215}$
 (D) $\frac{13}{108}$

9. Consider a differential equation is a

$$\frac{dy}{dx} = \frac{-2a^2xy \cos(a^2x^2) - bx^{b-1} \cos y}{\sin(a^2x^2) - x^b \sin y}$$

In list-I values of a & b are given and in list-II is corresponding solution of differential equation

	List-I		List-II (c is integration constant)
(A)	a = 0, b = 1	(I)	$y \sin(x^2) + \cos y = c$
(B)	b = 0, a = 1	(II)	$y \sin(x^2) + x \cos y = c$
(C)	a = 1, b = 1	(III)	$x \cos y = c$
(D)	a = 0, b = -1	(IV)	$\frac{\cos y}{x} = c$

(A) A \rightarrow (III), B \rightarrow (I), C \rightarrow (II), D \rightarrow (IV)

(B) A \rightarrow (II), B \rightarrow (IV), C \rightarrow (III), D \rightarrow (I)

(C) A \rightarrow (I), B \rightarrow (II), C \rightarrow (III), D \rightarrow (IV)

(D) A \rightarrow (II), B \rightarrow (IV), C \rightarrow (I), D \rightarrow (III)

10. Let R be a relation from A = {2,3,4,5} to B = {3,6,7,10} defined by R = {(a,b) | a divides b, a \in A, b \in B}, then number of elements in R⁻¹ will be-

(A) 0
 (B) 3
 (C) 4
 (D) 5

11. If mean and sum of n -terms of an increasing sequence are 19 and $\frac{3n^2}{2} - \frac{n}{2}$ respectively, then the variance is equal to
(A) 130
(B) 128
(C) 126
(D) 132
12. If $\Delta(\alpha, \beta, \gamma) = \begin{vmatrix} 3\alpha^2 & \alpha^2 + \alpha\beta + \beta^2 & \alpha^2 + \alpha\gamma + \gamma^2 \\ \alpha^2 + \alpha\beta + \beta^2 & 3\beta^2 & \beta^2 + \beta\gamma + \gamma^2 \\ \alpha^2 + \alpha\gamma + \gamma^2 & \beta^2 + \beta\gamma + \gamma^2 & 3\gamma^2 \end{vmatrix}$ and α, β, γ are distinct prime numbers, then the minimum value of $|\Delta(\alpha, \beta, \gamma)|$ is
(A) 25
(B) 49
(C) 16
(D) 36
13. Let C be the largest circle centred at $(1, 0)$ and inscribed in the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$, then the area of C is
(A) $\frac{125\pi}{9}$
(B) $\frac{128\pi}{9}$
(C) $\frac{120\pi}{9}$
(D) $\frac{126\pi}{9}$
14. Let $\int e^{x+x^2}(2x^2 + 3x + 2) dx = f(x) + C$; where $f(0) = 3$ then the value of $f(-1)$ is equal to
(A) 2
(B) 3
(C) -6
(D) -3
15. Let a hyperbola H is $xy = 8$ and a point P lies on it whose distance from focus is 3 units, then
Statement-1 : Length of focal chord passing through P is 9
Statement-2 : Harmonic mean of focal radii of hyperbola is semi latus rectum.
(A) Statement-1 is true, statement 2 is true
(B) Statement-1 is false, statement 2 is false
(C) Statement-1 is true, statement 2 is false
(D) Statement-1 is false, statement 2 is is true.
16. If 'K' denotes the total no of points of non differentiability of the function $f(x) = \max \left\{ \sin^{-1}x, \frac{\pi}{3}, \cos^{-1}x \right\} - 1 < x < 1$, then the set of all possible values of m for which 'K' lies between the roots of the quadratic equation $mx^2 + (m-1)x + 1 = 0$ is equal to
(A) $(0, 1)$
(B) $\left(0, \frac{1}{2}\right)$
(C) $\left(0, \frac{1}{6}\right)$
(D) $(-1, 0)$

17. If $f(n)$ is sum of all possible products of first n natural numbers taking two at a time and $g(n)$ is the sum of the series $(1 \cdot n + 2 \cdot (n-1) + 3 \cdot (n-2) + \dots + n \cdot 1)$, then the value of $\lim_{n \rightarrow \infty} \frac{f(n)}{n \cdot g(n)}$ is equal to

- (A) $\frac{1}{2}$ (B) $\frac{3}{4}$
(C) 1 (D) $\frac{5}{2}$

18. Consider the function

$g(x) = 4.f\left(\frac{x^2}{4}\right) + f(125 - x^2) \forall x \in \mathbb{R}$ and $f''(x) < 0 \forall x \in \mathbb{R}$, then the interval in which $g(x)$ increases is

- (A) $(-\infty, -10)$
(B) $(-10, 0)$
(C) $(-10, 10)$
(D) $(10, \infty)$

19. Let S be the set of points where the function $f(x) = |2 - |x - 3||$, $x \in \mathbb{R}$ is not differentiable, then the value of the expression $\sum_{x \in S} f(f(x))$ is equal to

- (A) 2 (B) 4
(C) 3 (D) 8

20. The value of the series $\sum_{k=1}^{\infty} k^2 \cdot \frac{1}{2^k}$ is equal to

- (A) 6
(B) 12
(C) 18
(D) 3

SECTION-II : (Maximum Marks: 20)

This section contains 05 questions.

The answer to each question is a **Numerical Value**.

For each question, enter the correct integer value (In case of non-integer value, the answer should be rounded off to the nearest Integer).

Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If correct answer is entered.

Zero Marks : 0 If the question is unanswered.

Negative Marks : -1 If wrong answer is entered.

1. Consider a matrix $M = ABA^{-1}$ where $A = \begin{bmatrix} -1 & 5 \\ 3 & 1 \end{bmatrix}$

and $B = \begin{bmatrix} 1 & 0 \\ 0 & 2024 \end{bmatrix}$, if $M^{10} = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ then the value of $(a - 3b)$ is equal to

2. Shortest distance between two curves $y^2 - x + 4 = 0$ and $x^2 - y + 4 = 0$ is 'd' then the value of $2\sqrt{2}d$ is equal to

3. Consider a differentiable function $f : \mathbb{R} \rightarrow \mathbb{R}$ such that $f(1) = 2$ and $f(x + y) = 2^x \cdot f(y) + 4^y f(x) \forall x, y \in \mathbb{R}$, if minimum value of $f(x)$ is K , then the value of $|100K|$

4. Consider a set $A = \{(x, y) : x, y \in \mathbb{N} \text{ and } |x| + |y| = 5\}$, then the number of non-empty subsets of set A is

5. If the sum of all possible solution(s) of the equation $5 \cos 2x (1 - \tan x) - 5 \tan x + 7 = 0$ in $x \in [0, 2\pi] - \left\{ \frac{\pi}{2}, \frac{3\pi}{2} \right\}$ is $\frac{m\pi}{2}$ then the value of m is equal to

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