| | | |
|---|---|---|
| **Sec:** Sr.Super60_STERLING BT | **2022_P1** | **Date: 14-09-2025** |
| **Time: 09.00Am to 12.00Pm** | RPTA-06 | **Max. Marks:180** |

**MATHEMATICS** : Areas and Differential Equations

**PHYSICS** : Gauss law: Flux of electric field, Gauss's law and its application in simple cases, such as, to find field due to infinitely long straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell. Dielectrics and electric polarization, Properties of Condutors, Capacitors: Capacitance, Parallel plate capacitor with and without dielectrics, Capacitors in series and parallel, Energy stored in a capacitor.(Exclude RC Circuits)

**CHEMISTRY** : Amines: Basicity of substituted anilines and aliphatic amines, Preparation from nitro compounds, nitriles and amides, Reactions: Hoffmann bromamide degradation, Gabriel phthalimide synthesis, Reaction with nitrous acid, Azo coupling reaction of diazonium salts of aromatic amines, Sandmeyer and related reactions of diazonium salts, Carbylamine reaction, Hinsberg test, Alkylation and acylation reaction Carboxylic acids & derivatives: Physical properties, Preparation: from nitriles, Grignard reagents, hydrolysis of esters and amides, Formation of esters, acid chlorides, and amides, Preparation of benzoic acid from alkylbenzenes, Reactions: reduction, halogenation, formation of esters, acid chlorides, anhydrides and amides Polymers: Types of polymerization (addition, condensation), Homo and copolymers, Natural rubber, Cellulose, Nylon, Teflon, Bakelite, PVC, polythene, synthetic rubber, Bio-degradable polymers, Applications of polymers.
**NOTE: POLYMERS (NOT IN JEE MAINS)**

**Name of the Student:** _____  **H.T. NO:** ☐☐☐☐☐☐☐☐☐☐

# JEE-ADVANCE-2022-P1-Model

**Time:3Hr's**     IMPORTANT INSTRUCTIONS     **Max Marks: 180**

## MATHEMATICS:

| Section | Question Type | +Ve Marks | - Ve Marks | No.of Qs | Total marks |
|---|---|---|---|---|---|
| Sec – I(Q.N : 1 – 8) | Questions with Numerical Value Answer Type% | +3 | 0 | 8 | 24 |
| Sec – II(Q.N : 9 – 14) | Questions with Multiple Correct Choice with partial mark | +4 | -2 | 6 | 24 |
| Sec – III(Q.N : 15 – 18) | Matching Type | +3 | -1 | 4 | 12 |
| **Total** | | | | **18** | **60** |

## PHYSICS:

| Section | Question Type | +Ve Marks | - Ve Marks | No.of Qs | Total marks |
|---|---|---|---|---|---|
| Sec – I(Q.N : 19 – 26) | Questions with Numerical Value Answer Type | +3 | 0 | 8 | 24 |
| Sec – II(Q.N : 27 – 32) | Questions with Multiple Correct Choice with partial mark | +4 | -2 | 6 | 24 |
| Sec – III(Q.N : 33 – 36) | Matching Type | +3 | -1 | 4 | 12 |
| **Total** | | | | **18** | **60** |

## CHEMISTRY:

| Section | Question Type | +Ve Marks | - Ve Marks | No.of Qs | Total marks |
|---|---|---|---|---|---|
| Sec – I(Q.N : 37 – 44 | Questions with Numerical Value Answer Type | +3 | 0 | 8 | 24 |
| Sec – II(Q.N : 45 – 50) | Questions with Multiple Correct Choice with partial mark | +4 | -2 | 6 | 24 |
| Sec – III(Q.N : 51 – 54) | Matching Type | +3 | -1 | 4 | 12 |
| **Total** | | | | **18** | **60** |

## MATHEMATICS
**Max Marks: 60**

### SECTION – I
### (NUMERICAL VALUE TYPE)

This section contains **EIGHT (08)** questions.
- The answer to each question is a **NUMERICAL VALUE.**
- For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.
- Answer to each question will bee evaluated <u>according to the following marking scheme :</u>

*Full Marks:*+3 **ONLY** if the correct numerical value is entered ;
*Partial Mark*: 0 In all other cases.

1.   Consider the functions $f, g : R \to R$ defined by $f(x) = x^2 + \dfrac{5}{12}$ and

$$g(x) = \begin{cases} 2\left(1 - \dfrac{4|x|}{3}\right), & |x| \le \dfrac{3}{4} \\ 0 & |x| > \dfrac{3}{4} \end{cases}$$ . If $\alpha$ is the area of region

$\left\{(x,y) \in R \times R : |x| \le \dfrac{3}{4}, 0 \le y \le \min\{f(x), g(x)\}\right\}$, then the value of $9\alpha$ is _____

2.   The area (in sq. units) of the figure enclosed by the curve $5x^2 + 6xy + 2y^2 + 7x + 6y + 6 = 0$

is k , then $[k] = $          (where $[.]$ denotes G.I.F)

3.   Let $f(x) = x^3 + 3x + 2$ and $g(x)$ be the inverse of $f(x)$. The area bounded by $g(x)$,

the x-axis and the ordinates $x = -2$ and $x = 6$ is K, then $[K + 1]$ is ($[\cdot]$ denotes GIF).

4.   Let $f : [1, \infty) \to [2, \infty)$ be a differentiable function such that $f(1) = 2$. If

$6\int_{1}^{x} f(t)\, dt = 3xf(x) - x^3$ for all $x \ge 1$, then the value of $f(2)$ is

5.   The differential equation whose solution represents the family $y = ae^{2x} + be^{7x}$ is

$y_2 - 9y_1 + \lambda y = 0$ then the value of $\lambda$ must be _____.

6.   Let $f : R \to R$ be a differentiable function with $f(0) = 0$. If $y = f(x)$ satisfies the

differential equation $\dfrac{dy}{dx} = (2 + 5y)(5y - 2)$, then the value of $\lim_{x \to -\infty} f(x)$ is _____.

7. Let a curve C that passes through $(2,1)$ satisfies the differential equation

$2xy\dfrac{dx}{dy} = x^2 + y^2$. The eccentricity of curve C is $\lambda$ then $7 - \lambda^2$ is _____.

8. If $x^2 y - x^3 \dfrac{dy}{dx} = y^4 \cos x \Rightarrow \dfrac{x^3}{y^3} = 3f(x) + c$ then $f\left(\dfrac{\pi}{2}\right) = $ _____.

### SECTION – II
### (ONE OR MORE CORRECT ANSWER TYPE)

This section contains **SIX (06)** questions.

- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated <u>according to the following marking scheme :</u>

*Full Marks* :+4 **ONLY** if (all) the correct option(s) is(are) chosen;
*Partial Marks*: +3 If all the four options are correct but **ONLY** three options are chosen;
*Partial Marks*: +2 If three or more options are correct but **ONLY** two options are chosen, both of which are correct ;
*Partial Marks*: +1 If two or more options are correct but **ONLY** two options are chosen, and it is a correct option ;
*Zero Marks* : 0 If none of the options is chosen (i.e. the question is unanswered);
*Negative Marks* : –2 In all other cases.

9. A solution curve of the differential equation $\left(x^2 + xy + 4x + 2y + 4\right)\dfrac{dy}{dx} - y^2 = 0, x > 0$

passes through the point $(1,3)$. Then the solution curve

(A) Intersects $y = x + 2$ exactly at one point

(B) Intersects $y = x + 2$ exactly at two point

(C) Intersects $y = (x+2)^2$

(D) Does NOT intersect $y = (x+3)^2$

10. The solution of $\left(\dfrac{dy}{dx}\right)^2 + 2y\cot x \dfrac{dy}{dx} = y^2$ is

(A) $x = 2\sin^{-1}\sqrt{\dfrac{c}{2y}}$   (B) $x = 2\cos^{-1}\sqrt{\dfrac{c}{2y}}$   (C) $y = \dfrac{c}{1 - \cos x}$   (D) $y - \dfrac{c}{1 + \cos x} = 0$

11. Let $f[0,\infty) \to R$ be a continuous function such that $f(x) = 1 - 2x + \displaystyle\int_0^x e^{x-t} f(t)\,dt$ for all

$x \in [0,\infty)$. Then which of the following statement(s) is (are) TRUE?

(A) The curve $y = f(x)$ passes through the point $(1,2)$

(B) The curve $y = f(x)$ passes through the point $(2,-1)$

(C) The area of the region $\left\{(x,y) \in [0,1] \times R : f(x) \le y \le \sqrt{1-x^2}\right\}$ is $\dfrac{\pi - 2}{4}$

(D) The area of the region $\left\{(x,y) \in [0,1] \times R : f(x) \le y \le \sqrt{1-x^2}\right\}$ is $\dfrac{\pi - 1}{4}$

12.  Area bounded by the parabola $y = x^2 - 2x + 3$ and tangents drawn to it from the point $P(1,0)$ is equal to $A_1$ and the parabola with the chord of contact of P is $A_2$ then

(A) $A_1 = 4\sqrt{2}sq.$ units

(B) $A_1 = \dfrac{4\sqrt{2}}{3}sq.$ units

(C) $A_2 = \dfrac{8\sqrt{2}}{3}sq.$ units

(D) $A_2 = \dfrac{16}{3}\sqrt{2}sq.$ units

13.  For the differential equation whose solution is $y = c_1 \cos(x + c_2) - c_3 e^{-x + c_4} + c_5 \sin x$ where $c_1, c_2, c_3, c_4, c_5$ arbitrary constants are is of

(A) Order 3          (B) order 5          (C) degree 1          (D) degree 3

14.  For any real numbers $\alpha$ and $\beta$, let $y_{\alpha,\beta}(x), x \in R$ be the solution of the differential equation $\dfrac{dy}{dx} + \alpha y = x e^{\beta x}, y(1) = 1$. Let $S = \left\{y_{\alpha,\beta}(x) : \alpha, \beta \in R\right\}$.

Then which of the following functions belong(s) to the set S?

(A) $f(x) = \dfrac{x^2}{2}e^{-x} + \left(e - \dfrac{1}{2}\right)e^{-x}$

(B) $f(x) = \dfrac{x^2}{2}e^{-x} + \left(e + \dfrac{1}{2}\right)e^{-x}$

(C) $f(x) = \dfrac{e^x}{2}\left(x - \dfrac{1}{2}\right) + \left(e - \dfrac{e^2}{4}\right)e^{-x}$

(D) $f(x) = \dfrac{e^x}{2}\left(\dfrac{1}{2} - x\right) + \left(e + \dfrac{e^2}{4}\right)e^{-x}$

## SECTION – III
## (MATCHING TYPE)

This section contains **FOUR (04)** Matching List Sets.

• Each set has **ONE** Multiple Choice Question.

• Each set has **TWO** lists : **List-I** and **List-II.**

• **List-I** has **Four** entries (I), (II), (III) and (IV) and **List-II** has **Five** entries (P), (Q), (R), (S) and (T).

• **FOUR** options are given in each Multiple Choice Question based on **List-I** and **List-II** and **ONLY ONE** of these four options satisfies the condition asked in the Multiple Choice Question.

• Answer to each question will be evaluated <u>according to the following marking scheme :</u>

*Full Marks*:+3 **ONLY** if the option corresponding to the correct combination is chosen;

*Zero Marks*: 0 If none of the options is chosed (i.e. the question is unanswered);

*Negative Marks*: –1 In all other cases.

15. Match the following lists:

| | List – I | List – II |
|---|---|---|
| **a.** | The area bounded by the curve $y = x\|x\|$, x-axis and the ordinates $x = 1, x = -1$ | **p.** $10/3$ sq. units |
| **b.** | The area of the region lying between the lines $x - y + 2 = 0, x = 0$, and the curve $x = \sqrt{y}$ | **q.** $64/3$ sq. units |
| **c.** | The area enclosed between the curves $y^2 = x$ and $y = \|x\|$ | **r.** $2/3$ sq. units |
| **d.** | The area bounded by parabola $y^2 = x$, straight line $y = 4$, and the y-axis | **s.** $1/6$ sq. units |
| | | **t.** $8$ sq. units |

(A) $a \to r, b \to p, c \to s, d \to q$    (B) $a \to q, b \to p, c \to s, d \to r$

(C) $a \to r, b \to q, c \to s, d \to p$    (D) $a \to p, b \to q, c \to s, d \to r$

16.    Match the following lists:

| | List – I | List – II |
|---|---|---|
| **a.** | Area bounded by curve $y^2 = x$ and $x = 4$ is divided into 4 equal parts by the lines $x = a$ and $y = b$. Then the value of $\left[a^2\right]$ is, where $[\cdot]$ represents greatest integer part function | **p.** 1 |
| **b.** | The area bounded by the curves $f(x) = \begin{cases} x^{\frac{1}{\log_e x}}, & x \neq 1 \\ e, & x = 1 \end{cases}$ and $y = \|x - e\|$ is A then the value of $[A]$ is, where $[\cdot]$ represents greatest integer part function | **q.** 6 |
| **c.** | Area bounded by the curves $y = e^x, y = \log_e x$ and the lines $x = 0, y = 0, y = 1$ is A, then the value of $[A]$ is, where $[\cdot]$ represents greatest integer part function | **r.** 8 |
| **d.** | The area of the region whose boundaries are defined by the curves $y = 2\cos x, y = 3\tan x$ and the y-axis, is $1 + \frac{3}{2}\log_e 3 - \log_e k$, then the value of k is | **s.** 7 |
| | | **t.** 10 |

(A)    a→q, b→p, c→s, d→r        (B)    a→s, b→p, c→q, d→r

(C)    a→q, b→s, c→p, d→r        (D)    a→q, b→p, c→r, d→s

**17.**        Match the following lists:

| List – I | | List – II |
|---|---|---|
| **a.** | If the function $y = e^{4x} + 2e^{-x}$ is a solution of the differential equation $\dfrac{\dfrac{d^3 y}{dx^3} - 13\dfrac{dy}{dx}}{y} = K$, then the value of $K/3$ is | **p.** 3 |
| **b.** | Let a curve $y = f(x), f(x) \geq 0 \, \forall x \in R$ have property that for every point P on the curve, length of subnormal is equal to abscissa of P. If $f(1) = 3$, then $\dfrac{f(4)}{\sqrt{6}} =$ | **q.** 4 |
| **c.** | If real value of $m$ for which the substitution, $y = u^m$ will transform the differential equation, $2x^4 y \dfrac{dy}{dx} + y^4 = 4x^6$ into a homogeneous equation, then the value of $2m$ is | **r.** 2 |
| **d.** | If the solution of differential equation $x^2 \dfrac{d^2 y}{dx^2} + 2x\dfrac{dy}{dx} = 12y$ is $y = Ax^m + Bx^{-n}$, then possible value of $|m+n|$ is | **s.** 0 |
| | | **t.** 8 |

(A)   $a \to r, b \to p, c \to s, d \to q$     (B)   $a \to q, b \to r, c \to p, d \to s$

(C)   $a \to r, b \to q, c \to s, d \to p$     (D)   $a \to p, b \to q, c \to s, d \to r$

**18.**    Match the differential equation in List I with its solution in List II and then    choose the correct code.

| List – I | | List – II | |
|---|---|---|---|
| **a.** | $y = kx + k^2$ | **p.** | $y\left(1 - \left(\dfrac{dy}{dx}\right)^2\right) = 2x.\dfrac{dy}{dx}$ |
| **b.** | $y = ae^{2x} + be^{3x}$ | **q.** | $x\dfrac{d^2 y}{dx^2} + 2\dfrac{dy}{dx} - xy + x^2 = 2$ |
| **c.** | $y^2 = 4a(x+a)$ | **r.** | $\dfrac{d^2 y}{dx^2} - 5\dfrac{dy}{dx} + 6y = 0$ |
| **d.** | $xy = ae^x + be^{-x} + x^2$ | **s.** | $y = x\dfrac{dy}{dx} + \left(\dfrac{dy}{dx}\right)^2$ |

(A) $a \to p, b \to s, c \to q, d \to r$     (B) $a \to s, b \to r, c \to p, d \to q$

(C) $a \to r, b \to p, c \to s, d \to q$     (D) $a \to q, b \to p, c \to r, d \to s$

**PHYSICS**                          **Max Marks: 60**

## SECTION – I
## (NUMERICAL VALUE TYPE)

This section contains **EIGHT (08)** questions.
- The answer to each question is a **NUMERICAL VALUE.**
- For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.
- Answer to each question will bee evaluated <u>according to the following marking scheme :</u>

*Full Marks:*+3 **ONLY** if the correct numerical value is entered ;
*Partial Mark*: 0 In all other cases.

19. If a charge in coulombs q=4.90 times permittivity of free space is placed symmetrically at point 'O' of a hemispherical surface as shown below
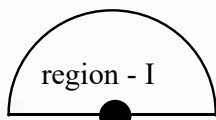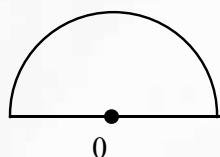


region - I

$q = 4.90 \times \in_0$ coulomb

region = II

Symmetrically placed

     The ratio of total flux to the flux associated with the given hemispherical surface (region-I) is_____

20. Five identical capacitors connected in series have a resultant capacity $4\mu F$. When this series combination is connected to a potential of $2\sqrt{5}$ volt then energy stored is "$U_s$".If the same five capacitors are connected in parallel and a source of 1 volt is connected to this combination then energy stored is "$U_p$".The ratio of $U_p / U_s = $ _____

21. A half cylinder of radius R and length L >> R is formed by cutting a cylindrical pipe made of an insulating material along a plane containing its axis. The rectangular base of the half cylinder is closed by a dielectric plate of length L and width 2R. A charge Q on the half cylinder and a charge q on the dielectric plate are uniformly sprinkled. If electrostatic force between the plate and the half cylinder is closed to $\dfrac{qQ}{p\varepsilon_0 RL}$ then find the value of p/5
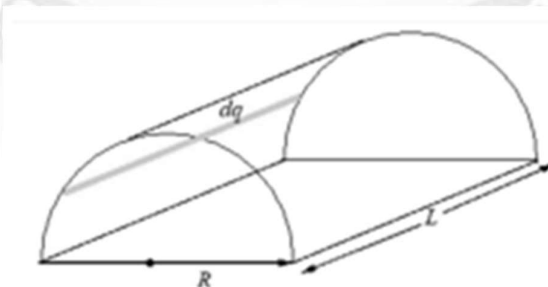
22. A cylindrical capacitor has two co-axial cylinders of length $\frac{1}{2\pi}$ m and radii 'er' cm and 'r' cm. The outer cylinder is earthed and inner cylinder is given a charge of $3.5\mu C$. The capacitance of the system in SI units if given by $C = n \times 10^{-12}$ (Take $\varepsilon_0 = 8.85 \times 10^{-12}$) in SI units and here '$er$' = 2.718....times r ). What is suitable value in place of ' n'.

23. Two identical circuits built as shown in below figure. In first circuit voltage of left battery **V** is 6 Volts and in second circuit (take identical circuit) **V** is 12 Volts. In first circuit, the charge storage in $C_3$ is $8\mu C$. What is the charge storage in $C_3$ in $\mu C$ in the second circuit? (In both the circuits take $C_1 = 12\mu F, C_2 = C_3 = 4\mu F$ and $C_4 = C_5 = 2\mu F$ )
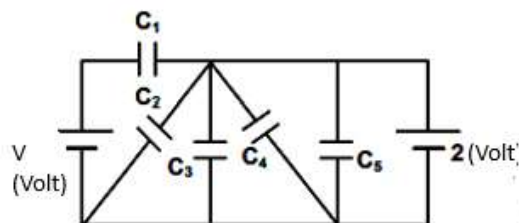


24. The middle branch capacitor $2\mu F$ is charged for longer time as shown in figure. The energy dissipated after the switch S is turned to position 2 is x and the initial energy stored when switch S connected to 1 was y. If y is n times the value of x (both x and y in same units) find the value of n
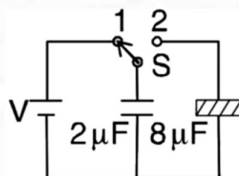


25. The flux of the electric field, through the closed spherical surface $S^I$(Outer surface) is found to be four times that through the closed spherical surface S. Find the value of (Q-10.00) in micro coulombs
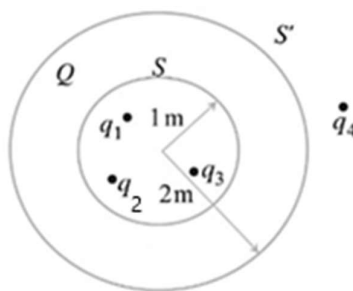


$\left[\text{Given, } q_1 = +20\mu C, q_2 = -25\mu C, q_3 = +9.75\mu C \text{ and } q_4 = +30\mu C.\right]$

26.     Three uniformly charged wires with linear charge density $\lambda$ are placed along X, Y and Z- axes respectively. If flux of electric field through Gaussian surface given by n times $\frac{\lambda}{\varepsilon_0}$. Gaussian surface equation is given by $X^2 + Y^2 + Z^2 = 1; X > 0; Y > 0; Z > 0$. Find the value of n? (All quantities in SI Units).

## SECTION – II
## (ONE OR MORE CORRECT ANSWER TYPE)

This section contains **SIX (06)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated <u>according to the following marking scheme :</u>
*Full Marks* :+4 **ONLY** if (all) the correct option(s) is(are) chosen;
*Partial Marks*: +3 If all the four options are correct but **ONLY** three options are chosen;
*Partial Marks*: +2 If three or more options are correct but **ONLY** two options are chosen, both of which are correct ;
*Partial Marks*: +1 If two or more options are correct but **ONLY** two options are chosen, and it is a correct option ;
*Zero Marks* : 0 If none of the options is chosen (i.e. the question is unanswered);
*Negative Marks* : –2 In all other cases.

27.     Choose correct of the following statements
        (A) There can be electric filed on the Gaussian surface even if the charge enclosed   by   it is zero.
        (B) If charge distribution within Gaussian surface changes inside it, the same net electric flux will pass through the surface.
        (C) Even though Electric flux is a scalar we consider it sometimes as positive and also as negative depending on how it flows through the given surface
        (D) Electric flux has no units and dimensions

28.     A dielectric slab of dielectric constant 10 is placed between the plates of a parallel plate capacitor which covers one-third (1/3) of the area of its plates as shown in the figure. The total capacitance is C while that of the portion with dielectric in between is $C_1$. When the capacitor is charged, the plate area covered by the dielectric gets charged $Q_1$ and the rest of the area gets charged $Q_2$. The electric field in the dielectric is $E_1$ and that in the other portion is $E_2$. Choose the correct option/options, ignoring the edge effects:
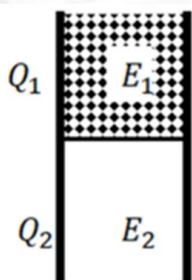


A) $\frac{E_1}{E_2} = 1$      B) $\frac{Q_1}{Q_2} = 5$      C) $\frac{C}{C - C_1} = 6$      D) $\frac{C}{C_1} = 1.2$
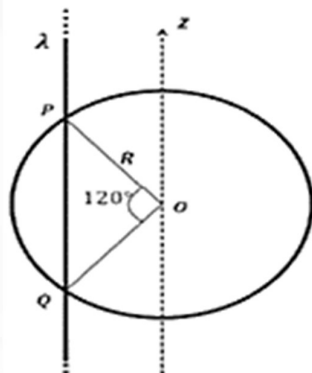
29. An infinitely long thin non-conducting wire is parallel to the $z$-axis and carries a uniform line charge density $\lambda$. It pierces a thin non-conducting spherical shell of radius R in such a way that the arc PQ subtends an angle $120°$ at the centre O of the spherical shell, as shown in the figure. The permittivity of free space is $\epsilon_0$. Which of the following statements is (are) true?



A) The electric flux through the shell is $\dfrac{\sqrt{3}R\lambda}{\varepsilon_0}$

B) The z-component of the electric field is non zero

C) The electric flux through the shell is $\dfrac{\sqrt{2}R\lambda}{\varepsilon_0}$

D) The z-component of the electric field is zero at all the points on the surface of the shell

30. Two capacitors of capacitances 1µF and 3µF are charged to the same voltages 5V. They are connected in parallel with oppositely charged plates connected together. Then
A) The final common voltage will be 2.5V
B) The final common voltage will be 5V
C) Heat produced in the circuit is 37.5 micro joule
D) Heat produced in the circuit is 18.75 micro joule

31. Choose the correct statement (s):
(A) If an electric dipole of certain dipole moment is enclosed by a closed surface, then net flux coming out of the surface will be zero
(B) A Gaussian surface need not to be symmetric
(C) Electric flux has units Volt meter
(D) A point charge "$8\epsilon_0$" in coulombs is placed on the top of a cone of semi vertex angle $\theta = 60°$. The electric flux through the base of cone is 2 in SI units
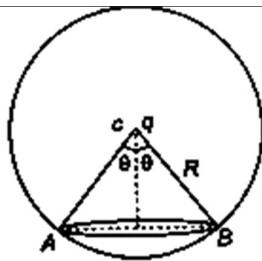
32.    In the given system a capacitor of plate area A is charged up to charge q. The mass of each plate is $m_2$. The lower plate is rigidly fixed. For the system to be in equilibrium-
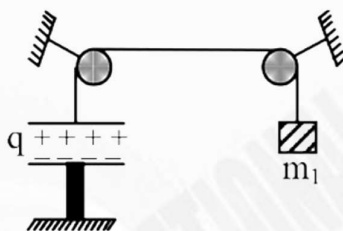


Choose the correct statement(s). Take T is tension in the ideal string and $F_e$ be the electrostatic force on the upper plate of the capacitor.

(A) For upper plate of the capacitor $T = F_e + m_2 g$

(B) For block of mass $m_1$, $F_e + m_2 g = m_1 g$

(C) For equilibrium $m_1 = \dfrac{q^2}{2A\varepsilon_0 g} + m_2$

(D) Electrostatic force on the capacitor plate cannot be balanced by tension

## SECTION – III
## (MATCHING TYPE)

This section contains **FOUR (04)** Matching List Sets.
• Each set has **ONE** Multiple Choice Question.
• Each set has **TWO** lists : **List-I** and **List-II.**
• **List-I** has **Four** entries (I), (II), (III) and (IV) and **List-II** has **Five** entries (P), (Q), (R), (S) and (T).
• **FOUR** options are given in each Multiple Choice Question based on **List-I** and **List-II** and **ONLY ONE** of these four options satisfies the condition asked in the Multiple Choice Question.
• Answer to each question will be evaluated <u>according to the following marking scheme :</u>
*Full Marks*:+3 **ONLY** if the option corresponding to the correct combination is chosen;
*Zero Marks*: 0 If none of the options is chosed (i.e. the question is unanswered);
*Negative Marks*: –1 In all other cases.

33.    Figure shows an arrangement of three identical capacitors (each capacity 'C') and a cell EMF 'E' along with switches $'S_1' \& 'S_2'$ which are initially open (and capacitors have no initial charge).
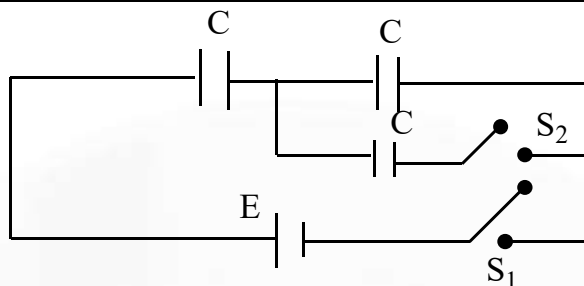
(**Note:** 1) For all the cases given in list – I take initially the capacitors are uncharged and consider long time after closing switches.

2) In II, III & IV Questions of List I take $E^1$ is new EMF value as mentioned)

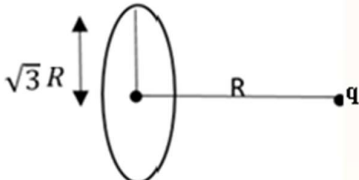| List – I | List - II |
|---|---|
| I) Charge flowing through the cell When $'S_1'$ is closed and $'S_2'$ is open | P) $CE$ |
| II)    Charge flowing through the cell When $'S_1'$ and $'S_2'$ are closed & $E' = 0.3E$ is EMF | Q) $\dfrac{CE}{5}$ |
| III)    Total energy stored when $'S_1'$ only Closed & $'S_2'$ is still open    & Take $E^1 = \sqrt{E}$ is the EMF of the cell | R) $\dfrac{CE}{4}$ |
| IV) Total energy stored when $'S_1'\&'S_2'$, both are closed and    $E^1 = \sqrt{E}$ is the EMF of the cell | S) $\dfrac{CE}{3}$ |
| | T) $\dfrac{EC}{2}$ |

(A) I- T, II- P , III- R, IV- S        (B) I- R, II- P , III- S, IV- T

(C) I- T, II- Q , III- R, IV- S        (D) I- Q, II- T , III- R, IV- S

34.    In the following figures "q" is the charge    "$\epsilon_o$" is permittivity of free space
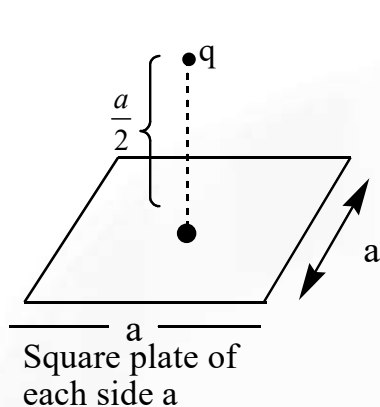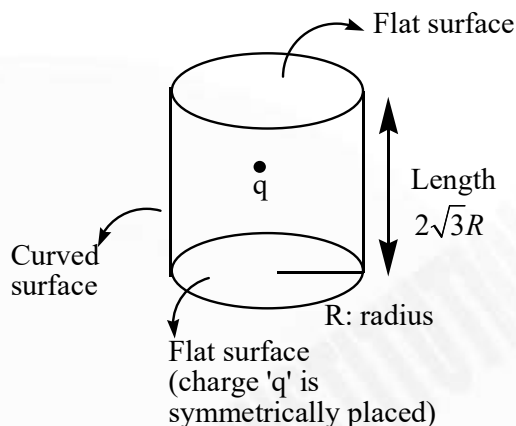


Figure - 1                                    Figure - 2

| List – I | List – II |
|---|---|
| I) Electric flux linked with the plate in figure (1) is___ | P) $\dfrac{q}{\epsilon_0}$ |
| II) Electric flux linked with the flat plate (any one) in figure (2) is___ | Q) $\dfrac{q}{\epsilon_0}\left(\dfrac{2-\sqrt{3}}{2}\right)$ |
| III) Electric flux linked with the curved surface is_(in figure (2)) | R) $\dfrac{q}{2\,\epsilon_0}\left(\dfrac{2-\sqrt{3}}{2}\right)$ |
| IV) Total Electric flux in both the cases is____ | S) $\dfrac{\sqrt{3}q}{2\,\epsilon_0}$ |
|  | T) $\dfrac{q}{6\,\epsilon_0}$ |
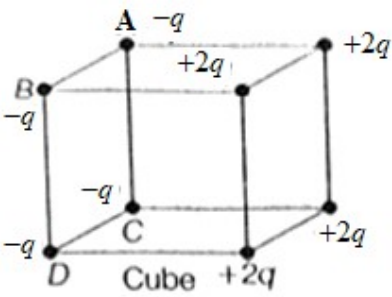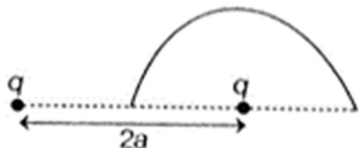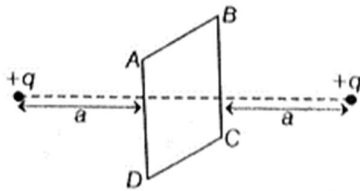
(A) I- T, II- R , III- S, IV- P          (B) I- P, II- R , III- S, IV- T
(C) I- T, II- Q , III- S, IV- R          (D) I- T, II- Q , III- S, IV- P

35.    In list – I there are some charge distributions and list- II has electric flux associated with the surface mentioned in list-I below each figure. In first figure radius of the circle is $\sqrt{3}R$ and the point is at R distance where charge q is placed , in second figure charges at vertices A, B,C and D all are –q and opposite vertices each charge is 2q, in figure III and IV each charge is q.

| List – I | List – II |
|---|---|
| I)  Flux through given circle due to point charge q | P) 0 |
| II)  Net flux through surface ABCD | Q) $\dfrac{q}{2\varepsilon_0}$ |
| III)  Net flux through given hemispherical surface | R) $\dfrac{q}{3\varepsilon_0}$ |
| IV)  Net flux through surface ABCD | S) $\dfrac{q}{4\varepsilon_0}$ |
|  | T) $\dfrac{q}{\varepsilon_0}$ |

(A) I- S, II- R, III- Q, IV- P        (B) I- T, II- R, III- Q, IV- P

(C) I- S, II- R, III- P, IV- T        (D) I- S, II- Q, III- T, IV- P

36. List I have some arrangement of capacitor plates and list II is equivalent capacity. Match the suitable (NOTE: "S" is area of each plate in I, II and III of column and S is the area of upper plate in IV).

| List – I | List – II |
|---|---|
| I) Plates 1, 2, 3, 4 with A at top and B at bottom; spacings $d$, $2d$, $3d$ | P) $\dfrac{3}{4}\dfrac{S\varepsilon_0}{d}$ |
| II) Plates 1, 2, 3 with A and B terminals; spacings $d$, $d$ | Q) $\dfrac{2}{3}\dfrac{S\varepsilon_0}{d}$ |
| III) Arrangement with spacings $d$, $d$, $d$; terminals A and B | R) $\dfrac{S\varepsilon_0}{4d}$ |
| IV) Plate A on top, lower plates of area $S/2$; spacings $d$, $2d$; terminal B | S) $\dfrac{S\varepsilon_0}{2d}$ |
|  | T) $\dfrac{S\varepsilon_0}{d}$ |

(A) I- S, II- R, III- Q, IV- P

(B) I- T, II- S, III- P, IV- Q

(C) I- R, II- S, III- Q, IV- P

(D) I- R, II- P, III- T, IV- Q

**CHEMISTRY**                  **Max Marks: 60**

## SECTION – I
## (NUMERICAL VALUE TYPE)

This section contains **EIGHT (08)** questions.
- The answer to each question is a **NUMERICAL VALUE.**
- For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.
- Answer to each question will bee evaluated <u>according to the following marking scheme :</u>

*Full Marks:* +3 **ONLY** if the correct numerical value is entered ;

*Partial Mark:* 0 In all other cases.

37.
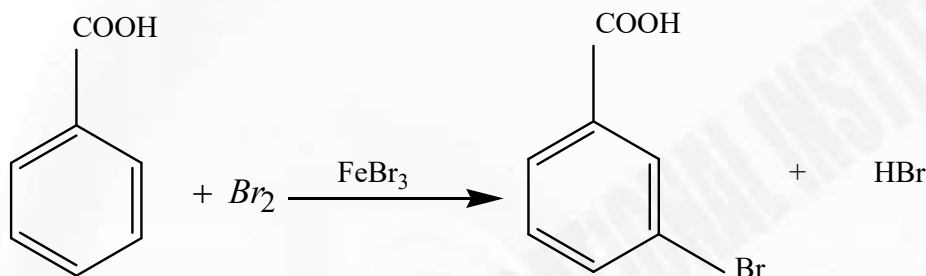


Consider the above reaction where 6.1 g of benzoic acid is used to get 7.8 g of $m$-bromobenzoic acid. The percentage yield of the product is _____. (Round off to nearest integer). [Given: Atomic masses: C;12 u, H:1.0 u,O:16.0 u Br:80.0 u

38. If Cyclohexane carboxylic acid is treated with $Cl_2$/phosphorus, $\alpha$-halogenation takes place. How many mono-chloro derivatives would be formed in product?

39. If 279 g of aniline is reacted with one equivalent of benzenediazonium chloride, the maximum amount of aniline yellow formed will be _____ g. (nearest integer) (consider complete conversion)

40. $x =$ Number of compounds which show C——N coupling with $PhN_2^{\oplus}$ ?
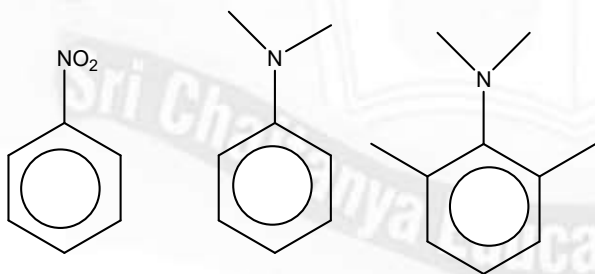


$y =$ Number of amines which will form stable diazonium salt



$H_3C$——$CH_2$——$NH_2$ ,     $Ph - NH_2$ ,     (Ph——NH, CH$_3$) , Find $= \dfrac{x+y}{2} = ?$

41.



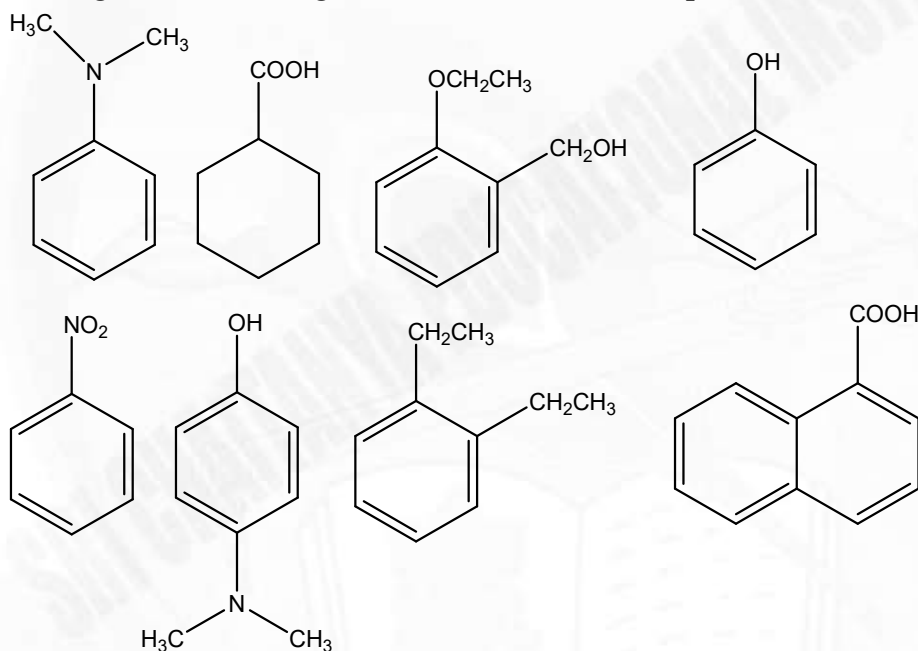$$\xrightarrow{NH_3/\Delta}(A)\xrightarrow[R-Cl]{1.KOH}(C)\xrightarrow{H_2O/H^+}(D)+1^o \text{ amine}$$
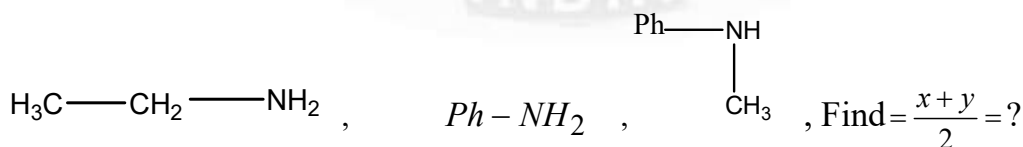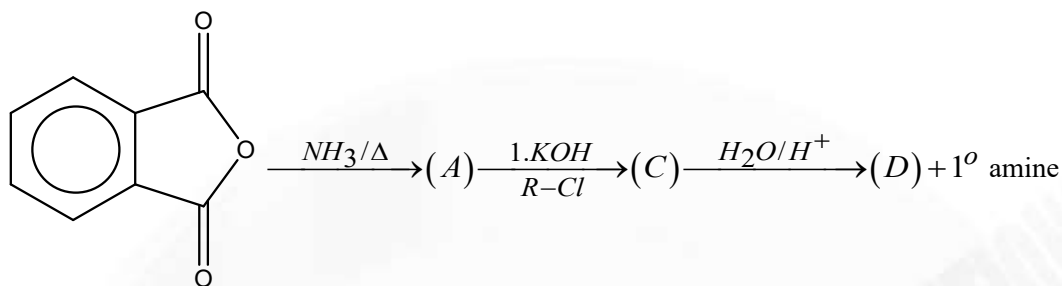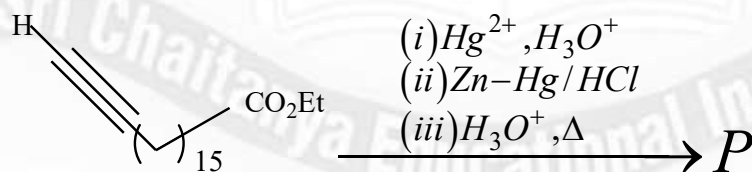
DBE of D is x. Then $\dfrac{x+24}{3}=$

42. Amongst the following, the total number of compounds soluble in aqueous NaOH is



43. In the following reaction sequence, the major product P is formed.



$$\xrightarrow[\begin{array}{l}(i)Hg^{2+},H_3O^+\\(ii)Zn-Hg/HCl\\(iii)H_3O^+,\Delta\end{array}]{} P$$

Glycerol reacts completely with excess P in the presence of an acid catalyst to form Q. Reaction of Q with excess NaOH followed by the treatment with $CaCl_2$ yields Ca- soap R, quantitatively. Starting with one mole of Q, the amount of R produced in gram is _____ [Given, atomic weight $H=1, C=12, N=14, O=16, Na=23, Cl=35, Ca=40$

44.    How many $1°$ amine of the formula $C_5H_{13}N$ can be used to resolve racemic 2-methylbutanoic acid?

## SECTION – II
### (ONE OR MORE CORRECT ANSWER TYPE)

This section contains **SIX (06)** questions.

• Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).

• For each question, choose the option(s) corresponding to (all) the correct answer(s).

• Answer to each question will be evaluated <u>according to the following marking scheme :</u>

*Full Marks* :+4 **ONLY** if (all) the correct option(s) is(are) chosen;

*Partial Marks*: +3 If all the four options are correct but **ONLY** three options are chosen;

*Partial Marks*: +2 If three or more options are correct but **ONLY** two options are chosen, both of which are correct ;

*Partial Marks*: +1 If two or more options are correct but **ONLY** two options are chosen, and it is a correct option ;

*Zero Marks* : 0 If none of the options is chosen (i.e. the question is unanswered);

*Negative Marks* : –2 In all other cases.

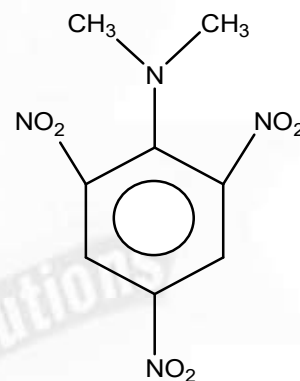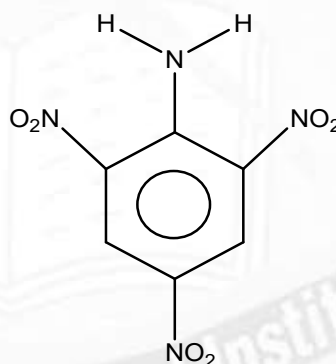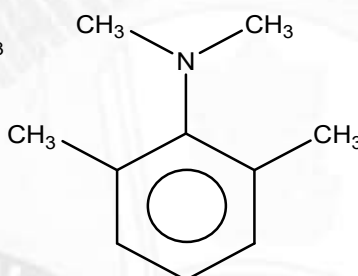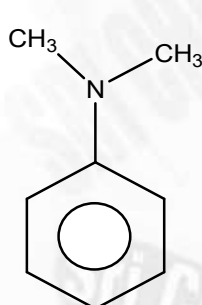45.    In the following reactions, P, Q, R, and S are the major products.
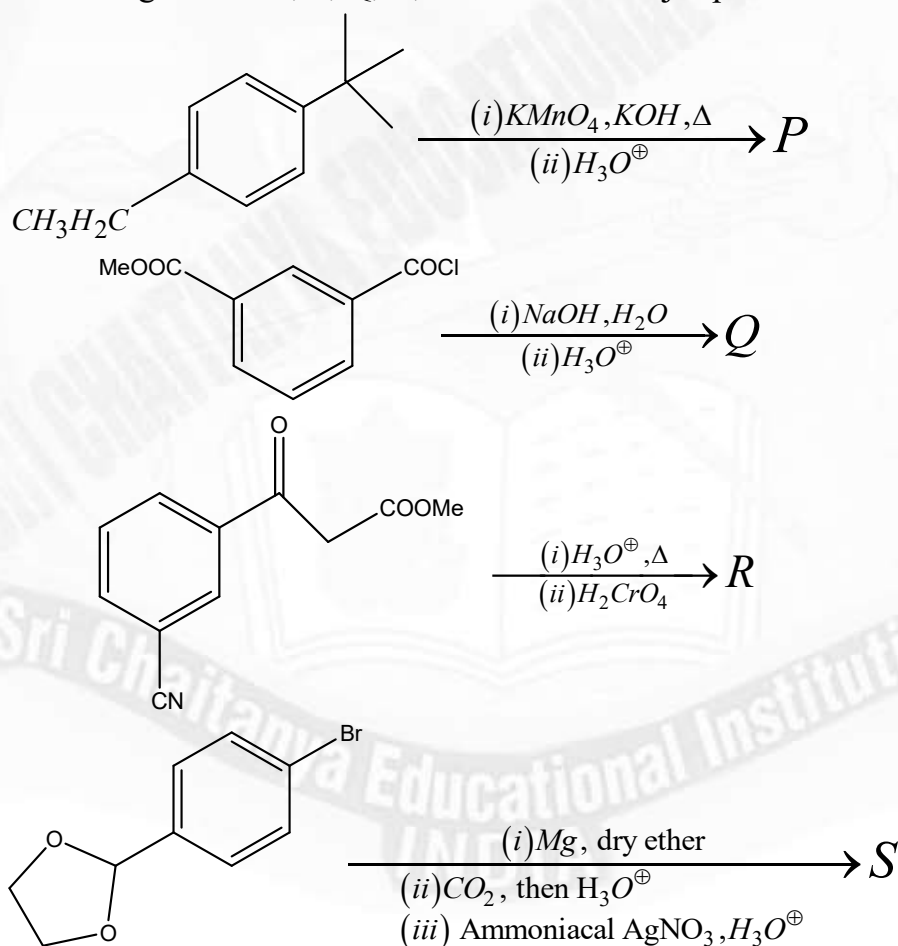


The correct statement(s) about P, Q, R and S is (are)

(A) P and Q are monomers of polymers Dacron and glyptal, respectively.

(B) P, Q and R are dicarboxylic acids.

(C) Compounds Q and R are the same.

(D) R does not undergo aldol condensation and S does not undergo Cannizzaro reaction.

46.    Which of the following are correct method for the preparation of propanoic acid
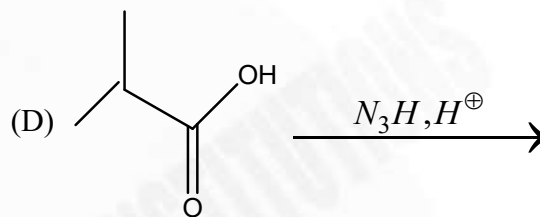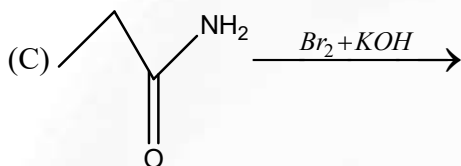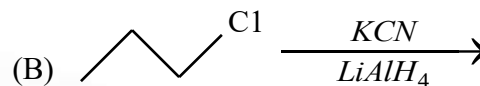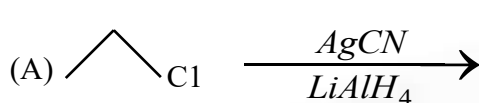
(A)    $H_3C - CH = CH_2 \xrightarrow{HBr} \xrightarrow[Ether]{Mg} \xrightarrow[H_3^{\oplus}O]{CO_2}$

(B)    $H_3C - C \equiv CH \xrightarrow[H_2O_2.^{\Theta}OH]{BH_3.THF} \xrightarrow{KMnO_4}$

(C)    $H_2C = CH_2 \xrightarrow{HBr} \xrightarrow[Ether]{Mg} \xrightarrow[H_3^{\oplus}O]{CO_2}$

(D)    $H_3C - HC = C(CH_3) - CH_3 \xrightarrow[Ag_2O]{O_3}$
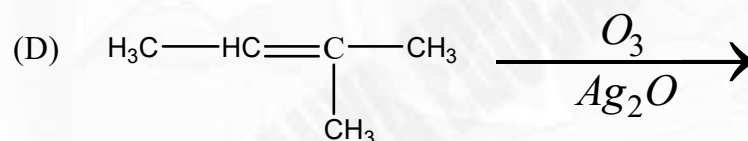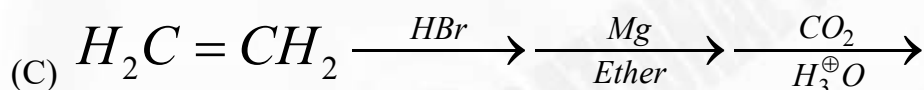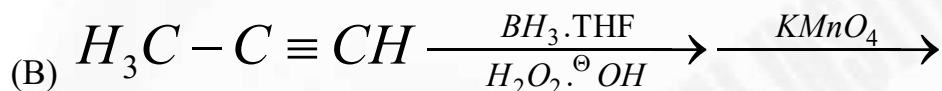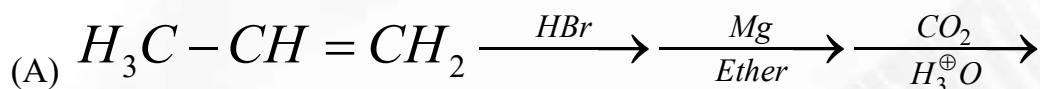
47.    Consider the structures:



(I)            (II)            (III)            (IV)

Which of the following statements are correct?
(A) Basic strength of II is greater than I
(B) Basic strength of II is less than that of I
(C) Basic strength of IV is greater than III
(D) Basic strength of IV is less than that of III

**48.** Which of the following can give $1°$ amine?

(A) $\ce{^^^Cl}$    $\xrightarrow[LiAlH_4]{AgCN}$

(B) $\ce{^^^^Cl}$    $\xrightarrow[LiAlH_4]{KCN}$

(C) (structure with NH₂ and O) $\xrightarrow{Br_2+KOH}$

(D) (structure with OH, O and methyl groups) $\xrightarrow{N_3H,\,H^{\oplus}}$

**49.** Choose the correct option (s) from the following.

(A) Nylon – 6 has amide linkages

(B) Polythene is a thermosetting polymer

(C) Teflon is prepared by heating tetrafluoroethene in presence of a persulphate catalyst at high pressure

(D) Natural rubber is polyisoprene containing trans alkene units

**50.** The correct functional group X and the reagent/reaction conditions Y in the following scheme are

$$X-(CH_2)_4-X \xrightarrow[HOOC-(CH_2)_4-COOH,\,heat]{(i)Y} \text{Condensation polymer}$$
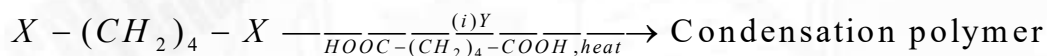
(A) $X = COOCH_3, Y = Br_2/NaOH$    (B) $X = CONH_2, Y = H_2/Ni/heat$

(C) $X = CONH_2, Y = Br_2/NaOH$      (D) $X = CN, Y = H_2/Ni/heat$

## SECTION – III
### (MATCHING TYPE)

This section contains **FOUR (04)** Matching List Sets.

- Each set has **ONE** Multiple Choice Question.
- Each set has **TWO** lists : **List-I** and **List-II.**
- **List-I** has **Four** entries (I), (II), (III) and (IV) and **List-II** has **Five** entries (P), (Q), (R), (S) and (T).
- **FOUR** options are given in each Multiple Choice Question based on **List-I** and **List-II** and **ONLY ONE** of these four options satisfies the condition asked in the Multiple Choice Question.
- Answer to each question will be evaluated <u>according to the following marking scheme :</u>

*Full Marks*:+3 **ONLY** if the option corresponding to the correct combination is chosen;

*Zero Marks*: 0 If none of the options is chosed (i.e. the question is unanswered);

*Negative Marks*: –1 In all other cases.

51.    Match the Column (I) and (II)

| Column(I) (Amines) | Column(II) (Distinguished by ) |
|---|---|
| (A) $C_2H_5NH_2 and C_6H_5NH_2$ | P. Carbylamine test |
| (B) $(C_2H_5)_3N \ and (C_2H_5)_2NH$ | Q. Azo dye test |
| (C) $C_2H_5NH_2 and (C_2H_5)_3N$ | R. Hinsberg reagents |
| (D) $(C_2H_5)_3N \ and C_6H_5NH_2$ | S. Liebermann nitroso reaction |

(A) $A \to Q; B \to R, S; C \to P, R; D \to P, Q, R$   (B) $A \to P; B \to R, S; C \to Q, R; D \to P, Q, R$

(C) $A \to P; B \to Q, S; C \to R; D \to P, Q, R$   (D) $A \to Q; B \to P, S; C \to S, R; D \to P, Q, R$

52.    Match the Column (I) and (II)

| Column (I) (Reactions) | Column (II) (Reagent) |
|---|---|
| (A)  $\underset{O}{\overset{\parallel}{C}} - OH \longrightarrow -CH_2OH$ | P. LiAlH$_4$ |
| (B)  $\underset{O}{\overset{\parallel}{C}} - Cl \longrightarrow -CH_2OH$ | Q. NaBH$_4$ |
| (C)  $\underset{O}{\overset{\parallel}{C}} - OR' \longrightarrow -CH_2OH$ | R. $B_2H_6 / THF$ |
| D)  $R - \underset{O}{\overset{\parallel}{C}} - O - \underset{O}{\overset{\parallel}{C}} - R \longrightarrow R - CH_2OH$ | S. $H_2 - Pd / BaSO_4$ |

(A)  $A \to, R, S; B \to P,, S; C \to P, R, S; D \to, R, S$

(B)  $A \to P, R, S; B \to, P, S; C \to, R, S; D \to P, S$

(C)  $A \to P, R, S; B \to, P, R; C \to, S, R; D \to P, R, S$

(D)  $A \to P, R; B \to P, Q; C \to P, R; D \to P, R,$

53. Match the chemical substances in Column I with type of polymers/type of monomers in Column II.

| Column – I | Column – II |
|---|---|
| (A)   Orlon | (P)   Capro Lactum |
| (B)   Bakelite | (Q)   Acrylo nitrile |
| (C)   Dacron | (R)   Phenol+Formaldehyde |
| (D)   Perlon-L | (S)   Terephthalic acid+ Ethylene glycol |

(A) $A \to P; B \to S; C \to R; D \to Q$       (B) $A \to Q; B \to R; C \to S; D \to P$

(C) $A \to P; B \to Q; C \to R; D \to S$       (D) $A \to Q; B \to R; C \to P; D \to S$

54. Match the Column (I) and (II). (Matrix)

| | Column (I) Reaction | | Column (II) Products formed |
|---|---|---|---|
| (a) | HO₂C—C(CH₃)(CO₂H), H—C—D, Ph $\xrightarrow{\Delta}$ | (p) | Diastereomers |
| (b) | HO₂C—C(CH₃)(CO₂H)—Et $\xrightarrow{\Delta}$ | (q) | Racemic mixture |
| (c) | cyclohexane with CO₂H, ⫴CO₂H and CH₃ $\xrightarrow{\Delta}$ | (r) | Meso compound |
| (d) | cyclohexane with CO₂H, CO₂H $\xrightarrow{\Delta}$ | (s) | $CO_2$ gas will evolve |

(A) $a \to q,s; b \to p,s; c \to p; d \to r$      (B) $a \to p,r; b \to p,q; c \to s; d \to r$

(C) $a \to p,s; b \to q,r; c \to r; d \to s$      (D) $a \to p,s; b \to q,s; c \to p,s; d \to r$