VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

Mock JEE Advanced-4 (CBT) | Paper – 1 | JEE 2024

Date: 15/05/2024 **Maximum Marks: 180**

Timing: 9:00 AM to 12:00 PM **Duration : 3.0 Hours**

General Instructions

1. The question paper consists of 3 Subject (Subject I: **Physics**, Subject II: **Chemistry**, Subject III: **Mathematics**). Each Part has **four** sections (Section 1, Section 2, Section 3 and Section 4).
2. **Section 1** contains **3 Multiple Correct Answers Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

   Section 2 contains **4 Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

   Section 3 contains **4** Matching List sets. Each set has **TWO** lists: **List I** and **List II**. **List-I** has **Four** entries (P), (Q), (R) and (S) and **List-II** has **Five** entries (1), (2), (3), (4) and (5). **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.

   Section 4 contains **6 Non-Negative Integer Type Questions**. The answer to each question is a **NON-NEGATIVE INTEGER.** For each question, enter the correct integer corresponding to the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer.

3. For answering a question, an ANSWER SHEET (OMR SHEET) is provided separately. Please fill your **Test Code, Roll No.** and **Group** properly in the space given in the ANSWER SHEET.

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

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

MARKING SCHEME

SECTION – 1 | (Maximum Marks: 12)

- This section consists of **Three (03)** Questions. Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).
- Answer to each question will be evaluated according to the following marking scheme:

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

SECTION – 2 | (Maximum Marks: 12)

- This section contains **Four (04)** Multiple Choice Questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme.

Full Marks	: +3 If ONLY the correct option is chosen.
Zero Marks	: 0 If none of the options is chosen (i.e. the question is unanswered).
Negative Marks	: −1 In all other cases.

SECTION – 3 | (Maximum Marks: 12)

- This section contains **Four (04)** Matching List sets. Each set has **TWO** lists: **List I** and **List II**. **List-I** has **Four** entries (P), (Q), (R) and (S) and **List-II** has **Five** entries (1), (2), (3), (4) and (5).
- **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 according to the following marking scheme.

Full Marks	: +3 If ONLY the correct option is chosen.
Zero Marks	: 0 If none of the options is chosen (i.e. the question is unanswered).
Negative Marks	: −1 In all other cases.

SECTION – 4 | (Maximum Marks: 24)

- This section contains **SIX (06)** Questions.
- The answer to each question is a **NON-NEGATIVE INTEGER**
- For each question, enter the correct integer corresponding to the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme.

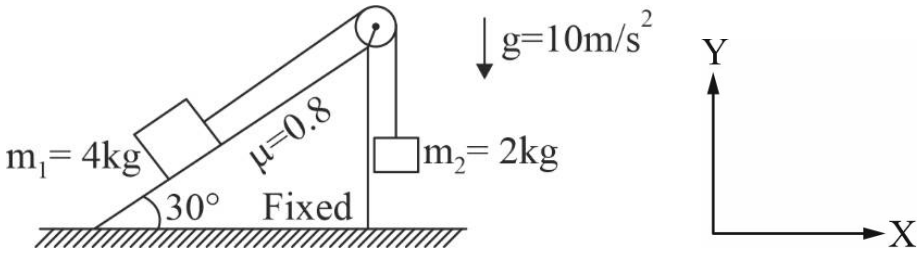
Full Marks	: +4 If ONLY the correct integer is entered;
Zero Marks	: 0 In all other cases.

SUBJECT I : PHYSICS 60 MARKS

SECTION-1

This section consists of 3 Multiple Correct Answers Type Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

1. Two blocks of masses m_1 and m_2 are connected through a massless inextensible string. Block of mass m_1 is placed at the fixed rigid inclined surface while the block of mass m_2 hanging at the other end of the string, which is passing through a fixed massless frictionless pulley shown in figure. The coefficient of static friction between the block and the inclined plane is 0.8. The system of masses m_1 and m_2 is released from rest. Choose the correct option(s).



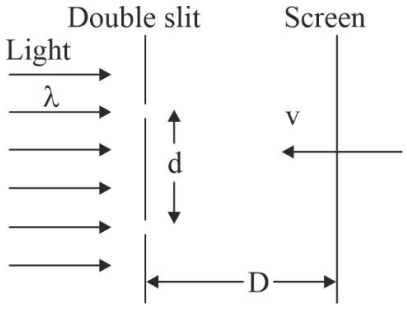
(A) The tension in the string is 20 N after releasing the system

(B) The contact force by the inclined surface on the block is along normal to the inclined surface

(C) The magnitude of contact force by the inclined surface on the block m_1 is $20\sqrt{3}N$

(D) The force exerted on the pulley by wedge is given by $(10\sqrt{3}\hat{i}+30\hat{j})N$

2. In YDSE setup (see in the figure), the screen moves towards the double slit with speed *v*. The wavelength of light used is λ, the distance between the slits d and the distance of the screen from the slits D(d << D), then choose the correct option(s).



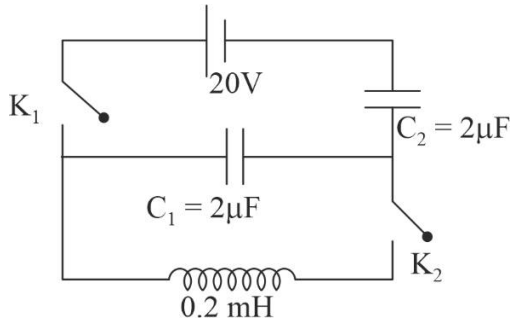
(A) All the fringes shrink towards the central one.

(B) The speed of the 2nd bright fringe with respect to the screen is $2\lambda v/d$

(C) The central fringe remains at rest.

(D) The fringes below the central one moves upward on the screen

3. A circuit containing two capacitors C_1 and C_2 shown in the figure is in the steady state with switch K_1 closed and K_2 open. At the instant $t = 0$, K_1 is opened and K_2 is closed. The correct statement(s) is/are:



(A) Angular frequency of oscillation of LC circuit is 5×10^4 rad/s

(B) Charge on capacitor C_1 at $t = 0$ is $40\mu C$

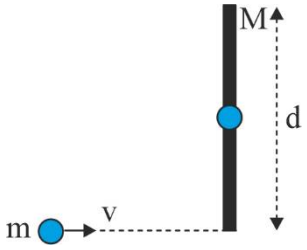
(C) maximum current in inductor is 1A

(D) Charge on capacitor C_1 is $10\sqrt{3}\mu C$ when energy in the inductor becomes one third of that in capacitor.

SECTION-2

This section consists of 4 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

4. A mass *m* is moving at speed *v* perpendicular to a rod of length *d* and mass $M = 6\,m$ which pivots around a frictionless axle running through its centre. It strikes to the end of the rod and returns back with one fourth of initial speed. The moment of inertia of the rod about its centre is $Md^2/12$. Then the angular speed of the system just after the collision and the value of coefficient of restitution are:



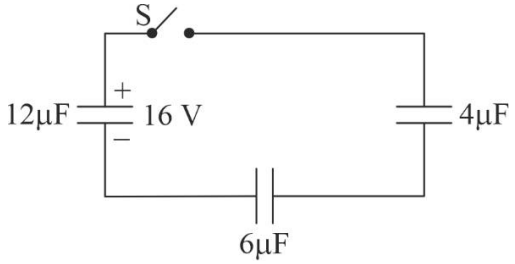
(A) $\frac{2v}{3d},\frac{1}{2}$ **(B)** $\frac{5v}{4d},\frac{7}{8}$ **(C)** $\frac{v}{d},\frac{2}{3}$ **(D)** $\frac{3v}{2d},\frac{2}{3}$

5. An ideal gas expands isothermally from volume V_1 to V_2 and is then compressed to original volume V_1 adiabatically. Initial pressure is P_1 and final pressure is P_3. The total work done by gas is *W*. Then:

(A) $P_3 > P_1, W > 0$ **(B)** $P_3 < P_1, W < 0$

(C) $P_3 > P_1, W < 0$ **(D)** $P_3 = P_1, W = 0$

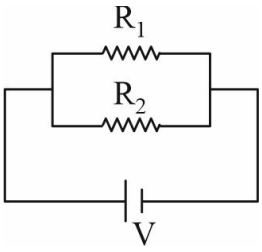
6. In the arrangement shown in figure, the switch S is closed at $t = 0$.



The final charge on $6\mu F$ capacitor will be:

(A) $12\mu F$ **(B)** $24\mu F$ **(C)** $32\mu F$ **(D)** $48\mu F$

7. An experiment is performed for determination of heat dissipated in a circuit consisting of two resistors connected in parallel as shown in the figure. If $R_1 = (5 \pm 0.2)\Omega, R_2 = (10 \pm 0.1)\Omega, V = (20 \pm 0.5)V$ the error in the determination of heat dissipated in time $(10 \pm 0.2)\,s$ will be:



(A) 10% **(B)** 12% **(C)** 13% **(D)** 16%

SECTION-3

This section consists of 4 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 (P), (Q), (R) and (S) and **List-II** has **Five** entries (1), (2), (3), (4) and (5). **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.

8. List-I shows different radioactive decay processes and List-II provides possible emitted particles. Match each entry in List-I with an appropriate entry from List-II, and choose the correct option

	List-I		**List-II**
(P)	$^{238}_{92}U \rightarrow {}^{206}_{82}Pb$	**(1)**	Five α-particle and four β^- particle
(Q)	$^{226}_{89}Ac \rightarrow {}^{226}_{88}Ra$	**(2)**	One β^+ particle
(R)	$^{226}_{88}Ra \rightarrow {}^{206}_{82}Pb$	**(3)**	Eight α-particle and six β^- particle
(S)	$^{239}_{92}U \rightarrow {}^{239}_{94}Pu$	**(4)**	Two β^- particle

Codes:

	P	**Q**	**R**	**S**		**P**	**Q**	**R**	**S**
(A)	3	2	2	4	**(B)**	1	4	4	2
(C)	3	2	1	4	**(D)**	3	4	2	2

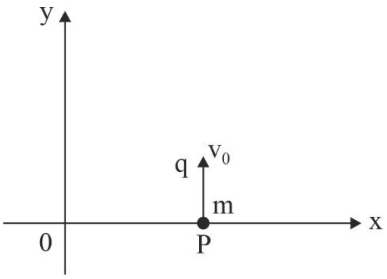
9. A series *LCR* circuit has L = 10 mH, $R = 3\Omega$ and $C = 1\mu F$ connected in series to a source of 15 $\cos\omega t$ volt, where ω is 10% lower than the resonant frequency. At this frequency (ω), current amplitude is I_0. Match each entry in List-I with an appropriate value from List-II and choose the correct option.
(Given $\sqrt{454.21} = 21.32$)

	List-I		List-II
(P)	I_0 in (m_A)	**(1)**	0.141
(Q)	Average power dissipated per cycle in watt at frequency 10% lower than resonant frequency.	**(2)**	21.32
(R)	Power factor of the circuit	**(3)**	0.744
(S)	The quality factor of the circuit	**(4)**	33.3
		(5)	0.704

Codes:

	P	Q	R	S		P	Q	R	S
(A)	5	2	1	4	**(B)**	5	4	3	2
(C)	3	5	1	4	**(D)**	5	3	1	4

10. A negatively charged particle of mass '*m*' and magnitude *q* enters a magnetic field $\vec{B} = B_0\hat{k}\ T$ at point P(3m, 0, 0) with velocity $\vec{v}_0 = 3\hat{j} + 4\hat{k}$ m/s at *t* = 0 as shown in the figure. [Given $\frac{qB_0}{m} = 1\text{rad/ s}$] [No other field is present]



Now match the following:

	Column I		Column II
(P)	Pitch of the motion of the particle	**(1)**	$(-3\sin t\,\hat{i} + 3\cos t\,\hat{j} + 4\hat{k})$ unit
(Q)	Velocity of particle at time *t*.	**(2)**	$(-3\cos t\,\hat{i} - 3\sin t\,\hat{j} + 0\hat{k})$ unit
(R)	Acceleration of particle at time *t*.	**(3)**	8π unit
(S)	Position vector at time *t*.	**(4)**	$(3\cos t\,\hat{i} + 3\sin t\,\hat{j} + 4t\hat{k})$ unit
		(5)	4π unit

Codes:

	P	Q	R	S		P	Q	R	S
(A)	5	2	1	4	**(B)**	3	4	2	1
(C)	3	1	2	4	**(D)**	5	4	1	2

11. A standing wave, formed in an organ pipe aligned along the x-axis, is given by (displacement) $=\left(5\times10^{-6}m\right)\sin\left(4\pi x\right)\cos\left(1320\pi t\right)$ were x is in meter and t is in seconds. Based on the above information, match the following lists:

List-I		List-II	
(P)	Change in pressure is maximum	**1.**	$x = 1/2\ m$
(Q)	Change in pressure is minimum	**2.**	$x = 1\ m$
(R)	Maximum amplitude of vibration	**3.**	$x = 1/8\ m$
(S)	Minimum amplitude of vibration	**4.**	$x=\frac{3}{8}m$

Codes:

	P	Q	R	S		P	Q	R	S
(A)	2	1	3	4	**(B)**	4	3	2	1
(C)	1	2	4	3	**(D)**	1	4	3	2

SECTION-4

This section consists of 6 NON-NEGATIVE INTEGER Type Questions. For each question, enter the correct integer corresponding to the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer.

1. The vertical displacement of light rays parallel to the axis of a lens after refraction through the lens 'd' is measured as a function of the vertical displacement h of the incident ray from the principal axis as shown in figure (a). The data is plotted in figure (b). The distance D from the lens to the screen is 1.0 m. If the focal length of the lens (for paraxial rays) is (10) K cm, then what is K?

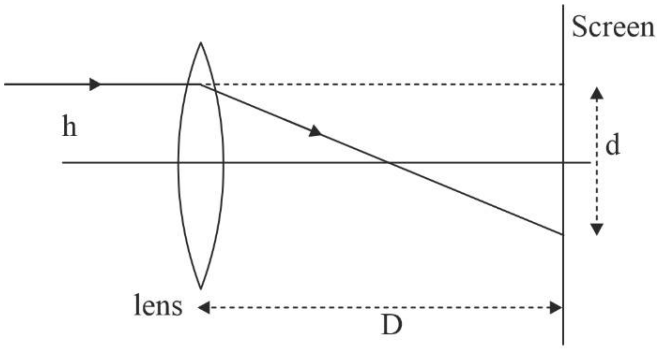


Figure (a)

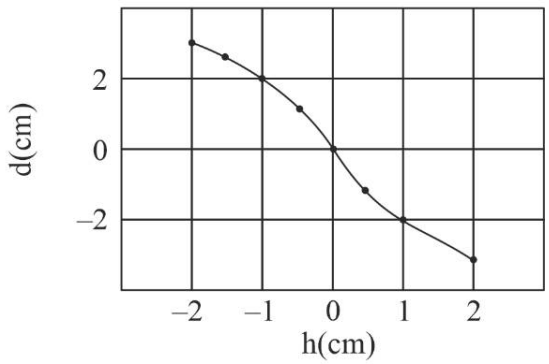
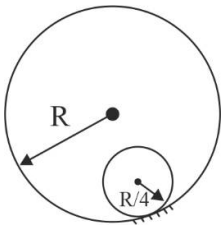
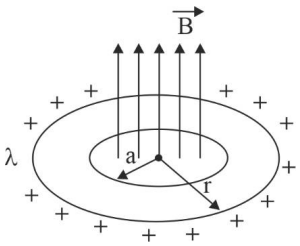


Figure (b)

2. A ring of mass m and radius R/4 rolls inside a fixed vertical hoop of radius R such that at the highest point of its trajectory the normal reaction becomes zero. The friction on the hoop is sufficient to ensure pure rolling. The angular velocity of the ring at the bottommost point is $\omega = 2\sqrt{\frac{\eta g}{R}}$, then find the value of η.

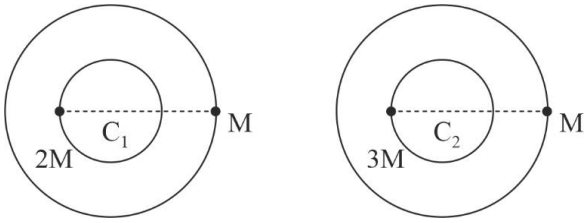


3. A ring of mass 4 kg is uniformly charged with $\lambda = 4$ C/m and kept on rough horizontal surface with friction coefficient $\mu = \frac{\pi}{4}$. A time varying magnetic field $B = B_0 t^2$ is applied in a circular region of radius a (a < r) perpendicular to the plane of ring as shown in figure. Let, the time when ring just starts to rotate on surface is t (in seconds). Find the value of *t*. (Take a = 5 cm, $g = 10\ m/s^2$ and B_0 = 125 SI units).



4. Consider a nuclear reaction. $A + B \rightarrow C$. A nucleus A moving with kinetic energy of 5 MeV collides with a nucleus B moving with kinetic energy of 3 MeV and forms a nucleus *C* in excited state. If the kinetic energy of nucleus C (in MeV) just after its formation is *k*, find the value of 2*k*.
It is formed in a state with excitation energy 10.65 MeV. Take masses of nuclei of *A, B* and *C* as 25.0, 10.0 and 34.995 amu, 1 amu $\approx 930\ MeV/c^2$

5. Figure shows two binary star systems such that the distance of lighter star from the centre of rotation is same in both the cases. If the ratio of time periods of rotation is $\frac{T_1}{T_2} = \frac{n}{8}\sqrt{\frac{3}{2}}$. Find n.



6. One end of copper rod of uniform cross section and length 13.5 m is kept in contact with ice at $0°C$ and other end with water at $100°C$. At distance '*x*' (in meter) from $100°C$ water along its length a temperature of $400°C$ be maintained so that in steady state, the mass of ice melting be equal to that of the steam produced in same interval of time. Assume that whole system is insulated from surrounding. Latent heat of fusion of ice and vaporization of water are 80 cal/gm and 540 cal/gm, respectively. If $x = \eta \times 10^{-2}$ meter, then the value of η is _____.

SUBJECT II : CHEMISTRY 60 MARKS

SECTION-1

This section consists of 3 Multiple Correct Answers Type Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

1. Select the correct statement(s).

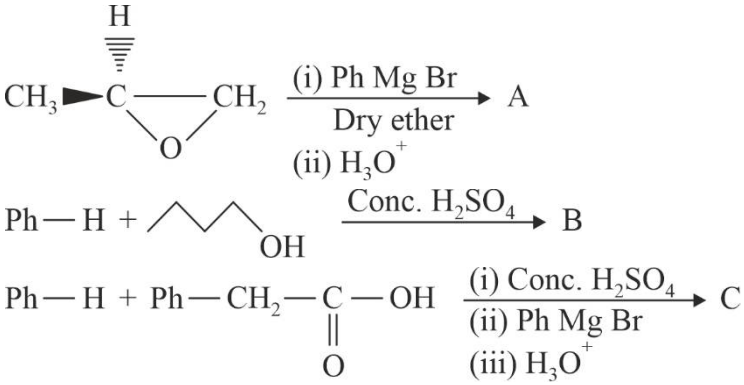
(A) Kaolinite is the ore of Aluminium

(B) Extraction of lead from Galena involves roasting in limited supply of air at moderate temperature followed by self-reduction at higher temperature.

(C) Extraction of zinc from zinc blende involves roasting followed by reduction with carbon

(D) Major chemical component of 'slag' formed during the extraction of iron & copper is $FeSiO_3$

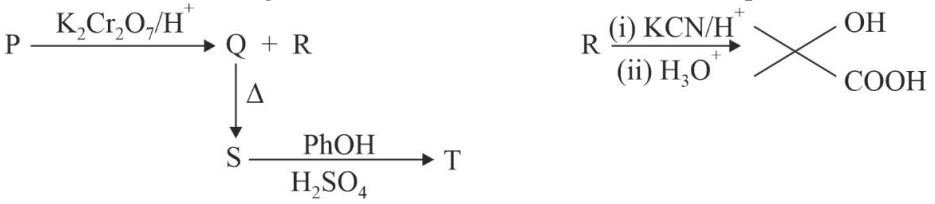
2. In the following reaction



(A) Retention of configuration in product A **(B)** Both A & B have asymmetric carbon(s)

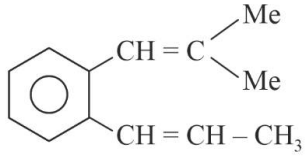
(C) Total two isomers of A are possible **(D)** Both B & C have asymmetric carbon

3. Consider the following reaction scheme & choose the correct option for reactant P and major products Q, R

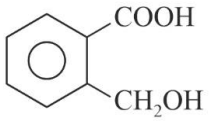


T gives pink colour in basic medium

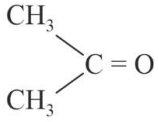
(A)



(P)

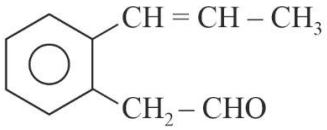


(Q)

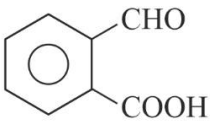


(R)

(B)



(P)

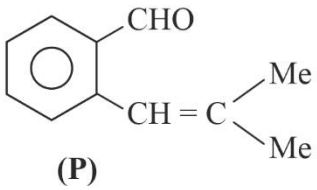


(Q)

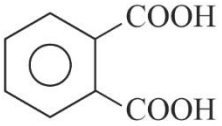
CH_3CHO

(R)

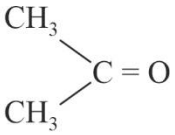
(C)



(P)

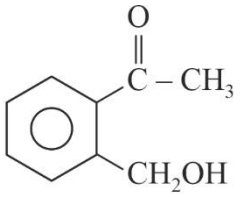


(Q)

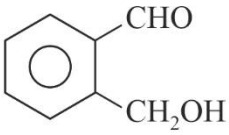


(R)

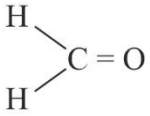
(D)



(P)



(Q)



(R)

SECTION-2

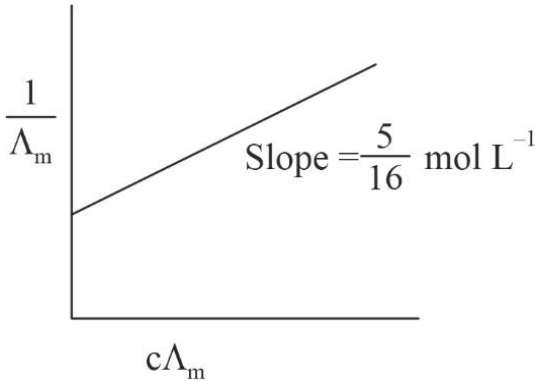
This section consists of 4 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

4. A white metal sulphide (A) gives (B) gas with rotten egg smell and (C) a colourless sulphate, when treated with dil. H_2SO_4. (B) reacts with $K_2Cr_2O_7 / H^+$ to form (D), a pale yellow element. (D) burns in oxygen to yield (E), a colourless gas. If (B) is added in (E), it gives (D) and a colourless liquid which turns anhydrous $CuSO_4$ blue. (C) gives a precipitate with NaOH which dissolves in excess of NaOH.

Identify metal sulphide (A) and colourless gas (E)

(A) $CuS \,\&\, H_2O$ **(B)** $ZnS \,\&\, SO_2$ **(C)** $NiS \,\&\, SO_3$ **(D)** $MnS \,\&\, CO_2$

5. The plot of $\frac{1}{\Lambda_m}$ against $c\Lambda_m$ for aqueous solution of weak monobasic acid (HX) resulted in following graph. If Λ_m° for acid is $400\,S\,cm^2mol^{-1}$. Then degree of dissociation when $c = 0.1\ M$ is



(A) 1.4×10^{-2} **(B)** 1.4×10^{-3} **(C)** 2×10^{-4} **(D)** 8×10^{-3}

6. A solution has 0.1 M Mg^{2+} and 0.05 M NH_3. The concentration of NH_4Cl required to prevent the formation of precipitate of $Mg(OH)_2$ in solution. $K_{sp[Mg(OH)_2]} = 18.0 \times 10^{-12}$ and ionisation constant of NH_3 is 1.8×10^{-5} is:

(A) 0.067 M **(B)** 0.67 M **(C)** 0.133 M **(D)** 0.0133 M

7. In the given reaction scheme, P on heating in presence of Oxygen followed by Hydrolysis forms aromatic compound Q.

R & S are the major products.

$$P(C_9H_{12}) \xrightarrow[\substack{heat \\ (ii)\,H_3O^+}]{(i)\,O_2(air)} Q \xrightarrow[NaOH,60°C]{CCl_4} R \xrightarrow[H^{\oplus}]{CH_3OH} S$$

Choose the correct statement

(A) The intermediate formed during formation of R is carbene

(B) S is used for joint pain & muscular pain

(C) S is a narcotic drug

(D) S is o-acetyl benzoic acid

SECTION-3

This section consists of 4 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 (P), (Q), (R) and (S) and **List-II** has **Five** entries (1), (2), (3), (4) and (5). **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.

8. Match the following

	Column I		**Column II**
(P)	$NaNO_2 + FeSO_4 + 3H_2SO_4 \rightarrow$	**(1)**	N_2O
(Q)	$HNO_3 + P_4O_{10} \rightarrow$	**(2)**	NO_2
(R)	$Cu + HNO_3(Conc.) \rightarrow$	**(3)**	NO
(S)	$NH_4NO_3 \xrightarrow{\Delta}$	**(4)**	N_2O_5
		(5)	N_2O_3

(A) P-1, Q-4, R-2, S-3 **(B)** P-3, Q-4, R-2, S-1

(C) P-2, Q-3, R-1, S-4 **(D)** P-3, Q-2, R-4, S-1

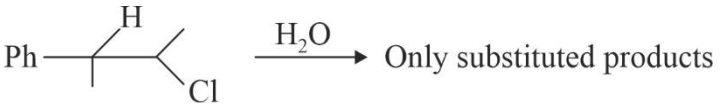
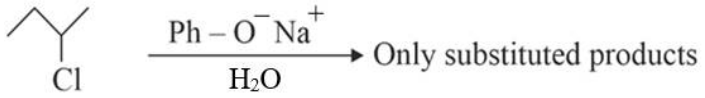
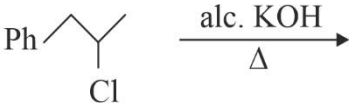
9. Match the metal complexes in List – I with their spin only magnetic moment in List – II & choose correct option

	Column I		**Column II**
(P)	$[Mn(NH_3)_6]^{2+}$	**(1)**	$\sqrt{3}$ B.M
(Q)	$[Co(ox)_3]^{3-}$	**(2)**	0 B.M
(R)	$[Fe(H_2O)_6]^{2+}$	**(3)**	$\sqrt{15}$ B.M
(S)	$[Co(H_2O)_6]^{2+}$	**(4)**	$\sqrt{35}$ B.M
		(5)	$\sqrt{24}$ B.M

(A) P-4, Q-2, R-3, S-5 **(B)** P-1, Q-5, R-3, S-2

(C) P-4, Q-2, R-5, S-3 **(D)** P-1, Q-5, R-2, S-3

10. Match the reactions in List – I with the no. of products (including stereoisoners) in List – II & choose the correct option

(P)	 Single isomer	**(1)**	1
(Q)		**(2)**	4
(R)		**(3)**	5
(S)		**(4)**	2
		(5)	3

(A) P-4, Q-2, R-1, S-3 **(B)** P-2, Q-4, R-3, S-1

(C) P-2, Q-4, R-1, S-5 **(D)** P-4, Q-2, R-5, S-1

11. Match the following:

	Column I		**Column II**
(P)	Hell-Volhard-Zelinsky reaction	**(1)**	Preparation of amines
(Q)	Reformatsky reaction	**(2)**	Preparation of $\beta-$hydroxy aldehyde
(R)	Claisen condensation reaction	**(3)**	Preparation of $\beta-$hydroxy ester
(S)	Gabriel-phthalimide synthesis	**(4)**	α -halogenation of carboxylic acid
		(5)	Preparation of $\beta-$keto ester

(A) P-3, Q-4, R-2, S-1 **(B)** P-5, Q-3, R-1, S-4

(C) P-4, Q-3, R-5, S-1 **(D)** P-3, Q-4, R-3, S-5

SECTION-4

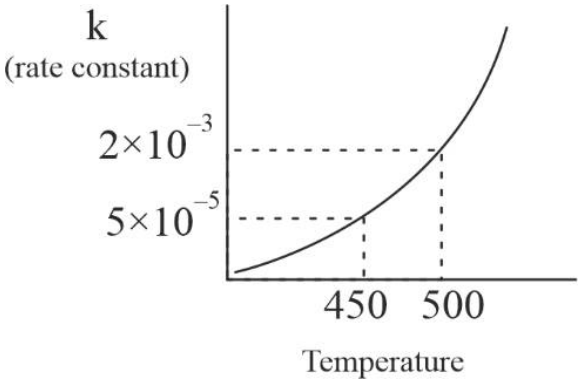
This section consists of 6 NON-NEGATIVE INTEGER Type Questions. For each question, enter the correct integer corresponding to the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer.

1. The chain length of straight chain silicones is controlled by adding 'X' which blocks the end of chain. If yield of the reaction of formation of linear chain polymer silicone is 50%. Find mass of X required to form 1 mole of straight chain silicones. [X is Hydrogen, Carbon, Silicon and Chlorine containing substance]

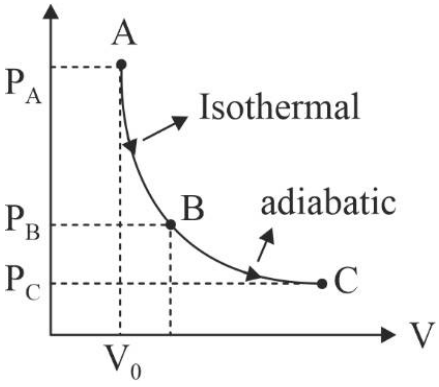
2. A gas at 183°C and 30 atm has molar volume 20% smaller than an ideal gas under same temperature pressure. Calculate molar volume of gas at the same condition. [Round off to nearest integer]

[Use $R = 0.082\ \text{L atm mol}^{-1}\text{K}^{-1}$]

3. The following graph shows variation of rate constant with temperature for following reversible reaction $A \rightleftharpoons P$. Find activation Energy of the reaction in KJ (rounded off to nearest integer) [Use $\ln 40 = 3.7$ & $R = 8\text{J K}^{-1}\text{mol}^{-1}$]



4. One mole of ideal gas $(\gamma = 1.5)$ under goes two reversible processes as shown in following PV curve



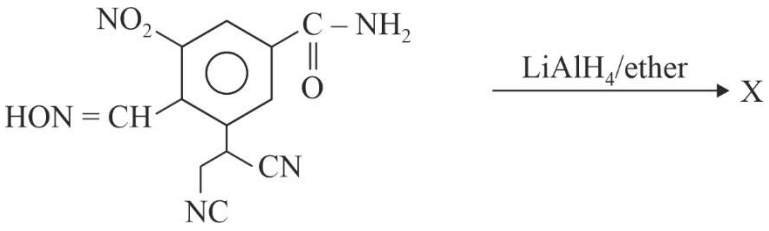
Temperature at state A is 300K

The reversible isothermal expansion A to B doubles the volume from V_0 to $2V_0$ & then pressure is reduced to one fourth. Total work done from A to C is –xR J. Find value of 'x' rounded off to nearest integer (Take $\frac{300}{4^{\frac{1}{3}}} = 189$ & ln2 = 0.7)

5. Calculate the value of lnK for the following reaction at temperature 300K $A(g) \rightleftharpoons B(g)$ (round off your answer to nearest integer) [Use $R = 8\ J\ K^{-1}mol^{-1}$]

	A(g)	B(g)
$\Delta H°$(kJ)	120	80
$\Delta S°$(J)	210	170

6.



The total number of sp^3 hybrid carbon in major product X of the above reaction is:

SUBJECT III: MATHEMATICS 60 MARKS

SECTION-1

This section consists of 3 Multiple Correct Answers Type Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

1. Consider the two sets $A=\{0,1,2\}$ and $B=\{-2,-1,0,1,2,3,4\}$. The number of functions $f: A \to B$ is

(A) 84 if $f(i) \le f(j) \quad \forall i > j$

(B) 210, if f is injective

(C) 35 if $f(i) > f(j) \quad \forall i > j$

(D) 180 if $f(i) \ge f(j) \quad \forall i > j$

2. A point $P(x,\ y)$ satisfying the equation $\sqrt{ax}+\sqrt{by}=\sqrt{cx+1}$ lies on

(A) A parabola if $a=2, b=1$ and $c=0$

(B) A hyperbola if $a=1, b=2$ and $c=2$

(C) An ellipse if $a=1, b=2$ and $c=2$

(D) A line if $a=0, b=1$ and $c=1$

3. Let $f(x)=x^2-2|x|$ and $g(x)=\begin{cases}\text{minimum}\{f(t):-2\le t\le x\}, x\in[-2,0)\\ \text{maximum}\{f(t):0\le t\le x\}, x\in[0,3]\end{cases}$, then:

(A) The range of $g(x)$ is $[-1,3]$

(B) $f(x)$ is an even function

(C) The value of $g(-1)+g(1)+g(2)+g(3)=2$

(D) The value of $g(-1)+g(0)+g(2)=-2$

SECTION-2

This section consists of 4 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

4. If the area of the region bounded by the curves $f(x)=|\sin x|$ and $g(x)=\frac{2}{\pi}\sin^{-1}(\sin x)$ lying between the lines $x=0$ and $x=16\pi$ is $\left(p+q\frac{\pi}{2}\right)$ sq. units, where p and q are integers, then the value of $p+q$ is:

(A) 32 **(B)** 36 **(C)** 28 **(D)** 60

5. The shortest distance between any two opposite edges of a tetrahedron formed by the planes $y+z=0$, $x+z=0, x+y=0$ and $x+y+z=\sqrt{6}$ is:

(A) $\sqrt{6}$ **(B)** $2\sqrt{6}$ **(C)** 2 **(D)** 3

6. Two buses A and B are scheduled to arrive at a bus stop at noon. The probability that bus A will be late is $\frac{1}{5}$, that bus B will be late is 7/25 and that bus B will be late given the bus A is late is $\frac{9}{10}$. Then the probability that

(A) Neither bus will be late on a particular day is $\frac{7}{10}$

(B) Neither bus will be late on a particular day is $\frac{12}{25}$

(C) Bus A is late given that bus B is late is $\frac{1}{14}$

(D) Bus A is late given that bus B is late is $\frac{5}{14}$

7. DP and DQ are tangents to the parabola $y^2 = 8x$ and normals at P and Q intersect at a point R on the parabola. The locus of circumcentre of ΔDPQ is:

(A) A parabola with length of latus rectum 2 **(B)** A parabola with vertex at (2, 0)

(C) A circle with radius 2 units **(D)** A circle with centre at (2, 0)

SECTION-3

This section consists of 4 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 (P), (Q), (R) and (S) and **List-II** has **Five** entries (1), (2), (3), (4) and (5). **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.

8. Match the entries of Column I with those of Column II:

	Column I		**Column II**
(P)	If $A=[a_{ij}]_{3\times3}$ and $a_{ij}=i^2+j^2$, then A is	**(1)**	Singular and skew symmetric
(Q)	$A=[a_{ij}]_{3\times3}$ and $a_{ij}=3^{i-j}$, then A is	**(2)**	Singular and Symmetric
(R)	$A=[a_{ij}]_{3\times3}$ and $a_{ij}=i^2-j^2$, then A is	**(3)**	Singular but neither symmetric nor skew Symmetric
(S)	$A=\begin{bmatrix}2 & -2 & -4\\ -1 & 3 & 4\\ 1 & -2 & -3\end{bmatrix}$ is	**(4)**	Involutory matrix
		(5)	A null matrix

(A) P-2, Q-3, R-1, S-3 **(B)** P-4, Q-3, R-1, S-2

(C) P-4, Q-5, R-1, S-3 **(D)** P-2, Q-5, R-1, S-4

9. **Match the Column:**

	Column I		**Column II**
(P)	If $\alpha_1,\alpha_2,\alpha_3,\alpha_4,\alpha_5,\alpha_6,\alpha_7$ are the roots of equation $z^7=1$ such that $\sum_{i=1}^{7}\alpha_i^k \neq 0$, then k may be equal to	**(1)**	3
(Q)	Number of complex numbers satisfying $z^{20}=1$ and $z^{30}=1$ simultaneously is:	**(2)**	5
(R)	Number of complex numbers z such that $z^{19}=1$ and $-\pi<\arg z<-\frac{\pi}{2}$ is:	**(3)**	8
(S)	If λ is the product of real parts of complex numbers satisfying $z^{14}=1(\mathrm{Re}(z)>0 \ \& \ \mathrm{Im}(z)>0)$ then $\frac{1}{\lambda}$ equals:	**(4)**	10
		(5)	14

(A) P-3, Q-4, R-2, S-1 **(B)** P-3, Q-3, R-1, S-1

(C) P-5, Q-4, R-2, S-3 **(D)** P-5, Q-3, R-1, S-3

10. Match the entries in Column I with Column II

	Column I		**Column II**
(P)	In the expansion of $\left(x^3-\frac{1}{x^2}\right)^n$, sum of the coefficient of x^5 and x^{10} is 0, then n is	**(1)**	7
(Q)	The number of distinct terms in the expansion of $(x_1+x_2+x_3+x_4)^3$ is	**(2)**	15
(R)	If T_k is the numerically greatest term in the expansion of $(3+2x)^{50}$, where $x=\frac{1}{5}$, then k is	**(3)**	20
(S)	If the last term in the binomial expansion of $\left(2^{\frac{1}{3}}-\frac{1}{\sqrt{2}}\right)^n$ is $\left(\frac{1}{3^{5/3}}\right)^{\log_3 8}$ then n is	**(4)**	10
		(5)	5

(A) P-4, Q-2, R-5, S-1 **(B)** P-4, Q-2, R-1, S-3

(C) P-2, Q-3, R-1, S-4 **(D)** P-2, Q-3, R-5, S-3

11. Column Matching:

	Column I		**Column II**
(P)	Volume of parallelepiped determined by vectors $\vec{a},\vec{b}$ and $\vec{c}$ is 2. Then the volume of the parallelepiped determined by vectors $2(\vec{a}\times\vec{b}),3(\vec{b}\times\vec{c})$ and $(\vec{c}\times\vec{a})$ is	**(1)**	100
(Q)	Volume of parallelepiped determined by vectors $\vec{a},\vec{b}$ and $\vec{c}$ is 5. Then the volume of the parallelepiped determined by vectors $3(\vec{a}+\vec{b}),(\vec{b}+\vec{c})$ and $2(\vec{c}+\vec{a})$ is	**(2)**	30
(R)	Area of a triangle with adjacent sides determined by vectors $\vec{a}$ and $\vec{b}$ is 20. Then the area of the triangle with adjacent sides determined by vectors $(2\vec{a}+3\vec{b})$ and $(\vec{a}-\vec{b})$ is	**(3)**	24
(S)	Area of a parallelogram with adjacent sides by vectors $\vec{a}$ and $\vec{b}$ is 30. Then the area of parallelogram with adjacent sides determined by vectors $(\vec{a}+\vec{b})$ and $\vec{a}$ is	**(4)**	48
		(5)	60

(A) P-2, Q-5, R-3, S-1 **(B)** P-2, Q-3, R-1, S-4

(C) P-3, Q-5, R-1, S-2 **(D)** P-3, Q-4, R-3, S-2

SECTION-4

This section consists of 6 NON-NEGATIVE INTEGER Type Questions. For each question, enter the correct integer corresponding to the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer.

1. If $y=f(x)$ satisfies the inequality $2y^2-2\sqrt{2}y\cos\left(x-\frac{\pi}{4}\right)+\sin 2x\le 0$ and the maximum and minimum values of the integration $\int_0^{\frac{\pi}{4}} f(x)dx$ are k_1 and k_2, then the value of $[10k_1]\cdot[10k_2]$, where [•] represents the greatest integer function, is:

2. Let $f(x)$ be a continuous function given by the equation $f(x)=\int_0^1 e^{x+t}f(t)dt+e^x$ .The value of $\left|(e^2-3)f(0)\right|$ is:

3. Let $a_1=2, a_{n+1}=a_n^2-a_n+1$ for $n\ge 1$. Find $\sum_{n=1}^{\infty}\frac{1}{a_n}$

4. If $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6$ are the roots of the equation $7z^6 + 6z^5 + 5z^4 + 4z^3 + 3z^2 + 2z + 1 = 0$, where z is a complex number, then the value of $\sum_{i=1}^{6} \frac{1}{1-\alpha_i}$ is equal to:

5. The line which contains all points (x, y, z) which are of the form $(x, y, z) = (2, -3, 4) + \lambda(1, 2, -3)$ intersects the plane $2x + 3y - z = 13$ at the point P and intersects the yz-plane at Q. If the distance between P and Q is $a\sqrt{b}$, where $a, b \in N$ and $a > 3$, then $\frac{a+b}{3}$ equals.

6. If $\frac{{}^nC_r + 4\cdot {}^nC_{r+1} + 6\cdot {}^nC_{r+2} + 4\cdot {}^nC_{r+3} + {}^nC_{r+4}}{{}^nC_r + 3\cdot {}^nC_{r+1} + 3\cdot {}^nC_{r+2} + {}^nC_{r+3}} = \frac{n+k}{r+k}$ then the value of k is: