VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Advanced Full Test-1| Paper – 1 | JEE 2024

Maximum Marks: 180

Timing: 10:00 AM to 1:00 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 **three** sections (Section 1, Section 2 & Section 3).

2. **Section 1** contains **8 Numerical Value Type Questions**. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.

Section 2 contains **6 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 3 contains **FOUR (04)** Matching List sets. Each set has **TWO** lists: **List I** and **List II**.
Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct 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: 24)

- This section contains **Eight (08) Numerical Value Type Questions**. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.
- Answer to each question will be evaluated according to the following marking scheme:

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

  Zero Mark: 0 In all other cases.

SECTION – 2 | (Maximum Marks: 24)

- This section consists of **Six (06)** 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 – 3 | (Maximum Marks: 12)

- This section contains **Four (04**) Matching List sets. Each set has **TWO** lists: **List I** and **List II**.
- 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.

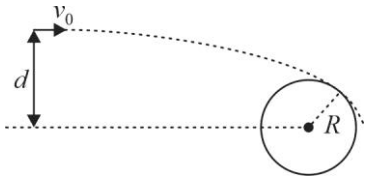
PHYSICS 60 MARKS

SECTION 1

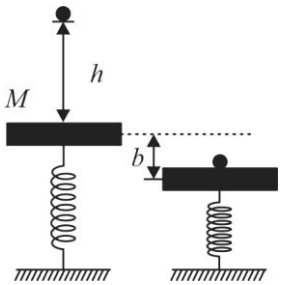
NUMERICAL VALUE TYPE

This section contains **8 Numerical Value Type Questions**. For each question, enter the correct numerical value of the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.

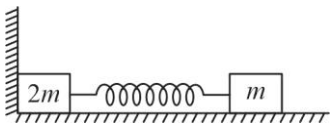
1. A cosmic body of mass '*m*' approaches the earth surface, from a large distance with initial speed $v_0 = \sqrt{\frac{GM}{4R}}$, where *M* and *R* are mass and radius of earth respectively. If the cosmic body passes off tangentially to the earth's surface, then find the ratio *d*/*R*.



2. A mass *M* is in static equilibrium on a massless vertical spring of spring constant *k* as shown in the figure. A ball of mass *m* dropped from certain height *h* sticks to the mass *M* after colliding with it. The oscillations they perform reach to height '*a*' above the original level of *M* and depth '*b*' below it. Find the height *h* (in meters). (Given that $M = m;\ b = \frac{3mg}{k}; m = 1kg, k = 10$ N/m, $g = 10$ m/s^2)



3. Two blocks of mass *m* and 2*m* connected by a weightless spring of stiffness *k* rest on a smooth horizontal plane. Block of mass *m* is shifted to a small distance *x* to the left and then released. Find average force (in Newton) exerted by wall on mass 2*m* between the moments of releasing mass m and breaking off of mass 2*m* from wall. [$m = 1$kg, $k = 90$N/m, $x = \pi$ cm]

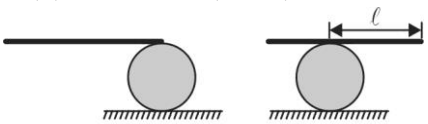


4. A rod of mass 3*M* and length 2*L* is made by connecting two rods of mass 2*M* and *M* respectively and length *L* each (system can be considered a rigid body). The setup is pivoted at one end and released from horizontal position. Just when the rod becomes vertical, lower half potion (*M*, *L*) breaks off spontaneously. Maximum height to which center of remaining rod rises in subsequent motion is *nL*, where *n* is _____ .

5. A cylinder of height $h = 10$ cm and radius $r = 2$ cm is open at the top and it is completely filled with a liquid. Now it is rotated about its vertical axis with angular speed ω such that half the base area of the cylinder gets exposed. Find the value of ω (in rad/s).

6. A cylindrical tube with a frictionless piston ends in a small hole of area of cross-section $4\times10^{-6}\,\text{m}^2$, which is very small as compared to the area of cross-section of the tube. The tube is filled with a liquid of density 10^4 kg/m^3. The tube is fixed horizontally and the piston is pushed at a constant speed so that liquid comes out of the hole at a constant volumetric rate $Q\ \text{m}^3/\text{s}$. No liquid leaks around the piston. The material of the tube can bear a maximum pressure 6×10^5 Pa. The maximum possible value of Q so that the tube does not break is _____ $\times10^{-5}$. (Atmospheric pressure $=10^5$ Pa)

7. A small roller of diameter 20 cm lies on a horizontal floor and a meter scale is positioned horizontally on it with one edge of the scale on top of it as shown in figure (i). The scale is now pushed slowly from the other end so that it moves without sliding on the roller and the roller starts rolling without slipping on the floor. After the roller has moved 40 cm, the length *l* of the scale that moves to the right of the roller as shown in figure (ii) is _____ (in cm).



8. A small ball is projected from a very high tower horizontally with speed 5m/s. Radius of curvature of the trajectory (in m) after 0.5*s* is _____. [$g = 10$ m/s^2; $\sqrt{2} = 1.414$]

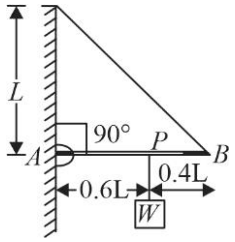
SPACE FOR ROUGH WORK

SECTION 2

MULTIPLE CORRECT ANSWERS TYPE

This Section contains **6 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.

9. A uniform beam of mass 50 kg and length L is hinged to a vertical wall at one of its ends and the other end is tied to a rope as shown in the figure. A load W is suspended at point P. The tie rope can support a maximum load of 180 kg. Which of the following statement(s) is (are) correct? [Take $g = 10\ \text{ms}^{-2}$]



(A) Maximum laod W that can be supported from the point P of the beam is nearly 212.2 kg

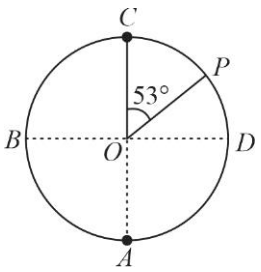
(B) Maximum laod W that can be supported from the point P of the beam is nearly 170.4 kg

(C) If the point of suspension of the load is moved to the mid-point of the beam, then the maximum load that can be supported reduces

(D) If a load of 60 kg is suspended from the mid-point of the beam, the tension in the rope then is nearly 778 N.

10. A circular frame $ABCD$ of radius 1 m with section ABC being smooth and CDA being rough is held vertical as shown in the Figure. A bead of mass 0.5 kg is projected from the bottommost point A with speed $10\ \text{ms}^{-1}$ to move along the frame ABC. It hits an identical bead at rest, kept at the topmost point C inelastically. The combined mass after collision, moves along CPD and when it reaches P, the force exerted by combined mass on the frame is zero. Which of the following statement(s) is (are) correct?

$\left[\text{Take } g = 10\text{ms}^{-2},\ \cos 37° = \frac{4}{5}\right]$



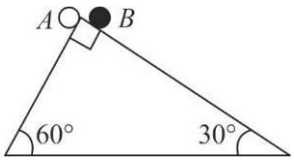
(A) The speed of the combined mass at C is $3.87\ \text{ms}^{-1}$

(B) The speed with which the combined mass reaches P is $6\ \text{ms}^{-1}$

(C) The net work done on the combined mass from C to P is 19 J

(D) The work done on the combined mass by friction till it reaches P is –8.5 J

11. A hollow sphere A and a solid sphere B, both having same mass and radius are released simultaneously from the top of a right triangular fixed wedge as shown. They roll down the wedge without slipping. Choose the correct statements.



(A) They reach the bottom of the wedge simultaneously

(B) A reaches the bottom of wedge before B

(C) They reach the bottom of wedge with the same kinetic energy

(D) A reaches the bottom of wedge with speed more than that of B

12. A particle of mass M is moving in a plane due to a force F whose magnitude is constant and whose direction rotates with constant angular velocity ω in that plane. Initially particle is at rest at origin and force F is along $+x$ axis. Which of the following statement(s) is(are) correct ?

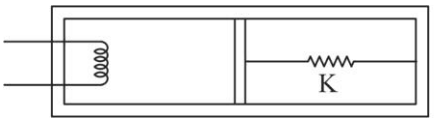
(A) x coordinate of the particle is non-negative during the motion

(B) Particle comes to rest at every interval of $\frac{\pi}{\omega}$ starting from $t=0$

(C) Average speed of the particle for time it comes to rest starting from $t=0$ is $\frac{4F}{\pi m\omega}$

(D) y-coordinate of the particle is linearly increasing with time

13. A closed insulated cylindrical container with an insulated piston which can freely move along the cylinder is kept in a horizontal position. Piston is connected to right wall of the container with a spring (negligible volume) of spring constant k. Initially equal amount of an ideal gas $(\gamma = 5/3)$ is present on the both sides with pressure P_0, volume V_0 and temperature T_0. When a heater slowly supplies ΔQ amount of heat, piston is found to shift to the right by x_0. Final pressure and temperature on the left and right side in final position is found to be (P_L, T_L) and (P_R, T_R) respectively. Work done by the gas on left side of piston and right side of the piston during the process are W_L and W_R respectively. Which of the following option(s) is(are) correct ?



A : Area of piston

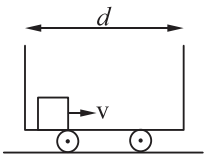
(A) $P_R = P_0\left(\frac{V_0}{V_0 - Ax_0}\right)^{5/3}$

(B) $|W_L| = |W_R|$

(C) $P_L = P_R + \frac{kx_0}{A}$

(D) ΔQ is equal to sum of change in internal energies of the gas on two sides

14. In a stationary cart of mass $32m$ and length d, a small block of mass m is projected along its length with velcotiy v towards front end from rear end as shown in figure. If $e = \frac{1}{2}$ and friction is absent then, which of the following option(s) is(are) correct ?



(A) Final velocity of cart is $\frac{v}{33}$

(B) After five collisions block will be at rest w.r.t ground for some time

(C) Time after which the block comes to rest w.r.t ground is $\frac{31d}{v}$

(D) Time interval between fourth and fifth collision is $\frac{16d}{v}$

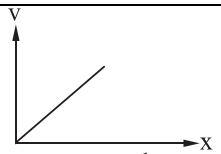
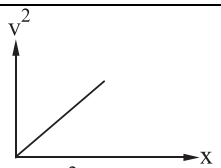
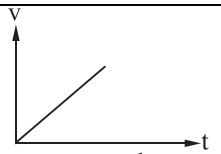
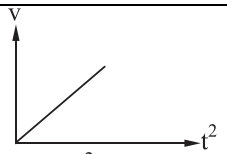
SPACE FOR ROUGH WORK

SECTION - 3

MATCHING LIST TYPE

This section contains **4** Matching List sets. Each set has **TWO** lists: **List I** and **List II**. Each question has **FOUR** options **(A)**, **(B)**, **(C)** and **(D)**. **ONLY ONE** of these four options is the correct answer.

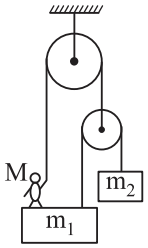
15. Column-I gives some graphs for a particle moving along x-axis in positive x-direction. The variables v, x, and t represent speed of particle, x-coordinate of particle and time respectively. Column-II gives certain resulting interpretation. Match the graphs in Column-I with the statements in Column-II.

Column-I		Column-II	
(I)	 v-x graph	**(A)**	Acceleration of particle is uniform and equal to slope of graph.
(II)	 v^2-x graph	**(B)**	Acceleration of particle is uniform and equal to (slope/2) of the graph
(III)	 v-t graph	**(C)**	Acceleration of particle is directly proportional to 't'
(IV)	 v-t^2 graph	**(D)**	Acceleration of particle is directly proportional to 'x'
		(E)	Acceleration of the particle is inversely proportional to t

(A) (I)-(A); (II)-(B); (III)-(A); (IV)-(E) **(B)** (I)-(D); (II)-(B); (III)-(A); (IV)-(C)

(C) (I)-(D); (II)-(E); (III)-(A); (IV)-(B) **(D)** (I)-(C); (II)-(B); (III)-(A); (IV)-(D)

16. A man of mass M is standing on a platform of mass m_1 and holding a string passing over a system of ideal pulleys. Another mass m_2 is hanging as shown. Which option is the correct match? $(m_2 = 20\,\text{kg},\ m_1 = 10\,\text{kg},\ g = 10\ \text{m/s}^2)$.

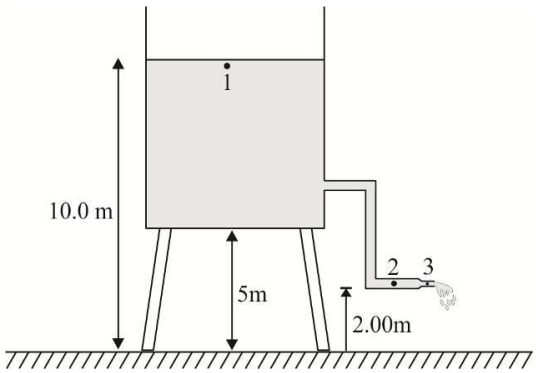


Column-I		Column-II	
(I)	Weight of man for equilibrium	**(A)**	100 N
(II)	Force exerted by man on string so that normal by platform is equal to weight of man	**(B)**	250 N
(III)	If man let go of the string, normal force by platform on the man	**(C)**	500 N
(IV)	Normal reaction of platform on man in equilibrium	**(D)**	600 N
		(E)	2000 N

(A) (I)-(C); (II)-(E); (III)-(B); (IV)-(A) **(B)** (I)-(C); (II)-(D); (III)-(E); (IV)-(B)

(C) (I)-(D); (II)-(B); (III)-(C); (IV)-(A) **(D)** (I)-(E); (II)-(C); (III)-(D); (IV)-(B)

17. Water flows steadily from an open tank as shown in the figure. The elevation of point 1 is 10.0m, and the elevation of points 2 and 3 is 2.00m. The cross-sectional area at point 2 is 0.0480 m^2 and at point 3 it is 0.0160 m^2. The area of the tank is very large compared with the cross-sectional area of the pipe. Assuming that Bernoulli's equation applies, match the two columns. (Take g = 10m/s^2)



Column-I		Column-II	
(I)	Velocity of fluid at point 3 (in m/s)	**(P)**	5
(II)	Gauge pressure at 2 (in 10^4 Pa)	**(Q)**	12.6
(III)	Gauge pressure at the bottom of tank (in 10^4 Pa)	**(R)**	7.1
(IV)	Velocity of fluid at point 2 (in m/s)	**(S)**	4.2

Code :

(A) I-Q; II-R; III-P; IV-S **(B)** I-S; II-P; III-R; IV-Q

(C) I-Q; II-P; III-R; IV-S **(D)** I-S; II-R; III-P; IV-Q

18. In column I, certain thermodynamic process are given and in column II, the value of physical quantities are given. Match the two columns.

ΔQ = amount of heat exchange,

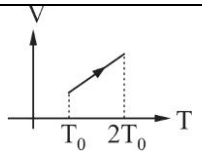
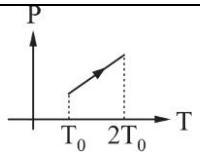
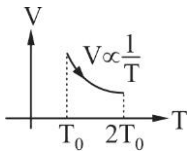
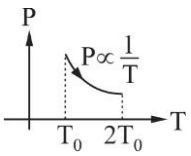
ΔU = change in internal energy.

ΔW = amount of pressure-volume work,

T = Temperature of the gas,

P = Pressure of the gas,

ρ = Density of the gas.

Column-I		Column-II	
(I)	1 mole of N_2 	**(A)**	$\lvert\Delta Q\rvert = 4RT_0$
(II)	1 mole of He 	**(B)**	$\lvert\Delta U\rvert = \frac{3}{2}RT_0$
(III)	1 mole of a gaseous mixture having adiabatic index $\gamma = 1.5$ 	**(C)**	$\Delta W = RT_0$
(IV)	1 mole of a gas having degree of freedom $f = 4$ 	**(D)**	ρ Vs T graph for the process is a straight line
		(E)	P Vs ρ graph for the process is a parabola

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

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

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

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

SUBJECT II : CHEMISTRY 60 MARKS

SECTION 1

NUMERICAL VALUE TYPE

This section contains **8 Numerical Value Type Questions**. For each question, enter the correct numerical value of the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.

1. For 10 minutes each, at 0°C from two identical holes nitrogen and an unknown gas were leaked into a common vessel of 4 litre capacity. The resulting pressure in vessel is 2.8 atm and the mixture contain 0.4 mole of nitrogen. What is the molar mass (in g mol^{-1}) of unknown gas?
[Take $R = 0.0821\,L\text{-}atm/molK$]

2. The magnitude of heat of formation of CH_4 in kJ/mole is:

If given heat : $C(s) + O_2(g) \longrightarrow CO_2(g)$ $\Delta H = -393.5$ kJ

$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(\ell)$ $\Delta H = -285.8$ kJ

$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(\ell)$ $\Delta H = -890.3$kJ

1 cal = 4.18 J

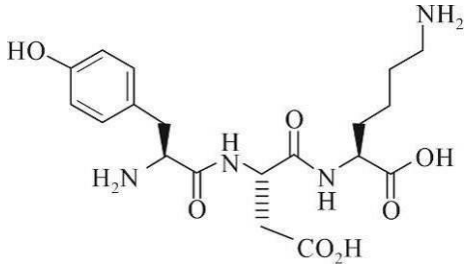
3. An alloy of iron and carbon is treated with H_2SO_4 in which only iron reacts with H_2SO_4 to form H_2 and $Fe_2(SO_4)_3$. If a sample of alloy weighing 140 gm gave 6 gm of H_2, then what is percent by mass of iron in the alloy? [Atomic mass: Fe = 56, C = 12, H = 1]

4. The enthalpy of neutralization of a strong base and strong acid is 57.0 kJ/eq. Find the value of heat evolved in kJ when 0.5 mole of HNO_3 are added to 1 L of 0.2M NaOH solution.

5. How many isomers including stereoisomers are possible for C_7H_{16} ?

6. The pKa_1, and pKa_2 of carbonic acid (H_2CO_3) are 6.3 and 10.3 respectively at 25ºC. If $pKw = 14$, then the pH of 0.01 M sodium bicarbonate solution in water at 25°C is _____.

7. The structure of a peptide is given below.



If number of sp^2 hybridized carbon atoms is Z_1, sp^3 hybridized carbon atoms is Z_2 and number of lone pair of electrons is Z_3 respectively, then what is $Z_1+Z_2+Z_3$?

8. How many electrons in a ground-state As atom (in the gas phase) have quantum numbers n = 3 and l = 1? [Given: Atomic Number of As = 33]

SECTION 2

MULTIPLE CORRECT ANSWERS TYPE

This Section contains **6 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.

9. A solution contains 0.01 M concentration each of Zn^{2+}, Mg^{2+} and Mn^{2+} ions. They are to be precipitated as their sulphide by passing H_2S gas into the solution and the solution is saturated with 0.1 M H_2S. If pH of the solution can be regulated by using certain buffer, then select correct statements: [Given: $K_{sp}(ZnS) = 10^{-18}$, $K_{sp}(MnS) = 10^{-22}$; $K_{sp}(MgS) = 10^{-12}$, $K_a(H_2S) = 10^{-21}$]

(A) Only MnS is precipitated in pH range of 1 to 3

(B) ZnS is precipitated when the pH > 3

(C) MgS gets precipitated when the pH > 6

(D) MgS gets precipitated when pH < 3

10. Assume the Pauli's exclusion principle can permit three electrons per orbital rather than two. The **CORRECT** statement(s) is(are) :

(A) 9 electrons are needed in the outermost shell for a noble gas configuration

(B) 3 electrons would be shared in a covalent bond as per the molecular orbital theory

(C) The electron dot structure of an element X with Z = 12 can be $\vdots\ddot{\underset{\cdot\cdot}{X}}\vdots$

(D) Assuming MO diagram of N_2 is valid for X_2 (Z = 12), the bond order of X_2 is 2

11. One mol of an ideal gas is expanded isothermally as following:

$$\underset{(10\,atm,\,300K)}{A} \xrightarrow{\text{reversible}} \underset{(5atm,\,300K)}{B} \xrightarrow{P_{ext.}=1atm} \underset{(1atm,\,300K)}{C}$$

Which is/are correct statements? (Given: $\ell n4 = 1.4, R = 2\,Cal\,mol^{-1}K^{-1}$)

(A) Net work done by the system is –900 Cal

(B) Change in entropy of the system for path AB is 1.4 Cal K^{-1}

(C) Change in free energy for path AB is –420 Cal

(D) Change in entropy of the surrounding for path BC is –1.6 Cal K^{-1}

12. Which of the following is (are) true for an ideal gas system which is been expanded from state A to state B and then compressed back to A?

(A) $\left|W_{\text{reversible expansion}}\right|_{\text{isothermal}} > \left|W_{\text{reversible expansion}}\right|_{\text{adiabatic}}$

(B) $\left|W_{\text{irreversible compression}}\right|_{\text{isothermal}} > \left|W_{\text{irreversible expansion}}\right|_{\text{isothermal}}$

(C) $\left|W_{\text{reversible expansion}}\right|_{\text{isothermal}} = \left|W_{\text{reversible compression}}\right|_{\text{isothermal}}$

(D) $\left|W_{\text{reversible expansion}}\right|_{\text{adiabatic}} = \left|W_{\text{irreversible expansion}}\right|_{\text{adiabatic}}$

13. Which of the following is/are correct as per molecular orbital theory of bonding ?

(A) HOMO for O_2 is $\pi^*_{2p_x}$ or $\pi^*_{2p_y}$

(B) LUMO for N_2 is $\pi^*_{2p_x}$ or $\pi^*_{2p_y}$

(C) C_2 is unstable due to lack of head on overlap, having only lateral overlap

(D) C_2^{2-} is unstable due to presence of head on overlap along with lateral overlap

14. Which of the following mixtures can form a buffer?

(A) HCl, NaOH **(B)** CH_3COONa, HCl

(C) NH_4OH, HCl **(D)** NH_4Cl, NaOH

SECTION - 3

MATCHING LIST TYPE

This section contains **4** Matching List sets. Each set has **TWO** lists: **List I** and **List II**. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

15. MATCH THE FOLLOWING:

	Column 1		**Column 2**
(I)	Reversible cooling of an ideal gas at constant volume	**(P)**	$w = 0;\ \Delta U < 0$
(II)	Reversible isothermal expansion of an ideal gas	**(Q)**	$w > 0;\ \Delta U = 0$
(III)	Adiabatic expansion of ideal gas against vacuum	**(R)**	$w = 0;\ \Delta U = 0$
(IV)	Reversible isothermal compression of an ideal gas	**(S)**	$w < 0;\ \Delta U = 0$

Code :

(A) I-P ; II-S ; III –R ; IV- Q **(B)** I-P ; II-S ; III –Q ; IV- R

(C) I-S ; II-P ; III –R ; IV- Q **(D)** I-P ; II-R ; III – S ; IV- Q

16. Match the Column (under identical conditions)

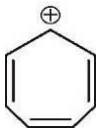
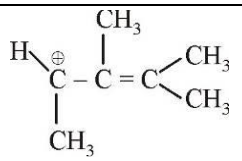
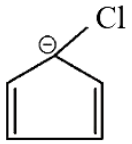
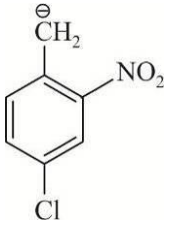
Column I		**Column II**	
(I)	a (vander Waals constant)	**(P)**	$He > CH_4 > SO_2$
(II)	Root mean square velocity	**(Q)**	$He = CH_4 = SO_2$
(III)	Kinetic energy (per mole) as per K.T.G.	**(R)**	$SO_2 > CH_4 > He$
(IV)	Rate of diffusion	**(S)**	$He < SO_2 < CH_4$

Code :

(A) I-R ; II-P ; III-R ; IV-P **(B)** I-R ; II-P ; III-R ; IV-Q

(C) I-R ; II-P ; III-Q ; IV-P **(D)** I-S ; II-P ; III-Q ; IV-R

17. Match the following Column I and Column II

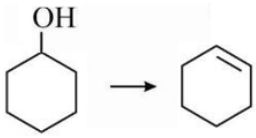
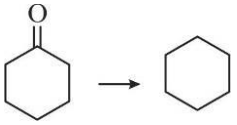
Column I (Reaction Intermediate)		**Column II (Stabilizing effects for the intermediate)**	
(I)		**(P)**	Inductive effect
(II)		**(Q)**	Resonance stabilization via conjugation
(III)		**(R)**	Aromaticity of the charged ring
(IV)		**(S)**	Hyperconjugation

Code :

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

(C) I-P,Q,R ; II-P,Q ; III-P,Q,R ; IV-Q,R **(D)** I-P,Q,R ; II-P,Q ; III-Q,R ; IV-Q,R

18. Match conversions given in List 1 with the appropriate reagent given in List 2.

List 1 (Reactions)		**List 2 (Appropriate reagent)**	
(P)	$CH_3-CH_2-X \rightarrow CH_3-CH_2-CH_2-CH_3$	**1.**	NH_2-NH_2/OH^-
(Q)		**2.**	NBS. Followed by alc. KOH / Δ
(R)		**3.**	Na/dry ether
(S)		**4.**	conc.H_2SO_4 / Δ

Codes :

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

SUBJECT III : MATHEMATICS 60 MARKS

SECTION 1

NUMERICAL VALUE TYPE

This section contains **8 Numerical Value Type Questions**. For each question, enter the correct numerical value of the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.

1. Define polynomial $f_n(x)$ of n^{th} degree as:

$f_n(\cos\theta) = \cos n\theta$, n : natural number

i.e $f_2(x) = 2x^2 - 1$ $\qquad$ $f_3(x) = 4x^3 - 3x$

If $\left(x+\sqrt{x^2-1}\right)^{10} + \left(x-\sqrt{x^2-1}\right)^{10}$ is equal to $af_b(x)$, then the value of a +b is _____.

2. If $S = \sum_{n=2}^{\infty} \frac{3n^2+1}{\left(n^2-1\right)^3}$ then the value of S is equal to _____.

3. Let $z_1 = 10+6i$ and $z_2 = 4+6i$. If z is any complex number such that the argument of $(z-z_1)/(z-z_2)$ is $\pi/4$, then value of $|z-7-9i|$ is _____.

4. If $x^2 - 10ax - 11b = 0$ have roots c and d ; and $x^2 - 10cx - 11d = 0$ have roots a and b, then $a+b+c+d$ = _____.

5. Let p, q be integers and let α, β be the roots of the equation, $x^2 - x - 1 = 0$ where $\alpha \neq \beta$. For $n = 0,1,2,.....$, let $a_n = p\alpha^n + q\beta^n$.

Fact: If a and b are rational numbers and $a + b\sqrt{5} = 0$, then $a = 0 = b$.

If $a_4 = 28$, then value of $p+2q$ is _____.

6. If $\sin^3 x \sin 3x = \sum_{m=0}^{6} C_m \cos^m x$, where $C_0, C_1, C_2, \ldots . C_6$ are constants, then the value of $C_0 + C_2 + C_4 + C_6$ is _____.

7. The number of distinct solutions of $\sin 5\theta \,.\, \cos 3\theta = \sin 9\theta \,.\, \cos 7\theta$ in $[0, \pi/2]$ is _____.

8. Sum to infinite terms of the series $\frac{2}{3} - \frac{5}{6} + \frac{2}{3} - \frac{11}{24} + ...$ is _____.

SECTION 2

MULTIPLE CORRECT ANSWERS TYPE

This Section contains **6 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.

9. $x+y=2$ and $x-y=2$ are tangents on a parabola at (1, 1) and (4, 2) are respectively. Which of the following is/are **CORRECT**?

(A) Equation of directrix is $x+3y=2$ **(B)** Equation of axis is $3x-y=5$

(C) Focus of the parabola is at $\left(\frac{8}{5},\frac{6}{5}\right)$ **(D)** Vertex of the parabola is at $\left(\frac{33}{20},\frac{13}{20}\right)$

10. In ΔABC, X and Y are foot of perpendicular from A and C respectively on median BE. If $\frac{\text{area}\left(\Delta BYC\right)}{\text{area}\left(\Delta AXE\right)}=4$, then which of the following is/are **CORRECT**?

(A) $\frac{\text{area}\left(\Delta ABC\right)}{\text{area}\left(\Delta AXB\right)}=3$ **(B)** $BX=2EY$

(C) $2\,area\left(\Delta AXB\right)=area\left(\Delta XEC\right)$ **(D)** $area\left(\Delta AXB\right)=2area\left(\Delta XEC\right)$

11. If a, b, c are in AP and A, B, C are in GP (common ratio $\neq 1$). Then which of the following is/are **CORRECT**?

(A) $\frac{A}{a},\frac{B}{b},\frac{C}{c}$ are in HP if common ratio of GP is c/a.

(B) $\frac{a}{A},\frac{b}{B},\frac{c}{C}$ are in HP if common ratio of GP is equal to common difference of AP.

(C) $\frac{A^2}{a},\frac{B^2}{b},\frac{C^2}{c}$ are in HP if common ratio of GP is $\sqrt{\frac{c}{a}}$.

(D) $\frac{a}{A^2},\frac{b}{B^2},\frac{c}{C^2}$ are in HP if common ratio of GP is equal to square root of common difference of AP.

12. A circle touches y-axis at distance 3 units from origin and cuts off intercept of length 8 units on x-axis. The possible equation can be:

(A) $x^2+y^2+10x+6y+9=0$ **(B)** $x^2+y^2-10x+6y+9=0$

(C) $x^2+y^2-10x-6y+9=0$ **(D)** $x^2+y^2+10x-6y+9=0$

13. Let $f(x)=x^3+px^2+qx+r$, where p, q and r are integers, $f(0)$ and $f(-1)$ are odd integers. Which of the following is/are **CORRECT**?

(A) $f(1)$ is an even integer

(B) $f(1)$ is an odd integer

(C) $f(x)=0$ has three distinct integer roots

(D) $f(x)=0$ cannot have three integer roots.

14. A parabola C whose focus is $S(0,0)$ and passes through $P(3,4)$. Equation of tangent at P to parabola is $3x+4y-25=0$. A chord through S parallel to tangent at P intersect the parabola at A and B. Which of the following is/are **CORRECT**?

(A) Length of AB is 20 units.

(B) Latus rectum of parabola is 20 units

(C) Only one real normal can be drawn from the point $(-3,-4)$.

(D) Only one real normal can be drawn from the point $(-6,-8)$.

SECTION - 3

MATCHING LIST TYPE

This section contains **4** Matching List sets. Each set has **TWO** lists: **List I** and **List II**. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

15. Match the inequality in column-I with their complete solution set in column-II.

	Column-1	**Column-1**	
(P)	$\log_{\sin x}\log_3\log_{0.2}x<0$	(i)	$\{0\}$
(Q)	$\dfrac{(e^x-1)(2x-3)(x^2+x+2)}{(\sin x-2)x(x+1)}\le 0$	(ii)	$[-3,5]$
(R)	$\lvert 2-\lvert x-1\rvert\ \rvert\le 2$	(iii)	$\left(0,\dfrac{1}{125}\right)$
(S)	$\lvert\sin(3x-4x^3)\rvert\le 0\ ,\ x\in I$	(iv)	$(-\infty,-1)\cup\left[\dfrac{3}{2},\infty\right)$
		(v)	ϕ

Codes:

	P	**Q**	**R**	**S**
(A)	(iii)	(iv)	(ii)	(i)
(B)	(iv)	(i)	(ii)	(iii)
(C)	(ii)	(iii)	(i)	(iv)
(D)	(iv)	(iii)	(i)	(iii)

16. Match List I with List II and select the correct answer using the code given below the lists:

	List-I	List-II	
(P)	$\sin\frac{\pi}{21}\sin\frac{2\pi}{21}\sin\frac{3\pi}{21}.....\sin\frac{9\pi}{21}\sin\frac{10\pi}{21}=$	(i)	$\frac{\sqrt{11}}{2^{10}}$
(Q)	$\sin\frac{\pi}{22}\sin\frac{2\pi}{22}\sin\frac{3\pi}{22}.....\sin\frac{9\pi}{22}\sin\frac{10\pi}{22}=$	(ii)	$\frac{1}{2^{10}}$
(R)	$\cos\frac{\pi}{21}\cos\frac{2\pi}{21}\cos\frac{3\pi}{21}.....\cos\frac{9\pi}{21}\cos\frac{10\pi}{21}=$	(iii)	$\frac{\sqrt{11}}{2^{5}}$
(S)	$\cos\frac{\pi}{22}\cos\frac{2\pi}{22}\cos\frac{3\pi}{22}.....\cos\frac{9\pi}{22}\cos\frac{10\pi}{22}=$	(iv)	$\frac{\sqrt{21}}{2^{10}}$

Codes:

	P	Q	R	S
(A)	(iii)	(iv)	(iii)	(ii)
(B)	(iv)	(i)	(ii)	(i)
(C)	(ii)	(iii)	(i)	(iv)
(D)	(iv)	(iii)	(i)	(iii)

17. From the point $P(4,-4)$ tangents *PA* and *PB* are drawn to the circles $x^2+y^2-6x+2y+5=0$ (*C* is centre of the circle).

	Column-I	Column-II	
(P)	Length of *AB* (in units) = _____.	(i)	$\frac{5}{2}$
(Q)	Tangents of angle between *PA* and *PC* = _____.	(ii)	$\sqrt{10}$
(R)	Area of triangle *PAB* (in square units) = _____.	(iii)	1
(S)	Absolute difference of slope of *PA* and *PB* = _____.	(iv)	$\frac{3}{4}$

Codes:

	P	Q	R	S
(A)	(iii)	(iv)	(iv)	(ii)
(B)	(iv)	(i)	(ii)	(i)
(C)	(ii)	(iii)	(i)	(i)
(D)	(iv)	(iii)	(i)	(iii)

18. Match the following.

	Column-I	Column-II	
(P)	If $\sqrt{3}bx+ay=2ab$ touches the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ at a part whose Eccentric angle is θ then $\operatorname{cosec}\theta$ = _____.	(i)	0
(Q)	If e_k is the eccentricity of $(x-3)(y+2)=k^2$ then e_2-e_3 = _____.	(ii)	1
(R)	If $x^2+y^2=a^2$ is drawn without intersecting the Curve $xy=9$ then integral values of '*a*' are _____.	(iii)	2
(S)	If $xy=1+\sin^2\theta$ is a family of rectangular hyperbolas And '*K*' is the area of the triangle formed by any tangent With co-ordinate axes then *K* can be equal to _____.	(iv)	3
		(v)	4

Codes:

	P	Q	R	S
(A)	(ii)	(iii)	(i), (ii), (iii), (iv), (v)	(i), (iii), (v)
(B)	(i)	(iii)	(i), (ii), (iii), (iv), (v)	(ii), (iii), (iv)
(C)	(ii)	(i)	(iii), (iv), (v)	(i), (ii), (iii), (iv), (v)
(D)	(iii)	(i)	(i), (ii), (iii), (iv), (v)	(iii), (iv), (v)

SPACE FOR ROUGH WORK

End of JEE Advanced Full Test-1 | PAPER-1 | JEE-2024