JEE ADVANCED TEST - 04 (PAPER-1) (#1376)

Total Marks: 180 Total Duration: 180 minutes

Instructions

The test consists of total **51** questions.

1. Each subject **(PCM)** has **17** questions.

2. This question paper contains Three Parts.
3. **Part - I is Physics, Part - II is Chemistry and Part III is Mathematics**.
4. Each Part is further divided into **fourSections:Section-1 To Section 4**

4.**Section - 1THREE (03)** questions.
5. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these **four** option(s) is (are) the correct
answer(s).

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

7. Answer to each question will be evaluated according to the following marking scheme:
   - **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 **one** option is chosen and it is a correct option;
   - **Zero Marks : 0** If **unanswered**;
   - **Negative Marks : -2** In all other cases.

8. For example, in a question, if (A), (B) and (D) are the ONLY **three** options corresponding to
   - correct answers, then
     choosing **ONLY (A), (B) and (D)** will get **+4** marks;
   - choosing **ONLY (A) and (B)** will get **+2** marks;
   - choosing ONLY (A) and (D) will get **+2** marks;
   - choosing **ONLY (B) and (D)** will get **+2** marks;
   - choosing **ONLY (A)** will get **+1** mark;
   - choosing **ONLY (B)** will get **+1** mark;
   - choosing **ONLY (D)** will get **+1** mark;
   - choosing no option(s) (i.e. the question is unanswered) will get **0** marks;
   - choosing any other option(s) will get **-2** marks.

9. **Section - 2** contains **FOUR (04)** questions.

10. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

11.For each question, choose the option corresponding to the correct answer.

12. 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.

13.**Section - 3** contains **SIX (06)** questions.

14. The answer to each question is a **NON-NEGATIVE INTEGER.**

15. For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual
numeric keypad in the place designated to enter the answer.

16. 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

17.**Section - 4** contains **TWO (02)** paragraphs.

18.Based on each paragraph, there are **TWO (02)** questions.

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

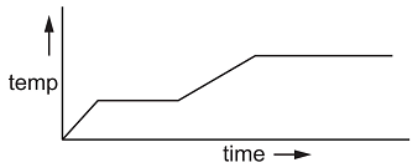
- **Full Marks :+3** If ONLY the correct integer is entered;
- **Zero Marks : 0** In all other cases

Section: Physics - Section 1

Marks per question: 4
3 of 3 question(s) in this section will be shown to examinee
Examinee should answer all 3 question(s) in this section
This section has negative marking for incorrect answer(s). 50% marks will be deducted for every incorrect answer.

Q1 **Difficulty Level: Easy**

Knowledge Level: K1



Heat is supplied to a certain homogenous sample of matter, at a uniform rate. Its temperature is plotted against time, as shown. Which of the following statement/statements are true?

- ☐ Its specific heat capacity is greater in the solid state than in the liquid state.
- ☐ Its specific heat capacity is greater in the liquid state than in the solid state.
- ☐ Its latent heat of vaporization is greater than its latent heat of fusion.
- ☐ Its latent heat of vaporization is smaller than its latent heat of fusion.

Q2 **Difficulty Level: Easy**

Knowledge Level: K1

A plane progressive wave of frequency 25 Hz, amplitude 2.5×10^{-5} m and initial phase zero moves along the negative x-direction with a velocity of 300 m/s. A and B are two points 6 m apart on the line of propagation of the wave. At any instant the phase difference between A and B is ϕ. The maximum difference in the displacements at A and B is Δ.

- ☐ $\phi = \pi$
- ☐ $\phi = \frac{\pi}{2}$
- ☐ $\Delta = 2.5 \times 10^{-5}$
- ☐ $\Delta = 5 \times 10^{-5}$ m

Q3 **Difficulty Level: Easy**

Knowledge Level: K1

A coin is placed on a horizontal platform, which undergoes vertical simple harmonic motion of angular frequency ω. The amplitude of oscillation is gradually increased. The coin will leave contact with the platform for the first time

- ☐ at the highest position of the platform
- ☐ at the mean position of the platform
- ☐ for an amplitude of g/ω^2
- ☐ for an amplitude of $\frac{\sqrt{g}}{\omega}$

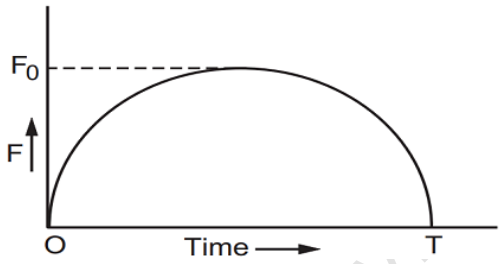
Section: Physics - Section 2

Marks per question: 3
4 of 4 question(s) in this section will be shown to examinee
Examinee should answer all 4 question(s) in this section
This section has negative marking for incorrect answer(s). 25% marks will be deducted for every incorrect answer.

Q1 Difficulty Level: Easy

Knowledge Level: K1

A particle of mass m, initially at rest, is acted upon by a variable force F for a brief interval of time T. It begins to move with a velocity u after the force stops acting. F is shown in the graph as a function of time. Value of u will be

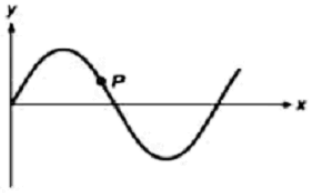


- ○ $u = \frac{\pi F_0^2}{2m}$
- ○ $u = \frac{\pi T^2}{8m}$
- ○ $u = \frac{\pi F_0 T}{4m}$
- ○ $u = \frac{\pi F_0 T}{2m}$

Q2 **Difficulty Level: Easy**

Knowledge Level: K1

A transverse sinusoidal wave moves along a string in the positive x-direction at a speed of 10 cm/s. The wavelength of the wave is 0.5 m and its amplitude is 10 cm. At a particular time t, the snapshot of the wave is shown in figure. The velocity of point P when its displacement is 5 cm is



- $\frac{\sqrt{3}\pi}{50}\hat{j}$ m/s
- $-\frac{\sqrt{3}\pi}{50}\hat{j}$ m/s
- $\frac{\sqrt{3}\pi}{50}\hat{i}$ m/s
- $-\frac{\sqrt{3}\pi}{50}\hat{i}$ m/s

Q3 **Difficulty Level: Easy**

Knowledge Level: K1

The work done on a particle of mass m by a force $K\left[\frac{x}{(x^2+y^2)^{3/2}}\hat{i}+\frac{y}{(x^2+y^2)^{3/2}}\hat{j}\right]$ (K being a constant of appropriate dimensions, when the particle is taken from the point (a, 0) to the point (0, a) along a circular path of radius a about the origin in the x-y plane is

- $\frac{2K\pi}{a}$
- $\frac{K\pi}{a}$
- $\frac{K\pi}{2a}$
- 0

Q4 **Difficulty Level: Easy**

Knowledge Level: K1

Two non-reactive monoatomic ideal gases have their atomic masses in the ratio 2 : 3. The ratio of their partial pressures, when enclosed in a vessel kept at a constant temperature, is 4 : 3. The ratio of their densities is

- 1 : 4
- 1 : 2
- 6 : 9
- 8 : 9

Section: Physics - Section 3

Marks per question: 4
6 of 6 question(s) in this section will be shown to examinee
Examinee should answer all 6 question(s) in this section

Q1 **Difficulty Level: Easy**

Knowledge Level: K1

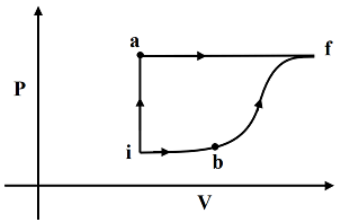
A horizontal stretched string fixed at two ends, is vibrating in its fifth harmonic according to the equation $y(x,t) = 0.01m \sin[(62.8m^{-1})x]\cos[(628s^{-1})t]$. If ℓ be the length of the string, n be the number of nodes of the wave produced and p be the maximum displacement of the midpoint of the string from the equillibrium position. Calculate $n + 100\ell + 1000p =$ _____(Take $\pi = 3.14$)

SNo	Blank
1	Integers

Q2 **Difficulty Level: Easy**

Knowledge Level: K1

A thermodynamic system is taken from an initial state i with internal energy $U_i = 100$ J to the final state f along two different paths iaf and ibf, as schematically shown in the figure. The work done by the system along the paths af, ib and bf are $W_{af} = 200$ J, $W_{ib} = 50$ J and $W_{bf} = 100$ J respectively. The heat supplied to the system along the path iaf, ib and bf are Q_{iaf}, Q_{ib} and Q_{bf} respectively. If the internal energy of the ystem in the state b is $U_b = 200$ J and $Q_{iaf} = 500$ J. Calculate $Q_{bf} + Q_{ib} =$ ____J.



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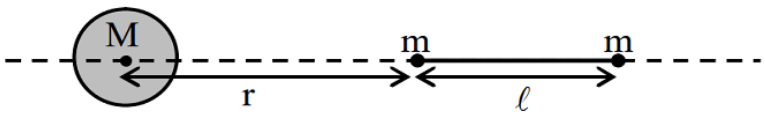
1	Integers

Q3 **Difficulty Level: Easy**

Knowledge Level: K1

A large spherical mass M is fixed at one position and two identical point masses m are kept on a line passing through the centre of M (see figure). The point masses are connected by a rigid massless rod of length ℓ and this assembly is free to move along the line connecting them. All three masses interact only through their mutual gravitational interaction. When the point mass nearer to M is at a distance $r = 3\ell$ from M, the tension in the rod is zero for $m = k\left(\frac{M}{288}\right)$. The value of k is



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1	Integers

Q4 **Difficulty Level: Easy**

Knowledge Level: K1

The densities of two solid spheres A and B of the same radii R vary with radial distance r as $\rho_A(r) = k\left(\frac{r}{R}\right)$ and $\rho_B(r) = k\left(\frac{r}{R}\right)^5$, respectively, where k is a constant. The moments of inertia of the individual spheres about axes passing through their centres are I_A and I_B, respectively. If $\frac{I_B}{I_A} = \frac{n}{10}$, the value of n is ____.

SNo	Blank
1	Integers

Q5 **Difficulty Level: Easy**

Knowledge Level: K1

A block with mass M = 0.81 kg is connected by a massless spring with stiffness constant k = 10N/m to a rigid wall and moves without friction on a horizontal surface. The block oscillates with small amplitude A about an equilibrium position x_0. Consider two cases: (i) when the block is at x_0 ; and (ii) when the block is at $x = x_0 + A$. In both the cases, a particle with mass m = 0.09 kg is softly placed on the block after which they stick to each other. If A_i and A_{ii} be the amplitudes of oscillation in first and second case respectively. Calculate $10\left(\frac{A_i}{A_{ii}}\right)^2 =$ _____.

SNo	Blank
1	Integers

Q6 **Difficulty Level: Easy**

Knowledge Level: K1

Consider two solid spheres P and Q each of density 8 gm cm^{-3} and diameters 1cm and 0.5cm, respectively. Sphere P is dropped into a liquid of density 0.8 gm cm^{-3} and viscosity $\eta = 3$ poiseulles. Sphere Q is dropped into a liquid of density 1.6 gm cm^{-3} and viscosity $\eta = 2$ poiseulles. The ratio of the terminal velocities of P and Q is ____.

SNo	Blank
1	Integers

Section: Physics - Section 4

Marks per question: 3

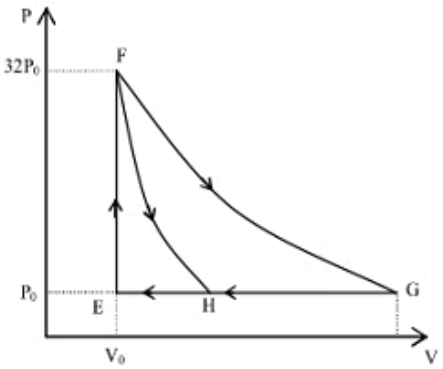
4 of 4 question(s) in this section will be shown to examinee

Examinee should answer all 4 question(s) in this section

Q1 **Difficulty Level: Easy**

Knowledge Level: K1

One mole of mono-atomic ideal gas is taken along two cyclic processes E→F→G→E and E→F→H→E as shown in the PV diagram. The processes involved are purely isochoric, isobaric, isothermal or adiabatic.



Match the paths in List I with the magnitudes of the work done in List II and select the correct answer using the codes given below the lists.

	List I		List II
P.	G → E	1.	160 P_0V_0 ln2
Q.	G → H	2.	36 P_0V_0
R.	F → H	3.	24 P_0V_0
S.	F → G	4.	31 P_0 V_0

- P. → (1); Q. → (3); R. → (2); S. → (4)
- P. → (4); Q. → (3); R. → (2); S. → (1)
- P. → (2); Q. → (4); R. → (1); S. → (3)
- P. → (4); Q. → (2); R. → (1); S. → (3)

Q2 **Difficulty Level: Easy**

Knowledge Level: K1

A person in a lift is holding a water jar, which has a small hole at the lower end of its side. When the lift is at rest, the water jet coming out of the hole hits the floor of the lift at a distance d of 1.2 m from the person. In the following, state of the lift's motion is given in List I and the distance where the wate jet hits the floor of the lift is given in List II. Match the statements from List I with those in List II and select the correct answer using the code given below the lists.

List I		List II	
P.	Lift is accelerating vertically up.	1.	d = 1.2 m
Q.	Lift is accelerating vertically down with an acceleration less than the gravitational acceleration.	2.	d > 1.2 m
R.	Lift is moving vertically up with constant speed.	3.	d < 1.2 m
S.	Lift is falling freely.	4.	No water leaks out of the jar

- P-2, Q-3, R-2, S-4
- P-2, Q-3, R-1, S-4
- P-1, Q-1, R-1, S-4
- P-2, Q-3, R-1, S-1

Q3 **Difficulty Level: Easy**

Knowledge Level: K1

A planet of mass M, has two natural satellites with masses m_1 and m_2. The radii of their circular orbits ar R_1 and R_2 respectively. Ignore the gravitational force between the satellites. Define v_1, L_1, K_1 and T_1 to be respectively, the orbital speed, angular momentum, kinetic energy and time period of revolution of satellit 1; and v_2, L_2, K_2 and T_2 to be the corresponding quantities of satellite 2. Given $m_1/m_2 = 2$ and $R_1/R_2 = 1/4$ match the ratios in List-I to the numbers in List-II.

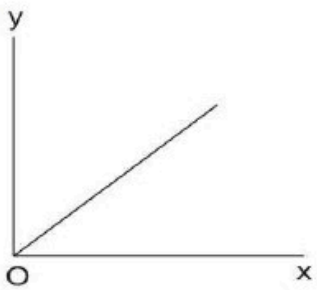
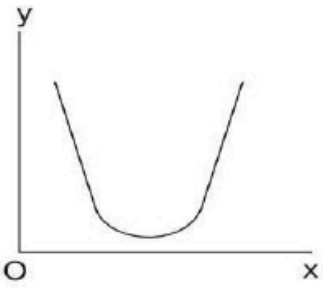
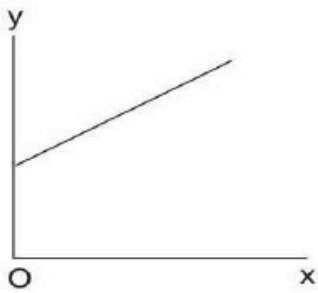
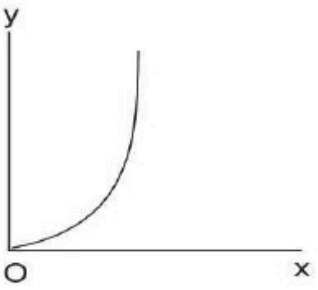
LIST–I		**LIST–II**	
P.	$\frac{v_1}{v_2}$	**1.**	$\frac{1}{8}$
Q.	$\frac{L_1}{L_2}$	**2.**	1
R.	$\frac{K_1}{K_2}$	**3.**	2
S.	$\frac{T_1}{T_2}$	**4.**	8

- **P → 4; Q → 2; R → 1; S → 3**
- **P → 3; Q → 2; R → 4; S → 1**
- **P → 2; Q → 3; R → 1; S → 4**
- **P → 2; Q → 3; R → 4; S → 1**

Q4 **Difficulty Level: Easy**

Knowledge Level: K1

Column A gives a list of possible set of parameters measured in some experiments. The variations of the parameters in the form of graphs are shown in column B.

Column A	Column B
(i) The potential energy of a simple pendulum (y-axis) as a function of its displacement (x-axis)	(a) 
(ii) Displacement (y-axis) as a function of time (x-axis) for a one-dimensional motion at zero or constant acceleration when the body is moving along the positive x-direction	(b) 
(iii) The range of a projectile (y-axis) as a function of its velocity (x-axis) when projected at a fixed angle	(c) 
(iv) The square of the time period (y-axis) of a simple pendulum as a function of its length (x-axis)	(d) 

- ○ (i) → a,d (ii) → b,d (iii) → d (iv) → b
- ○ (i) → a (ii) → b,d (iii) → b (iv) → d
- ○ (i) → d (ii) → a,d (iii) → d (iv) → b

Section: Chemistry - Section 1

Marks per question: 4
3 of 3 question(s) in this section will be shown to examinee
Examinee should answer all 3 question(s) in this section
This section has negative marking for incorrect answer(s). 50% marks will be deducted for every incorrect answer.

Q1 **Difficulty Level: Easy**

Knowledge Level: K1

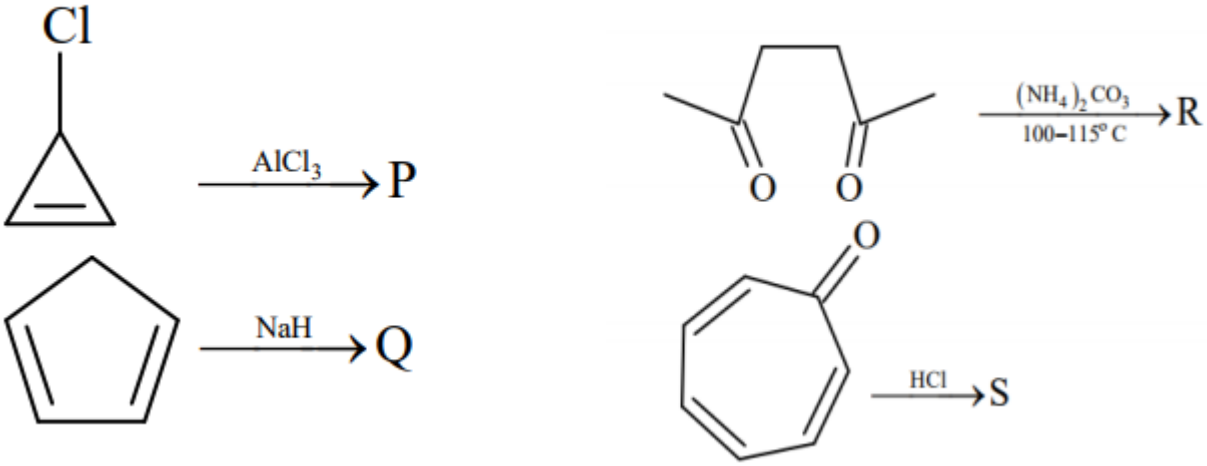
The hyperconjugative stabilities of tert-butyl cation and 2-butene, respectively, are due

- ☐ $\sigma \rightarrow p$ (empty) and $\sigma \rightarrow \pi^*$ electron delocalisations.
- ☐ $\sigma \rightarrow \sigma^*$ and $\sigma \rightarrow \pi$ electron delocalisations.
- ☐ $\sigma \rightarrow p$ (filled) and $\sigma \rightarrow \pi$ electron delocalisations.
- ☐ $p(\text{filled}) \rightarrow \sigma^*$ and $\sigma \rightarrow \pi^*$ electron delocalisations.

Q2 **Difficulty Level: Easy**

Knowledge Level: K1

Among **P, Q, R** and **S,** the aromatic compound(s) is/are



- ☐ P
- ☐ Q
- ☐ R
- ☐ S

Q3 **Difficulty Level: Easy**

Knowledge Level: K1

The compound that does NOT liberate CO_2, on treatment with aqueous sodium bicarbonate solution,

- ☐ Benzoic acid
- ☐ Benzenesulphonic acid
- ☐ Salicylic acid
- ☐ Carbolic acid (Phenol)

Section: Chemistry - Section 2

Marks per question: 3
4 of 4 question(s) in this section will be shown to examinee
Examinee should answer all 4 question(s) in this section
This section has negative marking for incorrect answer(s). 25% marks will be deducted for every incorrect answer.

Q1 **Difficulty Level: Easy**

Knowledge Level: K1

Concentrated nitric acid, upon long standing, turns yellow–brown due to the formation

- ○ NO
- ○ NO_2
- ○ N_2O
- ○ N_2O_4

Q2 **Difficulty Level: Easy**

Knowledge Level: K1

The standard enthalpies of formation of $CO_2(g)$, $H_2O(l)$ and glucose(s) at 25^0C are –400 kJ/m –300 kJ/mol and –1300 kJ/mol, respectively. The standard enthalpy of combustion per gram of glucose 25^0C is

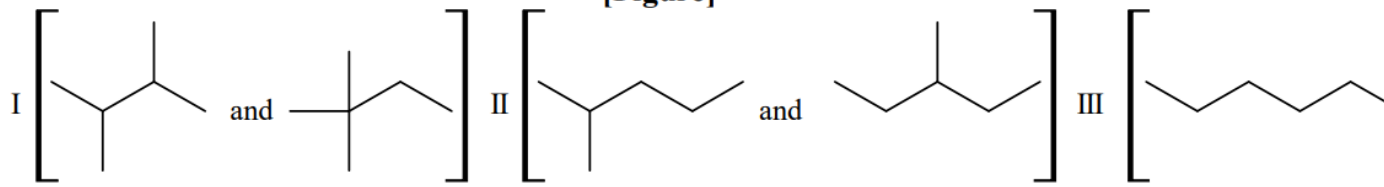
- ○ +2900 kJ
- ○ – 2900 kJ
- ○ –16.11 kJ
- ○ +16.11 kJ

Q3 **Difficulty Level: Easy**

Knowledge Level: K1

Isomers of hexane, based on their branching, can be divided into three distinct classes as shown in figure.

[Figure]



The correct order of their boiling point is

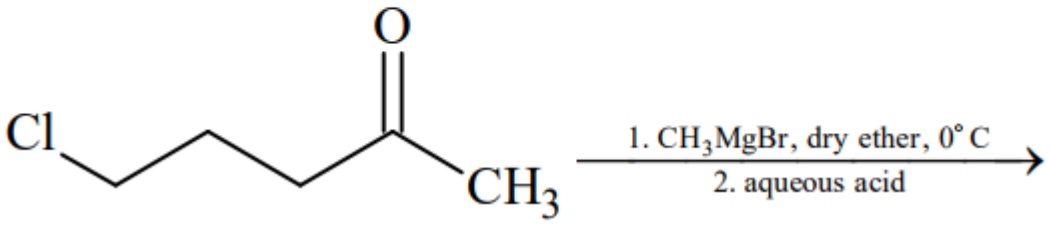
- I > II > III
- III > II > I
- II > III > I
- III > I > II

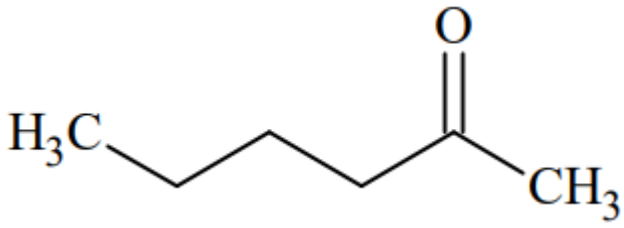
Q4 **Difficulty Level: Easy**

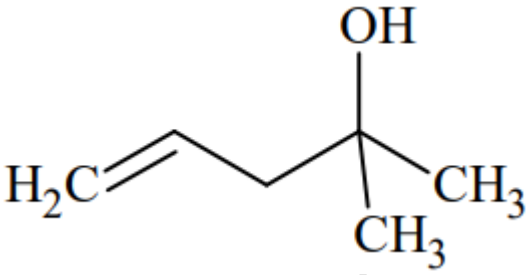
Knowledge Level: K1

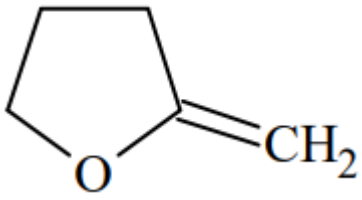
The major product in the following reaction is

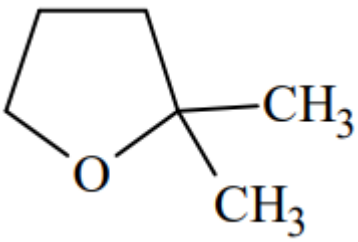
[Figure]



○ 

○ 

○ 

○ 

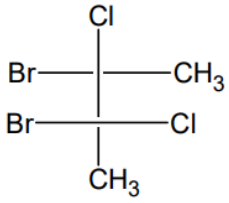
Section: Chemistry - Section 3

Marks per question: 4
6 of 6 question(s) in this section will be shown to examinee
Examinee should answer all 6 question(s) in this section

Q1 Difficulty Level: Easy

Knowledge Level: K1

The total number(s) of stable conformers with non-zero dipole moment for the following compound is



SNo	Blank
1	Integers

Q2 Difficulty Level: Easy

Knowledge Level: K1

In an atom, the total number of electrons having quantum numbers $n = 4$, $|m_l| = 1$ and $m_s = -1/$

SNo	Blank
1	Integers

Q3 **Difficulty Level: Easy**

Knowledge Level: K1

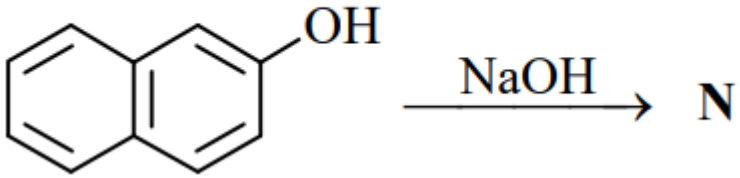
A compound H_2X with molar weight of 80g is dissolved in a solvent having density of 0.4 gml^{-1}. Assur
no change in volume upon dissolution, the molality of a 3.2 molar solution is

SNo	Blank
1	Integers

Q4 **Difficulty Level: Easy**

Knowledge Level: K1

The number of resonance structures for **N** is



SNo	Blank
1	Integers

Q6 **Difficulty Level: Easy**

Knowledge Level: K1

The mole fraction of a solute in a solution is 0.1. At 298 K, molarity of this solution is the same a
molality. Density of this solution at 298 K is 2.0 g cm^{-3}. The ratio of the molecular weights of the s
and solvent, $\left(\frac{MW_{solute}}{MW_{solvent}}\right)$, is

SNo	Blank
1	Integers

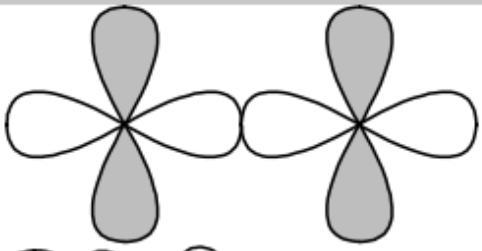
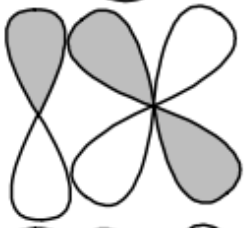
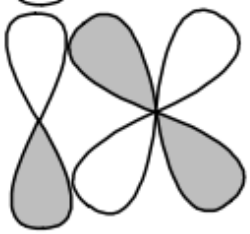
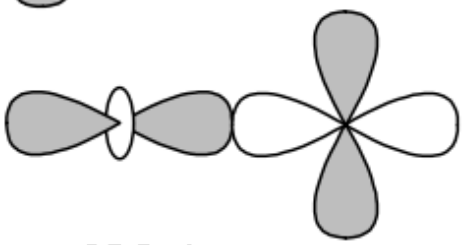
Section: Chemistry - Section 4

Marks per question: 3
4 of 4 question(s) in this section will be shown to examinee
Examinee should answer all 4 question(s) in this section

Q1 **Difficulty Level: Easy**

Knowledge Level: K1

Match the orbital overlap figures shown in **List-I** with the description given in **List-II** and select the c
answer using the code given below the lists.

List – I		List - II
P.		**1.** $p-d\ \pi$ antibonding
Q.		**2.** $d-d\ \sigma$ bonding
R.		**3.** $p-d\ \pi$ bonding
S.		**4.** $d-d\ \sigma$ antibonding

○ P Q R S
2 1 3 4

○ P Q R S
4 3 1 2

○ P Q R S
2 3 1 4

○ P Q R S
4 1 3 2

Q2 **Difficulty Level: Easy**

Knowledge Level: K1

Match the thermodynamic processes given under Column I with the expression given under Colu

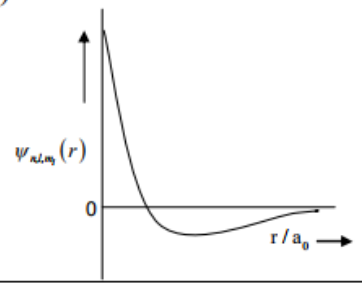
	Column I		**Column II**
(A)	Freezing of water at 273 K and 1 atm	(P)	$q = 0$
(B)	Expansion of 1 mol of an ideal gas into a vacuum under isolated conditions	(Q)	$w = 0$
(C)	Mixing of equal volumes of two ideal gases at constant temperature and pressure in an isolated container	(R)	$\Delta S_{sys} < 0$
(D)	Reversible heating of $H_2(g)$ at 1 atm from 300 K to 600 K, followed by reversible cooling to 300 K at 1 atm	(S)	$\Delta U = 0$
		(T)	$\Delta G = 0$

- (A) → (R, T); (B) → (P, Q); (C) → (R, Q, S); (D) → (
- (A) → (S, T); (B) → (Q, S); (C) → (T, Q, S); (D) → (P, Q,
- (A) → (P, Q); (B) → (S); (C) → (R, T, S); (D) → (
- (A) → (R, T); (B) → (P, Q, S); (C) → (P, Q, S); (D) → (P, Q,

Q3 **Difficulty Level: Easy**

Knowledge Level: K1

The wave function ψ_{n,l,m_l} is a mathematical function whose value depends upon spherical coordinates (r, θ, ϕ) of the electron and characterized by the quantum numbers n, l and m_l. Here distance from nucleus, θ is colatitude and ϕ is azimuth. In the mathematical functions given in the T Z is atomic number and a_0 is Bohr radius.

Column 1	Column 2	Column 3
(I) 1s orbital	(i) $\psi_{n,l,m_l} \propto \left(\frac{Z}{a_0}\right)^{\frac{3}{2}} e^{-\left(\frac{Zr}{a_0}\right)}$	(P) 
(II) 2s orbital	(ii) One radial node	(Q) Probability density at nucleus $\propto \frac{1}{a_0^3}$
(III) $2p_z$ orbital	(iii) $\psi_{n,l,m_l} \propto \left(\frac{Z}{a_0}\right)^{\frac{5}{2}} re^{-\left(\frac{Zr}{2a_0}\right)} \cos\theta$	(R) Probability density is maximum at nucl
(IV) $3d_z^2$ orbital	(iv) xy-plane is a nodal plane	(S) Energy needed to excite electron $n = 2$ state to $n = 4$ state is $\frac{27}{32}$ times the en needed to excite electron from $n = 2$ sta $n = 6$ state

For hydrogen atom, the only CORRECT combination is

- ○ (I) (iv) (R)
- ○ (I) (i) (P)
- ○ (II) (i) (Q)
- ○ (I) (i) (S)

Q4 **Difficulty Level: Easy**

Knowledge Level: K1

Dilution processes of different aqueous solutions, with water, are given in LIST-I. The effects of dilutio the solutions on $[H^+]$ are given in LIST-II.

(Note: Degree of dissociation (α) of weak acid and weak base is << 1; degree of hydrolysis of salt $[H^+]$ represents the concentration of H^+ ions)

LIST-I	LIST-II
P. (10 mL of 0.1 M NaOH + 20 mL of 0.1 M acetic acid) diluted to 60 mL	**1.** the value of $[H^+]$ does not change on dilution
Q. (20 mL of 0.1 M NaOH + 20 mL of 0.1 M acetic acid) diluted to 80 mL	**2.** the value of $[H^+]$ changes to half initial value on dilution
R. (20 mL of 0.1 M HCl + 20 mL of 0.1 M ammonia solution) diluted to 80 mL	**3.** the value of $[H^+]$ changes to two tim of its initial value on dilution
S. 10 mL saturated solution of $Ni(OH)_2$ in equilibrium with excess solid $Ni(OH)_2$ is diluted to 20 mL (solid $Ni(OH)_2$ is still present after dilution).	**4.** the value of $[H^+]$ changes to $\frac{1}{\sqrt{2}}$ tim of its initial value on dilution
	5. the value of $[H^+]$ changes to $\sqrt{2}$ tim its initial value on dilution

Match each process given in LIST-I with one or more effect(s) in LIST-II. The correct option is

- ○ **P** → 4; **Q** → 2; **R** → 3; **S** → 1
- ○ **P** → 4; **Q** → 3; **R** → 2; **S** → 3
- ○ **P** → 1; **Q** → 4; **R** → 5; **S** → 3
- ○ **P** → 1; **Q** → 5; **R** → 4; **S** → 1

Section: Mathematics - Section 1

Marks per question: 4
3 of 3 question(s) in this section will be shown to examinee
Examinee should answer all 3 question(s) in this section
This section has negative marking for incorrect answer(s). 50% marks will be deducted for every incorrect answer.

Q1 **Difficulty Level: Easy**

Knowledge Level: K1

If $ax^2+bx+c=0$ and $cx^2+bx+a=0$ $(a,b,c\in R)$ have a common non-real roo

- ☐ $-2|a|<b<2|a|$
- ☐ $-2|c|\leq|b|<2|c|$
- ☐ $a=\pm c$
- ☐ $a=c$

Q3 **Difficulty Level: Easy**

Knowledge Level: K1

If $\tan x = \frac{2b}{a-c}, (a \neq c)$ y = a $\cos^2 x$ + 2b sin x cos x + c $\sin^2 x$ z = a $\sin^2 x$ -2b sin x cos x + c then

- ☐ $y = z$
- ☐ $y + z = a + c$
- ☐ $y - z = a - c$
- ☐ $y - z = (a - c)^2 + 4b^2$

Section: Mathematics - Section 2

Marks per question: 3
4 of 4 question(s) in this section will be shown to examinee
Examinee should answer all 4 question(s) in this section
This section has negative marking for incorrect answer(s). 25% marks will be deducted for every incorrect answer.

Q1 **Difficulty Level: Easy**

Knowledge Level: K1

If $a > 0$ and the equation $|z - a^2| + |z - 2a| = 3$ represents an ellipse then a

- $(1, 3)$
- $\left(\sqrt{2}, \sqrt{3}\right)$
- $(0, 3)$
- $\left(1, \sqrt{3}\right)$

Q3 **Difficulty Level: Easy**

Knowledge Level: K1

$$\text{If } w = \frac{z}{z - \frac{1}{3}i} \text{ and } |w| = 1, \text{ then } z \text{ lies on}$$

- a parabola
- a straight line
- a circle
- an ellipse

Q4 **Difficulty Level: Easy**

Knowledge Level: K1

If the two circles, $x^2 + y^2 + 2g_1x + 2f_1y = 0$ and $x^2 + y^2 + 2g_2x + 2f_2y = 0$ touches each oth

- $f_1g_1 = f_2g_2$
- $\frac{f_1}{g_1} = \frac{t_2}{g_2}$
- $f_1f_2 = g_1g_2$
- None of these

Section: Mathematics - Section 3

Marks per question: 4
6 of 6 question(s) in this section will be shown to examinee
Examinee should answer all 6 question(s) in this section

Q1 **Difficulty Level: Easy**

Knowledge Level: K1

Let K is a positive integer such that $36 + K, 300 + K, 596 + K$ are the squares of three con terms of an arithmetic progression. Find (K-920).

SNo	Blank
1	Integers

Q2 **Difficulty Level: Easy**

Knowledge Level: K1

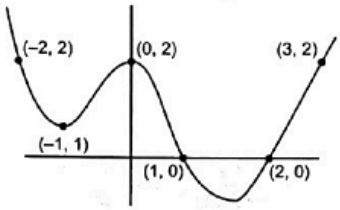
If the straight line drawn through the point $P(\sqrt{3},2)$ and inclined at an angle $\frac{\pi}{6}$ with the x-axis, line $\sqrt{3}x - 4y + 8 = 0$ at Q. Find the length PQ

SNo	Blank
1	Integers

Q3 **Difficulty Level: Easy**

Knowledge Level: K1

In the given figure, the graph of $y = p(x) = x^4 + ax^3 + bx^2 + cx + d$ go i



The product of all the imaginary roots of $p(x) = 0$ is

SNo	Blank
1	Integers

Q4 **Difficulty Level: Easy**

Knowledge Level: K1

Let a, b and e be the three distinct non-zero real numbers satisfying the system of e

$\frac{1}{a}+\frac{1}{a-1}+\frac{1}{a-2}=1, \frac{1}{b}+\frac{1}{b-1}+\frac{1}{b-2}=1$ and $\frac{1}{c}+\frac{1}{c-1}+\frac{1}{c-2}=1$. Then abc is e

SNo	Blank
1	Integers

Q5 **Difficulty Level: Easy**

Knowledge Level: K1

Let $X_1, X_2, X_3 \ldots$ are in arithmetic progression ession w with a common difference equal to d whic digit natural number. $y_1, y_2, y_3 \ldots$are in geometric progression with common ratio equal to 16. Arith mean of $X_1, X_2 \ldots X_n$ is equal to the arithmetic mean of $y_1, y_2 \ldots . y_n$ which is equal to 5. If the arith mean of $X_6, X_7 \ldots X_n + 5$ is equal to the mean arithmetic mean of yp + 1, YP + 2... YP + n, then *d*

SNo	Blank
1	Integers

Q6 **Difficulty Level: Easy**

Knowledge Level: K1

If the mean and variance of eight numbers 3, 7, 9, 12, 13, 20, x and y be 10 and 25 respectiv x . y is equal to

SNo	Blank
1	Integers

Section: Mathematics - Section 4

Marks per question: 3
4 of 4 question(s) in this section will be shown to examinee
Examinee should answer all 4 question(s) in this section

Q1 **Difficulty Level: Easy**

Knowledge Level: K1

Consider a sequence $\{b_n\}$ of integers such that b_1, b_2, b_3, are in A.P., b_3, b_4, b_5 are in G.P. are in A.P., b_5, b_6, b_7 are in G.P. and so on. Also given that $b = 1$ and $b_5 + b_6 = 198$. Then

Column-I	Column-II
(A) $\sqrt{b_7}$ is equal to	(P) 5
(B) Sum of digits of b_8 is equal to	(Q) 15
(C) $\sqrt{b_9}$ is equal to	(R) 9
(D) Sum of digits of b_{10} is equal to	(S) 17
	(T) 13

- $A \rightarrow T, B \rightarrow P, C \rightarrow S, D \rightarrow Q$
- $A \rightarrow T, B \rightarrow P, C \rightarrow R, D \rightarrow Q$
- $A \rightarrow P, B \rightarrow T, C \rightarrow R, D \rightarrow S$
- $A \rightarrow P, B \rightarrow R, C \rightarrow S, D \rightarrow Q$

Q2 **Difficulty Level: Easy**

Knowledge Level: K1

Five balls are to be placed in three boxes. Each can hold all the five balls. The number of diff
can we place the balls so that no box remain empty if

Column-I	Column-II
(A) balls and boxes are all different is equal to	(P) 2
(B) balls are identical but boxes are different is equal to	(Q) 6
(C) balls are different but boxes are identical is equal to	(R) 25
(D) balls as well as boxes are identical is equal to	(S) 50
	(T) 150

- $A \rightarrow P, B \rightarrow Q, C \rightarrow S, D \rightarrow R$
- $A \rightarrow T, B \rightarrow Q, C \rightarrow R, D \rightarrow S$
- $A \rightarrow T, B \rightarrow Q, C \rightarrow P, D \rightarrow R$
- $A \rightarrow S, B \rightarrow Q, C \rightarrow P, D \rightarrow T$

Q3 **Difficulty Level: Easy**

Knowledge Level: K1

Column-I	Colu
(A) $2^{(32)^{32}}$ is divided by 7, then the remainder is	(P) 0
(B) 5^{99} is divided by 13, then the remainder is	(Q) 2
(C) $(20)^{13} + (13)^{20}$ is divided by 9, then the	(R) 4
(D) $32^{(32)^{32}}$ is divided by 7, then the remainder is	(S) 6
	(T) 8

- $A \rightarrow Q, B \rightarrow T, C \rightarrow P, D \rightarrow R$
- $A \rightarrow Q, B \rightarrow T, C \rightarrow S, R \rightarrow D$
- $A \rightarrow R, B \rightarrow T, C \rightarrow Q, D \rightarrow S$
- $A \rightarrow S, B \rightarrow T, C \rightarrow P, Q \rightarrow R$

Q4 **Difficulty Level: Easy**

Knowledge Level: K1

If Z_1, Z_2, Z_3, Z_4 are the roots of the equation $z^4 + z^3 + z^2 + z + 1 =$

Column-I	Column-II
(A) $(z_1^2 - 1)(z_2^2 - 1)(z_3^2 - 1)(z_4^2 - 1) =$	(P) -1
(B) $(z_1^2 + 1)(z_2^2 + 1)(z_3^2 + 1)(z_4^2 + 1) =$	(Q) 0
(C) $z_1^4 + z_2^4 + z_3^4 + z_4^4 =$	(R) 1
(D) The last value of $[\lvert z_1 + z_2 \rvert] =$ ([.] denote greatest integer function)	(S) 4
	(T) 5

- $A \rightarrow T, B \rightarrow R, C \rightarrow P, D \rightarrow Q$
- $A \rightarrow P, B \rightarrow Q, C \rightarrow S, D \rightarrow R$
- $A \rightarrow P, B \rightarrow T, C \rightarrow Q, D \rightarrow R$
- $A \rightarrow T, B \rightarrow R, C \rightarrow S, D \rightarrow Q$