

**FIITJEE**  
**ALL INDIA TEST SERIES**  
**JEE (Advanced)-2025**  
**FULL TEST – VII**  
**PAPER –1**  
**TEST DATE: 20-04-2025**

**Time Allotted: 3 Hours**

**Maximum Marks: 180**

**General Instructions:**

- The test consists of total 54 questions.
- Each subject (PCM) has 18 questions.
- This question paper contains **Three Parts**.
- **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
- Each **Part** is further divided into **Two Sections: Section-A & Section-B**.

**Section – A (01 – 06, 19 – 24, 37 – 42):** This section contains **EIGHTEEN (18)** questions. Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).

**Section – A (07 – 10, 25 – 28, 43 – 46):** This section contains **TWELVE (12)** Matching List Type Questions. Each question has **FOUR** statements in **List-I** entries (I), (II), (III) and (IV) and **FIVE** statements in **List-II** entries (P), (Q), (R), (S) and (T). The codes for lists have choices (A), (B), (C), (D) out of which, **ONLY ONE** of these four options is correct answer.

**Section – B (11 – 18, 29 – 36, 47 – 54):** This section contains **TWENTY FOUR (24)** numerical based questions. The answer to each question is a **NUMERICAL VALUE**. If the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places.

**MARKING SCHEME**

**Section – A (One or More than One Correct):** 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 <b>ONLY</b> three options are chosen;
Partial marks	:	+2	if three or more options are correct but <b>ONLY</b> two options are chosen and both of which are correct;
Partial Marks	:	+1	If two or more options are correct but <b>ONLY</b> one option is chosen and it is a correct option;
Zero Marks	:	0	If none of the options is chosen (i.e. the question is unanswered);
Negative Marks	:	–2	In all other cases.

**Section – A (Single Correct):** Answer to each question will be evaluated according to the following marking scheme:

Full Marks	:	+3	If <b>ONLY</b> 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 – B:** Answer to each question will be evaluated according to the following marking scheme:

Full Marks	:	+3	If <b>ONLY</b> the correct numerical value is entered at the designated place;
Zero Marks	:	0	In all other cases.

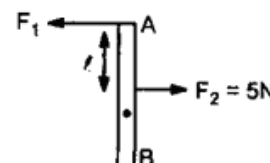
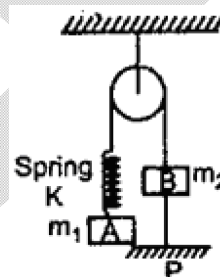
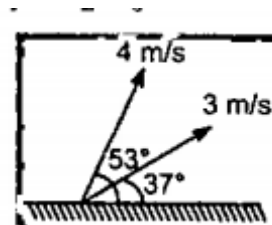
# Physics

## PART – I

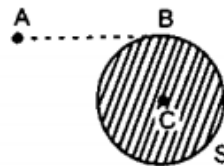
### Section – A (Maximum Marks: 24)

This section contains **SIX (06)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).

- Two particles are projected with speed 4 m/s and 3 m/s simultaneously from same point as shown in the figure. Then:  
 (A) Their relative velocity is along vertical direction.  
 (B) Their relative acceleration is non-zero and it is along vertical direction.  
 (C) They will hit the surface simultaneously.  
 (D) Their relative velocity is constant and has magnitude 1.4 m/s.
- In the system shown in figure  $m_1 > m_2$ . system is held at rest by thread BP. Just after the thread BP is burnt:  
 (A) Magnitude of acceleration of both blocks will be equal to  $\left( \frac{m_1 - m_2}{m_1 + 2m_2} \right) g$   
 (B) Acceleration of  $m_1$  will be equal to zero.  
 (C) Acceleration of  $m_2$  will be upwards  
 (D) Magnitudes of acceleration of two blocks will be non-zero and unequal.
- A body of mass  $m$  was slowly hauled up the rough hill by a force which at each point was directed along tangent to the hill. Work done by the force  
 (A) Is independent of shape of trajectory  
 (B) Depends upon vertical component of displacement but independent of horizontal component.  
 (C) Depends upon both the components of displacement.  
 (D) Does not depend upon coefficient of friction.
- A thin uniform rod AB of mass 1 kg move translationally with acceleration  $a = 2\text{m/s}^2$  due to two antiparallel force as shown. If  $\ell = 20\text{ cm}$  then:  
 (A)  $F_1 = 3\text{ N}$   
 (B)  $F_1 = 5\text{ N}$   
 (C) Length of rod is 1 m  
 (D) Length of rod is 80 cm

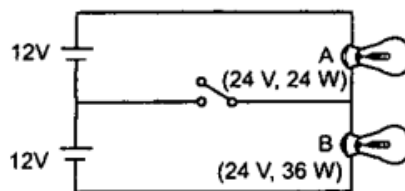


5. S is solid neutral conducting sphere. A point charge  $q$  of  $1 \times 10^{-6}$  C is placed at point A. Point C is the centre of sphere and AB is a tangent.  $BC = 3\text{m}$  and  $AB = 4\text{m}$ :



- (A) The electric potential of the conductor is 1.8 kV.  
 (B) The electric potential of the conductor is 2.25 kV.  
 (C) The electric potential at B due to induced charges on the sphere is  $-0.45$  kV.  
 (D) The electric potential at B due to induced charges on the sphere is  $0.45$  kV.

6. Two light bulbs shown in the circuit have ratings A(24 V, 24 W) and B(24 V and 36 W) as shown. When the switch is closed:



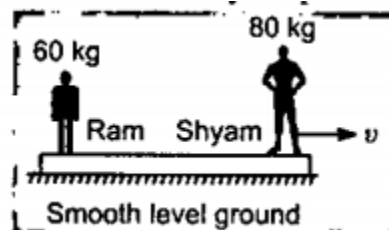
- (A) the intensity of light in bulb A increases.  
 (B) the intensity of light in bulb A decreases.  
 (C) the intensity of light in bulb B increases.  
 (D) the intensity of light in bulb B decreases.

### Section – A (Maximum Marks: 12)

This section contains **FOUR (04)** Matching List Type Questions. Each question has **FOUR** statements in **List-I** entries (I), (II), (III) and (IV) and **FIVE** statements in **List-II** entries (P), (Q), (R), (S) and (T). The codes for lists have choices (A), (B), (C), (D) out of which **ONLY ONE** of these four options is correct answer.

7. Two men of mass 60 kg and 80 kg stand on a plank of mass 20 kg. Both of them can jump with a velocity of 1 m/s relative to the plank. In each event shown in List-I, find the velocity of plank after the event.

Sign of right direction is (+ve) and (–ve) for left direction.



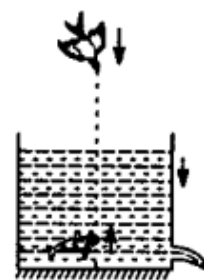
List-I		List-II	
(I)	Ram alone jumps to the left	(P)	$-\frac{17}{40}\text{m/s}$
(II)	Shyam alone jumps to the right	(Q)	$-\frac{1}{2}\text{m/s}$
(III)	Ram jumps to left and Shyam jumps to right simultaneously	(R)	$\frac{3}{8}\text{m/s}$
(IV)	Ram jumps to left and after that Shyam jumps to right.	(S)	$-\frac{1}{8}\text{m/s}$
		(T)	$\frac{1}{3}\text{m/s}$

The correct option is:

- (A) I  $\rightarrow$  R, II  $\rightarrow$  Q, III  $\rightarrow$  S, IV  $\rightarrow$  P  
 (C) I  $\rightarrow$  P, II  $\rightarrow$  Q, III  $\rightarrow$  T, IV  $\rightarrow$  P

- (B) I  $\rightarrow$  R, II  $\rightarrow$  Q, III  $\rightarrow$  P, IV  $\rightarrow$  S  
 (D) I  $\rightarrow$  S, II  $\rightarrow$  T, III  $\rightarrow$  P, IV  $\rightarrow$  Q

8. A bird in air is diving vertically over a tank with speed 6 cm/s. Base of tank is silvered. A fish in the tank is rising upward along the same line with speed 4 cm/s. Water level is falling at rate of 2 cm/s. (take:  $\mu_{\text{water}} = 4/3$ )

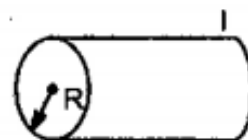


List-I		List-II	
(I)	Speed of the image of fish as seen by the bird directly (Apparent)	(P)	12
(II)	Speed of the image of fish formed after reflection from the mirror as seen by the bird.	(Q)	4
(III)	Speed of image of bird relative to the fish looking upwards	(R)	9
(IV)	Speed of image of bird relative to the fish looking downwards in the mirror	(S)	3
		(T)	5

The correct option is:

- (A) I  $\rightarrow$  R, II  $\rightarrow$  Q, III  $\rightarrow$  T, IV  $\rightarrow$  P  
 (B) I  $\rightarrow$  R, II  $\rightarrow$  S, III  $\rightarrow$  P, IV  $\rightarrow$  Q  
 (C) I  $\rightarrow$  P, II  $\rightarrow$  Q, III  $\rightarrow$  T, IV  $\rightarrow$  P  
 (D) I  $\rightarrow$  T, II  $\rightarrow$  S, III  $\rightarrow$  P, IV  $\rightarrow$  Q

9. A long straight conductor of radius R carries a current I as shown. The current density  $j$  varies as a function of radius according to  $j = br$  where  $b$  is a constant. Match the quantities in List-I with those in List-II.



List-I		List-II	
(I)	$B_{\text{inside}}$	(P)	Maximum
(II)	$B_{\text{surface}}$	(Q)	$\frac{\mu_0 b r^2}{3}$
(III)	$B_{\text{outside}}$	(R)	$\frac{2\pi b r^3}{3}$
(IV)	I (total current inside wire)	(S)	$\frac{\mu_0 b R^3}{3r}$
		(T)	$\frac{\mu_0 b r^2}{3}$

The correct option is:

- (A) I  $\rightarrow$  R, II  $\rightarrow$  Q, III  $\rightarrow$  T, IV  $\rightarrow$  P  
 (B) I  $\rightarrow$  R, II  $\rightarrow$  S, III  $\rightarrow$  P, IV  $\rightarrow$  Q  
 (C) I  $\rightarrow$  P, II  $\rightarrow$  Q, III  $\rightarrow$  R, IV  $\rightarrow$  S  
 (D) I  $\rightarrow$  Q, II  $\rightarrow$  PT, III  $\rightarrow$  S, IV  $\rightarrow$  R

10. List-I shows the cylindrical region of radius  $r$  where a downward magnetic field  $\vec{B}$  exists, and  $\vec{B}$  is increasing at the rate of  $\frac{dB}{dt}$ . A rod PQ is placed in different situation as shown. Match the list-I with the correct statement in list-II regarding the induced e.m.f. in rod.

List-I		List-II	
(I)		(P)	Induced e.m.f. in rod PQ is $\frac{1}{2}r^2\theta\frac{dB}{dt}$
(II)		(Q)	Induced e.m.f. in rod PQ is less than $\frac{1}{2}r^2\theta\frac{dB}{dt}$
(III)		(R)	End P is positive with respect to point Q
(IV)		(S)	End Q is positive with respect to point P
		(T)	End P and Q are at same potential

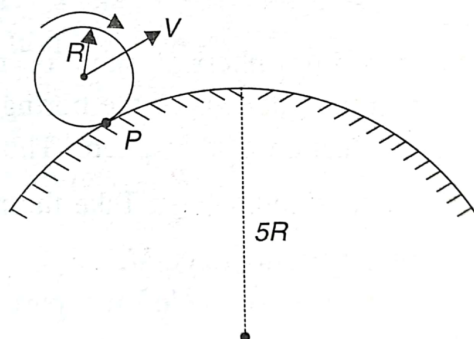
The correct option is:

- (A) I  $\rightarrow$  RS, II  $\rightarrow$  T, III  $\rightarrow$  TP, IV  $\rightarrow$  PS  
 (B) I  $\rightarrow$  RQ, II  $\rightarrow$  S, III  $\rightarrow$  PT, IV  $\rightarrow$  QP  
 (C) I  $\rightarrow$  QS, II  $\rightarrow$  PR, III  $\rightarrow$  SP, IV  $\rightarrow$  QR  
 (D) I  $\rightarrow$  QR, II  $\rightarrow$  PS, III  $\rightarrow$  RP, IV  $\rightarrow$  QS

**Section – B (Maximum Marks: 24)**

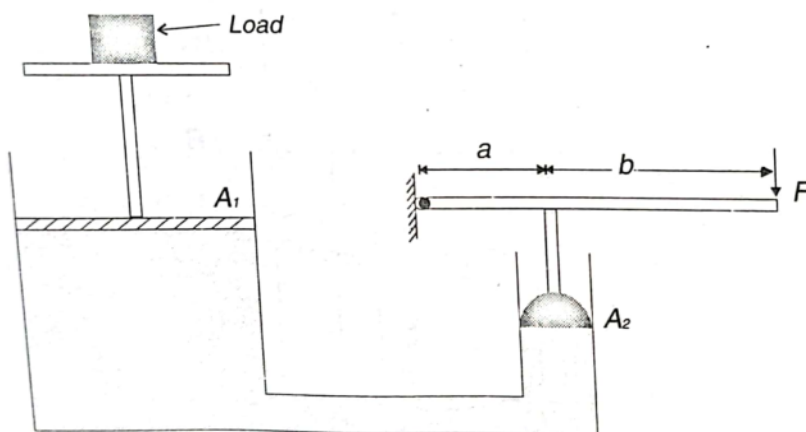
This section contains **EIGHT (08)** numerical based questions. The answer to each question is a **NUMERICAL VALUE**. If the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places.

11. A convex surface has a uniform radius of curvature equal to  $5R$ . A wheel of radius  $R$  is rolling without sliding on it with a constant speed  $V$ . Find the acceleration of the point (P) of the wheel which is in contact with the convex surface.



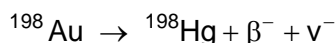
( $V = 6$  meter/second,  $R = 4$  meter)

12. A man can jump up to a height of  $h_0 = 1$  m on the surface of the earth. What should be the radius of a spherical planet (in km) so that the man makes a jump on its surface and escapes out of its gravity? Assume that the man jumps with same speed as on earth and the density of planet is same as that of earth. Take escape speed on the surface of the earth to be  $11.2$  km/s and radius of earth to be  $6400$  km. ( $g = 10$  m/sec<sup>2</sup>)
13. The figure shows a schematic layout of a hydraulic jack. The load to be raised weighs  $20,000$  N. The area of cross section of the two pistons are  $A_1 = 50$  cm<sup>2</sup> and  $A_2 = 10$  cm<sup>2</sup>. The force ( $F$ ) is applied at the end of a light lever bar as shown in the figure. Lengths  $a$  and  $b$  are  $4$  cm and  $36$  cm respectively. Find the force ( $F$ ) required to raise the load slowly.





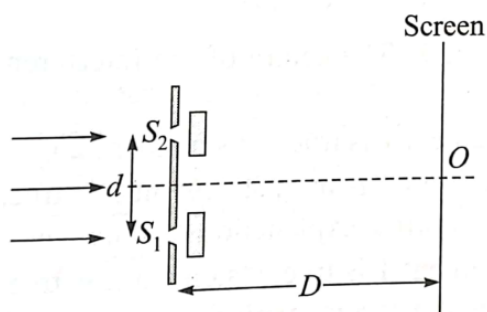
14. Consider the  $\beta$ -decay



where  $^{198}\text{Hg}$  represents a mercury nucleus in an excited state of energy 1.088 MeV above the ground state. What can be maximum kinetic energy of the electron emitted (in kilo electron volt). The atomic mass of  $^{198}\text{Au}$  is 197.968233 u and that of  $^{198}\text{Hg}$  is 197.966760 u.  $1 \text{ u} = 931 \text{ MeV}/c^2$ .

15. Two circular aperture  $S_1$  and  $S_2$  of radii 1 mm and 2 mm. A parallel beam of light of intensity  $\frac{7}{22} \text{ Wm}^{-2}$  and wavelength 600 nm is incident normally as shown in the figure.

A transparent film of thickness 200 nm having refractive index  $\mu_1 = 2$  is placed in front of  $S_1$ , and other transparent film of thickness 200 nm and refractive index 1.5 is placed in front of other slit. Find the resultant intensity (in  $\mu\text{W}$ ) at the centre of screen.



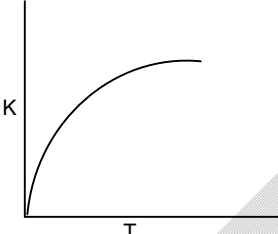
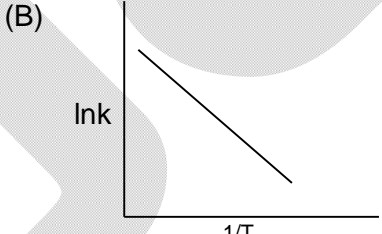
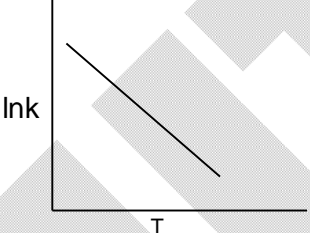
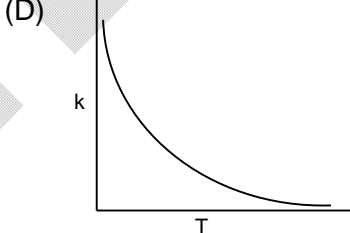
16. A vessel of volume  $0.2 \text{ m}^3$  contains hydrogen gas at temperature 300 K and pressure 1 bar. Find the heat (in Kcal) required to raise the temperature to 400 K. The molar heat capacity of hydrogen at constant volume is 5 cal/mol K. ( $R = 8.31$ )
17. Steel wire of length 'L' at  $40^\circ\text{C}$  is suspended from the ceiling and then a mass 'm' is hung from its free end. The wire is cooled down from  $40^\circ\text{C}$  to  $30^\circ\text{C}$  to regain its original length 'L'. The coefficient of linear thermal expansion of the steel is  $10^{-5} / ^\circ\text{C}$ . Young's modulus of steel is  $10^{11} \text{ N/m}^2$  and radius of the wire is 1 mm. Assume that  $L \gg$  diameter of the wire. Then the value of 'm' in kg is nearly. ( $g = 10 \text{ m/sec}^2$ )
18. A tuning fork of frequency 200 Hz is in unison with a sonometer wire. How many beats are heard in 30 s if the tension is increased by 1%.

# Chemistry

## PART – II

### Section – A (Maximum Marks: 24)

This section contains **SIX (06)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).

19. Silicate having one monovalent corner oxygen atom in each tetrahedron unit is  
 (A) Sheet silicate (B) Cyclic silicate  
 (C) Single chain silicate (D) Double chain silicate
20. Given  $\Delta H_f^\circ (\text{C}_2\text{H}_6, \text{g}) = -85 \text{ kJ / mole}$ ,  
 $\Delta H_f^\circ (\text{C}_3\text{H}_8, \text{g}) = -104 \text{ kJ / mole}$ ,  
 $\Delta H_{\text{sub}}^\circ (\text{C}, \text{s}) = 718 \text{ kJ / mole}$  & B.E. of  $(\text{H} - \text{H}) = 436 \text{ kJ/mole}$ .  
 Then, in kJ/mole, the  
 (A) C – C bond enthalpy is 218 (B) C – H bond enthalpy is 414  
 (C) C – C bond enthalpy is 345 (D) C – H bond enthalpy is 448
21. Which of the following plots of rate constant vs temperature is correct?  
 (A)   
 (B)   
 (C)   
 (D) 
22. The correct statement regarding Ytterbium is/are  
 (A) it contains no unpaired electrons  
 (B)  $\text{Yb}^{2+}$  contains a full-filled electronic configuration  
 (C) it produces  $\text{H}_2$  gas when reacts with  $\text{HCl}$   
 (D) radius of  $\text{Yb}^{3+}$  is larger than  $\text{Yb}^{2+}$  ion
23. Which of the following carbide(s) form  $\text{CH}_4$  when react(s) with water?  
 (A)  $\text{Be}_2\text{C}$  (B)  $\text{CaC}_2$   
 (C)  $\text{Mg}_2\text{C}_3$  (D)  $\text{Al}_4\text{C}_3$

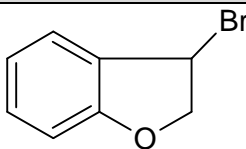
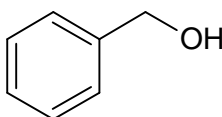
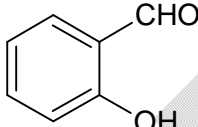
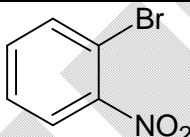


24. Which of the following statement(s) is/are false?
- (A) All adiabatic processes are isentropic (or isentropic) process
- (B) The heat of vaporization of water at  $100^{\circ}\text{C}$  is  $40.6 \text{ kJ/mole}$ . When  $9\text{g}$  of water vapour condenses to liquid at  $100^{\circ}\text{C}$  of  $1 \text{ atm}$ , then  $\Delta S_{\text{system}} = 54.42 \text{ J/K}$
- (C) When  $(\Delta G_{\text{system}})_{T,P} < 0$ ; the reaction must be exothermic
- (D)  $dG = Vdp - S dT$  is applicable for closed system, both PV and non – PV work

### Section – A (Maximum Marks: 12)

This section contains **FOUR (04) Matching List Type Questions**. Each question has **FOUR** statements in **List-I** entries (I), (II), (III) and (IV) and **FIVE** statements in **List-II** entries (P), (Q), (R), (S) and (T). The codes for lists have choices (A), (B), (C), (D) out of which **ONLY ONE** of these four options is correct answer.

25. Answer the following by appropriately matching the lists

List – I		List – II	
(I)		(P)	Nucleophilic substitution
(II)		(Q)	Elimination
(III)		(R)	Nucleophilic addition
(IV)		(S)	Esterification with acetic anhydride
		(T)	Dehydrogenation

Which of the following is the correct combination?

- (A) I  $\rightarrow$  PQT, II  $\rightarrow$  PST, III  $\rightarrow$  RS, IV  $\rightarrow$  P      (B) I  $\rightarrow$  PST, II  $\rightarrow$  PQT, III  $\rightarrow$  PRS, IV  $\rightarrow$  PS
- (C) I  $\rightarrow$  QT, II  $\rightarrow$  QR, III  $\rightarrow$  T, IV  $\rightarrow$  S      (D) I  $\rightarrow$  SU, II  $\rightarrow$  PQR, III  $\rightarrow$  ST, IV  $\rightarrow$  ST

26. Answer the following by appropriately matching the lists

List – I		List – II	
(I)	Work done in isobaric process	(P)	$-P_{\text{ext}} \times \Delta V$
(II)	Work done during free expansion	(Q)	$nRT \ln \frac{P_1}{P_2}$
(III)	Work done in reversible adiabatic process	(R)	$nRT \ln \frac{V_1}{V_2}$
(IV)	Work done in adiabatic irreversible process	(S)	$-nR(T_{\text{final}} - T_{\text{initial}})$
		(T)	Zero

Which of the following is the correct combination?

- (A) I  $\rightarrow$  PS, II  $\rightarrow$  T, III  $\rightarrow$  P, IV  $\rightarrow$  PS  
 (B) I  $\rightarrow$  T, II  $\rightarrow$  PQ, III  $\rightarrow$  P, IV  $\rightarrow$  Q  
 (C) I  $\rightarrow$  R, II  $\rightarrow$  S, III  $\rightarrow$  PS, IV  $\rightarrow$  QR  
 (D) I  $\rightarrow$  P, II  $\rightarrow$  QT, III  $\rightarrow$  QR, IV  $\rightarrow$  ST

27. Match the following list-I with list-II.

List – I (Electronic configuration)		List - II (Corresponding elements)	
(I)	$[\text{Xe}]4f^{14}5d^{10}6s^2$	(P)	s-block elements
(II)	$[\text{Rn}]5f^{14}6d^17s^2$	(Q)	Transition elements
(III)	$[\text{Xe}]4f^{14}5d^{10}6s^26p^67s^2$	(R)	d-block elements
(IV)	$[\text{Xe}]4f^{14}5d^26s^2$	(S)	Representative elements
		(T)	Inner transition elements

- (A) I  $\rightarrow$  T, II  $\rightarrow$  R, III  $\rightarrow$  QS, IV  $\rightarrow$  PR  
 (B) I  $\rightarrow$  RS, II  $\rightarrow$  RS, III  $\rightarrow$  P, IV  $\rightarrow$  Q  
 (C) I  $\rightarrow$  R, II  $\rightarrow$  T, III  $\rightarrow$  PS, IV  $\rightarrow$  QR  
 (D) I  $\rightarrow$  P, II  $\rightarrow$  QT, III  $\rightarrow$  QR, IV  $\rightarrow$  ST

28. Answer the following by appropriately matching the lists

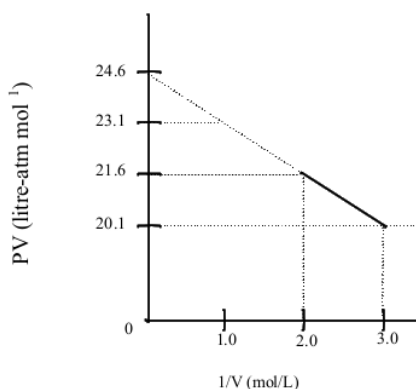
List – I		List - II	
(I)	Gas evolved by the action of dilute $\text{H}_2\text{SO}_4$ on a sulphite	(P)	Colour of acidified $\text{KMnO}_4$ is discharged
(II)	Gas evolved by the action of dilute $\text{H}_2\text{SO}_4$ carbonate	(Q)	Acidified dichromate solution is turned green
(III)	Gas evolved by heating an ammonium salt with NaOH	(R)	Nessler's reagent gives a brown precipitate
(IV)	Gas evolved by the action of dilute $\text{H}_2\text{SO}_4$ on a sulphide	(S)	Bartya water turns milky
		(T)	Alkaline nitroprusside turns violet

- (A) I  $\rightarrow$  PS, II  $\rightarrow$  ST, III  $\rightarrow$  RS, IV  $\rightarrow$  PQ  
 (B) I  $\rightarrow$  PQS, II  $\rightarrow$  S, III  $\rightarrow$  R, IV  $\rightarrow$  PQT  
 (C) I  $\rightarrow$  PQ, II  $\rightarrow$  RS, III  $\rightarrow$  PQ, IV  $\rightarrow$  PQT  
 (D) I  $\rightarrow$  ST, II  $\rightarrow$  QRS, III  $\rightarrow$  QR, IV  $\rightarrow$  ST

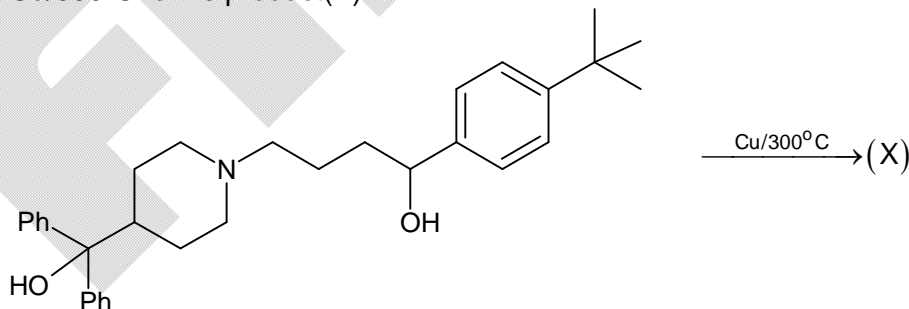
### Section – B (Maximum Marks: 24)

This section contains **EIGHT (08)** numerical based questions. The answer to each question is a **NUMERICAL VALUE**. If the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places.

29. A sample of camphor used in a method for determining of molar mass had melting point of 450 K. The melting point of a solution containing 0.5 gm camphor and 0.04 gm of an unknown non-volatile non-electrolyte compound was 430 K. The molar mass of camphor is 152 and its  $\Delta H_{\text{fusion}} = 1.52 \text{ Kcal mol}^{-1}$ . The molar mass of unknown compound in gm/mole is.....  
( $R = 2 \text{ cal mol}^{-1} \text{ K}^{-1}$ ).
30. What volume of 0.001 M HCl solution be added into 100 mL of 0.001 NaOH to change the pH by one unit?
31. The molar conductance at infinite dilution of  $\text{CaCl}_2$ ,  $\text{Ca}(\text{CH}_3\text{COO})_2$  and HCl are respectively 271.6, 200.8 and  $425.95 \text{ S cm}^2 \text{ mol}^{-1}$ . What will be the molar conductance of  $\text{CH}_3\text{COOH}$  in  $\text{S cm}^2 \text{ mol}^{-1}$  unit?
32. For one mole of a vander Waals gas when  $b = 0$  and  $T = 300 \text{ K}$ , the PV vs  $1/V$  plot is shown below. The value of the van der Waals constant  $a$  ( $\text{atm. litre}^2 \text{ mol}^{-2}$ ) is



33. Seldane contains a chemical named terfenadine. Reaction of this chemical with  $\text{Cu}/300^\circ\text{C}$  forms product(X).



How many pi-bond(s) is/are present in (X)?

34. How much gram of  $\text{Fe}^{2+}$  ions can be completely oxidized into  $\text{Fe}^{3+}$  ions by 104.3 litre of acidified  $\text{KMnO}_4$  solution of 0.1 M concentration, according to the following reaction.
- $$\text{MnO}_4^- + \text{Fe}^{2+} + \text{H}^+ \longrightarrow \text{Mn}^{2+} + \text{Fe}^{3+} + \text{H}_2\text{O}$$
35. What is the percentage of ferric ion in the non-stoichiometric solid having formula  $\text{Fe}_{0.96}\text{O}$ .
36. Aluminium crystallises in a cubic system with unit cell edge length equal to  $4.0 \text{ \AA}$ . It its density is  $\frac{45}{16} \text{ g/cm}^3$ , then the atomic radius of Al atom in  $\text{\AA}$  is

**Mathematics****PART – III****Section – A (Maximum Marks: 24)**

This section contains **SIX (06)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).

37. Let  $V$  be the volume of the parallelepiped formed by the vectors  $\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$ ,  $\vec{b} = b_1\hat{i} + b_2\hat{j} + b_3\hat{k}$ ,  $\vec{c} = c_1\hat{i} + c_2\hat{j} + c_3\hat{k}$ . If  $a_r, b_r, c_r$  where  $r = 1, 2, 3$  are non-negative real numbers and  $\sum_{r=1}^3 (a_r + b_r + c_r) = 3L$ , then which of the following may hold
- (A)  $L^3 > V$  (B)  $L^3 < V$   
 (C)  $L^3 = V$  (D) Nothing can be said
38. The real parameters  $m$  and  $n$  are such that the graph of the function  $f(x) = \sqrt[3]{8x^3 + mx^2 - nx}$  has the horizontal asymptote  $y = 1$  then
- (A)  $|m + n| = 10$  (B)  $|m + n| = 14$   
 (C)  $|m - n| = 10$  (D)  $|m - n| = 2$
39. If  $\int \frac{x^4 + 1}{x^6 + 1} dx = \alpha \arctan \frac{P(x)}{Q(x)} + C$ ,  $\alpha \in \mathbb{Q}$ ,
- (A)  $\alpha = \frac{1}{3}$  (B)  $P(1) = 0$   
 (C)  $P(-1) = 0$  (D)  $Q(1) = -4$
40. Let  $a$  and  $b$  be positive real numbers and  $f(a, b) = \int_a^b \frac{e^{\frac{x}{a}} - e^{\frac{b}{x}}}{x} dx$ , then
- (A)  $f(1, 2) = 0$  (B)  $f(3, 1) = 2$   
 (C)  $f(2, 1) = 0$  (D)  $f(1, 3) = 2$
41. 
$$\frac{1}{\cot 9^\circ - 3 \tan 9^\circ} + \frac{3}{\cot 27^\circ - 3 \tan 27^\circ} + \frac{9}{\cot 81^\circ - 3 \tan 81^\circ} + \frac{27}{\cot 243^\circ - 3 \tan 243^\circ} =$$
- (A)  $10 \tan 9^\circ$  (B)  $10 \cot 81^\circ$   
 (C)  $10 \cot 9^\circ$  (D)  $10 \tan 81^\circ$

42. Point M moved on the circle  $(x-4)^2 + (y-8)^2 = 20$ . Then it broke away from it and moving along a tangent to the circle, cuts the  $x$ -axis at the point  $(-2, 0)$ . The coordinates of a point on the circle at which the moving point broke away is:

- (A)  $\left(-\frac{3}{5}, \frac{46}{5}\right)$  (B)  $\left(-\frac{2}{5}, \frac{44}{5}\right)$   
 (C)  $(6, 4)$  (D)  $(3, 5)$

### Section – A (Maximum Marks: 12)

This section contains **FOUR (04) Matching List Type Questions**. Each question has **FOUR** statements in **List-I** entries (I), (II), (III) and (IV) and **FIVE** statements in **List-II** entries (P), (Q), (R), (S) and (T). The codes for lists have choices (A), (B), (C), (D) out of which **ONLY ONE** of these four options is correct answer.

43. Match the following list-I with list-II.

List- I		List- II	
(I)	Let $f(x) = \begin{cases} x^{3/5} & \text{if } x \leq 1 \\ -(x-2)^3 & \text{if } x > 1 \end{cases}$ then the number of critical points on the graph of the function is	(P)	5
(II)	Number of real solution of the equation, $\log_2^2 x + (x-1)\log_2 x = 6 - 2x$ , is	(Q)	4
(III)	The number of values of $c$ such that the straight line $3x + 4y = c$ touches the curve $\frac{x^4}{2} = x + y$ is	(R)	3
(IV)	If $f(x) = \int_x^{x^2} (t-1)dt$ , $1 \leq x \leq 2$ , then global maximum value of $f(x)$ is	(S)	2
		(T)	1

Which is correct option?

- (A) I  $\rightarrow$  Q (B) II  $\rightarrow$  S  
 (C) III  $\rightarrow$  P (D) IV  $\rightarrow$  T



44. Match the following list-I with list-II.

List- I		List- II	
(I)	If $\lim_{x \rightarrow 0} \left( \frac{\sin x}{x} \right)^{\frac{1}{1-\cos x}}$ is L then $\ln(L)$ equals k. The value of $\frac{1}{k^2}$ is equal to	(P)	0
(II)	The value of $\lim_{n \rightarrow \infty} \left( \frac{n^2}{n-1} \right)^{\tan \frac{1}{\sqrt{n}}}$ is	(Q)	1
(III)	Number of solution of the equation $8 \sin^4 x + 8 \cos^4 x = 5$ in the interval $0 < x < 2\pi$ is	(R)	3
(IV)	Let $f(x)$ be a non – constant polynomial function and $g(x) =  x(x-1)(x-2)f(x) $ . If $g(x)$ is differentiable $\forall x \in \mathbb{R}$ , then minimum number of distinct roots of $f(x) = 0$ is	(S)	8
		(T)	9

Which is correct option?

(A) I  $\rightarrow$  Q(B) II  $\rightarrow$  S(C) III  $\rightarrow$  P(D) IV  $\rightarrow$  R

45. The number of 10 letter permutations comprising 4a's, 3b's and 3c's such that

List- I		List- II	
(I)	a's are separated and all b's are together is equal to	(P)	18
(II)	a's are separated and exactly two b's are together is equal to	(Q)	20
(III)	no two adjacent letters are identical is equal to	(R)	150
(IV)	no two b's are together, no two c's are together and all 'a's are	(S)	180
		(T)	248

Which is correct option?

(A) I  $\rightarrow$  Q(B) II  $\rightarrow$  T(C) III  $\rightarrow$  P(D) IV  $\rightarrow$  Q

46. In a tournament, there are twelve players  $S_1, S_2, \dots, S_{12}$  and divided into six pairs at random. From each game a winner is decided on the basis of a game played between the two players of the pair. Assuming all the players are of equal strength, then

List- I		List- II	
(I)	Probability that $S_2$ is among the losers is	(P)	$\frac{5}{22}$
(II)	Probability that exactly one of $S_3$ and $S_4$ is among the losers is	(Q)	$\frac{1}{2}$
(III)	Probability that both $S_2$ and $S_4$ are among the winners is	(R)	$\frac{6}{11}$
(IV)	Probability that $S_4$ and $S_5$ not playing against each other is	(S)	$\frac{10}{11}$
		(T)	$\frac{3}{11}$

Which is correct option?

(A)  $I \rightarrow P$

(B)  $II \rightarrow Q$

(C)  $III \rightarrow R$

(D)  $IV \rightarrow S$

### Section – B (Maximum Marks: 24)

This section contains **EIGHT (08)** numerical based questions. The answer to each question is a **NUMERICAL VALUE**. If the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places.

47. Let  $N$  be the integer next above  $(\sqrt{3} + 1)^{2018}$ . The greatest integer 'p' such that  $(16)^p$  divides  $N$  is equal to
48. The coefficient of  $x^{\frac{n^2+n-14}{2}}$  in  $(x-1)(x^2-2)(x^3-3)(x^4-4)\dots(x^n-n), n \geq 30$  is equal to
49. If  $\alpha, \beta, \gamma$  are such that  $\alpha + \beta + \gamma = 2, \alpha^2 + \beta^2 + \gamma^2 = 6, \alpha^3 + \beta^3 + \gamma^3 = 8$ , then  $\alpha^4 + \beta^4 + \gamma^4$  is
50. Find the global minimum of the function  
 $f: \mathbb{R}^2 \rightarrow \mathbb{R}, f(x, y) = x^4 + 6x^2y^2 + y^4 - \frac{9}{4}x - \frac{7}{4}y$
51. Let  $f: \mathbb{R} \rightarrow \mathbb{R}$  be a differentiable function such that  $f'$  is continuous on  $\mathbb{R}$  with  $f'(3) = 18$ . Define  $g_n(x) = n \left\{ f\left(x + \frac{5}{n}\right) - f\left(x - \frac{2}{n}\right) \right\}$ . Then  $\lim_{n \rightarrow \infty} g_n(3)$  equals \_\_\_\_\_

52. Find the area of the region bounded by the curves  $y = x^2$ ,  $y = |2 - x^2|$  and  $y = 2$ , which lies to the right of the line  $x = 1$ .
53. Find the maximum value of  $S = (1 - x_1)(1 - y_1) + (1 - x_2)(1 - y_2)$  if  $x_1^2 + x_2^2 = y_1^2 + y_2^2 = 8$
54. Let  $[x] =$  greatest integer less than or equal to  $x$ . If all the values of  $x$  such that the product  $\left[x - \frac{1}{2}\right]\left[x + \frac{1}{2}\right]$  is prime, belongs to the set  $[x_1, x_2) \cup [x_2, x_4)$ , find the value of  $x_1^2 + x_2^2 + x_3^2 + x_4^2$