Vidyamandir Classes
Gurukul for IITJEE Preparation

Advanced Practice Test-4

TIME : 3 hrs	M.M. : 270

Read the following Instructions very carefully before you proceed.

1. The question paper consists of 3 parts (Part I : Chemistry, Part II : Physics, Part III : Mathematics). Each Part has 2 sections (Section I & Section II).

2. **Section I** contains **10 Multiple Correct Answer Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE or More CHOICES may be correct**.

- *Marking scheme* [5 *Marks for Correct answer &* ***–2 NEGATIVE MARKING*** *for wrong answer*]

3. **Section III** contains **10 Match the columns type questions**. Each question contains statements given in 2 columns. Statements in the first column have to be matched with statements in the second column. The answers to these questions have to be appropriately bubbled in the answer sheet.

- *Marking scheme* [**4** ***Marks*** *if you darken ALL the bubbles corresponding ONLY to the correct answer or given* **1** ***Marks*** *each for correct bubbling of answer in any row. There is* ***NO NEGATIVE*** *Marking.*

4. 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.

5. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc., except the Admit Card inside the examination hall/room.

6. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. However, the candidates are allowed to take away this Test Booklet with them.

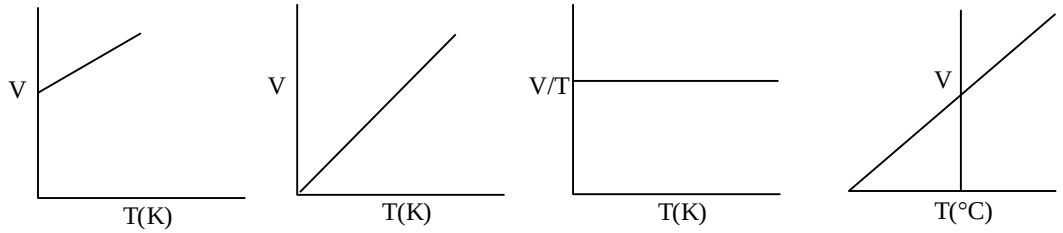
PART - I (CHEMISTRY)	90 MARKS

SECTION-I

MULTIPLE CORRECT ANSWERS

This section contains 10 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct :

1. For a fixed mass of gas and constant pressure, which of the following graphs is/are correct?



(A) **(B)** **(C)** **(D)**

2. Which of the following is(are) true for quantum numbers ?

(A) The azimuthal quantum number (ℓ) determines the shape of the electron cloud

(B) The spin quantum number determines the orientation of an orbital in space

(C) The magnetic quantum number may have values from $+\ell$ to $-\ell$ (including zero)

(D) The magnetic quantum number determines orientation of an orbital in space

3. Which of the following statements(s) is(are) correct ?

(A) 0.2 moles of $KMnO_4$ will oxidise one moles of ferrous ions to ferric in acidic medium

(B) 1.5 moles of $KMnO_4$ will oxidise 1 mole of ferrous oxalate of ferric oxalate in acidic medium

(C) 0.6 moles of $KMnO_4$ will oxidise 1 mole of ferrous oxalate to one mole of ferric ion and carbon dioxide in acidic medium

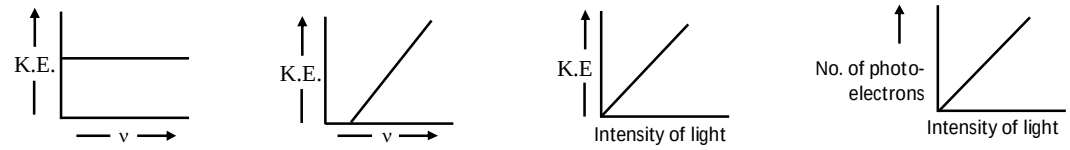
(D) 1 moles of $K_2Cr_2O_7$ will oxidise 2 moles of ferrous oxalate to ferric ions and carbon dioxide in acidic medium

4. Mark out the correct options.

(A) First ionisation energy : Ca > K **(B)** Second ionisation energy : Mg > Al

(C) Electron affinity : S > O **(D)** Ionic radius : $Sc^{3+} > K^+$

5. Which of the graphical representation based on photoelectric effect is(are) correct ?



(A) **(B)** **(C)** **(D)**

6. Which of the following pairs have the first compound more covalent than the second ?

(A) $BeCl_2$, LiCl **(B)** LiI, LiF **(C)** AgCN, KCN **(D)** $ZnCl_2$, $CaCl_2$

7. Which of the following are CORRECT :

(A) $Si^{+2} < Ge^{+2} < Sn^{+2} < Pb^{+2}$ (Stability)

(B) $C_2H_6 < C_2H_4 < C_2H_2$ (Carbon-carbon bond length)

(C) $3s < 3p < 3d$ (Increasing order of energy)

(D) $B < C < O < N < F$ (1^{st} ionisation energy)

8. If an ideal gas expands at constant temperature :

(A) The pressure decreases

(B) The kinetic energy of the molecules remains the same

(C) The K.E. of the molecules decrease **(D)** The number of molecules of the gas increase

9. According to second law of thermodynamics.

(A) Heat can't flow spontaneously from a reservoir at lower temperature to a reservoir at higher temperature

(B) All spontaneous processes lead to increase in entropy of universe

(C) Melting a solid increases entropy, therefore it is a spontaneous process

(D) When an apple falls down a tree, entropy of the universe increases

10. Which of the following species have zero dipole moment ?

(A) BrF_3 **(B)** CF_4 **(C)** BF_3 **(D)** SF_6

SECTION - III
MATRIX MATCH TYPE

This section contains 10 questions. Each question contains statements given in two columns which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. The answers to these questions have to be appropriately bubbled. More than one choice from Column 2 can be matched with Column 1.

1. MATCH THE FOLLOWING COLUMNS :

	Column 1		Column 2
(A)	2p	**(p)**	Angular node = 0 Radial node = 0
(B)	1s	**(q)**	Angular node = 0 Radial node = 1
(C)	2s	**(r)**	Angular node = 1 Radial node = 0
(D)	3p	**(s)**	Angular node = 1 Radial node = 1

2. MATCH THE FOLLOWING COLUMNS :

	Column 1		Column 2
(A)	If force of attraction among the gas molecules be negligible	**(p)**	$\left(P+\frac{a}{V^2}\right)(V-b)=RT$
(B)	If the volume of the gas molecules be negligible	**(q)**	$PV=RT-\frac{a}{V}$
(C)	If both force of attraction and volume of gas molecules is negligible	**(r)**	$PV=RT+Pb$
(D)	If both the force of attraction and volume of gas molecule is significant	**(s)**	$PV=RT$

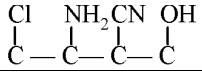
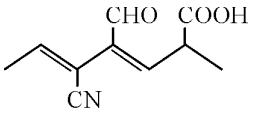
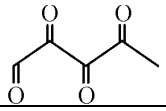
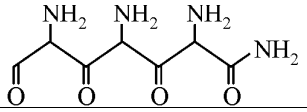
3. MATCH THE FOLLOWING COLUMNS :

	Column 1 (Molecule)		Column 2 (Shape)
(A)	SO_2	**(p)**	Linear
(B)	PCl_5	**(q)**	Bent
(C)	CO_2	**(r)**	Trigonal planar
(D)	C_2H_4	**(s)**	Trigonal bipyramidal

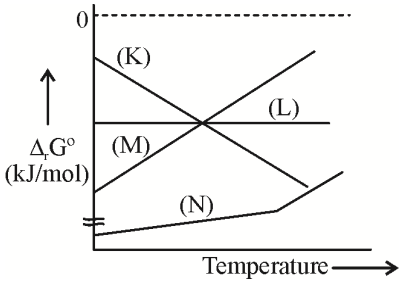
4. MATCH THE FOLLOWING COLUMNS :

	Column 1		Column 2
(A)	Basicity of H_3PO_4	**(p)**	6
(B)	Oxidation state of S in H_2SO_4	**(q)**	1
(C)	'n' factor of H_2O_2 as an oxidising agent	**(r)**	3
(D)	'n' factor H_2O_2, when it disproportionates	**(s)**	2

5. MATCH THE FOLLOWING COLUMNS :

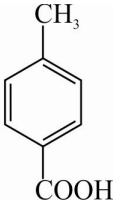
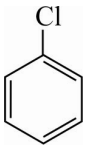
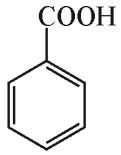
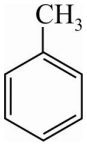
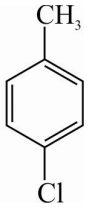
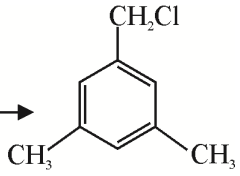
	Column 1 (Structures)		Column 2 (Secondary suffix)
(A)		**(p)**	-amide
(B)		**(q)**	-nitrile
(C)		**(r)**	-oic-acid
(D)		**(s)**	-al

6. Consider the following curves between standard free energy change $\left(\Delta_r G^0\right)$ and temperature (T). Match the reaction (column 1) and corresponding curve between $\Delta_r G^0$ and T (column 2).

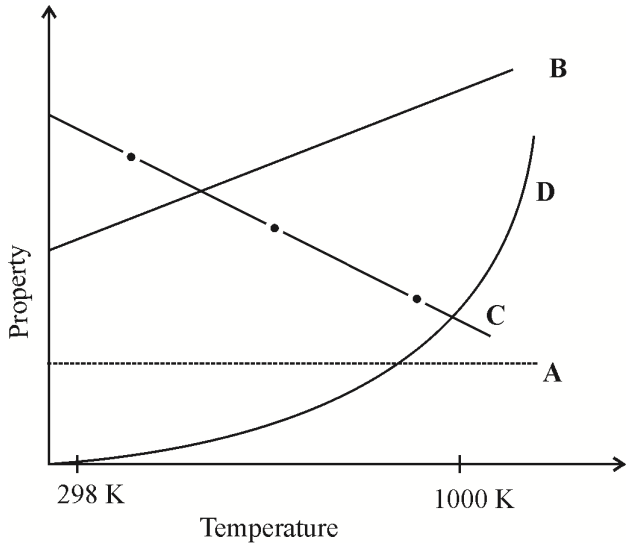


	Column 1 [Reaction]		Column 2 [Plot of $\Delta_r G^\circ$ and Temperature]
(A)	$2CO + O_2 \rightarrow 2CO_2$	**(p)**	Curve (K)
(B)	$C + O_2 \rightarrow CO_2$	**(q)**	Curve (L)
(C)	$2C + O_2 \rightarrow 2CO$	**(r)**	Curve (M)
(D)	$2Ca + O_2 \rightarrow 2CaO$	**(s)**	Curve (N)

7. Match the starting material (Column 1) with proper reaction schemes (Column 2) to get appropriate product :

	Column 1 (Starting materials)		**Column 2 (Reaction schemes)**
(A)	$CH_3 - C \equiv CH$	**(p)**	$\xrightarrow{\text{(i) Mg/dry ether, (ii) } CO_2\text{, (iii) } H^+}$ 
(B)		**(q)**	$\xrightarrow{\text{(i) excess } Cl_2/h\nu\text{, (ii) NaOH excess, (iii) } H^+}$ 
(C)		**(r)**	$\xrightarrow{\text{(i) } CH_3Cl/AlCl_3}$ 
(D)		**(s)**	$\xrightarrow{\text{(i) Red hot Fe; (ii) } Cl_2/h\nu}$ 

8. The following graph represents the dependence of certain properties (Column-1) as a function of temperature.



	Column 1 (Property)		Column 2 (Curve/line)
(A)	The compressibility factor of an ideal gas	**(p)**	Curve 'A'
(B)	The rate constant of a reaction with E_a = 100 kJmol^{-1}	**(q)**	Curve 'B'
(C)	The standard Gibb's free energy of formation of metal oxide	**(r)**	Curve 'D'
(D)	The enthalpy change of a gas phase reaction in which the sum of the number of moles of products is greater than the sum of the number of moles of reactants.	**(s)**	Curve 'C'

9. Consider the following oxygen containing molecular species (Column 1) and inter-atomic distance O–O (Column 2) in these species and select the correct answer using the code given below the columns.

	Column 1 (Molecular species)		Column 2 (O-O bond distance in pm)
(A)	O_2^-	**(p)**	121
(B)	O_2	**(q)**	112
(C)	O_2^+	**(r)**	132
(D)	O_2^{2-}	**(s)**	149

10. Match the pair of elements (Column 1) with their characteristic properties (Column 2).

	Column 1		Column 2
(A)	F, Na	**(p)**	Shows only one non zero oxidation state
(B)	F, Cl	**(q)**	Same value of charge/size ratio
(C)	Li, Mg	**(r)**	Highest electronegativity & highest electron gain enthalpy
(D)	K, Ca	**(s)**	Shows flame test

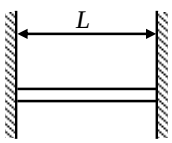
PART - II (PHYSICS) — 90 MARKS

SECTION-I

MULTIPLE CORRECT ANSWERS

This section contains 10 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct :

1. A horizontal rod (length L, mass m, cross section A, coefficient of linear expansion α) fits exactly (without tension) between two rigid vertical supports. Choose the correct option(s).



(A) Since the length of rod cannot increases beyond L, on increasing temperature, the effect of thermal expansion is neutralized by compressive forces developed by the wall

(B) If the walls and rod are rough with mutual friction coefficient μ, then increment in temperature θ of the rod, required to prevent the rod from falling is $\Delta\theta = \frac{mg}{2\mu YA\alpha}$

(C) If the walls and rod are rough with mutual friction coefficient μ, then increment in temperature θ of the rod, required to prevent the rod from falling is $\Delta\theta = \frac{mg}{4\mu YA\alpha}$

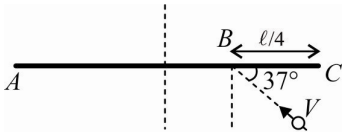
(D) The stress developed in wire is $\alpha y \Delta\theta$

2. Two points on string are being observed as a traveling wave passes them. The points are at $x_1 = 0$ and $x_2 = 1$ *m*. The transverse motions of two points are found to be as follows $y_1 = A\sin(3\pi t)$ and $y_2 = A\sin\left(3\pi t + \frac{\pi}{8}\right)$ where *t* is in seconds and *y* in meters. Mark correct options.

(A) Frequency of wave is 3 *Hz* **(B)** Frequency of wave is 1.5 *Hz*

(C) Wavelength may be 16 *m* **(D)** Wavelength may be $\frac{16}{15}$ *m*

3. A uniform rod *AC* of length ℓ and mass *m* is kept on a horizontal smooth plane. It is free to rotate and move. A particle of same mass *m* moving on the plane with velocity *v* strikes the rod at point *B* making an angle 37° with the rod. The collision is elastic. After collision:



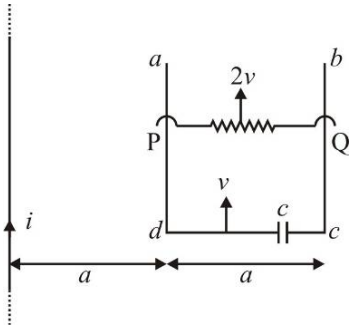
(A) The angular velocity of the rod will be $\frac{72v}{55\ell}$

(B) The centre of the rod will travel a distance $\frac{\pi\ell}{3}$ in the time in which it makes half rotation

(C) Impulse of the impact force is $\frac{24mv}{55}$

(D) None of these

4. A frame *adcb* having a capacitor *C* and a sliding rod PQ of resistance R, start moving with constant velocities *v* and 2*v* respectively parallel to a long wire carrying steady current *i*, as shown in the figure. [Capacitor is initially uncharged]



(A) charge on the capacitor at time *t* is $q = \frac{C\mu_0 iv\ln 2}{2\pi}\left[1 - e^{-t/RC}\right]$

(B) charge on the capacitor at time *t* is $q = \frac{C\mu_0 iv\ln 2}{\pi}\left[1 - e^{-t/RC}\right]$

(C) current passing through the resistor at time *t* is $i = \frac{\mu_0 iv\ln 2}{2\pi R}\left[e^{-t/RC}\right]$

(D) current passing through the capacitor at time *t* is $i = \frac{\mu_0 iv\ln 2}{\pi R}\left[e^{-t/RC}\right]$

5. A 20 gm particle is subjected to two simple harmonic motions

$x_1 = 2\sin 10t, \quad x_2 = 4\sin\left(10t + \frac{\pi}{3}\right)$. where x_1 & x_2 are in metre and *t* is in sec.

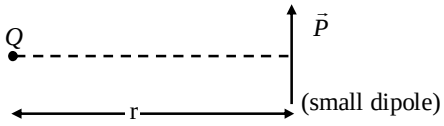
(A) The displacement of particle at $t = 0$ will be $2\sqrt{3}m$

(B) Maximum speed of the particle will be $20\sqrt{7}$ m/s

(C) Magnitude of maximum acceleration of the particle will be $200\sqrt{7}$ m/s^2

(D) Mechanical energy of the resultant motion will be 28 J considering P.E. = 0 at mean position

6. For the situation shown in the figure (Assume $r >>$ length of dipole) mark out the correct statements.



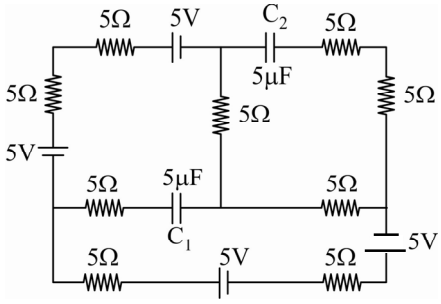
(A) Force acting on the dipole is zero

(B) Force acting on the dipole is $\frac{PQ}{4\pi \in_0 r^3}$

(C) Torque acting on the dipole is $\frac{PQ}{4\pi \in_0 r^2}$

(D) Torque acting on the dipole is $\frac{PQ}{2\pi \in_0 r^2}$

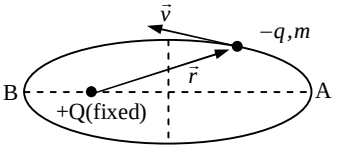
7. A resistance-capacitor network is shown in the figure. The charge on the capacitors C_1 and C_2 are Q_1 and Q_2 respectively. Then



(A) $Q_1 = 20\mu C$ **(B)** $Q_1 = 25\ \mu C$

(C) $Q_2 = 50/3\,\mu C$ **(D)** $Q_2 = 25\mu C$

8. A positive point charge +Q is fixed in space. A negative point charge $-q$ of mass m revolves around fixed charge in elliptical orbit. The fixed charge +Q is at one focus of the ellipse. $\vec{r}$ is the position vector of charge from positive point charge and $\vec{v}$ its velocity when it is at general point P.



The only force acting on negative charge is the electrostatic force due to positive charge. Then which of the following statements is(are) true ?

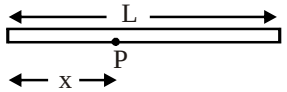
(A) $|m\vec{v}|$ of the negative point charge is constant

(B) $|\vec{r} \times \vec{v}|$ remains constant as negative point charge moves from A to B

(C) Total mechanical energy of the systems of charges is conserved.

(D) $|\vec{r}\,.\,\vec{v}|$ first increases and then decreases as negative charge moves from A to B

9. Consider a uniform bar for which the centre of gravity coincides with the geometrical centre. Weight of rod and length are W and L respectively. Mark the correct statements about the rod.



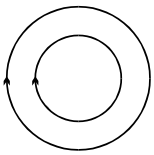
(A) Total gravitational torque about P may be considered as arising from a single force w at the bar's centre

(B) Total gravitational torque about P may be considered as arising from two individual forces of magnitudes $\frac{wx}{L}$ and $\frac{w(L-x)}{L}$ acting at the midpoints of the two segments defined by P

(C) If a fulcrum is placed at P the rod is balanced if x = L/2

(D) Total gravitational torque about P may be considered as arising from two individual forces of magnitudes $\frac{wx}{2L}$ and $\frac{w(L-x)}{2L}$ acting at the midpoints of the two segments defined by P

10. Two concentric, coplanar, circular loop of wire, with different diameter carry current in the same sense as shown in the figure. Which of the following statement(s) is(are) correct?



(A) the magnetic force exerted by the outer loop on a short portion of the inner loop is radially outward

(B) the magnetic force exerted by the outer loop on a short portion of the inner loop is radially inward

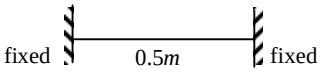
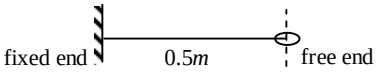
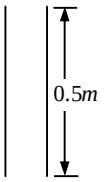
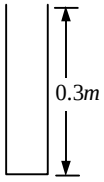
(C) the net magnetic force exerted by the outer loop on a whole inner loop is non zero and is radially outward

(D) the net magnetic force exerted by the outer loop on a whole inner loop is zero

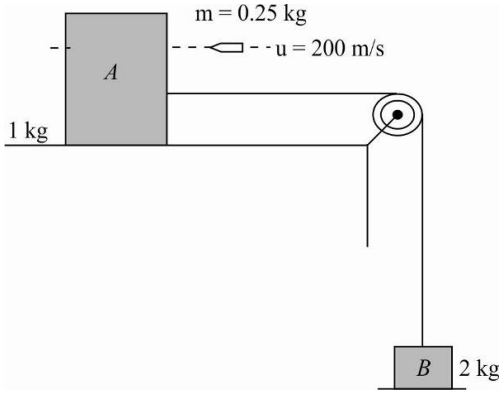
SECTION - III
MATRIX MATCH TYPE

This section contains 10 questions. Each question contains statements given in two columns which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. The answers to these questions have to be appropriately bubbled. More than one choice from Column 2 can be matched with Column 1.

1. In each of the four situations of column 1 a stretched string or an organ pipe is given along with the required data. In case of strings the tension in string is T = 102.4 N and the mass per unit length of string is 1 g/m. Speed of sound in air is 320 m/s. Neglect end corrections. The frequencies of resonance are given in column 2. Match each situation in column 1 with the possible resonance frequencies given in column 2.

	Column 1		Column 2
(A)	String fixed at both ends (Ist overtone) 	**(p)**	800Hz
(B)	String fixed at one end at free at other end (1st overtone) 	**(q)**	480 Hz
(C)	Open organ pipe (2nd overtone) 	**(r)**	640 Hz
(D)	Closed organ pipe (2nd overtone) 	**(s)**	960Hz

2. A block A of mass M_A = 1 kg is kept on a smooth horizontal surface and attached by a light thread to another block B of mass M_B = 2 kg. Block B is resting on ground, and thread and pulley are massless and frictionless. A bullet of mass m = 0.25 kg moving horizontally with velocity of u = 200 m/s penetrates through block A and comes out with a velocity of 100 m/s.

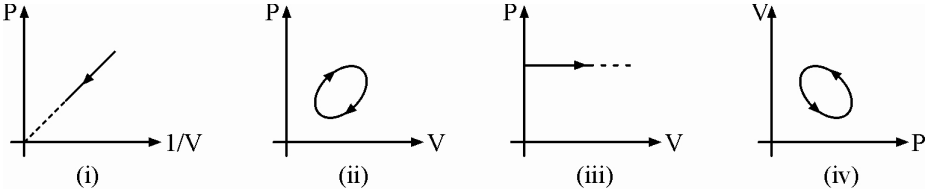


	Column 1		Column 2 (Values are in their respective SI units)
(A)	Velocity of the 2 kg block just after the bullet comes out	**(p)**	50/3
(B)	Maximum displacements of 1 kg block in left direction	**(q)**	25
(C)	Impulse by the string on block B	**(r)**	25/3
(D)	Impulse by the particle on block A	**(s)**	5.2

3. Match the following. (Here gas is ideal, P = pressure, V = volume, γ = ratio of molar specific heat at constant pressure & constant volume)

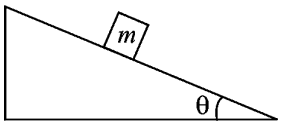
	Column 1		Column 2
(A)	Adiabatic Bulk modulus of gas	**(p)**	$-\frac{P}{V}$
(B)	Slope of P–V graph in isothermal process	**(q)**	$\frac{2}{\gamma-1}$
(C)	Degree of freedom	**(r)**	γP
(D)	Molar heat capacity at constant pressure divided by R	**(s)**	$\frac{\gamma}{\gamma-1}$

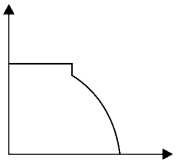
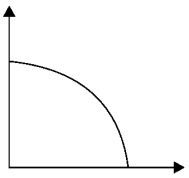
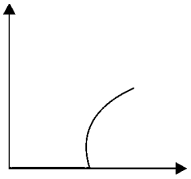
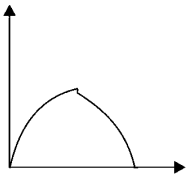
4. The figure given below depict different processes for a given amount of an ideal gas.



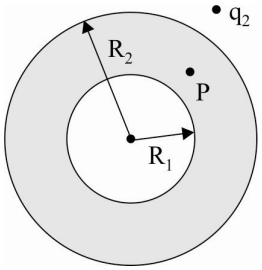
	Column 1		Column 2
(A)	In figure (i)	**(p)**	Heat is absorbed by the system
(B)	In figure (ii)	**(q)**	Work is done on the system
(C)	In figure (iii)	**(r)**	Heat is rejected by the system
(D)	In figure (iv)	**(s)**	Internal energy of system decreases.

5. A block placed on a rough inclined plane. Angle of inclination θ of the plane as shown is varied starting from zero. The coefficient of static friction and kinetic friction between the block and the plane is μ_s and μ_k respectively $(\mu_s > \mu_k)$. Column 2 shown the graph which necessarily contains θ taken on x-axis. Colum-1 represents the quantities taken on Y-axis of column –1.



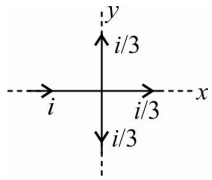
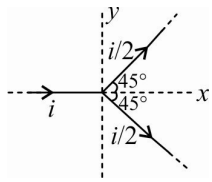
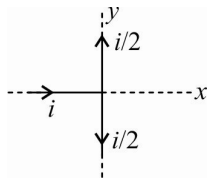
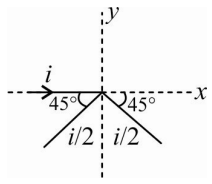
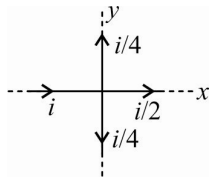
Column 1		Column 2	
(A)	Friction force between the block and plane	**(p)**	
(B)	Normal force between the block and plane	**(q)**	
(C)	Total contact force between the block and plane.	**(r)**	
(D)	Acceleration of block	**(s)**	

6. A conducting shell of inner radius R_1 and outer radius R_2 is given a charge +Q. A point charge q_1 is placed inside the shell and q_2 is placed outside the shell. Then for various locations of q_1 and q_2, match the entries of Column 1 with the entries of Column 2.

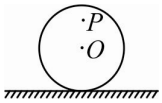


Column - 1		Column - 2	
(A)	If q_1 is at centre and $q_2 = 0$, then $\vec{E}$ at centre of shell due to charge on outer surface of shell is	**(p)**	$\frac{q_2}{4\pi\varepsilon_0 (r - R_1)^2}$
(B)	If q_1 is not at centre and q_2 is at distance r from the centre, then $\vec{E}$ at the inner surface of shell (at a point closest to q_2) due to charge on outer surface of the shell is	**(q)**	$\frac{q_1}{4\pi\varepsilon_0 r^2}$
(C)	If q_1 is a at centre and q_2 is at distance r from the centre, then $\vec{E}$ at a point distant r_2 (> r) from the centre of the shell due to outer surface charge is	**(r)**	Zero
(D)	If q_1 is not at centre and $q_2 = 0$, then $\vec{E}$ at point P (P is at distance r from q_1) due to charge of the inner surface of shell is (where $R_1 < r < R_2$)	**(s)**	Cannot be determined

7. Column 2 gives four situations in which three or four semi infinite current carrying wires are placed in *xy*-plane as shown. The magnitude and direction of current is shown in each figure. Column 1 gives statements regarding the *x* and *y* components of magnetic field at a point *P* whose coordinates are $P(0,0,d)$. Match the statements in column 1 with the corresponding figures in column 2.

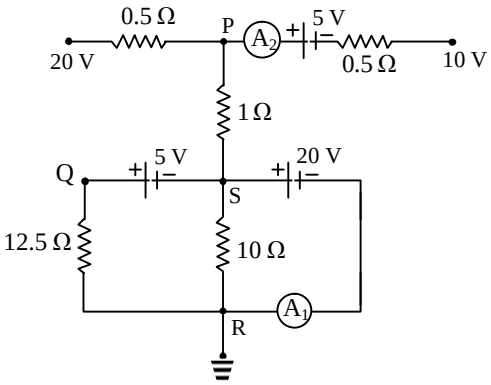
Column 1		Column 2	
(A)	The *x* component of magnetic field at point *P* is zero in	**(p)**	
(B)	The *z* component of magnetic field at point *P* is zero in	**(q)**	
(C)	The magnitude of magnetic field at point *P* is $\frac{\mu_0 i}{4\pi d}$ in	**(r)**	
(D)	The magnitude of magnetic field at point *P* is less than $\frac{\mu_0 i}{2\pi d}$ in	**(s)**	
		(t)	

8. A uniform disc rolls without slipping on a rough horizontal surface with uniform angular velocity. Point O is the centre of disc and P is a point on disc as shown in figure. In each situation of column 1 a statement is given and the corresponding results are given in column 2. Match the statements in column 1 with the results in column 2.



Column 1		Column 2	
(A)	The velocity of point P on disc	**(p)**	Changes in magnitude with time
(B)	The acceleration of point P on disc	**(q)**	Is always directed from that point (the point on disc given in column 1) towards centre of disc.
(C)	The tangential acceleration of point P on disc	**(r)**	Is always zero
(D)	The acceleration of point on disc which is in contact with rough horizontal surface	**(s)**	Is non-zero and remains constant in magnitude
		(t)	Changes in direction with time

9. In the adjacent circuit shown, all ammeters and batteries are ideal. Internal resistances of all the batteries are negligible. Point R is grounded. Then, match the following.



	Column 1		Column 2
(A)	Potential of point P	**(p)**	6 *SI* unit
(B)	Potential of point Q	**(q)**	25 *SI* unit
(C)	Reading of ammeter A_1	**(r)**	18 *SI* unit
(D)	Reading of ammeter A_2	**(s)**	64 *SI* unit

10. Consider an incompressible and non-viscous liquid in a container. Density of liquid is ρ, acceleration due to gravity is g and h represents the vertical separation between two points. All points considered in Column 1 are inside the liquid. Match the statements given in Column 1 with corresponding all possible conditions given in Column 2.

	Column 1		Column 2
(A)	Pressure difference between two distinct points is ρgh where two points are at same vertical line at a separation h.	**(p)**	Container is stationary.
(B)	Pressure difference between any pair of two distinct point on same horizontal level may be zero.	**(q)**	Container is accelerating is horizontal direction.
(C)	Pressure difference between any pair of two distinct points on same horizontal level be non-zero.	**(r)**	Container is falling freely.
(D)	Pressure difference between any two distinct points on same vertical line is zero.	**(s)**	Container is accelerating up in vertical direction with an acceleration < g.
		(t)	Container is rotating about a vertical axis passing through its symmetry.

PART - III (MATHEMATICS) — 90 MARKS

SECTION-I
MULTIPLE CORRECT ANSWERS

This section contains 10 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct :

1. If $tan\frac{t}{2}$ is the root of quadratic equation $ax^2+bx+1=0$, where $b, c \in R$ and $sin t + cos t = \frac{4}{3}$ then :

(A) $a+b=1$ **(B)** $a+b=8$ **(C)** $2a+3b=3$ **(D)** $2a+b=8$

2. If the area of the quadrilateral formed by the tangents from the origin to the circle $x^2+y^2+6x-10y+c=0$ and the radii corresponding to the points of contact is 15, then values of c is (are):

(A) 9 **(B)** 4 **(C)** 5 **(D)** 25

3. If the two rays $x + y = |a|$ and $ax - y = 1$ intersect in the first quadrant (excluding the axes), then the possible integral values of a are :

(A) 3 **(B)** -1 **(C)** 2 **(D)** 1

4. If ${}^{n}C_{r-1} = \left(k^2 - 8\right)\left({}^{n+1}C_{r}\right)$, then k belongs to :

(A) $\left[-3, -2\sqrt{2}\right)$ **(B)** $(-3, 3)$ **(C)** $\left(2\sqrt{2}, 3\right]$ **(D)** $\left[-2\sqrt{2}, 2\sqrt{2}\right]$

5. Let $f(x) = \begin{Bmatrix} x^2 & ; & 0 < x < 2 \\ 2x - 3 & ; & 2 \le x < 3 \\ x + 2 & ; & x \ge 3 \end{Bmatrix}$ then which of the following is(are) true?

(A) $f\left(f\left(f\left(\frac{3}{2}\right)\right)\right) = f\left(\frac{3}{2}\right)$ **(B)** $1 + f\left(f\left(f\left(\frac{5}{2}\right)\right)\right) = f\left(\frac{5}{2}\right)$

(C) $f(f(f(2))) = f(1)$ **(D)** $\underbrace{f\left(f\left(f\left(.....f(4)\right)\right).....\right)}_{1004\ times} = 2012$

6. If $\tan\theta_i$; $i = 1, 2, 3, 4$ are the roots of equation $x^4 - x^3 \sin 2\beta + x^2 \cos 2\beta - x\cos\beta - \sin\beta = 0$, then $\tan\left(\theta_1 + \theta_2 + \theta_3 + \theta_4\right)$ is equal to :

(A) $\frac{1 - \cos 2\beta}{\sin 2\beta}$ **(B)** $\frac{1 + \cos 2\beta}{\sin 2\beta}$ **(C)** $\tan\beta$ **(D)** $\cot\beta$

7. The function $f(x) = \sqrt{ax^3 + bx^2 + cx + d}$ has its non-zero local minimum and local maximum values at -2 and 2 respectively. Given a is root of the equation $x^2 - x - 6 = 0$. The value of $(a + b + c)$ is divisible by :

(A) 16 **(B)** 2 **(C)** 11 **(D)** 22

8. If A and B are the sets of Domain and Range of function :

$f(x) = \log_e\left(\log_e\{x\} + \log_e\left(\frac{1}{\{x\}\{-x\}} - 1\right)\right)$, then : (where $\{\cdot\}$ denotes fractional part of x)

(A) $A = R$ **(B)** $B = R$ **(C)** $A \cup B = R$ **(D)** $A \cap B = R - I$

9. The complete set of values of x for which $\left|\tan^{-1}x\right| + \left|\cot^{-1}x\right| = \frac{\pi}{2}$ is valid :

(A) $(-3, 3)$ **(B)** $(-1, 1)$ **(C)** $(-\infty, 0]$ **(D)** $[0, \infty)$

10. Let $y^2 = 3x^2 + 2x + 1$ and $I_n = \int \frac{x^n}{y}dx$, then $a_1 I_{10} + a_2 I_9 + a_3 I_8 - x^9 y$ for :

(A) $a_1 = 30$ **(B)** $a_2 = 17$ **(C)** $a_3 = 9$ **(D)** $a_1 - a_2$ is a prime

SECTION - III
MATRIX MATCH TYPE

This section contains 10 questions. Each question contains statements given in two columns which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. The answers to these questions have to be appropriately bubbled. More than one choice from Column 2 can be matched with Column 1.

1. MATCH THE FOLLOWING COLUMN :

	Column 1		Column 2
(A)	The length of the common chord of two circles of radii 3 and 4 units which intersect orthogonally is $\frac{k}{5}$, then k equals to	**(p)**	1
(B)	The circumference of the circle $x^2+y^2+4x+12y+p=0$ is bisected by the circle $x^2+y^2-2x+8y-q=0$, then $p+q$ is equal to	**(q)**	24
(C)	Number of distinct chords of the circle $2x\left(x-\sqrt{2}\right)+y(2y-1)=0$ passing through the point $\left(\sqrt{2},\frac{1}{2}\right)$ and are bisected by X-axis, is equal to	**(r)**	2
(D)	Number of common tangents to circles $x^2+y^2+6x+2y-6=0$ and $x^2+y^2-2x-6y+1=0$ are equal to	**(s)**	36

2. For $a\neq 0$ the equation $ax^2+b|x|+c=0$ has exactly k real roots. Based on this information, match the following columns :

	Column 1		Column 2
(A)	If $k=1$, then there must be	**(p)**	$ab<0$
(B)	If $k=2$, then there must be	**(q)**	$ab>0$
(C)	If $k=3$, then there must be	**(r)**	$ac<0$
(D)	If $k=4$, then there must be	**(s)**	$ac>0$

3. MATCH THE FOLLOWING COLUMN :

	Column 1		Column 2
(A)	The number of solutions of the equation $\lvert\cot x\rvert=\cot x+\frac{1}{\sin x}(0<x<\pi)$ is (are)	**(p)**	No solution
(B)	The number of solutions of the equations $\sin\theta+\sin\phi=\frac{1}{2}$ and $\cos\theta+\cos\phi=2$ is (are)	**(q)**	$\frac{1}{3}$
(C)	The value of $\sin^2\alpha+\sin\left(\frac{\pi}{3}-\alpha\right)\sin\left(\frac{\pi}{3}+\alpha\right)$ is	**(r)**	1
(D)	If $\tan\theta=3\tan\phi$, then maximum value of $\tan^2(\theta-\phi)$ is	**(s)**	$\frac{3}{4}$

4. MATCH THE FOLLOWING COLUMNS :

If z_1, z_2, z_3, z_4 are the roots of the equation $z^4+z^3+z^2+z+1=0$ then :

	Column 1		**Column 2**
(A)	$\left\lvert\sum_{i=1}^{4} z_i^4\right\rvert$ is equal to	**(p)**	0
(B)	$\sum_{i=1}^{4} z_i^5$ is equal to	**(q)**	4
(C)	$\prod_{i=1}^{4}(z_i+2)$ is equal to	**(r)**	1
(D)	$\prod_{i=1}^{4} z_i^2$ is equal to	**(s)**	11

5. MATCH THE FOLLOWING COLUMNS:

	Column 1		**Column 2**
(A)	The units place in $S=\underline{\lfloor 1}+\underline{\lfloor 4}+\underline{\lfloor 7}+\underline{\lfloor 10}+\ldots.+\underline{\lfloor 400}$ is :	**(p)**	1
(B)	The number of solutions of the system of equations $\mathrm{Re}(z^2)=0,\ \lvert z\rvert=2$ is :	**(q)**	4
(C)	If the number of triangles that can be formed with 10 points as vertices, n of them being collinear, is 110, then n is	**(r)**	5
(D)	Let $f(x)=x^2-x+1,\ x\ge\frac{1}{2}$, then the solution of the equation $f^{-1}(x)=f(x)$ is $x=$	**(s)**	6

6. Let $\beta+\beta^2+\beta^4$ and $\beta^3+\beta^5+\beta^6$, (where β is the non-real complex root of the equation $z^7=1$) are the roots of the equation $z^2+az+b=0$ where $a,b\in R$; then :

	Column 1		**Column 2**
(A)	a is equal to	**(p)**	1/8
(B)	b is equal to	**(q)**	2
(C)	$16\left(\cos\frac{2\pi}{7}\cos\frac{4\pi}{7}\cos\frac{6\pi}{7}\right)$ is equal to	**(r)**	1
(D)	$\left(\cos\frac{2\pi}{7}+\cos\frac{4\pi}{7}+\cos\frac{8\pi}{7}\right)$ is equal to	**(s)**	$-1/2$

7. MATCH THE FOLLOWING COLUMNS :

	Column 1		**Column 2**
(A)	If $f(x)=\sqrt{\frac{1+\sin^{-1}x}{1-\tan^{-1}x}}$; then $f'(0)$ equals to	**(p)**	0
(B)	Let $g(x)=\lim_{t\to\infty} t\,\ell n\left(\frac{\tan(x+1/t)}{\tan x}\right)$ then $\frac{3}{2}\lvert g'(\pi/6)\rvert$ equals to	**(q)**	1
(C)	Let $h(x)=2\sin^{-1}\sqrt{1-x}+\sin^{-1}\left(2\sqrt{x(1-x)}\right)$ then $h'(1/4)$ equals to	**(r)**	2
(D)	Let $k(x)=x+\tan x+2$ and $\ell(x)$ be the inverse of $k(x)$ then $2\ell'(2)$ equals to	**(s)**	4

8. MATCH THE FOLLOWING COLUMNS :

	Column 1		Column 2
(A)	Number of five digit numbers of the form $d_1d_2d_3d_4d_5$ where d_i are digits $\forall$, i = 1, 2, 3, 4, 5 and satisfying $d_1 < d_2 \le d_3 < d_4 \le d_5$ is divisible by	**(p)**	5
(B)	$256\left(\cos 12^\circ \cos 24^\circ \cos 36^\circ \cos 48^\circ \cos 60^\circ \cos 72^\circ \cos 84^\circ\right)$ is divisible by	**(q)**	2
(C)	A badminton team has to be selected comprising of 5 students out of 10 students for inter school tournament. Number of ways this can be done if a particular players is to be always included or always excluded from the team, is a multiple of	**(r)**	7
(D)	Let $y = \sin^2 x + \cos x$ for $0 \le x \le \frac{2\pi}{3}$. The ratio of the maximum and minimum value of y is	**(s)**	3

9. MATCH THE FOLLOWING COLUMNS :

	Column 1		Column 2
(A)	$25\int_0^{\pi/4}\left(\tan^6\left(x-[x]\right)+\tan^4\left(x-[x]\right)\right)dx$	**(p)**	e^2
(B)	Let $f(x)$ be a function satisfying $f'(x) = f(x)$ with $f(0) = 1$ and g be the function satisfying $f(x)+g(x)=x^2$, then the value of the integral $\int_0^1 f(x)g(x)dx$	**(q)**	1
(C)	$\lim_{k\to 0}\frac{1}{k}\int_0^k (1+\sin 2x)^{1/x}\,dx$ is equal to	**(r)**	$e-\frac{1}{2}e^2-\frac{3}{2}$
(D)	If $f(x)$ is an integrable function for $x \in \left[\frac{\pi}{6},\frac{\pi}{3}\right]$ and $I_1 = \int_{\pi/6}^{\pi/3} \sec^2\theta f(2\sin 2\theta)d\theta$ and $I_2 = \int_{\pi/6}^{\pi/3} \operatorname{cosec}^2\theta f(2\sin 2\theta)d\theta$, then I_1/I_2	**(s)**	5

10. MATCH THE COLUMN COLUMNS :

	Column 1		Column 2
(A)	The value of $\left\{\sin^{-1}\left(\frac{1}{3}\right)+\sin^{-1}\left(\frac{1}{3\sqrt{11}}\right)+\sin^{-1}\left(\frac{3}{\sqrt{11}}\right)\right\}$	**(p)**	9/2
(B)	If $2\sec 2\alpha = \tan\beta + \cot\beta$ then $(\alpha+\beta)$ is equal to	**(q)**	$\pi/2$
(C)	The last digit of $\left(1!+2!+.....+(2010)!\right)^{102}$ is	**(r)**	$\pi/4$
(D)	Minimum value of $\left(\left(x^2+4\right)+\frac{2}{\left(x^2+4\right)}\right)$ is	**(s)**	9