JEE EXPERT

STAYHOME#STAYSAFE

CORONA KO STOP KARNA HAI
AT LOCKDOWN, UNLOCK YOUR POTENTIAL
PRACTICE TEST – 07

Time : 3 hours ***Maximum Marks : 240***

- ***Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.***
- ***You are not allowed to leave the examination hall before end of the test.***

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
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 three sections: **Section-A, Section-B & Section-C**
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

(i) **Section-A (01 – 08)** contains 8 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (09 – 12) contains 4 multiple choice questions which have one or more than one correct answer. Each question carries **+4 marks** for correct answer. There is no negative marking.

Section-A (13 – 17) contains 2 paragraphs. Based upon paragraph, 3 and 2 multiple choice questions have to be answered. Each question has only one correct answer and carries **+4 marks** for correct answer and **– 1 mark** for wrong answer.

(ii) **Section-B (01)** contains 1 Matrix Match Type question containing statements given in 2 columns. Statements in the first column have to be matched with statements in the second column. Each question carries **+6 marks** for all correct answer. For each correct row **+1 mark** will be awarded. There may be one or more than one correct choice. No marks will be given for any wrong match in any question. There is no negative marking.

(iii) **Section-C (01 – 05)** contains 5 Numerical based questions with single digit integer as answer, ranging from 0 to 9 and each question carries **+3 marks** for correct answer. There is no negative marking.

Useful Data Chemistry :

Gas Constant	R	=	$8.314\ J\ K^{-1}\ mol^{-1}$
		=	$0.0821\ Lit\ atm\ K^{-1}\ mol^{-1}$
		=	$1.987 \approx 2\ Cal\ K^{-1}\ mol^{-1}$
Avogadro's Number	N_a	=	6.023×10^{23}
Planck's Constant	h	=	6.626×10^{-34} Js
		=	6.25×10^{-27} erg.s
1 Faraday		=	96500 Coulomb
1 calorie		=	4.2 Joule
1 amu		=	1.66×10^{-27} kg
1 eV		=	1.6×10^{-19} J

Atomic No : H=1, D=1, Li=3, Na=11, K=19, Rb=37, Cs=55, F=9, Ca=20, He=2, O=8, Au=79.

Atomic Masses: He=4, Mg=24, C=12, O=16, N=14, P=31, Br=80, Cu=63.5, Fe=56, Mn=55, Pb=207,
Au=197, Ag=108, F=19, H=2, Cl=35.5, Sn=118.6

Useful Data Physics :

Acceleration due to gravity g = 10 m/s^2

PART – I : PHYSICS

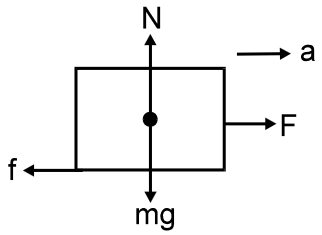
SECTION –A
(Single Correct Choice Type)

This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. A particle describes a horizontal circle on the smooth surface of an inverted cone where the height of the plane of the circle is 9.8 cm above the vertex. The speed of the particle is

(A) 0.098 ms^{-1} (B) 0.98 ms^{-1} (C) 9.8 ms^{-1} (D) 9.8 cm s^{-1}

2. A block of mass m is kept on a rough horizontal floor having coefficient of friction m. A constant horizontal force F is applied on the block towards right due to which it is moving with a constant acceleration a. Free body diagram of the object is shown in the figure.



Choose the correct alternative.

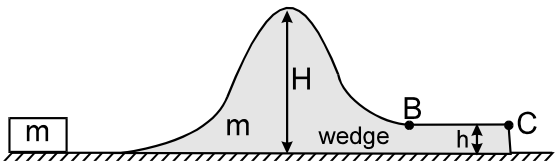
(A) According to Newton's 3rd law, mg is action and N is reaction

(B) According to Newton's 3rd law, F is action and f is reaction

(C) Friction force f can have any value between 0 to μmg

(D) $a = \frac{F-f}{m}$

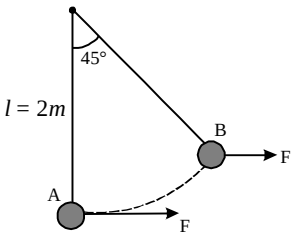
3. Figure shows an irregular wedge of mass m placed on a smooth horizontal surface. Part BC is rough. What minimum velocity should be imparted to a small block of same mass m so that it may reach point B :



(A) $2\sqrt{gH}$ **(B)** $\sqrt{2gH}$

(C) $2\sqrt{g(H-h)}$ **(D)** $\sqrt{gh}$

4. In the given diagram a force F = 10N acts always along horizontal direction on the bob of mass $\sqrt{2}$ kg. Find the velocity of the bob at point B in the Figure. given that g = 10 m/s^2. bob is at rest initially and length of string is l = 2m



(A) $\sqrt{20(\sqrt{2}-1)}$ (B) $\sqrt{20(\sqrt{2}+1)}$

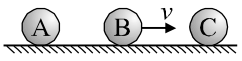
(C) $\sqrt{10(\sqrt{2}-1)}$ (D) $\sqrt{10(\sqrt{2}+1)}$

5. An object is acted upon by the forces $\vec{F}_1 = 4\hat{i}\,N$ and $\vec{F}_2 = (\hat{i}-\hat{j})N$. If the displacement of the object is D = $(\hat{i}+6\hat{j}-6\hat{k})m$, the kinetic energy of the object:

(A) Remain constant (B) Increase by 1J

(C) Decrease by 1J (D) Decrease by 2J

6. Three balls A, B and C ($m_A = m_C = 4m_B$) are placed on a smooth horizontal surface. Ball B collides with ball C with an initial velocity v as shown in figure. Total number of collisions between the balls will be (all collisions are elastic)

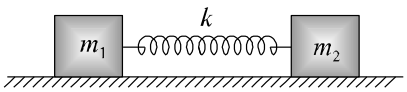


(A) 1 (B) 2 (C) 3 (D) 4

7. The masses and radii of the earth and moon are M_1, R_1 and M_2, R_2 respectively. Their centres are a distance d apart. The minimum speed with which a particle of mass m should be projected from a point midway between the two centres so as to escape to infinity is equal to

(A) $\left[\frac{G(M_1-M_2)}{d}\right]^{1/2}$ (B) $\left[\frac{G(M_1+M_2)}{a}\right]^{1/2}$ (C) $2\left[\frac{G(M_1+M_2)}{md}\right]^{1/2}$ (D) $2\left[\frac{G(M_1-M_2)}{md}\right]^{1/2}$

8. Two blocks m_1 and m_2 are pulled on a smooth horizontal surface, and are joined together with a spring of stiffness k as shown in figure. Suddenly, block m_2 receives a horizontal velocity v_0, then the maximum extension x_m in the spring is :



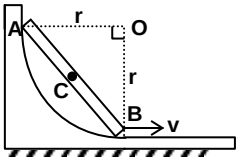
(A) $v_0\sqrt{\frac{m_1m_2}{m_1+m_2}}$ (B) $v_0\sqrt{\frac{2m_1m_2}{(m_1+m_2)k}}$

(C) $v_0\sqrt{\frac{m_1m_2}{2(m_1+m_2)k}}$ (D) $v_0\sqrt{\frac{m_1m_2}{(m_1+m_2)k}}$

(Multi Correct Choice Type)

This section contains **4 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

9. A rigid rod of mass M slides along a fixed semicircular track (in vertical plane) followed by a flat track. At the given instant velocity of end B is v along horizontal plane. Then at the given instant

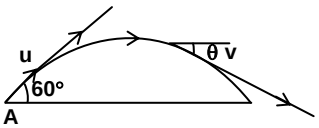


(A) angular speed of rod is v/r
(B) velocity of centre of mass is $v/\sqrt{2}$
(C) angular momentum of rod about O is 2/3 mvr
(D) the ratio of rotational to translational kinetic energy is 1:2

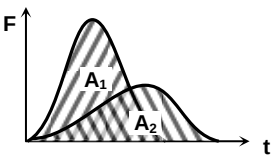
10. A particle is projected from point A with speed u and angle of projection is 60°. At some instant magnitude of velocity of particle is v and it makes an angle θ with horizontal. If radius of curvature of path of particle at the given instant is $8/3\sqrt{3}$ times the minimum radius of curvature during the whole flight, then,

(A) $\theta = 37°$ (B) $\theta = 30°$

(C) $v = \frac{u}{2}$ (D) $\frac{u}{2\sqrt{3}}$



11. In the figure shown,



(A) impulse in the two cases will be same if $A_1 = A_2$
(B) maximum force is greater in case I
(C) impulse in the two cases may or may not be equal and it does not depend on area under the curve
(D) none of these

12. Pick the correct statements:

(A) Average speed of a particle in a given time is never less than the magnitude of the average velocity.

(B) It is possible to have a situation in which $\left|\frac{d\vec{v}}{dt}\right| \neq 0$ but $\frac{d}{dt}|\vec{v}| = 0$.

(C) The average velocity of a particle is zero in a time interval. It is possible that the instantaneous velocity is never zero in the interval.

(D) The average velocity of a particle moving on a straight line is zero in a time interval. It is possible that the instantaneous velocity is never zero in the interval. (Infinite acceleration are not allowed)

(Paragraph Type)

This section contains **2 paragraphs.** Based upon the paragraphs **3 multiple choice questions** and **2 multiple choice questions** have to be answered. Each of these questions has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Paragraph for Question no. 13 to 15

A rod AB of mass M and length L is lying on a horizontal frictionless surface. A particle of mass m traveling along surface hits the end 'A' of the rod with velocity v_0 in direction perpendicular to AB. The collision in elastic. After the collision the particle comes to rest :

13. Ratio of $\frac{m}{M}$ is:

(A) $\frac{1}{4}$ (B) $\frac{1}{2}$ (C) $\frac{1}{3}$ (D) $\frac{1}{5}$

14. A point P on the rod is at rest immediately after collusion. Find the distance AP.

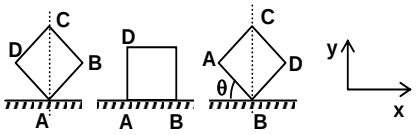
(A) $\frac{2L}{5}$ (B) $\frac{L}{6}$ (C) $\frac{2L}{3}$ (D) $\frac{L}{3}$

15. Find the linear speed of point p after a time $t=\frac{\pi L}{3v_0}$ after the collision:

(A) $\frac{v_0}{2}$ (B) $\frac{v_0}{2\sqrt{2}}$ (C) $\frac{v_0}{\sqrt{2}}$ (D) $\frac{v_0}{\sqrt{3}}$

Paragraph for Question no. 16 to 17

A cube of mass M and edge a is released from rest with its corner C vertically above A. It rotates about A until its corner B strikes the floor, and then rotates about B. The floor is sufficiently rough to prevent slipping and the impact at B is perfectly plastic. ω_0 denotes the angular speed of cube just before B strikes the floor. (Motion of cube is in x-y plane only)



16. The value of ω_0 =

(A) $\sqrt{\left[\frac{3g\left(\sqrt{2}-1\right)}{\sqrt{2}a}\right]}$ (B) $\sqrt{\left[\frac{3g\left(\sqrt{2}-1\right)}{2\sqrt{2}a}\right]}$

(C) $\sqrt{\frac{3g}{a}}$ (D) none of these

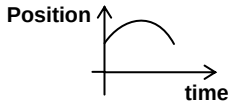
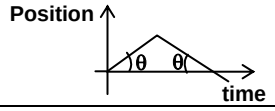
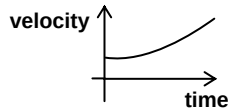
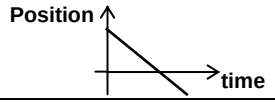
17. The angular speed of cube after B strikes the floor is

(A) $\frac{\omega_0}{3}$ (B) $\frac{2\omega_0}{3}$ (C) $\frac{\omega_0}{4}$ (D) $\frac{\omega_0}{2}$

SECTION – B
(Matrix Type)

This section contains **1 questions**. Each question has **four statements** (A, B, C and D) given in **Column I** and **four statements** (p, q, r and s) in **Column II.** Any given statement in **Column I** can have correct matching with one or more statement(s) in **Column II.** For example, if for a given question, statement B matches with the statements given in Q and R, then for that particular question, against statement B, darken the bubbles corresponding to Q and R in the ORS.

1. Match the situation given in column A with the possible curves in column B

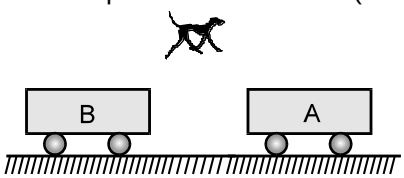
Column A		Column B	
(A)	Particle moving with constant speed	(p)	
(B)	Particle moving with increasing acceleration	(q)	
(C)	Particle moving with constant negative acceleration	(r)	
(D)	Particle moving with zero acceleration	(s)	

SECTION – C
(Integer Type)

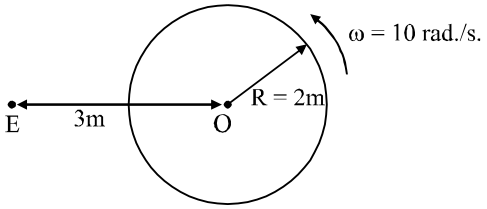
This section contains **5 questions**. The answer to each question is a **single-digit integer**, ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

1. An engineer works at a plant out of town. A car is sent for him from the plant every day that arrives at the railway station at the same time as the train he takes. One day the engineer arrived at the station half an hour before his usual time and without waiting for the car, started walking towards factory. On his way he met the car and reached his plant 20 minutes before the usual time. The time (in minute) did the engineer walk before he met the car is 5t.Then value of t is ?

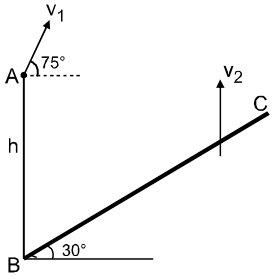
2. In a circus act, a 4 kg dog is trained to jump from B cart to A cart and then immediately back to the B cart. The carts each have a mass of 20 kg and they are initially at rest. In both cases the dog jumps at 6 m/s relative to the cart. If the cart moves along the same line with negligible friction, If the final magnitude of velocity of cart B with respect to the floor is 11(X/36) fill x in your answer sheet.



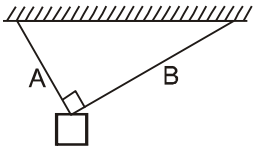
3. A disc of mass 2 kg and radius 2 meter is rotating about its own centre. The angular momentum of disc about a point 'E' at distance 3m from centre of disc is 10 P $\frac{kg \times m^2 \times rad}{sec}$. The value of P will be :



4. A particle is projected with a speed of $v_1 = 10\sqrt{2}$ m/s at an angle of 75° with the horizontal towards an inclined plane 'BC', having angle of inclination 30°, which moves along upward direction with constant velocity v_2 = 10 m/s. An observer on inclined surface observes that particle hits the inclined plane perpendicularly. Initial vertical distance between particle and point on inclined surface 'B' is $h = \frac{15\sqrt{K} - 20}{\sqrt{K}}$ m. Then find the value of K.



5. An object is hanged from ceiling with help of two light strings A & B. Object stays in equilibrium with tension in string A & B equal to 40 N and 30 N respectively. Now the object is pulled by a constant horizontal force F = 120 N perpendicular to initial plane of object and two strings. if object stays at rest in new equilibrium position (g = 10 m/s^2). Tension in string B is 39 K. Then find the value of K:



PART – II : CHEMISTRY

SECTION –A
(Single Correct Choice Type)

This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. Select the correct statements :
(I) The magnitude of spin angular momentum of the electron is constant
(II) Orbital angular momentum is a vector quantity and can have different orientations relative to the chosen axis
(III) Orbital angular momentum is constant irrespective of the orbital
(A) I & II (B) II & III (C) 1 & III (D) 1, II, & III

2. $CaO + C \longrightarrow X + a\ gas$
$X + N_2 \longrightarrow Y + C$
$Y + H_2O \longrightarrow a\ solid + Z$
Z is :
(A) $CaCN_2$ (B) NH_4OH (C) $Ca(NO_3)_2$ (D) $Ca(NO_2)_2$

3. The bond angle of NH_3, NH_2^- and NH_4^+ are in the order :
(A) $NH_2^- > NH_3 > NH_4^+$ (B) $NH_4^+ > NH_3 > NH_2^-$ (C) $NH_3 > NH_2^- > NH_4^+$ (D) $NH_3 > NH_4^+ > NH_2^-$

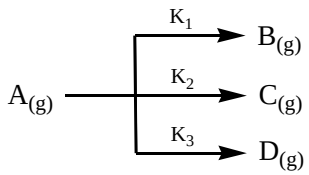
4. A gas mixture contain twice as many moles of O_2 as N_2 ($O_2 : N_2 = 2 : 1$). Addition of 0.2 moles of argon to this mixture increase the pressure from 0.8 atm to 1.1 atm. How many moles of O_2 are in the mixture:
(A) 0.355 mol (B) 0.178 mol (C) 0.533 mol (D) 0.208 mol

5. For a certain reaction the variation of the rate constant with temperature is given by the equation
$\ln k_t = \ln k_0 + 0.0693\ t\ \ (t \geq 0°C)\ (\ln 2 = 0.693)$
The value of the temperature coefficient of the reaction rate is therefore
(A) 0.1 (B) 1.0 (C) 10 (D) 2

6. On introduction of a catalyst at 500 K, the rate of a first order reaction increases by 1.718 times. If the activation energy in the presence of a catalyst is 4.15 kJ mol^{-1}. Then the E_a in absence of catalyst is
(ln 1.718 = 0.541)
(A) 4.15 kJ (B) 2.08 kJ (C) 6.4 kJ (D) 8.3 kJ.

7. 200 gm of $CaCO_3(s)$ taken in 4 ltr container at a certain temperature. K_c for the dissociation of $CaCO_3$ at this temperature is found to be 1/4 mole ltr^{-1}. Then the concentration of CaO in mole/litre is
[Given ρ_{CaO} = 1.12 gm cm^{-3}] [Ca = 40, O = 16]
(A) $\frac{1}{2}$ (B) $\frac{1}{4}$ (C) 0.02 (D) 20

8.



$K_1 = 10^{-3}\ sec^{-1}$
$K_2 = 2 \times 10^{-3}\ sec^{-1}$
$K_3 = 3 \times 10^{-3}\ sec^{-1}$

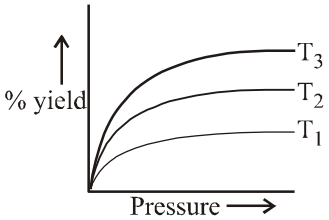
Initial pressure of A = 8 atm. After 100 sec. partial pressure of A is found to be 4.4 atm. What is the partial pressure of B at that time ?
(A) 2 atm (B) 0.6 atm (C) 1.25 atm (D) 0.24 atm

(Multi Correct Choice Type)

This section contains **4 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

9. Percentage yield of following reaction is plotted against pressure at a definite temperature

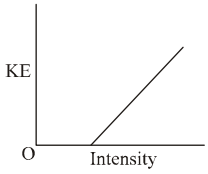
$$2SO_2 + O_{2(g)} \rightleftharpoons 2SO_{3(g)}.$$

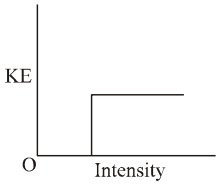


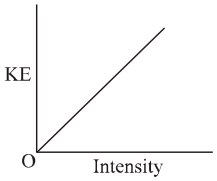
Which of the following relation is/are incorrect?
(A) $T_1 > T_2 > T_3$ (B) $T_3 > T_2 > T_1$
(C) $T_1 = T_2 = T_3$ (D) $T_2 > T_3 > T_1$

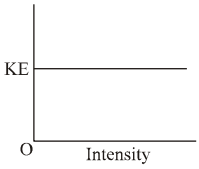
10. In a hydrogen like sample two different types of photons A and B are produced by electronic transition. Photon B has its wavelength in infrared region. If photon A has more energy than B, then the photon A may belong to the region.
(A) Ultraviolet (B) Visible (C) Infrared (D) radio-waves

11. Select the correct curve(s) regarding photo-electric effect.

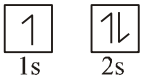
(A) 

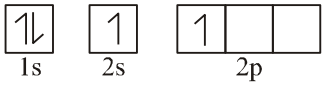
(B) 

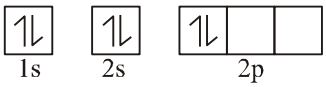
(C) 

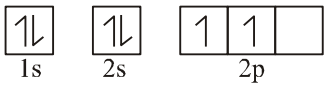
(D) 

12. Which of the following configurations violate Aufbau's principle :

(A) 

(B) 

(C) 

(D) 

(Paragraph Type)

This section contains **2 paragraphs.** Based upon the paragraphs **3 multiple choice questions** and **2 multiple choice questions** have to be answered. Each of these questions has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Paragraph for Question no. 13 to 15

In a study of dimerization of vaporized acetic acid by Dumas method the mass of substance contained in a 20.00 ml bulb at 160°C and 1 atm was found to be 40.7 mg. On calculation the average molar mass of acetic acid at 160°C = 72.3 g/mol. In a second experiment, conducted at 200°C and 1 atm it was
33.00 mg. On calculation the average molar mass of acetic acid at 200°C = 64.8 g/mol

13. Calculate the equilibrium constant for dimerization of vaporized acetic acid at 160°C :
(A) 0.648 atm^{-1} (B) 0.324 atm^{-1} (C) 0.095 atm^{-1} (D) 1.05 atm^{-1}

14. Calculate the equilibrium constant for dimerization of vaporized acetic acid at 200°C :
(A) 0.095 atm^{-1} (B) 0.195 atm^{-1} (C) 0.190 atm^{-1} (D) 0.380 atm^{-1}

15. Select the correct statement about dimerisation reaction :
(A) It is exothermic
(B) It is endothermic
(C) Extent of dimerisation increase with temperature
(D) Extent of dimerisation does not change with temperature

Paragraph for Question no. 16 to 17

The reaction rate is the increase in molar concentration of product of a reaction per unit time or the decrease in molar concentration of reactant per unit time. However, also because of stoichiometry of

the balanced chemical reaction, rates of reactions in terms of individual reactants and products are related.

$$m_1A + m_2B \longrightarrow n_1C + n_2D$$

Instantaneous rate of reaction = $-\frac{1}{m_1}\frac{d[A]}{dt} = -\frac{1}{m_2}\frac{d[B]}{dt} = +\frac{1}{n_1}\frac{d[C]}{dt} = +\frac{1}{n_2}\frac{d[D]}{dt}$

In appreciable interval of time, the average rate of reaction my be given as :

Average rate of reaction = $-\frac{1}{m_1}\frac{\Delta[A]}{\Delta t} = -\frac{1}{m_2}\frac{\Delta[B]}{\Delta t} = +\frac{1}{n_1}\frac{\Delta[C]}{\Delta t} = +\frac{1}{n_2}\frac{\Delta[D]}{\Delta t}$

16. In the reaction $xA \longrightarrow yB$.

$$\log\left\{-\frac{d[A]}{dt}\right\} = \log\left\{+\frac{d[B]}{dt}\right\} + 0.3010$$

Then, x : y is :

(A) 2 : 1 (B) 1 : 2 (C) 3 : 1 (D) 3 : 10

17. In the following reaction : $2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g)$. The rate of formation of SO_3 is 100 g min^{-1}, hence the rate of disappearance of O_2 is :

(A) 50 g min^{-1} (B) 20 g min^{-1} (C) 100 g min^{-1} (D) 200 g min^{-1}

SECTION – B
(Matrix Type)

This section contains **1 questions**. Each question has **four statements** (A, B, C and D) given in **Column I** and **four statements** (p, q, r and s) in **Column II.** Any given statement in **Column I** can have correct matching with one or more statement(s) in **Column II.** For example, if for a given question, statement B matches with the statements given in Q and R, then for that particular question, against statement B, darken the bubbles corresponding to Q and R in the ORS.

1. Match the following column :

Column-I		Column-II	
(A)	$\frac{E_f}{E_b} = \frac{20}{31}; E_f - E_b = -33$ kJ mol^{-1} E_f = activation energy for forward reaction E_b = activation energy for backward reaction	(p)	$E_f = 60$ kJ mol^{-1}
(B)	$\frac{K_{eq_2}}{Keq_1} = 10; \left[\frac{1}{T_1} - \frac{1}{T_2}\right] = 0.0005802$	(q)	$E_f = 104$ kJ mol
(C)	$A = 10^{11.44}$; $k = 10\ s^{-1}$ $E_f = 1.818 \times \Delta H$ kJ mol^{-1}; $T = 300$ K	(r)	$\Delta H = 33$ kJ mol^{-1} approx (only magnitude in consideration)
(D)	$\ln k_f = 14.34 - \frac{1.25\times10^4}{T}$; $T = 513$ K, $\Delta H = 11$ kJ mol^{-1}	(s)	endothermic reaction

SECTION – C
(Integer Type)

This section contains **5 questions**. The answer to each question is a **single-digit integer**, ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

1. For the reaction $2A(g)+B(g) \rightleftharpoons C(g)+D(g)$; $K_C = 10^{12}$. If the initial concentrations of A, B, C and D are 2, 1, 7 and 3 moles / litre respectively. The equilibrium concentration of A was found to be $x \times 10^{-4}$. The value of x is:

2. At 340 K and one atmospheric pressure N_2O_4 is 66% dissociated into NO_2. What volume (in L) of 10 g N_2O_4 occupy under these condition.

3. At some temperature and under a pressure of 4 atm, PCl_5 is 10% dissociated. Calculate the pressure (in atm.) at which PCl_5 will be 20% dissociated temperature remaining same.

4. The equilibrium $N_2 + O_2$ established in a reaction vessel of 0.25 L capacity. The amounts of N_2 and O_2 taken at the beginning were respectively 2 moles and 4 moles. Half a mole of nitrogen has been used up at equilibrium. The molar concentration of nitric oxide is

$N_{2\,(g)} + O_{2\,(g)} \rightleftharpoons 2NO_{(g)}$

5. Decomposition of A follows first order kinetics by the following equation.

$$4A(g) \longrightarrow B(g) + 2C(g)$$

If initially, total pressure was 800 mm of Hg and after 10 minutes it is found to be 650 mm of Hg. What is half-life (in min.) of A ? (Assume only A is present initially)

PART – III : MATHEMATICS

SECTION –A
(Single Correct Choice Type)

This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. If $2^{(\log_2 3)^x} = 3^{(\log_3 2)^x}$ then the value of x is equal to :

(A) $\frac{1}{2}$ (B) $\frac{1}{4}$ (C) $\frac{1}{3}$ (D) $\frac{1}{6}$

2. The smallest positive value of x (in degrees) for which

$\tan x = \frac{\cos 5^o \cos 20^o + \cos 35^o \cos 50^o - \sin 5^o \sin 20^o - \sin 35^o \sin 50^o}{\sin 5^o \cos 20^o - \sin 35^o \cos 50^o + \cos 5^o \sin 20^o - \cos 35^o \sin 50^o}$

is equal to :

(A) 30º (B) 60º (C) 75º (D) 120º

3. The value of x satisfying the equation $\sqrt{2}^{\log_2 2^{\log_2 2^{\log_2 2^{\log_2 x}}}} = 5$, is :

(A) 5 (B) 16 (C) 25 (D) 32

4. Suppose that θ is a positive acute angle such that $\left(\frac{\theta}{2}\right) = \sqrt{\frac{x-1}{2x}}$, then the value of $\tan\theta$ is :

(A) x (B) $\frac{\sqrt{x-1}}{x+1}$ (C) $\sqrt{x^2-1}$ (D) $\frac{\sqrt{x^2-1}}{x}$

5. Number of possible value of θ with $0^o < \theta < 360^o$ such that $\log_2(-3\sin\theta) = 2\log_2(\cos\theta) + 1$ is :

(A) 0 (B) 1 (C) 2 (D) infinite

6. The expression $E = \sin^2\alpha + \sin^2\beta + \sin^2\left(\frac{\pi}{2} - \alpha - \beta\right) + 2\sin\alpha \cdot \sin\beta \cdot \sin\left(\frac{\pi}{2} - \alpha - \beta\right)$ is :

(A) independent of both α and β (B) independent of α but dependent on β

(C) independent of β but dependent on α (D) dependent on both α and β

7. The expression $\frac{\left(\log_{\frac{a}{b}} p\right)^2 + \left(\log_{\frac{b}{c}} p\right)^2 + \left(\log_{\frac{c}{a}} p\right)^2}{\left(\log_{\frac{a}{b}} p + \log_{\frac{b}{c}} p + \log_{\frac{c}{a}} p\right)^2}$, wherever defined, simplifies to :

(A) 1 (B) 2 (C) 3 (D) 4

8. The sum to n terms of the series 1.3.5 + 3.5.7 + 5.7.9 + ... is :

(A) $n^3 + 12n^2 - 2n - 3$ (B) $n(2n^3 + 8n^2 + 7n - 2)$

(C) $n(8n^3 + 11n^2 - n - 3)$ (D) None of these

(Multi Correct Choice Type)

This section contains **4 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

9. The value of n with $0^o \le n < 360^o$ such that $\tan n^o = \frac{\cos 2012^o + \sin 2012^o}{\cos 2012^o - \sin 2012^o}$ is :

(A) 157º (B) 257º (C) 97º (D) 77º

10. The expression $\frac{(3+\log_3 5)}{(1+\log_5 3)}+\log_{15} 3+\frac{1}{(1+\log_3 5)}$ reduces to :

(A) an irrational number (B) a rational number which is not integer
(C) a real number between 3 and 4 (D) a composite number

11. Which of the following real numbers are non-negative ?

(A) $\log_5 \sqrt{25.\sqrt[4]{8^{\frac{-5}{3}}.4^{\frac{-3}{2}}}}$ (B) $\log_{\cos\frac{7\pi}{4}}\left(\sin\frac{5\pi}{6}\right)$ (C) $\log_{\tan\frac{4\pi}{3}}\left(\cot\frac{7\pi}{6}\right)$ (D) $\log_2 \sqrt{9.\sqrt[3]{27^{\frac{-5}{3}}.243^{\frac{-7}{5}}}}$

12. Let P (x) = $\left(1+\cos\frac{\pi}{6x}\right)\left(1+\cos\left(\frac{3x-1}{6x}\right)\pi\right)\left(1+\cos\left(\frac{3x+1}{6x}\right)\pi\right)\left(1+\cos\left(\frac{6x-1}{6x}\right)\pi\right)$, then which of the following is/are correct ?

(A) P (1) = $\frac{3}{16}$ (B) P(2) = $\frac{1}{16}$ (C) P(3) = 0 (D) P(4) = $\frac{2-\sqrt{3}}{16}$

(Paragraph Type)

This section contains **2 paragraphs.** Based upon the paragraphs **3 multiple choice questions** and **2 multiple choice questions** have to be answered. Each of these questions has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Paragraph for Question no. 13 to 15

Let z be a complex number satisfying $z^2 + 2z\lambda + 1 = 0$, where λ is a parameter which can take any real value.
Now answer the following questions :

13. The roots of the above equation lie on a certain circle if :
(A) $-1 < \lambda < 1$ (B) $\lambda > 1$ (C) $\lambda < 1$ (D) None of these

14. One root lies inside the unit circle and one outside if :
(A) $-1 < \lambda < 1$ (B) $\lambda > 1$ (C) $\lambda < 1$ (D) None of these

15. For every large value of λ, the roots are approximately :
(A) $-2, \lambda, 1/\lambda$ (B) $-\lambda, -1/\lambda$ (C) $-2\lambda, -1/2\lambda$ (D) None of these

Paragraph for Question no. 16 to 17

The real numbers x_1, x_2, x_3 satisfying the equation $x^3 - x^2 + \beta x + \gamma = 0$ are in A.P.
Now answer the following questions :

16. All possible values of β are :

(A) $\left(-\infty, \frac{1}{3}\right)$ (B) $\left(-\infty, -\frac{1}{3}\right)$ (C) $\left(\frac{1}{3}, \infty\right)$ (D) $\left(-\frac{1}{3}, \infty\right)$

17. All possible values of γ are :

(A) $\left(-\frac{1}{9}, \infty\right)$ (B) $\left(-\frac{1}{27}, \infty\right)$ (C) $\left(\frac{2}{9}, \infty\right)$ (D) None of these

SECTION – B
(Matrix Type)

This section contains **1 questions**. Each question has **four statements** (A, B, C and D) given in **Column I** and **four statements** (p, q, r and s) in **Column II.** Any given statement in **Column I** can have correct matching with one or more statement(s) in **Column II.** For example, if for a given question, statement B matches with the statements given in Q and R, then for that particular question, against statement B, darken the bubbles corresponding to Q and R in the ORS.

1. Match the following with their roots :

Column-I		Column-II	
(A)	If $\alpha, \alpha+4$ are two roots of $x^2-8x+k=0$, then k =	(p)	19
(B)	If one root of $x^2+kx+27=0$ is triple the other, then k =	(q)	12
(C)	If 3 + 4i is a root of $x^2+px+q=0$, then p + q =	(r)	6
(D)	If the quadratic expression $x^2-(a-1)x+\left(a+\frac{1}{4}\right)$ to be a perfect square, then a =	(s)	–12

SECTION – C
(Integer Type)

This section contains **5 questions**. The answer to each question is a **single-digit integer**, ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

1. If $\arg z^{\frac{1}{3}} = \frac{1}{2}\arg(z^2 + \bar{z}z^{\frac{1}{3}})$, then the value of | z | is _____ .

2. Let α and β be the roots of a quadratic equation $4x^2 - (5p + 1)x + 5p = 0$. If $\beta = 1 + \alpha$, then find the integral value of p.

3. If 'α' 'β' 'γ' are roots of $x^3 - 3x^2 + 3x + 7 = 0$ then the modulus of the complex number $\frac{\alpha-1}{\beta-1}+\frac{\beta-1}{\gamma-1}+\frac{\gamma-1}{\alpha-1}$ is _____ .

4. Find the sum $\sum_{r=1}^{11} \sin^4 \frac{r\pi}{24}$.

5. The parabola $y = ax^2 + bx + c$ does not meet the x-axis and passes through the points A(–2, 1) and B(2, 9). If range of the abscissa of vertex of parabola is (x_1, x_2), then find the value of $|x_1 + x_2|$.

* * * * *