NEW STANDARD ACADEMY

Test Type : Unit Test # 02

Do not open this Test Booklet until you are asked to do so. **31-07-2023**

JEE(MAIN): 12th Undergoing/Pass Students

Read carefully the Instructions on the Back Cover of this Test Booklet.

Important Instructions :

1. Immediately fill in the form number on this page of the Test Booklet with Blue/Black Ball Point Pen. Use of pencil is strictly prohibited.
2. The candidates should not write their Form Number anywhere else (except in the specified space) on the Test Booklet/Answer Sheet.
3. The Test Booklet consists of 90 questions.
4. There are three parts in the question paper 1,2,3 consisting of Physics, Chemistry and Mathematics having 30 questions in each subject and each subject having Two sections. (i) Section-I contains 20 multiple choice questions with only one correct option. Marking scheme : +4 for correct answer, 0 if not attempted and –1 in all other cases. (ii) Section-II contains 10 Numerical Value Type questions. Attempt any 5 questions. First 5 attempted questions will be considered for marking. Marking scheme : +4 for correct answer, 0 if not attempted and –1 in all other cases.
5. Use Blue/Black Ball Point Pen only for writting particulars/marking responses on Side –1 and Side–2 of the Answer Sheet. Use of pencil is strictly prohibited.
6. No candidate is allowed to carry any textual material, printed or written, bits of papers, mobile phone any electronic device etc, except the Identity Card inside the examination hall/room.
7. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
8. On completion of the test, the candidate must hand over the Answer Sheet to the invigilator on duty in the Room/ Hall. However, the candidate are allowed to take away this Test Booklet with them.

Name of the Candidate(In Capitals) _____

Date of Examintation _____

Candidate`s Signature:_____ Invigilator`s Signature: _____

PART-1 : PHYSICS

SECTION-I : (Maximum Marks: 80)

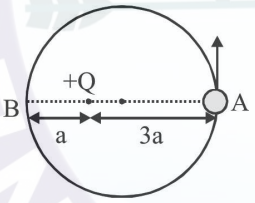
This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

Full Marks : +4 If correct answer is selected.

Zero Marks : 0 If none of the option is selected.

Negative Marks : –1 If wrong option is selected.

1. The diagram shows a small bead of mass m carrying charge q. The bead can freely move on the smooth fixed ring placed on a smooth horizontal plane. In the same plane a charge + Q has also been fixed as shown. The potential at the point A due to +Q is V. The minimum velocity with which the bead should projected from the point A so that it can complete a circle should be ($K = 1/4\pi\in_0$)



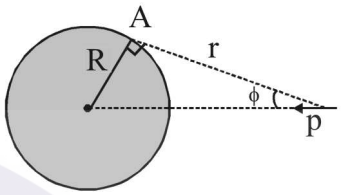
(A) $\sqrt{\frac{4KQq}{ma}}$

(B) $\sqrt{\frac{6KQq}{ma}}$

(C) $\sqrt{\frac{4KQq}{3ma}}$

(D) $\sqrt{\frac{KQq}{ma}}$

2. A dipole having dipole moment p is placed in front of a solid uncharged conducting sphere as shown in the diagram. The net potential at point A lying on the surface of the sphere is :-



(A) $\frac{kp\cos\phi}{r^2}$ (B) $\frac{kp\cos^2\phi}{r^2}$

(C) 0 (D) $\frac{2kp\cos^2\phi}{r^2}$

3. Two identical rings, each of radius R metres, are coaxially placed R metres apart. If Q_1 coulombs and Q_2 coulombs are the charges uniformly spread on the two rings respectively, then the work done in moving a charge q from the centre of one ring to that of the other is :–

(A) zero (B) $\frac{q(Q_1-Q_2)(\sqrt{2}-1)}{\sqrt{2}(4\pi\varepsilon_0 R)}$

(C) $\frac{q\sqrt{2}(Q_1+Q_2)}{(4\pi\varepsilon_0 R)}$ (D) $\frac{q(Q_1+Q_2)(\sqrt{2}+1)}{\sqrt{2}(4\pi\varepsilon_0 R)}$

4. The electric field in a region is given by $\vec{E} = 200\hat{i}$ N/C for $x > 0$ and $-200\hat{i}$ N/C for $x < 0$. A closed cylinder of length 2m and cross-section area 10^2 m^2 is kept in such a way that the axis of cylinder is along X-axis and its centre coincides with origin. The total charge inside the cylinder is :

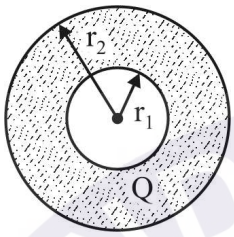
[Take : $\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N–m^2$]

(A) 0 (B) 1.86×10^{-5} C

(C) 1.77×10^{-11} C (D) 35.4×10^{-8} C

Space for Rough Work

5. A charge Q is distributed uniformly within the material of a hollow sphere of inner and outer radii r_1 and r_2 (See figure). The electric field at distance x from centre for $r_1 < x < r_2$ will be :-



(A) $\frac{Q(x^3 - r_1^3)}{4\pi\epsilon_0 x^2 r_2^3}$

(B) $\frac{Q(x^3 - r_1^3)}{4\pi\epsilon_0 x^2 (r_2^3 - r_1^3)}$

(C) $\frac{Qx}{4\pi\epsilon_0 (r_2^3 - r_1^3)}$

(D) $\frac{Q(x^3 - r_1^3)}{4\pi\epsilon_0 r_1^2 (r_2^2 - r_1^2)}$

6. There is a solid insulating sphere of radius R and charge q distributed uniformly. If E_1, E_2 and V_1, V_2 are the electric field and potential at distance $\frac{R}{2}$ and R from centre respectively then :

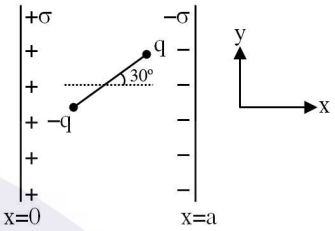
(A) $\frac{E_1}{E_2} = \frac{2}{3}$

(B) $\frac{E_1}{E_2} = \frac{1}{3}$

(C) $\frac{V_1}{V_2} = \frac{11}{8}$

(D) $\frac{V_1}{V_2} = \frac{3}{8}$

7. An electric dipole has charges –q and q separated by d, kept at an angle 30° with x-axis between two large plane sheet of charge as shown in figure. The incorrect option is



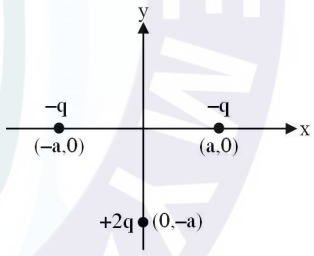
(A) Net force on dipole is zero

(B) Torque acting on dipole is $\frac{\sigma q d}{2\epsilon_0}$

(C) Potential energy of dipole is $\frac{-\sigma q d}{2\epsilon_0}\sqrt{3}$

(D) Potential energy of dipole is $\frac{-\sigma q d}{2\epsilon_0}$

8. Three point charges –q, –q & +2q are kept at position (–a, 0), (a,0) and (0, –a) as shown. Consider following statements S_1, S_2, S_3 and S_4



S_1 : Net dipole moment of the system is 2qa.

S_2 : Electric potential at origin is zero.

S_3 : Electric field at origin is $\frac{q}{2\pi\epsilon_0 a^2}$.

S_4 : Net force at charge 2q is $\frac{\sqrt{2}q^2}{4\pi\epsilon_0 a^2}$

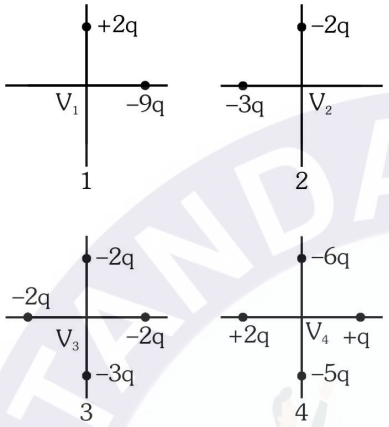
The correct statment is :

(A) S_1 only (B) S_1, S_2 only

(C) S_1, S_2, S_3 only (D) All statements

Space for Rough Work

9. Figure given shows four arrangement of charged particles, all at the same distance from the origin. Rank the situations according to the net electric potentials (V_1, V_2, V_3, V_4) at the origin, most positive first :-



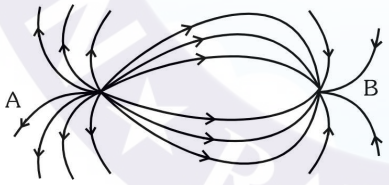
(A) $V_1 > V_2 > V_3 > V_4$

(B) $V_2 > V_1 > V_3 > V_4$

(C) $V_2 > V_1 > V_4 > V_3$

(D) $V_4 > V_1 > V_3 > V_2$

10. The spatial distribution of the electric field lines due to charges (A, B) is shown in figure. Which one of the following statements is correct ?



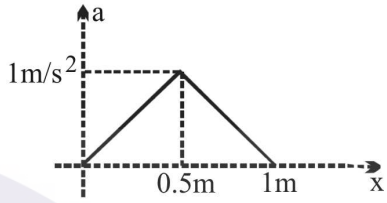
(A) A is +ve and B is −ve and |A| > |B|

(B) A is −ve and B is +ve ; |A| = |B|

(C) Both are +ve but A > B

(D) Both are −ve but A > B

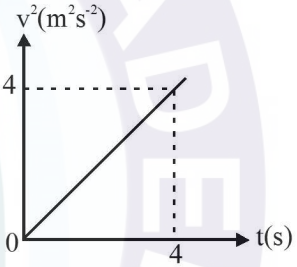
11. A body initially at rest, starts moving along x-axis in such a way so that its acceleration vs displacement plot is as shown in figure. The maximum velocity of particle is :-



(A) 1 m/s (B) 6 m/s

(C) 2 m/s (D) None

12. A particle is moving along a straight line such that square of its velocity varies with time as shown in the figure. What is the acceleration of the particle at t = 4 s ?



(A) 4 m/s^2 (B) 1/4 m/s^2

(C) 1/2 m/s^2 (D) 0

13. A ship A is moving Westwards with a speed of 10 km h^{-1} and a ship B 100 km South of A, is moving Northwards with a speed of 10 km h^{-1}. The time after which the distance between them becomes shortest, is :-

(A) 5 h

(B) $5\sqrt{2}$h

(C) $10\sqrt{2}$h

(D) 0 h

Space for Rough Work

14. A man runs at a speed of 4.0 m/s to overtake a standing bus. When he is 6.0 m behind the door (at t = 0), the bus moves forward and continues with a constant acceleration of 1.2 m/s^2. The man shall access the door at time t equal to

(A) 5.2 s

(B) 4.3 s

(C) 2.3 s

(D) the man shall never access the door

15. A particle is thrown upwards from ground. It experiences a constant resistance force which can produce retardation 2 m/s^2. The ratio of time of ascent to the time of descent is [g=10 m/s^2]

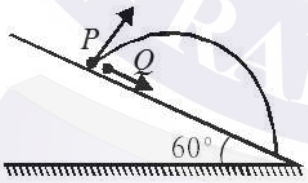
(A) 1 : 1 (B) $\sqrt{\frac{2}{3}}$ (C) $\frac{2}{3}$ (D) $\sqrt{\frac{3}{2}}$

16. A ball is projected horizontally. After 3 s from projection its velocity becomes 1.25 times of the velocity of projection. Its velocity of projection is :-

(A) 10 m/s (B) 20 m/s

(C) 30 m/s (D) 40 m/s

17. A particle P is projected from a point on the surface of smooth inclined plane (see figure). Simultaneously another particle Q is released on the smooth inclined plane from the same position. P and Q collide after t = 4 s. The speed of projection of P is :-



(A) 5 m/s (B) 10 m/s

(C) 15 m/s (D) 20 m/s

18. A particle is projected up the incline such that its component of velocity along the incline is 10m/s. Time of flight is 2 second and maximum perpendicular distance during the motion from the incline is 5 m. Then velocity of projection will be :-

(A) 10 m/s

(B) $10\sqrt{2}$ m/s

(C) $5\sqrt{5}$ m/s

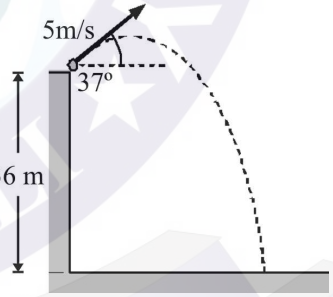
(D) none of these

19. A boat having a speed of 5 km/hr in still water, crosses a river of width 1 km along the shortest possible path in 15 minutes. The speed of the river in Km/hr.

(A) 1 (B) 3

(C) 4 (D) $\sqrt{41}$

20. A ball is thrown from the top of 36 m high tower with velocity 5 m/s at an angle 37° above the horizontal as shown. Its horizontal range on the ground is closest to [g = 10 m/s^2]



(A) 12 m (B) 18 m

(C) 24 m (D) 30 m

Space for Rough Work

SECTION-II : (Maximum Marks: 20)

This section contains 10 questions Candidates have to attempt any 5 questions out of 10. If more than 5 questions are attempted, then only first 5 attempted questions will be evaluated.

The answer to each question is a **Numerical Value.**

For each question, enter the correct integer value (In case of non-integer value, the answer should be rounded off to the nearest Integer).

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

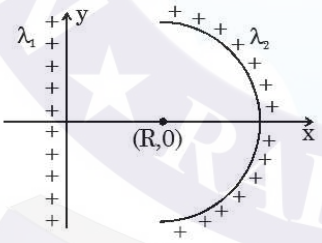
Full Marks : +4 If correct answer is entered.

Zero Marks : 0 If the question is unanswered.

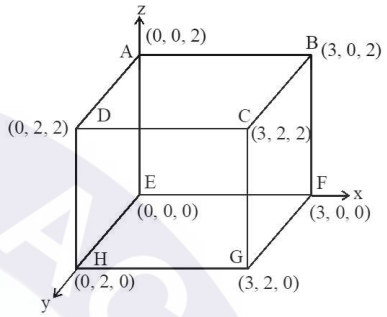
Negative Marks : –1 If wrong answer is entered.

1. A uniformly charged infinite wire is placed along 'y' axis having linear charge density 'λ_1'.

A semicircle wire of radius R having linear charge density 'λ_2' centred at (R, 0) is placed as shown. Find the ratio of $\frac{\lambda_1}{\lambda_2}$, If electric field at (R, 0) is zero.

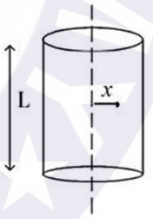


2. An electric field $\vec{E} = 4x\hat{i} - (y^2 + 1)\hat{j}$ N/C passes through the box shown in figure. The flux of the electric field through surfaces ABCD and BCGF are marked as ϕ_I and ϕ_{II} respectively. The difference between $(\phi_I - \phi_{II})$ is (in Nm^2/C).



3. 27 identical drops are charged at 22V each. They combine to form a bigger drop. The potential of the bigger drop will be ____ V.

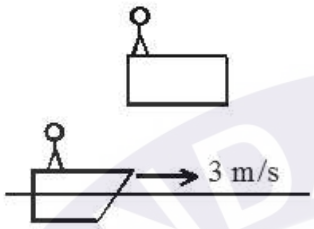
4. A long cylindrical volume contains a uniformly distributed charge of density ρ Cm^{-3}. The electric field inside the cylindrical volume at a distance $x = \frac{2\varepsilon_0}{\rho}$ m from its axis is _____ Vm^{-1}



5. Three point charges of magnitude 5μC, 0.16μC and 0.3μC are located at the vertices A, B, C of a right angled triangle whose sides are AB = 3cm, BC = $3\sqrt{2}$ cm and CA=3 cm and point A is the right angle corner. Charge at point A experiences _____ N of electrostatic force due to the other two charges.

Space for Rough Work

6. You are standing on the chambal Bridge watching the boats in the river. You see a motorboat pass directly below you, traveling perpendicular to the bridge at a speed of 3 m/s. A person on the boat throws a baseball at an initial



speed of v_0 and at an angle of 37° from the vertical (Note: both v_0 and the angle are with respect to the boat). Find the value of v_0 (in m/s) necessary for the ball to travel straight up towards you.

7. A boy throws a ball from shoulder height at an initial velocity of 30 m/s. Spending 4.8 s in air, the ball is caught by another boy as the same shoulder-height level. What is the angle of projection?

8. A ball was thrown by a boy A at angle 60° with horizontal at height 1m from ground. Boy B is running in the plane of motion of ball and catches the ball at height 1m from ground. He finds the ball falling vertically. If the boy is running at a speed 20 km/hr. Then the velocity of projection of ball is-

9. A car accelerates with uniform rate from rest on a straight road. The distance travelled in the last second of a three second interval from the start is 15 m then find the distance travelled in first second in m.

10. A particle moving in one-dimension with constant acceleration of 10 m/s^2 is observed to cover a distance of 100 m during a 4s interval. How far will the particle move in the next 4s?

PART-2 : CHEMISTRY

SECTION-I : (Maximum Marks: 80)

This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

Full Marks : +4 If correct answer is selected.
Zero Marks : 0 If none of the option is selected.
Negative Marks : –1 If wrong option is selected.

1. Half life ($t_{1/2}$) and completion time (T) for a zero order reaction will be $K = 0.001 \frac{mol}{L/sec}$ and a = 1 M.

(A) 500 min, 750 min

(B) 500 sec, 750 sec

(C) 500 sec, 1000 sec

(D) None of these

2. The rate constant of which of the following reactions is independent of concentration of the reactants ?

(A) First order reactions

(B) Zero order reactions

(C) Second order reactions

(D) All of these

3. In a reaction $A_2B_3(g) \longrightarrow A_2(g) + \frac{3}{2}B_2(g)$, the pressure increases from 60 torr to 75 torr in 2.5 minutes. The rate of disappearance of A_2B_3 is -

(A) 8 torr min^{-1} (B) 18 torr min^{-1}

(C) 4 torr min^{-1} (D) 10 torr min^{-1}

Space for Rough Work

4. In the reaction, A + B ⟶ C + D, the rate $\left(\frac{dx}{dt}\right)$ when plotted against time 't' gives a straight line parallel to time axis. The order and rate of reaction will be :-

(A) 1, k (B) 0, k

(C) 1, k + 1 (D) 0, k + 1

5. For the reaction A ⟶ B, data of initial concentration and corresponding half life period are given in the tabular from :

[A]	1M	2M	4M
$T_{0.5}$	300s	600s	1200s

The order of the reaction is :-

(A) 0 (B) 1

(C) 2 (D) 3

6. For a reaction A + B ⟶ C + D, if the concentration of only A is doubled, the rate gets doubled. While if the concentration of B is increased by nine times the rate gets tripled. The order of the reaction is :-

(A) 2 (B) 1

(C) 3/2 (D) 4/3

7. The rate of hypothetical reaction

A+B+C⟶products is given

$r = -\frac{d(A)}{dt} = K[A]^{1/2}[B]^{1/3}[C]^{1/4}$. The order of reaction is given by -

(A) 1 (B) $\frac{13}{6}$ (C) $\frac{13}{11}$ (D) $\frac{13}{12}$

8. For a reaction, $AB_5 \longrightarrow AB + 4B$ The rate can be expressed in following ways

$\frac{-d[AB_5]}{dt} = K[AB_5]; \frac{d[B]}{dt} = K_1[AB_5]$

So the correct relation between K and K_1 is :-

(A) $K_1 = K$ (B) $K_1 = 2K$

(C) $K_1 = 4K$ (D) $2K_1 = K$

9. The rate constant of a first order reaction is 3×10^{-6} per sec. If the initial concentration is 0.10M, the initial rate of reaction is :-

(A) $3 \times 10^{-7}\ Ms^{-1}$

(B) $3 \times 10^{-6}\ Ms^{-1}$

(C) $3 \times 10^{-5}\ Ms^{-1}$

(D) $3 \times 10^{-8}\ Ms^{-1}$

10. A first order reaction takes 69.3 minutes for 50% completion. How much time will be needed for 80% completion:-

(A) 160. 97 min (B) 170.97 min

(C) 150.97 min (D) None of these

11. Which of the following statement is true :-

(a) 6 electrons present in Mg for which m = 0

(b) 6 electron present in one p-orbital

(c) Maximum 18 electrons present in M-shell

(d) 3–electron present in phosphorous for which, $l = 0, S = +\frac{1}{2}$

(A) a, b, c, d (B) a, b c

(C) a, c, d (D) c, d

Space for Rough Work

12. The electrons identified by quantum numbers n and l,

(i) $n = 4, l = 1$ (ii) $n = 4, l = 0$

(iii) $n = 3, l = 2$ (iv) $n = 3, l = 1$

can be placed in order of increasing energy, from the lowest to highest as :-

(A) iv < ii < iii < i

(B) ii < iv < i < iii

(C) i < iii < ii < iv

(D) iii < i < iv < ii

13. The orbital angular momentum of an electron in a single electron system is $\sqrt{3}\frac{h}{\pi}$. Which of the following angular momentum value (s) are not possible for this electron in Bohr orbit.

(A) $\frac{3h}{2\pi}$ (B) $\frac{5h}{2\pi}$

(C) $\frac{2h}{\pi}$ (D) $\frac{7h}{2\pi}$

14. Which of the following set of quantum number not possible ?

	n	**ℓ**	**m**	**s**
(1)	2	0	0	±½
(2)	3	1	–1	±½
(3)	3	1	–2	±½
(4)	4	2	0	±½

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

15. Which of the following statement(s) is/are correct?

(a) Vander waal's radius of iodine is more than its covalent radius

(b) All isoelectronic ions belong to the same period of the periodic table

(c) IE_1 of N is higher than that of O while IE_2 of O is higher than that of N

(d) The 1st electron gain enthalpy of Cl is negative while second is positive

(A) a, b

(B) a, b, c

(C) a, c, d

(D) a, b, c, d

16. IE_2 for an element is invariably higher than IE_1 because :-

(A) It is difficult to remove electron from cation

(B) The size of the cation is smaller than its atom

(C) Z_{eff} is more for cation

(D) All the above

17. Which of the following order of radius is incorrect ?

(A) $Ti^{+4} < Zr^{+4} \approx Hf^{+4}$

(B) Sc < Y < La

(C) $La^{+3} > Pr^{+3} > Gd^{+3} > Yd^{+3}$

(D) $F^{-} > O^{-2} > F > O$

Space for Rough Work

18. Arrange the following statements in order of True(T)/False (F) :-

(a) Among Li^+, Be^+ and B^+ ions Li^+ has the highest ionization enthalpy

(b) The negative value of electron gain enthalpy of Cl > F because there is weak electron-electron repulsion in the bigger 3p-subshell of Cl as compared to compact 2p-subshell of F

(c) Formation of S^{-2} and Ar^-, both require the absorption of energy

(d) Incorrect order of electron affinity is

S > Se > Te > O

(A) TTTF (B) FFFT

(C) FFTT (D) TTTT

19. Amongst the following statements, which is correct?

(A) Electronegativity of sulphur is greater than that of oxygen

(B) Electron affinity of oxygen is smaller than that of sulphur

(C) Electron gain enthalpy of fluorine is most negative in periodic table

(D) HCl is more acidic than HI

20. In the following, which configuration of element has maximum electronegativity ?

(A) $1s^2,2s^2 2p^3$

(B) $1s^2,2s^2 2p^6$

(C) $1s^2,2s^2 2p^4$

(D) $1s^2,2s^2 2p^6,3s^2 3p^3$

SECTION-II : (Maximum Marks: 20)

This section contains 10 questions Candidates have to attempt any 5 questions out of 10. If more than 5 questions are attempted, then only first 5 attempted questions will be evaluated.

The answer to each question is a **Numerical Value.**

For each question, enter the correct integer value (In case of non-integer value, the answer should be rounded off to the nearest Integer).

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

Full Marks : +4 If correct answer is entered.

Zero Marks : 0 If the question is unanswered.

Negative Marks : –1 If wrong answer is entered.

1. Half life of first order reaction is 30 minute. Calculate the time of completion of 99.999% of reaction [in (min)]

2. The half-life of decomposition of gaseous CH_3CHO at initial pressure of 364 mm and 182 mm of Hg were 440 sec and 880 sec respectively. The order of the reaction is :-

3. A first order reaction is 75% completed in 100 min. How long time will it take for its 87.5% completion

4. Reaction A $\longrightarrow$ Product, is a order of $\frac{3}{2}$ and then $t_{1/2} \propto \frac{1}{[A]_0^m}$ value of m is :

(Give your answer multiply by 2)

Space for Rough Work

5. If rate of formation of SO_3 is 0.8 g.lit^{-1} sec^{-1} then calculate the rate of disappearance of O_2 in g.lit^{-1} sec^{-1} for the reaction $2SO_2 + O_2 \longrightarrow 2SO_3$

(Give your answer multiply by 100)

6. Sum of unpaired electrons in the ground state of sulphur and number of electrons in oxygen for which $\ell = 0$.

7. How many of following orders are correct?

(a) Order of IE : $O^{-2} > O^{+} > O > O^{-}$

(b) Order of EN : Zn < Cd < Hg

(c) Order of IE : B > Tl > Ga > Al > In

(d) Order of EA : S > Se > Te > O

(e) Order of atomic radius : Ni < Cu < Zn

(f) Order of ionic radius : $Na^{+} > Mg^{+2} > Li^{+} > Be^{+2}$

(g) Order of IE_2 : N < O < F < Ne

8. Most stable oxidation state of thallium is +n. What is the value of n?

9. Number of unpaired electrons in Nitrogen = P and number of electrons for which $S = +\frac{1}{2}$ in cadmium is = Q and number of neutrons in tritium = R then $\left(\frac{Q}{P} + R\right) = ?$

10. In $_6C^{12}$, if number of neutron become double and electron become half. Calculate change in mass percent ?

PART-3 : MATHEMATICS

SECTION-I : (Maximum Marks: 80)

This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

Full Marks : +4 If correct answer is selected.

Zero Marks : 0 If none of the option is selected.

Negative Marks : –1 If wrong option is selected.

1. Set of values of 'a' for which

$1 + \log_5(x^2 + 1) > \log_5 (ax^2 + 4x + a)$

is satisfied for all values of x' is :

(A) (2, 3) (B) $(2,3] \cup [7, \infty)$

(C) [2, 3] (D) $(-\infty, 3]$

2. Number of integral solutions of

$f(x) = \sqrt{\log_2 \left(4\sin^2 x - 2\sqrt{3}\sin x - 2\sin x + \sqrt{3} + 1\right)}$

in $x \in [-\pi, \pi]$ is :

(A) 4 (B) 5 (C) 6 (D) 3

3. The equation $3^{\log_{10} x} = 54 - x^{\log_{10} 3}$ has :

(A) only one solution (B) two solutions

(C) no solution (D) three soutions

4. The sum of 50 terms of the series $\frac{3}{1^2} + \frac{5}{1^2+2^2} + \frac{7}{1^2+2^2+3^2} + \ldots\ldots\ldots$ is –

(A) $\frac{100}{17}$ (B) $\frac{150}{17}$

(C) $\frac{200}{51}$ (D) $\frac{50}{17}$

Space for Rough Work

5. If $t_n = \frac{1}{4}(n+2)(n+3)$ for n = 1, 2, 3,....., then $\frac{1}{t_1} + \frac{1}{t_2} + \frac{1}{t_3} + \ldots\ldots\ldots + \frac{1}{t_{2011}} = ?$

(A) $\frac{4022}{3021}$ (B) $\frac{2011}{3021}$

(C) $\frac{4006}{2011}$ (D) None

6. Let the positive numbers a, b, c and d be in A.P., then abc, abd, acd and bcd are in :-

(A) A.P. (B) G.P.

(C) H.P. (D) None of these

7. If $ax^3 + bx^2 + cx + d$ is divisible by $ax^2 + c$, then a, b, c, d are in :-

(A) AP (B) GP

(C) HP (D) None of these

8. The sum of the series $3 + 15 + 35 + 63 + ...$ n terms is :-

(A) $\frac{1}{6}\{(2n-1)(2n+1)(2n+3)+3\}$

(B) $\frac{1}{2}\{(2n-1)(2n+1)(2n+3)+3\}$

(C) $\frac{n(n+1)(2n+1)}{6} - n$

(D) None

9. If log 2, log $(2^x - 1)$, log $(2^x + 3)$ are in A.P., then x is equal to :-

(A) $\frac{5}{2}$ (B) $\log_2 5$

(C) $\log_5 2$ (D) -1

10. If $x > 0$, then greatest value of the expression $\frac{x^{50}}{1 + x + x^2 + \ldots\ldots + x^{100}}$ is

(A) $\frac{1}{102}$ (B) $\frac{1}{101}$

(C) $\frac{1}{100}$ (D) None of these

11. $\lim\limits_{x\to 0} \frac{(1-\cos 2x).\sin 7x}{x^2.\sin 5x}$ is :-

(A) $\frac{14}{5}$ (B) $\frac{5}{14}$

(C) $\frac{5}{7}$ (D) $\frac{7}{10}$

12. If $\lim\limits_{x\to\infty}\left(\frac{3x^2+x+1}{x+1} - ax - b\right) = 2012$; then a & b are:

(A) a = 1, b = 4 (B) a = 1, b = – 4

(C) a = 3, b = 2010 (D) a = 3, b = – 2014

13. $\lim\limits_{x\to 4}\left(\frac{\sqrt{1-\cos\{2(x-4)\}}}{x-4}\right)$ is equals to :-

(A) L.H.L. = $-\sqrt{2}$ & R.H.L. = $\sqrt{2}$

(B) L.H.L. = $-\sqrt{4}$ & R.H.L. = $\sqrt{4}$

(C) L.H.L. = – 4 & R.H.L. = 4

(D) Limit exist & equal to $\sqrt{2}$

14. The value of $\lim\limits_{n\to\infty} n^2\left\{\sqrt{\left(1-\cos\frac{1}{n}\right)\sqrt{\left(1-\cos\frac{1}{n}\right)\sqrt{\left(1-\cos\frac{1}{n}\right)\ldots\infty}}}\right\}$ is :

(A) 1 (B) 2

(C) 0 (D) 1/2

Space for Rough Work

15. If $f(x) = \begin{cases} \dfrac{\sqrt{1+px}-\sqrt{1-px}}{2^x+1} & , \quad -1 \leq x < 0 \\ \dfrac{x}{x-2} & , \quad 0 \leq x \leq 1 \end{cases}$ is continuous in the interval $[-1, 1]$ then p equals

(A) -1 (B) 1

(C) 1/2 (D) $-1/2$

16. Let $f(x) = \begin{cases} x^2 & ; \ x \in Q \\ 1 - x^2 & ; \ x \notin Q \end{cases}$, then f(x) is continuous at

(A) $x = 0$ (B) $x = \pm\dfrac{1}{2}$

(C) $x = \pm\dfrac{1}{\sqrt{2}}$ (D) $x = \dfrac{1}{\sqrt{2}}$

17. Let

$$f(x) = \begin{cases} \lim\limits_{x\to\infty} \left(\sqrt{n^2+n+1}-\sqrt{n^2-n+1}\right)x \ ; & x \neq 0 \\ 0 \qquad\qquad\qquad\qquad\qquad\quad ; & x = 0 \end{cases}$$

Which one of the following statement is correct ?

(A) f(x) is continuous at x = 0

(B) f(x) is non-derivable at x=0

(C) f(x) has non-removable type of discontinuity at x=0

(D) f(x) has removable type of discontinuity at x = 0

18. If $f(x) = \begin{cases} \frac{3x-x^2}{2}, & x \leq 2 \\ [x-1], & 2 < x \leq 3 \\ x^2-8x+17, & x > 3 \end{cases}$, then f(x) is (where [.] denotes greatest integer function)

(A) discontinuous at x = 3

(B) discontinuous at x = 2

(C) continuous $\forall\ x \in R$

(D) none of these

19. Given $f(x) = \begin{cases} \frac{\ell n\left(1+\text{sgn}[x]+\{x\}^2\right)}{1-\cos\{x\}} & \text{if } x \neq 0 \\ k & \text{if } x = 0 \end{cases}$, then (where [.], {.} and sgnx denotes greatest integer function, fractional part function and signum function respectively)

(A) $f(x)$ is continuous at x = 0 if k = 2

(B) for k = 1, $f(x)$ has removable discontinuity at x = 0

(C) for k = 2, $f(x)$ has non-removable discontinuity at x = 0.

(D) $\lim\limits_{x\to 0} f(x)$ exists.

20. If the function

$$f(x) = \begin{cases} \frac{\sqrt{2+\cos x}-1}{(\pi-x)^2}, & x \neq \pi \\ k & , \quad x = \pi \end{cases}$$

is continuous at $x = \pi$, then k equals :-

(A) $\dfrac{1}{4}$

(B) $\dfrac{1}{2}$

(C) 2

(D) 0

Space for Rough Work

SECTION-II : (Maximum Marks: 20)

This section contains 10 questions Candidates have to attempt any 5 questions out of 10. If more than 5 questions are attempted, then only first 5 attempted questions will be evaluated.

The answer to each question is a **Numerical Value.**

For each question, enter the correct integer value (In case of non-integer value, the answer should be rounded off to the nearest Integer).

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

Full Marks : +4 If correct answer is entered.

Zero Marks : 0 If the question is unanswered.

Negative Marks : –1 If wrong answer is entered.

1. $2^{\frac{1}{4}}.4^{\frac{1}{8}}.8^{\frac{1}{16}}.---\infty$ is equal to ?

2. In an infinite G.P., the sum of first three terms is 70. If first & third terms are multiplied by 4 and second term is multiplied by 5, the resulting terms form an A.P., then the sum of infinite G.P. is :-

3. If expression $x + \frac{1}{x^2}(x > 0)$ attains its minimum value at $x = \alpha$, then α^3 is

4. Let p, q, r, s are positive real numbers and 256 $pqrs \geq (p + q + r + s)^4$ & $3p + 2q + 5r + 4s = 14$ then $p^2 + 2q^3 + 3r^4 + s^5$ is equal to :-

5. Minimum value of $\frac{b+c}{a} + \frac{c+a}{b} + \frac{a+b}{c}$, (for real positive number a, b, c) is

6. $\lim\limits_{x\to 0} \frac{x\cot(4x)}{\sin^2 x\cot^2(2x)}$ is equal to :-

7. $\lim\limits_{x\to 0}\left[\min\left(y^2-4y+11\right)\frac{\sin x}{x}\right]$ is equal to

(where [.] denotes the greatest integer function) is :-

8. If $f(x)=\begin{cases} A+Bx^2, & x<1 \\ Ax+3x^2-B, & x\geq 1 \end{cases}$ is

differentiable at x = 1, then the value of (A + 4B) is :

9. Let f(x) be a twice-differentiable function and $f''(0) = 2$. Then evaluate $\lim\limits_{x\to 0}\frac{2f(x)-3f(2x)+f(4x)}{x^2}$

10. If the function f defined on $\left(-\frac{1}{3}, \frac{1}{3}\right)$ by

$$f(x) = \begin{cases} \frac{1}{x}\log_e\left(\frac{1+3x}{1-2x}\right), & \text{when } x \neq 0 \\ k, & \text{when } x = 0 \end{cases}$$

is continuous, then k is equal to_____

Space for Rough Work