

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - CPT-1

QP Code:

PAPER - 1

Time Allotted: 3 Hours

Maximum Marks: 183

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the 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 Sections**.
3. **Section-I** is Physics, **Section-II** is Chemistry and **Section-III** is Mathematics.
4. Each **Section** is further divided into **Two Parts: Part-A & B** in the OMR.
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 Two Parts.

- (i) **Part-A (01-07)** – Contains seven (07) multiple choice questions which have **One or More** correct answer.
Full Marks: +4 If only the bubble(s) corresponding to all the correct options(s) is (are) darkened.
Partial Marks: +1 For darkening a bubble corresponding to **each correct option**, provided NO incorrect option is darkened.
Zero Marks: 0 If none of the bubbles is darkened.
Negative Marks: –1 In all other cases.
For example, if **(A), (C) and (D)** are all the correct options for a question, darkening all these three will result in **+4 marks**; darkening only **(A) and (D)** will result in **+2 marks**; and darkening **(A) and (B)** will result in **–1 marks**, as a wrong option is also darkened.
- (i) **Part-A (08-13)** – Contains six (06) multiple choice questions which have **ONLY ONE CORRECT** answer
Each question carries **+3 marks** for correct answer and **-1 marks** for wrong answer.
- (ii) **Part-B (01-05)** contains five (05) Numerical based questions, the answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries **+3 marks** for correct answer and **there will be no negative marking**.

Name of the Candidate : _____

Batch : _____ Date of Examination : _____

Enrolment Number : _____

SECTION-1 : PHYSICS

PART – A

(Multi Correct Choice Type)

This section contains 7 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

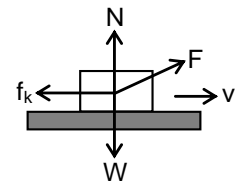
1. Two non-conducting solid spheres of radii R and $2R$, having uniform volume charge densities ρ_1 and ρ_2 respectively, touch each other. The net electric field at a distance $2R$ from the centre of the smaller sphere, along the line joining the centres of the spheres, is zero. The ratio

$\frac{\rho_1}{\rho_2}$ can be

- (A) -4 (B) $-\frac{32}{25}$ (C) $\frac{32}{25}$ (D) 4
1. **BD**
2. Choose the correct option(s)
- (A) If only conservative forces act on a particle, the kinetic energy stays constant.
 (B) If the net force acting on an object is zero, then the object is at rest.
 (C) If net work is done on a body, the velocity of body must change.
 (D) If net work is done on a body, the speed of body must change.

2. **CD**

3. A person pulls a block across a rough horizontal surface at a constant speed by applying a force F . The arrows in the figure correctly indicate the directions, but not necessarily the magnitudes of the various forces on the block. Which of the following relations among the force magnitudes W , f_k , N and F must be true?

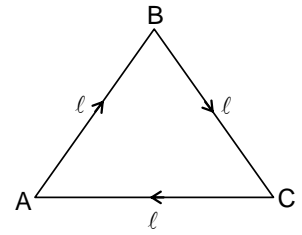


- (A) $F = f_k$ (B) $F > f_k$
 (C) $N < W$ (D) $N > W$
3. **BC**
4. The two vectors \vec{A} and \vec{B} are drawn from a common point and $\vec{C} = \vec{A} + \vec{B}$, then angle between \vec{A} and \vec{B} is
- (A) 90° if $C^2 = A^2 + B^2$ (B) greater than 90° if $C^2 < A^2 + B^2$
 (C) greater than 90° if $C^2 > A^2 + B^2$ (D) less than 90° if $C^2 < A^2 + B^2$

4. **AB**

5. A particle moves over the side of an equilateral triangle of side ℓ with constant speed v as shown in figure. Then

- (A) The magnitude of average acceleration from A to C is $\frac{v^2}{\ell}$.
 (B) The magnitude of average acceleration from A to C is $\frac{\sqrt{3} v^2}{2\ell}$.
 (C) The magnitude of average velocity as it moves from A to C is $\frac{v}{2}$.
 (D) The magnitude of average velocity as its moves from A to C is v .



5. **BC**

6. In case of earth:

- (A) Potential is minimum at the centre of earth
 (B) Potential is same, both at centre and infinity but not zero
 (C) Potential is zero, both at centre and infinity
 (D) Field is zero, both at centre and infinity

6. **AD**

7. A stone is projected with a velocity $20\sqrt{2}$ m/s at an angle of 45° to the horizontal. The magnitude of average velocity of stone during its motion from starting point to its maximum height is (take $g = 10$ m/s²)

- (A) 20 m/s
 (B) $20\sqrt{5}$ m/s
 (C) $5\sqrt{5}$ m/s
 (D) $10\sqrt{5}$ m/s

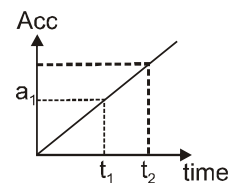
7. **D**

(Single Correct Choice Type)

This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

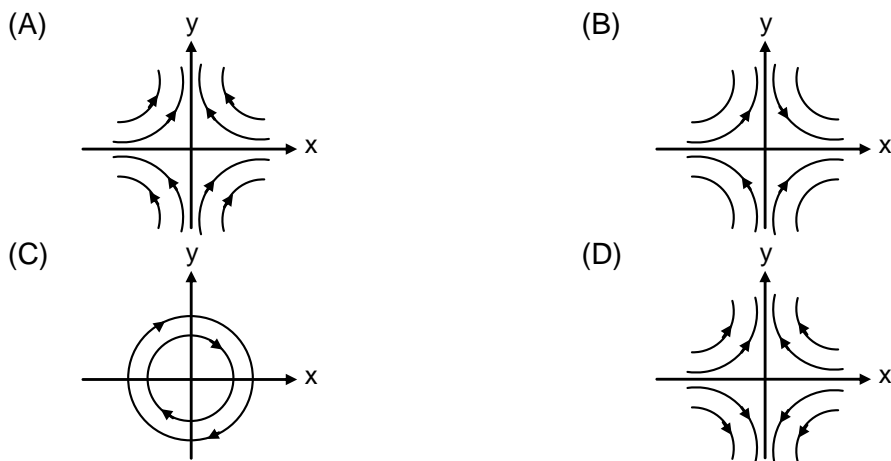
8. Acceleration time graph of a particle is shown. Work done by all the forces acting on the particle of mass m in time interval from t_1 to t_2 while a_1 is the acceleration at time t_1 , is given by :

- (A) $\frac{ma_1^2}{4t_1}(t_2^3 - t_1^3)$
 (B) $\frac{ma_1^2}{8t_1^2}(t_2^4 - t_1^4)$
 (C) $\frac{ma_1^2}{4t_1^2}(t_2^4 - t_1^4)$
 (D) $\frac{ma_1}{2t_1}(t_2^2 - t_1^2)$



8. **B**

9. Potential is varying with x and y as $V = 2(x^2 - y^2)$. The corresponding field pattern is:



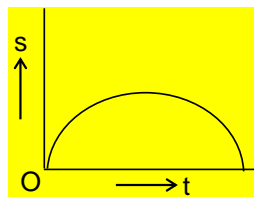
9. **D**

10. The potential energy of a particle of mass m is given by $U = \frac{1}{2}kx^2$ for $x < 0$ and $U = 0$ for $x \geq 0$. If total mechanical energy of the particle is E. Then its speed at $x = \sqrt{\frac{2E}{k}}$ is :

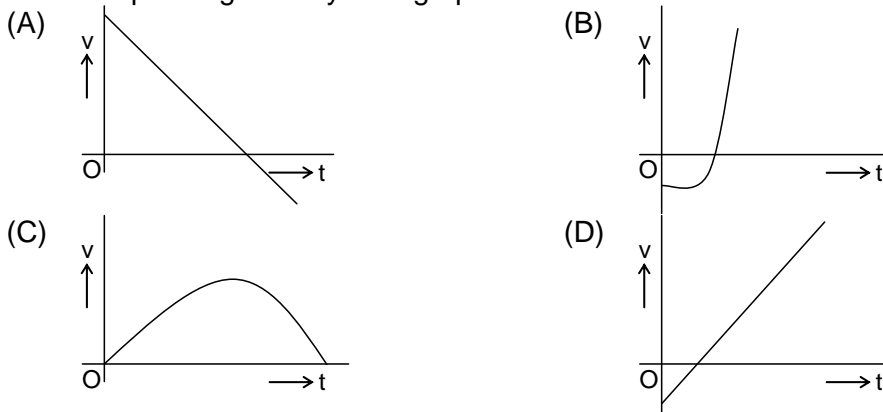
- (A) Zero (B) $\sqrt{\frac{E}{2m}}$ (C) $\sqrt{\frac{E}{m}}$ (D) $\sqrt{\frac{2E}{m}}$

10. **D**

11. The graph of displacement v/s time is



Its corresponding velocity time graph will be



11. **A**

12. A stone falls freely from rest and the total distance covered by it in the last second of its motion equals the distance covered by the first three seconds of its motion. The stone remains in the air for

- (A) 3 sec (B) 5 sec (C) 7 sec (D) 4 sec

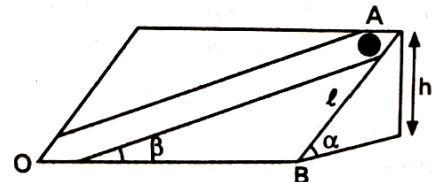
12. **B**

13. A block of mass 2 kg is gently placed over a massive plank moving horizontally over a smooth surface with velocity 6 m/s. The coefficient of friction between the block and plank is 0.2. The distance traveled by the block till it slides on the plank is ($g = 10 \text{ m/s}^2$)
- (A) 4 m (B) 6 m
(C) 9 m (D) 12 m

13. C

PART – B (Numerical based)

1. Plane of height $h = 1.6$ meter and inclination $\alpha = 30^\circ$ to the horizontal has a smooth groove cut in it inclined at an angle $\beta = 45^\circ$ to the line of greatest slope as shown in figure. Time that a particle would take to move from top point A to bottom point O in groove, starting from rest at the top. ($g = 10 \text{ m/sec}^2$)

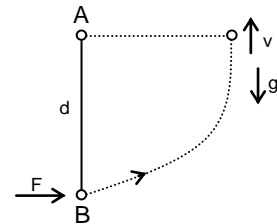


1. 1.60

2. A 100 pF capacitor is charged to a potential difference of 24 V. It is connected to an uncharged capacitor of 20 pF. The new potential difference across the 100 pF capacitor is 10 K volt. Find the value of 'K'.

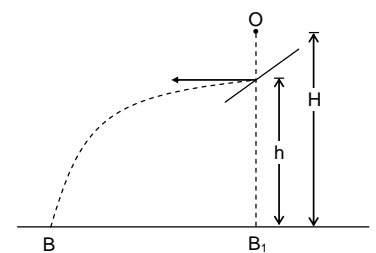
2. 2

3. A particle B of mass 5 kg is attached to a frictionless pivot, A, by a thread of length $d = 0.2$ m so that B hangs freely. At some instant of time a strong wind begins to apply a constant horizontal force $F = 100$ N on B, as a result it rotates about A in a vertical plane. Find the speed (in m/s) of B at the instant when the string is horizontal. ($g = 10 \text{ m/s}^2$)



3. 2

4. A body falling freely from a given height 'H' hits an inclined plane in its path at a height 'h'. As a result of this impact, the velocity of the body become horizontal. For what value of (h/H) will the body take maximum time to reach the ground?



4. 0.50

5. An object is displaced from point A(1 m, 2 m, 3 m) to a point B(2 m, 3 m, 4 m) under a constant force $\vec{F} = (2\hat{i} + 3\hat{j} + 4\hat{k}) \text{ N}$. Find the work done by this force in this process (in joule).

5. 9

SECTION-2 : CHEMISTRY

PART – A

(Multi Correct Choice Type)

This section contains 7 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

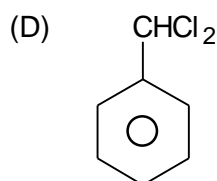
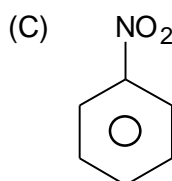
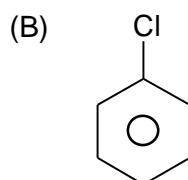
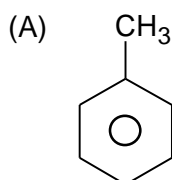
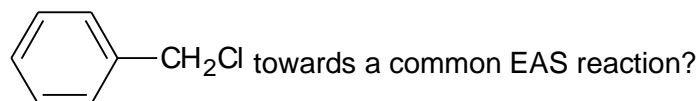
1. Which of the following substance(s) form hydrogen bonding?
 (A) Tautomer of CH_3COCH_3 (B) Functional isomer of $\text{C}_2\text{H}_5\text{OCH}_3$
 (C) Position isomer of 2-butanol (D) Functional isomer of carboxylic acids

1. **ABC**

2. Which of the following substance(s) show(s) more than two stereoisomers?
 (A) $\text{CH}_3\text{CH}=\text{CH}-\text{CH}_2-\text{CH}=\text{CH}_2$
 (B) $\text{ClCH}=\text{CH}-\text{CH}=\text{CHBr}$
 (C) $\text{CH}_2=\text{CH}-\text{CH}_2-\underset{\text{Cl}}{\text{CH}}-\text{CH}_2-\text{CH}=\text{CH}_2$
 (D) $\text{CH}_3-\text{CH}=\text{CH}-\underset{\text{Cl}}{\text{CH}}-\text{CH}_2\text{CH}_3$

2. **BD**

3. Which of the following substance(s) is/are more reactive than



3. **A**

4. Which of the following substances are more reactive than $\text{C}_2\text{H}_5\text{Br}$ towards $\text{S}_{\text{N}}2$ hydrolysis reaction with aqueous KOH ?
 (A) $\text{C}_2\text{H}_5\text{Cl}$ (B) CH_3Br
 (C) $\text{C}_2\text{H}_5\text{I}$ (D) CH_3I

4. **BCD**

5. Which of the following substance(s) react(s) with Na metal in a substitution reaction?
 (A) CH_3OH (B) $\text{C}_2\text{H}_5\text{Cl}$
 (C) $\text{CH}_3\text{CH}=\text{CH}_2$ (D) $\text{C}_2\text{H}_5\text{C}\equiv\text{CH}$

5. **A**

6. Which properties of 'F' is/are higher than that of 'Cl'?
- (A) Electronegativity (B) Electron affinity
(C) Ionization energy (D) Ionic radius of X^- ion ($X = F, Cl$)
6. AC
7. Which of the following ion(s) is/are larger than that of Mg^{2+} ion?
- (A) F^- (B) Na^+
(C) Al^{3+} (D) O^{2-}
7. ABD

(Single Correct Choice Type)

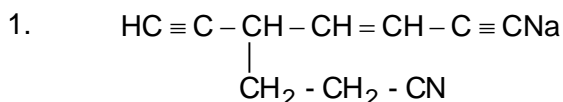
This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

8. Which of the following intermediate is stabilized by resonance?
- (A) $CH_2 = CH - CH_2 - \overset{\ominus}{CH_2}$ (B) $CH_3CH = CH - \overset{\ominus}{CH} - CH_3$
(C) $CH_2 = CH - \underset{\overset{\ominus}{|}}{CH} - CH_3$ (D) $CH_3CH_2CH = \overset{\ominus}{CH}$
8. B
9. The strongest nucleophile in water out of the following is:
- (A) F^- (B) Cl^-
(C) Br^- (D) I^-
9. D
10. Which of the following reaction forms ethyl alcohol?
- (A) $CH_3CH_3 + O_2 \longrightarrow$ (B) $CH_2 = CH_2 + H_2O \xrightarrow{H^+}$
(C) $CH_3CH_2Cl \xrightarrow[\Delta]{\text{Alcoholic KOH}}$ (D) $CH_3CH_2Cl + Na \xrightarrow{\text{Dry ether}}$
10. B
11. Which of the following compound display tautomerism?
- (A) $CH_3CH_2OCH_2CH_3$ (B) $CH_3CH_2CH_2OH$
(C) $CH_3COCH_2CH_3$ (D) $CH_3OCH_2CH_2CH_3$
11. C
12. $Q \xleftarrow[\text{Cold}]{KMnO_4/OH^-} CH_3 - CH = CH - CH_3 \xrightarrow[\Delta]{KMnO_4/H^+} P$
- Which of the following statement is correct for the products 'P' and 'Q'?
- (A) Both products contain same number of hydrogen atoms.
(B) Both are addition products.
(C) Both contain same number of oxygen atoms.
(D) Both contain same number of carbon atoms.
12. C

13. Which of the following substance forms $\text{CH}_3\text{CH}_2\text{CHO}$ and CH_3CHO , when subjected to reductive ozonolysis with $\text{O}_3/\text{Zn}/\text{H}_2\text{O}$
- (A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH} = \text{CH}_2$ (B) $\text{CH}_3\text{CH}_2\text{CH} = \text{CHCH}_3$
- (C) $\text{CH}_3\text{CH}_2\text{C} \equiv \text{CCH}_3$ (D) $\text{CH}_3\text{CH}_2\underset{\text{OH}}{\text{C}}\underset{\text{OH}}{\text{C}}\text{CH}_3$

13. **B**

PART – B
(Numerical based)

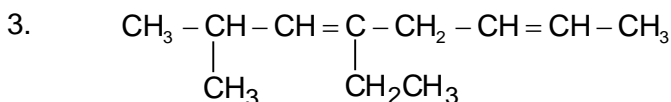


How many sp -hybridized carbon atom(s) is/are present in the above compound?

1. **5**

2. How many minimum number of carbon atom(s) should a cycloalkane contain in order to show optical isomerism?

2. **5**

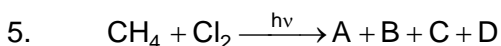


How many allylic hydrogen atom(s) is/are present in the above molecule?

3. **8**

4. The successive ionization energies of a normal metal are 12.8, 24.6, 1218.9, 1620.6 eV. How many electron(s) is/are present in the outermost orbit of the metal?

4. **2**



What is the molar mass of the most acidic product of above reaction?

5. **119.5**

SECTION-3 : MATHEMATICS

PART – A

(Multi Correct Choice Type)

This section contains 7 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. Which of the following function(s) has/have the same range?

(A) $f(x) = \frac{1}{1+x}$

(B) $f(x) = \frac{1}{1+x^2}$

(C) $f(x) = \frac{1}{1+\sqrt{x}}$

(D) $f(x) = \frac{1}{\sqrt{3-x}}$

1. **BC**

2. Let $h(x) = f(x) - (f(x))^2 + (f(x))^3$ for every real number x , then

- (A) h is increasing whenever f is increasing
 (B) h is increasing whenever f is decreasing
 (C) h is decreasing whenever f is decreasing
 (D) nothing can be said general

2. **AC**

3. Let $f(x) = |x^2 - 3x - 4|$, $-1 \leq x \leq 4$, then

- (A) $f(x)$ monotonically increases in $\left(-1, \frac{3}{2}\right)$
 (B) $f(x)$ monotonically decreases in $\left(\frac{3}{2}, 4\right)$
 (C) local maximum value of $f(x)$ is $\frac{25}{4}$
 (D) local minimum value of $f(x)$ is 0

3. **ABC**

4. If $f(x) = 2x + \cot^{-1} x + \ln(\sqrt{1+x^2} - x)$, then $f(x)$

- (A) increases in $(0, \infty)$ (B) decreases in $[0, \infty)$
 (C) neither increases nor decreases $(0, \infty)$ (D) increases in $(-\infty, \infty)$

4. **AD**

5. If $f(x) = \int_1^x 2(t-1)(t-2)^3 + 3(t-1)^2(t-2)^2 dt$, then

- (A) $f(x)$ attains maximum at $x = 2$ (B) $f(x)$ attains minimum at $x = 1$
 (C) $f(x)$ has a point of inflection at $x = 2$ (D) $f(x)$ attains maximum at $x = 1$

5. **CD**

6. Let $y = \sqrt{x + \sqrt{x + \sqrt{x + \dots + \infty}}}$, then $\frac{dy}{dx}$ is equal to:
- (A) $\frac{1}{2y-1}$ (B) $\frac{x}{x+2y}$
 (C) $\frac{1}{\sqrt{1+4x}}$ (D) $\frac{y}{2x+y}$

6. **AC**

7. $\lim_{x \rightarrow 1} \frac{\sqrt{1 - \cos 2(x-1)}}{x-1}$
- (A) exists and it equal to $\sqrt{2}$
 (B) exists and it equals $-\sqrt{2}$
 (C) exists but cannot be determined
 (D) does not exist because the left hand limit is not equal to the right hand limit

7. **D**

(Single Correct Choice Type)

This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

8. The range of the function $y = \frac{8}{9-x^2}$ is:
- (A) $(-\infty, 0) - \{\pm 3\}$ (B) $\left[\frac{8}{9}, \infty\right)$
 (C) $\left(0, \frac{8}{9}\right)$ (D) $(-\infty, 0) \cup \left[\frac{8}{9}, \infty\right)$

8. **D**

9. If $f(x) = \frac{x}{\sqrt{1+x^2}}$ and $\frac{(f \circ f \circ f)(x)}{f(x)} = \lambda$ has a solution then all the values of λ is/are
- (A) $\left(\frac{1}{\sqrt{3}}, 1\right)$ (B) $\left(-1, -\frac{1}{\sqrt{3}}\right)$
 (C) $\left(-1, -\frac{1}{\sqrt{3}}\right) \cup \left(\frac{1}{\sqrt{3}}, 1\right)$ (D) none of these

9. **A**

10. $\lim_{x \rightarrow 1} (1-x) \tan \frac{\pi x}{2} =$
- (A) $\frac{1}{\pi}$ (B) π
 (C) $\frac{\pi}{2}$ (D) $\frac{2}{\pi}$

10. **D**

11. If $f(x) = \begin{cases} -4 \sin x + \cos x & \text{for } x \leq -\frac{\pi}{2} \\ a \sin x + b & \text{for } \frac{\pi}{2} < x < \frac{\pi}{2} \\ \cos x + 2 & \text{for } x \geq \frac{\pi}{2} \end{cases}$ is continuous then:
- (A) $a = -1, b = 3$ (B) $a = 1, b = -3$
 (C) $a = 1, b = 3$ (D) $a = -1, b = -3$

11. **A**

12. Let $f(x) = [x^3 - 3]$ where $[]$ g.i.f. then the number of points in $(1, 2)$ where function is discontinuous is _____.

- (A) 2 (B) 4
 (C) 6 (D) 8

12. **C**

13. The set of real values of x for which $\log_{0.2} \frac{x+2}{x} \leq 1$

- (A) $(-\infty, -\frac{5}{2}] \cup (0, +\infty)$ (B) $[\frac{5}{2}, +\infty)$
 (C) $(-\infty, -2) \cup (0, +\infty)$ (D) none

13. **A**

PART – B (Numerical based)

1. $\lim_{x \rightarrow \infty} \left(\frac{2+x}{1+x} \right)^{2x+1}$ is equal to e^k , then k will be

1. **2**

2. Let $f: \mathbb{R} \rightarrow \mathbb{R}$ is function which is defined by $f(x) = \max\{x, x^3\}$. The number of points on which $f(x)$ is not differentiable is,

2. **3**

3. Period of the function $f(x) = \sin(\sin(\pi x)) + e^{\{3x\}}$, (where $\{.\}$ denotes the fractional part of x) is

3. **2**

4. The number of solutions of $x + \int_0^x \ln t dt = \frac{x^2}{3}$, ($x \in \mathbb{R}^+$) is

4. **2**

5. Number of positive roots of the equation $3x^5 + 15x - 8 = 0$ is

5. **1**

ANSWERS

SECTION-1 : PHYSICS

PART – A

PART – B

PAPER – 1 : CHEMISTRY

PART – A

PART – B

SECTION – 3 : MATHEMATICS

PART – A

PART – B