PHYSICS, CHEMISTRY & MATHEMATICS

QP CODE: 101012 | **Paper-2**

Time Allotted: 3 Hours | **Maximum Marks: 180**

- 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. All the section can be filled in **PART-A & B** of 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 ***Blue/Black Ball Point Pen*** 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 (01-04)** – Contains Four (04) 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–A (05–08)** contains **(4) Multiple Choice Questions** which have **One or More Than One 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.

(iii) **Part-B –** This section contains Eight **(08)** questions numerical based questions. The answer to each question is a **NUMERICAL VALUE.** If the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places. Each question carries **+4 marks** for correct answer. **There is no negative marking.**

Name of the Candidate: _____

Batch: _____ **Date of Examination:** _____

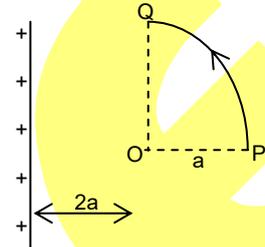**Enrolment Number:** _____

SECTION – I: PHYSICS
(PART – A)
(Single Correct Answer Type)
This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. A arc PQ with centre at O and infinitely long wire having linear charge density λ are lying in the same plane. The minimum amount of work to be done to move a point charge q_0 from point P to Q through circular path PQ of radius a is equal to:

   (A) $\dfrac{q_0^2}{2\pi\varepsilon_0}\ln\left(\dfrac{2}{3}\right)$

   (B) $\dfrac{q_0\lambda}{2\pi\varepsilon_0}\ln\left(\dfrac{2}{3}\right)$

   (C) $\dfrac{q_0\lambda}{2\pi\varepsilon_0}\ln\left(\dfrac{3}{2}\right)$

   (D) $\dfrac{q_0^2}{2\pi\varepsilon_0}\ln\left(\dfrac{3}{2}\right)$

2. An ideal battery of EMF ε is connected in series with an ammeter and a voltmeter of unknown internal resistance. If a certain resistance is connected in parallel with voltmeter. The voltmeter and ammeter readings becomes 1/n and n times of their respective initial readings. What is initial reading of voltmeter ?

   (A) $\dfrac{\varepsilon}{(n+1)}$

   (B) $\dfrac{\varepsilon n}{(n+1)}$

   (C) $\dfrac{\varepsilon n}{(n-1)}$

   (D) $\dfrac{(n+1)\varepsilon}{n}$
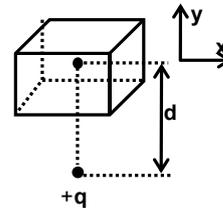
3. In the given figure the time constant of the circuit for current is
   (A) RC
   (B) 2RC
   (C) 3RC
   (D) RC/2
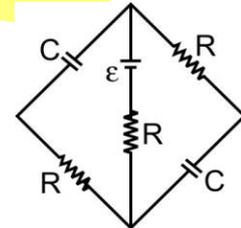
4. A charge +q is placed at a distance 'd' from the centre of the uncharged metallic cube of side 'a'. The electric field at the centre of the cube due to induced charges on the cube will be

   (A) zero

   (B) $\dfrac{q}{4\pi\in_0 d^2}\left(-\hat{j}\right)$

   (C) $\dfrac{q}{4\pi\in_0 d^2}\left(\hat{j}\right)$

   (D) $\dfrac{q}{4\pi\in_0\left(d-\dfrac{a}{2}\right)^2}\left(-\hat{j}\right)$

Space For Rough Work

**(One or More Than One Options Correct Type)**
This section contains **4 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

5. The diagram show is a modified meter bridge, which is used for measuring two unknown resistances R_1 and R_2 at the same time. When only the first galvanometer is used, balance point is found at point C. Now the first galvanometer is removed and the second galvanometer is used, which gives balance point D. Using the details given in the diagram, find out the value of R_1 and R_2
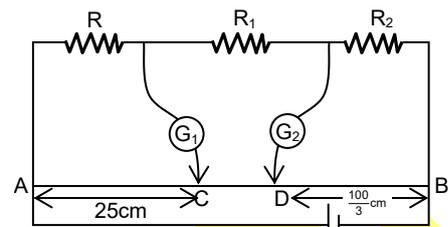
    (A) $R_1 = 5\,R/3$ (B) $R_2 = 4\,R/3$ (C) $R_1 = 4\,R/3$ (D) $R_2 = 5\,R/3$

6. Three identical plates of area A are arranged as shown. a charge $+Q$ is given to plate (2). Then,
    (A) charge $+2Q/3$ appears on plate 1
    (B) charge $-2Q/3$ appears on plate 1
    (C) charge $-Q/3$ appears on plate 3
    (D) charge on plate 1 + charge on plate 3 = 0
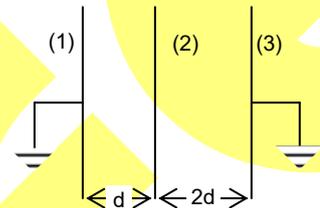
7. The figure shows a potentiometer arrangement, ε is emf of driving cell. ε' is to be determined. Then which of the following are essential condition?
    (A) ε must be greater than ε'
    (B) the positive terminals of C and D must be joined to A only.
    (C) Either the '+ve' terminal of C and D or '–ve' terminal of both C and D must be joined to A.
   (D) The resistance r must be smaller than total resistance of wire AB.
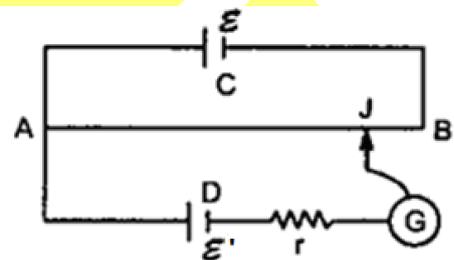
8. Two conducting plates form a parallel plate capacitor of capacitance C_0. The two plates are given charges Q_1 and Q_2. If they are connected by a conducting wire, then,

    (A) charge transfer through this wire will be $\dfrac{Q_1 + Q_2}{2}$

    (B) charge transfer through this wire will be $\dfrac{Q_1 - Q_2}{2}$

    (C) heat produced in the connecting wire will be $\dfrac{(Q_1 - Q_2)^2}{4C_0}$

    (D) heat produced in the connecting wire will be $\dfrac{(Q_1 - Q_2)^2}{8C_0}$

Space For Rough Work

(PART – B)

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

1.   The circuit shown has been connected for a long time. The potential difference across the capacitor is found to be n volt. The value of n is.
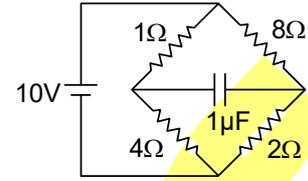
2.   Electric field $\vec{E} = x\hat{i} + y\hat{j}$ exist in the region. The flux linked with the surface of cube of side 'a' as shown in the figure is ka^3 then 'k' is
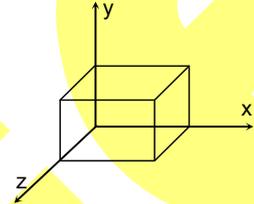


3.   In the circuit shown the capacitor is initially uncharged. The switch S is closed at time t = 0. The internal resistance of the battery is negligible and the capacitance of the capacitor C is $2\mu F$. Calculate Initial current (in Ampere) through 2Ω resistance.
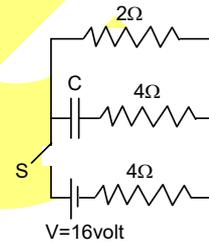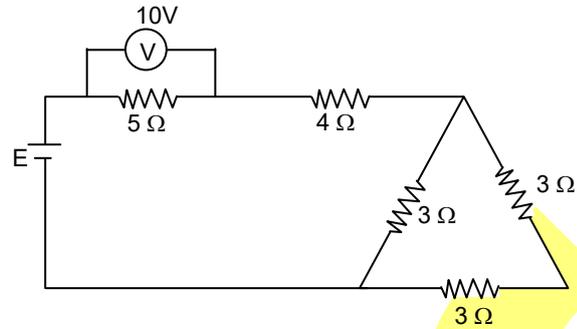

4.   A dipole of moment $\vec{p} = 10^{-7}\left(5\hat{i} + \hat{j} - 2\hat{k}\right)$ cm is placed in an electric field $\vec{E} = 10^{-7}\left(5\hat{i} + \hat{j} - 2\hat{k}\right)$ V m^{-1}. Find the torque experienced ?

5.   A parallel plate square capacitor of capacitance C = $2\mu F$ (without dielectrics) is filled by dielectric slabs as shown in figure. Then the new capacitance of the capacitor is
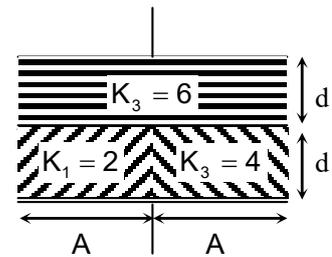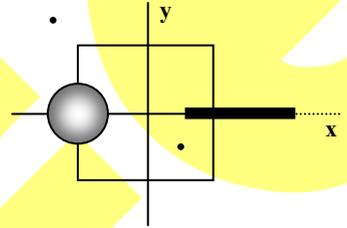
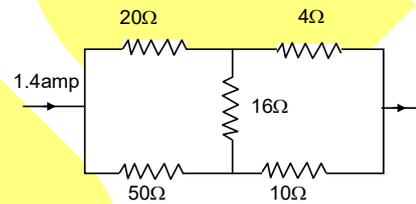

Space For Rough Work

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6.   Find the value of $\dfrac{E}{11}$

7.   A disk of radius a/4 having a uniformly distributed charge $-(6\varepsilon_0)$
      Coulombs is placed in the x-y plane with its centre at
      $(-a/2, 0, 0)$. A rod of length a carrying a uniformly distributed
      charge $-(8\varepsilon_0)$ Coulombs is placed on the x-axis from x = a/4 to
      x = 5a/4. Two point charges $+(12\varepsilon_0)$ Coulombs and $+(3\varepsilon_0)$
      Coulombs are placed at (a/4, $-$a/4, 0) and ($-$3a/4, 3a/4, 0),
      respectively. Consider a cubical surface formed by six surfaces
      x = ± a/2, y = ± a/2, z = ± a/2. The electric flux through this
      cubical surface in SI unit is

8.   In the following figure the current through 4 ohm
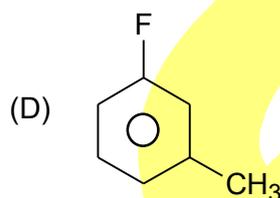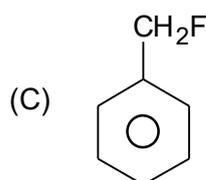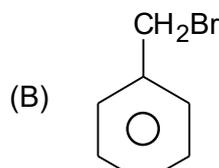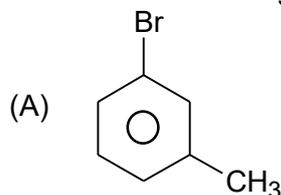   resistor is

Space For Rough Work
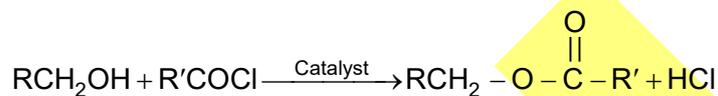
SECTION – II: CHEMISTRY

(PART – A)

(Single Correct Answer Type)

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

1. Which of the following compound is most reactive towards OH^- ion through S_N1 path?

(A) [benzene ring with Br at top and CH_3 at bottom]

(B) [benzene ring with CH_2Br]

(C) [benzene ring with CH_2F]

(D) [benzene ring with F at top and CH_3 at bottom]

2.
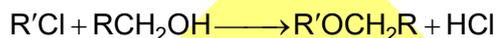$$RCH_2OH + R'COCl \xrightarrow{\text{Catalyst}} RCH_2 - O - \overset{\overset{\displaystyle O}{||}}{C} - R' + HCl$$

The correct statement regarding above reaction is
(A) H_2SO_4 can be used as a catalyst to absorb HCl
(B) This is called transesterification reaction
(C) This is a nucleophilic substitution reaction
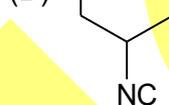(D) The rate of the reaction is slower than that of the reaction

$$R'Cl + RCH_2OH \longrightarrow R'OCH_2R + HCl$$
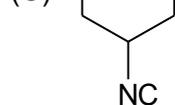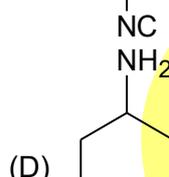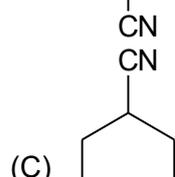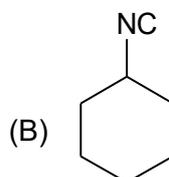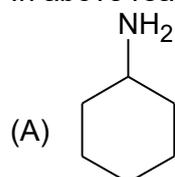
3. Which reagent do you need to convert butan-2-one to propanoic acid?
(A) Tollen's reagent   (B) Fehling's solution
(C) $NaOH/I_2 / H^+$ (D) $NaOH / NaI / H^+$

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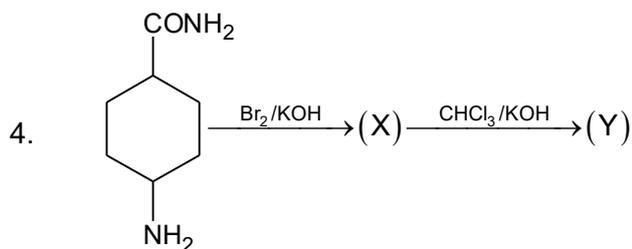
4.

In above reaction(Y) is

(A)

(B)

(C)

(D)

(One or More Than One Options Correct Type)

This section contains **4 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

5.   Dehydrohalogenation of $CH_3 - CH - CH - CH_3$ by $NaNH_2$ can produce
$\qquad\qquad\qquad\qquad\quad |\quad\ |$
$\qquad\qquad\qquad\qquad\ Cl\quad Cl$

(A) $CH_3 - CH = CH - CH_3$ (B) $CH_3 - C \equiv C - CH_3$
(C) $CH_3CH_2C \equiv CH$ (D) $CH_2 = CH - CH = CH_2$
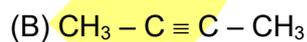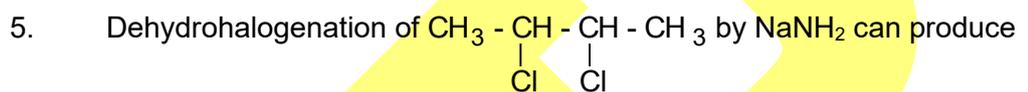
6. $HOOC - (CH_2)_5 - COOH$
Which substance(s) is/are formed by heating above di-carboxylic acid?
(A) CO_2 (B) H_2O
(C) Cyclohexanone   (D) H_2
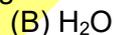
Space For Rough Work

7.   Which of the following reaction(s) produces secondary amine(s)?

(A) $CH_3NC \xrightarrow{LiAlH_4}$ (B) $CH_3NH_2 + CH_3I(1\ eq) \longrightarrow$

(C) $\xrightarrow{Sn/HCl}$ (D) $NH_2 + CH_3Cl(1\ eq) \xrightarrow{py}$

8.   Which of the following reaction(s) can form mesitylene ?
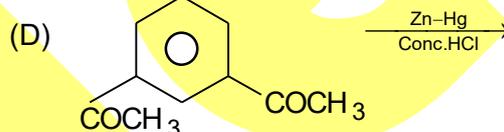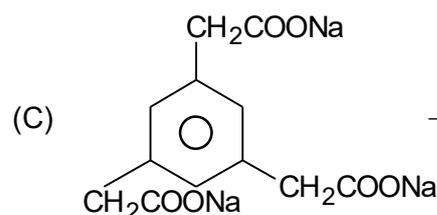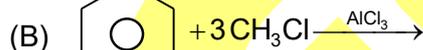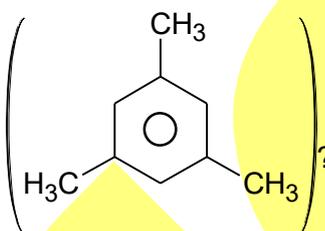
(A) $3\,CH_3COCH_3 \xrightarrow{Conc.H_2SO_4}$ (B) $+3\,CH_3Cl \xrightarrow{AlCl_3}$

(C) $\xrightarrow[\text{Heat}]{\text{Soda lime}}$ (D) $\xrightarrow[\text{Conc.HCl}]{Zn–Hg}$

(PART – B)

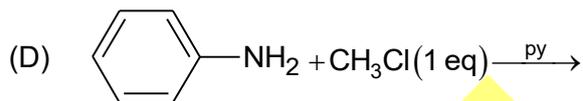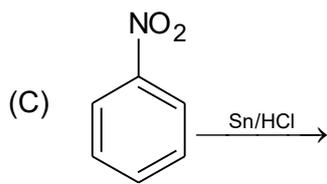This section contains **Eight (08)** numerical based questions. The answer to each question is a NUMERICAL VALUE. If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.

1.   undergoes dehydration on heating and forms a product that show geometrical isomerism. What is the molar mass of the product in g mol^{-1} unit?

2.
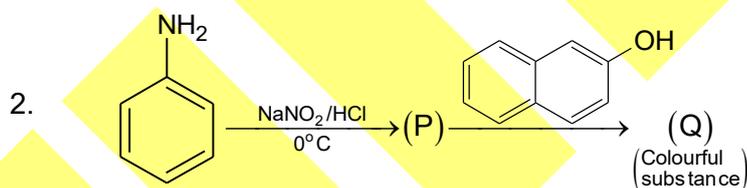
How many pi(π)-bond(s) is/are present in a molecule of (Q)

3.   How many oxime(s) is/are formed when the smallest ketone and its next homologue react with NH$_2$OH?

Space For Rough Work

4.

$$\underset{\underset{Cl}{\overset{CH_3}{|}}}{CH_3C} - \underset{\underset{Cl}{\overset{CH_3}{|}}}{CCH_3} \xrightarrow[\Delta]{Zn\ dust} (A) \xrightarrow{KMnO_4/H^+/\Delta} (B)$$

$$(B) \xrightarrow[\Delta]{I_2/NaOH} \underset{\substack{Yellow \\ ppt.}}{(C)\downarrow} + (D)$$

$$(D) \xrightarrow{H_2O/H^+} (E)$$
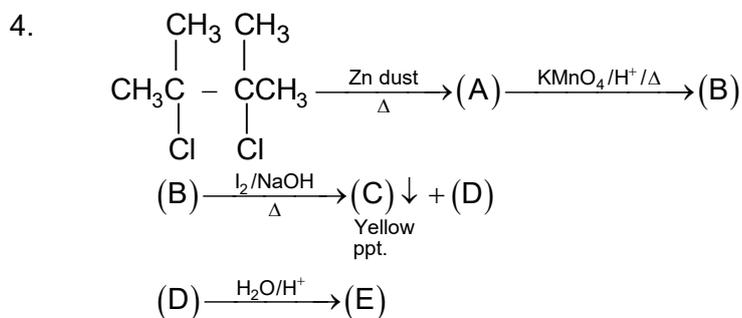
How many oxygen atom(s) are present in (E)?

5.

$$R \xleftarrow[Conc.HCl]{Zn-Hg} CH_3CHO \xrightarrow{NH_2OH/H^+} P$$

with $\xrightarrow{HCN} Q$ (up) and $\xrightarrow{NH_3} S$ (down)
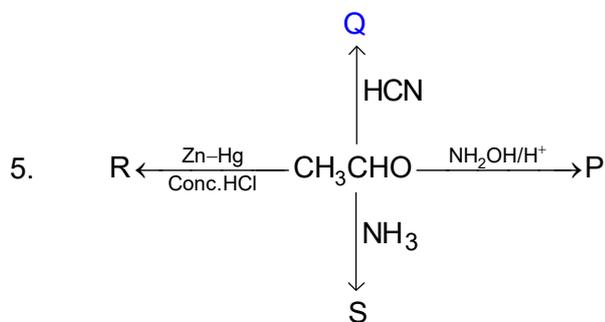
What is the molar mass of the lightest(smallest) unknown product in above reaction?

6.

 cyclobutyl–CH$_2$–OH $\xrightarrow[Heat]{Conc.H_2SO_4}$ Product(s)
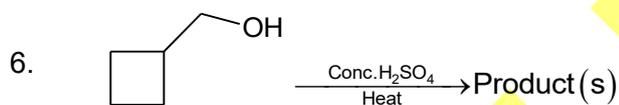
How many product(s) containing five-membered ring(s) is/are formed in the above reaction? (consider stereoisomers)

7. $CH_3CH = CH - CH_2 - CHO \xrightarrow{Zn-Hg/Conc.HCl(excess)}$ Product
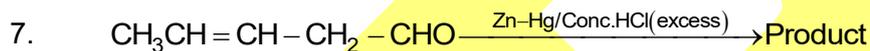
What is the molar mass of the product of above reaction in g mol^{-1} unit?

8.   Decarboxylation of

 (m-hydroxyphenyl)–CH$_2$COOH

forms a product(X) and CO_2. If molar mass of (X) is M g mol^{-1}, what is the value of $\dfrac{M}{10}$?
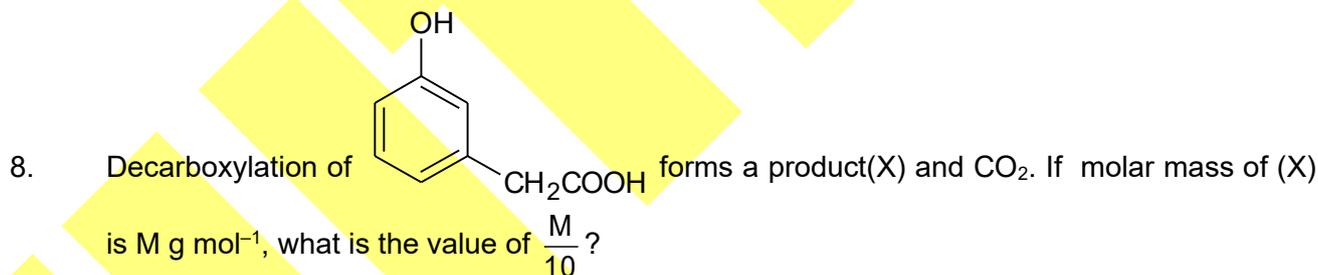
Space For Rough Work

SECTION – III: MATHEMATICS

(PART – A)

(Single Correct Answer Type)

This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**
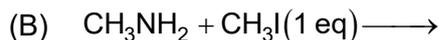
1. The total number of real solutions of the equation $\theta = \tan^{-1}(2\tan\theta) - \dfrac{1}{2}\sin^{-1}\left(\dfrac{6\tan\theta}{9+\tan^2\theta}\right)$ is

   (A) 1   (B) 2   (C) 3   (D) 5

2. If $g(x) = x^2 + x - 2$ and $\dfrac{1}{2}(g\circ f)(x) = 2x^2 - 5x + 2,$ then f(x) is equal to

   (A) 2x – 3   (B) 2x + 3   (C) $2x^2 + 3x + 1$ (D) $2x^2 - 3x - 1$

3. Range of $f(x) = \sin^{-1}x + \cos^{-1}x + \tan^{-1}x + \sec^{-1}x$ is

   (A) $\left[\dfrac{3\pi}{4}, \dfrac{5\pi}{4}\right]$ (B) $\left(\dfrac{3\pi}{4}, \dfrac{5\pi}{4}\right)$ (C) $\left\{\dfrac{3\pi}{4}, \dfrac{5\pi}{4}\right\}$ (D) $\{-1, 1\}$

4. The value of $\lim\limits_{n\to\infty}\left(\prod\limits_{r=3}^{n}\dfrac{r^3-8}{r^3+8}\right)$ is equal to

   (A) $\dfrac{1}{7}$ (B) $\dfrac{2}{7}$ (C) $\dfrac{3}{7}$ (D) $\dfrac{4}{7}$

(One or More Than One Options Correct Type)

This section contains **4 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE** is correct.

5. Let N denote the set of all natural numbers, and Z denote the set of all integers. Consider the functions $f:N\to Z$ and $g:Z\to N$ defined by

   $$f(n) = \begin{cases} \dfrac{(n+1)}{2} & \text{if n is odd} \\[2mm] \dfrac{(4-n)}{2} & \text{if n is even,} \end{cases}$$

   and

   $$g(n) = \begin{cases} 3 + 2n & \text{if } n \geq 0 \\ -2n & \text{if } n < 0 \end{cases}.$$

   Define $(g\circ f)(b) = g(f(n))$ for all $n \in N$, and $(f\circ g(n)) = f(g(n))$ for all $n \in Z$.

   Then which of the following statements is (are) TRUE?

   (A) $g\circ f$ is NOT one – one and g o f is NOT onto

   (B) f o g is NOT one – one but f o g is onto

   (C) g is one – one and g is onto

   (D) f is NOT one – one but f is onto

Space For Rough Work

6.   If $f(x) = \dfrac{\cos 2 - \cos 2x}{x^2 - |x|}$, then

(A) $\underset{x \to 1}{\ell im} f(x) = 2\sin 2$

(B) $\underset{x \to 1}{\ell im} f(x) = -2\sin 2$

(C) $\underset{x \to -1}{\ell im} f(x) = 2\sin 2$

(D) $\underset{x \to 1}{\ell im} f(x) = 2\cos 2$

7.   If $\underset{x \to 0}{\lim} \dfrac{a\sin x - bx + cx^2 + x^3}{2x^2 \log(1+x) - 2x^3 + x^4}$ exists and is finite, then

(A) a = b   (B) c = 0   (C) a = 6   (D) c = 2

8.   The function $f(x) = \begin{cases} 5x - 4, & \text{for } 0 < x \le 1 \\ 4x^2 - 3x, & \text{for } 1 < x < 2 \\ 3x + 4, & \text{for } x \ge 2 \end{cases}$ is

(A) continuous at $x = 1$ and $x = 2$
(B) continuous at $x = 1$ but not derivable at $x = 2$
(C) continuous at $x = 2$ but not derivable at $x = 1$
(D) continuous at $x = 1$ and $x = 2$ but not derivable at $x = 1$ and $x = 2$

(PART – B)

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

1.   Let R denote the set of all real numbers. Let $f : R \to R$ and $g : R \to (0, 4)$ be functions

defined by $f(x) = \log_e(x^2 + 2x + 4)$, and $g(x) = \dfrac{4}{1 + e^{-2x}}$.

Define the composite function $f \circ g^{-1}$ by $(f \circ g^{-1})(x) = f(g^{-1}(x))$, where g^{-1} is the inverse of the function g.

Then the value of the derivative of the composite function $f \circ g^{-1}$ at $x = 2$ is _____

2.   Let $f(x) = (2x - \pi)^3 + 2x - \cos x$ then the value of $\left| \dfrac{d}{dx} f^{-1}(x) \right|_{x=\pi}$ is _____

3.   The differential coefficient of $-f(\cos x)$ w.r. t. to $g(\sin x)$ at $x = \dfrac{\pi}{3}$ if $f'\left(\dfrac{1}{2}\right) = g'\left(\dfrac{\sqrt{3}}{2}\right) = -2$ is

Space For Rough Work

4. Let $x \in \mathbb{R}$, and [.] denote the Greatest Integer Function and if

$$\left[x + \frac{29}{100}\right] + \left[x + \frac{30}{100}\right] + \ldots + \left[x + \frac{91}{100}\right] = 546,$$

then $\dfrac{[100x]}{100} =$

5. The period of the function $f(x) = \{x\} + \left\{x + \dfrac{1}{2}\right\}$ is

6. Let $f(x) = \underset{n \to \infty}{\text{Lim}} \dfrac{x^{2n-1} + ax^3 + bx^2}{x^{2n} + 1}$. If $f(x)$ is continuous for all $x \in R$, then the bisector of angle between the lines $2x + y - 6 = 0$ and $2x - 4y + 7 = 0$ which contains the point (a, b) be $\ell x + my + n = 0$ then $\dfrac{|\ell| + |m|}{|n|} = $.

7. The value of $\tan\left(\dfrac{1}{2}\cos^{-1}\left(\dfrac{\sqrt{5}}{3}\right)\right)$

8. The value of the expression $\left|y^3 \dfrac{d^2 y}{dx^2}\right|$ for the ellipse $3x^2 + 4y^2 = 12$ equals

Space For Rough Work

FIITJEE INTERNAL TEST

BATCHES – PANINI426-G1 & PANINI426XII-1

Phase Test – 5 (Paper-2)
Code: 101012
JEE ADVANCED
ANSWER KEY

ANSWER KEYS

Physics

PART – A

1.	C	2.	B	3.	C	4.	B
5.	AB	6.	BC	7.	AC	8.	BD

PART – B

1.	6.00	2.	2.00	3.	2.00	4.	0.00
5.	7.80	6.	2.00	7.	7.00	8.	1.00

Chemistry

PART – A

1.	B	2.	C	3.	C	4.	B
5.	BCD	6.	ABC	7.	ABD	8.	AC

PART – B

1.	144	2.	9	3.	3	4.	2
5.	30	6.	1	7.	106.5	8.	10.8

Mathematics

PART – A

1.	C	2.	A	3.	C	4.	B
5.	AD	6.	AC	7.	ABC	8.	AB

PART – B

1.	0.25	2.	0.33	3.	1.73	4.	8.5
5.	0.5	6.	1.6	7.	0.38	8.	2.25