FIITJEE (JEE-Advanced)

PHYSICS, CHEMISTRY & MATHEMATICS

Forthcoming Exam – BBE Test on 17th Nov. 2024.

QP Code: 100832

RIT- VII

Time Allotted: 3 Hours

Maximum Marks: 198

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 & Part-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 (01-06) –** Contains seven (06) 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: **–2 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 **–2 marks**, as a wrong option is also darkened.

(ii) **Part-B (01-06)** contains Six (06) Numerical based questions with single digit integer as answer, ranging from 0 to 9 (both inclusive) and each question carries **+3 marks** for correct answer and **-1 marks** for wrong answer.

(iii) **Part-B (07-12)** contains Six (06) Numerical based questions, the answer of which maybe positive or negative numbers or decimals to **Two decimal places** (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries **+4 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 6 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.
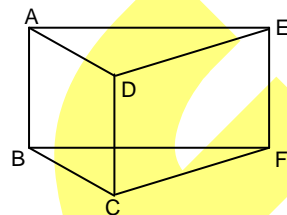
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1. Nine wires each of resistance r are connected to make a prism as shown in figure. Find the equivalent resistance of the arrangement across

    (A) AD is $\dfrac{8R}{15}$ (B) AD is $\dfrac{3R}{5}$

    (C) AB is $\dfrac{8R}{15}$ (D) AB is $\dfrac{3R}{5}$

2. A particle of mass m and charge q is projected in a region where an electric field is existing and given by $\vec{E} = E_0 \hat{i}$, with a velocity $v_0 \hat{j}$ from the origin at time $t = 0$, then choose the correct statements (assuming $m^2 v_0^2 = 2qE_0 m x_0$). (Neglect gravity)

    (A) radius of curvature of the particle when its x-coordinate becomes x_0 is $2x_0$.

    (B) radius of curvature of the particle when its x-coordinate becomes x_0 is $4\sqrt{2}\, x_0$.

    (C) speed of the particle when its x-coordinate becomes x_0 is $\sqrt{2}v_0$.

    (D) speed of the particle when its x-coordinate becomes x_0 is $2v_0$.

3. In the current shown in figure the battery is an ideal one, with emf 3ξ. The capacitor is initially uncharged the switch is closed at t = 0
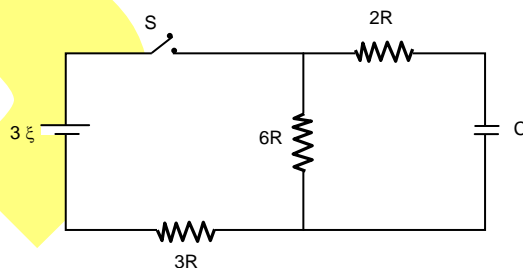
    (A) The current in resistor of resistance 6R at time t will be $\dfrac{\xi}{6R}\left(2 - e^{-t/4RC}\right)$ downward

    (B) The current in resistor of resistance 6R at time t will be $\dfrac{\xi}{6R}\left(2 + e^{-t/4RC}\right)$ downward

    (C) The current in battery at time t will $\dfrac{\xi}{3R}\left(1 + e^{-t/4RC}\right)$ upward

    (D) The current in battery at time t will $\dfrac{\xi}{3R}\left(1 - e^{-t/4RC}\right)$ upward

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Space For Rough Work

4. In the arrangement shown in the figure when the switch S_2 is open, the galvanometer shows no deflection for $\ell = L/2$. When the switch S_2 is closed, the galvanometer shows no deflection for $\ell = \dfrac{5}{12}L$.

(A) Internal resistance of 6V cell is 3 Ω
(B) Internal resistance of 6V cell is 2 Ω
(C) emf E of other battery is 12 V
(D) emf E of other battery is 24 V
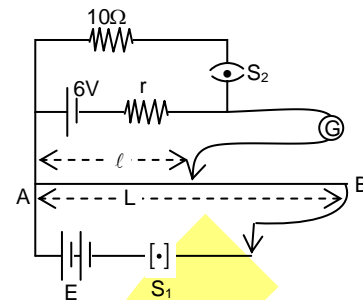
5. A capacitor of capacitance C is charged by a cell of emf 'V'. Then work done by an agent to double the separation between the plates is

(A) $\dfrac{1}{4}CV^2$ when the cell is not removed

(B) $\dfrac{1}{2}CV^2$ when the cell is not removed

(C) $\dfrac{1}{4}CV^2$ when the cell is removed

(D) $\dfrac{1}{2}CV^2$ when the cell is removed

6. A uniformly charged non-conducting hollow sphere of radius 1m and mass 2kg having angular speed $\omega_0 = 9$ rad/s is gently placed on non-conducting rough horizontal surface with coefficient of friction μ at $t = 0$. Charge on the sphere is Q_0 and uniform electric field E is present in the region parallel to horizontal surface. (given $Q_0E = 10$ N, $g = 10\text{m/s}^2$). Then which of the following are correct options

(A) If $\mu = 0.6$, then a_{cm} till 1s is along $-$ve x-axis

(B) If $\mu = 0.4$, then a_{cm} till 1s is along $+$ve x-axis

(C) If $\mu = 0.5$, then a_{cm} till 1s is zero

(D) If $\mu = 0.6$, then friction force till 1s is along $-$ve x-axis
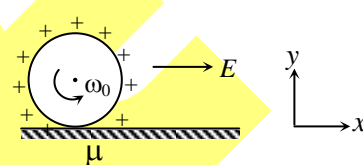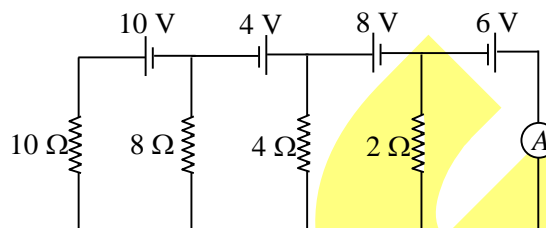
Space For Rough Work

PART – B
Integer Answer Type

This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

1. Find the reading of the ideal ammeter (to the nearest integer) connected in the given circuit. Assume that the cells have negligible internal resistance.


2. The field potential in a certain region of space depends only on the x-coordinate as $\phi = -ax^3 + b$ where a and b are constants. If the distribution of space charge is $\rho_{(x)} = n\epsilon_0 ax$. (Charge per unit volume). Find 'n'.

3. A, B, C, D, E, F are conducting plates each of area A and only two conservative plates separated by a distance d. The net energy stored in the system after the switch S is closed is

   closed is $\dfrac{K \in_0 AV^2}{8d}$ then value of K is _____ :
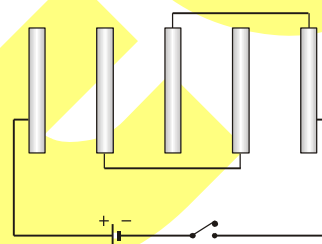
4. Consider a thin conducting shell of radius r carrying total charge q. Two point charges q and 2q are placed on points A and B, which are at distances 0.5r and 2r from the centre C of the shell respectively. If the shell is earthed, then charge will flow to the earth is nq. Find the value of 'n'.
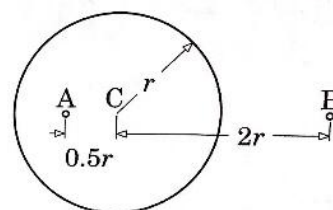

5. The diagram shows a part of a circuit. The capacitor is fully charged. What is the energy (in S.I. unit) stored in the capacitor?

   $$\left[\text{Take } I = \frac{2V}{R} \ \& \ CV^2 = \frac{8}{7} \text{S.I. unit} \right]$$
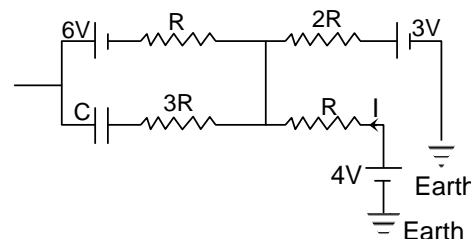
Space For Rough Work

6.   A cell of internal resistance 1Ω is connected across a resistor. A voltmeter having variable resistance G is used to measure p.d. across resistor. The plot of voltmeter reading V against G is shown. What is value of external resistor R?
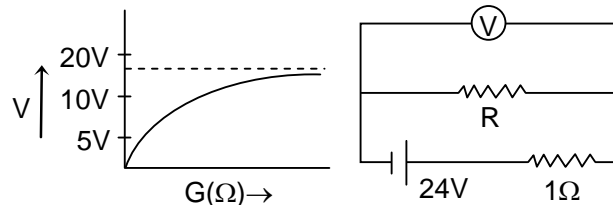

PART – B
(Numerical Type)

This section contains **6 questions**, numerical based questions, (answer of which maybe positive or negative numbers or decimals to **Two decimal places**).

7.   Three identical electric dipoles are arranged parallel to each other at equal separations as shown in the figure. The separation between the charges of a dipole is negligible as compared to the separation between the dipoles. In the given configuration, total electrostatic interaction energy of these dipoles is U_0. Now one of the end dipole is gradually reversed, how much work is done by the electric forces?

8.   A short electric dipole is placed at the origin of the Co-ordinate system with its dipole moment P along y direction. Give answer to following questions for points which are at large distance r from the origin in x-y plane. [r is large compared to length of the dipole]. For $(0 < \theta < 90°)$ all the points, where electric field due to the dipole is parallel to x-axis, fall on a straight line. Find the slope of the line.
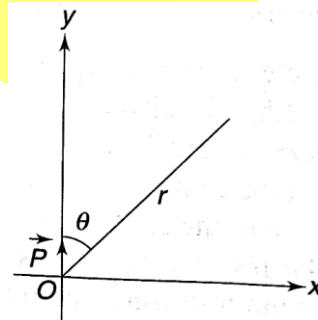

9.   When steady state is reached, switch S is closed. Then the amount of heat rejected in the circuit is x KJoule. Then find the value of 'x'.
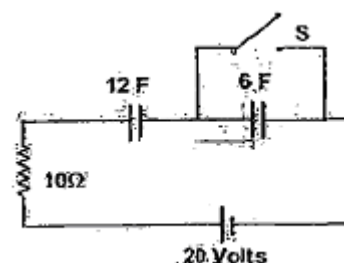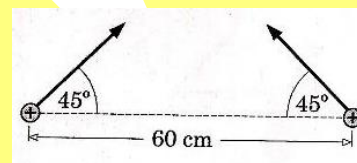

Space For Rough Work

10. The figure shows a *RC* circuit with a parallel plate capacitor. Before switching on the circuit, plate *A* of the capacitor has a charge $-Q_0$ while plate *B* has no net charge. Now, at *t* = 0, the circuit is switched on. Time (in second) will elapse before the net charge on plate *A* becomes zero is 4m, then the value of 'm' is _____.

    (Given $C = 1\mu F$, $Q_0 = 1mC$, $\varepsilon = 1000$ V and $R = \dfrac{2 \times 10^6}{\ln 3} \Omega$)
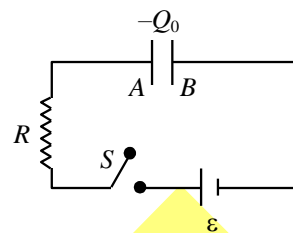
11. Three conducting concentric spherical shell of radii R, 2R and 3R carry some charge on them. The potential at the centre is 50 V and that of middle and outer shell is 20 V and 10 V respectively. The potential of the inner shell is 500 n, then the value of 'n' is _____.

12. Two identical point charges are moving in free space, when they are 60 cm apart their velocity vectors are equal in modulus and make angles of 45° from the line joining them as shown in the figure. If at this instant, their total kinetic energy is equal to their potential energy, Then the distance of closest approach between them is _____ (in m).

Space For Rough Work

SECTION-2 : CHEMISTRY
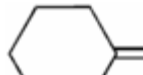## PART – A
(Multi Correct Choice Type)

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

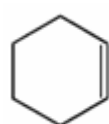1. HBO, oxymercuration-demercuration and acid catalysed hydration will not give same product in
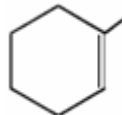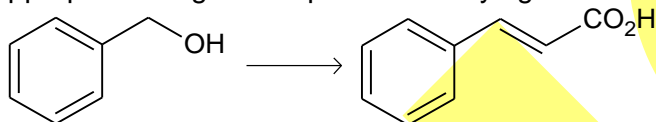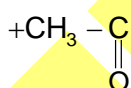
   (A)   (B)

   (C)   (D)
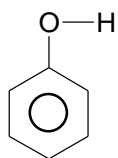
2. The appropriate reagents required for carrying out the following transformation are

   (A) (i) PCC, CH_2Cl_2 (ii) $Ph_3P = CHCOOEt$ (iii) aq. NaOH, Heat, then acidify
   (B) (i) CrO_3, H_2SO_4, aq. acetone (ii) Ac_2O, NaOAc
   (C) (i) MnO_2 (ii) $CH_2(CO_2H)_2$, piperidine, pyridine
   (D) (i) PCC, CH_2Cl_2 (ii) $BrCH_2CO_2C(CH_3)_3$, Zn (iii) H_3O^+, heat

3.

   Possible structure(s) of (B) is/are:

   (A)   (B)
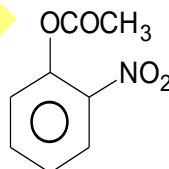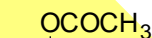
   (C)   (D) All of these

Space For Rough Work

4. Which of the following species is/are aromatic in nature?

(A)

(B)

(C)

(D)
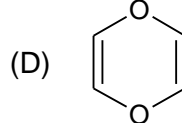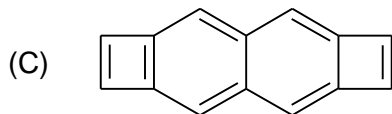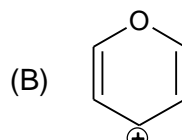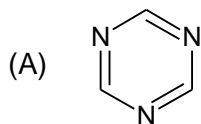
5. Choose correct statements regarding the staggerd form of $ClCH_2CH_2Cl$?
   (A) It's dipole moment is zero
   (B) It's dipole moment increases on heating
   (C) It forms a hydrocarbon when heated with Zn dust
   (D) It's reaction with aq. KOH produces an alcohol whose dipole moment is zero

6. End product of which of the following reaction gives positive iodoform test?
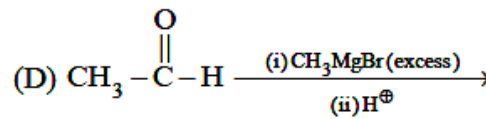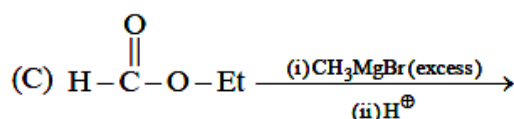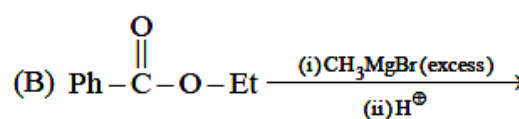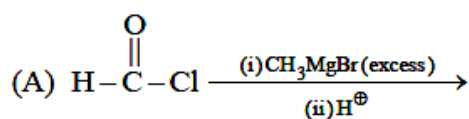
(A) $H-\overset{\overset{O}{\|}}{C}-Cl \xrightarrow[\text{(ii)}H^{\oplus}]{\text{(i)}CH_3MgBr\,(\text{excess})}$

(B) $Ph-\overset{\overset{O}{\|}}{C}-O-Et \xrightarrow[\text{(ii)}H^{\oplus}]{\text{(i)}CH_3MgBr\,(\text{excess})}$

(C) $H-\overset{\overset{O}{\|}}{C}-O-Et \xrightarrow[\text{(ii)}H^{\oplus}]{\text{(i)}CH_3MgBr\,(\text{excess})}$

(D) $CH_3-\overset{\overset{O}{\|}}{C}-H \xrightarrow[\text{(ii)}H^{\oplus}]{\text{(i)}CH_3MgBr\,(\text{excess})}$

Space For Rough Work

PART – B
Integer Answer Type

This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

1. The amount of bromine(at wt = 80) required (in gram) for the estimation of 42.3 g of phenol(mol wt = 94) is x gm. The value of x/27 is

2.

$$\text{OH} \text{ (phenol with } CH_2OH \text{ para substituent)} \xrightarrow[\Delta]{CH_2N_2(1\ eq)} (P)$$

$$(P) \xrightarrow[-CH_3I]{HI\ (excess)} (Q)$$

$$(Q) \xrightarrow{Na(1\ eq)} (R)$$

$$(R) \xrightarrow[\text{Dry ether}]{Na} (S)$$
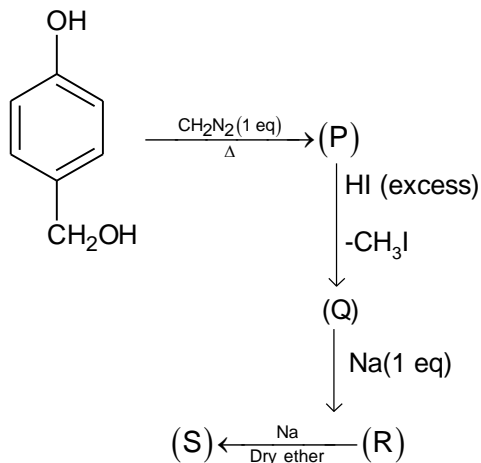
Product(S) is a solution of sodium salt. If the molar mass of the anion of (S) in g mol^{-1} unit is X, what is the value of $\dfrac{X}{53}$?

3. The total number of pair of enantiomers possible with molecular formula $C_5H_{12}O$ is

4. The number of possible monoalkylated products formed in the Friedel-crafts reaction of anisole with 2-chloro-3-methylbutane in the presence of anhydrous $AlCl_3$ at 50°C is

5.

$$CH_2CH_2\overset{\overset{\displaystyle Cl}{|}}{\underset{\underset{\displaystyle Cl}{|}}{C}}CH_3 \xrightarrow{H_2O} (Q)$$

$$(P) \xrightarrow[H_2SO_4\ (dil)]{HgSO_4} (Q)$$
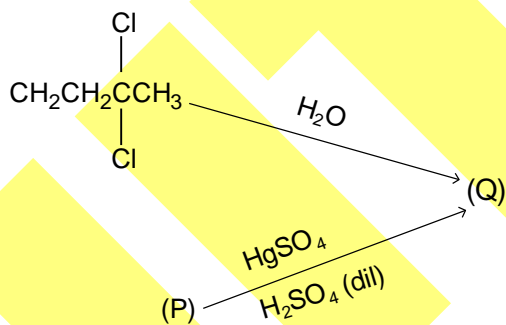
How many sp^3-carbon atom(s) is/are present in (P)?

Space For Rough Work

6.   The number of all possible isomers for the molecular formula C_6H_{14} is

PART – B
(Numerical Type)

This section contains **6 questions**, numerical based questions, (answer of which maybe positive or negative numbers or decimals to **Two decimal places**).

7.

$$\xrightarrow[\text{Heat}]{\text{Conc.}H_2SO_4} \text{Products}$$

If x = Number of products having one exocyclic double bond

y = Number of products obtained through tertiary carbocation intermediate
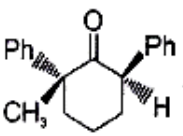
then $\dfrac{x+y}{10}$ is

[Do not consider any stereoisomers]

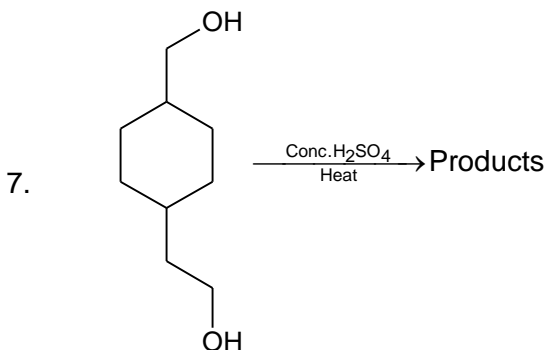8.   The number of resonance structures for M is X, then find the value of $\dfrac{X-1}{2}$

$$\xrightarrow{\text{NaOH}} M$$
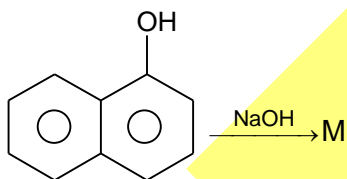
9. $CH_3 - CH = CH - O - CH_2 - CH_3 \xrightarrow{\text{dil.acid}} X + Y \,(\text{Positive haloform test})$

The number of possible isomers for X excluding stereoisomers and including X

10.

$$\xrightarrow{\overset{\ominus}{O}H / H_2O} \text{Number of isomeric products (m)} \xrightarrow[\text{distillation}]{\text{Fractional}} \text{Number of fractions (n)}$$

The value of (m + n is)

Space For Rough Work

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11. Lowest molecular mass of cyclic alcohol which can show geometrical isomerism is X. So the value of $\dfrac{X}{10}$ is

12.
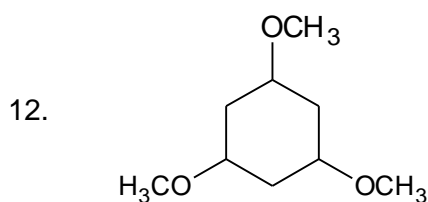
How many maximum moles of HI is needed for complete reaction of one mole of the above compound?

Space For Rough Work

SECTION-3 : MATHEMATICS

PART – A

(Multi Correct Choice Type)

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

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1. Which of the following functions is an even function?

    (A) $f(x) = \sqrt{1+x+x^2} - \sqrt{1-x+x^2}$

    (B) $f(x) = x\left(\dfrac{a^x+1}{a^x-1}\right)$

    (C) $f(x) = \log_{10}\left(\dfrac{1-x^2}{1+x^2}\right)$

    (D) $f(x) = k$ (constant)

2. Let $f : R \to R$ be a defined by $f(x) = [x]$ and $g(x) = \dfrac{3-2x}{4}$ then

    (A) f is neither one – one nor onto

    (B) g is one – one but f is not one – one

    (C) f is one – one and g is onto

    (D) neither f nor g is onto

3. Let ρ be the relation on the set R of all real number defined by setting $a\rho b$ iff $|a-b| \le \dfrac{1}{2}$.

    Then ρ is

    (A) reflexive and transitive

    (B) reflexive and symmetric

    (C) reflexive and symmetric but not transitive

    (D) equivalence

4. Let $f(x) = \dfrac{\sin x}{\sqrt{1+\tan^2 x}} + \dfrac{\cos x}{\sqrt{1+\cot^2 x}}$, then

    (A) fundamental period of $f(x)$ is 2π

    (B) fundamental period of $f(x)$ is π

    (C) domain of $f(x)$ is R

    (D) range of $f(x)$ is $[-1, 1]$

5. Which of the following function(s) has/have removable discontinuity at $x = 1$?

    (A) $f(x) = \dfrac{1}{\ell n|x|}$

    (B) $f(x) = \dfrac{x^2-1}{x^3-1}$

    (C) $f(x) = 2^{-2\frac{1}{1-x}}$

    (D) $f(x) = \dfrac{\sqrt{x+1} - \sqrt{2x}}{x^2-x}$

Space For Rough Work

6. If $f(x) = \begin{cases} 3 - x^2, & -1 \le x < 2 \\ 2x - 4, & 2 \le x \le 4 \end{cases}$, then $fof(x)$ is

    (A) Continuous at $x = 1$ (B) discontinuous at $x = 1$
    (C) Discontinuous $x = 3$ (D) discontinuous at $x = 2$

PART – B
Integer Answer Type
This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

1. The period of the function $f(x) = \sin\left(2\pi x + \dfrac{\pi}{3}\right) + 2\sin\left(3\pi x + \dfrac{\pi}{4}\right) + 3\sin 5\pi x$ is

2. Let $A = \{a, b, c, d\}$ and $B = \{a, b, c\}$. Then the number of sets X contained in A and not contained in B is

3. f is a function such that $f(x) + 2f(1 - x) = x^2 + 1$. Value of $f(3)$ is

4. The number of points of non – differentiable of function
    $f(x) = \max\{\sin^{-1}|\sin x|, \cos^{-1}|\sin x|\}, 0 < x < 2\pi$, is

5. The number of values of $x \in [0, 2]$ and in domain of $f(x)$ at which
    $f(x) = \left|x - \dfrac{1}{2}\right| + |x - 1| + \tan x$ is not differentiable at

6. The number of points where the function $f(x) = \max(|\tan x|, |\cos x|)$ is non differentiable in the interval $(-\pi, \pi)$ and in domain of $f(x)$, is

PART – B
(Numerical Type)
This section contains **6 questions**, numerical based questions, (answer of which maybe positive or negative numbers or decimals to **Two decimal places**).

7. Let $A_1, A_2, A_3, \ldots\ldots A_{40}$ are 40 sets each with 7 elements and $B_1, B_2, \ldots B_n$ are n sets each with 7 elements. If $\bigcup_{i=1}^{40} A_i = \bigcup_{j=1}^{n} B_j = S$ and each element of S belongs to exactly ten of A_i's and exactly 9 of B_j's, then n equals

Space For Rough Work

8.   If $f\left(\dfrac{x+y}{2}\right) = \dfrac{f(x)+f(y)}{2}$ for all $x, y \in R$, $f^1(0)$ exists and equals to -1 and $f(0) = 1$ then $f(-2009)$ equals

9.   Let $f(x) = \left[x^2\right]\sin\pi x, x \in R$, the number of points in the interval $(0, 3]$ at which the function is discontinuous is _____

10.   If $f(x) = \begin{cases} \dfrac{\tan\left[x^2\right]\pi}{ax^2} + ax^3 + b, & 0 \le x \le 1 \\ 2\cos\pi x + \tan^{-1} x, & 1 < x \le 2 \end{cases}$ is differentiable in $[0, 2]$, then $a = \dfrac{1}{k_1}, b = \dfrac{\pi}{4} - \dfrac{26}{k_2}$.
      Find $k_1^2 + k_2^2$ (where [.] denotes greatest integer function)

11.   If $\underset{x\to 0}{\text{Lt}} \dfrac{ae^x - b\cos x + ce^{-x}}{x\sin x} = 2$ then the value of $10a + 20b + 10c =$

12.   If $\underset{x\to 0}{\lim} \dfrac{\log_e(1+x)^{1+x}}{x^2} - \dfrac{1}{x} = k$ then value of k is

Space For Rough Work

BATCHES – Two Year CRP-2325

RIT – VII
Code : 100832
ANSWERS

SECTION-1 : PHYSICS
PART – A

1.	AD	2.	BC	3.	AC	4.	BC
5.	AD	6.	ABCD				

PART – B

1.	2	2.	6	3.	3	4.	3
5.	7	6.	5	7.	1.06 (range: 1.05 to 1.06)		
8.	0.71 (range: 0.70 to 0.71)			9.	1.60	10.	0.50
11.	0.10	12.	0.40				

SECTION – 2 : CHEMISTRY
PART – A

1.	ABD	2.	ACD	3.	BC	4.	ABC
5.	ABC	6.	ABCD				

PART – B

1.	8	2.	4	3.	4	4.	4
5.	2	6.	5	7.	0.6	8.	4.5
9.	8	10.	4	11.	7.2	12.	6

SECTION – 3 : MATHEMATICS
PART – A

1.	BCD	2.	AB	3.	BC	4.	AD
5.	BD	6.	BCD				

PART – B

1.	2	2.	8	3.	0	4.	7
5.	2	6.	4	7.	36	8.	2010
9.	6	10.	180	11.	60	12.	0.5