FIITJEE (JEE-Advanced)

BATCHES – Two Year CRP – 2325

PHYSICS, CHEMISTRY & MATHEMATICS

QP Code: 100868 **RIT – 8**

Time Allotted: 3 Hours **Maximum Marks: 198**

- 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 (01-06) –** 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-A (07-12) –** Contains Six (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, 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 :_____

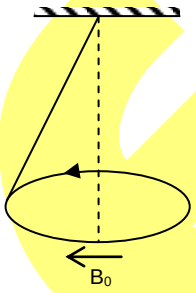
SECTION – 1: PHYSICS

PART – A

(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.**

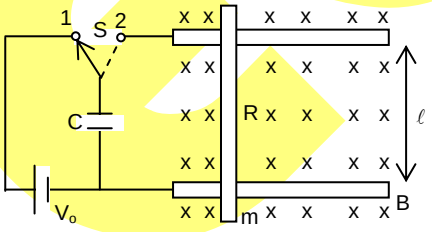
1. A uniform current carrying ring of mass m and radius R is connected by a massless string as shown in figure. A uniform magnetic field B_0 exists in the region to keep the ring in horizontal position, then the current in the ring is (l = length of string)



(A) $\frac{mg}{\pi RB_0}$ (B) $\frac{mg}{RB_0}$

(C) $\frac{mg}{3\pi RB_0}$ (D) $\frac{mg\ell}{\pi R^2B_0}$

2. One end of a horizontal fixed track of gauge ℓ and negligible resistance is connected to a capacitor of capacitance C charged to voltage V_o. The inductance of the assembly is negligible. The system is placed in a homogenous, vertical magnetic field of induction B as shown in the figure.

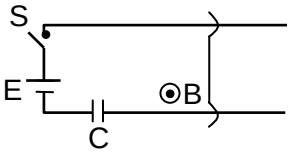


A frictionless conducting rod of mass m and negligible resistance is placed perpendicularly on to the track. The polarity of the capacitor is such that the rod is repelled from the capacitor. Now the switch is turned from 1 to 2. What is the maximum velocity of the rod?

(A) $\frac{B\ell CV_o}{m+B^2\ell^2C}$ (B) $\frac{2B\ell CV_o}{m+B^2\ell^2C}$

(C) $\frac{B\ell CV_o}{2\left(m+B^2\ell^2C\right)}$ (D) none of these

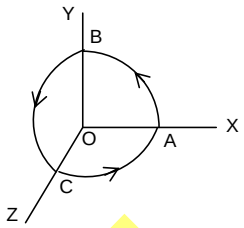
3. The circuit shown in the adjacent figure lies in a uniform magnetic field B coming out of the plane of paper. Initially, capacitor C is uncharged and the switch S is open. A conducting slider of mass m and length ℓ can move freely over parallel tracks. The velocity of the slider as soon as switch S is closed is (neglect effects of magnetic field due to the current in the shown circuit)



(A) $\frac{B\ell CE}{2m}$ (B) $\frac{B\ell CE}{m}$ (C) $\frac{CE^2}{2\ell m}$ (D) None of these

Space For Rough Work

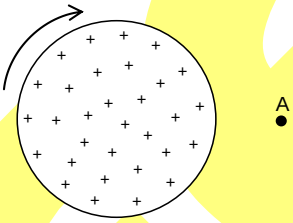
4. A wire is bent into three successive quadrants. The quadrant AB lies in the xy plane, BC in yz plane and CA in xz plane. What is the magnetic moment of this system if a current I flows through it? Given : r = radius of each quadrant.



(A) $\frac{\sqrt{3}\pi r^2 I}{4}$ (B) $\frac{\sqrt{2}\pi r^2 I}{4}$

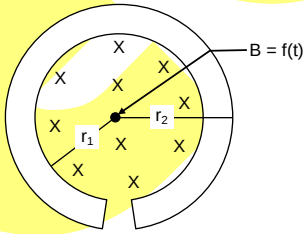
(C) $\frac{\pi r^2 I}{4}$ (D) $\frac{3\pi r^2 I}{4}$

5. A positively charged disk is rotated clockwise as shown in figure. The direction of the magnetic field at point A in the plane of the disk is



(A) pointing out of plane
(B) pointing into the plane
(C) towards right
(D) towards left

6. If the magnetic field B changes at a rate $\frac{dB}{dt}$, the induced current in the loop is



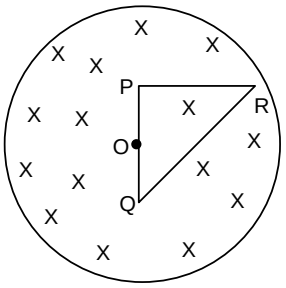
(A) $\propto \frac{dB}{dt}$ (B) $\left(\frac{r_1^2 - r_2^2}{2}\right)$

(C) zero (D) indeterminate

(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.

7. Consider a region of cylindrical magnetic field, changing with time at the rate α. Three conducting rods PQ, QR and RP are placed in the field such that the mid point of side PQ coincides with axis of the magnetic field region as shown in figure but their ends are not connected and joined with insulating material. PQ = 2ℓ, PR = 2ℓ,



(A) EMF induced between P and Q; $V_P - V_Q = 0$

(B) EMF induced between R and Q; $V_R - V_Q = \ell^2\alpha$

(C) EMF induced between P and R; $V_P - V_R = \ell^2\alpha$

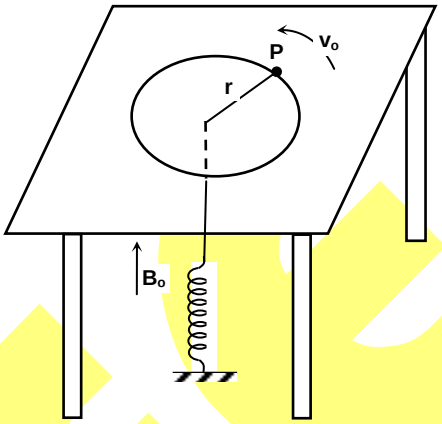
(D) None of these

Space For Rough Work

8. A charged particle moves in a gravity-free space without change in velocity. Which of the following is/are possible?

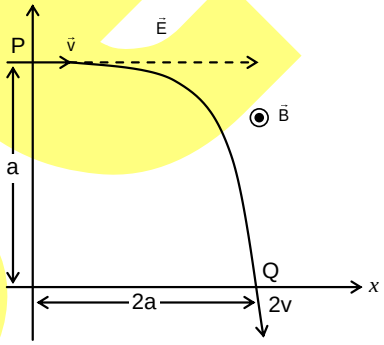
(A) $E = 0, B = 0$ (B) $E = 0, B \neq 0$ (C) $E \neq 0, B = 0$ (D) $E \neq 0, B \neq 0$

9. A particle mass m charge q is moving on a circular path on the surface of a frictionless table with speed v_o where a magnetic field B_o exists uniformly over the whole region. It is attached by a string which passes through a hole in the table to a spring as shown. The spring is stretched by x_o. If now the magnetic field is increased slowly to $2B_o$,



(A) The extension in the spring will increase
(B) The speed of the particle will increase
(C) The speed of the particle will decrease
(D) The kinetic energy of the particle will decrease

10. A particle of charge +q and mass m moving under the influence of a uniform electric field $E\hat{i}$ and uniform magnetic field $B\hat{k}$ follows a trajectory from P to Q as shown in figure. The velocities at P and Q are $v\hat{i}$ and $-2v\hat{j}$ which of the following statements(s) is/are correct?



(A) $E = \frac{3}{4}\left[\frac{mv^2}{qa}\right]$.

(B) Rate of work done by the electric field at P is $\frac{3}{4}\left[\frac{mv^3}{a}\right]$.

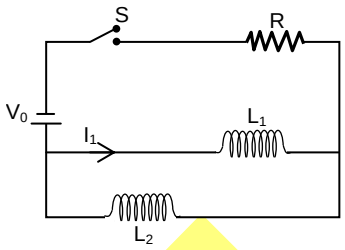
(C) Rate of work done by the electric field at P is zero.
(D) Rate of work done by both the fields at Q is zero.

11. H^+, He^+ and O^{++} ions having same kinetic energy pass through a region of space filled with uniform magnetic field B directed perpendicular to the velocity of ions. The masses of the ions H^+, He^+ and O^{++} are respectively in the ratio 1 : 4 : 16. As a result

(A) H^+ ions will be deflected most
(B) only O^{++} ions will be deflected least
(C) He^+ and O^{++} ions will suffer same deflection
(D) All ions will suffer the same deflection

Space For Rough Work

12. As situation shown in figure. The switch S is closed at t = 0. Then, after long time.



(A) Effective resistance of each inductor is zero

(B) Total current through cell is V_o/ R

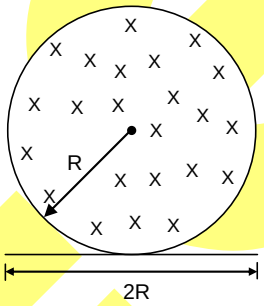
(C) The current through L_1 is $\frac{V_0 L_2}{R(L_1 + L_2)}$

(D) None of these

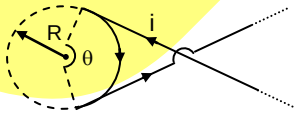
PART – B

(Numerical Type)

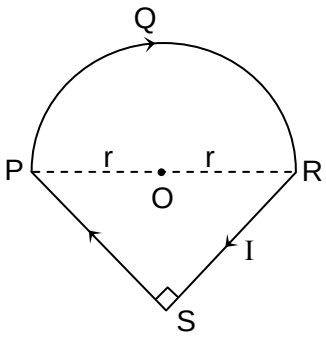
1. A uniform but time varying magnetic field is present in a circular region of radius R = 4 m. The magnetic field is perpendicular and into the plane of the paper and the magnitude of the field is increasing at a constant rate $\alpha = \frac{1}{\pi}$ T sec^{-1}. There is a straight conducing rod of length 2R placed as shown in the figure. Find the magnitude of induced emf (in volt) across the rod.



2. A wire carrying current i has the configuration shown in figure. Two semi-infinite straight section, each tangent to the same circle, are connected by a circular arc, of angle θ, along the circumference of the circle, with all sections lying in the same plane. What must θ (in rad) be in order for B to be zero at the centre of circle?

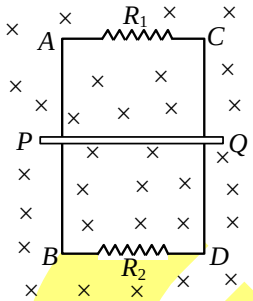


3. A steady current I = 10 A goes through a wire loop PQRS. Part PQR is semi-circle of radius r = 1 m. RS = SP and ∠RSP = 90°. Find the magnetic field at O in 10^{-6}T to the nearest integer.

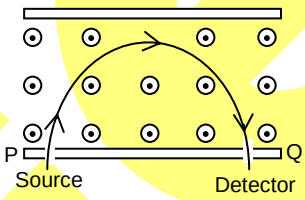


Space For Rough Work

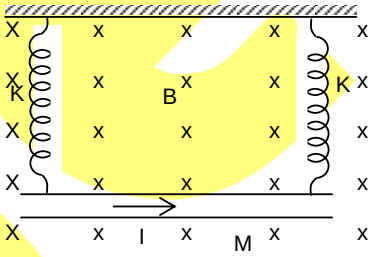
4. Two parallel vertical metallic rails AB and CD are separated by 1 m. They are connected at the two ends by resistances R_1 and R_2 as shown. A horizontal metallic bar PQ of mass 0.2 kg slides without friction, vertically down the rails under the action of gravity. There is uniform horizontal magnetic field of 0.6 T perpendicular to plane of the rails. It is observed that when the terminal velocity attained, the power dissipated in R_1 and R_2 are 0.76 W and 1.2 W respectively. Find the terminal velocity of bar in m/s. ($g = 9.8\ m/s^2$)



5. A uniform magnetic field with a slit system as shown in the figure is to be used as a momentum filter for high energy charged particles (enter and exit perpendicular to PQ) . With a field of 1T, it is found that the filter transmits α particle each of energy 2.2 MeV. The magnetic field is increased to 2.13T and deuteron ions are passed into the filter. What is the approximate energy (In MeV) of each deuteron ions transmitted by the filter?



6. A metal rod of mass 10gm and length 25 cm is suspended on two springs as shown in figure. The springs are extended by 4 cm. When a 20 ampere current passes through the rod it rises by 1 cm. The magnetic field is $x \times 10^{-2}$ T ($g = 10\ m/s^2$). Find the value of 2x.



Space For Rough Work

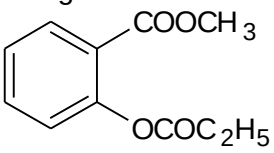
SECTION – 2: CHEMISTRY

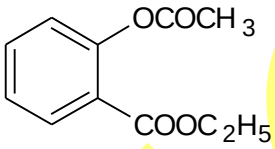
PART – A

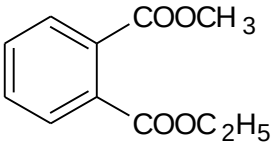
(Single Correct Choice Type)

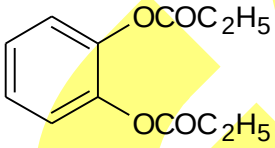
This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. Which of the following, upon hydrolysis produces a product that forms cyclic anhydride upon heating?

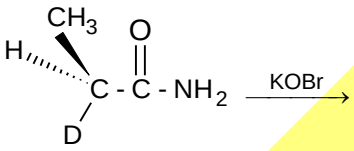
(A) 

(B) 

(C) 

(D) 

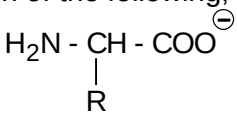
2. The structure of an amine(X) is
$CH_3CH_2CH_2CH_2NH_2$
Which isomer of (X) is more basic as well as less soluble in water than it?
(A) Chain isomer (B) Position isomer
(C) Functional isomer (D) Optical isomer

3. 

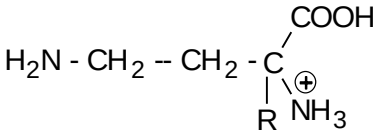
What is the configuration of chiral C in the final product?
(A) R (B) S
(C) Both (D) can't defined

Space For Rough Work

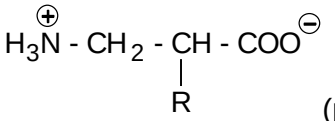
4. Which of the following, form of amino acid is correct at pH = 5?

(A) 

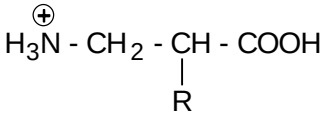
(pH at isoelectric point = 6.2)

(B) 

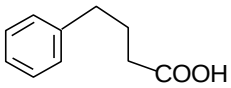
(pH at isoelectric point = 4.6)

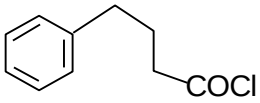
(C) 

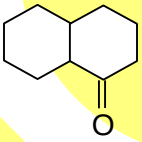
(pH at isoelectric point = 6)

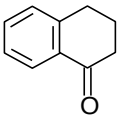
(D) 

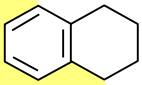
(pH at isoelectric point = 7.1)

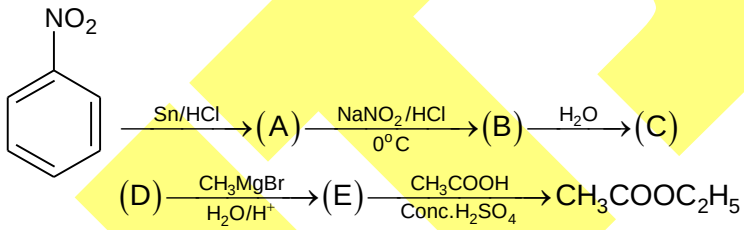
5.  on reaction with $SOCl_2$ and then $AlCl_3$ forms

(A) 

(B) 

(C) 

(D) 

6. 

Which of the following two compounds are monomers of a polymer?

(A) C and D (B) A and B

(C) E and C (D) B and C

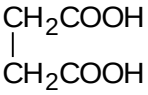
Space For Rough Work

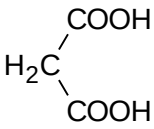
(Multi Correct Choice Type)

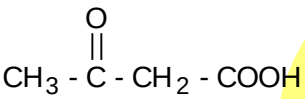
This section contains 6 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

7. Which of the following produce(s) CO_2 gas upon heating?

(A) 

(B) 

(C) 

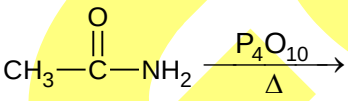
(D) 

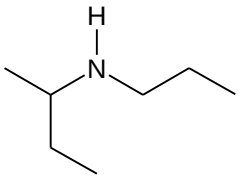
8. CH_3CN can be prepared by the reaction of

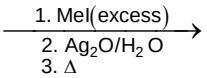
(A) $CH_3Br \xrightarrow[DMF]{KCN}$

(B) $CH_3NH_2 + CHCl_3 \xrightarrow{KOH}$

(C) $CH_3 - CH = NOH \xrightarrow[\Delta]{P_2O_5}$

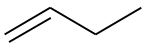
(D) 

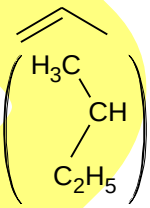
9. 



Products

The product(s) of above reaction is/are

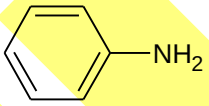
(A) 

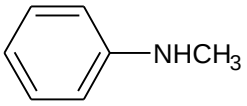
(B) 

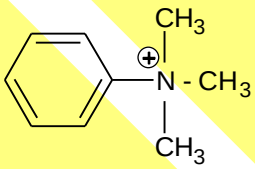
(C) $(C_3H_7)N(Me)_2$

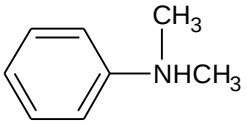
(D)

10. In which of the following N, N diazo coupling can take place

(A) 

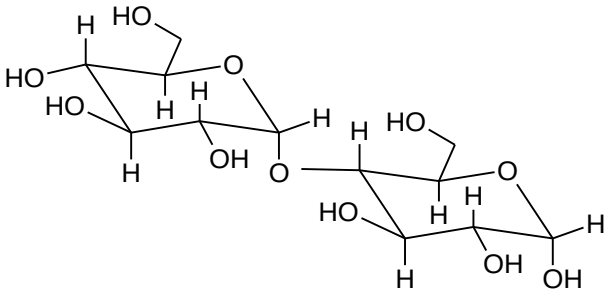
(B) 

(C) 

(D) 

Space For Rough Work

11. Which of the following bond(s) is/are found in the repeating unit of polymer Nylon 6, 6?
(A) C – N
(B) N – H
(C) N – H
(D) O – H

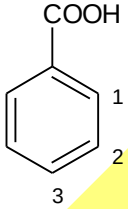
12. 

Which of the following statement/s is/are correctly stated about the given compound?
(A) Glycosidic linkage is 'β'
(B) reducing disacciride
(C) Compound can undergo mutarotation
(D) compound can exist in two anomeric forms in solution

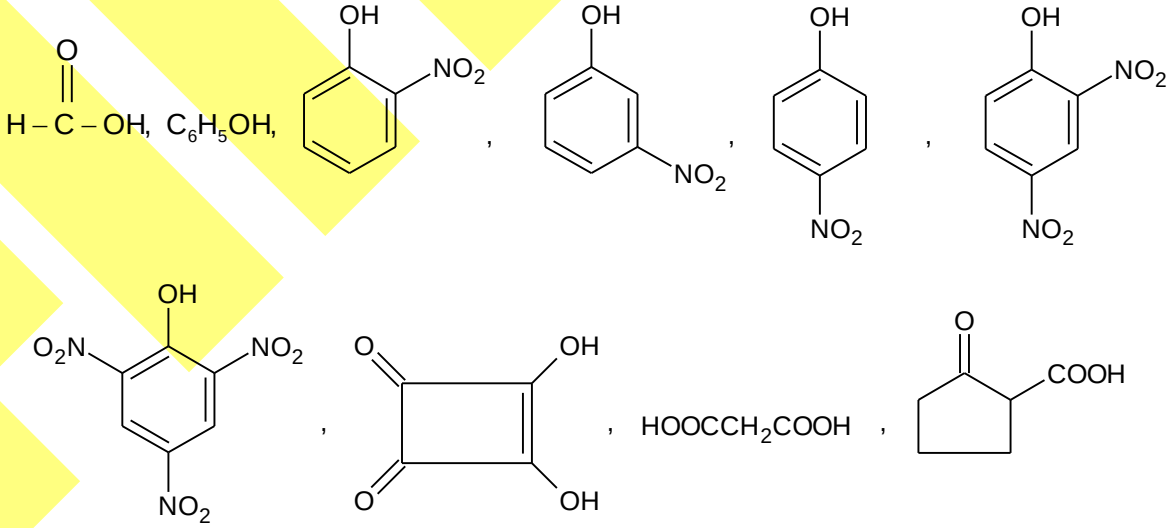
PART – B
(Numerical Type)

1. How many of the given amino acid can yield N_2 gas on treatment with HNO_2.
Lysine, Valine, Tyrosine, Proline, Leucine, Tryptophane, Phenylalanine, Serine, Aspartic acid

2. Determine (a + b), where a is the position of OH group in the isomer which is most acidic and b is the position of OH group in the isomer which has maximum boiling point.



3. Total how many compounds can release CO_2 on treating with $NaHCO_3$ solution.



Space For Rough Work

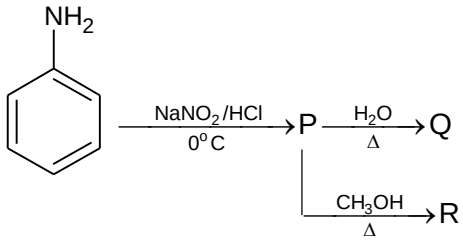
4. $HOOC-(CH_2)_5-COOH \xrightarrow{Heat} P + Q + R$

The products constitute organic as well as inorganic compound(consider all possible products)

Order of molar mass: P > Q > R

$Q + CH_3MgBr \xrightarrow{H_3O^+} (S) + Mg(OH)Br$

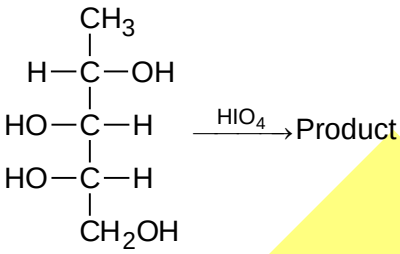
If the molar mass of (S) is X, what is the value of $\frac{X}{8}$?

5. 

x = number of hydrogen atoms present in Q and if

y = number of hydrogen atoms present in R

What is the value of $\frac{x-y}{4}$?

6. 

If the molar mass of the simplest organic product of above reaction is X g mol^{-1}, what is the value of $\frac{X}{8}$?

Space For Rough Work

SECTION – 3: MATHEMATICS

PART – A

(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.**

1. $I=\int_0^{\ell n2}\left\{\frac{1}{e^x-1}\right\}dx=$

(where $\{.\}$ denotes the fractional function)

(A) $1-\ell n2$ (B) $1+\ell n2$

(C) $\ell n2$ (D) $e+\ell n2$

2. $\int\frac{\sin^2 x}{\sin x+2\cos x}dx=$

(A) $-\frac{1}{5}\cos x-\frac{2}{5}\sin x+\frac{4}{5}\ell n\left|\tan^2\frac{x}{2}+\tan\frac{x}{2}+1\right|+c$

(B) $-\frac{2}{5}\cos x+\frac{1}{5}\sin x-\frac{4}{5}\ell n\left|\tan^2\frac{x}{2}-\tan\frac{x}{2}-1\right|+c$

(C) $-\frac{1}{5}\cos x-\frac{2}{5}\sin x-\frac{4}{5}\ell n\left|\tan^2\frac{x}{2}-\tan\frac{x}{2}-1\right|+c$

(D) $-\frac{1}{5}\cos x+\frac{2}{5}\sin x-\frac{4}{5}\ell n\left|\tan^2\frac{x}{2}-\tan\frac{x}{2}-1\right|+c$

3. $\lim_{n\to\infty}\int_{-1}^{1}|x|\left(1+x+\frac{x^2}{2}+\frac{x^3}{3}+....+\frac{x^{2n}}{2n}\right)dx=$

(A) 1 (B) $\frac{3}{2}$

(C) $\frac{1}{2}$ (D) $\frac{1}{3}$

4. Let $f:R\to R$ be twice differentiable function such that $f''(x)>0\,\forall\,x\in R$ and suppose $f(0)=1, f(1)=4$. Which of the following is not a possible value of $f(2)$

(A) 7 (B) 8

(C) 9 (D) 10

Space For Rough Work

5. Let $f:[0, 4] \to R$ be a continuous function such that $|f(x)| \le 2$ for all $x \in [0, 4]$ and $\int_0^4 f(t)dt = 2$. Then for all $x \in [0, 4]$ the value of $\int_0^x f(t)dt$ lies on the interval

(A) $[-6+2x, 10-2x]$ (B) $[-12+2x, -7+2x]$

(C) $[11-2x, 17+2x]$ (D) $[-8-2x, 6-2x]$

6. $$\int_{\frac{25\pi}{4}}^{\frac{53\pi}{4}} \frac{1}{\left(1+2^{\cos x}\right)\left(1+2^{\sin x}\right)}dx =$$

(A) $\frac{\pi}{4}$ (B) $\frac{3\pi}{4}$

(C) $\frac{5\pi}{4}$ (D) $\frac{7\pi}{4}$

(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.

7. Let f be differentiable function on $[a, b]$ such that $f(a) = a$ and $f(b) = b$, then

(A) $f(c) = \frac{1}{b-a}\int_a^b f(x)dx$ for some $c \in (a, b)$

(B) $f'(c) = 1$ for some $c \in (a, b)$

(C) $f'(c_1) + f'(c_2) = 2$ for some distinct c_1, c_2 in (a, b)

(D) $\frac{1}{f'(c_1)} + \frac{1}{f'(c_2)} = 2$ for some distinct c_1, c_2 in (a, b)

8. For every twice differentiable function $f:R \to [-2, 2]$ with $(f(0))^2 + (f'(0))^2 = 85$

Which of the following statement(s) is/are true?

(A) There exist $r, s \in R$ where $r < s$, such that f is one – one on the open interval (r, s)

(B) There exists $x_0 \in (-4, 0)$ such that $|f'(x_0)| \le 1$

(C) $\lim_{x\to\infty} f(x) = 1$

(D) There exist $\alpha \in (-4, 4)$ such that $f(\alpha) + f''(\alpha) = 0$ and $f'(\alpha) \ne 0$

Space For Rough Work

9. Let $f(x)=e^{-x^2}$, then which of the following is true

(A) $\int_0^1 f(x)dx \le \frac{1}{\sqrt{2}}+\frac{1}{\sqrt{e}}\left(1-\frac{1}{\sqrt{2}}\right)$

(B) $\int_0^1 f(x)dx \le 1-\frac{1}{e}$

(C) $\int_1^2 f(x)dx \ge \frac{1}{4}\left(e^{-1}+e^{-4}\right)$

(D) $\int_1^2 f(x)dx \le \frac{1}{2}\left(e^{-1}+e^{-4}\right)$

10. $\int \frac{x^2+20}{(x\sin x+5\cos x)^2}dx =$

(A) $\cot\left(x-\tan^{-1}\frac{5}{x}\right)+c$

(B) $-\cot\left(x+\tan^{-1}\frac{5}{x}\right)+c$

(C) $\frac{5\sin x-x\cos x+c}{x\sin x+5\cos x}$

(D) $\frac{x\cos x+5\sin x}{x\sin x+5\cos x}+c$

11. Let $f(x)$ be a polynomial of degree 4 with two inflection points. A line is drawn through two inflection points and three bounded regions are generated. Then

(A) Two of these regions have equal areas

(B) Area of one of the regions is equal to the sum of the other two

(C) Area of one of the regions is double the sum of area of the other two

(D) Area of one of the regions is square of the sum of the areas of the other two

12. Let $(-c, c)$ be the largest open interval in $R(c>0)$ on which the solution of the differential equation $\frac{dy}{dx}=x^2+y^2+1$ with the initial condition $y(0)=0$ exists and is unique. Then which of the following is/are true

(A) $y(x)$ is an odd function on (–c, c)

(B) $y(x)$ is an even function on (–c, c)

(C) $(y(x))^2$ has a local minimum at $x=0$

(D) $(y(x))^2$ has a local maximum at $x=0$

Space For Rough Work

PART – B
(Numerical Type)

1. Let $a<b<c$ be real numbers such that $a+b+c=6$ and $ab+bc+ca=9$. The number of integral values that $a^3+b^3+c^3$ may take is _____

2. Let $f:R\to R$ be three times differentiable function such that f has at least five real distinct zeros. Then the minimum number of distinct real zeros of the equation $f+6f'+12f''+8f'''=0$ is _____

3. f is differentiable function in $[0,1]$ such that $f(f(x))=x$ and $f(0)=1$. Then

   $2025\int_0^1 (x-f(x))^{2024}\,dx =$ _____

4. Given $y=f(x)$ be differentiable function on

   $[4,8], f(x)\neq 0\ \forall x\in[4,8], \int_4^8 \frac{(f'(x))^2}{(f(x))^4}dx=1$, $f(4)=\frac{1}{4}$, $f(8)=\frac{1}{2}$. Then $3f(6)=$ _____

5. $\int_0^4 \frac{\ell n\,x}{\sqrt{4x-x^2}}dx =$

6. The value of 'a' for which $f(x)=x^3+x^2+a\cos x$ is injective is

Space For Rough Work

RIT – VIII

QP Code: 100868

ANSWERS

SECTION-1 : PHYSICS

PART – A

1.	A	2.	A	3.	D	4.	A
5.	A	6.	C	7.	ABC	8.	ABD
9.	ACD	10.	ABD	11.	AC	12.	ABC

PART – B

1.	4	2.	2	3.	7	4.	1
5.	5	6.	1				

SECTION – 2 : CHEMISTRY

PART – A

1.	C	2.	C	3.	B	4.	D
5.	C	6.	A	7.	ACD	8.	ACD
9.	ABCD	10.	AB	11.	AC	12.	BCD

PART – B

1.	8	2.	4	3.	6
4.	7.5 (range 7.2 to 7.6)			5.	3.5
6.	3.75 (range 3.6 to 3.8)				

SECTION – 3 : MATHEMATICS

PART – A

1.	A	2.	C	3.	B	4.	A
5.	A	6.	D	7.	ABCD	8.	ABD
9.	ABCD	10.	BC	11.	AB	12.	AC

PART – B

1.	11	2.	2	3.	1	4.	1
5.	0	6.	2				