VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Advanced - 1 | Paper – 2 | JEE 2024

Date : 29/10/2023 **Maximum Marks: 180**

Timing: 2:00 PM to 5:00 PM **Duration: 3.0 Hours**

General Instructions

1. The question paper consists of 3 Subject (Subject I: **Physics**, Subject II: **Chemistry**, Subject III: **Mathematics**). Each Part has **four** sections (Section 1, Section 2, Section 3 and Section 4).
2. **Section 1** contains **4 Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

   Section 2 contains **3 Multiple Correct Answers Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

   Section 3 contains **2** Paragraphs. Based on each paragraph, there are **TWO (02)** 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

   Section 4 contains **6 Non-Negative Integer Type Questions**. The answer to each question is a **NON-NEGATIVE INTEGER.**
3. For answering a question, an ANSWER SHEET (OMR SHEET) is provided separately. Please fill your **Test Code, Roll No.** and **Group** properly in the space given in the ANSWER SHEET.

Syllabus:

Physics: Electrostatics, DC Circuits, Capacitors, Magnetic Effect of Current, EMI, AC Circuits, EM Waves

Chemistry: Solid State, Theory of Solution, Chemical Kinetics, Electrochemistry, Surface Chemistry, Organic Halides, Organic Concepts, OCOC-I, II & III

Mathematics : Functions, Inverse Trigonometry, DC - I & II, IC - I & II, Statistics

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

Candidate's Signature : _____ Invigilator's Signature _____

MARKING SCHEME

SECTION – 1 | (Maximum Marks: 12)

- This section contains **Four (04)** Multiple Choice Questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme.

Full Marks : +3 If ONLY the correct option is chosen.
Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered).
Negative Marks : −1 In all other cases.

SECTION – 2 | (Maximum Marks: 12)

- This section consists of **Three (03)** Questions. Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks: +4 If only (all) the correct option(s) is(are) chosen
Partial Marks: +3 If all the four options are correct but ONLY three options are chosen
Partial Marks: +2 If three or more options are correct but ONLY two options are chosen and both of which are correct
Partial Marks: +1 If two or more options are correct but ONLY one option is chosen, and it is a correct option
Zero Mark: 0 if none of the options is chosen (i.e. the question is unanswered)
Negative Marks: –2 In all other cases.

SECTION – 3 | (Maximum Marks: 12)

- This section contains **Two (02)** Paragraphs. Based on each paragraph, there are **TWO (02)** 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.
- Answer to each question will be evaluated according to the following marking scheme.

Full Marks : +3 If ONLY the correct numerical value is entered in the designated place.
Zero Marks : 0 In all other cases

SECTION – 4 | (Maximum Marks: 24)

- This section contains **SIX (06)** Questions.
- The answer to each question is a **NON-NEGATIVE INTEGER**
- Answer to each question will be evaluated according to the following marking scheme.

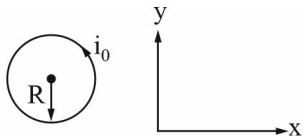
Full Marks : +4 If ONLY the correct integer is entered;
Zero Marks : 0 In all other cases.

SUBJECT I : PHYSICS 60 MARKS

SECTION-1

This section consists of 4 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

1. A small current carrying ring having current i_0 and radius R is kept in *x-y* plane (the plane of paper) as shown in figure. Another current carrying small ring having radius $r\,(r << R)$ is kept at a large distance *d* from the centre of first ring in *yz* plane such that the centres of both rings lie on the z-axis and current in second ring is in anticlockwise direction as seen from +ve *x*. Find the torque acting on second ring due to the magnetic field of first ring.



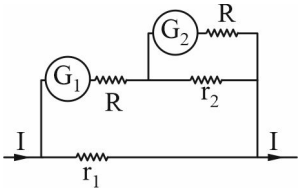
(A) Zero

(B) $\frac{\mu_0}{4}\frac{\pi i i_0 R^2 \cdot r^2}{d^3}(-\hat{j})$

(C) $\frac{\mu_0}{2}\frac{\pi i_0 i R^2 \cdot r^2}{d^3}(-\hat{j})$

(D) $\frac{\mu_0}{2}\frac{i_0 i R^2 \cdot r^2}{d^3}(\hat{j})$

2. The diagram shows two galvanometers G_1 and G_2. When curent $I = 1\,A$, both G_1 and G_2 show full scale deflection. It is given that G_1 shows full scale deflection for 10 mA and G_2 shows full scale deflection for 1 mA. The values of r_1 and r_2 are : (G_1 and G_2 are of negligible resistances)



(A) $r_1 = \frac{R}{9}$ and $r_2 = \frac{R}{90}$

(B) $r_1 = \frac{R}{90}$ and $r_2 = \frac{R}{9}$

(C) $r_1 = \frac{2R}{9}$ and $r_2 = \frac{2R}{90}$

(D) $r_1 = \frac{4R}{9}$ and $r_2 = \frac{4R}{90}$

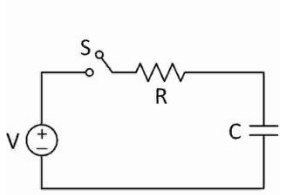
SPACE FOR ROUGH WORK

3. The intensity of an electric field depends on the co-ordinates x, y and z as follows $\vec{E}=\frac{a(x\hat{i}+y\hat{j}+zk)}{(x^2+y^2+z^2)^{3/2}}$.

The electrostatic energy stored between two imaginary concentric spherical shells of radii R and $2R$ with centre at origin is:

(A) $\frac{4\pi\varepsilon_0 a^2}{R}$ **(B)** $\frac{2\pi\varepsilon_0 a^2}{R}$ **(C)** $\frac{\pi\varepsilon_0 a^2}{R}$ **(D)** $\frac{\pi\varepsilon_0 a^2}{2R}$

4. Consider a simple RC circuit as shown in Figure. The voltage is first set to $\frac{V_0}{3}$ and maintained for a charging time T >> RC. Then the voltage is raised to $\frac{2V_0}{3}$ without discharging the capacitor and again maintained for a time T >> RC. The process is repeated one more time by raising the voltage to V_0.



Total energy dissipated across the resistance E_D in the process is :

(A) $E_D = 3\left(\frac{1}{2}CV_0^2\right)$ **(B)** $E_D = \frac{1}{2}CV_0^2$

(C) $E_D = 3CV_0^2$ **(D)** $E_D = \frac{1}{3}\left(\frac{1}{2}CV_0^2\right)$

SPACE FOR ROUGH WORK

SECTION-2

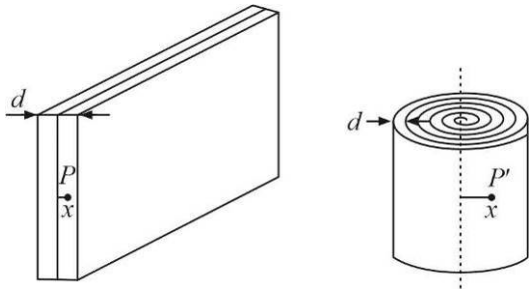
This section consists of 3 Multiple Correct Answers Type Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

5. For plane electromagnetic waves propagating in the +z-direction, which of the following combination(s) give the correct possible direction for $\vec{E}$ and $\vec{B}$ field, respectively?

(A) $(i+2\hat{j})$ and $(2\hat{i}-\hat{j})$ **(B)** $(-2\hat{i}-3\hat{j})$ and $(3\hat{i}-2\hat{j})$

(C) $(2\hat{i}+3\hat{j})$ and $(\hat{i}+2\hat{j})$ **(D)** $(\hat{j})$ and $(-\hat{i})$

6. A non-conducting sheet of thickness d and large surface area contains a uniformly distributed charge of density ρ thorough out its volume. The electric field at a point P inside the sheet at a distance 'x' from the central plane is E_1. Now the sheet is rolled to form a large solid cylinder. Field at point P inside the cylinder at a distance 'x' from the axis is E_2. Then:



(A) $E_1 = \dfrac{\rho x}{\varepsilon_0}$ **(B)** $E_2 = \dfrac{\rho x}{2\varepsilon_0}$ **(C)** $E_1 = \dfrac{\rho}{2\varepsilon_0}$ **(D)** $E_1/E_2 = 1$

7. The current density in a wire of radius 'a' varies with radial distance 'r' as $J = kr^2$, where k is a constant. Choose the correct statements.

(A) Total current passing through the cross section of the wire is $I = \dfrac{\pi k a^4}{2}$

(B) Total current passing through the cross section of the wire is $I = \dfrac{3\pi k a^3}{2}$

(C) The magnetic field at a radial distance $r > a$ is $B = \dfrac{\mu_0 k a^4}{4r}$

(D) The magnetic field at a radial distance $r < a$ is $B = \dfrac{\mu_0 k r^3}{4}$

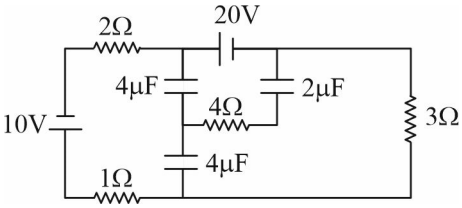
SPACE FOR ROUGH WORK

SECTION-3

This section consists of 2 Paragraphs. Based on each paragraph, there are **TWO (02)** 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

Paragraph for Questions 1 - 2

The circuit shown in figure is in steady state. All the cells in the given circuit are ideal. Answer the following two questions:



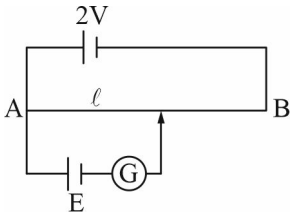
1. Charge on $2\mu F$ capacitor is_____ μC.

2. Ratio of energy stored in the two $4\mu F$ capacitors is _____. (Give the ratio which is greater than one)

SPACE FOR ROUGH WORK

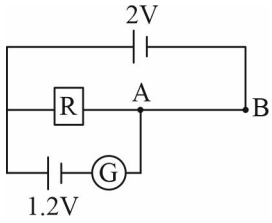
Paragraph for Questions 3 - 4

Potentiometer is an instrument that can be used to measure the emf of a source without drawing any curent from the source. As shwon in the figure, the potentiometer wire AB of length $10m$ and resistance 20Ω is connected to a battery of emf 2.0 V. Then, the emf of projected cell $E = K\ell$, where K is voltage drop per meter of potentiometner wire AB and ℓ is the balancing length, when G the galvanometer shows null deflection [Battery is of negligible internal resistance].



3. A cell of emf 1.2 V gives null deflection at certain length *x m* of potentiometer wire and for another cell of emf E, the balancing length is found to be $(x+0.6)m$. The emf of second cell then is_____V.

4. Now a resistance box is introduced in the circuit as shown. The resistance in the box R is adjusted to get null deflection in the galvanometer so that the potential difference per metre of the potentiometer wire AB is $1mV$. The resistance R is _____$k\Omega$.



SPACE FOR ROUGH WORK

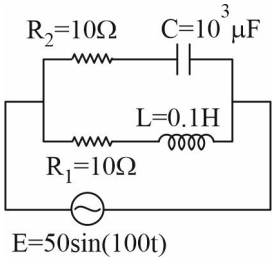
SECTION-4

This section consists of 6 NON-NEGATIVE INTEGER Type Questions. The answer to each question is a **NON-NEGATIVE INTEGER.**

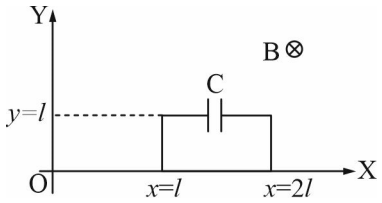
5. A charged particle is projected in magnetic field $\vec{B} = 10\hat{k}$ from origin in $x - y$ plane. The particle moves in a circle and just touches the line $y = 5\ m$ at $x = 5\ \sqrt{3}\ m$. Find the speed of particle (in m/s) given that its mass $= 5\times10^{-5}\,kg$ and charge $= 1\mu C$.

6. A plane electromagnetic wave, $E = 100\cos(6\times10^{8}t + 4x)V/m$, is propagating in a medium. The dielectric constant of the medium is _____.

7. For the circuit shown in the figure, find the peak current (in ampere) through the source.



8. A square frame of wire connected to a capacitor is kept in a magnetic field which varies with position as well as time and is given as $\vec{B} = \alpha xt(-\hat{k})$ as shown in figure, where α is a constant. The charge on the capacitor at any time is $\frac{n}{2}C\alpha l^3$. Find n.



SPACE FOR ROUGH WORK

9. A region in space contains a total positive chage Q that is distributed spherically such that the charge density is given by

$$\rho(r) = \rho_0 \text{ for } r \le \frac{R}{2}$$

$$= 2\rho_0\left(1-\frac{r}{R}\right) \text{ for } \frac{R}{2} \le r \le R$$

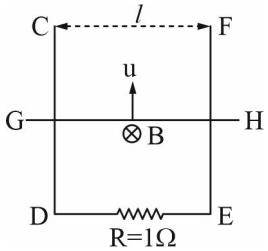
$$= 0 \text{ for } r \ge R$$

It is found that an electron executes simple harmonic motion about the center r = 0 of the distribution with time period $T = KR^{x/2}$, if and only if the amplitude is less than $R/2$.

Find the value of x. $\left[K^2 = \left(\frac{15\pi\varepsilon_0 m}{8eQ}\right)\right]$

10. In the figure, CDEF is a fixed conducting smooth frame in a vertical plane. A conducting uniform rod GH of mass $m = 3kg$ can move vertically and smoothly without losing contact with the frame. GH always remains horizontal. It is given velocity $u = 30ms^{-1}$ upwards and released. Taking the acceleration due to gravity as g and assuming that no resistance is present other than $R = 1\Omega$, find out time (in S) taken by rod to reach the highest point. Round-off your answwer to nearest integer.

(Given $B = 1T, g = 10\,m/s^2, l = 1m, \ln(2) = 0.7$)

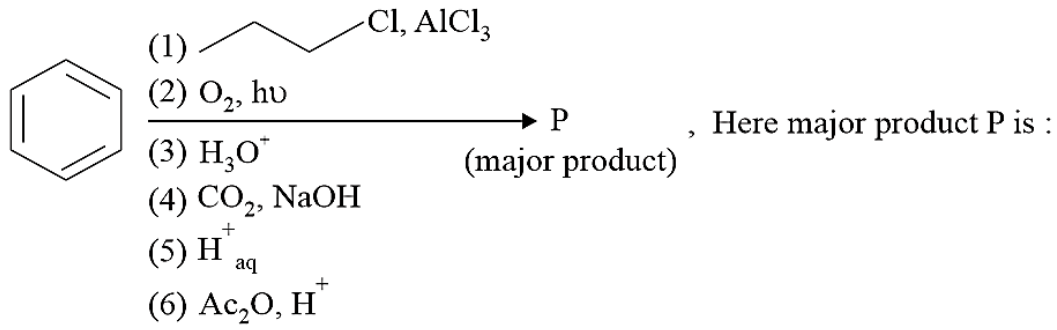


SPACE FOR ROUGH WORK

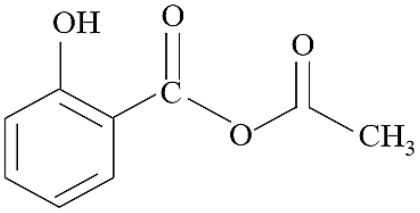
SUBJECT II : CHEMISTRY 60 MARKS

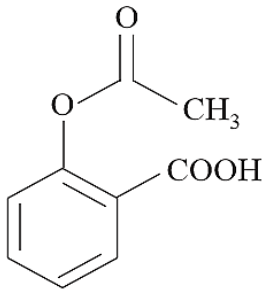
SECTION-1

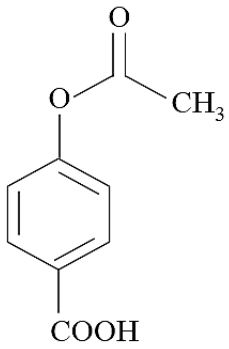
This section consists of 4 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

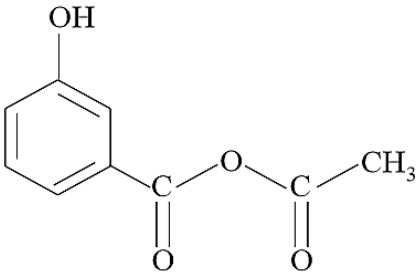
1. 

, Here major product P is :

(A) 

(B) 

(C) 

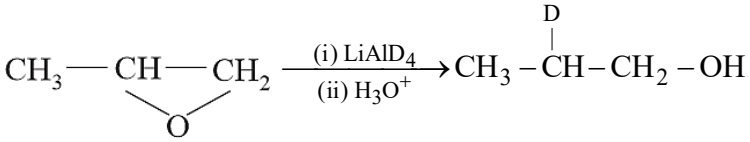
(D) 

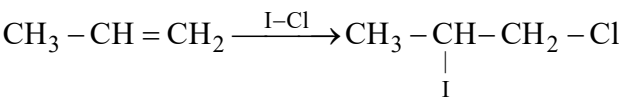
SPACE FOR ROUGH WORK

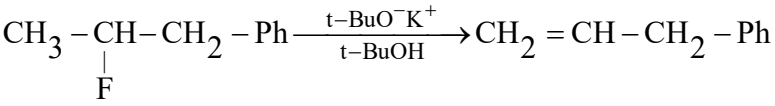
2. A closed vessel with rigid walls contains 1 mol of $^{238}_{92}U$ and 2 mol of air at 298 K. Considering complete decay of $^{238}_{92}U$ to $^{206}_{82}Pb$, the ratio of the final pressure to the initial pressure of the system at 298 K is _____ .

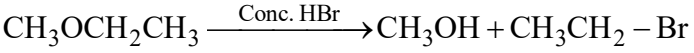
(A) 10 **(B)** 8 **(C)** 5 **(D)** 7

3. Identify the correct chemical transformation into major organic product/s.

(A) 

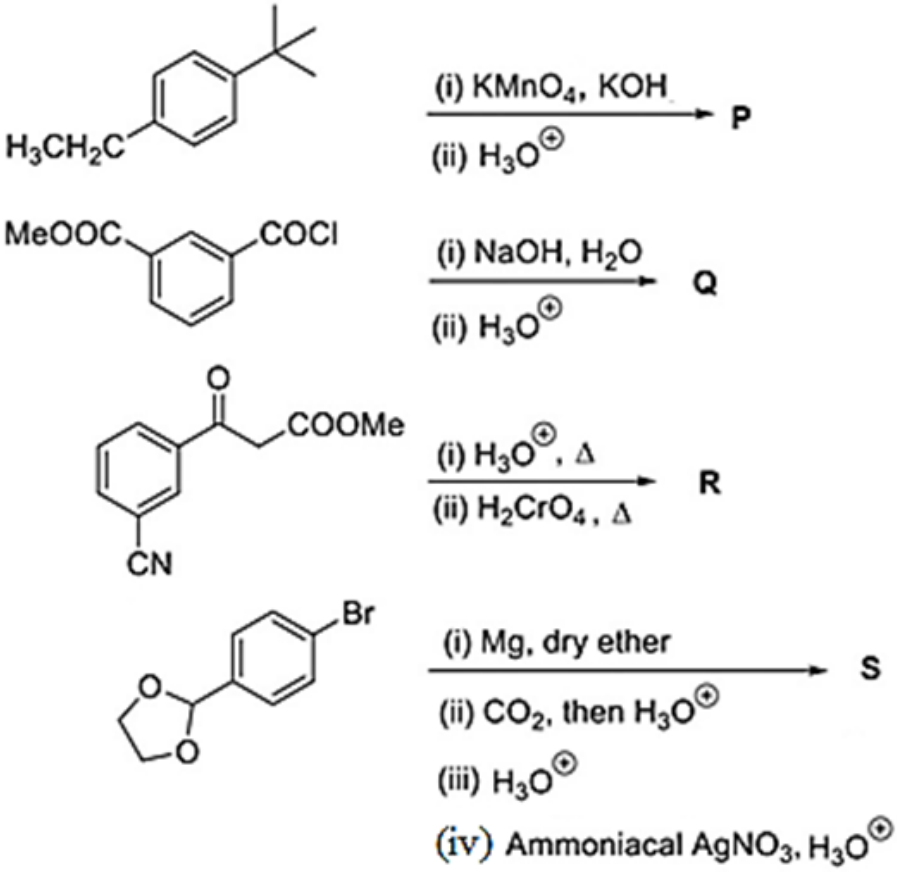
(B) 

(C) 

(D) 

SPACE FOR ROUGH WORK

4. Out of given four organic products P, Q, R and S which one is a compound of molecular formula $C_8H_6O_4$?



(A) Q, R and S **(B)** P and R **(C)** P only **(D)** R and S

SPACE FOR ROUGH WORK

SECTION-2

This section consists of 3 Multiple Correct Answers Type Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

5. Select correct statements for electrochemical cells:

(A) Such cells can be electrolytic or galvanic in nature

(B) For spontaneous cell reactions ΔG° must be negative

(C) Flow of current is always from cathode to anode via external circuit

(D) $E^\circ_{AgBr/Ag,Br^-_{aq.}}$ is exactly equal to $E^\circ_{Ag^+/Ag_{(s)}}$

6. For a chemical reaction (I) $2R_{(g)} \rightleftharpoons P_{(g)}$ the net rate of formation of $P_{(g)}$ is given as:

$$\frac{d[P]}{dt} = 2\times10^3[R] - 5\times10^3[P].$$

For another chemical reaction (II) $2X_{(g)} \rightleftharpoons 3Y_{(g)}$ the net rate of formation of $Y_{(g)}$ is given as

$$\frac{d[Y]}{dt} = 6\times10^2[X]^2 - 4.5\times10^3[Y].$$

[Given that Arrhenius factors of all the gaseous reaction are equal]

Select correct statements

(A) The ratio of forward rate constant i.e. $k_{f(I)} / k_{f(II)}$ is $10/3$.

(B) The ratio of backward rate constant i.e. $k_{b(I)} / k_{b(II)}$ is $10/3$.

(C) Both gaseous reaction i.e. I and II are exothermic.

(D) Both gaseous reactions i.e. I and II are endothermic.

7. Select correct statements:

(A) For a given non volatile, non-electrolyte solute boiling point and freezing point of the ideal solution shows a linear variation with molality

(B) Addition of catalytic amount of H^+ ions to an aqueous solution of sucrose shows a significant drop in freezing point of the solution

(C) For an ideal solution of ethanol and n-propyl alcohol, $\underset{mix}{\Delta H}$ is significantly negative.

(D) Henry's law is NOT applicable for a gas at $P_{gas} = 1$ atm, if at the given temperature

Henry's constant K_H of the gas is 500 torr

SPACE FOR ROUGH WORK

SECTION-3

This section consists of 2 Paragraphs. Based on each paragraph, there are **TWO (02)** 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

Paragraph for Questions 1 - 2

Consider the given reaction mechanism for reaction between $H_{2(g)}$ and $Br_{2(g)}$ to form $HBr_{(g)}$.

Step 1 : $Br_2 \rightleftharpoons 2B\dot{r}$ $E_f = 20.52\ KJ/mole$, $E_b = 30.81\ KJ/mole$

Step 2 : $\dot{B}r + H_2 \rightleftharpoons HBr + H^{\bullet}$ $E_f = 56.30\ KJ/mole$, $E_b = 15\ KJ/mole$

Step 3 : $H^{\bullet} + Br^{\bullet} \longrightarrow HBr$ $E_f = 0.15\ KJ/mole$

1. Based upon above mechanism the value of overall activation energy E_A for the reaction $H_{2(g)} + Br_{2(g)} \longrightarrow 2HBr$ is _____ . (in KJ/mole)

2. If concentration of both $H_{2(g)}$ and $Br_{2(g)}$ become four times of the original then ratio of new rate of the reaction and original rate of the reaction will be _____ .

SPACE FOR ROUGH WORK

Paragraph for Questions 3 - 4

Ti_xO is a non stoichiometric compound formed due to metal deficiency defects in TiO. The metal can exist in two states, Ti^{2+} and Ti^{3+} to maintain electrical neutrality.

3. In $Ti_{0.96}O$ percentage of the metal existing in +3 state is _____ .

4. If X-ray diffraction density of $Ti_xO(x<1)$ is 5.35 g/cc while its pyknometer density is 5.20 g/cc then mass(g) of 1.2 mole sample of the Ti_xO is _____ .
[Atomic masses : Ti = 45, O = 16]

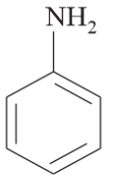
SPACE FOR ROUGH WORK

SECTION-4

This section consists of 6 NON-NEGATIVE INTEGER Type Questions. The answer to each question is a **NON-NEGATIVE INTEGER.**

5. $Ph-CH_2-\underset{\underset{O}{\|}}{C}-Ph \xrightarrow{\text{Conc. } H_2SO_4}$ major organic product P.

Maximum number of atoms in a plane for a molecule of product P would be _____.

6. 

(10 moles)

$\xrightarrow[0°C]{NaNO_2+HCl}$ A $\xrightarrow{\text{Ethanol}}$ B $\xrightarrow[(1\text{ equivalent})]{Cl_2/FeCl_3}$ C $\xrightarrow[(\text{in dry ether})]{Na}$ D

(100% yield) (50% yield) (80% yield) (50% yield)

Moles of organic product D produced in above reaction sequence is _____ .

SPACE FOR ROUGH WORK

7. As per the given mechanism the rate law for the reaction between $H-\underset{\underset{O}{\|}}{C}-H$ and nearly 100% KOH is rate $r = k[HCHO]^x\left[OH^-\right]^y$. Value of x + y is _____.

Mechanism:

$$1^{st}\text{ step}: H-\underset{\underset{O}{\|}}{C}-H + OH^- \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} H-\underset{\underset{O^-}{|}}{\overset{\overset{OH}{|}}{C}}-H$$

$$2^{nd}\text{ Step}: H-\underset{\underset{O^-}{|}}{\overset{\overset{OH}{|}}{C}}-H + OH^- \underset{k_{-2}}{\overset{k_2}{\rightleftharpoons}} H-\underset{\underset{O^-}{|}}{\overset{\overset{O^-}{|}}{C}}-H + H_2O$$

$$3^{rd}\text{ Step}: H-\underset{\underset{^-O}{|}}{\overset{\overset{O^-}{|}}{C}}-H + H-\underset{\underset{O}{\|}}{C}-H \underset{k_{-3}}{\overset{k_3}{\rightleftharpoons}} H-\underset{\underset{O}{\|}}{C}-O^- + CH_3-O^-$$

$$4^{th}\text{ Step}: CH_3-O^- + H_2O \xrightarrow{k_4} CH_3-OH + OH^-$$

8. 0.01M, 100 ml HCl was tritated with 0.01 M NaOH. If $\lambda^\circ_{H^+} = 380\ S\,cm^2\ mole^{-1}$, $\lambda^\circ_{Na^+} = 150\ S\,cm^2\ mole^{-1}$, $\lambda^\circ_{OH^-} = 270\ S\,cm^2\ mole^{-1}$ and $\lambda^\circ_{Cl^-} = 250\ S\,cm^2\ mole^{-1}$ and the λ° values remain invariable during the reaction then value of resistance of the solution at the equivalent point is $x\Omega$. If cell constant is $0.2\ cm^{-1}$. Value of x is _____ .

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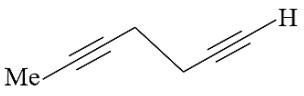
9. 

(1) Na, Liquid NH_3
(2) CH_3CH_2Br
(3) Pd-$BaSO_4$, Quinoline
(4) Cold dilute $KMnO_4$, OH^-

Number of stereoisomers of the organic product P that will be formed in above reaction is _____ .

10. A first order reaction is found to take t_1 minutes for 99.9% completion and t_2 minutes for 50% completion. Find the value of $\frac{t_1}{t_2}$.

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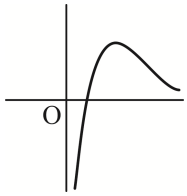
SUBJECT III : MATHEMATICS 60 MARKS

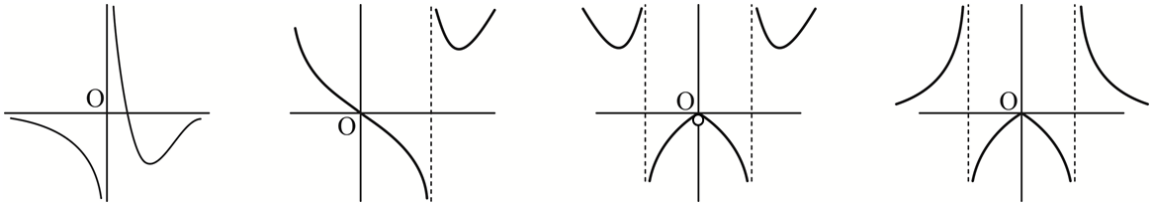
SECTION-1

This section consists of 4 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

1. The graph of function $f(x)$ is shown below :



Then the graph of $g(x)=\frac{1}{f(|x|)}$ is :



(A) **(B)** **(C)** **(D)**

2. The value of $sec^2\left(tan^{-1}2\right)+cosec^2\left(cot^{-1}3\right)$ is :

(A) 14 **(B)** 15 **(C)** 16 **(D)** 17

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3. Let g be the inverse function of a differentiable function f and $G(x)=\frac{1}{g(x)}$. If $f(4) = 2$ and $f'(4)=\frac{1}{16}$, then the value of $\left(G'(2)\right)^2$ equals to :

(A) 1 **(B)** 4 **(C)** 16 **(D)** 64

4. Let $f(x)=\begin{cases} 1+\sin x, & x<0 \\ x^2-x+1, & x\geq 0 \end{cases}$, then :

(A) f has a local maximum at $x = 0$ **(B)** f has a local minimum at $x = 0$

(C) f is increasing everywhere **(D)** f is decreasing everywhere

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SECTION-2

This section consists of 3 Multiple Correct Answers Type Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

5. Which of the following is(are) incorrect ?

(A) If $f(x)=\sin x$ and $g(x)=\ell nx$ then range of $g(f(x))$ is $[-1, 1]$

(B) If $x^2+ax+9>x\ \forall\ x\in R$ then $-5<a<7$

(C) If $f(x)=\left(2011-x^{2012}\right)^{\frac{1}{2012}}$ then $f(f(2))=\frac{1}{2}$

(D) The function $f:\ R\to R$ defined as $f(x)=\frac{x^2+4x+30}{x^2-8x+18}$ is not surjective

6. Let $|f(x)|\le \sin^2 x,\ \forall\ x\in R$, then :

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

(B) $f(x)$ is differentiable at $x = 0$

(C) $f(x)$ is continuous but not differentiable at $x = 0$

(D) $f(0) = 0$

7. If $y=mx+5$ is a tangent to the curve $x^3y^3=ax^3+by^3$ at $P(1, 2)$, then :

(A) $a+b=\frac{18}{5}$ **(B)** $a>b$ **(C)** $a<b$ **(D)** $a+b=\frac{19}{5}$

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SECTION-3

This section consists of 2 Paragraphs. Based on each paragraph, there are **TWO (02)** 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

Paragraph for Questions 1 - 2

Let $f: R \to R$ be differentiable function such that $f(x) = x^2 + \int_0^x e^{-t} f(x-t)\,dt$.

1. The value of $\frac{12}{5}\int_0^1 f(x)\,dx$.

2. If $f(x) = \frac{x^{k_1}}{k_1} + x^{k_2}$. Find $k_1 + k_2$.

Paragraph for Questions 3 - 4

Consider the two curves $C_1: y = 1 + \cos x$ and $C_2: y = 1 + \cos(x-\alpha)$ for $\alpha \in \left(0, \frac{\pi}{2}\right)$, where $x \in [0, \pi]$. Also the area of the figure bounded by the curves C_1, C_2 and $x = 0$ is same as that of the figure bounded by $C_2, y = 1$ and $x = \pi$.

3. The value of $[\alpha]$ is _____. ([.] represents greatest integer function)

4. For the values of α, area bounded by $C_1, C_2, x = 0$ and $x = \pi$ is _____.

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SECTION-4

This section consists of 6 NON-NEGATIVE INTEGER Type Questions. The answer to each question is a **NON-NEGATIVE INTEGER.**

5. If $2\tan^{-1}\frac{1}{5}-\sin^{-1}\frac{3}{5}=-\cos^{-1}\frac{63}{\lambda}$, then λ =

6. The value of $x,\ x\in(2,\infty)$ where $f(x)=\sqrt{x+\sqrt{8x-16}}+\sqrt{x-\sqrt{8x-16}}$ is not differentiable is _____.

7. Let set of all possible values of λ such that $f(x)=e^{2x}-(\lambda+1)e^{x}+2x$ is monotonically increasing for $\forall\ x\in R$ is $(-\infty,\ k]$. Find the value of *k*.

8. If the mean and the standard derivation of the data 3, 5, 7, $\alpha,\ \beta$ are 5 and 2 respectively, and $\alpha,\ \beta$ are roots of equation $x^2+ax+b=0$; find *a* + *b*.

9. The value of $\int\frac{tan\,x}{tan^2\,x+tan\,x+1}dx=x-\frac{2}{\sqrt{A}}tan^{-1}\left(\frac{2\,tan\,x+1}{\sqrt{A}}\right)+C$

Then the value of A is _____.

10. If $\int\frac{dx}{cos^3\,x-sin^3\,x}=A\,tan^{-1}\left(f(x)\right)+B\ell n\left|\frac{\sqrt{2}+f(x)}{\sqrt{2}-f(x)}\right|+C$ where $f(x)=sin\,x+cos\,x$ find the value of $\left(12A+9\sqrt{2}B\right)-3$.

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