VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Main-3 | JEE-2024

Date: 28/08/2023 **Maximum Marks: 300**

Timing: 4:00 PM to 7:00 PM **Duration : 3.0 Hours**

General Instructions

1. The test is of **3 hours** duration and the maximum marks is **300.**
2. The question paper consists of **3 Parts** (Part I: **Physics**, Part II: **Chemistry**, Part III: **Mathematics**). Each Part has **two** sections (Section 1 & Section 2).
3. **Section 1** contains **20 Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.
4. **Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. You will NOT be allowed to attempt the sixth question. If you wish to attempt any other question apart from the five already attempted, then you will have to delete any one response from the five previously answered and then proceed to answer the new one.**
   The answer to each question should be **rounded off to the nearest integer**.
5. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. inside the examination room/hall.
6. On completion of the test, the candidate must hand over the Answer Sheet to the **Invigilator** on duty in the Room/Hall. **However, the candidates are allowed to take away this Test Booklet with them**.

Marking Scheme

1. **Section – 1:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.
2. **Section – 2:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.

Syllabus:

Physics: DC Circuits, Capacitors, Magnetic Effects of Current

Chemistry : Electrochemistry, Surface Chemistry, Organic Halides

Mathematics: DC – I, DC - II

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

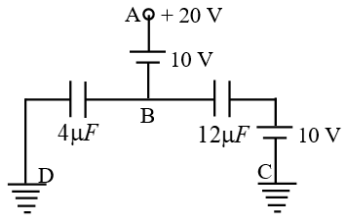
Candidate's Signature : _____ **Invigilator's Signature** _____

PART I : PHYSICS	MARKS: 100

SECTION-1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

1. For the arrangement shown in figure, identify the correct statement.



(A) The charge on the $12\,\mu F$ capacitor is zero

(B) The charge on the $12\,\mu F$ capacitor is $120\,\mu F$

(C) The charge on the $4\,\mu F$ capacitor is $30\,\mu F$

(D) The charge on the $4\,\mu F$ capacitor is $80\,\mu F$

2. A particle of specific charge $q/m = \pi C/kg$ is projected from the origin towards positives *x*-axis with a velocity of 10 *m*/*s* in a uniform magnetic field $\vec{B} = -2k$ Tesla. The velocity $\vec{V}$ of the particle after time $t = 1/6s$ will be:

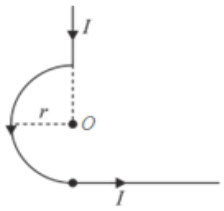
(A) $\left(5i + 5\sqrt{3}j\right)m/s$ **(B)** $10j\ m/s$

(C) $\left(5\sqrt{3}\hat{i} - 5j\right)m/s$ **(D)** $-10j\,m/s$

3. If 25% part of length of wire is stretched by 25%, then percentage change in resistance of wire will be about :

(A) 7% **(B)** 14% **(C)** 25% **(D)** 62.5%

4. In the given figure, what is the magnetic field induction at point *O* ?

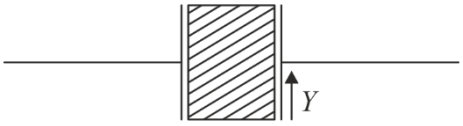


(A) $\frac{\mu_o I}{4\pi r}$ **(B)** $\frac{\mu_o I}{4r} + \frac{\mu_o I}{2\pi r}$

(C) $\frac{\mu_o I}{4r} + \frac{\mu_o I}{4\pi r}$ **(D)** $\frac{\mu_o I}{4r} - \frac{\mu_o I}{4\pi r}$

SPACE FOR ROUGH WORK

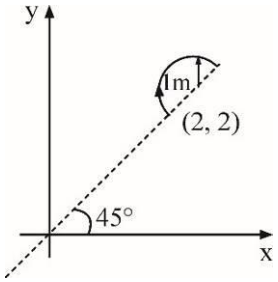
5. A parallel square plate capacitor of side length a and separation d is filled with a dielectric material of dielectric constant given by $K = K_0(1+\alpha Y)$. Calculate the capacitance of system.



(A) $\frac{K_0 \in_0 a^2}{d}\left(1+\frac{\alpha d}{2}\right)$ **(B)** $\frac{K_0 \in_0 a^2}{2d}(1+\alpha d)$

(C) $\frac{K_0 \in_0 a^2}{d}\left(1+\frac{\alpha a}{2}\right)$ **(D)** $\frac{K_0 \in_0 a^2}{2d}(1+\alpha a)$

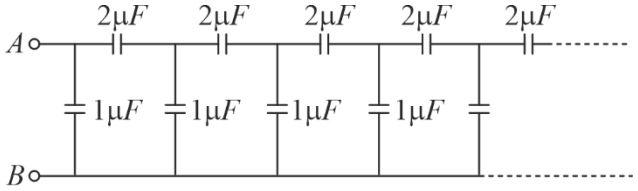
6. A uniform magnetic field $\vec{B} = 3\hat{i} + 4j + k$ exists in region of space. A semicircular wire of radius 1 m carrying current 1A having its centre at (2, 2, 0) is placed in x-y plane as shown in figure. The force on semicircular wire will be :



(A) $\sqrt{2}\left(\hat{i} + j + k\right)$ **(B)** $\sqrt{2}\left(\hat{i} - j + k\right)$

(C) $\sqrt{2}\left(\hat{i} + j - k\right)$ **(D)** $\sqrt{2}\left(-\hat{i} + j + k\right)$

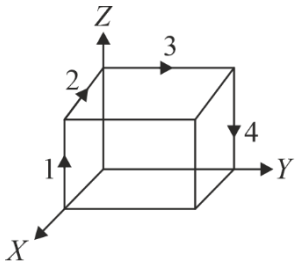
7. Find the equivalent capacitance of the infinite ladder shown in figure between the points A & B.



(A) $\left(\sqrt{3}+1\right)\mu F$ **(B)** $2\mu F$ **(C)** $4\mu F$ **(D)** $8\mu F$

SPACE FOR ROUGH WORK

8. Four wires of a cube of side a carry equal currents i in the directions shown in figure. A uniform magnetic field $\vec{B} = B_0 j$ exists in space, then :



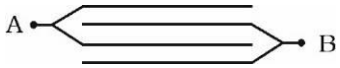
(A) force on wire 1 is iaB_0 in positive X-direction

(B) force on wire 2 is iaB_0 in positive Z-direction

(C) force on wire 3 is iaB_0 in positive Z-direction

(D) force on wire 4 is iaB_0 in positive X-direction

9. Four metallic plates, each with a surface area of one side A, are placed at a distance d from each other. The alternating plates are connected to points A and B, as shown in the figure. Then the capacitance of the system is:

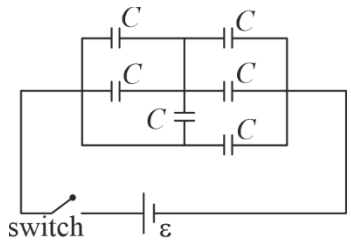


(A) $\frac{\varepsilon_0 A}{d}$ **(B)** $\frac{2\varepsilon_0 A}{d}$ **(C)** $\frac{3\varepsilon_0 A}{d}$ **(D)** $\frac{4\varepsilon_0 A}{d}$

10. A proton, an electron, and a Helium nucleus, have the same energy. They are in circular orbits in a plane due to magnetic field perpendicular to the plane. Let r_p, r_e and r_{He} be their respective radii, then:

(A) $r_e > r_p > r_{He}$ **(B)** $r_e < r_p < r_{He}$ **(C)** $r_e > r_p = r_{He}$ **(D)** $r_e < r_p = r_{He}$

11. Six capacitors each of capacitance 'C' are connected as shown in the figure and initially all the capacitors are uncharged. Now a battery of emf = ε is connected. How much charge will flow through the battery if the switch is closed?



(A) $\frac{9C\varepsilon}{5}$ **(B)** $\frac{11C\varepsilon}{5}$

(C) $\frac{13C\varepsilon}{5}$ **(D)** $\frac{7C\varepsilon}{5}$

SPACE FOR ROUGH WORK

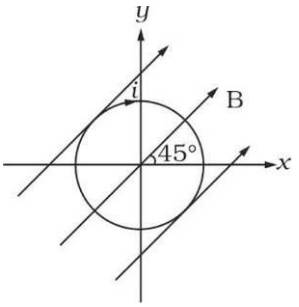
12. An unknown resistance R_1 is connected in series with a resistance of 10Ω This combination is connected to one gap of meter bridge while a resistance R_2 is connected in the other gap. The balance point is at 50 cm. Now, when the 10Ω resistance is removed the balance point shifts to 40 cm. The value of R_1 (in ohm) is:

(A) 20 **(B)** 10 **(C)** 60 **(D)** 40

13. A 72Ω galvanometer is shunted by a resistance of 8Ω. The percentage of the total current which passes through the galvanometer is :

(A) 0.1% **(B)** 10% **(C)** 25% **(D)** 0.25%

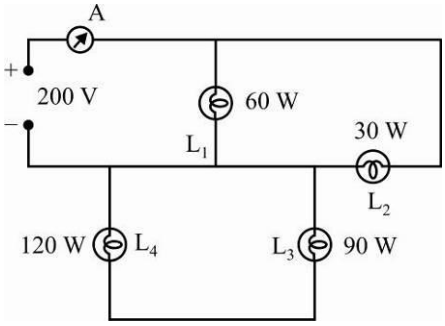
14. A circular loop of radius R = 20 cm is placed in a uniform magnetic field $\vec{B} = 2\,\text{T}$ in x-y plane as shown in figure. The loop carries a current i = 1.0 A in the direction shown in figure. Find the magnitude of torque acting on the loop.



(A) $0.16\pi\,\text{N-m}$ **(B)** $0.08\pi\,\text{N-m}$

(C) $\frac{0.08}{\sqrt{2}}\pi\,\text{N-m}$ **(D)** $\frac{0.16}{\sqrt{2}}\pi\,\text{N-m}$

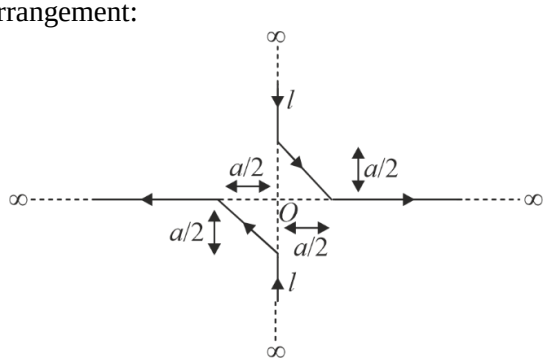
15. In the circuit shown in figure, the rated powers are as shown and rated voltage is 200 V. The reading of ideal ammeter A is :



(A) 0.45 A **(B)** 0.85 A **(C)** 1.5 A **(D)** 1.2 A

SPACE FOR ROUGH WORK

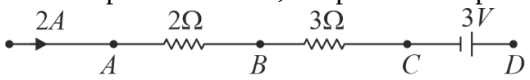
16. Consider the following arrangement:



Find the magnetic field at point *O*.

(A) $\frac{\mu_0 l}{\pi a}$ **(B)** $\frac{2\mu_0 l}{\pi a}$ **(C)** $\frac{\mu_0 l}{\sqrt{2}\pi a}$ **(D)** Zero

17. In the given circuit the potential at point *B* is zero, the potential at points *A* and *D* will be :



(A) $V_A = 4V;\ V_D = 9V$ **(B)** $V_A = 3V;\ V_D = 4V$

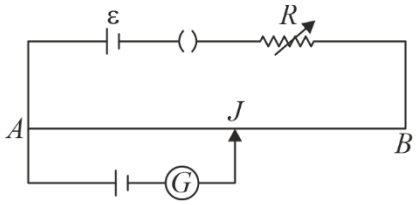
(C) $V_A = 9V;\ V_D = 3V$ **(D)** $V_A = 4V;\ V_D = -3V$

SPACE FOR ROUGH WORK

18. A particle of mass m and charge q moves with a constant velocity v along the positive x-direction. It enters a region containing a uniform magnetic field B directed along the negative z-direction, extending from $x = a$ to $x = b$. The minimum value of v required so that the particle can just enter the region $x > b$ is :

(A) $qb\ B/m$ **(B)** $q(b-a)B/m$ **(C)** $q\ aB/m$ **(D)** $q(b+a)B/2m$

19. AB is a wire of potentiometer. With the increase in the value of resistance R, the shift in the balance point J will be :



(A) towards B **(B)** towards A

(C) remains constant **(D)** first towards B then back towards A.

20. An electron is moving at a speed of $3.2\times10^{7}\ ms^{-1}$ in a magnetic field of $5\times10^{-4}T$ perpendicular to it. What is the frequency of this electron? ($q = 1.6\times10^{-19}\ C$, $m_e = 9.1\times10^{-31}\ kg$)

(A) $1.4\times10^{5}\ Hz$ **(B)** $1.4\times10^{7}\ Hz$ **(C)** $1.4\times10^{6}\ Hz$ **(D)** $1.4\times10^{9}\ Hz$

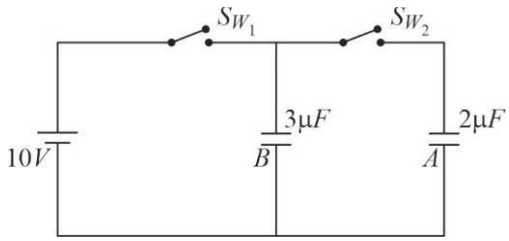
SPACE FOR ROUGH WORK

SECTION-2

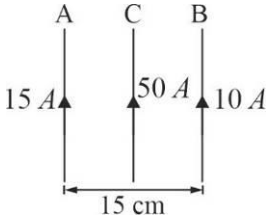
Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted.
The answer to each question should be **rounded off to the nearest integer**.

1. The magnitude of the magnetic field at the center of an equilateral triangular loop of side 1 m which is carrying a current of 10 A is _____ ($in\,\mu T$). [Take $\mu_0 = 4\pi \times 10^{-7}\ NA^{-2}$]

2. In given circuit first switch S_{W_1} is closed and S_{W_2} is open. After long time S_{W_1} is opened and S_{W_2} is closed. Charge on capacitor *A* after a long time is _____ ($in\,\mu C$).

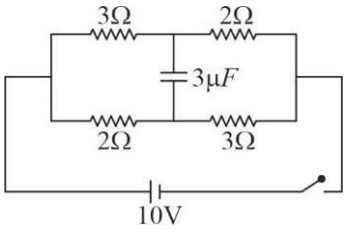


3. Three long, straight and parallel wires carrying currents are arranged as shown in the figure.



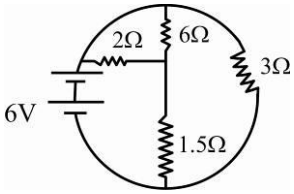
Wire *C* which carries a current of 50 *A* is so placed that it experiences zero force. The distance of wire *C* from wire *A* is_____ (in cm).

4. Initially the capacitor is uncharged. What is the steady state charge on it (in μC) after the switch is closed?



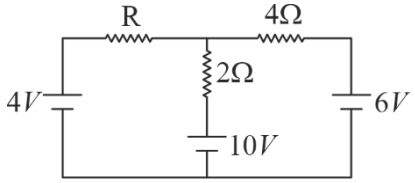
SPACE FOR ROUGH WORK

5. In the circuit shown in figure, the total current supplied by the battery is_____(in A)



6. In a certain region of space, there exists a uniform and constant electric field of strength E along x - axis and uniform constant magnetic field of induction B along z-axis. A charged particle having charge q and mass m is projected with speed v parallel to x-axis from a point (a, b, 0). When the particle reaches a point $2a$, $b/2$, 0 its speed becomes $2v$. The value of electric field strength in terms of m, v and co-ordinates is $\eta\frac{mv^2}{2qa}$. Find η.

7. For what value of R (in Ω) in circuit, current through 4Ω resistance is zero ?



8. A long straight non-conducting string carries a charge density of $40\mu C/m$. It is pulled along its length at a speed of 30m/sec. The magnetic field at a normal distance of 5mm from the moving string is_____ (in nT).

9. If a slab of insulating material $5\times10^{-5}m$ thick is introduced between the plates of a parallel plate capacitor, the distance between the plates has to be increased by $4.5\times10^{-5}m$ to restore the capacity to initial value. Then the dielectric constant of the material of slab is _____. (The area of dielectric slab in equal to the area of capacitor plates)

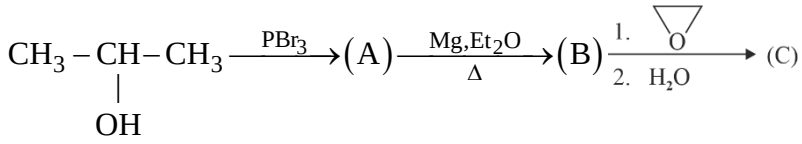
10. A fully charged capacitor is connected to a resistor at t = 0. If time constant of this R-C circuit is $\frac{2}{\ln 2}$ seconds, then the ratio of charge left on the capacitor at $t=2s$ and $t=6s$ is_____.

SPACE FOR ROUGH WORK

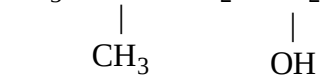
PART II : CHEMISTRY	MARKS: 100

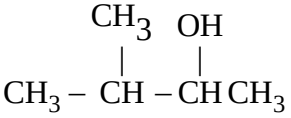
SECTION-1

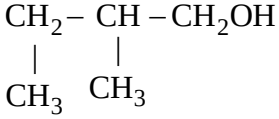
This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

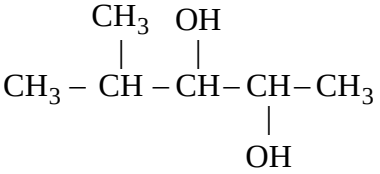
1. 

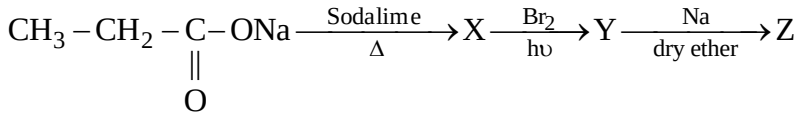
The final product (C) is:

(A) 

(B) 

(C) 

(D) 

2. 

(A) 

(B) 

(C)

(D)

SPACE FOR ROUGH WORK

3. Which combination of reagents will bring about the following conversion?

(A) **(i)** MeMgI / dry ether, acidic workup **(ii)** H_2SO_4 / Δ **(iii)** HBr / peroxide

(B) **(i)** MeMgI / dry ether, acidic workup **(ii)** H_2SO_4 / Δ **(iii)** HBr

(C) **(i)** MeMgI / dry ether, acidic workup **(ii)** HBr

(D) **(i)** MeMgI / dry ether, acidic workup **(ii)** H_2SO_4 / Δ **(iii)** Br_2 / hυ

4. **Statement I :** n-butyl chloride has higher boiling point than n-butyl bromide.

Statement II : C – Cl bond is more polar than C – Br bond

(A) Both Statement I & Statement II are correct, Statement – II is correct explanation of Statement I

(B) Both Statement I & Statement II are correct, but Statement II is not correct explanation of Statement-I

(C) Statement II is correct, Statement I is incorrect

(D) Statement I is correct, Statement II is incorrect

5. Which of the following are incorrect statements?

(I) Primary batteries cannot be recharged and reused again

(II) In Lead storage batteries, $PbSO_4(s)$ is converted to Pb & PbO_2 at cathode & anode respectively during charging

(III) In mercury cell, zinc & mercury amalgam is used as anode & a paste of KOH & ZnO forms cathode.

(IV) Fuel cells produces electricity with an efficiency of about 70%

(V) During corrosion Fe(s) gets converted to $Fe^{2+}(aq)$ at Anode

(A) II, III & V **(B)** II & III **(C)** II, III & IV **(D)** V only

6. If molar conductance of 0.1M aqueous solution of a weak monobasic acid is 25 S cm^2 mol^{-1} & molar conductance at infinite dilution is 125 S cm^2 mol^{-1}, then the dissociation constant of weak acid is:

(A) 5×10^{-3} **(B)** 1×10^{-3} **(C)** 5×10^{-4} **(D)** 1×10^{-4}

SPACE FOR ROUGH WORK

7. Which of the following colloidal solution is used in photography?

(A) Colloidal Silver Bromide **(B)** Colloidal Gold

(C) Colloidal Silver **(D)** Colloidal Sulphur

8. Which of the following statements about enzymes are correct?

(I) The optimum temperature range for enzymatic activity is 298 – 310 K

(II) Enzymes are complex nitrogenous organic compounds which are made synthetically

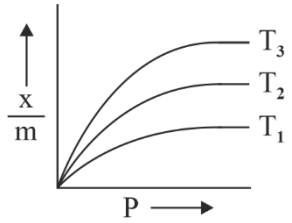
(III) Enzymes forms true solutions in water

(IV) Diastase enzyme converts starch into maltose

(V) The Enzyme urease which catalyses the hydrolysis of urea can catalyse hydrolysis of other amides too.

(A) I, III, IV & V **(B)** III & V **(C)** I & IV **(D)** All are correct

9. In the given adsorption isotherms, correct order of temperature will be:



(A) $T_1 = T_2 = T_3$ **(B)** $T_1 > T_2 > T_3$

(C) $T_3 > T_2 > T_1$ **(D)** Cannot be determined

10. Consider the following statement:

Statement I : Chloroform is stored in dark coloured bottles

Statement II : Chloroform in presence of sun light & air forms Phosgene

(A) Statement I is False, Statement II is True.

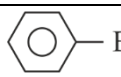
(B) Statement I is True, Statement II is False.

(C) Statement I & Statement II both are True and Statement II is correct explanation of Statement I

(D) Statement I & Statement II both are True but Statement II is not correct explanation of Statement I

SPACE FOR ROUGH WORK

11. Match Column I with Column II:

	Column I		Column II
(a)		(i)	Swartz Reaction
(b)	$CH_3CH_2 - Br + NaI$	(ii)	Wurtz Reaction
(c)	$CH_3CH_2 - Cl + Na$	(iii)	Fittig Reaction
(d)	$CH_3 - CH_2 - Br + CoF_2$	(iv)	Finkelstein Reaction

(A) (a) – (iv), (b) – (i), (c) – (iii), (d) – (ii) **(B)** (a) – (iii), (b) – (iv), (c) – (ii), (d) – (i)

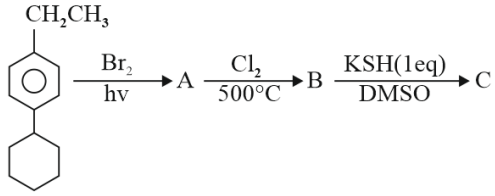
(C) (a) – (iii), (b) – (i), (c) – (ii), (d) – (iv) **(D)** (a) – (iv), (b) – (i), (c) – (ii), (d) – (iii)

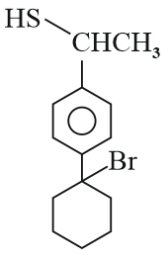
12. Molar conductivities ($\wedge_m^\circ$) at infinite dilution of CH_3COOK, HBr & KBr are 142.7, 423.7 and 117.6 S cm^2 mol^{-1} respectively. Molar conductivity ($\wedge_m^\circ$) for CH_3COOH will be:

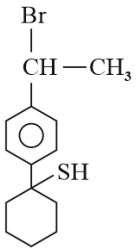
(A) 448.8 S cm^2mol^{-1} **(B)** 408.8 S cm^2mol^{-1}

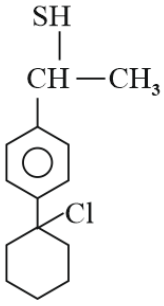
(C) 163.4 S cm^2mol^{-1} **(D)** 257.6 S cm^2mol^{-1}

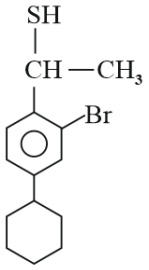
13. Identify product (C) in the following series of reactions:



(A) 

(B) 

(C) 

(D) 

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14. Gold Number of a lyophilic sol is a property that:

(A) The larger its value, the larger is the peptizing power

(B) The lower its value, the greater is the peptizing power

(C) The lower its value, the greater is the protecting power

(D) The larger its value, greater is the protecting power

15. Match Column I with Column II:

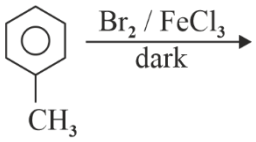
	Column I		**Column II**
(a)	Methylene Chloride	**(i)**	Insecticide
(b)	Carbon tetrachloride	**(ii)**	Produced for aerosols, refrigeration etc.
(c)	DDT	**(iii)**	Harms human central nervous system
(d)	Freon-12	**(iv)**	Can cause liver cancer in human

(A) (a) – (iii), (b) – (iv), (c) – (ii), (d) – (i) **(B)** (a) – (iii), (b) – (iv), (c) – (i), (d) – (ii)

(C) (a) – (iv), (b) – (iii), (c) – (i), (d) – (ii) **(D)** (a) – (iv), (b) – (i), (c) – (iii), (d) – (ii)

16. In which of the following 1° halide is formed as product?

(A) $CH_2 = CH - CH_3 \xrightarrow{Cl_2/500^\circ C}$ **(B)** $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_3 \xrightarrow{Br_2/hv}$

(C) $CH_3 - CH = CH_2 \xrightarrow{HCl}$ **(D)** 

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17. Which of the following statement is incorrect for 'Electric Disintegration' method for preparation of colloids?

(A) It is also known as Bredig's arc method

(B) It involves both vaporisation & condensation

(C) It is used to prepare gold, silver & platinum sols

(D) It needs an electric arc between electrodes of metal immersed in the dispersed phase

18. Gold number of starch, gelatine & albumin are respectively 25, 0.01, 40.15. Which of the following is correct decreasing order of protective power:

(A) Starch > Gelatine > Albumin **(B)** Starch > Albumin > Gelatine

(C) Gelatine > Starch > Albumin **(D)** Data insufficient

19. Given

$$Pt\,|\,H_2(g,0.1atm)\,|\,H^+(aq,10^{-2}\,M)\,||\,MnO_4^-(aq,0.1M)\,|\,Mn^{2+}(aq,0.01M)\,|\,Pt$$

The cell potential of above cell in volt will be:

$$E^\circ_{MnO_4^-/Mn^{2+}} = 1.5V$$

(A) 1 V **(B)** 1.41 V **(C)** 1.37 V **(D)** 1.6 V

20. The Zn act as sacrificial protection to prevent rusting of iron because:

(A) E°_{op} of Zn < E°_{op} of Fe **(B)** E°_{op} Zn > E°_{op} of Fe

(C) E°_{op} Zn = E°_{op} of Fe **(D)** Zn is cheaper than iron

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SECTION-2

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted.
The answer to each question should be **rounded off to the nearest integer**.

1. $\underset{\text{'X'}}{C_6H_{12}} \xrightarrow[CCl_4]{Br_2} \underset{\text{'A'}}{C_6H_{12}Br_2}$ (optically inactive single product with 2 chiral center)

How many structure of 'X' can satisfy above reaction condition?

2. The emf of given cell $Zn(s)\,|\,Zn^{++}(aq)(0.1M)\,||\,Fe^{++}(aq)(0.01M)\,|\,Fe(s)$ is 0.3 V.

The value of log K_{eq} of cell reaction will be _____. (Take : $\frac{2.303RT}{F} = 0.06$)

3. In commercial preparation of Aluminium, Aluminium oxide (Al_2O_3) is electrolyzed at 1000°C. The coulombs of electricity required to produce 27 kg of Aluminium are 2.9×10^{x}. Find value of x.
(Use IF = 96500 C)

4. How many of the following are positively charged sol among the following?
Methylene blue sol, congo red sols, $Al_2O_3.xH_2O$, TiO_2, charcoal, gelatin, copper sols, Haemoglobin, As_2S_3, clay

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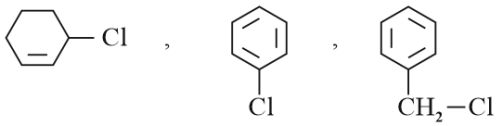
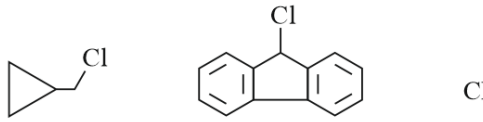
5. How many of the following will give white precipitate of silver salt when treated with ammonical $AgNO_3$ solution?



$CH_2=CH-Cl$, $CH_2=CH-CH_2-Cl$,



CH_3-CH_2-Cl

6. How many of the following statements regarding adsorption are correct?

(I) The enthalpy of physical adsorption is 20-60 kJ / mol

(II) The order of adsorption of gases on 1gm of activated charcoal is $NH_3 > SO_2 > CH_4 > H_2$

(III) Chemisorption increases with increasing temperature

(IV) As adsorption occurs ΔH becomes more & more negative

(V) Chemisorption results into multimolecular layers on adsorbent surface under high pressure.

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7. On addition of 1 ml of 10% NaCl to 100 ml of gold sol in presence of 0.05 gm starch, the coagulation is just prevented, gold number of starch is:

8. Consider efficiency of fuel cell as 60% working under standard condition at 1 bar & 298K. The cell reaction of half cell are:

$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O(l) \quad E° = 1.23\,V$

$2H^+(aq) + 2e^- \rightarrow H_2(g) \qquad E° = 0\,V$

Use $F = 96500\,C$

The amount of work that can be derived from this cell on consumption of 1.0×10^{-2} mol of $H_2(g)$ is 1.425×10^x J. find value of x.

9. Electrolysis of NaCl gives $NaClO_3$. Then number of Faraday required to deposit 640 gm of $NaClO_3$ is_____. (Approximate to nearest integer)

10. How many of the following correctly represent product obtained at cathode & anode on electrolysis of following aqueous solution:

		Cathode	Anode
(I)	Aq. NaCl solution	Cl_2	$H_2(g)$
(II)	Aq. Na_2SO_4 solution	$H_2(g)$	$O_2(g)$
(III)	Aq. NaCl solution (using Hg electrode)	Na(s)	$Cl_2(g)$
(IV)	Aq. $AgNO_3$ solution (using Ag electrodes)	$O_2(g)$	Ag(s)
(V)	Aq. RCOONa solution	R-R	Na(s)

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PART III : MATHEMATICS	MARKS: 100

SECTION-1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

1. Which of the following curve has vertical tangent at indicated point?

(A) $f(x)=x^{2/3}$ at $x=0$ **(B)** $f(x)=\text{sgn}(x)$ at $x=0$

(C) $f(x)=\sqrt{|x|}$ at $x=0$ **(D)** $f(x)=\begin{cases}0, & x<0\\ 1, & x\geq 0\end{cases}$ at $x=0$

2. If $y=e^{2x}$ and $kx^2=y$ touches each other. Find "*k*".

(A) e **(B)** e^2 **(C)** $2e$ **(D)** None of these

3. For what value of '*x*' for which, tangent drawn to curve $f(x)=x^5+3x^3+4x+8$ would make an acute angle with *x*-axis.

(A) R **(B)** R^+ **(C)** [0, 1] **(D)** [0, ∞)

4. $\lim\limits_{x\to 2}\dfrac{x-2}{\sqrt{x-1}-\sqrt{3-x}}=?$

(A) 0 **(B)** 1 **(C)** 2 **(D)** 3

5. $\lim\limits_{x\to 0}\dfrac{e^{\tan x^2}-e^{x^2}}{\tan x^2-x^2}=?$

(A) 0 **(B)** 1 **(C)** 4 **(D)** None of these

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6. $f(x)=\begin{cases}\pi-\cot^{-1}\left(\dfrac{2x^3-10}{x^2}\right), & x>0\\ 0 & \\ \left\{x^2\right\}\cos\left(e^{\frac{1}{x}}\right), & x<0\end{cases}$

$\{\cdot\}$ denoted fractional part of function. $f(x)$ is continuous at $x = 0$, find $f(0)$.

(A) 0 **(B)** 1 **(C)** 2 **(D)** None of these

7. $f(x)=\max(x,-x,3)$. Find point where $f(x)$ is not differentiable.

(A) $2,-2$ **(B)** $3,-3$ **(C)** 0 **(D)** Infinite point

8. If $f(x)=\begin{cases}\sin\dfrac{\pi}{\sqrt{x}}, & x>0\\ 0, & x=0\end{cases}$

Find number of point in $\left(0,\dfrac{1}{2}\right)$, where derivative of $f(x)$ vanishes.

(A) 0 **(B)** 2 **(C)** 3 **(D)** Infinite

9. Find number of extremum point of function $f(x)=3x^4-4x^3-6x^2-24x+60$.

(A) 0 **(B)** 1 **(C)** 2 **(D)** 4

10. Find critical point of function $f(x)=\cos 2x+\cos^2 x$ in $x\in[0,\pi]$.

(A) $\dfrac{\pi}{2}$ **(B)** $0,\dfrac{\pi}{2},\pi$ **(C)** $0,\pi$ **(D)** None of these

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11. $f(x)=10x^2+\ln x$, find interval where curve increasing.

(A) $[0,\infty)$ **(B)** $(0,\infty)$ **(C)** R **(D)** None of these

12. A function has second order derivative. If its graph passes through the point $(1,2)$ and its second derivative is $(3x-6)$ and graph of its first derivative is passes through $(1,3)$ then function is :

(A) x^3-15x^2+2x+1 **(B)** $\frac{x^3}{2}-3x^2+\frac{15}{2}x-3$

(C) $\frac{x^3}{2}+3x^2+15x-4$ **(D)** None of these

13. Let $P(x)$ be real polynomial of least degree which has local maximum at $x=4$ and a minimum at $x=5$. If $P(0)=1$ and $P(2)=0$, find $P'(0)=?$

(A) $-\frac{37}{30}$ **(B)** $\frac{37}{30}$ **(C)** $\frac{30}{37}$ **(D)** $-\frac{30}{37}$

14. The set of value of 'a' for which the function $f(x)=\frac{ax^3}{3}+(a+2)x^2+2(a-5)x+10$ possess a positive point of inflection is:

(A) $a\in(0,2)$ **(B)** $a\in(-2,0)$ **(C)** $a\in R$ **(D)** None of these

15. Find distance between the origin and normal to curve $y=e^{3x}+3x^2$ at $x=0$.

(A) 3 **(B)** 1 **(C)** $\frac{3}{\sqrt{10}}$ **(D)** $\frac{3}{10}$

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16. Let $f(x)$ be real value function not identically zero such that $f(x+y^{2n+1}) = f(x)+(f(y))^{2n+1}$, $n \in N$ and $x, y \in R$ if $f'(0) \geq 0$, find $f'(10)$.

(A) 3 **(B)** 2 **(C)** 0 **(D)** 1

17. If $f(x) = 4x^2 + 3x^4$ and $f^{-1}(x) = g(x)$. Find $g'(20)$.

(A) $\frac{1}{16\sqrt{2}}$ **(B)** $32\sqrt{2}$ **(C)** $\frac{1}{32\sqrt{2}}$ **(D)** None of these

18. If $f(x) = \tan^{-1}\left(\frac{\sqrt{1+x}-\sqrt{1-x}}{\sqrt{1+x}+\sqrt{1-x}}\right)$, find $f'\left(\frac{\sqrt{3}}{2}\right)$.

(A) $\frac{\pi}{3}$ **(B)** 1 **(C)** $\frac{\pi}{2}$ **(D)** 0

19. Find shortest distance between line $y = 2x-5$ and parabola $y = 3x^2 - 4x + 2$.

(A) $\frac{5}{\sqrt{5}}$ **(B)** 4 **(C)** $\frac{4}{\sqrt{5}}$ **(D)** $\frac{6}{\sqrt{5}}$

20. $f(x) = \frac{6}{11}x^{11} - x^6 + \frac{6}{5}x^5 - 3x^2 + 6x - 10$. Find interval when $f(x)$ is increasing.

(A) R **(B)** R^+ **(C)** $(-\infty, 0]$ **(D)** None of these

SPACE FOR ROUGH WORK

SECTION-2

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted.
The answer to each question should be **rounded off to the nearest integer**.

1. If $\dfrac{4\left(\dfrac{d^2x}{dy^2}\right)\cdot\left(\dfrac{dy}{dx}\right)^3}{\left(\dfrac{d^2y}{dx^2}\right)} = -k$ then find value of k.

2. $f(x) = \sin x + |\sin x|$, find number of non-differentiable point in $(-2\pi, 2\pi)$.

3. If $f'(\sin x) < 0,\ f''(\sin x) \geq 0\ \forall\ x \in (0, \pi)$ and $g(x) = f(\sin x) + f(\cos x)$. Find number of integral point where $g(x)$ is increasing function.

4. Find greatest value of "m" for which the function $f(x) = \begin{cases} x^{\frac{m}{5}} \sin\left(\dfrac{1}{x}\right), & x \neq 0 \\ 0, & x = 0 \end{cases}$ is continuous but not differentiable at $x = 0$.

5. Find number of all possible integral value of λ, so that $2x^3 - 6x + 3\lambda = 0$ has three real and distinct roots.

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6. $\lim\limits_{x\to\frac{\pi}{3}} \dfrac{\sin\left(x-\frac{\pi}{3}\right)}{\frac{1}{2}-\cos x} = \lambda$. Find $\sqrt{3}\lambda$.

7. On the curve $x^3 = 12y$. Find number of integral value of x for which abscissa change at a faster rate than the ordinate.

8. A curve passes through (2, 2) and slope of tangent at any point (x, y) is given by $\dfrac{x^2}{2} - 6x$, if maximum ordinate on curve in $[-2, 17.9]$ is given by $'\lambda'$ then find 3λ.

9. If $\lim\limits_{x\to\infty}\left(x^2 - \dfrac{x}{2}\right) - x^3 \ln\left(1+\dfrac{1}{x}\right) = \lambda$. Find $|3\lambda|$.

10. If $\lim\limits_{x\to 0} \dfrac{x\tan 3x - 3x\tan x}{(1-\cos 2x)^2} = A$. Find A.

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