VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Advanced Home Practice Test -2 | Paper -2 | JEE 2024

Date: 23/04/2024 **Maximum Marks: 180**

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 **three** sections (Section 1, Section 2 & Section 3).

Section 1 contains **8 Single Digit Integer Type Questions** ranging from **0 to 9**, Both Inclusive. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer.

Section 2 contains **6 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 **4 Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

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.

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

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

MARKING SCHEME

SECTION – 1 | (Maximum Marks: 24)

- **Section 1** contains **8 Single Digit Integer Type Questions** ranging from **0 to 9**, Both Inclusive. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks: +3 **ONLY** the correct integer is entered.

Zero Mark: 0 If the questions is unanswered.

Negative Marks: –1 In all other cases.

SECTION – 2 | (Maximum Marks: 24)

- This section consists of **Six (06)** 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 **FOUR (04)** Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks: +3 If only (all) the correct option(s) is(are) chosen

Zero Mark: 0 if none of the options is chosen (i.e. the question is unanswered)

Negative Marks: –1 In all other cases.

SUBJECT I : PHYSICS 60 MARKS

SECTION 1

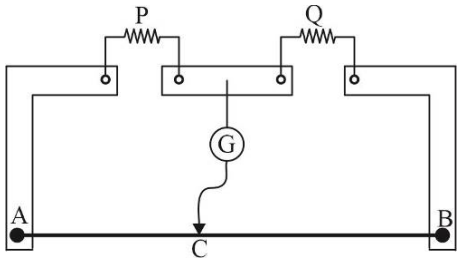
SINGLE DIGIT INTEGER TYPE

This section contains **8 Single Digit Integer Type Questions** ranging from **0 to 9**, Both Inclusive. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer.

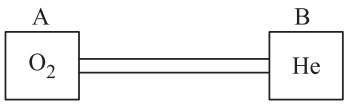
1. Acceleration of a particle of mass 2 kg, moving in space is given as $\vec{a} = (-9x\hat{i} - 16y\hat{j})m/s^2$. Initially the particle is at origin and its velocity is $\vec{v}_0 = (3\hat{i} + 4\hat{j} + \frac{1}{\sqrt{2}}\hat{k})\,m/s$. At time $t = \frac{\pi}{12}$sec, the kinetic energy of the particle is _____ Joule.

2. A radioactive sample has a half-life of 40 seconds. When its activity is measured 80 seconds after the beginning, it is found to be $6.932\times10^{18}\,dps$. During this time total energy released is 6×10^{8} joule. Energy released per decay is _____$\times10^{-13}J$ (ln 2 = 0.6932).

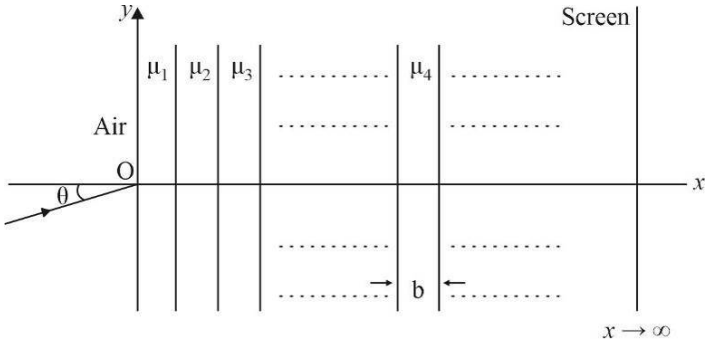
3. Wire AB used in the given metre bridge has uniform dimension and its resistivity at distance x from end A varies as $\rho(x) = \frac{\rho_0}{(1-kx)^2}$ where x is in metre and $\rho_0 = 5\times10^{-3}$ ohm-m. If $P = 2\Omega$ and $Q = 9\Omega$, then zero deflection point C is 40 cm from end A. The value of 3k is _____m^{-1}.



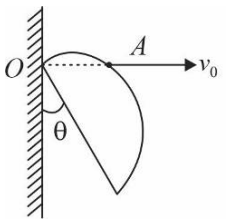
4. Two containers A and B are connected by a conducting solid cylindrical rod of length $\frac{242}{7}$ cm and radius $\sqrt{8.3}\,cm$. Thermal conductivity of the rod is 693 watt/mole-K. The container A contains two mole of oxygen gas and the container B contains four mole of helium gas. At time t = 0 temperature difference of the containers is 50°C. After what time (in seconds) temperature difference between them will be 25°C? Transfer of heat takes place through the rod only through conduction. Neglect specific heat of rod and any radiation loss. (Take R = 8.3 J/mole–K, $\pi = \frac{22}{7}$ and ln(2) = 0.693)



5. There is a system of infinite layers of varying refractive indices as shown in the figure. The width of each layer is $b = 15\,cm$ and refractive index of n^{th} layer from origin is $\mu_n = \left(\frac{5}{2}\right)^n$. A very narrow laser beam of light incident at an angle of $\theta = \frac{\pi}{100}$ radian at the origin and enters into the system. At very large distance from the origin $(x \to \infty)$ there is a screen placed parallel to the y-axis. Laser beam hit at the screen at $y = k\,mm$. The nearest integer value of k is _____.

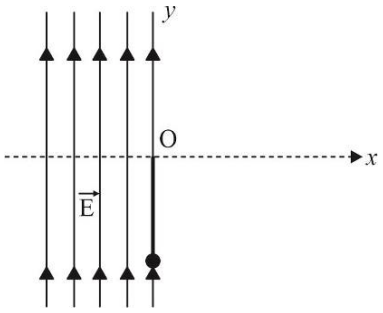


6. A rigid semi-circular wire of radius r = 50 cm is supported on its vertical plane by a hinge at O and a smooth peg A. If the peg starts from O and moves with constant speed $v_0 = 2\ cm/s$ along the horizontal, the angular velocity ω (in rad/s) of the wire at the instant $\theta = 60°$ is $\frac{x}{100} rad/s$, where x is _____.



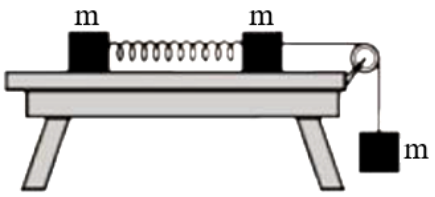
7. A small bob of mass m = 20 g is suspended by a string of length $l = 40cm$ near the surface of the earth. If the bob is displaced slightly from its mean position, the time period of its oscillations is T_0. Now the bob is given a charge $q = +200\mu C$ and an electric field of magnitude E = 900 V/m is switched on in vertically upward direction for the region $x < 0$ as shown in the figure. Again, the bob is displaced slightly from its mean position to set into oscillations, which have time period T. The nearest integer value of $\frac{T}{T_0}$ is _____.

(Take $g = \pi^2 m/s^2$; $\pi = \sqrt{10}$)



8. At a smooth horizontal table there are two identical cubes each of mass m, connected by a spring of spring constant k. The length of spring in unstretched state is l_0. The right cube is linked to a load mass m at the end as shown. At some time, the system is released from rest when spring is unstretched. Find the maximum distance (in cm) between blocks during the motion of the system.

$[l_0 = 1cm, m = 3kg,\ k = 1000\ N/m, g = 10\ m/s^2]$



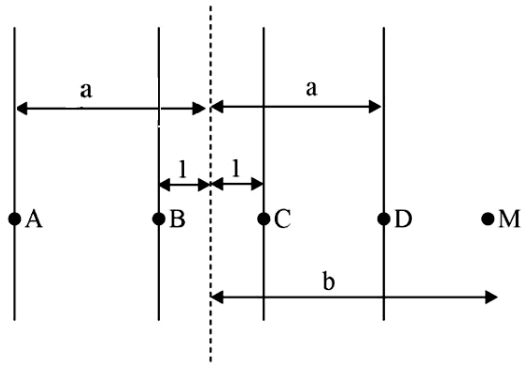
SECTION 2

MULTIPLE CORRECT ANSWERS TYPE

This Section contains **6 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.

9. In the given figure, there is an infinite thick sheet of thickness a which has electrostatic charge density varying with the perpendicular distance r from the central plane of the sheet as :

$$\rho(x)=\begin{Bmatrix}\rho_0 r & for\ 0<r\le 1\\ \rho_0 r^2 & for\ 1<r\le a\\ 0 & for\ r>a\end{Bmatrix};\ \rho_0>0$$

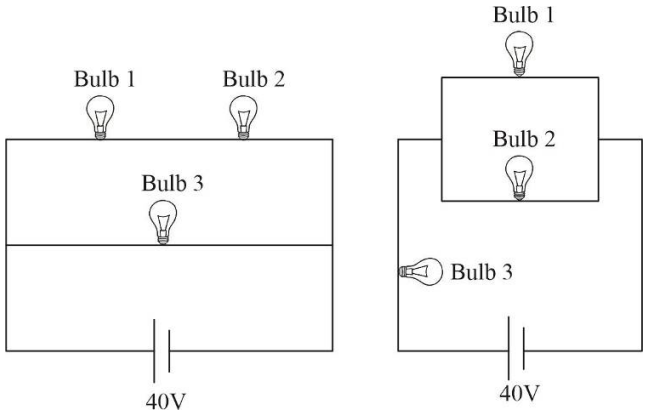


Assume that dimensions are taken care of. All physical quantities are in their SI units. Consider points A, B, C, D and M of the figure. Which of the following statement(s) is(are) correct?
[E = Magnitude of electric field; V = Electric potential]

(A) For $a=3, b=5$; $E_M=\dfrac{55\rho_0}{6\varepsilon_0}$ **(B)** For $a=2, b=\dfrac{7}{2}$; $V_A-V_M=\dfrac{17\rho_0}{4\varepsilon_0}$

(C) For $a=2, b=3$; $V_D-V_B=\dfrac{-17\rho_0}{12\varepsilon_0}$ **(D)** For $a=2, b=3$; $V_C-V_B=\dfrac{\rho_0}{6\varepsilon_0}$

10. In circuit 1 and circuit 2 shown in the figure, Bulb 1 (40V, 80W). Bulb 2 (80V, 40W), Bulb 3 (40V, 20W) are used. B_1, B_2 & B_3 are the brightness of bulbs 1, 2 and 3 respectively in circuit 1. B_1', B_2' and B_3' are the brightness of the bulbs 1, 2 and 3 respectively in circuit 2. Which of the following statement(s) is(are) correct?



(A) $B_1<B_2<B_3$ **(B)** $B_3'>B_1'>B_2'$

(C) $B_1>B_2'$; $B_1'<B_3$ **(D)** $B_2>B_1'$; $B_1<B_3'$

11. A perfect thermal insulting liquid l_1 having density d_1 is filled in a vessel upto height h at temperature T_0. Another liquid l_2 which is a perfect thermal conductor having density d_2 is filled in another identical vessel upto same height h. Atmospheric pressure is P_0 and temperature is T_0. Each vessel has one bubble of radius r at its bottom at $t = 0$. Due to buoyancy bubbles come to the top surface of liquid. When bubbles are just below the surface of liquid, its radius is r_1 and r_2 respectively. (Assume r is very small $r <<< h$). Which of the following statement(s) is (are) correct?

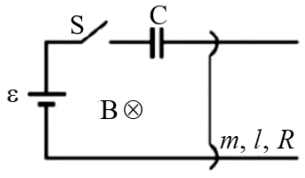
(A) If bubble in liquid l_1 contain an ideal gas $\left(\gamma = \frac{5}{3}\right)$ and surface tension of liquid gas interface is S_1 then $r_1^3 = r^3\left(\frac{P_0 + hd_1g + \frac{2S_1}{r}}{P_0 + \frac{2S_1}{r_1}}\right)^{\frac{3}{5}}$

(B) If bubble in liquid l_1 contain an ideal gas $\left(\gamma = \frac{5}{3}\right)$ and surface tension of liquid gas interface is S_1 then temperature of the bubble at the surface is $T_1 = T_0\left(\frac{P_0 + \frac{2S_1}{r_1}}{P_0 + hd_1g + \frac{2S_1}{r}}\right)^{\frac{2}{5}}$

(C) If bubble in liquid l_2 contains an ideal gas $\left(\gamma = \frac{7}{5}\right)$ and surface tension of liquid gas interface is S_2 then $r_2 = r\left(\frac{P_0 + nd_2g + \frac{2S_2}{r}}{P_0 + \frac{2S_2}{r}}\right)$

(D) If $d_1 = d_2 = d$, $S_1 = S_2 = S$ and both bubbles contain same ideal gas mixture $\left(\gamma = \frac{3}{2}\right)$ then $\frac{r_2}{r_1} = \left(\frac{P_0 + ndg + \frac{2S}{r}}{P_0 + \frac{2S}{r}}\right)^{1/3}$

12. In the figure shown a conducting rod of mass m. length 'l' and resistance 'R' can smoothly move along parallel rails in horizontal plane. Initially the rod is at rest. A uniform magnetic field B perpendicular to the plane of motion exists in the region. Now switch S is closed at $t = 0$, then which of the following statement(s) is(are) correct?



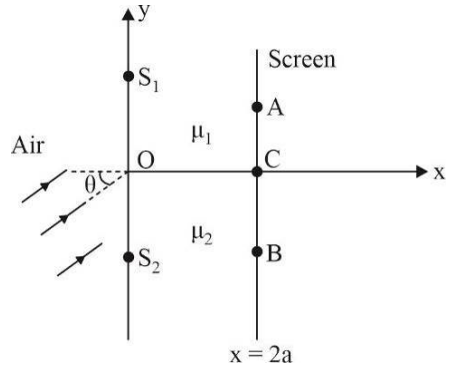
(A) The charge on the capacitor in steady state is $\frac{mC\varepsilon}{(m + 2CB^2l^2)}$

(B) The charge on the capacitor is steady state is $\frac{2mC\varepsilon}{(m + 2CB^2l^2)}$

(C) Velocity of conducting rod in steady state is $\frac{2BlC\varepsilon}{(m + CB^2l^2)}$

(D) Velocity of conducting rod in steady state is $\frac{BlC\varepsilon}{(m + CB^2l^2)}$

13. A double slit setup is shown in the figure. Slits are in y-z plane at $y = \pm a$. Screen is at $x = 2a$. A beam of monochromatic light is incident at an angle of incidence θ on the slits plane from the air $(x \le 0)$. For $x > 0$ and $y < 0$ refractive index of medium is μ_2. For $x > 0,\ y > 0$ refractive index of medium is μ_1. Co-ordinates of point A, C and B are $(2a, a, 0), (2a, 0, 0)$ and $(2a, -a, 0)$ respectively.



Which of the following statement(s) is (are) correct?

(A) For $\theta = 45°$ and $\mu_2 - \mu_1 = \sqrt{2}$ there will be central maxima at C

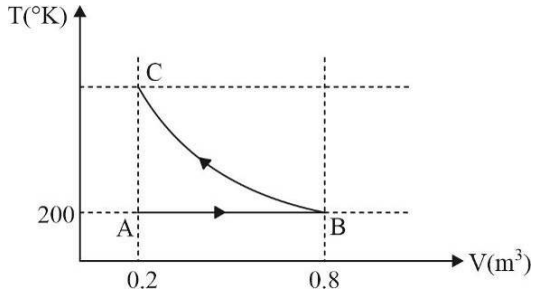
(B) For $\theta = 0^o$ and $\mu_1 = \mu_2 = \dfrac{\lambda}{4\left(\sqrt{2}-1\right)a}$, a minima is obtained at B

(C) For $\theta = 45^o$ and $\mu_1 = \mu_2 = \dfrac{\sqrt{2}}{2\left(\sqrt{2}-1\right)}$, central maxima is obtained at A

(D) For $\theta = 45°$ and $\sqrt{5}(\mu_2 - \mu_1) = \sqrt{2},$ phase difference at C will be zero

14. In the given T-V diagram, 2 moles of a diatomic gas $\left(\gamma = \dfrac{7}{5}\right)$ first expands isothermally from state A to state B. Then it is compressed adiabatically from state B to state C.

[Given $(2)^{0.8} = 1.74,\ \ln 2 \simeq 0.7$]



Which of the following statement(s) is (are) correct?

(A) Temperature of state *C* is 348°K

(B) Work done in the process $A \to B$ is 560R

(C) Work done in the process $B \to C$ is 740R

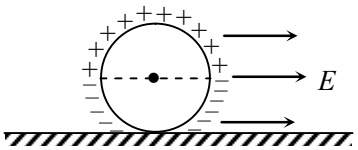
(D) Work done in the process $A \to B \to C$ is 650R

SECTION - 3

SINGLE CHOICE CORRECT TYPE

Section 3 contains **4 Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

15. A non-conducting spherical shell of radius R having charge distribution $+q$ and $-q$ is released from rest on a horizontal non-conducting rough surface as shown in figure. A horizontal uniform electric field E exists in the region. The initial value of friction force so that the sphere does not slip is:



(A) qE **(B)** $\frac{3qE}{5}$ **(C)** $\frac{qE}{4}$ **(D)** zero

16. In a study of photoelectric effect, experiments are performed using different metals, lights of different wavelengths and different intensities. The observation table given below shows stopping potentials for each case. What will be the value of ϕ_0 and λ_0 respectively? (Take hc = 1240 eV-nm)

Experiment	Metal	Work-function (eV)	Wavelength of light (nm)	Intensity of light (W/m^2)	Stopping potential (V)
1	Metal 1	ϕ_0	$2\lambda_0$	I_0	2.5
2	Metal 2	$3\phi_0$	λ_0	$4I_0$	3.9
3	Metal 3	$2\phi_0$	λ_0	$3I_0$	5

(A) 0.8 eV, 344 nm **(B)** 2.2 eV, 780 nm **(C)** 1.1 eV, 172 nm **(D)** 0.4 eV, 700 nm

17. Diameter of a nail is measured using a vernier caliper which has 1 cm divided into 10 equal divisions on the main scale. Also, vernier scale has 10 equal divisions that are equal to 11 main scale divisions. The measured readings are listed below.

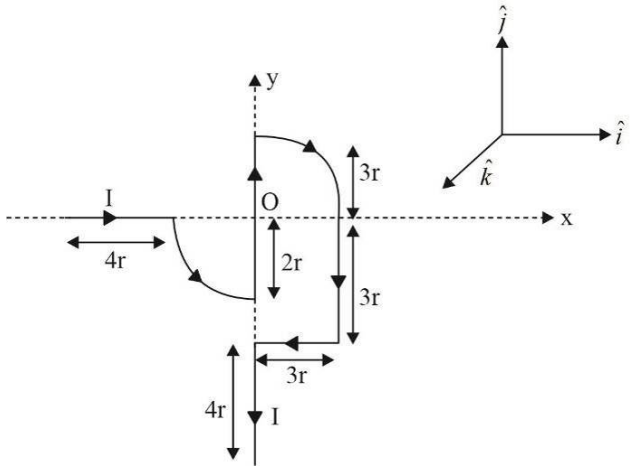
Measurement conditions	Main scale reading	Vernier scale reading
Two jaws are touching each other without nails	0 mm	2^{nd} division coincides (while 0 of veriner scale lies to right of 0 of main scale)
Attempt 1 : With nail	3 mm	3^{rd} division coincides
Attempt 2 : With nail	3 mm	5^{th} division coincides

What are the diameter and cross-sectional area of the nail measured using the veriner calliper.

(A) $(1.9 \pm 0.2)mm,\ \pi(1.42 \pm 0.23)\,mm^2$ **(B)** $(2.8 \pm 0.1)mm,\ \pi(1.96 \pm 0.14)\,mm^2$

(C) $(2.7 \pm 0.2)mm,\ \pi(1.44 \pm 0.12)\,mm^2$ **(D)** $(1.8 \pm 0.1)mm,\ \pi(1.82 \pm 0.08)\,mm^2$

18. Which of the following options represents the magnetic field $\vec{B}$ at the origin due to the current flowing in the given wire segments lying on the x-y plane as shown in the figure?



(A) $\vec{B}_{net} = \dfrac{-\mu_0 I}{6r}\left[\dfrac{5}{12} - \dfrac{1}{2\sqrt{2}\pi}\right]\hat{k}$ **(B)** $\vec{B}_{net} = \dfrac{\mu_0 I}{6r}\left[\dfrac{1}{4} - \dfrac{1}{\sqrt{2}\pi}\right]\hat{k}$

(C) $\vec{B}_{net} = \dfrac{-\mu_0 I}{6r}\left[\dfrac{1}{4} - \dfrac{1}{\sqrt{2}\pi}\right]\hat{k}$ **(D)** $\vec{B}_{net} = \dfrac{\mu_0 I}{6r}\left[\dfrac{1}{8} - \dfrac{1}{\sqrt{2}\pi}\right]\hat{k}$

SPACE FOR ROUGH WORK

SUBJECT II : CHEMISTRY 60 MARKS

SECTION 1

SINGLE DIGIT INTEGER TYPE

This section contains **8 Single Digit Integer Type Questions** ranging from **0 to 9**, Both Inclusive. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer.

1. The solubility of cuprous cyanide $(K_{sp} = 1.2 \times 10^{-15})$ in a buffer solution maintained at pH = 3 is $x \times 10^{-5}$ M. What is the value of x? $(K_a(HCN) = 4.8 \times 10^{-10})$

2. When 2g non-volatile compound A_xB_y containing 90% 'A' by mass is dissolved in 100 g of compound 'M' the vapour pressure of M at 30°C is lowered from 89.78 mm to 89.0 mm. Determine the value of x in the molecular formula of the compound A_xB_y. (Given A_xB_y will not dissociate or associate in compound M)
(Mol. Wt. of M = 78 g/mol, At Wt. of A is 17.96 u and of B is 3.6 u)

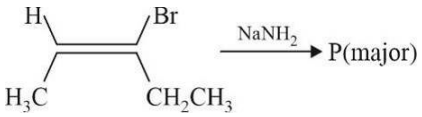
3. The conductivity of saturated solution of sparingly soluble salt, $Ba_3(PO_4)_2$, is 1.2×10^{-5} ohm^{-1} cm^{-1}. The limiting equivalent conductance's of $BaCl_2$, K_3PO_4 and KCl are 160, 140 and 100 ohm^{-1} cm^2 eq^{-1}, respectively. The k_{sp} of $Ba_3(PO_4)_2$ is $a \times 10^{-23}$. Determine the value of 'a' (Round off to nearest integer value).

4. Mixture of common salt and concentrated H_2SO_4 is mixed with manganese dioxide to produce gas 'X'. 2 moles of gas 'X' is completely reacted with _____ moles of acidified ferrous sulphate.

5. Total number of compounds with sp^3 hybridized underlined atom :

$\underline{Xe}O_3, \underline{O}(SiH_3)_2, \underline{N}(CH_3)_3, \underline{C}F_3, \underline{P}Br_5(s), \underline{Be}Cl_2(s), \underline{I}_3^+, \underline{Cl}O_2^-, \underline{Sn}Cl_2\ H_2\underline{O}, \underline{N}(SiH_3)_3, Ca\underline{C}O_3$

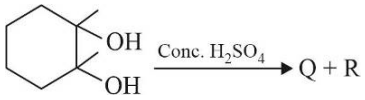
6.



Number of optically active stereoisomers of P is _____.

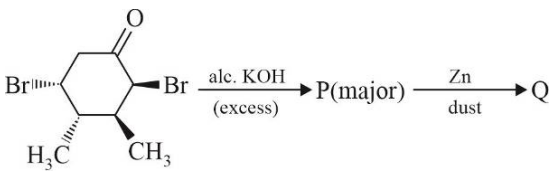
7.

$$CH_3CHO + \underset{\text{(excess)}}{HCHO} \xrightarrow{^-OH} P$$



If R contains a five-membered ring, the sum of tertiary & quaternary carbon atoms in P, Q & R is ___.

8.



If Q undergoes ozonolysis $(O_3, Zn / H_2O)$ then number of possible products is _____.

SECTION 2

MULTIPLE CORRECT ANSWERS TYPE

This Section contains **6 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.

9. Souring of wine occurs when ethanol is converted to acetic acid by oxygen by the following reaction : $C_2H_5OH + O_2 \rightarrow CH_3COOH + H_2O$. A 100 L container of wine labelled as 8.5% (by volume) ethanol is found to have a defective seal. Analysis of 1.00 mL showed that there were 0.024 grams of acetic acid in that 1.00 mL. The density of ethanol is 0.82 g/mL and the density of water is 1.00 g/mL. (Neglect evaporation)

(A) Percent yield for the conversion of ethanol to acetic acid if O_2 is in excess is 0.266%

(B) Mass of ethanol present in 200 mL of wine is 13.94 g

(C) Percent yield for the conversion of ethanol to acetic acid if O_2 is in excess is 26.66%

(D) Mass of ethanol present in 200 mL of wine is 164 g

10. EMF of the cell : $Cd(s)\,|\,CdCl_2 \cdot 5H_2O(sat.)\,|\,Cl^-\,||\,AgCl(s)\,|\,Ag(s)\,|\,Cl^-$ is +0.70 V at 0°C and +0.60 V at 50°C. If $\Delta H°$ and $\Delta S°$ are temperature independent, then the correct information(s) regarding the cell reaction is/are

(A) $\Delta G° = -115.8\,kJ$ at 50°C **(B)** $\Delta G° = 135.1\,kJ$ at 0°C

(C) $\Delta S° = -386\,J/K$ **(D)** $\Delta H° = -221.178\,kJ$

11. The compound(s) which react(s) with NH_3 to give inorganic benzene is(are)

(A) B_2O_3 **(B)** HBF_4 **(C)** B **(D)** B_2H_6

12. During the extraction of copper. Which of the following is not true?

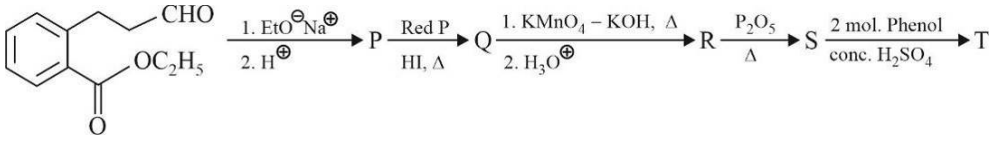
(A) Ore is heated in reverbratory furnace after mixing with silica

(B) Molten matte is electrolysed

(C) $CaCO_3$ is used as a flux to remove impurity

(D) Solidified copper obtained has blister appearance due to evolution of CO_2

13.



The incorrect statement(s) is/are :

(A) Compound S is a carboxylic acid

(B) Compound Q is a hydrocarbon

(C) Enol of compound P is stable due to intramolecular H-bonding

(D) Compound T which is finally formed will be pink-coloured

14. Among the following the correct statement(s) about polymer is(are)

(A) In polymerization of ethylene to polyethylene wilkinson's catalyst is used

(B) Nylons are characterized by high degree of crystallinity

(C) PHBV is obtained by polymerization of 3-hydroxybutanoicacid and 4-hydroxypentanoic acid which undergoes bacterial degradation in the environment

(D) In manufacture of tyre 5% sulphur is used as cross-linking agent

SECTION - 3

SINGLE CHOICE CORRECT TYPE

Section 3 contains **4 Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

15. In a compound XY_2O_4, the oxide ions are arranged in CCP arrangement and cations X are present in octahedral voids. Cations Y are equally distributed between octahedral and tetrahedral voids. The fraction of the octahedral voids occupied is :

(A) $\frac{1}{2}$ **(B)** $\frac{1}{4}$ **(C)** $\frac{1}{6}$ **(D)** $\frac{1}{8}$

16. Reaction of a yellowish white compound 'X' with acetic acid gives a compound 'Y' which on hydrolysis gives an acid 'Z' which can be obtained on heating orthophosphorous acid. Then X is?

(A) PCl_3 **(B)** PCl_5 **(C)** $POCl_3$ **(D)** P_4

17. Which of the following statement is incorrect?

(A) Yellow precipitate of tin sulphide on reaction with HCl releases hydrogen sulphide gas

(B) Copper nitrate react with sodium hydroxide forms Blue colour of copper hydroxide ppt

(C) Lead nitrate react with HCl to form compound which is soluble in hot water

(D) $Bi(OH)_3$ is soluble in dilute HCl to form BiOCl compound

18. Which of the following statement is not correct?

(A) $\text{Glucose} + \text{ROH} \xrightarrow{\text{dry HCl}} \text{Acetal} \xrightarrow[(CH_3CO)_2O]{4\,\text{eq.of}} \text{acetyl derivative}$

(B) Glucose doesnot gives schiff's test for aldehyde

(C) Thymine and proline will not give carbylamine test

(D) Seliwanoff's reagent gives red colour with both aldoses and ketoses

SUBJECT III : MATHEMATICS 60 MARKS

SECTION 1

SINGLE DIGIT INTEGER TYPE

This section contains **8 Single Digit Integer Type Questions** ranging from **0 to 9**, Both Inclusive. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer.

1. If $\frac{\cos\theta_1}{\cos\theta_2}+\frac{\sin\theta_1}{\sin\theta_2}=\frac{\cos\theta_0}{\cos\theta_2}+\frac{\sin\theta_0}{\sin\theta_2}=1$, where θ_1 & θ_0 donot differ by an even multiple of π then $2+\frac{\cos\theta_1\cos\theta_0}{\cos^2\theta_2}+\frac{\sin\theta_1\sin\theta_0}{\sin^2\theta_2}$ is _____.

2. Let $y=g(x)$ is solution of differential equation $g'(x)+g(x)=\frac{2xe^{-x}}{1+g(x)e^{x}}$ such that $g(0)=1$, then $\left[\frac{g(-1)}{e}\right]$ is equal to _____. [where [.] denotes G.I.F.]

3. $I_0=\int_0^1(1-x^9)^{\frac{1}{7}}-(1-x^7)^{\frac{1}{9}}dx$ is equal to _____.

4. If sum of maximum and minimum value of $y=\log_2(x^4+x^2+1)-\log_2(x^4+x^3+2x^2+x+1)$ can be expressed in form $((\log_2 m)-n)$, where *m* and *n* are coprime then value of $(m+n)$ is _____.

5. Let $\lim\limits_{x\to\infty} x\ \ln\left(e\left(1+\frac{1}{x}\right)^{1-x}\right)$ equals $\frac{m}{n}$ where *m* and *n* are relatively prime positive integer. Then $(m+n)=$_____.

6. If A is a non-singular square matrix and $A+(A^T)^2=I$, such that $A^3+I=KA$, then the value of *K* is equal to _____.

7. ABC is a triangle such that $\angle ABC=2\angle BAC$. If now keeping AB fixed, C is moved so that the base angles satisfy the given relationship, showing that C describes a hyperbola, then the eccentricity of hyperbola is _____.

8. Area of the region containing all point (x,y) satisfying $0\le y\le\sqrt{4-x^2}, y\le x^2+x+1$ and $y\le\left[\sin^2\frac{x}{4}+\cos\frac{x}{4}\right]$ is equal to $\frac{a\pi-1}{b}+\sqrt{c}$ sq. units where $a,b,c\in N$, then $a+b-c=$_____. [where [.] denotes G.I.F.]

SECTION 2

MULTIPLE CORRECT ANSWERS TYPE

This Section contains **6 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.

9. In ΔABC, D is a point on BC such that $DB = 14$, $DA = 13$ & $DC = 4$. If the circumcircle of the ΔADB is congruent to the circumcircle of the ΔADC then which of the following is/are correct?

(A) Angle B > 45° but angle C < 45°

(B) Both the angles B and C are greater than 45°

(C) Area of the triangle is 108 sq. units

(D) Measure of angle A equal to $\tan^{-1}\left(\frac{24}{7}\right)$

10. The function $f(x) = x^{1/3}(x-1)$:

(A) has 2 inflection points

(B) is strictly increasing for $x > \frac{1}{4}$ and strictly decreasing for $x < \frac{1}{4}$

(C) is concave down in $\left(-\frac{1}{2}, 0\right)$

(D) area enclosed by the curve lying in the fourth quadrant is $\frac{9}{28}$ sq.units

11. Let function $y = f(x)$ satisfies the differential equation $x^2\frac{dy}{dx} = y^2e^{1/x}(x \neq 0)$ and $\lim\limits_{x\to 0^-} f(x) = 1$.

Identify the correct statement(s).

(A) Range of $f(x)$ is $(0,1) - \left\{\frac{1}{2}\right\}$

(B) $f(x)$ is bounded

(C) $\lim\limits_{x\to 0^+} f(x) = 1$

(D) $\int_0^e f(x)dx > \int_0^1 f(x)\,dx$

12. If $A(\vec{a})$; $B(\vec{b})$; $C(\vec{c})$ & $D(\vec{d})$ are four points such that $\vec{a} = -2\hat{i} + 4\hat{j} + 3\hat{k}$; $\vec{b} = 2\hat{i} - 8\hat{j}$; $\vec{c} = \hat{i} - 3\hat{j} + 5\hat{k}$; $\vec{d} = 4\hat{i} + \hat{j} - 7\hat{k}$, d is the shortest distance between the lines AB and CD, then which of the following is/are correct?

(A) $d = 0$, hence AB and CD intersect

(B) $d = \frac{\left[\overrightarrow{AB}\,\overrightarrow{CD}\,\overrightarrow{BD}\right]}{\left|\overrightarrow{AB}\times\overrightarrow{CD}\right|}$

(C) AB and CD are skew lines and $d = \frac{23}{13}$

(D) $d = \frac{\left[\overrightarrow{AB}\,\overrightarrow{CD}\,\overrightarrow{AC}\right]}{\left|\overrightarrow{AB}\times\overrightarrow{CD}\right|}$

13. The loci of point $P(z)$ in the complex plane satisfying $\left|z+\frac{1}{z}\right|=2$ are two circles C_1 & C_2. These circles :

(A) Have centres on real axis **(B)** Cut each other orthogonally

(C) Are congruent **(D)** Have exactly two common tangents

14. Let A_n be the area that is outside a n-sided regular polygon and inside it's circumscribing circle. Also B_n is the area inside the polygon and outside the circle inscribed in the polygon. Let R be the radius of the circle circumscribing n-sided polygon. Which of the following is/are correct?

(A) If $n=6$ then A_n is $R^2\left(\frac{2\pi-6\sqrt{3}}{2}\right)$ **(B)** If $n=4$ then B_n is $R^2\frac{(4-\pi)}{2}$

(C) If $n=6$ then A_n is $R^2\left(\frac{2\pi-3\sqrt{3}}{2}\right)$ **(D)** If $n=4$ then B_n is $R^2\frac{(4\sqrt{2}-\pi)}{2}$

SECTION - 3

SINGLE CHOICE CORRECT TYPE

Section 3 contains **4 Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

15. $\lim\limits_{n\to\infty}\frac{1^2n+2^2(n-1)+3^2(n-2)+....+n^2\cdot1}{1^3+2^3+3^3+....+n^3}$ is equal to :

(A) $\frac{1}{3}$ **(B)** $\frac{2}{3}$ **(C)** $\frac{1}{2}$ **(D)** $\frac{1}{6}$

16. In a certain factory, machines A, B and C produce bolts. Of their production, machines A, B and C produces 2%, 1% and 3% defective bolts respectively. Machine A produces 35% of the total output of bolts, machine B produces 25% and machine C produces 40%. A bolts is chosen at random from the factory's production and is found to be defective. The probability it was produced on machine C is :

(A) $\frac{6}{11}$ **(B)** $\frac{23}{45}$ **(C)** $\frac{24}{43}$ **(D)** $\frac{3}{11}$

17. The number of solution of the matrix equation $X^2=I$ other than I, is: (Where I is the 2×2 unit matrix)

(A) 0 **(B)** 1 **(C)** 2 **(D)** more than 2

18. A four-digit number is called a doublet if any of its digit is the same as only one neighbour. For example, 1221 is a doublet but 1222 is not. Number of such doublets are :

(A) 2259 **(B)** 2268 **(C)** 2277 **(D)** 2349