VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

Mock JEE Advanced-3 (CBT) | Paper – 2 | JEE 2024

Date: 12/05/2024 **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 Subject has **FOUR** sections (Section 1, Section 2, Section 3 & Section 4).

Section 1 contains **SIX (06)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s). For each question, choose the option(s) corresponding to (all) the correct answer(s).

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

Section 3 contains **THREE (03)** question stems. There are **TWO (02)** questions corresponding to each question stem. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value corresponding to the answer. If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.

Section 4 contains **THREE (03)** questions. The answer to each question is a **NON-NEGATIVE INTEGER.**
For each question, enter the correct integer corresponding to the answer.

2. 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.

3. 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.

4. Rough work is to be done on the space provided for this purpose in the Test Booklet only.

5. 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**.

6. **Do not fold or make any stray mark on the Answer Sheet (OMR).**

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

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

MARKING SCHEME

SECTION-1

- This section contains **SIX (06)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the 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, 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 Marks : 0 If unanswered;
  Negative Marks : −2 In all other cases.
- For example, in a question, if (A), (B) and (D) are the ONLY three options corresponding to correct answers, then
  choosing ONLY (A), (B) and (D) will get +4 marks ;
  choosing ONLY (A) and (B) will get +2 marks ; choosing ONLY (A) and (D) will get +2marks;
  choosing ONLY (B) and (D) will get +2 marks ; choosing ONLY (A) will get +1 mark;
  choosing ONLY (B) will get +1 mark ; choosing ONLY (D) will get +1 mark;
  choosing no option(s) (i.e. the question is unanswered) will get 0 marks and
  choosing any other option(s) will get −2 marks.

SECTION-2

- This section contains **TWO (02) paragraphs**. Based on each paragraph, there are **TWO (02)** 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-3

- his section contains **THREE (03)** question stems. There are **TWO (02)** questions corresponding to each question stem. The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value corresponding to the answer in the designated place using the mouse and the on-screen virtual numeric keypad.
- 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 : +2 If ONLY the correct numerical value is entered at the designated place;
  Zero Marks : 0 In all other cases.

SECTION-4

- This section contains **THREE (03)** questions. The answer to each question is a **NON-NEGATIVE INTEGER**. For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen 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 : +4 If ONLY the correct integer is entered;
  Zero Marks : 0 In all other cases.

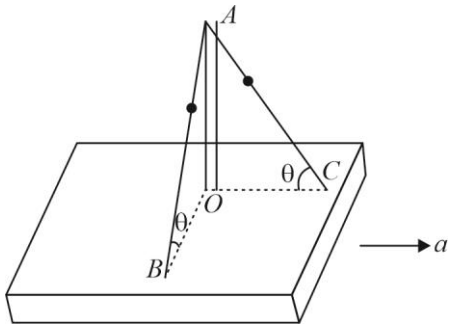
SUBJECT I : PHYSICS 60 MARKS

SECTION-1

This section contains **SIX (06)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s). For each question, choose the option(s) corresponding to (all) the correct answer(s).

1. A horizontal wooden block has a fixed rod *OA* standing on it, from top point *A* of the rod, two wires have been fixed to points *B* and *C* on the block. The plane of triangle *OAB* is perpendicular to the plane of the triangle *OAC*. There are two identical beads on the two wires. One of the wire is perfectly smooth while the other is rough.

The wooden block is moved with a horizontal acceleration *a* that is perpendicular to the line *OB* and it is observed that both the beads do not slide on the wire. Mark the correct options.



(A) The wire which is smooth is wire *AC*

(B) The wire which is smooth is wire *AB*

(C) The minimum coefficient of friction between the rough wire and the bead is $\frac{g\sin\theta}{\sqrt{(g\cos\theta)^2+(a)^2}}$

(D) the minimum coefficient of friction between the rough wire and the bead is $\frac{g\cos\theta}{\sqrt{(g\sin\theta)^2+(a)^2}}$

2. A stationary source *S*, located at the origin, emits a sound of frequency f_s. An observer *O* is moving with constant speed u along the path $xy = 2$, where *x* and *y* are in meters. The moment *O* crosses the point (1, 2), it records the frequency of the sound it hears as f_0. (Take the speed of sound in air as 330m/s). Which of the following statements is/are correct?

(A) For $u = 5$ *m/s*, $f_O = \frac{111}{110} f_s$

(B) For $u = 20$ m/s, $f_O = \frac{114}{110} f_s$

(C) For $u = 5$ m/s, $f_O = \frac{62}{66} f_s$

(D) For $u = 20$ m/s, $f_O = \frac{35}{33} f_s$

3. For an equiconvex lens, the refractive indices of the left half and the right half are, respectively, n_1 and n_2 ($n_2 \geq n_1$) as shown in the figure. An object *O* is placed at a distance 2*R* from the lens, where *R* is the radius of curvature of each surface of the lens.

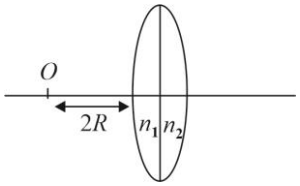


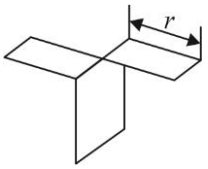
Image distance from the lens is V if $n_1 = n_2 = n = 1.5$ and it is $V + \Delta V$ for the case $n_1 = n$ and $n_2 = n + \Delta n$ (where $\Delta n << n$) (Take R = 10 *cm*)

Which of the following statements is/are correct?

(A) ΔV is proportional to Δn **(B)** The sign of Δn and ΔV are opposite.

(C) $|\Delta V|$ = 0.6 mm if $\Delta n = 1.5\times10^{-3}$ **(D)** $|\Delta V|$ = 0.3 mm if $\Delta n = 1.5\times10^{-3}$

4. A paper helicopter with rotor radius r and weight W is dropped from a height h in air with a density of ρ. Assuming that the helicopter quickly reaches terminal velocity, a function for the time of flight T can be found in the form $T = kh^{\alpha}r^{\beta}\rho^{\delta}W^{\omega}$.



Where k is an unknown dimensionless constant, α, β, δ and ω are constant exponents to be determined. Experimental observation shows that $\alpha = \beta$. Mark the correct options.

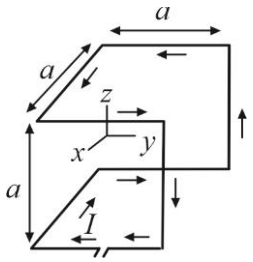
(A) $\alpha = -1$ **(B)** $\alpha = 1$ **(C)** $\delta = \frac{1}{2}$ **(D)** $\omega = -\frac{1}{2}$

5. A $^{238}_{92}\text{U}$ nucleus initially at rest undergoes a radioactive decay emitting an α-particle of energy E_1 and momentum p_1. The daughter nucleus thus formed carries energy E_2 and momentum p_2. Which of the following statements is/are correct?

(A) Daughter nucleus is $^{234}_{90}\text{Th}$ **(B)** $\frac{p_1}{p_2} = 1$

(C) $\frac{E_1}{E_2} = 1$ **(D)** $\frac{E_1}{E_2} = \frac{117}{2}$

6. Current I flows around the wire frame shown below. Magnetic field at the center of the cube is given by: $\vec{B} = B_x\hat{i} + B_y\hat{j} + B_z\hat{k}$



Mark the correct options.

(A) $B_x = B_z = \frac{2\mu_0 I}{\pi a}$ **(B)** $B_x = B_z = 0$

(C) $B_y = \frac{2\mu_0 I}{\pi a}$ **(D)** $B_y = \frac{2\mu_0 I}{\sqrt{3}\pi a}$

SECTION-2

This section contains **TWO (02) paragraphs**. Based on each paragraph, there are **TWO (02)** 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.

Paragraph-I

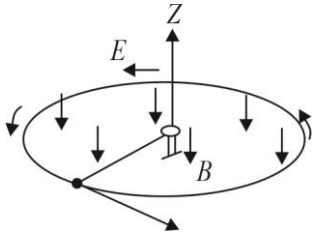
There is an object of mass M and electric charge q, tethered to a fixed point by a cord of fixed length r as shown below. There is a magnetic field B_0 in the negative Z direction, uniform over the whole region. The tension in the

chord and the inward magnetic force together provide the centripetal force that holds the object in its circular orbit moving with uniform speed V_0.

When the field is increased by small amount $\Delta B(\Delta B << B_0)$, an electric field *E* is induced around the circular orbit during the process, which in turn provides tangential acceleration, a_t. It can be found out using the relation,

$$\oint \vec{E}.d\vec{l} = \pi r^2 \frac{dB}{dt} \text{ and } Ma_t = qE$$

The tangential acceleration thus produced during the process results in an increase in speed by ΔV in the final state. The increase in speed of the charge means an increase of $\Delta\mu$ in the upward directed magnetic moment μ, in the final state. The increase in the field and the speed of the charge also imply an increase in inward magnetic force. Hence, the tension in the chord may also change by ΔT in the final state. (Ignore gravity)



7. If $\Delta\mu = \frac{q^2r^2}{\alpha M}\Delta B$, then $\alpha =$

(A) 1 **(B)** 2 **(C)** 4 **(D)** 16

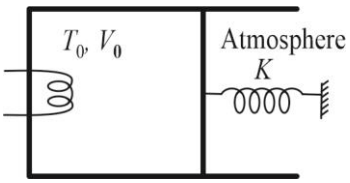
8. If $|\Delta T| = \beta.\frac{B_0}{r}\Delta\mu$, then $\beta =$ _____.

(A) 1 **(B)** 2 **(C)** 4 **(D)** 16

Paragraph-II

A thermally insulating cylinder has a thermally insulating and frictionless movable spring loaded piston of cross-section *A* which is open to atmosphere on the right. Initially the spring is in relaxed state and *K* is its spring constant.

In the chamber, there is one mole of an ideal gas, with specific heat at constant volume $C_V = 2R$. Here, *R* is the gas constant. Initially it has a volume V_0, temperature T_0 and at atmospheric pressure P_0. It has an electric heater, which is turned on at very low power to transfer heat Q to the gas on the left side. As a result the piston moves slowly towards right by a distance x_0. Consequently the gas temperature changes to T'. Ignore the changes of the temperature of the cylinder, heater and the piston. (Take $Kx_0 = P_0A$ and $Ax_0 = V_0$)



9. The value of $\frac{T'}{T_0}$ is:

(A) 2 **(B)** 4 **(C)** 6 **(D)** 8

10. The value of $\frac{Q}{RT_0}$ is:

(A) 2 **(B)** 3 **(C)** 4 **(D)** 7.5

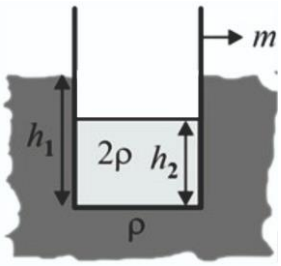
SECTION-3

This section contains **THREE (03)** question stems. There are **TWO (02)** questions corresponding to each question stem. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value corresponding to the answer. If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.

Question Stem for Question Nos. 1 to 2

An empty cylindrical steel flask of mass m and thin walls is floating in a liquid A of density ρ. A liquid B of density 2ρ starts filling the flask gradually at a steady rate k. The figure below shows the situation at some time t after the filling started. The flask has sunk to a depth of h_1 in liquid A and liquid B has risen to a height of h_2 inside the flask. At some time instant $t_1, \frac{h_1}{h_2} = 4$ and at some other instant $t_2, \frac{h_1}{h_2} = 3$.

(Take ρ = 1gm/cc, m = 400 gm and k = 30 cc/minute)

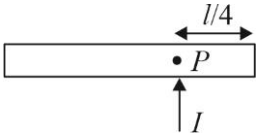


1. The value of t_1 = _____ seconds.

2. The value of t_2 = _____ seconds.

Questions Stem for Questions Nos. 3 to 4

A uniform rod of m = 1 *kg* and length l = 20 *cm* is kept on a frictionless horizontal floor. A horizontal impulse I = 2 *kg m/s* is imparted to the rod at point P perpendicular to its length at some instant as shown below. The angular velocity of the rod is ω and its kinetic energy is k after the impulse is imparted.



3. The value of ω is_____ rad/s.

4. The value of K is _____Joules.

Question Stem for Questions Nos. 5 to 6

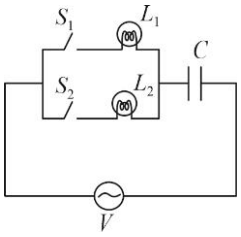
In the circuit shown below, L_1 and L_2 are two purely resistive filament lamps connected to the circuit through switches S_1 and S_2 respectively.

C is a capacitor of reactance $X_C = 100\,\Omega$

V is an AC source of 440V.

When S_1 is closed and S_2 is open, voltage drop across the capacitor is 220V. When S_2 is closed and S_1 is open, voltage drop across capacitor is $220\sqrt{3}V$. Take rms values of the voltages.

When both S_1 and S_2 are closed, voltage drop across the capacitor is V_0 volt and the rms value of current supplied by the source is I amperes. (Take $\sqrt{19} \approx 4.4$)



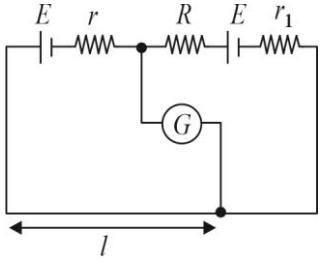
5. The value of V_0 is _____.

6. The value of I is _____ .

SECTION-4

This section contains **THREE (03**) questions. The answer to each question is a **NON-NEGATIVE INTEGER.** For each question, enter the correct integer corresponding to the answer.

7. In order to measure the internal resistance r_1 of a cell of emf E, a meter bridge of wire resistance $R_0 = 60\Omega$, a resistance $R = 20\ \Omega$, another cell of identical emf E and internal resistance $r = 1\ \Omega$ and a galvanometer G are used in a circuit as shown in the figure. If the null point is found at l = 70 cm, then the value of $r_1 =$ _____ Ω.



8. The distance between two stars of masses $3M$ and $6M$ is R. The two starts orbit their common center of mass in circular orbits.

If the total mechanical energy of the binary star system is $-\sqrt{n}\dfrac{GM^2}{R}$, then the value of n is _____.

9. A neutral sphere of radius 5 cm of work function 2.2 eV is suspended in vacuum chamber by an insulating thread. Light of wavelength $0.31\mu m$ strikes the metal surface. Total Number of electrons that will be knocked out of the metal sphere is $n\times10^5$ electrons. The value of n is _____.

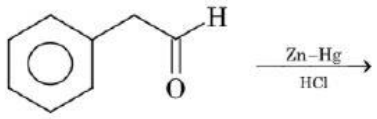
(Take $hc = 1240\times10^{-9}eV$, $e = 1.6\times10^{-19}C$ and $\dfrac{1}{4\pi\varepsilon_0} = 9\times10^9\dfrac{Nm^2}{C^2}$)

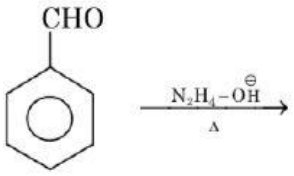
SUBJECT II : CHEMISTRY 60 MARKS

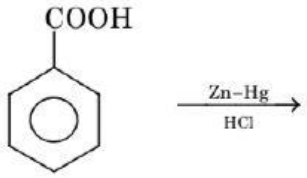
SECTION-1

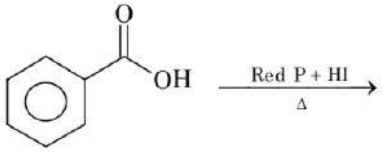
This section contains **SIX (06)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s). For each question, choose the option(s) corresponding to (all) the correct answer(s).

1. Identify the reactions which will yield aromatic hydrocarbons as product?

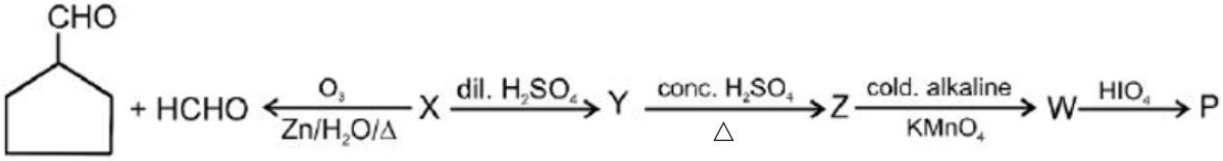
(A) 

(B) 

(C) 

(D) 

2. Observe the following sequence of reaction and answer the related question.



(A) Product P gives positive test with Tollen's reagent

(B) Product Z has degree of unsaturation as 2

(C) Product P shows positive test with I_2 / NaOH

(D) Product P gives positive 2,4 DNP test

3. A container of 2 litre contains 4 moles of N_2O_5. On heating to 100°C, N_2O_5 undergoes complete dissociation to NO_2 and O_2. If rate constant for decomposition of N_2O_5 is $6.2\times10^{-4}\,sec^{-1}$, select the correct statements:

(A) The mole ratio before and after dissociation is 4 : 2

(B) The time required to complete 40% of reaction is 824 sec

(C) $t_{1/2}$ of N_2O_5 is 1117.7 sec and it is dependent of temperature

(D) If volume of container is doubled, the rate of decomposition becomes half of the initial rate

4. The reactions taking place in the dry cell are:

Anode : $Zn \rightarrow Zn^{2+} + 2e^-$

Cathode : $2MnO_2 + 2NH_4^+ + 2e^- \rightarrow Mn_2O_3 + 2NH_3 + H_2O$

The minimum mass of reactants, if a dry cell is to generate 0.25 A for 9.65 h, are (Mn = 55, Zn = 65.4) (neglect any other chemical reactions occurring in the cell)

(A) 2.943 g Zn **(B)** 7.83 g MnO_2

(C) 1.62 g NH_4^+ **(D)** 3.915 g MnO_2

5. Which of the following is/are correct about Tetraamminedithiocyanato-S-cobalt (III) tris (oxalato) cobaltate (III)?

(A) Formula of the complex is $[Co(SCN)_2(NH_3)_4][Co(ox)_3]$

(B) It is a chelating complex and show linkage isomerism

(C) It shows optical isomerism

(D) It shows geometrical isomerism

6. The correct statements about pyrophosphorus acid is/are:

(A) Contains P in +5 oxidation state **(B)** Is a dibasic acid

(C) Is oxidizing in nature **(D)** Contains one P – O – P bond

SECTION-2

This section contains **TWO (02) paragraphs**. Based on each paragraph, there are **TWO (02)** 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.

Paragraph-I

Heat of neutralization is amount of heat evolved or absorbed when 1 g-equivalent of an acid reacts with 1 g-equivalent of a base in dilute solution. If weak acid or weak base are neutralized, the heat released during neutralization is somewhat lesser then 13.7 kcal or 57.27 kJ. Heat of neutralization is also referred as heat of formation of water from H^+ and OH^- ions i.e., $H^+ + OH^- \rightarrow H_2O$; $\Delta H = -13.7$ kcal.

7. Which of the following statements are correct?

I. $\Delta H = \Delta U + \Delta ngRT$

II. Heat changes measured by bomb calorimeter give change in heat enthalpy during the reaction.

III. $\Delta H = \Delta U$ for the reaction : $C(s) + O_2(g) \rightarrow CO_2(g)$

IV. Heat of neutralization of HF a weak acid with NaOH a strong base is greater than 13.7 kcal.

(A) II, III **(B)** I, III **(C)** I, II, III **(D)** I, III, IV

8. 200 mL of 0.1 M NaOH is mixed with 100 mL of 0.1 M H_2SO_4 in I experiment. In II experiment 100 mL of 0.1 M NaOH is mixed with 50 mL of $0.1M$ H_2SO_4. Select the correct statements:

I. Heat liberated in each of the two reactions is 274 cal.

II. Heat liberated in I is 274 cal and in II is 137 cal.

III. Temperature rise in I reaction is more than the temperature rise in II.

IV. Temperature rise in I reaction is equal to the temperature rise in II.

(A) I, III **(B)** II, IV **(C)** II, III **(D)** I, IV

Paragraph-II

A metal complex having composition $Cr(NH_3)_4Cl_2Br$ has been isolated in two forms (X) and (Y). The form (X) reacts with $AgNO_3$ to give a white precipitate readily soluble in dilute aqueous ammonia, whereas (Y) gives a pale-yellow precipitate soluble in concentrated ammonia.

9. X is:

(A) $[Cr(NH_3)_4Cl_2]Br$ **(B)** $[Cr(NH_3)_4BrCl]Cl$

(C) $[Cr(NH_3)_6]Cl$ **(D)** $[Cr(NH_3)_6]Br$

10. 'Y' is:

(A) $[Cr(NH_3)_4Cl_2]Br$ **(B)** $[Cr(NH_3)_4BrCl]Cl$

(C) $[Cr(NH_3)_6]Cl$ **(D)** $[Cr(NH_3)_6]Br$

SECTION-3

This section contains **THREE (03)** question stems. There are **TWO (02)** questions corresponding to each question stem. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value corresponding to the answer. If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.

Question Stem for Question Nos. 1 to 2

The conductivity of 0.001028 M CH_3COOH is $4.95\times10^{-5}\,S\,cm^{-1}$ and $\wedge^{\circ}_{M}$ for CH_3COOH is $390.5 S cm^2 mol^{-1}$. If degree of dissociation is $x\times10^{-2}$ and dissociation constant is $y\times10^{-5}$ then:

1. Find the value of x _____.

2. Find the value of y _____.

Question Stem for Question Nos. 3 to 4

6 gm of magnesium (Mg) is burnt with insufficient amount of oxygen. The residue is treated with 100 ml of H_2SO_4 solution (30% by mass, 1.4 gm/ml density), resulting in an evolution of 3.36 litre of H_2 gas at STP. After the reaction, density of H_2SO_4 solution is found to be 1.25 gm/ml. Assume no change in volume of H_2SO_4 solution. (Molar volume at STP = 22.4)

If % w/w of final H_2SO_4 solution is y% and mass (in gm) of O_2 used is $x\times10^{-1}$ then:

3. The value of x is _____.

4. The value of y is _____.

Question Stem for Question Nos. 5 to 6

A 1.10 g sample of copper ore is dissolved and the Cu^{2+} of this is treated with excess KI. The liberated I_2 requires 12.12 mL of $0.10 M$ $Na_2S_2O_3$ solution for titration.

If % of Cu present in ore is x% & milli equivalents of Cu^{+2} are $y\times10^{-2}$ then:

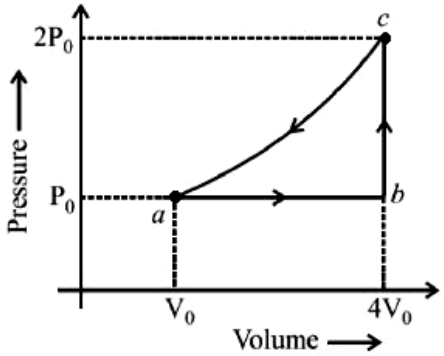
5. Find the value of x _____.

6. Find the value of y _____.

SECTION-4

This section contains **THREE (03**) questions. The answer to each question is a **NON-NEGATIVE INTEGER.** For each question, enter the correct integer corresponding to the answer.

7. One mole of an ideal monoatomic gas is made to go through the cycle shown in figure. Then, the change in internal energy in expanding the gas from a to c along path abc is xRT_0 where T_0 is the temperature of the gas at point a. Calculate x? (Round-off to nearest integer).



8. The value of de-Broglie wavelength of the helium gas at -73°C is M times that of the de-Broglie wavelength of Ne at 727 °C. The value of M is _____.

9. Chlorine on reaction with hot and concentrated NaOH produces two compounds X and Y along with water. If oxidation number of chlorine in X is a and in Y is b (b > a) then find 2b + a.

SUBJECT III : MATHEMATICS 60 MARKS

SECTION-1

This section contains **SIX (06)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s). For each question, choose the option(s) corresponding to (all) the correct answer(s).

1. Let,

$$S_1 = \{(i, j, k) : i < j < k; i, j, k \in \{1, 2, 3, ..., 10\}\}$$

$$S_2 = \{(i, j, k) : i \le j < k; i, j, k \in \{1, 2, 3, ..., 10\}\}$$

$$S_3 = \{(i, j, k, l) : i \le j \le k \le l; i, j, k, l \in \{1, 2, 3, ..., 10\}\}$$

$$S_4 = \{(i, j, k) : i < j > k; i, j, k \in \{1, 2, 3, ..., 10\}\}$$

If the total number of elements is S_r is n_r, for $r = 1, 2, 3,$ then which of the following is/are true?

(A) $n_1 = 120$ **(B)** $n_2 = 165$ **(C)** $n_3 = 715$ **(D)** $n_4 = 285$

2. A triangle *ABC* is such that a circle passing through vertex *C*, centroid *G* touches side *AB* at B. If $AB = 6, BC = 4$ then:

(A) $AG = 2\sqrt{\frac{14}{3}}$ **(B)** $AG = \sqrt{\frac{14}{3}}$ **(C)** $AC = 2\sqrt{14}$ **(D)** $AC = \sqrt{14}$

3. If $f(x) = x^4 - \frac{4}{3}x^3 + 2x^2 + px + q$, where *p, q* $\in$ *R*, then:

(A) $f(x_1) < f(x_2)$ *for* $x_1 > x_2 \ \forall\ x_1, x_2 \in (-\infty, 0)$ is true for all the values of *q*

(B) $f(x_1) > f(x_2)$ *for* $x_1 > x_2 \ \forall\ x_1, x_2 \in (-1, \infty)$ is true for all the values of *p*

(C) $f(x_1) < f(x_2)$ *for* $x_1 > x_2 \ \forall\ x_1, x_2 \in (0, 1)$ is true for infinitely many values of *p*

(D) No values of '*p*' and '*q*' can ensure that the function *f*(*x*) is monotonic in its domain

4. If $2xy\,dy = (x^2 + y^2 + 1)dx,\ y(1) = 0$ and $y(x_0) = \sqrt{3},$ then x_0 can be:

(A) 2 **(B)** –2 **(C)** 3 **(D)** –3

5. The position vectors of the vertices *A*, *B* and *C* of a tetrahedron are (1, 1, 1), (1, 0, 0) and (3, 0, 0) respectively. The altitude from the vertex *D* to the opposite face ABC meets the median line through A of the ΔABC at a point *E*. If the length of side AD is 4 and volume of the tetrahedron is $\frac{2\sqrt{2}}{3}$ then the correct statement(s) is/are:

(A) The altitude from the vertex *D* is 2

(B) There is exactly one position for the point *E*

(C) There can be two positions form the point *E*

(D) Vector $j - k$ is normal to the plane ABC

6. *PQ* is a double ordinate of the parabola $y^2 = 8x$. If the normal at *P* intersect the line passing through Q and parallel to *x*-axis at *G*, then locus of *G* is a parabola then which of the following is/are FALSE:

(A) vertex (9, 0) **(B)** focus (12, 0)

(C) directrix as the line *x* = 6 **(D)** length of latus rectum equal to 10

SECTION-2

This section contains **TWO (02) paragraphs**. Based on each paragraph, there are **TWO (02)** 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.

Paragraph-I

The locus of a point $P(x, y)$ is defined as the path travelled by the moving point under certain mathematical constraint. Let $P(x, y)$ be a moving point in the plane and it moves such that the mathematical constraint $x+y=\left[x^2+y^2\right]$ is always satisfied, where $[x]$ = greatest integer less than or equal x. Let the curve denoting the locus of point P be S.

7. The curve S is:

(A) A line **(B)** A union of line segments

(C) A circle **(D)** A Union of circles

8. The length of the curve is:

(A) 1 unit **(B)** 4 units

(C) $4+\sqrt{6}$ units **(D)** $4+\sqrt{6}-\sqrt{2}$ units

Paragraph-II

Let $f, g:(0,\infty)\to\mathbb{R}$ be two functions defined by $f(x)=\int_{-x}^{x}(|t|-t^2)e^{-t^2}dt$ and $g(x)=\int_0^{x^2}\sqrt{t}e^{-t}dt$, then:

9. Which if the following statements is TRUE?

(A) f is a one-one function **(B)** f is increasing in $(1,\infty)$

(C) f is surjective **(D)** f is differentiable

10. $f(x)+g(x)$ is equal to:

(A) x **(B)** $2x$ **(C)** e^{-x^2} **(D)** $1-e^{-x^2}$

SECTION-3

This section contains **THREE (03)** question stems. There are **TWO (02)** questions corresponding to each question stem. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value corresponding to the answer. If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.

Question Stem for Question Nos. 1 to 2

Tangents are drawn to the parabola $y^2=4x$ from the point $P(6,5)$ to touch the parabola at Q and R (abscissa of Q is lesser than abscissa of R). C_1 is a circle which touches the parabola at Q and C_2 is a circle which touches the parabola at R. Both the circles C_1 and C_2 pass through the focus of the parabola. Then

1. Six time the area of the ΔPQR equals …… .

2. If radius of the circle C_2 is $5\sqrt{k}$ then k is equal to …… .

Question Stem for Question Nos. 3 to 4

Consider the equation $E_1: 4^x+6^{x^2}=5^x+5^{x^2}$ and the expression E_2 :

$|x-1|+|x-2|+|x-3|+...+|x-100|$

Let $x_i, i\in\{1,2,...\}$ be the solution of the equation E_1 and $y_i, i\in\{1,2,...\}$ be the integral values of x for which the expression E_2 is minimum, then:

3. The total number of such numbers x_i is:

4. The sum of all such values of y_i is:

Question Stem for Question Nos. 5 to 6

Consider functions f and g defined on $\mathbb{R}$ such that:

$f(x)=\sqrt[3]{2x^3-3x^2-x+1}$ and $g(x)=(2x-1)^2$ such that $f:\mathbb{R}\to\mathbb{R}$ and $g:\mathbb{R}\to\mathbb{R}$

5. $\int_0^1 f(x)dx$ is equal to:

6. $\int_0^1 f(x)g(x)dx$ is equal to:

SECTION-4

This section contains **THREE (03**) questions. The answer to each question is a **NON-NEGATIVE INTEGER.** For each question, enter the correct integer corresponding to the answer.

7. Nine number 1, 2, 3,…., 9 are put into a 3 × 3 array so that each number occur exactly once. If the probability that the sum of the numbers in atleast one horizontal row is greater than 21 is $\frac{p}{q}$ (p and q are coprime) then $p + q$ = _____.

8. Let E be an ellipse whose axes are along co-ordiante axes and distance between foci is 8 units. At any point P on E, tangent and normal are drawn which cut the co-ordinate axes at A, B and A', B' respectively. If Δ_1 and Δ_2 are the areas of triangles OAB and $OA'B'$ (O being origin), then the value of $\Delta_1 \cdot \Delta_2$ is _____.

9. Value of $\int_0^{\pi/4} \frac{x}{\cos x(\sin x+\cos x)}dx-\int_0^1 \frac{\sin^{-1}x}{4x}dx=$_____.