VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE ADVANCED BOOSTER TEST-4

JEE 2024

Date	Timing	Maximam Marks	Duration
27th November, 2023	4:00 PM - 7:00 PM	177	3 Hours

General Instructions

1. The question paper consists of 3 Subjects (Subject I: **Physics**, Subject II: **Chemistry**, Subject III: **Mathematics**). Each Subject has **two** sections (Section 1 & Section 2).

2. **Section 1** contains **3 types** of questions **[Type A, Type B and Type C].**

Type A contains **Five (05) Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

Type B contains **Five (05) 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.

Type C contains **ONE (01) paragraph**. Based on the 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.

3. **Section 2** contains **6 Numerical Value Type Questions**. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. *In the OMR, do not bubble the ⊕ sign for positive values. However, for negative values, Θ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)

4. For answering a question, an ANSWER SHEET (OMR SHEET) is provided separately. Please fill your **Test Code, Roll No.** and **Group** properly in the space given in the ANSWER SHEET.

Syllabus:

Physics : Ray Optics, Wave Optics, Liquids, POM
Chemistry : OCOC - 3, NCOC, Acidity and Basicity, Coordination Compounds, d - Block, Biomolecules, Thermochemistry, Thermodynamics
Mathematics : IC - I, IC - 2, Differential Equations, Vectors, Complex Numbers, Sequence and Series

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

Candidate's Signature : _____ Invigilator's Signature _____

MARKING SCHEME

SECTION-1 | Type A

- This section contains **Five (05)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the 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-1 | Type B

- This section contains **Five (05)** 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 (D) will get +2 marks;
  choosing ONLY (A) 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-1 | Type C

- This section contains **ONE paragraphs**. Based on each paragraph, there are **TWO** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme;

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

SECTION - 2

- This section contains **6 Integer Type Questions**. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. *In the OMR, do not bubble the ⊕ sign for positive values. However, for negative values, Θ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)
- Answer to each question will be evaluated according to the following marking scheme:

  Full Marks: +3 If ONLY the correct Integer value is entered. There is **NO negative marking.**
  Zero Marks: 0 In all other cases.

SUBJECT I : PHYSICS 59 MARKS

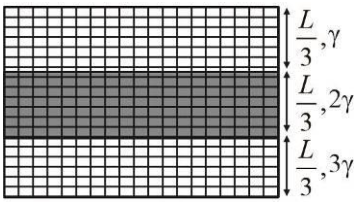
SECTION-1 | Type A

This section consists of 5 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

1. A point source of heat having power P is placed at the centre of a spherical shell of inner radius r_1 and outer radius r_2. The material of the shell has thermal conductivity K. If the average temperature gradient across the shell at steady state should not exceed unity, then the product of the radii of the shell should not be less than :

(A) $\frac{P}{4\pi K}$ **(B)** $\frac{2\pi P}{K}$ **(C)** $\frac{\pi P}{2K}$ **(D)** $\frac{4P}{\pi K}$

2. Three immiscible liquids are filled in a container as shown. The base area of the container is A and coefficient of cubical expansion of the material of the container is $\frac{3\gamma}{2}$ while the coefficient of cubical expansion of the liquids are shown in the figure. The temperature of the system is increased by ΔT. The volume of the liquid flown out of the container is

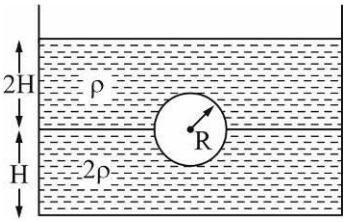


(A) $\frac{Al\gamma\Delta T}{3}$ **(B)** $Al\gamma\Delta T$

(C) $\frac{2Al\gamma\Delta T}{3}$ **(D)** $\frac{Al\gamma\Delta T}{2}$

SPACE FOR ROUGH WORK

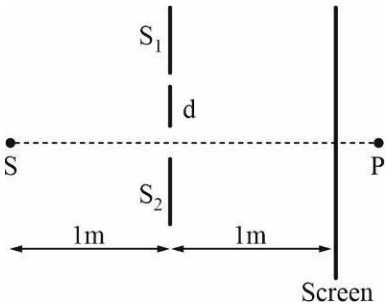
3. A spherical ball of radius R is floating at the interface of two liquids with densities ρ and 2ρ. The volumes of the ball immersed in two liquids are equal. Find the force exerted by the liquid with density 2ρ on the ball.



(A) $\pi R^2 \rho g\left(H+\frac{2R}{3}\right)$ **(B)** $\frac{2}{3}\pi R^2 \rho g$

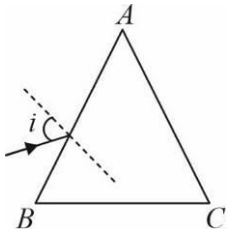
(C) $\frac{4}{3}\pi R^2 \rho g$ **(D)** $2\pi R^2 \rho g\left(H+\frac{2R}{3}\right)$

4. In an arrangement shown in the figure, $d << D$, where d is the distance of separation of the slits S_1 and S_2 and D is the distance between the slits and the screen. Source S is emitting monochromatic light of wavelength λ. Minimum value of d for which dark fringe is formed at P is:



(A) $\sqrt{\frac{\lambda}{2}}$ **(B)** $\sqrt{\frac{\lambda}{3}}$ **(C)** $\sqrt{2\lambda}$ **(D)** $\sqrt{\frac{\lambda}{4}}$

5. A ray of light is incident on face AB of an equilateral prism ABC of refractive index $\sqrt{3}$ placed in air, at an angle of incidence i. After entering the prism, the ray strikes the face AC first. The ray suffers total internal reflection at face AC if:



(A) $i > \sin^{-1}\left(\frac{\sqrt{6}-1}{2}\right)$ **(B)** $i < \sin^{-1}\left(\frac{\sqrt{6}-1}{2}\right)$

(C) $i < \sin^{-1}\left(\frac{2\sqrt{3}-1}{3}\right)$ **(D)** $i > \sin^{-1}\left(\frac{2\sqrt{3}-1}{2}\right)$

SPACE FOR ROUGH WORK

SECTION-1 | Type B

This section consists of 5 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.

6. A planoconvex lens $(\mu = 1.5)$ of focal length 20 cm has its plane side silvered. Which of the following statement(s) is/(are) correct?

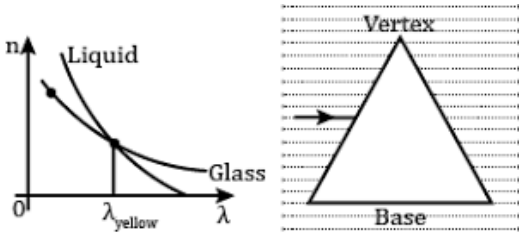
(A) The radius of curvature of its curved surface is half that of a surface of equiconvex lens of focal length 20 cm made of same material

(B) An object placed at 15 cm on the axis on the convex side gives rise to an image at a distance of 30 cm from it

(C) An object placed at a distance of 20 cm on the axis on the convex side gives rise to an image at 40 cm from it

(D) It acts as a convex mirror

7. A glass prism is immersed in a hypothetical liquid. The curves showing the refractive index n as a function of wavelength λ for glass and liquid are as shown in the figure. When a ray of white light is incident on the prism parallel to the base, then choose the correct option(s).



(A) Yellow ray travels without deviation **(B)** Blue ray is deviated towards the vertex

(C) Red ray is deviated towards the base **(D)** There is no dispersion

8. YDSE is performed with slits having width a and separation between the slits as 'd'. Light of wavelength λ is used and distance between screen and plane of slits is kept $D[D >> d, a]$. Which of the following statement(s) is/(are) correct?

(A) If $a = \lambda$, no diffraction minima will be obtained on screen

(B) With increase in 'a' keeping other parameters constant, number of interference maxima within central maxima of diffraction pattern decreases

(C) If d is increased, more interference maxima will lie in central maxima of diffraction pattern

(D) With increase in λ fringe width of interference increases and no. of maxima of interference within central maxima decrease

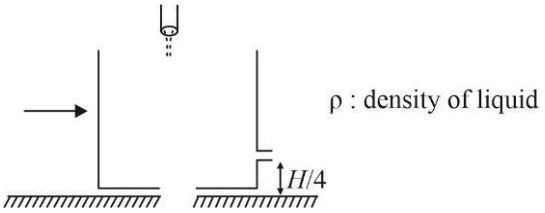
SPACE FOR ROUGH WORK

9. A beam of light is incident on a mirror and after reflection forms a real image. The beam incident on the mirror can be:

(A) parallel if the mirror is concave **(B)** converging if the mirror is convex

(C) diverging if the mirror is plane **(D)** converging if the mirror is plane

10. An empty cylindrical vessel of height *H* and area A is kept on a smooth horizontal table. Vessel has a small hole of area *a* in its side wall at a distance $\frac{H}{4}$ from bottom and another hole at its bottom also with area *a*. Initially side hole is kept closed with a plug and vessel is filled by placing it below a tap supplying it water at a constant volume rate $Q\left(\frac{Q^2}{a^2gH}=1\right)$, after sometime level of liquid in the container becomes constant, equal to h_1. Now tap is closed, the side plug is opened and bottom plug is closed, a force F is applied along horizontal to the vessel to keep it at rest. Choose the correct alternative(s) : [Assume table has a hole so that bottom hole is open to atmosphere]



(A) $h_1=\frac{H}{2}$

(B) Value of force F just after the plug is opened is $\frac{\rho gHa}{2}$

(C) Time for level of water to reach the level of side hole from the moment plug was opened is $\frac{A}{a}\sqrt{\frac{H}{2g}}$

(D) If the tap was not closed while the bottom hole was closed & side hole opened then after long time a steady level of $\frac{3H}{4}$ will be present in vessel

SPACE FOR ROUGH WORK

SECTION-1 | Type C

This section consists of ONE (01) paragraph. 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.

PARAGRAPH FOR Q-11 & 12

In YDSE two coherent wave interfere to produce resultant Intensity. Depending on the Phase difference ϕ, the resulting Intensity (I) = $I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$. The phase difference ϕ between two waves at a point will depend upon

(a) The difference in path lengths of the two waves from their respective sources.

(b) The refractive index of the medium

(c) Initial phase difference, between the source, if any

(d) Reflections, if any, in the path followed by waves

In case of light waves, the phase difference on account of path difference

$$= \left[\frac{\text{Optical path difference}}{\lambda}\right]\times 2\pi = \left[\frac{\mu(\text{Geometrical path difference})}{\lambda}\right]2\pi$$

where λ is the wavelength in free space.

11. Two slits S_1 and S_2 illuminated by a white light source give a white central maxima. A transparent sheet of refractive index 1.25 and thickness t_1 is placed in front of S_1. Another transparent sheet of refractive index 1.50 and thickness t_2 is placed in front of S_2. If central maxima is not effected, then ratio of the thickness of the two sheets will be:

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

12. In Young's double slit experiment, distance between the slits S_1 and S_2 is *d* and the distance between slits and screen is *D*. Then first missing wavelength on the screen in front of S_1 is:

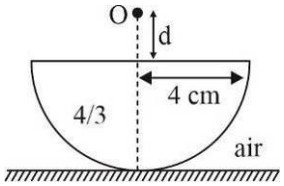
(A) $\frac{d^2}{D}$ **(B)** $\frac{d^2}{2D}$ **(C)** $\frac{D}{d^2}$ **(D)** $\frac{d^2}{3D}$

SPACE FOR ROUGH WORK

SECTION-2

This section consists of 6 Numerical Value Type Questions. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. *In the OMR, do not bubble the ⊕ sign for positive values. However, for negative values, Θ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)

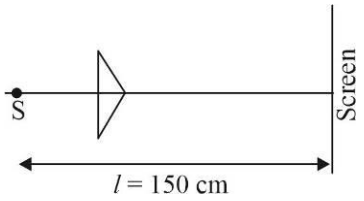
1. A glass hemisphere of refractive index $\frac{4}{3}$ and of radius 4 cm is placed on a plane mirror. A point object is placed at distance *d* on axis of this sphere as shown in figure. If the final image is at infinity, find the value of *d* in cm.



2. Two separate wires A and B are stretched by 2 *mm* and 4 *mm* respectively, when they are subjected to a force of 2N. Assume that both the wires are made up of same material and the radius of wire B is 4 times that of the radius of wire A. The length of the wires A and B are in the ratio of a : b. Then $\frac{a}{b}$ can be expressed as $\frac{1}{x}$ where *x* is _____ .

SPACE FOR ROUGH WORK

3. A narrow-slit *S* allows monochromatic light of wavelength $\lambda = 4000\,\text{Å}$ to fall on a prism of very small angle as shown in the figure. A screen is placed at a distance $l = 150\,cm$ from the source. To determine the distance between the virtual images formed by the prism an experiment is done. The prism and screen are kept fixed, and a converging lens is moved between the prism and the screen. For two positions of the lens (between the prism and the screen) we get two sharp point images on the screen in each case. The images are separated from each other by distance 4.5 mm in one case and 2 mm in the other. Find the focal length of the lens (in cm).



4. A metal block is placed in a room which is at 10°C. It is heated by an electric heater of power 500 W till its temperature becomes 50°C (Neglect any heating losses to the surrounding). Its initial rate of rise of temperature is 2.5°C/sec. The heater is switched off and now a heater of 100W is required to maintain the temperature of the block at 50°C. (Assume Newtons Law of colling to be valid). If the rate of cooling of block at 50°C after switching off the 100W heater is $\frac{1}{n}°C/s,$ find *n*.

5. A soap bubble of radius 3 cm is formed inside the another soap bubble of radius 6 cm. The radius of an equivalent soap bubble which has the same excess pressure as inside the smaller bubble with respect to the atmospheric pressure is _____ cm.

6. Light is incident on water surface $(\mu_w = 4/3).$ Light reflected from the surface is found to be completely polarized. Find angle of deviation of refracted light (in degrees). (Use $\sin 37° = \frac{3}{5}$)

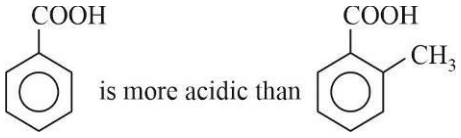
SPACE FOR ROUGH WORK

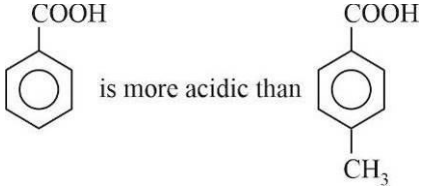
SUBJECT II : CHEMISTRY 59 MARKS

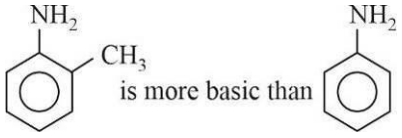
SECTION-1 | Type A

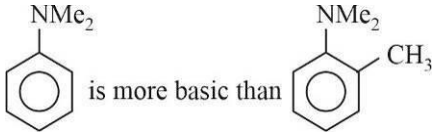
This section consists of 5 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

1. Which of the following options is correct?

(A)  is more acidic than

(B) 

(C)  is more basic than

(D) 

2. Select the correct code regarding total number of stereoisomers for the following compounds:

I. $[Ma_3b_2c]^{n\pm}$ **II.** $[M(AB)_3]^{n\pm}$ **III.** $[Ma_2b_2c_2]^{n\pm}$

	I	II	III		I	II	III
(A)	4	4	6	**(B)**	4	3	5
(C)	3	3	5	**(D)**	3	4	6

3. Manganese ions (Mn^{2+}) can be oxidized by Persulphate ions $S_2O_8^{2-}$. How many moles of $S_2O_8^{2-}$ are required to oxidise 1 mole of Mn^{2+}?

(A) 2.5 **(B)** 2.0 **(C)** 11.0 **(D)** 0.4

SPACE FOR ROUGH WORK

4. Reactions involving gold have been of particular interest to a chemist. Consider the following reactions.

$Au(OH)_3 + 4HCl \rightarrow HAuCl_4 + 3H_2O$; $\Delta H = -28$ kcal

$Au(OH)_3 + 4HBr \rightarrow HAuBr_4 + 3H_2O$; $\Delta H = -36.8$ kcal

In an experiment, there was absorption of 0.44 kcal when one mole of $HAuBr_4$ was mixed with 4 moles of HCl. What is the percentage conversion of $HAuBr_4$ to $HAuCl_4$?

(A) 0.5 % **(B)** 0.6 % **(C)** 5 % **(D)** 50 %

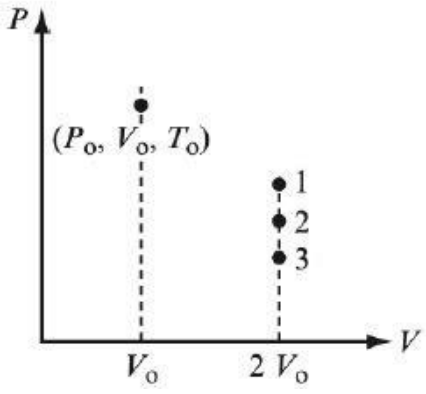
5. If four identical samples of an ideal gas initially at the same state (P_0, V_0, T_0) are allowed to expand to double their volumes by the following processes

Process I: Isothermal reversible process

Process II: Reversible process $P^2V =$ Constant

Process III: Reversible adiabatic process

If the final states of gases are shown by different points in the graph represented, then match each point with the correct process.



(A) I – 3, II – 1, III – 2

(B) I – 2, II – 1, III – 3

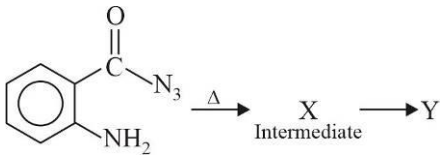
(C) I – 1, II – 2, III – 3

(D) I – 1, II – 3, III – 2

SPACE FOR ROUGH WORK

SECTION-1 | Type B

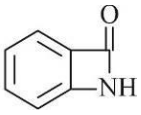
This section consists of 5 Multiple Correct Answers Type Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

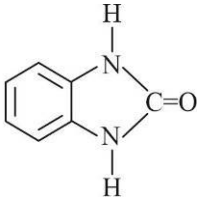
6. 

X and Y are :

(A) X is acyl cation

(B) X is nitrene

(C) Y is 

(D) Y is 

7. A d-block element forms octahedral complex but its magnetic moment remains same either in strong field or in weak field ligand. Which of the following is/are correct?

(A) Element always forms colourless compound

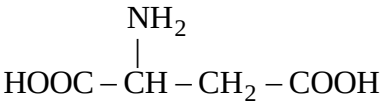
(B) If compound is coloured it will be paramagnetic too

(C) It can have either $d^1 - d^3$ or $d^8 - d^{10}$ configuration

(D) It can have either $d^4 - d^7$ configuration

SPACE FOR ROUGH WORK

8. Which of the following statements correctly describes the migration aptitude of aspartic acid during electrophoresis? $(pK_1 = 2\ ;\ pK_2 = 3.90\ ;\ pK_3 = 10.0)$



(A) At pH = 1 ; aspartic acid will migrate towards anode

(B) At pH = 2.95 ; aspartic acid will not move towards cathode or anode

(C) At pH = 10 ; aspartic acid will migrate towards anode

(D) At pH = 12 ; aspartic acid will migrate towards cathode

9. $\underset{(\alpha)}{C_3H_5N} \xrightarrow{\text{Hydrolysis}} \underset{(x)}{C_3H_6O_2} \xrightarrow[\text{(ii) } H_3O^+]{\text{(i) } Cl_2/P} \underset{(y)}{C_3H_5O_2Cl} \xrightarrow{NH_3} \underset{(z)}{C_3H_7NO_2}$

Correct option(s) is/are for the above reaction

(A) $\alpha = C_2H_5CN$ **(B)** $x = C_2H_5COOH$

(C) $y = H_3C - \underset{\displaystyle Cl}{\underset{|}{CH}} - COOH$ **(D)** $z = H_3C - \underset{\displaystyle NH_2}{\underset{|}{CH}} - COOH$

10. Consider the following transformation:

$2CuX_2 \xrightarrow{\text{Room temperature}} 2CuX + X_2 \uparrow$

Then X^- can be :

(A) F^- **(B)** Cl^- **(C)** CN^- **(D)** I^-

SPACE FOR ROUGH WORK

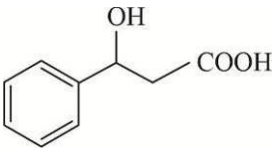
SECTION-1 | Type C

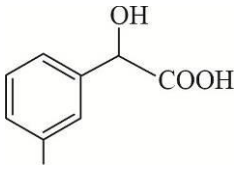
This section consists of ONE (01) paragraph. Based on each paragraph, there are **TWO (02)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

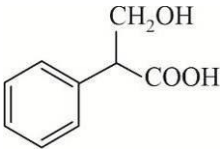
PARAGRAPH FOR Q-11 & 12

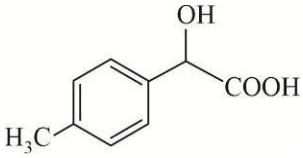
An organic compound X $(C_9H_{10}O_3)$ is optically active. X changes orange colour of $CrO_3 - H_2SO_4$ solution to blue green. X on vigorous oxidation with hot, concentrated, alkaline $KMnO_4$ gives benzoic acid. Also, X on treatment with HBr gives B $(C_9H_9O_2Br)$ with same configuration as that of X.

11. What is the structure of X

(A) 

(B) 

(C) 

(D) 

12. $B \xrightarrow[(ii)\ H_3O^+]{(i)\ NaOH} \xrightarrow[Heat]{H_3PO_4} \xrightarrow[H_2]{(PPh_3)_3RhCl} C$

Which of the following sequence of reaction gives C as the major product?

(A) $Ph - CH_2CH_2Cl \xrightarrow[Et_2O]{Mg} \xrightarrow[(ii)\ H_3O^+]{(i)\ CO_2}$

(B) $Ph - \underset{\displaystyle Cl}{\underset{|}{CH}} - CH_3 \xrightarrow[(ii)\ CO_2]{(i)\ Mg/Et_2O} \xrightarrow{H_3O^+}$

(C) $Ph - CH_2CH_2 - CH = CH_2 \xrightarrow[H_2O_2]{O_3}$

(D) $Ph - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH = CH_2 \xrightarrow[NaOH/Heat]{Conc.\ KMnO_4} \xrightarrow[\Delta]{NaOH-CaO}$

SPACE FOR ROUGH WORK

SECTION-2

This section consists of 6 Numerical Value Type Questions. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. *In the OMR, do not bubble the ⊕ sign for positive values. However, for negative values, Θ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)

1. How many of the below are inner orbital complexes.

(a) $[MnCl_6]^{3-}$ **(b)** $[Fe(NH_3)_6]^{3+}$ **(c)** $[Fe(CN)_6]^{4-}$

(d) $[Co(C_2O_4)_3]^{3-}$ **(e)** $[Ni(NH_3)_6]^{2+}$ **(f)** $[Mn(CN)_6]^{3-}$

(g) $[CoF_3]^{3-}$

2. A slice of banana weighing 2.5 g was burnt in a bomb calorimeter and produced a temperature rise of 3.0 K. In the same calorimeter, combustion of a 0.305 g sample of benzoic acid produced a temperature rise of 4.0 K. The heat of combustion of benzoic acid at constant volume is -800 kcal/mol. If an average banana weighs 125 g, then how many kilo calories can be obtained from one average banana?

3. The diamonds are formed from graphite under very high pressure. At equilibrium pressure $P \times 10^4$ bar graphite is converted into diamond at 25°C. The densities of graphite and diamond are 2.4 and 3.6 g/cm^3 respectively and are independent of pressure. $\Delta G°$ for the conversion of graphite into diamond is 5.0 kJ/mol. Find value of P. (Nearest integer)

SPACE FOR ROUGH WORK

4. How many of the following statement(s) is/are correct?

I. A dipeptide has one peptide link between two amino acids.

II. By convention N-Terminus is kept at left and C- terminus at right in the structure of a peptide.

III. D-mannose and D-galactose are epimers

IV. On changing pH or increasing temperature the primary structure of protein remains intact

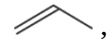
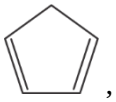
V. D (+) Glucose and D (–) fructose form same osazone

VI. Aldoses are reducing sugars while ketoses are non-reducing sugars

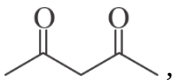
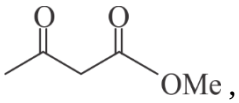
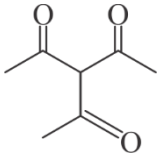
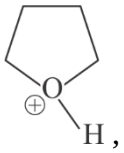
VII. All disaccharides are non-reducing sugars

5. 2.79 gm of nitrogenous compound on reaction with $CHCl_3$ and KOH forms 0.27 moles of KCl. If same amount of nitrogenous compound is reacted with HNO_2, how many litres of gas at STP would be formed? (Round off the answer to nearest integer)

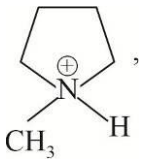
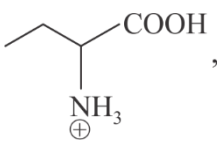
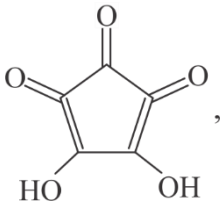
6. Number of compounds which are more acidic than Acetylene.

CH_4,  , $CH_2=CH_2$,  , $CH_3-C\equiv CH$, H_2O,

(1) (2) (3) (4) (5) (6)

 ,  , $CH_2(CN)_2$, $CH(CN)_3$,  ,  ,

(7) (8) (9) (10) (11) (12)

 ,  ,  , Phenol

(13) (14) (15) (16)

SPACE FOR ROUGH WORK

SUBJECT - III : MATHEMATICS 59 MARKS

SECTION-1 | Type A

This section consists of 5 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

1. The solution of differential equation $2x^3ydy+(1-y^2)(x^2y^2+y^2-1)dx=0$.

(A) $x^2y^2=(cx+1)(1-y^2)$ **(B)** $x^2y^2=(cx+1)(1+y^2)$

(C) $x^2y^2=(cx-1)(1-y^2)$ **(D)** $x^2y^2=(cx-1)(1+y^2)$

2. For each positive integer n, define $f_n(x)=\min\left(\frac{x^n}{n!},\frac{(1-x)^n}{n!}\right), 0\le x\le 1$. Let $I_n=\int_0^1 f_n(x)\,dx,\ n\ge 1$

then $\sum_{n=1}^{\infty} I_n$ equals:

(A) $2\sqrt{e}+3$ **(B)** $2\sqrt{e}-3$ **(C)** $2\sqrt{e}$ **(D)** 3

3. $\int e^{x\sin x+\cos x}\left(\frac{x^4\cos^3 x-x\sin x+\cos x}{x^2\cos^2 x}\right)dx=$

(A) $e^{x\sin x+\cos x}\left(x-\frac{1}{\cos x}\right)+C$ **(B)** $e^{x\sin x+\cos x}\left(x-\frac{1}{x\cos x}\right)+C$

(C) $e^{x\sin x+\cos x}\left(1-\frac{1}{x\cos x}\right)+C$ **(D)** $e^{x\sin x+\cos x}\left(1-\frac{x}{\cos x}\right)+C$

4. Let $f, g: R\to[1,\infty)$ are two differentiable functions on the real line satisfying the differential equation $(f^2+g^2)f'+(fg)g'=0,$ then:

(A) f is bounded, but g is not **(B)** f is unbounded, but g is bounded

(C) Both are unbounded **(D)** Both f and $f.\ g$ are bounded

5. The area of the set of points (x,y) in the plane that satisfy the two inequalities $x^2+y^2\le 2$ and $x^4+x^3y^3\le xy+y^4$ is :

(A) π **(B)** $\frac{2\pi}{3}$ **(C)** $\frac{19\pi}{21}$ **(D)** $\frac{3\pi}{2}$

SPACE FOR ROUGH WORK

SECTION-1 | Type B

This section consists of 5 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.

6. Let a, b, c be distinct complex numbers with $|a|=|b|=|c|=1$ and z_1, z_2 be the roots of the equation $az^2+bz+c=0$ with $|z_1|=1$. Also, let points P and Q represents the complex numbers z_1 and z_2 in the complex plane with $\angle POQ=\theta$, where O is the origin, then:

(A) $b^2=ac, \theta=\frac{2\pi}{3}$ **(B)** $\theta=\frac{2\pi}{3}, PQ=\sqrt{3}$

(C) $PQ=2\sqrt{3}, b^2=ac$ **(D)** $\theta=\frac{\pi}{3}, b^2=ac$

7. Let $\int_0^{\pi/2^n} \ln(\sin x)\,dx=a_n$, $\int_0^{\pi/2^n} \ln(\cos x)\,dx=b_n$, then:

(A) $a_1+b_1=-\pi\ln 2$ **(B)** $a_2+b_2=-\frac{\pi}{2}\ln 2$

(C) $a_2+b_2=\frac{\pi}{2}\ln 2$ **(D)** $a_1+b_1=-\frac{\pi}{4}\ln 2$

8. Let $\vec{b}$ and $\vec{c}$ be two non-collinear vectors and $\vec{a}$ is a vector such that $\vec{a}\cdot\left(\vec{b}+\vec{c}\right)=6$ and $\vec{a}\times\left(\vec{b}\times\vec{c}\right)=\left(-x^2-4x+1\right)\vec{b}+\cos y\vec{c}$. Then which of the following equation(s) are satisfied by atleast one ordered pair (x,y).

(A) $2x+y-\pi+4=0$ **(B)** $x-y+2\pi+2=0$

(C) $x=-2$ **(D)** $7x-y+15\pi+14=0$

SPACE FOR ROUGH WORK

9. If the complex number z satisfies $|iz+2| = \text{Im}(z)$, then:

(A) minimum value of $|z|$ is 1

(B) maximum value of $|z|$ is $\sqrt{5}$

(C) minimum value of arg z is $\frac{\pi}{4}$

(D) maximum value of arg z is $\frac{3\pi}{4}$

10. $\int \frac{x^4+1}{x^6+1}dx$ is:

(A) $\tan^{-1}x + \frac{1}{3}\tan^{-1}(x^3) + c$

(B) $\frac{1}{3}\tan^{-1}\left(\frac{3x-3x^5}{1-3x^2-3x^4+x^6}\right)+c$

(C) $\frac{1}{3}\tan^{-1}\left(\frac{2x-x^4}{1-2x^5-3x^2}\right)+c$

(D) $\frac{1}{2}\tan^{-1}\left(\frac{x-x^3-1}{1-x^4-3x^5}\right)+c$

SPACE FOR ROUGH WORK

SECTION-1 | Type C

This section consists of ONE (01) paragraph. 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.

PARAGRAPH FOR Q-11 & 12

Consider two curves $y = f(x)$ passing through (0, 1) and the curve $g(x) = \int_{-\infty}^{x} f(t)\,dt$ passing through $\left(0, \frac{1}{2}\right)$. The tangents drawn to both curves at the point with equal abscissas intersect on the *x*-axis.

11. $\lim\limits_{x \to 0} \dfrac{f^2(x) - 1}{x}$ equals:

(A) 4 **(B)** 5 **(C)** 6 **(D)** 7

12. The area bounded by the *x*-axis, the tangent and normal to the curve $y = f(x)$ at the point where it cuts the *y*-axis, is $\frac{a}{b}$ (HCF of *a*, *b* is 1), then $a + b$.

(A) 8 **(B)** 9 **(C)** 10 **(D)** 11

SPACE FOR ROUGH WORK

SECTION-2

This section consists of 6 Numerical Value Type Questions. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. *In the OMR, do not bubble the ⊕ sign for positive values. However, for negative values, Θ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)

1. The area enclosed by $\left[\frac{|3x+4y|}{5}\right]+\left[\frac{|4x-3y|}{5}\right]=3$ is (where [.] denotes the greatest integer function)

2. Let $S_n(x)=\frac{1}{(1+x)(1+2x)}+\frac{1}{(1+2x)(1+3x)}+\frac{1}{(1+3x)(1+4x)}+.....+\frac{1}{(1+nx)(1+(n+1)x)}$ then the value of $S_{50}\left(\frac{1}{3}\right)=\frac{m}{n}$, where *m*, *n* are coprime then $(m+n)$ is equal to _____.

3. Let $f(x)$ & $g(x)$ be two differentiable functions defined form $R\to R$ such that $f(x)=\cos x-\cos^3 x$ and $g(x)=x^2-\frac{\pi^2}{4}$. If area of the region bounded by $y=f(x)$ and $g(x)$ is $\left(\frac{2}{3}+\frac{\pi^3}{a}\right)$. Then the number of ordered pairs (x, y) satisfying xy = a (where $x,y\in z$) is _____.

SPACE FOR ROUGH WORK

4. Let T_n be the n[th] term of a series for $n \geq 1$ and $T_1 = 1, T_{n+1} = 2T_n + 4^n, n \geq 1$. If $S_n =$ Sum of first n terms of the series and $S_n = \dfrac{a.4^n + b.2^n + 1}{3}$ where $a, b \in I$, then the value of $\left|\dfrac{b}{a}\right|$ is _____.

5. Let $\vec{a}, \vec{b}, \vec{c}$ be three vectors satisfying $\vec{a} = \vec{b} \times \vec{c} + 2\vec{b}$, where $\left|\vec{b}\right| = \left|\vec{c}\right| = 2$ and $\left|\vec{a}\right| = 4$, then sum of all possible values of $\left|2\vec{a} + \vec{b} + \vec{c}\right|$ is _____.

6. Given that $U_n = (x(1-x))^n, n \geq 2$ and further if $V_n = \int_0^1 e^x U_n dx$ then for $n \geq 2$ we have $V_{100} + K_1 V_{99} + K_2 V_{98} = 0$. Then $\dfrac{K_1 + K_2}{5980}$ is equal to _____.

SPACE FOR ROUGH WORK

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