VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Advanced Home Practice Test -7 | Paper -1 | JEE 2024

Date: 10/05/2024 **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).

2. **Section 1** contains **SIX (06) 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 2 contains **8 Numerical Value Type Questions**. 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).

Section 3 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.

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)

- 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 – 2 (Maximum Marks: 24)

- This section contains **8 Numerical Value Type Questions**. 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.

Zero Marks: 0 In all other cases.

SECTION – 3 (Maximum Marks: 12)

- 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.

SUBJECT I : PHYSICS 60 MARKS

SECTION 1

This section consists of 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.

1. Choose the correct statement(s) from the following:

(A) A constant force acting on a particle for equal time intervals can produce different change in momentum but same change in kinetic energy

(B) A constant force acting on a particle for equal displacement can produce different change in kinetic energy but same change in momentum

(C) A constant force acting on a particle for equal time intervals can produce the same change in momentum but different change in kinetic energy

(D) A constant force acting on a particle for equal displacements can produce the same change in kinetic energy but different change in momentum

2. The potential energy φ, in joule, of particle of mass 4 kg, moving in the x – y plane, obeys the law $\varphi = 12x + 16y$, where (x, y) are the coordinates of the particle in metre. If the particle is at rest at (6, 4) at time $t = 0$, then which of these options is(are) correct?

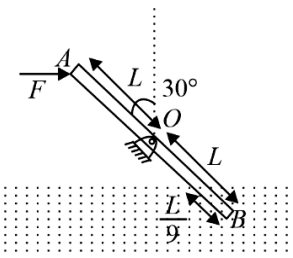
(A) The particle has constant acceleration

(B) The work done by the external forces, from the position of rest to the instant crossing the x-axis is 25 J

(C) The speed of the particle when it crosses the y-axis is 10 ms^{-1}

(D) The coordinate of the particle at time $t = 4$ s are (–18, –28)

3. A rod of length $2L$ and cross-sectional area A_0 is kept in a liquid of density ρ and is pivoted at point O in a vertical plane. The rod makes angle $30°$ with the vertical with a length of $L/9$ immersed in the liquid. The mass density of rod is linearly increasing from O on both sides as given by equation $\lambda = \lambda_0\left(1+\frac{x}{L}\right)$, where λ_0 is constant and x is distance form point O on either side. Rod is held in vertical plane by applying a force at end A in horizontal direction. Then, choose the correct options.



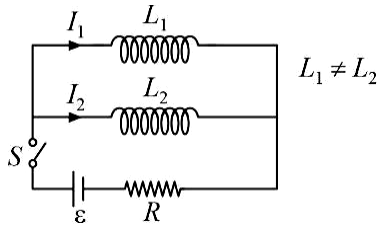
(A) center of mass of rod OA is at a distance $\frac{4L}{9}$ from point A.

(B) Mass of rod AB is $\frac{3\lambda_0 L}{2}$.

(C) Applied force at end A is $\frac{17}{162\sqrt{3}}LA_0\rho g$.

(D) Buoyant force will act at the center of mass of the part of rod inside the liquid.

4. In the circuit shown in figure, the switch is closed at $t = 0$. Let I_1 and I_2 represent the current flowing in the inductor L_1 and L_2 respectively after closing the switch. Which of these options is(are) correct?



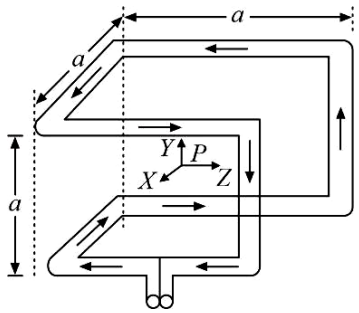
(A) At any time t, $I_1 = I_2$

(B) At any time t, $\frac{I_1}{I_2} = \frac{L_2}{L_1}$

(C) At $t = 0^+$, $I_1 = I_2 = 0$

(D) At $t = \infty$, $I_1 + I_2 = \frac{\varepsilon}{R}$

5. Current I flows around the wire frame along the edges of a cube as shown in figure. Point 'P' is the centre of the cube. The incoming and outgoing wires have orientation towards P. Then, which of these options is(are) correct?



(A) The magnetic field at P is towards $+z$ direction

(B) The magnetic field at P is towards $-z$ direction

(C) The unit vector in the direction of magnetic field at P is $-\frac{1}{\sqrt{2}}(\hat{i} - \hat{j})$

(D) The magnitude of magnetic field at P is $B_P = \frac{2\mu_0 I}{\pi\sqrt{3}a}$

6. One mole of an ideal gas, whose adiabatic exponent equal to γ, is expanded so that the amount of heat transferred to the gas is equal to the decrease in internal energy. Choose the correct options.

(A) Molar specific heat of the gas in this process is $\left(-\frac{R}{\gamma - 1}\right)$

(B) The equation of the process is TV = constant

(C) The equation of the process is $TV^{\left(\frac{1-\gamma}{2}\right)} = \text{Constant}$

(D) Molar specific heat of the gas in this process is $\left(\frac{\gamma R}{1 - r}\right)$

SPACE FOR ROUGH WORK

SECTION 2

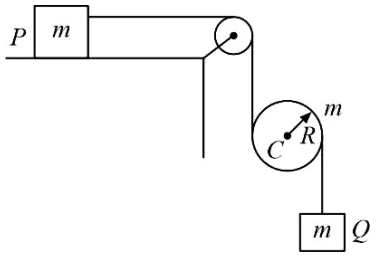
NUMERICAL VALUE TYPE QUESTIONS

Section 2 contains **8 Numerical Value Type Questions**. 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).

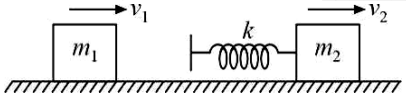
7. The component of vector $2\hat{i}-3\hat{j}+2\hat{k}$ perpendicular to $\hat{i}+\hat{j}+\hat{k}$ has magnitude equal to $\sqrt{a}$ units, where a is _____.

8. A heavy but uniform rope of length $L=6m$ is suspended from a ceiling. A particle is dropped from the ceiling at the instant when the bottom end is given a transverse wave pulse. The particle meets the pulse after the pulse has travelled a distance_____ (in m).

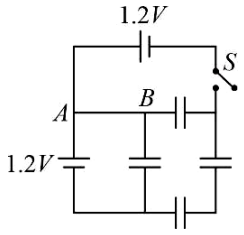
9. Two blocks each of mass m and a cylinder C are connected as shown in figure. Angular acceleration of the cylinder C of radius R is xg/R (all strings and pulley are ideal). Then the value of x is _____.



10. Two blocks of masses $m_1=2kg$ and $m_2=4kg$ are moving in the same direction with speeds $v_1=6\,m/s$ and $v_2=3\,m/s$, respectively on a frictionless surface as shown in figure. An ideal spring with spring constant k = 30000 N/m is attached to the back side of m_2. Then the maximum compression of the spring (in cm) during collision will be _____.



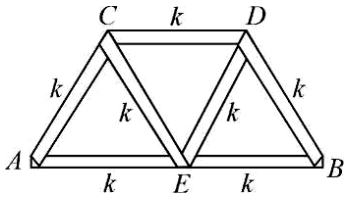
11. Find the charge $(\text{in } \mu C)$ that will flow through the wire A to B if the switch S is closed. The capacitance of each capacitor shown in the figure is $C=4.5\ \mu F$.



12. The diameter of a wire of length 100 cm is measured with the help of a screw gauge. The main scale reading is 1 mm and circular scale reading is 25. Pitch of the screw gauge is 1 mm and the total number of divisions on the circular scale is 100. The wire is used in an experiment for determination of Young's modulus of the wire by Searle's method. The following data are available: elongation in the wire $\Delta l=0.125\ cm$ under the tension of 50 N, least count for measuring normal length of wire is 0.1 cm and for elongation in the wire is 0.001 cm. Find the maximum percentage error in calculating the value of Young's modulus (Y), assuming that the force is measured very accurately.

13. A convex lens made of material 'A' is combined with a concave lens made of material 'B' so as to form an achromatic doublet. If an object of height 6 cm is placed 30 cm in front of the doublet, it forms an erect image of size 2 cm. Find the focal length (in cm) of the convex lens, given that the ratio of dispersive powers of materials A and B is 2 : 1.

14. In given figure rods are identical, each having length l and cross-sectional area S. The system is thermally insulated from surrounding. If one end A is kept at $100°C$ and the other end B is kept at 0°C, in steady state the temperature of the junctions C, D and E are θ_C, θ_D and θ_E then find the value of $\frac{\theta_E + \theta_C + \theta_D}{2}$ in °C.



SPACE FOR ROUGH WORK

SECTION-3

This section consists of 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.

Paragraph For Q.15 & 16

The Casimir effect describes the attraction between two uncharged conducting plates placed parallel to each other in vacuum. The astonishing force (Predicted in 1948 by Hendrik Casimir) per unit area of each plate depends on the planck's constant (h), speed of light (c) and separation between the plates (r).

15. Using dimensional analysis, the formula for the Casimir force per unit area on the plates can be given by: (where K is a dimensionless constant)

(A) $F = K\frac{hc}{r^2}$ **(B)** $F = K\frac{hc}{r^4}$ **(C)** $F = K\frac{h}{cr^4}$ **(D)** $F = K\frac{hc^2}{r^2}$

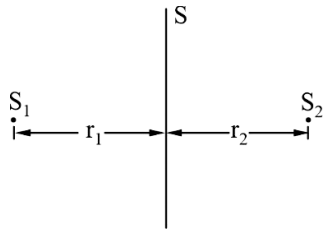
16. If the force acting on 1×1 cm plates separated by $1\mu m$ is 0.013 dyne, the value of constant K, is:

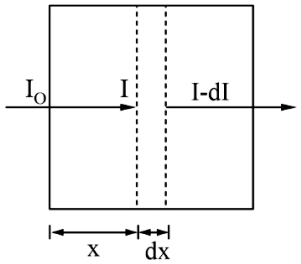
(A) 6.5×10^{-3} **(B)** 6.5×10^{6} **(C)** 1.53×10^{2} **(D)** 1.53×10^{-2}

SPACE FOR ROUGH WORK

Paragraph for Q.17 & 18

The given figure shows two point sources of light S_1 and S_2 of power P_1 and P_2 respectively at distances r_1 and r_2 from a photometer screen *S*. It is a basic feature of a photometer screen that power of two sources can be compared by adjusting r_1 and r_2 such that intensity at the screen due to any of the two is equal to that due to the other. In such a situation, the two are said to match each other. Let us assume that, initially, when S_1 is at distance r_1 from the screen and S_2 at distance r_2, these sources are said to match each other. A thin glass plate of thickness 10.2 *mm* is now kept between S_1 and the screen.





The glass plate has linear absorption characteristics which implies that loss of intensity in travelling a thickness '*dx*' at a penetration *x*,

$-dI \propto I$ [I – intensity at penetration x]

$\propto dx$

$\therefore \quad -dI = \mu I dx$

Where μ is called the linear absorption coefficient and depends on nature of material.

μ of the given plate is $0.1(mm)^{-1}$. It is found that, with the plate between S_1 and screen, the source S_1 has to be moved by a distance 20 *cm* so that it matched again with S_2. However, instead of the given plate of thickness 10.2 *mm*, if a plate of the same material but of half this thickness is placed between S_1 and screen, it is found that S_1 and S_2 match each other whenever they are equidistant from the screen.

Assuming normal incidence, answer the following questions: (use $e^{-1.02} = 0.36$)

17. Initially, before any glass plate is inserted, so that S_1 and S_2 match each other, the distances r_1 and r_2 are respectively:

(A) 60 *cm*, 51.2 *cm* **(B)** 48 *cm*, 32.8 *cm*
(C) 50 *cm*, 38.7 *cm* **(D)** 40 *cm*, 24.6 *cm*

18 Starting with an initially matched condition, if the plate of thickness 10.2 *mm* is kept between S_1 and screen and that of thickness 5.1 *mm* between S_2 and screen, then r_1 and r_2 will need to be readjusted. In this situation $\frac{r_1}{r_2}$ is:

(A) 2 **(B)** 1 **(C)** 0.5 **(D)** 0.25

SPACE FOR ROUGH WORK

SUBJECT I : CHEMISTRY — 60 MARKS

SECTION 1

This section consists of 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.

1. NO_2 can be obtained by heating:

(A) NH_4NO_3 **(B)** $NaNO_3$ **(C)** $Pb(NO_3)_2$ **(D)** $LiNO_3$

2. Which of the following statement is correct with respect to metal carbonyls?

(A) As M – C π bonding increases, the C – O bond length increases

(B) As the positive charge on the central metal atom increases, the C – O bond length increases

(C) As electron density on the central metal atom increases, the C – O bond length increases

(D) The effective atomic number of the metal atom in the complex $Cr(CO)_6$ is 36

3. Based on the compounds and elements of Group 15, the correct statement(s) is/are:

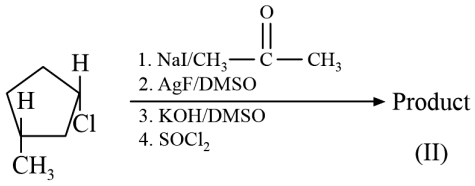
(A) d-orbitals are available for bonding

(B) H_3PO_3 disproportionate on heating

(C) The reducing nature of hydrides increases down the group

(D) P_2O_3 is more basic than Sb_2O_3

4.



(I) Reactant (II)

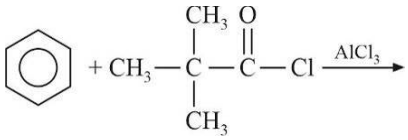
Which statement(s) are not true regarding (I) and (II)?

(A) They are enantiomers **(B)** They are structural isomers

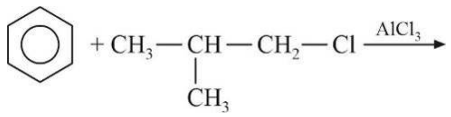
(C) They are geometrical isomers **(D)** They are diastereomers

5. Which of the following leads to the formation of tertiary butyl benzene?

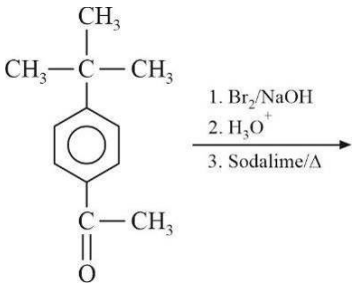
(A)



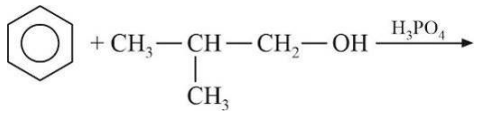
(B)



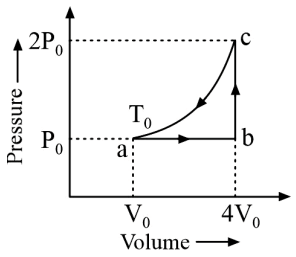
(C)



(D)



6. One mole of an ideal monoatomic gas is caused to go through the cycle shown in the figure. The correct option(s) is/are:



(A) Change in internal energy from the path a to b is $8\ RT_0$

(B) Change in internal energy from path a to c is $\frac{21}{2}RT_0$

(C) Work done by the gas from path a to b is $4\ RT_0$

(D) Change in enthalpy from path a to b is $\frac{15}{2}RT_0$

SPACE FOR ROUGH WORK

SECTION 2

NUMERICAL VALUE TYPE QUESTIONS

Section 2 contains **8 Numerical Value Type Questions**. 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).

7. Among the species given below, the total number of paramagnetic species are _____.
O_2, $O_2[AsF_6]$, KO_2, Mg, NO^+, K_2PtCl_4, $[Cu(NH_3)_4]^{2+}$, $(NH_4)_2[CoCl_4]$, $K_2Cr_2O_7$

8. If ammonia prepared by treating ammonium sulphate with calcium hydroxide is used by $CrCl_3 \cdot 6H_2O$ to form a stable co-ordination compound. Assume that both the reactions are 100% complete. If 1584 gram of ammonium sulphate and 1066 gram of $CrCl_3 \cdot 6H_2O$ are used in the preparation, the combined weight (in grams) of gypsum and the chromium-ammonia co-ordination compound thus produced is _____.
(Atomic weights in grams/mol : H = 1, N = 14, O = 16, S = 32, Cl = 35.5, Ca = 40, Cr = 52).

9. Calcium crystallises in a face-centred cubic unit cell with edge length of 0.556 nm. It contains 0.1% vacancy defects. The density of the crystal is d in gm/cm^3. The value of 100 d is _____.
(Consider Avogadro's number $N_A = 6 \times 10^{23}$).

10. The E°_{cell} for the reaction $Fe + Zn^{2+} \rightleftharpoons Fe^{2+} + Zn$ is –0.32 volt at 25°C. The equilibrium concentration of Fe^{2+} is $x \times 10^{-13}$ M, when piece of iron is placed in a 1 M Zn^{2+} solution. The value of x is _____. $\left[\text{Given} : \frac{2.303\ RT}{F} = 0.0591,\ \log(1.48) = 0.17\right]$

11. A gas expands against a variable pressure given by $P = \frac{20 \text{ litre} - \text{atm}}{V}$. During expansion from volume of 1 litre to V_2 litre, the gas undergoes a change in internal energy of 353 J. Heat absorbed by the gas during expansion is 5005 J. The value of 15 V_2 is _____. [1 atm- litre = 101J]

12. Two liquids A and B form an ideal solution. At the specified temperature, the vapour pressure of pure A is 200 mm Hg while that of B is 75 mm Hg. If the total vapour pressure above the solution is 100 mm Hg. The mole percent of A in the vapour phase is _____.

13. The solubility of MgF_2 at $pH = 4$ is $Y \times 10^{-5}$ mol/litre. The value of Y is _____. (Given that solubility product of MgF_2 $(K_{sp}) = \frac{9}{14} \times 10^{-8}$ and the value of ionization constant of HF $(K_a) = 3.5 \times 10^{-4}$) $((45)^{1/3} = 3.5)$.

14. A solute S undergoes a reversible trimerisation when dissolved in a certain solvent. The boiling point elevation of its 0.1 molal solution was found to be identical to the boiling point elevation in case of a 0.08 molal solution of a solute (in same solvent) which neither undergoes association nor dissociation. The degree of trimerisation of solute S is $Y \times 10^{-2}$. The value of Y is _____.

SPACE FOR ROUGH WORK

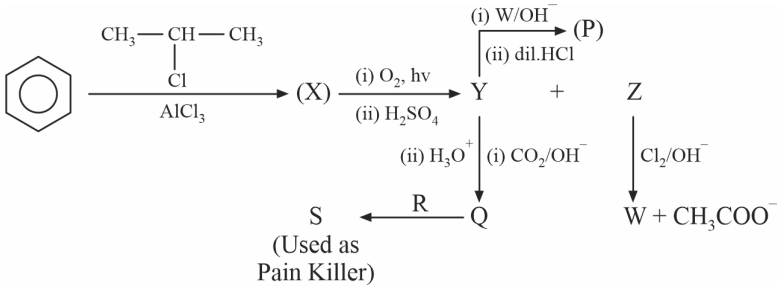
SECTION-3

This section consists of 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.

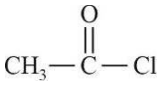
Paragraph For Q.15 & 16

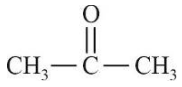
Based on paragraph **'X'** answers the following questions:

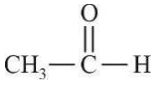
Paragraph " X "

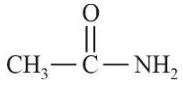


15. The compound 'R' is:

(A) 

(B) 

(C) 

(D) 

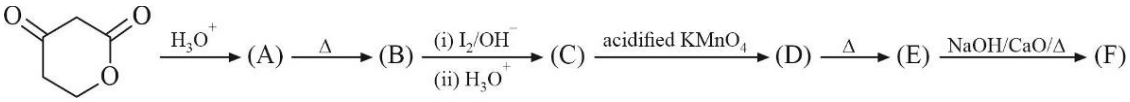
16. The degree of unsaturation in the compound (P) is:

(A) 4 **(B)** 3 **(C)** 5 **(D)** 6

Paragraph For Q.17 & 18

Based on the paragraph **"Y"** answers the following questions:

Paragraph " Y "

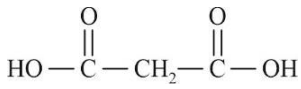


17. In how many steps decarboxylation reaction is not taking place.

(A) 2 **(B)** 5 **(C)** 4 **(D)** 3

18. The compound (F) is:

(A) $CH_3 - CH_3$ **(B)** CH_4

(C) $CH_3 - CHO$ **(D)** 

SPACE FOR ROUGH WORK

SUBJECT I : MATHEMATICS 60 MARKS

SECTION 1

This section consists of 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.

1. For a non-zero complex number z, let $\arg(z)$ denote the principal argument with $-\pi < \arg(z) \le \pi$. Then, which of the following statement(s) is(are) true?

(A) For any two non-zero complex numbers z_1 and z_2, $\arg(z_1 z_2) - \arg(z_1) - \arg(z_2)$ is an integer multiple of 2π

(B) $\arg(\sqrt{3} - i) = -\frac{\pi}{6}$

(C) The locus of a point z such that $\arg(z) = \frac{\pi}{4}$ is a straight line of slope 1 and passes through origin

(D) $\arg\left(\frac{(1+i)(1+2i)(1+3i)}{(1-i)(2-i)(3-i)}\right) = -\frac{\pi}{2}$

2. In a triangle ABC, if the sides AB, BC and CA have lengths $5\,cm$, $5\sqrt{3}\,cm$ and $5\,cm$ respectively. Then which of the following statement(s) is (are) false?

(A) $\angle BAC = 150°$

(B) The radius of the incircle of the triangle ABC is $\frac{10\sqrt{3}+15}{2} cm$

(C) The radius of the circumcircle of the triangle ABC is $5\,cm$

(D) The area of the triangle ABC is $\frac{25\sqrt{3}}{4} cm^2$

3. Let $P_1 : 2x - y + z = 2$ and $P_2 : x + 2y - z = 3$ be two planes. Then, which of the following statement(s) is (are) true?

(A) Equation of the plane which passes through the point (3, 2, –1) and is perpendicular to each of the planes is $x - 3y + 5z = 2$

(B) The acute angle between P_1 and P_2 is $\cos^{-1}\frac{1}{6}$

(C) The line of intersection of P_1 and P_2 has direction ratios –1, 3, 5

(D) The equation of the plane through the intersection of P_1 and P_2 and the point (1, 3, –2) is $17x + 4y + z = 27$

4. Let f be a real valued continuous function such that $f(x^2) = (f(x))^2$ for all x in the domain. Then which of the following is (are) correct?

(A) There is a unique function defined on [0, 1] such that $f(0) \neq 0$

(B) Let $f : (0,\infty) \to [0,\infty)$ be such that for some $a > 0, f(a) = 0$ then $f(x) = 0$ for all x in $(0,\infty)$

(C) There are infinitely many functions f with domain $(0,\infty)$ such that $\int_0^\infty f(x)\,dx < 1$

(D) There are only two such functions f with domain $(0,\infty)$ such that $\int_0^\infty f(x)\,dx < 1$

5. Let f be a differentiable function such that $f(f(x)) = x$ for all $x \in [0,1]$. Suppose that $f(0) = 1$, then:

(A) $f(1) = 0$

(B) f is strictly decreasing

(C) f is invertible

(D) $\int_0^1 (x - f(x))^{2020} dx = \frac{1}{2021}$

6. Let $f : [0,\infty) \to \mathbb{R}$ be a continuous function such that $f(x) = \int_0^x e^{x-t} f(t)\, dt$ for all $x \in [0,\infty)$. Then, which of the following statement(s) is (are) true?

(A) f is an exponential function **(B)** $f'(x) = 2f(x)$

(C) f is a constant function **(D)** f is not necessarily identically zero

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SECTION 2
NUMERICAL VALUE TYPE QUESTIONS

Section 2 contains **8 Numerical Value Type Questions**. 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, ⊖ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08).

7. The value of $\left((\log_3 7)^4\right)^{\frac{2}{\log_7(\log_9 49)}} \times \left(\frac{1}{5}\right)^{\frac{8}{\log_7 5}}$ is _____.

8. The number of 5 digits numbers which are divisible by 3, with digits from the set {0, 1, 2, 3, 4, 5} given that repetition of digits is not allowed, is _____.

9. Let X be the set consisting of the first 2021 terms of the arithmetic progression 2, 6, 10, 14, …… and Y be the set consisting of the first 2021 terms of the arithmetic progression 3, 8, 13, 18, ……. Then the number of elements in the set XUY is _____.

10. If $\cos^{-1}\left(\sum_{r=1}^{\infty}\left(-\frac{x}{2}\right)^r - \sum_{r=1}^{\infty}(-x)^r\right) = \frac{\pi}{2} - \sin^{-1}\left(\sum_{r=1}^{\infty} x^{r+1} - x\sum_{r=1}^{\infty}\left(\frac{x}{2}\right)^r\right)$ then number of real solutions of the above equation in $\left(0, \frac{1}{2}\right)$ is: _____

11. If $P_n = \frac{1}{n}\left((n+2)(n+4)(n+6)\ldots\ldots(n+2n)\right)^{1/n}$, where $n \in$ natural number and $\lim\limits_{n\to\infty} P_n = L$, then $[Le]$ is _____. ($[x]$ to the greatest integer less than or equal to x).

12. $\vec{a}, \vec{b}$ and $\vec{c}$ are three vectors such that $\vec{a}\cdot\vec{b} = 0$, $|\vec{a}| = |\vec{b}| = 1$ and $|\vec{c}| = 3$. For some $m, n \in R$, let $\vec{c} = m\vec{a} + n\vec{b} + (\vec{a}\times\vec{b})$. If $\vec{c}$ is inclined at the same angle β to both $\vec{a}$ and $\vec{b}$, then the value of $9\sin^2\beta$ is _____.

13. If $\sqrt{3}p\sin x + 2q\cos x = r$, $x \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ has two distinct real roots α and β with $\alpha + \beta = \frac{\pi}{3}$, where p, q, r are non-zero real numbers. Then the value of $\frac{3p}{q}$ is _____.

14. Let the area of triangle with vertices at $P(1, 1)$, $Q(0, 0)$ and $R(2, 0)$ be A_1. If area enclosed by the curve $y = x^n$, PR, QR is $0.6A_1$, then value of 'n' is:

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SECTION-3

This section consists of 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.

Paragraph For Q.15 & 16

In the *xy* plane, a circle *S* has equation $x^2 + y^2 = 4$.

15. M_1M_2 and N_1N_2 are two chords of '*S*' passing through a point $B_0(-1,-1)$ and parallel to *x*-axis and *y*-axis respectively. Let H_1H_2 be a chord of *S* passing through B_0 and having slope –1. If M_1M_2, N_1N_2 and H_1H_2 are chord of contact of points M_3, N_3 and H_3 respectively, then the points M_3, N_3 and H_3 lie on the curve.

(A) $x^2y^2 = 4$ **(B)** $x^2 + y^2 = 4$ **(C)** $x + y + 4 = 0$ **(D)** $(x-4)(y-4) = 4$

16. Let *Q* be a point on circle *S* lying in 3rd quadrant. Tangent at *S* to *Q* intersect coordinate axes at points *A* and *B*, and locus of midpoint of *AB* is given by $\mu_1 x^2 + \mu_2 y^2 = x^2y^2$ Then $\mu_1 + \mu_2$ is:

(A) 6 **(B)** 4 **(C)** 3 **(D)** 2

Paragraph For Q.17 & 18

In a class there are four chairs C_1, C_2, C_3, C_4 and four students P_1, P_2, P_3, P_4. Initially, chair C_i is allotted to the student $P_i, i = 1,2,3,4$. But on the examination day, this four students are randomly allotted four chairs.

17. On examination day, what will be the probability that P_2 gets previously allotted chair C_2 and None of the remaining students get the chair previously allotted to him/her is:

(A) $\frac{1}{12}$ **(B)** $\frac{2}{13}$ **(C)** $\frac{5}{12}$ **(D)** $\frac{11}{12}$

18. Let E_i denote event that the students P_i and P_{i-1} $(i = 2,3,4)$ do NOT sit adjacent to each other on the day of examination. Then probability of the event $E_2 \cap E_3 \cap E_4$ is:

(A) $\frac{1}{12}$ **(B)** $\frac{7}{60}$ **(C)** $\frac{2}{13}$ **(D)** $\frac{11}{12}$

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