VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Advanced-2 | Paper–2 | XII Pass - JEE 2024

Date: 19th November 2023 **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 Part has **three** sections (Section 1, Section 2 & Section 3).

2. **Section 1** contains **4 Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

   Section 2 contains **6 Multiple Correct Answers Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

   Section 3 contains **8 Single Digit Integer Type Questions** ranging from **0 to 9**, Both Inclusive. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer.

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** _____

Syllabus

Physics : Rotational motion, Electrostatics, Gravitation, DC Circuits, Capacitors, Magnetic Effects of current , Magnetism and Matter.

Chemistry : Ionic Equilibrium, Solid States, Liquid Solutions, Surface Chemistry, Electrochemistry, Chemical Kinetics, IOC, Hydrogen, Environmental Chemistry.

Mathematics : DC – 1 & II, IC – I & II, Differential Equation, Vectors, Three-Dimensional Geometry.

MARKING SCHEME

SECTION – 1 | (Maximum Marks: 12)

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

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

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

Negative Marks: –1 In all other cases.

SECTION – 2 | (Maximum Marks: 24)

- This section consists of **Six (06)** Questions. Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks: +4 If only (all) the correct option(s) is(are) chosen

Partial Marks: +3 If all the four options are correct but ONLY three options are chosen

Partial Marks: +2 If three or more options are correct but ONLY two options are chosen and both of which are correct

Partial Marks: +1 If two or more options are correct but ONLY one option is chosen, and it is a correct option

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

Negative Marks: –2 In all other cases.

SECTION – 3 | (Maximum Marks: 24)

- **Section 3** contains **8 Single Digit Integer Type Questions** ranging from **0 to 9**, Both Inclusive. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme:

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

Zero Mark: 0 If the questions is unanswered.

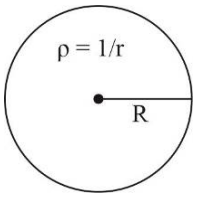
Negative Marks: –1 In all other cases.

SUBJECT I : PHYSICS 60 MARKS

SECTION - 1
SINGLE CHOICE CORRECT TYPE

Section 1 contains **4 Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

1. Positive charge is distributed in a non-conducting sphere of radius R with volume charge density that varies as $\rho = \frac{1}{r}$, where r is the distance of a point from center of sphere. Choose the correct option :



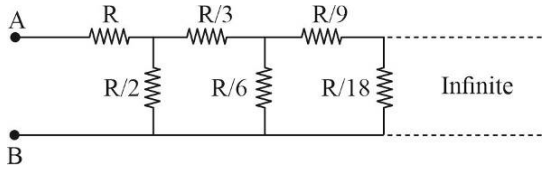
(A) At $r = \frac{R}{2}$ electric field is greater than electric field at $r = \frac{R}{4}$

(B) The electric field is uniform inside the sphere

(C) The electric field outside the sphere is inversely proportional to r

(D) The electric field inside the sphere is directly proportional to r

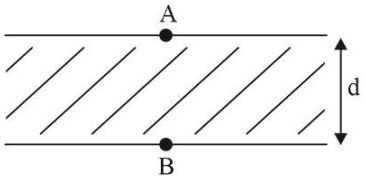
2. The R_{eq} between A and B is :



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

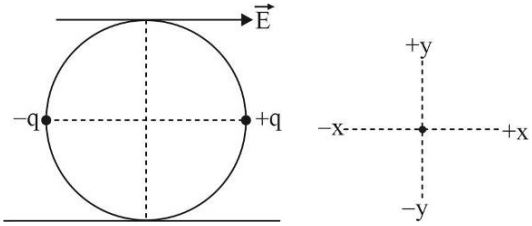
SPACE FOR ROUGH WORK

3. In the diagram a long non conducting medium with uniform volume charge density ρ is shown. If a charge $-q$ is released from point A, the time in which it will reach at point B, (Assume the medium offer negligible mechanical resistance.



(A) $\frac{\pi}{2}\sqrt{\frac{m\in_0}{2q\rho}}$ **(B)** $\pi\sqrt{\frac{m\in_0}{q\rho}}$ **(C)** $\frac{3}{2}\pi\sqrt{\frac{m\in_0}{q\rho}}$ **(D)** $2\pi\sqrt{\frac{m\in_0}{q\rho}}$

4. Two charge particles are fixed at diametrically opposite points of a non conducting vertical ring as shown. There is a horizontal electric field along +x direction. The ring is rotated slightly about vertical diameter and released, the time period of small oscillations is, [mass of ring is M, radius = R, mass of $+q$ is m_1 and $-q$ is m_2]



(A) $2\pi\sqrt{\frac{(M+m_1+m_2)R}{2qE}}$ **(B)** $2\pi\sqrt{\frac{(M+m_1+m_2)R}{4qE}}$

(C) $2\pi\sqrt{\frac{(M+2m_1+m_2)R}{2qE}}$ **(D)** $2\pi\sqrt{\frac{(M+2m_1+2m_2)R}{4qE}}$

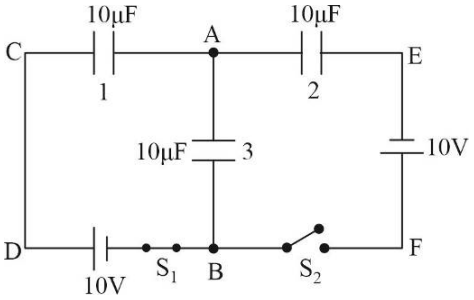
SPACE FOR ROUGH WORK

SECTION 2

MULTIPLE CORRECT ANSWERS TYPE

This Section contains **6 Multiple Correct Answers Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

5. In the figure shown capacitors are labelled as 1, 2 & 3 and switch S_1 is closed for long time. Then S_2 is closed and kept closed for long time, then:



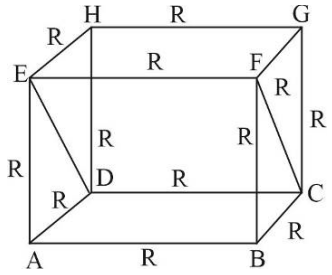
(A) Final charge on capacitor 3 is $50\mu C$

(B) Final charge on capacitor 3 is zero

(C) Magnitude of charge passed through point A after S_2 is kept closed for long time is $100\mu C$

(D) Final charge on capacitor 1 is $100\mu C$

6. Every branch of cube has resistance '*R*'. Two wires each of resistance '*R*' are connected between points, *E* and *D* and *F* and *C*.



(A) R_{eq} between A and B is $\frac{7R}{12}$ **(B)** R_{eq} between A and B is $\frac{5R}{6}$

(C) No current will pass from wire *ED* **(D)** No current will pass from wire *HD*

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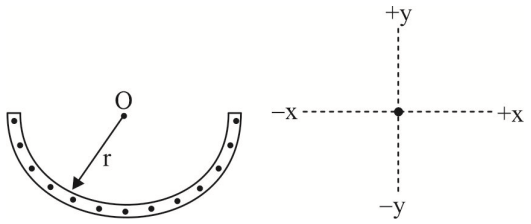
7. A current I is flowing in a long thin walled semi circular plane of shown in the diagram. It's cross section is shown in the diagram.



The direction perpendicular to plane of paper and out ward is +z. A charge particle of charge +q is project from point 'O' with a velocity $-v\hat{k}$.

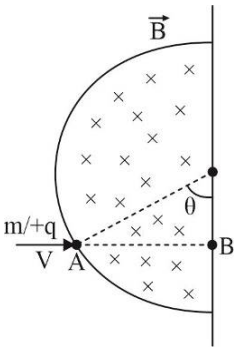
(A) $\left|\vec{B}\right|$ at O is $\dfrac{2\mu_0 I}{\pi^2 r}$

(B) $\left|\vec{B}\right|$ at O is $\dfrac{\mu_0 I}{\pi^2 r}$

(C) Radius of curvature of +q at O is $\dfrac{mv\pi^2 r}{q\mu_0 I}$

(D) Radius of curvature of +q at O is $\dfrac{2mv\pi^2 r}{3\mu_0 I}$

8. A charged particle enters a magnetic field region confined into the semicircle region. If $AB = \dfrac{mv}{2qB}$ and if the charge particle leaves the magnetic field region from the center 'O' of semicircle.



(A) $\tan\theta = 2 - \sqrt{3}$

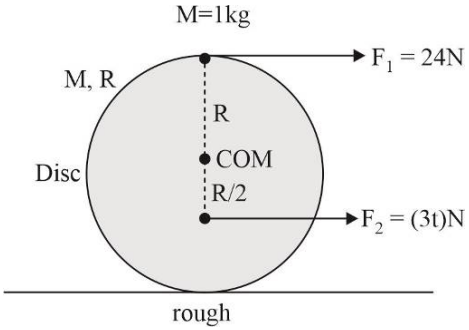
(B) $\tan\theta = \dfrac{1}{\left(2-\sqrt{3}\right)}$

(C) Distance travelled in the magnetic field is $\dfrac{\pi mv}{qB}$

(D) Distance travelled in the magnetic field is $\dfrac{\pi mv}{6qB}$

SPACE FOR ROUGH WORK

9. A disc of mass M and Radius R is subjected to two forces F_1 & F_2 as shown. Disc is kept on horizontal rough surface. Choose the correct options : (Friction is large enough to sustain pure rolling when required)



(A) The $\vec{a}_{CM}$ will first increase than decrease

(B) f_s will first act forward and after some time in backward direction

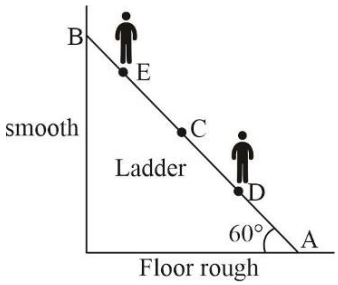
(C) $\vec{a}_{CM}$ at t = 1 sec is $33\,m/s^2$

(D) f_s will become zero at t = 4 sec

10. All person and ladder have same mass M, length of ladder is L. Two person stands at E & D. Choose the correct option/s :

$AE = x_1$

$AD = x_2$



(A) If $x_1 = \frac{3l}{4}$ and $x_2 = \frac{l}{4}$, the normal reaction on ladder from wall is $\sqrt{3}Mg$

(B) If $x_1 = \frac{3l}{4}$ and $x_2 = \frac{l}{4}$ the normal reaction on ladder from wall is $\frac{\sqrt{3}Mg}{2}$

(C) Value of friction on the floor is $\frac{\sqrt{3}Mg}{2}$

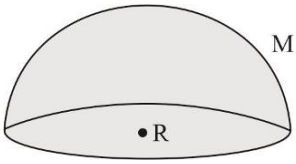
(D) If value of x_1 decreases the value of normal reaction on ladder due to floor will decrease

SPACE FOR ROUGH WORK

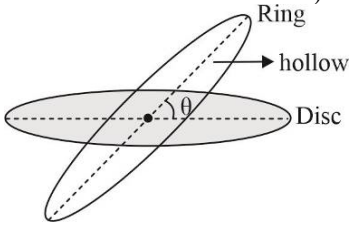
SECTION 3
SINGLE DIGIT INTEGER TYPE

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

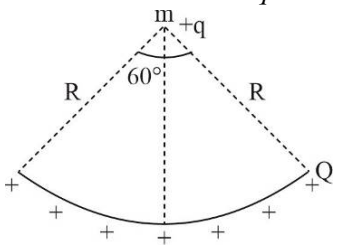
1. The value of gravitational field at the center of uniform hollow hemisphere is $\frac{GM}{XR^2}$. Value of X is _____.



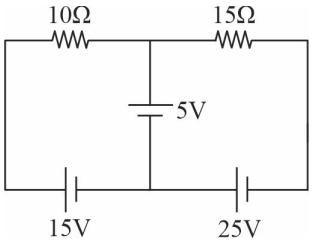
2. A ring and a disc of both same mass and radius are arranged as shown with their centers coincides. The angle between their diameters is 30°. External work done required to bring a mass m from infinity to the center of this two body system is $-\frac{XGMm}{R}$. The mass *m* is brought very slowly. Value of *X* is. (Both ring and disc has same mass '*m*' and radius *R*)



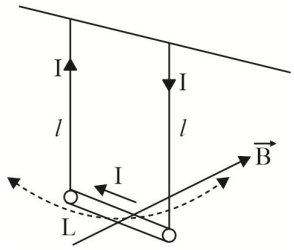
3. A charge particle is placed at the center O of an uniformly charged are is placed vertically arc. If the particle remain at rest, the charge on the arc is $\frac{\pi^2 R^2 X \in_0 mg}{3q}$, value of *X* is _____.



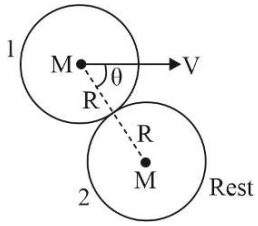
4. Ratio of power expenditure of 5V cell and power dissipated through 10Ω resistor is $\frac{1}{y}$. Value of *y* is _____.



5. A conducting rod having current I and length L is suspended with conducting wires of length ℓ (each) as shown. There is a uniform magnetic field $\vec{B}$ in horizontal direction and perpendicular to length of rod (towards right). If the system is displaced slightly from equilibrium position and released, the time period of it's oscillation is $2\pi\sqrt{\frac{2I'}{XlLIB}}$. (Neglect gravity and moment of inertia of oscillating system is I'). Value of X is _____.

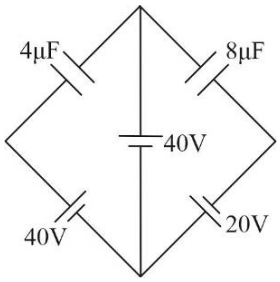


6. A ball hits another identical ball elastically. If the balls are rough the angular speed of 2nd ball after the collision is $\frac{5\mu v\cos\theta}{xR}$. Value of x is _____. [μ is friction coefficient]



7. A bar magnet of mass m and length l is oscillating in a uniform magnetic field $\vec{B}$. The time period of oscillation is $\left[2\pi\sqrt{\frac{ml^2}{6XMB}}\right]$ $M \rightarrow$ magnetic moment of the bar magnet. Value of X is _____.

8. The ratio of energy stored in $4\mu F$ to $8\mu F$ capacitor is z, Value of z is.



SPACE FOR ROUGH WORK

SUBJECT II : CHEMISTRY 60 MARKS

SECTION - 1
SINGLE CHOICE CORRECT TYPE

Section 1 contains **4 Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

1. The water quality of a pond was analysed and its BOD was found to be 4 ppm. The pond has:

(A) Highly polluted water

(B) Water has high amount of fluoride compounds

(C) Very clean water

(D) Slightly polluted water

2. An indicator 'X' is used for studying the effect of variation in concentration of iodide on the rate of reaction of iodide ion with H_2O_2 at room temperature. The indicator 'X' forms blue coloured complex with compound 'A' present in the solution. The indicator 'X' and compound 'A' respectively are :

(A) Starch and iodine **(B)** Methyl orange and H_2O_2

(C) Starch and H_2O_2 **(D)** Methyl orange and iodine

3. Solubility product constant (K_{sp}) of salts of types MX, MX_2 and M_3X at temperature 'T' are $4.0\times10^{-8}, 3.2\times10^{-14}$ and 2.7×10^{-15}, respectively. Solubilities (mol dm^{-3}) of the salts at temperature 'T' are in the order.

(A) $MX > MX_2 > M_3X$ **(B)** $M_3X > MX_2 > MX$

(C) $MX_2 > M_3X > MX$ **(D)** $MX > M_3X > MX_2$

4. 2.5 mL of $\frac{2}{5}$M weak monoacidic base $(K_b = 1\times10^{-12})$ at 25°C is titrated with $\frac{2}{15}$M HCl in water at 25°C. The concentration of H^+ at equivalence point is: $(K_w = 1\times10^{-14}$ at 25°C)

(A) 3.7×10^{-13}M **(B)** 3.2×10^{-7}M

(C) 3.2×10^{-2}M **(D)** 2.7×10^{-2}M

SPACE FOR ROUGH WORK

SECTION 2

MULTIPLE CORRECT ANSWERS TYPE

This Section contains **6 Multiple Correct Answers Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

5. A solution with components A and B is labeled as "non ideal solution with positive deviation". Which of the following is (are) correct about it?

(A) $P_{total} > P_A^0 X_A + P_B^0 X_B$

(B) It might forms minimum boiling azeotrope

(C) Mixture of any composition can be separated into pure components by distillation

(D) The A-B interactions in such solutions are stronger than the A-A and B-B interactions in the two liquids that make up the solution

6. The correct statement(s) regarding defects in solids is (are) :

(A) Frenkel defect is usually favoured by a very small difference in the sizes of cation and anion

(B) Frenkel defect is a dislocation defect

(C) Trapping of an electron in the lattice site leads to the formation of F-centre

(D) Schottky defects have no effect on the physical properties of solids

7. The reagent(s) used for softening the temporary hardness of water is (are) :

(A) $Ca_3(PO_4)_2$ **(B)** $Ca(OH)_2$ **(C)** Na_2CO_3 **(D)** NaCl

8. The correct opion(s) related to adsorption process is (are):

(A) Chemisorption results in unimolecular layer

(B) The enthalpy change during physisorption is in the range of 100 to $140\,kJ\,mol^{-1}$

(C) Chemisorption is an endothermic process

(D) Lowering the temperature favours physisorption process

9. Mixture (s) showing positive deviation from Raoult's law at 35°C is (are):

(A) Carbon tetrachloride + methanol **(B)** Carbon disulphide + acetone

(C) Benzene + toluene **(D)** Phenol + aniline

10. Benzene and naphthalene form an ideal solution at room temperature. For this process, the true statement(s) is (are):

(A) ΔG is positive **(B)** ΔS_{system} is positive

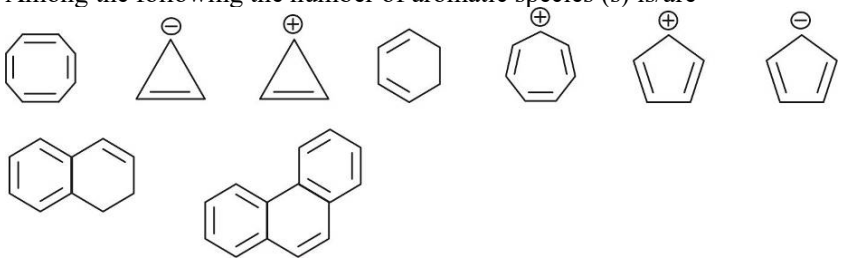
(C) $\Delta S_{surroundings} = 0$ **(D)** $\Delta H_{mix} = 0$

SPACE FOR ROUGH WORK

SECTION 3
SINGLE DIGIT INTEGER TYPE

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

1. Among the following the number of aromatic species (s) is/are



2. Concentration of H_2SO_4 and Na_2SO_4 in a solution is 1 M and 1.8×10^{-2}M, respectively. Molar solubility of $PbSO_4$ in the same solution is $X\times10^{-y}M$ (expressed in scientific notation). The value of Y is _____. (Given : Solubility product of $PbSO_4(K_{sp})=1.6\times10^{-8}$. For H_2SO_4, K_{a_1} is very large and $K_{a_2}=1.2\times10^{-2}$)

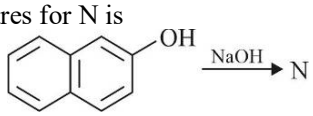
3. The concentration of R in the reaction $R \rightarrow P$ was measured as a function of time and the following data is obtained.

[R] in M	1.0	0.75	0.40	0.1
t in minute	0.0	0.05	0.12	0.18

The order of reaction is :

SPACE FOR ROUGH WORK

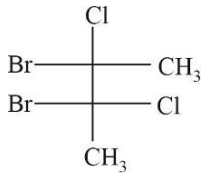
4. The number of resonance structures for N is



5. The conductance of a 0.0015M aqueous solution of a weak monobasic acid was determined by using a conductivity cell consisting of platinized Pt electrodes. The distance between the electrodes is 120cm with an area of cross section of 1cm^2. The conductance of this solution was found to be $5\times10^{-7}\text{S}$. The pH of the solution is 4. The value of limiting molar conductivity $(\wedge_m^0)$ of this weak monobasic acid in aqueous solution is $Z\times10^2\text{Scm}^{-1}\text{mol}^{-1}$. The value of Z is _____.

6. An aqueous solution is prepared by dissolving 0.1 mol of an ionic salt in 1.8 kg of water at 35°C. The salt remains 90% dissociated in the solution. The vapour pressure of the solution is 59.724 mm of Hg. Vapor pressure of water at 35°C is 60.000 mm of Hg. The number of ions present per formula unit of the ionic salt is _____.

7. The total number(s) of stable conformers with non-zero dipole moment for the following compound is(are)



8. For the electrochemical cell, $\text{Mg(s)}\,|\,\text{Mg}^{2+}\text{(aq., 1M)}\,||\,\text{Cu}^{2+}\text{(aq., 1M)}\,|\,\text{Cu(s)}$ the standard emf of the cell is 2.70 V at 300 K. When the concentration of Mg^{2+} is changed to xM and concentration of Cu^{+2} is 1M, the cell potential changes to 2.67 V at 300K. The value of $\frac{x}{10}$ is _____.

(Given : $\frac{RT}{F}=0.06\text{V}$ where F is the Faraday constant and R is the gas constant, ln(10) = 2.30)

SPACE FOR ROUGH WORK

SUBJECT III : MATHEMATICS 60 MARKS

SECTION - 1
SINGLE CHOICE CORRECT TYPE

Section 1 contains **4 Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

1. Given that f satisfies $|f(u)-f(v)| \le |u-v|$ for all u and v in $[a, b]$, $a<b$. Then maximum value of $\left|\int_a^b f(x)dx-(b-a)f(a)\right|$ equal to:

(A) $\frac{(b-a)^2}{4}$ **(B)** $\frac{(b-a)^2}{2}$ **(C)** $(b-a)^2$ **(D)** $2(b-a)^2$

2. Let $f'(x)=\frac{192x^3}{2+\sin^4\pi x}$ for all $x \in R$ with $f\left(\frac{1}{2}\right)=0$. If $m \le \int_{1/2}^{1} f(x)\,dx \le M$, then the possible values of m and M are :

(A) $m=13,\ M=24$ **(B)** $m=\frac{1}{4},\ M=\frac{1}{2}$

(C) $m=-11,\ M=0$ **(D)** $m=1,\ M=12$

3. If $\vec{b}$ is a vector whose initial point divides the line joining points $5\hat{i}$ and $5\hat{j}$ in the ratio $k:1$ and whose terminal point is the origin and $|\vec{b}| \le \sqrt{37}$, then range of k is:

(A) $[-6, -1/6]$ **(B)** $(-\infty, -6] \cup [-1/6, \infty)$

(C) $[0, 6]$ **(D)** $[1/6, \infty)$

4. Let the equation of the plane containing line $x-y-z-4=0=x+y+2z-4$ and parallel to the line of intersection of the planes $2x+3y+z=1$ and $x+3y+2z=2$ be $x+Ay+Bz+C=0$. Then find the value of $|A+B+C|$.

(A) 6 **(B)** 9 **(C)** 12 **(D)** 11

SPACE FOR ROUGH WORK

SECTION 2

MULTIPLE CORRECT ANSWERS TYPE

This Section contains **6 Multiple Correct Answers Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

5. If $f(\alpha)=\lim\limits_{x\to 2}\left(\sin^x\alpha+\cos^x\alpha\right)^{\frac{1}{(x-2)}}$ for $\alpha\in\left[0,\frac{\pi}{2}\right]$, then:

(A) $f(0)=1$

(B) $f\left(\frac{\pi}{2}\right)=1$

(C) $f(\alpha)=(\cos\alpha)^{\cos^2\alpha}\cdot(\sin\alpha)^{\sin^2\alpha}$ if $\alpha\in\left(0,\frac{\pi}{2}\right)$

(D) $f(\alpha)=\frac{(\sin\alpha)^{\sin^2\alpha}}{(\cos\alpha)^{\cos^2\alpha}}$ if $\alpha\in\left(0,\frac{\pi}{2}\right)$

6. Suppose f and g are functions having second derivatives f'' and g'' everywhere. If $f(x)\cdot g(x)=1$ for all x and f' and g' are never zero, then $\frac{f''(x)}{f'(x)}-\frac{g''(x)}{g'(x)}$ equals:

(A) $\frac{-2f'(x)}{f(x)}$ **(B)** $-\frac{2g'(x)}{g(x)}$ **(C)** $\frac{-f'(x)}{g(x)}$ **(D)** $\frac{2f'(x)}{f(x)}$

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7. If $y = e^{-x}\cos x$ and $y_n + k_n y = 0$, where $y_n = \dfrac{d^n y}{dx^n}$ and k_n are constants $\forall\ n \in N$, then:

(A) $k_4 = 4$ **(B)** $k_8 = -16$ **(C)** $k_{12} = 20$ **(D)** $k_{16} = -24$

8. If $f(x) = \lim\limits_{t\to\infty} \dfrac{|a+\sin\pi x|^t - 1}{|a+\sin\pi x|^t + 1},\ x \in (0, 6)$ then.

(A) If $a = 1$, then $f(x)$ has 5 points of discontinuity

(B) If $a = 3$, then $f(x)$ has no point of discontinuity

(C) If $a = 0.5$, then $f(x)$ has 6 points of discontinuity

(D) If $a = 0$, then $f(x)$ has 6 points of discontinuity

9. For the function $f : (0,1) \to R,\ f(x) = [2^n x] + \{2^m x\},\ (n, m \in N; n > m)$, the number of points of discontinuity of the function can be (where $[\cdot]$, $\{\}$ represent greatest integer function and fractional part of x respectively).

(A) 24 **(B)** 28 **(C)** 26 **(D)** 496

10. Which of the following is/are correct?

(A) Between any two roots of $e^x \cos x = 1$, there exists at least one root of $\tan x = 1$

(B) Between any two roots of $e^x \sin x = 1$, there exists at least one root of $\tan x = -1$

(C) Between any two roots of $e^x \cos x = 1$, there exists at least one root of $e^x \sin x = 1$

(D) Between any two roots of $e^x \sin x = 1$, there exists at least one root of $e^x \cos x = -1$

SPACE FOR ROUGH WORK

SECTION 3
SINGLE DIGIT INTEGER TYPE

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

1. If $L=\lim\limits_{x\to 2}\dfrac{\sqrt[3]{60+x^2}-4}{\sin(x-2)}$, then the value of $\dfrac{1}{2L}$ is _____.

2. If $L=\lim\limits_{n\to\infty}(2\times 3^2\times 2^3\times 3^4\times 2^5\times 3^6....\times 2^{n-1}\times 3^n)^{\frac{1}{(n^2+1)}}$, then the value of L^4 is _____.

3. Let $\alpha,\beta\in R$ be such that $\lim\limits_{x\to 0}\dfrac{x^2\sin(\beta x)}{\alpha x-\sin x}=1$. Then $6(\alpha+\beta)$ equals _____.

4. $f'(x)=\phi(x)$ and $\phi'(x)=f(x)$ for all x. Also, $f(3)=5$ and $f'(3)=4$. Then the value of $[f(10)]^2-[\phi(10)]^2$ is _____.

5. Let $f(x)=g(x)\left|(x-1)(x-2)(x-3)^2(x-4)^3\right|$, where $g(x)=x^3+bx^2+cx+d$. If $f(x)$ is differentiable for all $x\in R$ and $f(x)$ is thrice differentiable at x = 4 then the value of $\dfrac{g(5)}{2}$ is _____.

6. A differentiable function f is satisfying the relation $f(x+y)=f(x)+f(y)+2xy(x+y)-\dfrac{1}{3}$ $\forall x,y\in R$ and $\lim\limits_{h\to 0}\dfrac{3f(h)-1}{6h}=\dfrac{2}{3}$. Then the value of $[f(2)]$ is (where $[x]$ represents the greatest integer function) _____.

7. Let $y=f(x)$ be drawn with $f(0)=2$ and for each real number, the tangent to $y=f(x)$ at $(a,f(a))$ has x-intercept $(a-2)$. If $f(x)$ is of the form of ke^{px}, then $\left(\dfrac{k}{p}\right)$ has the value equal to _____.

8. Let S be the set of real numbers x for which $2x\tan^{-1}x$ is greater than $\ln(1+x^2)$, then the maximum possible value of $\left[4-|x|\right]$, $x\in S$ (where $[\cdot]$ represents the greatest integer function) is _____.

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