VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

Mock JEE Main-1 (CBT) | JEE-2024

Date: 02/01/2024 **Maximum Marks: 300**

Timing: 3:30 PM to 6:30 PM **Duration : 3.0 Hours**

General Instructions

1. The test is of **3 hours** duration and the maximum marks is **300.**
2. The question paper consists of **3 Parts** (Part I: **Physics**, Part II: **Chemistry**, Part III: **Mathematics**). Each Part has **two** sections (Section 1 & Section 2).
3. **Section 1** contains **20 Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.
4. **Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. You will NOT be allowed to attempt the sixth question. If you wish to attempt any other question apart from the five already attempted, then you will have to delete any one response from the five previously answered and then proceed to answer the new one.**
   The answer to each question should be **rounded off to the nearest integer**.
5. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. inside the examination room/hall.
6. On completion of the test, the candidate must hand over the Answer Sheet to the **Invigilator** on duty in the Room/Hall. **However, the candidates are allowed to take away this Test Booklet with them**.

Marking Scheme

1. **Section – 1:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.
2. **Section – 2:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

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

PART I : PHYSICS	MARKS: 100

SECTION-1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

1. The time period of oscillation of a simple pendulum is given by $T = 2\pi\sqrt{\frac{l}{g}}$. The length of the pendulum is measured as $l = (2 \pm 0.1)cm$ and time period as $T = (2.5 \pm 0.05)\text{s}$. The maximum percentage error in the value of g is :

(A) 7% **(B)** 8% **(C)** 9% **(D)** 11%

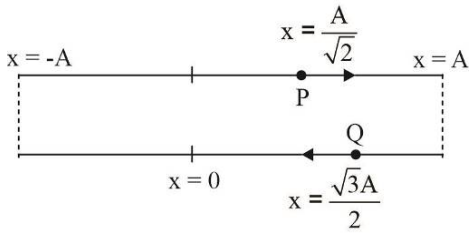
2. A string wave is described by the equation $Y = A\sin 2\pi(ax - bt)$. The maximum particle velocity is four times the wave velocity, then:

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

3. A person weighs 900 N at Earth's surface. Then its weight at a height of 3200 kms from Earth's surface will be :

(A) 800 N **(B)** 450 N **(C)** 400 N **(D)** 600 N

4. Figure shows a particle under simple harmonic motion having time period T. Then find the minimum time in which particle reaches from point P to Q. P and Q are positions of particle shown in the figure, having velocities indicated by arrows.



(A) $\frac{T}{24}$ **(B)** $\frac{T}{12}$ **(C)** $\frac{5T}{24}$ **(D)** $\frac{5T}{12}$

5. A series LR circuit is connected to an ac source of frequency ω and the inductive reactance is equal to $2R$. A capacitance of capacitive reactance equal to R is added in series with L and R. The ratio of the new power factor to the old one is:

(A) $\sqrt{\frac{2}{3}}$ **(B)** $\sqrt{\frac{2}{5}}$ **(C)** $\sqrt{\frac{3}{2}}$ **(D)** $\sqrt{\frac{5}{2}}$

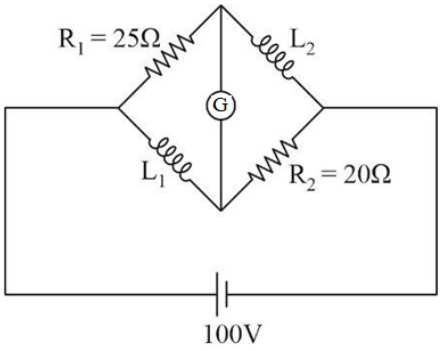
6. In terms of resistance 'R' and time 'T', the dimensions of relation $\frac{\mu}{\varepsilon}$, where μ is permeability and ε is permittivity is :

(A) $\left[RT^{-2}\right]$ **(B)** $\left[R^2T^2\right]$ **(C)** $\left[R^2\right]$ **(D)** $\left[R^2T^{-1}\right]$

7. Two projectiles A and B are thrown with initial velocity u_A and u_B at an angle of 30° and 60° with the horizontal respectively such that their maximum height is same. Find the ratio of ranges of A and B.

(A) 1 : 1 **(B)** $\sqrt{3}:1$ **(C)** $1:\sqrt{3}$ **(D)** 3 : 1

8. In the given figure the resistance of coil of galvanometer is 5Ω. The emf of the cell is 100 V. The ratio of current in L_1 and L_2 is :



(A) $\frac{5}{4}$ **(B)** $\frac{4}{5}$ **(C)** $\frac{15}{8}$ **(D)** $\frac{25}{24}$

9. A charged particle is moving in space where both magnetic field and electric field are present and these fields are parallel to each other. The path of particle will be:

(A) Helical with uniform pitch if velocity is at some angle with field

(B) Circular if velocity is perpendicular to field

(C) Straight line if velocity is parallel to field

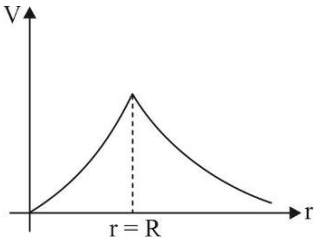
(D) Helical with variable pitch for any velocity

10. Find de-broglie wavelength of a charged particle having mass *m* and charge *q*, which starts moving inside an uniform electric field region which is time varying. This time varying electric field is $E = \frac{2ht}{\lambda_0 q T^2}$. (Here, *h* is planck constant, λ_0 and T are other constant values)

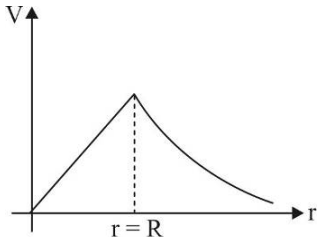
(A) $\lambda = \lambda_0\left(\frac{T}{t}\right)$ **(B)** $\lambda = \lambda_0\left(\frac{t}{T}\right)$ **(C)** $\lambda = \lambda_0\frac{t^2}{T^2}$ **(D)** $\lambda = \lambda_0\left(\frac{T^2}{t^2}\right)$

11. Graphical variation of electric potential due to a uniformly charged insulating solid sphere of radius *R*, with distance *r* from the center of sphere is represented by:

(A)



(B)



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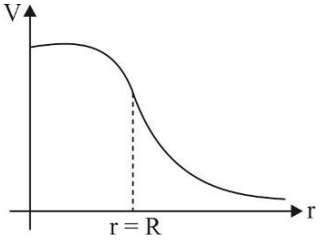

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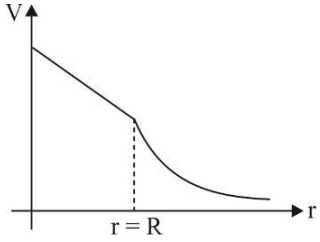


12. Mark out the correct statements :

I. Higher binding energy per nucleon means nucleus is more stable

II. Binding energy of a nucleus can be negative

III. Binding energy of a nucleus is always positive

IV. Energy is released when heavy nuclei undergo fission or lighter nuclei undergo fusion

V. For heavy nuclei, binding energy per nucleon increases with increasing z while for light nuclei it decreases with increasing z.

(A) I, II, IV only **(B)** I, III, IV only

(C) II, III, IV, V only **(D)** III, IV only

13. At any instant the position of particle of mass 200 gm is $(10t^2\hat{i} + 5t^3\hat{j})m$. If momentum of the particle at any instant is $(x\hat{i} + 12\hat{j})kg\,m/s$, then the value of x will be :

(A) 4 **(B)** 8 **(C)** 2 **(D)** 12

14. Given below are two statements

Statement I : If E is the binding energy of satellite moving around earth, then its kinetic energy will also be E.

Statement II : Kinetic energy and total energy of satellite are always same

(A) Both statement I and statement II are incorrect

(B) Statement I is correct but statement II is incorrect

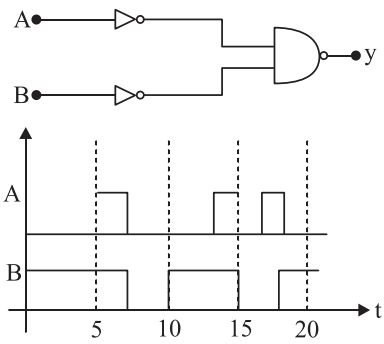
(C) Statement I is incorrect but statement II is correct

(D) Both statement I and statement II are correct

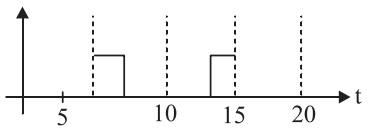
15. Two particles are moving with same speed V_0 and their directions of motion are inclined at 60° angle with each other. Then the magnitude of relative velocity is :

(A) $\sqrt{3}V_0$ **(B)** Zero **(C)** V_0 **(D)** $2V_0$

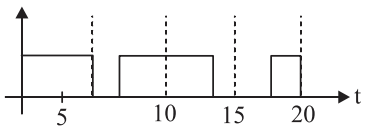
16. Identify the correct output signal Y in the given combination of gates (as shown) for the given inputs A and B.



(A)



(B)



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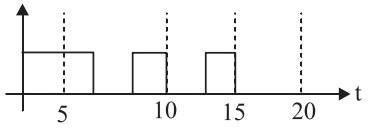

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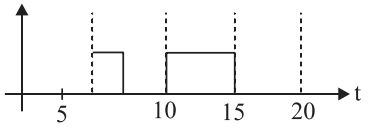


17. A copper wire $(Y = 1 \times 10^{11} N/m^2)$ of length 8 m, and a steel wire $(Y = 2 \times 10^{11} N/m^2)$ of length 4 m, each of cross-section $0.5 cm^2$ are fastened end to end and stretched with a tension of 500 N. The elastic potential energy stored in the system is :

(A) 0.125 J **(B)** 0.2 J **(C)** 0.25 J **(D)** 0.5 J

18. Given below are two statements :

Statement I : If net heat given to a thermodynamical system is zero, its temperature must remain same

Statement II : A thermodynamical system changes its internal energy only if temperature changes

(A) Both statement I and statement II are incorrect

(B) Statement I is correct but statement II is incorrect

(C) Statement I is incorrect but statement II is correct

(D) Both statement I and statement II are correct

19. A balloon has a volume of 0.09 m^3 below the surface of the water at a depth of 40m. If the temperature remains constant, what is its volume in m^3 when it is at the surface where the pressure is $1 \times 10^5 N/m^2$? (density of water $= 10^3 kg/m^3$)

(A) 0.43 **(B)** 0.45 **(C)** 0.36 **(D)** 0.51

20. The magnifying power of a telescope with tube length 60 cm is 5 in normal adjustment. What is the focal length of its eyepiece?

(A) 10 cm **(B)** 20 cm **(C)** 30 cm **(D)** 40 cm

SPACE FOR ROUGH WORK

SECTION-2

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. The answer to each question should be **rounded off to the nearest integer**.

1. The percentage increase in kinetic energy due to an impulsive force is 1500%. What percent of initial momentum is impulse given by this force?

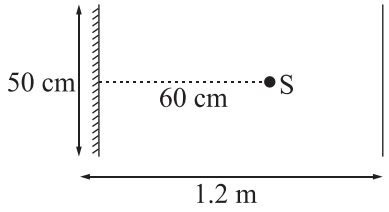
2. If mass of $U^{235} = 235.121420$ amu, mass of $U^{236} = 236.123050$ amu and mass of neutron = 1.008665 amu, then the energy required to remove one neutron from the nucleus of U^{236} is x MeV. Then value of 10x to the nearest integer is _____.

3. An electric dipole has a fixed dipole moment $\vec{p}$, which makes angle θ with respect to x-axis. When subjected to an electric field $\vec{E}_1 = E\hat{i}$, it experiences a torque $\vec{T}_1 = \tau\hat{k}$. When subjected to another electric field $\vec{E}_2 = \sqrt{3}E_1\hat{j}$, it experiences a torque $\vec{T}_2 = -\vec{T}_1$. The angle θ is _____. (in degree).

4. A closed organ pipe and an open organ pipe of same length produce 2 beats/second while vibrating in their fundamental modes. The length of the open organ pipe is halved and that of closed pipe is doubled. Then, the number of beats produced per second while vibrating in the fundamental mode is _____.

5. Moment of inertia of a hollow hemispherical shell about one of its diameter is $\frac{4}{x}MR^2$, where R is the radius and M is the mass of hemisphere, the value of x will be _____.

6. A point source of light S, placed at a distance 60 cm in front of the centre of a plane mirror of width 50 cm, hangs vertically on a wall. A man walks in front of the mirror along a line parallel to the mirror at a distance 1.2 m from it (see in the figure). The distance between the extreme points, where he can see the image of the light source in the mirror is _____cm.



7. A long solenoid has 200 turns per cm and carries a current I. The magnetic field at its centre is $6.28\times10^{-2} Wb/m^2$. Another long solenoid has 100 turns per cm and it carries a current $\frac{I}{3}$. The value of the magnetic field at its centre is x (mT). Value of 2x to the nearest integer is _____.

8. A current of 5 A passes through a copper conductor (resistivity $= 1.7\times10^{-8}\Omega - m$) of radius of cross-section 5mm. Find the mobility of the charges (in SI unit, rounded off the nearest integer), if their drift velocity is $1.1\times10^{-3} m/s$.

9. In oscillating LC circuit the total energy is U and maximum charge upon capacitor is Q. When the charge upon the capacitor is $Q/2$, then energy stored in inductor is $xU/4$. Then x is _____.

10. A metallic sphere of radius $1.0\times10^{-3} m$ and density $1.0\times10^{4} kg/m^3$ enters a tank of water, after a free fall through a distance of h in the earth's gravitational field. If its velocity remains unchanged after entering water, determine the value of h (in m). (Given : coefficient of viscosity of water $= 1.0\times10^{-3} N-s/m^2$, $g = 10 m/s^2$ and density of water $= 1.0\times10^{3} kg/m^3$)

PART II : CHEMISTRY	MARKS: 100

SECTION 1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

1. $S_8(s) + 12OH^-(aq.) \longrightarrow xS^{2-}(aq.) + yS_2O_3^{2-}(aq.) + zH_2O(\ell)$

For the above reaction find the value of x^y.

(A) 8 **(B)** 16 **(C)** 36 **(D)** 256

2. The cell reaction for the given cell is spontaneous if

$Pt, Cl_2\ (P_1\ atm)\,|\,Cl^-\,|\,Cl_2\ (P_2\ atm), Pt$

(A) $P_1 > P_2$ **(B)** $P_1 < P_2$ **(C)** $P_1 = P_2$ **(D)** $P_1 = 1$ atm

3. The pH of 0.5 L of 1.0 M NaCl after the electrolysis for 965 s using 5.0A current (100% efficiency) is:

(A) 1.00 **(B)** 13.00 **(C)** 12.70 **(D)** 1.30

4. The correct code for stability, of oxidation states for given cations is :

I. $Pb^{2+} > Pb^{4+}, Tl^{+} < Tl^{3+}$ II. $Bi^{3+} < Sb^{3+}, Sn^{2+} < Sn^{4+}$

III. $Pb^{2+} > Pb^{4+}, Bi^{3+} > Bi^{5+}$ IV. $Tl^{3+} < In^{3+}, Sn^{2+} > Sn^{4+}$

V. $Sn^{2+} < Pb^{2+}, Sn^{4+} > Pb^{4+}$ VI. $Sn^{2+} < Pb^{2+}, Sn^{4+} < Pb^{4+}$

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

5. If for a reaction $A \longrightarrow B$, $\Delta H = -10\,kJ\ mol^{-1}$ and $E_a = 50\ kJ\ mol^{-1}$, the energy of activation for reaction $B \longrightarrow A$ will be :

(A) $40\ kJ\ mol^{-1}$ **(B)** $50\ kJ\ mol^{-1}$ **(C)** $-50\ kJ\ mol^{-1}$ **(D)** $60\ kJ\ mol^{-1}$

6. An industrial method for the preparation of methanol is :

(A) By reacting CH_4 with steam at 900°C with a nickel catalyst

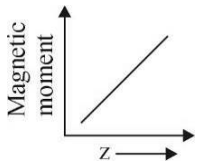
(B) By reduction of HCHO with $LiAlH_4$

(C) By catalytic reduction of CO in presence of $ZnO - Cr_2O_3$ at high temperature and pressure.

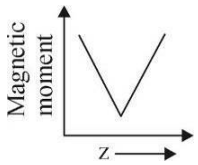
(D) By reaction of HCHO with NaOH(aq.)

7. Which of the following graph is correct representation between atomic number (Z) and magnetic moment of d-block elements? [Outer electronic configuration: $(n-1)d^x ns^{1 or 2}$]

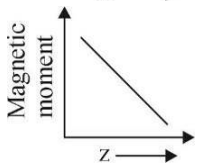
(A)



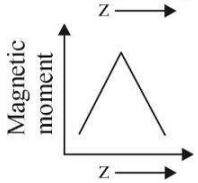
(B)



(C)



(D)



8. Assertion (A) : All molecules with polar bonds have non zero dipole moment.
Reason (R) : Dipole moment is a vector quantity.

(A) (A) and (R) are correct, and (R) is the correct explanation of the (A)
(B) (A) and (R) are correct but (R) is NOT the correct explanation of the (A)
(C) (A) is correct but (R) is incorrect
(D) (A) is incorrect but (R) is correct

9. For what 'X' below reaction doesn't occur?

$$2CuX_2 \longrightarrow Cu_2X_2 + X_2$$

(I) CN^- **(II)** Cl^- **(III)** I^- **(IV)** F^-

Select the correct answer using the codes given below :

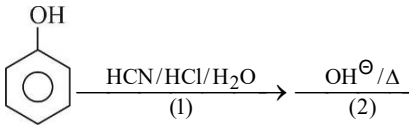
(A) I, II, IV **(B)** II, IV **(C)** I, III **(D)** IV

10. Which of the following are diamagnetic?

I. $K_4[Fe(CN)_6]$ **II.** $K_3[Cr(CN)_6]$ **III.** $K_3[Co(CN)_6]$ **IV.** $K_2[Ni(CN)_4]$

Select the correct answer using the codes given below :

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

11. 

X gives effervescence with $NaHCO_3$. Y can be :

(A) p-Hydroxy benzoic acid **(B)** p-Hydroxy benzaldehyde
(C) m-Hydoxy benzoic acid **(D)** p-Hydroxy benzyl alcohol

12. The hybridization states of the central atom in the complexes $[Fe(CN)_6]^{3-}$, $[Co(H_2O)_6]^{3+}$ and $[Co(NO_2)_6]^{3-}$ are :

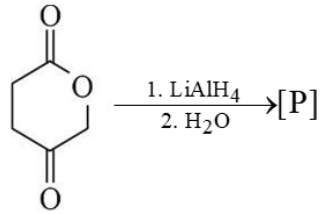
(A) d^2sp^3, sp^3d^2 and dsp^2 respectively **(B)** d^2sp^3, sp^3d^2 and sp^3d^2 respectively
(C) d^2sp^3, sp^3d^2 and d^2sp^3 respectively **(D)** All d^2sp^3

13. In the reaction

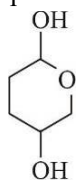
$$CH_3-\underset{\underset{Br}{|}}{CH}-CH_3 \xrightarrow{\text{Alc. KOH}} A \xrightarrow[\text{Peroxide}]{\text{HBr}} B \xrightarrow{CH_3ONa} C, \text{(major product)}$$

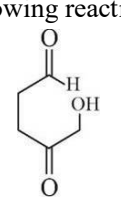
C is :

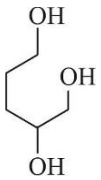
(A) diethyl ether **(B)** 1-methoxy propane
(C) isopropyl alcohol **(D)** propene

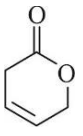
14. 

Identify product [P] of the following reaction.

(A) 

(B) 

(C) 

(D) 

15. Statement I : Boiling point of ethanol is more than ethylene glycol.
Statement II : Ethylene glycol forms intramolecular H-bonding.

(A) Statement I is true, Statement II is true ; Statement II is a correct explanation for Statement I

(B) Statement I is true, Statement 2 is true, Statement II is NOT a correct explanation for Statement I

(C) Statement I is true, Statement II is false

(D) Statement I is false, Statement II is true

16. Match the column I and II, and choose the correct combination from the option given:

Column I		Column II	
I.	$C_2H_5 - NH_2$	**P.**	Gives N_2 gas with Nitrous acid
II.	$(C_2H_5)_2NH$	**Q.**	Gives Foul Smelling gas with $CHCl_3$ and KOH
III.	$(C_2H_5)_3N$	**R.**	Lowest value of pK_b
IV.	$C_6H_5NH_2$	**S.**	Do not react with benzenesulphonyl chloride

(A) I – P, Q ; II – R ; III – S ; IV – Q **(B)** I – Q ; II – P ; III – R ; IV – S

(C) I – P, Q ; II – P ; III – R ; IV – S **(D)** I – P ; II – S ; III – R,S ; IV – Q

17. Which of the following amino acid have hydroxyl functional group?

(A) Tyrosine **(B)** Cysteine **(C)** Glutamine **(D)** Tryptophan

18. A sample of HI(g) is placed in flask at a pressure of 0.2 atm. At equilibrium the partial pressure of HI(g) is 0.04 atm. What is K_C for the given equilibrium $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$

(A) 0.6 **(B)** 0.16 **(C)** 4 **(D)** 2

19. Match the column I and II, and choose the correct combination from the option given:

Column I (Compound)		Column II (Used to Distinguish)	
I.	$NaHCO_3$ solution	**P.**	1-pentyne and 2-pentyne
II.	$NaHSO_3$	**Q.**	Isobutanol and tert-butanol
III.	$ZnCl_2 + HCl$	**R.**	CH_3CH_2OH and CH_3CHO
IV.	Tollen's reagent	**S.**	Ethanoic acid and phenol

(A) I – P ; II – R ; III – Q ; IV – S **(B)** I – S ; II – R ; III – Q ; IV – P

(C) I – Q ; II – R ; III – P ; IV – S **(D)** I – S ; II – P ; III – Q ; IV – R

20. The violet coloured complex formed in sodium nitroprusside test have metal ion with _____ no. of d-electrons.

(A) 5 **(B)** 6 **(C)** 7 **(D)** 8

SPACE FOR ROUGH WORK

SECTION-2

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. The answer to each question should be **rounded off to the nearest integer**.

1. An organic compound $A(C_{10}H_{18}O_8)$ on treatment with excess of CH_3COCl gives a fully acetylated product whose molar mass is found to be 518 g/mol. How many hydroxyl functional groups are present in A?

2. In a sample of H-atoms electrons are de-excited from 4^{th} excited state to ground state. How many of the following statements is/are correct?

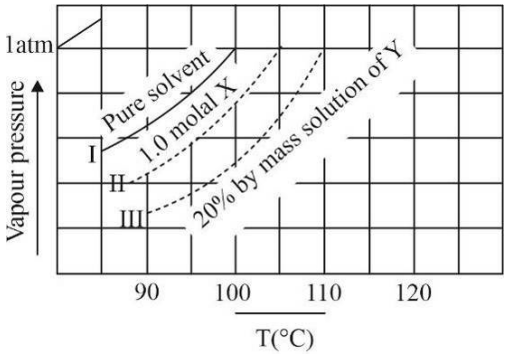
I. No line observed in P-fund series
II. Total ten lines observed in spectrum
III. 4 lines in UV-region and 3 lines in visible region are observed
IV. One line observed in Brackett series

3. How many of the following compound are more ionic than $AlCl_3$?

I. NaCl II. KCl III. $MgCl_2$ IV. $SiCl_4$
V. PCl_5

4. One mole of an ideal gas, $C_p = 4R$ at 300 K is reversibly expanded adiabatically to n times the original volume. What is value of n if temperature falls by 150 k ?

5. X and Y both are soluble in given solvent. Molar mass of the compound Y is _____.
(Given X, Y are non ionizable solutes)



6. A weak acid indicator when placed in a buffer solution of pH 4.63 was found to exhibit a colour which corresponds to 25% non-ionised and 75% ionized form. If K_a of the indicator is $x \times 10^{-5}$. Find x? (given : $10^{0.37} = 2.33$)

7. How many of the following statement(s) is/are correct :

I. When $T \to \infty$ or $Ea \to 0$ then k = A
II. A positive catalyst can change ΔH of the reaction
III. A mixture of reactants may be thermodynamically unstable but kinetically stable
IV. A negative catalyst increases the activation energy of the reaction

8. How many of the following orders is/are correct?

I. Bond energy : $Cl_2 > F_2 > Br_2 > I_2$

II. Atomic size : $Tl > In > Al > Ga > B$

III. Electronegativity : $C > Si > Ge > Sn > Pb$

IV. Density : $Si < C < Ge < Sn < Pb$

V. $E^{\circ}_{M^{+3}/M}$: $Al > Ga > In > Tl$

9. Hydrocarbon 'X' on ozonolysis consumes 2 moles of ozone (per mole of X) and gives 2 moles of methanal and 1 mole of propan-1, 3-dial. What is the molar mass of X?

10. 0.2 g of an organic compound containing C, H and O, on combustion gave 0.147 g CO_2 and 0.12 g water. The percentage of oxygen in organic compound is _____. (Round off the answer to nearest integer)

SPACE FOR ROUGH WORK

PART III : MATHEMATICS	MARKS: 100

SECTION 1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

1. Let $f(x) = x + \sin x,$ suppose g denotes the inverse function of f. Then, find the value of $g'\left(\frac{\pi}{4} + \frac{1}{\sqrt{2}}\right).$

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

2. If the direction cosines of two lines are such that $l+m+n=0, l^2+m^2-n^2=0,$ then the angle between them is:

(A) π **(B)** $\frac{\pi}{3}$ **(C)** $\frac{\pi}{4}$ **(D)** $\frac{\pi}{6}$

3. The value of $\int \frac{(1+x)}{x(1+xe^x)^2}dx,$ is equal to:

(A) $\log\left|\frac{x}{1+xe^x}\right| + \frac{1}{(1+xe^x)} + C$ **(B)** $\log\left|\frac{xe^x}{1+xe^x}\right| + \frac{1}{1+xe^x} + C$

(C) $\log\left|\frac{xe^x}{1+e^x}\right| + \frac{1}{1+xe^x} + C$ **(D)** None of the above

4. The value of $\sum_{r=1}^{\infty} \frac{(4r+5)5^{-r}}{r(5r+5)}$ is :

(A) $\frac{1}{5}$ **(B)** $\frac{2}{5}$ **(C)** $\frac{1}{25}$ **(D)** $\frac{2}{125}$

5. If z_1 & z_2 are two variable complex numbers such that, $|z_1|^2 \le 169$ & $|z_2+3-4i|^2 \le 25.$ Then the maximum value of $|z_1 - z_2|,$ is:

(A) 23 **(B)** 13 **(C)** 5 **(D)** 18

6. A doctor is called to see a sick child. The doctor knows (prior to the visit) that 90% of the sick children in that neighbourhood are sick with the flue, denoted by F, while 10% are sick with the measles, denoted by M. A well-known symptom of measles is a rash, denoted by R. The probability of having a rash for a child sick with measles is 0.95. However, occasionally children with the flue also develop a rash with conditional probability 0.08. Upon examination the child, the doctor finds a rash, then the probability that the child has the measles, is:

(A) $\frac{89}{167}$ **(B)** $\frac{91}{167}$ **(C)** $\frac{93}{167}$ **(D)** $\frac{95}{167}$

7. The tangent at point P(5, 2) on the parabola $y^2 = 2(x-3)$ meets the directrix of this parabola at Q then if circumcentre of ΔSPQ where S is focus of parabola is (α, β), then $\alpha + 2\beta$ is equal to:

(A) $\frac{13}{2}$ **(B)** $\frac{11}{2}$ **(C)** 7 **(D)** 26

8. If the position vectors of the points A, B and C be $\hat{i}+\hat{j}, \hat{i}-\hat{j}$ and $a\hat{i}+b\hat{j}+c\hat{k}$ respectively, then the points A, B and C are collinear, if:

(A) $a=b=c=1$ **(B)** $a=1$, b and c are arbitrary scalars

(C) $a=b=c=0$ **(D)** $c=0$, $a=1$ and b is an arbitrary scalar

9. Two lines $\frac{x-1}{2}=\frac{y+1}{3}=\frac{z-1}{4}$ and $\frac{x-3}{1}=\frac{y-k}{2}=\frac{z}{1}$ intersect at a point $P(\alpha,\beta,\gamma)$ then $\alpha+\gamma-2\beta$ is equal to :

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

10. A is a set containing n elements. A subset P of A is chosen. The set A is reconstructed by replacing the elements of P. A subset Q of A is again chosen, the number of ways of choosing so that $(P\cup Q)$ is a proper subset of A, is:

(A) 3^n **(B)** 4^n **(C)** 4^n-2^n **(D)** 4^n-3^n

11. If coefficient of x^n in the expansion of $(1+x)^{101}(1-x+x^2)^{100}$ is non-zero, then n cannot be of the form: (λ can be any whole number)

(A) $3\lambda+1$ **(B)** 3λ **(C)** $3\lambda+2$ **(D)** $4\lambda+1$

12. 12 boys and 2 girls are to be seated in a row such that there are atleast 3 boys between the 2 girls. The number of ways this can be done is $\lambda\times 12!$, the value of λ is:

(A) 55 **(B)** 110 **(C)** 20 **(D)** 45

13. Number of words of 4 letters that can be formed with the letters of the word IIT JEE is:

(A) 42 **(B)** 82 **(C)** 102 **(D)** 142

14. If $\lim\limits_{x\to 0}\dfrac{\log_e\cot\left(\frac{\pi}{4}-K_1x\right)}{\tan K_2x}=1$, then:

(A) $K_1=K_2$ **(B)** $2K_1=K_2$ **(C)** $K_1=2K_2$ **(D)** $K_1=4K_2$

15. If α,β are the roots of the equation $ax^2+bx+c=0$ and $A_n=\alpha^n+\beta^n$, then $aA_{n+2}+bA_{n+1}+cA_n$ is equal to

(A) 0 **(B)** 1 **(C)** $a+b+c$ **(D)** abc

16. Complete set of real value of x for which $\log_{(2x-3)}(x^2-5x-6)$ is defined is :

(A) $\left(\frac{3}{2},\infty\right)$ **(B)** $(6,\infty)$ **(C)** $\left(\frac{3}{2},6\right)$ **(D)** $\left(\frac{3}{2},2\right)\cup(2,\infty)$

17. If $A=\begin{bmatrix}1 & 2 & -1\\ -1 & 1 & 2\\ 2 & -1 & 1\end{bmatrix}$, then det(adj(adjA)) is equal to:

(A) 14^4 **(B)** 14^3 **(C)** 14^2 **(D)** 14

18. The value of positive real parameter a such that area of region bounded by parabola $y=x-ax^2$, $ay=x^2$ attains its maximum value is equal to :

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

19. If $A=\begin{pmatrix}1 & 2\\ 0 & 1\end{pmatrix}, P=\begin{pmatrix}\cos\theta & \sin\theta\\ -\sin\theta & \cos\theta\end{pmatrix}, Q=P^TAP,$ find $PQ^{2014}P^T$:

(A) $\begin{pmatrix}1 & 2^{2014}\\ 0 & 1\end{pmatrix}$ **(B)** $\begin{pmatrix}1 & 4028\\ 0 & 1\end{pmatrix}$

(C) $(P^T)^{2013}A^{2014}P^{2013}$ **(D)** $P^TA^{2014}P$

20. Let $C(\alpha,\beta)$ be the circumcenter of the triangle formed by the lines

$y=x$

$y=2x$, and $y=3x+4$

Then $(\alpha+\beta)^2+\alpha-\beta$ is equal to:

(A) 15 **(B)** 16 **(C)** 17 **(D)** 18

SPACE FOR ROUGH WORK

SECTION-2

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. The answer to each question should be **rounded off to the nearest integer**.

1. If a_n is the greatest term in the sequence $a_n = \frac{n^2}{n^3 + 200}$ then n is equal to _____.

2. If $y = f(x)$ passing through (4, 2) satisfies the differential equation $y(1+xy)dx - xdy = 0$ then $4 \cdot f(2)$ is equal to _____.

3. Three parallel chords of a circle have lengths 2,3,4 and subtend angles $\alpha, \beta, \alpha+\beta$ at the centre respectively (given $\alpha + \beta < \pi$), then $800\cos\alpha$ is equal to _____.

4. Let $f: R \to R$ and $g: R \to R$ be two one-one and onto functions such that they are the mirror images of each other about the line $y = 2$. If $h(x) = f(x) + g(x)$ then $h(0)$ equals to _____.

5. The shortest distance between the two straight lines $\frac{x-\frac{4}{3}}{2} = \frac{y+\frac{6}{5}}{3} = \frac{z-\frac{3}{2}}{4}$ and $\frac{3x-4}{5} = \frac{5y+6}{8} = \frac{2z-3}{9}$ is _____.

6. The largest natural number n such that 5^n divide 70! is _____.

7. A sample of 20 observations has mean of 50 and variance of 1, while a sample of 40 observations has mean of 50 and standard deviation 2. The 2 samples are combined to give complete set of 60 observations with variance σ^2, then $3\sigma^2$ is equal to _____.

8. The value of the definite integral $\int_0^2 \left(\sqrt{1+x^3} + \sqrt[3]{x^2+2x}\right)dx$ is _____.

9. Let $|\vec{a}| = 1, |\vec{b}| = 1$ & $|\vec{a}+\vec{b}| = \sqrt{3}$. If $\vec{c}$ be a vector such that $\vec{c} = \vec{a} + 2\vec{b} - 3(\vec{a}\times\vec{b})$ and $p = \left|(\vec{a}\times\vec{b})\times\vec{c}\right|$, then $[p]$ is equal to _____. (where [ ] represents greatest integer function).

10. The sum of possible real values of x for which the sixth term of $\left(3^{\log_3\sqrt{9^{|x-2|}}} + 7^{\left(\frac{1}{5}\right)\log_7(3^{|x-2|}-9)}\right)^7$ equals 567, is _____.

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

End of 2024-Mock JEE Main - 1