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Mock JEE Main – 6 (CBT) | JEE - 2024

Date: 29/02/2024   **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 electric field of an electromagnetic wave is given by

$$7.2 \times 10^3 \cos[1.5 \times 10^7 z + 4.5 \times 10^{15} t](3\hat{i} + 4\hat{j}) \frac{V}{m}.$$

The associated magnetic field will be:

(A) $2.4 \times 10^{-5} \cos(1.5 \times 10^7 z + 4.5 \times 10^{15} t)(4\hat{i} + 3\hat{j}) Wb/m^2$

(B) $2.4 \times 10^{-5} \cos(1.5 \times 10^7 z + 4.5 \times 10^{15} t)(3\hat{i} + 4\hat{j}) Wb/m^2$

(C) $2.4 \times 10^{-5} \cos(1.5 \times 10^7 z + 4.5 \times 10^{15} t)(4\hat{i} - 3\hat{j}) Wb/m^2$

(D) $2.4 \times 10^{-5} \cos(1.5 \times 10^7 z + 4.5 \times 10^{15} t)(-4\hat{i} + 3\hat{j}) Wb/m^2$

2. An energy of 68 eV is required to excite a hypothetical hydrogen-like atom from its 2nd Bohr orbit to 3rd. If the nuclear charge is Ze then kinetic energy of electron in 1st orbit is:

(A) $490 eV$ **(B)** $520 eV$ **(C)** $620 eV$ **(D)** $310 eV$

3. The minimum heat energy required for complete dissociation of 2 moles of H_2 gas at $300K$ at constant volume is:

(A) $1 kJ$ **(B)** $1.75 kJ$ **(C)** $2.5 kJ$ **(D)** $3.5 kJ$

4. The height y and distance x along the horizontal of a projectile on a certain planet vary with time t as $y = (16t - 5t^2)m$ and $x = 9t\, m$, where t is in seconds.

If range of the projectile is R and time of flight is T, then which of the following option is correct?

(A) $R = 28.8\, m, T = 3.2s$ **(B)** $R = 32\, m, T = 6.4s$

(C) $R = 14.4\, m, T = 3.2s$ **(D)** $R = 15.6\, m, T = 1.6s$

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5. Given below are two statements:

Statement I: Plank's constant and Boltzmann's constant have same dimensions.

Statement II: Reynold's number is a dimensionless quantity.

In the light of above statements, choose the correct answer from the statements given below:

(A) Both Statement I and Statement II are true.

(B) Statement I is false but Statement II is true.

(C) Both Statement I and Statement II are false.

(D) Statement I is true but Statement II is false.

6. A body of mass 500 *kg* is moving horizontally with a velocity of 6 *m/s*. If 100 *kg* extra mass is added, the change in kinetic energy of body (in *J*) will be:

(A) 300   (B) –1500   (C) 1500   (D) –500

7. If in a *p-n* junction diode, a square wave input signal of 10V is applied as shown in figure,
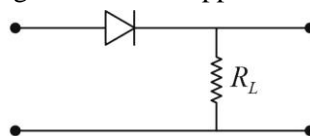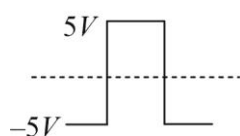
Then the value of output signal across R_L will be:

(A)   (B)

(C)   (D)
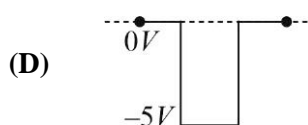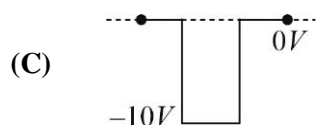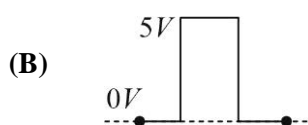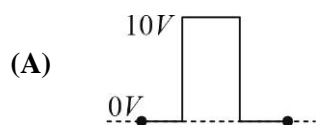
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8. A wire of length 15 cm and radius $\sqrt{7} \times 10^{-4} m$ is connected across the right gap of a meter bridge. When a resistance of 4.5Ω is connected on the left gap by using resistance box, the balance length is found to be 30 cm from the left end. If the resistivity of the wire is $R \times 10^{-7} \Omega m$, then value of R is:

(A) 110   (B) 77   (C) 154   (D) 165

9. A convex lens of focal length 40 *cm* forms real image of an object. Another convex lens of focal length 20 *cm* forms real image of the same object for the same object distance but the image formed in this case is 36 *cm* closer to the lens than the previous one. What is the object distance?

(A) 60 *cm*   (B) 120 *cm*   (C) 30 *cm*   (D) 15 *cm*

10. **Statement I:** Angle of contact between glass and water interface is acute.

Statement II: Water molecules are more attracted by glass molecules than by themselves.

(A) Both statement I and statement II are incorrect.

(B) Both statement I and statement II are correct.

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

(D) Statement I is incorrect but statement II is correct.

11. 2 wires of same metal are connected in series. They have their length in the ratio 4 : 1 and their cross-section area in the ratio 9 : 4. The resistance of thinner wire is 20Ω. The total resistance of the combination will be:

(A) $\dfrac{500}{9} \Omega$ (B) $\dfrac{100}{3} \Omega$ (C) $\dfrac{81}{200} \Omega$ (D) $\dfrac{9}{200} \Omega$

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12. The refracting angle of a prism for a monochromatic light is $74°$ and refractive index is $\frac{4}{3}$. For minimum deviation angle of incidence will be :

    (A) $37°$ **(B)** $30°$ **(C)** $53°$ **(D)** $60°$

13. A square loop of side $4\ m$ is placed in a region of magnetic field as shown. The magnetic field is switched off in $5s$. What is the charge flown through it (in C) if the resistance per unit length is $1\Omega / m$?
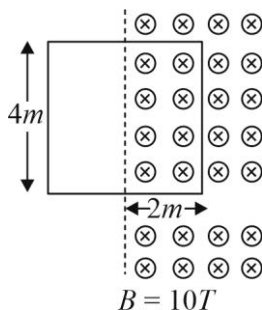
    (A) $2C$ **(B)** $1C$ **(C)** $4C$ **(D)** $5C$

14. The mass of a planet is eighty one times mass of earth and radius is half that of earth. If time period of a simple pendulum on surface of earth is $4s$, then its time period on the surface of planet is (in SI):

    (A) $\frac{1}{4}s$ **(B)** $3s$ **(C)** $\frac{2}{9}s$ **(D)** $4s$

15. 3 charges q, $2q$, $-3q$ are located at the vertices of an equilateral triangle. At the centre of the triangle:

    (A)   The field is zero but potential is non-zero.

    (B)   The field is non-zero but potential is zero.

    (C)   Both field and potential are zero.

    (D)   Both field and potential are non-zero.

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16. 2 bodies *A* and *B* moving towards each other of mass 5 kg and 2 kg respectively and speed 4 m/s & 2 m/s respectively collide head on with each other. If coefficient of restitution $e = \dfrac{1}{2}$. The final speed(s) (in m/s) for A and B are respectively.

(A) $\dfrac{10}{7}, 14$ (B) $\dfrac{31}{7}, \dfrac{5}{7}$ (C) $\dfrac{10}{7}, \dfrac{31}{7}$ (D) $\dfrac{5}{7}, \dfrac{10}{7}$

17. A car is travelling at 57.6 km/h on an unbanked (horizontal) circular road of radius $\dfrac{160}{3}\, m$. If the coefficient of friction between the road and the car is 0.8, then the maximum tangential deceleration that the driver of car can achieve by applying the brakes at this moment is:

(A) $8\, m/s^2$ (B) $4.8\, m/s^2$ (C) $6.4\, m/s^2$ (D) $16\, m/s^2$

18. A particle of charge *q* and velocity *v* passes undeflected through a space with non-zero electric field *E* and magnetic field *B*. The undeflecting condition will hold if:

(A) $\vec{E}$ and $\vec{B}$ are parallel   (B) $\vec{E}$ and $\vec{B}$ are antiparallel

(C) $(\vec{v} \times \vec{B})$ is parallel to $\vec{E}$ (D) $(\vec{B} \times \vec{v})$ is parallel to $\vec{E}$

19. One centimeter on the main scale of vernier caliper is divided into ten equal parts. If 10 divisions of vernier scale coincide with 8 small divisions of the main scale, the least count of the caliper is:

(A) 0.01 cm   (B) 0.02 cm   (C) 0.05 cm   (D) 0.07 cm

20. The ratio of rms speed of molecules in Nitrogen gas to that in Helium gas at 300 K is:

(A) $\sqrt{\dfrac{2}{7}}$ (B) $\sqrt{\dfrac{1}{7}}$ (C) $\sqrt{\dfrac{3}{5}}$ (D) $\sqrt{\dfrac{6}{5}}$
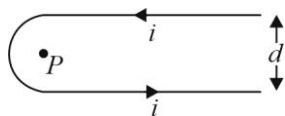
SPACE FOR ROUGH WORK

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 stress vs strain graph for wires of materials A and B are as shown in the figure. If Y_A and Y_B are the young's modulus of the materials, then $\dfrac{Y_A}{Y_B} = \dfrac{x\sqrt{3}}{4}$. Find x.
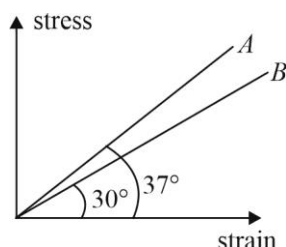
2. A particle starts motion from origin at time $t = 0$ with initial velocity $\vec{v} = 4\, m/s\, \hat{i}$ under a constant acceleration $\vec{a} = (-2\hat{i} + 3\hat{j})\text{m/s}^2$. The displacement of particle when particle starts moving parallel to y axis is $2\sqrt{x}\, m$. Then x is _____.

3. The curved portion as shown in the figure is a semicircle and the straight wires are long P is the centre of curved portion of the wire. The magnetic field at P is $\dfrac{12x}{7}\,\mu T$. ($i = 1A\ \&\ d = 5cm$).

   Then $x =$ _____.

4. The charge on the $6\mu F$ capacitor is (in μC) _____.
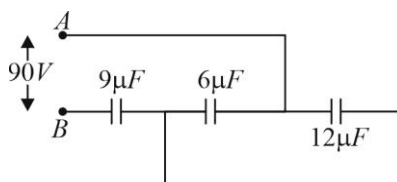

SPACE FOR ROUGH WORK

5. A biconvex thick lens is constructed with glass $(\mu = 1\cdot5)$. Each of the surface has a radius of curvature of 20 cm and the thickness of the middle is 4cm. The image of an object placed far away from the lens is $\dfrac{560}{x}\, cm$ from the farther surface on the other side of lens. Then $x =$ _____.

6. A boy pedals a stationary bicycle at $\dfrac{1}{\pi}$ revolution per second. The pedals are attached to 100 turns of coil of area $0.1\,m^2$ and placed in a uniform magnetic field of 0.1T. The maximum voltage generated in the coil (in V) is _____.

7. Four thin metal rods each of mass 'M' and length L are welded to form a square $ABCD$ as shown in the figure. The moment of inertia of the composite structure about a line which bisects rod AB and CD is $\dfrac{2ML^2}{x}$. Then x is _____.
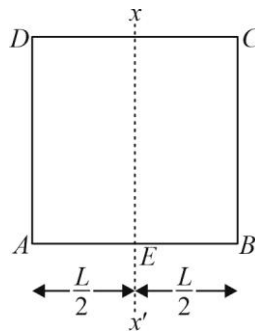
SPACE FOR ROUGH WORK

8. An electric charge $q = 2\mu C$ is fixed on the axis of a uniformly charged ring of radius 5 cm lying on a horizontal floor. The ring is in equilibrium and has a charge density $\lambda = \dfrac{40}{\pi}\mu C/m$. Mass of the ring is $\dfrac{826}{(13)^3}$ kg. The normal reaction acting on the ring is $\dfrac{x}{13}N$. Then x is _____.

(Take $g = 10\, m/s^2$).
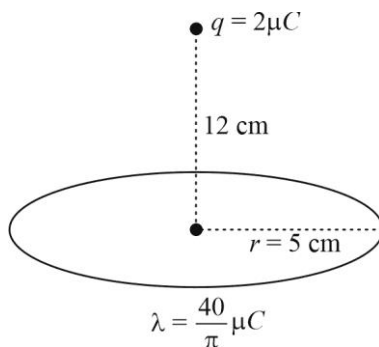
9. A particle executes simple harmonic motion with an amplitude of 20 cm. At mean position, velocity of the particle is 10 cm/s. Speed of the particle when it has covered phase equal to $\dfrac{\pi}{6}$ radians w.r.t mean position is $\dfrac{\sqrt{3}}{x}m/s$. Then x is _____.

10. The energy required to separate a nucleus $_{50}Sn^{120}$ into its constituent nucleus is $203x$. If atomic masses of Sn^{120}, H^1 & $_0n^1$ are $119.9022u$, $1.0078u$ and $1.0086u$ respectively then value of x to closest integer is: $\left(1u = 931\dfrac{MeV}{c^2}\right)$

SPACE FOR ROUGH WORK

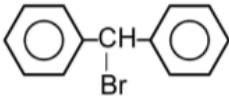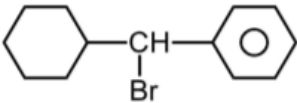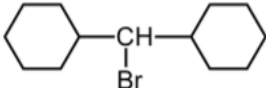| PART II: CHEMISTRY	MARKS: 100

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. During qualitative analysis of salt having cation Y^{2+}, on addition of reagent (X) a yellow precipitate (Z) is formed. Then cation Y^{2+}, reagent X & precipitate Z are?

    (A) Pb^{2+}, KI, PbI_2 (B) Cu^{2+}, KI, Cu_2I_2

    (C) Ni^{2+}, H_2S, NiS   (D) Zn^{2+}, H_2S, ZnS

2. Consider the following complex ions:

    $P \rightarrow \left[Fe(CN)_6\right]^{4-}$ $Q \rightarrow \left[Fe(H_2O)_6\right]^{2+}$ $R \rightarrow \left[Cr(NH_3)_6\right]^{3+}$

    The correct order of the complex ions, according to their spin only magnetic moment values (in BM) is:

    (A) $P > Q > R$ (B) $Q > P > R$ (C) $Q > R > P$ (D) $R > P > Q$

3. Electronic configuration of Ytterbium in its most common oxidation state is:

    (A) $\left[Xe\right]4f^{14}6s^2$ (B) $\left[Xe\right]4f^{13}$ (C) $\left[Xe\right]4f^{14}$ (D) $\left[Xe\right]4f^{14}5d^1$

4. Given below are two statements.

    Statements I: Degree of hydrolysis & pH of a salt, NH_4CN is independent of concentration of NH_4CN.

    Statements II: The solution of NH_4CN in water has pH slightly greater than 7.

    (A) Statement I is incorrect but Statement II is correct

    (B) Both Statement I and Statement II are correct

    (C) Both Statement I and Statement II are incorrect

    (D) Statement I is correct but Statement II is incorrect

SPACE FOR ROUGH WORK

5. Given below are two statements.

Statements I: Ortho-nitrophenol is less soluble in water than the meta & para isomers.

Statements II: Meta & Para nitrophenols exist as associated molecules.

(A) Statement I is incorrect but Statement II is correct

(B) Both Statement I and Statement II are incorrect

(C) Both Statement I and Statement II are correct

(D) Statement I is correct but Statement II is incorrect

6. Given below are two statements.

Statements I: Helium & Beryllium are chemically inert due to similar outer electronic configuration.

Statements II: The first ionisation enthalpy of Aluminium is lower than that of Magnesium.

(A) Statement I is incorrect but Statement II is correct

(B) Both Statement I and Statement II are incorrect

(C) Both Statement I and Statement II are correct

(D) Statement I is correct but Statement II is incorrect

7. Which of the following molecules are expected to exhibit intermolecular H-bonding?

(I) Acetic acid   (II) o-nitrophenol   (III) m-nitrophenol   (IV) ortho-boric acid

Select correct alternative:

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

8. Which of the following ions has spin only magnetic moment equal to 2.83 BM?

(Ti = 22, Cr = 24, Mn = 25, Ni = 28)

(A) Ti^{3+} (B) Ni^{2+} (C) Cr^{3+} (D) Mn^{2+}
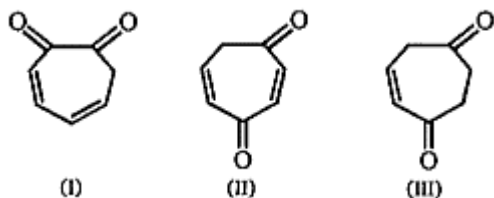
SPACE FOR ROUGH WORK

9. Insulin has 51 amino acids in two polypeptide chains, these polypeptide chains are cross-linked by:

(A) Peroxy linkage **(B)** Disulphide linkage

(C) Glycosidic linkage **(D)** Peptide linkage

10. Given below are two statements one is labelled as Assertion **(A)** & the other is labelled as Reason **(R)**.

Assertion (A): Boron only forms covalent compounds.

Reason (R): Small size and very high value of sum of first three ionization enthalpies of boron prevent it to form + 3 ions.

(A) A is false but R is true

(B) Both A and R are correct and R is the correct explanation of A

(C) A is true but R is false

(D) Both A and R are correct and R is not the correct explanation of A

11. The rate of $S_N 1$ reaction is fastest with:

(A)

(B)

(C)

(D)

SPACE FOR ROUGH WORK

12. Which of the following presents the correct order of the acidity in the given compounds?
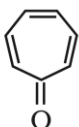
(A) $BrCH_2COOH > ClCH_2COOH > FCH_2COOH > CH_3COOH$

(B) $FCH_2COOH > ClCH_2COOH > BrCH_2COOH > CH_3COOH$

(C) $CH_3COOH > BrCH_2COOH > ClCH_2COOH > FCH_2COOH$

(D) $FCH_2COOH > CH_3COOH > BrCH_2COOH > ClCH_2COOH$

13.

(I)   (II)   (III)

Among the given compounds, the correct order of enol content is:

(A) $I > II > III$ (B) $III > II > I$ (C) $II > I > III$ (D) $II > III > I$

14. Tropone is _____ type of an organic compound.
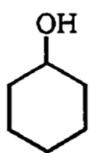
(A)   Benzenoid aromatic   (B)   Alicyclic

(C)   Non-benzenoid non-aromatic   (D)   Non-benzenoid aromatic.
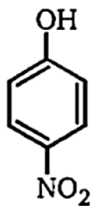
SPACE FOR ROUGH WORK

15. Rank the following compounds in order of their decreasing acidic strength (most acidic → least acidic).
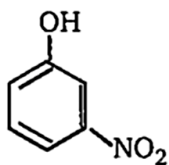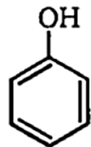
      (1)   (2)   (3)   (4)

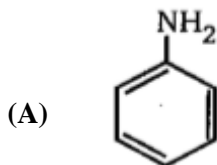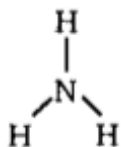**(A)** $2 > 4 > 1 > 3$ **(B)** $1 > 3 > 4 > 2$ **(C)** $3 > 1 > 2 > 4$ **(D)** $3 > 1 > 4 > 2$

16. Which of the following is the strongest Bronsted base?
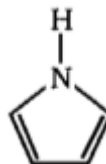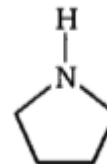
17. If mole fraction of the solvent in a solution decreases then:

  (A) Vapour pressure of solution increases   **(B)** Boiling point decreases

  (C) Osmotic pressure increases   **(D)** All are correct.

SPACE FOR ROUGH WORK

18. A metal salt solution forms a yellow precipitate (A) with potassium chromate in acetic acid, a white precipitate (B) with dilute sulphuric acid, but gives no precipitate with sodium chloride or iodide. Then A & B are respectively:

(A) $BaCrO_4$, $Ba(NO_3)_2$ **(B)** $Ba(NO_3)_2$, $BaSO_4$

(C) $BaCrO_4$, $BaSO_4$ **(D)** $BaSO_4$, $BaCrO_4$

19. IUPAC name of the following compound is:
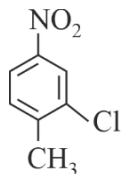
(A) 4-methyl-5-chloro-nitrobenzene   **(B)** 2-chloro-1-methyl-4-nitrobenzene

(C) 2-chloro-4-nitro-1-methylbenzene   **(D)** 5-chloro-4-methylnitrobenzene

20. Which one of the following elements shows both positive & negative oxidation states?

(A) Cesium   **(B)** Fluorine   **(C)** Iodine   **(D)** Xenon

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. Among the given organic compounds, the total number of aromatic compounds are:
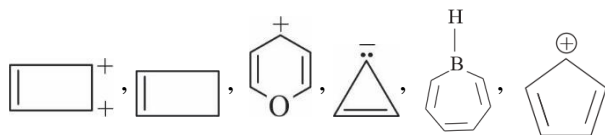
2. W is the weight of iron (in gram) which will be converted into Fe_3O_4 by the action of 18 gram of steam. The value of W/7 is _____. (Molar weight of Fe = 56 g/mol)

$$(Fe + H_2O \rightarrow Fe_3O_4 + H_2)$$

3. During the electrolysis of a concentrated brine solution, the moles of chlorine gas produced by the passage of 4F electricity is_____.

4. 3, 4-dimethylhex-3-ene on reaction with HBr in pressence of peroxide forms an addition product (A). The number of possible stereoisomers for A is _____.

5. The number of electrons in argon atom having $m_l = 1$ are _____.

SPACE FOR ROUGH WORK

6. From the given list, the number of compounds with +6 oxidation state of sulphur are _____.

$SO_3, H_2S_2O_7, H_2S_2O_8, SO_2Cl_2, Na_2SO_3, SOF_2$

7. Sum of bond order of N_2^+ and O_2^+ is _____.

8. Consider the following data for the following reaction.

$A + B \longrightarrow AB$
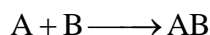
S. No.	Concentration of A (in mol/L)	Concentration of B (in mol/L)	Rate (in mol L^{-1} sec^{-1})
1.	1×10^{-2}	2×10^{-2}	2×10^{-4}
2.	2×10^{-2}	2×10^{-2}	4×10^{-4}
3.	2×10^{-2}	4×10^{-2}	8×10^{-4}

The order of reaction is_____.

9. Among the following, total number of ortho and para directing groups are _____.

$-OC_2H_5, -CHO, -SO_3H, -NHCH_3, -OH, -Br, -NO_2, -CH_3$

10. An ideal gas expands against a constant external pressure of 2 atmosphere from 20 litre to 40 litre and absorbs 10.04 kJ of heat from surroundings. The change in internal energy of the system (in kJ) is _____. (Given 1 L-atm = 101 J)

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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 $f(x) = \begin{cases} (1+ax)^{1/x} & x < 0 \\ b & x = 0 \\ \dfrac{(x+1)^{1/3} - 1}{(x+1)^{1/2} - 1} & x > 0 \end{cases}$, is continuous at $x = 0$, then $3(e^a + b)$ is equal to:

(A) 3   **(B)** 6   **(C)** 4   **(D)** 8

2. Equation of the perpendicular line from $(3, -1, 11)$ to the line $\dfrac{x}{2} = \dfrac{y-2}{3} = \dfrac{z-3}{4}$ is:

(A) $\dfrac{x-3}{1} = \dfrac{y+1}{-6} = \dfrac{z-11}{4}$ **(B)** $\dfrac{x-3}{2} = \dfrac{y+1}{5} = \dfrac{z-11}{7}$

(C) $\dfrac{x-3}{1} = \dfrac{y+1}{11} = \dfrac{z-11}{3}$ **(D)** $\dfrac{x-3}{1} = \dfrac{y+1}{6} = \dfrac{z-11}{4}$

3. The radius of largest circle inscribed in the parabola, $y^2 = 4x$ which passes through its focus and is contained in it, is:

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

4. If x_1, y_1 are the roots of $x^2 + 8x - 20 = 0$, x_2, y_2 are the roots of $4x^2 + 32x - 57 = 0$ and x_3, y_3 are the roots of $9x^2 + 72x - 112 = 0$, then the points, $(x_1, y_1), (x_2, y_2)$ and (x_3, y_3):

(A) Are collinear   **(B)** Form an equilateral triangle

(C) Form a right angled isosceles triangle   **(D)** Are concyclic

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5. Consider two straight lines and a family of straight lines $L_1 : x + y = 0$ & $L_2 : 3x - 4y = 7$ and a family of straight lines $L : y = 3x + c$, where c is parameter. The locus of mid point of segment intercepted on L between L_1 & L_2 is:

(A) $4x - 25y = 29$ (B) $x - y = 2$

(C) $3x - 25y = 28$ (D) $7x - y = 8$

6. If standard deviation of $x_i, i = 1, 2, ..., n$ is σ_x, then the standard deviation of $\dfrac{ax_i + b}{p}$

$\forall\, a, b, p \in R, i = 1, 2, 3, ..., n$, is:

(A) $\left|\dfrac{a}{p}\right|\sigma_x$ (B) $\left|\dfrac{p}{a}\right|\sigma_x$ (C) $\dfrac{p}{a}\sigma_x$ (D) $\dfrac{p}{2a}\sigma_x$

7. $^{35}C_0 \cdot {}^{35}C_{15} - {}^{35}C_1 \cdot {}^{35}C_{16} + {}^{35}C_2 \cdot {}^{35}C_{17} - .... + {}^{35}C_{20} \cdot {}^{35}C_{35}$ is equal to:

(A) Zero   (B) $-{}^{35}C_{25}$ (C) $^{35}C_{25}$ (D) 1

8. If a, b, c are three distinct numbers in AP and $b - a$, $c - b$, a are in GP, then $a : b : c =$

(A) $2 : 3 : 1$ (B) $\dfrac{1}{2} : \dfrac{1}{3} : 1$ (C) $1 : 2 : 3$ (D) $2 : 1 : 6$

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9. Let P be a variable point on the ellipse $3x^2 + 4y^2 = 12$ whose foci are F_1 and F_2. The incentre of the triangle PF_1F_2 always lies on a conic whose eccentricity is e. Then $81e^2$ is equal to:

(A) 54   (B) 45   (C) 27   (D) 72

10. Shortest distance between the lines $\dfrac{x-1}{1} = \dfrac{y-1}{1} = \dfrac{z-1}{1}$ and $\dfrac{x-2}{1} = \dfrac{y-3}{1} = \dfrac{z-4}{1}$ is equal to:

(A) $\sqrt{14}$ (B) $\sqrt{7}$ (C) $\sqrt{2}$ (D) $\sqrt{3}$

11. Let $I - \{0\}$ be the set of all non-zero integers and a relation R is defined as $(x, y) \in R \Rightarrow x^y = y^x$ for $x, y \in I - \{0\}$, then relation R is:

(A) Reflexive but not symmetric   (B) Symmetric but not reflexive

(C) Reflexive and symmetric both   (D) Neither reflexive nor symmetric

12. The value of $\displaystyle \lim_{x \to 0} \dfrac{x + 2\sin x}{\sqrt{x^2 + 2\sin x + 1} - \sqrt{\sin^2 x - x + 1}}$ is:

(A) Zero   (B) 3   (C) 2   (D) 1

13. $\displaystyle \int_{-1}^{1} \dfrac{dx}{(1 + e^x)(1 + x^2)} =$

(A) $\dfrac{\pi}{2}$ (B) $\dfrac{\pi}{4}$ (C) $\dfrac{\pi}{8}$ (D) $\dfrac{\pi}{16}$

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14. Let $A = \begin{bmatrix} x+\lambda & x & x \\ x & x+\lambda & x \\ x & x & x+\lambda \end{bmatrix}$, then A^{-1} exists if:

(A) $x \neq 0$ (B) $\lambda \neq 0$

(C) $3x + \lambda \neq 0, \lambda \neq 0$ (D) $x \neq 0, \lambda \neq 0$

15. A mapping $f : R \to R$ defined by $f(x) = (x-\alpha)(x-\beta)(x-\gamma)$, where $\alpha, \beta, \gamma \in R$, $\alpha \neq \beta \neq \gamma$. The mapping is:

(A) One-to-one but not onto   (B) Onto but not one-one

(C) Both one-one and onto   (D) Neither one-one nor onto

16. If $\vec{a}, \vec{b}$ and $\vec{c}$ are unit vectors such that $\left| \vec{a} + 2\vec{b} + 3\vec{c} \right| = \sqrt{3 + 2\sqrt{2}}$, angle between $\vec{a}$ and $\vec{b}$ is α, angle between $\vec{a}$ and $\vec{c}$ is β and angle between $\vec{b}$ and $\vec{c}$ is θ such that $\theta \in \left[\dfrac{\pi}{2}, \dfrac{2\pi}{3} \right]$, then the maximum value of $4\cos\alpha + 6\cos\beta$ is equal to:

(A) $2\sqrt{2} + 5$ (B) $5 - 2\sqrt{2}$ (C) $2\sqrt{2} - 5$ (D) $4\sqrt{2}$

17. The sum of the coefficients of all the even powers of x in the expansion of $(2x^2 - 3x + 1)^{11}$ is:

(A) $2 \cdot 6^{10}$ (B) $3 \cdot 6^{10}$ (C) 6^{11} (D) 6^9

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18. Equation of circle passing through point of intersection of $7x + 2y - 9 = 0$ and $x - 7y + 6 = 0$ and having centre at (2, 1) is:

(A) $x^2 + y^2 - 4x - 2y + 4 = 0$

(B) $x^2 + y^2 - 2x - 4y - 1 = 0$

(C) $x^2 + y^2 - 2x - 2y + 1 = 0$

(C) $x^2 + y^2 - 2x - 2y - 1 = 0$

19. The general solution of the differential equation $\dfrac{dy}{dx} + \sin\dfrac{x+y}{2} = \sin\dfrac{x-y}{2}$ is:

(A) $\ell n \tan\dfrac{y}{2} = c - 2\sin x$

(B) $\ell n\left(\tan\dfrac{y}{4}\right) = c - 2\sin\left(\dfrac{x}{2}\right)$

(C) $\ell n \tan\left(\dfrac{y}{2} + \dfrac{\pi}{4}\right) = c - 2\sin x$

(D) $\ell n\, \tan\left(\dfrac{y}{4} + \dfrac{\pi}{4}\right) = c - 2\sin\left(\dfrac{x}{2}\right)$

20. If $|z - 1| = \sqrt{5} - |z - 4\sin\theta|$, $\theta \in \left(-\dfrac{\pi}{2}, \dfrac{\pi}{2}\right)$ represents an ellipse, then exhaustive set of values of θ belongs to:

(A) $\left(-\dfrac{\pi}{10}, \dfrac{3\pi}{10}\right)$

(B) $\left(-\dfrac{\pi}{5}, \dfrac{3\pi}{10}\right)$

(C) $\left(-\dfrac{\pi}{3}, \dfrac{\pi}{3}\right)$

(D) $\left(-\dfrac{\pi}{18}, \dfrac{\pi}{18}\right)$

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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. Product $3^{\frac{1}{4}} \cdot 9^{\frac{1}{8}} \cdot 27^{\frac{1}{16}} \cdot 81^{\frac{1}{32}}...\infty$ is equal to _____.

2. If $x^2 + x + 1 = 0$, then the value of $\frac{1}{9} \times \left[\left(x + \frac{1}{x} \right)^2 + \left(x^2 + \frac{1}{x^2} \right)^2 + ... + \left(x^{27} + \frac{1}{x^{27}} \right)^2 \right]$ is _____.

3. A box containing 24 balls out of which 8 are black and 16 are white. The balls are drawn at random from the box one at a time with replacement. If the probability that a white ball is drawn for the 4$^{\text{th}}$ time on the 7$^{\text{th}}$ draw is $\left(\dfrac{a}{b} \right)^3 \times \dfrac{40}{81}$, where a and b are relatively prime numbers, then the value of $(a + b + 1)$ is _____.

4. If solution of differential equation $\dfrac{dy}{dx} - y = 1 - e^{-x}$ and $y(0) = \dfrac{-1}{2}$. Then value of $\lim\limits_{x \to \infty} |y|$ is _____.

5. Let $f(x + y) = f(x)f(y)$ for all x and y, and $f'(0) = 3$, then absolute value of $\dfrac{f'(15)}{e^{45}}$ is equal to _____.

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6. If $\vec{a}$ and $\vec{b}$ are two vectors such that $|\vec{a}|=1, |\vec{b}|=4,\ \vec{a}\cdot\vec{b}=2$. If $\vec{c}=(2\vec{a}\times\vec{b})-3\vec{b}$ then the angle between $\vec{b}$ and $\vec{c}$ is θ then the value of $[\theta]$ is _____.

Where [.] is greatest integer function

7. If $y(x)$ is a solution of $\dfrac{dy}{dx}-\dfrac{xy}{1+x}=\dfrac{1}{1+x}$ and $y(0)=-1$, then the value of $|3y(2)|$ is _____.

8. Let $g(x)=f\left(\dfrac{x}{f(x)}\right)$ where $f(x)$ is a differentiable positive function on $(0,\infty)$ such that $f(1)=f'(1)$. then $g'(1)=$ _____.

9. Let $A=\begin{bmatrix}\cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha\end{bmatrix}$ and matrix B is defined such that $B=A+4A^2+6A^3+4A^4+A^5$. If $\det(B)=1$, then the number of values of α in $[-2\pi,2\pi]$ is _____.

10. The value of $\cos\dfrac{\pi}{31}\cos\dfrac{2\pi}{31}\cos\dfrac{4\pi}{31}\cos\dfrac{8\pi}{31}\cos\dfrac{16\pi}{31}$ is equal to N, then $\left|\dfrac{1}{N}\right|$ equals _____.

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