VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Main - 7 | JEE 2024 Gen-1

Date: 31/3/2023 **Maximum Marks: 300**

Timing: 04:00 PM to 07:00 PM

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.** 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. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
7. 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**.
8. **Do not fold or make any stray mark on the Answer Sheet (OMR).**

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** _____

Syllabus

Physics: Liquids, Properties of matter, Gaseous State and Thermodynamics
Chemistry: Ionic Equilibrium, Stoichiometry-II, IOC
Mathematics: Conic Sections, Binomial Theorem

PART - I : PHYSICS 100 MARKS

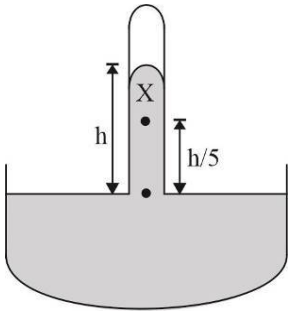
SECTION-1

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 height of liquid column raised in a capillary tube of certain radius when dipped in liquid *A* vertically is, 5 *cm*. If the tube is dipped in a similar manner in another liquid *B* of surface tension and density double the values of liquid *A*, the height of liquid column raised in liquid *B* would be _____ *m*.

(A) 0.20 **(B)** 0.5 **(C)** 0.10 **(D)** 0.05

2. The height of mercury barometer is h when the atmospheric pressure is $10^5\,Pa$. The pressure at *x* in the shown diagram is:



(A) $10^5\,Pa$

(B) $0.8\times10^5\,Pa$

(C) $0.2\times10^5\,Pa$

(D) $120\times10^5\,Pa$

3. Two spheres (made of same material & surface finish) emit maximum radiation corresponding to wavelengths λ & 2λ. What is the ratio of their radii so that they emit equal amount of radiant energy per unit time?

(A) $\frac{1}{2\sqrt{2}}$ **(B)** $\frac{1}{2}$ **(C)** $\frac{1}{4}$ **(D)** $\frac{1}{\sqrt{2}}$

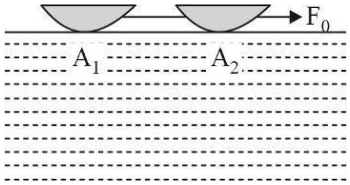
SPACE FOR ROUGH WORK

4. A cubical block of side 0.5 m floats on water with 30% of its volume under water. What is the maximum weight that can be put on the block without fully submerging it under water?

[Take, density of water $=10^3$ kg/m^3]

(A) 87.5 kg **(B)** 30.1 kg **(C)** 46.3 kg **(D)** 65.4 kg

5. Two boats of base areas A_1 & A_2, connected by a string are being pulled by an external force F_0. The viscosity of water is η and depth of the water body is H. When the system attains a constant speed, the tension in the thread will be:



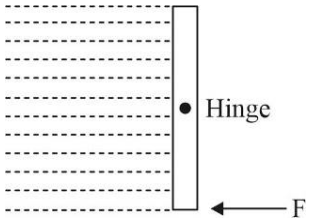
(A) Zero

(B) $F_0\dfrac{A_2}{(A_1+A_2)}$

(C) $F_0\dfrac{A_1}{(A_1+A_2)}$

(D) $F_0\left(\dfrac{A_2}{A_1}\right)$

6. A square gate of size $1m\times 1m$ is hinged at its mid-point. A fluid of density ρ fills the space to the left of the gate. The force F required to hold the gate stationary is :



(A) $\dfrac{\rho g}{3}$

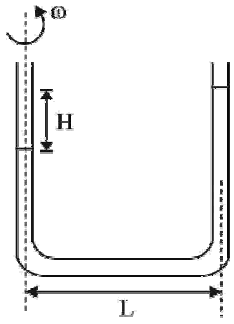
(B) $\dfrac{1}{2}\rho g$

(C) $\dfrac{\rho g}{6}$

(D) $\dfrac{3}{2}\rho g$

SPACE FOR ROUGH WORK

7. A U-shaped tube contains a liquid of density ρ and it is rotated about the left dotted line as shown in the figure. Find the difference in the levels of the liquid column.



(A) $\frac{\omega^2 L^2}{2\sqrt{2}g}$ **(B)** $\frac{\omega^2 L^2}{2g}$

(C) $\frac{2\omega^2 L^2}{g}$ **(D)** $\frac{2\sqrt{2}\omega^2 L^2}{g}$

8. One mole of an ideal monoatomic gas undergoes a process described by the equation $PV^3 =$ constant. The heat capacity of gas during this process is :

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

9. Two gases *A* (monoatomic) and *B* (diatomic) are at absolute temperatures 350 K and 300 K respectively. Ratio of average kinetic energy of their molecule is :

(A) 7 : 6 **(B)** 7 : 10 **(C)** 35 : 18 **(D)** 7 : 5

10. Half mole of an ideal monoatomic gas is heated at constant pressure of 1atm from 20°C to 90°C. Work done by gas is close to : (Gas constant R = 8.31J/mol K)

(A) 581 *J* **(B)** 291 *J* **(C)** 73 *J* **(D)** 146 *J*

SPACE FOR ROUGH WORK

11. Heat is given to an ideal gas in an isothermal process.

A. Internal energy of the gas will decrease.

B. Internal energy of the gas will increase.

C. Internal energy of the gas will not change.

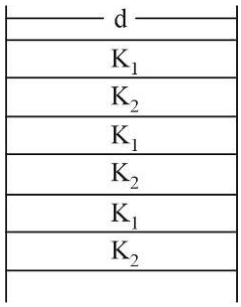
D. The gas will do positive work.

D. The gas will do negative work.

Choose the **correct** answer from the options given below:

(A) *C* and *E* only **(B)** *A* and *E* only **(C)** *B* and *D* only **(D)** *C* and *D* only

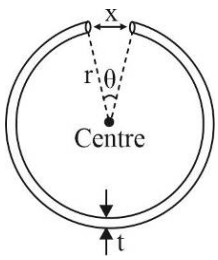
12. A wall consists of alternating blocks with length *d* and coefficient of thermal conductivity K_1 & K_2 as shown in the figure. The cross-sectional area of the blocks is the same. The equivalent coefficient of thermal conductivity of the wall between left and right end is :



(A) $K_1 + K_2$ **(B)** $\frac{(K_1 + K_2)}{2}$

(C) $\frac{K_1 K_2}{K_1 + K_2}$ **(D)** $\frac{2K_1 K_2}{K_1 + K_2}$

13. A uniform metallic object of circular shape which is free to expand in every direction is shown in figure. The parameter which will not increase on heating the object is :



(A) *x* (gap)

(B) *r* (radius of circle)

(C) θ (angle formed at centre)

(D) *t* (thickness)

SPACE FOR ROUGH WORK

14. A liquid cools down from 70°C to 60°C in 5 minutes. The time taken to cool it from 60°C to 50°C will be:

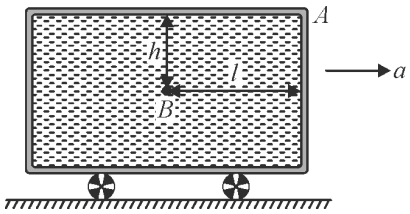
(A) 5 minutes

(B) Lesser than 5 minutes

(C) Greater than 5 minutes

(D) Lesser or greater than 5 minutes depending upon the density of the liquid

15. A closed tank filled with water is mounted on a cart. The cart moves with an acceleration 'a' on a plane road. What is the difference in pressure between points B & A shown in figure?



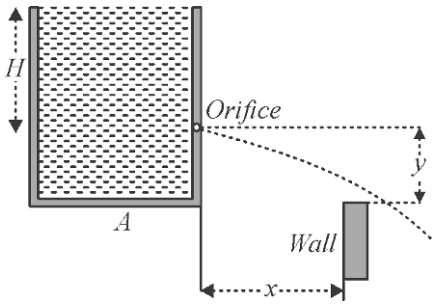
(A) $P_B - P_A = (hg + la)\rho$

(B) $P_A - P_B = (hg + la)\rho$

(C) $P_B - P_A = 0$

(D) $P_B - P_A = hg\rho$

16. For the arrangement shown in figure, find the time interval after which the water jet ceases to cross the wall of negligible thickness. Area of the tank is A and area of orifice is a ($A >> a$). (H is the height of liquid level above the orifice initially at $t = 0$).



(A) $\frac{A}{a}\sqrt{\frac{2}{g}}\left(\sqrt{H} - \sqrt{\frac{x^2}{4y}}\right)$

(B) $\frac{A}{a}\sqrt{\frac{2}{g}}\left(\sqrt{H} - \sqrt{\frac{x^2}{y}}\right)$

(C) $\frac{A}{a}\sqrt{\frac{2}{g}}\left(\sqrt{H} - \sqrt{\frac{4x^2}{y}}\right)$

(D) $\frac{A}{a}\sqrt{\frac{2}{g}}\left(\sqrt{H} - \frac{1}{4}\sqrt{\frac{x^2}{y}}\right)$

SPACE FOR ROUGH WORK

17. Given below are two statements :

Statement I : The temperature of a gas is -73°C. When the gas is heated to 572°C, the root mean square speed of the molecules is doubled.

Statement II : The product of pressure and volume of an ideal gas will be equal to translational kinetic energy of the molecules.

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

(A) Statement I is true but Statement II is false

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

(C) Both Statement I and Statement II are false

(D) Both Statement I and Statement II are true

18. The temperature of a body on Kelvin scale is found to be *x K*. When it is measured by Fahrenheit thermometer, it is found to be *x*° *F*, then the value of *x* is:

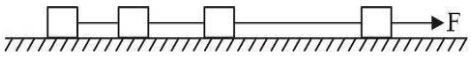
(A) 40 **(B)** 313 **(C)** 574.25 **(D)** 301.25

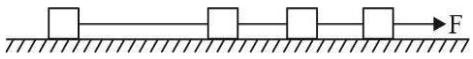
19. An ice block at $0°C$ and of mass *m* is dropped from height '*h*' such that the loss in gravitational potential energy of block is exactly equal to the heat required to just completely melt the ice. Taking latent heat of fusion of ice = 80 Cal/*gm*, acceleration due to gravity $=10 m/s^2$ and mechanical equivalent of heat $=4.2 J/Cal.$ The value of '*h*' is :

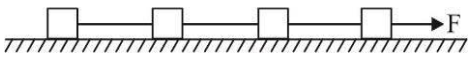
(A) 8 *m* **(B)** 8 *km* **(C)** 33.6 *m* **(D)** 33.6 *km*

20. Each of the pictures shows four objects tied together with rubber bands being pulled to the right across a horizontal frictionless surface by a horizontal force F. All the objects have the same mass, all the rubber bands obey Hooke's law and have the same equilibrium length and the same force constant. Which of these pictures is drawn most correctly?

(A) 

(B) 

(C) 

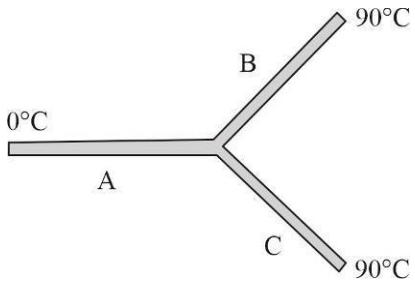
(D) 

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. Three rods made of the same material and having the same cross-section have been joined as shown in the figure. Each is of the same length. The left and right ends are kept at 0 degree Celsius and 90 degree Celsius respectively. The temperature of the junction of the three rods will be θ (in degree Celsius). Find the value of $\frac{\theta}{10}$.



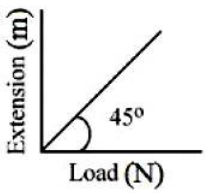
2. A pendulum clock is 5 sec fast at a temperature of 15 degree Celsius and 10 sec slow at a temperature of 30 degree Celsius. The temperature at which it gives the correct time is 10x degree Celsius. Find the value of *x*.

3. A spherical drop of liquid splits into 1000 identical spherical drops. If u_i is the surface energy of the original drop and u_f is the total surface energy of the resulting drops, then $\frac{u_f}{u_i}=\left(\frac{10}{x}\right)$. Then value of *x* is_____.

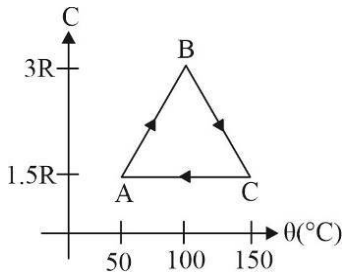
4. If two rods of length *L* and 2*L* having coefficients of linear expansion α & 2α respectively are connected so that length becomes 3*L*, the average coefficient of linear expansion of the composite rod equals $\frac{m}{n}\alpha$. Find the value of $(m-n)$. [*m* and *n* are coprimes]

SPACE FOR ROUGH WORK

5. As shown in the figure, in an experiment to determine young's modulus of a wire, the extension-load curve is plotted. The curve is a straight line passing through the origin and makes an angle of 45° with the load axis. The length of wire is $62.8\,cm$ and its diameter is $4\,mm$. The Young's modulus is found to be $x \times 10^4\, Nm^{-2}$. The value of x is_____ .



6. One mole of an ideal monoatomic gas undergoes quasi-static process $A \to B \to C \to A$ as shown. The amount of heat received by the gas from the heater is _____ kJ. (Here C is molar heat capacity) (Round off to integer).



7. Two parallel wires each of length 10 cm are 0.5 cm apart. A film of water is formed between them. If surface tension of water is 0.072 N/m, then the work done in increasing the distance between the wires by 1 mm is $36m \times 10^{-7}\, J$. Then find the value of *m.*

SPACE FOR ROUGH WORK

8. One mole of monoatomic gas is supplied heat by a polytrophic process in such a way that its molar heat capacity during the heating process is 2R. Here R is the universal gas constant. If due to heating volume of the gas is doubled, by what factor does its temperature increases ?

9. A Carnot engine with efficiency 50% takes heat from a source at 600 K. In order to increase the efficiency to 70%, keeping the temperature of sink same, the temperature of the source has to be increased by $100n$ *K*, where *n* is _____ .

10. A vessel of volume 3 *V* contains a gas at pressure $4P_0$ and another vessel of volume 2*V* contains the same gas at pressure $1.5P_0$. Both vessels have the same temperature. When both vessels are connected by a tube of negligible volume, the equilibrium pressure is IP_0, where *I* is an integer. Find the value of *I*.

SPACE FOR ROUGH WORK

PART - II : CHEMISTRY 100 MARKS

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. Zirconium (IV) phosphate is a sparingly soluble salt of molar mass $M(g\,mol^{-1})$ and solubility $x\,gL^{-1}$. The ratio of the molar concentration of phosphate ion to the solubility product of the salt is :

(A) $\frac{1}{6912}\frac{M^6}{x^6}$ **(B)** $1728\frac{M^6}{x^6}$ **(C)** $\frac{1}{1728}\frac{M^6}{x^6}$ **(D)** $\frac{1}{1728}\frac{x^6}{M^6}$

2. The dissociation constants of two acids HA_1 and HA_2 are 3.0×10^{-4} and 1.875×10^{-5} respectively. The ratio of $[H^+]$ ion concentration in equimolar solution of these acids are: $([H^+]_{HA_1} : [H^+]_{HA_2})$

(A) 1 : 4 **(B)** 4 : 1 **(C)** 1 : 16 **(D)** 16 : 1

3. Choose the correct code:

Column I		Column II	
I.	pK_b of X^- (K_a of $HX = 10^{-6}$) at 25°C	**P.**	6.98
II.	pH of 10^{-8} M HCl	**Q.**	8
III.	pH of 10^{-2} M acetic acid solution (K_a of acetic acid $= 1.6\times10^{-5}$) ($\log_{10}1.6 = 0.2$)	**R.**	10.7
IV.	pOH of a solution obtained by mixing equal volumes of solution with pH 3 and 5	**S.**	3.4

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

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

SPACE FOR ROUGH WORK

4. The pH of $0.1M\ NaHCO_3$ will be?

$(K_{a_1})_{H_2CO_3} = 10^{-6}$

$(K_{a_2})_{H_2CO_3} = 10^{-11}$

(A) 6.5 **(B)** 8.5 **(C)** 6 **(D)** 11

5. The pH of 0.5M $Ba(CN)_2$ solution is [Given : pK_b of $CN^- = 9.3$]

(A) 8.35 **(B)** 3.35 **(C)** 9.35 **(D)** 4.65

6. 100 mL solution (I) of buffer containing 0.1M HA and 0.2 M A^- is mixed with another solution (II) of 100 mL containing 0.2M HA and $0.3M\ A^-$. After mixing, what is the pH of resulting solution?

[Given : pK_a of HA = 5]

(A) $5 - \log\frac{5}{3}$ **(B)** $5 + \log\frac{5}{3}$ **(C)** $5 + \log\frac{2}{5}$ **(D)** $5 - \log\frac{5}{2}$

7. The concentration of Mg^{2+} in the solution made by mixing 10 mL of 0.25 M $Mg(NO_3)_2$ and 30 mL of 0.2 M NaF will be: $(K_{sp}(MgF_2) = 32 \times 10^{-12})$

(A) 1.28×10^{-9} M **(B)** 5.12×10^{-8} M

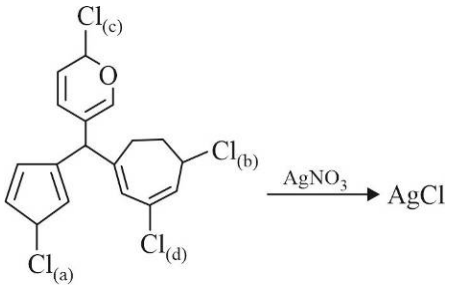
(C) 1.24×10^{-7} M **(D)** 2.56×10^{-9} M

SPACE FOR ROUGH WORK

8. A metal exhibits the valencies of 2 and 3. Its equivalent weight is 28 when it forms a metal oxide of formula MO. What mass of H_2SO_4 is needed for complete reaction with 4.8 g of M_2O_3?

(A) 8.82 g **(B)** 4.41 g **(C)** 13.23 g **(D)** 5.94 g

9.



Which Cl will be ionized with fastest rate in form of $Cl^{\ominus}$ to form AgCl?

(A) $Cl_{(c)}$ **(B)** $Cl_{(b)}$ **(C)** $Cl_{(a)}$ **(D)** $Cl_{(d)}$

10. A 150 mL solution of I_2 reacted with 15 mL of 0.4 M hypo solution in acidic medium. What is molarity of I_2 solution.

(A) 0.08 M **(B)** 0.1 M **(C)** 0.02 M **(D)** 0.04 M

11. Which of following sequence of compounds is according to the decreasing order of oxidation state of nitrogen.

(A) HNO_3, NO, N_2, CN^- **(B)** CN^-, HNO_3, NO, N_2

(C) HNO_3, NO, CN^-, N_2 **(D)** NO, HNO_3, N_2, CN^-

SPACE FOR ROUGH WORK

12. In quantitative analysis of $FeSO_4$ with $KMnO_4$, HNO_3 cannot be used because:

(A) It reduces MnO_4^- **(B)** It oxidize Mn^{2+} formed

(C) It reduces Fe^{3+} formed **(D)** It oxidizes Fe^{2+}

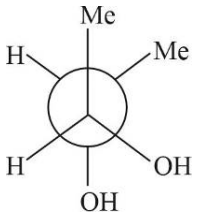
13. For the following reaction

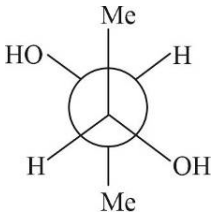
$$As_2S_3 + H^+ + NO_3^- \rightarrow NO + H_2O + AsO_4^{3-} + SO_4^{2-}$$

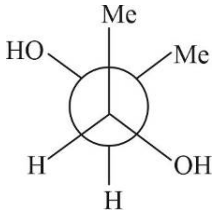
The equivalent mass of As_2S_3 in terms of molecular mass (M) is :

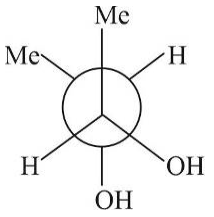
(A) $\frac{M}{2}$ **(B)** $\frac{M}{4}$ **(C)** $\frac{M}{28}$ **(D)** $\frac{M}{24}$

14. Most stable form of meso-2,3-butanediol is :

(A) 

(B) 

(C) 

(D) 

SPACE FOR ROUGH WORK

15. Point out the incorrect statement about resonance.

(A) All resonating structures should have equal energy

(B) In resonating structures, the constituent atoms should be in the same position

(C) In resonating structures, there should be the same number of electron pairs

(D) Resonating structures should differ only in the location of electrons around the constituent atoms

16. The C – Cl bond length is shortest in:

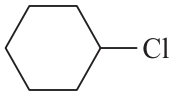
(A) $CH_2 = CH - \ddot{Cl}:$

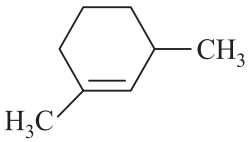
(B) $CH_3 - Cl$

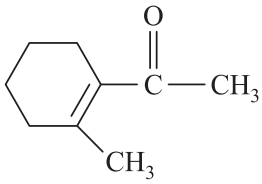
(C) $C_6H_5 - CH_2 - Cl$

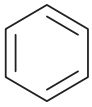
(D) $CH_2 = CH - CH_2 - Cl$

17. In which of the following molecules all the effects namely inductive, mesomeric and hyperconjugation operate?

(A) 

(B) 

(C) 

(D) 

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18. Most stable carbanion is:

(A) CH_3^-

(B) $CH_2=CH-\overset{\ominus}{C}H_2$

(C) 

(D) 

19. Keto – enol tautomerism is observed in:

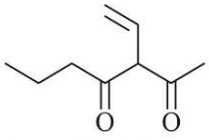
(A) $C_6H_5-\overset{\overset{O}{\|}}{C}-H$

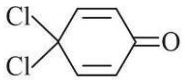
(B) $C_6H_5-\overset{\overset{O}{\|}}{C}-CH_3$

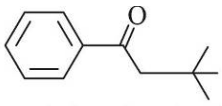
(C) $C_6H_5-\overset{\overset{O}{\|}}{C}-C_6H_5$

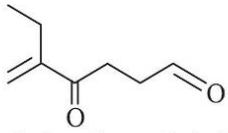
(D) $C_6H_5-\overset{\overset{O}{\|}}{C}-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-C_6H_5$

20. Which of the following compound is not named correctly?

(A) 
3-ethenyl-2,4-heptanedione

(B) 
4,4-dichloro-2,5-cyclohexadien-1-one

(C) 
3,3-dimenthyl-1-phenyl-1-butanone

(D) 
5-methylene-hepta-1, 4-dione

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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. A volume of 12.5 ml of 0.05 M SeO_2 reacts with 25 ml of 0.1 M $CrSO_4$ which is oxidized to Cr^{3+}. To what oxidation state was selenium converted by the reaction.

2. How many of the following statements are correct?

I. Silver chloride is more soluble in ammonia solution than in pure water

II. Silver chloride is more soluble in concentrated sodium chloride solution than in pure water

III. The pH of a buffer does not change significantly on addition of small amount of an acid or base

IV. Degree of hydrolysis of ammonium acetate does not depend upon the concentration of ammonium acetate solution

3. If 'x' mL of water is to be added to 200 mL of 0.2 M solution of CH_3COOH for the degree of dissociation of the acid to double. Then the value of $\frac{x}{100}$ will be _____.

(K_a of acetic acid is 1.8×10^{-5})

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4. The solubility of $Pb(OH)_2$ in water is $8.0\times10^{-6}M$. The solubility of $Pb(OH)_2$ in buffer solution of pH = 12 is $x\times10^{-14}$ mol L^{-1}. What is the value of x/4?

5. How many isomers of $C_5H_{11}OH$ will be primary alcohols?

6. Stannic sulphate $Sn(SO_4)_2$ and potassium permanganate are used as oxidizing agents in acidic medium for oxidation of ferrous ammonium sulphate to ferric sulphate. If the ratio of number of moles of stannic sulphate required per mole of ferrous ammonium sulphate to the number of moles of $KMnO_4$ required per mole of ferrous ammonium sulphate is x. Value of 10x will be _____.
(Stannic ion gets reduced to stannous ion)

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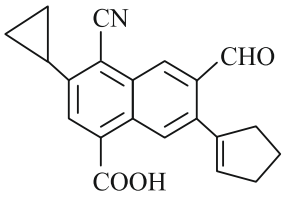
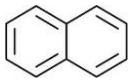
7. Valency factor (n-factor) for barium permanganate as an oxidizing agent in acidic medium is _____.

8. Degree of unsaturation for the following organic compound (P) is x then value of $\frac{x}{2}$ is _____.



(P)

9. Number of aromatic compounds from the following is _____.

(i) 

(ii) 

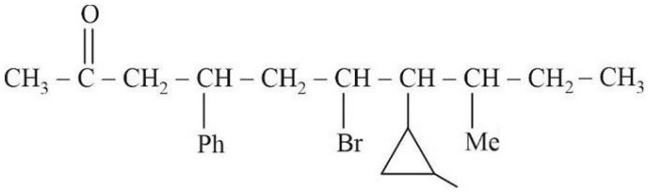
(iii) 

(iv) 

(v) 

(vi) 

10. How many chiral carbons are present in the following compound?



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PART - III: MATHEMATICS 100 MARKS

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. If the sum of the coefficients in the expansion of $(x+y)^n$ is 4096, then the greatest coefficient in the expansion is:

(A) 1594 **(B)** 924 **(C)** 792 **(D)** 2924

2. The term independent of x in the expansion of $\left(9x-\frac{1}{3\sqrt{x}}\right)^{18}$, $x>0$, is α times the corresponding binomial coefficient. Then α is :

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

3. For hyperbola $\frac{x^2}{\cos^2\alpha}-\frac{y^2}{\sin^2\alpha}=1$ which of the following remains constant if α varies, where α is acute.

(A) Eccentricity **(B)** Directrix

(C) Abscissae of vertices **(D)** Abscissa of foci

4. The coefficient of x^{11} in the expression $(1+x)^5(3+x)^4(7+x)^3$ equals :

(A) 28 **(B)** 34 **(C)** 38 **(D)** 42

5. $\sum_{r=1}^{100}\frac{r\cdot {}^{100}C_r}{{}^{100}C_{r-1}}$ equals:

(A) 100 **(B)** 4950 **(C)** 5050 **(D)** 5151

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6. The locus of the point of trisection of all the double ordinates of the parabola $y^2 = lx$ is a parabola whose latus rectum is :

(A) $\frac{l}{9}$ **(B)** $\frac{2l}{9}$ **(C)** $\frac{4l}{9}$ **(D)** $\frac{l}{39}$

7. All points on the curve $y^2 = 4a\left(x + a\sin\frac{x}{a}\right)$ at which the tangent is parallel to *x*-axis lie on :

(A) A circle **(B)** A parabola **(C)** An ellipse **(D)** A line

8. The straight line joining any point *P* on the parabola $y^2 = 4ax$ to the vertex and perpendicular from the focus to the tangent at *P*, intersect at *R*, then the equation of the locus of *R* is :

(A) $x^2 + 2y^2 - ax = 0$ **(B)** $2x^2 + y^2 - 2ax = 0$

(C) $2x^2 + 2y^2 - ay = 0$ **(D)** $2x^2 + y^2 - 2ay = 0$

9. If the 4th term in the expansion of $\left(px + \frac{1}{x}\right)^n$, $n \in N$ is $\frac{5}{2}$ and three normals to the parabola $y^2 = x$ are drawn through a point $(q,0)$, then:

(A) $q = p$ **(B)** $q > p$ **(C)** $q < p$ **(D)** $pq = 1$

10. If focus of a parabola is at (5, 2) and equation of directrix is $3x - 4y + 8 = 0$, then length of Latus Rectum is:

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

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11. Through the focus of the parabola $y^2 = 2px (p > 0)$ a line is drawn which intersects the curve at $A(x_1, y_1)$ and $B(x_2, y_2)$. The ratio $\frac{y_1 y_2}{x_1 x_2}$ equals :

(A) 2 **(B)** –1 **(C)** –4 **(D)** Some function of *p*

12. An ellipse has *OB* as a semi minor axis where *O* is the origin. F_1, F_2 are its foci and the angle F_1BF_2 is a right angle. Then the eccentricity of the ellipse is :

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

13. An ellipse having foci at (3, 3) and (-4, 4) and passing through the origin has eccentricity equal to :

(A) $\frac{3}{7}$ **(B)** $\frac{2}{7}$ **(C)** $\frac{5}{7}$ **(D)** $\frac{3}{5}$

14. $x - 2y + 4 = 0$ is a common tangent to $y^2 = 4x$ and $\frac{x^2}{4} + \frac{y^2}{b^2} = 1$. Then the value of *b* and the other common tangent are given by :

(A) $b = \sqrt{3};\ x + 2y + 4 = 0$ **(B)** $b = 3;\ x + 2y + 4 = 0$

(C) $b = \sqrt{3};\ x + 2y - 4 = 0$ **(D)** $b = \sqrt{3};\ x - 2y - 4 = 0$

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15. If $\alpha \& \beta$ are the eccentric angles of the extremities of a focal chord of an standard ellipse, then the eccentricity of the ellipse is :

(A) $\frac{\cos\alpha+\cos\beta}{\cos(\alpha+\beta)}$ **(B)** $\frac{\sin\alpha-\sin\beta}{\sin(\alpha-\beta)}$

(C) $\frac{\cos\alpha-\cos\beta}{\cos(\alpha-\beta)}$ **(D)** $\frac{\sin\alpha+\sin\beta}{\sin(\alpha+\beta)}$

16. A line is drawn from $A(-2,0)$ to intersects the curve $y^2=4x$ at P and Q in the first quadrant such that $\frac{1}{AP}+\frac{1}{AQ}<\frac{1}{4}$. Then the slope of the line is always:

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

17. If the normal to the parabola $y^2=4ax$ at P meet the curve again at Q and if PQ and the normal at Q make angles $\alpha \& \beta$ respectively with the X-axis, then $\tan\alpha(\tan\alpha+\tan\beta)$ has the value equal to:

(A) -2 **(B)** -1 **(C)** $-\frac{1}{2}$ **(D)** 0

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18. If $\frac{x^2}{f(4a)}+\frac{y^2}{f(a^2-5)}$ represents an ellipse with major axis as y-axis and f is a strictly decreasing function, then :

(If $f(x)$ is strictly decreasing then $x_1 > x_2 \Leftrightarrow f(x_1) < f(x_2)$)

(A) $a \in (-\infty, 1)$ **(B)** $a \in (5, \infty)$

(C) $a \in (1, 4)$ **(D)** $a \in (-1, 5)$

19. The remainder, if $1+2+2^2+2^3+....+2^{1999}$ is divided by 5 is :

(A) 0 **(B)** 1 **(C)** 2 **(D)** 3

20. Normal to curve $xy = 4$ at $(2, 2)$ meets the curve again at point:

(A) $(1, 4)$ **(B)** $(-2, -2)$ **(C)** $(4, 1)$ **(D)** $(-1, -4)$

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 slope of the line which belongs to the family of $(1+a)x+(a-1)y+2(1-a)=0$ and makes shortest intercept on $x^2-4y+4=0$ is _____.

2. Let a line L_1 be tangent to the hyperbola $\frac{x^2}{16}-\frac{y^2}{4}=1$ and let L_2 be the line passing through the origin and perpendicular to L_1. If the locus of the point of intersection of L_1 and L_2 is $(x^2+y^2)^2=\alpha x^2+\beta y^2$, then $\alpha+\beta$ is equal to _____.

3. If equation of common tangent to curves $y^2=4(x+1)$, $x^2=4(y+1)$ and $x^2+y^2=2$ is $ax+by+4=0$ and A is area of triangle formed by line $ax+by+4=0$ with co-ordinate axes, then A is _____.

4. Let P(2, 2) be a point on an ellipse whose foci are (5,2) and (2,6). If e be the eccentricity of ellipse, then the value of square of semi-minor axis is _____.

5. Let the locus of the points from which the tangents drawn to $y=x^2$ make an angle of 45° with each other is $16y^2-16x^2+ky+1=0$ then *k* is equal to _____.

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6. If the fractional part of $2^{4n}/15, (n \in N)$ is f then $15f =$ _____.

7. Radius of the largest circle which passes through the focus of the parabola $y^2 = 4x$ and contained in it, is _____.

8. If the sum of the coefficients in the expansion of $(x-2y+3z)^n, n \in N$ is 128 then the greatest coefficient in the expansion of $(1+x)^n$ is _____.

9. Let $H: \frac{x^2}{a^2} - \frac{y^2}{b^2} = 1, a > 0, b > 0,$ be a hyperbola such that the sum of lengths of transverse and the conjugate axes is $4\left(2\sqrt{2} + \sqrt{14}\right)$. If the eccentricity H is $\frac{\sqrt{11}}{2}$, then value of $a^2 + b^2$ is equal to _____.

10. If the eccentricity of the hyperbola $x^2 - y^2 \sec^2\theta = 5$ is $\sqrt{3}$ times the eccentricity of the ellipse $x^2 \sec^2\theta + y^2 = 25,$ then smallest positive value of θ is $\frac{\pi}{P}$, where twice the value of 'P' is _____.

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••• End of JEE Main – 7 (Gen-1) [JEE - 2024] •••