VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Main Home Practice Test - 11 | JEE - 2024

Date: 23/02/2024 **Maximum Marks: 300**

Timing: 10:00 AM to 1:00 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.

Syllabus

Physics: Full Syllabus

Chemistry: Full Syllabus

Mathematics: Full Syllabus

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

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

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. If R is resistance, L is inductance, C is capacitance, H is latent heat, and S is specific heat, then match the quantity given in Column-I with the dimensions given in Column-II.

Column-I		Column-II	
(i)	LC	**(a)**	L^2T^{-2}
(ii)	LR	**(b)**	$L^2T^{-2}K^{-1}$
(iii)	H	**(c)**	T^2
(iv)	S	**(d)**	$M^2L^4T^{-5}A^{-4}$

(A) (i) – (c), (ii) – (d), (iii) – (a), (iv) – (b) **(B)** (i) – (a), (ii) – (b), (iii) – (c), (iv) – (d)

(C) (i) – (d), (ii) – (c), (iii) – (b), (iv) – (a) **(D)** (i) – (c), (ii) – (d), (iii) – (b), (iv) – (a)

2. Two electrons each are fixed at a distance 2d. A third charge proton placed at the mid-point is displaced slightly by a distance $x(x << d)$ perpendicular to the line joining the two fixed charges. Proton will execute simple harmonic motion having angular frequency? (m = mass of charged particle)

(A) $\left(\frac{2q^2}{\pi\varepsilon_0 md^3}\right)^{1/2}$ **(B)** $\left(\frac{\pi\varepsilon_0 md^3}{2q^2}\right)^{1/2}$

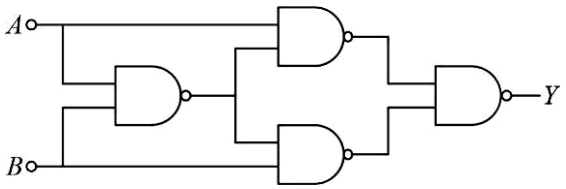
(C) $\left(\frac{q^2}{2\pi\varepsilon_0 md^3}\right)^{1/2}$ **(D)** $\left(\frac{2\pi\varepsilon_0 md^3}{q^2}\right)^{1/2}$

3. If length of the pendulum in pendulum clock increases by 0.2%, then error in time per day is:

(A) 86.4 s **(B)** 8.64 s

(C) 43.2 s **(D)** 4.32 s

4. Four NAND gates are as shown below. Correct truth table is:



(A)

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	0

(B)

A	B	T
0	0	1
0	1	0
1	0	0
1	1	1

(C)

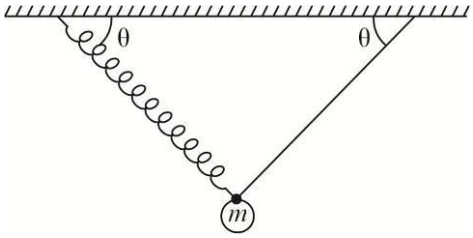
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

(D)

A	B	Y
0	0	0
0	1	0
1	0	1
1	1	1

Space for Rough Work

5. A point mass '*m*' is attached to a light spring and light string as shown in figure. At equilibrium, both the spring and the string make an angle θ with the horizontal at equilibrium. Find the instantaneous acceleration of the mass '*m*' when the string is suddenly cut.



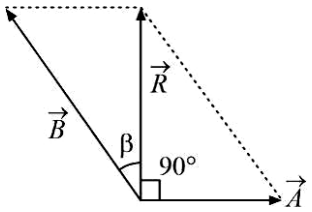
(A) $\frac{g}{\cos\theta}$ **(B)** $\frac{g}{\sin\theta}$ **(C)** $\frac{g}{2\sin\theta}$ **(D)** $\frac{2g}{\sin\theta}$

6. The radius R of a nucleus of mass number A can be estimated by the formula $R = (1.3\times10^{-15})A^{1/3}\,\text{m}$. It follows that the mass density of a nucleus is of the order of $(M_{proton} \cong M_{neutron} \simeq 1.67\times10^{-27}\,kg)$

(A) $10^{17}\,kg\,m^{-3}$ **(B)** $10^{24}\,kg\,m^{-3}$

(C) $10^{10}\,kg\,m^{-3}$ **(D)** $10^{3}\,kg\,m^{-3}$

7. The resultant of two vectors $\vec{A}$ and $\vec{B}$ is perpendicular to the vector $\vec{A}$ and its magnitude is equal to half of the magnitude of vector $\vec{B}$ figure. The angle between $\vec{A}$ and $\vec{B}$ is:



(A) 120° **(B)** 150° **(C)** 135° **(D)** None of these

8. The de-Broglie wavelength of a particle having kinetic energy *E* is λ. How much extra energy must be given to this particle so that the de-broglie wavelength reduces to 50% of the initial value?

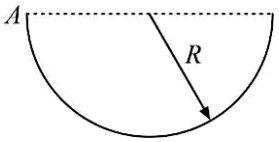
(A) $\frac{7}{9}E$ **(B)** E **(C)** $\frac{16}{9}E$ **(D)** $3E$

Space for Rough Work

9. A particle of mass m is suspended from a ceiling through a string of length L. Particle moves in horizontal circle of radius r such that $r = \frac{L}{2}$. The speed of particle will be:

(A) $\sqrt{\sqrt{3}\,rg}$ **(B)** $\sqrt{3rg}$ **(C)** $\sqrt{\frac{rg}{\sqrt{3}}}$ **(D)** $\sqrt{\frac{rg}{3}}$

10. A uniform rod of mass m is bent into the form of semicircle of radius R. The moment of inertia of the rod about an axis passing through A and perpendicular to the plane of the paper is:



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

11. A light beam travelling in the x-direction is described by the electric field $E_y = (300\,V/m)\sin\omega t(t - x/c)$. An electron is constrained to move along the y-direction with a speed of $2.0\times10^7\,m/s$. Maximum electric force on the electron is:

(A) $4.8\times10^{-17}\,N$ **(B)** $2.4\times10^{-17}\,N$

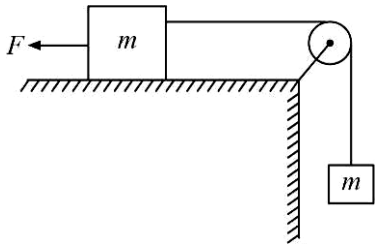
(C) $5.6\times10^{-17}\,N$ **(D)** $1.6\times10^{-17}\,N$

12. The temperature of equal masses of three different liquids A, B and C are 10°C, 15°C and 20°C respectively. The temperature when A and B are mixed is 13°C and when B and C are mixed, it is 16°C. What will be the temperature when A and C are mixed?

(A) $\left(\frac{50}{11}\right)°C$ **(B)** $\left(\frac{500}{11}\right)°C$ **(C)** $\left(\frac{100}{11}\right)°C$ **(D)** $\left(\frac{140}{11}\right)°C$

Space for Rough Work

13. In the figure shown $F = mg$, if area of cross section of wire is A, Young's modulus is Y, strain developed in wire is:



[Assume there is no friction]

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

14. A refrigerator consumes an average $55W$ power to operate between temperature $-20°C$ to $35°C$. If there is no loss of energy then how much average heat per second does it transfer?

(A) 253 J/s **(B)** 263 J/s **(C)** 350 J/s **(D)** 35 J/s

15. A capacitor of capacitance $100\ \mu F$ and a coil of resistance $50\ \Omega$ and inductance 0.5 H are connected in series with a 110 V, 50 Hz AC source. Then rms value of the current is :

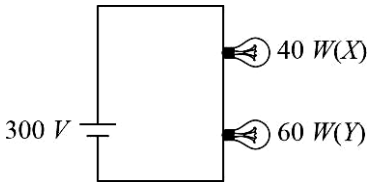
(A) 0.41 A **(B)** 0.5 A **(C)** 0.82 A **(D)** 2 A

16. A vessel volume $2\times10^{-2}m^3$ contains a mixture of hydrogen and helium at $47°C$ temperature and $4.15\times10^5 N/m^2$ pressure. The mass of the mixture is $10^{-2}kg$. Calculate the mass of hydrogen in the given mixture.

(A) $5\times10^{-3}kg$ **(B)** $2.5\times10^{-3}kg$ **(C)** $7.5\times10^{-3}kg$ **(D)** $10\times10^{-3}kg$

Space for Rough Work

17. Two bulbs *X* and *Y* having the same voltage rating and of power 40 *W* and 60 *W* respectively are connected in series across a potential difference of 300 *V*, then



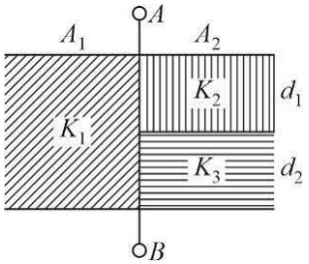
(A) *X* will glow brighter

(B) Resistance of *Y* is greater than *X*

(C) Heat produced in *Y* will be greater than *X*

(D) Voltage drop in *Y* will be greater than *X*

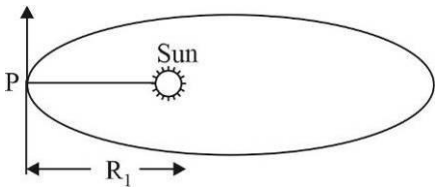
18. Find out capacitance between *A* and *B* if three dielectric slabs of dielectric constant K_1 of area A_1 and thickness d, K_2 of area A_2 and thickness d_1 and K_3 of area A_2 and thickness d_2 are inserted between the plates of parallel plate capacitor of plate area *A* as shown in figure. (Given distance between the two plates $d = d_1 + d_2$).



(A) $\dfrac{A_1K_1\varepsilon_0}{d_1+d_2}+\dfrac{A_2K_2K_3\varepsilon_0}{K_2d_2+K_3d_1}$ **(B)** $\dfrac{2A_1K_1\varepsilon_0}{d_1+d_2}+\dfrac{A_2K_2K_3\varepsilon_0}{K_2d_2+K_3d_1}$

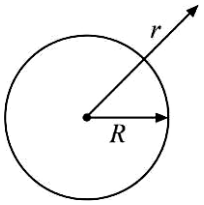
(C) $\dfrac{A_1K_1\varepsilon_0}{d_1+d_2}+\dfrac{2A_2K_2K_3\varepsilon_0}{K_2d_2+K_3d_1}$ **(D)** $\dfrac{2A_1K_1\varepsilon_0}{d_1+d_2}+\dfrac{2A_2K_2K_3\varepsilon_0}{K_2d_2+K_3d_1}$

19. A comet is moving in an elliptical orbit around the sun. It is observed at a point P and has a speed 1.2 times the speed required for a circular orbit at that position, (figure). Find the greatest distance of the comet from the sun in terms of R_1.



(A) $2.57R_1$ **(B)** $3.14R_1$ **(C)** $4.16R_1$ **(D)** None of these

20. If the potential at the centre of a uniformly charged hollow sphere of radius *R* is *V* then electric field at a distance *r* from the centre of sphere will be ($r > R$).



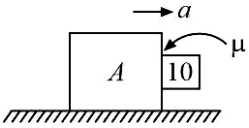
(A) $\dfrac{VR}{r^2}$ **(B)** $\dfrac{Vr}{R^2}$ **(C)** $\dfrac{VR}{r}$ **(D)** $\dfrac{VR}{R^2+r^2}$

Space for Rough Work

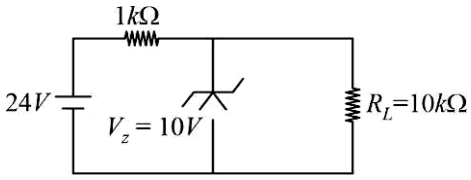
SECTION-2

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. Find out minimum acceleration $(\text{in } m/s^2)$ of block *A* so that the 10 *kg* block doesn't fall $(\mu = 0.5,\ g = 10\ m/s^2)$



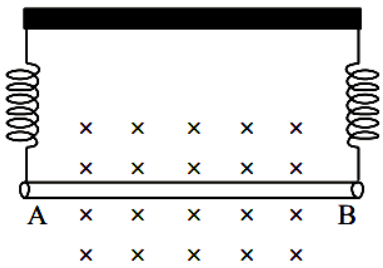
2. For the given circuit, the power across zener diode is _____ *mW*.



3. Two bodies A and B are moving along a straight line heading towards each other. Initial velocities of A and B are 5 m/s and 3 m/s respectively. Also both bodies have constant acceleration of magnitude 2 m/s^2 each, directed against their corresponding velocities. If x is the maximum possible initial distance between the bodies so that they meet during the motion. Then the value of x is _____m.

4. A parallel plate capacitor is to be designed which is to be connected across 1kV potential difference. The dielectric material which is to be filled between the plates has dielectric constant k = 6π and dielectric strength $10^7 v/m$. For safety, the electric field is never to exceed 10% of the dielectric strength. With such specifications, if we want a capacitor of capacitance 50PF, what minimum area (in mm^2) of plates is required for safe working? [use $\varepsilon_0 = \frac{1}{36\pi} \times 10^{-9}$ in *MKS*]

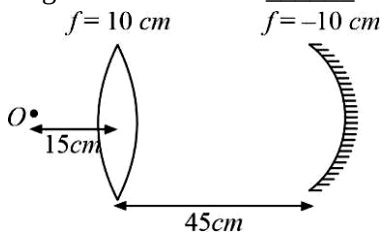
5. A straight wire AB of mass 40 g and length 50 cm is suspended by a pair of flexible leads in uniform magnetic field of magnitude 0.40 T as shown in the figure. The magnitude of the current required in the wire to remove the tension in the supporting leads is _____A. (take $g = 10\,ms^{-2}$)



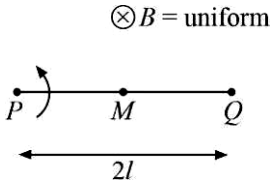
6. A source of light is placed in front of a screen. Intensity of light on the screen is *I*. Two polaroids, P_1 and P_2 are so placed in between the source of light and screen that the intensity of light on screen is *I*/2. P_2 should be rotated by an angle of _____ (degrees) so that intensity of light on screen becomes *I*/8.

Space for Rough Work

7. See the figure, distance of final image from the lens is _____ *cm*.



8. A rod *PQ* of length 2*l* is rotating about one end *P* in a uniform magnetic field *B* which is perpendicular to the plane of rotation of the rod. Point *M* is the mid-point of the rod. Find the induced emf (in volts) between *M* and *Q* if that between *P* and *Q* = 100*V*.



9. A coil in the shape of a square of side 10 *cm* lies in vertical plane between the pole pieces of permanent magnet producing a horizontal magnetic field 20 *mT*. The torque acting on the coil when a current of 0.2 *A* is passed through it and its plane becomes parallel to the magnetic field will be $x \times 10^{-5}\, Nm$. Value of *x* is _____.

10. Three one dimensional mechanical waves in an elastic medium is given by

$$y_1 = 3A\sin(\omega t - kx)$$

$$y_2 = A\sin(\omega t - kx + \pi)$$

$$y_3 = 2A\sin(\omega t + kx)$$

are super imposed with each other. The maximum displacement amplitude of the medium particle would be *xA* value of *x* will be _____.

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.

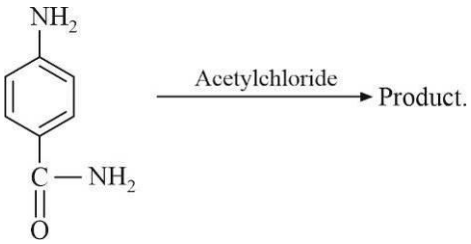
1. Which of the following is aromatic?

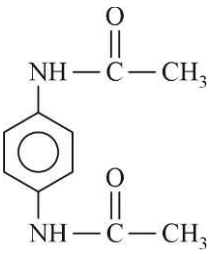
(A) 

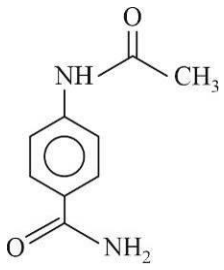
(B) 

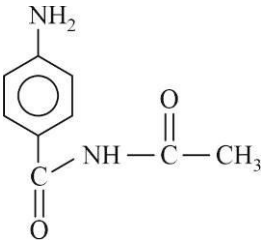
(C) 

(D) 

2. 

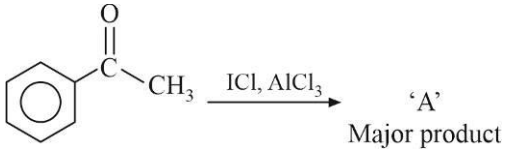
(A) 

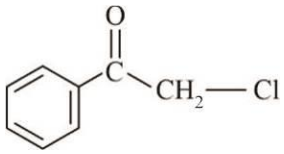
(B) 

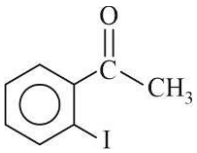
(C) 

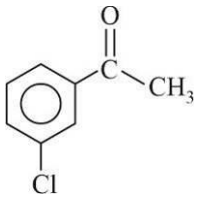
(D) No Reaction

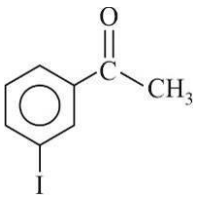
Space for Rough Work

3. 

(A) 

(B) 

(C) 

(D) 

4. Choose the incorrect option regarding atomic size.

(A) Zr = Hf **(B)** Fe = Co = Ni **(C)** Y = La **(D)** All of these

5. Select suitable set known as Pnictogens:

(A) N, P, As, Te **(B)** O, Se, Te, Pb

(C) P, As, Sb, Bi **(D)** C, Si, Ge, Sn

6. Which the following does not show any geometrical isomerism?

(A) $[Co(CN)_2(en)_2]$ **(B)** $[Co(NH_3)_4Cl_2]^+$

(C) $[Co(NH_3)_3(NO_2)_3]$ **(D)** $[Co(NC)_5(CN)]^{3-}$

7. The number of enantiomeric pairs of 1, 3-dimethylcyclobutane:

(A) 0 **(B)** 4 **(C)** 3 **(D)** 2

Space for Rough Work

8. Assertion (A) : $KMnO_4$ is purple in colour due to charge transfer

Reason (R) : In MnO_4^- there is no electron present in d-orbitals of manganese

(A) Both A and R are true but (R) is not the true explanation of A

(B) A is true but R is false

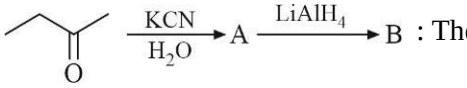
(C) A is false but R is true

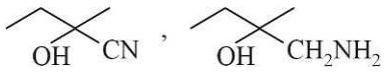
(D) Both A and R are true and R is the true explanation of A

9. The magnetic properties of oxide (O^{-2}) and peroxide (O_2^{2-}) respectively are:

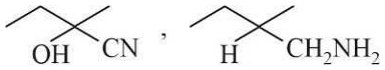
(A) Diamagnetic, diamagnetic **(B)** Diamagnetic, paramagnetic

(C) Paramagnetic, paramagnetic **(D)** Paramagnetic, diamagnetic

10.  : The product A and B are :

(A) 

(B) 

(C) 

(D) None of these

11. Among $[Co(CN)_6]^{3-}, [Co(H_2O)_6]^{3+}, [Co(NH_3)_6]^{3+}, [Co(en)_3]^{3+}$, what is the order of CFSE?

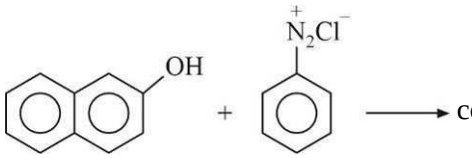
(A) $[Co(H_2O)_6]^{3+} < [Co(NH_3)_6]^{3+} < [Co(en)_3]^{3+} < [Co(CN)_6]^{3-}$

(B) $[Co(H_2O)_6]^{3+} < [Co(NH_3)_6]^{3+} < [Co(CN)_6]^{3-} < [Co(en)_3]^{3+}$

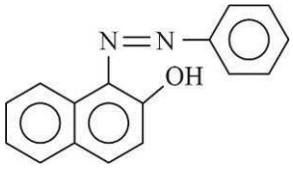
(C) $[Co(NH_3)_6]^{3+} < [Co(H_2O)_6]^{3+} < [Co(en)_3]^{3+} < [Co(CN)_6]^{3-}$

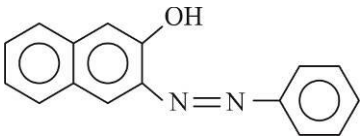
(D) $[Co(CN)_6]^{3-} < [Co(en)_3]^{3+} < [Co(H_2O)_6]^{3+} < [Co(NH_3)_6]^{3+}$

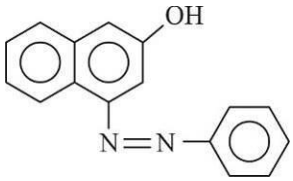
Space for Rough Work

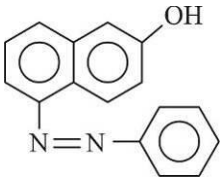
12.  coloured product (P).

P is?

(A) 

(B) 

(C) 

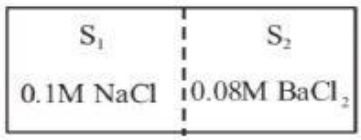
(D) 

13. If Interaction energy between two particles is proportional to r^{-3}, where "r" is distance between the particles, then force is:

(A) Ionic interaction **(B)** London forces

(C) Dipole dipole interaction **(D)** All of the above

14. Two solutions S_1 and S_2 containing 0.1 M NaCl(aq.) and 0.08 M $BaCl_2(aq.)$ are separated by semipermeable membrane. Which among the following statement(s) is correct.



(A) S_1 and S_2 are isotonic

(B) S_1 is hypertonic and S_2 is hypotonic

(C) S_1 is hypotonic and S_2 is hypertonic

(D) Incomplete data

15. Thiol group is present in :

(A) Methionine **(B)** Cytosine **(C)** Cystine **(D)** Cysteine

Space for Rough Work

16. Match List-I with List-II:

List – I (Chemical Reaction)		List – II (Reagent used)	
(a)	$CH_3COOH \longrightarrow CH_3-\overset{\overset{O}{\|\|}}{C}-CH_3$	**(i)**	$(CH_3)_2CuLi$
(b)	$CH_3COCl \longrightarrow CH_3CHO$	**(ii)**	$SnCl_2, HCl \mid H_2O$
(c)	$CH_3CN \longrightarrow CH_3CHO$	**(iii)**	(i) $Ca(OH)_2$ (ii) Δ
(d)	$CH_3COCl \longrightarrow CH_3COCH_3$	**(iv)**	$H_2, Pd, BaSO_4$

(A) (a) – (i), (b) – (iv), (c) – (ii), (d) – (iii)

(B) (a) – (iii), (b) – (iv), (c) – (ii), (d) – (i)

(C) (a) – (i), (b) – (iii), (c) – (ii), (d) – (iv)

(D) (a) – (iii), (b) – (i), (c) – (ii), (d) – (iv)

17. Assertion (A) : F atom has a less negative electron gain enthalpy than Cl atom

Reason (R) : Additional electron is repelled more efficiently by 3p electrons in Cl atom than by 2p electrons in F atom.

(A) Both A and R are true but R is not true explanation of A

(B) A is true but R is false

(C) Both A and R are true and R is correct explanation of A

(D) A is false but R is true

18. **Assertion (A):** Sucrose is disaccharide and reducing sugar.

Reason (R): Sucrose involves glycosidic linkage between C_1 of $\alpha-$D-glucose and C_2 of β-D-fructose.

(A) Both A and R are true but R is not the true explanation of A

(B) A is false but R is true

(C) A is true but R is false

(D) Both A and R are true and R is the true explanation of A

19. Assertion (A) : $[Ti(H_2O)_6]^{3+}$ is coloured while $[Sc(H_2O)_6]^{3+}$ is colourless

Reason (R) : d-d transition is not possible in $[Sc(H_2O)]^{3+}$ because no d-electron is present while it is possible for Ti^{3+} having d^1 system.

(A) Both A and R are true but R is not the true explanation of A

(B) A is false but R is true

(C) A is true but R is false

(D) Both A and R are true and R is the true explanation of A

20. Assertion (A) : Promethium is a man made element

Reason (R) : It is radioactive and has been prepared by artifical means

(A) Both A and R are true and R is true explanation of A

(B) Both A and R are true but R is not true explanation of A

(C) A is false but R is true

(D) Both A and R are false

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 formation constant of complex ion $[ML_4]^{2+}$ is 2×10^{10}. What is y if dissociation constant is $y\times10^{-11}$.

2. What is cell potential (in V) for reaction $Cu^{+2}_{(aq)} + Zn(s) \rightleftharpoons Cu(s) + Zn^{+2}_{(aq)}$ at 25ºC and $[Zn^{+2}] = 0.08M, [Cu^{+2}] = 0.04\ M.$ (Given $E^{\circ}_{Zn^{+2}/Zn} = -0.76V, E^{\circ}_{Cu^{+2}/Cu} = 0.34V$)

3. If 200 ml solution of Na_3PO_4 contains 6.9 gm of Na^+. The molarity of solution is $x\times10^{-1}\ M,$ then x is:

4. Rate of reaction $[PtCl_4]^{2-} + H_2O \rightleftharpoons [Pt(H_2O)Cl_3]^- + Cl^-$ was measured as a function of concentrations of different species. It was observed that

$$\frac{-d[[PtCl_4]^{2-}]}{dt} = 4.8\times10^{-8}[[PtCl_4]^{2-}] - 1.2\times10^{-3}[[Pt(H_2O)Cl_3]]^-[Cl^-]$$

Where square brackets are used to denote molar concentrations, and the equilibrium constant $K_c = x\times10^{-5}$. What is x?

5. A 3.06 gm of Chloroalkane vapourised completely to gives 873 mL of vapour at STP. Determine the number of carbons in chloroalkane ?

6. In the process of Sulphur estimation, 0.5 g of an organic compound gave 2.33 g of barium sulphate. The percentage of Sulphur in the compound is _____. (Atomic mass of $Ba = 137$ u)

Space for Rough Work

7. When 1000 nm radiation is striked upon metal surface having threshold frequency $\frac{1}{6.63}\times10^{14}S^{-1}$. The velocity of ejected electrons is $6.5\times10^{x}\,m/sec$. Determine value of 'X'?
$(Use: h = 6.63\times10^{-34}Js,\ M_e = 9\times10^{-31}Kg)$

8. What would be internal energy (kJ/mol) change during evaporation of water. Assuming water vapour as an ideal gas and $\Delta H_{vap} = 43\,kJ/mol$ at 373 K and 1 bar pressure: [Use : $R = 8.3\,J\,mol^{-1}\,K^{-1}$]

9. 62g of ethylene glycol is dissolved in 1 kg of water. The freezing point of the solution is _____ K. [Nearest integer] (Use : $K_{f_{(H_2O)}} = 1.86\,K\,kg\,mol^{-1}$, freezing point of water = 273 K).

10. The reaction $A + B \rightleftharpoons C + D$ has equilibrium constant K_C at 298 K is 144. Initially equimolar solution with [A] = [B] = [C] = [D] = 1M is taken in 1 Litre container. The equilibrium concentration of D is _____ M.
[Nearest integer]

Space for Rough Work

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. Let $A=\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 1\\ 2 & 0 & 0\end{bmatrix}$ then $A^{2022}-A^{2010}$ is equal to:

(A) $A^{28}-A^{4}$ **(B)** $A^{12}-A^{8}$ **(C)** $A^{20}-A^{8}$ **(D)** $A^{24}-A^{16}$

2. The value of $\int_0^{20} e^{x-[x]}\,dx$ is equal to (where [.] denotes greatest integer function):

(A) $20(e^2-e)$ **(B)** 0 **(C)** $10(e-2)$ **(D)** $20(e-1)$

3. A line passes through (1, 0) and (2, 1) is rotated in anticlockwise direction about the point (1, 0) by an angle of 15°**.** Then the equation of line in its new position is:

(A) $\sqrt{3}x-y=\sqrt{3}$ **(B)** $\sqrt{3}x-y+\sqrt{3}=0$

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

4. If A and B are two events such that $P(A)=\frac{1}{2}$ and $P(B)=\frac{2}{3}$, then $P(A'\cap B)$ may not equal to

(A) $\frac{1}{2}$ **(B)** $\frac{1}{3}$ **(C)** $\frac{1}{4}$ **(D)** $\frac{3}{5}$

Space for Rough Work

5. $\lim\limits_{x\to 2}\sum\limits_{n=2}^{10}\dfrac{2x}{n(n+2)x^2+6(n+1)x+9}$ is equal to:

(A) $\dfrac{836}{4725}$ **(B)** $\dfrac{736}{4725}$ **(C)** $\dfrac{836}{4975}$ **(D)** $\dfrac{736}{4975}$

6. The sum $\sum\limits_{n=1}^{\infty}\tan^{-1}\left(\dfrac{3}{n^2+n-1}\right)$ is equal to:

(A) $\dfrac{3\pi}{4}+\cot^{-1}2$ **(B)** $\dfrac{\pi}{2}+\cot^{-1}3$ **(C)** π **(D)** $\dfrac{\pi}{2}+\tan^{-1}2$

7. Maximum value of $f(x)=\left(\dfrac{1}{x}\right)^x$ is:

(A) $\left(\dfrac{1}{e}\right)^e$ **(B)** $e^{2/e}$ **(C)** $\left(\dfrac{1}{e}\right)^{1/e}$ **(D)** $e^{1/e}$

8. The value of $\int\limits_{-\pi/4}^{\pi/4}\dfrac{\tan^2 x}{1+e^x}\,dx$ is:

(A) $2-\dfrac{\pi}{2}$ **(B)** $1-\dfrac{\pi}{4}$ **(C)** $2-\dfrac{\pi}{4}$ **(D)** $\dfrac{1}{2}-\dfrac{\pi}{8}$

9. Two fair dice are thrown. The numbers on them are taken as p and q, and a system of linear equations.

$$2x+py+6z=8$$
$$x+2y+qz=5$$
$$x+y+3z=4$$

is constructed.

If p_1 is the probability that the system has a unique solution and p_2 is the probability that the system has infinite solutions, then $\dfrac{p_1}{p_2}$ is:

(A) $\dfrac{25}{36}$ **(B)** $\dfrac{25}{6}$ **(C)** $\dfrac{35}{6}$ **(D)** None of these

Space for Rough Work

10. The domain of the function $f(x)=\sec^{-1}\left(\frac{1+2x}{x}\right)$ is:

(A) $(-\infty,-1]\cup\left[-\frac{1}{3},\infty\right)$ **(B)** $\left(-\infty,-\frac{1}{3}\right]$

(C) $(-\infty,-1]\cup\left[-\frac{1}{3},0\right)\cup(0,\infty)$ **(D)** $\left(-\infty,-\frac{1}{3}\right]\cup(0,\infty)$

11. If the shortest distance between the straight lines $3(x-1)=6(y-2)=2(z-1)$ and $4(x-2)=2(y-\lambda)=(z-3),\ \lambda\in R$ is $\frac{1}{\sqrt{38}}$ equal to :

(A) -1 **(B)** 5 **(C)** 3 **(D)** 2

12. Radius of the circle which passes through the point (–1, 2) and touches the circle $x^2+y^2-8x+6y=0$ at the origin is:

(A) $\frac{3}{4}$ **(B)** $\frac{7}{4}$ **(C)** $\frac{5}{4}$ **(D)** $\frac{5}{2}$

13. The number of 6 digit numbers that can be formed using the digits 0, 1, 2, 5, 7 and 9 which are divisible by 11 and no digit is repeated, is :

(A) 60 **(B)** 72 **(C)** 48 **(D)** 36

14. If $(1-i)^{50}=-2^k i$ then k is:

(A) 24 **(B)** 25 **(C)** 50 **(D)** 48

Space for Rough Work

15. The cosine of angle between any two body diagonals of a cube is:

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

16. If $f(x)$ is a decreasing function, then the set of values of 'k' for which the major axis of the ellipse $\frac{x^2}{f(k^2+2k+5)}+\frac{y^2}{f(k+11)}=1$ is the x-axis is :

(A) $k \in (-2,3)$ **(B)** $k \in (-3,2)$

(C) $k \in (-\infty,-3) \cup (2,\infty)$ **(D)** $k \in (-\infty,-2) \cup (3,\infty)$

17. Consider a circle with its centre lying on the focus of the parabola $y^2 = 2px$ such that it touches the directrix of the parabola, then a point of intersection of the circle and the parabola is :

(A) $\left(\frac{P}{2}, P\right)$ **(B)** $(P, -P)$ **(C)** $\left(\frac{-P}{2}, P\right)$ **(D)** $\left(\frac{-P}{2}, -P\right)$

18. Let $y(x)$ be the solution of the differential equation $2x^2dy+(e^y+2x)dx=0$; $x>0$, $y(1)=0$ then $y(2)$ is equal to:

(A) $\log_e\left(\frac{8}{19}\right)$ **(B)** $\log_e\left(\frac{19}{8}\right)$ **(C)** 0 **(D)** $\log_e(2e)$

Space for Rough Work

19. Let [t] denotes the greatest integer less than or equal to t. $f(x) = x - [x]$, $g(x) = 1 - x + [x]$, and $h(x) = \max\{f(x), g(x)\}$, $x \in [-2, 2]$. Then h is:

(A) Continuous in [–2, 2] but not differentiable at exactly three points in (–2, 2)

(B) Not continuous at exactly four points in [–2, 2]

(C) Not continuous at exactly three points in [–2, 2]

(D) Continuous in [–2, 2] but not differentiable at more than four points in (–2, 2)

20. The value of $2\cos\left(\frac{\pi}{8}\right)\cos\left(\frac{2\pi}{8}\right)\cos\left(\frac{3\pi}{8}\right)\cos\left(\frac{5\pi}{8}\right)\cos\left(\frac{6\pi}{8}\right)\cos\left(\frac{7\pi}{8}\right)$.

(A) $-\frac{1}{4}$ **(B)** $-\frac{1}{4\sqrt{2}}$ **(C)** $-\frac{1}{8\sqrt{2}}$ **(D)** $-\frac{1}{8}$

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. If the projection of vector $\hat{i}+2j+k$ on the sum of the two vectors $2\hat{i}+\lambda j-5k$ and $-\lambda\hat{i}-2j+3k$ is 1 then $|\lambda|$ is equal to:

2. Let S be the set of all values of λ, for which the shortest distance between the lines $\frac{x-\lambda}{0}=\frac{y-3}{4}=\frac{z+6}{1}$ and $\frac{x+\lambda}{3}=\frac{y}{-4}=\frac{z-6}{0}$ is 13. Then $8\left|\sum_{\lambda\in S}\lambda\right|$ is equal to

3. The least positive integer *n*. Such that $\frac{(2i)^n}{(1-i)^{n-2}}, i=\sqrt{-1},$ is a real no is:

4. Let $a_1, a_2, a_3 \ldots a_{10}$ are in A.P. with common difference 1 and $b_1, b_2, b_3 \ldots b_{10}$ be in G.P. with common ratio 2. Let $C_k = a_k \cdot b_k, k = 1,2,3 \ldots 10.$ If $C_2 = 12$ and $C_3 = 32$ if C_{10} is $\alpha \cdot 2^{\beta}$ where α a prime number then find $|\alpha-\beta|$.

5. Let *A* and *B* are two 3 × 3 real matrices if det(*A*) = 2 and det(*B*) = 3. Then number of division of the form $(4k+2); K \in W$ of $\det(5A^4B^3)$ is (*W* denotes set of whole numbers):

Space for Rough Work

6. Let *a* and *b* respectively be the points of local maxima and local minima of the function $f(x) = x^3 - 3x$. If *A* is the total area of the region bounded by $y = f(x)$, the *x*-axis and the lines $x = a$ and $x = b$ then 2*A* equal to _____.

7. Let a line *L* passes through the origin and be perpendicular to the lines $L_1 : \vec{r} = (\hat{i} - 11\hat{j} - 7\hat{k}) + \lambda(\hat{i} + 2\hat{j} + 3\hat{k}), \lambda \in R$ and $L_2 : \vec{r} = (-\hat{i} + \hat{k}) + \mu(2\hat{i} + 2\hat{j} + \hat{k}), \mu \in R$. If *P* is the point of intersection of *L* and L_1 and $Q(\alpha, \beta, \gamma)$ is the foot of perpendicular from P on L_2, then $9(\alpha + \beta + \gamma)$ is equal to.

8. If mean and variance of 2, 3, 7, *x* and *y* be 5 and 10 respectively then the value of *xy* will be:

9. The sum of all 3-digit number less than or equal to 500, that are formed without using the digit "1" and "2" and all are multiple of 11 is:

10. Let λ be a negative real number. If α and β are the roots of equation $x^2 - \lambda x + 2 = 0$ and α and γ are the roots of the equation $3x^2 - 10\lambda x + 27 = 0$ then $\left(\frac{\beta\gamma}{\lambda^2}\right)$_____.

Space for Rough Work