# JEE Mains (Dropper)

## Sample Paper - IV

**DURATION : 180 Minutes** **M. MARKS : 300**

### General Instructions:

1. Immediately fill in the particulars on this page of the test booklet.
2. The test is of **3 hours** duration.
3. The test booklet consists of **90** questions **(75 to attempt)**. The maximum marks are **300**.
4. There are three subjects in the question paper, Subject I, II and III consisting of Section-I (**Physics),** Section-II **(Chemistry)**, Section-III **(Mathematics)**, and having **30 questions** in each part.
5. There will be a total of **20 MCQs** and **10 Numerical** Value Based Questions **(attempt any 5)**.
6. Each correct answer will give 4 marks while 1 Marks will be deducted for a wrong response.
7. No student 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.
8. 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.
9. **Do not fold or make any stray mark on the Answer Sheet (OMR).**

**Name of the Student (In CAPITALS): _____**

**Roll Number: _____**

**Candidate's Signature: _____**

# Section-I (PHYSICS)

## Section-A

**1.** A bob of mass $M$ is suspended by a massless string of length $L$. The horizontal velocity $v$ at position $A$ is just sufficient to make it reach the point $B$. The angle $\theta$ at which the speed of the bob is half of that at $A$, satisfies

(Given: $\cos^{-1}\left(\frac{-7}{8}\right)=151°$)

(1) $\theta=\frac{\pi}{4}$ (2) $\frac{\pi}{4}<\theta<\frac{\pi}{2}$

(3) $\frac{\pi}{2}<\theta<\frac{3\pi}{4}$ (4) $\frac{3\pi}{4}<\theta<\pi$

**2.** A diatomic molecule is made of two masses $m_1$ and $m_2$ which are separated by a distance $r$. If we calculate its rotational energy by applying Bohr's rule of angular momentum quantization, its energy will be given by ($n$ is an integer)

(1) $\frac{n^2h^2}{2(m_1+m_2)r^2}$

(2) $\frac{2n^2h^2}{(m_1+m_2)r^2}$

(3) $\frac{(m_1+m_2)n^2h^2}{2m_1m_2r^2}$

(4) $\frac{(m_1+m_2)^2n^2h^2}{2m_1^2m_2^2r^2}$

**3.** The concentration of hole-electron pairs in pure Silicon at T = 300 K is $7\times10^{15}$ m$^{-3}$. Antimony is doped into Silicon in a proportion of 1 atom in $10^7$ Si atoms. Assuming that half of the impurity atoms contribute electron in the conduction band, calculate the factor by which the number of charge carriers increases due to doping of $5\times10^{28}$ m$^{-3}$ of Si atoms.

(1) $1.8\times10^5$ (2) $5.8\times10^5$

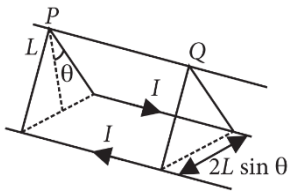
(3) $6.8\times10^5$ (4) $8.8\times10^5$

**4.** A uniform rod of length $L$ and mass $M$ is held vertical, with its bottom end pivoted to the floor. The rod falls under gravity, freely turning about the pivot. If acceleration due to gravity is g, what is the instantaneous angular speed of the rod when it makes an angle 60° with the vertical?

(1) $\left(\frac{g}{L}\right)^{1/2}$ (2) $\left(\frac{3g}{4L}\right)^{1/2}$

(3) $\left(\frac{3\sqrt{3}g}{2L}\right)^{1/2}$ (4) $\left(\frac{3g}{2L}\right)^{1/2}$

**5.** Two long parallel wires carry currents of equal magnitude but in opposite directions. These wires are suspended from rod $PQ$ by four chords of same length $L$ as shown in the figure. The mass per unit length of the wire is $\lambda$. Determine the value of $\theta$ assuming it to be small.




(1) $I\sqrt{\frac{\mu_0}{4\pi\lambda gL}}$ (2) $I\sqrt{\frac{4\pi\lambda gL}{\mu_0}}$

(3) $I\sqrt{\frac{\mu_0}{2\pi\lambda g}}$ (4) $2\pi\lambda\sqrt{\frac{\mu_0}{g}}I$

**6.** A circular coil of radius 8.0 cm and of 20 turns is rotated about its vertical diameter with an angular speed of 50 rad s$^{-1}$ in a uniform horizontal magnetic field of magnitude $3.0\times10^{-2}$ T. If the coil forms a closed loop of resistance 10 Ω, calculate the average power loss due to Joule heating.

(1) 9 mW (2) 18 mW

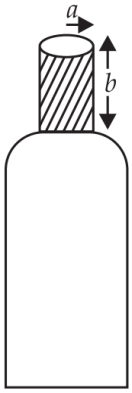
(3) 27 mW (4) 36 mW

**7.** A train moves from rest with acceleration a and in time $t_1$ covers a distance $x$. It then decelerates to rest at constant retardation b for distance $y$ in time $t_2$. Then

(1) $\frac{x}{y}=\frac{\beta}{\alpha}$ (2) $\frac{\beta}{\alpha}=\frac{t_2y}{t_1x}$

(3) $x=y$ (4) $\frac{x}{y}=\frac{\beta t_1}{\alpha t_2}$

**8.** A bottle has an opening of radius $a$ and length $b$. A cork of length $b$ and radius $(a+\Delta a)$ where ($\Delta a << a$) is compressed to fit into the opening completely (see figure). If the bulk modulus of cork is $B$ and frictional coefficient between the bottle and cork is m then the force needed to push the cork into the bottle is




(1) $(\pi\mu Bb)a$

(2) $(2\pi\mu Bb)\Delta a$

(3) $(\pi\mu Bb)\Delta a$

(4) $(4\pi\mu Bb)\Delta a$

**9.** A particle is projected from the ground with an initial speed of $v$ at angle $\theta$ with horizontal. The average velocity of the particle between its point of projection and the highest point of trajectory is

(1) $\frac{v}{2}\sqrt{1+2\cos^2\theta}$ (2) $\frac{v}{2}\sqrt{1+\cos^2\theta}$

(3) $\frac{v}{2}\sqrt{1+3\cos^2\theta}$ (4) $v\cos\theta$

**10.** A direct current of magnitude $a$ is superimposed on an alternating current $b$ sin ωt. Find the resulting effective current in the circuit.

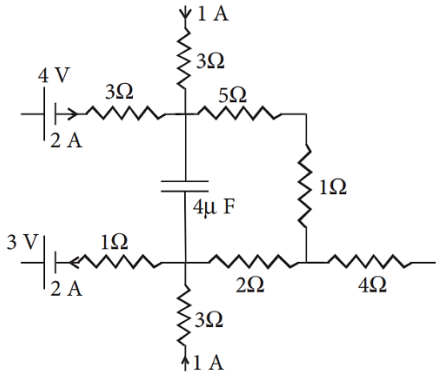
(1) $\sqrt{\left[a^2+\frac{b^2}{2}\right]}$

(2) $\sqrt{\left[a^2+\frac{b^2}{4}\right]}$

(3) $\sqrt{\left[a+\frac{b}{2}\right]}$

(4) $\sqrt{\left[a+\frac{b}{4}\right]}$

**11.** A part of circuit in a steady state along with the currents flowing in the branches, the values of resistances etc., is shown in the figure.




Calculate the energy stored in the capacitor C(4 μF).

(1) 0.73 mJ (2) 0.7 mJ

(3) 0.8 mJ (4) 8.0 J

**12.** When two bar magnets have their like poles tied together, they make 12 oscillations per minute and when their unlike poles are tied together, they make 4 oscillations per minute. Find the ratio of their magnetic moments.

(1) $\frac{2}{3}$ (2) $\frac{3}{2}$

(3) $\frac{5}{4}$ (4) $\frac{4}{5}$

**13.** A ceiling fan rotates about its own axis with some angular velocity. When the fan is switched off, the angular velocity becomes $\left(\frac{1}{4}\right)^{\text{th}}$ of the original in time $t$ and $n$ revolution are made in that time. The number of revolutions made by the fan during the time internal between switch off and rest are (Angular retardation is uniform)

(1) $\frac{4n}{15}$ (2) $\frac{8n}{15}$

(3) $\frac{16n}{15}$ (4) $\frac{32n}{15}$

**14.** If the radius of the opening of a dropper is $r = 5 \times 10^{-4}$ m, density of liquid $\rho = 10^3$ kg m$^{-3}$, $g = 10$ m s$^{-2}$ and surface tension $T = 0.11$ N m$^{-1}$, the radius of the drop when the drop detaches from the dropper is approximately

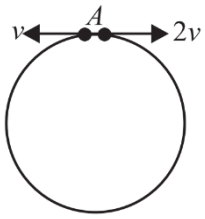
(1) $1.4 \times 10^{-3}$ m

(2) $3.3 \times 10^{-3}$ m

(3) $2.0 \times 10^{-3}$ m

(4) $4.1 \times 10^{-3}$ m

**15.** Two small particles of equal masses start moving in opposite directions from a point A in a horizontal circular orbit. Their tangential velocities are v and 2$v$ respectively, as shown in the figure. Between collisions, the particles move with constant speeds. After making how many elastic collisions, other than that at A, these two particles will again reach the point A?




(1) 4

(2) 3

(3) 2

(4) 1

**16.** A body of mass 5 kg rests on a rough horizontal surface of coefficient of friction 0.2. The body is pulled through a distance of 10 m by a horizontal force of 25 N. The kinetic energy acquired by it is (take g = 10 ms$^{-2}$)

(1) 200 J

(2) 150 J

(3) 100 J

(4) 50 J

**17.** There is a stream of neutrons with a kinetic energy of 0.0327 eV. If the half-life of neutrons is 700 s, what fraction of neutrons will decay before they travel a distance of 10 m?

(1) $4.6 \times 10^{-5}$

(2) $3.9 \times 10^{-6}$

(3) $9.2 \times 10^{-5}$

(4) $7.8 \times 10^{-6}$

**18.** A modulated signal $c_m(t)$ has the form $c_m(t) = 30 \sin 300\pi t + 10 (\cos 200\pi t - \cos 400\pi t)$. The carrier frequency $\upsilon_c$, the modulating frequency (message frequency) $\upsilon_m$, and the modulation index m are respectively given by

(1) $\upsilon_c$= 200 Hz; $\upsilon_m$ = 50 Hz; m = 1/2

(2) $\upsilon_c$ = 150 Hz; $\upsilon_m$ = 50 Hz; m = 2/3

(3) $\upsilon_c$ = 150 Hz; $\upsilon_m$ = 30 Hz; m = 1/3

(4) $\upsilon_c$ = 200 Hz; $\upsilon_m$ = 30 Hz; m = 1/2

**19.** Three very large plates of same area are kept parallel and close to each other. They are considered as ideal black surfaces and have very high thermal conductivity. The first and third plates are maintained at temperatures 2T and 3T respectively. The temperature of the middle (i.e. second) plate under steady state condition is

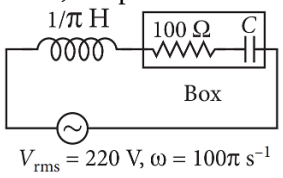
(1) $\left(\frac{65}{2}\right)^{1/4} T$

(2) $\left(\frac{97}{4}\right)^{1/4} T$

(3) $\left(\frac{97}{2}\right)^{1/4} T$

(4) $(97)^{1/4} T$

**20.** For the circuit as shown in figure, if the value of rms current is 2.2 A, the power factor of the box is




(1) $\frac{1}{\sqrt{2}}$

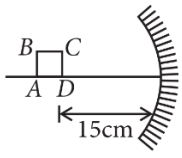
(2) 1

(3) $\frac{\sqrt{3}}{2}$

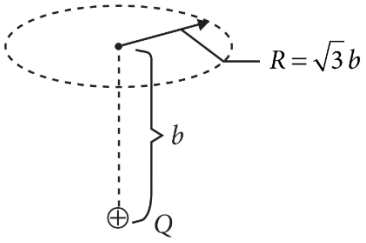
(4) $\frac{1}{2}$

## Section-B

**21.** A square ABCD of side 1 mm is kept at distance 15 cm infront of the concave mirror as shown in the figure. If focal length of the mirror is 10 cm, then the length of the perimeter of its image will be _____ mm.




**22.** In the given situation, radius of disc is $\sqrt{3}b$ and distance of point charge from the disc is $b$.




The ratio of electric flux not going through the disc and electric flux of charge through the disc is $x$ : 1. The value of $x$ is _____.

**23.** In Young's double slit experiment, slits are separated by 2 mm and the screen is placed at a distance of 1.2 m from the slits. Light consisting of two wavelengths 6500 Å and 5200 Å are used to obtain interference fringes. The separation between the fourth bright fringes of two different patterns produced by the two wavelengths is _____ mm.

**24.** When a light of photons of energy 4.2 eV is incident on a metallic sphere of radius 10 cm and work function 2.4 eV, photoelectrons are emitted. The number of photoelectrons liberated before the emission is stopped, is
$1.25 \times 10^x$. The value of $x$ is _____.

($e = 1.6 \times 10^{-19}$C and $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ N m$^2$C$^{-2}$)

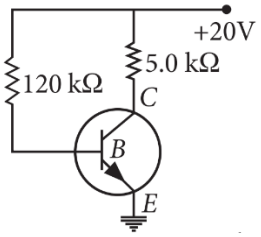
**25.** Water is in streamline flow along a horizontal pipe with non uniform cross-section. At a point in the pipe where the area of cross-section is 10 cm$^2$, the velocity of water is 1 m s$^{-1}$ and the pressure is 2000 Pa. The pressure at another point where the cross-sectional area is 5 cm$^2$ is _____ Pa.

**26.** A proton of mass m = $1.67 \times 10^{-27}$ kg moves uniformly in a space where there are uniform, mutually perpendicular electric and magnetic fields with $E_z = 4.5 \times 10^4$ V m$^{-1}$ and $B_x = 40$ mT at an angle $\phi = 60°$ with the x-axis in the $xy$-plane. The pitch of the trajectory after the electric field is switched off is _____ m.

**27.** A ball falls from height $h$. After 1 second, another ball falls freely from a point 20 m below the point from where the first ball falls. If both of them reach the ground at the same time, then value of $h$ is _____m.

**28.** A body undergoes no change in volume. Poisson's ratio is _____ .

**29.** In the given circuit, the value of β is 200. When $I_C$ = 2.5 mA, then $V_{BC}$ will be _____ V.

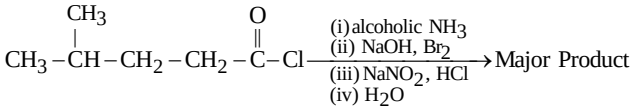



**30.** In Young's double slit experiment, the $y$-coordinates of central maxima and tenth maxima are 2 cm and 5 cm respectively. When the apparatus is immersed in a liquid of refractive index 1.5, will be _____ cm.

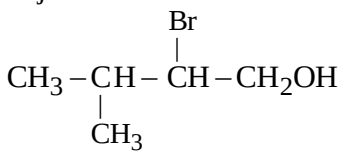
## Section-II (CHEMISTRY)

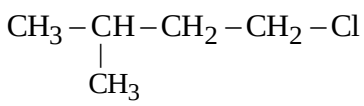
### Section - A

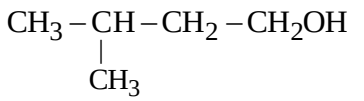
**31.** The major product of the following reaction is

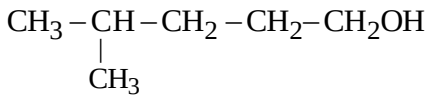



The Major Product in the above reaction is:

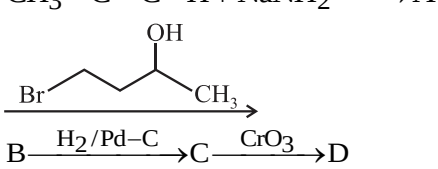
(1) 

(2) 

(3) 

(4) 

**32.** In the following sequence of reactions, the final product D is:




(1) 

(2) 

(3) 

(4) $CH_3-CH=CH-CH_2-CH_2-COOH$

**33.** Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

**Assertion (A):** Synthesis of ethyl phenyl ether may be achieved by Williamson synthesis.

**Reason (R):** Reaction of bromobenzene with sodium ethoxide yields ethyl phenyl ether.

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

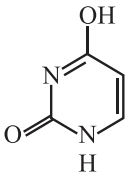
(1) Both (A) and (R) are correct and (R) is the correct explanation of (A)

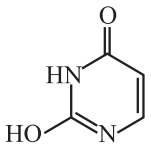
(2) (A) is correct but (R) is not correct

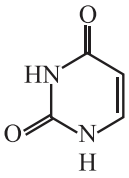
(3) Both (A) and (R) are correct but (R) is NOT the correct explanation of (A)

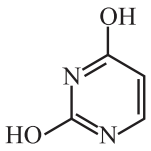
(4) (A) is not correct but (R) is correct

**34.** Out of following isomeric forms of uracil, which one is present in RNA?

(1) 

(2) 

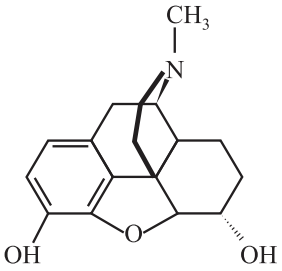
(3) 

(4) 

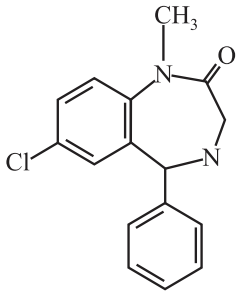
**35.** The gas 'A' is having very low reactivity reaches to stratosphere. It is non–toxic and non–flammable but dissociated by UV-radiations in stratosphere. The intermediates formed initially from the gas 'A' are:

(1) $\dot{C}H_3 + \dot{C}F_2Cl$ (2) $\dot{C}lO + \dot{C}F_2Cl$

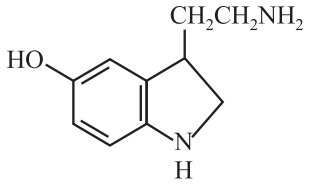
(3) $\dot{C}lO + \dot{C}H_3$ (4) $\dot{C}l + \dot{C}F_2Cl$

**36.** 

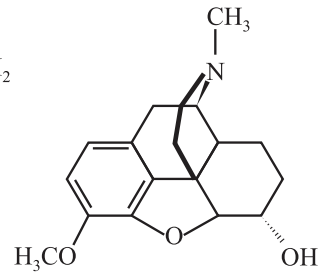
(A)



(B)



(C)



(D)

The correct statement about (A), (B), (C) and (D) is:

(1) (B) and (C) are tranquillizers

(2) (B), (C) and (D) are tranquillizers

(3) (A), (B) and (C) are narcotic analgesics

(4) (A) and (D) are tranquillizers

**37.** The number of water molecules in gypsum, dead burnt plaster and plaster of paris, respectively are:

(1) 2, 0 and 1

(2) 5, 0 and 0.5

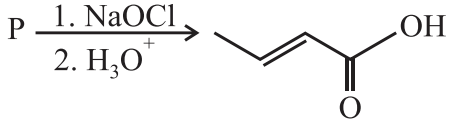
(3) 2, 0 and 0.5

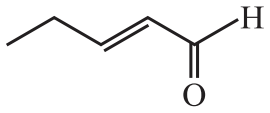
(4) 0.5, 0 and 2

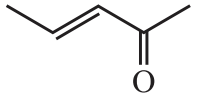
**38.** The unit of the van der Waals gas equation parameter 'a' in $\left(P+\frac{an^2}{V^2}\right)(V-nb)=nRT$ is:

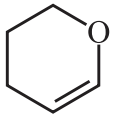
(1) atm $dm^6$ $mol^{-2}$ (2) $dm^3$ $mol^{-1}$
(3) kg m $s^{-1}$ (4) kg m $s^{-2}$

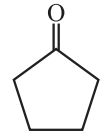
**39.** The structure of the starting compound **P** used in the reaction given below is:




(1) 


(2) 


(3) 


(4) 

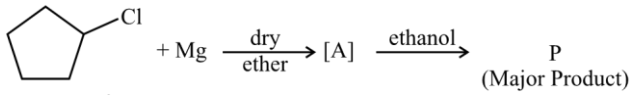

**40.** Deuterium resembles hydrogen in properties but:
(1) reacts vigorously than hydrogen
(2) emits $\beta^+$ particles
(3) reacts just as hydrogen
(4) reacts slower than hydrogen

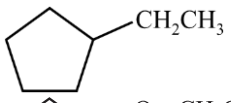
**41.** Match **List–I** with **List–II**:

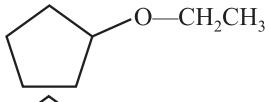
| **List–I (Species)** | **List–II (Number of lone pairs of electrons on the central atom)** |
|---|---|
| (A) $XeF_2$ | (i) 0 |
| (B) $XeO_2F_2$ | (ii) 1 |
| (C) $XeO_3F_2$ | (iii) 2 |
| (D) $XeF_4$ | (iv) 3 |

(1) (A)–(iv), (B)–(i), (C)–(ii), (D)–(iii)
(2) (A)–(iii), (B)–(ii), (C)–(iv), (D)–(i)
(3) (A)–(iii), (B)–(iv), (C)–(ii), (D)–(i)
(4) (A)–(iv), (B)–(ii), (C)–(i), (D)–(iii)

**42.** In the following sequence of reactions the P is:




(1) 


(2) 


(3) 

(4) 

**43.** The nature of oxides $V_2O_3$ and CrO is indexed as 'X' and 'Y' type respectively. The correct set of X and Y is:
(1) X = acidic Y = acidic
(2) X = basic Y = basic
(3) X = basic Y = amphoteric
(4) X = amphoteric Y = basic

**44.** In polythionic acid, $H_2S_xO_6$(x = 3 to 5) the oxidation state(s) of sulphur is/are:
(1) + 3 and + 5 only (2) + 6 only
(3) 0 and + 5 only (4) + 5 only

**45.** Which of the following is not a correct statement for primary aliphatic amines?
(1) The intermolecular association in primary amines is less than the intermolecular association in secondary amines.
(2) Primary amines can be prepared by the Gabriel phthalimide synthesis.
(3) Primary amines on treating with nitrous acid solution form corresponding alcohols except methyl amine.
(4) Primary amines are less basic than the secondary amines.

**46.** In which one of the following molecules strongest back donation of an electron pair from halide to boron is expected?
(1) $BBr_3$ (2) $BF_3$
(3) $BCl_3$ (4) $BI_3$

**47.** Tyndall effect is more effectively shown by:
(1) suspension
(2) lyophobic colloid
(3) true solution
(4) lyophilic colloid

**48.** Match items of **List–I** with those of **List–II**:

| **List–I (Property)** | **List–II (Example)** |
|---|---|
| (A) Diamagnetism | (i) MnO |
| (B) Ferrimagnetism | (ii) $O_2$ |
| (C) Paramagnetism | (iii) NaCl |
| (D) Antiferromagnetism | (iv) $Fe_3O_4$ |

Choose the **most appropriate** answer from the options given below:
(1) (A)–(ii), (B)–(i), (C)–(iii), (D)–(iv)
(2) (A)–(iv), (B)–(ii), (C)–(i), (D)–(iii)
(3) (A)–(i), (B)–(iii), (C)–(iv), (D)–(ii)
(4) (A)–(iii), (B)–(iv), (C)–(ii), (D)–(i)

**49.** Acidic ferric chloride solution on treatment with excess of potassium ferrocyanide gives a Prussian blue coloured colloidal species. It is:
(1) $KFe[Fe(CN)_6]$ (2) $K_5Fe[Fe(CN)_6]_2$
(3) $Fe_4[Fe(CN)_6]_3$ (4) $HFe[Fe(CN)_6]$

**50.** Which refining process is generally used in the purification of low melting metals?
(1) Zone refining
(2) Liquation
(3) Chromatographic method
(4) Electrolysis

**Section - B**

**51.** 1 mol of an octahedral metal complex with formula $MCl_3 \cdot 2L$ on reaction with excess of $AgNO_3$ gives 1 mol of AgCl. The denticity of Ligand L is

**52.** In Carius method for estimation of halogens, 0.2 g of an organic compound gave 0.188 g of AgBr. The percentage of bromine in the compound is _____. (Nearest integer)
[Atomic mass: Ag = 108, Br = 80]

**53.** The reaction that occurs in a breath analyser, a device used to determine the alcohol level in a person's blood stream is
$2K_2Cr_2O_7 + 8H_2SO_4 + 3C_2H_6O \longrightarrow 2Cr_2(SO_4)_3 + 3C_2H_4O_2 + 2K_2SO_4 + 11H_2O$
If the rate of appearance of $Cr_2(SO_4)_3$ is 2.67 mol $min^{-1}$ at a particular time, the rate of disappearance of $C_2H_6O$ at the same time is _____ mol $min^{-1}$. (Nearest integer)

**54.** The work done by the system in a cyclic process involving one mole of an ideal monoatomic gas is –50 kJ/cycle. The heat absorbed by the system per cycle is:

**55.** The kinetic energy of an electron in the second Bohr orbit of a hydrogen atom is equal to $\frac{h^2}{xma_0^2}$.
The value of 10x is _____. ($a_0$ is radius of Bohr's orbit) (Nearest integer) [Given: $\pi = 3.14$]

**56.** The number of moles of CuO, that will be utilized in Dumas method for estimating nitrogen in a sample of 57.5g of N, N-dimethylaminopentane is _____$\times 10^{-2}$.

**57.** The number of *f* electrons in the ground state electronic configuration of Np (Z = 93) is _____.

**58.** When 10 mL of an aqueous solution of $KMnO_4$ was titrated in acidic medium, equal volume of 0.1 M of an aqueous solution of ferrous sulphate was required for complete discharge of colour. The strength of $KMnO_4$ in grams per litre is _____ $\times 10^{-2}$. (Nearest integer)
[Atomic mass of K = 39, Mn = 55, O = 16]

**59.** 200 mL of 0.2 M HCl is mixed with 300 mL of 0.1 M NaOH. The molar heat of neutralization of this reaction is –57.1 kJ. The increase in temperature in °C of the system on mixing is $x \times 10^{-2}$.
The value of x is _____. (Nearest integer)
[Given: Specific heat of water = 4.18 J $g^{-1}$ $K^{-1}$
Density of water = 1.00 g $cm^{-3}$]
(Assume no volume change on mixing)

**60.** The number of moles of $NH_3$, that must be added to 2 L of 0.80 M $AgNO_3$ in order to reduce the concentration of $Ag^+$ ions to $5.0 \times 10^{-8}$ M ($K_{formation}$ for $[Ag(NH_3)_2]^+ = 1.0 \times 10^8$) is _____ .
[Assume no volume change on adding $NH_3$]

## Section-III (MATHEMATICS)

**Section - A**

**61.** If *a* and *b* are real numbers such that $(2+\alpha)^4 = a + b\alpha$, where $\alpha = \frac{-1+i\sqrt{3}}{2}$, then $a + b$ is equal to:
(1) 9
(2) 33
(3) 57
(4) 24

**62.** Contrapositive of the statement:
'If a function *f* is differentiable at *a*, then it is also continuous at *a*', is:
(1) If a function *f* is not continuous at *a*, then it is not differentiable at *a*.
(2) If a function *f* is continuous at *a*, then it is differentiable at *a*.
(3) If a function *f* is not continuous at *a*. then it is differentiable at *a*.
(4) If a function f is continuous at a, then it is not differentiable at a.

**63.** If for some positive integer n, the coefficients of three consecutive terms in the binomial expansion of $(1 + x)^{n+5}$ are in the ratio 5: 10: 14, then the largest coefficient in the expansion is:
(1) 252
(2) 330
(3) 792
(4) 462

**64.** The function $f(x)=\begin{cases}\frac{\pi}{4}+\tan^{-1}x, & |x|\le 1\\ \frac{1}{2}(|x|-1), & |x|>1\end{cases}$ is:

(1) both continuous and differentiable on $R-\{1\}$.

(2) both continuous and differentiable on $R-\{-1\}$.

(3) continuous on $R-\{1\}$ and differentiable on $R-\{-1, 1\}$.

(4) continuous on $R-\{-1\}$ and differentiable on $R-\{-1, 1\}$.

**65.** If the system of equations

$x + y + z = 2$

$2x + 4y - z = 6$

$3x + 2y + \lambda z = \mu$

has infinitely many solutions, then:

(1) $\lambda+2\mu=14$

(2) $2\lambda+\mu=14$

(3) $2\lambda-\mu=5$

(4) $\lambda-2\mu=-5$

**66.** Let $\lambda\neq 0$ be in $R$. If $\alpha$ and $\beta$ are the roots of the equation, $x^2-x+2\lambda=0$ and $\alpha$ and $\gamma$ are the roots of the equation $3x^2-10x+27\lambda=0$, then $\frac{\beta\gamma}{\lambda}$ is equal to:

(1) 18 (2) 36

(3) 9 (4) 27

**67.** The circle passing through the intersection of the circles, $x^2 + y^2 - 6x = 0$ and $x^2 + y^2 - 4y = 0$, having its centre on the line, $2x - 3y + 12 = 0$, also passes through the point:

(1) (–1, 3) (2) (–3, 6)

(3) (–3, 1) (4) (1, – 3)

**68.** The integral $\int_{\pi/6}^{\pi/3}\tan^3 x\cdot\sin^2 3x$

$\left(2\sec^2 x\cdot\sin^2 3x+3\tan x\cdot\sin 6x\right)dx$

(1) $-\frac{1}{18}$ (2) $-\frac{1}{9}$

(3) $\frac{9}{2}$ (4) $\frac{7}{18}$

**69.** The area (in sq. units) of the largest rectangle $ABCD$ whose vertices $A$ and $B$ lie on the $x$-axis and vertices $C$ and $D$ lie on the parabola, $y = x^2 - 1$ below the $x$-axis, is:

(1) $\frac{4}{3\sqrt{3}}$ (2) $\frac{1}{3\sqrt{3}}$

(3) $\frac{4}{3}$ (4) $\frac{2}{3\sqrt{3}}$

**70.** Suppose the vectors $x_1$, $x_2$ and $x_3$ are the solutions of the system of linear equations, $Ax = b$ when the vector $b$ on the right side is equal to $b_1$, $b_2$ and $b_3$ respectively. If $x_1=\begin{bmatrix}1\\1\\1\end{bmatrix}, x_2=\begin{bmatrix}0\\2\\1\end{bmatrix}, x_3=\begin{bmatrix}0\\0\\1\end{bmatrix}, b_1=\begin{bmatrix}1\\0\\0\end{bmatrix}$, $b_2=\begin{bmatrix}0\\2\\0\end{bmatrix}$ and $b_3=\begin{bmatrix}0\\0\\2\end{bmatrix}$, then the determinant of $A$ is equal to

(1) $\frac{1}{2}$ (2) 4

(3) 2 (4) $\frac{3}{2}$

**71.** The solution of differential equation $\frac{dy}{dx}-\frac{y+3x}{\log_e(y+3x)}+3=0$ is:

(1) $y+3x-\frac{1}{2}\left(\log_e x\right)^2=C$

(2) $x-\frac{1}{2}\left(\log_e(y+3x)\right)^2=C$

(3) $x-2\log_e(y+3x)=C$

(4) $x-\log_e(y+3x)=C$

**72.** The minimum value of $2^{\sin x}+2^{\cos x}$ is:

(1) $2^{1-\frac{1}{\sqrt{2}}}$ (2) $2^{1-\sqrt{2}}$

(3) $2^{-1+\sqrt{2}}$ (4) $2^{-1+\frac{1}{\sqrt{2}}}$

**73.** Let $f:(0,\infty)\to(0,\infty)$ be a differentiable function such that $f(1) = e$ and $\lim_{t\to x}\frac{t^2f^2(x)-x^2f^2(t)}{t-x}=0$. If $f(x) = 1$, then $x$ is equal to:

(1) $e$ (2) $\frac{1}{e}$

(3) $\frac{1}{2e}$ (4) $2e$

**74.** The distance of the point (1, –2, 3) from the plane $x - y + z = 5$ measured parallel to the line $\frac{x}{2}=\frac{y}{3}=\frac{z}{-6}$ is

(1) $\frac{1}{7}$ (2) 7

(3) $\frac{7}{5}$ (4) 1

**75.** In a game two players A and B take turns in throwing a pair of fair dice starting with player A and total of scores on the two dice, in each throw is noted. A wins the game if he throws a total of 6 before B throws a total of 7 and B wins the game if he throws a total of 7 before A throws a total of six. The game stops as soon as either of the players wins. The probability of A winning the game is:

(1) $\frac{5}{6}$ (2) $\frac{31}{61}$

(3) $\frac{30}{61}$ (4) $\frac{5}{31}$

**76.** The angle of elevation of a cloud *C* from a point *P*, 200 *m* above a still take is 30°. If the angle of depression of the image of *C* in the lake from the point *P* is 60°, then *PC* (in *m*) is equal to

(1) $200\sqrt{3}$

(2) 100

(3) 400

(4) $400\sqrt{3}$

**77.** Let $x = 4$ be a directrix to an ellipse whose centre is at the origin and its eccetnricy is $\frac{1}{2}$. If $P(1, \beta), \beta > 0$ is a point on this ellipse, then the equation of the normal to it at *P* is:

(1) $4x-2y=1$

(2) $4x-3y=2$

(3) $7x-4y=1$

(4) $8x-2y=5$

**78.** Let $\bigcup_{i=1}^{50} X_i = \bigcup_{i=1}^{n} Y_i = T$, where each $x_i$ contains 10 elements and each $Y_i$ contains 5 elements. If each element of the set *T* is an element of exactly 20 of sets $X_i$'s and exactly 6 of sets $Y_i$'s then *n* is equal to:

(1) 15 (2) 30

(3) 45 (4) 50

**79.** If the perpendicular bisector of the line segment joining the points *P*(1, 4) and *Q*(*k*, 3) has *y*-intercept equal to – 4, then a value of *k* is:

(1) $\sqrt{14}$ (2) $\sqrt{15}$

(3) – 4 (4) – 2

**80.** Let $a_1, a_2, ....., a_n$ be a given A.P. whose common difference is an integer and $S_n = a_1 + a_2 + ..... + a_n$. If $a_1 = 1, a_n = 300$ and $15 \le n \le 50$, then the ordered pair $(S_{n-4}, a_{n-4})$ is equal to

(1) (2490, 248) (2) (2480, 248)

(3) (2490, 249) (4) (2480, 249)

## Section - B

**81.** If $\vec{a} = 2\hat{i} + j + 2k$, then the value of $|\hat{i} \times (\vec{a} \times \hat{i})|^2 + |j \times (\vec{a} \times j)|^2 + |\hat{k} \times (\hat{a} \times \hat{k})|^2$ is equal to:

**82.** A test consists of 6 multiple choice questions, each having 4 alternative answers of which only one is correct. The number of ways, in which a candidate answers all six questions such that exactly four of the answers are correct, is.....

**83.** Let *PQ* be a dimeter of the circle $x^2 + y^2 = 9$. If $\alpha$ and $\beta$ are the lengths of the perpendiculars from *P* and *Q* on the straight line, $x + y = 2$ respectively, then the maximum value of $\alpha\beta$ is……

**84.** If the variance of the following frequency distribution :

| **Class:** | 10-20 | 20-30 | 30-40 |
|---|---|---|---|
| **Frequency:** | 2 | *x* | 2 |

is 50, then *x* is equal to:

**85.** Let $\{x\}$ and $[x]$ denote the fractional part of *x* and the greatest integer $\le x$ respectively of a real number *x*. If $\int_0^n \{x\}dx, \int_0^n [x]dx$ and $10(n^2 - n), (n \in N, n > 1)$ are three consecutive terms of a G.P. then *n* is equal to

**86.** Let ${}^nC_r$ denote the binomial coefficient of $x^r$ in the expansion $(1+x)^n$. If $\sum_{k=0}^{10} \left(2^2 + 3k\right) {}^{10}C_k = \alpha.3^{10} + \beta.2^{10}, \alpha, \beta \in R$ then $\alpha + \beta$ is equal to

**87.** Let *S* be the sum of all solutions (in radians) of equation $\sin^4\theta + \cos^4\theta - \sin\theta\cos\theta = 0$ in $[0, 4\pi]$. Then $\frac{8S}{\pi}$ is equal to

**88.** If $f(x) = \sin\left(\cos^{-1}\left(\frac{1-2^{2x}}{1+2^{2x}}\right)\right)$ and its first derivative with respect to *x* is $-\frac{b}{a}\log_e 2$ when $x = 1$, where *a* and *b* are integers, then the minimum value of $|a^2 - b^2|$ is_____

**89.** In $\Delta ABC$, the lengths of sides $AC$ and $AB$ are 12 cm and 5 cm, respectively. If the area of $\Delta ABC$ is 30 $cm^2$ and $R$ and $r$ are respectively the radii of circumcircle and incircle of $\Delta ABC$, then the value of $2R + r$ (in cm) is equal to.

**90.** A man starts walking from the point $P(-3, 4)$, touches the $x$-axis at $R$, and then turns to reach at the point $Q(0, 2)$. The man is walking at a constant speed. If the man reaches the point $Q$ in the minimum time, then $50((PR)^2 + (RQ)^2)$ is equal to_____.

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