

JEE MAIN 2024 · QUESTION PAPER

31 Jan 2024 **Shift 1**

87 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	20 Q1 to Q20	9 Q21 to Q29
● Chemistry	20 Q30 to Q49	8 Q50 to Q57
● Mathematics	20 Q58 to Q77	10 Q78 to Q87
In this PDF	87 questions · answer key at the end	

- 1 Set a 3 hour timer and attempt the paper in one sitting, like the real exam.
- 2 In the 2021 to 2024 papers, Section B asked you to answer any 5 numerical questions per subject. Try each one here.
- 3 Check yourself against the answer key at the end. Every question names its chapter, so you can see where marks went.
- 4 Got one wrong? Tap "Step-by-step solution" at the top right of it for the full working, where available.

Attempt this paper online

The same questions in the same order, with instant answer checking and step-by-step solutions where available.

prepwis.in/pyqs/paper/2024-01-31-morning · Free, no signup needed to start

Answers follow NTA's final answer keys. Typing errors are possible, so check doubtful answers against the official key. Spotted a mistake? prepwis.in/feedback · Terms: prepwis.in/terms

Q1 Atomic Physics

[Step-by-step solution](#) › [prepwisar.in/questions/AFgn2k5fiU](https://www.prepwisar.in/questions/AFgn2k5fiU)

If the wavelength of the first member of Lyman series of hydrogen is λ . The wavelength of the second member will be

- (A) $\frac{27}{5}\lambda$ (B) $\frac{5}{27}\lambda$ (C) $\frac{27}{32}\lambda$ (D) $\frac{32}{27}\lambda$

Q2 Centre of Mass & Linear Momentum

[Step-by-step solution](#) › [prepwisar.in/questions/lv8my1Osc-](https://www.prepwisar.in/questions/lv8my1Osc-)

An artillery piece of mass M_1 fires a shell of mass M_2 horizontally. Instantaneously after the firing, the ratio of kinetic energy of the artillery and that of the shell is:

- (A) $M_1/(M_1 + M_2)$ (B) $\frac{M_2}{M_1}$ (C) $\frac{M_1}{M_2}$ (D) $M_2/(M_1 + M_2)$

Q3 Circular Motion

[Step-by-step solution](#) › [prepwisar.in/questions/uYs3aYiSoy](https://www.prepwisar.in/questions/uYs3aYiSoy)

A coin is placed on a disc. The coefficient of friction between the coin and the disc is μ . If the distance of the coin from the center of the disc is r , the maximum angular velocity which can be given to the disc, so that the coin does not slip away, is:

- (A) $\sqrt{\frac{r}{\mu g}}$ (B) $\sqrt{\frac{\mu g}{r}}$ (C) $\frac{\mu g}{r}$ (D) $\frac{\mu}{\sqrt{r g}}$

Q4 Current Electricity

[Step-by-step solution](#) › [prepwisar.in/questions/01Pf4No0dS](https://www.prepwisar.in/questions/01Pf4No0dS)

Two conductors have the same resistances at 0°C but their temperature coefficients of resistance are α_1 and α_2 . The respective temperature coefficients for their series and parallel combinations are:

- (A) $\alpha_1 + \alpha_2, \frac{\alpha_1 \alpha_2}{\alpha_1 + \alpha_2}$ (B) $\frac{\alpha_1 + \alpha_2}{2}, \frac{\alpha_1 + \alpha_2}{2}$ (C) $\alpha_1 + \alpha_2, \frac{\alpha_1 + \alpha_2}{2}$ (D) $\frac{\alpha_1 + \alpha_2}{2}, \alpha_1 + \alpha_2$

Q5 Dual Nature of Radiation & Matter

[Step-by-step solution](#) › [prepwisar.in/questions/9DruLKND-H](https://www.prepwisar.in/questions/9DruLKND-H)

When a metal surface is illuminated by light of wavelength λ , the stopping potential is $8V$. When the same surface is illuminated by light of wavelength 3λ , stopping potential is $2V$. The threshold wavelength for this surface is:

- (A) 3λ (B) 9λ (C) 5λ (D) 4.5λ

Q6 Electromagnetic Induction

[Step-by-step solution](#) › [prepwisar.in/questions/XPF9BFL2Ia](https://www.prepwisar.in/questions/XPF9BFL2Ia)

A coil is placed perpendicular to a magnetic field of 5000T . When the field is changed to 3000T in 2s , an induced emf of 22V is produced in the coil. If the diameter of the coil is 0.02m , then the number of turns in the coil is:

- (A) 35 (B) 70 (C) 7 (D) 140

Q7 Electromagnetic Waves

[Step-by-step solution](#) › [prepwisar.in/questions/cUllt_2GzM](https://www.prepwisar.in/questions/cUllt_2GzM)

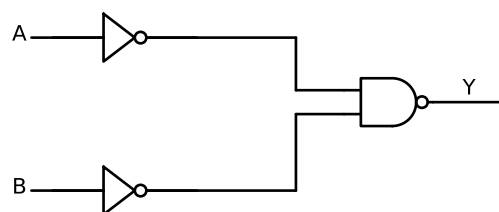
In a plane EM wave, the electric field oscillates sinusoidally at a frequency of $5 \times 10^{10}\text{Hz}$ and an amplitude of 50Vm^{-1} . The total average energy density of the electromagnetic field of the wave is : [Use $\epsilon_0 = 8.85 \times 10^{-12}\text{C}^2/\text{Nm}^2$]

- (A) $4.425 \times 10^{-8}\text{Jm}^{-3}$ (B) $2.212 \times 10^{-10}\text{Jm}^{-3}$ (C) $2.212 \times 10^{-8}\text{Jm}^{-3}$ (D) $1.106 \times 10^{-8}\text{Jm}^{-3}$

Q8 Semiconductors & Electronic Devices[Step-by-step solution > prepwiser.in/questions/gehIumfX_1](https://www.prepwiser.in/questions/gehIumfX_1)

Identify the logic operation performed by the given circuit.

- (A) AND (B) NOR (C) OR (D) NAND

**Q9** Electrostatics I: Charges, Field & Gauss's Law[Step-by-step solution > prepwiser.in/questions/lyhiR2iSZw](https://www.prepwiser.in/questions/lyhiR2iSZw)

Two charges q and $3q$ are separated by a distance ' r ' in air. At a distance x from charge q , the resultant electric field is zero. The value of x is:

- (A) $\frac{r}{3(1 + \sqrt{3})}$ (B) $\frac{(1 + \sqrt{3})}{r}$ (C) $\frac{r}{(1 + \sqrt{3})}$ (D) $r(1 + \sqrt{3})$

Q10 Ray Optics[Step-by-step solution > prepwiser.in/questions/wHu1pK7KtW](https://www.prepwiser.in/questions/wHu1pK7KtW)

The refractive index of a prism with apex angle A is $\cot A/2$. The angle of minimum deviation is:

- (A) $\delta_m = 180^\circ - 3A$ (B) $\delta_m = 180^\circ - 4A$ (C) $\delta_m = 180^\circ - 2A$ (D) $\delta_m = 180^\circ - A$

Q11 Gravitation[Step-by-step solution > prepwiser.in/questions/zP_JWbU03r](https://www.prepwiser.in/questions/zP_JWbU03r)

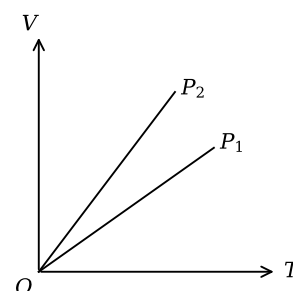
Four identical particles of mass m are kept at the four corners of a square. If the gravitational force exerted on one of the masses by the other masses is $\left(\frac{2\sqrt{2}+1}{32}\right) \frac{Gm^2}{L^2}$, the length of the sides of the square is

- (A) $4L$ (B) $3L$ (C) $2L$ (D) $\frac{L}{2}$

Q12 Thermodynamics[Step-by-step solution > prepwiser.in/questions/OCC6Lq_CXC](https://www.prepwiser.in/questions/OCC6Lq_CXC)

The given figure represents two isobaric processes for the same mass of an ideal gas, then

- (A) $P_2 > P_1$ (B) $P_1 > P_2$ (C) $P_1 = P_2$ (D) $P_2 \geq P_1$

**Q13** Kinetic Theory of Gases[Step-by-step solution > prepwiser.in/questions/9WA-Yeo6ch](https://www.prepwiser.in/questions/9WA-Yeo6ch)

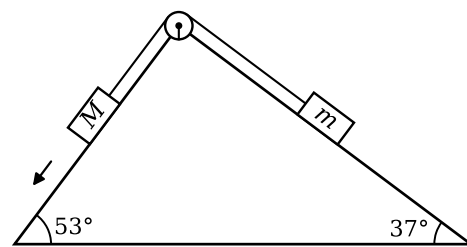
The parameter that remains the same for molecules of all gases at a given temperature is:

- (A) kinetic energy (B) mass (C) momentum (D) speed

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Q14 Newton's Laws of Motion[Step-by-step solution](https://www.prepwisar.in/questions/m0Jv2gDM2_)

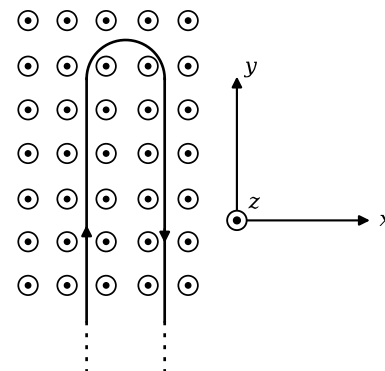
In the given arrangement of a doubly inclined plane two blocks of masses M and m are placed. The blocks are connected by a light string passing over an ideal pulley as shown. The coefficient of friction between the surface of the plane and the blocks is 0.25. The value of m , for which $M = 10\text{kg}$ will move down with an acceleration of 2m/s^2 , is: (take $g = 10\text{m/s}^2$ and $\tan 37^\circ = 3/4$)



- (A) 4.5 kg (B) 6.5 kg (C) 9 kg (D) 2.25 kg

Q15 Moving Charges & Magnetism[Step-by-step solution](https://www.prepwisar.in/questions/Vo_7fxfxrY)

A rigid wire consists of a semicircular portion of radius R and two straight sections. The wire is partially immersed in a perpendicular magnetic field $B = B_0 \hat{k}$ as shown in figure. The magnetic force on the wire if it has a current i is:



- (A) $iBR\hat{j}$ (B) $-2iBR\hat{j}$ (C) $2iBR\hat{j}$ (D) $-iBR\hat{j}$

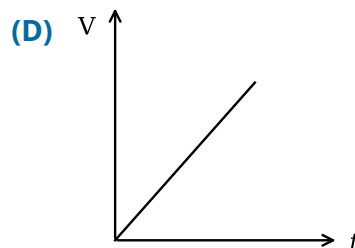
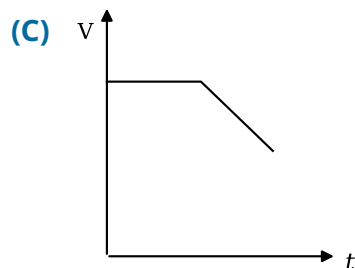
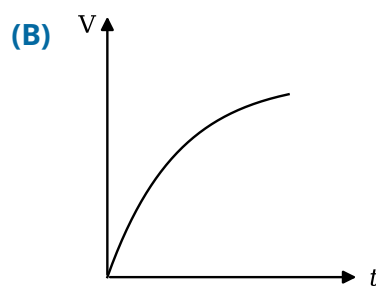
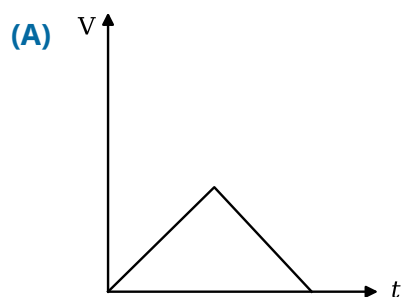
Q16 Rectilinear Motion[Step-by-step solution](https://www.prepwisar.in/questions/jjDVu8AjQU)

The relation between time ' t ' and distance ' x ' is $t = \alpha x^2 + \beta x$, where α and β are constants. The relation between acceleration (a) and velocity (v) is:

- (A) $a = -5\alpha v^5$ (B) $a = -3\alpha v^2$ (C) $a = -2\alpha v^3$ (D) $a = -4\alpha v^4$

Q17 Fluid Mechanics[Step-by-step solution](https://www.prepwisar.in/questions/FNLvNEgjyc)

A small steel ball is dropped into a long cylinder containing glycerine. Which one of the following is the correct representation of the velocity time graph for the transit of the ball?



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Q18 Mechanical Waves[Step-by-step solution](#) > [prepwiser.in/questions/2rXn9z1PYL](https://www.prepwiser.in/questions/2rXn9z1PYL)

The fundamental frequency of a closed organ pipe is equal to the first overtone frequency of an open organ pipe. If length of the open pipe is 60cm, the length of the closed pipe will be:

- (A) 15 cm (B) 60 cm (C) 45 cm (D) 30 cm

Q19 Units, Dimensions & Errors[Step-by-step solution](#) > [prepwiser.in/questions/KAhqQR8hi8](https://www.prepwiser.in/questions/KAhqQR8hi8)

If the percentage errors in measuring the length and the diameter of a wire are 0.1% each. The percentage error in measuring its resistance will be:

- (A) 0.144% (B) 0.2% (C) 0.1% (D) 0.3%

Q20 Units, Dimensions & Errors[Step-by-step solution](#) > [prepwiser.in/questions/nmpgBFz9XI](https://www.prepwiser.in/questions/nmpgBFz9XI)

A force is represented by $F = ax^2 + bt^{\frac{1}{2}}$

where x = distance and t = time. The dimensions of b^2/a are:

- (A) $[ML^2T^{-3}]$ (B) $[ML^3T^{-3}]$ (C) $[MLT^{-2}]$ (D) $[ML^{-1}T^{-1}]$

Physics Section B · Numerical value

Q21 to Q29

Q21 Nuclear Physics **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/btg6xWkZAJ](https://www.prepwiser.in/questions/btg6xWkZAJ)

The mass defect in a particular reaction is 0.4g. The amount of energy liberated is $n \times 10^7 \text{ kWh}$, where $n = \underline{\hspace{2cm}}$. (speed of light = $3 \times 10^8 \text{ m/s}$)

Q22 Electrostatics II: Potential & Capacitance **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/M90yKmeHxO](https://www.prepwiser.in/questions/M90yKmeHxO)

A parallel plate capacitor with plate separation 5mm is charged up by a battery. It is found that on introducing a dielectric sheet of thickness 2mm, while keeping the battery connections intact, the capacitor draws 25% more charge from the battery than before. The dielectric constant of the sheet is $\underline{\hspace{2cm}}$.

Q23 Rotational Motion **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/RzDLkKIG4a](https://www.prepwiser.in/questions/RzDLkKIG4a)

A solid circular disc of mass 50kg rolls along a horizontal floor so that its center of mass has a speed of 0.4m/s. The absolute value of work done on the disc to stop it is $\underline{\hspace{2cm}}$ J.

Q24 Projectile Motion & Relative Motion **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/jIgxPDciBg](https://www.prepwiser.in/questions/jIgxPDciBg)

A body starts falling freely from height H hits an inclined plane in its path at height h . As a result of this perfectly elastic impact, the direction of the velocity of the body becomes horizontal. The value of $\frac{H}{h}$ for which the body will take the maximum time to reach the ground is $\underline{\hspace{2cm}}$.

Q25 Electromagnetic Induction **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/FjSiLAI7NB](https://www.prepwiser.in/questions/FjSiLAI7NB)

A small square loop of wire of side l is placed inside a large square loop of wire of side L ($L = l^2$). The loops are coplanar and their centers coincide. The value of the mutual inductance of the system is $\sqrt{x} \times 10^{-7} \text{ H}$, where $x = \underline{\hspace{2cm}}$.

Q26 Moving Charges & Magnetism **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/hiCNMNwfnC](https://www.prepwiser.in/questions/hiCNMNwfnC)

An electron moves through a uniform magnetic field $\vec{B} = B_0\hat{i} + 2B_0\hat{j}T$. At a particular instant of time, the velocity of electron is $\vec{u} = 3\hat{i} + 5\hat{j} \text{ m/s}$. If the magnetic force acting on electron is $\vec{F} = 5e\hat{k}N$, where e is the charge of electron, then the value of B_0 is $\underline{\hspace{2cm}}$ T.

The depth below the surface of sea to which a rubber ball be taken so as to decrease its volume by 0.02% is _____ m .

(Take density of sea water = 10^3 kg m^{-3} , Bulk modulus of rubber = $9 \times 10^8 \text{ Nm}^{-2}$, and $g = 10 \text{ ms}^{-2}$)

A particle performs simple harmonic motion with amplitude A . Its speed is increased to three times at an instant when its displacement is $\frac{2A}{3}$. The new amplitude of motion is $\frac{nA}{3}$. The value of n is _____.

Two waves of intensity ratio 1 : 9 cross each other at a point. The resultant intensities at that point, when (a) Waves are incoherent is I_1 (b) Waves are coherent is I_2 and differ in phase by 60° . If $\frac{I_1}{I_2} = \frac{10}{x}$ then $x =$ _____.

Chemistry Section A · Multiple choice

Q30 to Q49

Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R:

Assertion A: Alcohols react both as nucleophiles and electrophiles.

Reason R: Alcohols react with active metals such as sodium, potassium and aluminum to yield corresponding alkoxides and liberate hydrogen.

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

- (A) A is false but R is true.
- (B) Both A and R are true but R is NOT the correct explanation of A .
- (C) Both A and R are true and R is the correct explanation of A .
- (D) A is true but R is false.

Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R:

Assertion A: $\text{p}K_a$ value of phenol is 10.0 while that of ethanol is 15.9.

Reason R: Ethanol is stronger acid than phenol.

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

- (A) A is false but R is true.
- (B) Both A and R are true but R is NOT the correct explanation of A .
- (C) Both A and R are true and R is the correct explanation of A .
- (D) A is true but R is false.

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Match List I with List II

	List - I		List - II
(A)	Glucose/ NaHCO_3/Δ	(I)	Gluconic acid
(B)	Glucose / HNO_3	(II)	No reaction
(C)	Glucose / HI/Δ	(III)	n-hexane
(D)	Glucose/Bromine water	(IV)	Saccharic acid

Choose the correct answer from the options given below:

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

The linear combination of atomic orbitals to form molecular orbitals takes place only when the combining atomic orbitals

- A. have the same energy
 B. have the minimum overlap
 C. have same symmetry about the molecular axis
 D. have different symmetry about the molecular axis

Choose the most appropriate from the options given below:

- (A) B, C, D only (B) A, B, C only (C) B and D only (D) A and C only

Integrated rate law equation for a first order gas phase reaction is given by (where P_i is initial pressure and P_t is total pressure at time t)

- (A) $k = \frac{2.303}{t} \times \log \frac{P_i}{(2P_i - P_t)}$ (B) $k = \frac{2.303}{t} \times \log \frac{(2P_i - P_t)}{P_i}$
 (C) $k = \frac{2.303}{t} \times \log \frac{P_i}{(2P_i - P_t)}$ (D) $k = \frac{2.303}{t} \times \log \frac{2P_i}{(2P_i - P_t)}$

The correct statements from following are:

- A. The strength of anionic ligands can be explained by crystal field theory.
 B. Valence bond theory does not give a quantitative interpretation of kinetic stability of coordination compounds.
 C. The hybridization involved in formation of $[\text{Ni}(\text{CN})_4]^{2-}$ complex is dsp^2 .
 D. The number of possible isomer(s) of $\text{cis-}[\text{PtCl}_2(\text{en})_2]^{2+}$ is one

Choose the correct answer from the options given below:

- (A) B, C only (B) B, D only (C) A, C only (D) A, D only

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Identify correct statements from below:

- A. The chromate ion is square planar.
- B. Dichromates are generally prepared from chromates.
- C. The green manganate ion is diamagnetic.
- D. Dark green coloured K_2MnO_4 disproportionates in a neutral or acidic medium to give permanganate.
- E. With increasing oxidation number of transition metal, ionic character of the oxides decreases.

Choose the correct answer from the options given below:

- (A) B, D, E only (B) A, B, C only (C) A, D, E only (D) B, C, D only

The metals that are employed in the battery industries are

- A. Fe
- B. Mn
- C. Ni
- D. Cr
- E. Cd

Choose the correct answer from the options given below:

- (A) A, B, C, D and E (B) A, B, C and D only (C) B, D and E only (D) B, C and E only

Identify the factor from the following that does not affect electrolytic conductance of a solution.

- (A) The nature of solvent used. (B) The nature of the electrolyte added.
(C) The nature of the electrode used. (D) Concentration of the electrolyte.

The product (C) in the below mentioned reaction is:



- (A) Propan-1-ol (B) Propyne (C) Propan-2-ol (D) Propene

Consider the oxides of group 14 elements SiO_2 , GeO_2 , SnO_2 , PbO_2 , CO and GeO. The amphoteric oxides are

- (A) SnO_2 , CO (B) SiO_2 , GeO_2 (C) SnO_2 , PbO_2 (D) GeO, GeO_2

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Give below are two statements:

Statement - I: Noble gases have very high boiling points.

Statement - II: Noble gases are monoatomic gases. They are held together by strong dispersion forces. Because of this they are liquefied at very low temperature. Hence, they have very high boiling points.

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

- (A) Both Statement I and Statement II are false. (B) Statement I is true but Statement II is false.
(C) Statement I is false but Statement II is true. (D) Both Statement I and Statement II are true.

The correct sequence of electron gain enthalpy of the elements listed below is

- A. Ar
B. Br
C. F
D. S

Choose the **most appropriate** from the options given below:

- (A) $A > D > C > B$ (B) $A > D > B > C$ (C) $D > C > B > A$ (D) $C > B > D > A$

Identify the mixture that shows positive deviations from Raoult's Law

- (A) $(\text{CH}_3)_2\text{CO} + \text{CS}_2$ (B) $(\text{CH}_3)_2\text{CO} + \text{C}_6\text{H}_5\text{NH}_2$
(C) $\text{CHCl}_3 + \text{C}_6\text{H}_6$ (D) $\text{CHCl}_3 + (\text{CH}_3)_2\text{CO}$

'Adsorption' principle is used for which of the following purification method?

- (A) Chromatography (B) Sublimation (C) Distillation (D) Extraction

A species having carbon with sextet of electrons and can act as electrophile is called

- (A) pentavalent carbon (B) carbon free radical (C) carbanion (D) carbocation

Given below are two statements:

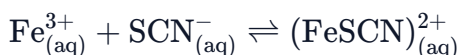
Statement I: IUPAC name of $\text{HO} - \text{CH}_2 - (\text{CH}_2)_3 - \text{CH}_2 - \text{COCH}_3$ is 7-hydroxyheptan-2-one.

Statement II: 2-oxoheptan-7-ol is the correct IUPAC name for above compound. In the light of the above statements, choose the most appropriate answer from the options given below:

- (A) Statement I is incorrect but Statement II is correct.
(B) Statement I is correct but Statement II is incorrect.
(C) Both Statement I and Statement II are correct.
(D) Both Statement I and Statement II are incorrect.

Q47 Chemical Equilibrium[Step-by-step solution](https://www.prepwiser.in/questions/FpGcYZV_T5) > prepwiser.in/questions/FpGcYZV_T5

For the given reaction, choose the correct expression of K_C from the following :-



- (A) $K_C = \frac{[\text{Fe}^{3+}][\text{SCN}^{-}]}{[\text{FeSCN}^{2+}]}$ (B) $K_C = \frac{[\text{FeSCN}^{2+}]}{[\text{Fe}^{3+}][\text{SCN}^{-}]}$ (C) $K_C = \frac{[\text{FeSCN}^{2+}]^2}{[\text{Fe}^{3+}][\text{SCN}^{-}]}$ (D) $K_C = \frac{[\text{FeSCN}^{2+}]}{[\text{Fe}^{3+}]^2[\text{SCN}^{-}]^2}$

Q48 Purification & Characterisation of Organic Compounds[Step-by-step solution](https://www.prepwiser.in/questions/EUjgLimt_Y) > prepwiser.in/questions/EUjgLimt_Y

Match List I with List II

	List - I (Technique)		List - II (Application)
(A)	Distillation	(I)	Separation of glycerol from spent-lye
(B)	Fractional distillation	(II)	Aniline - Water mixture
(C)	Steam distillation	(III)	Separation of crude oil fractions
(D)	Distillation under reduced pressure	(IV)	Chloroform - Aniline

Choose the correct answer from the options given below:

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

Q49 Qualitative Analysis: Salt Analysis[Step-by-step solution](https://www.prepwiser.in/questions/34bm8ejpfr) > prepwiser.in/questions/34bm8ejpfr

The compound that is white in color is

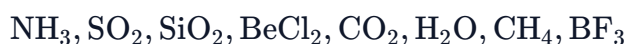
- (A) ammonium sulphide (B) ammonium arsinomolybdate
(C) lead iodide (D) lead sulphate

Chemistry Section B · Numerical value

Q50 to Q57

Q50 Chemical Bonding & Molecular Structure **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/ZIXB-KIOFM) > prepwiser.in/questions/ZIXB-KIOFM

The number of species from the following in which the central atom uses sp^3 hybrid orbitals in its bonding is _____.

**Q51** Coordination Compounds **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/p1FvRdI_Aa) > prepwiser.in/questions/p1FvRdI_Aa

The 'Spin only' Magnetic moment for $[\text{Ni}(\text{NH}_3)_6]^{2+}$ is _____ $\times 10^{-1}$ BM. (given = Atomic number of Ni : 28)

Q52 Electrochemistry **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/CcyEd9y6dU) > prepwiser.in/questions/CcyEd9y6dU

Number of alkanes obtained on electrolysis of a mixture of CH_3COONa and $\text{C}_2\text{H}_5\text{COONa}$ is _____.

Q53 Electrochemistry **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/SEe2Zk997X) > prepwiser.in/questions/SEe2Zk997X

One Faraday of electricity liberates $x \times 10^{-1}$ gram atom of copper from copper sulphate. x is _____.

Q54 Mole Concept & Stoichiometry **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/3AcI7RsOH3) > prepwiser.in/questions/3AcI7RsOH3

Number of moles of methane required to produce $22\text{gCO}_{2(\text{g})}$ after combustion is $x \times 10^{-2}$ moles. The value of x is _____.

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Q55 Qualitative Analysis: Salt Analysis **NUMERICAL**

[Step-by-step solution](#) > [prepwiser.in/questions/P-8hvTfeuE](https://www.prepwiser.in/questions/P-8hvTfeuE)

Molar mass of the salt from NaBr, NaNO₃, KI and CaF₂ which does not evolve coloured vapours on heating with concentrated H₂SO₄ is _____ gmol⁻¹.

(Molar mass in

gmol⁻¹ : Na : 23, N : 14, K : 39, O : 16, Br : 80, I : 127, F : 19, Ca : 40)

Q56 Atomic Structure **NUMERICAL**

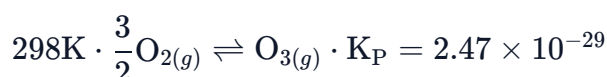
[Step-by-step solution](#) > [prepwiser.in/questions/9ckCZ4wdII](https://www.prepwiser.in/questions/9ckCZ4wdII)

The ionization energy of sodium in kJmol⁻¹, if electromagnetic radiation of wavelength 242nm is just sufficient to ionize sodium atom is _____.

Q57 Chemical Equilibrium **NUMERICAL**

[Step-by-step solution](#) > [prepwiser.in/questions/HykGxUzQBR](https://www.prepwiser.in/questions/HykGxUzQBR)

Consider the following reaction at



. $\Delta_r G^\ominus$ for the reaction is _____ kJ. (Given R = 8.314 JK⁻¹mol⁻¹)

Mathematics Section A · Multiple choice

Q58 to Q77

Q58 Determinants

[Step-by-step solution](#) > [prepwiser.in/questions/sJrli8Ttc8](https://www.prepwiser.in/questions/sJrli8Ttc8)

If $f(x) = \begin{vmatrix} x^3 & 2x^2 + 1 & 1 + 3x \\ 3x^2 + 2 & 2x & x^3 + 6 \\ x^3 - x & 4 & x^2 - 2 \end{vmatrix}$ for all $x \in \mathbb{R}$, then $2f(0) + f'(0)$ is equal to

(A) 24

(B) 18

(C) 42

(D) 48

Q59 Quadratic Equations & Polynomial Inequalities

[Step-by-step solution](#) > [prepwiser.in/questions/w1sterCUEB](https://www.prepwiser.in/questions/w1sterCUEB)

Let a be the sum of all coefficients in the expansion of $(1 - 2x + 2x^2)^{2023} (3 - 4x^2 + 2x^3)^{2024}$ and

$$b = \lim_{x \rightarrow 0} \left(\frac{\int_0^x \frac{\log(1+t)}{t^{2024}+1} dt}{x^2} \right)$$

. If the equation $cx^2 + dx + e = 0$ and $2bx^2 + ax + 4 = 0$ have a common root, where $c, d, e \in \mathbb{R}$, then $d : c : e$ equals

(A) 2 : 1 : 4

(B) 1 : 1 : 4

(C) 1 : 2 : 4

(D) 4 : 1 : 4

Q60 Circles

[Step-by-step solution](#) > [prepwiser.in/questions/kQsvTY37nn](https://www.prepwiser.in/questions/kQsvTY37nn)

If one of the diameters of the circle $x^2 + y^2 - 10x + 4y + 13 = 0$ is a chord of another circle C, whose center is the point of intersection of the lines $2x + 3y = 12$ and $3x - 2y = 5$, then the radius of the circle C is:

(A) 4

(B) $3\sqrt{2}$

(C) 6

(D) $\sqrt{20}$

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Q61 Differential Equations[Step-by-step solution > prepwisar.in/questions/pD7zN5dcXv](https://www.prepwisar.in/questions/pD7zN5dcXv)

Let $y = y(x)$ be the solution of the differential equation

$$\frac{dy}{dx} = \frac{(\tan x) + y}{\sin x (\sec x - \sin x \tan x)}, x \in \left(0, \frac{\pi}{2}\right)$$

satisfying the condition $y\left(\frac{\pi}{4}\right) = 2$. Then, $y\left(\frac{\pi}{3}\right)$ is

- (A) $\sqrt{3}(2 + \log_e 3)$ (B) $\sqrt{3}(1 + 2 \log_e 3)$ (C) $\sqrt{3}(2 + \log_e \sqrt{3})$ (D) $\frac{\sqrt{3}}{2}(2 + \log_e 3)$

Q62 Differential Equations[Step-by-step solution > prepwisar.in/questions/nojWuoACDS](https://www.prepwisar.in/questions/nojWuoACDS)

The solution curve of the differential equation $y \frac{dx}{dy} = x (\log_e x - \log_e y + 1)$, $x > 0, y > 0$ passing through the point $(e, 1)$ is

- (A) $\left| \log_e \frac{y}{x} \right| = y^2$ (B) $\left| \log_e \frac{y}{x} \right| = x$ (C) $\left| \log_e \frac{x}{y} \right| = y$ (D) $2 \left| \log_e \frac{x}{y} \right| = y + 1$

Q63 Relations & Functions (Basic)[Step-by-step solution > prepwisar.in/questions/dtFZe4n5JA](https://www.prepwisar.in/questions/dtFZe4n5JA)

If $f(x) = \frac{4x+3}{6x-4}$, $x \neq \frac{2}{3}$ and $(f \circ f)(x) = g(x)$, where

$$g : \mathbb{R} - \left\{ \frac{2}{3} \right\} \rightarrow \mathbb{R} - \left\{ \frac{2}{3} \right\}$$

, then $(g \circ g)(4)$ is equal to

- (A) -4 (B) $\frac{19}{20}$ (C) $-\frac{19}{20}$ (D) 4

Q64 Hyperbola[Step-by-step solution > prepwisar.in/questions/eLX909LQfD](https://www.prepwisar.in/questions/eLX909LQfD)

If the foci of a hyperbola are same as that of the ellipse $\frac{x^2}{9} + \frac{y^2}{25} = 1$ and the eccentricity of the hyperbola is $\frac{15}{8}$ times the eccentricity of the ellipse, then the smaller focal distance of the point $\left(\sqrt{2}, \frac{14}{3}\sqrt{\frac{2}{5}}\right)$ on the hyperbola, is equal to

- (A) $14\sqrt{\frac{2}{5}} - \frac{4}{3}$ (B) $7\sqrt{\frac{2}{5}} + \frac{8}{3}$ (C) $7\sqrt{\frac{2}{5}} - \frac{8}{3}$ (D) $14\sqrt{\frac{2}{5}} - \frac{16}{3}$

Q65 Inverse Trigonometric Functions[Step-by-step solution > prepwisar.in/questions/AZ3x_ihMmO](https://www.prepwisar.in/questions/AZ3x_ihMmO)

For $\alpha, \beta, \gamma \neq 0$, if $\sin^{-1} \alpha + \sin^{-1} \beta + \sin^{-1} \gamma = \pi$ and $(\alpha + \beta + \gamma)(\alpha - \gamma + \beta) = 3\alpha\beta$, then γ equals

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

Q66 Limits[Step-by-step solution > prepwisar.in/questions/Zzni-bPkd9](https://www.prepwisar.in/questions/Zzni-bPkd9)

$$\lim_{x \rightarrow 0} \frac{e^{2|\sin x|} - 2|\sin x| - 1}{x^2}$$

- (A) is equal to 1 (B) does not exist (C) is equal to -1 (D) is equal to 2

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Let $g(x)$ be a linear function and

$$f(x) = \begin{cases} g(x) & , x \leq 0 \\ \left(\frac{1+x}{2+x}\right)^{\frac{1}{x}} & , x > 0 \end{cases}$$

, is continuous at $x = 0$. If $f'(1) = f(-1)$, then the value $g(3)$ is

- (A) $\log_e \left(\frac{4}{9}\right) - 1$ (B) $\frac{1}{3} \log_e \left(\frac{4}{9e^{1/3}}\right)$ (C) $\log_e \left(\frac{4}{9e^{1/3}}\right)$ (D) $\frac{1}{3} \log_e \left(\frac{4}{9}\right) + 1$

If the system of linear equations

$$x - 2y + z = -4$$

$$2x + \alpha y + 3z = 5$$

$$3x - y + \beta z = 3$$

has infinitely many solutions, then $12\alpha + 13\beta$ is equal to

- (A) 60 (B) 54 (C) 64 (D) 58

Three rotten apples are accidentally mixed with fifteen good apples. Assuming the random variable x to be the number of rotten apples in a draw of two apples, the variance of x is

- (A) $\frac{57}{153}$ (B) $\frac{40}{153}$ (C) $\frac{37}{153}$ (D) $\frac{47}{153}$

Two marbles are drawn in succession from a box containing 10 red, 30 white, 20 blue and 15 orange marbles, with replacement being made after each drawing. Then the probability, that first drawn marble is red and second drawn marble is white, is

- (A) $\frac{4}{25}$ (B) $\frac{2}{3}$ (C) $\frac{2}{25}$ (D) $\frac{4}{75}$

Let S be the set of positive integral values of a for which $\frac{ax^2+2(a+1)x+9a+4}{x^2-8x+32} < 0, \forall x \in \mathbb{R}$. Then, the number of elements in S is:

- (A) 0 (B) ∞ (C) 3 (D) 1

For $0 < c < b < a$, let $(a+b-2c)x^2 + (b+c-2a)x + (c+a-2b) = 0$ and $\alpha \neq 1$ be one of its root. Then, among the two statements

(I) If $\alpha \in (-1, 0)$, then b cannot be the geometric mean of a and c

(II) If $\alpha \in (0, 1)$, then b may be the geometric mean of a and c

- (A) only (II) is true (B) Both (I) and (II) are true
(C) only (I) is true (D) Neither (I) nor (II) is true

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The sum of the series

$$\frac{1}{1 - 3 \cdot 1^2 + 1^4} + \frac{2}{1 - 3 \cdot 2^2 + 2^4} + \frac{3}{1 - 3 \cdot 3^2 + 3^4} + \dots$$

up to 10 -terms is

- (A) $\frac{45}{109}$ (B) $-\frac{55}{109}$ (C) $\frac{55}{109}$ (D) $-\frac{45}{109}$

Q74 Vectors

Step-by-step solution › prepwiser.in/questions/FWh7OH9Vd6

Let $\vec{a} = 3\hat{i} + \hat{j} - 2\hat{k}$, $\vec{b} = 4\hat{i} + \hat{j} + 7\hat{k}$ and $\vec{c} = \hat{i} - 3\hat{j} + 4\hat{k}$ be three vectors. If a vectors $\vec{p}$ satisfies $\vec{p} \times \vec{b} = \vec{c} \times \vec{b}$ and $\vec{p} \cdot \vec{a} = 0$, then $\vec{p} \cdot (\hat{i} - \hat{j} - \hat{k})$ is equal to

- (A) 24 (B) 32 (C) 36 (D) 28

Q75 Three Dimensional Geometry

Step-by-step solution › prepwiser.in/questions/xJlGMECcov

The distance of the point $Q(0, 2, -2)$ form the line passing through the point $P(5, -4, 3)$ and perpendicular to the lines

$$\vec{r} = (-3\hat{i} + 2\hat{k}) + \lambda(2\hat{i} + 3\hat{j} + 5\hat{k}), \lambda \in \mathbb{R}$$

and

$$\vec{r} = (\hat{i} - 2\hat{j} + \hat{k}) + \mu(-\hat{i} + 3\hat{j} + 2\hat{k}), \mu \in \mathbb{R}$$

is:

- (A) $\sqrt{74}$ (B) $\sqrt{86}$ (C) $\sqrt{54}$ (D) $\sqrt{20}$

Q76 Area Under Curves

Step-by-step solution › prepwiser.in/questions/WOHuJgoKYV

The area of the region $\left\{ (x, y) : y^2 \leq 4x, x < 4, \frac{xy(x-1)(x-2)}{(x-3)(x-4)} > 0, x \neq 3 \right\}$ is

- (A) $\frac{32}{3}$ (B) $\frac{16}{3}$ (C) $\frac{8}{3}$ (D) $\frac{64}{3}$

Q77 Straight Lines

Step-by-step solution › prepwiser.in/questions/qrvVfhw2L-

Let $\alpha, \beta, \gamma, \delta \in \mathbb{Z}$ and let $A(\alpha, \beta)$, $B(1, 0)$, $C(\gamma, \delta)$ and $D(1, 2)$ be the vertices of a parallelogram ABCD. If $AB = \sqrt{10}$ and the points A and C lie on the line $3y = 2x + 1$, then $2(\alpha + \beta + \gamma + \delta)$ is equal to

- (A) 8 (B) 5 (C) 12 (D) 10

Mathematics Section B · Numerical value

Q78 to Q87

Q78 Three Dimensional Geometry NUMERICAL

Step-by-step solution › prepwiser.in/questions/-uocgCW1zm

Let Q and R be the feet of perpendiculars from the point $P(a, a, a)$ on the lines $x = y, z = 1$ and $x = -y, z = -1$ respectively. If $\angle QPR$ is a right angle, then $12a^2$ is equal to _____.

Q79 Binomial Theorem NUMERICAL

Step-by-step solution › prepwiser.in/questions/ZbZSXCfFLT

In the expansion of

$$(1+x)(1-x^2) \left(1 + \frac{3}{x} + \frac{3}{x^2} + \frac{1}{x^3} \right)^5, x \neq 0$$

, the sum of the coefficients of x^3 and x^{-13} is equal to _____.

Q80 Complex Numbers **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/EVrMQ_qsu0

If α denotes the number of solutions of $|1 - i|^x = 2^x$ and $\beta = \left(\frac{|z|}{\arg(z)}\right)$, where

$$z = \frac{\pi}{4}(1 + i)^4 \left[\frac{1 - \sqrt{\pi}i}{\sqrt{\pi} + i} + \frac{\sqrt{\pi} - i}{1 + \sqrt{\pi}i} \right], i = \sqrt{-1}$$

, then the distance of the point (α, β) from the line $4x - 3y = 7$ is _____.

Q81 Definite Integration **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/p_1Fi4dumg

If the integral

$$525 \int_0^{\frac{\pi}{2}} \sin 2x \cos^{\frac{11}{2}} x \left(1 + \cos^{\frac{5}{2}} x\right)^{\frac{1}{2}} dx$$

is equal to $(n\sqrt{2} - 64)$, then n is equal to _____.

Q82 Applications of Derivatives **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/mP9TzvO7DZ

Let $S = (-1, \infty)$ and $f : S \rightarrow \mathbb{R}$ be defined as

$$f(x) = \int_{-1}^x (e^t - 1)^{11} (2t - 1)^5 (t - 2)^7 (t - 3)^{12} (2t - 10)^{61} dt,$$

Let p = Sum of squares of the values of x , where $f(x)$ attains local maxima on S , and q = Sum of the values of x , where $f(x)$ attains local minima on S . Then, the value of $p^2 + 2q$ is _____.

Q83 Definite Integration **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/XDTTYqs3ZA

Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a function defined by $f(x) = \frac{4^x}{4^x + 2}$ and

$$M = \int_{f(a)}^{f(1-a)} x \sin^4(x(1-x)) dx, N = \int_{f(a)}^{f(1-a)} \sin^4(x(1-x)) dx; a \neq \frac{1}{2}$$

. If $\alpha M = \beta N$, $\alpha, \beta \in \mathbb{N}$, then the least value of $\alpha^2 + \beta^2$ is equal to _____.

Q84 Hyperbola **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/G7_LO6xfU9

Let the foci and length of the latus rectum of an ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, $a > b$ be $(\pm 5, 0)$ and $\sqrt{50}$, respectively. Then, the square of the eccentricity of the hyperbola $\frac{x^2}{b^2} - \frac{y^2}{a^2} = 1$ equals

Q85 Permutations & Combinations **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/Rd8m0bbVIL

The total number of words (with or without meaning) that can be formed out of the letters of the word 'DISTRIBUTION' taken four at a time, is equal to _____.

Q86 Relations & Functions (Basic) **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/hwhb3DFNqF

Let $A = \{1, 2, 3, 4\}$ and $R = \{(1, 2), (2, 3), (1, 4)\}$ be a relation on A . Let S be the equivalence relation on A such that $R \subset S$ and the number of elements in S is n . Then, the minimum value of n is _____.

Q87 Vectors **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/yIShmepwq_

Let $\vec{a}$ and $\vec{b}$ be two vectors such that $|\vec{a}| = 1$, $|\vec{b}| = 4$, and $\vec{a} \cdot \vec{b} = 2$. If $\vec{c} = (2\vec{a} \times \vec{b}) - 3\vec{b}$ and the angle between $\vec{b}$ and $\vec{c}$ is α , then $192 \sin^2 \alpha$ is equal to _____.

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Physics

1. C	2. B	3. B	4. B	5. B	6. B	7. D	8. C
9. C	10. C	11. A	12. B	13. A	14. A	15. B	16. C
17. B	18. A	19. D	20. B	21. 1	22. 2	23. 6	24. 2
25. 128	26. 5	27. 18	28. 7	29. 13			

Chemistry

30. B	31. D	32. A	33. D	34. A	35. A	36. A	37. D
38. C	39. C	40. C	41. A	42. B	43. A	44. A	45. D
46. B	47. B	48. D	49. D	50. 4	51. 28	52. 3	53. 5
54. 50	55. 78	56. 494	57. 163				

Mathematics

58. C	59. B	60. C	61. C	62. C	63. D	64. C	65. B
66. D	67. C	68. D	69. B	70. D	71. A	72. B	73. B
74. B	75. A	76. A	77. A	78. 12	79. 118	80. 3	81. 176
82. 27	83. 5	84. 51	85. 3734	86. 16	87. 48		

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