

JEE MAIN 2024 · QUESTION PAPER

1 Feb 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	18 Q30 to Q47	10 Q48 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/2024-02-01-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 Electromagnetic Waves

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

A parallel plate capacitor has a capacitance $C = 200\mu\text{F}$. It is connected to 230V ac supply with an angular frequency 300rad/s . The rms value of conduction current in the circuit and displacement current in the capacitor respectively are:

- (A) $14.3\mu\text{A}$ and $143\mu\text{A}$ (B) $13.8\mu\text{A}$ and $13.8\mu\text{A}$
(C) $13.8\mu\text{A}$ and $138\mu\text{A}$ (D) $1.38\mu\text{A}$ and $1.38\mu\text{A}$

Q2 Alternating Current

[Step-by-step solution](#) › [prepwisar.in/questions/bTU7DrnLPB](https://www.prepwisar.in/questions/bTU7DrnLPB)

In series LCR circuit, the capacitance is changed from C to $4C$. To keep the resonance frequency unchanged, the new inductance should be:

- (A) increased by $2L$ (B) reduced by $\frac{1}{4}L$ (C) reduced by $\frac{3}{4}L$ (D) increased to $4L$

Q3 Atomic Physics

[Step-by-step solution](#) › [prepwisar.in/questions/lyScqKO2bo](https://www.prepwisar.in/questions/lyScqKO2bo)

The minimum energy required by a hydrogen atom in ground state to emit radiation in Balmer series is nearly:

- (A) 13.6eV (B) 1.5eV (C) 12.1eV (D) 1.9eV

Q4 Electrostatics II: Potential & Capacitance

[Step-by-step solution](#) › [prepwisar.in/questions/TCStjvPO2F](https://www.prepwisar.in/questions/TCStjvPO2F)

Two identical capacitors have same capacitance C . One of them is charged to the potential V and other to the potential $2V$. The negative ends of both are connected together. When the positive ends are also joined together, the decrease in energy of the combined system is:

- (A) $\frac{1}{4}CV^2$ (B) $\frac{3}{4}CV^2$ (C) $\frac{1}{2}CV^2$ (D) $2CV^2$

Q5 Circular Motion

[Step-by-step solution](#) › [prepwisar.in/questions/F4836-QOyG](https://www.prepwisar.in/questions/F4836-QOyG)

A ball of mass 0.5kg is attached to a string of length 50cm . The ball is rotated on a horizontal circular path about its vertical axis. The maximum tension that the string can bear is 400N . The maximum possible value of angular velocity of the ball in rad/s is:

- (A) 1600 (B) 20 (C) 40 (D) 1000

Q6 Projectile Motion & Relative Motion

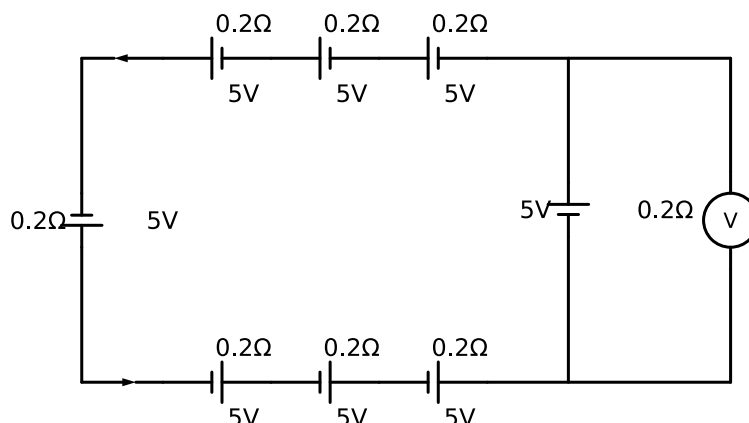
[Step-by-step solution](#) › [prepwisar.in/questions/WLRLo4K8lg](https://www.prepwisar.in/questions/WLRLo4K8lg)

A particle moving in a circle of radius R with uniform speed takes time T to complete one revolution. If this particle is projected with the same speed at an angle θ to the horizontal, the maximum height attained by it is equal to $4R$. The angle of projection θ is then given by:

- (A) $\sin^{-1} \left[\frac{2gT^2}{\pi^2 R} \right]^{\frac{1}{2}}$ (B) $\sin^{-1} \left[\frac{\pi^2 R}{2gT^2} \right]^{\frac{1}{2}}$ (C) $\cos^{-1} \left[\frac{\pi R}{2gT^2} \right]^{\frac{1}{2}}$ (D) $\cos^{-1} \left[\frac{2gT^2}{\pi^2 R} \right]^{\frac{1}{2}}$

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The reading in the ideal voltmeter (V) shown in the given circuit diagram is:



- (A) 3V (B) 10V (C) 5V (D) 0V

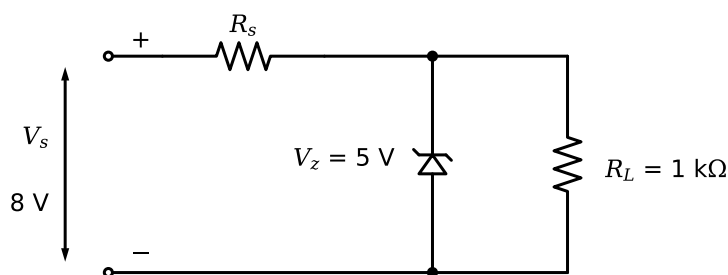
A galvanometer has a resistance of 50Ω and it allows maximum current of 5mA . It can be converted into voltmeter to measure upto 100V by connecting in series a resistor of resistance:

- (A) 19500Ω (B) 5975Ω (C) 20050Ω (D) 19950Ω

The de Broglie wavelengths of a proton and an α particle are λ and 2λ respectively. The ratio of the velocities of proton and α particle will be:

- (A) 8 : 1 (B) 1 : 2 (C) 1 : 8 (D) 4 : 1

In the given circuit if the power rating of Zener diode is 10mW , the value of series resistance R_s to regulate the input unregulated supply is:



- (A) $10\text{k}\Omega$ (B) 10Ω (C) $1\text{k}\Omega$ (D) $\frac{3}{7}\text{k}\Omega < R_s < \frac{3}{5}\text{k}\Omega$

If R is the radius of the earth and the acceleration due to gravity on the surface of earth is $g = \pi^2\text{m/s}^2$, then the length of the second's pendulum at a height $h = 2R$ from the surface of earth will be,:

- (A) $\frac{1}{9}\text{m}$ (B) $\frac{8}{9}\text{m}$ (C) $\frac{2}{9}\text{m}$ (D) $\frac{4}{9}\text{m}$

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Q12 Kinetic Theory of Gases[Step-by-step solution](#) > [prepwisar.in/questions/28hqaS2whC](https://www.prepwisar.in/questions/28hqaS2whC)

Two moles a monoatomic gas is mixed with six moles of a diatomic gas. The molar specific heat of the mixture at constant volume is:

- (A) $\frac{3}{2}R$ (B) $\frac{7}{4}R$ (C) $\frac{5}{2}R$ (D) $\frac{9}{4}R$

Q13 Thermodynamics[Step-by-step solution](#) > [prepwisar.in/questions/mjkj5v2YCU](https://www.prepwisar.in/questions/mjkj5v2YCU)

The pressure and volume of an ideal gas are related as $PV^{\frac{3}{2}} = K$ (Constant). The work done when the gas is taken from state $A (P_1, V_1, T_1)$ to state $B (P_2, V_2, T_2)$ is:

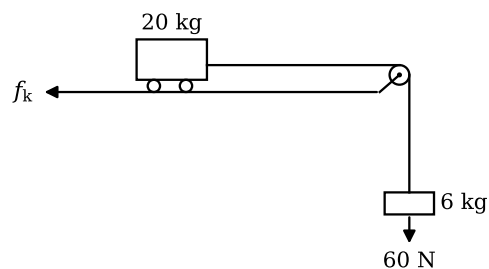
- (A) $2 (P_2 \sqrt{V_2} - P_1 \sqrt{V_1})$ (B) $2 (\sqrt{P_1} V_1 - \sqrt{P_2} V_2)$
(C) $2 (P_2 V_2 - P_1 V_1)$ (D) $2 (P_1 V_1 - P_2 V_2)$

Q14 Newton's Laws of Motion[Step-by-step solution](#) > [prepwisar.in/questions/k8QYHeLI28](https://www.prepwisar.in/questions/k8QYHeLI28)

Consider a block and trolley system as shown in figure. If the coefficient of kinetic friction between the trolley and the surface is 0.04, the acceleration of the system in ms^{-2} is:

(Consider that the string is massless and unstretchable and the pulley is also massless and frictionless):

- (A) 1.2 (B) 4 (C) 3 (D) 2

**Q15** Elasticity[Step-by-step solution](#) > [prepwisar.in/questions/R7HrcZNEND](https://www.prepwisar.in/questions/R7HrcZNEND)

With rise in temperature, the Young's modulus of elasticity:

- (A) changes erratically (B) increases
(C) decreases (D) remains unchanged

Q16 Collision[Step-by-step solution](#) > [prepwisar.in/questions/eqytjmbWMW](https://www.prepwisar.in/questions/eqytjmbWMW)

A simple pendulum of length 1m has a wooden bob of mass 1kg. It is struck by a bullet of mass 10^{-2}kg moving with a speed of $2 \times 10^2 \text{ms}^{-1}$. The bullet gets embedded into the bob. The height to which the bob rises before swinging back is. (use $g = 10\text{m/s}^2$)

- (A) 0.20m (B) 0.40m (C) 0.30m (D) 0.35m

Q17 Wave Optics[Step-by-step solution](#) > [prepwisar.in/questions/DPgpFkfA4S](https://www.prepwisar.in/questions/DPgpFkfA4S)

A monochromatic light of wavelength $6000\text{\AA}$ is incident on the single slit of width 0.01mm. If the diffraction pattern is formed at the focus of the convex lens of focal length 20cm, the linear width of the central maximum is:

- (A) 12mm (B) 24mm (C) 60mm (D) 120mm

Q18 Experimental Skills[Step-by-step solution](#) > [prepwisar.in/questions/K3yeDD6nE7](https://www.prepwisar.in/questions/K3yeDD6nE7)

10 divisions on the main scale of a Vernier calliper coincide with 11 divisions on the Vernier scale. If each division on the main scale is of 5 units, the least count of the instrument is:

- (A) $\frac{5}{11}$ (B) $\frac{10}{11}$ (C) $\frac{50}{11}$ (D) $\frac{1}{2}$

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The dimensional formula of angular impulse is:

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

The radius (r), length (l) and resistance (R) of a metal wire was measured in the laboratory as

$$r = (0.35 \pm 0.05)\text{cm}$$

$$R = (100 \pm 10)\text{ohm}$$

$$l = (15 \pm 0.2)\text{cm}$$

The percentage error in resistivity of the material of the wire is:

- (A) 37.3% (B) 25.6% (C) 35.6% (D) 39.9%

Physics Section B · Numerical value

Q21 to Q29

The radius of a nucleus of mass number 64 is 4.8 fermi. Then the mass number of another nucleus having radius of 4 fermi is $\frac{1000}{x}$, where x is _____.

Three identical spheres each of mass $2M$ are placed at the corners of a right angled triangle with mutually perpendicular sides equal to $4m$ each. Taking point of intersection of these two sides as origin, the magnitude of position vector of the centre of mass of the system is $\frac{4\sqrt{2}}{x}$, where the value of x is _____.

The current in a conductor is expressed as $I = 3t^2 + 4t^3$, where I is in Ampere and t is in second. The amount of electric charge that flows through a section of the conductor during $t = 1\text{s}$ to $t = 2\text{s}$ is _____ C.

A rectangular loop of sides 12cm and 5cm , with its sides parallel to the x -axis and y -axis respectively, moves with a velocity of 5cm/s in the positive x axis direction, in a space containing a variable magnetic field in the positive z direction. The field has a gradient of 10^{-3}T/cm along the negative x direction and it is decreasing with time at the rate of 10^{-3}T/s . If the resistance of the loop is $6\text{m}\Omega$, the power dissipated by the loop as heat is _____ $\times 10^{-9}\text{W}$.

Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle θ with each other. When suspended in water the angle remains the same. If density of the material of the sphere is 1.5g/cc , the dielectric constant of water will be _____.

(Take density of water = 1g/cc)

The distance between object and its 3 times magnified virtual image as produced by a convex lens is 20cm . The focal length of the lens used is _____ cm.

Q27 Rectilinear Motion **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/4LTSMBJvaf) › prepwisar.in/questions/4LTSMBJvaf

A particle is moving in one dimension (along x axis) under the action of a variable force. It's initial position was 16m right of origin. The variation of its position (x) with time (t) is given as

$$x = -3t^3 + 18t^2 + 16t, \text{ where } x \text{ is in m and } t \text{ is in s.}$$

The velocity of the particle when its acceleration becomes zero is _____ m/s.

Q28 Fluid Mechanics **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/TI6WseVHsR) › prepwisar.in/questions/TI6WseVHsR

A plane is in level flight at constant speed and each of its two wings has an area of 40m^2 . If the speed of the air is 180km/h over the lower wing surface and 252km/h over the upper wing surface, the mass of the plane is _____ kg.

(Take air density to be 1kgm^{-3} and $g = 10\text{ms}^{-2}$)

Q29 Sound Waves **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/IvIkTcLvSf) › prepwisar.in/questions/IvIkTcLvSf

A tuning fork resonates with a sonometer wire of length 1m stretched with a tension of 6N. When the tension in the wire is changed to 54N, the same tuning fork produces 12 beats per second with it. The frequency of the tuning fork is _____ Hz.

Chemistry Section A · Multiple choice

Q30 to Q47

Q30 Carbohydrates & Biomolecules[Step-by-step solution](https://www.prepwisar.in/questions/m7S8qPaRR9) › prepwisar.in/questions/m7S8qPaRR9

If one strand of a DNA has the sequence ATGCTTCA, sequence of the bases in complementary strand is:

- (A) CATTAGCT (B) TACGAAGT (C) ATGCGACT (D) GTACTTAC

Q31 Chemical Bonding & Molecular Structure[Step-by-step solution](https://www.prepwisar.in/questions/lqVExdp407) › prepwisar.in/questions/lqVExdp407

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

Assertion (A): PH_3 has lower boiling point than NH_3 .

Reason (R): In liquid state NH_3 molecules are associated through vander Waal's forces, but PH_3 molecules are associated through hydrogen bonding.

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

- (A) Both (A) and (R) are correct and (R) is the correct explanation of (A)
(B) (A) is not correct but (R) is correct
(C) (A) is correct but (R) is not correct
(D) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

Q32 Chemical Bonding & Molecular Structure[Step-by-step solution](https://www.prepwisar.in/questions/e33uy4Y3Xp) › prepwisar.in/questions/e33uy4Y3Xp

Arrange the bonds in order of increasing ionic character in the molecules. LiF , K_2O , N_2 , SO_2 and ClF_3 :

- (A) $\text{N}_2 < \text{SO}_2 < \text{ClF}_3 < \text{K}_2\text{O} < \text{LiF}$ (B) $\text{ClF}_3 < \text{N}_2 < \text{SO}_2 < \text{K}_2\text{O} < \text{LiF}$
(C) $\text{LiF} < \text{K}_2\text{O} < \text{ClF}_3 < \text{SO}_2 < \text{N}_2$ (D) $\text{N}_2 < \text{ClF}_3 < \text{SO}_2 < \text{K}_2\text{O} < \text{LiF}$

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Which of the following complex is homoleptic?

- (A) $[\text{Ni}(\text{NH}_3)_2\text{Cl}_2]$ (B) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$ (C) $[\text{Fe}(\text{NH}_3)_4\text{Cl}_2]^+$ (D) $[\text{Ni}(\text{CN})_4]^{2-}$

Given below are two statements:

Statement (I): A solution of $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ is green in colour.

Statement (II): A solution of $[\text{Ni}(\text{CN})_4]^{2-}$ is colourless.

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) Both Statement I and Statement II are correct
(C) Both Statement I and Statement II are incorrect
(D) Statement I is correct but Statement II is incorrect

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

Assertion (A): Haloalkanes react with KCN to form alkyl cyanides as a main product while with AgCN form isocyanide as the main product.

Reason (R): KCN and AgCN both are highly ionic compounds.

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

- (A) (A) is correct but (R) is not correct
(B) Both (A) and (R) are correct and (R) is the correct explanation of (A)
(C) (A) is not correct but (R) is correct
(D) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

Which of the following reactions are disproportionation reactions?

- (A) $\text{Cu}^+ \rightarrow \text{Cu}^{2+} + \text{Cu}$
(B) $3\text{MnO}_4^{2-} + 4\text{H}^+ \rightarrow 2\text{MnO}_4^- + \text{MnO}_2 + 2\text{H}_2\text{O}$
(C) $2\text{KMnO}_4 \rightarrow \text{K}_2\text{MnO}_4 + \text{MnO}_2 + \text{O}_2$
(D) $2\text{MnO}_4^- + 3\text{Mn}^{2+} + 2\text{H}_2\text{O} \rightarrow 5\text{MnO}_2 + 4\text{H}^+$

Choose the correct answer from the options given below:

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

In acidic medium, $\text{K}_2\text{Cr}_2\text{O}_7$ shows oxidising action as represented in the half reaction:



X, Y, Z and A are respectively are:

- (A) 14, 7, 6 and Cr^{3+} (B) 14, 6, 7 and Cr^{3+} (C) 8, 4, 6 and Cr_2O_3 (D) 8, 6, 4 and Cr_2O_3

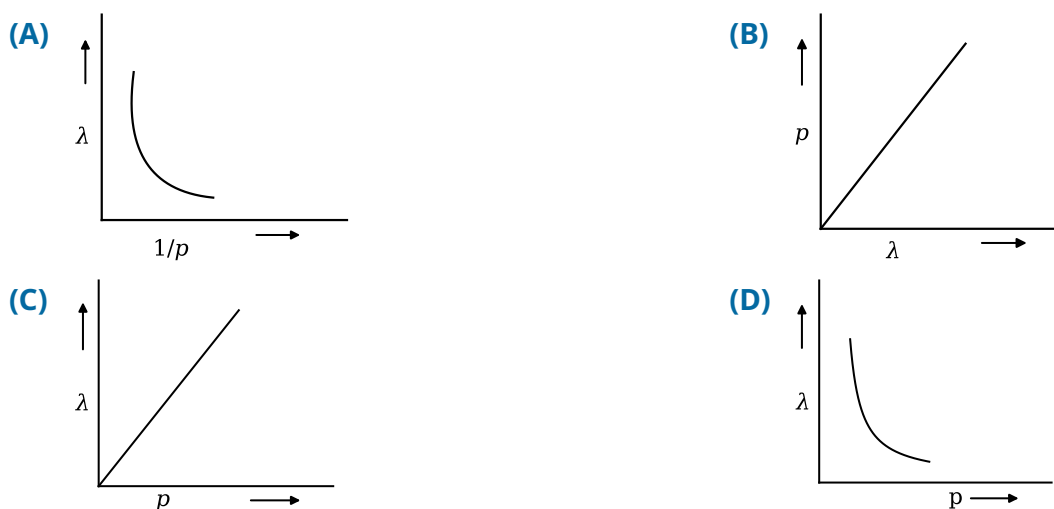
We have three aqueous solutions of NaCl labelled as 'A', 'B' and 'C' with concentration 0.1M, 0.01M and 0.001M, respectively. The value of van 't Hoff factor(*i*) for these solutions will be in the order:

- (A) $i_A < i_C < i_B$ (B) $i_A < i_B < i_C$ (C) $i_A > i_B > i_C$ (D) $i_A = i_B = i_C$

In case of isoelectronic species the size of F^- , Ne and Na^+ is affected by:

- (A) Nuclear charge (*z*)
(B) None of the factors because their size is the same
(C) Electron-electron interaction in the outer orbitals
(D) Principal quantum number (*n*)

According to the wave-particle duality of matter by de-Broglie, which of the following graph plot presents most appropriate relationship between wavelength of electron (λ) and momentum of electron (*p*)?



Choose the correct option for free expansion of an ideal gas under adiabatic condition from the following:

- (A) $q = 0, \Delta T = 0, w = 0$ (B) $q = 0, \Delta T \neq 0, w = 0$
(C) $q \neq 0, \Delta T = 0, w = 0$ (D) $q = 0, \Delta T < 0, w \neq 0$

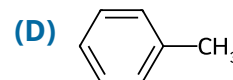
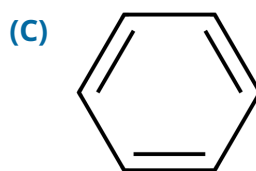
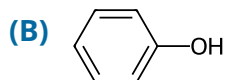
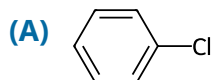
Ionic reactions with organic compounds proceed through:

- (A) homolytic bond cleavage
(B) heterolytic bond cleavage
(C) free radical formation
(D) primary free radical
(E) secondary free radical

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

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

Which of the following compound will most easily be attacked by an electrophile?



Given below are two statements:

Statement (I): The NH_2 group in Aniline is ortho and para directing and a powerful activating group.

Statement (II): Aniline does not undergo Friedel-Craft's reaction (alkylation and acylation).

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

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

Given below are two statements:

Statement (I): Aminobenzene and aniline are same organic compounds.

Statement (II): Aminobenzene and aniline are different organic compounds.

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

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

In Kjeldahl's method for estimation of nitrogen, CuSO_4 acts as:

- (A) catalytic agent
- (B) hydrolysis agent
- (C) reducing agent
- (D) oxidising agent

Given below are two statements:

Statement (I): Potassium hydrogen phthalate is a primary standard for standardisation of sodium hydroxide solution.

Statement (II): In this titration phenolphthalein can be used as indicator.

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

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

Q48 Chemical Bonding & Molecular Structure **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/A04FE35zid

The number of molecules/ion/s having trigonal bipyramidal shape is _____.

**Q49** Redox Reactions **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/uIPx2O9lIQ

The lowest oxidation number of an atom in a compound A_2B is -2. The number of electrons in its valence shell is _____.

Q50 Nuclear & Radiochemistry **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/XF1qYLLRAh

The ratio of $^{14}_6\text{C}$ in a piece of wood is $\frac{1}{8}$ part that of atmosphere. If half life of $^{14}_6\text{C}$ is 5730 years, the age of wood sample is _____ years.

Q51 Electrochemistry **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/RgoM4jnoCm

The potential for the given half cell at 298K is (-) _____ $\times 10^{-2}\text{V}$



$$[\text{H}^+] = 1\text{M}, P_{\text{H}_2} = 2\text{atm}$$

(Given: $2.303RT/F = 0.06\text{V}$, $\log 2 = 0.3$)

Q52 Ionic Equilibrium **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/7FhIOwLtR

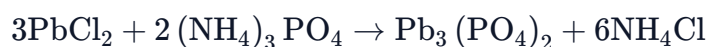
K_a for CH_3COOH is 1.8×10^{-5} and K_b for NH_4OH is 1.8×10^{-5} . The pH of ammonium acetate solution will be _____.

Q53 p-Block Elements: Part I (Group 13 & 14) **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/STRiF81mwt

Among the following oxides of p-block elements, number of oxides having amphoteric nature is _____.

**Q54** Mole Concept & Stoichiometry **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/tfsp2xuetA

Consider the following reaction:



If 72mmol of PbCl_2 is mixed with 50mmol of $(\text{NH}_4)_3\text{PO}_4$, then the amount of $\text{Pb}_3(\text{PO}_4)_2$ formed is _____ mmol (nearest integer).

Q55 Hydrocarbons: Aromatic (Arenes) **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/4y0vZCcAnk

Total number of deactivating groups in aromatic electrophilic substitution reaction among the following is _____.

**Q56** General Organic Chemistry (GOC) **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/l_DWI-4S-E

Number of optical isomers possible for 2-chlorobutane _____.

The number of white coloured salts, among the following is

- (a) SrSO_4
- (b) $\text{Mg}(\text{NH}_4)\text{PO}_4$
- (c) BaCrO_4
- (d) $\text{Mn}(\text{OH})_2$
- (e) PbSO_4
- (f) PbCrO_4
- (g) AgBr
- (h) PbI_2
- (i) CaC_2O_4
- (j) $[\text{Fe}(\text{OH})_2(\text{CH}_3\text{COO})]$

Mathematics Section A · Multiple choice

Q58 to Q77

Q58 Three Dimensional Geometry

[Step-by-step solution](#) > [prepwisar.in/questions/n6bMXj_SOG](https://www.prepwisar.in/questions/n6bMXj_SOG)

If the shortest distance between the lines

$\frac{x-\lambda}{-2} = \frac{y-2}{1} = \frac{z-1}{1}$ and $\frac{x-\sqrt{3}}{1} = \frac{y-1}{-2} = \frac{z-2}{1}$ is 1, then the sum of all possible values of λ is:

- (A) 0 (B) $2\sqrt{3}$ (C) $3\sqrt{3}$ (D) $-2\sqrt{3}$

Q59 Applications of Derivatives

[Step-by-step solution](#) > [prepwisar.in/questions/6MjtbpKEjM](https://www.prepwisar.in/questions/6MjtbpKEjM)

If $5f(x) + 4f\left(\frac{1}{x}\right) = x^2 - 2, \forall x \neq 0$ and $y = 9x^2 f(x)$, then y is strictly increasing in:

- (A) $\left(0, \frac{1}{\sqrt{5}}\right) \cup \left(\frac{1}{\sqrt{5}}, \infty\right)$ (B) $\left(-\frac{1}{\sqrt{5}}, 0\right) \cup \left(\frac{1}{\sqrt{5}}, \infty\right)$
 (C) $\left(-\frac{1}{\sqrt{5}}, 0\right) \cup \left(0, \frac{1}{\sqrt{5}}\right)$ (D) $\left(-\infty, \frac{1}{\sqrt{5}}\right) \cup \left(0, \frac{1}{\sqrt{5}}\right)$

Q60 Circles

[Step-by-step solution](#) > [prepwisar.in/questions/dIyhRP-73F](https://www.prepwisar.in/questions/dIyhRP-73F)

Let $C : x^2 + y^2 = 4$ and $C' : x^2 + y^2 - 4\lambda x + 9 = 0$ be two circles. If the set of all values of λ so that the circles C and C' intersect at two distinct points, is $\mathbb{R} - [a, b]$, then the point $(8a + 12, 16b - 20)$ lies on the curve:

- (A) $x^2 + 2y^2 - 5x + 6y = 3$ (B) $5x^2 - y = -11$
 (C) $x^2 - 4y^2 = 7$ (D) $6x^2 + y^2 = 42$

Q61 Complex Numbers

[Step-by-step solution](#) > [prepwisar.in/questions/Vprk0NEfRy](https://www.prepwisar.in/questions/Vprk0NEfRy)

Let $S = \{z \in \mathbb{C} : |z - 1| = 1 \text{ and } (\sqrt{2} - 1)(z + \bar{z}) - i(z - \bar{z}) = 2\sqrt{2}\}$. Let $z_1, z_2 \in S$ be such that $|z_1| = \max_{z \in S} |z|$ and $|z_2| = \min_{z \in S} |z|$. Then $|\sqrt{2}z_1 - z_2|^2$ equals:

- (A) 1 (B) 4 (C) 3 (D) 2

Q62 Definite Integration

[Step-by-step solution](#) > [prepwisar.in/questions/9DHs6G7RjJ](https://www.prepwisar.in/questions/9DHs6G7RjJ)

The value of the integral $\int_0^{\pi/4} \frac{x dx}{\sin^4(2x) + \cos^4(2x)}$ equals:

- (A) $\frac{\sqrt{2}\pi^2}{8}$ (B) $\frac{\sqrt{2}\pi^2}{16}$ (C) $\frac{\sqrt{2}\pi^2}{32}$ (D) $\frac{\sqrt{2}\pi^2}{64}$

Q63 Differential Equations[Step-by-step solution](https://www.prepwiser.in/questions/AnKsIRi5Z7) > prepwiser.in/questions/AnKsIRi5Z7

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

$$\frac{dy}{dx} = 2x(x+y)^3 - x(x+y) - 1, y(0) = 1.$$

Then, $\left(\frac{1}{\sqrt{2}} + y\left(\frac{1}{\sqrt{2}}\right)\right)^2$ equals:

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

Q64 Ellipse[Step-by-step solution](https://www.prepwiser.in/questions/kwhJuIUNKI) > prepwiser.in/questions/kwhJuIUNKI

Let $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, a > b$ be an ellipse, whose eccentricity is $\frac{1}{\sqrt{2}}$ and the length of the latusrectum is $\sqrt{14}$.

Then the square of the eccentricity of $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ is:

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

Q65 Relations & Functions (Basic)[Step-by-step solution](https://www.prepwiser.in/questions/ZCL2NvQ2iA) > prepwiser.in/questions/ZCL2NvQ2iA

Let $f : \mathbf{R} \rightarrow \mathbf{R}$ and $g : \mathbf{R} \rightarrow \mathbf{R}$ be defined as

$$f(x) = \begin{cases} \log_e x, & x > 0 \\ e^{-x}, & x \leq 0 \end{cases} \text{ and } g(x) = \begin{cases} x, & x \geq 0 \\ e^x, & x < 0 \end{cases}.$$
 Then, $\text{gof} : \mathbf{R} \rightarrow \mathbf{R}$ is:

- (A) one-one but not onto (B) neither one-one nor onto
(C) onto but not one-one (D) both one-one and onto

Q66 Hyperbola[Step-by-step solution](https://www.prepwiser.in/questions/o-KCiqAnrz) > prepwiser.in/questions/o-KCiqAnrz

For $0 < \theta < \pi/2$, if the eccentricity of the hyperbola

$$x^2 - y^2 \operatorname{cosec}^2 \theta = 5$$
 is $\sqrt{7}$ times eccentricity of the

$$\text{ellipse } x^2 \operatorname{cosec}^2 \theta + y^2 = 5,$$
 then the value of θ is:

- (A) $\frac{\pi}{6}$ (B) $\frac{5\pi}{12}$ (C) $\frac{\pi}{3}$ (D) $\frac{\pi}{4}$

Q67 Continuity & Differentiability[Step-by-step solution](https://www.prepwiser.in/questions/iidW8UWn3r) > prepwiser.in/questions/iidW8UWn3r

Let $f : \mathbf{R} \rightarrow \mathbf{R}$ be defined as:

$$f(x) = \begin{cases} \frac{a-b \cos 2x}{x^2}, & x < 0 \\ x^2 + cx + 2; & 0 \leq x \leq 1 \\ 2x + 1; & x > 1 \end{cases}$$

If f is continuous everywhere in $\mathbf{R}$ and m is the number of points where f is NOT differential then $m + a + b + c$ equals:

- (A) 1 (B) 4 (C) 3 (D) 2

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Q68 Determinants[Step-by-step solution](#) › prepwiser.in/questions/LIQWk_21V9

If $A = \begin{bmatrix} \sqrt{2} & 1 \\ -1 & \sqrt{2} \end{bmatrix}$, $B = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$, $C = ABA^T$ and $X = A^T C^2 A$, then $\det X$ is equal to:

- (A) 243 (B) 729 (C) 27 (D) 891

Q69 Determinants[Step-by-step solution](#) › prepwiser.in/questions/18qwItQwbp

If the system of equations

$$2x + 3y - z = 5$$

$$x + \alpha y + 3z = -4$$

$$3x - y + \beta z = 7$$

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

- (A) 1110 (B) 1120 (C) 1210 (D) 1220

Q70 Permutations & Combinations[Step-by-step solution](#) › prepwiser.in/questions/vwF-8UTw8w

If n is the number of ways five different employees can sit into four indistinguishable offices where any office may have any number of persons including zero, then n is equal to:

- (A) 47 (B) 53 (C) 51 (D) 43

Q71 Probability: Advanced[Step-by-step solution](#) › prepwiser.in/questions/tLFgW2O8cV

A bag contains 8 balls, whose colours are either white or black. 4 balls are drawn at random without replacement and it was found that 2 balls are white and other 2 balls are black. The probability that the bag contains equal number of white and black balls is:

- (A) $\frac{2}{5}$ (B) $\frac{2}{7}$ (C) $\frac{1}{7}$ (D) $\frac{1}{5}$

Q72 Quadratic Equations & Polynomial Inequalities[Step-by-step solution](#) › prepwiser.in/questions/-gpNcW3bDI

Let $S = \{x \in \mathbf{R} : (\sqrt{3} + \sqrt{2})^x + (\sqrt{3} - \sqrt{2})^x = 10\}$. Then the number of elements in S is:

- (A) 4 (B) 0 (C) 2 (D) 1

Q73 Sequences & Series[Step-by-step solution](#) › prepwiser.in/questions/pEZpJB88H-

Let $3, a, b, c$ be in A.P. and $3, a - 1, b + 1, c + 9$ be in G.P. Then, the arithmetic mean of a, b and c is:

- (A) -4 (B) -1 (C) 13 (D) 11

Q74 Statistics[Step-by-step solution](#) › prepwiser.in/questions/E5vLkgoFTq

Let the median and the mean deviation about the median of 7 observation 170, 125, 230, 190, 210, a, b be 170 and $\frac{205}{7}$ respectively. Then the mean deviation about the mean of these 7 observations is:

- (A) 31 (B) 28 (C) 30 (D) 32

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Q75 Vectors[Step-by-step solution](https://www.prepwiser.in/questions/L2U8v2Edti) › prepwiser.in/questions/L2U8v2Edti

Let $\vec{a} = -5\hat{i} + \hat{j} - 3\hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - 4\hat{k}$ and $\vec{c} = (((\vec{a} \times \vec{b}) \times \hat{i}) \times \hat{i}) \times \hat{i}$. Then $\vec{c} \cdot (-\hat{i} + \hat{j} + \hat{k})$ is equal to:

(A) -12**(B)** -10**(C)** -13**(D)** -15**Q76** Area Under Curves[Step-by-step solution](https://www.prepwiser.in/questions/mBrNaqfeN8) › prepwiser.in/questions/mBrNaqfeN8

The area enclosed by the curves $xy + 4y = 16$ and $x + y = 6$ is equal to:

(A) $28 - 30 \log_e 2$ **(B)** $30 - 28 \log_e 2$ **(C)** $30 - 32 \log_e 2$ **(D)** $32 - 30 \log_e 2$ **Q77** Trigonometric Ratios & Identities[Step-by-step solution](https://www.prepwiser.in/questions/yFjKiYy3sF) › prepwiser.in/questions/yFjKiYy3sF

If $\tan A = \frac{1}{\sqrt{x(x^2+x+1)}}$, $\tan B = \frac{\sqrt{x}}{\sqrt{x^2+x+1}}$ and $\tan C = (x^{-3} + x^{-2} + x^{-1})^{1/2}$, $0 < A, B, C < \frac{\pi}{2}$, then $A + B$ is equal to:

(A) C**(B)** $\pi - C$ **(C)** $2\pi - C$ **(D)** $\frac{\pi}{2} - C$ **Mathematics Section B · Numerical value**

Q78 to Q87

Q78 Three Dimensional Geometry**NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/nnY-yjESPG) › prepwiser.in/questions/nnY-yjESPG

Let the line of the shortest distance between the lines

$$L_1 : \vec{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(\hat{i} - \hat{j} + \hat{k}) \text{ and}$$

$$L_2 : \vec{r} = (4\hat{i} + 5\hat{j} + 6\hat{k}) + \mu(\hat{i} + \hat{j} - \hat{k})$$

intersect L_1 and L_2 at P and Q respectively. If (α, β, γ) is the mid point of the line segment PQ, then $2(\alpha + \beta + \gamma)$ is equal to _____.

Q79 Binomial Theorem**NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/Hw7seH40oK) › prepwiser.in/questions/Hw7seH40oK

If the Coefficient of x^{30} in the expansion of $(1 + \frac{1}{x})^6 (1 + x^2)^7 (1 - x^3)^8$; $x \neq 0$ is α , then $|\alpha|$ equals _____.

Q80 Complex Numbers**NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/E08_IFn9gv) › prepwiser.in/questions/E08_IFn9gv

Let $P = \{z \in \mathbb{C} : |z + 2 - 3i| \leq 1\}$ and $Q = \{z \in \mathbb{C} : z(1 + i) + \bar{z}(1 - i) \leq -8\}$. Let in $P \cap Q$, $|z - 3 + 2i|$ be maximum and minimum at z_1 and z_2 respectively. If $|z_1|^2 + 2|z_2|^2 = \alpha + \beta\sqrt{2}$, where α, β are integers, then $\alpha + \beta$ equals _____.

Q81 Definite Integration**NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/qyyUxxwAHj) › prepwiser.in/questions/qyyUxxwAHj

If $\int_{-\pi/2}^{\pi/2} \frac{8\sqrt{2} \cos x dx}{(1 + e^{\sin x})(1 + \sin^4 x)} = \alpha\pi + \beta \log_e(3 + 2\sqrt{2})$, where α, β are integers, then $\alpha^2 + \beta^2$ equals:

Q82 Differential Equations**NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/aKf1bcuissW) › prepwiser.in/questions/aKf1bcuissW

If $x = x(t)$ is the solution of the differential equation $(t + 1)dx = (2x + (t + 1)^4) dt$, $x(0) = 2$, then, $x(1)$ equals _____.

Q83 Limits **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/qRBFAQQeTm) › prepwisar.in/questions/qRBFAQQeTm

Let $\{x\}$ denote the fractional part of x and $f(x) = \frac{\cos^{-1}(1-\{x\}^2) \sin^{-1}(1-\{x\})}{\{x\}-\{x\}^3}$, $x \neq 0$. If L and R respectively denotes the left hand limit and the right hand limit of $f(x)$ at $x = 0$, then $\frac{32}{\pi^2} (L^2 + R^2)$ is equal to _____.

Q84 Circles **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/jMfr6COusx) › prepwisar.in/questions/jMfr6COusx

Let the line $L : \sqrt{2}x + y = \alpha$ pass through the point of the intersection P (in the first quadrant) of the circle $x^2 + y^2 = 3$ and the parabola $x^2 = 2y$. Let the line L touch two circles C_1 and C_2 of equal radius $2\sqrt{3}$. If the centres Q_1 and Q_2 of the circles C_1 and C_2 lie on the y -axis, then the square of the area of the triangle PQ_1Q_2 is equal to _____.

Q85 Permutations & Combinations **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/Q1g2UHxD5m) › prepwisar.in/questions/Q1g2UHxD5m

The number of elements in the set $S = \{(x, y, z) : x, y, z \in \mathbf{Z}, x + 2y + 3z = 42, x, y, z \geq 0\}$ equals _____.

Q86 Sequences & Series **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/cdAzRjKSWY) › prepwisar.in/questions/cdAzRjKSWY

Let $3, 7, 11, 15, \dots, 403$ and $2, 5, 8, 11, \dots, 404$ be two arithmetic progressions. Then the sum, of the common terms in them, is equal to _____.

Q87 Relations & Functions (Basic) **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/iBWjE17nSY) › prepwisar.in/questions/iBWjE17nSY

Let $A = \{1, 2, 3, \dots, 20\}$. Let R_1 and R_2 two relation on A such that

$$R_1 = \{(a, b) : b \text{ is divisible by } a\}$$

$$R_2 = \{(a, b) : a \text{ is an integral multiple of } b\}.$$

Then, number of elements in $R_1 - R_2$ is equal to _____.

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Physics

1.	B	2.	C	3.	C	4.	A	5.	C	6.	A	7.	D	8.	D
9.	A	10.	D	11.	A	12.	D	13.	D	14.	D	15.	C	16.	A
17.	B	18.	A	19.	C	20.	D	21.	27	22.	3	23.	22	24.	216
25.	3	26.	15	27.	52	28.	9600	29.	6						

Chemistry

30.	B	31.	C	32.	A	33.	D	34.	B	35.	A	36.	A	37.	B
38.	B	39.	A	40.	D	41.	A	42.	B	43.	B	44.	A	45.	C
46.	A	47.	A	48.	3	49.	6	50.	17190	51.	1	52.	7	53.	3
54.	24	55.	2	56.	2	57.	5								

Mathematics

58.	B	59.	B	60.	D	61.	D	62.	C	63.	D	64.	C	65.	B
66.	C	67.	D	68.	B	69.	B	70.	C	71.	B	72.	C	73.	D
74.	C	75.	A	76.	C	77.	A	78.	21	79.	678	80.	36	81.	8
82.	14	83.	18	84.	72	85.	169	86.	6699	87.	46				

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