

JEE MAIN 2024 · QUESTION PAPER

27 Jan 2024 Shift 1

88 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	20 Q1 to Q20	10 Q21 to Q30
● Chemistry	19 Q31 to Q49	9 Q50 to Q58
● Mathematics	20 Q59 to Q78	10 Q79 to Q88
In this PDF 88 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/2024-01-27-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/-EdBDE5tOz](https://www.prepwisar.in/questions/-EdBDE5tOz)

The radius of third stationary orbit of electron for Bohr's atom is R . The radius of fourth stationary orbit will be:

- (A) $\frac{4}{3}R$ (B) $\frac{16}{9}R$ (C) $\frac{3}{4}R$ (D) $\frac{9}{16}R$

Q2 Centre of Mass & Linear Momentum

[Step-by-step solution](#) › [prepwisar.in/questions/W_FLeE53Fm](https://www.prepwisar.in/questions/W_FLeE53Fm)

Two bodies of mass 4g and 25g are moving with equal kinetic energies. The ratio of magnitude of their linear momentum is:

- (A) 3 : 5 (B) 5 : 4 (C) 2 : 5 (D) 4 : 5

Q3 Centre of Mass & Linear Momentum

[Step-by-step solution](#) › [prepwisar.in/questions/30J3TEn2N](https://www.prepwisar.in/questions/30J3TEn2N)

A body of mass 1000kg is moving horizontally with a velocity 6m/s. If 200kg extra mass is added, the final velocity (in m/s) is:

- (A) 6 (B) 2 (C) 3 (D) 5

Q4 Circular Motion

[Step-by-step solution](#) › [prepwisar.in/questions/ys1iZBWcCp](https://www.prepwisar.in/questions/ys1iZBWcCp)

A train is moving with a speed of 12m/s on rails which are 1.5m apart. To negotiate a curve radius 400m, the height by which the outer rail should be raised with respect to the inner rail is (Given, $g = 10\text{m/s}^2$):

- (A) 6.0 cm (B) 5.4 cm (C) 4.8 cm (D) 4.2 cm

Q5 Current Electricity

[Step-by-step solution](#) › [prepwisar.in/questions/PP2bE_szhD](https://www.prepwisar.in/questions/PP2bE_szhD)

A wire of length 10cm and radius $\sqrt{7} \times 10^{-4}\text{m}$ connected across the right gap of a meter bridge. When a resistance of 4.5Ω is connected on the left gap by using a resistance box, the balance length is found to be at 60cm from the left end. If the resistivity of the wire is $R \times 10^{-7}\Omega\text{m}$, then value of R is:

- (A) 63 (B) 70 (C) 66 (D) 35

Q6 Current Electricity

[Step-by-step solution](#) › [prepwisar.in/questions/gMyA-wVy8t](https://www.prepwisar.in/questions/gMyA-wVy8t)

A wire of resistance R and length L is cut into 5 equal parts. If these parts are joined parallelly, then resultant resistance will be:

- (A) $\frac{1}{25}R$ (B) $\frac{1}{5}R$ (C) 25 R (D) 5 R

Q7 Electromagnetic Induction

[Step-by-step solution](#) › [prepwisar.in/questions/yr4cEjUm7](https://www.prepwisar.in/questions/yr4cEjUm7)

A rectangular loop of length 2.5m and width 2m is placed at 60° to a magnetic field of 4T. The loop is removed from the field in 10sec. The average emf induced in the loop during this time is

- (A) -2V (B) +2V (C) +1V (D) -1V

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Q8 Electromagnetic Waves[Step-by-step solution > prepwiser.in/questions/8KM1s1iHzn](https://www.prepwiser.in/questions/8KM1s1iHzn)

A plane electromagnetic wave propagating in x-direction is described by

$$E_y = (200 \text{Vm}^{-1}) \sin [1.5 \times 10^7 t - 0.05x];$$

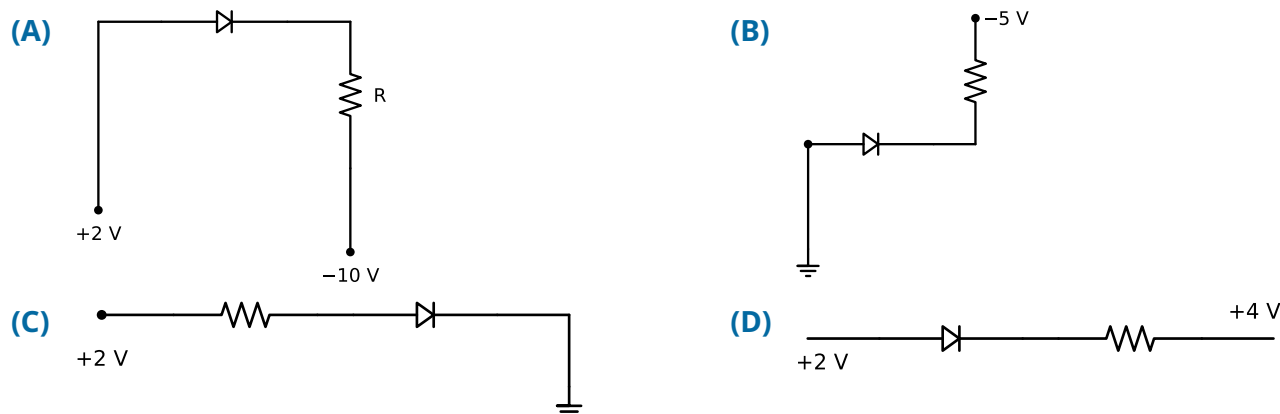
The intensity of the wave is:

(Use $\epsilon_0 = 8.85 \times 10^{-12} \text{C}^2\text{N}^{-1}\text{m}^{-2}$)

- (A) 35.4Wm^{-2} (B) 53.1Wm^{-2} (C) 26.6Wm^{-2} (D) 106.2Wm^{-2}

Q9 Semiconductors & Electronic Devices[Step-by-step solution > prepwiser.in/questions/ki9xRLTdLa](https://www.prepwiser.in/questions/ki9xRLTdLa)

Which of the following circuits is reverse - biased?

**Q10** Electrostatics II: Potential & Capacitance[Step-by-step solution > prepwiser.in/questions/PKgSng3vil](https://www.prepwiser.in/questions/PKgSng3vil)

An electric charge $10^{-6} \mu\text{C}$ is placed at origin (0, 0) m of X – Y co-ordinate system. Two points P and Q are situated at $(\sqrt{3}, \sqrt{3})\text{m}$ and $(\sqrt{6}, 0)\text{m}$ respectively. The potential difference between the points P and Q will be:

- (A) $\sqrt{3}\text{V}$ (B) $\sqrt{6}\text{V}$ (C) 0V (D) 3V

Q11 Ray Optics[Step-by-step solution > prepwiser.in/questions/dNS2SVopEa](https://www.prepwiser.in/questions/dNS2SVopEa)

If the refractive index of the material of a prism is $\cot\left(\frac{A}{2}\right)$, where A is the angle of prism then the angle of minimum deviation will be

- (A) $\pi - 2A$ (B) $\frac{\pi}{2} - 2A$ (C) $\pi - A$ (D) $\frac{\pi}{2} - A$

Q12 Experimental Skills[Step-by-step solution > prepwiser.in/questions/Y1GME7ongO](https://www.prepwiser.in/questions/Y1GME7ongO)

Identify the physical quantity that cannot be measured using spherometer:

- (A) Radius of curvature of concave surface (B) Specific rotation of liquids
(C) Thickness of thin plates (D) Radius of curvature of convex surface

Q13 Ray Optics[Step-by-step solution > prepwiser.in/questions/jNZg2vOcbB](https://www.prepwiser.in/questions/jNZg2vOcbB)

A convex lens of focal length 40cm forms an image of an extended source of light on a photoelectric cell. A current I is produced. The lens is replaced by another convex lens having the same diameter but focal length 20cm. The photoelectric current now is:

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

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Q14 Gravitation[Step-by-step solution](https://www.prepwiser.in/questions/q9gn0jdO2W) › prepwiser.in/questions/q9gn0jdO2W

The acceleration due to gravity on the surface of earth is g . If the diameter of earth reduces to half of its original value and mass remains constant, then acceleration due to gravity on the surface of earth would be:

- (A) $g/4$ (B) $2g$ (C) $g/2$ (D) $4g$

Q15 Thermodynamics[Step-by-step solution](https://www.prepwiser.in/questions/HFViLYp_oj) › prepwiser.in/questions/HFViLYp_oj

0.08kg air is heated at constant volume through 5°C . The specific heat of air at constant volume is $0.17\text{kcal/kg}^\circ\text{C}$ and $J = 4.18\text{ joule/cal}$. The change in its internal energy is approximately.

- (A) 318 J (B) 298 J (C) 284 J (D) 142 J

Q16 Kinetic Theory of Gases[Step-by-step solution](https://www.prepwiser.in/questions/cJwkKA5wZ4) › prepwiser.in/questions/cJwkKA5wZ4

The average kinetic energy of a monatomic molecule is 0.414eV at temperature:

(Use $K_B = 1.38 \times 10^{-23}\text{J/mol} - \text{K}$)

- (A) 3000 K (B) 3200 K (C) 1600 K (D) 1500 K

Q17 Moving Charges & Magnetism[Step-by-step solution](https://www.prepwiser.in/questions/jm6WhZPKpS) › prepwiser.in/questions/jm6WhZPKpS

A proton moving with a constant velocity passes through a region of space without any change in its velocity. If $\vec{E}$ and $\vec{B}$ represent the electric and magnetic fields respectively, then the region of space may have:

- (A) $E = 0, B = 0$
(B) $E = 0, B \neq 0$
(C) $E \neq 0, B = 0$
(D) $E \neq 0, B \neq 0$

Choose the most appropriate answer from the options given below:

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

Q18 Rectilinear Motion[Step-by-step solution](https://www.prepwiser.in/questions/op1IgsGIhb) › prepwiser.in/questions/op1IgsGIhb

Position of an ant (S in metres) moving in Y - Z plane is given by $S = 2t^2\hat{j} + 5t\hat{k}$ (where t is in second). The magnitude and direction of velocity of the ant at $t = 1\text{s}$ will be:

- (A) 16m/s in y -direction (B) 4m/s in x -direction
(C) 9m/s in z -direction (D) 4m/s in y -direction

Attempt this paper online with instant answer checking › [prepwiser.in/pyqs/paper/2024-01-27-morning](https://www.prepwiser.in/pyqs/paper/2024-01-27-morning)

Given below are two statements:

Statement (I) : Viscosity of gases is greater than that of liquids.

Statement (II) : Surface tension of a liquid decreases due to the presence of insoluble impurities.

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

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

Given below are two statements:

Statement (I) : Planck's constant and angular momentum have same dimensions.

Statement (II) : Linear momentum and moment of force have same dimensions.

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

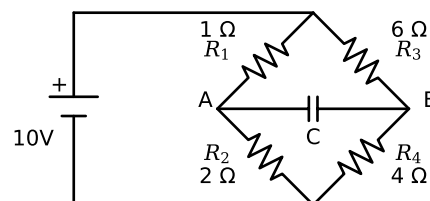
- (A) Statement I is true but Statement II is false
- (B) Both Statement I and Statement II are false
- (C) Both Statement I and Statement II are true
- (D) Statement I is false but Statement II is true

Physics Section B · Numerical value

Q21 to Q30

In a nuclear fission process, a high mass nuclide ($A \approx 236$) with binding energy 7.6 MeV/Nucleon dissociated into middle mass nuclides ($A \approx 118$), having binding energy of 8.6 MeV/Nucleon . The energy released in the process would be ____ MeV.

The charge accumulated on the capacitor connected in the following circuit is ____ μC (Given $C = 150 \mu\text{F}$)

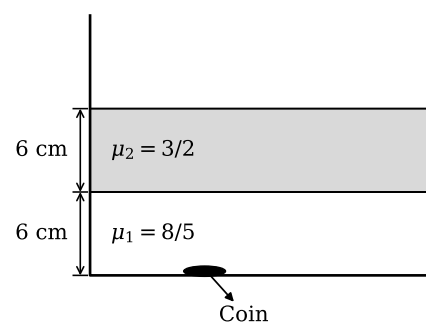


Two coils have mutual inductance 0.002 H . The current changes in the first coil according to the relation $i = i_0 \sin \omega t$, where $i_0 = 5 \text{ A}$ and $\omega = 50\pi \text{ rad/s}$. The maximum value of emf in the second coil is $\frac{\pi}{\alpha} \text{ V}$. The value of α is ____.

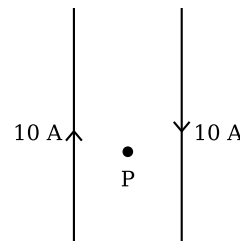
A thin metallic wire having cross sectional area of 10^{-4} m^2 is used to make a ring of radius 30 cm . A positive charge of $2\pi \text{ C}$ is uniformly distributed over the ring, while another positive charge of 30 pC is kept at the centre of the ring. The tension in the ring is ____ N; provided that the ring does not get deformed (neglect the influence of gravity). (given, $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ SI units}$)

Q25 Ray Optics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/j2VpJ7_uEy)

Two immiscible liquids of refractive indices $\frac{8}{5}$ and $\frac{3}{2}$ respectively are put in a beaker as shown in the figure. The height of each column is 6 cm. A coin is placed at the bottom of the beaker. For near normal vision, the apparent depth of the coin is $\frac{\alpha}{4}$ cm. The value of α is _____.

**Q26** Moving Charges & Magnetism **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/GfQTWk49Qu)

Two long, straight wires carry equal currents in opposite directions as shown in figure. The separation between the wires is 5.0 cm. The magnitude of the magnetic field at a point P midway between the wires is _____ μT (Given: $\mu_0 = 4\pi \times 10^{-7} \text{TmA}^{-1}$)

**Q27** Rectilinear Motion **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/hEDJDNz3vR)

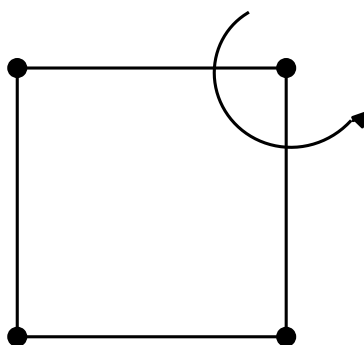
A particle starts from origin at $t = 0$ with a velocity $5\hat{i} \text{ m/s}$ and moves in $x - y$ plane under action of a force which produces a constant acceleration of $(3\hat{i} + 2\hat{j}) \text{ m/s}^2$. If the x -coordinate of the particle at that instant is 84 m, then the speed of the particle at this time is $\sqrt{\alpha} \text{ m/s}$. The value of α is _____.

Q28 Elasticity **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/inLW8wfwKJ)

If average depth of an ocean is 4000 m and the bulk modulus of water is $2 \times 10^9 \text{ Nm}^{-2}$, then fractional compression $\frac{\Delta V}{V}$ of water at the bottom of ocean is $\alpha \times 10^{-2}$. The value of α is _____ (Given, $g = 10 \text{ ms}^{-2}$, $\rho = 1000 \text{ kgm}^{-3}$)

Q29 Rotational Motion **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/kvJeWGVn--)

Four particles each of mass 1 kg are placed at four corners of a square of side 2 m. Moment of inertia of system about an axis perpendicular to its plane and passing through one of its vertex is _____ kgm^2 .

**Q30** Simple Harmonic Motion **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/VPfdhzXNwI)

A particle executes simple harmonic motion with an amplitude of 4 cm. At the mean position, velocity of the particle is 10 cm/s. The distance of the particle from the mean position when its speed becomes 5 cm/s is $\sqrt{\alpha} \text{ cm}$, where $\alpha =$ _____.

Q31 Alcohols, Phenols & Ethers[Step-by-step solution](https://www.prepwisar.in/questions/vwd7PXsGh4)

Given below are two statements:

Statement (I): p-nitrophenol is more acidic than m-nitrophenol and o-nitrophenol.

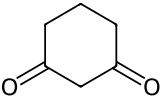
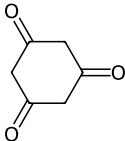
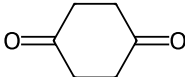
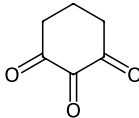
Statement (II): Ethanol will give immediate turbidity with Lucas reagent.

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

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

Q32 General Organic Chemistry (GOC)[Step-by-step solution](https://www.prepwisar.in/questions/9UqfukkSoA)

Highest enol content will be shown by:

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

Q33 Carbohydrates & Biomolecules[Step-by-step solution](https://www.prepwisar.in/questions/VVY6kybU_m)

Two nucleotides are joined together by a linkage known as:

- (A) Phosphodiester linkage (B) Glycosidic linkage
(C) Disulphide linkage (D) Peptide linkage

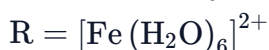
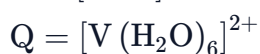
Q34 Chemical Bonding & Molecular Structure[Step-by-step solution](https://www.prepwisar.in/questions/TXVfKSo5Bg)

Choose the polar molecule from the following:

- (A) CCl_4 (B) CO_2 (C) $\text{CH}_2 = \text{CH}_2$ (D) CHCl_3

Q35 Coordination Compounds[Step-by-step solution](https://www.prepwisar.in/questions/DZfnKYRvFU)

Consider the following complex ions



The correct order of the complex ions, according to their spin only magnetic moment values (in B.M.) is:

- (A) $\text{R} < \text{Q} < \text{P}$ (B) $\text{R} < \text{P} < \text{Q}$ (C) $\text{Q} < \text{R} < \text{P}$ (D) $\text{Q} < \text{P} < \text{R}$

Q36 d & f Block Elements[Step-by-step solution](https://www.prepwisar.in/questions/hN7IstP5I1)

Yellow compound of lead chromate gets dissolved on treatment with hot NaOH solution. The product of lead formed is a:

- (A) Tetraanionic complex with coordination number six
(B) Neutral complex with coordination number four
(C) Dianionic complex with coordination number six
(D) Dianionic complex with coordination number four

Which of the following electronic configuration would be associated with the highest magnetic moment?

- (A) $[\text{Ar}]3d^7$ (B) $[\text{Ar}]3d^8$ (C) $[\text{Ar}]3d^3$ (D) $[\text{Ar}]3d^6$

NaCl reacts with conc. H_2SO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ to give reddish fumes (B), which react with NaOH to give yellow solution (C). (B) and (C) respectively are;

- (A) CrO_2Cl_2 , Na_2CrO_4 (B) Na_2CrO_4 , CrO_2Cl_2
(C) CrO_2Cl_2 , KHSO_4 (D) CrO_2Cl_2 , $\text{Na}_2\text{Cr}_2\text{O}_7$

The electronic configuration for Neodymium is:

[Atomic Number for Neodymium 60]

- (A) $[\text{Xe}]4f^46s^2$ (B) $[\text{Xe}]5f^47s^2$ (C) $[\text{Xe}]4f^66s^2$ (D) $[\text{Xe}]4f^15d^16s^2$

The correct statement regarding nucleophilic substitution reaction in a chiral alkyl halide is;

- (A) Retention occurs in S_N1 reaction and inversion occurs in S_N2 reaction.
(B) Racemisation occurs in S_N1 reaction and retention occurs in S_N2 reaction.
(C) Racemisation occurs in both S_N1 and S_N2 reactions.
(D) Racemisation occurs in S_N1 reaction and inversion occurs in S_N2 reaction.

Given below are two statements:

Statement (I) : Aqueous solution of ammonium carbonate is basic.

Statement (II) : Acidic/basic nature of salt solution of a salt of weak acid and weak base depends on K_a and K_b value of acid and the base forming it.

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

Element not showing variable oxidation state is:

- (A) Bromine (B) Iodine (C) Chlorine (D) Fluorine

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

Assertion (A) : Melting point of Boron (2453 K) is unusually high in group 13 elements.

Reason (R) : Solid Boron has very strong crystalline lattice.

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

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

Given below are two statements:

Statement (I) : The 4f and 5f - series of elements are placed separately in the Periodic table to preserve the principle of classification.

Statement (II) : S-block elements can be found in pure form in nature.

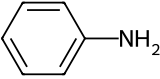
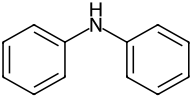
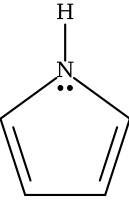
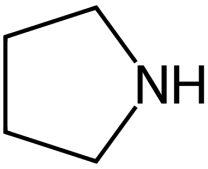
In the light of the above statements, choose the most appropriate answer from the options given below:

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

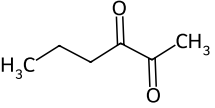
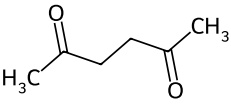
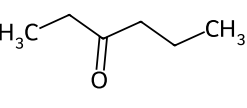
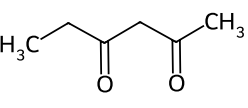
A solution of two miscible liquids showing negative deviation from Raoult's law will have:

- (A) increased vapour pressure, increased boiling point
- (B) increased vapour pressure, decreased boiling point
- (C) decreased vapour pressure, decreased boiling point
- (D) decreased vapour pressure, increased boiling point

Which of the following is strongest Bronsted base?

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

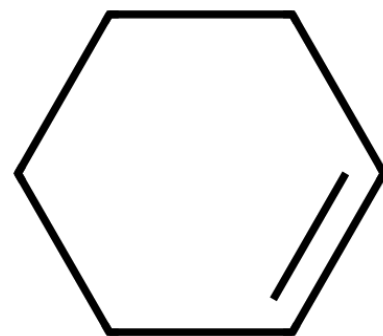
Which of the following has highly acidic hydrogen?

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

Cyclohexene

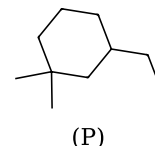
is _____ type of an organic compound.

- (A) Benzenoid aromatic (B) Benzenoid non-aromatic
(C) Acyclic (D) Alicyclic



IUPAC name of following compound (P) is:

- (A) 1-Ethyl-5, 5-dimethylcyclohexane (B) 3-Ethyl-1,1-dimethylcyclohexane
(C) 1-Ethyl-3, 3-dimethylcyclohexane (D) 1,1-Dimethyl-3-ethylcyclohexane



Chemistry Section B · Numerical value

Q50 to Q58

Sum of bond order of CO and NO⁺ is _____.

Consider the following data for the given reaction



The order of the reaction is _____.

	1	2	3
HI (mol L ⁻¹)	0.005	0.01	0.02
Rate (mol L ⁻¹ s ⁻¹)	7.5 × 10 ⁻⁴	3.0 × 10 ⁻³	1.2 × 10 ⁻²

The mass of silver (Molar mass of Ag : 108g mol⁻¹) displaced by a quantity of electricity which displaces 5600mL of O₂ at S.T.P. will be _____ g.

From the given list, the number of compounds with +4 oxidation state of Sulphur _____.

Mass of methane required to produce 22g of CO₂ after complete combustion is _____ g.(Given Molar mass in g mol⁻¹ C = 12.0, H = 1.0, O = 16.0)

The number of electrons present in all the completely filled subshells having $n = 4$ and $s = +\frac{1}{2}$ is _____.

(Where n = principal quantum number and s = spin quantum number)

If three moles of an ideal gas at 300K expand isothermally from 30dm³ to 45dm³ against a constant opposing pressure of 80kPa, then the amount of heat transferred is _____ J.

3-Methylhex-2-ene on reaction with HBr in presence of peroxide forms an addition product (A). The number of possible stereoisomers for 'A' is _____.

Among the following, total number of meta directing functional groups is (Integer based)

$-\text{OCH}_3$, $-\text{NO}_2$, $-\text{CN}$, $-\text{CH}_3$, $-\text{NHCOCH}_3$, $-\text{COR}$, $-\text{OH}$, $-\text{COOH}$, $-\text{Cl}$

Mathematics Section A · Multiple choice

Q59 to Q78

The distance, of the point $(7, -2, 11)$ from the line

$\frac{x-6}{1} = \frac{y-4}{0} = \frac{z-8}{3}$ along the line $\frac{x-5}{2} = \frac{y-1}{-3} = \frac{z-5}{6}$, is:

- (A) 12 (B) 18 (C) 21 (D) 14

If the shortest distance between the lines

$\frac{x-4}{1} = \frac{y+1}{2} = \frac{z}{-3}$ and $\frac{x-\lambda}{2} = \frac{y+1}{4} = \frac{z-2}{-5}$ is $\frac{6}{\sqrt{5}}$, then the sum of all possible values of λ is:

- (A) 10 (B) 5 (C) 7 (D) 8

${}^{n-1}C_r = (k^2 - 8) {}^nC_{r+1}$ if and only if:

- (A) $2\sqrt{2} < k < 2\sqrt{3}$ (B) $2\sqrt{2} < k \leq 3$ (C) $2\sqrt{3} < k < 3\sqrt{3}$ (D) $2\sqrt{3} < k \leq 3\sqrt{2}$

If A denotes the sum of all the coefficients in the expansion of $(1 - 3x + 10x^2)^n$ and B denotes the sum of all the coefficients in the expansion of $(1 + x^2)^n$, then:

- (A) $B = A^3$ (B) $3A = B$ (C) $A = 3B$ (D) $A = B^3$

Four distinct points $(2k, 3k)$, $(1, 0)$, $(0, 1)$ and $(0, 0)$ lie on a circle for k equal to:

- (A) $\frac{3}{13}$ (B) $\frac{2}{13}$ (C) $\frac{5}{13}$ (D) $\frac{1}{13}$

If $S = \{z \in C : |z - i| = |z + i| = |z - 1|\}$, then, $n(S)$ is:

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

If $\int_0^1 \frac{1}{\sqrt{3+x} + \sqrt{1+x}} dx = a + b\sqrt{2} + c\sqrt{3}$, where a, b, c are rational numbers, then $2a + 3b - 4c$ is equal to:

- (A) 10 (B) 7 (C) 4 (D) 8

Q66 Definite Integration[Step-by-step solution](#) > [prepwise.in/questions/71zyyVfX4s](https://www.prepwise.in/questions/71zyyVfX4s)

If (a, b) be the orthocentre of the triangle whose vertices are $(1, 2)$, $(2, 3)$ and $(3, 1)$, and

$$I_1 = \int_a^b x \sin(4x - x^2) dx, I_2 = \int_a^b \sin(4x - x^2) dx, \text{ then } 36 \frac{I_1}{I_2} \text{ is equal to:}$$

- (A) 80 (B) 72 (C) 66 (D) 88

Q67 Differential Equations[Step-by-step solution](#) > [prepwise.in/questions/081oCKXTzH](https://www.prepwise.in/questions/081oCKXTzH)

Let $x = x(t)$ and $y = y(t)$ be solutions of the differential equations $\frac{dx}{dt} + ax = 0$ and $\frac{dy}{dt} + by = 0$ respectively, $a, b \in \mathbf{R}$. Given that $x(0) = 2$; $y(0) = 1$ and $3y(1) = 2x(1)$, the value of t , for which $x(t) = y(t)$, is:

- (A) $\log_{\frac{2}{3}} 2$ (B) $\log_{\frac{4}{3}} 2$ (C) $\log_4 3$ (D) $\log_3 4$

Q68 Ellipse[Step-by-step solution](#) > [prepwise.in/questions/xDTZQxIB1J](https://www.prepwise.in/questions/xDTZQxIB1J)

The length of the chord of the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$, whose mid point is $(1, \frac{2}{5})$, is equal to:

- (A) $\frac{\sqrt{1691}}{5}$ (B) $\frac{\sqrt{2009}}{5}$ (C) $\frac{\sqrt{1541}}{5}$ (D) $\frac{\sqrt{1741}}{5}$

Q69 Relations & Functions (Basic)[Step-by-step solution](#) > [prepwise.in/questions/7C3eISZQGw](https://www.prepwise.in/questions/7C3eISZQGw)

The function $f : \mathbf{N} - \{1\} \rightarrow \mathbf{N}$; defined by $f(n)$ = the highest prime factor of n , is:

- (A) one-one only (B) neither one-one nor onto
(C) onto only (D) both one-one and onto

Q70 Continuity & Differentiability[Step-by-step solution](#) > [prepwise.in/questions/jNC6k_yrYe](https://www.prepwise.in/questions/jNC6k_yrYe)

Consider the function.

$$f(x) = \begin{cases} \frac{a(7x-12-x^2)}{b|x^2-7x+12|} & , x < 3 \\ 2^{\frac{\sin(x-3)}{x-[x]}} & , x > 3 \\ b & , x = 3, \end{cases}$$

where $[x]$ denotes the greatest integer less than or equal to x . If S denotes the set of all ordered pairs (a, b) such that $f(x)$ is continuous at $x = 3$, then the number of elements in S is:

- (A) Infinitely many (B) 4 (C) 2 (D) 1

Q71 Limits[Step-by-step solution](#) > [prepwise.in/questions/eLzmFim6IO](https://www.prepwise.in/questions/eLzmFim6IO)

If $a = \lim_{x \rightarrow 0} \frac{\sqrt{1+\sqrt{1+x^4}}-\sqrt{2}}{x^4}$ and $b = \lim_{x \rightarrow 0} \frac{\sin^2 x}{\sqrt{2}-\sqrt{1+\cos x}}$, then the value of ab^3 is:

- (A) 36 (B) 25 (C) 32 (D) 30

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Q72 Matrices[Step-by-step solution](#) › [prepwise.in/questions/lZuB3JSwpT](https://www.prepwise.in/questions/lZuB3JSwpT)

Consider the matrix $f(x) = \begin{bmatrix} \cos x & -\sin x & 0 \\ \sin x & \cos x & 0 \\ 0 & 0 & 1 \end{bmatrix}$.

Given below are two statements:

Statement I: $f(-x)$ is the inverse of the matrix $f(x)$.

Statement II: $f(x)f(y) = f(x+y)$.

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

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

Q73 Parabola[Step-by-step solution](#) › [prepwise.in/questions/phHJqWH5rP](https://www.prepwise.in/questions/phHJqWH5rP)

If the shortest distance of the parabola $y^2 = 4x$ from the centre of the circle $x^2 + y^2 - 4x - 16y + 64 = 0$ is d , then d^2 is equal to:

- (A) 16 (B) 24 (C) 20 (D) 36

Q74 Sequences & Series[Step-by-step solution](#) › [prepwise.in/questions/O6ZDP-jLgr](https://www.prepwise.in/questions/O6ZDP-jLgr)

The number of common terms in the progressions

4, 9, 14, 19, ..., up to 25th term and

3, 6, 9, 12, ..., up to 37th term is:

- (A) 9 (B) 8 (C) 5 (D) 7

Q75 Relations & Functions (Basic)[Step-by-step solution](#) › [prepwise.in/questions/zcKUth9_Kx](https://www.prepwise.in/questions/zcKUth9_Kx)

Let $S = \{1, 2, 3, \dots, 10\}$. Suppose M is the set of all the subsets of S , then the relation

$R = \{(A, B) : A \cap B \neq \phi; A, B \in M\}$ is:

- (A) symmetric only (B) reflexive only
(C) symmetric and reflexive only (D) symmetric and transitive only

Q76 Statistics[Step-by-step solution](#) › [prepwise.in/questions/CPpzeKk1GY](https://www.prepwise.in/questions/CPpzeKk1GY)

Let $a_1, a_2, \dots, a_{10}$ be 10 observations such that $\sum_{k=1}^{10} a_k = 50$ and $\sum_{\forall k < j} a_k \cdot a_j = 1100$. Then the standard deviation of $a_1, a_2, \dots, a_{10}$ is equal to:

- (A) 5 (B) $\sqrt{115}$ (C) 10 (D) $\sqrt{5}$

Q77 Vectors[Step-by-step solution](#) › [prepwise.in/questions/bmL9psp7WT](https://www.prepwise.in/questions/bmL9psp7WT)

Let $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$,

$\vec{b} = 3(\hat{i} - \hat{j} + \hat{k})$.

Let $\vec{c}$ be the vector such that $\vec{a} \times \vec{c} = \vec{b}$ and $\vec{a} \cdot \vec{c} = 3$.

Then $\vec{a} \cdot ((\vec{c} \times \vec{b}) - \vec{b} - \vec{c})$ is equal to:

- (A) 32 (B) 36 (C) 24 (D) 20

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The portion of the line $4x + 5y = 20$ in the first quadrant is trisected by the lines L_1 and L_2 passing through the origin. The tangent of an angle between the lines L_1 and L_2 is:

- (A) $\frac{30}{41}$ (B) $\frac{8}{5}$ (C) $\frac{2}{5}$ (D) $\frac{25}{41}$

Mathematics Section B · Numerical value

Q79 to Q88

Q79 Differentiation NUMERICAL

[Step-by-step solution](#) › [prepwisar.in/questions/af30CIBVKG](https://www.prepwisar.in/questions/af30CIBVKG)

Let for a differentiable function $f : (0, \infty) \rightarrow \mathbf{R}$, $f(x) - f(y) \geq \log_e \left(\frac{x}{y} \right) + x - y, \forall x, y \in (0, \infty)$.

Then $\sum_{n=1}^{20} f' \left(\frac{1}{n^2} \right)$ is equal to _____.

Q80 Complex Numbers NUMERICAL

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

If α satisfies the equation $x^2 + x + 1 = 0$ and $(1 + \alpha)^7 = A + B\alpha + C\alpha^2, A, B, C \geq 0$, then $5(3A - 2B - C)$ is equal to _____.

Q81 Differential Equations NUMERICAL

[Step-by-step solution](#) › [prepwisar.in/questions/nlpkwI1t79](https://www.prepwisar.in/questions/nlpkwI1t79)

If the solution of the differential equation

$$(2x + 3y - 2)dx + (4x + 6y - 7)dy = 0, y(0) = 3, \text{ is}$$

$\alpha x + \beta y + 3 \log_e |2x + 3y - \gamma| = 6$, then $\alpha + 2\beta + 3\gamma$ is equal to _____.

Q82 Differentiation NUMERICAL

[Step-by-step solution](#) › [prepwisar.in/questions/PWKg23ZcoV](https://www.prepwisar.in/questions/PWKg23ZcoV)

Let $f(x) = x^3 + x^2 f'(1) + x f''(2) + f'''(3), x \in \mathbf{R}$. Then $f'(10)$ is equal to _____.

Q83 Matrices NUMERICAL

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

Let $A = \begin{bmatrix} 2 & 0 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}, B = [B_1, B_2, B_3]$, where B_1, B_2, B_3 are column matrices, and

$$AB_1 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, AB_2 = \begin{bmatrix} 2 \\ 3 \\ 0 \end{bmatrix}, AB_3 = \begin{bmatrix} 3 \\ 2 \\ 1 \end{bmatrix}$$

If $\alpha = |B|$ and β is the sum of all the diagonal elements of B , then $\alpha^3 + \beta^3$ is equal to _____.

Q84 Probability: Advanced NUMERICAL

[Step-by-step solution](#) › [prepwisar.in/questions/0SXfXyLxcg](https://www.prepwisar.in/questions/0SXfXyLxcg)

A fair die is tossed repeatedly until a six is obtained. Let X denote the number of tosses required and let

$a = P(X = 3), b = P(X \geq 3)$ and $c = P(X \geq 6 | X > 3)$. Then $\frac{b+c}{a}$ is equal to _____.

Q85 Sequences & Series NUMERICAL

[Step-by-step solution](#) › [prepwisar.in/questions/0ptLfOeAih](https://www.prepwisar.in/questions/0ptLfOeAih)

If $8 = 3 + \frac{1}{4}(3 + p) + \frac{1}{4^2}(3 + 2p) + \frac{1}{4^3}(3 + 3p) + \dots \infty$, then the value of p is _____.

Q86 Vectors NUMERICAL

[Step-by-step solution](#) › [prepwisar.in/questions/zv9-oEPRKC](https://www.prepwisar.in/questions/zv9-oEPRKC)

The least positive integral value of α , for which the angle between the vectors $\alpha \hat{i} - 2\hat{j} + 2\hat{k}$ and $\alpha \hat{i} + 2\alpha \hat{j} - 2\hat{k}$ is acute, is _____.

Let the area of the region $\{(x, y) : x - 2y + 4 \geq 0, x + 2y^2 \geq 0, x + 4y^2 \leq 8, y \geq 0\}$ be $\frac{m}{n}$, where m and n are coprime numbers. Then $m + n$ is equal to _____.

Let the set of all $a \in \mathbf{R}$ such that the equation $\cos 2x + a \sin x = 2a - 7$ has a solution be $[p, q]$ and $r = \tan 9^\circ - \tan 27^\circ - \frac{1}{\cot 63^\circ} + \tan 81^\circ$, then pqr is equal to _____.

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Physics

1. B	2. C	3. D	4. B	5. C	6. A	7. C	8. B
9. D	10. C	11. A	12. B	13. D	14. D	15. C	16. B
17. C	18. D	19. B	20. A	21. 236	22. 400	23. 2	24. 3
25. 31	26. 160	27. 673	28. 2	29. 16	30. 12		

Chemistry

31. A	32. B	33. A	34. D	35. C	36. D	37. D	38. A
39. A	40. D	41. A	42. D	43. B	44. C	45. D	46. D
47. D	48. D	49. B	50. 6	51. 2	52. 108	53. 3	54. 8
55. 16	56. 1200	57. 4	58. 4				

Mathematics

59. D	60. D	61. B	62. D	63. C	64. A	65. D	66. B
67. B	68. A	69. B	70. D	71. C	72. C	73. C	74. D
75. A	76. D	77. C	78. A	79. 2890	80. 5	81. 29	82. 202
83. 28	84. 12	85. 9	86. 5	87. 119	88. 48		

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