

JEE MAIN 2023 · QUESTION PAPER

13 Apr 2023 **Shift 1**

79 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	18 Q1 to Q18	10 Q19 to Q28
● Chemistry	14 Q29 to Q42	8 Q43 to Q50
● Mathematics	19 Q51 to Q69	10 Q70 to Q79
In this PDF 79 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/2023-04-13-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 Nuclear Physics

[Step-by-step solution](https://www.prepwise.in/questions/pCj7VuAHCc) > prepwise.in/questions/pCj7VuAHCc



In the given nuclear reaction, the approximate amount of energy released will be:

[Given, mass of

$${}_{92}^{238}\text{A} = 238.05079 \times 931.5 \text{MeV}/c^2,$$

mass of

$${}_{90}^{234}\text{B} = 234.04363 \times 931.5 \text{MeV}/c^2,$$

mass of

$${}_2^4\text{D} = 4.00260 \times 931.5 \text{MeV}/c^2]$$

(A) 2.12 MeV

(B) 4.25 MeV

(C) 3.82 MeV

(D) 5.9 MeV

Q2 Centre of Mass & Linear Momentum

[Step-by-step solution](https://www.prepwise.in/questions/b2KDD6BIHi) > prepwise.in/questions/b2KDD6BIHi

A bullet of 10g leaves the barrel of gun with a velocity of 600m/s. If the barrel of gun is 50cm long and mass of gun is 3kg, then value of impulse supplied to the gun will be:

(A) 12 Ns

(B) 3 Ns

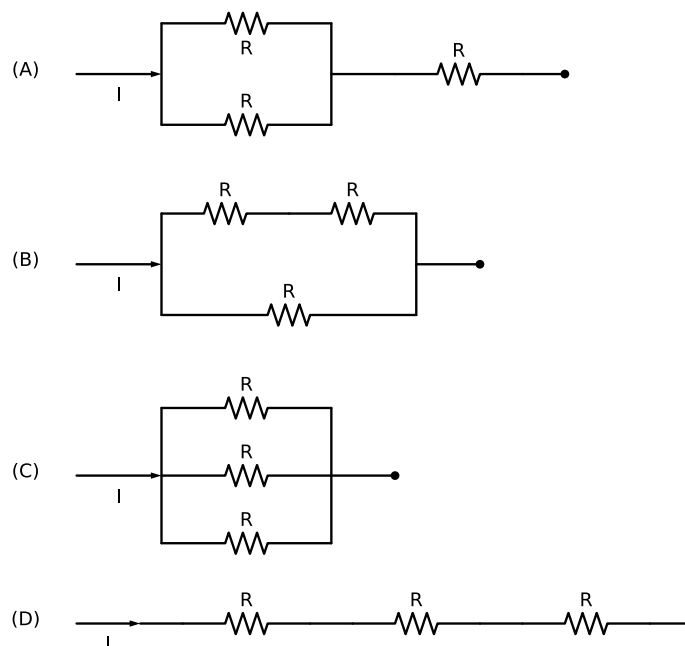
(C) 6 Ns

(D) 36 Ns

Q3 Current Electricity

[Step-by-step solution](https://www.prepwise.in/questions/YgZrC2xPgN) > prepwise.in/questions/YgZrC2xPgN

Different combination of 3 resistors of equal resistance R are shown in the figures. The increasing order for power dissipation is:



(A) $P_B < P_C < P_D < P_A$

(B) $P_C < P_B < P_A < P_D$

(C) $P_C < P_D < P_A < P_B$

(D) $P_A < P_B < P_C < P_D$

The difference between threshold wavelengths for two metal surfaces A and B having work function $\phi_A = 9\text{eV}$ and $\phi_B = 4.5\text{eV}$ in nm is:

{ Given, $hc = 1242\text{eVnm}$ }

(A) 264

(B) 138

(C) 540

(D) 276

Which of the following Maxwell's equation is valid for time varying conditions but not valid for static conditions:

(A) $\oint \vec{E} \cdot d\vec{l} = 0$

(B) $\oint \vec{B} \cdot d\vec{l} = \mu_0 I$

(C) $\oint \vec{E} \cdot d\vec{l} = -\frac{\partial \phi_B}{\partial t}$

(D) $\oint \vec{D} \cdot d\vec{A} = Q$

Two charges each of magnitude 0.01C and separated by a distance of 0.4mm constitute an electric dipole. If the dipole is placed in an uniform electric field ' $\vec{E}$ ' of 10 dyne/C making 30° angle with $\vec{E}$, the magnitude of torque acting on dipole is:

(A) $4.0 \times 10^{-10}\text{Nm}$

(B) $1.5 \times 10^{-9}\text{Nm}$

(C) $1.0 \times 10^{-8}\text{Nm}$

(D) $2.0 \times 10^{-10}\text{Nm}$

A vessel of depth ' d ' is half filled with oil of refractive index n_1 and the other half is filled with water of refractive index n_2 . The apparent depth of this vessel when viewed from above will be-

(A) $\frac{2d(n_1 + n_2)}{n_1 n_2}$

(B) $\frac{d(n_1 + n_2)}{2n_1 n_2}$

(C) $\frac{dn_1 n_2}{2(n_1 + n_2)}$

(D) $\frac{dn_1 n_2}{(n_1 + n_2)}$

A planet having mass $9M_e$ and radius $4R_e$, where M_e and R_e are mass and radius of earth respectively, has escape velocity in km/s given by:

(Given escape velocity on earth $V_e = 11.2 \times 10^3\text{m/s}$)

(A) 33.6

(B) 11.2

(C) 16.8

(D) 67.2

The rms speed of oxygen molecule in a vessel at particular temperature is $(1 + \frac{5}{x})^{\frac{1}{2}} v$, where v is the average speed of the molecule. The value of x will be:

(Take $\pi = \frac{22}{7}$)

(A) 4

(B) 8

(C) 28

(D) 27

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Q10 Electromagnetic Waves[Step-by-step solution > prepwisar.in/questions/tfTqeBEswp](https://www.prepwisar.in/questions/tfTqeBEswp)

The source of time varying magnetic field may be

- (A) a permanent magnet
- (B) an electric field changing linearly with time
- (C) direct current
- (D) a decelerating charge particle
- (E) an antenna fed with a digital signal

Choose the correct answer from the options given below:

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

Q11 Projectile Motion & Relative Motion[Step-by-step solution > prepwisar.in/questions/8V7GLxbiRV](https://www.prepwisar.in/questions/8V7GLxbiRV)

Two trains 'A' and 'B' of length ' l ' and ' $4l$ ' are travelling into a tunnel of length ' L ' in parallel tracks from opposite directions with velocities 108km/h and 72km/h , respectively. If train 'A' takes 35s less time than train 'B' to cross the tunnel then. length ' L ' of tunnel is:

(Given $L = 60l$)

- (A) 900 m (B) 1200 m (C) 1800 m (D) 2700 m

Q12 Fluid Mechanics[Step-by-step solution > prepwisar.in/questions/t98D60Y8Y0](https://www.prepwisar.in/questions/t98D60Y8Y0)

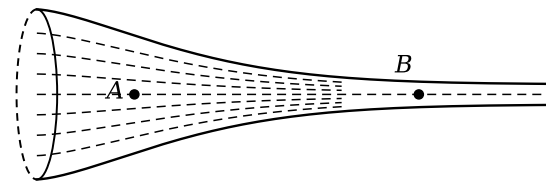
The figure shows a liquid of given density flowing steadily in horizontal tube of varying cross - section. Cross sectional areas at A is 1.5cm^2 , and B is 25mm^2 , if the speed of liquid at B is 60cm/s then $(P_A - P_B)$ is:

(Given P_A and P_B are liquid pressures at A and B% points.

density $\rho = 1000\text{kgm}^{-3}$

A and B are on the axis of tube

- (A) 27Pa (B) 175Pa (C) 135Pa (D) 36Pa

**Q13** Elasticity[Step-by-step solution > prepwisar.in/questions/Tko4ofNmJ9](https://www.prepwisar.in/questions/Tko4ofNmJ9)

Under isothermal condition, the pressure of a gas is given by $P = aV^{-3}$, where a is a constant and V is the volume of the gas. The bulk modulus at constant temperature is equal to

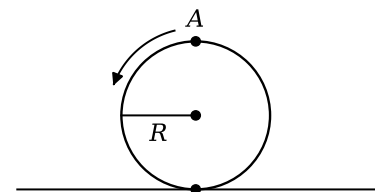
- (A) $\frac{P}{2}$ (B) $2P$ (C) $3P$ (D) P

Q14 Rotational Motion[Step-by-step solution > prepwisar.in/questions/ITmIW0nrEZ](https://www.prepwisar.in/questions/ITmIW0nrEZ)

A disc is rolling without slipping on a surface. The radius of the disc is R .

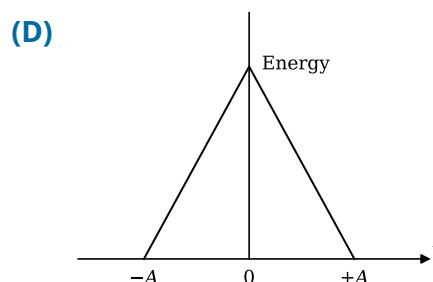
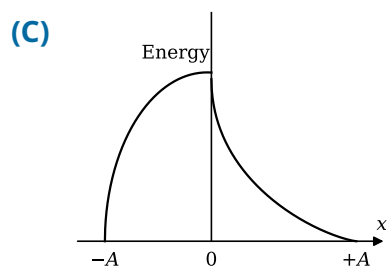
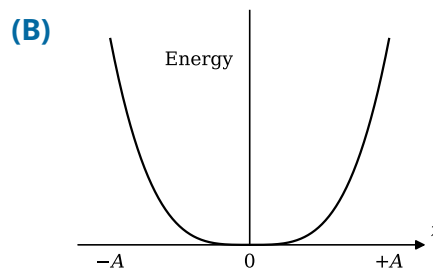
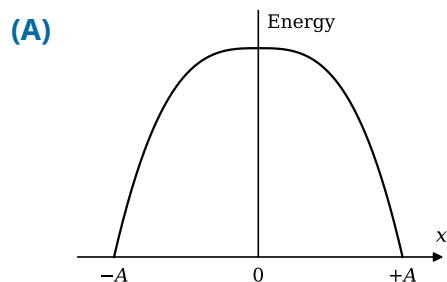
At $t = 0$, the top most point on the disc is A as shown in figure. When the disc completes half of its rotation, the displacement of point A from its initial position is

- (A) $R\sqrt{(\pi^2 + 1)}$ (B) $2R$ (C) $R\sqrt{(\pi^2 + 4)}$ (D) $2R\sqrt{(1 + 4\pi^2)}$



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Which graph represents the difference between total energy and potential energy of a particle executing SHM vs its distance from mean position?



The ratio of powers of two motors is $\frac{3\sqrt{x}}{\sqrt{x+1}}$, that are capable of raising 300kg water in 5 minutes and 50kg water in 2 minutes respectively from a well of 100m deep. The value of x will be

- (A)** 16 **(B)** 4 **(C)** 2 **(D)** 2.4

Two bodies are having kinetic energies in the ratio 16 : 9. If they have same linear momentum, the ratio of their masses respectively is:

- (A)** 3 : 4 **(B)** 4 : 3 **(C)** 9 : 16 **(D)** 16 : 9

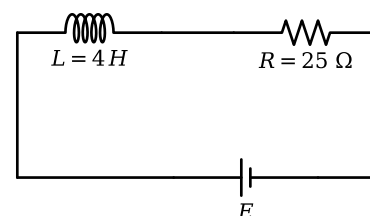
A body of mass $(5 \pm 0.5)\text{kg}$ is moving with a velocity of $(20 \pm 0.4)\text{m/s}$. Its kinetic energy will be

- (A)** $(1000 \pm 140)\text{J}$ **(B)** $(500 \pm 0.14)\text{J}$ **(C)** $(1000 \pm 0.14)\text{J}$ **(D)** $(500 \pm 140)\text{J}$

Physics Section B · Numerical value

Q19 to Q28

In the given figure, an inductor and a resistor are connected in series with a battery of emf E volt. $\frac{E^a}{2b}\text{J/s}$ represents the maximum rate at which the energy is stored in the magnetic field (inductor). The numerical value of $\frac{b}{a}$ will be _____.



The radius of 2nd orbit of He^+ of Bohr's model is r_1 and that of fourth orbit of Be^{3+} is represented as r_2 . Now the ratio $\frac{r_2}{r_1}$ is $x : 1$. The value of x is _____.

Q21 Moving Charges & Magnetism **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/UZA_k7QuEB](https://www.prepwisar.in/questions/UZA_k7QuEB)

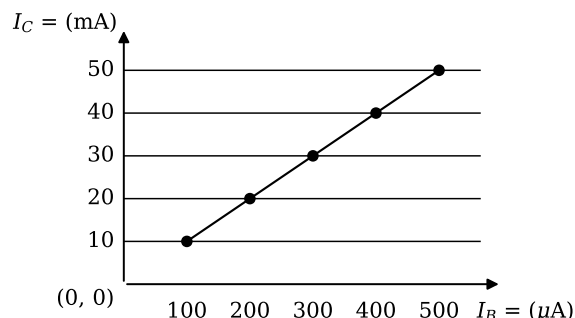
When a resistance of 5Ω is shunted with a moving coil galvanometer, it shows a full scale deflection for a current of 250mA , however when 1050Ω resistance is connected with it in series, it gives full scale deflection for 25 volt. The resistance of galvanometer is _____ Ω .

Q22 Current Electricity **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/LbxIBxiXHT](https://www.prepwisar.in/questions/LbxIBxiXHT)

A potential V_0 is applied across a uniform wire of resistance R . The power dissipation is P_1 . The wire is then cut into two equal halves and a potential of V_0 is applied across the length of each half. The total power dissipation across two wires is P_2 . The ratio $P_2 : P_1$ is $\sqrt{x} : 1$. The value of x is _____.

Q23 Semiconductors & Electronic Devices **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/8MGOuA1hjb](https://www.prepwisar.in/questions/8MGOuA1hjb)

From the given transfer characteristic of a transistor in CE configuration, the value of power gain of this configuration is 10^x , for $R_B = 10\text{k}\Omega$, and $R_C = 1\text{k}\Omega$. The value of x is _____.

**Q24** Electrostatics I: Charges, Field & Gauss's Law **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/XjFijUuPvZ](https://www.prepwisar.in/questions/XjFijUuPvZ)

A thin infinite sheet charge and an infinite line charge of respective charge densities $+\sigma$ and $+\lambda$ are placed parallel at 5m distance from each other. Points 'P' and 'Q' are at $\frac{3}{\pi}\text{m}$ and $\frac{4}{\pi}\text{m}$ perpendicular distances from line charge towards sheet charge, respectively. ' E_P ' and ' E_Q ' are the magnitudes of resultant electric field intensities at point 'P' and 'Q', respectively. If $\frac{E_P}{E_Q} = \frac{4}{a}$ for $2|\sigma| = |\lambda|$, then the value of a is _____.

Q25 Ray Optics **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/aVUt-hN2si](https://www.prepwisar.in/questions/aVUt-hN2si)

A fish rising vertically upward with a uniform velocity of 8ms^{-1} , observes that a bird is diving vertically downward towards the fish with the velocity of 12ms^{-1} . If the refractive index of water is $\frac{4}{3}$, then the actual velocity of the diving bird to pick the fish, will be _____ ms^{-1} .

Q26 Elasticity **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/Es3wg8gI4t](https://www.prepwisar.in/questions/Es3wg8gI4t)

The elastic potential energy stored in a steel wire of length 20m stretched through 2cm is 80J . The cross sectional area of the wire is _____ mm^2 .
(Given, $y = 2.0 \times 10^{11}\text{Nm}^{-2}$)

Q27 Rotational Motion **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/6G_0n1u4Ad](https://www.prepwisar.in/questions/6G_0n1u4Ad)

A solid sphere is rolling on a horizontal plane without slipping. If the ratio of angular momentum about axis of rotation of the sphere to the total energy of moving sphere is $\pi : 22$ then, the value of its angular speed will be _____ rad/s .

Q28 Simple Harmonic Motion **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/t8bFJaYmPO](https://www.prepwisar.in/questions/t8bFJaYmPO)

At a given point of time the value of displacement of a simple harmonic oscillator is given as $y = A \cos(30^\circ)$. If amplitude is 40cm and kinetic energy at that time is 200J , the value of force constant is $1.0 \times 10^x\text{Nm}^{-1}$. The value of x is _____.

Q29 Halogen Derivatives: Haloalkanes & Haloarenes[Step-by-step solution](#) › [prepwisar.in/questions/L6Psas5HMT](https://www.prepwisar.in/questions/L6Psas5HMT)

2-Methyl propyl bromide reacts with $\text{C}_2\text{H}_5\text{O}^-$ and gives 'A' whereas on reaction with $\text{C}_2\text{H}_5\text{OH}$ it gives 'B'. The mechanism followed in these reactions and the products 'A' and 'B' respectively are:

- (A) $\text{S}_{\text{N}}1$, A = tert-butyl ethyl ether; $\text{S}_{\text{N}}2$, B = iso-butyl ethyl ether
(B) $\text{S}_{\text{N}}1$, A = tert-butyl ethyl ether; $\text{S}_{\text{N}}1$, B = 2-butyl ethyl ether
(C) $\text{S}_{\text{N}}2$, A = iso-butyl ethyl ether; $\text{S}_{\text{N}}1$, B = tert-butyl ethyl ether
(D) $\text{S}_{\text{N}}2$, A = 2-butyl ethyl ether; $\text{S}_{\text{N}}2$, B = iso-butyl ethyl ether

Q30 Chemical Bonding & Molecular Structure[Step-by-step solution](#) › [prepwisar.in/questions/pjg6qHecdP](https://www.prepwisar.in/questions/pjg6qHecdP)

In which of the following processes, the bond order increases and paramagnetic character changes to diamagnetic one?

- (A) $\text{O}_2 \rightarrow \text{O}_2^{2-}$ (B) $\text{N}_2 \rightarrow \text{N}_2^+$ (C) $\text{NO} \rightarrow \text{NO}^+$ (D) $\text{O}_2 \rightarrow \text{O}_2^+$

Q31 Coordination Compounds[Step-by-step solution](#) › [prepwisar.in/questions/kJRTYhnyy1](https://www.prepwisar.in/questions/kJRTYhnyy1)

The mismatched combinations are

- A. Chlorophyll - Co
B. Water hardness - EDTA
C. Photography – $[\text{Ag}(\text{CN})_2]^-$
D. Wilkinson catalyst – $[(\text{Ph}_3\text{P})_3\text{RhCl}]$
E. Chelating ligand - D-Penicillamine

Choose the correct answer from the options given below:

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

Q32 d & f Block Elements[Step-by-step solution](#) › [prepwisar.in/questions/JLaehoBh00](https://www.prepwisar.in/questions/JLaehoBh00)

The pair of lanthanides in which both elements have high third - ionization energy is:

- (A) Dy, Gd (B) Lu, Yb (C) Eu, Yb (D) Eu, Gd

Q33 Environmental Chemistry[Step-by-step solution](#) › [prepwisar.in/questions/bMANGZVTZv](https://www.prepwisar.in/questions/bMANGZVTZv)

Given below are two statements:

Statement I : Permutit process is more efficient compared to the synthetic resin method for the softening of water.

Statement II : Synthetic resin method results in the formation of soluble sodium salts.

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

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Q34 Metallurgy[Step-by-step solution](#) › prepwiser.in/questions/9onDWbuZ50

Which one of the following is most likely a mismatch?

- (A) Titanium - van Arkel Method
(B) Zinc - Liquation
(C) Nickel - Mond process
(D) Copper - Electrolysis

Q35 p-Block Elements: Part I (Group 13 & 14)[Step-by-step solution](#) › prepwiser.in/questions/gWexcTNGu_

The incorrect statement from the following for borazine is:

- (A) It can react with water.
(B) It is a cyclic compound.
(C) It has electronic delocalization.
(D) It contains banana bonds.

Q36 Periodic Table & Periodicity[Step-by-step solution](#) › prepwiser.in/questions/bMtEyqenbB

Which of the following statements are not correct?

- A. The electron gain enthalpy of F is more negative than that of Cl.
B. Ionization enthalpy decreases in a group of periodic table.
C. The electronegativity of an atom depends upon the atoms bonded to it.
D. Al_2O_3 and NO are examples of amphoteric oxides.

Choose the most appropriate answer from the options given below:

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

Q37 Polymers[Step-by-step solution](#) › prepwiser.in/questions/7geu8xAt3y

Match the following

	Column A		Column B
(a)	Nylon 6	(I)	Natural Rubber
(b)	Vulcanized Rubber	(II)	Cross Linked
(c)	cis-1, 4-polyisoprene	(III)	Caprolactam
(d)	Polychloroprene	(IV)	Neoprene

Choose the correct answer from options given below:

- (A) $a \rightarrow \text{III}, b \rightarrow \text{II}, c \rightarrow \text{I}, d \rightarrow \text{IV}$
(B) $a \rightarrow \text{II}, b \rightarrow \text{III}, c \rightarrow \text{IV}, d \rightarrow \text{I}$
(C) $a \rightarrow \text{IV}, b \rightarrow \text{III}, c \rightarrow \text{I}, d \rightarrow \text{II}$
(D) $a \rightarrow \text{III}, b \rightarrow \text{IV}, c \rightarrow \text{I}, d \rightarrow \text{II}$

Q38 Hydrogen & s-Block Elements[Step-by-step solution](#) › prepwiser.in/questions/n3xa6iDjvU

$\text{Be}(\text{OH})_2$ reacts with $\text{Sr}(\text{OH})_2$ to yield an ionic salt.

Choose the incorrect option related to this reaction from the following:

- (A) Be is tetrahedrally coordinated in the ionic salt.
(B) The element Be is present in the cationic part of the ionic salt.
(C) Both Sr and Be elements are present in the ionic salt.
(D) The reaction is an example of acid - base neutralization reaction.

Q39 Atomic Structure[Step-by-step solution](#) › prepwiser.in/questions/p5Sm_WLzfw

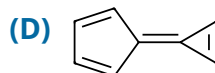
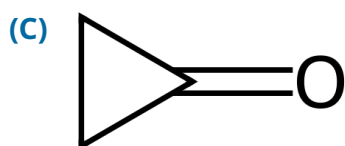
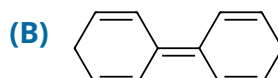
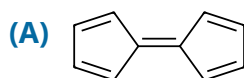
The energy of an electron in the first Bohr orbit of hydrogen atom is $-2.18 \times 10^{-18} \text{J}$. Its energy in the third Bohr orbit is _____.

- (A) One third of this value
(B) Three times of this value
(C) $\frac{1}{9}$ th of this value
(D) $\frac{1}{27}$ of this value

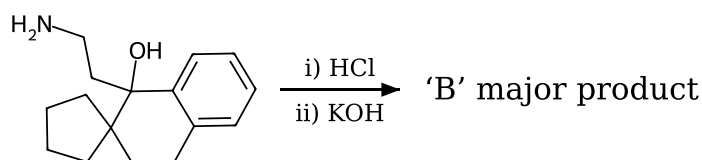
What happens when a lyophilic sol is added to a lyophobic sol?

- (A) Film of lyophobic sol is formed over lyophilic sol.
 (B) Lyophilic sol is dispersed in lyophobic sol.
 (C) Film of lyophilic sol is formed over lyophobic sol.
 (D) Lyophobic sol is coagulated

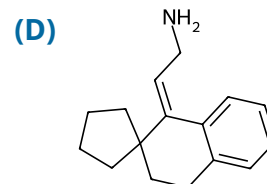
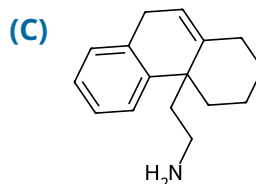
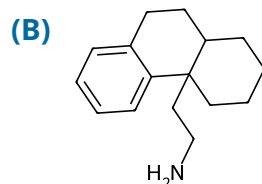
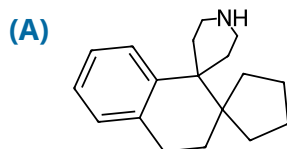
Among the following compounds, the one which shows highest dipole moment is



In the reaction given below



'B' is



Chemistry Section B · Numerical value

Q43 to Q50

$t_{87.5}$ is the time required for the reaction to undergo 87.5% completion and t_{50} is the time required for the reaction to undergo 50% completion. The relation between $t_{87.5}$ and t_{50} for a first order reaction is $t_{87.5} = x \times t_{50}$. The value of x is _____. (Nearest integer)

A metal surface of 100cm^2 area has to be coated with nickel layer of thickness 0.001mm . A current of 2A was passed through a solution of $\text{Ni}(\text{NO}_3)_2$ for 'x' seconds to coat the desired layer. The value of x is _____. (Nearest integer) (ρ_{Ni} (density of Nickel) is 10g/mL , Molar mass of Nickel is 60g/mol^{-1} $F = 96500\text{C/mol}^{-1}$)

25.0mL of 0.050M $\text{Ba}(\text{NO}_3)_2$ is mixed with 25.0mL of 0.020M NaF . K_{sp} of BaF_2 is 0.5×10^{-6} at 298K . The ratio of $[\text{Ba}^{2+}] [\text{F}^-]^2$ and K_{sp} is _____. (Nearest integer)

Solution of 12g of non-electrolyte (A) prepared by dissolving it in 1000mL of water exerts the same osmotic pressure as that of 0.05M glucose solution at the same temperature. The empirical formula of A is CH_2O . The molecular mass of A is _____ g. (Nearest integer)

An organic compound gives 0.220g of CO_2 and 0.126g of H_2O on complete combustion. If the % of carbon is 24 then the % of hydrogen is _____ $\times 10^{-1}$. (Nearest integer)

20mL of calcium hydroxide was consumed when it was reacted with 10mL of unknown solution of H_2SO_4 . Also 20mL standard solution of 0.5M HCl containing 2 drops of phenolphthalein was titrated with calcium hydroxide, the mixture showed pink colour when burette displayed the value of 35.5mL whereas the burette showed 25.5mL initially. The concentration of H_2SO_4 is _____ M. (Nearest integer)



AB, A_2 and B_2 are diatomic molecules. If the bond enthalpies of A_2 , B_2 and AB are in the ratio 1 : 0.5 : 1, then the bond enthalpy of A_2 is _____ kJ mol^{-1} (Nearest integer)

KMnO_4 is titrated with ferrous ammonium sulphate hexahydrate in presence of dilute H_2SO_4 . Number of water molecules produced for 2 molecules of KMnO_4 is _____.

Mathematics Section A · Multiple choice

Q51 to Q69

Let the equation of plane passing through the line of intersection of the planes $x + 2y + az = 2$ and $x - y + z = 3$ be $5x - 11y + bz = 6a - 1$. For $c \in \mathbb{Z}$, if the distance of this plane from the point $(a, -c, c)$ is $\frac{2}{\sqrt{a}}$, then $\frac{a+b}{c}$ is equal to:

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

The distance of the point $(-1, 2, 3)$ from the plane $\vec{r} \cdot (\hat{i} - 2\hat{j} + 3\hat{k}) = 10$ parallel to the line of the shortest distance between the lines $\vec{r} = (\hat{i} - \hat{j}) + \lambda(2\hat{i} + \hat{k})$ and $\vec{r} = (2\hat{i} - \hat{j}) + \mu(\hat{i} - \hat{j} + \hat{k})$ is:

- (A) $3\sqrt{6}$ (B) $3\sqrt{5}$ (C) $2\sqrt{6}$ (D) $2\sqrt{5}$

$$\max_{0 \leq x \leq \pi} \left\{ x - 2 \sin x \cos x + \frac{1}{3} \sin 3x \right\} =$$

- (A) $\frac{5\pi + 2 + 3\sqrt{3}}{6}$ (B) 0 (C) $\frac{\pi + 2 - 3\sqrt{3}}{6}$ (D) π

Q54 Relations & Functions (Basic)[Step-by-step solution](https://www.prepwiser.in/questions/0DK8EMVTKX) › prepwiser.in/questions/0DK8EMVTKXFractional part of the number $\frac{4^{2022}}{15}$ is equal to

(A) $\frac{8}{15}$

(B) $\frac{4}{15}$

(C) $\frac{1}{15}$

(D) $\frac{14}{15}$

Q55 Definite Integration[Step-by-step solution](https://www.prepwiser.in/questions/OBuCbZQIBK) › prepwiser.in/questions/OBuCbZQIBK

Among

(S1): $\lim_{n \rightarrow \infty} \frac{1}{n^2} (2 + 4 + 6 + \dots + 2n) = 1$

(S2):

$$\lim_{n \rightarrow \infty} \frac{1}{n^{16}} (1^{15} + 2^{15} + 3^{15} + \dots + n^{15}) = \frac{1}{16}$$

(A) Only (S1) is true**(B)** Both (S1) and (S2) are true**(C)** Both (S1) and (S2) are false**(D)** Only (S2) is true**Q56** Definite Integration[Step-by-step solution](https://www.prepwiser.in/questions/ShoLIYf74I) › prepwiser.in/questions/ShoLIYf74I

$$\int_0^{\infty} \frac{6}{e^{3x} + 6e^{2x} + 11e^x + 6} dx =$$

(A) $\log_e \left(\frac{256}{81} \right)$

(B) $\log_e \left(\frac{64}{27} \right)$

(C) $\log_e \left(\frac{32}{27} \right)$

(D) $\log_e \left(\frac{512}{81} \right)$

Q57 Differential Equations[Step-by-step solution](https://www.prepwiser.in/questions/bSpwr0p6SA) › prepwiser.in/questions/bSpwr0p6SALet $y = y_1(x)$ and $y = y_2(x)$ be the solution curves of the differential equation $\frac{dy}{dx} = y + 7$ with initial conditions $y_1(0) = 0$ and $y_2(0) = 1$ respectively. Then the curves $y = y_1(x)$ and $y = y_2(x)$ intersect at**(A)** no point**(B)** two points**(C)** infinite number of points**(D)** one point**Q58** Functions (Advanced)[Step-by-step solution](https://www.prepwiser.in/questions/a75uwLwACW) › prepwiser.in/questions/a75uwLwACWFor the differentiable function $f : \mathbb{R} - \{0\} \rightarrow \mathbb{R}$, let $3f(x) + 2f\left(\frac{1}{x}\right) = \frac{1}{x} - 10$, then $|f(3) + f'\left(\frac{1}{4}\right)|$ is equal to

(A) 13

(B) $\frac{29}{5}$

(C) $\frac{33}{5}$

(D) 7

Q59 Ellipse[Step-by-step solution](https://www.prepwiser.in/questions/6s3RneZf33) › prepwiser.in/questions/6s3RneZf33Let the tangent and normal at the point $(3\sqrt{3}, 1)$ on the ellipse $\frac{x^2}{36} + \frac{y^2}{4} = 1$ meet the y -axis at the points A and B respectively. Let the circle C be drawn taking AB as a diameter and the line $x = 2\sqrt{5}$ intersect C at the points P and Q . If the tangents at the points P and Q on the circle intersect at the point (α, β) , then $\alpha^2 - \beta^2$ is equal to:

(A) 61

(B) $\frac{304}{5}$

(C) 60

(D) $\frac{314}{5}$

Q60 Relations & Functions (Basic)[Step-by-step solution](https://www.prepwiser.in/questions/nmpBPZjRen) › prepwiser.in/questions/nmpBPZjRenFor $x \in \mathbb{R}$, two real valued functions $f(x)$ and $g(x)$ are such that, $g(x) = \sqrt{x} + 1$ and $f \circ g(x) = x + 3 - \sqrt{x}$. Then $f(0)$ is equal to

(A) 5

(B) 0

(C) -3

(D) 1

Q61 Determinants[Step-by-step solution](https://www.prepwise.in/questions/a49XREILvT) › prepwise.in/questions/a49XREILvT

For the system of linear equations

$$2x + 4y + 2az = b$$

$$x + 2y + 3z = 4$$

$$2x - 5y + 2z = 8$$

which of the following is NOT correct?

- (A) It has infinitely many solutions if $a = 3, b = 8$ (B) It has infinitely many solutions if $a = 3, b = 6$
(C) It has unique solution if $a = b = 8$ (D) It has unique solution if $a = b = 6$

Q62 Determinants[Step-by-step solution](https://www.prepwise.in/questions/qMvUUMeVgR) › prepwise.in/questions/qMvUUMeVgR

Let

$$B = \begin{bmatrix} 1 & 3 & \alpha \\ 1 & 2 & 3 \\ \alpha & \alpha & 4 \end{bmatrix}, \alpha > 2$$

be the adjoint of a matrix A and $|A| = 2$. Then

$$\begin{bmatrix} \alpha & -2\alpha & \alpha \end{bmatrix} B \begin{bmatrix} \alpha \\ -2\alpha \\ \alpha \end{bmatrix}$$

is equal to:

- (A) 32 (B) -16 (C) 0 (D) 16

Q63 Matrices[Step-by-step solution](https://www.prepwise.in/questions/XxBbbYRezQ) › prepwise.in/questions/XxBbbYRezQ

The number of symmetric matrices of order 3, with all the entries from the set $\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$ is:

- (A) 10^9 (B) 9^{10} (C) 10^6 (D) 6^{10}

Q64 Parabola[Step-by-step solution](https://www.prepwise.in/questions/JOIBX7UvLH) › prepwise.in/questions/JOIBX7UvLH

Let PQ be a focal chord of the parabola $y^2 = 36x$ of length 100, making an acute angle with the positive x -axis. Let the ordinate of P be positive and M be the point on the line segment PQ such that $PM : MQ = 3 : 1$. Then which of the following points does NOT lie on the line passing through M and perpendicular to the line PQ?

- (A) (6, 29) (B) (-3, 43) (C) (3, 33) (D) (-6, 45)

Q65 Probability: Advanced[Step-by-step solution](https://www.prepwise.in/questions/0ADjgYEz9W) › prepwise.in/questions/0ADjgYEz9W

A coin is biased so that the head is 3 times as likely to occur as tail. This coin is tossed until a head or three tails occur. If X denotes the number of tosses of the coin, then the mean of X is:

- (A) $\frac{81}{64}$ (B) $\frac{37}{16}$ (C) $\frac{21}{16}$ (D) $\frac{15}{16}$

Q66 Quadratic Equations & Polynomial Inequalities[Step-by-step solution](https://www.prepwise.in/questions/ab6kSn0XDY) › prepwise.in/questions/ab6kSn0XDY

The set of all $a \in \mathbb{R}$ for which the equation $x|x - 1| + |x + 2| + a = 0$ has exactly one real root, is:

- (A) $(-\infty, \infty)$ (B) $(-6, \infty)$ (C) $(-\infty, -3)$ (D) $(-6, -3)$

Q67 Sequences & Series[Step-by-step solution](https://www.prepwisar.in/questions/typAoCVMRe) > prepwisar.in/questions/typAoCVMRe

Let $s_1, s_2, s_3, \dots, s_{10}$ respectively be the sum to 12 terms of 10 A.P. s whose first terms are 1, 2, 3, $\dots$, 10 and the common differences are 1, 3, 5, $\dots$, 19 respectively. Then $\sum_{i=1}^{10} s_i$ is equal to:

- (A) 7360 (B) 7220 (C) 7260 (D) 7380

Q68 Vectors[Step-by-step solution](https://www.prepwisar.in/questions/FFNQKGayTZ) > prepwisar.in/questions/FFNQKGayTZ

Let $\vec{a} = \hat{i} + 4\hat{j} + 2\hat{k}$, $\vec{b} = 3\hat{i} - 2\hat{j} + 7\hat{k}$ and $\vec{c} = 2\hat{i} - \hat{j} + 4\hat{k}$. If a vector $\vec{d}$ satisfies $\vec{d} \times \vec{b} = \vec{c} \times \vec{b}$ and $\vec{d} \cdot \vec{a} = 24$, then $|\vec{d}|^2$ is equal to:

- (A) 313 (B) 413 (C) 423 (D) 323

Q69 Area Under Curves[Step-by-step solution](https://www.prepwisar.in/questions/RWrqQXhrCR) > prepwisar.in/questions/RWrqQXhrCR

The area of the region enclosed by the curve $f(x) = \max\{\sin x, \cos x\}$, $-\pi \leq x \leq \pi$ and the x -axis is

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

Mathematics Section B · Numerical value

Q70 to Q79

Q70 Three Dimensional Geometry **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/scFukdRy9h) > prepwisar.in/questions/scFukdRy9h

Let the image of the point $(\frac{5}{3}, \frac{5}{3}, \frac{8}{3})$ in the plane $x - 2y + z - 2 = 0$ be P. If the distance of the point $Q(6, -2, \alpha)$, $\alpha > 0$, from P is 13, then α is equal to _____.

Q71 Binomial Theorem **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/Nn16MjTux1) > prepwisar.in/questions/Nn16MjTux1

Let α be the constant term in the binomial expansion of $(\sqrt{x} - \frac{6}{x^2})^n$, $n \leq 15$. If the sum of the coefficients of the remaining terms in the expansion is 649 and the coefficient of x^{-n} is $\lambda\alpha$, then λ is equal to _____.

Q72 Complex Numbers **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/lnhi9xHYBX) > prepwisar.in/questions/lnhi9xHYBX

Let $w = z\bar{z} + k_1z + k_2iz + \lambda(1 + i)$, $k_1, k_2 \in \mathbb{R}$. Let $\text{Re}(w) = 0$ be the circle C of radius 1 in the first quadrant touching the line $y = 1$ and the y -axis. If the curve $\text{Im}(w) = 0$ intersects C at A and B, then $30(AB)^2$ is equal to _____.

Q73 Definite Integration **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/VQsNujLuDo) > prepwisar.in/questions/VQsNujLuDo

Let for $x \in \mathbb{R}$, $S_0(x) = x$, $S_k(x) = C_kx + k \int_0^x S_{k-1}(t)dt$, where $C_0 = 1$, $C_k = 1 - \int_0^1 S_{k-1}(x)dx$, $k = 1, 2, 3, \dots$. Then $S_2(3) + 6C_3$ is equal to _____.

Q74 Hyperbola **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/qMLsh0jh57) > prepwisar.in/questions/qMLsh0jh57

Let m_1 and m_2 be the slopes of the tangents drawn from the point P(4, 1) to the hyperbola $H : \frac{y^2}{25} - \frac{x^2}{16} = 1$. If Q is the point from which the tangents drawn to H have slopes $|m_1|$ and $|m_2|$ and they make positive intercepts α and β on the x -axis, then $\frac{(PQ)^2}{\alpha\beta}$ is equal to _____.

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If

$$S = \left\{ x \in \mathbb{R} : \sin^{-1} \left(\frac{x+1}{\sqrt{x^2+2x+2}} \right) - \sin^{-1} \left(\frac{x}{\sqrt{x^2+1}} \right) = \frac{\pi}{4} \right\}$$

, then

$$\sum_{x \in S} \left(\sin \left((x^2 + x + 5) \frac{\pi}{2} \right) - \cos \left((x^2 + x + 5) \pi \right) \right)$$

is equal to _____.

The number of seven digit positive integers formed using the digits 1, 2, 3 and 4 only and sum of the digits equal to 12 is _____.

The sum to 20 terms of the series $2 \cdot 2^2 - 3^2 + 2 \cdot 4^2 - 5^2 + 2 \cdot 6^2 - \dots$ is equal to _____.

Let the mean of the data

x	1	3	5	7	9
Frequency (f)	4	24	28	α	8

be 5. If m and σ^2 are respectively the mean deviation about the mean and the variance of the data, then $\frac{3\alpha}{m+\sigma^2}$ is equal to _____.

Let $\vec{a} = 3\hat{i} + \hat{j} - \hat{k}$ and $\vec{c} = 2\hat{i} - 3\hat{j} + 3\hat{k}$. If $\vec{b}$ is a vector such that $\vec{a} = \vec{b} \times \vec{c}$ and $|\vec{b}|^2 = 50$, then $|7\vec{2} - \vec{b} + \vec{c}|^2$ is equal to _____.

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Physics

1. B	2. C	3. B	4. B	5. C	6. D	7. B	8. C
9. C	10. A	11. C	12. B	13. C	14. C	15. A	16. A
17. C	18. A	19. 25	20. 2	21. 50	22. 16	23. 3	24. 6
25. 3	26. 40	27. 4	28. 4				

Chemistry

29. C	30. C	31. C	32. C	33. C	34. B	35. D	36. B
37. A	38. B	39. C	40. C	41. D	42. C	43. 3	44. 161
45. 5	46. 240	47. 56	48. 1	49. 400	50. 68		

Mathematics

51. D	52. C	53. A	54. C	55. B	56. C	57. A	58. A
59. B	60. A	61. B	62. B	63. C	64. B	65. C	66. A
67. C	68. B	69. B	70. 15	71. 36	72. 24	73. 18	74. 8
75. 4	76. 413	77. 1310	78. 8	79. 66			

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