

JEE MAIN 2024 · QUESTION PAPER

29 Jan 2024 Shift 1

84 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	17 Q30 to Q46	9 Q47 to Q55
● Mathematics	19 Q56 to Q74	10 Q75 to Q84
In this PDF	84 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/2024-01-29-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 Alternating Current

[Step-by-step solution](#) › prepwiser.in/questions/-mNNBC1bYu

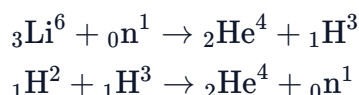
A capacitor of capacitance $100\mu\text{F}$ is charged to a potential of 12V and connected to a 6.4mH inductor to produce oscillations. The maximum current in the circuit would be:

- (A) 2.0 A (B) 3.2 A (C) 1.5 A (D) 1.2 A

Q2 Nuclear Physics

[Step-by-step solution](#) › prepwiser.in/questions/860xCh0if9

The explosive in a Hydrogen bomb is a mixture of ${}_1\text{H}^2$, ${}_1\text{H}^3$ and ${}_3\text{Li}^6$ in some condensed form. The chain reaction is given by



During the explosion the energy released is approximately

[Given;

$$M(\text{Li}) = 6.01690\text{amu}, M({}_1\text{H}^2) = 2.01471\text{amu}, M({}_2\text{He}^4) = 4.00388$$

amu, and $1\text{amu} = 931.5\text{MeV}$]

- (A) 22.22 MeV (B) 28.12 MeV (C) 16.48 MeV (D) 12.64 MeV

Q3 Circular Motion

[Step-by-step solution](#) › prepwiser.in/questions/6LiaRONoXC

If the radius of curvature of the path of two particles of same mass are in the ratio 3 : 4, then in order to have constant centripetal force, their velocities will be in the ratio of:

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

Q4 Moving Charges & Magnetism

[Step-by-step solution](#) › prepwiser.in/questions/qQ59gN6UJ_

The deflection in moving coil galvanometer falls from 25 divisions to 5 division when a shunt of 24Ω is applied. The resistance of galvanometer coil will be:

- (A) 48Ω (B) 100Ω (C) 96Ω (D) 12Ω

Q5 Moving Charges & Magnetism

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

A galvanometer having coil resistance 10Ω shows a full scale deflection for a current of 3mA . For it to measure a current of 8A , the value of the shunt should be:

- (A) $3.75 \times 10^{-3}\Omega$ (B) $3 \times 10^{-3}\Omega$ (C) $4.85 \times 10^{-3}\Omega$ (D) $2.75 \times 10^{-3}\Omega$

Q6 Current Electricity

[Step-by-step solution](#) › prepwiser.in/questions/O7TfK0aKUY

The electric current through a wire varies with time as $I = I_0 + \beta t$, where $I_0 = 20\text{A}$ and $\beta = 3\text{A/s}$. The amount of electric charge crossed through a section of the wire in 20s is:

- (A) 80 C (B) 800 C (C) 1000 C (D) 1600 C

Q7 Dual Nature of Radiation & Matter

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

The de-Broglie wavelength of an electron is the same as that of a photon. If velocity of electron is 25% of the velocity of light, then the ratio of K.E. of electron and K.E. of photon will be:

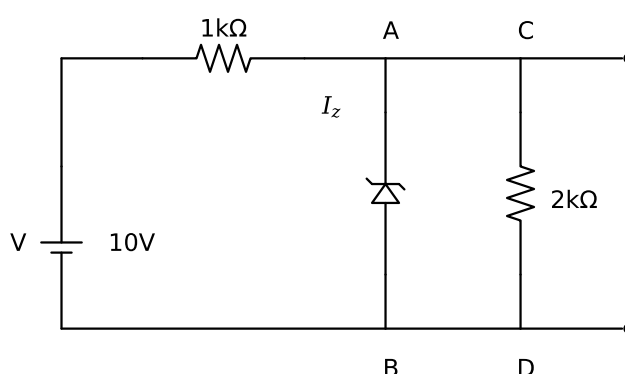
- (A) $\frac{1}{4}$ (B) $\frac{8}{1}$ (C) $\frac{1}{8}$ (D) $\frac{1}{1}$

Match List I with List II

	List - I		List - II
(A)	$\oint \vec{B} \cdot d\vec{l} = \mu_0 i_c + \mu_0 \epsilon_0 \frac{d\phi_E}{dt}$	(I)	Gauss' law for electricity
(B)	$\oint \vec{E} \cdot d\vec{l} = \frac{d\phi_B}{dt}$	(II)	Gauss' law for magnetism
(C)	$\oint \vec{E} \cdot d\vec{A} = \frac{Q}{\epsilon_0}$	(III)	Faraday law
(D)	$\oint \vec{B} \cdot d\vec{A} = 0$	(IV)	Ampere - Maxwell law

Choose the correct answer from the options given below:

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

In the given circuit, the breakdown voltage of the Zener diode is 3.0V. What is the value of I_z ?

- (A) 3.3 mA (B) 10 mA (C) 5.5 mA (D) 7 mA

Two charges of $5Q$ and $-2Q$ are situated at the points $(3a, 0)$ and $(-5a, 0)$ respectively. The electric flux through a sphere of radius ' $4a$ ' having center at origin is:

- (A) $\frac{2Q}{\epsilon_0}$ (B) $\frac{7Q}{\epsilon_0}$ (C) $\frac{3Q}{\epsilon_0}$ (D) $\frac{5Q}{\epsilon_0}$

A convex mirror of radius of curvature 30cm forms an image that is half the size of the object. The object distance is:

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

A biconvex lens of refractive index 1.5 has a focal length of 20cm in air. Its focal length when immersed in a liquid of refractive index 1.6 will be:

- (A) -16 cm (B) +16 cm (C) +160 cm (D) -160 cm

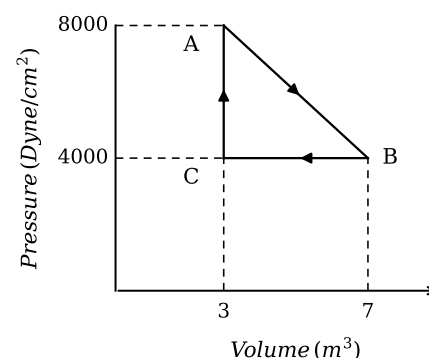
At what distance above and below the surface of the earth a body will have same weight. (take radius of earth as R .)

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

Q14 Thermodynamics[Step-by-step solution](#) > [prepwisar.in/questions/5n1xBqspB8](https://www.prepwisar.in/questions/5n1xBqspB8)

A thermodynamic system is taken from an original state A to an intermediate state B by a linear process as shown in the figure. It's volume is then reduced to the original value from B to C by an isobaric process. The total work done by the gas from A to B and B to C would be:

- (A) 800 J (B) 2200 J (C) 33800 J (D) 1200 J

**Q15** Kinetic Theory of Gases[Step-by-step solution](#) > [prepwisar.in/questions/RcnIkQv2Dy](https://www.prepwisar.in/questions/RcnIkQv2Dy)

Two vessels A and B are of the same size and are at same temperature. A contains 1g of hydrogen and B contains 1g of oxygen. P_A and P_B are the pressures of the gases in A and B respectively, then $\frac{P_A}{P_B}$ is:

- (A) 4 (B) 32 (C) 8 (D) 16

Q16 Rectilinear Motion[Step-by-step solution](#) > [prepwisar.in/questions/4drWekPliq](https://www.prepwisar.in/questions/4drWekPliq)

A body starts moving from rest with constant acceleration covers displacement S_1 in first $(p - 1)$ seconds and S_2 in first p seconds. The displacement $S_1 + S_2$ will be made in time:

- (A) $(2p + 1)s$ (B) $(2p - 1)s$ (C) $(2p^2 - 2p + 1)s$ (D) $\sqrt{(2p^2 - 2p + 1)}s$

Q17 Surface Tension[Step-by-step solution](#) > [prepwisar.in/questions/J41N-UrCCS](https://www.prepwisar.in/questions/J41N-UrCCS)

Given below are two statements:

Statement I : If a capillary tube is immersed first in cold water and then in hot water, the height of capillary rise will be smaller in hot water.

Statement II : If a capillary tube is immersed first in cold water and then in hot water, the height of capillary rise will be smaller in cold water.

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

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

Q18 Friction[Step-by-step solution](#) > [prepwisar.in/questions/CoS_0jfWUu](https://www.prepwisar.in/questions/CoS_0jfWUu)

A block of mass 100kg slides over a distance of 10m on a horizontal surface. If the co-efficient of friction between the surfaces is 0.4, then the work done against friction (in J) is:

- (A) 3900 (B) 4500 (C) 4200 (D) 4000

Q19 Work, Energy & Power[Step-by-step solution](#) > [prepwisar.in/questions/ICL03c1tzp](https://www.prepwisar.in/questions/ICL03c1tzp)

The potential energy function (in J) of a particle in a region of space is given as

$U = (2x^2 + 3y^3 + 2z)$. Here x, y and z are in meter. The magnitude of x -component of force (in N) acting on the particle at point $P(1, 2, 3)m$ is:

- (A) 4 (B) 2 (C) 8 (D) 6

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The resistance $R = \frac{V}{I}$ where $V = (200 \pm 5)V$ and $I = (20 \pm 0.2)A$, the percentage error in the measurement of R is:

- (A) 5.5% (B) 3% (C) 7% (D) 3.5%

Physics Section B · Numerical value

Q21 to Q29

Q21 Atomic Physics NUMERICAL

[Step-by-step solution](#) > [prepwiser.in/questions/E87IEcPQDn](https://www.prepwiser.in/questions/E87IEcPQDn)

When a hydrogen atom going from $n = 2$ to $n = 1$ emits a photon, its recoil speed is $\frac{x}{5} \text{ m/s}$. Where $x = \underline{\hspace{2cm}}$. (Use, mass of hydrogen atom $= 1.6 \times 10^{-27} \text{ kg}$)

Q22 Electrostatics II: Potential & Capacitance NUMERICAL

[Step-by-step solution](#) > [prepwiser.in/questions/2d1fFKbCJN](https://www.prepwiser.in/questions/2d1fFKbCJN)

A 16Ω wire is bent to form a square loop. A $9V$ battery with internal resistance 1Ω is connected across one of its sides. If a $4\mu F$ capacitor is connected across one of its diagonals, the energy stored by the capacitor will be $\frac{x}{2} \mu J$, where $x = \underline{\hspace{2cm}}$

Q23 Electromagnetic Induction NUMERICAL

[Step-by-step solution](#) > [prepwiser.in/questions/rnj9ShmUD](https://www.prepwiser.in/questions/rnj9ShmUD)

A square loop of side 10cm and resistance 0.7Ω is placed vertically in east-west plane. A uniform magnetic field of $0.20T$ is set up across the plane in north east direction. The magnetic field is decreased to zero in 1s at a steady rate. Then, magnitude of induced emf is $\sqrt{x} \times 10^{-3}V$. The value of x is $\underline{\hspace{2cm}}$.

Q24 Electrostatics I: Charges, Field & Gauss's Law NUMERICAL

[Step-by-step solution](#) > [prepwiser.in/questions/MYcNop8D8n](https://www.prepwiser.in/questions/MYcNop8D8n)

An electron is moving under the influence of the electric field of a uniformly charged infinite plane sheet S having surface charge density $+\sigma$. The electron at $t = 0$ is at a distance of 1m from S and has a speed of 1m/s . The maximum value of σ if the electron strikes S at $t = 1\text{s}$ is $\alpha \left[\frac{m\epsilon_0}{e} \right] \frac{C}{m^2}$, the value of α is $\underline{\hspace{2cm}}$.

Q25 Magnetism & Matter NUMERICAL

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

The magnetic potential due to a magnetic dipole at a point on its axis situated at a distance of 20cm from its center is $1.5 \times 10^{-5} \text{ Tm}$. The magnetic moment of the dipole is $\underline{\hspace{2cm}} \text{ Am}^2$. (Given: $\frac{\mu_0}{4\pi} = 10^{-7} \text{ TmA}^{-1}$)

Q26 Projectile Motion & Relative Motion NUMERICAL

[Step-by-step solution](#) > [prepwiser.in/questions/x5uEuOmm-D](https://www.prepwiser.in/questions/x5uEuOmm-D)

A ball rolls off the top of a stairway with horizontal velocity u . The steps are 0.1m high and 0.1m wide. The minimum velocity u with which that ball just hits the step 5 of the stairway will be $\sqrt{x} \text{ ms}^{-1}$ where $x = \underline{\hspace{2cm}}$ [use $g = 10\text{m/s}^2$].

Q27 Fluid Mechanics NUMERICAL

[Step-by-step solution](#) > [prepwiser.in/questions/NpSWpuyi6s](https://www.prepwiser.in/questions/NpSWpuyi6s)

In a test experiment on a model aeroplane in wind tunnel, the flow speeds on the upper and lower surfaces of the wings are 70ms^{-1} and 65ms^{-1} respectively. If the wing area is 2m^2 , the lift of the wing is $\underline{\hspace{2cm}} N$.

(Given density of air $= 1.2\text{kgm}^{-3}$)

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A cylinder is rolling down on an inclined plane of inclination 60° . Its acceleration during rolling down will be $\frac{x}{\sqrt{3}} m/s^2$, where $x = \underline{\hspace{2cm}}$ (use $g = 10 m/s^2$).

When the displacement of a simple harmonic oscillator is one third of its amplitude, the ratio of total energy to the kinetic energy is $\frac{x}{8}$, where $x = \underline{\hspace{2cm}}$.

Chemistry Section A · Multiple choice

Q30 to Q46

Type of amino acids obtained by hydrolysis of proteins is:

- (A) γ (B) β (C) α (D) δ

The difference in energy between the actual structure and the lowest energy resonance structure for the given compound is

- (A) electromeric energy (B) resonance energy
(C) ionization energy (D) hyperconjugation energy

Match List I with List II

	List - I (Substances)		List - II (Element Present)
(A)	Ziegler catalyst	(I)	Rhodium
(B)	Blood Pigment	(II)	Cobalt
(C)	Wilkinson catalyst	(III)	Iron
(D)	Vitamin B ₁₂	(IV)	Titanium

Choose the correct answer from the options given below:

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

In which one of the following metal carbonyls, CO forms a bridge between metal atoms?

- (A) $[\text{Os}_3(\text{CO})_{12}]$ (B) $[\text{Ru}_3(\text{CO})_{12}]$ (C) $[\text{Mn}_2(\text{CO})_{10}]$ (D) $[\text{Co}_2(\text{CO})_8]$

KMnO_4 decomposes on heating at 513K to form O_2 along with

- (A) K_2MnO_4 & Mn (B) MnO_2 & K_2O_2 (C) K_2MnO_4 & MnO_2 (D) Mn & KO_2

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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: Aryl halides cannot be prepared by replacement of hydroxyl group of phenol by halogen atom.

Reason R: Phenols react with halogen acids violently.

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

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

Identify the incorrect pair from the following:

- (A) Fluoroapatite $-3\text{Ca}_3(\text{PO}_4)_2 \cdot \text{CaF}_2$
- (B) Carnallite $-\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
- (C) Cryolite $-\text{Na}_3\text{AlF}_6$
- (D) Fluorspar $-\text{BF}_3$

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

Assertion A: The first ionisation enthalpy decreases across a period.

Reason R: The increasing nuclear charge outweighs the shielding across the period.

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

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

Given below are two statements:

Statement I: The electronegativity of group 14 elements from Si to Pb, gradually decreases.

Statement II: Group 14 contains non-metallic, metallic, as well as metalloid elements.

In the light of the above statements, choose the **most appropriate** 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) Both Statement I and Statement II are false
- (D) Statement I is true but Statement II is false

Chlorine undergoes disproportionation in alkaline medium as shown below:



The values of a , b , c and d in a balanced redox reaction are respectively:

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

Q40 Redox Reactions[Step-by-step solution](https://www.prepwiser.in/questions/PUKk9ZuI2d) › prepwiser.in/questions/PUKk9ZuI2d

In alkaline medium, MnO_4^- oxidises I^- to

- (A) I_2 (B) IO_3^- (C) IO^- (D) IO_4^-

Q41 Atomic Structure[Step-by-step solution](https://www.prepwiser.in/questions/CokjCjhgit) › prepwiser.in/questions/CokjCjhgit

The correct set of four quantum numbers for the valence electron of rubidium atom ($Z = 37$) is:

- (A) $5, 1, 1, +\frac{1}{2}$ (B) $5, 0, 0, +\frac{1}{2}$ (C) $5, 0, 1, +\frac{1}{2}$ (D) $5, 1, 0, +\frac{1}{2}$

Q42 Chemical Thermodynamics[Step-by-step solution](https://www.prepwiser.in/questions/gDEFraG9GR) › prepwiser.in/questions/gDEFraG9GR

Which of the following is not correct?

- (A) ΔG is positive for a spontaneous reaction
(B) ΔG is positive for a non-spontaneous reaction
(C) ΔG is zero for a reversible reaction
(D) ΔG is negative for a spontaneous reaction

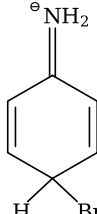
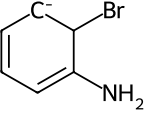
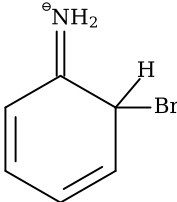
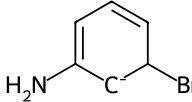
Q43 General Organic Chemistry (GOC)[Step-by-step solution](https://www.prepwiser.in/questions/p68-c6ghkh) › prepwiser.in/questions/p68-c6ghkh

The interaction between π bond and lone pair of electrons present on an adjacent atom is responsible for

- (A) Resonance effect (B) Electromeric effect (C) Hyperconjugation (D) Inductive effect

Q44 Hydrocarbons: Aromatic (Arenes)[Step-by-step solution](https://www.prepwiser.in/questions/GhYUCpPSRb) › prepwiser.in/questions/GhYUCpPSRb

the arenium ion which is not involved in the bromination of Aniline is _____.

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

Q45 Qualitative Analysis: Salt Analysis[Step-by-step solution](https://www.prepwiser.in/questions/z_Pp2w1vDY) › prepwiser.in/questions/z_Pp2w1vDY

In chromyl chloride test for confirmation of Cl^- ion, a yellow solution is obtained. Acidification of the solution and addition of amyl alcohol and 10% H_2O_2 turns organic layer blue indicating formation of chromium pentoxide. The oxidation state of chromium in that is

- (A) +6 (B) +5 (C) +3 (D) +10

Q46 Purification & Characterisation of Organic Compounds[Step-by-step solution](https://www.prepwiser.in/questions/IjKIXs8qtc) › prepwiser.in/questions/IjKIXs8qtc

Appearance of blood red colour, on treatment of the sodium fusion extract of an organic compound with FeSO_4 in presence of concentrated H_2SO_4 indicates the presence of element/s

- (A) Br (B) S (C) N and S (D) N

Q47 Practical Organic Chemistry **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/NV470ll6TT) › prepwisar.in/questions/NV470ll6TT

From the compounds given below, number of compounds which give positive Fehling's test is _____.

Benzaldehyde, Acetaldehyde, Acetone, Acetophenone, Methanal, 4nitrobenzaldehyde, cyclohexane carbaldehyde.

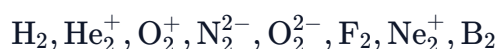
Q48 Carbohydrates & Biomolecules **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/De5gXV1NXC) › prepwisar.in/questions/De5gXV1NXC

Number of compounds among the following which contain sulphur as heteroatom is _____.

Furan, Thiophene, Pyridine, Pyrrole, Cysteine, Tyrosine

Q49 Chemical Bonding & Molecular Structure **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/wGA2S8s_AN) › prepwisar.in/questions/wGA2S8s_AN

The number of species from the following which are paramagnetic and with bond order equal to one is _____.

**Q50** Chemical Bonding & Molecular Structure **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/Hok1kc2hB_) › prepwisar.in/questions/Hok1kc2hB_

Number of compounds with one lone pair of electrons on central atom amongst following is _____.

**Q51** Chemical Kinetics **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/m3dheFXzx-) › prepwisar.in/questions/m3dheFXzx-

For a reaction taking place in three steps at same temperature, overall rate constant $K = \frac{K_1 K_2}{K_3}$. If E_{a1} , E_{a2} and E_{a3} are 40, 50 and 60 kJ/mol respectively, the overall E_a is _____ kJ/mol.

Q52 Electrochemistry **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/gTW9thBUt1) › prepwisar.in/questions/gTW9thBUt1

The mass of zinc produced by the electrolysis of zinc sulphate solution with a steady current of 0.015 A for 15 minutes is _____ $\times 10^{-4}$ g.

(Atomic mass of zinc = 65.4 amu)

Q53 Solutions & Colligative Properties **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/oH5Ot4zPJS) › prepwisar.in/questions/oH5Ot4zPJS

The osmotic pressure of a dilute solution is 7×10^5 Pa at 273 K. Osmotic pressure of the same solution at 283 K is _____ $\times 10^4$ Nm⁻².

Q54 Mole Concept & Stoichiometry **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/aIB-t2a_Zs) › prepwisar.in/questions/aIB-t2a_Zs

A solution of H_2SO_4 is 31.4% H_2SO_4 by mass and has a density of 1.25 g/mL. The molarity of the H_2SO_4 solution is _____ M (nearest integer)

[Given molar mass of $\text{H}_2\text{SO}_4 = 98 \text{ g mol}^{-1}$]

Q55 Chemical Equilibrium **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/s_O0ol5OS9) › prepwisar.in/questions/s_O0ol5OS9

For the reaction $\text{N}_2\text{O}_{4(g)} \rightleftharpoons 2\text{NO}_{2(g)}$, $K_p = 0.492 \text{ atm}$ at 300 K. K_c for the reaction at same temperature is _____ $\times 10^{-2}$.

(Given: $R = 0.082 \text{ Latm mol}^{-1} \text{ K}^{-1}$)

Q56 Vectors

[Step-by-step solution](#) › [prepwiser.in/questions/3C4VuTBXih](https://www.prepwiser.in/questions/3C4VuTBXih)

Let O be the origin and the position vectors of A and B be $2\hat{i} + 2\hat{j} + \hat{k}$ and $2\hat{i} + 4\hat{j} + 4\hat{k}$ respectively. If the internal bisector of $\angle AOB$ meets the line AB at C , then the length of OC is

- (A) $\frac{3}{2}\sqrt{34}$ (B) $\frac{2}{3}\sqrt{31}$ (C) $\frac{2}{3}\sqrt{34}$ (D) $\frac{3}{2}\sqrt{31}$

Q57 Three Dimensional Geometry

[Step-by-step solution](#) › [prepwiser.in/questions/ZCQlxq0-4y](https://www.prepwiser.in/questions/ZCQlxq0-4y)

Let PQR be a triangle with $R(-1, 4, 2)$. Suppose $M(2, 1, 2)$ is the mid point of PQ . The distance of the centroid of $\triangle PQR$ from the point of intersection of the lines $\frac{x-2}{0} = \frac{y}{2} = \frac{z+3}{-1}$ and $\frac{x-1}{1} = \frac{y+3}{-3} = \frac{z+1}{1}$ is

- (A) 69 (B) $\sqrt{99}$ (C) $\sqrt{69}$ (D) 9

Q58 Trigonometric Ratios & Identities

[Step-by-step solution](#) › [prepwiser.in/questions/LDJf5-xrvF](https://www.prepwiser.in/questions/LDJf5-xrvF)

Consider the function $f : [\frac{1}{2}, 1] \rightarrow \mathbb{R}$ defined by $f(x) = 4\sqrt{2}x^3 - 3\sqrt{2}x - 1$. Consider the statements

(I) The curve $y = f(x)$ intersects the x -axis exactly at one point.

(II) The curve $y = f(x)$ intersects the x -axis at $x = \cos \frac{\pi}{12}$.

Then

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

Q59 Complex Numbers

[Step-by-step solution](#) › [prepwiser.in/questions/4WJty-E9aI](https://www.prepwiser.in/questions/4WJty-E9aI)

If $z = \frac{1}{2} - 2i$ is such that $|z + 1| = \alpha z + \beta(1 + i)$, $i = \sqrt{-1}$ and $\alpha, \beta \in \mathbb{R}$, then $\alpha + \beta$ is equal to

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

Q60 Limits

[Step-by-step solution](#) › [prepwiser.in/questions/-Iin3PO2pa](https://www.prepwiser.in/questions/-Iin3PO2pa)

$$\lim_{x \rightarrow \frac{\pi}{2}} \left(\frac{1}{(x - \frac{\pi}{2})^2} \int_{x^3}^{\left(\frac{\pi}{2}\right)^3} \cos\left(t^{\frac{1}{3}}\right) dt \right)$$

is equal to

- (A) $\frac{3\pi^2}{4}$ (B) $\frac{3\pi^2}{8}$ (C) $\frac{3\pi}{4}$ (D) $\frac{3\pi}{8}$

Q61 Definite Integration

[Step-by-step solution](#) › [prepwiser.in/questions/m-J8VpQEEJ](https://www.prepwiser.in/questions/m-J8VpQEEJ)

If the value of the integral

$$\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \left(\frac{x^2 \cos x}{1 + \pi^x} + \frac{1 + \sin^2 x}{1 + e^{\sin x^{2123}}} \right) dx = \frac{\pi}{4}(\pi + a) - 2$$

, then the value of a is

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

Q62 Differential Equations[Step-by-step solution](https://www.prepwiser.in/questions/mL4Pcz2H6)

A function $y = f(x)$ satisfies $f(x) \sin 2x + \sin x - (1 + \cos^2 x) f'(x) = 0$ with condition $f(0) = 0$. Then, $f\left(\frac{\pi}{2}\right)$ is equal to

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

Q63 Differentiation[Step-by-step solution](https://www.prepwiser.in/questions/0D4h5PRXNi)

Suppose

$$f(x) = \frac{(2^x + 2^{-x}) \tan x \sqrt{\tan^{-1}(x^2 - x + 1)}}{(7x^2 + 3x + 1)^3}$$

. Then the value of $f'(0)$ is equal to

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

Q64 Functions (Advanced)[Step-by-step solution](https://www.prepwiser.in/questions/dRMYlpz6t3)

If

$$f(x) = \begin{cases} 2 + 2x, & -1 \leq x < 0 \\ 1 - \frac{x}{3}, & 0 \leq x \leq 3 \end{cases}; g(x) = \begin{cases} -x, & -3 \leq x \leq 0 \\ x, & 0 < x \leq 1 \end{cases}$$

, then range of $(f \circ g)(x)$ is

- (A) $[0, 1)$ (B) $[0, 3)$ (C) $(0, 1]$ (D) $[0, 1]$

Q65 Determinants[Step-by-step solution](https://www.prepwiser.in/questions/d1x0wwTm-2)

Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \alpha & \beta \\ 0 & \beta & \alpha \end{bmatrix}$ and $|2A|^3 = 2^{21}$ where $\alpha, \beta \in Z$, Then a value of α is

- (A) 9 (B) 17 (C) 3 (D) 5

Q66 Matrices[Step-by-step solution](https://www.prepwiser.in/questions/FiWs3uOlhW)

Let A be a square matrix such that $AA^T = I$. Then $\frac{1}{2}A \left[(A + A^T)^2 + (A - A^T)^2 \right]$ is equal to

- (A) $A^2 + A^T$ (B) $A^3 + I$ (C) $A^3 + A^T$ (D) $A^2 + I$

Q67 Probability: Basic[Step-by-step solution](https://www.prepwiser.in/questions/Ob2RkdPzLN)

A fair die is thrown until 2 appears. Then the probability, that 2 appears in even number of throws, is

- (A) $\frac{5}{11}$ (B) $\frac{5}{6}$ (C) $\frac{1}{6}$ (D) $\frac{6}{11}$

Q68 Sequences & Series[Step-by-step solution](https://www.prepwiser.in/questions/kpvBAWOBdk)

If in a G.P. of 64 terms, the sum of all the terms is 7 times the sum of the odd terms of the G.P, then the common ratio of the G.P. is equal to

- (A) 7 (B) 6 (C) 5 (D) 4

Q69 Sequences & Series[Step-by-step solution](https://www.prepwiser.in/questions/4WqS8M9RVW)

In an A.P., the sixth term $a_6 = 2$. If the product $a_1 a_4 a_5$ is the greatest, then the common difference of the A.P. is equal to

- (A) $\frac{2}{3}$ (B) $\frac{5}{8}$ (C) $\frac{3}{2}$ (D) $\frac{8}{5}$

Let R be a relation on $Z \times Z$ defined by $(a, b)R(c, d)$ if and only if $ad - bc$ is divisible by 5. Then R is

- (A) Reflexive and transitive but not symmetric (B) Reflexive and symmetric but not transitive
(C) Reflexive but neither symmetric nor transitive (D) Reflexive, symmetric and transitive

If $\alpha, -\frac{\pi}{2} < \alpha < \frac{\pi}{2}$ is the solution of $4 \cos \theta + 5 \sin \theta = 1$, then the value of $\tan \alpha$ is

- (A) $\frac{10 - \sqrt{10}}{12}$ (B) $\frac{\sqrt{10} - 10}{6}$ (C) $\frac{\sqrt{10} - 10}{12}$ (D) $\frac{10 - \sqrt{10}}{6}$

Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three non-zero vectors such that $\vec{b}$ and $\vec{c}$ are non-collinear. If $\vec{a} + 5\vec{b}$ is collinear with $\vec{c}$, $\vec{b} + 6\vec{c}$ is collinear with $\vec{a}$ and $\vec{a} + \alpha\vec{b} + \beta\vec{c} = \vec{0}$, then $\alpha + \beta$ is equal to

- (A) 30 (B) -30 (C) -25 (D) 35

In a $\triangle ABC$, suppose $y = x$ is the equation of the bisector of the angle B and the equation of the side AC is $2x - y = 2$. If $2AB = BC$ and the points A and B are respectively $(4, 6)$ and (α, β) , then $\alpha + 2\beta$ is equal to

- (A) 42 (B) 39 (C) 48 (D) 45

For $x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$, if $y(x) = \int \frac{\operatorname{cosec} x + \sin x}{\operatorname{cosec} x \sec x + \tan x \sin^2 x} dx$, and $\lim_{x \rightarrow \left(\frac{\pi}{2}\right)^-} y(x) = 0$ then $y\left(\frac{\pi}{4}\right)$ is equal to

- (A) $-\frac{1}{\sqrt{2}} \tan^{-1} \left(\frac{1}{\sqrt{2}} \right)$ (B) $\tan^{-1} \left(\frac{1}{\sqrt{2}} \right)$
(C) $\frac{1}{2} \tan^{-1} \left(\frac{1}{\sqrt{2}} \right)$ (D) $\frac{1}{\sqrt{2}} \tan^{-1} \left(-\frac{1}{2} \right)$

Mathematics Section B · Numerical value

Q75 to Q84

A line with direction ratios 2, 1, 2 meets the lines $x = y + 2 = z$ and $x + 2 = 2y = 2z$ respectively at the points P and Q. If the length of the perpendicular from the point $(1, 2, 12)$ to the line PQ is l , then l^2 is _____.

Let $f(x) = 2^x - x^2, x \in \mathbb{R}$. If m and n are respectively the number of points at which the curves $y = f(x)$ and $y = f'(x)$ intersect the x -axis, then the value of $m + n$ is _____.

If $\frac{{}^{11}C_1}{2} + \frac{{}^{11}C_2}{3} + \dots + \frac{{}^{11}C_9}{10} = \frac{n}{m}$ with $\gcd(n, m) = 1$, then $n + m$ is equal to

_____.

Q78 Circles **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/ZPA9qa2U1R) › prepwiser.in/questions/ZPA9qa2U1R

Equations of two diameters of a circle are $2x - 3y = 5$ and $3x - 4y = 7$. The line joining the points $(-\frac{22}{7}, -4)$ and $(-\frac{1}{7}, 3)$ intersects the circle at only one point $P(\alpha, \beta)$. Then, $17\beta - \alpha$ is equal to _____.

Q79 Complex Numbers **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/iZgR7CILB4) › prepwiser.in/questions/iZgR7CILB4

Let α, β be the roots of the equation $x^2 - x + 2 = 0$ with $\text{Im}(\alpha) > \text{Im}(\beta)$. Then $\alpha^6 + \alpha^4 + \beta^4 - 5\alpha^2$ is equal to _____.

Q80 Differential Equations **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/FRfz7kP9J8) › prepwiser.in/questions/FRfz7kP9J8

If the solution curve $y = y(x)$ of the differential equation $(1 + y^2)(1 + \log_e x) dx + x dy = 0, x > 0$ passes through the point $(1, 1)$ and

$$y(e) = \frac{\alpha - \tan\left(\frac{3}{2}\right)}{\beta + \tan\left(\frac{3}{2}\right)}$$

, then $\alpha + 2\beta$ is _____.

Q81 Permutations & Combinations **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/wT9KE2NkdD) › prepwiser.in/questions/wT9KE2NkdD

All the letters of the word "GTWENTY" are written in all possible ways with or without meaning and these words are written as in a dictionary. The serial number of the word "GTWENTY" is _____.

Q82 Statistics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/E-XjIbpRDs) › prepwiser.in/questions/E-XjIbpRDs

If the mean and variance of the data 65, 68, 58, 44, 48, 45, 60, $\alpha, \beta, 60$ where $\alpha > \beta$, are 56 and 66.2 respectively, then $\alpha^2 + \beta^2$ is equal to _____.

Q83 Area Under Curves **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/dooq9v1Eif) › prepwiser.in/questions/dooq9v1Eif

The area (in sq. units) of the part of the circle $x^2 + y^2 = 169$ which is below the line $5x - y = 13$ is $\frac{\pi\alpha}{2\beta} - \frac{65}{2} + \frac{\alpha}{\beta} \sin^{-1}\left(\frac{12}{13}\right)$, where α, β are coprime numbers. Then $\alpha + \beta$ is equal to _____.

Q84 Area Under Curves **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/E-JRnoa2PI) › prepwiser.in/questions/E-JRnoa2PI

If the points of intersection of two distinct conics $x^2 + y^2 = 4b$ and $\frac{x^2}{16} + \frac{y^2}{b^2} = 1$ lie on the curve $y^2 = 3x^2$, then $3\sqrt{3}$ times the area of the rectangle formed by the intersection points is _____.

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1. C	2. A	3. C	4. C	5. A	6. C	7. C	8. A
9. C	10. D	11. B	12. D	13. C	14. A	15. D	16. D
17. C	18. D	19. A	20. D	21. 17	22. 81	23. 2	24. 8
25. 6	26. 2	27. 810	28. 10	29. 9			

Chemistry

30. C	31. B	32. A	33. D	34. C	35. A	36. D	37. A
38. A	39. B	40. B	41. B	42. A	43. A	44. D	45. A
46. C	47. 3	48. 2	49. 1	50. 4	51. 30	52. 46	53. 73
54. 4	55. 2						

Mathematics

56. C	57. C	58. A	59. C	60. B	61. B	62. B	63. B
64. D	65. D	66. C	67. A	68. B	69. D	70. B	71. C
72. D	73. A	74. D	75. 65	76. 5	77. 2041	78. 2	79. 13
80. 3	81. 553	82. 6344	83. 171	84. 432			

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