

JEE MAIN 2024 · QUESTION PAPER

27 Jan 2024 **Shift 2**

85 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	19 Q1 to Q19	10 Q20 to Q29
● Chemistry	16 Q30 to Q45	10 Q46 to Q55
● Mathematics	20 Q56 to Q75	10 Q76 to Q85
In this PDF	85 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-evening · 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](#) › [prepwisar.in/questions/37g1C2QFMr](https://www.prepwisar.in/questions/37g1C2QFMr)

Primary side of a transformer is connected to 230V, 50Hz supply. Turns ratio of primary to secondary winding is 10 : 1. Load resistance connected to secondary side is 46Ω . The power consumed in it is:

- (A) 11.5 W (B) 12.5 W (C) 10.0 W (D) 12.0 W

Q2 Nuclear Physics

[Step-by-step solution](#) › [prepwisar.in/questions/zn8IoHJERW](https://www.prepwisar.in/questions/zn8IoHJERW)

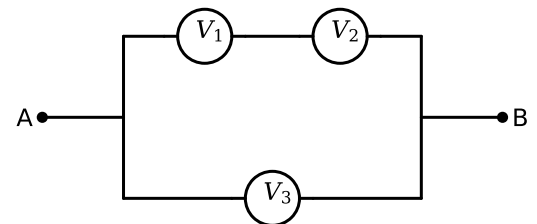
The atomic mass of ${}^6\text{C}^{12}$ is 12.000000u and that of ${}^6\text{C}^{13}$ is 13.003354u. The required energy to remove a neutron from ${}^6\text{C}^{13}$, if mass of neutron is 1.008665u, will be:

- (A) 62.5 MeV (B) 6.25 MeV (C) 4.95 MeV (D) 49.5 MeV

Q3 Current Electricity

[Step-by-step solution](#) › [prepwisar.in/questions/1p08QZNk5W](https://www.prepwisar.in/questions/1p08QZNk5W)

Three voltmeters, all having different internal resistances are joined as shown in figure. When some potential difference is applied across A and B, their readings are V_1 , V_2 and V_3 . Choose the correct option.



- (A) $V_1 = V_2$ (B) $V_1 \neq V_3 - V_2$
(C) $V_1 + V_2 = V_3$ (D) $V_1 + V_2 > V_3$

Q4 Moving Charges & Magnetism

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

A current of $200\mu\text{A}$ deflects the coil of a moving coil galvanometer through 60° . The current to cause deflection through $\frac{\pi}{10}$ radian is:

- (A) $120\mu\text{A}$ (B) $180\mu\text{A}$ (C) $30\mu\text{A}$ (D) $60\mu\text{A}$

Q5 Current Electricity

[Step-by-step solution](#) › [prepwisar.in/questions/Q0NS9Hxcfr](https://www.prepwisar.in/questions/Q0NS9Hxcfr)

Wheatstone bridge principle is used to measure the specific resistance (S_1) of given wire, having length L , radius r . If X is the resistance of wire, then specific resistance is; $S_1 = X \left(\frac{\pi r^2}{L} \right)$. If the length of the wire gets doubled then the value of specific resistance will be:

- (A) $\frac{S_1}{4}$ (B) $2S_1$ (C) $\frac{S_1}{2}$ (D) S_1

Q6 Dual Nature of Radiation & Matter

[Step-by-step solution](#) › [prepwisar.in/questions/0KcxOwp9PH](https://www.prepwisar.in/questions/0KcxOwp9PH)

The threshold frequency of a metal with work function 6.63eV is:

- (A) $16 \times 10^{15}\text{Hz}$ (B) $16 \times 10^{12}\text{Hz}$ (C) $1.6 \times 10^{15}\text{Hz}$ (D) $1.6 \times 10^{12}\text{Hz}$

Q7 Electromagnetic Waves

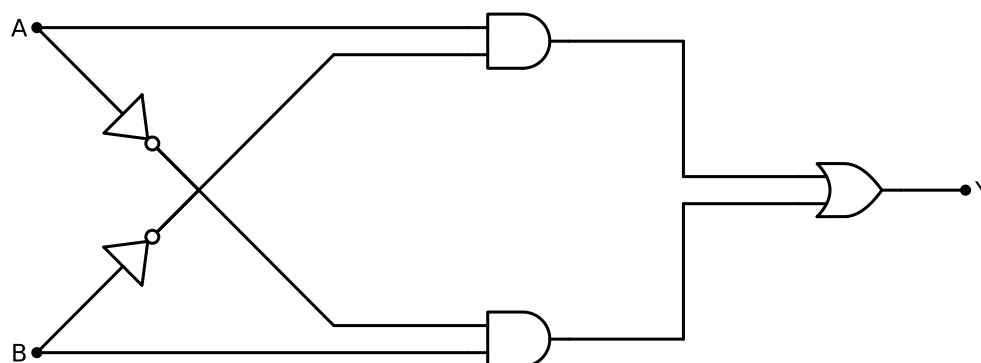
[Step-by-step solution](#) › [prepwisar.in/questions/pChij--ruf](https://www.prepwisar.in/questions/pChij--ruf)

An object is placed in a medium of refractive index 3. An electromagnetic wave of intensity $6 \times 10^8\text{W/m}^2$ falls normally on the object and it is absorbed completely. The radiation pressure on the object would be (speed of light in free space = $3 \times 10^8\text{m/s}$):

- (A) 6Nm^{-2} (B) 36Nm^{-2} (C) 18Nm^{-2} (D) 2Nm^{-2}

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The truth table of the given circuit diagram is:



(A)	A	B	Y	(B)	A	B	Y	(C)	A	B	Y	(D)	A	B	Y
	0	0	0		0	0	1		0	0	0		0	0	1
	0	1	1		0	1	1		0	1	0		0	1	0
	1	0	1		1	0	1		1	0	0		1	0	0
	1	1	0		1	1	0		1	1	1		1	1	1

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

Assertion (A) : Work done by electric field on moving a positive charge on an equipotential surface is always zero.

Reason (R) : Electric lines of forces are always perpendicular to equipotential surfaces.

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

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

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

Assertion (A) : The angular speed of the moon in its orbit about the earth is more than the angular speed of the earth in its orbit about the sun.

Reason (R) : The moon takes less time to move around the earth than the time taken by the earth to move around the sun.

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

Q11 Thermodynamics[Step-by-step solution](https://www.prepwise.in/questions/3fjtEMITho) › prepwise.in/questions/3fjtEMITho

During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its absolute temperature. The ratio of $\frac{C_p}{C_v}$ for the gas is:

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

Q12 Units, Dimensions & Errors[Step-by-step solution](https://www.prepwise.in/questions/eyzel7HJhD) › prepwise.in/questions/eyzel7HJhD

The equation of state of a real gas is given by

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

, where P, V and T are pressure, volume and temperature respectively and R is the universal gas constant. The dimensions of $\frac{a}{b^2}$ is similar to that of:

- (A) P (B) RT (C) PV (D) R

Q13 Kinetic Theory of Gases[Step-by-step solution](https://www.prepwise.in/questions/hjXftuPvuq) › prepwise.in/questions/hjXftuPvuq

The total kinetic energy of 1 mole of oxygen at 27°C is : [Use universal gas constant (R) = 8.31J/mole K]

- (A) 6232.5 J (B) 5670.5 J (C) 6845.5 J (D) 5942.0 J

Q14 Friction[Step-by-step solution](https://www.prepwise.in/questions/JMIxAhRBcu) › prepwise.in/questions/JMIxAhRBcu

Given below are two statements:

Statement (I) : The limiting force of static friction depends on the area of contact and independent of materials.

Statement (II) : The limiting force of kinetic friction is independent of the area of contact and depends on materials.

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

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

Q15 Elasticity[Step-by-step solution](https://www.prepwise.in/questions/jumdpDPorV) › prepwise.in/questions/jumdpDPorV

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

Assertion (A) : The property of body, by virtue of which it tends to regain its original shape when the external force is removed, is Elasticity.

Reason (R) : The restoring force depends upon the bonded inter atomic and inter molecular force of solid.

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

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

Q16 Wave Optics[Step-by-step solution](#) › [prepwisar.in/questions/99bWwM9Ut0](https://www.prepwisar.in/questions/99bWwM9Ut0)

When a polaroid sheet is rotated between two crossed polaroids then the transmitted light intensity will be maximum for a rotation of:

- (A) 90° (B) 30° (C) 45° (D) 60°

Q17 Simple Harmonic Motion[Step-by-step solution](#) › [prepwisar.in/questions/I5MTLNS63X](https://www.prepwisar.in/questions/I5MTLNS63X)

A ball suspended by a thread swings in a vertical plane so that its magnitude of acceleration in the extreme position and lowest position are equal. The angle (θ) of thread deflection in the extreme position will be:

- (A) $\tan^{-1}\left(\frac{1}{2}\right)$ (B) $2 \tan^{-1}\left(\frac{1}{2}\right)$ (C) $2 \tan^{-1}\left(\frac{1}{\sqrt{5}}\right)$ (D) $\tan^{-1}(\sqrt{2})$

Q18 Work, Energy & Power[Step-by-step solution](#) › [prepwisar.in/questions/39AcjXWcAE](https://www.prepwisar.in/questions/39AcjXWcAE)

A bullet is fired into a fixed target loses one third of its velocity after travelling 4cm. It penetrates further $D \times 10^{-3}\text{m}$ before coming to rest. The value of D is:

- (A) 23 (B) 32 (C) 42 (D) 52

Q19 Experimental Skills[Step-by-step solution](#) › [prepwisar.in/questions/e5sGjKUUmE](https://www.prepwisar.in/questions/e5sGjKUUmE)

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

Assertion (A) : In Vernier calliper if positive zero error exists, then while taking measurements, the reading taken will be more than the actual reading.

Reason (R) : The zero error in Vernier Calliper might have happened due to manufacturing defect or due to rough handling.

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

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

Physics Section B · Numerical value

Q20 to Q29

Q20 Alternating Current **NUMERICAL**[Step-by-step solution](#) › [prepwisar.in/questions/u1NCw9UmDv](https://www.prepwisar.in/questions/u1NCw9UmDv)

A series LCR circuit with

$$L = \frac{100}{\pi} \text{mH}, C = \frac{10^{-3}}{\pi} \text{F}$$

and $R = 10\Omega$, is connected across an ac source of 220V, 50Hz supply. The power factor of the circuit would be _____.

Q21 Atomic Physics **NUMERICAL**[Step-by-step solution](#) › [prepwisar.in/questions/T-Z_cdDoPz](https://www.prepwisar.in/questions/T-Z_cdDoPz)

If Rydberg's constant is R , the longest wavelength of radiation in Paschen series will be $\frac{\alpha}{7R}$, where $\alpha =$ _____.

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Q22 Electrostatics I: Charges, Field & Gauss's Law **NUMERICAL**

[Step-by-step solution](#) > prepwiser.in/questions/WW6Ry-z37y

Two charges of $-4\mu\text{C}$ and $+4\mu\text{C}$ are placed at the points $A(1, 0, 4)\text{m}$ and $B(2, -1, 5)\text{m}$ located in an electric field $\vec{E} = 0.20\hat{i}\text{V/cm}$. The magnitude of the torque acting on the dipole is $8\sqrt{\alpha} \times 10^{-5}\text{Nm}$, where $\alpha = \underline{\hspace{2cm}}$.

Q23 Electrostatics II: Potential & Capacitance **NUMERICAL**

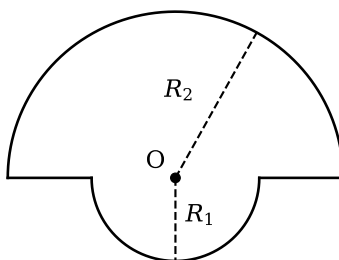
[Step-by-step solution](#) > prepwiser.in/questions/uhFMXQku3V

The electric potential at the surface of an atomic nucleus ($z = 50$) of radius $9 \times 10^{-13}\text{cm}$ is $\underline{\hspace{2cm}} \times 10^6\text{V}$.

Q24 Moving Charges & Magnetism **NUMERICAL**

[Step-by-step solution](#) > prepwiser.in/questions/iS5jCIVZ7e

The magnetic field at the centre of a wire loop formed by two semicircular wires of radii $R_1 = 2\pi\text{m}$ and $R_2 = 4\pi\text{m}$, carrying current $I = 4\text{A}$ as per figure given below is $\alpha \times 10^{-7}\text{T}$. The value of α is $\underline{\hspace{2cm}}$. (Centre O is common for all segments)



Q25 Rectilinear Motion **NUMERICAL**

[Step-by-step solution](#) > prepwiser.in/questions/8zvrHvZnFj

A body falling under gravity covers two points A and B separated by 80m in 2s . The distance of upper point A from the starting point is $\underline{\hspace{2cm}}\text{m}$ (use $g = 10\text{ms}^{-2}$).

Q26 Fluid Mechanics **NUMERICAL**

[Step-by-step solution](#) > prepwiser.in/questions/r_mdzRONKQ

The reading of pressure metre attached with a closed pipe is $4.5 \times 10^4\text{N/m}^2$. On opening the valve, water starts flowing and the reading of pressure metre falls to $2.0 \times 10^4\text{N/m}^2$. The velocity of water is found to be $\sqrt{V}\text{m/s}$. The value of V is $\underline{\hspace{2cm}}$.

Q27 Rotational Motion **NUMERICAL**

[Step-by-step solution](#) > prepwiser.in/questions/YMZ-_X4S-T

A ring and a solid sphere roll down the same inclined plane without slipping. They start from rest. The radii of both bodies are identical and the ratio of their kinetic energies is $\frac{7}{x}$, where x is $\underline{\hspace{2cm}}$.

Q28 Wave Optics **NUMERICAL**

[Step-by-step solution](#) > prepwiser.in/questions/xzK0i7HVuz

A parallel beam of monochromatic light of wavelength $5000\overset{\circ}{\text{\AA}}$ is incident normally on a single narrow slit of width 0.001mm . The light is focused by convex lens on screen, placed on its focal plane. The first minima will be formed for the angle of diffraction of $\underline{\hspace{2cm}}$ (degree).

Q29 Sound Waves **NUMERICAL**

[Step-by-step solution](#) > prepwiser.in/questions/gXnQZIWX28

A closed organ pipe 150cm long gives 7 beats per second with an open organ pipe of length 350cm , both vibrating in fundamental mode. The velocity of sound is $\underline{\hspace{2cm}}\text{m/s}$.

Q30 Practical Organic Chemistry[Step-by-step solution](#) › [prepwiser.in/questions/VCFyTxYgdI](#)

Phenolic group can be identified by a positive:

- (A) Tollen's test (B) Phthalein dye test (C) Carbylamine test (D) Lucas test

Q31 General Organic Chemistry (GOC)[Step-by-step solution](#) › [prepwiser.in/questions/N4z-cscycf](#)

The molecular formula of second homologue in the homologous series of mono carboxylic acids is

- (A) $C_2H_4O_2$ (B) $C_2H_2O_2$ (C) CH_2O (D) $C_3H_6O_2$

Q32 Carbohydrates & Biomolecules[Step-by-step solution](#) › [prepwiser.in/questions/j-6a6vYiF9](#)

Which structure of protein remains intact after coagulation of egg white on boiling?

- (A) Quaternary (B) Primary (C) Secondary (D) Tertiary

Q33 d & f Block Elements[Step-by-step solution](#) › [prepwiser.in/questions/ynbjdVERqE](#)

Identify the incorrect pair from the following:

- (A) Haber process - Iron (B) Polythene preparation - $TiCl_4$, $Al(CH_3)_3$
(C) Photography - $AgBr$ (D) Wacker process - $PtCl_2$

Q34 Chemical Bonding & Molecular Structure[Step-by-step solution](#) › [prepwiser.in/questions/OSfB28GEGM](#)

Identify from the following species in which d^2sp^3 hybridization is shown by central atom:

- (A) $[Co(NH_3)_6]^{3+}$ (B) SF_6 (C) $[Pt(Cl_4)]^{2-}$ (D) BrF_5

Q35 d & f Block Elements[Step-by-step solution](#) › [prepwiser.in/questions/74E9-HyTOM](#)

Given below are two statements:

Statement (I) : In the Lanthanoids, the formation Ce^{+4} is favoured by its noble gas configuration.

Statement (II): Ce^{+4} is a strong oxidant reverting to the common +3 state.

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

Q36 Atomic Structure[Step-by-step solution](#) › [prepwiser.in/questions/Yyz-j6yR0n](#)

Choose the correct option having all the elements with d^{10} electronic configuration from the following:

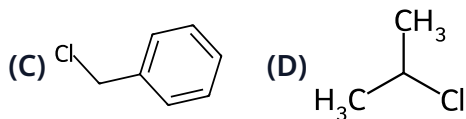
- (A) ^{46}Pd , ^{28}Ni , ^{26}Fe , ^{24}Cr (B) ^{29}Cu , ^{30}Zn , ^{48}Cd , ^{47}Ag
(C) ^{27}Co , ^{28}Ni , ^{26}Fe , ^{24}Cr (D) ^{28}Ni , ^{24}Cr , ^{26}Fe , ^{29}Cu

Q37 Electrochemistry[Step-by-step solution](#) › [prepwiser.in/questions/HVcDydURFV](#)

Which of the following statements is not correct about rusting of iron?

- (A) Rusting of iron is envisaged as setting up of electrochemical cell on the surface of iron object.
(B) Dissolved acidic oxides SO_2 , NO_2 in water act as catalyst in the process of rusting.
(C) Coating of iron surface by tin prevents rusting, even if the tin coating is peeling off.
(D) When pH lies above 9 or 10, rusting of iron does not take place.

Which among the following halide/s will not show S_N1 reaction:



Choose the most appropriate answer from the options given below:

(A) (B) and (C) only

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

(C) (B) only

(D) (A) and (B) only

Given below are two statements:

Statement (I) : Oxygen being the first member of group 16 exhibits only -2 oxidation state.

Statement (II) : Down the group 16 stability of +4 oxidation state decreases and +6 oxidation state increases.

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 Statement I and Statement II are incorrect

(C) Statement I is incorrect but Statement II is correct

(D) Both Statement I and Statement II are correct

Which of the following cannot function as an oxidising agent?



The quantity which changes with temperature is:

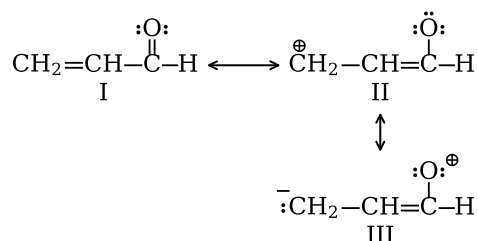
(A) Molality

(B) Molarity

(C) Mole fraction

(D) Mass percentage

The order of relative stability of the contributing structure is:



Choose the correct answer from the options given below:

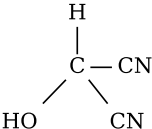
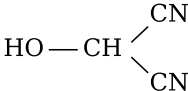
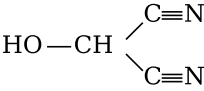
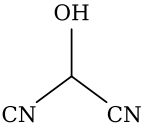
(A) $I = II = III$ (B) $I > II > III$ (C) $III > II > I$ (D) $II > I > III$

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The incorrect statement regarding conformations of ethane is:

- (A) The dihedral angle in staggered conformation is 60° .
- (B) Ethane has infinite number of conformations.
- (C) Eclipsed conformation is the most stable conformation.
- (D) The conformations of ethane are inter-convertible to one-another.

Bond line formula of $\text{HOCH}(\text{CN})_2$ is:

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

The technique used for purification of steam volatile water immiscible substances is:

- (A) Fractional distillation
- (B) Distillation
- (C) Fractional distillation under reduced pressure
- (D) Steam distillation

Chemistry Section B · Numerical value

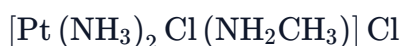
Q46 to Q55

The number of non-polar molecules from the following is _____.



Time required for completion of 99.9% of a First order reaction is _____ times of half life ($t_{1/2}$) of the reaction.

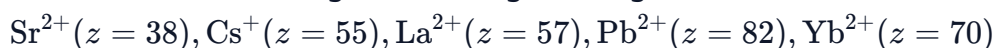
The Spin only magnetic moment value of square planar complex



is _____ B.M. (Nearest integer)

(Given atomic number for Pt = 78)

Total number of ions from the following with noble gas configuration is _____.



and $\text{Fe}^{2+}(z = 26)$

The hydrogen electrode is dipped in a solution of $\text{pH} = 3$ at 25°C . The potential of the electrode will be _____ $\times 10^{-2}\text{V}$.

$$\left(\frac{2.303RT}{F} = 0.059\text{V}\right)$$

Q51 Mole Concept & Stoichiometry **NUMERICAL**

[Step-by-step solution](#) > [prepwiser.in/questions/HS_4YRv4Vt](https://www.prepwiser.in/questions/HS_4YRv4Vt)

1 mole of PbS is oxidised by "X" moles of O_3 to get "Y" moles of O_2 . $X + Y =$ _____.

Q52 Mole Concept & Stoichiometry **NUMERICAL**

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

9.3g of aniline is subjected to reaction with excess of acetic anhydride to prepare acetanilide. The mass of acetanilide produced if the reaction is 100% completed is _____ $\times 10^{-1}$ g.

(Given molar mass in $g\text{mol}^{-1}$

N : 14, O : 16,
C : 12, H : 1)

Q53 Mole Concept & Stoichiometry **NUMERICAL**

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

Volume of 3MNaOH (formula weight $40g\text{mol}^{-1}$) which can be prepared from 84g of NaOH is _____ $\times 10^{-1}dm^3$.

Q54 Chemical Thermodynamics **NUMERICAL**

[Step-by-step solution](#) > [prepwiser.in/questions/c225A4mVV-](https://www.prepwiser.in/questions/c225A4mVV-)

For a certain thermochemical reaction $M \rightarrow N$ at

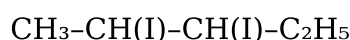
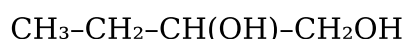
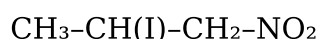
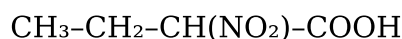
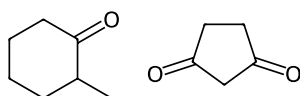
$$T = 400K, \Delta H^\ominus = 77.2kJ\text{mol}^{-1}, \Delta S = 122JK^{-1}, \log$$

equilibrium constant ($\log K$) is _____ $\times 10^{-1}$.

Q55 General Organic Chemistry (GOC) **NUMERICAL**

[Step-by-step solution](#) > [prepwiser.in/questions/9xd2WSq5zD](https://www.prepwiser.in/questions/9xd2WSq5zD)

Total number of compounds with Chiral carbon atoms from following is _____.



Mathematics Section A · Multiple choice

Q56 to Q75

Q56 Three Dimensional Geometry

[Step-by-step solution](#) > [prepwiser.in/questions/yO2_6pzUYD](https://www.prepwiser.in/questions/yO2_6pzUYD)

Let the image of the point $(1, 0, 7)$ in the line $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$ be the point (α, β, γ) . Then which one of the following points lies on the line passing through (α, β, γ) and making angles $\frac{2\pi}{3}$ and $\frac{3\pi}{4}$ with y -axis and z -axis respectively and an acute angle with x -axis?

(A) $(1, -2, 1 + \sqrt{2})$

(B) $(3, -4, 3 + 2\sqrt{2})$

(C) $(3, 4, 3 - 2\sqrt{2})$

(D) $(1, 2, 1 - \sqrt{2})$

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Q57 Applications of Derivatives[Step-by-step solution](#) › [prepwiser.in/questions/u0LR1SoGoD](https://www.prepwiser.in/questions/u0LR1SoGoD)

Let $g(x) = 3f\left(\frac{x}{3}\right) + f(3-x)$ and $f''(x) > 0$ for all $x \in (0, 3)$. If g is decreasing in $(0, \alpha)$ and increasing in $(\alpha, 3)$, then 8α is:

- (A) 0 (B) 24 (C) 18 (D) 20

Q58 Definite Integration[Step-by-step solution](#) › [prepwiser.in/questions/BljRCsWzaw](https://www.prepwiser.in/questions/BljRCsWzaw)

For $0 < a < 1$, the value of the integral $\int_0^{\pi} \frac{dx}{1-2a \cos x + a^2}$ is:

- (A) $\frac{\pi^2}{\pi + a^2}$ (B) $\frac{\pi^2}{\pi - a^2}$ (C) $\frac{\pi}{1 - a^2}$ (D) $\frac{\pi}{1 + a^2}$

Q59 Differential Equations[Step-by-step solution](#) › [prepwiser.in/questions/qRuOQj8xXF](https://www.prepwiser.in/questions/qRuOQj8xXF)

If $y = y(x)$ is the solution curve of the differential equation

$$(x^2 - 4) dy - (y^2 - 3y) dx = 0, x > 2, y(4) = \frac{3}{2}$$

and the slope of the curve is never zero, then the value of $y(10)$ equals:

- (A) $\frac{3}{1 + (8)^{1/4}}$ (B) $\frac{3}{1 - (8)^{1/4}}$ (C) $\frac{3}{1 - 2\sqrt{2}}$ (D) $\frac{3}{1 + 2\sqrt{2}}$

Q60 Relations & Functions (Basic)[Step-by-step solution](#) › [prepwiser.in/questions/tkv0gYnMtO](https://www.prepwiser.in/questions/tkv0gYnMtO)

Let $f: \mathbf{R} - \left\{-\frac{1}{2}\right\} \rightarrow \mathbf{R}$ and $g: \mathbf{R} - \left\{-\frac{5}{2}\right\} \rightarrow \mathbf{R}$ be defined as $f(x) = \frac{2x+3}{2x+1}$ and $g(x) = \frac{|x|+1}{2x+5}$. Then, the domain of the function fog is:

- (A) $\mathbf{R} - \left\{-\frac{7}{4}\right\}$ (B) $\mathbf{R}$ (C) $\mathbf{R} - \left\{-\frac{5}{2}, -\frac{7}{4}\right\}$ (D) $\mathbf{R} - \left\{-\frac{5}{2}\right\}$

Q61 Ellipse[Step-by-step solution](#) › [prepwiser.in/questions/wq0FB2UK0s](https://www.prepwiser.in/questions/wq0FB2UK0s)

Let e_1 be the eccentricity of the hyperbola $\frac{x^2}{16} - \frac{y^2}{9} = 1$ and e_2 be the eccentricity of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, $a > b$, which passes through the foci of the hyperbola. If $e_1 e_2 = 1$, then the length of the chord of the ellipse parallel to the x -axis and passing through $(0, 2)$ is:

- (A) $\frac{8\sqrt{5}}{3}$ (B) $3\sqrt{5}$ (C) $4\sqrt{5}$ (D) $\frac{10\sqrt{5}}{3}$

Q62 Inverse Trigonometric Functions[Step-by-step solution](#) › [prepwiser.in/questions/IFTyf2NmJA](https://www.prepwiser.in/questions/IFTyf2NmJA)

Considering only the principal values of inverse trigonometric functions, the number of positive real values of x satisfying $\tan^{-1}(x) + \tan^{-1}(2x) = \frac{\pi}{4}$ is:

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

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Q63 Continuity & Differentiability[Step-by-step solution](#) › prepwiser.in/questions/NOsyZf-8pX

Consider the function $f : (0, 2) \rightarrow \mathbf{R}$ defined by $f(x) = \frac{x}{2} + \frac{2}{x}$ and the function $g(x)$ defined by

$$g(x) = \begin{cases} \min\{f(t)\}, & 0 < t \leq x \text{ and } 0 < x \leq 1 \\ \frac{3}{2} + x, & 1 < x < 2 \end{cases}. \text{ Then,}$$

- (A) g is continuous but not differentiable at $x = 1$
 (B) g is continuous and differentiable for all $x \in (0, 2)$
 (C) g is not continuous for all $x \in (0, 2)$
 (D) g is neither continuous nor differentiable at $x = 1$

Q64 Limits[Step-by-step solution](#) › prepwiser.in/questions/Ytj2DQzee3

If $\lim_{x \rightarrow 0} \frac{3 + \alpha \sin x + \beta \cos x + \log_e(1-x)}{3 \tan^2 x} = \frac{1}{3}$, then $2\alpha - \beta$ is equal to :

- (A) 2 (B) 1 (C) 5 (D) 7

Q65 Determinants[Step-by-step solution](#) › prepwiser.in/questions/W6PIC_pQUh

The values of α , for which

$$\begin{vmatrix} 1 & \frac{3}{2} & \alpha + \frac{3}{2} \\ 1 & \frac{1}{3} & \alpha + \frac{1}{3} \\ 2\alpha + 3 & 3\alpha + 1 & 0 \end{vmatrix} = 0$$

, lie in the interval

- (A) $(-2, 1)$ (B) $(-\frac{3}{2}, \frac{3}{2})$ (C) $(-3, 0)$ (D) $(0, 3)$

Q66 Binomial Theorem[Step-by-step solution](#) › prepwiser.in/questions/CV-HBIUhfl

Let $\alpha = \frac{(4!)!}{(4!)^3!}$ and $\beta = \frac{(5!)!}{(5!)^4!}$. Then:

- (A) $\alpha \in \mathbf{N}$ and $\beta \in \mathbf{N}$ (B) $\alpha \in \mathbf{N}$ and $\beta \notin \mathbf{N}$ (C) $\alpha \notin \mathbf{N}$ and $\beta \in \mathbf{N}$ (D) $\alpha \notin \mathbf{N}$ and $\beta \notin \mathbf{N}$

Q67 Probability: Basic[Step-by-step solution](#) › prepwiser.in/questions/mC73zJ_Uxr

An urn contains 6 white and 9 black balls. Two successive draws of 4 balls are made without replacement. The probability, that the first draw gives all white balls and the second draw gives all black balls, is:

- (A) $\frac{3}{256}$ (B) $\frac{5}{256}$ (C) $\frac{3}{715}$ (D) $\frac{5}{715}$

Q68 Sequences & Series[Step-by-step solution](#) › prepwiser.in/questions/qCMn7vwIOy

If α, β are the roots of the equation, $x^2 - x - 1 = 0$ and $S_n = 2023\alpha^n + 2024\beta^n$, then:

- (A) $2S_{12} = S_{11} + S_{10}$ (B) $S_{12} = S_{11} + S_{10}$ (C) $S_{11} = S_{10} + S_{12}$ (D) $2S_{11} = S_{12} + S_{10}$

Q69 Sequences & Series[Step-by-step solution](#) › prepwiser.in/questions/E1NMFyx7zi

The 20th term from the end of the progression $20, 19\frac{1}{4}, 18\frac{1}{2}, 17\frac{3}{4}, \dots, -129\frac{1}{4}$ is :

- (A) -115 (B) -100 (C) -110 (D) -118

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Q70 Sets[Step-by-step solution](https://www.prepwiser.in/questions/wwh01Kztll) › prepwiser.in/questions/wwh01Kztll

Let A and B be two finite sets with m and n elements respectively. The total number of subsets of the set A is 56 more than the total number of subsets of B . Then the distance of the point $P(m, n)$ from the point $Q(-2, -3)$ is:

- (A) 8 (B) 10 (C) 4 (D) 6

Q71 Trigonometric Equations[Step-by-step solution](https://www.prepwiser.in/questions/M0kOhj7DNI) › prepwiser.in/questions/M0kOhj7DNI

If $2 \tan^2 \theta - 5 \sec \theta = 1$ has exactly 7 solutions in the interval $\left[0, \frac{n\pi}{2}\right]$, for the least value of $n \in \mathbf{N}$, then $\sum_{k=1}^n \frac{k}{2^k}$ is equal to:

- (A) $\frac{1}{2^{14}} (2^{15} - 15)$ (B) $1 - \frac{15}{2^{13}}$ (C) $\frac{1}{2^{15}} (2^{14} - 14)$ (D) $\frac{1}{2^{13}} (2^{14} - 15)$

Q72 Vectors[Step-by-step solution](https://www.prepwiser.in/questions/XwiGPQ8Jan) › prepwiser.in/questions/XwiGPQ8Jan

Let the position vectors of the vertices A, B and C of a triangle be $2\hat{i} + 2\hat{j} + \hat{k}$, $\hat{i} + 2\hat{j} + 2\hat{k}$ and $2\hat{i} + \hat{j} + 2\hat{k}$ respectively. Let l_1, l_2 and l_3 be the lengths of perpendiculars drawn from the ortho center of the triangle on the sides AB, BC and CA respectively, then $l_1^2 + l_2^2 + l_3^2$ equals:

- (A) $\frac{1}{4}$ (B) $\frac{1}{5}$ (C) $\frac{1}{3}$ (D) $\frac{1}{2}$

Q73 Vectors[Step-by-step solution](https://www.prepwiser.in/questions/VkXpBJjbZf) › prepwiser.in/questions/VkXpBJjbZf

The position vectors of the vertices A, B and C of a triangle are $2\hat{i} - 3\hat{j} + 3\hat{k}$, $2\hat{i} + 2\hat{j} + 3\hat{k}$ and $-\hat{i} + \hat{j} + 3\hat{k}$ respectively. Let l denotes the length of the angle bisector AD of $\angle BAC$ where D is on the line segment BC, then $2l^2$ equals:

- (A) 45 (B) 50 (C) 42 (D) 49

Q74 Straight Lines[Step-by-step solution](https://www.prepwiser.in/questions/f4DG2Boxmv) › prepwiser.in/questions/f4DG2Boxmv

Let R be the interior region between the lines $3x - y + 1 = 0$ and $x + 2y - 5 = 0$ containing the origin. The set of all values of a , for which the points $(a^2, a + 1)$ lie in R , is:

- (A) $(-3, 0) \cup \left(\frac{2}{3}, 1\right)$ (B) $(-3, 0) \cup \left(\frac{1}{3}, 1\right)$ (C) $(-3, -1) \cup \left(\frac{1}{3}, 1\right)$ (D) $(-3, -1) \cup \left(-\frac{1}{3}, 1\right)$

Q75 Indefinite Integration[Step-by-step solution](https://www.prepwiser.in/questions/bxo1qk7eRk) › prepwiser.in/questions/bxo1qk7eRk

The integral $\int \frac{(x^8 - x^2)dx}{(x^{12} + 3x^6 + 1) \tan^{-1}\left(x^3 + \frac{1}{x^3}\right)}$ is equal to:

- (A) $\log_e \left(\left| \tan^{-1} \left(x^3 + \frac{1}{x^3} \right) \right| \right)^{1/3} + C$ (B) $\log_e \left(\left| \tan^{-1} \left(x^3 + \frac{1}{x^3} \right) \right| \right) + C$
 (C) $\log_e \left(\left| \tan^{-1} \left(x^3 + \frac{1}{x^3} \right) \right| \right)^{1/2} + C$ (D) $\log_e \left(\left| \tan^{-1} \left(x^3 + \frac{1}{x^3} \right) \right| \right)^3 + C$

Q76 Three Dimensional Geometry **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/is1tT5YGAt](https://www.prepwisar.in/questions/is1tT5YGAt)

The lines $\frac{x-2}{2} = \frac{y}{-2} = \frac{z-7}{16}$ and $\frac{x+3}{4} = \frac{y+2}{3} = \frac{z+2}{1}$ intersect at the point P . If the distance of P from the line $\frac{x+1}{2} = \frac{y-1}{3} = \frac{z-1}{1}$ is l , then $14l^2$ is equal to _____.

Q77 Binomial Theorem **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/BR8I1WoWVg](https://www.prepwisar.in/questions/BR8I1WoWVg)

The coefficient of x^{2012} in the expansion of $(1-x)^{2008} (1+x+x^2)^{2007}$ is equal to _____.

Q78 Circles **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/4pBtqO1j5k](https://www.prepwisar.in/questions/4pBtqO1j5k)

Consider a circle $(x-\alpha)^2 + (y-\beta)^2 = 50$, where $\alpha, \beta > 0$. If the circle touches the line $y+x=0$ at the point P , whose distance from the origin is $4\sqrt{2}$, then $(\alpha+\beta)^2$ is equal to _____.

Q79 Complex Numbers **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/_LA3QTg0o5](https://www.prepwisar.in/questions/_LA3QTg0o5)

Let the complex numbers α and $\frac{1}{\alpha}$ lie on the circles $|z-z_0|^2 = 4$ and $|z-z_0|^2 = 16$ respectively, where $z_0 = 1+i$. Then, the value of $100|\alpha|^2$ is _____.

Q80 Definite Integration **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/ohIF8g-xHK](https://www.prepwisar.in/questions/ohIF8g-xHK)

Let

$$f(x) = \int_0^x g(t) \log_e \left(\frac{1-t}{1+t} \right) dt$$

, where g is a continuous odd function. If

$$\int_{-\pi/2}^{\pi/2} \left(f(x) + \frac{x^2 \cos x}{1+e^x} \right) dx = \left(\frac{\pi}{\alpha} \right)^2 - \alpha$$

, then α is equal to _____.

Q81 Differential Equations **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/tycYj3wH9w](https://www.prepwisar.in/questions/tycYj3wH9w)

If the solution curve, of the differential equation $\frac{dy}{dx} = \frac{x+y-2}{x-y}$ passing through the point $(2, 1)$ is

$$\tan^{-1} \left(\frac{y-1}{x-1} \right) - \frac{1}{\beta} \log_e \left(\alpha + \left(\frac{y-1}{x-1} \right)^2 \right) = \log_e |x-1|$$

, then $5\beta + \alpha$ is equal to _____.

Q82 Matrices **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/QAeBFWLga9](https://www.prepwisar.in/questions/QAeBFWLga9)

Let A be a 2×2 real matrix and I be the identity matrix of order 2. If the roots of the equation $|A - xI| = 0$ be -1 and 3 , then the sum of the diagonal elements of the matrix A^2 is

Q83 Statistics **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/tjPntUlj2](https://www.prepwisar.in/questions/tjPntUlj2)

The mean and standard deviation of 15 observations were found to be 12 and 3 respectively. On rechecking it was found that an observation was read as 10 in place of 12. If μ and σ^2 denote the mean and variance of the correct observations respectively, then $15(\mu + \mu^2 + \sigma^2)$ is equal to _____.

Q84 Area Under Curves **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/3_WZobuV-U](https://www.prepwisar.in/questions/3_WZobuV-U)

If the area of the region $\{(x, y) : 0 \leq y \leq \min \{2x, 6x - x^2\}\}$ is A , then $12A$ is equal to _____.

If the sum of squares of all real values of α , for which the lines $2x - y + 3 = 0$, $6x + 3y + 1 = 0$ and $\alpha x + 2y - 2 = 0$ do not form a triangle is p , then the greatest integer less than or equal to p is _____.

Answer key: JEE Main 2024 · 27 Jan · Shift 2

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Physics

1. A	2. C	3. C	4. D	5. D	6. C	7. A	8. A
9. A	10. C	11. B	12. A	13. A	14. A	15. C	16. C
17. B	18. B	19. B	20. 1	21. 144	22. 2	23. 8	24. 3
25. 45	26. 50	27. 7	28. 30	29. 294			

Chemistry

30. B	31. A	32. B	33. D	34. A	35. C	36. B	37. C
38. C	39. B	40. C	41. B	42. B	43. C	44. D	45. D
46. 4	47. 10	48. 0	49. 2	50. 18	51. 8	52. 135	53. 7
54. 37	55. 5						

Mathematics

56. C	57. C	58. C	59. A	60. D	61. D	62. D	63. A
64. C	65. C	66. A	67. C	68. B	69. A	70. B	71. D
72. D	73. A	74. B	75. A	76. 108	77. 0	78. 100	79. 20
80. 2	81. 11	82. 10	83. 2521	84. 304	85. 32		

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