

JEE MAIN 2024 · QUESTION PAPER

30 Jan 2024 Shift 1

85 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	20 Q1 to Q20	10 Q21 to Q30
● Chemistry	16 Q31 to Q46	9 Q47 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.

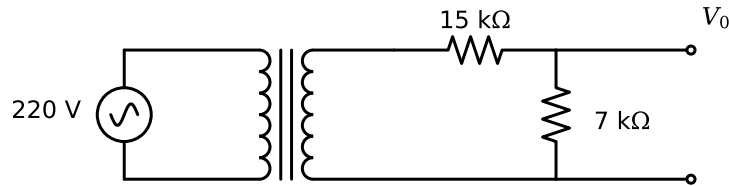
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Answers follow NTA's final answer keys. Typing errors are possible, so check doubtful answers against the official key. Spotted a mistake? prepwis.in/feedback · Terms: prepwis.in/terms

Q1 Alternating Current

[Step-by-step solution](#) > [prepwiser.in/questions/mZXBCuSdE4](https://www.prepwiser.in/questions/mZXBCuSdE4)

Primary coil of a transformer is connected to 220V ac. Primary and secondary turns of the transforms are 100 and 10 respectively. Secondary coil of transformer is connected to two series resistances shown in figure. The output voltage (V_0) is:



- (A) 7 V (B) 44 V (C) 22 V (D) 15 V

Q2 Alternating Current

[Step-by-step solution](#) > [prepwiser.in/questions/VINXbfn0Ai](https://www.prepwiser.in/questions/VINXbfn0Ai)

A series L.R circuit connected with an ac source $E = (25 \sin 1000t)V$ has a power factor of $\frac{1}{\sqrt{2}}$. If the source of emf is changed to $E = (20 \sin 2000t)V$, the new power factor of the circuit will be:

- (A) $\frac{1}{\sqrt{3}}$ (B) $\frac{1}{\sqrt{2}}$ (C) $\frac{1}{\sqrt{5}}$ (D) $\frac{1}{\sqrt{7}}$

Q3 Atomic Physics

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

The ratio of the magnitude of the kinetic energy to the potential energy of an electron in the 5th excited state of a hydrogen atom is:

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

Q4 Centre of Mass & Linear Momentum

[Step-by-step solution](#) > [prepwiser.in/questions/M3rXT1I1Y](https://www.prepwiser.in/questions/M3rXT1I1Y)

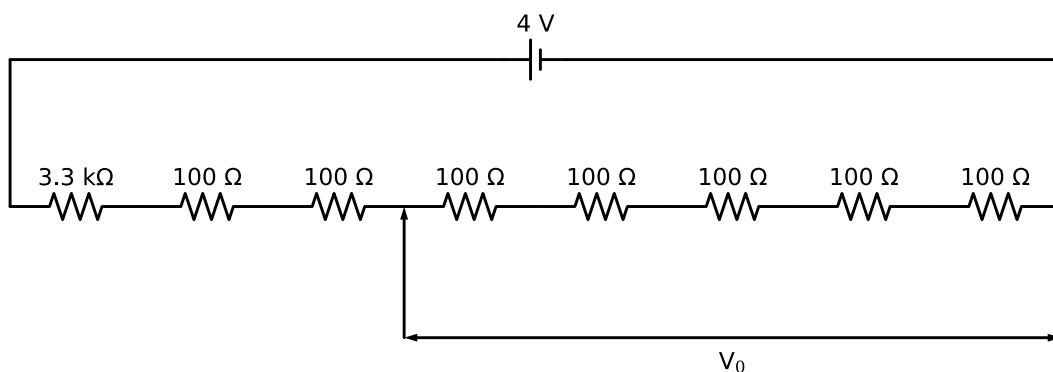
A spherical body of mass 100g is dropped from a height of 10m from the ground. After hitting the ground, the body rebounds to a height of 5m. The impulse of force imparted by the ground to the body is given by : (given, $g = 9.8\text{m/s}^2$)

- (A) 43.2kgms^{-1} (B) 2.39kgms^{-1} (C) 4.32kgms^{-1} (D) 23.9kgms^{-1}

Q5 Current Electricity

[Step-by-step solution](#) > [prepwiser.in/questions/DkHIW8NZuF](https://www.prepwiser.in/questions/DkHIW8NZuF)

A potential divider circuit is shown in figure. The output voltage V_0 is:



- (A) 2 mV (B) 4 V (C) 0.5 V (D) 12 mV

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Q6 Current Electricity[Step-by-step solution > prepwisar.in/questions/2G2rdI3QV3](https://www.prepwisar.in/questions/2G2rdI3QV3)

An electric toaster has resistance of 60Ω at room temperature (27°C). The toaster is connected to a 220V supply. If the current flowing through it reaches 2.75A, the temperature attained by toaster is around : (if $\alpha = 2 \times 10^{-4}/^\circ\text{C}$)

- (A) 1235°C (B) 1667°C (C) 694°C (D) 1694°C

Q7 Dual Nature of Radiation & Matter[Step-by-step solution > prepwisar.in/questions/O819OcUN7D](https://www.prepwisar.in/questions/O819OcUN7D)

The work function of a substance is 3.0eV. The longest wavelength of light that can cause the emission of photoelectrons from this substance is approximately;

- (A) 215 nm (B) 400 nm (C) 414 nm (D) 200 nm

Q8 Electromagnetic Waves[Step-by-step solution > prepwisar.in/questions/LWTmk2BDHf](https://www.prepwisar.in/questions/LWTmk2BDHf)

The electric field of an electromagnetic wave in free space is represented as

$$\vec{E} = E_0 \cos(\omega t - kz) \hat{i}$$

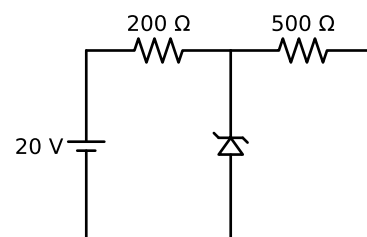
. The corresponding magnetic induction vector will be:

- (A) $\vec{B} = E_0 C \cos(\omega t + kz) \hat{j}$ (B) $\vec{B} = \frac{E_0}{C} \cos(\omega t - kz) \hat{j}$
(C) $\vec{B} = E_0 C \cos(\omega t - kz) \hat{j}$ (D) $\vec{B} = \frac{E_0}{C} \cos(\omega t + kz) \hat{j}$

Q9 Semiconductors & Electronic Devices[Step-by-step solution > prepwisar.in/questions/sP_uqdm01](https://www.prepwisar.in/questions/sP_uqdm01)

A Zener diode of breakdown voltage 10V is used as a voltage regulator as shown in the figure. The current through the Zener diode is:

- (A) 0 (B) 30 mA (C) 20 mA (D) 50 mA

**Q10** Electrostatics II: Potential & Capacitance[Step-by-step solution > prepwisar.in/questions/o06BSfgzon](https://www.prepwisar.in/questions/o06BSfgzon)

The electrostatic potential due to an electric dipole at a distance 'r' varies as:

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

Q11 Gravitation[Step-by-step solution > prepwisar.in/questions/4OUXcXL3MQ](https://www.prepwisar.in/questions/4OUXcXL3MQ)

The gravitational potential at a point above the surface of earth is $-5.12 \times 10^7 \text{ J/kg}$ and the acceleration due to gravity at that point is 6.4 m/s^2 . Assume that the mean radius of earth to be 6400km. The height of this point above the earth's surface is:

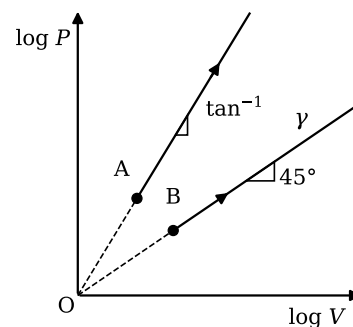
- (A) 1600 km (B) 1200 km (C) 540 km (D) 1000 km

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Q12 Thermodynamics[Step-by-step solution](https://www.prepwisar.in/questions/ZKskQIKtK5)

Two thermodynamical processes are shown in the figure. The molar heat capacity for process A and B are C_A and C_B . The molar heat capacity at constant pressure and constant volume are represented by C_P and C_V , respectively. Choose the correct statement.

- (A) $C_P > C_B > C_A > C_V$ (B) $C_P > C_V > C_A = C_B$
 (C) $C_A = 0$ and $C_B = \infty$ (D) $C_A = \infty, C_B = 0$

**Q13** Kinetic Theory of Gases[Step-by-step solution](https://www.prepwisar.in/questions/eFikKimOJI)

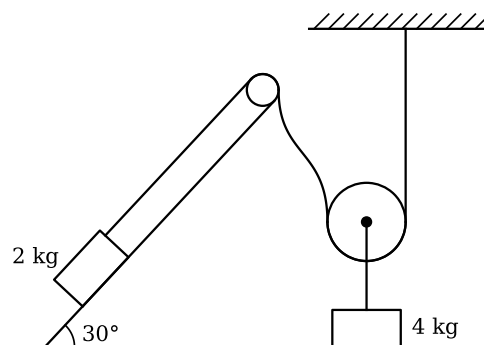
At which temperature the r.m.s. velocity of a hydrogen molecule equal to that of an oxygen molecule at 47°C ?

- (A) 20 K (B) 80 K (C) 4 K (D) -73 K

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

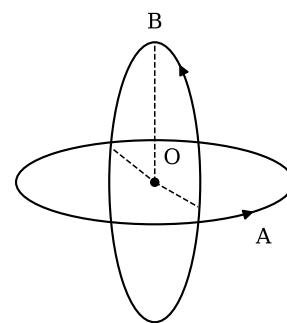
All surfaces shown in figure are assumed to be frictionless and the pulleys and the string are light. The acceleration of the block of mass 2 kg is:

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

**Q15** Moving Charges & Magnetism[Step-by-step solution](https://www.prepwisar.in/questions/vQv_ASbZah)

Two insulated circular loop A and B of radius ' a ' carrying a current of ' I ' in the anti clockwise direction as shown in the figure. The magnitude of the magnetic induction at the centre will be:

- (A) $\frac{\sqrt{2}\mu_0 I}{a}$ (B) $\frac{\mu_0 I}{\sqrt{2}a}$ (C) $\frac{\mu_0 I}{2a}$ (D) $\frac{2\mu_0 I}{a}$

**Q16** Elasticity[Step-by-step solution](https://www.prepwisar.in/questions/3f2MlpIG_Y)

Young's modulus of material of a wire of length ' L ' and cross-sectional area A is Y . If the length of the wire is doubled and cross-sectional area is halved then Young's modulus will be:

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

Q17 Projectile Motion & Relative Motion[Step-by-step solution](https://www.prepwisar.in/questions/LnD_1Uy5B-)

A particle of mass m is projected with a velocity ' u ' making an angle of 30° with the horizontal. The magnitude of angular momentum of the projectile about the point of projection when the particle is at its maximum height h is:

- (A) $\frac{mu^3}{\sqrt{2}g}$ (B) zero (C) $\frac{\sqrt{3}}{2} \frac{mu^2}{g}$ (D) $\frac{\sqrt{3}}{16} \frac{mu^3}{g}$

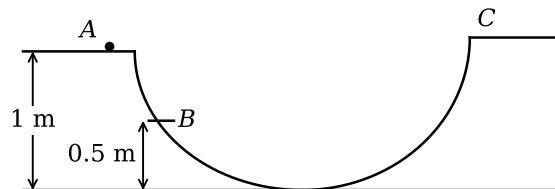
Q18 Wave Optics[Step-by-step solution](#) > prepwiser.in/questions/yq_CeeoqtC

The diffraction pattern of a light of wavelength 400nm diffracting from a slit of width 0.2mm is focused on the focal plane of a convex lens of focal length 100cm . The width of the 1^{st} secondary maxima will be:

- (A) 2 mm (B) 0.2 mm (C) 0.02 mm (D) 2 cm

Q19 Work, Energy & Power[Step-by-step solution](#) > prepwiser.in/questions/NuoDAaVU9j

A particle is placed at the point A of a frictionless track ABC as shown in figure. It is gently pushed towards right. The speed of the particle when it reaches the point B is: (Take $g = 10\text{m/s}^2$).



- (A) $2\sqrt{10}\text{m/s}$ (B) 10m/s (C) $\sqrt{10}\text{m/s}$ (D) 20m/s

Q20 Units, Dimensions & Errors[Step-by-step solution](#) > prepwiser.in/questions/eUL0OgRnI7

Match List I with List II.

	List I		List II
(A)	Coefficient of viscosity	(I)	$[\text{ML}^2\text{T}^{-2}]$
(B)	Surface tension	(II)	$[\text{ML}^2\text{T}^{-1}]$
(C)	Angular momentum	(III)	$[\text{ML}^{-1}\text{T}^{-1}]$
(D)	Rotational kinetic energy	(IV)	$[\text{ML}^0\text{T}^{-2}]$

Choose the correct answer from the options given below:

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

Physics Section B · Numerical value

Q21 to Q30

Q21 Atomic Physics **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/yxJG-11oXU

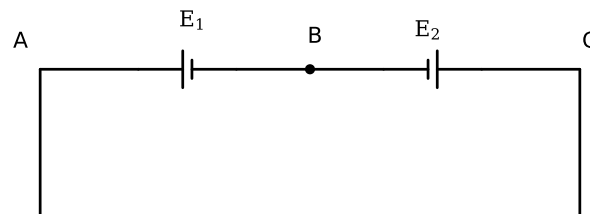
A electron of hydrogen atom on an excited state is having energy $E_n = -0.85\text{eV}$. The maximum number of allowed transitions to lower energy level is _____.

Q22 Electrostatics II: Potential & Capacitance **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/Uf9sXU21JX

A capacitor of capacitance C and potential V has energy E . It is connected to another capacitor of capacitance $2C$ and potential $2V$. Then the loss of energy is $\frac{x}{3}E$, where x is _____.

Q23 Current Electricity **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/zbcZLSXrXx

Two cells are connected in opposition as shown. Cell E_1 is of 8V emf and 2Ω internal resistance; the cell E_2 is of 2V emf and 4Ω internal resistance. The terminal potential difference of cell E_2 is _____ V.

**Q24** Electromagnetic Induction **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/IK_cKt7EYV

A ceiling fan having 3 blades of length 80cm each is rotating with an angular velocity of 1200 rpm . The magnetic field of earth in that region is 0.5G and angle of dip is 30° . The emf induced across the blades is $N\pi \times 10^{-5}\text{V}$. The value of N is _____.

Q25 Ray Optics **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/oP1cfRqOKO](https://www.prepwiser.in/questions/oP1cfRqOKO)

The distance between object and its two times magnified real image as produced by a convex lens is 45cm. The focal length of the lens used is _____ cm.

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

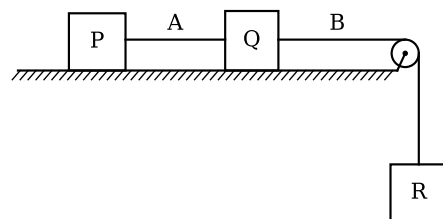
The horizontal component of earth's magnetic field at a place is $3.5 \times 10^{-5} \text{ T}$. A very long straight conductor carrying current of $\sqrt{2} \text{ A}$ in the direction from South east to North West is placed. The force per unit length experienced by the conductor is _____ $\times 10^{-6} \text{ N/m}$.

Q27 Rectilinear Motion **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/9S8Iv2l30u](https://www.prepwiser.in/questions/9S8Iv2l30u)

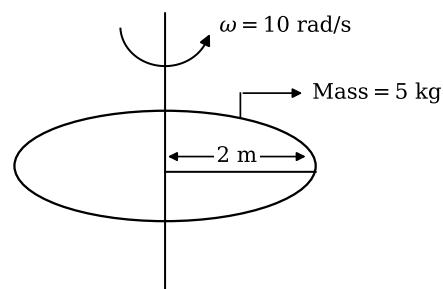
The displacement and the increase in the velocity of a moving particle in the time interval of t to $(t + 1) \text{ s}$ are 125m and 50m/s, respectively. The distance travelled by the particle in $(t + 2) \text{ s}$ is _____ m.

Q28 Elasticity **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/xko6SoAZqN](https://www.prepwiser.in/questions/xko6SoAZqN)

Each of three blocks P, Q and R shown in figure has a mass of 3kg. Each of the wires A and B has cross-sectional area 0.005 cm^2 and Young's modulus $2 \times 10^{11} \text{ Nm}^{-2}$. Neglecting friction, the longitudinal strain on wire B is _____ $\times 10^{-4}$. (Take $g = 10 \text{ m/s}^2$)

**Q29** Rotational Motion **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/ONs9bvVxY_](https://www.prepwiser.in/questions/ONs9bvVxY_)

Consider a Disc of mass 5kg, radius 2m, rotating with angular velocity of 10 rad/s about an axis perpendicular to the plane of rotation. An identical disc is kept gently over the rotating disc along the same axis. The energy dissipated so that both the discs continue to rotate together without slipping is _____ J.

**Q30** Mechanical Waves **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/cXaMqH86Ad](https://www.prepwiser.in/questions/cXaMqH86Ad)

In a closed organ pipe, the frequency of fundamental note is 30Hz. A certain amount of water is now poured in the organ pipe so that the fundamental frequency is increased to 110Hz. If the organ pipe has a cross-sectional area of 2 cm^2 , the amount of water poured in the organ tube is _____ g. (Take speed of sound in air is 330 m/s)

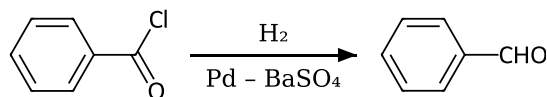
Chemistry Section A · Multiple choice

Q31 to Q46

Q31 Aldehydes & Ketones[Step-by-step solution](#) > [prepwiser.in/questions/4YhgTP7Mv9](https://www.prepwiser.in/questions/4YhgTP7Mv9)

This reduction reaction is known as:

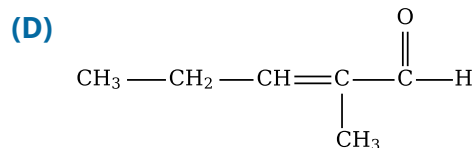
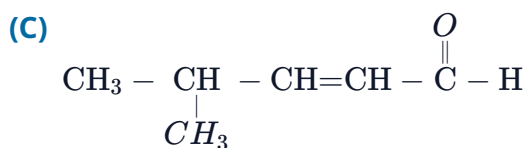
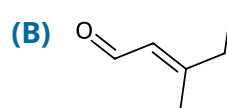
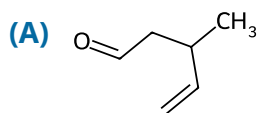
- (A) Wolff-Kishner reduction (B) Etard reduction
(C) Stephen reduction (D) Rosenmund reduction



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Q32 General Organic Chemistry (GOC)[Step-by-step solution > prepwiser.in/questions/8VpZoZcaJm](https://www.prepwiser.in/questions/8VpZoZcaJm)

Structure of 4-Methylpent-2-enal is:

**Q33** Carbohydrates & Biomolecules[Step-by-step solution > prepwiser.in/questions/hsrhTNTbu8](https://www.prepwiser.in/questions/hsrhTNTbu8)

Sugar which does not give reddish brown precipitate with Fehling's reagent, is:

(A) Glucose

(B) Sucrose

(C) Lactose

(D) Maltose

Q34 Chemical Bonding & Molecular Structure[Step-by-step solution > prepwiser.in/questions/CvVIt5rUPI](https://www.prepwiser.in/questions/CvVIt5rUPI)

Aluminium chloride in acidified aqueous solution forms an ion having geometry

(A) Square planar

(B) Octahedral

(C) Trigonal bipyramidal

(D) Tetrahedral

Q35 Periodic Table & Periodicity[Step-by-step solution > prepwiser.in/questions/7L6PkSxvPa](https://www.prepwiser.in/questions/7L6PkSxvPa)

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

Assertion (A) : There is a considerable increase in covalent radius from N to P. However from As to Bi only a small increase in covalent radius is observed.

Reason (R) : Covalent and ionic radii in a particular oxidation state increases down the group. In the light of the above statements, choose the most appropriate answer from the options given below:

(A) (A) is false but (R) is true

(B) Both (A) and (R) are true and (R) is the correct explanation of (A)

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

(D) (A) is true but (R) is false

Q36 Coordination Compounds[Step-by-step solution > prepwiser.in/questions/SL9dY4xvOs](https://www.prepwiser.in/questions/SL9dY4xvOs)

Choose the correct statements from the following:

(A) Ethane-1, 2-diamine is a chelating ligand.

(B) Metallic aluminium is produced by electrolysis of aluminium oxide in presence of cryolite.

(C) Cyanide ion is used as ligand for leaching of silver.

(D) Phosphine act as a ligand in Wilkinson catalyst.

(E) The stability constants of Ca^{2+} and Mg^{2+} are similar with EDTA complexes.

Choose the correct answer from the options given below:

(A) (B), (C), (E) only

(B) (A), (D), (E) only

(C) (C), (D), (E) only

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

Q37 d & f Block Elements[Step-by-step solution > prepwiser.in/questions/5pGjKf712S](https://www.prepwiser.in/questions/5pGjKf712S)

Diamagnetic Lanthanoid ions are:

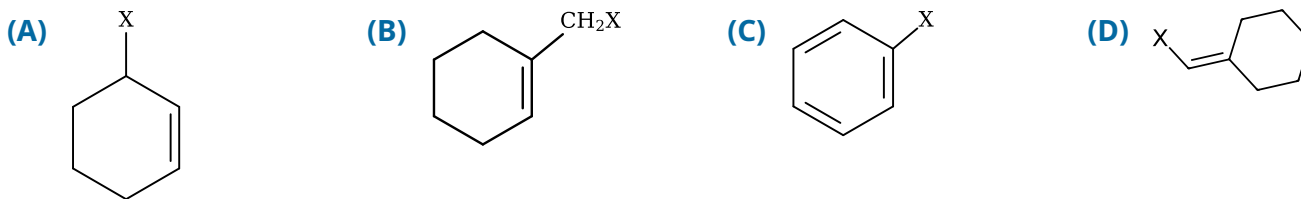
(A) La^{3+} & Ce^{4+}

(B) Nd^{3+} & Ce^{4+}

(C) Lu^{3+} & Eu^{3+}

(D) Nd^{3+} & Eu^{3+}

Example of vinylic halide is:



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

Assertion (A): $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{Cl}$ is an example of allyl halide.

Reason (R) : Allyl halides are the compounds in which the halogen atom is attached to sp^2 hybridised carbon atom.

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

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

The Lassaigne's extract is boiled with dil HNO_3 before testing for halogens because,

- (A) Silver halides are soluble in HNO_3 . (B) AgCN is soluble in HNO_3 .
 (C) Na_2S and NaCN are decomposed by HNO_3 . (D) Ag_2S is soluble in HNO_3 .

Match List I with List II.

	List I Species		List II Electronic distribution
(A)	Cr^{+2}	(I)	$3d^8$
(B)	Mn^{+}	(II)	$3d^3 4s^1$
(C)	Ni^{+2}	(III)	$3d^4$
(D)	V^{+}	(IV)	$3d^5 4s^1$

Choose the correct answer from the options given below:

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

What happens to freezing point of benzene when small quantity of naphthalene is added to benzene?

- (A) Increases (B) Decreases
 (C) Remains unchanged (D) First decreases and then increases

Given below are two statements:

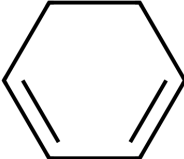
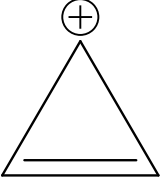
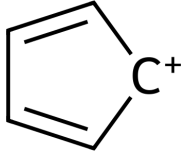
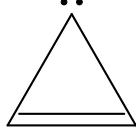
Statement (I) : The orbitals having same energy are called as degenerate orbitals.

Statement (II) : In hydrogen atom, 3p and 3d orbitals are not degenerate orbitals.

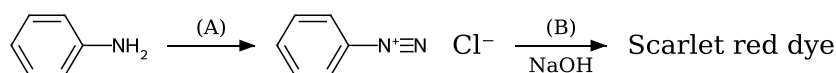
In the light of the above statements, choose the most appropriate answer from the options given below:

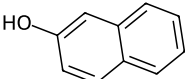
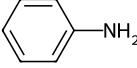
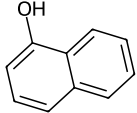
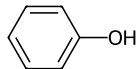
- (A) Statement I is true but Statement II is false (B) Statement I is false but Statement II is true
(C) Both Statement I and Statement II are false (D) Both Statement I and Statement II are true

Which of the following molecule/species is most stable?

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

Following is a confirmatory test for aromatic primary amines. Identify reagent (A) and (B).



- (A) $\text{A} = \text{NaNO}_2 + \text{HCl}$, $0-5^\circ\text{C}$; $\text{B} =$ 
(B) $\text{A} = \text{NaNO}_2 + \text{HCl}$, $0-5^\circ\text{C}$; $\text{B} =$ 
(C) $\text{A} = \text{NaNO}_2 + \text{HCl}$, $0-5^\circ\text{C}$; $\text{B} =$ 
(D) $\text{A} = \text{HNO}_3/\text{H}_2\text{SO}_4$ $\text{B} =$ 

Given below are two statements:

Statement (I) : The gas liberated on warming a salt with dil H_2SO_4 , turns a piece of paper dipped in lead acetate into black, it is a confirmatory test for sulphide ion.

Statement (II) : In statement-I the colour of paper turns black because of formation of lead sulphite. 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

Q47 Chemical Bonding & Molecular Structure **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/8kriZ47z3O

The total number of molecular orbitals formed from 2s and 2p atomic orbitals of a diatomic molecule is _____.

Q48 Chemical Kinetics **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/1bcdncVQR

The rate of First order reaction is $0.04\text{molL}^{-1}\text{s}^{-1}$ at 10 minutes and $0.03\text{molL}^{-1}\text{s}^{-1}$ at 20 minutes after initiation. Half life of the reaction is _____ minutes.
(Given $\log 2 = 0.3010$, $\log 3 = 0.4771$)

Q49 Ionic Equilibrium **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/VHW_jwo41s

The pH at which



begins to precipitate from a solution containing 0.10MMg^{2+} ions is _____.

Q50 Periodic Table & Periodicity **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/KXd69A8dWP

If IUPAC name of an element is "Unununnium" then the element belongs to n^{th} group of Periodic table. The value of n is _____.

Q51 Redox Reactions **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/RhQCuxeobA



If the above equation is balanced with integer coefficients, the value of z is _____.

Q52 Mole Concept & Stoichiometry **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/tj3nKWVLQv

The mass of sodium acetate (CH_3COONa) required to prepare 250mL of 0.35M aqueous solution is _____ g. (Molar mass of CH_3COONa is 82.02g mol^{-1})

Q53 Electrochemistry **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/fq230Uk02d

0.05cm thick coating of silver is deposited on a plate of 0.05m^2 area. The number of silver atoms deposited on plate are _____ $\times 10^{23}$. (At mass $\text{Ag} = 108$, $d = 7.9\text{g cm}^{-3}$)

Q54 Aldehydes & Ketones **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/UoSW1CjIXQ

The compound formed by the reaction of ethanal with semicarbazide contains _____ number of nitrogen atoms.

Q55 Purification & Characterisation of Organic Compounds **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/Fh1tzMP53-

On a thin layer chromatographic plate, an organic compound moved by 3.5cm, while the solvent moved by 5cm. The retardation factor of the organic compound is _____ $\times 10^{-1}$.

Mathematics Section A · Multiple choice

Q56 to Q75

Q56 Three Dimensional Geometry [Step-by-step solution](#) › prepwiser.in/questions/3mWBhfOyJN

Let (α, β, γ) be the foot of perpendicular from the point $(1, 2, 3)$ on the line $\frac{x+3}{5} = \frac{y-1}{2} = \frac{z+4}{3}$. Then $19(\alpha + \beta + \gamma)$ is equal to:

(A) 99

(B) 102

(C) 101

(D) 100

Q57 Vectors[Step-by-step solution](#) › [prepwise.in/questions/1rwqmqadm0](https://www.prepwise.in/questions/1rwqmqadm0)

Let $A(2, 3, 5)$ and $C(-3, 4, -2)$ be opposite vertices of a parallelogram $ABCD$. If the diagonal $\overrightarrow{BD} = \hat{i} + 2\hat{j} + 3\hat{k}$, then the area of the parallelogram is equal to:

- (A) $\frac{1}{2}\sqrt{410}$ (B) $\frac{1}{2}\sqrt{306}$ (C) $\frac{1}{2}\sqrt{586}$ (D) $\frac{1}{2}\sqrt{474}$

Q58 Applications of Derivatives[Step-by-step solution](#) › [prepwise.in/questions/SBTqMTjz_E](https://www.prepwise.in/questions/SBTqMTjz_E)

The maximum area of a triangle whose one vertex is at $(0, 0)$ and the other two vertices lie on the curve $y = -2x^2 + 54$ at points (x, y) and $(-x, y)$, where $y > 0$, is:

- (A) 108 (B) 122 (C) 88 (D) 92

Q59 Circles[Step-by-step solution](#) › [prepwise.in/questions/DfbRoXolWZ](https://www.prepwise.in/questions/DfbRoXolWZ)

If the circles $(x + 1)^2 + (y + 2)^2 = r^2$ and $x^2 + y^2 - 4x - 4y + 4 = 0$ intersect at exactly two distinct points, then

- (A) $\frac{1}{2} < r < 7$ (B) $3 < r < 7$ (C) $5 < r < 9$ (D) $0 < r < 7$

Q60 Complex Numbers[Step-by-step solution](#) › [prepwise.in/questions/uH6WF1wPyj](https://www.prepwise.in/questions/uH6WF1wPyj)

If $z = x + iy$, $xy \neq 0$, satisfies the equation $z^2 + i\bar{z} = 0$, then $|z^2|$ is equal to:

- (A) 9 (B) $\frac{1}{4}$ (C) 4 (D) 1

Q61 Definite Integration[Step-by-step solution](#) › [prepwise.in/questions/hTeND7ncsc](https://www.prepwise.in/questions/hTeND7ncsc)

The value of

$$\lim_{n \rightarrow \infty} \sum_{k=1}^n \frac{n^3}{(n^2 + k^2)(n^2 + 3k^2)}$$

is:

- (A) $\frac{\pi}{8(2\sqrt{3} + 3)}$ (B) $\frac{(2\sqrt{3} + 3)\pi}{24}$ (C) $\frac{13\pi}{8(4\sqrt{3} + 3)}$ (D) $\frac{13(2\sqrt{3} - 3)\pi}{8}$

Q62 Limits[Step-by-step solution](#) › [prepwise.in/questions/ld8KD0fTwC](https://www.prepwise.in/questions/ld8KD0fTwC)

Let $f : \left[-\frac{\pi}{2}, \frac{\pi}{2}\right] \rightarrow \mathbf{R}$ be a differentiable function such that $f(0) = \frac{1}{2}$. If the

$$\lim_{x \rightarrow 0} \frac{x \int_0^x f(t) dt}{e^{x^2} - 1} = \alpha$$

, then $8\alpha^2$ is equal to:

- (A) 4 (B) 2 (C) 1 (D) 16

Q63 Differential Equations[Step-by-step solution](#) › [prepwise.in/questions/qe3WTGpck5](https://www.prepwise.in/questions/qe3WTGpck5)

Let $y = y(x)$ be the solution of the differential equation $\sec x dy + \{2(1 - x) \tan x + x(2 - x)\} dx = 0$ such that $y(0) = 2$. Then $y(2)$ is equal to:

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

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Let $g : \mathbf{R} \rightarrow \mathbf{R}$ be a non constant twice differentiable function such that

$$g' \left(\frac{1}{2} \right) = g' \left(\frac{3}{2} \right)$$

. If a real valued function f is defined as $f(x) = \frac{1}{2}[g(x) + g(2-x)]$, then

- (A) $f''(x) = 0$ for atleast two x in $(0, 2)$ (B) $f' \left(\frac{3}{2} \right) + f' \left(\frac{1}{2} \right) = 1$
 (C) $f''(x) = 0$ for no x in $(0, 1)$ (D) $f''(x) = 0$ for exactly one x in $(0, 1)$

If

$$f(x) = \begin{vmatrix} 2 \cos^4 x & 2 \sin^4 x & 3 + \sin^2 2x \\ 3 + 2 \cos^4 x & 2 \sin^4 x & \sin^2 2x \\ 2 \cos^4 x & 3 + 2 \sin^4 x & \sin^2 2x \end{vmatrix},$$

then $\frac{1}{5}f'(0) =$ is equal to:

- (A) 2 (B) 1 (C) 0 (D) 6

If the length of the minor axis of an ellipse is equal to half of the distance between the foci, then the eccentricity of the ellipse is:

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

If the domain of the function $f(x) = \cos^{-1} \left(\frac{2-|x|}{4} \right) + \{\log_e(3-x)\}^{-1}$ is $[-\alpha, \beta] - \{\gamma\}$, then $\alpha + \beta + \gamma$ is equal to:

- (A) 11 (B) 12 (C) 9 (D) 8

Consider the system of linear equations $x + y + z = 4\mu$, $x + 2y + 2\lambda z = 10\mu$, $x + 3y + 4\lambda^2 z = \mu^2 + 15$ where $\lambda, \mu \in \mathbf{R}$. Which one of the following statements is NOT correct?

- (A) The system has unique solution if $\lambda \neq \frac{1}{2}$ and $\mu \neq 1, 15$
 (B) The system has infinite number of solutions if $\lambda = \frac{1}{2}$ and $\mu = 15$
 (C) The system is consistent if $\lambda \neq \frac{1}{2}$
 (D) The system is inconsistent if $\lambda = \frac{1}{2}$ and $\mu \neq 1$

Two integers x and y are chosen with replacement from the set $\{0, 1, 2, 3, \dots, 10\}$. Then the probability that $|x - y| > 5$, is:

- (A) $\frac{31}{121}$ (B) $\frac{60}{121}$ (C) $\frac{62}{121}$ (D) $\frac{30}{121}$

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Q70 Sequences & Series[Step-by-step solution](#) > prepwiser.in/questions/JKEE5j146_

Let S_n denote the sum of first n terms of an arithmetic progression. If $S_{20} = 790$ and $S_{10} = 145$, then $S_{15} - S_5$ is:

- (A) 405 (B) 390 (C) 410 (D) 395

Q71 Statistics[Step-by-step solution](#) > prepwiser.in/questions/4zRgwpvcWs

Let M denote the median of the following frequency distribution

Class	0 - 4	4 - 8	8 - 12	12 - 16	16 - 20
Frequency	3	9	10	8	6

Then 20M is equal to:

- (A) 104 (B) 52 (C) 208 (D) 416

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

If $2\sin^3 x + \sin 2x \cos x + 4\sin x - 4 = 0$ has exactly 3 solutions in the interval $[0, \frac{n\pi}{2}]$, $n \in \mathbb{N}$, then the roots of the equation $x^2 + nx + (n - 3) = 0$ belong to:

- (A) $(0, \infty)$ (B) $\mathbb{Z}$ (C) $(-\frac{\sqrt{17}}{2}, \frac{\sqrt{17}}{2})$ (D) $(-\infty, 0)$

Q73 Vectors[Step-by-step solution](#) > prepwiser.in/questions/0QYD-w4_C

Let

$$\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$$

and

$$\vec{b} = b_1\hat{i} + b_2\hat{j} + b_3\hat{k}$$

be two vectors such that $|\vec{a}| = 1$, $\vec{a} \cdot \vec{b} = 2$ and $|\vec{b}| = 4$. If $\vec{c} = 2(\vec{a} \times \vec{b}) - 3\vec{b}$, then the angle between $\vec{b}$ and $\vec{c}$ is equal to:

- (A) $\cos^{-1}\left(-\frac{1}{\sqrt{3}}\right)$ (B) $\cos^{-1}\left(\frac{2}{3}\right)$ (C) $\cos^{-1}\left(\frac{2}{\sqrt{3}}\right)$ (D) $\cos^{-1}\left(-\frac{\sqrt{3}}{2}\right)$

Q74 Area Under Curves[Step-by-step solution](#) > prepwiser.in/questions/yrz7xINHol

The area (in square units) of the region bounded by the parabola $y^2 = 4(x - 2)$ and the line $y = 2x - 8$, is:

- (A) 7 (B) 8 (C) 9 (D) 6

Q75 Straight Lines[Step-by-step solution](#) > prepwiser.in/questions/1g-sosWBnl

A line passing through the point A(9, 0) makes an angle of 30° with the positive direction of x -axis. If this line is rotated about A through an angle of 15° in the clockwise direction, then its equation in the new position is:

- (A) $\frac{y}{\sqrt{3}+2} + x = 9$ (B) $\frac{x}{\sqrt{3}+2} + y = 9$ (C) $\frac{x}{\sqrt{3}-2} + y = 9$ (D) $\frac{y}{\sqrt{3}-2} + x = 9$

Q76 Three Dimensional Geometry **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/OihrNQG1mZ

If d_1 is the shortest distance between the lines $x + 1 = 2y = -12z$, $x = y + 2 = 6z - 6$ and d_2 is the shortest distance between the lines

$$\frac{x-1}{2} = \frac{y+8}{-7} = \frac{z-4}{5}, \frac{x-1}{2} = \frac{y-2}{1} = \frac{z-6}{-3}$$

, then the value of $\frac{32\sqrt{3}d_1}{d_2}$ is:

Q77 Binomial Theorem **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/M1HP5jYCLL

Number of integral terms in the expansion of $\left\{7^{\left(\frac{1}{2}\right)} + 11^{\left(\frac{1}{6}\right)}\right\}^{824}$ is equal to _____.

Q78 Definite Integration **NUMERICAL**

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

The value of $9 \int_0^9 \left[\sqrt{\frac{10x}{x+1}} \right] dx$, where $[t]$ denotes the greatest integer less than or equal to t , is

Q79 Differential Equations **NUMERICAL**

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

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

$$(1 - x^2) dy = [xy + (x^3 + 2) \sqrt{3(1 - x^2)}] dx, -1 < x < 1, y(0) = 0$$

. If $y\left(\frac{1}{2}\right) = \frac{m}{n}$, m and n are co-prime numbers, then $m + n$ is equal to _____.

Q80 Permutations & Combinations **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/syOFy_J5b5

Let $A = \{1, 2, 3, \dots, 7\}$ and let $P(A)$ denote the power set of A . If the number of functions $f : A \rightarrow P(A)$ such that $a \in f(a), \forall a \in A$ is m^n , m and $n \in \mathbb{N}$ and m is least, then $m + n$ is equal to _____.

Q81 Hyperbola **NUMERICAL**

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

Let the latus rectum of the hyperbola $\frac{x^2}{9} - \frac{y^2}{b^2} = 1$ subtend an angle of $\frac{\pi}{3}$ at the centre of the hyperbola. If b^2 is equal to $\frac{l}{m}(1 + \sqrt{n})$, where l and m are co-prime numbers, then $l^2 + m^2 + n^2$ is equal to _____.

Q82 Continuity & Differentiability **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/qT6Syl2Klw

If the function

$$f(x) = \begin{cases} \frac{1}{|x|}, & |x| \geq 2 \\ ax^2 + 2b, & |x| < 2 \end{cases}$$

is differentiable on $\mathbb{R}$, then $48(a + b)$ is equal to _____.

Q83 Sets **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/ADSnkMg6Mn

A group of 40 students appeared in an examination of 3 subjects - Mathematics, Physics and Chemistry. It was found that all students passed in atleast one of the subjects, 20 students passed in Mathematics, 25 students passed in Physics, 16 students passed in Chemistry, atmost 11 students passed in both Mathematics and Physics, atmost 15 students passed in both Physics and Chemistry, atmost 15 students passed in both Mathematics and Chemistry. The maximum number of students passed in all the three subjects is _____.

Let $\alpha, \beta \in \mathbb{N}$ be roots of the equation $x^2 - 70x + \lambda = 0$, where $\frac{\lambda}{2}, \frac{\lambda}{3} \notin \mathbb{N}$. If λ assumes the minimum possible value, then $\frac{(\sqrt{\alpha-1} + \sqrt{\beta-1})(\lambda+35)}{|\alpha-\beta|}$ is equal to:

Let $\alpha = 1^2 + 4^2 + 8^2 + 13^2 + 19^2 + 26^2 + \dots$ upto 10 terms and $\beta = \sum_{n=1}^{10} n^4$. If $4\alpha - \beta = 55k + 40$, then k is equal to _____.

Answer key: JEE Main 2024 · 30 Jan · Shift 1

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Physics

1.	A	2.	C	3.	C	4.	B	5.	C	6.	D	7.	C	8.	B	9.	B	10.	C
11.	A	12.	A	13.	A	14.	D	15.	B	16.	D	17.	D	18.	A	19.	C	20.	D
21.	6	22.	2	23.	6	24.	32	25.	10	26.	35	27.	175	28.	2	29.	250	30.	400

Chemistry

31.	D	32.	C	33.	B	34.	B	35.	C	36.	D	37.	A	38.	D	39.	A	40.	C
41.	A	42.	B	43.	A	44.	B	45.	A	46.	B	47.	8	48.	24	49.	9	50.	11
51.	8	52.	7	53.	11	54.	3	55.	7										

Mathematics

56.	C	57.	D	58.	A	59.	B	60.	D	61.	C	62.	B	63.	B	64.	A	65.	C
66.	B	67.	A	68.	D	69.	D	70.	D	71.	C	72.	D	73.	D	74.	C	75.	D
76.	16	77.	138	78.	155	79.	97	80.	44	81.	182	82.	15	83.	10	84.	60	85.	353

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