

JEE MAIN 2024 · QUESTION PAPER

9 Apr 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.

prepwis.in/pyqs/paper/2024-04-09-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/plvnPaH1xo](https://www.prepwiser.in/questions/plvnPaH1xo)

A bulb and a capacitor are connected in series across an ac supply. A dielectric is then placed between the plates of the capacitor. The glow of the bulb:

- (A) becomes zero (B) remains same (C) increases (D) decreases

Q2 Nuclear Physics

[Step-by-step solution](#) > [prepwiser.in/questions/4TDqIHrKK-](https://www.prepwiser.in/questions/4TDqIHrKK-)

The energy equivalent of 1g of substance is:

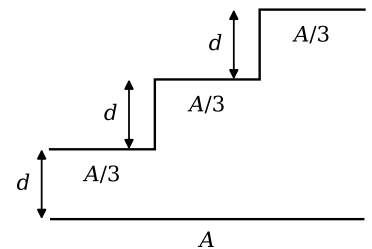
- (A) $5.6 \times 10^{26} \text{ MeV}$ (B) $5.6 \times 10^{12} \text{ MeV}$ (C) 5.6 eV (D) $11.2 \times 10^{24} \text{ MeV}$

Q3 Electrostatics II: Potential & Capacitance

[Step-by-step solution](#) > [prepwiser.in/questions/d-FgCrAJ0f](https://www.prepwiser.in/questions/d-FgCrAJ0f)

A capacitor is made of a flat plate of area A and a second plate having a stair-like structure as shown in figure. If the area of each stair is $\frac{A}{3}$ and the height is d , the capacitance of the arrangement is:

- (A) $\frac{11\epsilon_0 A}{20d}$ (B) $\frac{13\epsilon_0 A}{17d}$ (C) $\frac{18\epsilon_0 A}{11d}$ (D) $\frac{11\epsilon_0 A}{18d}$



Q4 Moving Charges & Magnetism

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

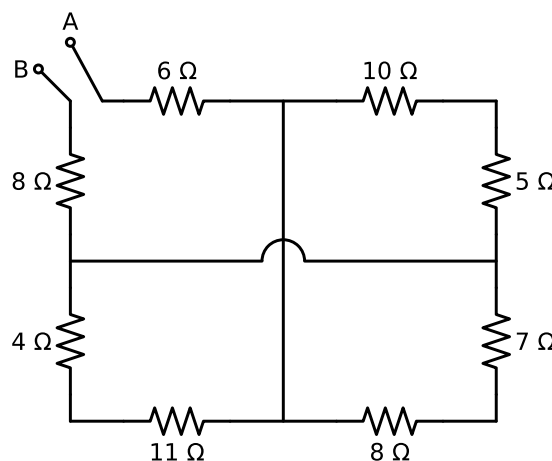
A galvanometer has a coil of resistance 200Ω with a full scale deflection at $20\mu\text{A}$. The value of resistance to be added to use it as an ammeter of range $(0 - 20)\text{mA}$ is:

- (A) 0.40Ω (B) 0.10Ω (C) 0.20Ω (D) 0.50Ω

Q5 Current Electricity

[Step-by-step solution](#) > [prepwiser.in/questions/_N2Kco3S4n](https://www.prepwiser.in/questions/_N2Kco3S4n)

The equivalent resistance between A and B is:



- (A) 18Ω (B) 27Ω (C) 19Ω (D) 25Ω

Q6 Dual Nature of Radiation & Matter

[Step-by-step solution](#) > [prepwiser.in/questions/I6SRQFnu94](https://www.prepwiser.in/questions/I6SRQFnu94)

A proton, an electron and an alpha particle have the same energies. Their de-Broglie wavelengths will be compared as:

- (A) $\lambda_p > \lambda_e > \lambda_\alpha$ (B) $\lambda_\alpha < \lambda_p < \lambda_e$ (C) $\lambda_e > \lambda_\alpha > \lambda_p$ (D) $\lambda_p < \lambda_e < \lambda_\alpha$

Q7 Electromagnetic Waves[Step-by-step solution](https://www.prepwiser.in/questions/oCW2W27qYR)

A plane EM wave is propagating along x direction. It has a wavelength of 4mm . If electric field is in y direction with the maximum magnitude of 60Vm^{-1} , the equation for magnetic field is:

- (A) $B_z = 2 \times 10^{-7} \sin \left[\frac{\pi}{2} (x - 3 \times 10^8 t) \right] \hat{k}\text{T}$
- (B) $B_z = 2 \times 10^{-7} \sin \left[\frac{\pi}{2} \times 10^3 (x - 3 \times 10^8 t) \right] \hat{k}\text{T}$
- (C) $B_z = 60 \sin \left[\frac{\pi}{2} (x - 3 \times 10^8 t) \right] \hat{k}\text{T}$
- (D) $B_x = 60 \sin \left[\frac{\pi}{2} (x - 3 \times 10^8 t) \right] \hat{i}\text{T}$

Q8 Semiconductors & Electronic Devices[Step-by-step solution](https://www.prepwiser.in/questions/ZcCBB2MrVk)

A light emitting diode (LED) is fabricated using GaAs semiconducting material whose band gap is 1.42eV . The wavelength of light emitted from the LED is:

- (A) 1243 nm (B) 875 nm (C) 650 nm (D) 1400 nm

Q9 Ray Optics[Step-by-step solution](https://www.prepwiser.in/questions/XH6j5ezyWe)

Given below are two statements:

Statement (I) : When an object is placed at the centre of curvature of a concave lens, image is formed at the centre of curvature of the lens on the other side.

Statement (II) : Concave lens always forms a virtual and erect image.

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

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

Q10 Gravitation[Step-by-step solution](https://www.prepwiser.in/questions/6C14YPmoIa)

An astronaut takes a ball of mass m from earth to space. He throws the ball into a circular orbit about earth at an altitude of 318.5km . From earth's surface to the orbit, the change in total mechanical energy of the ball is $x \frac{GM_e m}{21R_e}$. The value of x is (take $R_e = 6370\text{km}$):

- (A) 12 (B) 11 (C) 9 (D) 10

Q11 Thermodynamics[Step-by-step solution](https://www.prepwiser.in/questions/cvsU9GWF5J)

The volume of an ideal gas ($\gamma = 1.5$) is changed adiabatically from 5 litres to 4 litres. The ratio of initial pressure to final pressure is:

- (A) $\frac{4}{5}$ (B) $\frac{8}{5\sqrt{5}}$ (C) $\frac{2}{\sqrt{5}}$ (D) $\frac{16}{25}$

Q12 Thermodynamics[Step-by-step solution](https://www.prepwiser.in/questions/Z-egvNSepp)

A sample of 1 mole gas at temperature T is adiabatically expanded to double its volume. If adiabatic constant for the gas is $\gamma = \frac{3}{2}$, then the work done by the gas in the process is:

- (A) $RT[2 + \sqrt{2}]$ (B) $RT[2 - \sqrt{2}]$ (C) $\frac{R}{T}[2 - \sqrt{2}]$ (D) $\frac{T}{R}[2 + \sqrt{2}]$

Q13 Rotational Motion[Step-by-step solution](#) > [prepwiser.in/questions/CQymSN3e4e](https://www.prepwiser.in/questions/CQymSN3e4e)

A heavy iron bar, of weight W is having its one end on the ground and the other on the shoulder of a person. The bar makes an angle θ with the horizontal. The weight experienced by the person is:

- (A) $W \sin \theta$ (B) W (C) $\frac{W}{2}$ (D) $W \cos \theta$

Q14 Newton's Laws of Motion[Step-by-step solution](#) > [prepwiser.in/questions/LeGum62Fua](https://www.prepwiser.in/questions/LeGum62Fua)

A light unstretchable string passing over a smooth light pulley connects two blocks of masses m_1 and m_2 . If the acceleration of the system is $\frac{g}{8}$, then the ratio of the masses $\frac{m_2}{m_1}$ is:

- (A) 5 : 3 (B) 8 : 1 (C) 9 : 7 (D) 4 : 3

Q15 Moving Charges & Magnetism[Step-by-step solution](#) > [prepwiser.in/questions/rHXGbjwuSa](https://www.prepwiser.in/questions/rHXGbjwuSa)

Given below are two statements:

Statement (I) : When currents vary with time, Newton's third law is valid only if momentum carried by the electromagnetic field is taken into account

Statement (II) : Ampere's circuital law does not depend on Biot-Savart's law.

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

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

Q16 Rectilinear Motion[Step-by-step solution](#) > [prepwiser.in/questions/Hhaa-Mwrql](https://www.prepwiser.in/questions/Hhaa-Mwrql)

A particle moving in a straight line covers half the distance with speed 6 m/s . The other half is covered in two equal time intervals with speeds 9 m/s and 15 m/s respectively. The average speed of the particle during the motion is:

- (A) 9.2 m/s (B) 8.8 m/s (C) 10 m/s (D) 8 m/s

Q17 Fluid Mechanics[Step-by-step solution](#) > [prepwiser.in/questions/IXisSJLav4](https://www.prepwiser.in/questions/IXisSJLav4)

A sphere of relative density σ and diameter D has concentric cavity of diameter d . The ratio of $\frac{D}{d}$, if it just floats on water in a tank is:

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

Q18 Work, Energy & Power[Step-by-step solution](#) > [prepwiser.in/questions/E7TMAu6WrN](https://www.prepwiser.in/questions/E7TMAu6WrN)

A particle of mass m moves on a straight line with its velocity increasing with distance according to the equation $v = \alpha\sqrt{x}$, where α is a constant. The total work done by all the forces applied on the particle during its displacement from $x = 0$ to $x = d$, will be:

- (A) $\frac{m}{2\alpha^2 d}$ (B) $\frac{md}{2\alpha^2}$ (C) $\frac{m\alpha^2 d}{2}$ (D) $2m\alpha^2 d$

Q19 Units, Dimensions & Errors[Step-by-step solution](#) > [prepwiser.in/questions/rb6Zp7ke0h](https://www.prepwiser.in/questions/rb6Zp7ke0h)

The dimensional formula of latent heat is:

- (A) $[M^0 L T^{-2}]$ (B) $[MLT^{-2}]$ (C) $[M^0 L^2 T^{-2}]$ (D) $[ML^2 T^{-2}]$

Q20 Experimental Skills[Step-by-step solution](#) > prepwiser.in/questions/cyaRmGg9wT

One main scale division of a vernier caliper is equal to m units. If n^{th} division of main scale coincides with $(n + 1)^{\text{th}}$ division of vernier scale, the least count of the vernier caliper is:

- (A) $\frac{1}{(n + 1)}$ (B) $\frac{m}{(n + 1)}$ (C) $\frac{n}{(n + 1)}$ (D) $\frac{m}{n(n + 1)}$

Physics Section B · Numerical value

Q21 to Q30

Q21 Alternating Current **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/_fEbxFO9WV

When a coil is connected across a 20V dc supply, it draws a current of 5A. When it is connected across 20V, 50Hz ac supply, it draws a current of 4A. The self inductance of the coil is _____ mH. (Take $\pi = 3$)

Q22 Nuclear Physics **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/PDWZ-IbuPE

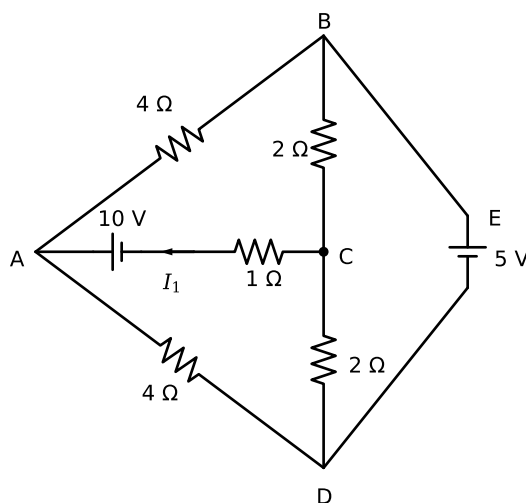
A star has 100% helium composition. It starts to convert three ${}^4\text{He}$ into one ${}^{12}\text{C}$ via triple alpha process as



. The mass of the star is $2.0 \times 10^{32}\text{kg}$ and it generates energy at the rate of $5.808 \times 10^{30}\text{W}$. The rate of converting these ${}^4\text{He}$ to ${}^{12}\text{C}$ is $n \times 10^{42}\text{s}^{-1}$, where n is _____. [Take, mass of ${}^4\text{He} = 4.0026\text{u}$, mass of ${}^{12}\text{C} = 12\text{u}$]

Q23 Current Electricity **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/5dwHPKCVD0

The current flowing through the 1Ω resistor is $\frac{n}{10}$ A. The value of n is _____.

**Q24** Electrostatics II: Potential & Capacitance **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/nwFPCAHC

At the centre of a half ring of radius $R = 10\text{cm}$ and linear charge density 4nCm^{-1} , the potential is $x\pi\text{V}$. The value of x is _____.

Q25 Moving Charges & Magnetism **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/HiejMfHPPm

A square loop of edge length 2m carrying current of 2A is placed with its edges parallel to the x - y axis. A magnetic field is passing through the x - y plane and expressed as $\vec{B} = B_0(1 + 4x)\hat{k}$, where $B_0 = 5\text{T}$. The net magnetic force experienced by the loop is _____ N.

Q26 Elasticity **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/_Mfmaj2jzD](https://www.prepwiser.in/questions/_Mfmaj2jzD)

Two persons pull a wire towards themselves. Each person exerts a force of 200N on the wire. Young's modulus of the material of wire is $1 \times 10^{11} \text{Nm}^{-2}$. Original length of the wire is 2m and the area of cross section is 2cm^2 . The wire will extend in length by _____ μm .

Q27 Rotational Motion **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/IN7IOvOMkz](https://www.prepwiser.in/questions/IN7IOvOMkz)

A string is wrapped around the rim of a wheel of moment of inertia 0.40kgm^2 and radius 10cm. The wheel is free to rotate about its axis. Initially the wheel is at rest. The string is now pulled by a force of 40N. The angular velocity of the wheel after 10s is $x\text{rad/s}$, where x is _____.

Q28 Simple Harmonic Motion **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/70462ASLVk](https://www.prepwiser.in/questions/70462ASLVk)

The position, velocity and acceleration of a particle executing simple harmonic motion are found to have magnitudes of 4m , 2ms^{-1} and 16ms^{-2} at a certain instant. The amplitude of the motion is $\sqrt{x}\text{m}$ where x is _____.

Q29 Wave Optics **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/B3BUYGZzxv](https://www.prepwiser.in/questions/B3BUYGZzxv)

In a Young's double slit experiment, the intensity at a point is $\left(\frac{1}{4}\right)^{\text{th}}$ of the maximum intensity, the minimum distance of the point from the central maximum is _____ μm . (Given:

$$\lambda = 600\text{nm}, d = 1.0\text{mm}, D = 1.0\text{m}$$

)

Q30 Vectors **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/cKxWMmT4dG](https://www.prepwiser.in/questions/cKxWMmT4dG)

If $\vec{a}$ and $\vec{b}$ makes an angle $\cos^{-1}\left(\frac{5}{9}\right)$ with each other, then $|\vec{a} + \vec{b}| = \sqrt{2}|\vec{a} - \vec{b}|$ for $|\vec{a}| = n|\vec{b}|$ The integer value of n is _____.

Chemistry Section A · Multiple choice

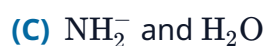
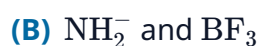
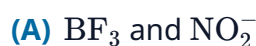
Q31 to Q46

Q31 p-Block Elements: Part II (Group 15-18)[Step-by-step solution](#) › [prepwiser.in/questions/hIjfNp9Cua](https://www.prepwiser.in/questions/hIjfNp9Cua)

The F^- ions make the enamel on teeth much harder by converting hydroxyapatite (the enamel on the surface of teeth) into much harder fluoroapatite having the formula.

**Q32** Chemical Bonding & Molecular Structure[Step-by-step solution](#) › [prepwiser.in/questions/SDSdi_KQfY](https://www.prepwiser.in/questions/SDSdi_KQfY)

In which one of the following pairs the central atoms exhibit sp^2 hybridization?



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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): The total number of geometrical isomers shown by $[\text{Co}(\text{en})_2\text{Cl}_2]^+$ complex ion is three.

Reason (R): $[\text{Co}(\text{en})_2\text{Cl}_2]^+$ complex ion has an octahedral geometry.

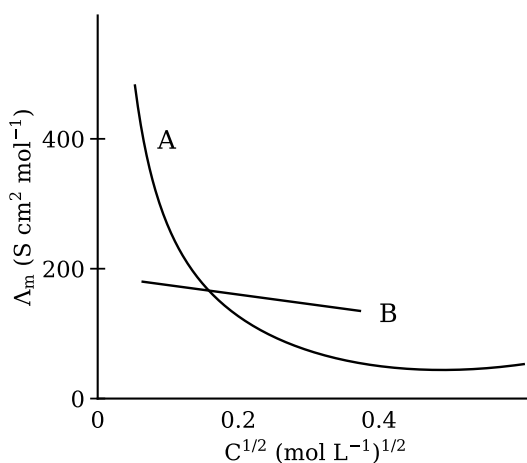
In the light of the above statements, choose the most appropriate answer from the options given below:

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

The electronic configuration of $\text{Cu}(\text{II})$ is $3d^9$ whereas that of $\text{Cu}(\text{I})$ is $3d^{10}$. Which of the following is correct?

- (A) $\text{Cu}(\text{II})$ is more stable
- (B) $\text{Cu}(\text{II})$ is less stable
- (C) $\text{Cu}(\text{I})$ and $\text{Cu}(\text{II})$ are equally stable
- (D) Stability of $\text{Cu}(\text{I})$ and $\text{Cu}(\text{II})$ depends on nature of copper salts

The molar conductivity for electrolytes A and B are plotted against $C^{3/2}$ as shown below. Electrolytes A and B respectively are:



- (A) A - weak electrolyte B - weak electrolyte (B) A - weak electrolyte B - strong electrolyte
- (C) A - strong electrolyte B - strong electrolyte (D) A - strong electrolyte B - weak electrolyte

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

Assertion (A): S_N2 reaction of $C_6H_5CH_2Br$ occurs more readily than the S_N2 reaction of CH_3CH_2Br .

Reason (R) : The partially bonded unhybridized p-orbital that develops in the trigonal bipyramidal transition state is stabilized by conjugation with the phenyl ring.

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

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

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

Assertion (A) : Both rhombic and monoclinic sulphur exist as S_8 while oxygen exists as O_2 .

Reason (R) : Oxygen forms $p\pi - p\pi$ multiple bonds with itself and other elements having small size and high electronegativity like C, N, which is not possible for sulphur.

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

On reaction of Lead Sulphide with dilute nitric acid which of the following is not formed?

- (A) Sulphur
- (B) Nitric oxide
- (C) Lead nitrate
- (D) Nitrous oxide

Given below are two statements:

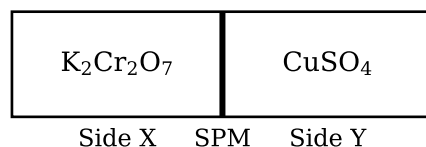
Statement (I) : The oxidation state of an element in a particular compound is the charge acquired by its atom on the basis of electron gain enthalpy consideration from other atoms in the molecule.

Statement (II): $p\pi - p\pi$ bond formation is more prevalent in second period elements over other periods.

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

0.05M CuSO_4 when treated with 0.01M $\text{K}_2\text{Cr}_2\text{O}_7$ gives green colour solution of $\text{Cu}_2\text{Cr}_2\text{O}_7$. The two solutions are separated as shown below : [SPM : Semi Permeable Membrane]



Due to osmosis:

- (A) Molarity of $\text{K}_2\text{Cr}_2\text{O}_7$ solution is lowered. (B) Green colour formation observed on side Y.
 (C) Molarity of CuSO_4 solution is lowered. (D) Green colour formation observed on side X.

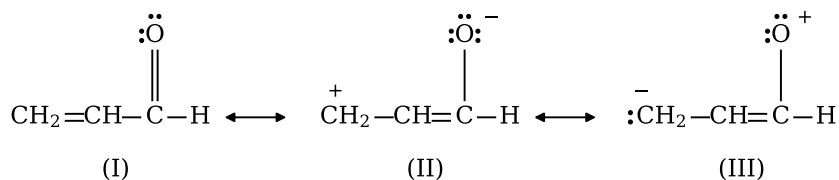
Compare the energies of following sets of quantum numbers for multielectron system.

- (A) $n = 4, l = 1$
 (B) $n = 4, l = 2$
 (C) $n = 3, l = 1$
 (D) $n = 3, l = 2$
 (E) $n = 4, l = 0$

Choose the correct answer from the options given below:

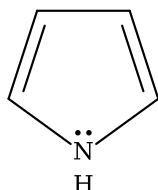
- (A) $(E) > (C) > (A) > (D) > (B)$ (B) $(B) > (A) > (C) > (E) > (D)$
 (C) $(C) < (E) < (D) < (A) < (B)$ (D) $(E) < (C) < (D) < (A) < (B)$

Relative stability of the contributing structures is:

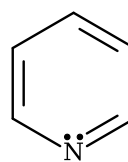


- (A) $(\text{II}) > (\text{I}) > (\text{III})$ (B) $(\text{III}) > (\text{II}) > (\text{I})$ (C) $(\text{I}) > (\text{III}) > (\text{II})$ (D) $(\text{I}) > (\text{II}) > (\text{III})$

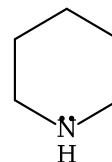
Correct order of basic strength of Pyrrole



, Pyridine



and Piperidine

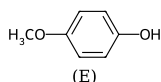
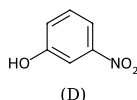
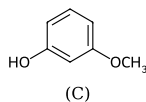
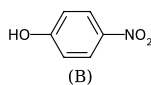
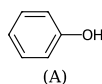


is:

- (A) Pyridine > Piperidine > Pyrrole (B) Pyrrole > Piperidine > Pyridine
 (C) Pyrrole > Pyridine > Piperidine (D) Piperidine > Pyridine > Pyrrole

Attempt this paper online with instant answer checking > [prepwisar.in/pyqs/paper/2024-04-09-morning](https://www.prepwisar.in/pyqs/paper/2024-04-09-morning)

For the given compounds, the correct order of increasing pK_a value:



Choose the correct answer from the options given below:

(A) $(E) < (D) < (C) < (B) < (A)$

(B) $(B) < (D) < (A) < (C) < (E)$

(C) $(D) < (E) < (C) < (B) < (A)$

(D) $(E) < (D) < (B) < (A) < (C)$

Methods used for purification of organic compounds are based on:

(A) neither on nature of compound nor on the impurity present.

(B) presence of impurity only.

(C) nature of compound and presence of impurity.

(D) nature of compound only.

Identify the incorrect statements regarding primary standard of titrimetric analysis.

(A) It should be purely available in dry form.

(B) It should not undergo chemical change in air.

(C) It should be hygroscopic and should react with another chemical instantaneously and stoichiometrically.

(D) It should be readily soluble in water.

(E) $KMnO_4$ & $NaOH$ can be used as primary standard.

Choose the correct answer from the options given below:

(A) (C) and (E) only

(B) (A) and (B) only

(C) (B) and (E) only

(D) (C) and (D) only

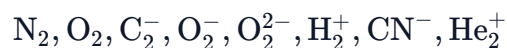
Q47 Carbohydrates & Biomolecules **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/9ADpQwN-kG) > prepwisar.in/questions/9ADpQwN-kG

Total number of essential amino acid among the given list of amino acids is _____.

Arginine, Phenylalanine, Aspartic acid, Cysteine, Histidine, Valine, Proline

Q48 Chemical Bonding & Molecular Structure **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/hcCl4gX-ew) > prepwisar.in/questions/hcCl4gX-ew

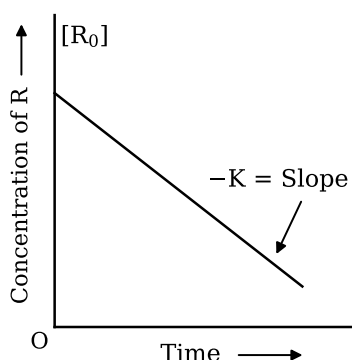
The total number of species from the following in which one unpaired electron is present, is _____.

**Q49** Chemical Kinetics **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/3zROSSZQbQ) > prepwisar.in/questions/3zROSSZQbQ

Given below are two statements:

Statement I : The rate law for the reaction $A + B \rightarrow C$ is rate $(r) = k[A]^2[B]$. When the concentration of both A and B is doubled, the reaction rate is increased " x " times.

Statement II:

The figure is showing "the variation in concentration against time plot" for a " y " order reaction.The Value of $x + y$ is _____.**Q50** Coordination Compounds **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/FrQj4RfOib) > prepwisar.in/questions/FrQj4RfOib

Number of ambidentate ligands among the following is _____.

**Q51** d & f Block Elements **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/vyXy9GXmnk) > prepwisar.in/questions/vyXy9GXmnk

Number of colourless lanthanoid ions among the following is _____.

**Q52** Electrochemistry **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/_6gEAw4y6_) > prepwisar.in/questions/_6gEAw4y6_

The standard reduction potentials at 298K for the following half cells are given below:



Consider the given electrochemical reactions,

The number of metal(s) which will be oxidized by $\text{Cr}_2\text{O}_7^{2-}$, in aqueous solution is _____.

Molarity (M) of an aqueous solution containing x g of anhyd. CuSO_4 in 500mL solution at 32°C is $2 \times 10^{-1}\text{M}$. Its molality will be _____ $\times 10^{-3}\text{m}$. (nearest integer). [Given density of the solution = 1.25g/mL]

When equal volume of 1M HCl and $1\text{M H}_2\text{SO}_4$ are separately neutralised by excess volume of 1M NaOH solution. x and $y\text{kJ}$ of heat is liberated respectively. The value of y/x is _____.

The heat of solution of anhydrous CuSO_4 and $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ are -70kJmol^{-1} and $+12\text{kJmol}^{-1}$ respectively.

The heat of hydration of CuSO_4 to $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ is $-x\text{kJ}$. The value of x is _____. (nearest integer).

Mathematics Section A · Multiple choice

Q56 to Q75

The shortest distance between the lines $\frac{x-3}{4} = \frac{y+7}{-11} = \frac{z-1}{5}$ and $\frac{x-5}{3} = \frac{y-9}{-6} = \frac{z+2}{1}$ is:

- (A) $\frac{185}{\sqrt{563}}$ (B) $\frac{187}{\sqrt{563}}$ (C) $\frac{178}{\sqrt{563}}$ (D) $\frac{179}{\sqrt{563}}$

Let the line L intersect the lines $x - 2 = -y = z - 1$, $2(x + 1) = 2(y - 1) = z + 1$ and be parallel to the line $\frac{x-2}{3} = \frac{y-1}{1} = \frac{z-2}{2}$. Then which of the following points lies on L ?

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

The coefficient of x^{70} in $x^2(1+x)^{98} + x^3(1+x)^{97} + x^4(1+x)^{96} + \dots + x^{54}(1+x)^{46}$ is ${}^{99}\text{C}_p - {}^{46}\text{C}_q$. Then a possible value of $p + q$ is:

- (A) 61 (B) 83 (C) 55 (D) 68

Let a circle passing through $(2, 0)$ have its centre at the point (h, k) . Let (x_c, y_c) be the point of intersection of the lines $3x + 5y = 1$ and $(2 + c)x + 5c^2y = 1$. If $h = \lim_{c \rightarrow 1} x_c$ and $k = \lim_{c \rightarrow 1} y_c$, then the equation of the circle is:

- (A) $5x^2 + 5y^2 - 4x - 2y - 12 = 0$ (B) $25x^2 + 25y^2 - 20x + 2y - 60 = 0$
(C) $25x^2 + 25y^2 - 2x + 2y - 60 = 0$ (D) $5x^2 + 5y^2 - 4x + 2y - 12 = 0$

The solution of the differential equation $(x^2 + y^2)dx - 5xydy = 0$, $y(1) = 0$, is:

- (A) $|x^2 - 4y^2|^5 = x^2$ (B) $|x^2 - 2y^2|^6 = x$ (C) $|x^2 - 2y^2|^5 = x^2$ (D) $|x^2 - 4y^2|^6 = x$

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Q61 Differential Equations[Step-by-step solution](#) > [prepwisar.in/questions/UZI5-wYOTp](https://www.prepwisar.in/questions/UZI5-wYOTp)

The solution curve, of the differential equation $2y \frac{dy}{dx} + 3 = 5 \frac{dy}{dx}$, passing through the point $(0, 1)$ is a conic, whose vertex lies on the line:

- (A) $2x + 3y = -9$ (B) $2x + 3y = -6$ (C) $2x + 3y = 9$ (D) $2x + 3y = 6$

Q62 Differentiation[Step-by-step solution](#) > [prepwisar.in/questions/3_DYOp9Cx7](https://www.prepwisar.in/questions/3_DYOp9Cx7)

Let $f(x) = ax^3 + bx^2 + cx + 41$ be such that $f(1) = 40$, $f'(1) = 2$ and $f''(1) = 4$. Then $a^2 + b^2 + c^2$ is equal to:

- (A) 54 (B) 51 (C) 73 (D) 62

Q63 Ellipse[Step-by-step solution](#) > [prepwisar.in/questions/f0V_eJN4Bw](https://www.prepwisar.in/questions/f0V_eJN4Bw)

Let $f(x) = x^2 + 9$, $g(x) = \frac{x}{x-9}$ and $a = f \circ g(10)$, $b = g \circ f(3)$. If e and l denote the eccentricity and the length of the latus rectum of the ellipse $\frac{x^2}{a} + \frac{y^2}{b} = 1$, then $8e^2 + l^2$ is equal to.

- (A) 6 (B) 12 (C) 8 (D) 16

Q64 Inverse Trigonometric Functions[Step-by-step solution](#) > [prepwisar.in/questions/WyhBVVZIgt](https://www.prepwisar.in/questions/WyhBVVZIgt)

If the domain of the function $f(x) = \sin^{-1}\left(\frac{x-1}{2x+3}\right)$ is $\mathbf{R} - (\alpha, \beta)$, then $12\alpha\beta$ is equal to:

- (A) 40 (B) 36 (C) 24 (D) 32

Q65 Determinants[Step-by-step solution](#) > [prepwisar.in/questions/r2igEYTHYr](https://www.prepwisar.in/questions/r2igEYTHYr)

Let $\lambda, \mu \in \mathbf{R}$. If the system of equations

$$\begin{aligned} 3x + 5y + \lambda z &= 3 \\ 7x + 11y - 9z &= 2 \\ 97x + 155y - 189z &= \mu \end{aligned}$$

has infinitely many solutions, then $\mu + 2\lambda$ is equal to:

- (A) 24 (B) 25 (C) 27 (D) 22

Q66 Quadratic Equations & Polynomial Inequalities[Step-by-step solution](#) > [prepwisar.in/questions/GA2lvrZONo](https://www.prepwisar.in/questions/GA2lvrZONo)

Let α, β be the roots of the equation $x^2 + 2\sqrt{2}x - 1 = 0$. The quadratic equation, whose roots are $\alpha^4 + \beta^4$ and $\frac{1}{10}(\alpha^6 + \beta^6)$, is:

- (A) $x^2 - 180x + 9506 = 0$ (B) $x^2 - 195x + 9506 = 0$
(C) $x^2 - 190x + 9466 = 0$ (D) $x^2 - 195x + 9466 = 0$

Q67 Sequences & Series[Step-by-step solution](#) > [prepwisar.in/questions/OH0YIBU6Y3](https://www.prepwisar.in/questions/OH0YIBU6Y3)

If the sum of the series

$$\frac{1}{1 \cdot (1+d)} + \frac{1}{(1+d)(1+2d)} + \dots + \frac{1}{(1+9d)(1+10d)}$$

is equal to 5, then $50d$ is equal to:

- (A) 5 (B) 10 (C) 15 (D) 20

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Q68 Statistics[Step-by-step solution](#) › [prepwiser.in/questions/qDjfp43xI6](https://www.prepwiser.in/questions/qDjfp43xI6)

The frequency distribution of the age of students in a class of 40 students is given below.

Age	15	16	17	18	19	20
No of Students	5	8	5	12	x	y

If the mean deviation about the median is 1.25, then $4x + 5y$ is equal to:

- (A) 43 (B) 46 (C) 44 (D) 47

Q69 Trigonometric Ratios & Identities[Step-by-step solution](#) › [prepwiser.in/questions/QLmjSNIADt](https://www.prepwiser.in/questions/QLmjSNIADt)

Let

$$|\cos \theta \cos(60 - \theta) \cos(60 + \theta)| \leq \frac{1}{8}, \theta \in [0, 2\pi]$$

. Then, the sum of all $\theta \in [0, 2\pi]$, where $\cos 3\theta$ attains its maximum value, is:

- (A) 6π (B) 9π (C) 18π (D) 15π

Q70 Vectors[Step-by-step solution](#) › [prepwiser.in/questions/-ldvrfjNGj](https://www.prepwiser.in/questions/-ldvrfjNGj)

Let three vectors,

$$\vec{a} = \alpha \hat{i} + 4\hat{j} + 2\hat{k}, \vec{b} = 5\hat{i} + 3\hat{j} + 4\hat{k}, \vec{c} = x\hat{i} + y\hat{j} + z\hat{k}$$

form a triangle such that $\vec{c} = \vec{a} - \vec{b}$ and the area of the triangle is $5\sqrt{6}$. If α is a positive real number, then $|\vec{c}|^2$ is equal to:

- (A) 14 (B) 12 (C) 16 (D) 10

Q71 Vectors[Step-by-step solution](#) › [prepwiser.in/questions/uRqchUBF-d](https://www.prepwiser.in/questions/uRqchUBF-d)

Let $\vec{OA} = 2\vec{a}$, $\vec{OB} = 6\vec{a} + 5\vec{b}$ and $\vec{OC} = 3\vec{b}$, where O is the origin. If the area of the parallelogram with adjacent sides $\vec{OA}$ and $\vec{OC}$ is 15 sq. units, then the area (in sq. units) of the quadrilateral $OABC$ is equal to:

- (A) 32 (B) 38 (C) 35 (D) 40

Q72 Area Under Curves[Step-by-step solution](#) › [prepwiser.in/questions/5bi12fee4w](https://www.prepwiser.in/questions/5bi12fee4w)

The parabola $y^2 = 4x$ divides the area of the circle $x^2 + y^2 = 5$ in two parts. The area of the smaller part is equal to:

- (A) $\frac{2}{3} + 5 \sin^{-1} \left(\frac{2}{\sqrt{5}} \right)$ (B) $\frac{2}{3} + \sqrt{5} \sin^{-1} \left(\frac{2}{\sqrt{5}} \right)$
 (C) $\frac{1}{3} + 5 \sin^{-1} \left(\frac{2}{\sqrt{5}} \right)$ (D) $\frac{1}{3} + \sqrt{5} \sin^{-1} \left(\frac{2}{\sqrt{5}} \right)$

Q73 Straight Lines[Step-by-step solution](#) › [prepwiser.in/questions/qYpnAyQEY0](https://www.prepwiser.in/questions/qYpnAyQEY0)

A variable line L passes through the point $(3, 5)$ and intersects the positive coordinate axes at the points A and B . The minimum area of the triangle OAB , where O is the origin, is:

- (A) 35 (B) 25 (C) 30 (D) 40

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

A ray of light coming from the point $P(1, 2)$ gets reflected from the point Q on the x -axis and then passes through the point $R(4, 3)$. If the point $S(h, k)$ is such that $PQRS$ is a parallelogram, then hk^2 is equal to:

(A) 60**(B)** 70**(C)** 80**(D)** 90**Q75** Indefinite Integration[Step-by-step solution](https://www.prepwiser.in/questions/Nq6TXtXXAi) > prepwiser.in/questions/Nq6TXtXXAi

Let $\int \frac{2-\tan x}{3+\tan x} dx = \frac{1}{2}(\alpha x + \log_e |\beta \sin x + \gamma \cos x|) + C$, where C is the constant of integration. Then $\alpha + \frac{\gamma}{\beta}$ is equal to:

(A) 3**(B)** 7**(C)** 1**(D)** 4**Mathematics Section B · Numerical value**

Q76 to Q85

Q76 Applications of Derivatives **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/m5408moW9z) > prepwiser.in/questions/m5408moW9z

Let the set of all positive values of λ , for which the point of local minimum of the function $(1 + x(\lambda^2 - x^2))$ satisfies $\frac{x^2+x+2}{x^2+5x+6} < 0$, be (α, β) . Then $\alpha^2 + \beta^2$ is equal to _____.

Q77 Binomial Theorem **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/awlmV6DhsM) > prepwiser.in/questions/awlmV6DhsM

The remainder when 428^{2024} is divided by 21 is _____.

Q78 Circles **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/oUdM0hYxjw) > prepwiser.in/questions/oUdM0hYxjw

Let the centre of a circle, passing through the points $(0, 0)$, $(1, 0)$ and touching the circle $x^2 + y^2 = 9$, be (h, k) . Then for all possible values of the coordinates of the centre (h, k) , $4(h^2 + k^2)$ is equal to _____.

Q79 Complex Numbers **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/JMvfjp0BE2) > prepwiser.in/questions/JMvfjp0BE2

The sum of the square of the modulus of the elements in the set

$$\{z = a + ib : a, b \in \mathbf{Z}, z \in \mathbf{C}, |z - 1| \leq 1, |z - 5| \leq |z - 5i|\}$$

is _____.

Q80 Definite Integration **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/yj20PSrFR0) > prepwiser.in/questions/yj20PSrFR0

Let

$$\lim_{n \rightarrow \infty} \left(\frac{n}{\sqrt{n^4 + 1}} - \frac{2n}{(n^2 + 1)\sqrt{n^4 + 1}} + \frac{n}{\sqrt{n^4 + 16}} - \frac{8n}{(n^2 + 4)\sqrt{n^4 + 16}} \right. \\ \left. + \dots + \frac{n}{\sqrt{n^4 + n^4}} - \frac{2n \cdot n^2}{(n^2 + n^2)\sqrt{n^4 + n^4}} \right)$$

be $\frac{\pi}{k}$, using only the principal values of the inverse trigonometric functions. Then k^2 is equal to _____.

Q81 Functions (Advanced) **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/8_kbHlBd-M) > prepwiser.in/questions/8_kbHlBd-M

If a function f satisfies $f(m + n) = f(m) + f(n)$ for all $m, n \in \mathbf{N}$ and $f(1) = 1$, then the largest natural number λ such that $\sum_{k=1}^{2022} f(\lambda + k) \leq (2022)^2$ is equal to _____.

Let $f : (0, \pi) \rightarrow \mathbf{R}$ be a function given by

$$f(x) = \begin{cases} \left(\frac{8}{7}\right)^{\frac{\tan 8x}{\tan 7x}}, & 0 < x < \frac{\pi}{2} \\ a - 8, & x = \frac{\pi}{2} \\ (1 + |\cot x|)^{\frac{b}{a} |\tan x|}, & \frac{\pi}{2} < x < \pi \end{cases}$$

where $a, b \in \mathbf{Z}$. If f is continuous at $x = \frac{\pi}{2}$, then $a^2 + b^2$ is equal to _____.

Let A be a non-singular matrix of order 3. If

$$\det(3 \operatorname{adj}(2 \operatorname{adj}((\det A)A))) = 3^{-13} \cdot 2^{-10}$$

and

$$\det(3 \operatorname{adj}(2A)) = 2^m \cdot 3^n$$

, then $|3m + 2n|$ is equal to _____.

Let a, b and c denote the outcome of three independent rolls of a fair tetrahedral die, whose four faces are marked 1, 2, 3, 4. If the probability that $ax^2 + bx + c = 0$ has all real roots is $\frac{m}{n}$, $\gcd(m, n) = 1$, then $m + n$ is equal to _____.

Let $A = \{2, 3, 6, 7\}$ and $B = \{4, 5, 6, 8\}$. Let R be a relation defined on $A \times B$ by $(a_1, b_1)R(a_2, b_2)$ if and only if $a_1 + a_2 = b_1 + b_2$. Then the number of elements in R is _____.

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Physics

1. C	2. A	3. D	4. C	5. C	6. B	7. B	8. B
9. A	10. B	11. B	12. B	13. C	14. C	15. D	16. D
17. D	18. C	19. C	20. B	21. 10	22. 5	23. 25	24. 36
25. 160	26. 20	27. 100	28. 17	29. 200	30. 3		

Chemistry

31. A	32. A	33. B	34. A	35. B	36. B	37. D	38. D
39. C	40. C	41. C	42. D	43. D	44. B	45. C	46. A
47. 4	48. 4	49. 8	50. 3	51. 2	52. 3	53. 164	54. 2
55. 82							

Mathematics

56. B	57. A	58. B	59. B	60. A	61. C	62. B	63. C
64. D	65. B	66. B	67. A	68. C	69. A	70. A	71. C
72. A	73. C	74. B	75. D	76. 39	77. 1	78. 9	79. 9
80. 32	81. 1010	82. 81	83. 14	84. 19	85. 25		

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