

JEE MAIN 2021 · QUESTION PAPER

16 Mar 2021 Shift 1

81 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	19 Q1 to Q19	9 Q20 to Q28
● Chemistry	16 Q29 to Q44	10 Q45 to Q54
● Mathematics	18 Q55 to Q72	9 Q73 to Q81
In this PDF	81 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.

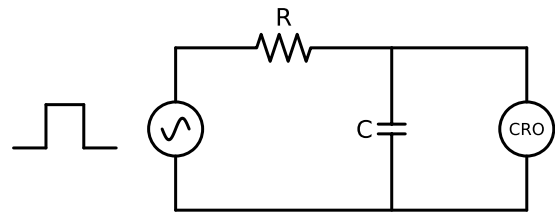
prepwise.in/pyqs/paper/2021-03-16-morning · Free, no signup needed to start

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

Q1 Electrostatics II: Potential & Capacitance

[Step-by-step solution](https://www.prepwiser.in/questions/O-f2i9wUj4) > prepwiser.in/questions/O-f2i9wUj4

An RC circuit as shown in the figure is driven by a AC source generating a square wave. The output wave pattern monitored by CRO would look close to:



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

Q2 Electrostatics II: Potential & Capacitance

[Step-by-step solution](https://www.prepwiser.in/questions/QBeHghE9fG) > prepwiser.in/questions/QBeHghE9fG

For changing the capacitance of a given parallel plate capacitor, a dielectric material of dielectric constant K is used, which has the same area as the plates of the capacitor. The thickness of the dielectric slab is $\frac{3}{4}d$, where 'd' is the separation between the plates of parallel plate capacitor. The new capacitance (C') in terms of original capacitance (C_0) is given by the following relation:

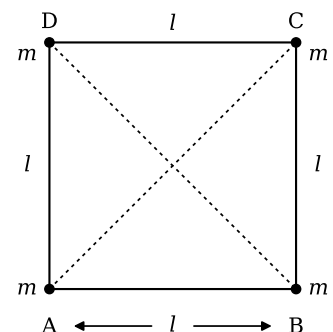
- (A) $C' = \frac{3+K}{4K} C_0$ (B) $C' = \frac{4+K}{3} C_0$ (C) $C' = \frac{4K}{K+3} C_0$ (D) $C' = \frac{4}{3+K} C_0$

Q3 Rotational Motion

[Step-by-step solution](https://www.prepwiser.in/questions/sfTscVaTb8) > prepwiser.in/questions/sfTscVaTb8

Four equal masses, m each are placed at the corners of a square of length (l) as shown in the figure. The moment of inertia of the system about an axis passing through A and parallel to DB would be:

- (A) $\sqrt{3} ml^2$ (B) $2 ml^2$ (C) ml^2 (D) $3 ml^2$



Q4 Circular Motion

[Step-by-step solution](https://www.prepwiser.in/questions/xwUprn0qUY) > prepwiser.in/questions/xwUprn0qUY

A block of 200 g mass moves with a uniform speed in a horizontal circular groove, with vertical side walls of radius 20 cm. If the block takes 40 s to complete one round, the normal force by the side walls of the groove is:

- (A) $9.859 \times 10^{-2} \text{ N}$ (B) 0.0314 N (C) $9.859 \times 10^{-4} \text{ N}$ (D) $6.28 \times 10^{-3} \text{ N}$

Q5 Current Electricity[Step-by-step solution](#) > [prepwisar.in/questions/IFWM-vWCo4](https://www.prepwisar.in/questions/IFWM-vWCo4)

A conducting wire of length 'l', area of cross-section A and electric resistivity ρ is connected between the terminals of a battery. A potential difference V is developed between its ends, causing an electric current.

If the length of the wire of the same material is doubled and the area of cross-section is halved, the resultant current would be:

- (A) $4 \frac{VA}{\rho l}$ (B) $\frac{3}{4} \frac{VA}{\rho l}$ (C) $\frac{1}{4} \frac{VA}{\rho l}$ (D) $\frac{1}{4} \frac{\rho l}{VA}$

Q6 Dual Nature of Radiation & Matter[Step-by-step solution](#) > [prepwisar.in/questions/aWQ_OJo_Vd](https://www.prepwisar.in/questions/aWQ_OJo_Vd)

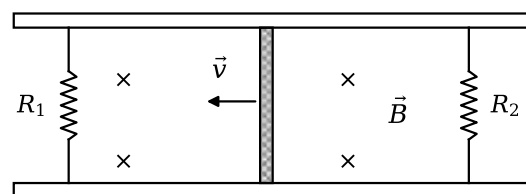
The stopping potential in the context of photoelectric effect depends on the following property of incident electromagnetic radiation:

- (A) Phase (B) Frequency (C) Amplitude (D) Intensity

Q7 Electromagnetic Induction[Step-by-step solution](#) > [prepwisar.in/questions/i4QEgUiLRW](https://www.prepwisar.in/questions/i4QEgUiLRW)

A conducting bar of length L is free to slide on two parallel conducting rails as shown in the figure

Two resistors R_1 and R_2 are connected across the ends of the rails. There is a uniform magnetic field $\vec{B}$ pointing into the page. An external agent pulls the bar to the left at a constant speed v.



The correct statement about the directions of induced currents I_1 and I_2 flowing through R_1 and R_2 respectively is:

- (A) Both I_1 and I_2 are in clockwise direction
(B) I_1 is in clockwise direction and I_2 is in anticlockwise direction
(C) I_1 is in anticlockwise direction and I_2 is in clockwise direction
(D) Both I_1 and I_2 are in anticlockwise direction

Q8 Electromagnetic Waves[Step-by-step solution](#) > [prepwisar.in/questions/AUq3cDy5xC](https://www.prepwisar.in/questions/AUq3cDy5xC)

A plane electromagnetic wave of frequency 500 MHz is travelling in vacuum along y-direction. At a particular point in space and time,

$\vec{B} = 8.0 \times 10^{-8} \hat{z} \text{ T}$. The value of electric field at this point is:

(speed of light = $3 \times 10^8 \text{ ms}^{-1}$)

$\hat{x}$, $\hat{y}$, $\hat{z}$ are unit vectors along x, y and z directions.

- (A) $2.6 \hat{x} \text{ V/m}$ (B) $-24 \hat{x} \text{ V/m}$ (C) $24 \hat{x} \text{ V/m}$ (D) $-2.6 \hat{y} \text{ V/m}$

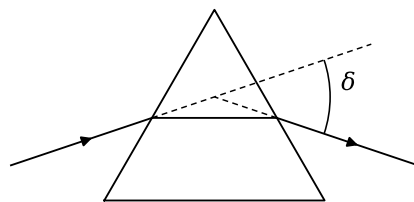
Q9 Electromagnetic Waves[Step-by-step solution](#) > [prepwisar.in/questions/IzhzF6G4Ej](https://www.prepwisar.in/questions/IzhzF6G4Ej)

For an electromagnetic wave travelling in free space, the relation between average energy densities due to electric (U_e) and magnetic (U_m) fields is:

- (A) $U_e = U_m$ (B) $U_e \neq U_m$ (C) $U_e < U_m$ (D) $U_e > U_m$

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The angle of deviation through a prism is minimum when



- (A) Incident ray and emergent ray are symmetric to the prism.
 (B) The refracted ray inside the prism becomes parallel to its base
 (C) Angle of incidence is equal to that of the angle of emergence
 (D) When angle of emergence is double the angle of incidence

Choose the correct answer from the options given below:

- (A) Statements (B) and (C) are true (B) Only statements (A) and (B) are true
 (C) Statements (A), (B) and (C) are true (D) Only statement (D) is true

The maximum and minimum distances of a comet from the Sun are 1.6×10^{12} m and 8.0×10^{10} m respectively. If the speed of the comet at the nearest point is $6 \times 10^4 \text{ ms}^{-1}$, the speed at the farthest point is:

- (A) $3.0 \times 10^3 \text{ m/s}$ (B) $6.0 \times 10^3 \text{ m/s}$ (C) $1.5 \times 10^3 \text{ m/s}$ (D) $4.5 \times 10^3 \text{ m/s}$

In thermodynamics, heat and work are:

- (A) Path functions (B) Point functions
 (C) Extensive thermodynamics state variables (D) Intensive thermodynamic state variables

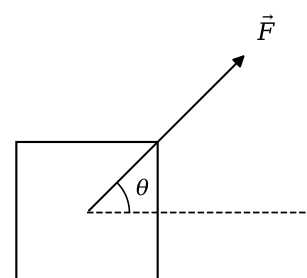
The volume V of an enclosure contains a mixture of three gases, 16 g of oxygen, 28 g of nitrogen and 44 g of carbon dioxide at absolute temperature T . Consider R as universal gas constant. The pressure of the mixture of gases is:

- (A) $\frac{3RT}{V}$ (B) $\frac{4RT}{V}$ (C) $\frac{88RT}{V}$ (D) $\frac{5}{2} \frac{RT}{V}$

A block of mass m slides along a floor while a force of magnitude F is applied to it at an angle θ as shown in figure. The coefficient of kinetic friction is μ_k . then, the block's acceleration 'a' is given by:

(g is acceleration due to gravity)

- (A) $\frac{F}{m} \cos \theta + \mu_K \left(g - \frac{F}{m} \sin \theta \right)$ (B) $\frac{F}{m} \cos \theta - \mu_K \left(g - \frac{F}{m} \sin \theta \right)$
 (C) $-\frac{F}{m} \cos \theta - \mu_K \left(g - \frac{F}{m} \sin \theta \right)$ (D) $\frac{F}{m} \cos \theta - \mu_K \left(g + \frac{F}{m} \sin \theta \right)$



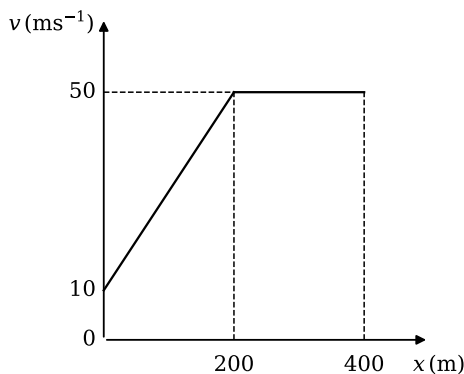
Q15 Magnetism & Matter[Step-by-step solution > prepwisar.in/questions/6UIzjibAwP](https://www.prepwisar.in/questions/6UIzjibAwP)

A bar magnet of length 14 cm is placed in the magnetic meridian with its north pole pointing towards the geographic north pole. A neutral point is obtained at a distance of 18 cm from the center of the magnet. If $B_H = 0.4 \text{ G}$, the magnetic moment of the magnet is : ($1\text{G} = 10^{-4} \text{ T}$)

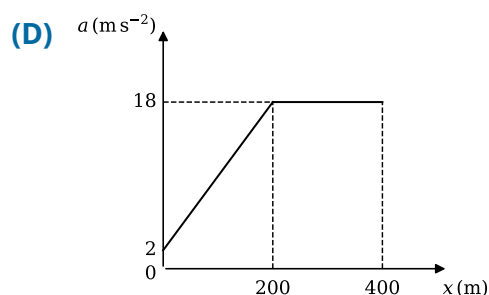
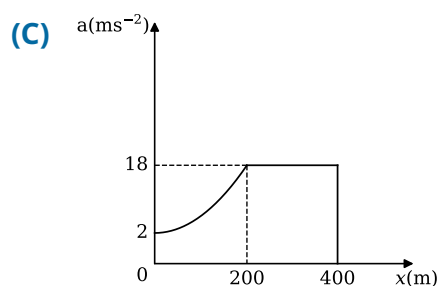
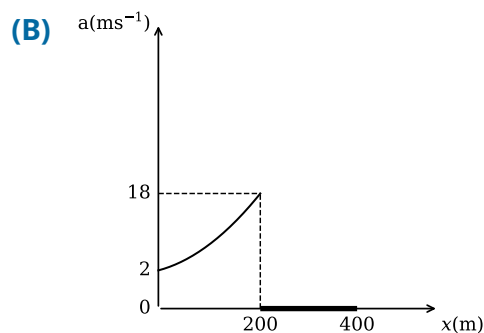
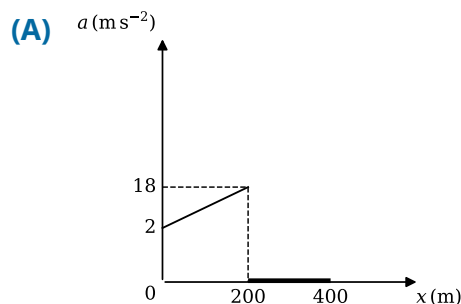
- (A) $2.880 \times 10^2 \text{ J T}^{-1}$ (B) 2.880 J T^{-1} (C) $2.880 \times 10^3 \text{ J T}^{-1}$ (D) 28.80 J T^{-1}

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

The velocity-displacement graph describing the motion of bicycle is shown in the figure.



The acceleration-displacement graph of the bicycle's motion is best described by:

**Q17** Fluid Mechanics[Step-by-step solution > prepwisar.in/questions/OJCwQIVt1D](https://www.prepwisar.in/questions/OJCwQIVt1D)

The pressure acting on a submarine is $3 \times 10^5 \text{ Pa}$ at a certain depth. If the depth is doubled, the percentage increase in the pressure acting on the submarine would be:

(Assume that atmospheric pressure is $1 \times 10^5 \text{ Pa}$ density of water is 10^3 kg m^{-3} , $g = 10 \text{ ms}^{-2}$)

- (A) $\frac{200}{5} \%$ (B) $\frac{200}{3} \%$ (C) $\frac{3}{200} \%$ (D) $\frac{5}{200} \%$

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Q18 Simple Harmonic Motion[Step-by-step solution](https://www.prepwiser.in/questions/WzktKKRoQL)

Time period of a simple pendulum is T inside a lift when the lift is stationary. If the lift moves upwards with an acceleration $g/2$, the time period of pendulum will be:

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

Q19 Experimental Skills[Step-by-step solution](https://www.prepwiser.in/questions/CyKrSfP2tZ)

One main scale division of a vernier callipers is ' a ' cm and n^{th} division of the vernier scale coincide with $(n - 1)^{\text{th}}$ division of the main scale. The least count of the callipers in mm is:

- (A) $\frac{10a}{n}$ (B) $\frac{10na}{(n - 1)}$ (C) $\left(\frac{n - 1}{10n}\right)a$ (D) $\frac{10a}{(n - 1)}$

Physics Section B · Numerical value

Q20 to Q28

Q20 Alternating Current **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/fvosIadTI)

A sinusoidal voltage of peak value 250 V is applied to a series LCR circuit, in which $R = 8\Omega$, $L = 24 \text{ mH}$ and $C = 60 \mu\text{F}$. The value of power dissipated at resonant condition is ' x ' kW. The value of x to the nearest integer is _____.

Q21 Atomic Physics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/fMgIqxCabY)

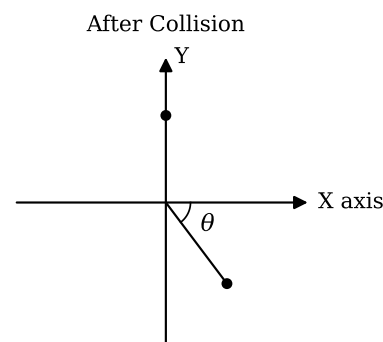
The first three spectral lines of H-atom in the Balmer series are given $\lambda_1, \lambda_2, \lambda_3$ considering the Bohr atomic model, the wave lengths of first and third spectral lines $\left(\frac{\lambda_1}{\lambda_3}\right)$ are related by a factor of approximately ' x ' $\times 10^{-1}$. The value of x , to the nearest integer, is _____.

Q22 Collision **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/AGP8dzfWtW)

A ball of mass 10 kg moving with a velocity $10\sqrt{3} \text{ m s}^{-1}$ along X-axis, hits another ball of mass 20 kg which is at rest. After collision, the first ball comes to rest and the second one disintegrates into two equal pieces. One of the pieces starts moving along Y-axis at a speed of 10 m/s. The second piece starts moving at a speed of 20 m/s at an angle θ (degree) with respect to the X-axis.

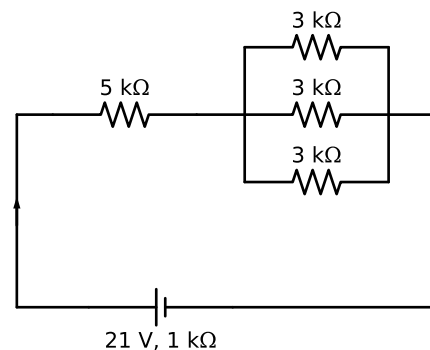
The configuration of pieces after collision is shown in the figure.

The value of θ to the nearest integer is _____.

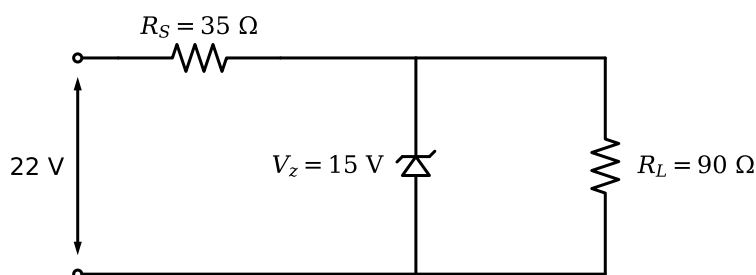
**Q23** Current Electricity **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/XU7ovXEWD3)

In the figure given, the electric current flowing through the 5 k Ω resistor is ' x ' mA.

The value of x to the nearest integer is _____.



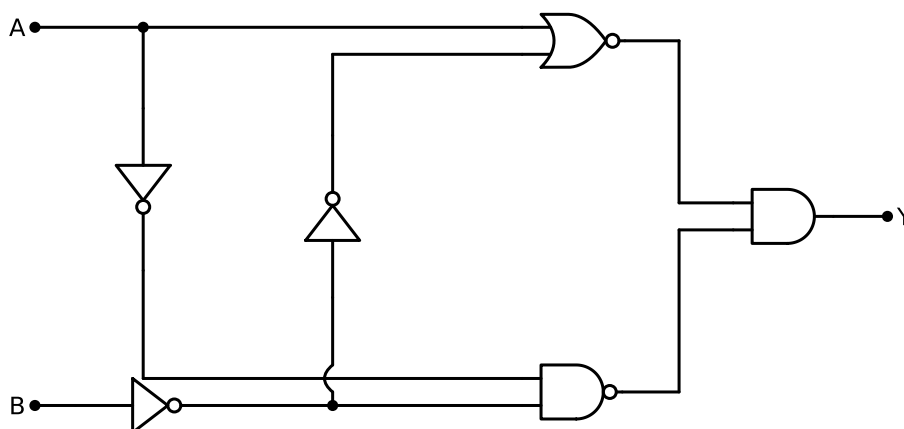
The value of power dissipated across the zener diode ($V_z = 15\text{V}$) connected in the circuit as shown in the figure is $x \times 10^{-1}$ watt.



The value of x , to the nearest integer, is _____.

In the logic circuit shown in the figure, if input A and B are 0 to 1 respectively, the output at Y would be 'x'.

The value of x is _____.

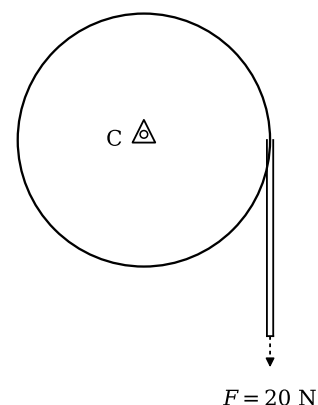


Consider a 20 kg uniform circular disk of radius 0.2 m. It is pin supported at its center and is at rest initially. The disk is acted upon by a constant force $F = 20\text{ N}$ through a massless string wrapped around its periphery as shown in the figure.

Suppose the disk makes n number of revolutions to attain an angular speed of 50 rad s^{-1} .

The value of n , to the nearest integer, is _____.

[Given : In one complete revolution, the disk rotates by 6.28 rad]



A fringe width of 6 mm was produced for two slits separated by 1 mm apart. The screen is placed 10 m away. The wavelength of light used is 'x' nm. The value of 'x' to the nearest integer is _____.

The resistance $R = \frac{V}{I}$, where $V = (50 \pm 2)\text{V}$ and $I = (20 \pm 0.2)\text{A}$. The percentage error in R is 'x'%. The value of 'x' to the nearest integer is _____.

Q29 Carbohydrates & Biomolecules[Step-by-step solution](https://www.prepwise.in/questions/kG3sd88bNb) › prepwise.in/questions/kG3sd88bNb

Which among the following pairs of Vitamins is stored in our body relatively for longer duration?

- (A) Thiamine and Vitamin A (B) Ascorbic acid and Vitamin D
(C) Thiamine and Ascorbic acid (D) Vitamin A and Vitamin D

Q30 Chemical Bonding & Molecular Structure[Step-by-step solution](https://www.prepwise.in/questions/4t60hfK35K) › prepwise.in/questions/4t60hfK35K

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

Assertion A : The H—O—H bond angle in water molecule is 104.5° .

Reason R : The lone pair - lone pair repulsion of electrons is higher than the bond pair - bond pair repulsion.

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

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

Q31 Chemistry in Everyday Life[Step-by-step solution](https://www.prepwise.in/questions/jEwx6WYUHY) › prepwise.in/questions/jEwx6WYUHY

The functions of antihistamine are:

- (A) Antiallergic and Analgesic (B) Antacid and antiallergic
(C) Analgesic and antacid (D) Antiallergic and antidepressant

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

Given below are two statements:

Statement I : The E° value for $\text{Ce}^{4+} / \text{Ce}^{3+}$ is + 1.74 V.

Statement II : Ce is more stable in Ce^{4+} state than Ce^{3+} state.

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

Q33 d & f Block Elements[Step-by-step solution](https://www.prepwise.in/questions/3JX2nqGQ6H) › prepwise.in/questions/3JX2nqGQ6H

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

Assertion A : Size of Bk^{3+} ion is less than Np^{3+} ion.

Reason R : The above is a consequence of the lanthanoid contraction.

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

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

Which of the following is Lindlar catalyst?

- (A) Partially deactivated palladised charcoal (B) Zinc chloride and HCl
(C) Sodium and Liquid NH_3 (D) Cold dilute solution of KMnO_4

Given below are two statements:

Statement I : H_2O_2 can act as both oxidising and reducing agent in basic medium.

Statement II : In the hydrogen economy, the energy is transmitted in the form of dihydrogen.

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

The process that involves the removal of sulphur from the ores is:

- (A) Roasting (B) Smelting (C) Leaching (D) Refining

Match List - I with List - II:

	List - I Industrial process		List - II Application
(a)	Haber's process	(i)	HNO_3 synthesis
(b)	Ostwald's process	(ii)	Aluminium extraction
(c)	Contact process	(iii)	NH_3 synthesis
(d)	Hal-Heroult process	(iv)	H_2SO_4 synthesis

Choose the correct answer from the options given below:

- (A) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii) (B) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)
(C) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i) (D) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

A group of 15 element, which is a metal and forms a hydride with strongest reducing power among group 15 hydrides. The element is:

- (A) As (B) Sb (C) Bi (D) P

Match List - I with List - II:

	List - I Name of oxo acid		List - II Oxidation state of 'P'
(a)	Hypophosphorous acid	(i)	+5
(b)	Orthophosphoric acid	(ii)	+4
(c)	Hypophosphoric acid	(iii)	+3
(d)	Orthophosphorous acid	(iv)	+2
		(v)	+1

Choose the correct answer from the options given below:

- (A) (a) - (iv), (b) - (v), (c) - (ii), (d) - (iii) (B) (a) - (iv), (b) - (i), (c) - (ii), (d) - (iii)
(C) (a) - (v), (b) - (i), (c) - (ii), (d) - (iii) (D) (a) - (v), (b) - (iv), (c) - (ii), (d) - (iii)

Given below are two statements:

Statement I : Both $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$ and $\text{MgCl}_2 \cdot 8\text{H}_2\text{O}$ undergo dehydration on heating.

Statement II : BeO is amphoteric whereas the oxides of other elements in the same group are acidic.

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

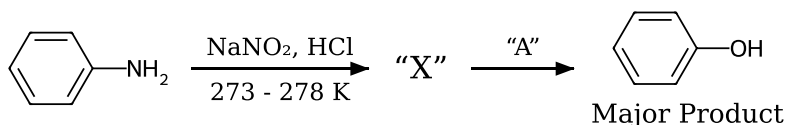
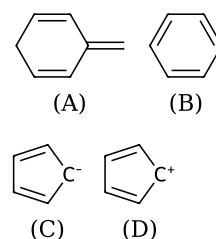
In chromatography technique, the purification of compound is independent of:

- (A) Solubility of the compound (B) Mobility or flow of solvent system
(C) Physical state of the pure compound (D) Length of the column or TLC plate

Among the following, the aromatic compounds are:

Choose the correct answer from the following options:

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



In the above chemical reaction, intermediate "X" and reagent/condition "A" are:

- (A) X - ; A - $\text{H}_2\text{O}/\Delta$ (B) X - ; A - $\text{H}_2\text{O}/\text{NaOH}$
(C) X - ; A - $\text{H}_2\text{O}/\text{NaOH}$ (D) X - ; A - $\text{H}_2\text{O}/\Delta$

Which of the following reactions DOES NOT involve Hoffmann bromamide degradation?

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

Q45 Chemical Kinetics **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/Vxb2QsXwsz) > prepwisar.in/questions/Vxb2QsXwsz

The decomposition of formic acid on gold surface follows first order kinetics. If the rate constant at 300 K is $1.0 \times 10^{-3} \text{ s}^{-1}$ and the activation energy $E_a = 11.488 \text{ kJ mol}^{-1}$, the rate constant at 200 K is _____ $\times 10^{-5} \text{ s}^{-1}$. (Round off to the Nearest Integer). (Given : $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$)

Q46 Coordination Compounds **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/xSVVecVbrW) > prepwisar.in/questions/xSVVecVbrW

The equivalents of ethylene diamine required to replace the neutral ligands from the coordination sphere of the trans-complex of $\text{CoCl}_3 \cdot 4\text{NH}_3$ is _____. (Round off to the Nearest Integer).

Q47 Ionic Equilibrium **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/uhxHLT-fQ7) > prepwisar.in/questions/uhxHLT-fQ7

Two salts A_2X and MX have the same value of solubility product of 4.0×10^{-12} . The ratio of their molar solubilities i.e. $\frac{S(\text{A}_2\text{X})}{S(\text{MX})} =$ _____. (Round off to the Nearest Integer)

Q48 Solid State **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/KBVBuYzNey) > prepwisar.in/questions/KBVBuYzNey

A certain element crystallises in a bcc lattice of unit cell edge length $27 \overset{\circ}{\text{A}}$. If the same element under the same conditions crystallises in the fcc lattice, the edge length of the unit cell in $\overset{\circ}{\text{A}}$ will be _____. (Round off to the Nearest Integer).

[Assume each lattice point has a single atom]

[Assume $\sqrt{3} = 1.73$, $\sqrt{2} = 1.41$]

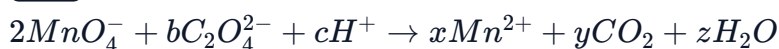
Q49 Solutions & Colligative Properties **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/_DBVmHUscu) > prepwisar.in/questions/_DBVmHUscu

AB_2 is 10% dissociated in water to A^{2+} and B^- . The boiling point of a 10.0 molal aqueous solution of AB_2 is _____ $^\circ\text{C}$. (Round off to the Nearest Integer).

[Given : Molal elevation constant of water $K_b = 0.5 \text{ K kg mol}^{-1}$ boiling point of pure water = 100°C]

Q50 Mole Concept & Stoichiometry **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/5KGKjs2god) > prepwisar.in/questions/5KGKjs2god

Complete combustion of 750 g of an organic compound provides 420 g of CO_2 and 210 g of H_2O . The percentage composition of carbon and hydrogen in organic compound is 15.3 and _____ respectively. (Round off to the Nearest Integer).

Q51 Redox Reactions **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/nouQUAsozt) > prepwisar.in/questions/nouQUAsozt

If the above equation is balanced with integer coefficients, the value of c is _____. (Round off to the Nearest Integer).

Q52 Solutions & Colligative Properties **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/CwkIOY_hT) > prepwisar.in/questions/CwkIOY_hT

A 6.50 molal solution of KOH (aq.) has a density of 1.89 g cm^{-3} . The molarity of the solution is _____ mol dm^{-3} . (Round off to the Nearest Integer).

[Atomic masses : K : 39.0 u; O : 16.0 u; H : 1.0 u]

Q53 Atomic Structure **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/ivEXhSVYFI) > prepwisar.in/questions/ivEXhSVYFI

When light of wavelength 248 nm falls on a metal of threshold energy 3.0 eV, the de-Broglie wavelength of emitted electrons is _____ $\overset{\circ}{\text{A}}$. (Round off to the Nearest Integer).

[Use: $\sqrt{3} = 1.73$, $h = 6.63 \times 10^{-34} \text{ Js}$

$m_e = 9.1 \times 10^{-31} \text{ kg}$; $c = 3.0 \times 10^8 \text{ ms}^{-1}$; $1\text{eV} = 1.6 \times 10^{-19} \text{ J}$]

For the reaction $A(g) \rightleftharpoons B(g)$ at 495 K, $\Delta_r G^\circ = -9.478 \text{ kJ mol}^{-1}$.

If we start the reaction in a closed container at 495 K with 22 millimoles of A, the amount of B in the equilibrium mixture is _____ millimoles.

(Round off to the Nearest Integer). [$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$; $\ln 10 = 2.303$]

Mathematics Section A · Multiple choice

Q55 to Q72

Q55 Three Dimensional Geometry

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

Let the position vectors of two points P and Q be $3\hat{i} - \hat{j} + 2\hat{k}$ and $\hat{i} + 2\hat{j} - 4\hat{k}$, respectively. Let R and S be two points such that the direction ratios of lines PR and QS are (4, -1, 2) and (-2, 1, -2), respectively. Let lines PR and QS intersect at T. If the vector $\overrightarrow{TA}$ is perpendicular to both $\overrightarrow{PR}$ and $\overrightarrow{QS}$ and the length of vector $\overrightarrow{TA}$ is $\sqrt{5}$ units, then the modulus of a position vector of A is:

- (A) $\sqrt{171}$ (B) $\sqrt{227}$ (C) $\sqrt{482}$ (D) $\sqrt{5}$

Q56 Three Dimensional Geometry

Step-by-step solution > [prepwisar.in/questions/5My0bNUoZL](https://www.prepwisar.in/questions/5My0bNUoZL)

Let P be a plane $lx + my + nz = 0$ containing the line, $\frac{1-x}{1} = \frac{y+4}{2} = \frac{z+2}{3}$. If plane P divides the line segment AB joining points A(-3, -6, 1) and B(2, 4, -3) in ratio k : 1 then the value of k is equal to:

- (A) 2 (B) 3 (C) 1.5 (D) 4

Q57 Three Dimensional Geometry

Step-by-step solution > [prepwisar.in/questions/hjed3gTztc](https://www.prepwisar.in/questions/hjed3gTztc)

If for $a > 0$, the feet of perpendiculars from the points A(a, -2a, 3) and B(0, 4, 5) on the plane $lx + my + nz = 0$ are points C(0, -a, -1) and D respectively, then the length of line segment CD is equal to:

- (A) $\sqrt{41}$ (B) $\sqrt{55}$ (C) $\sqrt{31}$ (D) $\sqrt{66}$

Q58 Binomial Theorem

Step-by-step solution > [prepwisar.in/questions/Bgz4IBL1yD](https://www.prepwisar.in/questions/Bgz4IBL1yD)

If n is the number of irrational terms in the expansion of $(3^{1/4} + 5^{1/8})^{60}$, then (n - 1) is divisible by:

- (A) 30 (B) 8 (C) 7 (D) 26

Q59 Binomial Theorem

Step-by-step solution > [prepwisar.in/questions/2M96jxg4Iq](https://www.prepwisar.in/questions/2M96jxg4Iq)

Let $[x]$ denote greatest integer less than or equal to x. If for $n \in \mathbb{N}$,

$$(1 - x + x^3)^n = \sum_{j=0}^{3n} a_j x^j,$$

then

$$\sum_{j=0}^{\left[\frac{3n}{2}\right]} a_{2j} + 4 \sum_{j=0}^{\left[\frac{3n-1}{2}\right]} a_{2j+1}$$

is equal to:

- (A) 2^{n-1} (B) n (C) 2 (D) 1

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Q60 Complex Numbers[Step-by-step solution](https://www.prepwisar.in/questions/gEzYmTy3D)

Let a complex number z , $|z| \neq 1$, satisfy

$$\log_{\frac{1}{\sqrt{2}}} \left(\frac{|z| + 11}{(|z| - 1)^2} \right) \leq 2$$

. Then, the largest value of $|z|$ is equal to _____.

- (A) 5 (B) 8 (C) 6 (D) 7

Q61 Differential Equations[Step-by-step solution](https://www.prepwisar.in/questions/0Qa_JTpwwu)

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

$\frac{dy}{dx} + 2y \tan x = \sin x$, $y\left(\frac{\pi}{3}\right) = 0$, then the maximum value of the function $y(x)$ over R is equal to:

- (A) $\frac{1}{8}$ (B) 8 (C) $-\frac{15}{4}$ (D) $\frac{1}{2}$

Q62 Applications of Derivatives[Step-by-step solution](https://www.prepwisar.in/questions/UBkmdT3NSI)

The range of $a \in R$ for which the

function $f(x) = (4a - 3)(x + \log_e 5) + 2(a - 7) \cot\left(\frac{x}{2}\right) \sin^2\left(\frac{x}{2}\right)$, $x \neq 2n\pi$, $n \in N$ has critical points, is:

- (A) $[1, \infty)$ (B) $(-3, 1)$ (C) $\left[-\frac{4}{3}, 2\right]$ (D) $(-\infty, -1]$

Q63 Hyperbola[Step-by-step solution](https://www.prepwisar.in/questions/fedFsTQuMP)

The locus of the midpoints of the chord of the circle, $x^2 + y^2 = 25$ which is tangent to the hyperbola, $\frac{x^2}{9} - \frac{y^2}{16} = 1$ is:

- (A) $(x^2 + y^2)^2 - 9x^2 + 16y^2 = 0$ (B) $(x^2 + y^2)^2 - 9x^2 + 144y^2 = 0$
(C) $(x^2 + y^2)^2 - 16x^2 + 9y^2 = 0$ (D) $(x^2 + y^2)^2 - 9x^2 - 16y^2 = 0$

Q64 Sequences & Series[Step-by-step solution](https://www.prepwisar.in/questions/DmwrSsejEL)

Let

$$S_k = \sum_{r=1}^k \tan^{-1} \left(\frac{6^r}{2^{2r+1} + 3^{2r+1}} \right)$$

. Then $\lim_{k \rightarrow \infty} S_k$ is equal to:

- (A) $\cot^{-1} \left(\frac{3}{2} \right)$ (B) $\frac{\pi}{2}$ (C) $\tan^{-1} (3)$ (D) $\tan^{-1} \left(\frac{3}{2} \right)$

Q65 Continuity & Differentiability[Step-by-step solution](https://www.prepwisar.in/questions/TZlZ0qX4PJ)

Let the functions $f : R \rightarrow R$ and $g : R \rightarrow R$ be defined as:

$$f(x) = \begin{cases} x + 2, & x < 0 \\ x^2, & x \geq 0 \end{cases}$$

and

$$g(x) = \begin{cases} x^3, & x < 1 \\ 3x - 2, & x \geq 1 \end{cases}$$

Then, the number of points in R where $(f \circ g)(x)$ is NOT differentiable is equal to:

- (A) 0 (B) 3 (C) 1 (D) 2

Let

$$A = \begin{bmatrix} i & -i \\ -i & i \end{bmatrix}, i = \sqrt{-1}$$

. Then, the system of linear equations

$$A^8 \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 8 \\ 64 \end{bmatrix}$$

has:

- (A) Exactly two solutions (B) Infinitely many solutions
(C) A unique solution (D) No solution

If the three normals drawn to the parabola, $y^2 = 2x$ pass through the point $(a, 0)$ $a \neq 0$, then 'a' must be greater than:

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

A pack of cards has one card missing. Two cards are drawn randomly and are found to be spades. The probability that the missing card is not a spade, is:

- (A) $\frac{39}{50}$ (B) $\frac{3}{4}$ (C) $\frac{22}{425}$ (D) $\frac{52}{867}$

The number of elements in the set $\{x \in \mathbb{R} : (|x| - 3) |x + 4| = 6\}$ is equal to:

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

Consider three observations a , b , and c such that $b = a + c$. If the standard deviation of $a + 2$, $b + 2$, $c + 2$ is d , then which of the following is true?

- (A) $b^2 = 3(a^2 + c^2) + 9d^2$ (B) $b^2 = 3(a^2 + c^2) - 9d^2$
(C) $b^2 = 3(a^2 + c^2 + d^2)$ (D) $b^2 = a^2 + c^2 + 3d^2$

The number of roots of the equation, $(81)^{\sin^2 x} + (81)^{\cos^2 x} = 30$ in the interval $[0, \pi]$ is equal to:

- (A) 2 (B) 3 (C) 4 (D) 8

If for $x \in (0, \frac{\pi}{2})$, $\log_{10} \sin x + \log_{10} \cos x = -1$ and $\log_{10}(\sin x + \cos x) = \frac{1}{2}(\log_{10} n - 1)$, $n > 0$, then the value of n is equal to:

- (A) 16 (B) 9 (C) 12 (D) 20

Q73 Complex Numbers **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/HfDmCGHU81

Let z and ω be two complex numbers such that $\omega = z\bar{z} - 2z + 2$, $\left|\frac{z+i}{z-3i}\right| = 1$ and $\text{Re}(\omega)$ has minimum value. Then, the minimum value of $n \in \mathbb{N}$ for which ω^n is real, is equal to _____.

Q74 Definite Integration **NUMERICAL**

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

Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be a continuous function such that $f(x) + f(x+1) = 2$, for all $x \in \mathbb{R}$.

If $I_1 = \int_0^8 f(x)dx$ and $I_2 = \int_{-1}^3 f(x)dx$, then the value of $I_1 + 2I_2$ is equal to _____.

Q75 Definite Integration **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/UahMA7eC97

Let $f: (0, 2) \rightarrow \mathbb{R}$ be defined as $f(x) = \log_2\left(1 + \tan\left(\frac{\pi x}{4}\right)\right)$. Then,

$$\lim_{n \rightarrow \infty} \frac{2}{n} \left(f\left(\frac{1}{n}\right) + f\left(\frac{2}{n}\right) + \dots + f(1) \right)$$

is equal to _____.

Q76 Applications of Derivatives **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/dSjthOve1j

If the normal to the curve $y(x) = \int_0^x (2t^2 - 15t + 10)dt$ at a point (a, b) is parallel to the line $x + 3y = -5$, $a > 1$, then the value of $|a + 6b|$ is equal to _____.

Q77 Differential Equations **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/FtsTBnUW88

Let the curve $y = y(x)$ be the solution of the differential equation, $\frac{dy}{dx} = 2(x+1)$. If the numerical value of area bounded by the curve $y = y(x)$ and x -axis is $\frac{4\sqrt{8}}{3}$, then the value of $y(1)$ is equal to _____.

Q78 Limits **NUMERICAL**

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

If

$$\lim_{x \rightarrow 0} \frac{ae^x - b \cos x + ce^{-x}}{x \sin x} = 2$$

, then $a + b + c$ is equal to _____.

Q79 Determinants **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/tqxbN0vElS

Let

$$P = \begin{bmatrix} -30 & 20 & 56 \\ 90 & 140 & 112 \\ 120 & 60 & 14 \end{bmatrix}$$

and

$$A = \begin{bmatrix} 2 & 7 & \omega^2 \\ -1 & -\omega & 1 \\ 0 & -\omega & -\omega + 1 \end{bmatrix}$$

where

$\omega = \frac{-1+i\sqrt{3}}{2}$, and I_3 be the identity matrix of order 3. If the

determinant of the matrix $(P^{-1}AP - I_3)^2$ is $\alpha\omega^2$, then the value of α is equal to _____.

Q80 Matrices **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/0n9VpCTQF8

The total number of 3×3 matrices A having entries from the set $\{0, 1, 2, 3\}$ such that the sum of all the diagonal entries of AA^T is 9, is equal to _____.

Consider an arithmetic series and a geometric series having four initial terms from the set {11, 8, 21, 16, 26, 32, 4}. If the last terms of these series are the maximum possible four digit numbers, then the number of common terms in these two series is equal to _____.

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Physics

1. D	2. C	3. D	4. C	5. C	6. B	7. B	8. B	9. A	10. C
11. A	12. A	13. D	14. B	15. B	16. A	17. B	18. B	19. A	20. 4
21. 15	22. 30	23. 3	24. 5	25. 0	26. 20	27. 600	28. 5		

Chemistry

29. D	30. A	31. B	32. D	33. C	34. A	35. D	36. A	37. B	38. C
39. C	40. A	41. C	42. B	43. D	44. B	45. 10	46. 2	47. 50	48. 33
49. 106	50. 3	51. 16	52. 9	53. 9	54. 20				

Mathematics

55. A	56. A	57. D	58. D	59. D	60. D	61. A	62. C	63. A	64. A
65. C	66. D	67. B	68. A	69. B	70. B	71. C	72. C	73. 4	74. 16
75. 1	76. 406	77. 2	78. 4	79. 36	80. 766	81. 3			

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