

JEE MAIN 2023 · QUESTION PAPER

31 Jan 2023 **Shift 1**

84 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	19 Q1 to Q19	10 Q20 to Q29
● Chemistry	17 Q30 to Q46	9 Q47 to Q55
● Mathematics	19 Q56 to Q74	10 Q75 to Q84
In this PDF	84 questions · answer key at the end	

- 1 Set a 3 hour timer and attempt the paper in one sitting, like the real exam.
- 2 In the 2021 to 2024 papers, Section B asked you to answer any 5 numerical questions per subject. Try each one here.
- 3 Check yourself against the answer key at the end. Every question names its chapter, so you can see where marks went.
- 4 Got one wrong? Tap “Step-by-step solution” at the top right of it for the full working, where available.

Attempt this paper online

The same questions in the same order, with instant answer checking and step-by-step solutions where available.

prepwis.in/pyqs/paper/2023-01-31-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](#) › [prepwisar.in/questions/6WT_mQMhrK](https://www.prepwisar.in/questions/6WT_mQMhrK)

If R , X_L , and X_C represent resistance, inductive reactance and capacitive reactance. Then which of the following is dimensionless:

- (A) $\frac{R}{X_L X_C}$ (B) $R X_L X_C$ (C) $\frac{R}{\sqrt{X_L X_C}}$ (D) $R \frac{X_L}{X_C}$

Q2 Nuclear Physics

[Step-by-step solution](#) › [prepwisar.in/questions/2GIs_m3srF](https://www.prepwisar.in/questions/2GIs_m3srF)

A free neutron decays into a proton but a free proton does not decay into neutron. This is because

- (A) neutron is an uncharged particle
(B) neutron has larger rest mass than proton
(C) neutron is a composite particle made of a proton and an electron
(D) proton is a charged particle

Q3 Centre of Mass & Linear Momentum

[Step-by-step solution](#) › [prepwisar.in/questions/K8SAkBC-iH](https://www.prepwisar.in/questions/K8SAkBC-iH)

100 balls each of mass m moving with speed v simultaneously strike a wall normally and reflected back with same speed, in time t s. The total force exerted by the balls on the wall is

- (A) $\frac{200mv}{t}$ (B) $\frac{100mv}{t}$ (C) $\frac{mv}{100t}$ (D) $200mvt$

Q4 Current Electricity

[Step-by-step solution](#) › [prepwisar.in/questions/1merSJE0I7](https://www.prepwisar.in/questions/1merSJE0I7)

The drift velocity of electrons for a conductor connected in an electrical circuit is V_d . The conductor is now replaced by another conductor with same material and same length but double the area of cross section. The applied voltage remains same. The new drift velocity of electrons will be

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

Q5 Dual Nature of Radiation & Matter

[Step-by-step solution](#) › [prepwisar.in/questions/4mHhjyg6ES](https://www.prepwisar.in/questions/4mHhjyg6ES)

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

Assertion A : The beam of electrons show wave nature and exhibit interference and diffraction.

Reason R : Davisson Germer Experimentally verified the wave nature of electrons.

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

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

Q6 Electromagnetic Waves

[Step-by-step solution](#) › [prepwisar.in/questions/he0DC5TxGD](https://www.prepwisar.in/questions/he0DC5TxGD)

If a source of electromagnetic radiation having power 15kW produces 10^{16} photons per second, the radiation belongs to a part of spectrum is.

(Take Planck constant $h = 6 \times 10^{-34} \text{Js}$)

- (A) Gamma rays (B) Radio waves (C) Micro waves (D) Ultraviolet rays

Spherical insulating ball and a spherical metallic ball of same size and mass are dropped from the same height. Choose the correct statement out of the following

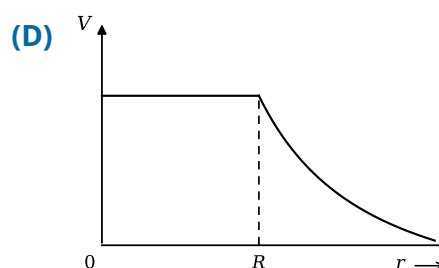
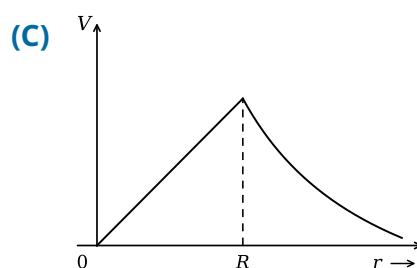
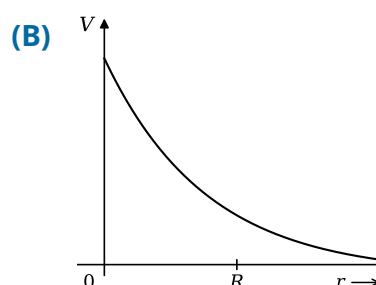
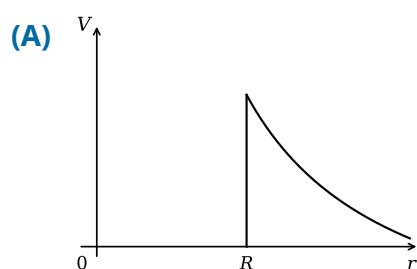
{Assume negligible air friction}

- (A) Metal ball will reach the earth's surface earlier than the insulating ball
- (B) Both will reach the earth's surface simultaneously.
- (C) Insulating ball will reach the earth's surface earlier than the metal ball
- (D) Time taken by them to reach the earth's surface will be independent of the properties of their materials

The effect of increase in temperature on the number of electrons in conduction band (n_e) and resistance of a semiconductor will be as:

- (A) n_e decreases, resistance increases
- (B) Both n_e and resistance increase
- (C) n_e increases, resistance decreases
- (D) Both n_e and resistance decrease

Which of the following correctly represents the variation of electric potential (V) of a charged spherical conductor of radius (R) with radial distance (r) from the center?



At a certain depth "d" below surface of earth, value of acceleration due to gravity becomes four times that of its value at a height $3R$ above earth surface. Where R is Radius of earth (Take $R = 6400\text{km}$). The depth d is equal to

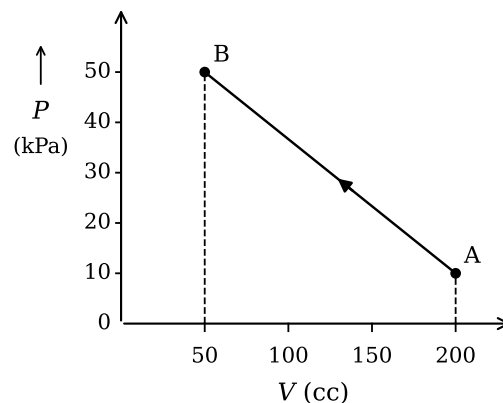
- (A) 5260 km
- (B) 2560 km
- (C) 640 km
- (D) 4800 km

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Q11 Thermodynamics[Step-by-step solution > prepwisar.in/questions/HldDF_j38k](https://www.prepwisar.in/questions/HldDF_j38k)

The pressure of a gas changes linearly with volume from A to B as shown in figure. If no heat is supplied to or extracted from the gas then change in the internal energy of the gas will be

- (A) 6 J (B) 4.5 J (C) zero (D) -4.5 J

**Q12** Kinetic Theory of Gases[Step-by-step solution > prepwisar.in/questions/sOjkhKTIkZ](https://www.prepwisar.in/questions/sOjkhKTIkZ)

The correct relation between $\gamma = \frac{c_p}{c_v}$ and temperature T is:

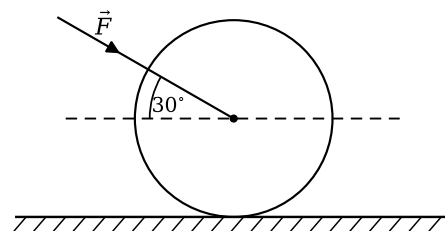
- (A) $\gamma \propto T$ (B) $\gamma \propto \frac{1}{\sqrt{T}}$ (C) $\gamma \propto \frac{1}{T}$ (D) $\gamma \propto T^\circ$

Q13 Newton's Laws of Motion[Step-by-step solution > prepwisar.in/questions/anLidhh4ss](https://www.prepwisar.in/questions/anLidhh4ss)

As shown in figure, a 70kg garden roller is pushed with a force of $\vec{F} = 200\text{N}$ at an angle of 30° with horizontal. The normal reaction on the roller is

(Given $g = 10\text{ms}^{-2}$)

- (A) 800 N (B) 600 N (C) $200\sqrt{3}$ N (D) $800\sqrt{2}$ N

**Q14** Magnetism & Matter[Step-by-step solution > prepwisar.in/questions/R9vLIYKGho](https://www.prepwisar.in/questions/R9vLIYKGho)

A bar magnet with a magnetic moment 5.0Am^2 is placed in parallel position relative to a magnetic field of 0.4T . The amount of required work done in turning the magnet from parallel to antiparallel position relative to the field direction is _____.

- (A) zero (B) 1 J (C) 2 J (D) 4 J

Q15 Magnetism & Matter[Step-by-step solution > prepwisar.in/questions/e9p42c0fFc](https://www.prepwisar.in/questions/e9p42c0fFc)

A rod with circular cross-section area 2cm^2 and length 40cm is wound uniformly with 400 turns of an insulated wire. If a current of 0.4A flows in the wire windings, the total magnetic flux produced inside windings is $4\pi \times 10^{-6}\text{Wb}$. The relative permeability of the rod is

(Given : Permeability of vacuum $\mu_0 = 4\pi \times 10^{-7}\text{NA}^{-2}$)

- (A) $\frac{5}{16}$ (B) 125 (C) $\frac{32}{5}$ (D) 12.5

Q16 Projectile Motion & Relative Motion[Step-by-step solution > prepwisar.in/questions/buQNXlq_xC](https://www.prepwisar.in/questions/buQNXlq_xC)

The initial speed of a projectile fired from ground is u . At the highest point during its motion, the speed of projectile is $\frac{\sqrt{3}}{2}u$. The time of flight of the projectile is:

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

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Q17 Surface Tension[Step-by-step solution](https://www.prepwiser.in/questions/Ktczk95F1k)

If 1000 droplets of water of surface tension 0.07N/m , having same radius 1mm each, combine to form a single drop. In the process the released surface energy is :-

(Take $\pi = \frac{22}{7}$)

- (A) $7.92 \times 10^{-4}\text{J}$ (B) $7.92 \times 10^{-6}\text{J}$ (C) $8.8 \times 10^{-5}\text{J}$ (D) $9.68 \times 10^{-4}\text{J}$

Q18 Simple Harmonic Motion[Step-by-step solution](https://www.prepwiser.in/questions/wmnT6ETzm2)

The maximum potential energy of a block executing simple harmonic motion is 25J . A is amplitude of oscillation. At $A/2$, the kinetic energy of the block is

- (A) 9.75J (B) 37.5J (C) 18.75J (D) 12.5J

Q19 Wave Optics[Step-by-step solution](https://www.prepwiser.in/questions/ue2Mj-xUCR)

Two polaroids A and B are placed in such a way that the pass-axis of polaroids are perpendicular to each other. Now, another polaroid C is placed between A and B bisecting angle between them. If intensity of unpolarized light is I_0 then intensity of transmitted light after passing through polaroid B will be:

- (A) $\frac{I_0}{4}$ (B) $\frac{I_0}{8}$ (C) Zero (D) $\frac{I_0}{2}$

Physics Section B · Numerical value

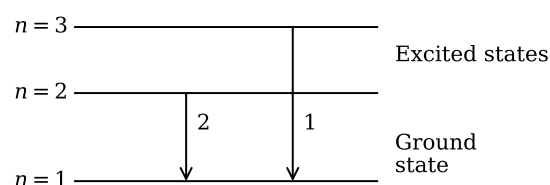
Q20 to Q29

Q20 Alternating Current **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/G_SV0Hsd6j)

An inductor of 0.5mH , a capacitor of $20\mu\text{F}$ and resistance of 20Ω are connected in series with a 220V ac source. If the current is in phase with the emf, the amplitude of current of the circuit is $\sqrt{x}\text{A}$. The value of x is _____

Q21 Atomic Physics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/eAS2MEh1Vw)

For hydrogen atom, λ_1 and λ_2 are the wavelengths corresponding to the transitions 1 and 2 respectively as shown in figure. The ratio of λ_1 and λ_2 is $\frac{x}{32}$. The value of x is _____.

**Q22** Current Electricity **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/aeZ4ZnnqoM)

Two identical cells, when connected either in parallel or in series gives same current in an external resistance 5Ω . The internal resistance of each cell will be _____ Ω .

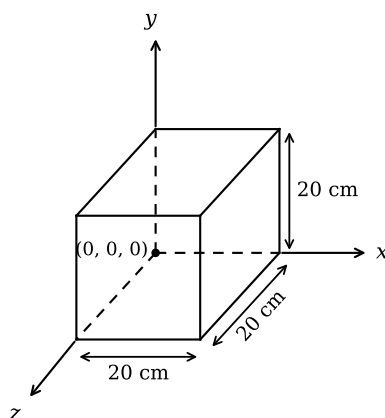
Q23 Electromagnetic Waves **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/fiEJje1DHI)

In a medium the speed of light wave decreases to 0.2 times to its speed in free space. The ratio of relative permittivity to the refractive index of the medium is $x : 1$. The value of x is _____.

(Given speed of light in free space $= 3 \times 10^8\text{ms}^{-1}$ and for the given medium $\mu_r = 1$)

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Expression for an electric field is given by $\vec{E} = 4000x^2\hat{i}\frac{\text{V}}{\text{m}}$. The electric flux through the cube of side 20cm when placed in electric field (as shown in the figure) is _____ Vcm.



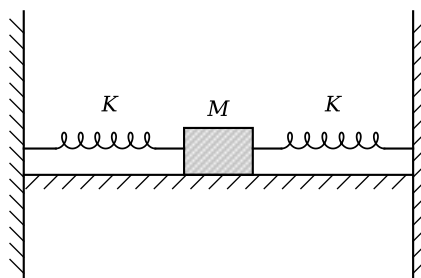
The speed of a swimmer is 4kmh^{-1} in still water. If the swimmer makes his strokes normal to the flow of river of width 1km, he reaches a point 750m down the stream on the opposite bank.

The speed of the river water is _____ kmh^{-1}

A thin rod having a length of 1m and area of cross-section $3 \times 10^{-6}\text{m}^2$ is suspended vertically from one end. The rod is cooled from 210°C to 160°C . After cooling, a mass M is attached at the lower end of the rod such that the length of rod again becomes 1m. Young's modulus and coefficient of linear expansion of the rod are $2 \times 10^{11}\text{Nm}^{-2}$ and $2 \times 10^{-5}\text{K}^{-1}$, respectively. The value of M is _____ kg. (Take $g = 10\text{ms}^{-2}$)

A solid sphere of mass 1kg rolls without slipping on a plane surface. Its kinetic energy is $7 \times 10^{-3}\text{J}$. The speed of the centre of mass of the sphere is _____ cm s^{-1}

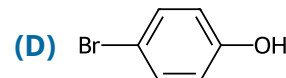
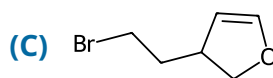
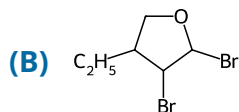
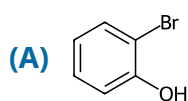
In the figure given below, a block of mass $M = 490\text{g}$ placed on a frictionless table is connected with two springs having same spring constant ($K = 2\text{Nm}^{-1}$). If the block is horizontally displaced through 'X' m then the number of complete oscillations it will make in 14π seconds will be _____.



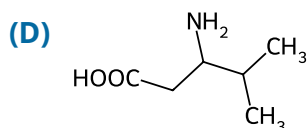
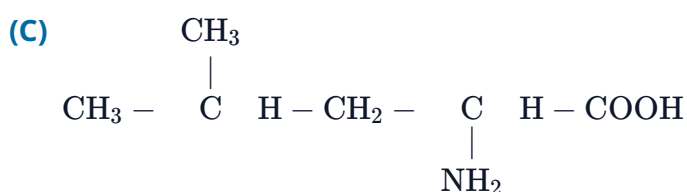
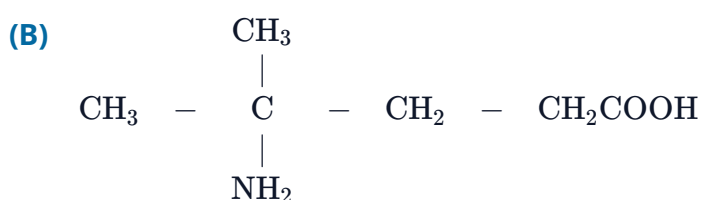
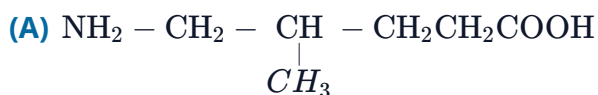
A lift of mass $M = 500\text{kg}$ is descending with speed of 2ms^{-1} . Its supporting cable begins to slip thus allowing it to fall with a constant acceleration of 2ms^{-2} . The kinetic energy of the lift at the end of fall through to a distance of 6m will be _____ kJ.

Q30 Alcohols, Phenols & Ethers[Step-by-step solution](https://www.prepwisar.in/questions/koav5KBbBU)

An organic compound 'A' with empirical formula C_6H_6O gives sooty flame on burning. Its reaction with bromine solution in low polarity solvent results in high yield of B. B is

**Q31** Carbohydrates & Biomolecules[Step-by-step solution](https://www.prepwisar.in/questions/13gGt7RdCB)

A protein 'X' with molecular weight of 70,000u, on hydrolysis gives amino acids. One of these amino acid is

**Q32** Chemistry in Everyday Life[Step-by-step solution](https://www.prepwisar.in/questions/zYb3BVLf3O)

Which of the following artificial sweeteners has the highest sweetness value in comparison to cane sugar?

(A) Alitame

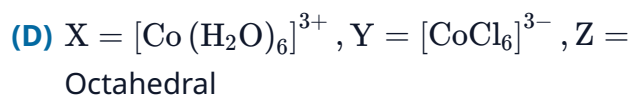
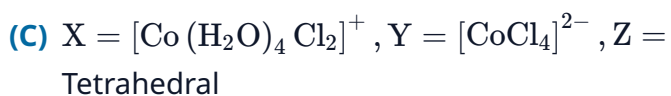
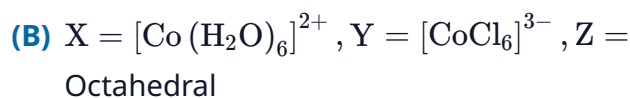
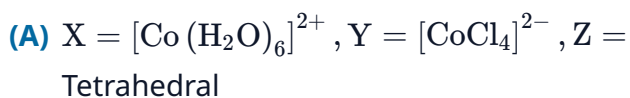
(B) Sucralose

(C) Saccharin

(D) Aspartame

Q33 Coordination Compounds[Step-by-step solution](https://www.prepwisar.in/questions/_KBLpiEpY3)

Cobalt chloride when dissolved in water forms pink colored complex X which has octahedral geometry. This solution on treating with conc HCl forms deep blue complex, Y which has a Z geometry. X, Y and Z, respectively, are



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Q34 Redox Reactions[Step-by-step solution](https://www.prepwiser.in/questions/Y0Npd0BGi8)

When Cu^{2+} ion is treated with KI, a white precipitate, X appears in solution. The solution is titrated with sodium thiosulphate, the compound Y is formed. X and Y respectively are:

- (A) $\text{X} = \text{CuI}_2$ $\text{Y} = \text{Na}_2\text{S}_4\text{O}_6$
- (B) $\text{X} = \text{Cu}_2\text{I}_2$ $\text{Y} = \text{Na}_2\text{S}_4\text{O}_6$
- (C) $\text{X} = \text{CuI}_2$ $\text{Y} = \text{Na}_2\text{S}_2\text{O}_3$
- (D) $\text{X} = \text{Cu}_2\text{I}_2$ $\text{Y} = \text{Na}_2\text{S}_4\text{O}_5$

Q35 d & f Block Elements[Step-by-step solution](https://www.prepwiser.in/questions/vuOG59zfPn)

$\text{Nd}^{2+} =$ _____

- (A) $4f^4 6s^2$ (B) $4f^3$ (C) $4f^4$ (D) $4f^2 6s^2$

Q36 d & f Block Elements[Step-by-step solution](https://www.prepwiser.in/questions/2sNDrv4d0j)

The correct order of basicity of oxides of vanadium is:

- (A) $\text{V}_2\text{O}_3 > \text{V}_2\text{O}_5 > \text{V}_2\text{O}_4$ (B) $\text{V}_2\text{O}_3 > \text{V}_2\text{O}_4 > \text{V}_2\text{O}_5$
- (C) $\text{V}_2\text{O}_5 > \text{V}_2\text{O}_4 > \text{V}_2\text{O}_3$ (D) $\text{V}_2\text{O}_4 > \text{V}_2\text{O}_3 > \text{V}_2\text{O}_5$

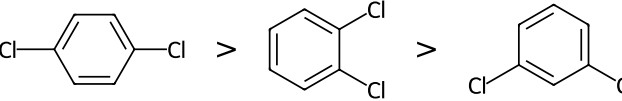
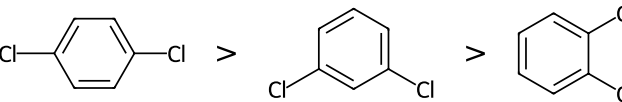
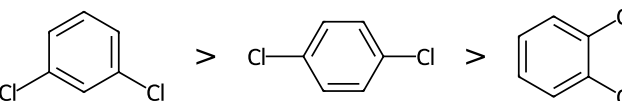
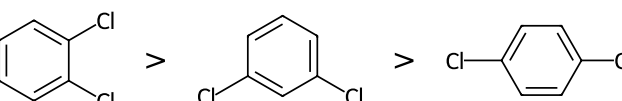
Q37 Electrochemistry[Step-by-step solution](https://www.prepwiser.in/questions/m3dTl_Uvgu)

Which one of the following statements is correct for electrolysis of brine solution?

- (A) O_2 is formed at cathode (B) H_2 is formed at anode
- (C) Cl_2 is formed at cathode (D) OH^- is formed at cathode

Q38 Halogen Derivatives: Haloalkanes & Haloarenes[Step-by-step solution](https://www.prepwiser.in/questions/d04mf0JiOt)

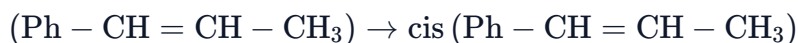
The correct order of melting points of dichlorobenzenes is

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

Q39 Hydrocarbons: Alkenes & Alkynes[Step-by-step solution](https://www.prepwiser.in/questions/iQhILEFdBf)

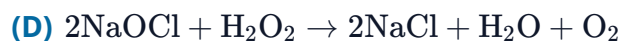
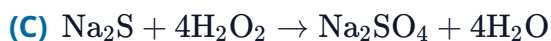
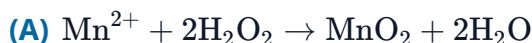
Choose the correct set of reagents for the following conversion.

trans



- (A) Br_2 , alc $\cdot$ KOH, NaNH_2 , H_2 Lindlar Catalyst (B) Br_2 , aq $\cdot$ KOH, NaNH_2 , Na (Liq NH_3)
- (C) Br_2 , alc $\cdot$ KOH, NaNH_2 , Na (Liq NH_3) (D) Br_2 , aq $\cdot$ KOH, NaNH_2 , H_2 Lindlar Catalyst

H_2O_2 acts as a reducing agent in:



The methods NOT involved in concentration of ore are

A. Liquation

B. Leaching

C. Electrolysis

D. Hydraulic washing

E. Froth floatation

Choose the correct answer from the options given below:

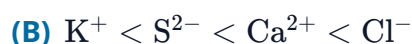
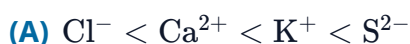
(A) A and C only

(B) C, D and E only

(C) B, D and C only

(D) B, D and E only

The correct increasing order of the ionic radii is



Which transition in the hydrogen spectrum would have the same wavelength as the Balmer type transition from $n = 4$ to $n = 2$ of He^+ spectrum

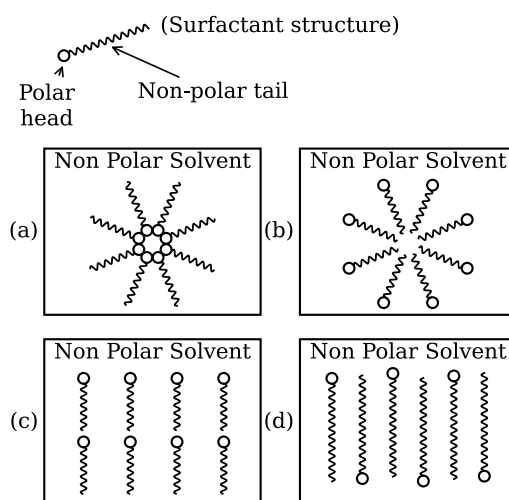
(A) $n = 3$ to $n = 4$

(B) $n = 2$ to $n = 1$

(C) $n = 1$ to $n = 2$

(D) $n = 1$ to $n = 3$

Adding surfactants in non polar solvent, the micelles structure will look like



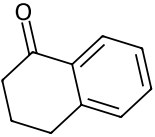
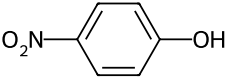
(A) d

(B) a

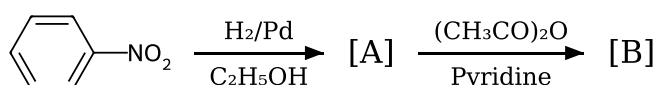
(C) c

(D) b

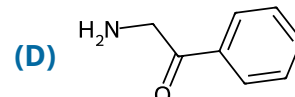
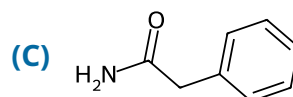
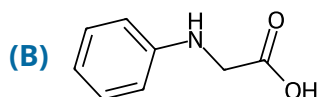
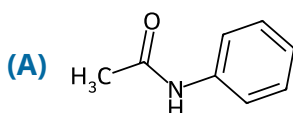
Match items of column I and II

	Column I (Mixture of compounds)		Column II (Separation Technique)
A.	H ₂ O/CH ₂ Cl ₂	i.	Crystallization
B.	 / 	ii.	Differential solvent extraction
C.	Kerosene / Naphthalene	iii.	Column chromatography
D.	C ₆ H ₁₂ O ₆ /NaCl	iv.	Fractional Distillation

Correct match is

(A) A-(ii), B-(iv), C-(i), D-(iii)**(B)** A-(iii), B-(iv), C-(ii), D-(i)**(C)** A-(i), B-(iii), C-(ii), D-(iv)**(D)** A-(ii), B-(iii), C-(iv), D-(i)

Consider the above reaction and identify the product B.

**Chemistry** Section B · Numerical value

Q47 to Q55

A → B

The rate constants of the above reaction at 200 K and 300 K are 0.03 min⁻¹ and 0.05 min⁻¹ respectively. The activation energy for the reaction is _____ J (Nearest integer)

(Given: ln10 = 2.3

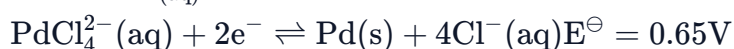
R = 8.3 JK⁻¹mol⁻¹

log 5 = 0.70

log 3 = 0.48

log 2 = 0.30)

The logarithm of equilibrium constant for the reaction $\text{Pd}^{2+} + 4\text{Cl}^- \rightleftharpoons \text{PdCl}_4^{2-}$ is _____ (Nearest integer)

Given: $\frac{2.303RT}{F} = 0.06\text{V}$ 

The oxidation state of phosphorus in hypophosphoric acid is + _____.

At 27°C, a solution containing 2.5g of solute in 250.0mL of solution exerts an osmotic pressure of 400Pa. The molar mass of the solute is _____ gmol⁻¹ (Nearest integer)
(Given: R = 0.083LbarK⁻¹mol⁻¹)

Zinc reacts with hydrochloric acid to give hydrogen and zinc chloride. The volume of hydrogen gas produced at STP from the reaction of 11.5g of zinc with excess HCl is _____ L (Nearest integer)
(Given : Molar mass of Zn is 65.4gmol⁻¹ and Molar volume of H₂ at STP = 22.7L)

On complete combustion, 0.492g of an organic compound gave 0.792g of CO₂. The % of carbon in the organic compound is _____ (Nearest integer)

The enthalpy change for the conversion of $\frac{1}{2}\text{Cl}_2(\text{g})$ to $\text{Cl}^-(\text{aq})$ is (-) _____ kJmol⁻¹ (Nearest integer)

Given:

$$\Delta_{\text{dis}} H_{\text{Cl}_{2(\text{g})}}^{\ominus} = 240 \text{ kJmol}^{-1}, \Delta_{\text{eg}} H_{\text{Cl}_{(\text{g})}}^{\ominus} = -350 \text{ kJmol}^{-1}$$

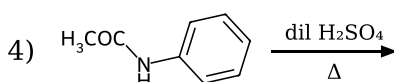
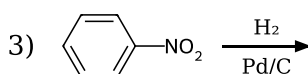
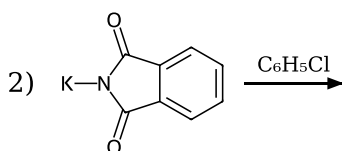
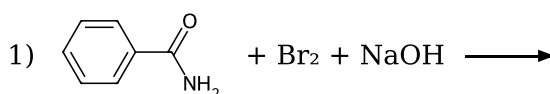
$$\Delta_{\text{hyd}} H_{\text{Cl}_{(\text{g})}^{-}}^{\ominus} = -380 \text{ kJmol}^{-1}$$

For reaction: $\text{SO}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightleftharpoons \text{SO}_3(\text{g})$

$K_p = 2 \times 10^{12}$ at 27°C and 1atm pressure. The K_c for the same reaction is _____ $\times 10^{13}$.
(Nearest integer)

(Given R = 0.082LatmK⁻¹mol⁻¹)

How many of the transformations given below would result in aromatic amines?



Q56 Three Dimensional Geometry

[Step-by-step solution](#) › [prepwise.in/questions/BfYSBS6_ua](https://www.prepwise.in/questions/BfYSBS6_ua)

Let the shortest distance between the lines

$$L : \frac{x-5}{-2} = \frac{y-\lambda}{0} = \frac{z+\lambda}{1}, \lambda \geq 0 \text{ and}$$

$L_1 : x + 1 = y - 1 = 4 - z$ be $2\sqrt{6}$. If (α, β, γ) lies on L , then which of the following is NOT possible?

- (A) $\alpha + 2\gamma = 24$ (B) $2\alpha + \gamma = 7$ (C) $\alpha - 2\gamma = 19$ (D) $2\alpha - \gamma = 9$

Q57 Applications of Derivatives

[Step-by-step solution](#) › [prepwise.in/questions/54Kvn9BQ9s](https://www.prepwise.in/questions/54Kvn9BQ9s)

A wire of length 20m is to be cut into two pieces. A piece of length l_1 is bent to make a square of area A_1 and the other piece of length l_2 is made into a circle of area A_2 . If $2A_1 + 3A_2$ is minimum then $(\pi l_1) : l_2$ is equal to:

- (A) 6 : 1 (B) 1 : 6 (C) 4 : 1 (D) 3 : 1

Q58 Circles

[Step-by-step solution](#) › [prepwise.in/questions/nUYA3HjyWG](https://www.prepwise.in/questions/nUYA3HjyWG)

Let a circle C_1 be obtained on rolling the circle $x^2 + y^2 - 4x - 6y + 11 = 0$ upwards 4 units on the tangent T to it at the point (3, 2). Let C_2 be the image of C_1 in T. Let A and B be the centers of circles C_1 and C_2 respectively, and M and N be respectively the feet of perpendiculars drawn from A and B on the x-axis. Then the area of the trapezium AMNB is:

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

Q59 Complex Numbers

[Step-by-step solution](#) › [prepwise.in/questions/0GrQWaRRL4](https://www.prepwise.in/questions/0GrQWaRRL4)

For all $z \in C$ on the curve $C_1 : |z| = 4$, let the locus of the point $z + \frac{1}{z}$ be the curve C_2 . Then:

- (A) the curves C_1 and C_2 intersect at 4 points (B) the curve C_2 lies inside C_1
(C) the curve C_1 lies inside C_2 (D) the curves C_1 and C_2 intersect at 2 points

Q60 Definite Integration

[Step-by-step solution](#) › [prepwise.in/questions/rpEw4qUW0I](https://www.prepwise.in/questions/rpEw4qUW0I)

Let $\alpha \in (0, 1)$ and $\beta = \log_e(1 - \alpha)$. Let

$$P_n(x) = x + \frac{x^2}{2} + \frac{x^3}{3} + \dots + \frac{x^n}{n}, x \in (0, 1)$$

. Then the integral $\int_0^\alpha \frac{t^{50}}{1-t} dt$ is equal to

- (A) $-(\beta + P_{50}(\alpha))$ (B) $\beta - P_{50}(\alpha)$ (C) $P_{50}(\alpha) - \beta$ (D) $\beta + P_{50} - (\alpha)$

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The value of

$$\int_{\frac{\pi}{3}}^{\frac{\pi}{2}} \frac{(2 + 3 \sin x)}{\sin x(1 + \cos x)} dx$$

is equal to:

(A) $\frac{10}{3} - \sqrt{3} + \log_e \sqrt{3}$

(B) $\frac{7}{2} - \sqrt{3} - \log_e \sqrt{3}$

(C) $\frac{10}{3} - \sqrt{3} - \log_e \sqrt{3}$

(D) $-2 + 3\sqrt{3} + \log_e \sqrt{3}$

Let a differentiable function f satisfy $f(x) + \int_3^x \frac{f(t)}{t} dt = \sqrt{x+1}$, $x \geq 3$. Then $12f(8)$ is equal to:

(A) 19

(B) 34

(C) 17

(D) 1

Let

$$y = f(x) = \sin^3 \left(\frac{\pi}{3} \left(\cos \left(\frac{\pi}{3\sqrt{2}} (-4x^3 + 5x^2 + 1)^{\frac{3}{2}} \right) \right) \right)$$

. Then, at $x = 1$,

(A) $2y' + \sqrt{3}\pi^2 y = 0$

(B) $y' + 3\pi^2 y = 0$

(C) $\sqrt{2}y' - 3\pi^2 y = 0$

(D) $2y' + 3\pi^2 y = 0$

If the maximum distance of normal to the ellipse $\frac{x^2}{4} + \frac{y^2}{b^2} = 1$, $b < 2$, from the origin is 1, then the eccentricity of the ellipse is:

(A) $\frac{\sqrt{3}}{4}$

(B) $\frac{1}{2}$

(C) $\frac{1}{\sqrt{2}}$

(D) $\frac{\sqrt{3}}{2}$

If the domain of the function $f(x) = \frac{[x]}{1+x^2}$, where $[x]$ is greatest integer $\leq x$, is $[2, 6)$, then its range is

(A) $\left(\frac{5}{37}, \frac{2}{5} \right] - \left\{ \frac{9}{29}, \frac{27}{109}, \frac{18}{89}, \frac{9}{53} \right\}$

(B) $\left(\frac{5}{37}, \frac{2}{5} \right]$

(C) $\left(\frac{5}{26}, \frac{2}{5} \right]$

(D) $\left(\frac{5}{26}, \frac{2}{5} \right] - \left\{ \frac{9}{29}, \frac{27}{109}, \frac{18}{89}, \frac{9}{53} \right\}$

If

$$\sin^{-1} \frac{\alpha}{17} + \cos^{-1} \frac{4}{5} - \tan^{-1} \frac{77}{36} = 0, 0 < \alpha < 13$$

, then $\sin^{-1}(\sin \alpha) + \cos^{-1}(\cos \alpha)$ is equal to:

(A) 16

(B) π

(C) $16 - 5\pi$

(D) 0

Q67 Determinants[Step-by-step solution](https://www.prepwiser.in/questions/P0NkoDeevQ) › prepwiser.in/questions/P0NkoDeevQ

For the system of linear equations

$$x + y + z = 6$$

$$\alpha x + \beta y + 7z = 3$$

$$x + 2y + 3z = 14$$

which of the following is **NOT** true?

- (A) If $\alpha = \beta = 7$, then the system has no solution
- (B) For every point $(\alpha, \beta) \neq (7, 7)$ on the line $x - 2y + 7 = 0$, the system has infinitely many solutions
- (C) There is a unique point (α, β) on the line $x + 2y + 18 = 0$ for which the system has infinitely many solutions
- (D) If $\alpha = \beta$ and $\alpha \neq 7$, then the system has a unique solution

Q68 Matrices[Step-by-step solution](https://www.prepwiser.in/questions/O7PuwLY7EL) › prepwiser.in/questions/O7PuwLY7EL

Let

$$A = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 4 & -1 \\ 0 & 12 & -3 \end{pmatrix}$$

. Then the sum of the diagonal elements of the matrix $(A + I)^{11}$ is equal to:

- (A) 4094 (B) 2050 (C) 6144 (D) 4097

Q69 Inverse Trigonometric Functions[Step-by-step solution](https://www.prepwiser.in/questions/k-ccfP1MZq) › prepwiser.in/questions/k-ccfP1MZq

Let $y = f(x)$ represent a parabola with focus $(-\frac{1}{2}, 0)$ and directrix $y = -\frac{1}{2}$. Then

$$S = \left\{ x \in \mathbb{R} : \tan^{-1}(\sqrt{f(x)}) + \sin^{-1}(\sqrt{f(x) + 1}) = \frac{\pi}{2} \right\}$$

:

- (A) is an empty set (B) contains exactly one element
- (C) contains exactly two elements (D) is an infinite set

Q70 Probability: Advanced[Step-by-step solution](https://www.prepwiser.in/questions/m2zzEW0MgD) › prepwiser.in/questions/m2zzEW0MgD

A bag contains 6 balls. Two balls are drawn from it at random and both are found to be black. The probability that the bag contains at least 5 black balls is:

- (A) $\frac{3}{7}$ (B) $\frac{5}{6}$ (C) $\frac{5}{7}$ (D) $\frac{2}{7}$

Q71 Quadratic Equations & Polynomial Inequalities[Step-by-step solution](https://www.prepwiser.in/questions/Yw_Yu1dCJm) › prepwiser.in/questions/Yw_Yu1dCJm

The number of real roots of the equation $\sqrt{x^2 - 4x + 3} + \sqrt{x^2 - 9} = \sqrt{4x^2 - 14x + 6}$, is:

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

Q72 Sequences & Series[Step-by-step solution](https://www.prepwiser.in/questions/AUn96-hrxj) › prepwiser.in/questions/AUn96-hrxj

If the sum and product of four positive consecutive terms of a G.P., are 126 and 1296, respectively, then the sum of common ratios of all such GPs is

- (A) 7 (B) 14 (C) 3 (D) $\frac{9}{2}$

Let R be a relation on $\mathbb{N} \times \mathbb{N}$ defined by $(a, b)R(c, d)$ if and only if $ad(b - c) = bc(a - d)$. Then R is

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

Let $\vec{a} = 2\hat{i} + \hat{j} + \hat{k}$, and $\vec{b}$ and $\vec{c}$ be two nonzero vectors such that $|\vec{a} + \vec{b} + \vec{c}| = |\vec{a} + \vec{b} - \vec{c}|$ and $\vec{b} \cdot \vec{c} = 0$. Consider the following two statements:

- (A) $|\vec{a} + \lambda\vec{c}| \geq |\vec{a}|$ for all $\lambda \in \mathbb{R}$.
(B) $\vec{a}$ and $\vec{c}$ are always parallel.

Then,

- (A) only (B) is correct (B) both (A) and (B) are correct
(C) only (A) is correct (D) neither (A) nor (B) is correct

Mathematics Section B · Numerical value

Q75 to Q84

Let the line $L : \frac{x-1}{2} = \frac{y+1}{-1} = \frac{z-3}{1}$ intersect the plane $2x + y + 3z = 16$ at the point P . Let the point Q be the foot of perpendicular from the point $R(1, -1, -3)$ on the line L . If α is the area of triangle PQR , then α^2 is equal to _____.

Let θ be the angle between the planes $P_1 : \vec{r} \cdot (\hat{i} + \hat{j} + 2\hat{k}) = 9$ and $P_2 : \vec{r} \cdot (2\hat{i} - \hat{j} + \hat{k}) = 15$. Let L be the line that meets P_2 at the point $(4, -2, 5)$ and makes an angle θ with the normal of P_2 . If α is the angle between L and P_2 , then $(\tan^2 \theta)(\cot^2 \alpha)$ is equal to _____.

The remainder on dividing 5^{99} by 11 is _____.

Let $\alpha > 0$, be the smallest number such that the expansion of $\left(x^{\frac{2}{3}} + \frac{2}{x^3}\right)^{30}$ has a term $\beta x^{-\alpha}$, $\beta \in \mathbb{N}$. Then α is equal to _____.

Let 5 digit numbers be constructed using the digits 0, 2, 3, 4, 7, 9 with repetition allowed, and are arranged in ascending order with serial numbers. Then the serial number of the number 42923 is _____.

Number of 4-digit numbers that are less than or equal to 2800 and either divisible by 3 or by 11, is equal to _____.

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Let $a_1, a_2, \dots, a_n$ be in A.P. If $a_5 = 2a_7$ and $a_{11} = 18$, then

$$12 \left(\frac{1}{\sqrt{a_{10}} + \sqrt{a_{11}}} + \frac{1}{\sqrt{a_{11}} + \sqrt{a_{12}}} + \dots + \frac{1}{\sqrt{a_{17}} + \sqrt{a_{18}}} \right)$$

is equal to _____.

If the variance of the frequency distribution

x_i	2	3	4	5	6	7	8
Frequency f_i	3	6	16	α	9	5	6

is 3, then α is equal to _____.

Let $\vec{a}$ and $\vec{b}$ be two vectors such that $|\vec{a}| = \sqrt{14}$, $|\vec{b}| = \sqrt{6}$ and $|\vec{a} \times \vec{b}| = \sqrt{48}$. Then $(\vec{a} \cdot \vec{b})^2$ is equal to _____.

Let for $x \in \mathbb{R}$,

$$f(x) = \frac{x+|x|}{2} \text{ and } g(x) = \begin{cases} x, & x < 0 \\ x^2, & x \geq 0 \end{cases}.$$

Then area bounded by the curve $y = (f \circ g)(x)$ and the lines $y = 0$, $2y - x = 15$ is equal to _____.

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Physics

1. C	2. B	3. A	4. B	5. B	6. A	7. C	8. C
9. D	10. D	11. B	12. D	13. A	14. D	15. B	16. A
17. A	18. C	19. B	20. 242	21. 27	22. 5	23. 5	24. 640
25. 3	26. 60	27. 10	28. 20	29. 7			

Chemistry

30. D	31. C	32. A	33. A	34. B	35. C	36. B	37. D
38. A	39. A	40. D	41. A	42. C	43. B	44. B	45. D
46. A	47. 2520	48. 6	49. 4	50. 62250	51. 4	52. 44	53. 610
54. 1	55. 3						

Mathematics

56. A	57. A	58. B	59. A	60. A	61. A	62. C	63. D
64. D	65. B	66. B	67. B	68. D	69. C	70. C	71. B
72. A	73. D	74. C	75. 180	76. 9	77. 9	78. 2	79. 2997
80. 710	81. 8	82. 5	83. 36	84. 72			

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