

JEE MAIN 2021 · QUESTION PAPER

25 Feb 2021 **Shift 1**

81 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	18 Q1 to Q18	10 Q19 to Q28
● Chemistry	16 Q29 to Q44	9 Q45 to Q53
● Mathematics	18 Q54 to Q71	10 Q72 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.

prepwis.in/pyqs/paper/2021-02-25-morning · Free, no signup needed to start

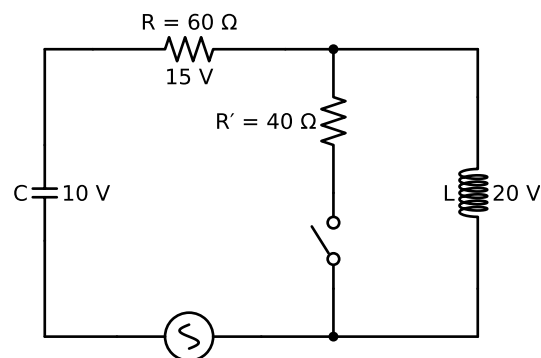
Answers follow NTA's final answer keys. Typing errors are possible, so check doubtful answers against the official key. Spotted a mistake? prepwis.in/feedback · Terms: prepwis.in/terms

Q1 Alternating Current

[Step-by-step solution](https://www.prepwiser.in/questions/Wg91ZHy9mc) > prepwiser.in/questions/Wg91ZHy9mc

The angular frequency of alternating current in a L-C-R circuit is 100 rad/s . The components connected are shown in the figure. Find the value of inductance of the coil and capacity of condenser.

- (A) 0.8 H and $150 \mu\text{F}$ (B) 0.8 H and $250 \mu\text{F}$
(C) 1.33 H and $150 \mu\text{F}$ (D) 1.33 H and $250 \mu\text{F}$



Q2 Nuclear Physics

[Step-by-step solution](https://www.prepwiser.in/questions/rvEbvJjy6j) > prepwiser.in/questions/rvEbvJjy6j

Two radioactive substances X and Y originally have N_1 and N_2 nuclei respectively. Half life of X is half of the half life of Y. After three half lives of Y, number of nuclei of both are equal. The ratio $\frac{N_1}{N_2}$ will be equal to:

- (A) $\frac{1}{8}$ (B) $\frac{3}{1}$ (C) $\frac{1}{3}$ (D) $\frac{8}{1}$

Q3 Dual Nature of Radiation & Matter

[Step-by-step solution](https://www.prepwiser.in/questions/G0M03sT8t4) > prepwiser.in/questions/G0M03sT8t4

An α particle and a proton are accelerated from rest by a potential difference of 200 V . After this, their de Broglie wavelengths are λ_α and λ_p respectively. The ratio $\frac{\lambda_p}{\lambda_\alpha}$ is:

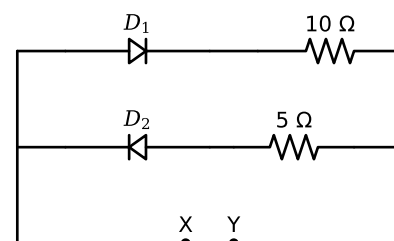
- (A) 8 (B) 2.8 (C) 7.8 (D) 3.8

Q4 Semiconductors & Electronic Devices

[Step-by-step solution](https://www.prepwiser.in/questions/ThSGoGMEg4) > prepwiser.in/questions/ThSGoGMEg4

A 5 V battery is connected across the points X and Y. Assume D_1 and D_2 to be normal silicon diodes. Find the current supplied by the battery if the +ve terminal of the battery is connected to point X.

- (A) $\sim 0.5 \text{ A}$ (B) $\sim 1.5 \text{ A}$ (C) $\sim 0.43 \text{ A}$ (D) $\sim 0.86 \text{ A}$

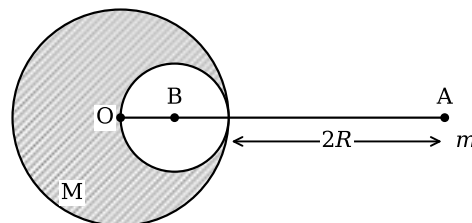


Q5 Gravitation

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

A solid sphere of radius R gravitationally attracts a particle placed at $3R$ from its centre with a force F_1 . Now a spherical cavity of radius $\left(\frac{R}{2}\right)$ is made in the sphere (as shown in figure) and the force becomes F_2 . The value of $F_1 : F_2$ is

- (A) $36 : 25$ (B) $41 : 50$ (C) $50 : 41$ (D) $25 : 36$



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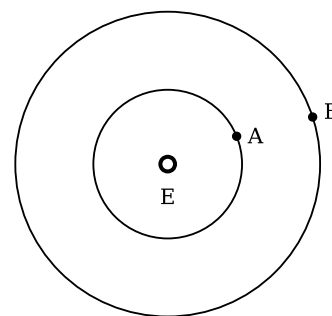
Q6 Gravitation[Step-by-step solution > prepwiser.in/questions/cF6kP-q21N](https://www.prepwiser.in/questions/cF6kP-q21N)

Two satellites A and B of masses 200 kg and 400 kg are revolving round the earth at height of 600 km and 1600 km respectively.

If T_A and T_B are the time periods of A and B respectively then the value of $T_B - T_A$:

[Given : radius of earth = 6400 km, mass of earth = 6×10^{24} kg]

- (A) 1.33×10^3 s (B) 4.24×10^2 s (C) 3.33×10^2 s (D) 4.24×10^3 s

**Q7** Gravitation[Step-by-step solution > prepwiser.in/questions/l2oELyujvQ](https://www.prepwiser.in/questions/l2oELyujvQ)

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

Assertion A : The escape velocities of planet A and B are same. But A and B are of unequal mass.

Reason R : The product of their mass and radius must be same. $M_1 R_1 = M_2 R_2$

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

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

Q8 Thermometry & Calorimetry[Step-by-step solution > prepwiser.in/questions/OByUwITkOM](https://www.prepwiser.in/questions/OByUwITkOM)

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

Assertion A : When a rod lying freely is heated, no thermal stress is developed in it.

Reason R : On heating, the length of the rod increases.

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

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

Q9 Thermodynamics[Step-by-step solution > prepwiser.in/questions/_-xWx-aiS9](https://www.prepwiser.in/questions/_-xWx-aiS9)

A diatomic gas, having $C_p = \frac{7}{2}R$ and $C_v = \frac{5}{2}R$, is heated at constant pressure. The ratio $dU : dQ : dW$:

- (A) 5 : 7 : 3 (B) 3 : 7 : 2 (C) 5 : 7 : 2 (D) 3 : 5 : 2

Q10 Moving Charges & Magnetism[Step-by-step solution > prepwiser.in/questions/m-XqGX2jSd](https://www.prepwiser.in/questions/m-XqGX2jSd)

A proton, a deuteron and an α particle are moving with same momentum in a uniform magnetic field. The ratio of magnetic forces acting on them is _____ and their speed is _____, in the ratio.

- (A) 2 : 1 : 1 and 4 : 2 : 1 (B) 4 : 2 : 1 and 2 : 1 : 1 (C) 1 : 2 : 4 and 2 : 1 : 1 (D) 1 : 2 : 4 and 1 : 1 : 2

Q11 Moving Charges & Magnetism[Step-by-step solution > prepwiser.in/questions/KLNfhO-Edt](https://www.prepwiser.in/questions/KLNfhO-Edt)

Magnetic fields at two points on the axis of a circular coil at a distance of 0.05 m and 0.2 m from the centre are in the ratio 8 : 1. The radius of coil is _____.

- (A) 1.0 m (B) 0.15 m (C) 0.2 m (D) 0.1 m

Q12 Rectilinear Motion[Step-by-step solution](https://www.prepwise.in/questions/heg9V8La6a)

An engine of a train, moving with uniform acceleration, passes the signal-post with velocity u and the last compartment with velocity v . The velocity with which middle point of the train passes the signal post is:

- (A) $\frac{u+v}{2}$ (B) $\sqrt{\frac{v^2 - u^2}{2}}$ (C) $\frac{v-u}{2}$ (D) $\sqrt{\frac{v^2 + u^2}{2}}$

Q13 Simple Harmonic Motion[Step-by-step solution](https://www.prepwise.in/questions/VWbjqX25aQ)

If the time period of a two meter long simple pendulum is $2s$, the acceleration due to gravity at the place where pendulum is executing S.H.M. is:

- (A) 16 m/s^2 (B) $2\pi^2 \text{ ms}^{-2}$ (C) $\pi^2 \text{ ms}^{-2}$ (D) 9.8 ms^{-2}

Q14 Wave Optics[Step-by-step solution](https://www.prepwise.in/questions/_KhcQwN8Ru)

Two coherent light sources having intensity in the ratio $2x$ produce an interference pattern. The ratio $\frac{I_{\max} - I_{\min}}{I_{\max} + I_{\min}}$ will be:

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

Q15 Sound Waves[Step-by-step solution](https://www.prepwise.in/questions/gTNOtwElZ6)

A student is performing the experiment of resonance column. The diameter of the column tube is 6 cm . The frequency of the tuning fork is 504 Hz . Speed of the sound at the given temperature is 336 m/s . The zero of the metre scale coincides with the top end of the resonance column tube. The reading of the water level in the column when the first resonance occurs is:

- (A) 13 cm (B) 18.4 cm (C) 16.6 cm (D) 14.8 cm

Q16 Units, Dimensions & Errors[Step-by-step solution](https://www.prepwise.in/questions/qk1H7GUeAb)

Match List - I with List - II:

	List I		List II
(a)	h (Planck's constant)	(i)	$[MLT^{-1}]$
(b)	E (kinetic energy)	(ii)	$[ML^2T^{-1}]$
(c)	V (electric potential)	(iii)	$[ML^2T^{-2}]$
(d)	P (linear momentum)	(iv)	$[ML^2I^{-1}T^{-3}]$

Choose the correct answer from the options given below:

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

Q17 Experimental Skills[Step-by-step solution](https://www.prepwise.in/questions/14z6jjhQNd)

The pitch of the screw gauge is 1 mm and there are 100 divisions on the circular scale. When nothing is put in between the jaws, the zero of the circular scale lies 8 divisions below the reference line. When a wire is placed between the jaws, the first linear scale division is clearly visible while 72^{nd} division on circular scale coincides with the reference line. The radius of the wire is:

- (A) 1.80 mm (B) 0.90 mm (C) 0.82 mm (D) 1.64 mm

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Q18 Vectors[Step-by-step solution > prepwiser.in/questions/VGRrgaEYG9](https://www.prepwiser.in/questions/VGRrgaEYG9)

In an octagon ABCDEFGH of equal side, what is the sum of

$$\vec{AB} + \vec{AC} + \vec{AD} + \vec{AE} + \vec{AF} + \vec{AG} + \vec{AH},$$

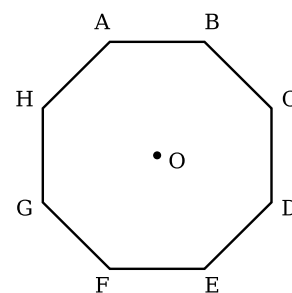
if, $\vec{AO} = 2\hat{i} + 3\hat{j} - 4\hat{k}$

(A) $-16\hat{i} - 24\hat{j} + 32\hat{k}$

(B) $16\hat{i} + 24\hat{j} - 32\hat{k}$

(C) $16\hat{i} + 24\hat{j} + 32\hat{k}$

(D) $16\hat{i} - 24\hat{j} + 32\hat{k}$

**Physics** Section B · Numerical value

Q19 to Q28

Q19 Alternating Current NUMERICAL[Step-by-step solution > prepwiser.in/questions/EjIGI76igk](https://www.prepwiser.in/questions/EjIGI76igk)

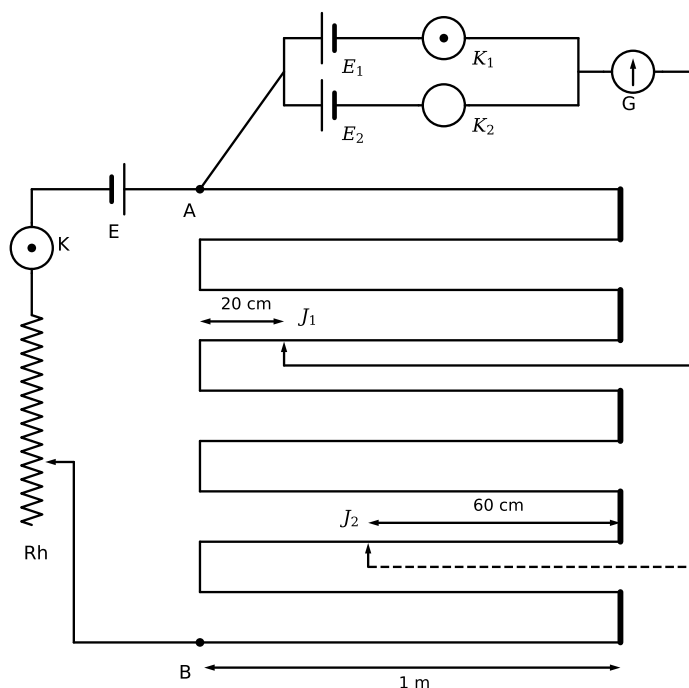
A transmitting station releases waves of wavelength 960 m. A capacitor of $2.56 \mu\text{F}$ is used in the resonant circuit. The self inductance of coil necessary for resonance is $\text{_____} \times 10^{-8} \text{ H}$.

Q20 Circular Motion NUMERICAL[Step-by-step solution > prepwiser.in/questions/KdOJmq5Y8](https://www.prepwiser.in/questions/KdOJmq5Y8)

A small bob tied at one end of a thin string of length 1 m is describing a vertical circle so that the maximum and minimum tension in the string are in the ratio 5 : 1. The velocity of the bob at the highest position is _____ m/s . (Take $g = 10 \text{ m/s}^2$)

Q21 Current Electricity NUMERICAL[Step-by-step solution > prepwiser.in/questions/d_0733DJ3E](https://www.prepwiser.in/questions/d_0733DJ3E)

In the given circuit of potentiometer, the potential difference E across AB (10 m length) is larger than E_1 and E_2 as well. For key K_1 (closed), the jockey is adjusted to touch the wire at point J_1 so that there is no deflection in the galvanometer. Now the first battery (E_1) is replaced by second battery (E_2) for working by making K_1 open and K_2 closed. The galvanometer gives then null deflection at J_2 . The value of $\frac{E_1}{E_2}$ is $\frac{a}{b}$, where $a = \text{_____}$.

**Q22** Electromagnetic Induction NUMERICAL[Step-by-step solution > prepwiser.in/questions/L8UuvOrmPC](https://www.prepwiser.in/questions/L8UuvOrmPC)

A coil of inductance 2 H having negligible resistance is connected to a source of supply whose voltage is given by $V = 3t$ volt. (where t is in second). If the voltage is applied when $t = 0$, then the energy stored in the coil after 4 s is _____ J .

The electric field in a region is given by

$$\vec{E} = \left(\frac{3}{5}E_0\hat{i} + \frac{4}{5}E_0\hat{j} \right) \frac{N}{C}$$

. The ratio of flux of reported field through the rectangular surface of area 0.2 m^2 (parallel to $y - z$ plane) to that of the surface of area 0.3 m^2 (parallel to $x - z$ plane) is $a : b$, where $a = \underline{\hspace{2cm}}$ [Here $\hat{i}$, $\hat{j}$ and $\hat{k}$ are unit vectors along x , y and z -axes respectively.]

512 identical drops of mercury are charged to a potential of 2V each. The drops are joined to form a single drop. The potential of this drop is $\underline{\hspace{2cm}}$ V.

The same size images are formed by a convex lens when the object is placed at 20 cm or at 10 cm from the lens. The focal length of convex lens is $\underline{\hspace{2cm}}$ cm.

A monoatomic gas of mass 4.0 u is kept in an insulated container. Container is moving with velocity 30 m/s. If container is suddenly stopped then change in temperature of the gas (R = gas constant) is $\frac{x}{3R}$. Value of x is $\underline{\hspace{2cm}}$.

In a certain thermodynamical process, the pressure of a gas depends on its volume as kV^3 . The work done when the temperature changes from 100°C to 300°C will be $\underline{\hspace{2cm}}$ nR, where n denotes number of moles of a gas.

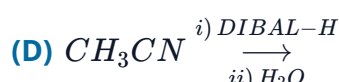
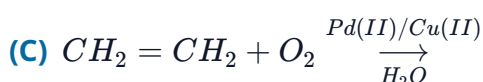
The potential energy (U) of a diatomic molecule is a function dependent on r (interatomic distance) as $U = \frac{\alpha}{r^{10}} - \frac{\beta}{r^5} - 3$

where, α and β are positive constants. The equilibrium distance between two atoms will be $\left(\frac{2\alpha}{\beta}\right)^{\frac{a}{b}}$, where $a = \underline{\hspace{2cm}}$.

Chemistry Section A · Multiple choice

Q29 to Q44

Which one of the following reactions will not form acetaldehyde?

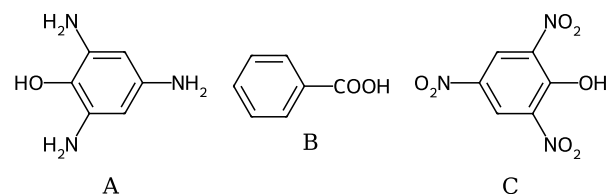


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Q30 General Organic Chemistry (GOC)[Step-by-step solution > prepwiser.in/questions/zZR9dRkbae](https://www.prepwiser.in/questions/zZR9dRkbae)

Compound(s) which will liberate carbon dioxide with sodium bicarbonate solution is/are:

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

**Q31** Carbohydrates & Biomolecules[Step-by-step solution > prepwiser.in/questions/Gk4-uLmQxj](https://www.prepwiser.in/questions/Gk4-uLmQxj)

Which of the glycosidic linkage between galactose and glucose is present in lactose?

- (A) C-1 of galactose and C-6 of glucose (B) C-1 of glucose and C-6 of galactose
(C) C-1 of galactose and C-4 of glucose (D) C-1 of glucose and C-4 of galactose

Q32 Chemical Bonding & Molecular Structure[Step-by-step solution > prepwiser.in/questions/ufpfB3Xmv4](https://www.prepwiser.in/questions/ufpfB3Xmv4)

According to molecular orbital theory, the species among the following that does not exist is:

- (A) O_2^{2-} (B) Be_2 (C) He_2^- (D) He_2^+

Q33 Coordination Compounds[Step-by-step solution > prepwiser.in/questions/Ix8q8HuzAc](https://www.prepwiser.in/questions/Ix8q8HuzAc)

The hybridization and magnetic nature of $[Mn(CN)_6]^{4-}$ and $[Fe(CN)_6]^{3-}$, respectively are:

- (A) sp^3d^2 and diamagnetic (B) d^2sp^3 and paramagnetic
(C) sp^3d^2 and paramagnetic (D) d^2sp^3 and diamagnetic

Q34 d & f Block Elements[Step-by-step solution > prepwiser.in/questions/WHIJBj6bf8](https://www.prepwiser.in/questions/WHIJBj6bf8)

Given below are two statements:

Statement I : CeO_2 can be used for oxidation of aldehydes and ketones.

Statement II : Aqueous solution of $EuSO_4$ is a strong reducing agent.

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

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

Q35 Atomic Structure[Step-by-step solution > prepwiser.in/questions/rEFHotRg-q](https://www.prepwiser.in/questions/rEFHotRg-q)

In which of the following pairs, the outer most electronic configuration will be the same?

- (A) Cr^+ and Mn^{2+} (B) Ni^{2+} and Cu^+ (C) V^{2+} and Cr^+ (D) Fe^{2+} and Co^+

Q36 Hydrogen & s-Block Elements[Step-by-step solution > prepwiser.in/questions/uvtHrndKW1](https://www.prepwiser.in/questions/uvtHrndKW1)

Which of the following equation depicts the oxidizing nature of H_2O_2 ?

- (A) $Cl_2 + H_2O_2 \rightarrow 2HCl + O_2$ (B) $KIO_4 + H_2O_2 \rightarrow KIO_3 + H_2O + O_2$
(C) $2I^- + H_2O_2 + 2H^+ \rightarrow I_2 + 2H_2O$ (D) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$

Q37 Ionic Equilibrium[Step-by-step solution > prepwiser.in/questions/GQDoqQ-yzQ](https://www.prepwiser.in/questions/GQDoqQ-yzQ)

The solubility of $AgCN$ in a buffer solution of $pH = 3$ is x . The value of x is : [Assume : No cyano complex is formed; $K_{sp}(AgCN) = 2.2 \times 10^{-16}$ and $K_a(HCN) = 6.2 \times 10^{-10}$]

- (A) 1.9×10^{-5} (B) 1.6×10^{-6} (C) 2.2×10^{-16} (D) 0.625×10^{-6}

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Ellingham diagram is a graphical representation of:

- (A) ΔG vs P (B) ΔG vs T (C) $(\Delta G - T\Delta S)$ vs T (D) ΔH vs T

The correct statement about B_2H_6 is:

- (A) Its fragment, BH_3 , behaves as a Lewis base.
(B) All B—H—B angles are of 120° .
(C) The two B—H—B bonds are not of same length.
(D) Terminal B—H bonds have less p-character when compared to bridging bonds.

Which statement is correct?

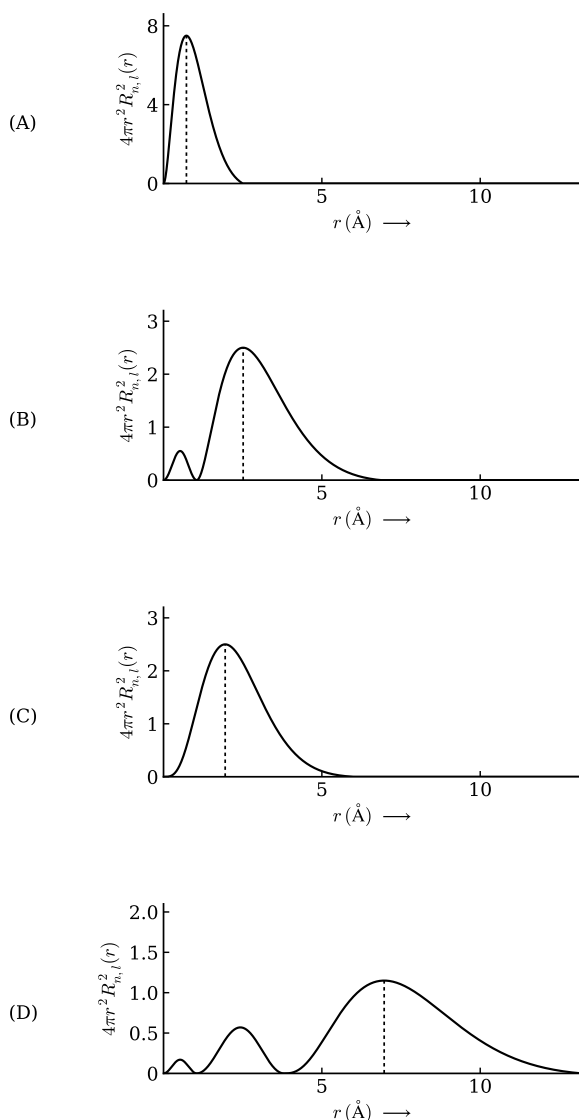
- (A) Buna-N is a natural polymer.
(B) Synthesis of Buna-S needs nascent oxygen.
(C) Buna-S is a synthetic and linear thermosetting polymer.
(D) Neoprene is an addition copolymer used in plastic bucket manufacturing.

Complete combustion of 1.80 g of an oxygen containing compound ($C_xH_yO_z$) gave 2.64 g of CO_2 and 1.08 g of H_2O . The percentage of oxygen in the organic compound is:

- (A) 51.63 (B) 50.33 (C) 63.53 (D) 53.33

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The plots of radial distribution functions for various orbitals of hydrogen atom against 'r' are given below:



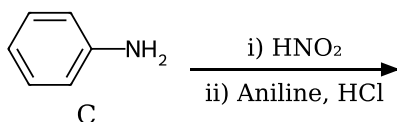
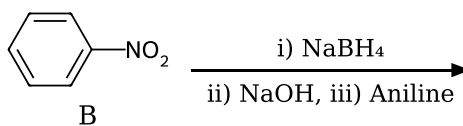
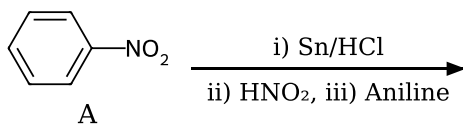
The correct plot for 3s orbital is:

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

In Freundlich adsorption isotherm at moderate pressure, the extent of adsorption $\left(\frac{x}{m}\right)$ is directly proportional to P^x . The value of x is:

- (A) ∞ (B) zero (C) 1 (D) $\frac{1}{n}$

Which of the following reaction/s will not give p-aminoazobenzene?



(A) C only

(B) A only

(C) A and B

(D) B only

Chemistry Section B · Numerical value

Q45 to Q53

Q45 p-Block Elements: Part II (Group 15-18)

NUMERICAL

[Step-by-step solution](https://www.prepwise.in/questions/v-8aWuKc9w) > prepwise.in/questions/v-8aWuKc9w

Among the following, the number of halide(s) which is/are inert to hydrolysis is _____.

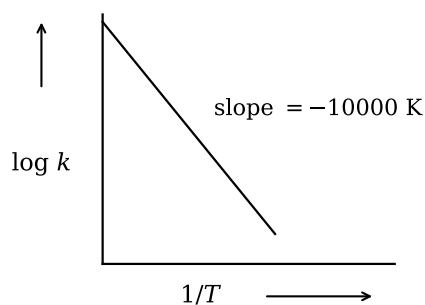
- (A) BF_3
 (B) SiCl_4
 (C) PCl_5
 (D) SF_6

Q46 Chemical Kinetics

NUMERICAL

[Step-by-step solution](https://www.prepwise.in/questions/is_4mieSH-) > prepwise.in/questions/is_4mieSH-

For the reaction, $a\text{A} + b\text{B} \rightarrow c\text{C} + d\text{D}$, the plot of $\log k$ vs $\frac{1}{T}$ is given below:



The temperature at which the rate constant of the reaction is 10^{-4} s^{-1} is _____ K. (Rounded off to the nearest integer)

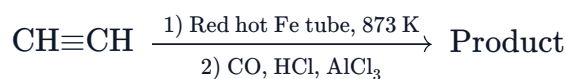
[Given : The rate constant of the reaction is 10^{-5} s^{-1} at 500 K.]

Q47 Chemical Bonding & Molecular Structure

NUMERICAL

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

Consider the following chemical reaction.



The number of sp^2 hybridized carbon atom(s) present in the product is _____.

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Q48 Mole Concept & Stoichiometry **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/UE4JGsCPuG

0.4 g mixture of NaOH, Na₂CO₃ and some inert impurities was first titrated with $\frac{N}{10}$ HCl using phenolphthalein as an indicator, 17.5 mL of HCl was required at the end point. After this methyl orange was added and titrated. 1.5 mL of same HCl was required for the next end point. The weight percentage of Na₂CO₃ in the mixture is _____. (Rounded off to the nearest integer)

Q49 Solutions & Colligative Properties **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/BUA-PrypNL

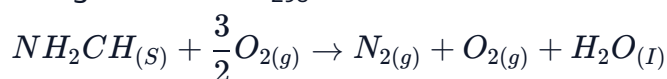
1 molal aqueous solution of an electrolyte A₂B₃ is 60% ionised. The boiling point of the solution at 1 atm is _____ K. (Rounded off to the nearest integer)
[Given K_b for (H₂O) = 0.52 K kg mol⁻¹]

Q50 Redox Reactions **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/AxmWITD1ZN

In basic medium CrO₄²⁻ oxidises S₂O₃²⁻ to form SO₄²⁻ and itself changes into Cr(OH)₄⁻. The volume of 0.154 M CrO₄²⁻ required to react with 40 mL of 0.25 M S₂O₃²⁻ is _____ mL. (Rounded off to the nearest integer)

Q51 Chemical Thermodynamics **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/i3LIj5x9Fr

The reaction of cyanamide, NH₂CN_(s) with oxygen was run in a bomb calorimeter and ΔU was found to be -742.24 kJ mol⁻¹. The magnitude of ΔH₂₉₈ for the reaction



is _____ kJ. (Rounded off to the nearest integer) [Assume ideal gases and R = 8.314 J mol⁻¹ K⁻¹]

Q52 Chemical Thermodynamics **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/-Tb8IV1K6G

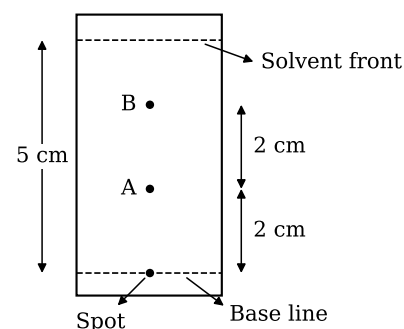
The ionization enthalpy of Na⁺ formation from Na_(g) is 495.8 kJ mol⁻¹, while the electron gain enthalpy of Br is -325.0 kJ mol⁻¹. Given the lattice enthalpy of NaBr is -728.4 kJ mol⁻¹. The energy for the formation of NaBr ionic solid is (-) _____ × 10⁻¹ kJ mol⁻¹.

Q53 Purification & Characterisation of Organic Compounds **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/a5aZ8YfHni

Using the provided information in the following paper chromatogram:

Fig : Paper chromatography for compounds A and B.

the calculated R_f value of A _____ × 10⁻¹.

**Mathematics Section A · Multiple choice**

Q54 to Q71

Q54 Three Dimensional Geometry[Step-by-step solution](#) > prepwiser.in/questions/muWx57P13g

The equation of the line through the point (0, 1, 2) and perpendicular to the line

$$\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{-2} \text{ is:}$$

(A) $\frac{x}{3} = \frac{y-1}{-4} = \frac{z-2}{3}$

(B) $\frac{x}{3} = \frac{y-1}{4} = \frac{z-2}{-3}$

(C) $\frac{x}{-3} = \frac{y-1}{4} = \frac{z-2}{3}$

(D) $\frac{x}{3} = \frac{y-1}{4} = \frac{z-2}{3}$

Q55 Three Dimensional Geometry[Step-by-step solution](#) › [prepwiser.in/questions/IuNpI5EfKI](https://www.prepwiser.in/questions/IuNpI5EfKI)

Let α be the angle between the lines whose direction cosines satisfy the equations $l + m - n = 0$ and $l^2 + m^2 - n^2 = 0$. Then the value of $\sin^4 \alpha + \cos^4 \alpha$ is:

- (A) $\frac{3}{8}$ (B) $\frac{3}{4}$ (C) $\frac{1}{2}$ (D) $\frac{5}{8}$

Q56 Ellipse[Step-by-step solution](#) › [prepwiser.in/questions/WtAGyLSjH8](https://www.prepwiser.in/questions/WtAGyLSjH8)

If the curves, $\frac{x^2}{a} + \frac{y^2}{b} = 1$ and $\frac{x^2}{c} + \frac{y^2}{d} = 1$ intersect each other at an angle of 90° , then which of the following relations is TRUE?

- (A) $a - c = b + d$ (B) $a + b = c + d$ (C) $ab = \frac{c+d}{a+b}$ (D) $a - b = c - d$

Q57 Applications of Derivatives[Step-by-step solution](#) › [prepwiser.in/questions/tzFK0YvDY](https://www.prepwiser.in/questions/tzFK0YvDY)

If Rolle's theorem holds for the function $f(x) = x^3 - ax^2 + bx - 4$, $x \in [1, 2]$ with $f'\left(\frac{4}{3}\right) = 0$, then ordered pair (a, b) is equal to:

- (A) $(-5, -8)$ (B) $(5, -8)$ (C) $(-5, 8)$ (D) $(5, 8)$

Q58 Complex Numbers[Step-by-step solution](#) › [prepwiser.in/questions/aBqKW9bXID](https://www.prepwiser.in/questions/aBqKW9bXID)

Let the lines $(2 - i)z = (2 + i)\bar{z}$ and $(2 + i)z + (i - 2)\bar{z} - 4i = 0$, (here $i^2 = -1$) be normal to a circle C. If the line $iz + \bar{z} + 1 + i = 0$ is tangent to this circle C, then its radius is:

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

Q59 Definite Integration[Step-by-step solution](#) › [prepwiser.in/questions/cpfFbBlwsm](https://www.prepwiser.in/questions/cpfFbBlwsm)

The value of $\int_{-1}^1 x^2 e^{[x^3]} dx$, where $[t]$ denotes the greatest integer $\leq t$, is:

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

Q60 Differential Equations[Step-by-step solution](#) › [prepwiser.in/questions/JW9xOvNNC](https://www.prepwiser.in/questions/JW9xOvNNC)

If a curve passes through the origin and the slope of the tangent to it at any point (x, y) is $\frac{x^2 - 4x + y + 8}{x - 2}$, then this curve also passes through the point:

- (A) $(4, 4)$ (B) $(5, 5)$ (C) $(5, 4)$ (D) $(4, 5)$

Q61 Relations & Functions (Basic)[Step-by-step solution](#) › [prepwiser.in/questions/b5OTJNPx00](https://www.prepwiser.in/questions/b5OTJNPx00)

Let $f, g : \mathbb{N} \rightarrow \mathbb{N}$ such that $f(n+1) = f(n) + f(1) \forall n \in \mathbb{N}$ and g be any arbitrary function. Which of the following statements is NOT true?

- (A) If g is onto, then $f \circ g$ is one-one (B) f is one-one
(C) If f is onto, then $f(n) = n \forall n \in \mathbb{N}$ (D) If $f \circ g$ is one-one, then g is one-one

Q62 Limits[Step-by-step solution](#) › [prepwiser.in/questions/4qaawkgBwg](https://www.prepwiser.in/questions/4qaawkgBwg)

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

is equal to:

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

Q63 Parabola[Step-by-step solution](https://www.prepwise.in/questions/T74Yvh7zvr)

A tangent is drawn to the parabola $y^2 = 6x$ which is perpendicular to the line $2x + y = 1$. Which of the following points does NOT lie on it?

- (A) (0, 3) (B) (-6, 0) (C) (4, 5) (D) (5, 4)

Q64 Permutations & Combinations[Step-by-step solution](https://www.prepwise.in/questions/dwTdD2oNIR)

The total number of positive integral solutions (x, y, z) such that $xyz = 24$ is:

- (A) 36 (B) 24 (C) 45 (D) 30

Q65 Probability: Advanced[Step-by-step solution](https://www.prepwise.in/questions/ufbBiXqFCz)

When a missile is fired from a ship, the probability that it is intercepted is $\frac{1}{3}$ and the probability that the missile hits the target, given that it is not intercepted, is $\frac{3}{4}$. If three missiles are fired independently from the ship, then the probability that all three hit the target, is:

- (A) $\frac{3}{4}$ (B) $\frac{3}{8}$ (C) $\frac{1}{27}$ (D) $\frac{1}{8}$

Q66 Probability: Basic[Step-by-step solution](https://www.prepwise.in/questions/i-rn_r-Fou)

The coefficients a, b and c of the quadratic equation, $ax^2 + bx + c = 0$ are obtained by throwing a dice three times. The probability that this equation has equal roots is:

- (A) $\frac{1}{72}$ (B) $\frac{5}{216}$ (C) $\frac{1}{36}$ (D) $\frac{1}{54}$

Q67 Quadratic Equations & Polynomial Inequalities[Step-by-step solution](https://www.prepwise.in/questions/NtMhjQqeRW)

The integer 'k', for which the inequality $x^2 - 2(3k - 1)x + 8k^2 - 7 > 0$ is valid for every x in R, is:

- (A) 4 (B) 2 (C) 3 (D) 0

Q68 Sequences & Series[Step-by-step solution](https://www.prepwise.in/questions/NLEb3Vx91W)

If

$$0 < \theta, \phi < \frac{\pi}{2}, x = \sum_{n=0}^{\infty} \cos^{2n} \theta, y = \sum_{n=0}^{\infty} \sin^{2n} \phi$$

and $z = \sum_{n=0}^{\infty} \cos^{2n} \theta \cdot \sin^{2n} \phi$ then:

- (A) $xy - z = (x + y)z$ (B) $xyz = 4$ (C) $xy + z = (x + y)z$ (D) $xy + yz + zx = z$

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Q69 Trigonometric Equations[Step-by-step solution](https://www.prepwisar.in/questions/L8zck63w0) › prepwisar.in/questions/L8zck63w0

All possible values of $\theta \in [0, 2\pi]$ for which $\sin 2\theta + \tan 2\theta > 0$ lie in:

- (A) $\left(0, \frac{\pi}{4}\right) \cup \left(\frac{\pi}{2}, \frac{3\pi}{4}\right) \cup \left(\frac{3\pi}{2}, \frac{11\pi}{6}\right)$
- (B) $\left(0, \frac{\pi}{2}\right) \cup \left(\pi, \frac{3\pi}{2}\right)$
- (C) $\left(0, \frac{\pi}{2}\right) \cup \left(\frac{\pi}{2}, \frac{3\pi}{4}\right) \cup \left(\pi, \frac{7\pi}{6}\right)$
- (D) $\left(0, \frac{\pi}{4}\right) \cup \left(\frac{\pi}{2}, \frac{3\pi}{4}\right) \cup \left(\pi, \frac{5\pi}{4}\right) \cup \left(\frac{3\pi}{2}, \frac{7\pi}{4}\right)$

Q70 Straight Lines[Step-by-step solution](https://www.prepwisar.in/questions/kqAYv6dOKX) › prepwisar.in/questions/kqAYv6dOKX

The image of the point (3, 5) in the line $x - y + 1 = 0$, lies on:

- (A) $(x - 4)^2 + (y - 4)^2 = 8$
- (B) $(x - 4)^2 + (y + 2)^2 = 16$
- (C) $(x - 2)^2 + (y - 2)^2 = 12$
- (D) $(x - 2)^2 + (y - 4)^2 = 4$

Q71 Indefinite Integration[Step-by-step solution](https://www.prepwisar.in/questions/iz0iBcoO5x) › prepwisar.in/questions/iz0iBcoO5x

The value of the integral

$$\int \frac{\sin \theta \cdot \sin 2\theta (\sin^6 \theta + \sin^4 \theta + \sin^2 \theta) \sqrt{2\sin^4 \theta + 3\sin^2 \theta + 6}}{1 - \cos 2\theta} d\theta \text{ is:}$$

- (A) $\frac{1}{18} [9 - 2\cos^6 \theta - 3\cos^4 \theta - 6\cos^2 \theta]^{\frac{3}{2}} + c$
- (B) $\frac{1}{18} [11 - 18\sin^2 \theta + 9\sin^4 \theta - 2\sin^6 \theta]^{\frac{3}{2}} + c$
- (C) $\frac{1}{18} [11 - 18\cos^2 \theta + 9\cos^4 \theta - 2\cos^6 \theta]^{\frac{3}{2}} + c$
- (D) $\frac{1}{18} [9 - 2\sin^6 \theta - 3\sin^4 \theta - 6\sin^2 \theta]^{\frac{3}{2}} + c$

Mathematics Section B · Numerical value

Q72 to Q81

Q72 Applications of Derivatives **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/I2vPnhYTrQ) › prepwisar.in/questions/I2vPnhYTrQ

Let $f(x)$ be a polynomial of degree 6 in x , in which the coefficient of x^6 is unity and it has extrema at $x = -1$ and $x = 1$. If $\lim_{x \rightarrow 0} \frac{f(x)}{x^3} = 1$, then $5 \cdot f(2)$ is equal to _____.

Q73 Hyperbola **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/mQSQOoroB0) › prepwisar.in/questions/mQSQOoroB0

The locus of the point of intersection of the lines $(\sqrt{3})kx + ky - 4\sqrt{3} = 0$ and $\sqrt{3}x - y - 4(\sqrt{3})k = 0$ is a conic, whose eccentricity is _____.

Q74 Continuity & Differentiability **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/EtBMD5dNc_) › prepwisar.in/questions/EtBMD5dNc_

The number of points, at which the function

$f(x) = |2x + 1| - 3|x + 2| + |x^2 + x - 2|$, $x \in \mathbb{R}$ is not differentiable, is _____.

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If

$$A = \begin{bmatrix} 0 & -\tan\left(\frac{\theta}{2}\right) \\ \tan\left(\frac{\theta}{2}\right) & 0 \end{bmatrix}$$

and

$$(I_2 + A)(I_2 - A)^{-1} = \begin{bmatrix} a & -b \\ b & a \end{bmatrix}$$

, then $13(a^2 + b^2)$ is equal to

Let

$$A = \begin{bmatrix} x & y & z \\ y & z & x \\ z & x & y \end{bmatrix}$$

, where x, y and z are real numbers such that $x + y + z > 0$ and $xyz = 2$. If $A^2 = I_3$, then the value of $x^3 + y^3 + z^3$ is _____.

If the system of equations

$$kx + y + 2z = 1$$

$$3x - y - 2z = 2$$

$$-2x - 2y - 4z = 3$$

has infinitely many solutions, then k is equal to _____.

The total number of numbers, lying between 100 and 1000 that can be formed with the digits 1, 2, 3, 4, 5, if the repetition of digits is not allowed and numbers are divisible by either 3 or 5, is _____.

Let $A_1, A_2, A_3, \dots$ be squares such that for each $n \geq 1$, the length of the side of A_n equals the length of diagonal of A_{n+1} . If the length of A_1 is 12 cm, then the smallest value of n for which area of A_n is less than one, is _____.

Let $\vec{a} = \hat{i} + 2\hat{j} - \hat{k}$, $\vec{b} = \hat{i} - \hat{j}$ and $\vec{c} = \hat{i} - \hat{j} - \hat{k}$ be three given vectors. If $\vec{r}$ is a vector such that

$$\vec{r} \times \vec{a} = \vec{c} \times \vec{a}$$

and $\vec{r} \cdot \vec{b} = 0$, then $\vec{r} \cdot \vec{a}$ is equal to _____.

The graphs of sine and cosine functions, intersect each other at a number of points and between two consecutive points of intersection, the two graphs enclose the same area A . Then A^4 is equal to _____.

Answer key: JEE Main 2021 · 25 Feb · Shift 1

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Physics

1. B	2. D	3. B	4. C	5. C	6. A	7. C	8. C
9. C	10. A	11. D	12. D	13. B	14. A	15. D	16. A
17. C	18. B	19. 10	20. 5	21. 1	22. 144	23. 1	24. 128
25. 15	26. 3600	27. 50	28. 1				

Chemistry

29. B	30. C	31. C	32. B	33. B	34. D	35. A	36. C
37. A	38. B	39. D	40. B	41. D	42. D	43. D	44. D
45. 1	46. 526	47. 7	48. 4	49. 375	50. 173	51. 741	52. 5576
53. 4							

Mathematics

54. C	55. D	56. D	57. D	58. A	59. D	60. B	61. A
62. B	63. D	64. D	65. D	66. B	67. C	68. C	69. D
70. D	71. C	72. 144	73. 2	74. 2	75. 13	76. 7	77. 21
78. 32	79. 9	80. 12	81. 64				

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