

JEE MAIN 2021 · QUESTION PAPER

24 Feb 2021 **Shift 1**

77 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	20 Q1 to Q20	8 Q21 to Q28
● Chemistry	13 Q29 to Q41	9 Q42 to Q50
● Mathematics	18 Q51 to Q68	9 Q69 to Q77
In this PDF 77 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/2021-02-24-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

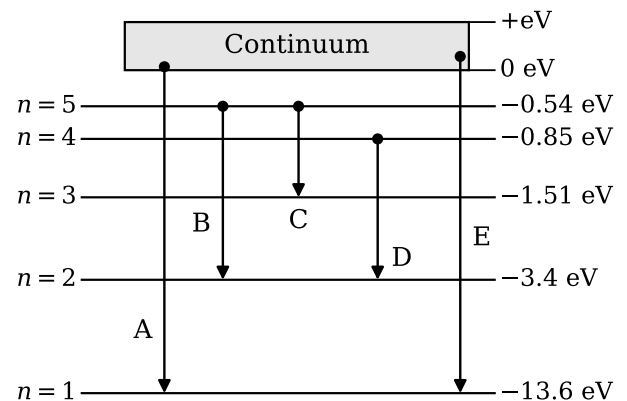
Q1 Atomic Physics

[Step-by-step solution](#) > prepwisar.in/questions/sIFodkUjyc

In the given figure, the energy levels of hydrogen atom have been shown along with some transitions marked A, B, C, D and E.

The transitions A, B and C respectively represent:

- (A) The series limit of Lyman series, second member of Balmer series and second member of Paschen series.
- (B) The ionization potential of hydrogen, second member of Balmer series and third member of Paschen series.
- (C) The series limit of Lyman series, third member of Balmer series and second member of Paschen series.
- (D) The first member of the Lyman series, third member of Balmer series and second member of Paschen series.



Q2 Electrostatics II: Potential & Capacitance

[Step-by-step solution](#) > prepwisar.in/questions/OBkQqL0EGQ

Two equal capacitors are first connected in series and then in parallel. The ratio of the equivalent capacities in the two cases will be:

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

Q3 Current Electricity

[Step-by-step solution](#) > prepwisar.in/questions/3rs0_0nFJP

A current through a wire depends on time as

$$i = \alpha_0 t + \beta t^2$$

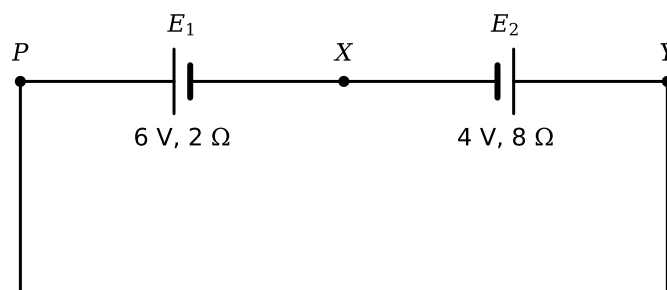
where $\alpha_0 = 20 \text{ A/s}$ and $\beta = 8 \text{ As}^{-2}$. Find the charge crossed through a section of the wire in 15 s.

- (A) 2250 C
- (B) 2100 C
- (C) 260 C
- (D) 11250 C

Q4 Current Electricity

[Step-by-step solution](#) > prepwisar.in/questions/FwqIW8q8Oy

A cell E_1 of emf 6V and internal resistance 2Ω is connected with another cell E_2 of emf 4V and internal resistance 8Ω (as shown in the figure). The potential difference across points X and Y is:



- (A) 10.0 V
- (B) 2.0 V
- (C) 5.6 V
- (D) 3.6 V

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Q5 Dual Nature of Radiation & Matter[Step-by-step solution](#) > [prepwisar.in/questions/VGPo99NSbR](https://www.prepwisar.in/questions/VGPo99NSbR)

Given below are two statements:

Statement I : Two photons having equal linear momenta have equal wavelengths.

Statement II : If the wavelength of photon is decreased, then the momentum and energy of a photon will also decrease.

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

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

Q6 Semiconductors & Electronic Devices[Step-by-step solution](#) > [prepwisar.in/questions/w1Wa04HX_q](https://www.prepwisar.in/questions/w1Wa04HX_q)

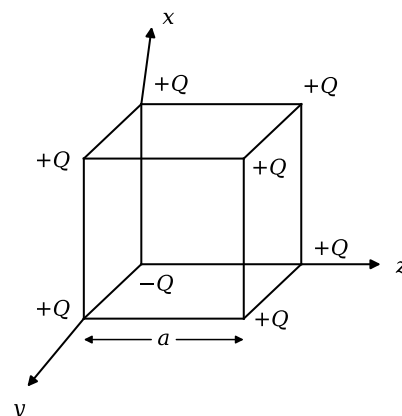
If an emitter current is changed by 4 mA, the collector current changes by 3.5 mA. The value of β will be:

- (A) 0.875 (B) 0.5 (C) 3.5 (D) 7

Q7 Electrostatics I: Charges, Field & Gauss's Law[Step-by-step solution](#) > [prepwisar.in/questions/6sHC4Wo3uO](https://www.prepwisar.in/questions/6sHC4Wo3uO)

A cube of side 'a' has point charges +Q located at each of its vertices except at the origin where the charge is -Q. The electric field at the centre of cube is:

- (A) $\frac{2Q}{3\sqrt{3}\pi\epsilon_0 a^2} (\hat{x} + \hat{y} + \hat{z})$ (B) $\frac{-Q}{3\sqrt{3}\pi\epsilon_0 a^2} (\hat{x} + \hat{y} + \hat{z})$
(C) $\frac{Q}{3\sqrt{3}\pi\epsilon_0 a^2} (\hat{x} + \hat{y} + \hat{z})$ (D) $\frac{-2Q}{3\sqrt{3}\pi\epsilon_0 a^2} (\hat{x} + \hat{y} + \hat{z})$

**Q8** Ray Optics[Step-by-step solution](#) > [prepwisar.in/questions/MfjvVdZics](https://www.prepwisar.in/questions/MfjvVdZics)

The focal length f is related to the radius of curvature r of the spherical convex mirror by:

- (A) $f = r$ (B) $f = -r$ (C) $f = +\frac{1}{2}r$ (D) $f = -\frac{1}{2}r$

Q9 Gravitation[Step-by-step solution](#) > [prepwisar.in/questions/vXSyZTD6Xb](https://www.prepwisar.in/questions/vXSyZTD6Xb)

Four identical particles of equal masses 1 kg made to move along the circumference of a circle of radius 1 m under the action of their own mutual gravitational attraction. The speed of each particle will be:

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

Q10 Gravitation[Step-by-step solution](#) > [prepwisar.in/questions/Su8r19TwuX](https://www.prepwisar.in/questions/Su8r19TwuX)

Consider two satellites S_1 and S_2 with periods of revolution 1 hr. and 8 hr. respectively revolving around a planet in circular orbits. The ratio of angular velocity of satellite S_1 to the angular velocity of satellite S_2 is:

- (A) 1 : 4 (B) 8 : 1 (C) 2 : 1 (D) 1 : 8

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Q11 Gravitation[Step-by-step solution](https://www.prepwisar.in/questions/dD2S_BNExH)

Two stars of masses m and $2m$ at a distance d rotate about their common centre of mass in free space. The period of revolution is:

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

Q12 Thermodynamics[Step-by-step solution](https://www.prepwisar.in/questions/uML0VmbPA2)

Match List I with List II.

	List I		List II
(a)	Isothermal	(i)	Pressure constant
(b)	Isochoric	(ii)	Temperature constant
(c)	Adiabatic	(iii)	Volume constant
(d)	Isobaric	(iv)	Heat content is constant

Choose the correct answer from the options given below:

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

Q13 Thermodynamics[Step-by-step solution](https://www.prepwisar.in/questions/Xk9WIL_5HF)

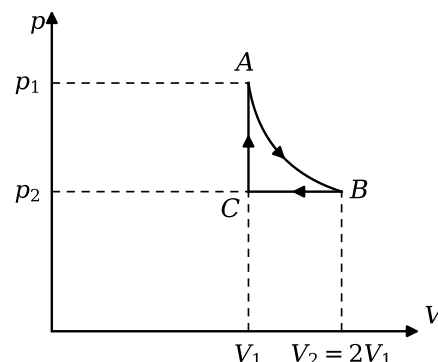
n mole of a perfect gas undergoes a cyclic process ABCA (see figure) consisting of the following processes.

$A \rightarrow B$: Isothermal expansion at temperature T so that the volume is doubled from V_1 to $V_2 = 2V_1$ and pressure changes from P_1 to P_2

$B \rightarrow C$: Isobaric compression at pressure P_2 to initial volume V_1 .

$C \rightarrow A$: Isochoric change leading to change of pressure from P_2 to P_1 .

Total workdone in the complete cycle ABCA is:



- (A) $nRT \ln 2$ (B) 0 (C) $nRT \left(\ln 2 - \frac{1}{2} \right)$ (D) $nRT \left(\ln 2 + \frac{1}{2} \right)$

Q14 Thermometry & Calorimetry[Step-by-step solution](https://www.prepwisar.in/questions/iHjRzPBU8E)

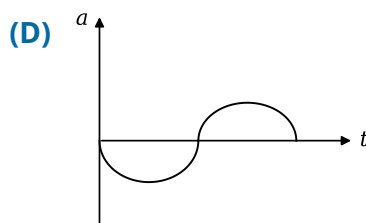
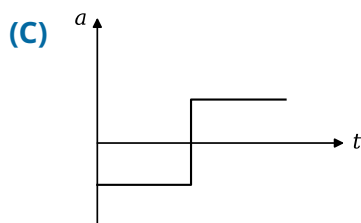
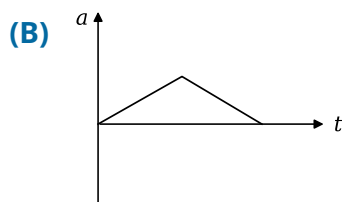
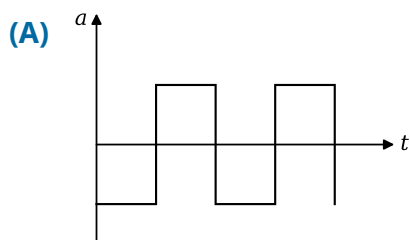
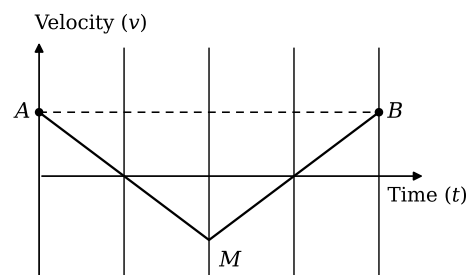
Each side of a box made of metal sheet in cubic shape is 'a' at room temperature 'T', the coefficient of linear expansion of the metal sheet is ' α '. The metal sheet is heated uniformly, by a small temperature ΔT , so that its new temperature is $T + \Delta T$. Calculate the increase in the volume of the metal box.

- (A) $3a^3\alpha\Delta T$ (B) $4\pi a^3\alpha\Delta T$ (C) $\frac{4}{3}\pi a^3\alpha\Delta T$ (D) $4a^3\alpha\Delta T$

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Q15 Rectilinear Motion[Step-by-step solution > prepwisar.in/questions/DRn6Azvn9k](https://www.prepwisar.in/questions/DRn6Azvn9k)

If the velocity-time graph has the shape AMB, what would be the shape of the corresponding acceleration-time graph?

**Q16** Elasticity[Step-by-step solution > prepwisar.in/questions/hnNgy4_o93](https://www.prepwisar.in/questions/hnNgy4_o93)

If Y , K and η are the values of Young's modulus, bulk modulus and modulus of rigidity of any material respectively. Choose the correct relation for these parameters.

- (A) $Y = \frac{9K\eta}{3K-\eta} N/m^2$ (B) $Y = \frac{9K\eta}{2\eta+3K} N/m^2$ (C) $\eta = \frac{3YK}{9K+Y} N/m^2$ (D) $K = \frac{Y\eta}{9\eta-3Y} N/m^2$

Q17 Rotational Motion[Step-by-step solution > prepwisar.in/questions/vuRvA6feDI](https://www.prepwisar.in/questions/vuRvA6feDI)

Moment of inertia (M. I.) of four bodies, having same mass and radius, are reported as;

I_1 = M.I. of thin circular ring about its diameter,

I_2 = M.I. of circular disc about an axis perpendicular to disc and going through the centre,

I_3 = M.I. of solid cylinder about its axis and

I_4 = M.I. of solid sphere about its diameter.

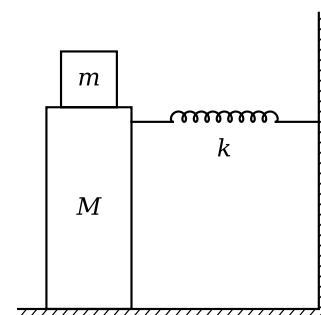
Then:

- (A) $I_1 = I_2 = I_3 > I_4$ (B) $I_1 + I_3 < I_2 + I_4$ (C) $I_1 = I_2 = I_3 < I_4$ (D) $I_1 + I_2 = I_3 + \frac{5}{2} I_4$

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

In the given figure, a mass M is attached to a horizontal spring which is fixed on one side to a rigid support. The spring constant of the spring is k .

The mass oscillates on a frictionless surface with time period T and amplitude A . When the mass is in equilibrium position, as shown in the figure, another mass m is gently fixed upon it. The new amplitude of oscillations will be:



- (A) $A\sqrt{\frac{M}{M-m}}$ (B) $A\sqrt{\frac{M-m}{M}}$ (C) $A\sqrt{\frac{M+m}{M}}$ (D) $A\sqrt{\frac{M}{M+m}}$

Q19 Wave Optics[Step-by-step solution > prepwisar.in/questions/XK09fO0jYK](https://www.prepwisar.in/questions/XK09fO0jYK)

In a Young's double slit experiment, the width of the one of the slit is three times the other slit. The amplitude of the light coming from a slit is proportional to the slit-width. Find the ratio of the maximum to the minimum intensity in the interference pattern.

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

The work done by a gas molecule in an isolated system is given by, $W = \alpha \beta^2 e^{-\frac{x^2}{\alpha kT}}$, where x is the displacement, k is the Boltzmann constant and T is the temperature. α and β are constants. Then the dimensions of β will be:

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

Physics Section B · Numerical value

Q21 to Q28

Q21 Alternating Current NUMERICAL

[Step-by-step solution](#) > [prepwise.in/questions/N0BI4upcro](#)

A common transistor radio set requires 12 V (D.C.) for its operation. The D.C. source is constructed by using a transformer and a rectifier circuit, which are operated at 220 V (A.C.) on standard domestic A.C. supply. The number of turns of secondary coil are 24, then the number of turns of primary are _____.

Q22 Alternating Current NUMERICAL

[Step-by-step solution](#) > [prepwise.in/questions/ytGEasZINI](#)

A resonance circuit having inductance and resistance $2 \times 10^{-4} \text{ H}$ and 6.28Ω respectively oscillates at 10 MHz frequency. The value of quality factor of this resonator is _____. [$\pi = 3.14$]

Q23 Collision NUMERICAL

[Step-by-step solution](#) > [prepwise.in/questions/oeo18foboV](#)

A ball with a speed of 9 m/s collides with another identical ball at rest. After the collision, the direction of each ball makes an angle of 30° with the original direction. The ratio of velocities of the balls after collision is $x : y$, where x is _____.

Q24 Electromagnetic Waves NUMERICAL

[Step-by-step solution](#) > [prepwise.in/questions/kjFpyj0aFi](#)

An electromagnetic wave of frequency 5 GHz, is travelling in a medium whose relative electric permittivity and relative magnetic permeability both are 2. Its velocity in this medium is _____ $\times 10^7 \text{ m/s}$.

Q25 Friction NUMERICAL

[Step-by-step solution](#) > [prepwise.in/questions/_dYStzm_sE](#)

An inclined plane is bent in such a way that the vertical cross-section is given by $y = \frac{x^2}{4}$ where y is in vertical and x in horizontal direction. If the upper surface of this curved plane is rough with coefficient of friction $\mu = 0.5$, the maximum height in cm at which a stationary block will not slip downward is _____ cm.

Q26 Friction NUMERICAL

[Step-by-step solution](#) > [prepwise.in/questions/jr0fy4r75d](#)

The coefficient of static friction between a wooden block of mass 0.5 kg and a vertical rough wall is 0.2. The magnitude of horizontal force that should be applied on the block to keep it adhere to the wall will be _____ N. [$g = 10 \text{ ms}^{-2}$]

Q27 Fluid Mechanics NUMERICAL

[Step-by-step solution](#) > [prepwise.in/questions/resimNNDgF](#)

A hydraulic press can lift 100 kg when a mass 'm' is placed on the smaller piston. It can lift _____ kg when the diameter of the larger piston is increased by 4 times and that of the smaller piston is decreased by 4 times keeping the same mass 'm' on the smaller piston.

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An unpolarised light beam is incident on the polarizer of a polarization experiment and the intensity of light beam emerging from the analyzer is measured as 100 Lumens. Now, if the analyzer is rotated around the horizontal axis (direction of light) by 30° in clockwise direction, the intensity of emerging light will be _____ Lumens.

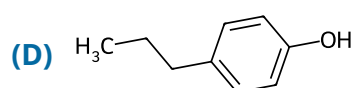
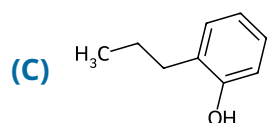
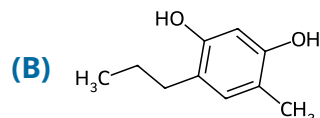
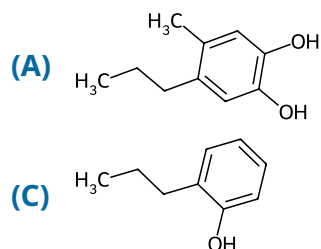
Chemistry Section A · Multiple choice

Q29 to Q41

Q29 Practical Organic Chemistry

Step-by-step solution > prepwiser.in/questions/Ynvj1eX0MQ

Which of the following compound gives pink colour on reaction with phthalic anhydride in conc. H_2SO_4 followed by treatment with NaOH?



Q30 Carbohydrates & Biomolecules

Step-by-step solution > prepwiser.in/questions/PmDzcsZHKb

Out of the following, which type of interaction is responsible for the stabilisation of α -helix structure of proteins?

(A) Covalent bonding

(B) vander Waals forces

(C) Ionic bonding

(D) Hydrogen bonding

Q31 Chemical Bonding & Molecular Structure

Step-by-step solution > prepwiser.in/questions/O5_-0py3wm

Which of the following are isostructural pairs?

A. SO_4^{2-} and CrO_4^{2-} B. $SiCl_4$, and $TiCl_4$ C. NH_3 and NO_3^- D. BCl_3 and $BrCl_3$

(A) B and C only

(B) C and D only

(C) A and B only

(D) A and C only

Q32 Qualitative Analysis: Salt Analysis

Step-by-step solution > prepwiser.in/questions/BPUC6xLMiA

Given below are two statements:

Statement I: Colourless cupric metaborate is reduced to cuprous metaborate in a luminous flame.

Statement II: Cuprous metaborate is obtained by heating boric anhydride and copper sulphate in a non-luminous flame.

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

(A) Statement I is true but Statement II is false

(B) Statement I is false but Statement II is true

(C) Both Statement I and Statement II are false

(D) Both Statement I and Statement II are true

Q33 d & f Block Elements

Step-by-step solution > prepwiser.in/questions/8yD83hS64F

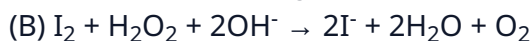
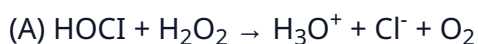
The electrode potential of M^{2+}/M of 3d-series elements shows positive value for:

(A) Zn

(B) Fe

(C) Cu

(D) Co

Q34 Redox Reactions[Step-by-step solution](https://www.prepwiser.in/questions/vt2aP46NQA)

Choose the correct option.

(A) H_2O_2 acts as reducing and oxidising agent respectively in equations (A) and (B).(B) H_2O_2 act as oxidizing and reducing agent respectively in equations (A) and (B).(C) H_2O_2 acts as oxidising agent in equations (A) and (B).(D) H_2O_2 acts as reducing agent in equations (A) and (B).**Q35** Metallurgy[Step-by-step solution](https://www.prepwiser.in/questions/fdQz0jw6IP)

The major components in "Gun Metal" are:

(A) Al, Cu, Mg and Mn

(B) Cu, Ni and Fe

(C) Cu, Sn and Zn

(D) Cu, Zn and Ni

Q36 Metallurgy[Step-by-step solution](https://www.prepwiser.in/questions/5xwIRkjLk9)

Which of the following ore is concentrated using group 1 cyanide salt?

(A) Sphalerite

(B) Malachite

(C) Siderite

(D) Calamine

Q37 Metallurgy[Step-by-step solution](https://www.prepwiser.in/questions/9aW4qpx14x)

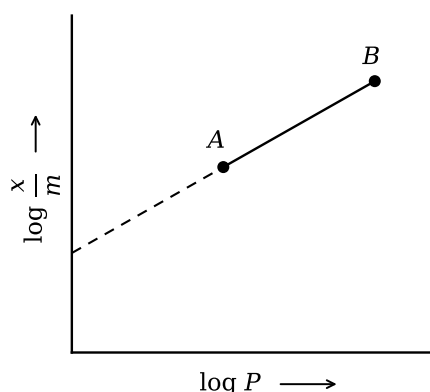
Al_2O_3 was leached with alkali to get X. The solution of X on passing of gas Y, forms Z. X, Y and Z respectively are:

(A) $\text{X} = \text{Na}[\text{Al}(\text{OH})_4]$, $\text{Y} = \text{CO}_2$, $\text{Z} = \text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ (B) $\text{X} = \text{Al}(\text{OH})_3$, $\text{Y} = \text{CO}_2$, $\text{Z} = \text{Al}_2\text{O}_3$ (C) $\text{X} = \text{Al}(\text{OH})_3$, $\text{Y} = \text{SO}_2$, $\text{Z} = \text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ (D) $\text{X} = \text{Na}[\text{Al}(\text{OH})_4]$, $\text{Y} = \text{SO}_2$, $\text{Z} = \text{Al}_2\text{O}_3$ **Q38** Periodic Table & Periodicity[Step-by-step solution](https://www.prepwiser.in/questions/RvCJhCK6K8)

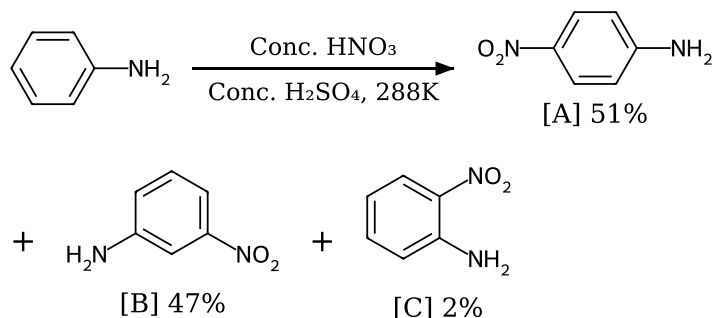
Consider the elements Mg, Al, S, P and Si, the correct increasing order of their first ionization enthalpy is:

(A) $\text{Al} < \text{Mg} < \text{Si} < \text{S} < \text{P}$ (B) $\text{Al} < \text{Mg} < \text{S} < \text{Si} < \text{P}$ (C) $\text{Mg} < \text{Al} < \text{Si} < \text{S} < \text{P}$ (D) $\text{Mg} < \text{Al} < \text{Si} < \text{P} < \text{S}$ **Q39** Surface Chemistry[Step-by-step solution](https://www.prepwiser.in/questions/146dITk5qH)

In Freundlich adsorption isotherm, slope of AB line is:

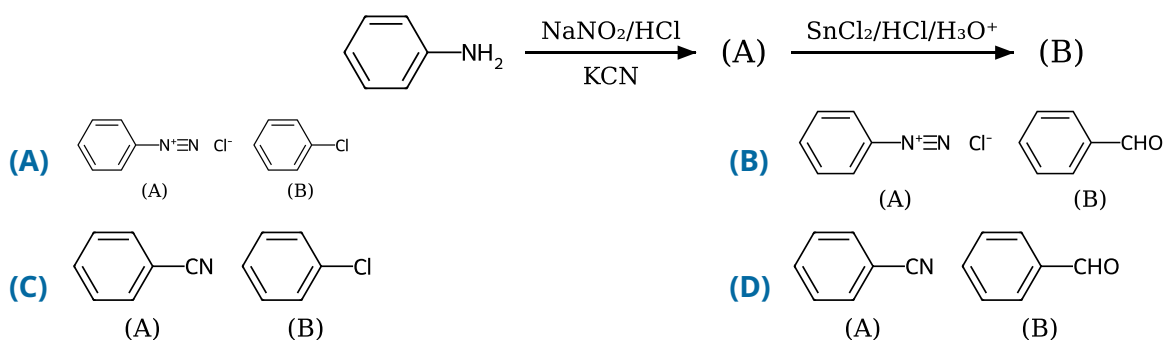
(A) $\frac{1}{n}$ with $\left(\frac{1}{n} = 0 \text{ to } 1\right)$ (B) n with $(n, 0.1 \text{ to } 0.5)$ (C) $\log \frac{1}{n}$ with $(n < 1)$ (D) $\log n$ with $(n > 1)$ Attempt this paper online with instant answer checking > [prepwiser.in/pyqs/paper/2021-02-24-morning](https://www.prepwiser.in/pyqs/paper/2021-02-24-morning)

In the following reaction the reason why meta-nitro product also formed is:



- (A) -NH_2 group is highly meta-directive
 (B) -NO_2 substitution always takes place at meta-position
 (C) Formation of anilinium ion
 (D) low temperature

'A' and 'B' in the following reactions are:



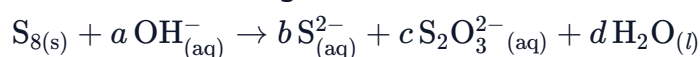
Chemistry Section B · Numerical value

Q42 to Q50

Gaseous cyclobutene isomerises to butadiene in a first order process which has a 'k' value of $3.3 \times 10^{-4} \text{ s}^{-1}$ at 153°C . The time in minutes it takes for the isomerization to proceed 40% to completion at this temperature is ____.

(Rounded off to the nearest integer)

The reaction of sulphur in alkaline medium is given below:



The values of 'a' is _____. (Integer answer)

Number of amphoteric compounds among the following is _____.

- (A) BeO
 (B) BaO
 (C) $\text{Be}(\text{OH})_2$
 (D) $\text{Sr}(\text{OH})_2$

Q45 Solid State **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/TQe_tvZmq) > prepwisar.in/questions/TQe_tvZmq

The coordination number of an atom in a body-centered cubic structure is _____.
[Assume that the lattice is made up of atoms.]

Q46 Mole Concept & Stoichiometry **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/VxKT0Ix0zG) > prepwisar.in/questions/VxKT0Ix0zG

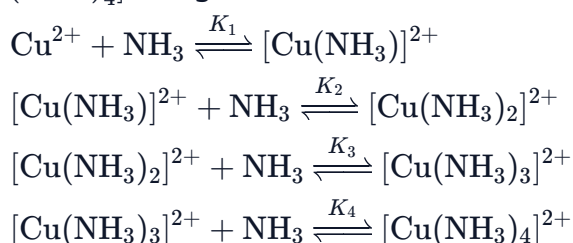
4.5 g of compound A (MW = 90) was used to make 250 mL of its aqueous solution. The molarity of the solution in M is $x \times 10^{-1}$.
The value of x is _____. (Rounded off to the nearest integer)

Q47 Atomic Structure **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/XqEiGp2brQ) > prepwisar.in/questions/XqEiGp2brQ

A proton and a Li^{3+} nucleus are accelerated by the same potential. If λ_{Li} and λ_p denote the de Broglie wavelengths of Li^{3+} and proton respectively, then the value of $\frac{\lambda_{\text{Li}}}{\lambda_p}$ is $x \times 10^{-1}$.
The value of x is _____. (Rounded off to the nearest integer)
[Mass of Li^{3+} = 8.3 mass of proton]

Q48 Chemical Equilibrium **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/wpO4vaLh9F) > prepwisar.in/questions/wpO4vaLh9F

The stepwise formation of $[\text{Cu}(\text{NH}_3)_4]^{2+}$ is given below:



The value of stability constants K_1 , K_2 , K_3 and K_4 are 10^4 , 1.58×10^3 , 5×10^2 and 10^2 respectively.
The overall equilibrium constants for dissociation of $[\text{Cu}(\text{NH}_3)_4]^{2+}$ is $x \times 10^{-12}$.
The value of x is _____. (Rounded off to the nearest integer)

Q49 Chemical Equilibrium **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/H8BvYyBNxr) > prepwisar.in/questions/H8BvYyBNxr

At 1990 K and 1 atm pressure, there are equal number of Cl_2 molecules and Cl atoms in the reaction mixture. The value of K_p for the reaction $\text{Cl}_2(\text{g}) \rightleftharpoons 2\text{Cl}(\text{g})$ under the above conditions is $x \times 10^{-1}$.
The value of x is _____. (Rounded off to the nearest integer)

Q50 Chemical Equilibrium **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/mcionDJjpC) > prepwisar.in/questions/mcionDJjpC

For the reaction $\text{A}_{(\text{g})} \rightarrow \text{B}_{(\text{g})}$ the value of the equilibrium constant at 300 K and 1 atm is equal to 100.0.
The value of $\Delta_r G$ for the reaction at 300 K and 1 atm in J mol^{-1} is $-xR$, where x is _____. (Rounded off to the nearest integer)
[$R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$ and $\ln 10 = 2.3$]

Mathematics Section A · Multiple choice

Q51 to Q68

Q51 Three Dimensional Geometry[Step-by-step solution](https://www.prepwisar.in/questions/ZDBPXZ5ESz) > prepwisar.in/questions/ZDBPXZ5ESz

The equation of the plane passing through the point (1, 2, -3) and perpendicular to the planes $3x + y - 2z = 5$ and $2x - 5y - z = 7$, is:

(A) $6x - 5y + 2z + 10 = 0$

(B) $3x - 10y - 2z + 11 = 0$

(C) $6x - 5y - 2z - 2 = 0$

(D) $11x + y + 17z + 38 = 0$

Q52 Three Dimensional Geometry[Step-by-step solution](#) > [prepwiser.in/questions/0l-VjrHGWT](https://www.prepwiser.in/questions/0l-VjrHGWT)

The distance of the point (1, 1, 9) from the point of intersection of the line $\frac{x-3}{1} = \frac{y-4}{2} = \frac{z-5}{2}$ and the plane $x + y + z = 17$ is:

- (A) $19\sqrt{2}$ (B) $2\sqrt{19}$ (C) 38 (D) $\sqrt{38}$

Q53 Applications of Derivatives[Step-by-step solution](#) > [prepwiser.in/questions/JYUfhmTQcb](https://www.prepwiser.in/questions/JYUfhmTQcb)

The function

$$f(x) = \frac{4x^3 - 3x^2}{6} - 2 \sin x + (2x - 1) \cos x:$$

- (A) increases in $(-\infty, \frac{1}{2}]$ (B) decreases in $(-\infty, \frac{1}{2}]$
(C) increases in $[\frac{1}{2}, \infty)$ (D) decreases in $[\frac{1}{2}, \infty)$

Q54 Applications of Derivatives[Step-by-step solution](#) > [prepwiser.in/questions/hlfh_a9XEp](https://www.prepwiser.in/questions/hlfh_a9XEp)

If the tangent to the curve $y = x^3$ at the point $P(t, t^3)$ meets the curve again at Q, then the ordinate of the point which divides PQ internally in the ratio 1 : 2 is:

- (A) 0 (B) $2t^3$ (C) $-2t^3$ (D) $-t^3$

Q55 Binomial Theorem[Step-by-step solution](#) > [prepwiser.in/questions/dRYOiz8Pot](https://www.prepwiser.in/questions/dRYOiz8Pot)

The value of

$$-^{15}C_1 + 2 \cdot ^{15}C_2 - 3 \cdot ^{15}C_3 + \dots - 15 \cdot ^{15}C_{15} + ^{14}C_1 + ^{14}C_3 + ^{14}C_5 + \dots + ^{14}C_{11} \text{ is:}$$

- (A) $2^{13} - 13$ (B) $2^{16} - 1$ (C) 2^{14} (D) $2^{13} - 14$

Q56 Limits[Step-by-step solution](#) > [prepwiser.in/questions/4mgkWQ-76a](https://www.prepwiser.in/questions/4mgkWQ-76a)

$$\lim_{x \rightarrow 0} \frac{\int_0^{x^2} (\sin \sqrt{t}) dt}{x^3}$$

is equal to:

- (A) $\frac{1}{15}$ (B) 0 (C) $\frac{2}{3}$ (D) $\frac{3}{2}$

Q57 Differential Equations[Step-by-step solution](#) > [prepwiser.in/questions/at3qpdpwGH9](https://www.prepwiser.in/questions/at3qpdpwGH9)

The population $P = P(t)$ at time 't' of a certain species follows the differential equation

$$\frac{dP}{dt} = 0.5P - 450. \text{ If } P(0) = 850, \text{ then the time at which population becomes zero is:}$$

- (A) $\log_e 18$ (B) $\frac{1}{2} \log_e 18$ (C) $2 \log_e 18$ (D) $\log_e 9$

Q58 Relations & Functions (Basic)[Step-by-step solution](#) > [prepwiser.in/questions/RH_iqN-HqB](https://www.prepwiser.in/questions/RH_iqN-HqB)

Let $f: R \rightarrow R$ be defined as $f(x) = 2x - 1$ and $g: R - \{1\} \rightarrow R$ be defined as $g(x) = \frac{x - \frac{1}{2}}{x - 1}$. Then the composition function $f(g(x))$ is:

- (A) one-one but not onto (B) onto but not one-one
(C) both one-one and onto (D) neither one-one nor onto

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Q59 Continuity & Differentiability[Step-by-step solution](https://www.prepwise.in/questions/hTSqcix5e9)

If $f: \mathbb{R} \rightarrow \mathbb{R}$ is a function defined by $f(x) = [x - 1] \cos\left(\frac{2x-1}{2}\right) \pi$, where $[.]$ denotes the greatest integer function, then f is:

- (A) continuous for every real x
- (B) discontinuous at all integral values of x except at $x = 1$
- (C) discontinuous only at $x = 1$
- (D) continuous only at $x = 1$

Q60 Determinants[Step-by-step solution](https://www.prepwise.in/questions/-Sy-ca50BF)

The system of linear equations

$$3x - 2y - kz = 10$$

$$2x - 4y - 2z = 6$$

$$x + 2y - z = 5m$$

is inconsistent if:

- (A) $k \neq 3, m \in \mathbb{R}$
- (B) $k = 3, m \neq \frac{4}{5}$
- (C) $k = 3, m = \frac{4}{5}$
- (D) $k \neq 3, m \neq \frac{4}{5}$

Q61 Parabola[Step-by-step solution](https://www.prepwise.in/questions/jRXJf3FLMw)

The locus of the mid-point of the line segment joining the focus of the parabola $y^2 = 4ax$ to a moving point of the parabola, is another parabola whose directrix is:

- (A) $x = 0$
- (B) $x = -\frac{a}{2}$
- (C) $x = a$
- (D) $x = \frac{a}{2}$

Q62 Permutations & Combinations[Step-by-step solution](https://www.prepwise.in/questions/hT4sUw4ZvS)

A scientific committee is to be formed from 6 Indians and 8 foreigners, which includes at least 2 Indians and double the number of foreigners as Indians. Then the number of ways, the committee can be formed, is:

- (A) 1050
- (B) 575
- (C) 560
- (D) 1625

Q63 Probability: Advanced[Step-by-step solution](https://www.prepwise.in/questions/jyxTPayevr)

An ordinary dice is rolled for a certain number of times. If the probability of getting an odd number 2 times is equal to the probability of getting an even number 3 times, then the probability of getting an odd number for odd number of times is:

- (A) $\frac{5}{36}$
- (B) $\frac{3}{16}$
- (C) $\frac{1}{2}$
- (D) $\frac{1}{32}$

Q64 Quadratic Equations & Polynomial Inequalities[Step-by-step solution](https://www.prepwise.in/questions/ZlvCVOsYdn)

Let p and q be two positive numbers such that $p + q = 2$ and $p^4 + q^4 = 272$. Then p and q are roots of the equation:

- (A) $x^2 - 2x + 8 = 0$
- (B) $x^2 - 2x + 136 = 0$
- (C) $x^2 - 2x + 16 = 0$
- (D) $x^2 - 2x + 2 = 0$

Q65 Area Under Curves[Step-by-step solution](https://www.prepwise.in/questions/wsWY-6BZCj)

The area (in sq. units) of the part of the circle $x^2 + y^2 = 36$, which is outside the parabola $y^2 = 9x$, is:

- (A) $12\pi - 3\sqrt{3}$
- (B) $24\pi + 3\sqrt{3}$
- (C) $24\pi - 3\sqrt{3}$
- (D) $12\pi + 3\sqrt{3}$

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Q66 Straight Lines[Step-by-step solution](#) › [prepwiser.in/questions/8LDVLndRMZ](https://www.prepwiser.in/questions/8LDVLndRMZ)

A man is walking on a straight line. The arithmetic mean of the reciprocals of the intercepts of this line on the coordinate axes is $\frac{1}{4}$. Three stones A, B and C are placed at the points (1, 1), (2, 2) and (4, 4) respectively. Then, which of these stones is / are on the path of the man?

- (A) A only (B) All the three (C) C only (D) B only

Q67 Indefinite Integration[Step-by-step solution](#) › [prepwiser.in/questions/Dv7iQ-WwMh](https://www.prepwiser.in/questions/Dv7iQ-WwMh)

If $\int \frac{\cos x - \sin x}{\sqrt{8 - \sin 2x}} dx = a \sin^{-1} \left(\frac{\sin x + \cos x}{b} \right) + c$, where c is a constant of integration, then the ordered pair (a, b) is equal to:

- (A) (-1, 3) (B) (1, 3) (C) (1, -3) (D) (3, 1)

Q68 Trigonometric Ratios & Identities[Step-by-step solution](#) › [prepwiser.in/questions/NTRIYNVw-r](https://www.prepwiser.in/questions/NTRIYNVw-r)

If $e^{(\cos^2 x + \cos^4 x + \cos^6 x + \dots \infty) \log_e 2}$ satisfies the equation $t^2 - 9t + 8 = 0$, then the value of $\frac{2 \sin x}{\sin x + \sqrt{3} \cos x}$ ($0 < x < \frac{\pi}{2}$) is:

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

Mathematics Section B · Numerical value

Q69 to Q77

Q69 Applications of Derivatives **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/EUxedy7HTv](https://www.prepwiser.in/questions/EUxedy7HTv)

The minimum value of α for which the equation $\frac{4}{\sin x} + \frac{1}{1 - \sin x} = \alpha$ has at least one solution in $(0, \frac{\pi}{2})$ is

Q70 Circles **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/s_PMuAPnAp](https://www.prepwiser.in/questions/s_PMuAPnAp)

If one of the diameters of the circle $x^2 + y^2 - 2x - 6y + 6 = 0$ is a chord of another circle 'C', whose center is at (2, 1), then its radius is _____.

Q71 Definite Integration **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/hmP8e9bga1](https://www.prepwiser.in/questions/hmP8e9bga1)

If

$$\int_{-a}^a (|x| + |x - 2|) dx = 22$$

, ($a > 2$) and $[x]$ denotes the greatest integer $\leq x$, then $\int_{-a}^a (x + [x]) dx$ is equal to _____.

Q72 Sequences & Series **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/wfisWueErS](https://www.prepwiser.in/questions/wfisWueErS)

$$\lim_{n \rightarrow \infty} \tan \left\{ \sum_{r=1}^n \tan^{-1} \left(\frac{1}{1 + r + r^2} \right) \right\}$$

is equal to _____.

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Let $P =$

$$\begin{bmatrix} 3 & -1 & -2 \\ 2 & 0 & \alpha \\ 3 & -5 & 0 \end{bmatrix}$$

, where $\alpha \in \mathbb{R}$. Suppose $Q = [q_{ij}]$ is a matrix satisfying $PQ = kI_3$ for some non-zero $k \in \mathbb{R}$.

If $q_{23} = -\frac{k}{8}$ and $|Q| = \frac{k^2}{2}$, then $a^2 + k^2$ is equal to ____.

Let M be any 3×3 matrix with entries from the set $\{0, 1, 2\}$. The maximum number of such matrices, for which the sum of diagonal elements of $M^T M$ is seven, is ____.

Let B_i ($i = 1, 2, 3$) be three independent events in a sample space. The probability that only B_1 occur is α , only B_2 occurs is β and only B_3 occurs is γ . Let p be the probability that none of the events B_i occurs and these 4 probabilities satisfy the equations $(\alpha - 2\beta)p = \alpha\beta$ and $(\beta - 3\gamma)p = 2\beta\gamma$ (All the probabilities are assumed to lie in the interval $(0, 1)$).

Then $\frac{P(B_1)}{P(B_3)}$ is equal to ____.

Let $A = \{n \in \mathbb{N} : n \text{ is a 3-digit number}\}$

$$B = \{9k + 2 : k \in \mathbb{N}\}$$

and $C = \{9k + l : k \in \mathbb{N}\}$ for some l ($0 < l < 9$)

If the sum of all the elements of the set $A \cap (B \cup C)$ is 274×400 , then l is equal to ____.

Let three vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ be such that $\vec{c}$ is coplanar with $\vec{a}$ and $\vec{b}$, $\vec{a} \cdot \vec{c} = 7$ and $\vec{b}$ is perpendicular to $\vec{c}$, where $\vec{a} = -\hat{i} + \hat{j} + \hat{k}$ and $\vec{b} = 2\hat{i} + \hat{k}$, then the value of

$$2|\vec{a} + \vec{b} + \vec{c}|^2$$

is ____.

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Physics

1. C	2. D	3. D	4. C	5. D	6. D	7. D	8. C
9. D	10. B	11. D	12. A	13. C	14. A	15. C	16. D
17. A	18. D	19. A	20. C	21. 440	22. 2000	23. 1	24. 15
25. 25	26. 25	27. 25600	28. 75				

Chemistry

29. C	30. D	31. C	32. C	33. C	34. D	35. C	36. A
37. A	38. A	39. A	40. C	41. D	42. 26	43. 12	44. 2
45. 8	46. 2	47. 2	48. 1	49. 5	50. 1380		

Mathematics

51. D	52. D	53. C	54. C	55. D	56. C	57. C	58. A
59. A	60. B	61. A	62. D	63. C	64. C	65. C	66. D
67. B	68. D	69. 9	70. 3	71. -3	72. 1	73. 17	74. 540
75. 6	76. 5	77. 75					

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