

JEE MAIN 2021 · QUESTION PAPER

1 Sep 2021 Shift 2

82 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	19 Q1 to Q19	9 Q20 to Q28
● Chemistry	16 Q29 to Q44	9 Q45 to Q53
● Mathematics	19 Q54 to Q72	10 Q73 to Q82
In this PDF	82 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.

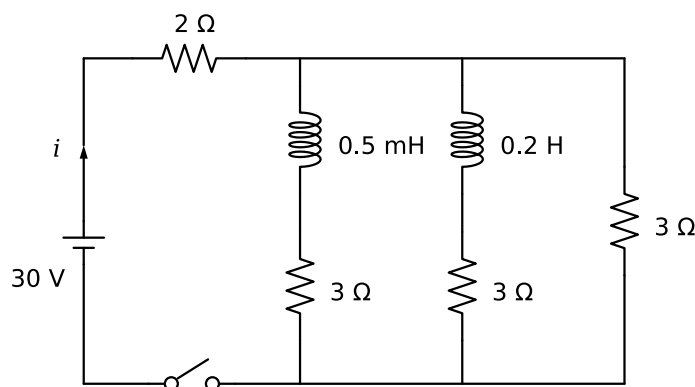
prepwisar.in/pyqs/paper/2021-09-01-evening · Free, no signup needed to start

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

Q1 Electrostatics II: Potential & Capacitance

[Step-by-step solution](#) > [prepwise.in/questions/YN8R6Y7Qem](https://www.prepwise.in/questions/YN8R6Y7Qem)

For the given circuit the current i through the battery when the key is closed and the steady state has been reached is _____.



- (A) 6 A (B) 25 A (C) 10 A (D) 0 A

Q2 Nuclear Physics

[Step-by-step solution](#) > [prepwise.in/questions/oJDOTY04R5](https://www.prepwise.in/questions/oJDOTY04R5)

The half life period of radioactive element x is same as the mean life time of another radioactive element y. Initially they have the same number of atoms. Then:

- (A) x-will decay faster than y.
 (B) y-will decay faster than x.
 (C) x and y have same decay rate initially and later on different decay rate.
 (D) x and y decay at the same rate always.

Q3 Electrostatics II: Potential & Capacitance

[Step-by-step solution](#) > [prepwise.in/questions/WFU1B03JFE](https://www.prepwise.in/questions/WFU1B03JFE)

A capacitor is connected to a 20 V battery through a resistance of 10Ω . It is found that the potential difference across the capacitor rises to 2 V in $1\mu s$. The capacitance of the capacitor is _____ μF .

Given: $\ln\left(\frac{10}{9}\right) = 0.105$

- (A) 9.52 (B) 0.95 (C) 0.105 (D) 1.85

Q4 Thermometry & Calorimetry

[Step-by-step solution](#) > [prepwise.in/questions/y3r2bsr3xq](https://www.prepwise.in/questions/y3r2bsr3xq)

Due to cold weather a 1 m water pipe of cross-sectional area 1 cm^2 is filled with ice at -10°C . Resistive heating is used to melt the ice. Current of 0.5A is passed through $4\text{ k}\Omega$ resistance. Assuming that all the heat produced is used for melting, what is the minimum time required? (Given latent heat of fusion for water/ice = $3.33 \times 10^5\text{ J kg}^{-1}$, specific heat of ice = $2 \times 10^3\text{ J kg}^{-1}$ and density of ice = 10^3 kg/m^3)

- (A) 0.353 s (B) 35.3 s (C) 3.53 s (D) 70.6 s

Q5 Units, Dimensions & Errors

[Step-by-step solution](#) > [prepwise.in/questions/FFoqcE7-6Y](https://www.prepwise.in/questions/FFoqcE7-6Y)

Two resistors $R_1 = (4 \pm 0.8)\Omega$ and $R_2 = (4 \pm 0.4)\Omega$ are connected in parallel. The equivalent resistance of their parallel combination will be:

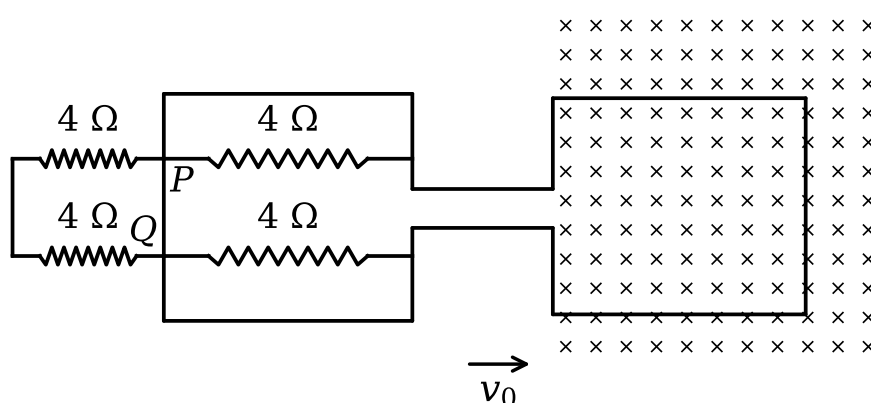
- (A) $(4 \pm 0.4)\Omega$ (B) $(2 \pm 0.4)\Omega$ (C) $(2 \pm 0.3)\Omega$ (D) $(4 \pm 0.3)\Omega$

The temperature of an ideal gas in 3-dimensions is 300 K. The corresponding de-Broglie wavelength of the electron approximately at 300 K, is:

[m_e = mass of electron = 9×10^{-31} kg, h = Planck constant = 6.6×10^{-34} Js, k_B = Boltzmann constant = 1.38×10^{-23} J K^{-1}]

- (A) 6.26 nm (B) 8.46 nm (C) 2.26 nm (D) 3.25 nm

A square loop of side 20 cm and resistance 1Ω is moved towards right with a constant speed v_0 . The right arm of the loop is in a uniform magnetic field of 5T. The field is perpendicular to the plane of the loop and is going into it. The loop is connected to a network of resistors each of value 4Ω . What should be the value of v_0 so that a steady current of 2 mA flows in the loop?

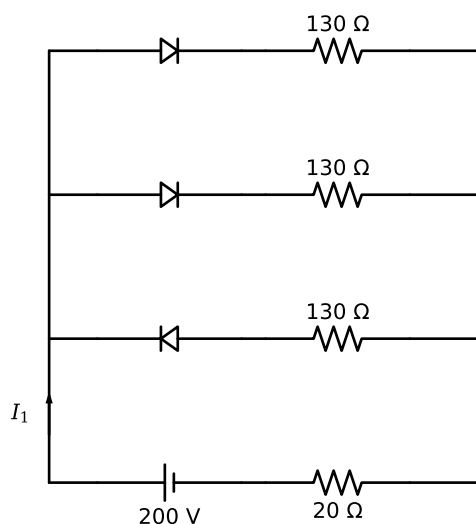


- (A) 1 m/s (B) 1 cm/s (C) 10^2 m/s (D) 10^{-2} cm/s

Electric field of plane electromagnetic wave propagating through a non-magnetic medium is given by $E = 20\cos(2 \times 10^{10} t - 200x)$ V/m. The dielectric constant of the medium is equal to : (Take $\mu_r = 1$)

- (A) 9 (B) 2 (C) $\frac{1}{3}$ (D) 3

In the given figure, each diode has a forward bias resistance of 30Ω and infinite resistance in reverse bias. The current I_1 will be:

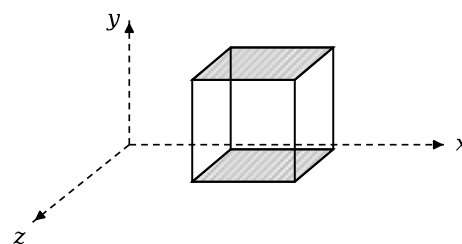


- (A) 3.75 A (B) 2.35 A (C) 2 A (D) 2.73 A

Q10 Electrostatics I: Charges, Field & Gauss's Law[Step-by-step solution > prepwiser.in/questions/-aLOUFTA50](https://www.prepwiser.in/questions/-aLOUFTA50)

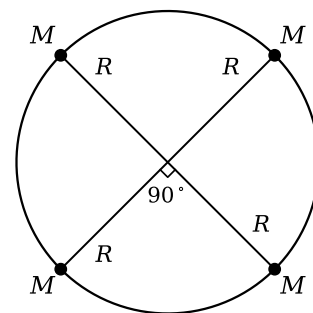
A cube is placed inside an electric field, $\vec{E} = 150y^2\hat{j}$. The side of the cube is 0.5 m and is placed in the field as shown in the given figure. The charge inside the cube is:

- (A) $3.8 \times 10^{-11} \text{ C}$ (B) $8.3 \times 10^{-11} \text{ C}$
 (C) $3.8 \times 10^{-12} \text{ C}$ (D) $8.3 \times 10^{-12} \text{ C}$

**Q11** Gravitation[Step-by-step solution > prepwiser.in/questions/8SGknF4-H9](https://www.prepwiser.in/questions/8SGknF4-H9)

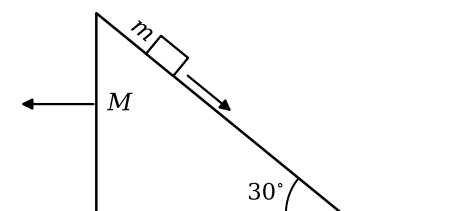
Four particles each of mass M , move along a circle of radius R under the action of their mutual gravitational attraction as shown in figure. The speed of each particle is:

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

**Q12** Newton's Laws of Motion[Step-by-step solution > prepwiser.in/questions/of4VfeXTwf](https://www.prepwiser.in/questions/of4VfeXTwf)

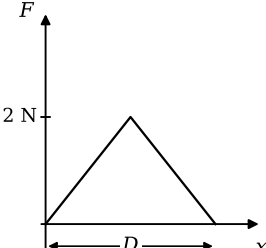
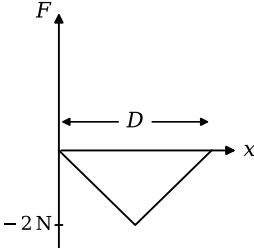
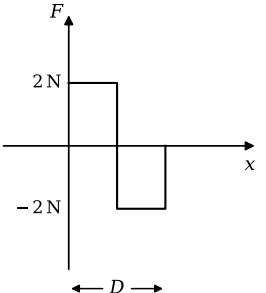
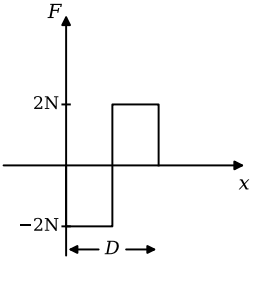
A block of mass m slides on the wooden wedge, which in turn slides backward on the horizontal surface. The acceleration of the block with respect to the wedge is : Given $m = 8 \text{ kg}$, $M = 16 \text{ kg}$. Assume all the surfaces shown in the figure to be frictionless.

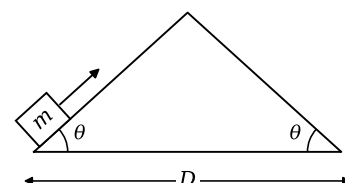
- (A) $\frac{4}{3}g$ (B) $\frac{6}{5}g$ (C) $\frac{3}{5}g$ (D) $\frac{2}{3}g$

**Q13** Newton's Laws of Motion[Step-by-step solution > prepwiser.in/questions/bd4FB5PzCp](https://www.prepwiser.in/questions/bd4FB5PzCp)

An object of mass ' m ' is being moved with a constant velocity under the action of an applied force of 2N along a frictionless surface with following surface profile.

The correct applied force vs distance graph will be:

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

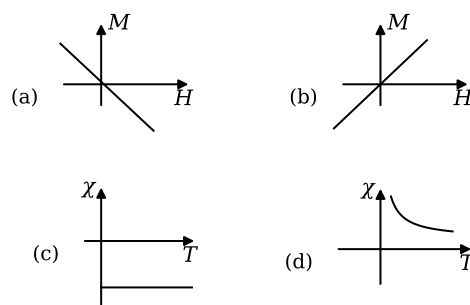


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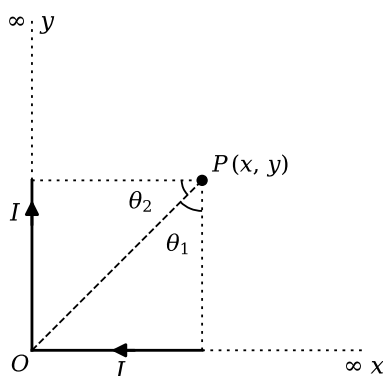
Q14 Magnetism & Matter[Step-by-step solution > prepwisar.in/questions/OCcou1rHjU](https://www.prepwisar.in/questions/OCcou1rHjU)

Following plots show magnetization (M) vs magnetizing field (H) and magnetic susceptibility (χ) vs temperature (T) graph:
Which of the following combination will be represented by a diamagnetic material?

- (A) (a), (c) (B) (a), (d) (C) (b), (d) (D) (b), (c)

**Q15** Moving Charges & Magnetism[Step-by-step solution > prepwisar.in/questions/2gADjA6Bbx](https://www.prepwisar.in/questions/2gADjA6Bbx)

There are two infinitely long straight current carrying conductors and they are held at right angles to each other so that their common ends meet at the origin as shown in the figure given below. The ratio of current in both conductor is 1 : 1. The magnetic field at point P is _____.



- (A) $\frac{\mu_0 I}{4\pi xy} [\sqrt{x^2 + y^2} + (x + y)]$ (B) $\frac{\mu_0 I}{4\pi xy} [\sqrt{x^2 + y^2} - (x + y)]$
(C) $\frac{\mu_0 Ixy}{4\pi} [\sqrt{x^2 + y^2} - (x + y)]$ (D) $\frac{\mu_0 Ixy}{4\pi} [\sqrt{x^2 + y^2} + (x + y)]$

Q16 Projectile Motion & Relative Motion[Step-by-step solution > prepwisar.in/questions/yAeK8MvTl0](https://www.prepwisar.in/questions/yAeK8MvTl0)

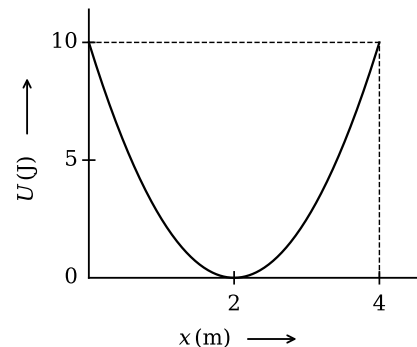
The ranges and heights for two projectiles projected with the same initial velocity at angles 42° and 48° with the horizontal are R_1 , R_2 and H_1 , H_2 respectively. Choose the correct option:

- (A) $R_1 > R_2$ and $H_1 = H_2$ (B) $R_1 = R_2$ and $H_1 < H_2$ (C) $R_1 < R_2$ and $H_1 < H_2$ (D) $R_1 = R_2$ and $H_1 = H_2$

Q17 Simple Harmonic Motion[Step-by-step solution > prepwisar.in/questions/OJld7w9mXa](https://www.prepwisar.in/questions/OJld7w9mXa)

A mass of 5 kg is connected to a spring. The potential energy curve of the simple harmonic motion executed by the system is shown in the figure. A simple pendulum of length 4 m has the same period of oscillation as the spring system. What is the value of acceleration due to gravity on the planet where these experiments are performed?

- (A) 10 m/s^2 (B) 5 m/s^2 (C) 4 m/s^2 (D) 9.8 m/s^2

**Q18** Work, Energy & Power[Step-by-step solution > prepwisar.in/questions/xzdkMXc_BA](https://www.prepwisar.in/questions/xzdkMXc_BA)

A body of mass ' m ' dropped from a height ' h ' reaches the ground with a speed of $0.8\sqrt{gh}$. The value of workdone by the air-friction is:

- (A) $-0.68 mgh$ (B) mgh (C) $1.64 mgh$ (D) $0.64 mgh$

A student determined Young's Modulus of elasticity using the formula $Y = \frac{MgL^3}{4bd^3\delta}$. The value of g is taken to be 9.8 m/s^2 , without any significant error, his observation are as following.

Physical Quantity	Least count of the Equipment used for measurement	Observed value
Mass (M)	1 g	2 kg
Length of bar (L)	1 mm	1 m
Breadth of bar (b)	0.1 mm	4 cm
Thickness of bar (d)	0.01 mm	0.4 cm
Depression (δ)	0.01 mm	5 mm

Then the fractional error in the measurement of Y is:

- (A) 0.0083 (B) 0.0155 (C) 0.155 (D) 0.083

Physics Section B · Numerical value

Q20 to Q28

Q20 Current Electricity NUMERICAL

[Step-by-step solution](#) > [prepwiser.in/questions/VV7iXawKaT](https://www.prepwiser.in/questions/VV7iXawKaT)

A uniform heating wire of resistance 36Ω is connected across a potential difference of 240 V. The wire is then cut into half and potential difference of 240V is applied across each half separately. The ratio of power dissipation in first case to the total power dissipation in the second case would be 1 : x, where x is _____.

Q21 Gravitation NUMERICAL

[Step-by-step solution](#) > [prepwiser.in/questions/uFpq-tX4NY](https://www.prepwiser.in/questions/uFpq-tX4NY)

Two satellites revolve around a planet in coplanar circular orbits in anticlockwise direction. Their period of revolutions are 1 hour and 8 hours respectively. The radius of the orbit of nearer satellite is $2 \times 10^3 \text{ km}$. The angular speed of the farther satellite as observed from the nearer satellite at the instant when both the satellites are closest is $\frac{\pi}{x} \text{ rad h}^{-1}$ where x is _____.

Q22 Thermodynamics NUMERICAL

[Step-by-step solution](#) > [prepwiser.in/questions/GlykHBbSG9](https://www.prepwiser.in/questions/GlykHBbSG9)

The temperature of 3.00 mol of an ideal diatomic gas is increased by 40.0°C without changing the pressure of the gas. The molecules in the gas rotate but do not oscillate. If the ratio of change in internal energy of the gas to the amount of workdone by the gas is $\frac{x}{10}$. Then the value of x (round off to the nearest integer) is _____. (Given $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$)

Q23 Kinetic Theory of Gases NUMERICAL

[Step-by-step solution](#) > [prepwiser.in/questions/fwa2FXomU8](https://www.prepwiser.in/questions/fwa2FXomU8)

The average translational kinetic energy of N_2 gas molecules at $^\circ\text{C}$ becomes equal to the K.E. of an electron accelerated from rest through a potential difference of 0.1 volt. (Given $k_B = 1.38 \times 10^{-23} \text{ J/K}$) (Fill the nearest integer).

Q24 Friction NUMERICAL

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

When a body slides down from rest along a smooth inclined plane making an angle of 30° with the horizontal, it takes time T. When the same body slides down from the rest along a rough inclined plane making the same angle and through the same distance, it takes time αT , where α is a constant greater than 1. The co-efficient of friction between the body and the rough plane is $\frac{1}{\sqrt{x}} \left(\frac{\alpha^2 - 1}{\alpha^2} \right)$ where x = _____.

Given below are two statements:

Statement I : The nucleophilic addition of sodium hydrogen sulphite to an aldehyde or a ketone involves proton transfer to form a stable ion.

Statement II : The nucleophilic addition of hydrogen cyanide to an aldehyde or a ketone yields amine as final product.

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

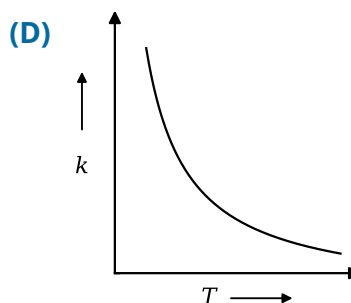
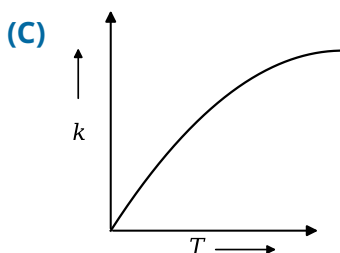
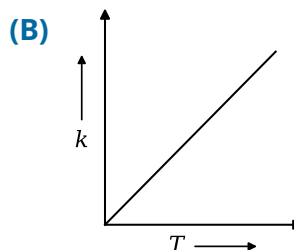
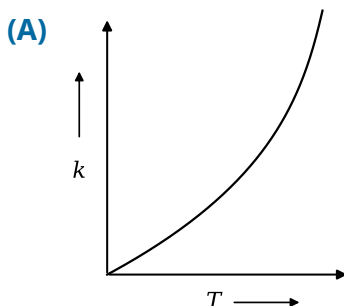
- (A) Both Statement I and Statement are true. (B) Statement I is true but Statement II is false.
(C) Statement I is false but Statement II is true. (D) Both Statement I and Statement II are false.

Number of paramagnetic oxides among the following given oxides is _____.

Li_2O , CaO , Na_2O_2 , KO_2 , MgO and K_2O

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

Which one of the following given graphs represents the variation of rate constant (k) with temperature (T) for an endothermic reaction?



The Crystal Field Stabilization Energy (CFSE) and magnetic moment (spin-only) of an octahedral aqua complex of a metal ion (M^{2+}) are $-0.8 \Delta_0$ and 3.87 BM, respectively. Identify (M^{2+}):

- (A) V^{3+} (B) Cr^{3+} (C) Mn^{4+} (D) Co^{2+}

The potassium ferrocyanide solution gives a Prussian blue colour, when added to:

- (A) CoCl_3 (B) FeCl_2 (C) CoCl_2 (D) FeCl_3

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Q36 Redox Reactions[Step-by-step solution](#) › [prepwiser.in/questions/lhBr8_I1r](#)

In the given chemical reaction, colors of the Fe^{2+} and Fe^{3+} ions, are respectively:



- (A) Yellow, Orange (B) Yellow, Green (C) Green, Orange (D) Green, Yellow

Q37 Atomic Structure[Step-by-step solution](#) › [prepwiser.in/questions/grWDvxBC7a](#)

Identify the element for which electronic configuration in +3 oxidation state is $[\text{Ar}]3d^5$:

- (A) Ru (B) Mn (C) Co (D) Fe

Q38 Hydrocarbons: Alkenes & Alkynes[Step-by-step solution](#) › [prepwiser.in/questions/Oguz0PxNDR](#)

The stereoisomers that are formed by electrophilic addition of bromine to trans-but-2-ene is/are:

- (A) 2 enantiomers and 2 mesomers (B) 2 identical mesomers
(C) 2 enantiomers (D) 1 racemic and 2 enantiomers

Q39 Redox Reactions[Step-by-step solution](#) › [prepwiser.in/questions/93CydxCYm](#)

Hydrogen peroxide reacts with iodine in basic medium to give:

- (A) IO_4^- (B) IO^- (C) I^- (D) IO_3^-

Q40 Metallurgy[Step-by-step solution](#) › [prepwiser.in/questions/XXG081RUFY](#)

Calamine and Malachite, respectively, are the ores of:

- (A) Nickel and Aluminium (B) Zinc and Copper
(C) Copper and Iron (D) Aluminium and Zinc

Q41 p-Block Elements: Part II (Group 15-18)[Step-by-step solution](#) › [prepwiser.in/questions/XAOwn4fUeK](#)

The oxide without nitrogen-nitrogen bond is:

- (A) N_2O (B) N_2O_4 (C) N_2O_3 (D) N_2O_5

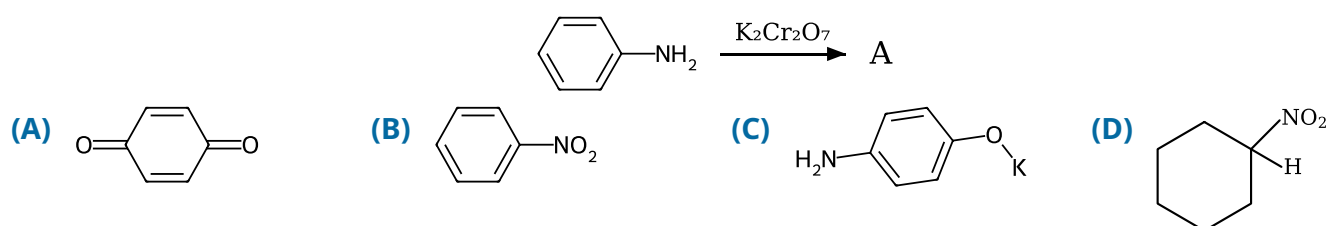
Q42 Polymers[Step-by-step solution](#) › [prepwiser.in/questions/1vLGEd4Gb](#)

Monomer units of Dacron polymer are:

- (A) ethylene glycol and phthalic acid (B) ethylene glycol and terephthalic acid
(C) glycerol and terephthalic acid (D) glycerol and phthalic acid

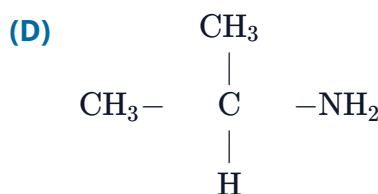
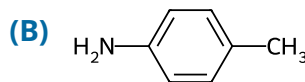
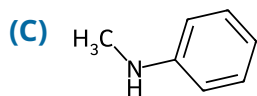
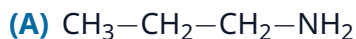
Q43 Amines & Diazonium Salts[Step-by-step solution](#) › [prepwiser.in/questions/iNB0J4FU7I](#)

Identify A in the following reaction.



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Which one of the following gives the most stable Diazonium salt?



Chemistry Section B · Numerical value

Q45 to Q53

A peptide synthesized by the reactions of one molecule each of Glycine, Leucine, Aspartic acid and Histidine will have _____ peptide linkages.

The spin-only magnetic moment value of B_2^+ species is _____ $\times 10^{-2}$ BM. (Nearest integer)
[Given: $\sqrt{3} = 1.73$]

The sum of oxidation states of two silver ions in $[\text{Ag}(\text{NH}_3)_2][\text{Ag}(\text{CN})_2]$ complex is _____.

If the conductivity of mercury at 0°C is $1.07 \times 10^6 \text{ S m}^{-1}$ and the resistance of a cell containing mercury is 0.243Ω , then the cell constant of the cell is $x \times 10^4 \text{ m}^{-1}$. The value of x is _____.
(Nearest integer)

The molar solubility of $\text{Zn}(\text{OH})_2$ in 0.1 M NaOH solution is $x \times 10^{-18} \text{ M}$. The value of x is _____.
(Nearest integer)
(Given : The solubility product of $\text{Zn}(\text{OH})_2$ is 2×10^{-20})

The number of atoms in 8g of sodium is $x \times 10^{23}$. The value of x is _____. (Nearest integer)
[Given : $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$
Atomic mass of Na = 23.0 u]

If 80 g of copper sulphate $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ is dissolved in deionised water to make 5L of solution. The concentration of the copper sulphate solution is $x \times 10^{-3} \text{ mol L}^{-1}$. The value of x is _____.
[Atomic masses Cu : 63.54u, S : 32u, O : 16u, H : 1u]

A 50 watt bulb emits monochromatic red light of wavelength of 795 nm. The number of photons emitted per second by the bulb is $x \times 10^{20}$. The value of x is _____. [Given : $h = 6.63 \times 10^{-34} \text{ Js}$ and $c = 3.0 \times 10^8 \text{ ms}^{-1}$]

For the reaction, $2\text{NO}_2(\text{g}) \rightleftharpoons \text{N}_2\text{O}_4(\text{g})$, when $\Delta S = -176.0 \text{ J K}^{-1}$ and $\Delta H = -57.8 \text{ kJ mol}^{-1}$, the magnitude of ΔG at 298 K for the reaction is _____ kJ mol^{-1} . (Nearest integer)

Mathematics Section A · Multiple choice

Q54 to Q72

Q54 Three Dimensional Geometry

Step-by-step solution > [prepwiser.in/questions/KQkkwOSMF8](https://www.prepwiser.in/questions/KQkkwOSMF8)

Let the acute angle bisector of the two planes $x - 2y - 2z + 1 = 0$ and $2x - 3y - 6z + 1 = 0$ be the plane P. Then which of the following points lies on P?

- (A) $\left(3, 1, -\frac{1}{2}\right)$ (B) $\left(-2, 0, -\frac{1}{2}\right)$ (C) $(0, 2, -4)$ (D) $(4, 0, -2)$

Q55 Three Dimensional Geometry

Step-by-step solution > [prepwiser.in/questions/_pie6jR2dW](https://www.prepwiser.in/questions/_pie6jR2dW)

The distance of line $3y - 2z - 1 = 0 = 3x - z + 4$ from the point $(2, -1, 6)$ is:

- (A) $\sqrt{26}$ (B) $2\sqrt{5}$ (C) $2\sqrt{6}$ (D) $4\sqrt{2}$

Q56 Applications of Derivatives

Step-by-step solution > [prepwiser.in/questions/_DxL0psi2y](https://www.prepwiser.in/questions/_DxL0psi2y)

The function $f(x) = x^3 - 6x^2 + ax + b$ is such that $f(2) = f(4) = 0$. Consider two statements:

Statement 1 : there exists $x_1, x_2 \in (2, 4)$, $x_1 < x_2$, such that $f'(x_1) = -1$ and $f'(x_2) = 0$.

Statement 2 : there exists $x_3, x_4 \in (2, 4)$, $x_3 < x_4$, such that f is decreasing in $(2, x_4)$, increasing in $(x_4, 4)$ and $2f'(x_3) = \sqrt{3}f(x_4)$.

Then

- (A) both Statement 1 and Statement 2 are true (B) Statement 1 is false and Statement 2 is true
(C) both Statement 1 and Statement 2 are false (D) Statement 1 is true and Statement 2 is false

Q57 Limits

Step-by-step solution > [prepwiser.in/questions/BvpuWZhTT7](https://www.prepwiser.in/questions/BvpuWZhTT7)

Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a continuous function. Then

$$\lim_{x \rightarrow \frac{\pi}{4}} \frac{\frac{\pi}{4} \int_{\frac{\pi}{4}}^{\sec^2 x} f(x) dx}{x^2 - \frac{\pi^2}{16}}$$

is equal to:

- (A) $f(2)$ (B) $2f(2)$ (C) $2f(\sqrt{2})$ (D) $4f(2)$

Q58 Determinants

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

Let $J_{n,m} = \int_0^{\frac{1}{2}} \frac{x^n}{x^m - 1} dx$, $\forall n > m$ and $n, m \in \mathbb{N}$. Consider a matrix $A = [a_{ij}]_{3 \times 3}$ where

$$a_{ij} = \begin{cases} j6+i,3 - j_{i+3,3}, & i \leq j \\ 0, & i > j \end{cases}$$

. Then $|adj A^{-1}|$ is:

- (A) $(15)^2 \times 2^{42}$ (B) $(15)^2 \times 2^{34}$ (C) $(105)^2 \times 2^{38}$ (D) $(105)^2 \times 2^{36}$

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Q59 Definite Integration[Step-by-step solution](#) › [prepwise.in/questions/3-ALYfg9on](https://www.prepwise.in/questions/3-ALYfg9on)

The function $f(x)$, that satisfies the condition

$$f(x) = x + \int_0^{\pi/2} \sin x \cdot \cos y f(y) dy, \text{ is:}$$

- (A) $x + \frac{2}{3}(\pi - 2) \sin x$ (B) $x + (\pi + 2) \sin x$ (C) $x + \frac{\pi}{2} \sin x$ (D) $x + (\pi - 2) \sin x$

Q60 Differential Equations[Step-by-step solution](#) › [prepwise.in/questions/8A4ydgH2jy](https://www.prepwise.in/questions/8A4ydgH2jy)

If $y = y(x)$ is the solution curve of the differential equation $x^2 dy + (y - \frac{1}{x}) dx = 0$; $x > 0$ and $y(1) = 1$, then $y(\frac{1}{2})$ is equal to:

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

Q61 Ellipse[Step-by-step solution](#) › [prepwise.in/questions/Nj1q49eq5](https://www.prepwise.in/questions/Nj1q49eq5)

Let θ be the acute angle between the tangents to the ellipse $\frac{x^2}{9} + \frac{y^2}{1} = 1$ and the circle $x^2 + y^2 = 3$ at their point of intersection in the first quadrant. Then $\tan \theta$ is equal to:

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

Q62 Trigonometric Ratios & Identities[Step-by-step solution](#) › [prepwise.in/questions/9wpBpTdkUD](https://www.prepwise.in/questions/9wpBpTdkUD)

The range of the function,

$$f(x) = \log_{\sqrt{5}} \left(3 + \cos \left(\frac{3\pi}{4} + x \right) + \cos \left(\frac{\pi}{4} + x \right) + \cos \left(\frac{\pi}{4} - x \right) - \cos \left(\frac{3\pi}{4} - x \right) \right)$$

is:

- (A) $(0, \sqrt{5})$ (B) $[-2, 2]$ (C) $\left[\frac{1}{\sqrt{5}}, \sqrt{5} \right]$ (D) $[0, 2]$

Q63 Inverse Trigonometric Functions[Step-by-step solution](#) › [prepwise.in/questions/qQD0thHbyR](https://www.prepwise.in/questions/qQD0thHbyR)

$$\cos^{-1}(\cos(-5)) + \sin^{-1}(\sin(6)) - \tan^{-1}(\tan(12))$$

is equal to:

(The inverse trigonometric functions take the principal values)

- (A) $3\pi - 11$ (B) $4\pi - 9$ (C) $4\pi - 11$ (D) $3\pi + 1$

Q64 Determinants[Step-by-step solution](#) › [prepwise.in/questions/fk9y-QVwlZ](https://www.prepwise.in/questions/fk9y-QVwlZ)

Consider the system of linear equations

$$-x + y + 2z = 0$$

$$3x - ay + 5z = 1$$

$$2x - 2y - az = 7$$

Let S_1 be the set of all $a \in \mathbb{R}$ for which the system is inconsistent and S_2 be the set of all $a \in \mathbb{R}$ for which the system has infinitely many solutions. If $n(S_1)$ and $n(S_2)$ denote the number of elements in S_1 and S_2 respectively, then

- (A) $n(S_1) = 2, n(S_2) = 2$ (B) $n(S_1) = 1, n(S_2) = 0$ (C) $n(S_1) = 2, n(S_2) = 0$ (D) $n(S_1) = 0, n(S_2) = 2$

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Q65 Parabola[Step-by-step solution](#) > [prepwisar.in/questions/a6EG-NcDIW](https://www.prepwisar.in/questions/a6EG-NcDIW)

Consider the parabola with vertex $(\frac{1}{2}, \frac{3}{4})$ and the directrix $y = \frac{1}{2}$. Let P be the point where the parabola meets the line $x = -\frac{1}{2}$. If the normal to the parabola at P intersects the parabola again at the point Q, then $(PQ)^2$ is equal to:

- (A) $\frac{75}{8}$ (B) $\frac{125}{16}$ (C) $\frac{25}{2}$ (D) $\frac{15}{2}$

Q66 Permutations & Combinations[Step-by-step solution](#) > [prepwisar.in/questions/2_G1LrQUch](https://www.prepwisar.in/questions/2_G1LrQUch)

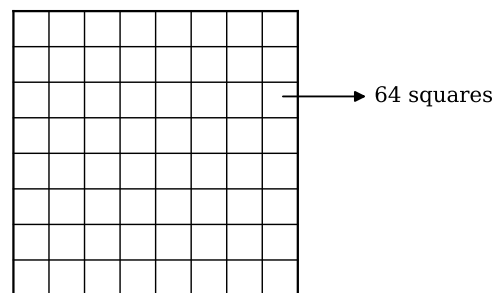
Let $P_1, P_2, \dots, P_{15}$ be 15 points on a circle. The number of distinct triangles formed by points P_i, P_j, P_k such that $i + j + k \neq 15$, is:

- (A) 12 (B) 419 (C) 443 (D) 455

Q67 Probability: Basic[Step-by-step solution](#) > [prepwisar.in/questions/tlyoKxCNDk](https://www.prepwisar.in/questions/tlyoKxCNDk)

Two squares are chosen at random on a chessboard (see figure). The probability that they have a side in common is:

- (A) $\frac{2}{7}$ (B) $\frac{1}{18}$ (C) $\frac{1}{7}$ (D) $\frac{1}{9}$

**Q68** Quadratic Equations & Polynomial Inequalities[Step-by-step solution](#) > [prepwisar.in/questions/E-ihEv048c](https://www.prepwisar.in/questions/E-ihEv048c)

The numbers of pairs (a, b) of real numbers, such that whenever α is a root of the equation $x^2 + ax + b = 0$, $\alpha^2 - 2$ is also a root of this equation, is:

- (A) 6 (B) 2 (C) 4 (D) 8

Q69 Sequences & Series[Step-by-step solution](#) > [prepwisar.in/questions/IQdwNn8tNa](https://www.prepwisar.in/questions/IQdwNn8tNa)

Let $S_n = 1 \cdot (n-1) + 2 \cdot (n-2) + 3 \cdot (n-3) + \dots + (n-1) \cdot 1$, $n \geq 4$.

The sum

$$\sum_{n=4}^{\infty} \left(\frac{2S_n}{n!} - \frac{1}{(n-2)!} \right)$$

is equal to:

- (A) $\frac{e-1}{3}$ (B) $\frac{e-2}{6}$ (C) $\frac{e}{3}$ (D) $\frac{e}{6}$

Q70 Sequences & Series[Step-by-step solution](#) > [prepwisar.in/questions/oWjIcZUqAo](https://www.prepwisar.in/questions/oWjIcZUqAo)

Let $a_1, a_2, \dots, a_{21}$ be an AP such that $\sum_{n=1}^{20} \frac{1}{a_n a_{n+1}} = \frac{4}{9}$. If the sum of this AP is 189, then $a_6 a_{16}$ is equal to:

- (A) 57 (B) 72 (C) 48 (D) 36

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Q71 Trigonometric Equations[Step-by-step solution](#) > [prepwiser.in/questions/reCzpbCDkC](https://www.prepwiser.in/questions/reCzpbCDkC)

If n is the number of solutions of the equation

$$2 \cos x \left(4 \sin \left(\frac{\pi}{4} + x \right) \sin \left(\frac{\pi}{4} - x \right) - 1 \right) = 1, x \in [0, \pi]$$

and S is the sum of all these solutions, then the ordered pair (n, S) is:

- (A) $(3, 13\pi / 9)$ (B) $(2, 2\pi / 3)$ (C) $(2, 8\pi / 9)$ (D) $(3, 5\pi / 3)$

Q72 Area Under Curves[Step-by-step solution](#) > [prepwiser.in/questions/1EndKFuN3F](https://www.prepwiser.in/questions/1EndKFuN3F)

The area, enclosed by the curves $y = \sin x + \cos x$ and $y = |\cos x - \sin x|$ and the lines $x = 0, x = \frac{\pi}{2}$, is:

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

Mathematics Section B · Numerical value

Q73 to Q82

Q73 Binomial Theorem **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/Q-BQXzBMCD](https://www.prepwiser.in/questions/Q-BQXzBMCD)

If the sum of the coefficients in the expansion of $(x + y)^n$ is 4096, then the greatest coefficient in the expansion is _____.

Q74 Complex Numbers **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/HNkh7ME-Pp](https://www.prepwiser.in/questions/HNkh7ME-Pp)

If for the complex numbers z satisfying $|z - 2 - 2i| \leq 1$, the maximum value of $|3iz + 6|$ is attained at $a + ib$, then $a + b$ is equal to _____.

Q75 Limits **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/EltiDevUp7](https://www.prepwiser.in/questions/EltiDevUp7)

Let $f(x) = x^6 + 2x^4 + x^3 + 2x + 3, x \in \mathbb{R}$. Then the natural number n for which $\lim_{x \rightarrow 1} \frac{x^n f(1) - f(x)}{x - 1} = 44$ is _____.

Q76 Continuity & Differentiability **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/Ze7b17cCkt](https://www.prepwiser.in/questions/Ze7b17cCkt)

Let $[t]$ denote the greatest integer $\leq t$. The number of points where the function

$$f(x) = [x] |x^2 - 1| + \sin \left(\frac{\pi}{[x] + 3} \right) - [x + 1], x \in (-2, 2)$$

is not continuous is _____.

Q77 Permutations & Combinations **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/s-CL0NIUOH](https://www.prepwiser.in/questions/s-CL0NIUOH)

All the arrangements, with or without meaning, of the word FARMER are written excluding any word that has two R appearing together. The arrangements are listed serially in the alphabetic order as in the English dictionary. Then the serial number of the word FARMER in this list is _____.

Q78 Probability: Advanced **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/IU8D65Dtgb](https://www.prepwiser.in/questions/IU8D65Dtgb)

Let X be a random variable with distribution. If the mean of X is 2.3 and variance of X is σ^2 , then $100 \sigma^2$ is equal to:

x	-2	-1	3	4	6
$P(X = x)$	$\frac{1}{5}$	a	$\frac{1}{3}$	$\frac{1}{5}$	b

Q79 Quadratic Equations & Polynomial Inequalities **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/4gZnt4s1wk](https://www.prepwiser.in/questions/4gZnt4s1wk)

Let $f(x)$ be a polynomial of degree 3 such that

$f(k) = -\frac{2}{k}$ for $k = 2, 3, 4, 5$. Then the value of $52 - 10f(10)$ is equal to:

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Q80 Vectors **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/oMWabbdGIfF](https://www.prepwiser.in/questions/oMWabbdGIfF)

Let $\vec{a} = 2\hat{i} - \hat{j} + 2\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$. Let a vector $\vec{v}$ be in the plane containing $\vec{a}$ and $\vec{b}$. If $\vec{v}$ is perpendicular to the vector $3\hat{i} + 2\hat{j} - \hat{k}$ and its projection on $\vec{a}$ is 19 units, then $|2\vec{v}|^2$ is equal to _____.

Q81 Straight Lines **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/MO6MwbS2x8](https://www.prepwiser.in/questions/MO6MwbS2x8)

Let the points of intersections of the lines $x - y + 1 = 0$, $x - 2y + 3 = 0$ and $2x - 5y + 11 = 0$ are the mid points of the sides of a triangle $\triangle ABC$. Then, the area of the $\triangle ABC$ is _____.

Q82 Straight Lines **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/92SqLinYfw](https://www.prepwiser.in/questions/92SqLinYfw)

A man starts walking from the point $P(-3, 4)$, touches the x-axis at R , and then turns to reach at the point $Q(0, 2)$. The man is walking at a constant speed. If the man reaches the point Q in the minimum time, then $50 \left((PR)^2 + (RQ)^2 \right)$ is equal to _____.

Answer key: JEE Main 2021 · 1 Sep · Shift 2

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Physics

1. C	2. B	3. B	4. B	5. C	6. A	7. B	8. A
9. C	10. B	11. B	12. D	13. C	14. A	15. A	16. B
17. C	18. A	19. B	20. 4	21. 3	22. 25	23. 500	24. 3
25. 8	26. 6	27. 1	28. 16				

Chemistry

29. B	30. C	31. B	32. A	33. A	34. D	35. D	36. D
37. D	38. B	39. C	40. B	41. D	42. B	43. A	44. B
45. 3	46. 173	47. 2	48. 26	49. 2	50. 2	51. 64	52. 2
53. 5							

Mathematics

54. B	55. C	56. A	57. B	58. C	59. D	60. D	61. B
62. D	63. C	64. C	65. B	66. C	67. B	68. A	69. A
70. B	71. A	72. A	73. 924	74. 5	75. 7	76. 2	77. 77
78. 781	79. 26	80. 1494	81. 6	82. 1250			

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