

JEE MAIN 2021 · QUESTION PAPER

22 Jul 2021 **Shift 2**

86 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	19 Q1 to Q19	10 Q20 to Q29
● Chemistry	18 Q30 to Q47	10 Q48 to Q57
● Mathematics	19 Q58 to Q76	10 Q77 to Q86
In this PDF	86 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.

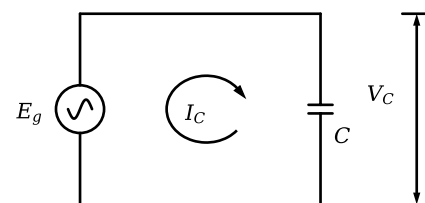
prepwisar.in/pyqs/paper/2021-07-22-evening · Free, no signup needed to start

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 Alternating Current

[Step-by-step solution > prepwiser.in/questions/bzktNvSM35](https://www.prepwiser.in/questions/bzktNvSM35)

In a circuit consisting of a capacitance and a generator with alternating emf $E_g = E_{g0} \sin \omega t$, V_C and I_C are the voltage and current. Correct phasor diagram for such circuit is



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

Q2 Alternating Current

[Step-by-step solution > prepwiser.in/questions/K16SP1_E7c](https://www.prepwiser.in/questions/K16SP1_E7c)

Match List - I with List - II

	List - I		List - II
(a)	$\omega L > \frac{1}{\omega C}$	(i)	Current is in phase with emf
(b)	$\omega L = \frac{1}{\omega C}$	(ii)	Current lags behind the applied emf
(c)	$\omega L < \frac{1}{\omega C}$	(iii)	Maximum current occurs
(d)	Resonant frequency	(iv)	Current leads the emf

Choose the correct answer from the options given below

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

Q3 Nuclear Physics

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

A nucleus with mass number 184 initially at rest emits an α -particle. If the Q value of the reaction is 5.5 MeV, calculate the kinetic energy of the α -particle.

- (A) 5.5 MeV (B) 5.0 MeV (C) 5.38 MeV (D) 0.12 MeV

Q4 Centre of Mass & Linear Momentum

[Step-by-step solution > prepwiser.in/questions/4mTVBo0ejv](https://www.prepwiser.in/questions/4mTVBo0ejv)

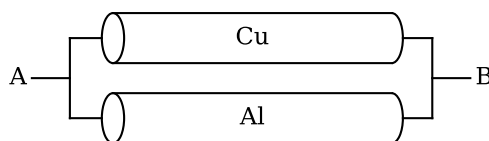
A bullet of '4 g' mass is fired from a gun of mass 4 kg. If the bullet moves with the muzzle speed of 50 ms^{-1} , the impulse imparted to the gun and velocity of recoil of gun are:

- (A) 0.2 kg ms^{-1} , 0.1 ms^{-1} (B) 0.4 kg ms^{-1} , 0.05 ms^{-1}
 (C) 0.2 kg ms^{-1} , 0.05 ms^{-1} (D) 0.4 kg ms^{-1} , 0.1 ms^{-1}

Attempt this paper online with instant answer checking > [prepwiser.in/pyqs/paper/2021-07-22-evening](https://www.prepwiser.in/pyqs/paper/2021-07-22-evening)

Q5 Current Electricity[Step-by-step solution](https://www.prepwiser.in/questions/jDecD66MxT) › prepwiser.in/questions/jDecD66MxT

A Copper (Cu) rod of length 25 cm and cross-sectional area 3 mm^2 is joined with a similar Aluminium (Al) rod as shown in figure. Find the resistance of the combination between the ends A and B. (Take Resistivity of Copper = $1.7 \times 10^{-8} \Omega\text{m}$ and Resistivity of Aluminium = $2.6 \times 10^{-8} \Omega\text{m}$)



- (A) $0.0858 \text{ m}\Omega$ (B) $1.420 \text{ m}\Omega$ (C) $0.858 \text{ m}\Omega$ (D) $2.170 \text{ m}\Omega$

Q6 Dual Nature of Radiation & Matter[Step-by-step solution](https://www.prepwiser.in/questions/dM3nQEpbFe) › prepwiser.in/questions/dM3nQEpbFe

An electron of mass m_e and a proton of mass m_p are accelerated through the same potential difference. The ratio of the de-Broglie wavelength associated with the electron to that with the proton is

- (A) $\frac{m_e}{m_p}$ (B) 1 (C) $\frac{m_p}{m_e}$ (D) $\sqrt{\frac{m_p}{m_e}}$

Q7 Electromagnetic Waves[Step-by-step solution](https://www.prepwiser.in/questions/mNErvhwHFI) › prepwiser.in/questions/mNErvhwHFI

Intensity of sunlight is observed as 0.092 Wm^{-2} at a point in free space. What will be the peak value of magnetic field at the point?

($\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{N}^{-1} \text{m}^{-2}$)

- (A) $2.77 \times 10^{-8} \text{ T}$ (B) $1.96 \times 10^{-8} \text{ T}$ (C) 8.31 T (D) 5.88 T

Q8 Semiconductors & Electronic Devices[Step-by-step solution](https://www.prepwiser.in/questions/1dboaagMEE) › prepwiser.in/questions/1dboaagMEE

Consider a situation in which reverse biased current of a particular P-N junction increases when it is exposed to a light of wavelength $\leq 621 \text{ nm}$. During this process, enhancement in carrier concentration takes place due to generation of hole-electron pairs. The value of band gap is nearly.

- (A) 1 eV (B) 4 eV (C) 0.5 eV (D) 2 eV

Q9 Electrostatics I: Charges, Field & Gauss's Law[Step-by-step solution](https://www.prepwiser.in/questions/MkN-80TUFI) › prepwiser.in/questions/MkN-80TUFI

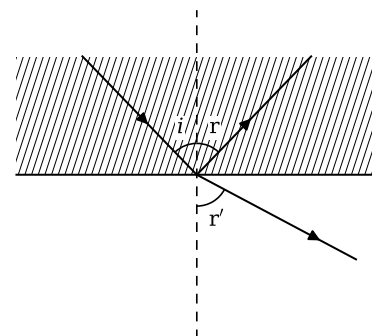
An electric dipole is placed on x-axis in proximity to a line charge of linear charge density $3.0 \times 10^{-6} \text{ C/m}$. Line charge is placed on z-axis and positive and negative charge of dipole is at a distance of 10 mm and 12 mm from the origin respectively. If total force of 4N is exerted on the dipole, find out the amount of positive or negative charge of the dipole.

- (A) 0.485 mC (B) 815.1 nC (C) $8.8 \mu\text{C}$ (D) $4.44 \mu\text{C}$

Q10 Ray Optics[Step-by-step solution](https://www.prepwiser.in/questions/NE-gJaRqxP) › prepwiser.in/questions/NE-gJaRqxP

A ray of light passes from a denser medium to a rarer medium at an angle of incidence i . The reflected and refracted rays make an angle of 90° with each other. The angle of reflection and refraction are respectively r and r' . The critical angle is given by

- (A) $\sin^{-1}(\tan r)$ (B) $\sin^{-1}(\cot r)$
(C) $\sin^{-1}(\tan r')$ (D) $\tan^{-1}(\sin i)$



Q11 Gravitation[Step-by-step solution](https://www.prepwise.in/questions/NU_qv0uu7K) › prepwise.in/questions/NU_qv0uu7K

A body is projected vertically upwards from the surface of earth with a velocity sufficient enough to carry it to infinity. The time taken by it to reach height h is _____ s.

(A) $\sqrt{\frac{2R_e}{g}} \left[\left(1 + \frac{h}{R_e} \right)^{\frac{3}{2}} - 1 \right]$

(B) $\frac{1}{3} \sqrt{\frac{R_e}{2g}} \left[\left(1 + \frac{h}{R_e} \right)^{\frac{3}{2}} - 1 \right]$

(C) $\sqrt{\frac{R_e}{2g}} \left[\left(1 + \frac{h}{R_e} \right)^{\frac{3}{2}} - 1 \right]$

(D) $\frac{1}{3} \sqrt{\frac{2R_e}{g}} \left[\left(1 + \frac{h}{R_e} \right)^{\frac{3}{2}} - 1 \right]$

Q12 Kinetic Theory of Gases[Step-by-step solution](https://www.prepwise.in/questions/HRX4-6OhnI) › prepwise.in/questions/HRX4-6OhnI

What will be the average value of energy for a monoatomic gas in thermal equilibrium at temperature T ?

(A) $\frac{3}{2} k_B T$

(B) $k_B T$

(C) $\frac{2}{3} k_B T$

(D) $\frac{1}{2} k_B T$

Q13 Magnetism & Matter[Step-by-step solution](https://www.prepwise.in/questions/fQOFrNBHPP) › prepwise.in/questions/fQOFrNBHPP

Choose the correct option

- (A)** True dip is always equal to apparent dip.
- (B)** True dip is not mathematically related to apparent dip.
- (C)** True dip is less than the apparent dip.
- (D)** True dip is always greater than the apparent dip.

Q14 Magnetism & Matter[Step-by-step solution](https://www.prepwise.in/questions/7Px408u1TF) › prepwise.in/questions/7Px408u1TF

Statement I : The ferromagnetic property depends on temperature. At high temperature, ferromagnet becomes paramagnet.

Statement II : At high temperature, the domain wall area of a ferromagnetic substance increases.

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

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

Q15 Rotational Motion[Step-by-step solution](https://www.prepwise.in/questions/8hQrv2Adm3) › prepwise.in/questions/8hQrv2Adm3

Consider a situation in which a ring, a solid cylinder and a solid sphere roll down on the same inclined plane without slipping. Assume that they start rolling from rest and having identical diameter.

The correct statement for this situation is

- (A)** All of them will have same velocity.
- (B)** The ring has greatest and the cylinder has the least velocity of the centre of mass at the bottom of the inclined plane.
- (C)** The sphere has the greatest and the ring has the least velocity of the centre of mass at the bottom of the inclined plane.
- (D)** The cylinder has the greatest and the sphere has the least velocity of the centre of mass at the bottom of the inclined plane.

Q16 Simple Harmonic Motion[Step-by-step solution](https://www.prepwiser.in/questions/Paqsdx2m) > prepwiser.in/questions/Paqsdx2m

T_0 is the time period of a simple pendulum at a place. if the length of the pendulum is reduced to $\frac{1}{16}$ times of its initial value, the modified time period is:

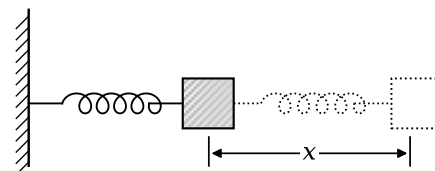
- (A) $4 T_0$ (B) $\frac{1}{4} T_0$ (C) T_0 (D) $8\pi T_0$

Q17 Simple Harmonic Motion[Step-by-step solution](https://www.prepwiser.in/questions/zNRFv8j_q3) > prepwiser.in/questions/zNRFv8j_q3

The motion of a mass on a spring, with spring constant K is as shown in figure.

The equation of motion is given by $x(t) = A \sin \omega t + B \cos \omega t$ with $\omega = \sqrt{\frac{K}{m}}$

Suppose that at time $t = 0$, the position of mass is $x(0)$ and velocity $v(0)$, then its displacement can also be represented as $x(t) = C \cos(\omega t - \phi)$, where C and ϕ are:



- (A) $C = \sqrt{\frac{2v(0)^2}{\omega^2} + x(0)^2}, \phi = \tan^{-1} \left(\frac{x(0)\omega}{2v(0)} \right)$ (B) $C = \sqrt{\frac{v(0)^2}{\omega^2} + x(0)^2}, \phi = \tan^{-1} \left(\frac{x(0)\omega}{v(0)} \right)$
- (C) $C = \sqrt{\frac{v(0)^2}{\omega^2} + x(0)^2}, \phi = \tan^{-1} \left(\frac{v(0)}{x(0)\omega} \right)$ (D) $C = \sqrt{\frac{2v(0)^2}{\omega^2} + x(0)^2}, \phi = \tan^{-1} \left(\frac{v(0)}{x(0)\omega} \right)$

Q18 Work, Energy & Power[Step-by-step solution](https://www.prepwiser.in/questions/yA-Qk-Uav3) > prepwiser.in/questions/yA-Qk-Uav3

A porter lifts a heavy suitcase of mass 80 kg and at the destination lowers it down by a distance of 80 cm with a constant velocity. Calculate the work done by the porter in lowering the suitcase. (take $g = 9.8 \text{ ms}^{-2}$)

- (A) +627.2 J (B) -62720.0 J (C) -627.2 J (D) 784.0 J

Q19 Vectors[Step-by-step solution](https://www.prepwiser.in/questions/UtWgn7ht-r) > prepwiser.in/questions/UtWgn7ht-r

What will be the projection of vector $\vec{A} = \hat{i} + \hat{j} + \hat{k}$ on vector $\vec{B} = \hat{i} + \hat{j}$?

- (A) $\sqrt{2}(\hat{i} + \hat{j} + \hat{k})$ (B) $(\hat{i} + \hat{j})$ (C) $\sqrt{2}(\hat{i} + \hat{j})$ (D) $2(\hat{i} + \hat{j} + \hat{k})$

Physics Section B · Numerical value

Q20 to Q29

Q20 Centre of Mass & Linear Momentum **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/jl79oWcVtC) > prepwiser.in/questions/jl79oWcVtC

The position of the centre of mass of a uniform semi-circular wire of radius 'R' placed in x-y plane with its centre at the origin and the line joining its ends as x-axis is given by $(0, \frac{xR}{\pi})$. Then, the value of $|x|$ is _____.

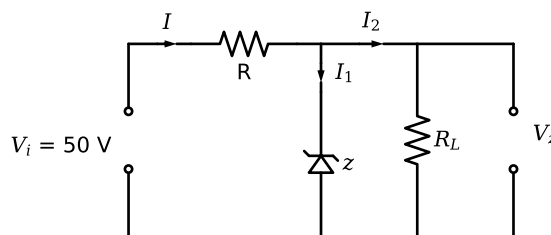
Q21 Current Electricity **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/xgIz9Logbd) > prepwiser.in/questions/xgIz9Logbd

In an electric circuit, a cell of certain emf provides a potential difference of 1.25 V across a load resistance of 5Ω . However, it provides a potential difference of 1 V across a load resistance of 2Ω . The emf of the cell is given by $\frac{x}{10} \text{ V}$. Then the value of x is _____.

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Q22 Semiconductors & Electronic Devices **NUMERICAL**[Step-by-step solution > prepwiser.in/questions/faK29edJJx](https://www.prepwiser.in/questions/faK29edJJx)

In a given circuit diagram, a 5 V zener diode along with a series resistance is connected across a 50 V power supply. The minimum value of the resistance required, if the maximum zener current is 90 mA will be _____ Ω .

**Q23** Electrostatics I: Charges, Field & Gauss's Law **NUMERICAL**[Step-by-step solution > prepwiser.in/questions/enL3E87B6s](https://www.prepwiser.in/questions/enL3E87B6s)

The total charge enclosed in an incremental volume of $2 \times 10^{-9} \text{ m}^3$ located at the origin is _____ nC, if electric flux density of its field is found as $D = e^{-x} \sin y \hat{i} - e^{-x} \cos y \hat{j} + 2z \hat{k} \text{ C/m}^2$

Q24 Ray Optics **NUMERICAL**[Step-by-step solution > prepwiser.in/questions/WNpZI03rVu](https://www.prepwiser.in/questions/WNpZI03rVu)

A ray of light passing through a prism ($\mu = \sqrt{3}$) suffers minimum deviation. It is found that the angle of incidence is double the angle of refraction within the prism. Then, the angle of prism is _____ (in degrees).

Q25 Elasticity **NUMERICAL**[Step-by-step solution > prepwiser.in/questions/ddtFiM1Aob](https://www.prepwiser.in/questions/ddtFiM1Aob)

The area of cross-section of a railway track is 0.01 m^2 . The temperature variation is 10°C . Coefficient of liner expansion of material of track is $10^{-5}/^\circ\text{C}$. The energy stored per meter in the track is _____ J/m.
(Young's modulus of material of track is 10^{11} Nm^{-2})

Q26 Heat Transfer **NUMERICAL**[Step-by-step solution > prepwiser.in/questions/APffeyhMTm](https://www.prepwiser.in/questions/APffeyhMTm)

In 5 minutes, a body cools from 75°C to 65°C at room temperature of 25°C . The temperature of body at the end of next 5 minutes is _____ $^\circ\text{C}$.

Q27 Rotational Motion **NUMERICAL**[Step-by-step solution > prepwiser.in/questions/no06D8s_Gj](https://www.prepwiser.in/questions/no06D8s_Gj)

The centre of a wheel rolling on a plane surface moves with a speed v_0 . A particle on the rim of the wheel at the same level as the centre will be moving at a speed $\sqrt{x}v_0$. Then the value of x is _____.

Q28 Units, Dimensions & Errors **NUMERICAL**[Step-by-step solution > prepwiser.in/questions/XP9ZxbozOl](https://www.prepwiser.in/questions/XP9ZxbozOl)

Three students S_1 , S_2 and S_3 perform an experiment for determining the acceleration due to gravity (g) using a simple pendulum. They use different lengths of pendulum and record time for different number of oscillations. The observations are as shown in the table.

Student No.	Length of Pendulum (cm)	No. of oscillations (n)	Total time for n oscillations	Time period (s)
1	64.0	8	128.0	16.0
2	64.0	4	64.0	16.0
3	20.0	4	36.0	9.0

(Least count of length = 0.1 cm and Least count for time = 0.1 s)

If E_1 , E_2 and E_3 are the percentage errors in 'g' for students 1, 2 and 3 respectively, then the minimum percentage error is obtained by student no. _____.

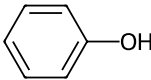
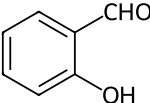
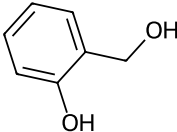
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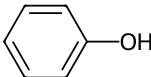
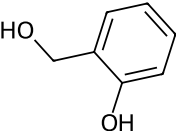
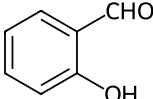
[Step-by-step solution](#) › [prepwiser.in/questions/TC--mcO9_Q](https://www.prepwiser.in/questions/TC--mcO9_Q)

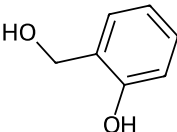
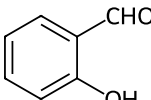
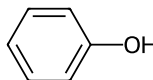
Chemistry Section A • Multiple choice

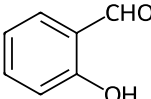
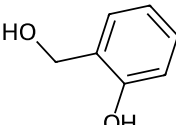
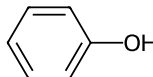
Q30 to Q47

Step-by-step solution › [prepwiser.in/questions/lxNFa7PFNk](https://www.prepwiser.in/questions/lxNFa7PFNk)

(A) $A =$  $B =$  $C =$ 

(B) $A =$  $B =$  $C =$ 

(C) $A =$  $B =$  $C =$ 

(D) $A =$  $B =$  $C =$ 

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

(A) Vitamin B₂ and Vitamin E
(B) Vitamin E and Vitamin B₂
(C) Vitamin B₆ and Vitamin B₂
(D) Vitamin B₁ and Vitamin B₆

Step-by-step solution › [prepwiser.in/questions/v7Z2sqjUqX](https://www.prepwiser.in/questions/v7Z2sqjUqX)

	List-I (Species)		List-II (Hybrid Orbitals)
(a)	SF_4	(i)	sp^3d^2
(b)	IF_5	(ii)	d^2sp^3
(c)	NO_2^+	(iii)	sp^3d
(d)	NH_4^+	(iv)	sp^3
		(v)	sp

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

Isotope(s) of hydrogen which emits low energy β^- particles with $t_{1/2}$ value > 12 years is/are

- (A) Protium (B) Tritium
(C) Deuterium (D) Deuterium and Tritium

The set having ions which are coloured and paramagnetic both is:

- (A) Cu^{2+} , Cr^{3+} , Sc^{+} (B) Cu^{2+} , Zn^{2+} , Mn^{4+} (C) Sc^{3+} , V^{5+} , Ti^{4+} (D) Ni^{2+} , Mn^{7+} , Hg^{2+}

The water having more dissolved O_2 is:

- (A) boiling water (B) water at 80°C (C) polluted water (D) water at 4°C

Sulphide ion is soft base and its ores are common for metals.

(a) Pb (b) Al (c) Ag (d) Mg

- (A) (a) and (c) only (B) (a) and (d) only (C) (a) and (b) only (D) (c) and (d) only

Given below are the statements about diborane

- (a) Diborane is prepared by the oxidation of NaBH_4 with I_2
(b) Each boron atom is in sp^2 hybridized state
(c) Diborane has one bridged 3 centre-2-electron bond
(d) Diborane is a planar molecule

The option with correct statements is:

- (A) (c) and (d) only (B) (a) only (C) (c) only (D) (a) and (b) only

Which one of the following group-15 hydride is the strongest reducing agent?

- (A) AsH_3 (B) BiH_3 (C) PH_3 (D) SbH_3

Which one of the following statements for D.I. Mendeleeff, is incorrect?

- (A) He authored the textbook - Principles of Chemistry
(B) At the time, he proposed Periodic Table of elements structure of atom was known.
(C) Element with atomic number 101 is named after him.
(D) He invented accurate barometer.

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Match List-I with List-II

	List-I (Elements)		List-II (Properties)
(a)	Ba	(i)	Organic solvent soluble compounds
(b)	Ca	(ii)	Outer electronic configuration $6s^2$
(c)	Li	(iii)	Oxalate insoluble in water
(d)	Na	(iv)	Formation of very strong monoacidic base

Choose the correct answer from the options given below:

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

Which one of the following 0.06 M aqueous solutions has lowest freezing point?

- (A) $Al_2(SO_4)_3$ (B) $C_6H_{12}O_6$ (C) KI (D) K_2SO_4

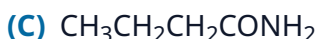
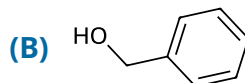
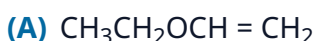
When silver nitrate solution is added to potassium iodide solution then the sol produced is:

- (A) AgI / I^- (B) AgI / Ag^+ (C) KI / NO_3^- (D) $AgNO_3 / NO_3^-$

Which purification technique is used for high boiling organic liquid compound (decomposes near its boiling point)?

- (A) Simple distillation (B) Steam distillation
 (C) Fractional distillation (D) Reduced pressure distillation

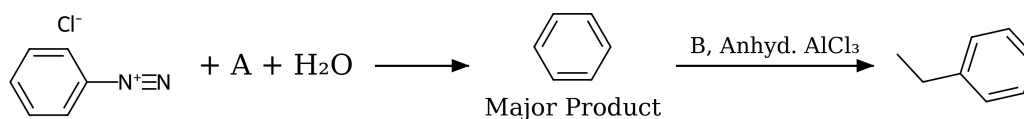
Which of the following compounds does not exhibit resonance?



Which of the following molecules does not show stereo isomerism?

- (A) 3, 4-Dimethylhex-3-ene (B) 3-Methylhex-1-ene
 (C) 3-Ethylhex-3-ene (D) 4-Methylhex-1-ene

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In the chemical reactions given above A and B respectively are:

- (A) H_3PO_2 and $\text{CH}_3\text{CH}_2\text{Cl}$ (B) $\text{CH}_3\text{CH}_2\text{OH}$ and H_3PO_2
 (C) H_3PO_2 and $\text{CH}_3\text{CH}_2\text{OH}$ (D) $\text{CH}_3\text{CH}_2\text{Cl}$ and H_3PO_2

Which one of the following reactions does not occur?

- (A) $\text{C}_6\text{H}_5\text{NH}_2 + (\text{CH}_3\text{CO})_2\text{O} / \text{Pyridine} \longrightarrow \text{H}_3\text{COC-NH-C}_6\text{H}_5$
 (B) $\text{C}_6\text{H}_5\text{NH}_2 + \text{H}_2\text{SO}_4 \longrightarrow \text{HO}_3\text{S-C}_6\text{H}_4\text{NH}_2$
 (C) $\text{C}_6\text{H}_5\text{NH}_2 + \text{AlCl}_3 + \text{CH}_3\text{Cl} \longrightarrow \text{CH}_3\text{-NHC}_6\text{H}_5$
 (D) $\text{C}_6\text{H}_5\text{NH}_2 + \text{HNO}_3 / \text{H}_2\text{SO}_4 \longrightarrow \text{NO}_2\text{-C}_6\text{H}_4\text{NH}_2$

Chemistry Section B · Numerical value

Q48 to Q57



In the above first order reaction the initial concentration of N_2O_5 is $2.40 \times 10^{-2} \text{ mol L}^{-1}$ at 318 K. The concentration of N_2O_5 after 1 hour was $1.60 \times 10^{-2} \text{ mol L}^{-1}$. The rate constant of the reaction at 318 K is _____ $\times 10^{-3} \text{ min}^{-1}$. (Nearest integer)

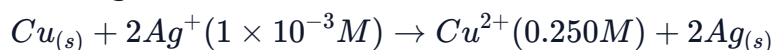
[Given : $\log 3 = 0.477$, $\log 5 = 0.699$]

The total number of unpaired electrons present in $[\text{Co}(\text{NH}_3)_6]\text{Cl}_2$ and $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ is:

Number of electrons that Vanadium ($Z = 23$) has in p-orbitals is equal to _____

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Assume a cell with the following reaction



$$E_{cell}^{\ominus} = 2.97 \text{ V}$$

E_{cell} for the above reaction is _____ V. (Nearest integer)

[Given : $\log 2.5 = 0.3979$, $T = 298 \text{ K}$]

A copper complex crystallising in a CCP lattice with a cell edge of 0.4518 nm has been revealed by employing X-ray diffraction studies. The density of a copper complex is found to be 7.62 g cm^{-3} . The molar mass of copper complex is _____ g mol^{-1} . (Nearest integer)

[Given : $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$]

If the concentration of glucose ($C_6H_{12}O_6$) in blood is 0.72 g L^{-1} , the molarity of glucose in blood is _____ $\times 10^{-3} \text{ M}$. (Nearest integer)

[Given : Atomic mass of C = 12, H = 1, O = 16 u]

If the standard molar enthalpy change for combustion of graphite powder is $-2.48 \times 10^2 \text{ kJ mol}^{-1}$, the amount of heat generated on combustion of 1 g of graphite powder is _____ kJ. (Nearest integer)

The number of acyclic structural isomers (including geometrical isomers) for pentene are _____

Value of K_p for the equilibrium reaction

$N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$ at 288 K is 47.9 . The K_c for this reaction at same temperature is _____.

(Nearest integer)

($R = 0.083 \text{ L bar K}^{-1} \text{ mol}^{-1}$)

Methylation of 10 g of benzene gave 9.2 g of toluene. Calculate the percentage yield of toluene _____. (Nearest integer)

Q58 Three Dimensional Geometry

[Step-by-step solution](#) · [prepwisar.in/questions/z_utbz3HjO](https://www.prepwisar.in/questions/z_utbz3HjO)

Let L be the line of intersection of planes $\vec{r} \cdot (\hat{i} - \hat{j} + 2\hat{k}) = 2$ and $\vec{r} \cdot (2\hat{i} + \hat{j} - \hat{k}) = 2$. If $P(\alpha, \beta, \gamma)$ is the foot of perpendicular on L from the point $(1, 2, 0)$, then the value of $35(\alpha + \beta + \gamma)$ is equal to:

- (A) 101 (B) 119 (C) 143 (D) 134

Q59 Three Dimensional Geometry

[Step-by-step solution](#) · [prepwisar.in/questions/KbL4Wn8KkA](https://www.prepwisar.in/questions/KbL4Wn8KkA)

If the shortest distance between the straight lines $3(x - 1) = 6(y - 2) = 2(z - 1)$ and $4(x - 2) = 2(y - \lambda) = (z - 3)$, $\lambda \in \mathbb{R}$ is $\frac{1}{\sqrt{38}}$, then the integral value of λ is equal to:

- (A) 3 (B) 2 (C) 5 (D) -1

Q60 Applications of Derivatives

[Step-by-step solution](#) · [prepwisar.in/questions/0gR7G5pB4f](https://www.prepwisar.in/questions/0gR7G5pB4f)

Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be defined as

$$f(x) = \begin{cases} -\frac{4}{3}x^3 + 2x^2 + 3x, & x > 0 \\ 3xe^x, & x \leq 0 \end{cases}$$

. Then f is increasing function in the interval

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

Q61 Circles

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

Let the circle $S: 36x^2 + 36y^2 - 108x + 120y + C = 0$ be such that it neither intersects nor touches the co-ordinate axes. If the point of intersection of the lines, $x - 2y = 4$ and $2x - y = 5$ lies inside the circle S , then:

- (A) $\frac{25}{9} < C < \frac{13}{3}$ (B) $100 < C < 165$ (C) $81 < C < 156$ (D) $100 < C < 156$

Q62 Complex Numbers

[Step-by-step solution](#) · [prepwisar.in/questions/UE5tN5uYQk](https://www.prepwisar.in/questions/UE5tN5uYQk)

Let n denote the number of solutions of the equation $z^2 + 3\bar{z} = 0$, where z is a complex number. Then the value of $\sum_{k=0}^{\infty} \frac{1}{n^k}$ is equal to:

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

Q63 Definite Integration

[Step-by-step solution](#) · [prepwisar.in/questions/KfQQNS3YLj](https://www.prepwisar.in/questions/KfQQNS3YLj)

If

$$\int_0^{100\pi} \frac{\sin^2 x}{e^{\left(\frac{x}{\pi} - \left[\frac{x}{\pi}\right]\right)}} dx = \frac{\alpha\pi^3}{1 + 4\pi^2}, \alpha \in \mathbb{R}$$

where $[x]$ is the greatest integer less than or equal to x , then the value of α is:

- (A) $200(1 - e^{-1})$ (B) $100(1 - e)$ (C) $50(e - 1)$ (D) $150(e^{-1} - 1)$

Q64 Differential Equations

[Step-by-step solution](#) · [prepwisar.in/questions/u5rCcX40Ao](https://www.prepwisar.in/questions/u5rCcX40Ao)

Let $y = y(x)$ be the solution of the differential equation $\cos e c^2 x dy + 2dx = (1 + y \cos 2x) \cos e c^2 x dx$, with $y\left(\frac{\pi}{4}\right) = 0$. Then, the value of $(y(0) + 1)^2$ is equal to:

- (A) $e^{1/2}$ (B) $e^{-1/2}$ (C) e^{-1} (D) e

Q65 Ellipse[Step-by-step solution](https://www.prepwiser.in/questions/usOEbNFXuo)

Let $E_1 : \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, a > b$. Let E_2 be another ellipse such that it touches the end points of major axis of E_1 and the foci of E_2 are the end points of minor axis of E_1 . If E_1 and E_2 have same eccentricities, then its value is:

- (A) $\frac{-1 + \sqrt{5}}{2}$ (B) $\frac{-1 + \sqrt{8}}{2}$ (C) $\frac{-1 + \sqrt{3}}{2}$ (D) $\frac{-1 + \sqrt{6}}{2}$

Q66 Parabola[Step-by-step solution](https://www.prepwiser.in/questions/inXFhuhDuf)

Let a line $L : 2x + y = k, k > 0$ be a tangent to the hyperbola $x^2 - y^2 = 3$. If L is also a tangent to the parabola $y^2 = \alpha x$, then α is equal to:

- (A) 12 (B) -12 (C) 24 (D) -24

Q67 Inverse Trigonometric Functions[Step-by-step solution](https://www.prepwiser.in/questions/eoN2qreq_C)

If the domain of the function

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

is the interval $(\alpha, \beta]$, then $\alpha + \beta$ is equal to:

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

Q68 Limits[Step-by-step solution](https://www.prepwiser.in/questions/nDRQM36jvh)

Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be defined as

$$f(x) = \begin{cases} \frac{x^3}{(1 - \cos 2x)^2} \log_e \left(\frac{1 + 2xe^{-2x}}{(1 - xe^{-x})^2} \right), & x \neq 0 \\ \alpha, & x = 0 \end{cases}$$

If f is continuous at $x = 0$, then α is equal to:

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

Q69 Determinants[Step-by-step solution](https://www.prepwiser.in/questions/vlDXTaGMC)

The values of λ and μ such that the system of equations $x + y + z = 6, 3x + 5y + 5z = 26, x + 2y + \lambda z = \mu$ has no solution, are:

- (A) $\lambda = 3, \mu = 5$ (B) $\lambda = 3, \mu \neq 10$ (C) $\lambda \neq 2, \mu = 10$ (D) $\lambda = 2, \mu \neq 10$

Q70 Matrices[Step-by-step solution](https://www.prepwiser.in/questions/8UY8inD2q8)

Let $A = [a_{ij}]$ be a real matrix of order 3×3 , such that $a_{i1} + a_{i2} + a_{i3} = 1$, for $i = 1, 2, 3$. Then, the sum of all the entries of the matrix A^3 is equal to:

- (A) 2 (B) 1 (C) 3 (D) 9

Q71 Probability: Basic[Step-by-step solution](https://www.prepwiser.in/questions/8GrV-ny25y)

Four dice are thrown simultaneously and the numbers shown on these dice are recorded in 2×2 matrices. The probability that such formed matrix have all different entries and are non-singular, is:

- (A) $\frac{45}{162}$ (B) $\frac{21}{81}$ (C) $\frac{22}{81}$ (D) $\frac{43}{162}$

Let $[x]$ denote the greatest integer less than or equal to x . Then, the values of $x \in \mathbb{R}$ satisfying the equation $[e^x]^2 + [e^x + 1] - 3 = 0$ lie in the interval:

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

Let S_n denote the sum of first n -terms of an arithmetic progression. If $S_{10} = 530$, $S_5 = 140$, then $S_{20} - S_6$ is equal to:

- (A) 1862 (B) 1842 (C) 1852 (D) 1872

The number of solutions of $\sin^7 x + \cos^7 x = 1$, $x \in [0, 4\pi]$ is equal to

- (A) 11 (B) 7 (C) 5 (D) 9

Let a vector $\vec{a}$ be coplanar with vectors $\vec{b} = 2\hat{i} + \hat{j} + \hat{k}$ and $\vec{c} = \hat{i} - \hat{j} + \hat{k}$. If $\vec{a}$ is perpendicular to $\vec{d} = 3\hat{i} + 2\hat{j} + 6\hat{k}$, and $|\vec{a}| = \sqrt{10}$. Then a possible value of

$$[\vec{a} \ \vec{b} \ \vec{c}] + [\vec{a} \ \vec{b} \ \vec{d}] + [\vec{a} \ \vec{c} \ \vec{d}]$$

is equal to:

- (A) -42 (B) -40 (C) -29 (D) -38

Let three vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ be such that $\vec{a} \times \vec{b} = \vec{c}$, $\vec{b} \times \vec{c} = \vec{a}$ and $|\vec{a}| = 2$. Then which one of the following is not true?

- (A) $\vec{a} \times ((\vec{b} + \vec{c}) \times (\vec{b} \times \vec{c})) = \vec{0}$ (B) Projection of $\vec{a}$ on $(\vec{b} \times \vec{c})$ is 2
(C) $[\vec{a} \ \vec{b} \ \vec{c}] + [\vec{c} \ \vec{a} \ \vec{b}] = 8$ (D) $|3\vec{a} + \vec{b} - 2\vec{c}|^2 = 51$

Mathematics Section B · Numerical value

Q77 to Q86

If the constant term, in binomial expansion of $(2x^r + \frac{1}{x^2})^{10}$ is 180, then r is equal to _____.

The number of elements in the set $\{n \in \{1, 2, 3, \dots, 100\} \mid (11)^n > (10)^n + (9)^n\}$ is _____.

Let $y = y(x)$ be the solution of the differential equation

$$\left((x+2)e^{\left(\frac{y+1}{x+2}\right)} + (y+1)\right) dx = (x+2) dy$$

, $y(1) = 1$. If the domain of $y = y(x)$ is an open interval (α, β) , then $|\alpha + \beta|$ is equal to _____.
(Round off to the nearest integer)

Let $A = \{0, 1, 2, 3, 4, 5, 6, 7\}$. Then the number of bijective functions $f : A \rightarrow A$ such that $f(1) + f(2) = 3 - f(3)$ is equal to

Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a function defined as

$$f(x) = \begin{cases} 3\left(1 - \frac{|x|}{2}\right) & \text{if } |x| \leq 2 \\ 0 & \text{if } |x| > 2 \end{cases}$$

Let $g : \mathbb{R} \rightarrow \mathbb{R}$ be given by $g(x) = f(x+2) - f(x-2)$. If n and m denote the number of points in $\mathbb{R}$ where g is not continuous and not differentiable, respectively, then $n + m$ is equal to _____.

Let

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

. Then the number of 3×3 matrices B with entries from the set $\{1, 2, 3, 4, 5\}$ and satisfying $AB = BA$ is _____.

If the digits are not allowed to repeat in any number formed by using the digits 0, 2, 4, 6, 8, then the number of all numbers greater than 10,000 is equal to _____.

The sum of all the elements in the set $\{n \in \{1, 2, \dots, 100\} \mid \text{H.C.F. of } n \text{ and } 2040 \text{ is } 1\}$ is equal to _____.

Consider the following frequency distribution:

Class :	0-6	6-12	12-18	18-24	24-30
Frequency :	a	b	12	9	5

If mean = $\frac{309}{22}$ and median = 14, then the value $(a - b)^2$ is equal to _____.

The area (in sq. units) of the region bounded by the curves $x^2 + 2y - 1 = 0$, $y^2 + 4x - 4 = 0$ and $y^2 - 4x - 4 = 0$, in the upper half plane is _____.

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Physics

1. C	2. A	3. C	4. C	5. C	6. D	7. A	8. D
9. D	10. A	11. D	12. A	13. C	14. B	15. C	16. B
17. C	18. C	19. B	20. 2	21. 15	22. 500	23. 4	24. 60
25. 5	26. 57	27. 2	28. 1	29. 3			

Chemistry

30. A	31. D	32. C	33. B	34. A	35. D	36. A	37. B
38. B	39. B	40. A	41. A	42. A	43. D	44. D	45. C
46. A	47. C	48. 7	49. 3	50. 12	51. 3	52. 106	53. 4
54. 21	55. 6	56. 2	57. 78				

Mathematics

58. B	59. A	60. C	61. D	62. B	63. A	64. C	65. A
66. D	67. A	68. A	69. D	70. C	71. D	72. D	73. A
74. C	75. A	76. D	77. 8	78. 96	79. 1	80. 720	81. 4
82. 3125	83. 96	84. 1251	85. 4	86. 2			

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