

JEE MAIN 2022 · QUESTION PAPER

29 Jun 2022 **Shift 2**

84 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	19 Q1 to Q19	10 Q20 to Q29
● Chemistry	20 Q30 to Q49	9 Q50 to Q58
● Mathematics	18 Q59 to Q76	8 Q77 to Q84
In this PDF	84 questions · answer key at the end	

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

Attempt this paper online

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

prepwise.in/pyqs/paper/2022-06-29-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? prepwise.in/feedback · Terms: prepwise.in/terms

Q1 Nuclear Physics

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

In the following nuclear reaction,



Mass number of D is 182 and atomic number is 74. Mass number and atomic number of D_4 respectively will be _____.

- (A) 174 and 71 (B) 174 and 69 (C) 172 and 69 (D) 172 and 71

Q2 Electrostatics II: Potential & Capacitance

[Step-by-step solution](#) › [prepwisar.in/questions/vp5pM7FU5q](https://www.prepwisar.in/questions/vp5pM7FU5q)

A capacitor is discharging through a resistor R. Consider in time t_1 , the energy stored in the capacitor reduces to half of its initial value and in time t_2 , the charge stored reduces to one eighth of its initial value. The ratio t_1/t_2 will be

- (A) 1/2 (B) 1/3 (C) 1/4 (D) 1/6

Q3 Current Electricity

[Step-by-step solution](#) › [prepwisar.in/questions/FFiVd8oi1h](https://www.prepwisar.in/questions/FFiVd8oi1h)

The combination of two identical cells, whether connected in series or parallel combination provides the same current through an external resistance of 2Ω . The value of internal resistance of each cell is

- (A) 2Ω (B) 4Ω (C) 6Ω (D) 8Ω

Q4 Dual Nature of Radiation & Matter

[Step-by-step solution](#) › [prepwisar.in/questions/pfCiQ-_6iW](https://www.prepwisar.in/questions/pfCiQ-_6iW)

The electric field at a point associated with a light wave is given by

$$E = 200 [\sin(6 \times 10^{15}t) + \sin(9 \times 10^{15}t)] \text{ Vm}^{-1}$$

Given : $h = 4.14 \times 10^{-15} \text{ eVs}$

If this light falls on a metal surface having a work function of 2.50 eV, the maximum kinetic energy of the photoelectrons will be

- (A) 1.90 eV (B) 3.27 eV (C) 3.60 eV (D) 3.42 eV

Q5 Electrostatics I: Charges, Field & Gauss's Law

[Step-by-step solution](#) › [prepwisar.in/questions/q-a2iNbudL](https://www.prepwisar.in/questions/q-a2iNbudL)

Two point charges Q each are placed at a distance d apart. A third point charge q is placed at a distance x from mid-point on the perpendicular bisector. The value of x at which charge q will experience the maximum Coulomb's force is:

- (A) $x = d$ (B) $x = \frac{d}{2}$ (C) $x = \frac{d}{\sqrt{2}}$ (D) $x = \frac{d}{2\sqrt{2}}$

Q6 Electrostatics II: Potential & Capacitance

[Step-by-step solution](#) › [prepwisar.in/questions/UmW6rSq5fC](https://www.prepwisar.in/questions/UmW6rSq5fC)

If the electric potential at any point (x, y, z) m in space is given by $V = 3x^2$ volt. The electric field at the point (1, 0, 3) m will be:

- (A) 3 Vm^{-1} , directed along positive x-axis. (B) 3 Vm^{-1} , directed along negative x-axis.
(C) 6 Vm^{-1} , directed along positive x-axis. (D) 6 Vm^{-1} , directed along negative x-axis.

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Q7 Ray Optics[Step-by-step solution](https://www.prepwisar.in/questions/6me-ffRMKK)

The speed of light in media 'A' and 'B' are 2.0×10^{10} cm/s and 1.5×10^{10} cm/s respectively. A ray of light enters from the medium B to A at an incident angle ' θ '. If the ray suffers total internal reflection, then

- (A) $\theta = \sin^{-1} \left(\frac{3}{4} \right)$ (B) $\theta > \sin^{-1} \left(\frac{2}{3} \right)$ (C) $\theta < \sin^{-1} \left(\frac{3}{4} \right)$ (D) $\theta > \sin^{-1} \left(\frac{3}{4} \right)$

Q8 Gravitation[Step-by-step solution](https://www.prepwisar.in/questions/kepRILE6dD)

The time period of a satellite revolving around earth in a given orbit is 7 hours. If the radius of orbit is increased to three times its previous value, then approximate new time period of the satellite will be

- (A) 40 hours (B) 36 hours (C) 30 hours (D) 25 hours

Q9 Thermometry & Calorimetry[Step-by-step solution](https://www.prepwisar.in/questions/PLYgg7fCs5)

At what temperature a gold ring of diameter 6.230 cm be heated so that it can be fitted on a wooden bangle of diameter 6.241 cm? Both the diameters have been measured at room temperature (27°C). (Given : coefficient of linear thermal expansion of gold $\alpha_L = 1.4 \times 10^{-5} \text{ K}^{-1}$)

- (A) 125.7°C (B) 91.7°C (C) 425.7°C (D) 152.7°C

Q10 Thermodynamics[Step-by-step solution](https://www.prepwisar.in/questions/oswoGQWgWo)

Starting with the same initial conditions, an ideal gas expands from volume V_1 to V_2 in three different ways. The work done by the gas is W_1 if the process is purely isothermal, W_2 , if the process is purely adiabatic and W_3 if the process is purely isobaric. Then, choose the correct option

- (A) $W_1 < W_2 < W_3$ (B) $W_2 < W_3 < W_1$ (C) $W_3 < W_1 < W_2$ (D) $W_2 < W_1 < W_3$

Q11 Kinetic Theory of Gases[Step-by-step solution](https://www.prepwisar.in/questions/4DY4XNI5wN)

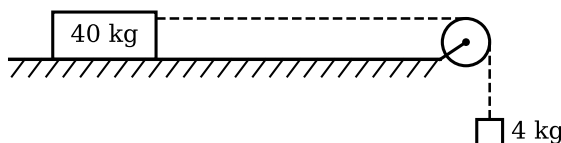
A vessel contains 16g of hydrogen and 128g of oxygen at standard temperature and pressure. The volume of the vessel in cm^3 is:

- (A) 72×10^5 (B) 32×10^5 (C) 27×10^4 (D) 54×10^4

Q12 Newton's Laws of Motion[Step-by-step solution](https://www.prepwisar.in/questions/jTWMe7ZsvK)

A block of mass 40 kg slides over a surface, when a mass of 4 kg is suspended through an inextensible massless string passing over frictionless pulley as shown below.

The coefficient of kinetic friction between the surface and block is 0.02. The acceleration of block is. (Given $g = 10 \text{ ms}^{-2}$.)



- (A) 1 ms^{-2} (B) $1/5 \text{ ms}^{-2}$ (C) $4/5 \text{ ms}^{-2}$ (D) $8/11 \text{ ms}^{-2}$

Q13 Newton's Laws of Motion[Step-by-step solution](https://www.prepwisar.in/questions/NvBe9zMDGW)

A block of mass M placed inside a box descends vertically with acceleration ' a '. The block exerts a force equal to one-fourth of its weight on the floor of the box. The value of ' a ' will be

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

Q14 Moving Charges & Magnetism[Step-by-step solution > prepwiser.in/questions/tMSJQKauoR](https://www.prepwiser.in/questions/tMSJQKauoR)

Two long current carrying conductors are placed to each other at a distance of 8 cm between them. The magnitude of magnetic field produced at mid-point between the two conductors due to current flowing in them is $300 \mu\text{T}$. The equal current flowing in the two conductors is:

- (A) 30A in the same direction. (B) 30A in the opposite direction.
(C) 60A in the opposite direction. (D) 300A in the opposite direction.

Q15 Moving Charges & Magnetism[Step-by-step solution > prepwiser.in/questions/VbXN2Im4rK](https://www.prepwiser.in/questions/VbXN2Im4rK)

Given below are two statements:

Statement I: The electric force changes the speed of the charged particle and hence changes its kinetic energy; whereas the magnetic force does not change the kinetic energy of the charged particle.

Statement II : The electric force accelerates the positively charged particle perpendicular to the direction of electric field. The magnetic force accelerates the moving charged particle along the direction of magnetic field.

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

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

Q16 Projectile Motion & Relative Motion[Step-by-step solution > prepwiser.in/questions/SuMvZvhH3F](https://www.prepwiser.in/questions/SuMvZvhH3F)

A person can throw a ball upto a maximum range of 100 m. How high above the ground he can throw the same ball?

- (A) 25 m (B) 50 m (C) 100 m (D) 200 m

Q17 Rectilinear Motion[Step-by-step solution > prepwiser.in/questions/qCjp3jdKfd](https://www.prepwiser.in/questions/qCjp3jdKfd)

A small toy starts moving from the position of rest under a constant acceleration. If it travels a distance of 10m in t s, the distance travelled by the toy in the next t s will be:

- (A) 10 m (B) 20 m (C) 30 m (D) 40 m

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

The motion of a simple pendulum executing S.H.M. is represented by the following equation.

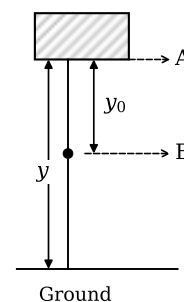
$y = A \sin(\pi t + \phi)$, where time is measured in second. The length of pendulum is

- (A) 97.23 cm (B) 25.3 cm (C) 99.4 cm (D) 406.1 cm

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In the given figure, the block of mass m is dropped from the point 'A'. The expression for kinetic energy of block when it reaches point 'B' is

- (A) $\frac{1}{2}mg y_0^2$ (B) $\frac{1}{2}mg y^2$ (C) $mg(y - y_0)$ (D) $mg y_0$



Physics Section B · Numerical value

Q20 to Q29

Q20 Alternating Current NUMERICAL

[Step-by-step solution](#) > [prepwisar.in/questions/6p-k5TWcB0](#)

An inductor of 0.5 mH , a capacitor of $200 \mu\text{F}$ and a resistor of 2Ω are connected in series with a 220 V ac source. If the current is in phase with the emf, the frequency of ac source will be $\text{_____} \times 10^2 \text{ Hz}$.

Q21 Nuclear Physics NUMERICAL

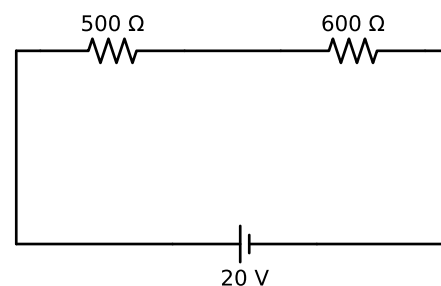
[Step-by-step solution](#) > [prepwisar.in/questions/pEMwvxqStq](#)

The half life of a radioactive substance is 5 years. After x years a given sample of the radioactive substance gets reduced to 6.25% of its initial value. The value of x is _____ .

Q22 Current Electricity NUMERICAL

[Step-by-step solution](#) > [prepwisar.in/questions/Sb4zvZDg4w](#)

Two resistors are connected in series across a battery as shown in figure. If a voltmeter of resistance 2000Ω is used to measure the potential difference across 500Ω resistor, the reading of the voltmeter will be _____ V .



Q23 Electromagnetic Waves NUMERICAL

[Step-by-step solution](#) > [prepwisar.in/questions/Ro5zffBww7](#)

The displacement current of $4.425 \mu\text{A}$ is developed in the space between the plates of parallel plate capacitor when voltage is changing at a rate of 10^6 Vs^{-1} . The area of each plate of the capacitor is 40 cm^2 . The distance between each plate of the capacitor is $x \times 10^{-3} \text{ m}$. The value of x is _____ . (Permittivity of free space, $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$).

Q24 Semiconductors & Electronic Devices NUMERICAL

[Step-by-step solution](#) > [prepwisar.in/questions/Wo9MvO7Vbd](#)

A potential barrier of 0.4 V exists across a p-n junction. An electron enters the junction from the n-side with a speed of $6.0 \times 10^5 \text{ ms}^{-1}$. The speed with which electron enters the p side will be $\frac{x}{3} \times 10^5 \text{ ms}^{-1}$ the value of x is _____ .

(Given mass of electron = $9 \times 10^{-31} \text{ kg}$, charge on electron = $1.6 \times 10^{-19} \text{ C}$.)

Q25 Fluid Mechanics NUMERICAL

[Step-by-step solution](#) > [prepwisar.in/questions/kRIRct5Z06](#)

A small spherical ball of radius 0.1 mm and density 10^4 kg m^{-3} falls freely under gravity through a distance h before entering a tank of water. If, after entering the water the velocity of ball does not change and it continue to fall with same constant velocity inside water, then the value of h will be _____ m .

(Given $g = 10 \text{ ms}^{-2}$, viscosity of water = $1.0 \times 10^{-5} \text{ N-sm}^{-2}$).

Q26 Rotational Motion **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/gl33cEFyMO) > prepwisar.in/questions/gl33cEFyMO

The moment of inertia of a uniform thin rod about a perpendicular axis passing through one end is I_1 . The same rod is bent into a ring and its moment of inertia about a diameter is I_2 . If $\frac{I_1}{I_2}$ is $\frac{x\pi^2}{3}$, then the value of x will be _____.

Q27 Wave Optics **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/qioor00Xam) > prepwisar.in/questions/qioor00Xam

In a double slit experiment with monochromatic light, fringes are obtained on a screen placed at some distance from the plane of slits. If the screen is moved by 5×10^{-2} m towards the slits, the change in fringe width is 3×10^{-3} cm. If the distance between the slits is 1 mm, then the wavelength of the light will be _____ nm.

Q28 Sound Waves **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/U6lcltaY40) > prepwisar.in/questions/U6lcltaY40

In an experiment to determine the velocity of sound in air at room temperature using a resonance tube, the first resonance is observed when the air column has a length of 20.0 cm for a tuning fork of frequency 400 Hz is used. The velocity of the sound at room temperature is 336 ms^{-1} . The third resonance is observed when the air column has a length of _____ cm.

Q29 Experimental Skills **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/1k_Tn601q3) > prepwisar.in/questions/1k_Tn601q3

The Vernier constant of Vernier callipers is 0.1 mm and it has zero error of (-0.05) cm. While measuring diameter of a sphere, the main scale reading is 1.7 cm and coinciding vernier division is 5. The corrected diameter will be _____ $\times 10^{-2}$ cm.

Chemistry Section A · Multiple choice

Q30 to Q49

Q30 Carbohydrates & Biomolecules[Step-by-step solution](https://www.prepwisar.in/questions/_qU90j4GYM) > prepwisar.in/questions/_qU90j4GYM

The structure of protein that is unaffected by heating is

- (A) secondary structure (B) tertiary structure
(C) primary structure (D) quaternary structure

Q31 Chemical Bonding & Molecular Structure[Step-by-step solution](https://www.prepwisar.in/questions/NSBUerbhqY) > prepwisar.in/questions/NSBUerbhqY

Consider the species CH_4 , NH_4^+ and BH_4^- . Choose the correct option with respect to these species.

- (A) They are isoelectronic and only two have tetrahedral structures.
(B) They are isoelectronic and all have tetrahedral structures.
(C) Only two are isoelectronic and all have tetrahedral structures.
(D) Only two are isoelectronic and only two have tetrahedral structures.

Q32 Chemical Bonding & Molecular Structure[Step-by-step solution](https://www.prepwisar.in/questions/6D9f97wmFG) > prepwisar.in/questions/6D9f97wmFG

Number of lone pair(s) of electrons on central atom and the shape BrF_3 molecule respectively, are

- (A) 0, triangular planar. (B) 1, pyramidal. (C) 2, bent T-shape. (D) 1, bent T-shape.

Q33 Chemistry in Everyday Life[Step-by-step solution](https://www.prepwisar.in/questions/YZjlkSBB-Z) > prepwisar.in/questions/YZjlkSBB-Z

The mixture of chloroxylenol and terpineol is an example of

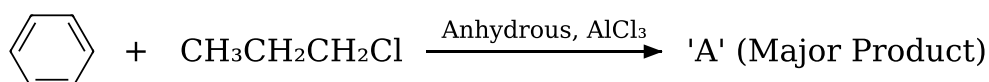
- (A) antiseptic (B) pesticide (C) disinfectant (D) narcotic analgesic

Given below are two statements.

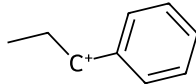
- Statement I : In $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, Cu-O bonds are present.
- Statement II : In $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, ligands coordinating with Cu(II) ion are O- and S-based ligands.

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

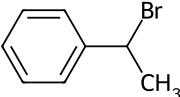
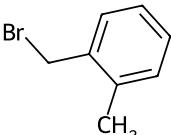
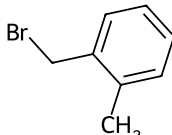
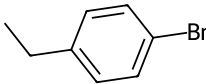
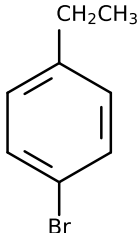
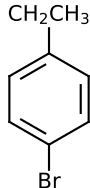
- (A) Both Statement I and Statement II are correct.
 (B) Both Statement I and Statement II are incorrect.
 (C) Statement I is correct but Statement II is incorrect.
 (D) Statement I is incorrect but Statement II is correct.



The stable carbocation formed in the above reaction is

- (A) $\text{CH}_3\text{CH}_2\text{CH}_2^+$ (B) $\text{CH}_3\text{CH}^+\text{CH}_3$
 (C) $\text{CH}_3 - \text{CH}^+ - \text{CH}_3$ (D) 

Two isomers (A) and (B) with Molar mass 184 g/mol and elemental composition C, 52.2%; H, 4.9% and Br 42.9% gave benzoic acid and p-bromobenzoic acid, respectively on oxidation with KMnO_4 . Isomer 'A' is optically active and gives a pale yellow precipitate when warmed with alcoholic AgNO_3 . Isomer 'A' and 'B' are, respectively

- (A)  and 
 (B)  and 
 (C) $\text{H}_3\text{C} - \text{CHBr} - \text{C}_6\text{H}_5$ and 
 (D)  and $\text{H}_3\text{C} - \text{CHBr} - \text{C}_6\text{H}_5$

Match List I with List II.

	List-I Ore		List-II Composition
(A)	Siderite	(I)	FeCO_3
(B)	Malachite	(II)	$\text{CuCO}_3 \cdot \text{Cu(OH)}_2$
(C)	Sphalerite	(III)	ZnS
(D)	Calamine	(IV)	ZnCO_3

Choose the correct answer from the options given below:

- (A) A-I, B-II, C-III, D-IV (B) A-III, B-IV, C-II, D-I (C) A-IV, B-III, C-I, D-II (D) A-I, B-II, C-IV, D-III

Aqueous solution of which of the following boron compounds will be strongly basic in nature?

- (A) NaBH_4 (B) LiBH_4 (C) B_2H_6 (D) $\text{Na}_2\text{B}_4\text{O}_7$

Sulphur dioxide is one of the components of polluted air. SO_2 is also a major contributor to acid rain. The correct and complete reaction to represent acid rain caused by SO_2 is:

- (A) $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$ (B) $\text{SO}_2 + \text{O}_3 \rightarrow \text{SO}_3 + \text{O}_2$
(C) $\text{SO}_2 + \text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{SO}_4$ (D) $2\text{SO}_2 + \text{O}_2 + 2\text{H}_2\text{O} \rightarrow 2\text{H}_2\text{SO}_4$

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

Assertion A : The first ionization enthalpy for oxygen is lower than that of nitrogen.

Reason R : The four electrons in 2p orbitals of oxygen experience more electron-electron repulsion.

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

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

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

Assertion A: Dacron is an example of polyester polymer.

Reason R: Dacron is made up of ethylene glycol and terephthalic acid monomers.

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

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

Amongst baking soda, caustic soda and washing soda, carbonate anion is present in:

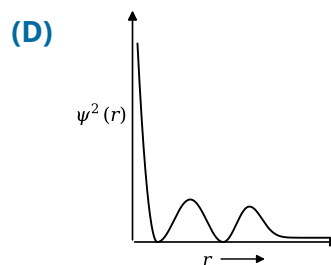
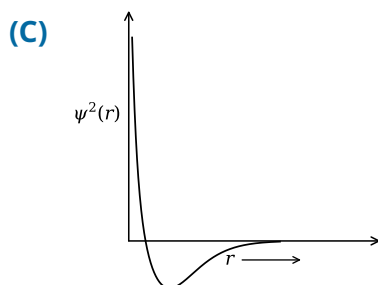
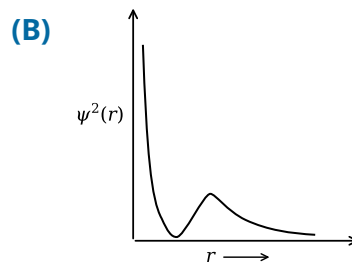
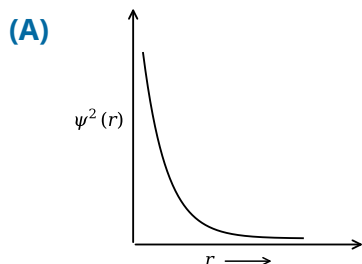
- (A) washing soda only. (B) washing soda and caustic soda only.
(C) washing soda and baking soda only. (D) baking soda, caustic soda and washing soda.

Using the rules for significant figures, the correct answer for the expression $\frac{0.02858 \times 0.112}{0.5702}$ will be

- (A) 0.005613 (B) 0.00561 (C) 0.0056 (D) 0.006

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Which of the following is the correct plot for the probability density $\psi^2(r)$ as a function of distance 'r' of the electron from the nucleus for 2s orbital?

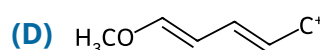
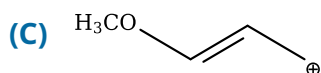
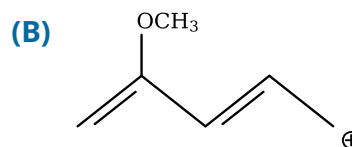
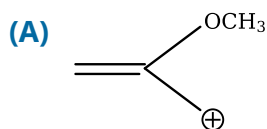


A 42.12% (w/v) solution of NaCl causes precipitation of a certain sol in 10 hours. The coagulating value of NaCl for the sol in 2 hours is:

[Given : Molar mass : Na = 23.0 g mol⁻¹; Cl = 35.5 g mol⁻¹]

- (A) 36 m mol L⁻¹ (B) 36 mol L⁻¹ (C) 1440 mol L⁻¹ (D) 1440 m mol L⁻¹

Which of the following carbocations is most stable?



4.0 moles of argon and 5.0 moles of PCl₅ are introduced into an evacuated flask of 100 litre capacity at 610 K. The system is allowed to equilibrate. At equilibrium, the total pressure of mixture was found to be 6.0 atm. The K_p for the reaction is:

[Given : R = 0.082 L atm K⁻¹ mol⁻¹]

- (A) 2.25 (B) 6.24 (C) 12.13 (D) 15.24

In Friedel-Crafts alkylation of aniline, one gets

- (A) alkylated product with ortho and para substitution.
 (B) secondary amine after acidic treatment.
 (C) an amide product.
 (D) positively charged nitrogen at benzene ring.

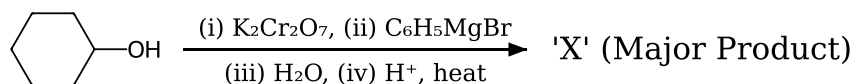
A white precipitate was formed when BaCl_2 was added to water extract of an inorganic salt. Further, a gas 'X' with characteristic odour was released when the formed white precipitate was dissolved in dilute HCl . The anion present in the inorganic salt is

- (A) I^- (B) SO_3^{2-} (C) S^{2-} (D) NO_2^-

Chemistry Section B · Numerical value

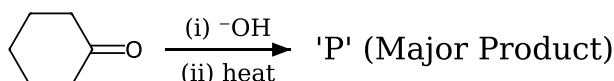
Q50 to Q58

In the given reaction,



the number of sp^2 hybridised carbon(s) in compound 'X' is _____.

In the given reaction,



The number of π electrons present in the product 'P' is _____.

The equation

$$k = (6.5 \times 10^{12} \text{ s}^{-1}) e^{-26000 \text{ K}/T}$$

is followed for the decomposition of compound A. The activation energy for the reaction is _____ kJ mol^{-1} . [nearest integer]

(Given : $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

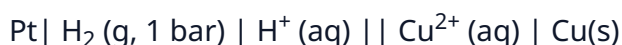
Spin only magnetic moment of $[\text{MnBr}_6]^{4-}$ is _____ B.M. (round off to the closest integer)

For the reaction given below:



If two equivalents of AgCl precipitate out, then the value of x will be _____.

The cell potential for the given cell at 298 K



is 0.31 V. The pH of the acidic solution is found to be 3, whereas the concentration of Cu^{2+} is 10^{-x} M . The value of x is _____.

(Given: $E_{\text{Cu}^{2+}/\text{Cu}}^\ominus = 0.34 \text{ V}$ and $\frac{2.303 RT}{F} = 0.06 \text{ V}$)

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Elevation in boiling point for 1.5 molal solution of glucose in water is 4 K. The depression in freezing point for 4.5 molal solution of glucose in water is 4 K. The ratio of molal elevation constant to molal depression constant (K_b/K_f) is _____.

2.2 g of nitrous oxide (N_2O) gas is cooled at a constant pressure of 1 atm from 310 K to 270 K causing the compression of the gas from 217.1 mL to 167.75 mL. The change in internal energy of the process, ΔU is $-x$ J. The value of x is _____. [nearest integer]

(Given : atomic mass of N = 14 g mol⁻¹ and of O = 16 g mol⁻¹. Molar heat capacity of N_2O is 100 J K⁻¹ mol⁻¹)

A box contains 0.90 g of liquid water in equilibrium with water vapour at 27°C. The equilibrium vapour pressure of water at 27°C is 32.0 Torr. When the volume of the box is increased, some of the liquid water evaporates to maintain the equilibrium pressure. If all the liquid water evaporates, then the volume of the box must be _____ litre. [nearest integer]

(Given : $R = 0.082$ L atm K⁻¹ mol⁻¹)

(Ignore the volume of the liquid water and assume water vapours behave as an ideal gas.)

Mathematics Section A · Multiple choice

Q59 to Q76

Let $\frac{x-2}{3} = \frac{y+1}{-2} = \frac{z+3}{-1}$ lie on the plane $px - qy + z = 5$, for some $p, q \in \mathbb{R}$. The shortest distance of the plane from the origin is:

(A) $\sqrt{\frac{3}{109}}$

(B) $\sqrt{\frac{5}{142}}$

(C) $\frac{5}{\sqrt{71}}$

(D) $\frac{1}{\sqrt{142}}$

Let Q be the mirror image of the point P(1, 2, 1) with respect to the plane $x + 2y + 2z = 16$. Let T be a plane passing through the point Q and contains the line

$$\vec{r} = -\hat{k} + \lambda(\hat{i} + \hat{j} + 2\hat{k}), \lambda \in \mathbb{R}$$

. Then, which of the following points lies on T?

(A) (2, 1, 0)

(B) (1, 2, 1)

(C) (1, 2, 2)

(D) (1, 3, 2)

Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be a function defined by $f(x) = (x - 3)^{n_1} (x - 5)^{n_2}$, $n_1, n_2 \in \mathbb{N}$. Then, which of the following is NOT true?

(A) For $n_1 = 3, n_2 = 4$, there exists $\alpha \in (3, 5)$ where f attains local maxima.

(B) For $n_1 = 4, n_2 = 3$, there exists $\alpha \in (3, 5)$ where f attains local minima.

(C) For $n_1 = 3, n_2 = 5$, there exists $\alpha \in (3, 5)$ where f attains local maxima.

(D) For $n_1 = 4, n_2 = 6$, there exists $\alpha \in (3, 5)$ where f attains local maxima.

Q62 Binomial Theorem[Step-by-step solution](https://www.prepwiser.in/questions/Z9SNvAHFbQ) > prepwiser.in/questions/Z9SNvAHFbQ

Let $n \geq 5$ be an integer. If $9^n - 8n - 1 = 64\alpha$ and $6^n - 5n - 1 = 25\beta$, then $\alpha - \beta$ is equal to

- (A) $1 + {}^nC_2(8 - 5) + {}^nC_3(8^2 - 5^2) + \dots + {}^nC_n(8^{n-1} - 5^{n-1})$
(B) $1 + {}^nC_3(8 - 5) + {}^nC_4(8^2 - 5^2) + \dots + {}^nC_n(8^{n-2} - 5^{n-2})$
(C) ${}^nC_3(8 - 5) + {}^nC_4(8^2 - 5^2) + \dots + {}^nC_n(8^{n-2} - 5^{n-2})$
(D) ${}^nC_4(8 - 5) + {}^nC_5(8^2 - 5^2) + \dots + {}^nC_n(8^{n-3} - 5^{n-3})$

Q63 Properties of Triangles[Step-by-step solution](https://www.prepwiser.in/questions/rgaWPzuHxE) > prepwiser.in/questions/rgaWPzuHxE

Let a triangle ABC be inscribed in the circle $x^2 - \sqrt{2}(x + y) + y^2 = 0$ such that $\angle BAC = \frac{\pi}{2}$. If the length of side AB is $\sqrt{2}$, then the area of the ΔABC is equal to:

- (A) 1 (B) $(\sqrt{6} + \sqrt{3})/2$ (C) $(3 + \sqrt{3})/4$ (D) $(\sqrt{6} + 2\sqrt{3})/4$

Q64 Complex Numbers[Step-by-step solution](https://www.prepwiser.in/questions/cwmWJbbSu9) > prepwiser.in/questions/cwmWJbbSu9

Let $\arg(z)$ represent the principal argument of the complex number z . Then, $|z| = 3$ and $\arg(z - 1) - \arg(z + 1) = \frac{\pi}{4}$ intersect:

- (A) exactly at one point. (B) exactly at two points.
(C) nowhere. (D) at infinitely many points.

Q65 Definite Integration[Step-by-step solution](https://www.prepwiser.in/questions/CjbC8RBO9x) > prepwiser.in/questions/CjbC8RBO9x

Let f be a real valued continuous function on $[0, 1]$ and $f(x) = x + \int_0^1 (x - t)f(t)dt$.

Then, which of the following points (x, y) lies on the curve $y = f(x)$?

- (A) (2, 4) (B) (1, 2) (C) (4, 17) (D) (6, 8)

Q66 Area Under Curves[Step-by-step solution](https://www.prepwiser.in/questions/nrCGq7S35P) > prepwiser.in/questions/nrCGq7S35P

If

$$\int_0^2 (\sqrt{2x} - \sqrt{2x - x^2}) dx = \int_0^1 \left(1 - \sqrt{1 - y^2} - \frac{y^2}{2}\right) dy + \int_1^2 \left(2 - \frac{y^2}{2}\right) dy + I$$

, then I equals

- (A) $\int_0^1 (1 + \sqrt{1 - y^2}) dy$ (B) $\int_0^1 \left(\frac{y^2}{2} - \sqrt{1 - y^2} + 1\right) dy$
(C) $\int_0^1 (1 - \sqrt{1 - y^2}) dy$ (D) $\int_0^1 \left(\frac{y^2}{2} + \sqrt{1 - y^2} + 1\right) dy$

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Q67 Differential Equations[Step-by-step solution](https://www.prepwiser.in/questions/DB4kd-U7bR) › prepwiser.in/questions/DB4kd-U7bR

If $y = y(x)$ is the solution of the differential equation

$$(1 + e^{2x}) \frac{dy}{dx} + 2(1 + y^2) e^x = 0$$

and $y(0) = 0$, then

$$6 \left(y'(0) + \left(y \left(\log_e \sqrt{3} \right) \right)^2 \right)$$

is equal to

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

Q68 Limits[Step-by-step solution](https://www.prepwiser.in/questions/COcGZ0ocXa) › prepwiser.in/questions/COcGZ0ocXa

The value of

$$\lim_{x \rightarrow 1} \frac{(x^2 - 1) \sin^2(\pi x)}{x^4 - 2x^3 + 2x - 1}$$

is equal to:

- (A) $\frac{\pi^2}{6}$ (B) $\frac{\pi^2}{3}$ (C) $\frac{\pi^2}{2}$ (D) π^2

Q69 Matrices[Step-by-step solution](https://www.prepwiser.in/questions/INUw8xI3BO) › prepwiser.in/questions/INUw8xI3BO

Let $A = \begin{pmatrix} 2 & -1 \\ 0 & 2 \end{pmatrix}$. If

$$B = I - {}^5C_1(\text{adj } A) + {}^5C_2(\text{adj } A)^2 - \dots - {}^5C_5(\text{adj } A)^5$$

, then the sum of all elements of the matrix B is

- (A) -5 (B) -6 (C) -7 (D) -8

Q70 Parabola[Step-by-step solution](https://www.prepwiser.in/questions/xOFIp3ExH-) › prepwiser.in/questions/xOFIp3ExH-

Let $P : y^2 = 4ax$, $a > 0$ be a parabola with focus S. Let the tangents to the parabola P make an angle of $\frac{\pi}{4}$ with the line $y = 3x + 5$ touch the parabola P at A and B. Then the value of a for which A, B and S are collinear is:

- (A) 8 only (B) 2 only (C) $\frac{1}{4}$ only (D) any $a > 0$

Q71 Relations & Functions (Basic)[Step-by-step solution](https://www.prepwiser.in/questions/tccp5uFeKe) › prepwiser.in/questions/tccp5uFeKe

The probability that a relation R from $\{x, y\}$ to $\{x, y\}$ is both symmetric and transitive, is equal to:

- (A) $\frac{5}{16}$ (B) $\frac{9}{16}$ (C) $\frac{11}{16}$ (D) $\frac{13}{16}$

Q72 Complex Numbers[Step-by-step solution](https://www.prepwiser.in/questions/KVhrc-Pj3) › prepwiser.in/questions/KVhrc-Pj3

Let α be a root of the equation $1 + x^2 + x^4 = 0$. Then, the value of $\alpha^{1011} + \alpha^{2022} - \alpha^{3033}$ is equal to:

- (A) 1 (B) α (C) $1 + \alpha$ (D) $1 + 2\alpha$

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The sum of the infinite series

$$1 + \frac{5}{6} + \frac{12}{6^2} + \frac{22}{6^3} + \frac{35}{6^4} + \frac{51}{6^5} + \frac{70}{6^6} + \dots$$

is equal to:

- (A) $\frac{425}{216}$ (B) $\frac{429}{216}$ (C) $\frac{288}{125}$ (D) $\frac{280}{125}$

The number of values of $a \in \mathbb{N}$ such that the variance of $3, 7, 12, a, 43 - a$ is a natural number is:

- (A) 0 (B) 2 (C) 5 (D) infinite

Let A, B, C be three points whose position vectors respectively are

$$\vec{a} = \hat{i} + 4\hat{j} + 3\hat{k}$$

$$\vec{b} = 2\hat{i} + \alpha\hat{j} + 4\hat{k}, \alpha \in \mathbb{R}$$

$$\vec{c} = 3\hat{i} - 2\hat{j} + 5\hat{k}$$

If α is the smallest positive integer for which $\vec{a}, \vec{b}, \vec{c}$ are noncollinear, then the length of the median, in $\triangle ABC$, through A is:

- (A) $\frac{\sqrt{82}}{2}$ (B) $\frac{\sqrt{62}}{2}$ (C) $\frac{\sqrt{69}}{2}$ (D) $\frac{\sqrt{66}}{2}$

The distance of the origin from the centroid of the triangle whose two sides have the equations $x - 2y + 1 = 0$ and $2x - y - 1 = 0$ and whose orthocenter is $(\frac{7}{3}, \frac{7}{3})$ is:

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

Mathematics Section B · Numerical value

Q77 to Q84

Let the coefficients of x^{-1} and x^{-3} in the expansion of $(2x^{\frac{1}{5}} - \frac{1}{x^{\frac{1}{5}}})^{15}$, $x > 0$, be m and n respectively.

If r is a positive integer such that $mn^2 = {}^{15}C_r \cdot 2^r$, then the value of r is equal to _____.

Let $y = y(x)$, $x > 1$, be the solution of the differential equation $(x - 1)\frac{dy}{dx} + 2xy = \frac{1}{x-1}$, with $y(2) = \frac{1+e^4}{2e^4}$.

If $y(3) = \frac{e^{\alpha+1}}{\beta e^{\alpha}}$, then the value of $\alpha + \beta$ is equal to _____.

Let f and g be twice differentiable even functions on $(-2, 2)$ such that $f(\frac{1}{4}) = 0$, $f(\frac{1}{2}) = 0$, $f(1) = 1$ and $g(\frac{3}{4}) = 0$, $g(1) = 2$. Then, the minimum number of solutions of $f(x)g''(x) + f'(x)g'(x) = 0$ in $(-2, 2)$ is equal to _____.

Let $f(x)$ and $g(x)$ be two real polynomials of degree 2 and 1 respectively. If $f(g(x)) = 8x^2 - 2x$ and $g(f(x)) = 4x^2 + 6x + 1$, then the value of $f(2) + g(2)$ is _____.

Let

$$M = \begin{bmatrix} 0 & -\alpha \\ \alpha & 0 \end{bmatrix}$$

, where α is a non-zero real number and $N = \sum_{k=1}^{49} M^{2k}$. If $(I - M^2)N = -2I$, then the positive integral value of α is _____.

The total number of four digit numbers such that each of first three digits is divisible by the last digit, is equal to _____.

Let 3, 6, 9, 12, ... upto 78 terms and 5, 9, 13, 17, ... upto 59 terms be two series. Then, the sum of the terms common to both the series is equal to _____.

The number of solutions of the equation $\sin x = \cos^2 x$ in the interval $(0, 10)$ is _____.

Answer key: JEE Main 2022 · 29 Jun · Shift 2

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Physics

1. A	2. D	3. A	4. D	5. D	6. D	7. D	8. B
9. D	10. D	11. C	12. D	13. C	14. B	15. C	16. B
17. C	18. C	19. D	20. 5	21. 20	22. 8	23. 8	24. 14
25. 20	26. 8	27. 600	28. 104	29. 180			

Chemistry

30. C	31. B	32. C	33. A	34. C	35. C	36. C	37. A
38. D	39. D	40. A	41. A	42. A	43. B	44. B	45. D
46. D	47. A	48. D	49. B	50. 8	51. 4	52. 216	53. 6
54. 5	55. 7	56. 3	57. 195	58. 29			

Mathematics

59. B	60. B	61. C	62. C	63. A	64. C	65. D	66. C
67. C	68. D	69. C	70. D	71. A	72. A	73. C	74. A
75. A	76. C	77. 5	78. 14	79. 4	80. 18	81. 1	82. 1086
83. 2223	84. 4						



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