

JEE MAIN 2025 · QUESTION PAPER

# 3 Apr 2025 **Shift 2**

72 questions in exam order, with answer key

| Subject              | Section A multiple choice                   | Section B numerical value |
|----------------------|---------------------------------------------|---------------------------|
| ● <b>Physics</b>     | <b>20</b> Q1 to Q20                         | <b>5</b> Q21 to Q25       |
| ● <b>Chemistry</b>   | <b>17</b> Q26 to Q42                        | <b>5</b> Q43 to Q47       |
| ● <b>Mathematics</b> | <b>20</b> Q48 to Q67                        | <b>5</b> Q68 to Q72       |
| <b>In this PDF</b>   | <b>72</b> questions · answer key at the end |                           |

- 1 Set a 3 hour timer and attempt the paper in one sitting, like the real exam.
- 2 Check yourself against the answer key at the end. Every question names its chapter, so you can see where marks went.
- 3 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.

[prepwisser.in/pyqs/paper/2025-04-03-evening](https://prepwisser.in/pyqs/paper/2025-04-03-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? [prepwisser.in/feedback](https://prepwisser.in/feedback)  
· Terms: [prepwisser.in/terms](https://prepwisser.in/terms)

**Q1** Alternating Current

[Step-by-step solution](#) › [prepwiser.in/questions/ly-ry\\_cyL6V](#)

An electric bulb rated as 100W – 220V is connected to an ac source of rms voltage 220 V. The peak value of current through the bulb is:

- (A) 0.32 A (B) 0.64 A (C) 0.45 A (D) 2.2 A

**Q2** Atomic Physics

[Step-by-step solution](#) › [prepwiser.in/questions/vkiTgH8Zo2](#)

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

Assertion **A** : The Bohr model is applicable to hydrogen and hydrogen-like atoms only.

Reason **R**: The formulation of Bohr model does not include repulsive force between electrons.

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

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

**Q3** Electrostatics II: Potential & Capacitance

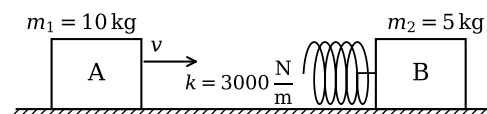
[Step-by-step solution](#) › [prepwiser.in/questions/tQvzRp8snL](#)

Using a battery, a 100 pF capacitor is charged to 60 V and then the battery is removed. After that, a second uncharged capacitor is connected to the first capacitor in parallel. If the final voltage across the second capacitor is 20 V, its capacitance is: (in pF)

- (A) 600 (B) 100 (C) 400 (D) 200

**Q4** Collision

[Step-by-step solution](#) › [prepwiser.in/questions/ZcyVqy48s8](#)



Consider two blocks A and B of masses  $m_1 = 10\text{kg}$  and  $m_2 = 5\text{kg}$  that are placed on a frictionless table. The block A moves with a constant speed  $v = 3\text{m/s}$  towards the block B kept at rest. A spring with spring constant  $k = 3000\text{N/m}$  is attached with the block B as shown in the figure. After the collision, suppose that the blocks A and B, along with the spring in constant compression state, move together, then the compression in the spring is, (Neglect the mass of the spring)

- (A) 0.3 m (B) 0.1 m (C) 0.4 m (D) 0.2 m

**Q5** Current Electricity

[Step-by-step solution](#) › [prepwiser.in/questions/nhRlrG19rp](#)

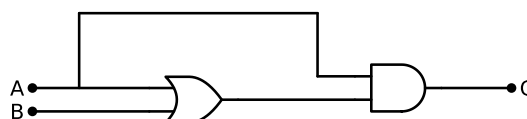
A motor operating on 100 V draws a current of 1 A. If the efficiency of the motor is 91.6%, then the loss of power in units of cal/s is

- (A) 6.2 (B) 2 (C) 8.4 (D) 4

**Q6** Semiconductors & Electronic Devices

[Step-by-step solution](#) › [prepwiser.in/questions/IIYNcf4-RC](#)

The truth table corresponding to the circuit given below is:



- (A) 

| A | B | C |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

 (B) 

| A | B | C |
|---|---|---|
| 0 | 0 | 1 |
| 1 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 1 | 0 |

 (C) 

| A | B | C |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 0 |

 (D) 

| A | B | C |
|---|---|---|
| 0 | 0 | 0 |
| 1 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 1 | 1 |

**Q7** Thermodynamics[Step-by-step solution](#) > [prepwiser.in/questions/L\\_KN6pvLyn](#)

An ideal gas exists in a state with pressure  $P_0$ , volume  $V_0$ . It is isothermally expanded to 4 times of its initial volume ( $V_0$ ), then isobarically compressed to its original volume. Finally the system is heated isochorically to bring it to its initial state. The amount of heat exchanged in this process is

- (A)  $P_0 V_0 (\ln 2 - 0.75)$  (B)  $P_0 V_0 (2 \ln 2 - 0.75)$  (C)  $P_0 V_0 (2 \ln 2 - 0.25)$  (D)  $P_0 V_0 (\ln 2 - 0.25)$

**Q8** Kinetic Theory of Gases[Step-by-step solution](#) > [prepwiser.in/questions/a-luVs62K5](#)

Pressure of an ideal gas, contained in a closed vessel, is increased by 0.4% when heated by  $1^\circ\text{C}$ . Its initial temperature must be:

- (A) 2500 K (B)  $25^\circ\text{C}$  (C)  $250^\circ\text{C}$  (D) 250 K

**Q9** Work, Energy & Power[Step-by-step solution](#) > [prepwiser.in/questions/msQzt\\_713d](#)

A block of mass 1 kg, moving along  $x$  with speed  $v_i = 10\text{m/s}$  enters a rough region ranging from  $x = 0.1\text{m}$  to  $x = 1.9\text{m}$ . The retarding force acting on the block in this range is  $F_r = -kx\text{N}$ , with  $k = 10\text{N/m}$ . Then the final speed of the block as it crosses rough region is.

- (A)  $4\text{m/s}$  (B)  $10\text{m/s}$  (C)  $8\text{m/s}$  (D)  $6\text{m/s}$

**Q10** Magnetism & Matter[Step-by-step solution](#) > [prepwiser.in/questions/v7cYaI1sIk](#)

A magnetic dipole experiences a torque of  $80\sqrt{3}\text{Nm}$  when placed in uniform magnetic field in such a way that dipole moment makes angle of  $60^\circ$  with magnetic field. The potential energy of the dipole is:

- (A)  $-40\sqrt{3}\text{J}$  (B)  $-80\text{J}$  (C)  $80\text{J}$  (D)  $-60\text{J}$

**Q11** Moving Charges & Magnetism[Step-by-step solution](#) > [prepwiser.in/questions/53BWMxR67K](#)

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

**Assertion A:** If Oxygen ion ( $\text{O}^{-2}$ ) and Hydrogen ion ( $\text{H}^+$ ) enter normal to the magnetic field with equal momentum, then the path of  $\text{O}^{-2}$  ion has a smaller curvature than that of  $\text{H}^+$ .

**Reason R:** A proton with same linear momentum as an electron will form a path of smaller radius of curvature on entering a uniform magnetic field perpendicularly.

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

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

**Q12** Projectile Motion & Relative Motion[Step-by-step solution](#) > [prepwiser.in/questions/ctkPUstD33](#)

A particle is projected with velocity  $u$  so that its horizontal range is three times the maximum height attained by it. The horizontal range of the projectile is given as  $\frac{nu^2}{25g}$ , where value of  $n$  is: (Given, ' $g$ ' is the acceleration due to gravity.)

- (A) 6 (B) 12 (C) 18 (D) 24

**Q13** Rectilinear Motion[Step-by-step solution](#) > [prepwiser.in/questions/fgU\\_IxpWkn](#)

A particle moves along the  $x$ -axis and has its displacement  $x$  varying with time  $t$  according to the equation:

$$x = c_0 (t^2 - 2) + c(t - 2)^2$$

where  $c_0$  and  $c$  are constants of appropriate dimensions.

Then, which of the following statements is correct?

- (A) the acceleration of the particle is  $2(c + c_0)$  (B) the acceleration of the particle is  $2c_0$   
(C) the acceleration of the particle is  $2c$  (D) the initial velocity of the particle is  $4c$

**Q14** Fluid Mechanics[Step-by-step solution](#) > prepwiser.in/questions/tIVqMnZApk

Two cylindrical vessels of equal cross sectional area of  $2\text{m}^2$  contain water upto heights 10 m and 6 m, respectively. If the vessels are connected at their bottom then the work done by the force of gravity is (Density of water is  $10^3\text{kg/m}^3$  and  $g = 10\text{m/s}^2$ )

- (A)  $1 \times 10^5\text{J}$  (B)  $4 \times 10^4\text{J}$  (C)  $8 \times 10^4\text{J}$  (D)  $6 \times 10^4\text{J}$

**Q15** Fluid Mechanics[Step-by-step solution](#) > prepwiser.in/questions/HoyYhq86ur

A solid steel ball of diameter 3.6 mm acquired terminal velocity  $2.45 \times 10^{-2}\text{m/s}$  while falling under gravity through an oil of density  $925\text{kgm}^{-3}$ . Take density of steel as  $7825\text{kgm}^{-3}$  and  $g$  as  $9.8\text{m/s}^2$ . The viscosity of the oil in SI unit is

- (A) 2.18 (B) 1.68 (C) 2.38 (D) 1.99

**Q16** Wave Optics[Step-by-step solution](#) > prepwiser.in/questions/OGvd5rWbz5

Two monochromatic light beams have intensities in the ratio 1:9. An interference pattern is obtained by these beams. The ratio of the intensities of maximum to minimum is

- (A) 8 : 1 (B) 4 : 1 (C) 3 : 1 (D) 9 : 1

**Q17** Wave Optics[Step-by-step solution](#) > prepwiser.in/questions/pfHMkjPj65

Width of one of the two slits in a Young's double slit interference experiment is half of the other slit. The ratio of the maximum to the minimum intensity in the interference pattern is:

- (A) 3 : 1 (B)  $(2\sqrt{2} + 1) : (2\sqrt{2} - 1)$   
(C) 9 : 1 (D)  $(3 + 2\sqrt{2}) : (3 - 2\sqrt{2})$

**Q18** Ray Optics[Step-by-step solution](#) > prepwiser.in/questions/TjAH1OVTGu

A monochromatic light of frequency  $5 \times 10^{14}\text{Hz}$  travelling through air, is incident on a medium of refractive index '2'. Wavelength of the refracted light will be:

- (A) 400 nm (B) 300 nm (C) 600 nm (D) 500 nm

**Q19** Sound Waves[Step-by-step solution](#) > prepwiser.in/questions/e0b4vnPoX8

In the resonance experiment, two air columns (closed at one end) of 100 cm and 120 cm long, give 15 beats per second when each one is sounding in the respective fundamental modes. The velocity of sound in the air column is:

- (A) 370m/s (B) 340m/s (C) 335m/s (D) 360m/s

**Q20** Units, Dimensions & Errors[Step-by-step solution](#) > prepwiser.in/questions/4oao8HMPBF

Match the LIST-I with LIST-II

| LIST-I |                          | LIST-II |                                         |
|--------|--------------------------|---------|-----------------------------------------|
| A.     | Boltzmann constant       | I       | $\text{ML}^2\text{T}^{-1}$              |
| B      | Coefficient of viscosity | II      | $\text{MLT}^{-3}\text{K}^{-1}$          |
| C      | Planck's constant        | III     | $\text{ML}^2\text{T}^{-2}\text{K}^{-1}$ |
| D      | Thermal conductivity     | IV      | $\text{ML}^{-1}\text{T}^{-1}$           |

Choose the correct answer from the options given below:

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

**Q21** Atomic Physics **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/XEr4LJA-MB

An electron in the hydrogen atom initially in the fourth excited state makes a transition to  $n^{\text{th}}$  energy state by emitting a photon of energy 2.86 eV. The integer value of  $n$  will be\_\_\_\_\_.

**Q22** Current Electricity **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/0vz\_ruT\_2E

Two cells of emfs 1 V and 2 V and internal resistances  $2\Omega$  and  $1\Omega$ , respectively, are connected in series with an external resistance of  $6\Omega$ . The total current in the circuit is  $I_1$ . Now the same two cells in parallel configuration are connected to same external resistance. In this case, the total current drawn is  $I_2$ . The value of  $\left(\frac{I_1}{I_2}\right)$  is  $\frac{x}{3}$ . The value of  $x$  is\_\_\_\_\_.

**Q23** Ray Optics **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/R5PssuuHHN

Light from a point source in air falls on a spherical glass surface (refractive index,  $\mu = 1.5$  and radius of curvature =  $50\text{cm}$ ). The image is formed at a distance of 200 cm from the glass surface inside the glass. The magnitude of distance of the light source from the glass surface is \_\_\_\_\_m.

**Q24** Surface Tension **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/oFV2xyzZQO

The excess pressure inside a soap bubble A in air is half the excess pressure inside another soap bubble B in air. If the volume of the bubble A is  $n$  times the volume of the bubble B, then, the value of  $n$  is\_\_\_\_\_.

**Q25** Units, Dimensions & Errors **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/ExCeREg98K

A physical quantity  $C$  is related to four other quantities  $p$ ,  $q$ ,  $r$  and  $s$  as follows

$$C = \frac{pq^2}{r^3\sqrt{s}}$$

The percentage errors in the measurement of  $p$ ,  $q$ ,  $r$  and  $s$  are 1%, 2%, 3% and 2%, respectively. The percentage error in the measurement of  $C$  will be\_\_\_\_\_%

Chemistry Section A · Multiple choice

**Q26** Carbohydrates & Biomolecules

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

Fat soluble vitamins are:

- A. Vitamin  $B_1$
- B. Vitamin C
- C. Vitamin E
- D. Vitamin B 12
- E. Vitamin K

Choose the correct answer from the options given below:

- (A) B & C Only                      (B) C & D Only                      (C) C & E Only                      (D) A & B Only

**Q27** Polymers

[Step-by-step solution](#) › prepwiser.in/questions/f9d5-07FGG

Given below are two statements:

Statement I : Wet cotton clothes made of cellulose based carbohydrate takes comparatively longer time to get dried than wet nylon polymer based clothes.

Statement II : Intermolecular hydrogen bonding with water molecule is more in nylon-based clothes than in the case of cotton clothes.

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

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

Consider the following statements related to temperature dependence of rate constants.

Identify the correct statements.

- A. The Arrhenius equation holds true only for an elementary homogenous reaction.
- B. The unit of  $A$  is same as that of  $k$  in Arrhenius equation.
- C. At a given temperature, a low activation energy means a fast reaction.
- D.  $A$  and  $E_a$  as used in Arrhenius equation depend on temperature.
- E. When  $E_a \gg RT$ ,  $A$  and  $E_a$  become interdependent.

Choose the correct answer from the options given below:

- (A) A, C and D Only      (B) B, D and E Only      (C) B and C Only      (D) A and B Only

Identify the diamagnetic octahedral complex ions from below;

- A.  $[\text{Mn}(\text{CN})_6]^{3-}$
- B.  $[\text{Co}(\text{NH}_3)_6]^{3+}$
- C.  $[\text{Fe}(\text{CN})_6]^{4-}$
- D.  $[\text{Co}(\text{H}_2\text{O})_3\text{F}_3]$

Choose the correct answer from the options given below:

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

Given below are two statements:

Statement I:  $\text{CrO}_3$  is a stronger oxidizing agent than  $\text{MoO}_3$

Statement II:  $\text{Cr(VI)}$  is more stable than  $\text{Mo(VI)}$

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

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

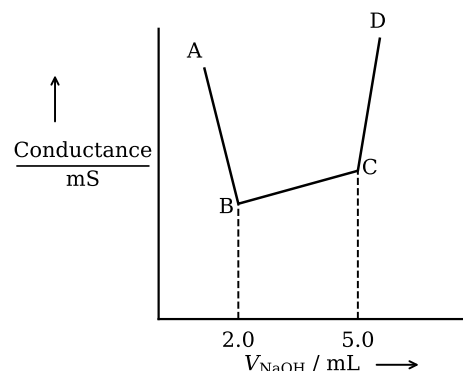
The standard cell potential ( $E_{\text{cell}}^\ominus$ ) of a fuel cell based on the oxidation of methanol in air that has been used to power television relay station is measured as 1.21 V. The standard half cell reduction potential for  $\text{O}_2$  ( $E_{\text{O}_2/\text{H}_2\text{O}}^\ominus$ ) is 1.229 V.

Choose the correct statement:

- (A) Reactants are fed at one go to each electrode.
- (B) Oxygen is formed at the anode.
- (C) The standard half cell reduction potential for the reduction of  $\text{CO}_2$  ( $E_{\text{CO}_2/\text{CH}_3\text{OH}}^\ominus$ ) is 19 mV
- (D) Reduction of methanol takes place at the cathode.

40 mL of a mixture of  $\text{CH}_3\text{COOH}$  and  $\text{HCl}$  (aqueous solution) is titrated against 0.1 M  $\text{NaOH}$  solution conductometrically. Which of the following statement is correct?

- (A) The concentration of  $\text{CH}_3\text{COOH}$  in the original mixture is 0.005 M
- (B) The concentration of  $\text{HCl}$  in the original mixture is 0.005 M
- (C)  $\text{CH}_3\text{COOH}$  is neutralised first followed by neutralisation of  $\text{HCl}$
- (D) Point 'C' indicates the complete neutralisation of  $\text{HCl}$



The correct orders among the following are

Atomic radius:  $B < Al < Ga < In < Tl$

Electronegativity:  $Al < Ga < In < Tl < B$

Density:  $Tl < In < Ga < Al < B$

1st Ionisation Energy:  $In < Al < Ga < Tl < B$

Choose the correct answer from the options given below:

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

Match the LIST-I with LIST-II

| LIST-I<br>(Family) |                      | LIST-II<br>(Symbol of Element) |    |
|--------------------|----------------------|--------------------------------|----|
| A.                 | Pnictogen (group 15) | I                              | Ts |
| B                  | Chalcogen            | II                             | Og |
| C                  | Halogen              | III                            | Lv |
| D                  | Noble gas            | IV                             | Mc |

Choose the correct answer from the options given below:

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

Mass of magnesium required to produce 220 mL of hydrogen gas at STP on reaction with excess of dil. HCl is

Given: Molar mass of Mg is  $24\text{g mol}^{-1}$ .

- (A) 0.24 mg      (B) 235.7 g      (C) 2.444 g      (D) 236 mg

10 mL of 2 M NaOH solution is added to 20 mL of 1 M HCl solution kept in a beaker. Now, 10 mL of this mixture is poured into a volumetric flask of 100 mL containing 2 moles of HCl and made the volume upto the mark with distilled water. The solution in this flask is:

- (A) 0.2 M NaCl solution      (B) 20 M HCl solution      (C) Neutral solution      (D) 10 M HCl solution

In Dumas' method for estimation of nitrogen 0.4 g of an organic compound gave 60 mL of nitrogen collected at 300 K temperature and 715 mm Hg pressure. The percentage composition of nitrogen in the compound is (Given : Aqueous tension at 300K = 15mmHg)

- (A) 15.71%      (B) 17.46%      (C) 7.85%      (D) 20.95%

For electrons in '2s' and '2p' orbitals, the orbital angular momentum values, respectively are:

- (A) 0 and  $\sqrt{6} \frac{h}{2\pi}$       (B) 0 and  $\sqrt{2} \frac{h}{2\pi}$       (C)  $\sqrt{2} \frac{h}{2\pi}$  and 0      (D)  $\frac{h}{2\pi}$  and  $\sqrt{2} \frac{h}{2\pi}$

Given below are two statements:

Statement I : When a system containing ice in equilibrium with water (liquid) is heated, heat is absorbed by the system and there is no change in the temperature of the system until whole ice gets melted.

Statement II : At melting point of ice, there is absorption of heat in order to overcome intermolecular forces of attraction within the molecules of water in ice and kinetic energy of molecules is not increased at melting point.

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

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

Given below are two statements:

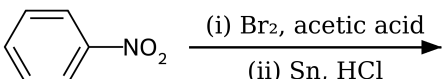
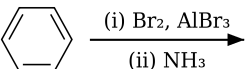
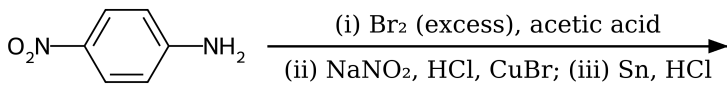
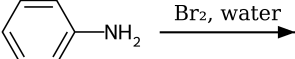
Statement I : Hyperconjugation is not a permanent effect.

Statement II : In general, greater the number of alkyl groups attached to a positively charged Cation, greater is the hyperconjugation interaction and stabilization of the cation.

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

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

The sequence from the following that would result in giving predominantly 3, 4, 5– Tribromoaniline is:

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

Compounds that should not be used as primary standards in titrimetric analysis are:

- A.  $\text{Na}_2\text{Cr}_2\text{O}_7$   
 B. Oxalic acid  
 C. NaOH  
 D.  $\text{FeSO}_4 \cdot 6\text{H}_2\text{O}$   
 E. Sodium tetraborate

Choose the most appropriate answer from the options given below:

- (A) C, D and E Only  
 (B) B and D Only  
 (C) D and E Only  
 (D) A, C and D Only

## Chemistry Section B · Numerical value

Q43 to Q47

Among, Sc, Mn, Co and Cu, identify the element with highest enthalpy of atomisation. The spin only magnetic moment value of that element in its +2 oxidation state is \_\_\_\_\_ BM (in nearest integer).

X g of nitrobenzene on nitration gave 4.2 g of m -dinitrobenzene. X = \_\_\_\_\_ g. (nearest integer)

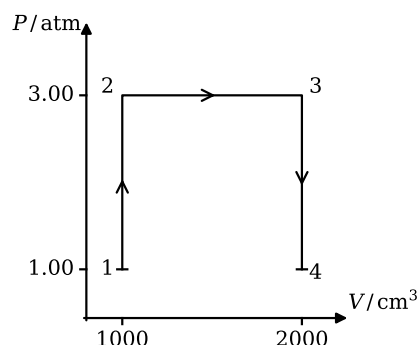
[Given : molar mass (in  $\text{g mol}^{-1}$ ) C : 12, H : 1, O : 16, N : 14]

Attempt this paper online with instant answer checking > [prepwiser.in/pyqs/paper/2025-04-03-evening](https://www.prepwiser.in/pyqs/paper/2025-04-03-evening)

**Q45** Chemical Thermodynamics **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/INs0xWIpAT

A perfect gas (0.1 mol) having  $\bar{C}_v = 1.50R$  (independent of temperature) undergoes the above transformation from point 1 to point 4. If each step is reversible, the total work done ( $w$ ) while going from point 1 to point 4 is (—) \_\_\_\_\_ J (nearest integer)

[Given:  $R = 0.082 \text{ LatmK}^{-1} \text{ mol}^{-1}$ ]

**Q46** Chemical Thermodynamics **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/fxl8OTXw9i

A sample of n-octane (1.14g) was completely burnt in excess of oxygen in a bomb calorimeter, whose heat capacity is  $5 \text{ kJ K}^{-1}$ . As a result of combustion reaction, the temperature of the calorimeter is increased by 5 K. The magnitude of the heat of combustion of octane at constant volume is \_\_\_\_\_  $\text{kJ mol}^{-1}$  (nearest integer).

**Q47** General Organic Chemistry (GOC) **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/KrZLmpk4r4

The total number of structural isomers possible for the substituted benzene derivatives with the molecular formula  $\text{C}_9\text{H}_{12}$  is \_\_\_\_\_.

**Mathematics Section A · Multiple choice**

Q48 to Q67

**Q48** Three Dimensional Geometry[Step-by-step solution](#) › prepwiser.in/questions/WIkegvOxwN

Each of the angles  $\beta$  and  $\gamma$  that a given line makes with the positive  $y$ - and  $z$ -axes, respectively, is half of the angle that this line makes with the positive  $x$ -axis. Then the sum of all possible values of the angle  $\beta$  is

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

**Q49** Three Dimensional Geometry[Step-by-step solution](#) › prepwiser.in/questions/ahb7dg-y4x

The distance of the point (7, 10, 11) from the line  $\frac{x-4}{1} = \frac{y-4}{0} = \frac{z-2}{3}$  along the line  $\frac{x-9}{2} = \frac{y-13}{3} = \frac{z-17}{6}$  is

- (A) 16 (B) 12 (C) 18 (D) 14

**Q50** Parabola[Step-by-step solution](#) › prepwiser.in/questions/mOh20LmW0u

The shortest distance between the curves  $y^2 = 8x$  and  $x^2 + y^2 + 12y + 35 = 0$  is:

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

**Q51** Applications of Derivatives[Step-by-step solution](#) › prepwiser.in/questions/YmILpzkwzb

Let  $f : \mathbb{R} \rightarrow \mathbb{R}$  be a function defined by  $f(x) = ||x + 2| - 2|x||$ . If  $m$  is the number of points of local minima and  $n$  is the number of points of local maxima of  $f$ , then  $m + n$  is

- (A) 3 (B) 4 (C) 2 (D) 5

**Q52** Circles[Step-by-step solution](#) › prepwiser.in/questions/xu9KXsZ3Z6

If the four distinct points (4, 6), (−1, 5), (0, 0) and (k, 3k) lie on a circle of radius  $r$ , then  $10k + r^2$  is equal to

- (A) 34 (B) 32 (C) 35 (D) 33

**Q53** Complex Numbers[Step-by-step solution](#) > [prepwiser.in/questions/sP2oQwwrmt](https://www.prepwiser.in/questions/sP2oQwwrmt)

If  $z_1, z_2, z_3 \in \mathbb{C}$  are the vertices of an equilateral triangle, whose centroid is  $z_0$ , then  $\sum_{k=1}^3 (z_k - z_0)^2$  is equal to

- (A) 0 (B) 1 (C) i (D) -i

**Q54** Definite Integration[Step-by-step solution](#) > [prepwiser.in/questions/UBfkAGrC-s](https://www.prepwiser.in/questions/UBfkAGrC-s)

The integral  $\int_0^\pi \frac{8x dx}{4 \cos^2 x + \sin^2 x}$  is equal to

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

**Q55** Differential Equations[Step-by-step solution](#) > [prepwiser.in/questions/8MXqc8XjSi](https://www.prepwiser.in/questions/8MXqc8XjSi)

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

$\frac{dy}{dx} + 3(\tan^2 x)y + 3y = \sec^2 x, y(0) = \frac{1}{3} + e^3$ . Then  $y\left(\frac{\pi}{4}\right)$  is equal to:

- (A)  $\frac{4}{3}$  (B)  $\frac{2}{3} + e^3$  (C)  $\frac{4}{3} + e^3$  (D)  $\frac{2}{3}$

**Q56** Applications of Derivatives[Step-by-step solution](#) > [prepwiser.in/questions/CrHugLEl5v](https://www.prepwiser.in/questions/CrHugLEl5v)

Let  $C$  be the circle of minimum area enclosing the ellipse  $E: \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  with eccentricity  $\frac{1}{2}$  and foci  $(\pm 2, 0)$ . Let  $PQR$  be a variable triangle, whose vertex  $P$  is on the circle  $C$  and the side  $QR$  of length  $2a$  is parallel to the major axis of  $E$  and contains the point of intersection of  $E$  with the negative  $y$ -axis. Then the maximum area of the triangle  $PQR$  is:

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

**Q57** Functions (Advanced)[Step-by-step solution](#) > [prepwiser.in/questions/SduSQEsbc0](https://www.prepwiser.in/questions/SduSQEsbc0)

Let  $f$  be a function such that  $f(x) + 3f\left(\frac{24}{x}\right) = 4x, x \neq 0$ . Then  $f(3) + f(8)$  is equal to

- (A) 13 (B) 11 (C) 10 (D) 12

**Q58** Functions (Advanced)[Step-by-step solution](#) > [prepwiser.in/questions/v\\_1BV8y5sR](https://www.prepwiser.in/questions/v_1BV8y5sR)

If the domain of the function  $f(x) = \log_7(1 - \log_4(x^2 - 9x + 18))$  is  $(\alpha, \beta) \cup (\gamma, \delta)$ , then  $\alpha + \beta + \gamma + \delta$  is equal to

- (A) 17 (B) 15 (C) 16 (D) 18

**Q59** Permutations & Combinations[Step-by-step solution](#) > [prepwiser.in/questions/hcSyZT7tu\\_](https://www.prepwiser.in/questions/hcSyZT7tu_)

Line  $L_1$  of slope 2 and line  $L_2$  of slope  $\frac{1}{2}$  intersect at the origin O. In the first quadrant,  $P_1, P_2, \dots, P_{12}$  are 12 points on line  $L_1$  and  $Q_1, Q_2, \dots, Q_9$  are 9 points on line  $L_2$ . Then the total number of triangles, that can be formed having vertices at three of the 22 points O,  $P_1, P_2, \dots, P_{12}, Q_1, Q_2, \dots, Q_9$ , is:

- (A) 1026 (B) 1188 (C) 1134 (D) 1080

**Q60** Probability: Advanced[Step-by-step solution](#) > [prepwiser.in/questions/14oq2XEZNR](https://www.prepwiser.in/questions/14oq2XEZNR)

If the probability that the random variable  $X$  takes the value  $x$  is given by

$P(X = x) = k(x + 1)3^{-x}, x = 0, 1, 2, 3, \dots$ , where  $k$  is a constant, then  $P(X \geq 3)$  is equal to

- (A)  $\frac{1}{9}$  (B)  $\frac{8}{27}$  (C)  $\frac{7}{27}$  (D)  $\frac{4}{9}$

**Q61** Straight Lines[Step-by-step solution](#) > [prepwiser.in/questions/BBaCGPCL-X](https://www.prepwiser.in/questions/BBaCGPCL-X)

Let the equation  $x(x + 2)(12 - k) = 2$  have equal roots. Then the distance of the point  $\left(k, \frac{k}{2}\right)$  from the line  $3x + 4y + 5 = 0$  is

- (A) 15 (B) 12 (C)  $5\sqrt{3}$  (D)  $15\sqrt{5}$

**Q62** Sequences & Series[Step-by-step solution](#) > [prepwiser.in/questions/rvoH7iH385](https://www.prepwiser.in/questions/rvoH7iH385)

The sum  $1 + \frac{1+3}{2!} + \frac{1+3+5}{3!} + \frac{1+3+5+7}{4!} + \dots$  upto  $\infty$  terms, is equal to

- (A)  $3e$  (B)  $2e$  (C)  $4e$  (D)  $6e$

**Q63** Relations & Functions (Basic)[Step-by-step solution](#) > prepwiser.in/questions/EjJq5nxhit

Let  $A = \{-2, -1, 0, 1, 2, 3\}$ . Let  $R$  be a relation on  $A$  defined by  $xRy$  if and only if  $y = \max\{x, 1\}$ . Let  $l$  be the number of elements in  $R$ . Let  $m$  and  $n$  be the minimum number of elements required to be added in  $R$  to make it reflexive and symmetric relations, respectively. Then  $l + m + n$  is equal to

- (A) 11 (B) 12 (C) 14 (D) 13

**Q64** Statistics[Step-by-step solution](#) > prepwiser.in/questions/lu\_jXcLJ3U

Let the Mean and Variance of five observations  $x_1 = 1, x_2 = 3, x_3 = a, x_4 = 7$  and  $x_5 = b, a > b$ , be 5 and 10 respectively. Then the Variance of the observations  $n + x_n, n = 1, 2, \dots, 5$  is

- (A) 17 (B) 16 (C) 16.4 (D) 17.4

**Q65** Trigonometric Equations[Step-by-step solution](#) > prepwiser.in/questions/-hDaxPWxj9

The number of solutions of the equation

$$(4 - \sqrt{3}) \sin x - 2\sqrt{3} \cos^2 x = -\frac{4}{1+\sqrt{3}}, x \in \left[-2\pi, \frac{5\pi}{2}\right] \text{ is}$$

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

**Q66** Area Under Curves[Step-by-step solution](#) > prepwiser.in/questions/4wpm-uC0qB

The area of the region  $\{(x, y) : |x - y| \leq y \leq 4\sqrt{x}\}$  is

- (A)  $\frac{512}{3}$  (B)  $\frac{2048}{3}$  (C) 512 (D)  $\frac{1024}{3}$

**Q67** Straight Lines[Step-by-step solution](#) > prepwiser.in/questions/PwXqkb77z3

Consider the lines  $x(3\lambda + 1) + y(7\lambda + 2) = 17\lambda + 5, \lambda$  being a parameter, all passing through a point  $P$ . One of these lines (say  $L$ ) is farthest from the origin. If the distance of  $L$  from the point  $(3, 6)$  is  $d$ , then the value of  $d^2$  is

- (A) 10 (B) 20 (C) 15 (D) 30

**Mathematics Section B · Numerical value**

Q68 to Q72

**Q68** Binomial Theorem **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/J2bK\_1LL7V

Let  $(1 + x + x^2)^{10} = a_0 + a_1x + a_2x^2 + \dots + a_{20}x^{20}$ . If  $(a_1 + a_3 + a_5 + \dots + a_{19}) - 11a_2 = 121k$ , then  $k$  is equal to\_\_\_\_\_.

**Q69** Hyperbola **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/I3MiziML9m

If the equation of the hyperbola with foci  $(4, 2)$  and  $(8, 2)$  is  $3x^2 - y^2 - \alpha x + \beta y + \gamma = 0$ , then  $\alpha + \beta + \gamma$  is equal to\_\_\_\_\_.

**Q70** Limits **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/EQaLpFED2a

$$\text{If } \lim_{x \rightarrow 0} \left( \frac{\tan x}{x} \right)^{\frac{1}{x^2}} = p, \text{ then } 96 \log_e p \text{ is equal to } \underline{\hspace{2cm}}$$

**Q71** Determinants **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/HqJU6uTHz7

Let  $I$  be the identity matrix of order  $3 \times 3$  and for the matrix  $A = \begin{bmatrix} \lambda & 2 & 3 \\ 4 & 5 & 6 \\ 7 & -1 & 2 \end{bmatrix}, |A| = -1$ . Let  $B$  be the inverse of the matrix  $\text{adj}(A \text{adj}(A^2))$ . Then  $|(\lambda B + I)|$  is equal to\_\_\_\_\_

**Q72** Vectors **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/7qZxv7Nmjq

Let  $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}, \vec{b} = 3\hat{i} - 3\hat{j} + 3\hat{k}, \vec{c} = 2\hat{i} - \hat{j} + 2\hat{k}$  and  $\vec{d}$  be a vector such that  $\vec{b} \times \vec{d} = \vec{c} \times \vec{d}$  and  $\vec{a} \cdot \vec{d} = 4$ . Then  $|(\vec{a} \times \vec{d})|^2$  is equal to\_\_\_\_\_.

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### Physics

|               |              |              |              |              |              |              |              |
|---------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 1. <b>B</b>   | 2. <b>B</b>  | 3. <b>D</b>  | 4. <b>B</b>  | 5. <b>B</b>  | 6. <b>A</b>  | 7. <b>B</b>  | 8. <b>D</b>  |
| 9. <b>C</b>   | 10. <b>B</b> | 11. <b>C</b> | 12. <b>D</b> | 13. <b>A</b> | 14. <b>C</b> | 15. <b>D</b> | 16. <b>B</b> |
| 17. <b>D</b>  | 18. <b>B</b> | 19. <b>D</b> | 20. <b>A</b> | 21. <b>2</b> | 22. <b>4</b> | 23. <b>4</b> | 24. <b>8</b> |
| 25. <b>15</b> |              |              |              |              |              |              |              |

### Chemistry

|              |              |              |                |                 |              |              |              |
|--------------|--------------|--------------|----------------|-----------------|--------------|--------------|--------------|
| 26. <b>C</b> | 27. <b>D</b> | 28. <b>C</b> | 29. <b>A</b>   | 30. <b>A</b>    | 31. <b>C</b> | 32. <b>B</b> | 33. <b>A</b> |
| 34. <b>B</b> | 35. <b>D</b> | 36. <b>B</b> | 37. <b>A</b>   | 38. <b>B</b>    | 39. <b>C</b> | 40. <b>A</b> | 41. <b>C</b> |
| 42. <b>D</b> | 43. <b>4</b> | 44. <b>3</b> | 45. <b>304</b> | 46. <b>2500</b> | 47. <b>8</b> |              |              |

### Mathematics

|                |              |              |              |                |                |               |                |
|----------------|--------------|--------------|--------------|----------------|----------------|---------------|----------------|
| 48. <b>C</b>   | 49. <b>D</b> | 50. <b>B</b> | 51. <b>A</b> | 52. <b>C</b>   | 53. <b>A</b>   | 54. <b>A</b>  | 55. <b>A</b>   |
| 56. <b>B</b>   | 57. <b>B</b> | 58. <b>D</b> | 59. <b>C</b> | 60. <b>A</b>   | 61. <b>A</b>   | 62. <b>B</b>  | 63. <b>B</b>   |
| 64. <b>B</b>   | 65. <b>D</b> | 66. <b>D</b> | 67. <b>B</b> | 68. <b>239</b> | 69. <b>141</b> | 70. <b>32</b> | 71. <b>-38</b> |
| 72. <b>128</b> |              |              |              |                |                |               |                |

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