

Q1. JEE Main 2026 (23 January Shift 1)

Consider the general reaction given below at 400 K
 $x A(g) \rightleftharpoons y B(g)$

The values of K_p and K_c are studied under the same condition of temperature but variation in x and y .

(i) $K_p = 85.87$ and $K_c = 2.586$ appropriate units

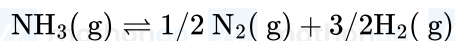
(ii) $K_p = 0.862$ and $K_c = 28.62$ appropriate units.

The values of x and y in (i) and (ii) respectively are:

- | | |
|--------------|--------------|
| (1) (i) (ii) | (2) (i) (ii) |
| 1, 3 2, 1 | 4, 1 4, 1 |
| (3) (i) (ii) | (4) (i) (ii) |
| 3, 1 3, 1 | 1, 2 2, 1 |

Q2. JEE Main 2026 (23 January Shift 1)

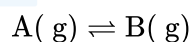
For the following gas phase equilibrium reaction at constant temperature,



if the total pressure is $\sqrt{3}$ atm and the pressure equilibrium constant (K_p) is 9 atm, then the degree of dissociation is given as $(x \times 10^{-2})^{-1/2}$. The value of x is _____. (nearest integer)

Q3. JEE Main 2026 (28 January Shift 2)

Observe the following equilibrium in a 1 L flask.

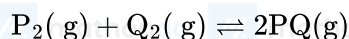


At T(K), the equilibrium concentrations of A and B are 0.5 M and 0.375 M respectively. 0.1 moles of A is added into the flask and heated to T(K) to establish the equilibrium again. The new equilibrium concentrations (in M) of A and B are respectively

- | | |
|-------------------|-------------------|
| (1) 0.53, 0.4. | (2) 0.742, 0.557. |
| (3) 0.557, 0.418. | (4) 0.367, 0.275. |

Q4. JEE Main 2026 (24 January Shift 2)

Consider the following gaseous equilibrium in a closed container of volume 'V' at T(K).

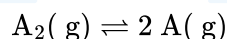


2 moles each of $P_2(g)$, $Q_2(g)$ and $PQ(g)$ are present at equilibrium. Now one mole each of ' P_2 ' and ' Q_2 ' are added to the equilibrium keeping the temperature at T(K). The number of moles of P_2 , Q_2 and PQ at the new equilibrium, respectively, are

- | | |
|----------------------|----------------------|
| (1) 1.66, 1.66, 1.66 | (2) 2.56, 1.62, 2.24 |
| (3) 2.67, 2.67, 2.67 | (4) 1.21, 2.24, 1.56 |

Q5. JEE Main 2026 (22 January Shift 1)

Dissociation of a gas A_2 takes place according to the following chemical reaction. At equilibrium, the total pressure is 1 bar at 300 K.



The standard Gibbs energy of formation of the involved substances has been provided below:

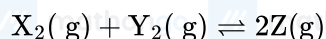
Substance	$\Delta G_f^\circ / \text{kJ mol}^{-1}$
A_2	-100.00
A	-50.832

The degree of dissociation of $A_2(g)$ is given by $(x \times 10^{-2})^{1/2}$ where $x = \underline{\hspace{1cm}}$. (Nearest integer).

[Given: $R = 8 \text{ J mol}^{-1} \text{ K}^{-1}$, $\log 2 = 0.3010$, $\log 3 = 0.48$]

Assume degree of dissociation is not negligible.

Q6. JEE Main 2026 (23 January Shift 2)

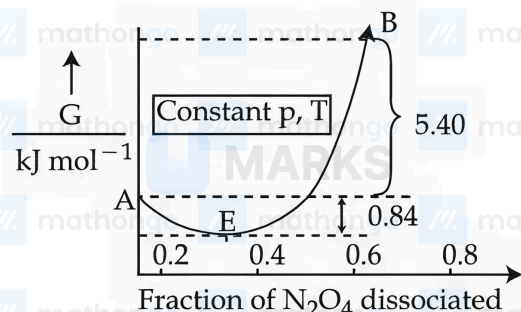


$X_2(g)$ and $Y_2(g)$ are added to a 1 L flask and it is found that the system attains the above equilibrium at $T(K)$ with the number of moles of $X_2(g)$, $Y_2(g)$ and $Z(g)$ being 3, 3 and 9 mol respectively (equilibrium moles). Under this condition of equilibrium, 10 mol of $Z(g)$ is added to the flask and the temperature is maintained at $T(K)$. Then the number of moles of $Z(g)$ in the flask when the new equilibrium is established is $\underline{\hspace{1cm}}$. (Nearest integer)

Q7. JEE Main 2026 (21 January Shift 1)

For the reaction, $N_2O_4 \rightleftharpoons 2NO_2$, graph is plotted as shown below. Identify correct statements.

- Standard free energy change for the reaction is $-5.40 \text{ kJ mol}^{-1}$.
- As $\Delta G^\ominus$ in graph is positive, N_2O_4 will not dissociate into NO_2 at all.
- Reverse reaction will go to completion.
- When 1 mole of N_2O_4 changes into equilibrium mixture, value of $\Delta G^\ominus = -0.84 \text{ kJ mol}^{-1}$.
- When 2 mole of NO_2 changes into equilibrium mixture, $\Delta G^\ominus$ for equilibrium mixture is $-6.24 \text{ kJ mol}^{-1}$.



Choose the correct answer from the options given below :

- (1) D and E only
- (2) A and D only
- (3) B and C only
- (4) C and E only

ANSWERS AND SOLUTIONS

1. (4) 2. 125 3. (3) 4. (3) 5. 33 6. 15 7. (1)

1. (4) The relationship between K_p and K_c is given by $K_p = K_c(RT)^{\Delta n_g}$, where $\Delta n_g = y - x$.

Given $T = 400$ K and $R = 0.0821$ L atm K⁻¹ mol⁻¹.

The value of $RT = 0.0821 \times 400 = 32.84$.

For case (i): $K_p = 85.87$ and $K_c = 2.586$.

$$\frac{K_p}{K_c} = \frac{85.87}{2.586} \approx 33.2.$$

Since $33.2 \approx 32.84^1$, we have $\Delta n_g = y - x = 1$.

Checking options for (i):

$$(1) y - x = 3 - 1 = 2$$

$$(2) y - x = 1 - 4 = -3$$

$$(3) y - x = 1 - 3 = -2$$

$$(4) y - x = 2 - 1 = 1. \text{ This matches.}$$

For case (ii): $K_p = 0.862$ and $K_c = 28.62$.

$$\frac{K_p}{K_c} = \frac{0.862}{28.62} \approx 0.0301.$$

Since $0.0301 \approx \frac{1}{32.84} = 32.84^{-1}$, we have $\Delta n_g = y - x = -1$.

Checking option (4) for (ii): $y - x = 1 - 2 = -1$. This also matches.

Thus, for (i) $x = 1, y = 2$ and for (ii) $x = 2, y = 1$.

2. (125) For the reaction: $NH_3(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{3}{2}H_2(g)$

At $t = 0$: 1 mole, $-$, $-$

At equilibrium: $1 - \alpha, \frac{\alpha}{2}, \frac{3\alpha}{2}$

Total moles = $1 + \alpha$

$$K_P = \frac{\left(\frac{\alpha}{2}\right)^{1/2} \left(\frac{3\alpha}{2}\right)^{3/2}}{(1-\alpha)} \cdot \left(\frac{P_T}{1+\alpha}\right)^1$$

Given $P_T = \sqrt{3}$ atm and $K_P = 9$ atm:

$$9 = \frac{\left(\frac{\alpha}{2}\right)^{1/2} \left(\frac{3\alpha}{2}\right)^{3/2}}{(1-\alpha)} \times \frac{(3)^{1/2}}{1+\alpha}$$

$$\text{Simplifying: } 9 = \frac{9\left(\frac{\alpha}{2}\right)^2}{1-\alpha^2}$$

$$1 - \alpha^2 = \frac{\alpha^2}{4}$$

$$\frac{5\alpha^2}{4} = 1 \Rightarrow \alpha^2 = 0.8$$

$$\alpha = (0.8)^{1/2} = \left(\frac{1}{0.8}\right)^{-1/2} = (125 \times 10^{-2})^{-1/2}$$

So $x = 125$.

3. (3) Initial equilibrium:

$$[A]=0.5 \text{ M}, [B]=0.375 \text{ M}; K_c = \frac{0.375}{0.5} = 0.75$$

After adding 0.1 mol A: $[A]=0.6 \text{ M}, [B]=0.375 \text{ M}; Q=0.625$

$Q < K_c$, so equilibrium shifts right.

Let x be A that decomposes:

$$\frac{0.375+x}{0.6-x} = 0.75$$

$$0.375+x=0.45-0.75x$$

$$1.75x=0.075; x \approx 0.0429$$

New $[A]=0.6-0.0429=0.557 \text{ M}; [B]=0.375+0.0429=0.418 \text{ M}$

4. (3) Initial equilibrium: 2 moles each of P_2 , Q_2 , PQ with $K = \frac{[PQ]^2}{[P_2][Q_2]} = \frac{4}{4} = 1$.

After adding 1 mole each of P_2 and Q_2 : initial composition is $(3, 3, 2)$. Reaction quotient $Q = \frac{4}{9} < K$, so reaction shifts right.

Let x moles of reactants combine:

$$\frac{(2+2x)^2}{(3-x)^2} = 1$$

$$2 + 2x = 3 - x$$

$$3x = 1 \rightarrow x = \frac{1}{3}$$

Final moles: $P_2 = 3 - \frac{1}{3} = 2.67$, $Q_2 = 2.67$, $PQ = 2 + \frac{2}{3} = 2.67$

5. (33) For the dissociation reaction $A_2(g) \rightleftharpoons 2A(g)$, first calculate the standard Gibbs free energy:

$$\Delta G^\circ_{rxn} = 2(-50.832) - (-100.00) = -1.664 \text{ kJ/mol.}$$

Using $\Delta G^\circ = -RT \ln K_p$:

$$-1664 = -8 \times 300 \times \ln K_p, \text{ giving } K_p = e^{0.6933} = 2.$$

For dissociation with degree of dissociation α , starting with 1 mole of A_2 at 1 bar total pressure:

At equilibrium, moles are $(1 - \alpha)$ for A_2 and 2α for A , with total $(1 + \alpha)$ moles.

$$K_p = \frac{4\alpha^2}{1-\alpha^2} = 2.$$

Solving: $2(1 - \alpha^2) = 4\alpha^2$ gives $\alpha^2 = 1/3$ or $\alpha = 0.577$.

Since degree of dissociation is $(x \times 10^{-2})^{1/2}$:

$$(x \times 10^{-2})^{1/2} = 0.577 \text{ gives } x \times 10^{-2} = 0.333, \text{ so } x = 33.3 \approx 33.$$

6. (15) The equilibrium constant for the reaction $X_2(g) + Y_2(g) \rightleftharpoons 2Z(g)$ is calculated from the initial equilibrium state:

$$K_c = \frac{[Z]^2}{[X_2][Y_2]} = \frac{9^2}{3 \times 3} = 9 \text{ mol/L.}$$

When 10 mol of Z(g) is added, the new concentrations are: $[X_2] = 3$, $[Y_2] = 3$, $[Z] = 19$ mol.

The reaction quotient is $Q = \frac{19^2}{3 \times 3} = 40.11$.

Since $Q > K_c$, the equilibrium shifts left (toward reactants).

Let x mol of Z decompose. At the new equilibrium: $[X_2] = 3 + \frac{x}{2}$, $[Y_2] = 3 + \frac{x}{2}$, $[Z] = 19 - x$.

Applying the equilibrium expression: $\frac{(19-x)^2}{(3+\frac{x}{2})^2} = 9$.

Taking the square root: $\frac{19-x}{3+\frac{x}{2}} = 3$.

Solving: $19 - x = 9 + \frac{3x}{2}$, which gives $10 = \frac{5x}{2}$, so $x = 4$.

The moles of Z at new equilibrium = $19 - 4 = 15$ mol.

7. (1) From the graph of G vs fraction of N_2O_4 dissociated:

At $x = 0$ (pure N_2O_4): $G = 0$

At equilibrium ($x \approx 0.4$): $G = -0.84$ kJ/mol (minimum)

At $x = 1$ (complete dissociation): $G = 5.40$ kJ/mol

Statement A: $\Delta G^\circ = 5.40$ kJ/mol (positive), not -5.40 kJ/mol. False.

Statement B: Even with positive ΔG° , equilibrium is established with partial dissociation. False.

Statement C: Reverse reaction reaches equilibrium, not completion. False.

Statement D: $\Delta G = G_{eq} - G_{N_2O_4} = -0.84 - 0 = -0.84$ kJ/mol. True.

Statement E: $\Delta G = G_{eq} - G_{NO_2} = -0.84 - 5.40 = -6.24$ kJ/mol. True.