Interactive Practice & Step-by-Step Solutions: Click any question to solve it with timer & full explanation on The Crucible.

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Percentage Composition Calculations · JEE Main 2019 · Shift-II

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1. The percentage composition of carbon **by mole** in methane (CH_4) is:

(A) 75%

(B) 20%

(C) 80%

(D) 25%

Comparison of Orbital Energies & Degeneracy · JEE Main 2024 · Shift-I

View Solution on Crucible ↗

2. Compare the energies of following sets of quantum numbers for a **multielectron** system: **(A)** $n = 4, l = 1$ (4p) **(B)** $n = 4, l = 2$ (4d) **(C)** $n = 3, l = 1$ (3p) **(D)** $n = 3, l = 2$ (3d) **(E)** $n = 4, l = 0$ (4s) Choose the correct answer:

(A) (B) > (A) > (C) > (E) > (D)

(B) (E) < (C) < (D) < (A) < (B)

(C) (E) > (C) > (A) > (D) > (B)

(D) (C) < (E) < (D) < (A) < (B)

Comparative Analysis · JEE Main 2020 · Shift-I

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3. For one mole of an ideal gas, which of these statements must be true? (a) Internal energy (U) and enthalpy (H) each depends on temperature. (b) Compressibility factor Z is not equal to 1. (c) $C_{P,m} - C_{V,m} = R$ (d) $dU = C_v\, dT$ for any process

(A) (a) and (c)

(B) (b), (c) and (d)

(C) (c) and (d)

(D) (a), (c) and (d)

Ostwald's Dilution Law · JEE Main 2023 · Shift-I

View Solution on Crucible ↗

4. For a concentrated solution of a weak electrolyte (K_{eq} = equilibrium constant) A_2B_3 of concentration C, the degree of dissociation α is

(A) $\left(\frac{K_{eq}}{5c^4}\right)^{1/5}$

(B) $\left(\frac{K_{eq}}{108c^4}\right)^{1/5}$

(C) $\left(\frac{K_{eq}}{25c^2}\right)^{1/5}$

(D) $\left(\frac{K_{eq}}{6c^5}\right)^{1/5}$

Kp-Kc Relationship · JEE Main 2024 · Shift-II

View Solution on Crucible ↗

5. The ratio $\frac{K_P}{K_C}$ for the reaction: $CO_{(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons CO_{2(g)}$ is:

(A) $\frac{1}{\sqrt{RT}}$

(B) $(RT)^{1/2}$

(C) RT

(D) 1

Titration Calculations (Volume & Normality) · JEE Main 2022 · Shift-II View Solution on Crucible ↗

6. The neutralization occurs when 10 mL of 0.1 M acid 'A' is allowed to react with 30 mL of 0.05 M base $\mathrm{M(OH)_2}$. The basicity of the acid 'A' is [M is a metal]

(A) 1
(B) 2
(C) 3
(D) 4

Significant Figures Rules · JEE Main PYQ View Solution on Crucible ↗

7. An electronic balance used in a mailroom displays tenths of a kilogram (range 0 to $140\,\mathrm{kg}$). How many significant figures should be used to express the mass of any package whose mass is between 80.2 and $83.5\,\mathrm{kg}$?

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

Four Quantum Numbers (n, l, m_l, m_s) · JEE Main 2024 · Shift-II View Solution on Crucible ↗

8. The four quantum numbers for the electron in the outermost orbital of potassium (atomic number 19) are:

(A) $n=4,\ l=2,\ m=-1,\ s=+\frac{1}{2}$
(B) $n=4,\ l=0,\ m=0,\ s=+\frac{1}{2}$
(C) $n=3,\ l=0,\ m=-1,\ s=+\frac{1}{2}$
(D) $n=2,\ l=0,\ m=0,\ s=+\frac{1}{2}$

ΔH vs ΔU Relationship · JEE Main 2023 · Shift-II View Solution on Crucible ↗

9. Which of the following relation is **not correct**?

(A) $\Delta H=\Delta U-P\Delta V$
(B) $\Delta U=q+W$
(C) $\Delta S_{\text{sys}}+\Delta S_{\text{surr}}\geq 0$
(D) $\Delta G=\Delta H-T\Delta S$

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pH Scale & Interpretation · JEE Main 2023 · Shift-II View Solution on Crucible ↗

10. When the hydrogen ion concentration $[\mathrm{H^+}]$ changes by a factor of 1000, the value of pH of the solution

(A) Increases by 1000 units
(B) Decreases by 3 units
(C) Decreases by 2 units
(D) Increases by 2 units

Kp-Kc Relationship · JEE Main 2020 · Shift-I View Solution on Crucible ↗

11. For the reaction $\mathrm{Fe_2N(s) + \frac{3}{2}H_2(g) \rightleftharpoons 2Fe(s) + NH_3(g)}$

(A) $K_c = K_p(RT)$

(B) $K_c = K_p(RT)^{-1/2}$

(C) $K_c = K_p(RT)^{1/2}$

(D) $K_c = K_p(RT)^{3/2}$

Oxidation Number Calculations · JEE Main 2021 · Shift-II View Solution on Crucible ↗

12. The oxidation states of nitrogen in NO, $\mathrm{NO_2}$, $\mathrm{N_2O}$ and $\mathrm{NO_3^-}$ are in the order of:

(A) $\mathrm{NO_3^- > NO_2 > NO > N_2O}$

(B) $\mathrm{NO_2 > NO_3^- > NO > N_2O}$

(C) $\mathrm{N_2O > NO_2 > NO > NO_3^-}$

(D) $\mathrm{NO > NO_2 > N_2O > NO_3^-}$

Mole Fraction & Mass Percent · JEE Main 2023 · Shift-II View Solution on Crucible ↗

13. A solution is prepared by adding $2\,\mathrm{g}$ of X to 1 mole of water. Mass percent of X in solution is:

(A) 5%

(B) 20%

(C) 2%

(D) 10%

Four Quantum Numbers (n, l, m_l, m_s) · JEE Main 2022 · Shift-I View Solution on Crucible ↗

14. Which of the following sets of quantum numbers is **not** allowed?

(A) $n = 3,\ l = 2,\ m_l = 0,\ s = +\frac{1}{2}$

(B) $n = 3,\ l = 2,\ m_l = -2,\ s = +\frac{1}{2}$

(C) $n = 3,\ l = 3,\ m_l = -3,\ s = -\frac{1}{2}$

(D) $n = 3,\ l = 0,\ m_l = 0,\ s = -\frac{1}{2}$

Hess's Law Applications · JEE Main 2022 · Shift-II View Solution on Crucible ↗

15. At STP, Enthalpy of combustion of benzene (l) and acetylene (g) are -3268 and $-1300\,\mathrm{kJ\ mol^{-1}}$ respectively. The ΔH for $3\mathrm{C_2H_2}(g) \rightarrow \mathrm{C_6H_6}(l)$ is:

(A) $+324\,\mathrm{kJ\ mol^{-1}}$

(B) $+632\,\mathrm{kJ\ mol^{-1}}$

(C) $-632\,\mathrm{kJ\ mol^{-1}}$

(D) $-732\,\mathrm{kJ\ mol^{-1}}$

Common Ion Effect · JEE Main 2019 · Shift-II View Solution on Crucible ↗

16. The molar solubility of $\mathrm{Cd(OH)_2}$ is 1.84×10^{-5} M in water. The expected solubility of $\mathrm{Cd(OH)_2}$ in a buffer solution of pH = 12 is:

(A) 2.49×10^{-10} M
(B) $\frac{2.49}{1.84} \times 10^{-9}$ M
(C) 1.84×10^{-9} M
(D) 6.23×10^{-11} M

Equilibrium Constant for Reverse Reaction · JEE Main 2024 · Shift-II View Solution on Crucible ↗

17. The equilibrium constant for the reaction $\mathrm{SO_3(g) \rightleftharpoons SO_2(g) + \frac{1}{2}O_2(g)}$ is $K_c = 4.9 \times 10^{-2}$. The value of K_c for the reaction $\mathrm{2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)}$ is:

(A) 4.9
(B) 49
(C) 41.6
(D) 416

Fractional Oxidation States · JEE Main 2021 · Shift-I View Solution on Crucible ↗

18. In polythionic acid, $\mathrm{H_2S_xO_6}$ $(x = 3 \text{ to } 5)$ the oxidation state(s) of sulphur is/are:

(A) +6 only
(B) +5 only
(C) 0 and +5 only
(D) +3 and +5 only

Interconversion of Concentration Units · JEE Main 2024 · Shift-II View Solution on Crucible ↗

19. Molality (m) of $3\,\mathrm{M}$ aqueous solution of NaCl is: (Density $= 1.25\,\mathrm{g\,mL^{-1}}$; M_r: Na $= 23$, Cl $= 35.5$)

(A) $1.9\,m$
(B) $3.85\,m$
(C) $2.79\,m$
(D) $2.90\,m$

Writing Electronic Configuration · JEE Main 2022 · Shift-I View Solution on Crucible ↗

20. The electronic configuration of Pt (atomic number 78) is:

(A) $[\mathrm{Kr}]\,4f^{14}\,5d^{10}$
(B) $[\mathrm{Xe}]\,4f^{14}\,5d^{10}$
(C) $[\mathrm{Xe}]\,4f^{14}\,5d^{8}\,6s^{2}$
(D) $[\mathrm{Xe}]\,4f^{14}\,5d^{9}\,6s^{1}$

Bond Enthalpy Calculations · JEE Main 2021 · Shift-I
View Solution on Crucible ↗

21. At 298.2 K the relationship between enthalpy of bond dissociation (in $\mathrm{kJ\ mol^{-1}}$) for hydrogen (E_H) and its isotope, deuterium (E_D), is best described by:

(A) $E_H = \frac{1}{2}E_D$
(B) $E_H = E_D$
(C) $E_H = E_D - 7.5$
(D) $E_H = 2E_D$

Solubility Calculations from Ksp · JEE Main 2020 · Shift-II
View Solution on Crucible ↗

22. The solubility product of $\mathrm{Cr(OH)_3}$ at 298 K is 6.0×10^{-31}. The concentration of hydroxide ions in a saturated solution of $\mathrm{Cr(OH)_3}$ will be

(A) $(2.22 \times 10^{-31})^{1/4}$
(B) $(18 \times 10^{-31})^{1/4}$
(C) $(18 \times 10^{-31})^{1/2}$
(D) $(4.86 \times 10^{-29})^{1/4}$

Effect of Concentration Change · JEE Main 2024 · Shift-II
View Solution on Crucible ↗

23. The equilibrium $\mathrm{Cr_2O_7^{2-} \rightleftharpoons 2CrO_4^{2-}}$ is shifted to the **right** in:

(A) An acidic medium
(B) A basic medium
(C) A neutral medium
(D) A weakly acidic medium

Oxidation Number Calculations · JEE Main 2021 · Shift-II
View Solution on Crucible ↗

24. Identify the process in which change in the oxidation state is five:

(A) $\mathrm{Cr_2O_7^{2-} \rightarrow 2Cr^{3+}}$
(B) $\mathrm{MnO_4^- \rightarrow Mn^{2+}}$
(C) $\mathrm{CrO_4^{2-} \rightarrow Cr^{3+}}$
(D) $\mathrm{C_2O_4^{2-} \rightarrow 2CO_2}$

Interconversion of Concentration Units · JEE Main PYQ
View Solution on Crucible ↗

25. Calculate the molarity of a solution of ethanol in water in which the mole fraction of ethanol is 0.04:

(A) 2.1
(B) 1.122
(C) 3.129
(D) 2.314

Node Calculations (Radial, Angular, Total) · JEE Main 2023 · Shift-II View Solution on Crucible ↗

26. The wave function (Ψ) of 2s is given by: $\Psi_{2s} = \frac{1}{2\sqrt{2\pi}} \left(\frac{1}{a_0}\right)^{1/2} \left(2 - \frac{r}{a_0}\right) e^{-r/2a_0}$ At $r = r_0$, radial node is formed. Thus r_0 in terms of a_0 is:

(A) $r_0 = a_0$
(B) $r_0 = 4a_0$
(C) $r_0 = a_0/2$
(D) $r_0 = 2a_0$

Heat Capacity (C, Cp, Cv) · JEE Main 2019 · Shift-I View Solution on Crucible ↗

27. For silver, $C_p\,(\mathrm{JK^{-1}mol^{-1}}) = 23 + 0.01T$. If the temperature (T) of 3 moles of silver is raised from 300 K to 1000 K at 1 atm pressure, the value of ΔH will be close to:

(A) 16 kJ
(B) 62 kJ
(C) 13 kJ
(D) 21 kJ

Mixture of Acids/Bases · JEE Main 2022 · Shift-II View Solution on Crucible ↗

28. 200 mL of 0.01 M HCl is mixed with 400 mL of 0.01 M $\mathrm{H_2SO_4}$. The pH of the mixture is

(A) 1.14
(B) 1.78
(C) 2.34
(D) 3.02

Relating α to Kp/Kc · JEE Main 2025 · Shift-I View Solution on Crucible ↗

29. At temperature T, compound $\mathrm{AB_{2(g)}}$ dissociates as: $\mathrm{AB_{2(g)}} \rightleftharpoons \mathrm{AB_{(g)}} + \frac{1}{2}\,\mathrm{B_{2(g)}}$ having degree of dissociation x (small compared to unity). The correct expression for x in terms of K_p and p is:

(A) $\left(\frac{2K_p}{p}\right)^{1/3}$
(B) $\left(\frac{2K_p}{p}\right)^{1/4}$
(C) $\left(\frac{2K_p^2}{p}\right)^{1/3}$
(D) $\sqrt{K_p}$

JEE Main 2023 · Shift-I View Solution on Crucible ↗

30. $2\mathrm{IO_3^-} + \mathrm{xI^-} + 12\mathrm{H^+} \rightarrow 6\mathrm{I_2} + 6\mathrm{H_2O}$. What is the value of x?

(A) 2
(B) 12
(C) 10
(D) 6

Answer Key (Q1 to Q30)

Click any question number below to open its exact step-by-step solution on The Crucible ↗

1: (B)	2: (D)	3: (D)	4: (B)	5: (A)	6: (C)	7: (A)	8: (B)	9: (A)	10: (B)
11: (C)	12: (A)	13: (D)	14: (C)	15: (C)	16: (A)	17: (D)	18: (C)	19: (C)	20: (D)
21: (C)	22: (B)	23: (B)	24: (B)	25: (A)	26: (D)	27: (B)	28: (B)	29: (C)	30: (C)

Sample Solution — Question 1 (Correct Option: B)

Open Full Solution on Crucible ↗

Q1. The percentage composition of carbon **by mole** in methane (CH_4) is:

"By mole" means count atoms, not weigh them — so percentage by mole is just this atom's share of the total atom count.

In CH_4: 1 carbon atom and 4 hydrogen atoms.

$\%\,C = \frac{1}{1+4} \times 100 = 20\%$

• **Watch out:** do not switch to mass here. By *mass* carbon is $\frac{12}{16} = 75\%$ — that is option (a), planted exactly for the student who reads "by mole" but solves "by mass".

Answer: (b) 20%

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