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

Open on The Crucible ↗

Percentage Composition Calculations · JEE Main 2019 · Shift-II

View Solution on Crucible ↗

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

View Solution on Crucible ↗

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)

Successive Ionization Energies · JEE Main 2020 · Shift-II

View Solution on Crucible ↗

4. The first and second ionisation enthalpies of a metal are 496 and $4560\,\text{kJ mol}^{-1}$, respectively. How many moles of HCl and H_2SO_4, respectively, will be needed to react completely with 1 mole of the metal hydroxide?

(A) 1 and 1

(B) 2 and 0.5

(C) 1 and 2

(D) 1 and 0.5

Properties of Ionic Compounds · JEE Main 2023 · Shift-II

View Solution on Crucible ↗

5. Identify the correct order of standard enthalpy of formation of sodium halides.

(A) $\text{NaI} < \text{NaBr} < \text{NaF} < \text{NaCl}$

(B) $\text{NaI} < \text{NaBr} < \text{NaCl} < \text{NaF}$

(C) $\text{NaF} < \text{NaCl} < \text{NaBr} < \text{NaI}$

(D) $\text{NaCl} < \text{NaF} < \text{NaBr} < \text{NaI}$

Lanthanoid Contraction · JEE Main 2019 · Shift-II

View Solution on Crucible ↗

6. The correct order of atomic radii is:

(A) $\mathrm{Ce} > \mathrm{Eu} > \mathrm{Ho} > \mathrm{N}$

(B) $\mathrm{N} > \mathrm{Ce} > \mathrm{Eu} > \mathrm{Ho}$

(C) $\mathrm{Ho} > \mathrm{N} > \mathrm{Eu} > \mathrm{Ce}$

(D) $\mathrm{Eu} > \mathrm{Ce} > \mathrm{Ho} > \mathrm{N}$

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

View Solution on Crucible ↗

7. For a concentrated solution of a weak electrolyte (K_{eq} = equilibrium constant) $\mathrm{A_2B_3}$ 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 ↗

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

9. 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

Molarity (M) · JEE Main 2024 · Shift-I

View Solution on Crucible ↗

10. The Molarity (M) of an aqueous solution containing 5.85 g of NaCl in 500 mL water is: (Given: Molar Mass Na: 23 and Cl: 35.5 g $\mathrm{mol^{-1}}$)

(A) 2

(B) 20

(C) 4

(D) 0.2

Reference Electrodes · JEE Main 2024 · Shift-I View Solution on Crucible ↗

11. One of the commonly used electrode is calomel electrode. Under which of the following categories, calomel electrode comes?

(A) Oxidation-Reduction electrodes
(B) Metal ion-Metal electrodes
(C) Gas-Ion electrodes
(D) Metal-Insoluble Salt-Anion electrodes

Reversible Reactions · JEE Main 2020 · Shift-II View Solution on Crucible ↗

12. For the reaction $2H_2(g) + 2NO(g) \rightarrow N_2(g) + 2H_2O(g)$, the observed rate expression is: $\text{rate} = k_f[NO]^2[H_2]$. The rate expression for the reverse reaction is:

(A) $k_b[N_2][H_2O]^2$
(B) $k_b[N_2][H_2O]^2/[NO]$
(C) $k_b[N_2][H_2O]$
(D) $k_b[N_2][H_2O]^2/[H_2]$

Allotropes of Carbon · JEE Main 2019 · Shift-II View Solution on Crucible ↗

13. The C–C bond length is maximum in:

(A) C_{70}
(B) C_{60}
(C) graphite
(D) diamond

Trends in Nitrogen Family · JEE Main 2024 · Shift-II View Solution on Crucible ↗

14. The strongest reducing agent among the following is:

(A) NH_3
(B) SbH_3
(C) BiH_3
(D) PH_3

Zero Group (NH_4^+) · JEE Main 2023 · Shift-II View Solution on Crucible ↗

15. Formula for Nessler's reagent is:

(A) KHg_2I_2
(B) $KHgI_3$
(C) K_2HgI_4
(D) HgI_2

Predicting Colour from Wavelength/Δ · JEE Main 2024 View Solution on Crucible ↗

16. The correct order of A, B, C and D in terms of wavenumber of light absorbed is: (A) $[CoCl(NH_3)_5]^{2+}$ (B) $[Co(CN)_6]^{3-}$ (C) $[Co(NH_3)_5(H_2O)]^{3+}$ (D) $[Cu(H_2O)_4]^{2+}$

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

Azo Coupling Reactions · JEE Main 2025 · Shift-II View Solution on Crucible ↗

17. When a concentrated solution of sulphanilic acid and 1-naphthylamine is treated with nitrous acid (273 K) and acidified with acetic acid, the mass (g) of 0.1 mole of product formed is: (Given molar mass in g mol^{-1}: H: 1, C: 12, N: 14, O: 16, S: 32)

(A) 343
(B) 330
(C) 33
(D) 66

JEE Main 2025 · Shift-I View Solution on Crucible ↗

18. The products A and B in the following reactions, respectively are: $A \xleftarrow{Ag\text{-}NO_2} CH_3-CH_2-CH_2-Br \xrightarrow{AgCN} B$

(A) $CH_3CH_2CH_2-ONO$, $CH_3CH_2CH_2-NC$
(B) $CH_3CH_2CH_2-ONO$, $CH_3CH_2CH_2-CN$
(C) $CH_3CH_2CH_2-NO_2$, $CH_3CH_2CH_2-CN$
(D) $CH_3CH_2CH_2-NO_2$, $CH_3CH_2CH_2-NC$

Steam Distillation · JEE Main 2025 · Shift-I View Solution on Crucible ↗

19. The steam volatile compounds among the following are: (A) 2-nitrophenol (OH and NO_2 ortho), (B) 2-nitroaniline (NH_2 and NO_2 ortho), (C) 4-aminophenol (NH_2 and OH para), (D) 4-nitroaniline (NH_2 and NO_2 para)

(A) (B) and (D) only
(B) (A) and (C) only
(C) (A) and (B) only
(D) (A), (B) and (C) only

Carbocation — structure & stability · JEE Main 2025 · Shift-II View Solution on Crucible ↗

20. Which among the following halides will generate the most stable carbocation in Nucleophilic substitution reaction?

(A) Allyl bromide
(B) Bromobenzene
(C) Cyclohexyl bromide
(D) Triphenylmethyl bromide

Halogenation of Phenols · JEE Main 2022 · Shift-I View Solution on Crucible ↗

21. Difference in reaction of phenol with bromine in chloroform vs water is due to:

(A) Hyperconjugation in substrate
(B) Polarity of solvent
(C) Free radical formation
(D) Electromeric effect of substrate

Structure & physical properties · JEE Main 2025 · Shift-II View Solution on Crucible ↗

22. The alkane from below having two secondary hydrogens is:

(A) 2,2,4,5-Tetramethylheptane
(B) 2,2,3,3-Tetramethylpentane
(C) 4-Ethyl-3,4-dimethyloctane
(D) 2,2,4,4-Tetramethylhexane

Haloform Reaction · JEE Main 2022 · Shift-II View Solution on Crucible ↗

23. Hex-4-en-2-ol on treatment with PCC gives 'A'. 'A' on reaction with sodium hypoiodite gives 'B', which on further heating with soda lime gives 'C'. The compound 'C' is

(A) 2-Pentene
(B) Proponaldehyde
(C) 2-Butene
(D) 4-Methylpent-2-ene

Denaturation · JEE Main 2024 · Shift-II View Solution on Crucible ↗

24. Which structure of protein remains intact after coagulation of egg white on boiling?

(A) Primary
(B) Tertiary
(C) Secondary
(D) Quaternary

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

25. 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 ↗

26. 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 ↗

27. 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) $\Delta G = \Delta H - T\Delta S$

Modern Periodic Law & Mendeleev's Law · JEE Main 2023 · Shift-II — View Solution on Crucible ↗

28. Henry Moseley studied characteristic X-ray spectra of elements. The graph which represents his observation correctly is: (Given: v = Frequency of X-ray emitted, Z = Atomic number)

(A) Option (1): $\sqrt{Z}$ vs v — straight line
(B) Option (2): $\sqrt{v}$ vs Z — straight line
(C) Option (3): v^2 vs Z — straight line
(D) Option (4): v vs Z — straight line

Strength of H-Bonds · JEE Main 2023 · Shift-I — View Solution on Crucible ↗

29. Decreasing order of the **hydrogen bonding** in following forms of water is correctly represented by: **A.** Liquid water **B.** Ice **C.** Impure water

(A) A = B > C
(B) B > A > C
(C) C > B > A
(D) A > B > C

Preparation of $KMnO_4$ · JEE Main 2024 · Shift-I — View Solution on Crucible ↗

30. $KMnO_4$ decomposes on heating at 513 K to form O_2 along with

(A) MnO_2 & K_2O_2
(B) K_2MnO_4 & Mn
(C) Mn & KO_2
(D) K_2MnO_4 & MnO_2

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

31. When the hydrogen ion concentration $[H^+]$ 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 ↗

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

(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 ↗

33. The oxidation states of nitrogen in NO, NO_2, N_2O and NO_3^- are in the order of:

(A) $NO_3^- > NO_2 > NO > N_2O$
(B) $NO_2 > NO_3^- > NO > N_2O$
(C) $N_2O > NO_2 > NO > NO_3^-$
(D) $NO > NO_2 > N_2O > NO_3^-$

Mole Fraction (X) · JEE Main 2024 · Shift-II View Solution on Crucible ↗

34. If a substance 'A' dissolves in solution of a mixture of 'B' and 'C' with their respective number of moles as n_A, n_B and n_C, mole fraction of C in the solution is:

(A) $\frac{n_C}{n_A \times n_B \times n_C}$
(B) $\frac{n_C}{n_A + n_B + n_C}$
(C) $\frac{n_C}{n_A - n_B - n_C}$
(D) $\frac{n_B}{n_A + n_B}$

Concentration Cells · JEE Main 2020 · Shift-II View Solution on Crucible ↗

35. For the given cell: $Cu(s)|Cu^{2+}(C_1\ M)||Cu^{2+}(C_2\ M)|Cu(s)$ change in Gibbs energy (ΔG) is negative, if:

(A) $C_1 = C_2$
(B) $C_2 = \frac{C_1}{\sqrt{2}}$
(C) $C_1 = 2C_2$
(D) $C_2 = \sqrt{2}\, C_1$

Zero Order Rate Law · JEE Main 2019 · Shift-I View Solution on Crucible ↗

36. Decomposition of X exhibits a rate constant of $0.05\ \mu g/year$. How many years are required for the decomposition of $5\ \mu g$ of X into $2.5\ \mu g$?

(A) 20
(B) 40
(C) 25
(D) 50

Tin & Lead Chemistry · JEE Main 2020 · Shift-I View Solution on Crucible ↗

37. On heating compound (A) gives a gas (B) which is constituent of air. This gas when treated with H_2 in the presence of a catalyst gives another gas (C) which is basic in nature. (A) should not be:

(A) NaN_3
(B) $Pb(NO_3)_2$
(C) $(NH_4)_2Cr_2O_7$
(D) NH_4NO_2

Nitrogen Oxides · JEE Main 2019 · Shift-I View Solution on Crucible ↗

38. The correct order of the oxidation states of nitrogen in NO, N_2O, NO_2 and N_2O_3 is

(A) $N_2O < NO < N_2O_3 < NO_2$
(B) $NO_2 < N_2O_3 < NO < N_2O$
(C) $NO_2 < NO < N_2O_3 < N_2O$
(D) $N_2O < N_2O_3 < NO < NO_2$

Zero Group (NH_4^+) · JEE Main 2025 · Shift-I View Solution on Crucible ↗

39. When a salt is treated with sodium hydroxide solution it gives gas X. On passing gas X through reagent Y a brown coloured precipitate is formed. X and Y respectively, are

(A) $X = NH_3$ and $Y = HgO$
(B) $X = NH_3$ and $Y = K_2HgI_4 + KOH$
(C) $X = NH_4Cl$ and $Y = KOH$
(D) $X = HCl$ and $Y = NH_4Cl$

Inner vs Outer Orbital Complexes · JEE Main 2024 View Solution on Crucible ↗

40. $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$ are respectively known as:

(A) Spin free Complex, Spin paired Complex
(B) Spin paired Complex, Spin free Complex
(C) Outer orbital Complex, Inner orbital Complex
(D) Inner orbital Complex, Spin paired Complex

Basicity of Amides & Heterocycles · JEE Main 2021 · Shift-II View Solution on Crucible ↗

41. Which of the following is least basic?

(A) $(CH_3CO)NHC_2H_5$
(B) $(C_2H_5)_3N$
(C) $(CH_3CO)_2NH$
(D) $(C_2H_5)_2NH$

Ambident Nucleophiles · JEE Main 2024 · Shift-II View Solution on Crucible ↗

42. Alkyl halide is converted into alkyl isocyanide by reaction with

(A) NaCN
(B) NH_4CN
(C) KCN
(D) AgCN

Chromatography · JEE Main 2024 · Shift-II View Solution on Crucible ↗

43. Chromatographic technique/s based on the principle of differential adsorption is/are A. Column chromatography B. Thin layer chromatography C. Paper chromatography Choose the most appropriate answer from the options given below:

(A) B only
(B) A only
(C) A & B only
(D) C only

Carbocation — structure & stability · JEE Main 2025 · Shift-I View Solution on Crucible ↗

44. Which one of the carbocations from the following is most stable?

(A) $\overset{+}{C}H_2$–CH=CH–CH_2–O–CH_3
(B) $\overset{+}{C}H_2$–CH=CH–O–CH_3
(C) $\overset{+}{C}H_2$–CH=CH–O–C(=O)–CH_3
(D) $\overset{+}{C}H_2$–CH=CH–F

Reimer-Tiemann Reaction · JEE Main 2024 · Shift-I View Solution on Crucible ↗

45. Phenol treated with chloroform in presence of sodium hydroxide, which further hydrolysed in presence of an acid results in:

(A) Salicylic acid
(B) Benzene-1, 2-diol (catechol)
(C) Benzene-1, 3-diol (resorcinol)
(D) 2-Hydroxybenzaldehyde (salicylaldehyde)

conformational_analysis · JEE Main 2019 · Shift-II View Solution on Crucible ↗

46. Which of these factors does not govern the stability of a conformation in acyclic compounds?

(A) Torsional strain
(B) Angle strain
(C) Steric interactions
(D) Electrostatic forces of interaction

Boiling Point & Solubility Trends · JEE Main 2024 · Shift-II View Solution on Crucible ↗

47. Which among the following has highest boiling point?

(A) $CH_3CH_2CH_2CH_3$
(B) $CH_3CH_2CH_2CH_2-OH$
(C) $CH_3CH_2CH_2CHO$
(D) $H_3C-O-C_2H_5$

Sucrose · JEE Main 2022 · Shift-II View Solution on Crucible ↗

48. Glycosidic linkage between C_1 of α-glucose and C_2 of β-fructose is found in

(A) Maltose
(B) Sucrose
(C) Lactose
(D) Amylose

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

49. A solution is prepared by adding $2\,g$ 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 ↗

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

Answer Key (Q1 to Q50)

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

1: (B)	2: (D)	3: (D)	4: (D)	5: (B)	6: (D)	7: (B)	8: (A)	9: (C)	10: (D)
11: (D)	12: (D)	13: (D)	14: (C)	15: (C)	16: (D)	17: (C)	18: (D)	19: (C)	20: (D)
21: (B)	22: (B)	23: (C)	24: (A)	25: (A)	26: (B)	27: (A)	28: (B)	29: (B)	30: (D)
31: (B)	32: (C)	33: (A)	34: (B)	35: (D)	36: (D)	37: (B)	38: (A)	39: (B)	40: (B)
41: (C)	42: (D)	43: (C)	44: (B)	45: (D)	46: (B)	47: (B)	48: (B)	49: (D)	50: (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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