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# Answers Key:

### Case Study Questions

1. (a) 2.54 x $10^{-3}$ m.
   (b) Diamond.
   (c) $3NO_2 + H_2O \rightarrow 2HNO_3 + NO$
   (d) % of Na $= \frac{\text{Total mass of Na}}{\text{Molar mass}} \times 100$
   $= \frac{46}{106} \times 100 = 43.39\%$
   (e) $\frac{3\times35+1\times37}{4} = 35.5$
   (f) $CH_2O$
   (g) Mass of magnesium atoms $= 2 \times \frac{2.68}{100}$
   $= \frac{5.36}{100} = 0.0536$ g

### 5 Marks

2. A limiting reagent determines the extent of a reaction. It is the reactant which is the first to get consumed during a reaction, thereby causing the reaction to stop and limiting the amount of products formed.
   (i) According to the given reaction, 1 atom of A reacts with 1 molecule of B. Thus, 200 molecules of B will react with 200 atoms of A, thereby leaving 100 atoms of A unused. Hence, B is the limiting reagent.
   (ii) According to the reaction, 1 mol of A reacts with 1 mol of B. Thus, 2 mol of A will react with only 2 mol of B. As a result, 1 mol of B will not be consumed. Hence, A is the limiting reagent.
   (iii) According to the given reaction, 1 atom of A combines with 1 molecule of B. Thus, all 100 atoms of A will combine with all 100 molecules of B. Hence, the mixture is stoichiometric where no limiting reagent is present.
   (iv) 1 mol of atom A combines with 1 mol of molecule B. Thus, 2.5 mol of B will combine with only 2.5 mol of A. As a result, 2.5 mol of A will be left as such. Hence, B is the limiting reagent.
   (v) According to the reaction, 1 mol of atom A combines with 1 mol of molecule B. Thus, 2.5 mol of A will combine with only 2.5 mol of B and the remaining 2.5 mol of B will be left as such. Hence, A is the limiting reagent.

### 3 Marks

3. M = 3 mol $L^{-1}$
   Mass of NaCl in 1 L soution = x 58.5 = 175.5 g
   Mass of 1 L solution =1000 x 1.25 = 1250 g
   (since density = 1.25 g $mL^{-1}$)
   Mass of water soultion = 1250 - 175.5
   = 1074.5 g = 1.0745 kg.
   Molality = $\frac{\text{number of moles of solute}}{\text{mass of solvent in kg}} = \frac{3mol}{1.0745kg} = 2.79\ m$
   Often in a chemistry laboratory, a solution of a desired concentration is prepared by diluting a solution of known higher concentration. The solution of higher concentration is also known as stock solution. Note that the molality of a solution does not change with temperature since mass remains unaffected with temperature.
4.

| Element | Percentage | Atomic mass | Relative No. of atoms | Divide by least | Simplest ratio |
|---|---|---|---|---|---|
| Fe | 36.76 | 56 | $\frac{36.76}{56} = 0.65$ | $\frac{0.65}{0.64} = 1$ | 1 |
| S | 21.11 | 32 | $\frac{21.12}{32} = 0.64$ | $\frac{0.64}{0.64} = 1$ | 1 |
| O | 42.11 | 16 | $\frac{42.11}{16} = 2.63$ | $\frac{2.63}{0.64} = 4$ | 4 |

   Empirical formula = $FeSO_4$

### 2 Marks

5. 0.04597
   The digit to be removed is more than 5, therefore the proceeding digit is increased by one.
   ∴ 0.04597 is rounded up to three significant figures = 0.0460.
6. Average molar mass of Ar = $\sum fi \times Ai$
   = ( 0.00337×35.96755 ) ( 0.00063×37.96272 ) ( 0.99600×39.9624 )
   = 0.121 + 0.024 + 39.803
   = 39.948 g $mol^{-1}$

### Multiple Choice Question

7. (a) 3
8. (c) 93.3 °C
9. (d) 1250 cc
10. (b) 4.53 g
11. (c) 0.12 M
12. (b) 7.10 g