Class 11 Chemistry · Chapter 1: Some Basic Concepts of Chemistry

Answer key and marking scheme · 20 marks · about 40 minutes · based on NCERT

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1. Which of these measurements has the same number of significant figures as 0.02060 g? [1]

(a) 2060 g (b) 20.60 g
(c) 2.06 g (d) 0.206 g

Answer: (b) In 0.02060 the leading zeros are not significant, the zero between 2 and 6 is, and the terminal zero after the decimal point is: four figures (2, 0, 6, 0). 20.60 also has four. 2060 (no decimal point) has three, and 2.06 and 0.206 have three.

2. Which of these facts about a strip of magnesium ribbon can be found only by making a chemical change happen? [1]

(a) its silvery-white colour (b) its density
(c) whether it burns in air to form magnesium oxide (d) its melting point

Answer: (c) Combustibility is a chemical property: observing it needs the magnesium to change into a new substance, magnesium oxide. Colour, density and melting point are physical properties, measured without changing the identity of the metal.

3. At what temperature do a Celsius thermometer and a Fahrenheit thermometer show the same number? [1]

(a) 0° (b) −32°
(c) −40° (d) 40°

Answer: (c) Put °F = °C = x in °F = (9/5)(°C) + 32: x = 9x/5 + 32, so −4x/5 = 32 and x = −40. So −40 °C = −40 °F.

4. The bond length in a molecule is 0.45 nm. Expressed in picometres it is [1]

(a) 450 pm (b) 45 pm
(c) 4.5 pm (d) 4500 pm

Answer: (a) 1 nm = 10^{-9} m and 1 pm = 10^{-12} m, so 0.45 nm × (10^{-9} m / 1 nm) × (1 pm / 10^{-12} m) = 0.45 × 10^{3} pm = 450 pm.

5. A student weighs three portions of a salt on different balances, 4.2 g, 0.153 g and 12.07 g, and mixes them. The total mass correctly reported is [1]

(a) 16.423 g (b) 16.42 g
(c) 16 g (d) 16.4 g

Answer: (d) The sum is 16.423 g. In addition the result may carry no more decimal places than the least precise figure, 4.2 g (one decimal place), so it is reported as 16.4 g.

6. Work out, giving each answer in scientific notation: (i) $(3.0 \times 10^{-4}) \times (4.0 \times 10^{7})$ (ii) $(7.2 \times 10^{5}) - (6.0 \times 10^{4})$ [2]

(i) $(3.0 \times 4.0) \times 10^{-4+7} = 12 \times 10^{3} = 1.2 \times 10^{4}$. (ii) Write both with the same exponent: $7.2 \times 10^{5} - 0.60 \times 10^{5} = (7.2 - 0.60) \times 10^{5} = 6.6 \times 10^{5}$.

- (i) multiply digit terms, add exponents: 1.2×10^{4} (1)
- (ii) same exponent first, then subtract: 6.6×10^{5} (1)

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7. How much water must be added to 25 mL of a 2.0 M HCl stock solution to make it 0.50 M? [2]

By $M_1V_1 = M_2V_2$: 2.0 M × 25 mL = 0.50 M × V_2, so V_2 = 100 mL. The moles of HCl stay the same, so water to be added = 100 − 25 = 75 mL.

- $M_1V_1 = M_2V_2$ gives final volume 100 mL (1)
- water added = 100 − 25 = 75 mL (1)

8. Ethyne (C_2H_2) and benzene (C_6H_6) have the same empirical formula. Write it, and state what the molecular formula tells us that the empirical formula does not. [2]

Both have C : H = 1 : 1 as the simplest whole-number ratio, so the empirical formula is CH. The molecular formula gives the exact number of each kind of atom in one molecule: two C and two H in ethyne, six C and six H in benzene.

- empirical formula CH (simplest whole-number ratio 1 : 1) (1)
- molecular formula gives the exact number of each kind of atom in a molecule (1)

9. State the postulates of Dalton's atomic theory that explain (i) the law of conservation of mass and (ii) the law of definite proportions. Name one thing the theory could not explain. [3]

(i) Chemical reactions involve reorganisation of atoms, which are neither created nor destroyed in a reaction, so total mass does not change. (ii) Compounds are formed when atoms of different elements combine in a fixed ratio, and all atoms of an element have identical mass, so a compound has a fixed composition by mass. The theory could not explain the law of gaseous volumes (nor why atoms combine).

- (i) atoms rearranged, neither created nor destroyed (1)
- (ii) atoms of identical mass combine in a fixed ratio (1)
- could not explain gaseous volumes (or the reason atoms combine) (1)

10. 6.0 g of magnesium ribbon is burnt in a closed flask containing 6.0 g of oxygen: $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$. (Mg = 24, O = 16) (i) Which is the limiting reagent? (ii) What mass of MgO forms? (iii) What further mass of magnesium would be needed to use up all the oxygen? [3]

(i) Mg = 6.0/24 = 0.25 mol; O_2 = 6.0/32 = 0.1875 mol. 0.25 mol Mg needs only 0.125 mol O_2, so magnesium is used up first: Mg is the limiting reagent. (ii) MgO formed = 0.25 mol × 40 g mol^{-1} = 10.0 g. (iii) O_2 left = 0.1875 − 0.125 = 0.0625 mol, which needs 2 × 0.0625 = 0.125 mol Mg = 3.0 g.

- moles compared: Mg (0.25 mol) is limiting (1)
- MgO = 10.0 g (1)
- O_2 left 0.0625 mol needs 3.0 g Mg (1)

11. Phosphorus forms two oxides, A and B. In A, 1.24 g of phosphorus is combined with 0.96 g of oxygen; in B, 1.24 g of phosphorus is combined with 1.60 g of oxygen. The molar masses of A and B are 220 g mol^{-1} and 284 g mol^{-1}. (P = 31, O = 16) (i) Show that the data obey the law of multiple proportions. (ii) Find the empirical formulas of A and B. (iii) Find their molecular formulas. [3]

(i) With the same 1.24 g of phosphorus, the masses of oxygen are 0.96 g and 1.60 g, in the ratio 0.96 : 1.60 = 0.6 = 3 : 5, a ratio of small whole numbers: the law of multiple proportions. (ii) P = 1.24/31 = 0.040 mol. In A, O = 0.96/16 = 0.060 mol, so P : O = 0.040 : 0.060 = 2 : 3 and the empirical formula is P_2O_3 (empirical formula mass 110). In B, O = 1.60/16 = 0.100 mol, so P : O = 2 : 5, P_2O_5 (142). (iii) A: n = 220/110 = 2, molecular formula P_4O_6. B: n = 284/142 = 2, molecular formula P_4O_{10}.

- (i) oxygen masses for fixed phosphorus in ratio 3 : 5 (1)
- (ii) empirical formulas P_2O_3 and P_2O_5 (1)
- (iii) n = 2 for both: P_4O_6 and P_4O_{10} (1)