1-4. What is the mass of each of the following quantities at 298 K and 101 kPa? At this temperature the density of liquid water is 0.997 g mL⁻¹.
Definitions: 1 atmosphere = 101.325 kPa 1 mL = 1 cm³

1. Argon (24.5 L)
   - (a) 39.9 g  (b) 100 g  (c) 80.0 g  (d) 980 g  (e) 24.5 g

2. Water (24.5 L)
   - (a) \(2.44 \times 10^3\) g  (b) 100 g  (c) \(1.00 \times 10^3\) g  (d) 180 g  (e) \(1.80 \times 10^4\) g

3. Chlorine (12.25 L)
   - (a) 17.7 g  (b) 70.8 g  (c) 1225 g  (d) 35.4 g  (e) 0.500 g

4. Zinc (1.00 mole)
   - (a) 130.8 g  (b) 24.5 g  (c) 49.0 g  (d) 1.00 g  (e) 65.4 g

5. Calculate the amount (in mole) of H₂ molecules in 4.52 L of hydrogen gas at a temperature of 298 K and a pressure of 130 kPa.
   - (a) \(2.37 \times 10^2\)  (b) 24.0  (c) \(2.40 \times 10^{-2}\)  (d) \(0.237\)  (e) 0.119

7. How many molecules are present in oxygen gas (1.0 x 10⁻³ mL) at 1.3 x 10⁻⁸ kPa and 298 K?
   - (a) \(5.5 \times 10^{-18}\)  (b) \(3.2 \times 10^{16}\)  (c) \(5.5 \times 10^{15}\)  (d) \(3.2 \times 10^9\)  (e) \(5.5 \times 10^{-12}\)

8. Which of the following quantities has the greatest mass?
   - (a) 5.00 gram silver
   - (b) 24.5 litre of helium measured at 298 K and 1.00 atmosphere
   - (c) \(3.01 \times 10^{20}\) atoms of beryllium
   - (d) 4.00 mL of water at 298 K and 101 kPa
   - (e) \(0.0850\) mole of chlorine gas at 298 K and 101 kPa

9-12. A solution of 0.0520 M barium hydroxide (25.00 mL) reacted exactly with dilute hydrochloric acid (16.40 mL). The same hydrochloric acid solution (100 mL) was allowed to react with excess zinc, and the hydrogen produced was collected over water at a temperature of 20°C and a pressure of 98.5 kPa. At this temperature the vapor pressure of water is 4.243 kPa.

9. What was the concentration of the hydrochloric acid solution?
   - (a) 0.317 M  (b) \(0.159\) M  (c) 0.0793 M  (d) 0.0682 M  (e) 0.0341 M

10. What amount (in mole) of hydrogen molecules (H₂) was produced?
    - (a) \(1.59 \times 10^{-2}\)  (b) \(7.93 \times 10^{-3}\)  (c) \(3.96 \times 10^{-3}\)  (d) \(3.41 \times 10^{-3}\)  (e) \(1.71 \times 10^{-3}\)

11. What was the partial pressure (in kPa) of hydrogen?
    - (a) 101.3  (b) 94.3  (c) 94.257  (d) 98.5  (e) 102.71

12. What volume (in mL) of (wet) hydrogen gas was collected over water?
    - (a) 221122  (b) 424  (c) 106  (d) 0.212  (e) 0.424

13. A gas syringe filled with carbon dioxide had an effusion time under vacuum of 6.2 s. The corresponding effusion time of an unknown gas was 8.6 s. What is the molecular weight of the unknown gas?
    - (a) 24  (b) 32  (c) 52  (d) 61  (e) 8855

14. Which one of the following statements concerning "ideal" and real gases is true?
    - (a) For all gases at 300 K, all the gas molecules travel at the same speed.
    - (b) In a sample of hydrogen gas at 300 K all molecules travel at the same speed.
    - (c) The particles of an "ideal" gas have zero volume.
    - (d) The kinetic energy of a gas is independent of its temperature.
    - (e) All real gases deviate significantly from "ideal" behaviour at very low pressures.