

1021SCG Chemistry 1A – Module 3: Physicochemical Concepts Week 10

References and resources: Blackman, Bottle, Schmid, Mocerino and Wille, 3rd Edn., Chapter 7, Sections 7.1-7.3

Learning Objectives

You should be able to:

- qualitatively describe the macroscopic characteristics of liquids and solids
- explain the phase changes between the common states of matter
- link basic thermodynamic concepts to the quantitative description of phase changes
- understand the concepts of and work with phase diagrams

Workshop and Study Questions

1. List the three states of matter in order of

- (a) increasing molecular disorder, and
- (b) increasing intermolecular attractions.

2. Why does increasing the temperature cause a substance to change in succession from a solid to a liquid to a gas?

3. Describe the inter-molecular forces that must be overcome to convert each of the following from a liquid to a gas:

- (a) Br₂;
- (b) CH₃OH;
- (c) H₂S.

4. Rationalise the difference in boiling points between the members of the following pairs of substances:

- (a) HF (20°C) and HCl (-85°C);
- (b) CHCl₃ (61°C) and CHBr₃ (150°C);
- (c) Br₂ (59°C) and ICl (97°C).

5. Name the phase transition in each of the following situations, and indicate whether it is exothermic or endothermic:

- (a) Bromine vapour turns to bromine liquid as it is cooled.
- (b) Crystals of iodine disappear from an evaporating dish as they stand in a fume hood.
- (c) Rubbing alcohol in an open container slowly disappears.
- (d) Molten lava from a volcano turns into solid rock.

6. The normal melting and boiling points of xenon are -112°C and -107°C, respectively. Its triple point is at -121°C and 37.5 kPa, and its critical point is at 16.6°C and $5.83 \cdot 10^3$ kPa.

- (a) Sketch the phase diagram for Xe, showing the four points given and indicating the area in which each phase is stable.

(b) Which is denser, $\text{Xe}_{(s)}$ or $\text{Xe}_{(l)}$? Explain.

(c) If Xe gas is cooled under an external pressure of 13 kPa, will it undergo condensation or deposition? Explain.

7. A swimmer emerging from a pool is covered with a film of water (about 75 g). How much heat must be supplied to evaporate this water film?