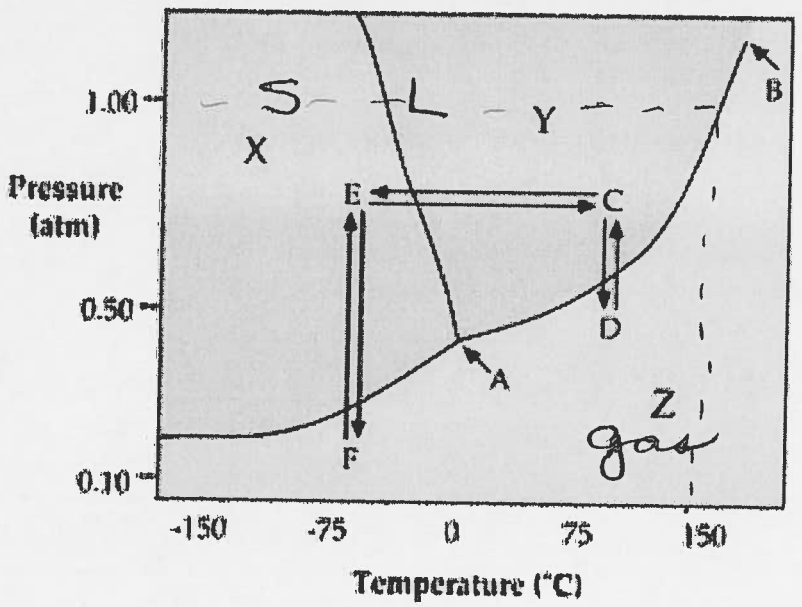
84.122
Dr. Nancy De Luca

Quiz 3 Liquids & Solids

Name KEY
February 11, 2016

Clearly indicate your final answer, and make sure it has the correct number of significant figures and proper units. If asked, clearly show your method, including cancellation of units, in calculating your final answer. Assume ideal behavior for all questions.

1) Identify each of the following regions (indicated with letters) or changes (indicated with two letters separated by an arrow) shown on the phase diagram. (2 pt each)



a) E to C melting (s→l) b) E to F sublimation (s→g)

c) A triple point d) B Critical point

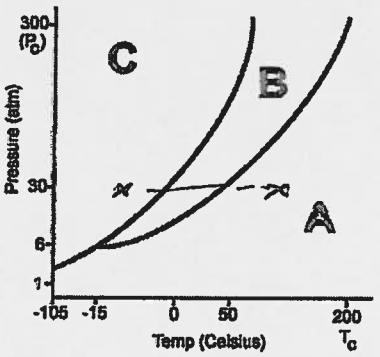
e) Estimate the normal boiling point of the substance. ~150°C (3 pts)

2) For any substance, the magnitude of ΔH°_{vap} is always greater than that of ΔH°_{fus}. Explain why, and be specific. Be sure to describe the changes involved in each process. (6 pts)

ΔHvap involves the liquid becoming gaseous. This requires completely overcoming all intermolecular forces of attraction.

ΔHfus involves converting the solid to the liquid. The intermolecular forces of attraction are disrupted, but the molecules (or atoms) are still in contact with each other, so less energy is involved.

3) Consider the phase diagram below.



a) Provide the physical state of matter for the three regions on the diagram.

A: gas B: liquid C: solid (6 pts)

b) If the substance is at 30 atm and - 20 °C, and it is heated under constant pressure to 100 °C, what changes in phase, if any occur? (4 pts)

solid ⇒ liquid ⇒ gas

c) Based on the diagram, which of the following statements is correct? (3 pts)

i) The solid is more dense than the liquid
ii) The liquid is more dense than the solid
iii) The substance is a solid at standard temperature and pressure
iv) The vapor will not condense at a pressure of 30 atm

4) Calculate the energy required to heat 40.0 g of H_2O at -5.0°C and 1 atm to a temperature of 75.0°C (also at 1 atm). Clearly show your method. (10 pts)

The specific heats for H_2O are: 2.09 J/g-°C for the solid; 4.18 J/g-°C for the liquid; and 1.99 /g-°C for the vapor.

ΔH_{fus} = 6.01 kJ/mol; ΔH_{vap} = 40.79 kJ/mol

ice at -5.0°C ⇒ ice at 0°C ⇒ liquid at 0°C ⇒ liq at 75°C

$(40.0\,g)\left[\frac{2.09\,J}{g\,°C}\right][5.0\,°C] = .418\,kJ$

$40.0\,g\left[\frac{1\,mole}{18.0\,g}\right]\left[6.01\frac{kJ}{mol}\right] = 13.4\,kJ$

$40.0\,g\left[\frac{4.18\,J}{g\,°C}\right][75.0\,°C] = 12.5\,kJ$

$26.4\,kJ$

Answer: 26.4 kJ