Chem 1063. Exam 2. J-Term 2009

Name Key

Show all work for credit! Remember sig figs!

Useful information: q= smDT, s= 4.17J/g•°C for water, R = 0.0821 L•atm/molK, 8.314 J/mol•K, PV=nRT, $\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$, $u = \sqrt{\frac{3RT}{MW}}$, $\frac{rate1}{rate2} = \sqrt{\frac{MW2}{MW1}}$

(1)(6 points)(a) How much energy would be required to heat 1000 kg of iron from 20 °C to its melting point (1540 °C)? For iron, s=0.449 J/g°C.

$q = (0.449 \frac{J}{g°C})(1.00 \times 10^6 g)(1520°C) = 6.82 \times 10^8 J = 6.82 \times 10^5 kJ$

(b) What is the DH_m for the combustion of coal (reaction below)?

$\Delta H_f° = 0$ $\Delta H_f° = 0$

$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ $\Delta H = -393.5 kJ$

$\Delta H = (\Delta H_{f CO_2})(1 mol) = (-393.5 \frac{kJ}{mol})(1 mol) = -393.5 kJ$

(c) How much coal (in kg) would be required to heat the iron in part a?

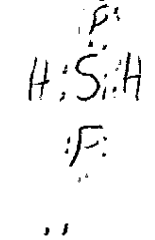
$6.82 \times 10^5 kJ \div \frac{393.5 kJ}{mol\ CO_2} = 1.73 \times 10^3 mol\ C$

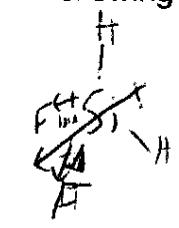
$1.73 \times 10^3 mol \times 12.01 \frac{g}{mol} = 2.08 \times 10^4 g = 20 kg$

(2) List all intermolecular forces for the following molecules. Show all work.

(a) SiH_2F_2

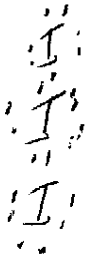
dispersion
dipole dipole

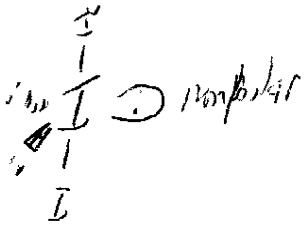




(b) I_3^-

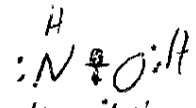
dispersion

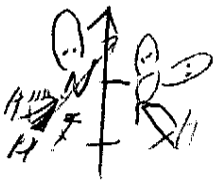




(c) NH_2OH (N and O are bonded)

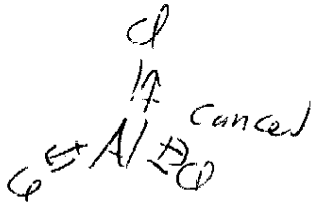
dispersion
dipole dipole
Hydrogen bonding





(d) $AlCl_3$

dispersion forces



8pts (3)Explain (not just list) the type of solid being described. The possibilities are; ionic solid, network covalent solid, metallic solid, polar molecular solid, and nonpolar molecular solid.

(a) The solid has a high mp, does not conduct electricity, and does not dissolve.

high mp - could be ionic, metallic, or network covalent
does not conduct - can't be metallic
does not dissolve - network covalent

(b) The solid dissolves in oil, does not conduct electricity, and has a low melting point.

dissolves in oil - only nonpolar covalent possible

Nonconductor + low mp is consistent.

(4)(6 points) Which of the following substances in each pair would have the higher melting point and why.

(a) CO_2 or (CSe_2) only dispersion forces + higher MW - stronger dispersion forces

(b) CH_3F or (CH_3OH)

CH_3OH has H-bonding, CH_3F doesn't. they have the same mass

(c) (quartz) or PCl_5

network covalent solids have much higher mp's than molecular solids.

(5)(10 points) Which of the following substances would you expect to dissolve in water? Explain why.

(a) NH_3 yes, it has hydrogen bonds as does water

(b) SF_6 no, it is nonpolar and has no hydrogen bonds

(c) $CH_3CH_2CH_2CH_3$ no, it is nonpolar so has only dispersion forces.

(d) K_2SO_4 yes, this is an ionic solid and water can disrupt ionic bonds, dissolving the solid.

(e) Fe no. Metallic solids do not dissolve

(6)(6 points) Answer the following questions using the phase diagram below.

(a) What is the triple point of this compound?

45°C, 0.50 atm

(b) In what region is this compound a supercritical fluid?

above 150 atm and 233°C

(c) What phases are present at point G?

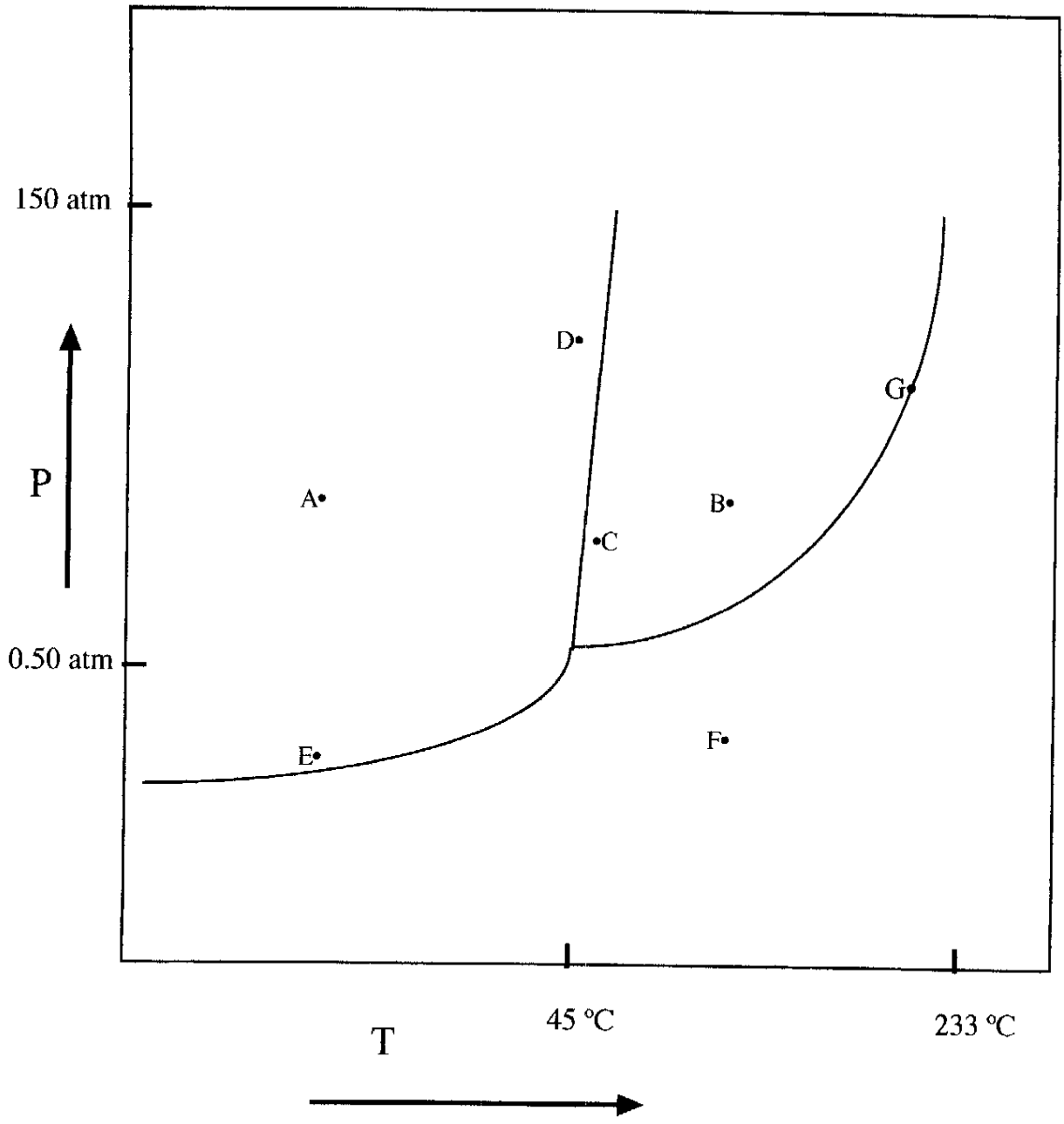
liquid & gas

(d) Is the liquid or solid more dense for this compound?

solid

(e) If the compound is heated from conditions A to conditions B, what transition, if any, would occur? fusion (melting)

(f) If the pressure was increased from conditions F to conditions B, what transition, if any, would occur? condensation (g→l)


150 atm
P
0.50 atm
D
G
A
B
C
E
F
45 °C
233 °C
T