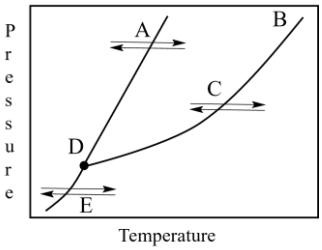
Chemistry 212 Test 1 Name: _____
Spring 2025 (Please print)

Multiple Choice (5 points each, Put answers in CAPS in the left margin.)
R = 8.314 J/mol•K = 0.0821 L•atm/mol•K

1. For the phase diagram, which of the following is associated with "B?"



A) Boiling
B) Critical point
C) Deposition
D) Melting
E) Triple point

2. Which molecules can form a hydrogen bond with another identical molecule?

A) HI B) H_2S C) H_2NNH_2 D) CH_3CH_2F E) All of these

3. In general, which of the following forces is weakest?

A) dipole-dipole
B) hydrogen bonding
C) ion-dipole
D) ion-ion
E) London dispersion forces

4. What is the freezing point of a 0.22 *m* aqueous solution of sodium chloride (K_b = 1.86 ºC/*m*)?

A) -0.82 ºC B) -0.41 ºC C) 0 ºC D) 0.41 ºC E) 0.82 ºC

5. Consider the following statements about vapor pressure:

i) Vapor pressures generally increase with increasing temperature.
ii) High vapor pressure substances evaporate more quickly than those with low vapor pressures.
iii) When the external pressure equals the vapor pressure of a liquid, it boils.

A) All are true.
B) Only (i) is true.
C) Some are true.
D) Only (i) and (iii) are true.
E) None are true.

6. What is the best explanation for why electrolyte solutions conduct electricity?

A) The presence of free-flowing ions
B) The presence of free-flowing electrons
C) The presence of water
D) The presence of atoms
E) None of these

7. For the reaction $N_{2\,(g)} + 3\,H_{2\,(g)} \longrightarrow 2\,NH_{3\,(g)}$ which of the following is a valid equation for rate (i.e. rate =)? (recall Δ can be used for *d*, i.e. Δt for *d*t)

A) $\frac{d[N_2]}{dt}$
B) $-2\,\frac{d[NH_3]}{dt}$
C) $3\,\frac{d[H_2]}{dt}$
D) $-\frac{1}{3}\frac{d[H_2]}{dt}$
E) $-\frac{1}{2}\frac{d[NH_3]}{dt}$

8. A reaction with an activation energy of 125 kJ and a frequency factor of 1.00×10^{10} is conducted at 100 ºC. What is its rate constant?

A) 5.06×10^{-66} B) 5.01×10^{-41} C) 3.15×10^{-8} D) 9.60×10^{9} E) 3.18×10^{27}

Discussion Questions (You must show your work to receive credit):

1. At 1 atm, how much energy is required to heat 87.0 g $H_2O_{(s)}$ at −14.0 ºC to $H_2O(g)$ at 169.0 ºC? (8 points)

Quantity	per gram
Enthalpy of fusion at 0°C	333.6 J/g
Enthalpy of vaporization at 100°C	2257 J/g
Specific heat of solid H_2O (ice)	2.087 J/(g·°C) *
Specific heat of liquid H_2O (water)	4.184 J/(g·°C) *
Specific heat of gaseous H_2O (steam)	2.000 J/(g·°C) *

2. Why are ionic solids typically harder and more brittle than molecular solids? (8 points)

3. Why is it that, at the melting point of a substance, as the material transitions from being a solid to being a liquid, energy input does not result in a temperature increase? (7 points)

4. Explain how dissolving sugar lowers the freezing point of water. (10 points)

5. At 298 K, the Henry's law constant for oxygen is 0.00130 M/atm. Air is 21.0% oxygen. At 298 K, what is the solubility of oxygen in water exposed to air at 1.00 atm? (5 points)

6. For the reaction: $H_2O_2 + 3\ I^- + 2\ H^+ \longrightarrow I_3^- + 2\ H_2O$ (all aqueous) the following rate data were obtained:

$[H_2O_2]$ (M)	$[I^-]$ (M)	$[H^+]$ (M)	initial rate (M/s)
1.0	1.0	0.050	0.012
1.8	1.0	0.050	0.022
1.8	0.6	0.050	0.013
1.0	1.0	0.025	0.012

a) What is the rate law? (Assume the reaction is zero-order in H^+.)
b) What is the rate constant? (10 points)

7. The following mechanism has been proposed for the gas-phase reaction of H_2 with ICl:

$H_{2\,(g)} + ICl_{(g)} \rightarrow HI_{(g)} + HCl_{(g)}$ (1)

$HI_{(g)} + ICl_{(g)} \rightarrow I_{2\,(g)} + HCl_{(g)}$ (2)

(a) Write the balanced equation for the overall reaction.
(b) Identify the intermediates in the reaction.
(c) Write the rate laws for each elementary step.
(d) If the first step is the 'slow' step, write the rate law for the overall reaction. (12 points)