

**Exam 4 – Chapters 14, 15, 16, 18**

- (15 pts) What is the pH of the following solutions and determine if they are acidic, basic, or neutral:
 

a. 0.0001 M HNO <sub>3</sub> (aq)	pH = <u>4</u>	acidic	basic	neutral
b. 0.0000001 M NaOH (aq)	pH = <u>7</u>	acidic	basic	neutral
c. 1.0 x 10 <sup>-9</sup> M H <sub>2</sub> SO <sub>4</sub> (aq)	pH = <u>9</u>	acidic	basic	neutral
d. 1.0 x 10 <sup>-2</sup> M LiOH (aq)	pH = <u>12</u>	acidic	basic	neutral
e. 0.00000000001 M H <sup>+</sup> (aq)	pH = <u>11</u>	acidic	basic	neutral
- (2 pts) What is the term used for a solution that maintains its pH when small amounts of acid or base are added to it?
 

a. unsaturated	b. saturated	c. <b>buffer</b>	d. indicator
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- (7 pts) What is the molarity of a CaF<sub>2</sub> solution made by dissolving 4.690 g in enough water to make a 150.0 mL solution?
 
$$\frac{4.690 \text{ g CaF}_2 \left( \frac{1 \text{ mol CaF}_2}{78.08 \text{ g}} \right)}{0.1500 \text{ L}} = 0.06007 \text{ mol CaF}_2 \quad M = \frac{\text{mol}}{\text{L}} = \frac{0.06007 \text{ mol}}{0.1500 \text{ L}} = 0.4004 \text{ M CaF}_2$$
- (2 pts) What is the term used for a solution where the maximum amount of solute is dissolved in the solvent?
 

a. unsaturated	b. <b>saturated</b>	c. buffer	d. indicator
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- (7 pts) Calculate the mass % concentration for a KBr solution prepared by dissolving 25.60 g in 200.0 g of water.
 
$$\text{m/m \%} = \frac{25.60 \text{ g}}{25.60 \text{ g} + 200.0 \text{ g}} \times 100 = 11.35 \% \text{ KBr}$$
- (6 pts) The half-life of <sup>214</sup>Bi is 19.7 min. Calculate the mass of a 255 mg sample that remains after 78.8 minutes.
 
$$78.8 / 19.7 = 4 \text{ half-lives passed} \quad 255 \text{ mg} / 2^4 = 15.9 \text{ mg}$$
- (6 pts) What is the daughter product when <sup>214</sup>Bi decays by alpha and gamma emission? **SHOW** the balanced nuclear reaction.
 
$${}^{214}_{83}\text{Bi} \rightarrow {}^4_2\alpha + {}^0_0\gamma + {}^{210}_{81}\text{Tl}$$
- (8 pts) Classify each of the following as an Arrhenius acid, and Arrhenius base, or a salt:
 

a. HBrO <sub>3</sub> (aq)	Arrhenius Acid	Arrhenius Base	Salt
b. KOH (aq)	Arrhenius Acid	Arrhenius Base	Salt
c. K <sub>2</sub> SO <sub>4</sub> (aq)	Arrhenius Acid	Arrhenius Base	Salt
d. Sr(OH) <sub>2</sub> (aq)	Arrhenius Acid	Arrhenius Base	Salt
- (2 pts) Which of the following is true about the addition of a catalyst?
 

a. ↑ ΔH	b. ↑ T °C	c. ↑ E <sub>a</sub> OOPS! ↓ E <sub>a</sub> <i>free point!</i>	d. ↑ transition state
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- (2 pts) What type of radioactive particle is produced when <sup>218</sup>Po decays to <sup>218</sup>At.
 

a. alpha	b. <b>beta</b>	c. gamma	d. neutron
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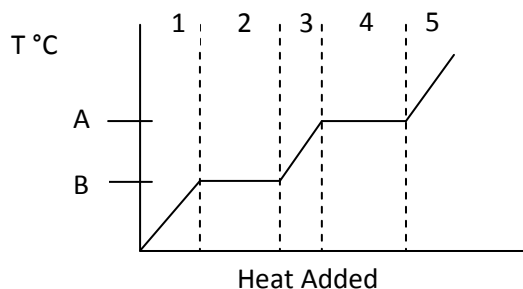


20. (2 pts) Which of the following is an observed property of liquids?
- Liquids have a fixed shape and variable volume.
  - Liquids that are soluble form a uniform mixture.**
  - Liquids compress and expand significantly.
  - Liquids are less dense than gases.
  - none of the above
21. (2 pts) If a reaction is exothermic, which of the following is always true?
- The reaction absorbs energy, so the surroundings feel colder.
  - The reaction releases energy, so the surroundings feel hotter.**
  - The reaction is at chemical equilibrium.
  - The reaction only occurs at hot temperatures.
  - The reaction only occurs at cold temperatures.
22. (2 pts) The addition of a catalyst to a chemical reaction will do all of the following *except*
- lower the activation energy,  $E_a$ .
  - increase the rate of reaction.
  - lower the heat of reaction,  $\Delta H$ .**
  - can be collected and reused.
23. (12 pts) Indicate if the substances below are soluble, insoluble, miscible, immiscible with butyl alcohol (a polar solvent).

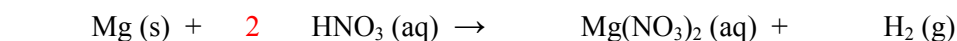
a. $I_2$ (s)	<b>soluble</b>	<b>insoluble</b>	<b>miscible</b>	<b>immiscible</b>
b. $C_6H_{14}$ (l)	<b>soluble</b>	<b>insoluble</b>	<b>miscible</b>	<b>immiscible</b>
c. $CH_3OH$ (l)	<b>soluble</b>	<b>insoluble</b>	<b>miscible</b>	<b>immiscible</b>
d. NaCl (s)	<b>soluble</b>	<b>insoluble</b>	<b>miscible</b>	<b>immiscible</b>
e. Water	<b>soluble</b>	<b>insoluble</b>	<b>miscible</b>	<b>immiscible</b>
f. $CO_2$ (s)	<b>soluble</b>	<b>insoluble</b>	<b>miscible</b>	<b>immiscible</b>

24. (2 pts) Which of the following statements is true regarding the heating-cooling curve?

- Region 1 contains only liquid.
- Region 3 contains both liquid and solid.
- A represents the boiling point of the substance.**
- B represents the boiling point of the substance.
- Region 4 contains only gas.



**Extra Credit: (5 pts)**



How many moles of  $H_2$  (g) are produced when 5.00 moles of Mg (s) react with 10.0 moles  $HNO_3$  (aq)?

**(SHOW ALL WORK FOR FULL CREDIT)**

$$5.00 \text{ mol Mg} \left( \frac{1 \text{ mol H}_2}{1 \text{ mol Mg}} \right) = 5.00 \text{ mol H}_2$$

$$10.00 \text{ mol HNO}_3 \left( \frac{1 \text{ mol H}_2}{2 \text{ mol HNO}_3} \right) = 5.00 \text{ mol H}_2$$