

# Chem 1121 Spring 2012 Exam 5A

Name: KEY

Multiple Choice. Select the best answer, and record your response on a scantron sheet.

Q1. [4 pts] Which of the following equations is Avogadro's law?

- a)  $p \propto V$       b)  $V \propto T$       **c)  $V \propto n$**       d)  $p \propto 1/V$       e)  $p \propto 1/T$

Q2. [4 pts] The partial pressure of a substance above its liquid is known as:

- a) vapor pressure**      b) barometric pressure      c) ideal pressure  
d) boiling point      e) osmotic pressure

Q3. [4 pts] A reaction that absorbs heat is called:

- a) dynamic      b) catalyzed      c) explosive      **d) endothermic**      e) non-ideal

Q4. [4 pts] A reaction with a high activation energy will be:

- a) fast      **b) slow**      c) exothermic

Q5. [4 pts] What can you say about a reaction at equilibrium:

- a) the molecules are no longer reacting  
b) the activation energy has been reduced to zero  
c) the rate of the forward reaction is zero  
**d) the rate of the forward reaction equals the rate of the reverse reaction**  
e) Le Chatelier's principle no longer applies

Q6. [4 pts] What is the Arrhenius definition of a base:

- a) proton donor      b) proton acceptor      c) releases  $H^+$  in solution  
**d) releases  $OH^-$  in solution**      e) turns litmus blue

Q7. [4 pts] Which of the following molecules is probably a triprotic acid?

- a)  $HC_2H_3O_2$       b)  $H_2SO_4$       **c)  $H_3PO_4$**       d)  $HCO_2H$       e)  $H_2CO_3$

Q8. [4 pts] An aqueous solution at 25 °C with  $[H^+] = 1.0 \times 10^{-8} M$  is:

- a) acidic      b) neutral      **c) basic**      d) a buffer      e) not enough information

$pH = 8.00$  ( $> 7$  means basic)  
 $< 7$  means acidic

Q9. [4 pts] What is the pOH of a solution if  $[H^+] = 1.0 \times 10^{-6}$

- a) 5.00      b) 6.00      c) 7.00      **d) 8.00**      e) 9.00

$pH = -\log[H^+] = 6.00$   
 $pH + pOH = 14.00$

Q10. [4 pts] Which radioactive particle is strongly repelled by a negatively charged plate?

- a) alpha      **b) beta**      c) gamma      d) delta      e) epsilon

$\beta = -1e^-$  ← negative  
⇒ will be repelled by -ve plate

Q11. [4 pts] Cobalt-60 ( $^{60}_{27}Co$ ) undergoes beta decay. What is the identity of the daughter atom formed?

- a)  $^{60}_{29}Cu$       b)  $^{64}_{29}Cu$       c)  $^{56}_{25}Mn$       d)  $^{61}_{27}Co$       **e)  $^{60}_{28}Ni$**

$$20 \text{ years} = 2 \times \text{half-lives!}$$

$$\Rightarrow 100\% \times \frac{1}{2} \times \frac{1}{2} = 25\%$$

Q12. [4 pts] Hydrogen-3 has a half life of approximately ten years. What percent of a sample of hydrogen-3 will remain after twenty years?

- a) 100 %    b) 50 %    **c) 25 %**    d) 10 %    e) 0 %

Show all work to receive credit. You must use the factor-label (conversion-factor) method for all conversions. Be sure to show all units and write your answers using the correct number of significant figures or decimal places.

Q13. [10 pts] What volume will 23.4 g of  $\text{NH}_3(\text{g})$  occupy at a pressure of 1.20 atm and a temperature of  $-5^\circ\text{C}$ ?

$$PV = nRT \Rightarrow V = \frac{nRT}{P}$$

$$\begin{array}{l} \text{NH}_3 \\ 1 \times \text{N} = 14.01 \\ 3 \times \text{H} = 3 \times 1.01 \\ \hline 17.04 \end{array}$$

$$\frac{23.4 \text{ g NH}_3}{17.04 \text{ g NH}_3} \left| \frac{1 \text{ mol NH}_3}{17.04 \text{ g NH}_3} \right. = 1.37 \text{ mol NH}_3 \quad (n)$$

$$(T) = 273 - 5 = 268 \text{ K}$$

$$\Rightarrow V = \frac{nRT}{P} = \frac{1.37 \text{ mol} \times 0.08206 \frac{\text{atm}\cdot\text{L}}{\text{mol}\cdot\text{K}} \times 268 \text{ K}}{1.20 \text{ atm}}$$

$$= 25.1 \text{ L} \quad (3 \text{ s.f.})$$

Q14. [10 pts] Consider the following reaction at equilibrium:

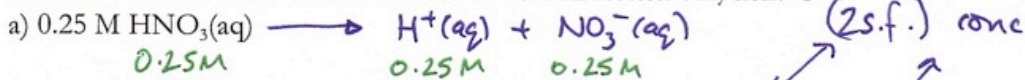


Which direction (left, right, or no change) will the equilibrium shift when:

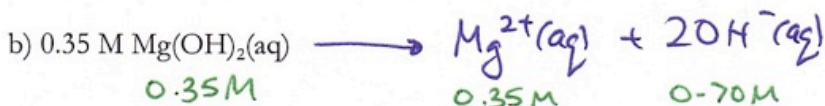
- a) The amount of  $\text{NO}(\text{g})$  is decreased: LEFT (to make more NO!)
- b) The pressure is increased: LEFT (to lower pressure by making fewer molecules!)
- c) The amount of  $\text{H}_2(\text{g})$  is decreased: RIGHT (to make more  $\text{H}_2$ )
- d) The temperature is increased: LEFT (to remove heat)
- e) The amount of  $\text{CO}(\text{g})$  is increased: LEFT (to make less CO)

Q15. [10 pts] Calculate the pH of the following solutions:

Be sure to show ALL work! Answers that do not show work will not receive any credit. ☹



$\text{pH} = -\log[\text{H}^+] = -\log[0.25] = \boxed{0.60}$  (2 d.p.) pH (2 s.f.) conc

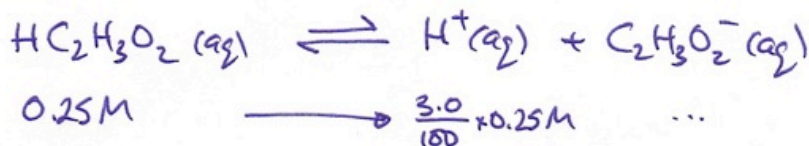


$\text{pOH} = -\log[\text{OH}^-] = -\log[0.70] = 0.15$

$\Rightarrow \text{pH} + \text{pOH} = 14.00$

$\Rightarrow \text{pH} = 14.00 - \text{pOH} = 14.00 - 0.15 = \boxed{13.85}$

c)  $0.25 \text{ M HC}_2\text{H}_3\text{O}_2(\text{aq})$ , a weak acid that undergoes 3.0 % dissociation.

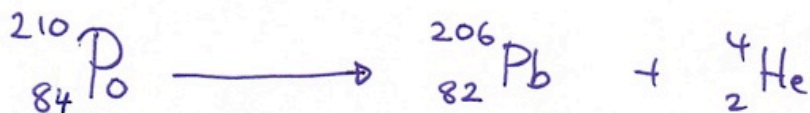


$\Rightarrow [\text{H}^+] = 0.0075\text{M}$

$\Rightarrow \text{pH} = -\log[\text{H}^+] = 2.12$

Q16. [10 pts] Write the balanced nuclear equation for the alpha-decay of Polonium-210.

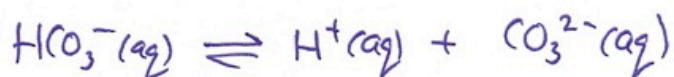
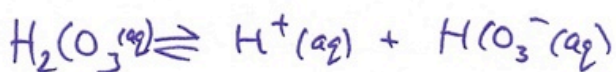
(Polonium is element number 84, Po)



Q17. [5 pts] Carbonic acid,  $H_2CO_3$ , is a weak diprotic acid. What does diprotic mean? Write out chemical equations that show the dissociation reactions of carbonic acid in water.

diprotic means it can lose  $2H^+$  / molecule.

weak  $\Rightarrow$  all rxns are eqm!



Q18. [7 pts] What does a buffer do? How is it made?

A buffer is a solution that resists changes in pH when small amounts of acids/bases are added to them.

Buffers are made from solutions containing both a weak acid and its conjugate base.

**BONUS** Question:

Explain why liquids boil at a lower temperature when atmospheric pressure is reduced?

liquids boil when their vapor pressure equals atmospheric pressure.  
if atmospheric pressure is reduced, then the b.p.  $\downarrow$   
since a lower T generates a pressure equal to the new atmospheric pressure.

