

1 [8] Describe how you would prepare a 1.0 L phosphate buffer having a pH of 12 using 25 grams of reagents (the combined mass of all reagents equals 25 g). Given below are the ionization constants of the phosphoric acids, H_3PO_4 , H_2PO_4^- , and HPO_4^{2-} , and the formula weights of their salts.

$K_{a1} = 7.5 \times 10^{-3}$	<u>Compound</u>	<u>Formula Weight</u>
$K_{a2} = 6.2 \times 10^{-8}$	H_3PO_4	79.98
$K_{a3} = 4.8 \times 10^{-13}$	$\text{NaH}_2\text{PO}_4 \cdot 2 \text{H}_2\text{O}$	177.99
	$\text{Na}_2\text{HPO}_4 \cdot 5 \text{H}_2\text{O}$	216.04
	$\text{Na}_3\text{PO}_4 \cdot 10 \text{H}_2\text{O}$	344.09

2. [6] Calculate ΔG for the following reaction at non-equilibrium condition.



$$[\text{B}] = \{(\exp \Delta G^\circ - \exp RT) [\text{A}]\}^{1/2}$$

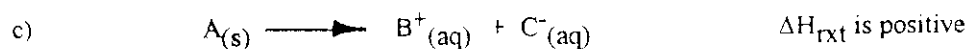
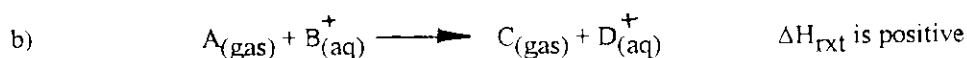
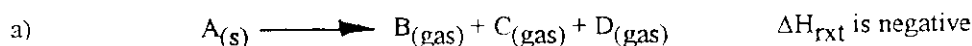
3. [6] a. Calculate the pH of a solution when 6.00 grams of acetic acid is dissolved in enough water to form a 1.00 L solution. ($\text{p}K_a = 4.74$)

b. Calculate the pH when 6.00 grams of sodium acetate is added to the above solution (Assume no change in volume.)

4. [6] What is the solubility of PbCl_2 (i.e. saturated aqueous solution at 25°C)? ($K_{sp} = 2.4 \times 10^{-4}$)

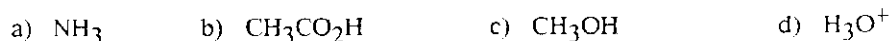
5. [6] A can of Pepsi is opened and left aside for a long period. What happens to the pH of the cola with time? Explain.

6. [12] Speculate on how likely the following reactions are spontaneous if given the following enthalpy conditions. For each problem, a perfect explanation is needed!

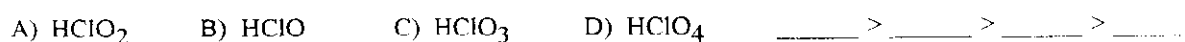


7. [6] The percent ionization of an acid (HA) is 78% when initial concentration is 5.0×10^{-4} M. Calculate for the K_a of that acid.

8. [8] Give the appropriate conjugate bases for the following acids (Some are very weak acids).



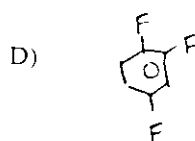
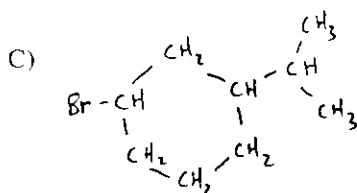
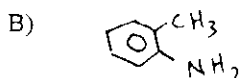
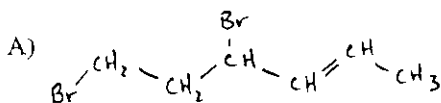
9. [4] Rank the following acids in decreasing strength of acidity:



10. [6] Calculate the pOH of
 a) 3.0×10^{-4} M hydrogen chloride solution
 b) 0.015 M barium hydroxide solution

11 [6] When chlorine reacts with water, the resulting solution is weakly acidic and reacts with silver nitrate to give a white precipitate. Write balanced equations to represent these reactions. Explain why manufacturers of household bleaches add bases such as NaOH to their products to increase their effectiveness.

12. [8] Give the names for the following compounds



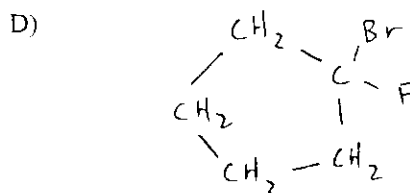
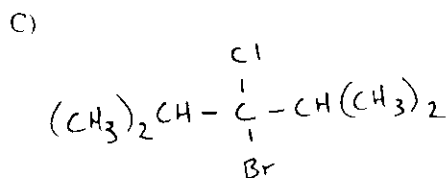
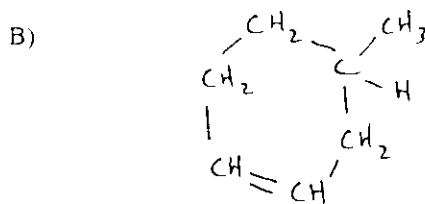
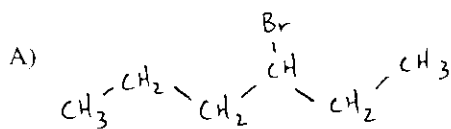
13. [4] What is the most stable allotrope of carbon at standard pressure and temperature conditions?

14. [6] Give the Lewis-dot structure of ozone. SHOW ALL RESONANCE STRUCTURES, IF ANY.

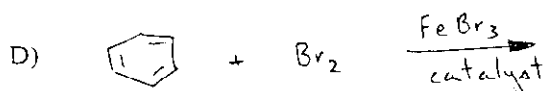
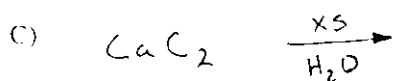
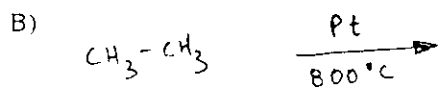
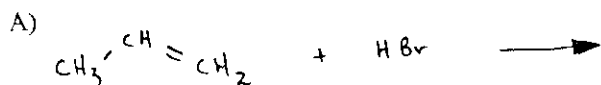
15. [6] At 25°C the molar solubility of $\text{Mg}(\text{OH})_2$ is 1.4×10^{-4} M. Calculate its molar solubility in a buffer medium whose pH is 11.50.

16. [8] How many structural isomers with the formula C_4H_8 can be obtained? Draw out all structures.

17. [8] Which of the following are potential optical isomers? Label all asymmetric carbons by circling them.



18. [12] What are the products of the following reactions, if any.



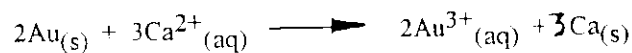
19) [6] What is the structure of Dewar's benzene?

20) [4] Give an example of an interstitial hydride.

21) [4] What is tritium? One mole of tritium would weigh how many grams?

22) [6] Draw the structures of white and red phosphorus.

23) [8] Calculate the standard free-energy change and equilibrium constant for the following reaction at 25°C .
Data: $E^\circ_{\text{Au}^{3+}/\text{Au}} = 1.50 \text{ V}$; $E^\circ_{\text{Ca}^{2+}/\text{Ca}} = -2.87 \text{ V}$; $F = 96,500 \text{ J/V}\cdot\text{mol}$; $R = 8.314 \text{ J/K}\cdot\text{mol}$



Give K as $\ln K$ or $\log K$