Name:……. Date:…….

CHEMISTRY HONORS HOMEWORK 5.1 – ACIDS, BASES, SALTS AND NEUTRALIZATION

1. Complete the following table:

nitric acid, HNO_3, acid
calcium hydroxide, $Ca(OH)_2$, base
calcium nitrate, $Ca(NO_3)_2$, salt
ammonium sulfate, $(NH_4)_2SO_4$, salt
sulfuric acid, H_2SO_4, acid
potassium carbonate, K_2CO_3, base

Name	Formula	Acid, base or salt?
nitric acid		
	$Ca(OH)_2$	
calcium nitrate		
	$(NH_4)_2SO_4$	
	H_2SO_4	
potassium carbonate		

/6

2. Write balanced equations, with state symbols, for the following reactions:

(a) magnesium hydroxide powder with dilute hydrochloric acid
$Mg(OH)_2(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + 2H_2O(l)$
(all species 1, balanced 1, state symbols 1) /3

(b) dilute sulfuric acid with sodium carbonate solution
$H_2SO_4(aq) + Na_2CO_3(aq) \rightarrow Na_2SO_4(aq) + CO_2(g) + H_2O(l)$
(reactants 1, products 1, state symbols 1) /3

(c) Ammonia solution with dilute nitric acid
$NH_3(aq) + HNO_3(aq) \rightarrow NH_4NO_3(aq)$
(reactants 1, products 1, state symbols 1) /3

3. (a) Describe what you would see as reaction 2 (a) was taking place.
The solid would dissolve /2

(b) State a useful application of reaction 2 (a).
Treating indigestion/neutralizing excess stomach acid /1

(c) Explain how you would prepare a pure sample of the salt produced in reaction 2 (a).
Add **excess** $Mg(OH)_2$ to HCl
Filter off excess $Mg(OH)_2$
Boil off water /3

(d) Explain why it is much easier to produce a pure sample of salt from reaction 2 (a) than from reactions 2 (b) or 2 (c)
Both reactants in (b) and (c) are soluble
So excess reactant cannot be filtered off or so you need to use exact quantities /2

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4.	In terms of the concentration of H^+ and OH^- ions, explain what it meant by the terms: acidic solution: concentration of H^+ ions > concentration of OH^- ions alkaline solution: concentration of H^+ ions < concentration of OH^- ions neutral solution: concentration of H^+ ions = concentration of OH^- ions		/3
5.	(a)	What is the concentration of H^+ ions in a solution with a pH of 5? 1×10^{-5} mol/L	/1
	(b)	What is the pH of a solution containing an OH^- concentration of 1×10^{-4} mol/L? H^+ concentration = $1 \times 10^{-14}/1 \times 10^{-4} = 1 \times 10^{-1}$ mol/L pH = 10	/2
	(c)	What is the hydrogen ion concentration and the hydroxide ion concentration in a solution with a pH of 12? H^+ concentration: 1×10^{-12} mol/L OH^- concentration: 1×10^{-2} mol/L	/2
		TOTAL	/30

CHEMISTRY HONORS HOMEWORK 5.2 – WEAK ACIDS, INDICATORS AND TITRATIONS

1.	Citric acid is a weak acid. It has the formula $HC_6H_7O_7$. In a solution of 0.10 mol/L $HC_6H_7O_7$, approximately 10% of the citric acid molecules are dissociated. In an experiment to compare the properties of citric acid and nitric acid, Ahmad added magnesium carbonate powder slowly to 50 mL of 0.10 mol/L $HC_6H_7O_7$ until no more magnesium carbonate powder dissolved. Ahmad then repeated the experiment using 50 mL of 0.10 mol/L HNO_3 instead of 50 mL of 0.10 mol/L $HC_6H_7O_7$. After the reaction, Ahmad added a small quantity of an indicator to the mixture to check whether the acid had been completely neutralised.		
	(a)	Write an equation to show the dissociation of citric acid in water. $HC_6H_7O_7 \rightleftharpoons H^+ + C_6H_7O_7^-$	/2
	(b)	Estimate the pH of 0.10 mol/L HNO_3: acid fully dissociated so concentration of H^+ = 0.1 mol/L, so pH = 1 0.10 mol/L $HC_6H_7O_7$: acid 10% dissociated so concentration of H^+ = 0.1 mol/L, so pH = 2	/2
	(c)	Write an equation, with state symbols, to show the reaction of nitric acid with magnesium carbonate. $MgCO_3(s) + 2HNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + CO_2(g) + H_2O(l)$ All species (1), balanced (1), state symbols (1)	/3
	(d)	Calculate the maximum mass of magnesium carbonate which will dissolve in 50 mL of 0.10 mol/L HNO_3. moles of HNO_3 = 0.1 x 50/1000 = 0.005 moles of $MgCO_3$ = 0.005/2 = 0.0025 mass of $MgCO_3$ = 0.0025 x 84.3 = 0.21 g	/3

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	(e)	Identify one similarity and one difference Ahmad would expect to observe between the reactions of 50 mL of 0.10 mol/L $HC_6H_7O_7$ and 50 mL of 0.10 mol/L HNO_3 with magnesium carbonate. Similarity: both would dissolve 0.21 g of $MgCO_3$ Difference: HNO_3 would dissolve the $MgCO_3$ much more quickly, or reaction much faster, or more bubbles	/2
	(f)	Name an indicator which would show whether or not the acid had been neutralised. State the color Ahmad would see if the acid had been neutralised, and the color Ahmad would see if the acid had not been neutralised. name of indicator: methyl red or methyl orange Color if acid neutralized: yellow color if acid not neutralized: red or pink	/3
	(g)	Name an indicator which would not work well in the above experiment and explain why it would not work. Phenolphthalein it changes color above pH 7 strong acid - weak base reaction takes place below pH 7 (4 – 7)	/3
2.	Nina wants to find the molarity of a sample of sulfuric acid which she has found in a cupboard. She decides to use a standard solution of 0.050 mol/L NaOH in order to do this. Nina first prepares 250 mL of 0.05 mol/L NaOH. She then uses a pipette to transfer 15 mL of the NaOH solution into a conical flask and adds a few drops of phenolphthalein indicator. Nina places the sulfuric acid solution into a burette and adds it slowly to the NaOH solution until the indicator changes color. She needs 12.4 mL of sulfuric acid to do this.		
	(a)	What is meant by the term “standard solution”? A solution of accurately known concentration	/1
	(b)	Calculate the mass of NaOH Nina would need to make 250 mL of 0.05 mol/L NaOH. moles of NaOH = 0.25 x 0.05 = 0.0125 molar mass of NaOH = 40 mass of NaOH = 40 x 0.0125 = 0.50 g	/3
	(b)	Write an equation for the reaction between sulfuric acid and sodium hydroxide solution. $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$	/2
	(c)	State the initial color of the indicator, and its color at the equivalence point. Initial color: pink Color at equivalence point: colorless	/2
	(d)	Calculate the molarity of the sulfuric acid solution. moles of NaOH = 15/1000 x 0.05 = 0.00075 moles of H_2SO_4 = 0.00075/2 = 0.000375 molarity of H_2SO_4 = 0.000375/0.0124 = 0.030 mol/L	/3
		TOTAL	/25