Titrations Practice Worksheet

Find the requested quantities in the following problems:

1) If it takes 54 mL of 0.1 M NaOH to neutralize 125 mL of an HCl solution, what is the concentration of the HCl?

2) If it takes 25 mL of 0.05 M HCl to neutralize 345 mL of NaOH solution, what is the concentration of the NaOH solution?

3) If it takes 50 mL of 0.5 M KOH solution to completely neutralize 125 mL of sulfuric acid solution (H_2SO_4), what is the concentration of the H_2SO_4 solution?

4) Can I titrate a solution of unknown concentration with another solution of unknown concentration and still get a meaningful answer? Explain your answer in a few sentences.

5) Explain the difference between an endpoint and equivalence point in a titration.

Worksheet: Neutralization and Titration **Name**_____

1. Give the word equation for the neutralization reaction of an acid and a base.

2. Complete these equations:

   $HCl + LiOH \rightarrow$

   $HC_2H_3O_2 + Mg(OH)_2 \rightarrow$

3. A _____ is a laboratory method used to determine the concentration of an acid or a _____ in solution by performing a _____ reaction with a standard solution.
4. At the _____ of the titration, the indicator changes color, which indicates neutralization. Once neutralized, moles of _____ and moles of _____ are equal.
5. In a titration of HCl with NaOH, 100.0 mL of the base was required to neutralize 20.0 mL of 5.0 M HCl. What is the molarity of the NaOH? (Be sure to write the neutralization reaction.)

6. In a titration of H_2SO_4 with NaOH, 60.0 mL of 0.020 M NaOH was needed to neutralize 15.0 mL of H_2SO_4. What is the molarity of the acid? (Be sure to write the neutralization reaction.)

7. If 10.0 mL of 0.300 M KOH are required to neutralize 30.0 mL of gastric juice (HCl), what is the molarity of the gastric juice?

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Name _____ Date _____

Acid-Base Titration Practice

1. How many mL of 0.100M HCl are required to neutralize 25.0mL of 0.100M NaOH?

2. What is the molarity of a 30mL hydrochloric acid solution that was just neutralized by 48.0mL of 0.100M NaOH?

3. 50 mL of unknown concentration of HBr is titrated with 0.500M KOH. It is found that to complete neutralization, 75mL of KOH was used. What was the original volume of HBr that was titrated?

4. What is a titration?

5. What is an end point?

6. What is a standard solution?

7. What is a neutralization reaction?

8. How many milliliters of 0.200M HCl are required to neutralized 25.0mL of 0.200M $Ba(OH)_2$?

9. A solution of sulfuric acid is titrated with a solution of calcium hydroxide. If you use 56mL of 0.175M H_2SO_4 to titrate 100mL of the base, what is the concentration of the base?

10. You want to titrate a solution of H_3PO_4 with a solution of $Mg(OH)_2$. What volume of acid will you need if you use 50mL of 0.250M base and titrate it with the acid which has a concentration of 0.300M?

11. A 135.0 g sample of $Al(OH)_3$ is reacted with 0.375M sulfuric acid. How many grams of the acid are needed to neutralize the base?

LE CHATELIER'S PRINCIPLE

Name _____

Le Chatelier's Principle states that when a system at equilibrium is subjected to a stress, the system will shift its equilibrium point in order to relieve the stress.

Complete the following chart by writing left, right or none for equilibrium shift, and decreases, increases or remains the same for the concentrations of reactants and products, and for the value of K.

$$N_2(g) + 3H_2(g) \leftrightarrow 2NH_3(g) + 22.0 \text{ kcal}$$

Stress	Equilibrium Shift	$[N_2]$	$[H_2]$	$[NH_3]$	K
1. Add N_2	right	____	decreases	increases	remains the same
2. Add H_2			____		
3. Add NH_3				____	
4. Remove N_2		____			
5. Remove H_2			____		
6. Remove NH_3				____	
7. Increase Temperature					
8. Decrease Temperature					
9. Increase Pressure					
10. Decrease Pressure					

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5

LE CHATELIER'S PRINCIPLE CONTINUED

Name _____

$$12.6\ kcal + H_2(g) + I_2(g) \leftrightarrow 2HI(g)$$

Stress	Equilibrium Shift	$[H_2]$	$[I_2]$	[HI]	K
1. Add H_2	right	———	decreases	increases	remains the same
2. Add I_2			———		
3. Add HI				———	
4. Remove H_2		———			
5. Remove I_2			———		
6. Remove HI				———	
7. Increase Temperature					
8. Decrease Temperature					
9. Increase Pressure					
10. Decrease Pressure					

$$NaOH(s) \leftrightarrow Na^+(aq) + OH^-(aq) + 10.6\ kcal$$

(Remember that pure solids and liquids do not affect equilibrium values.)

Stress	Equilibrium Shift	Amount NaOH(s)	$[Na^+]$	$[OH^-]$	K
1. Add NaOH(s)		———			
2. Add NaCl (Adds Na^+)			———		
3. Add KOH (Adds OH^-)				———	
4. Add H^+ (Removes OH^-)				———	
5. Increase Temperature					
6. Decrease Temperature					
7. Increase Pressure					
8. Decrease Pressure					

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6

Name _____ Date _____

Rates of Reactions

1. The rate of a reaction can be increased by four factors, list them below:
   a. _____
   b. _____
   c. _____
   d. _____
2. For each scenario below, state which factor is being changed to alter the reaction rate:
   a. Firewood is chopped into small pieces to make lighting a fire easier.

      i. _____

   b. Food left in the fridge lasts longer than food left out.

      i. _____

   c. Coal dust can cause explosions.

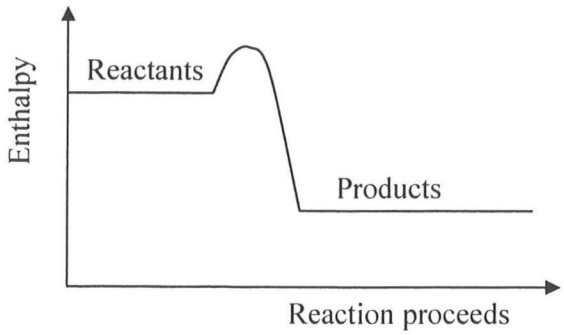
      i. _____

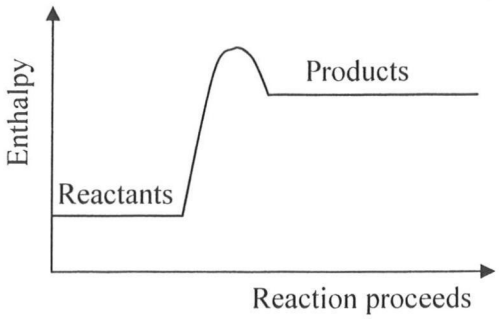
   d. A piece of magnesium ribbon takes long to react in 20 mL of 2M HCl mixed with water than it does in 40 mL of 2M HCl.

      i. _____

3. Explain what is meant by activation energy of a reaction.

4. Label the activation energy on the energy profiles below. Tell whether the reaction is endothermic or exothermic.





5. Use the collision theory to explain the following observations:
   a. A piece of magnesium metal burns faster in a jar of pure oxygen than in air.

   b. In 2M HCl, iron wool produces hydrogen gas fast than an iron nail of the same mass.

   c. Hydrogen peroxide takes longer to decompose when it is left in the fridge.

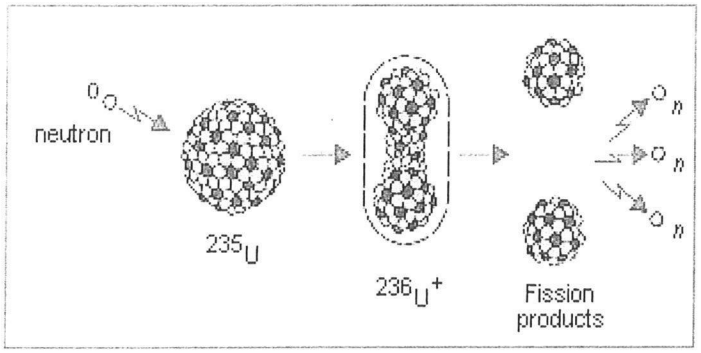
   d. A mixture of petrol and oxygen does not combust until a spark is added.

   e. Marble chips (calcium carbonate) react slowly with ethanoic acid, whereas powdered calcium carbonate reacts vigorously with the same acid.

(8)

Nuclear Fission vs. Nuclear Fusion

Nuclear f "i" s s i o n (Spl"i"tting an atom into two new ones)

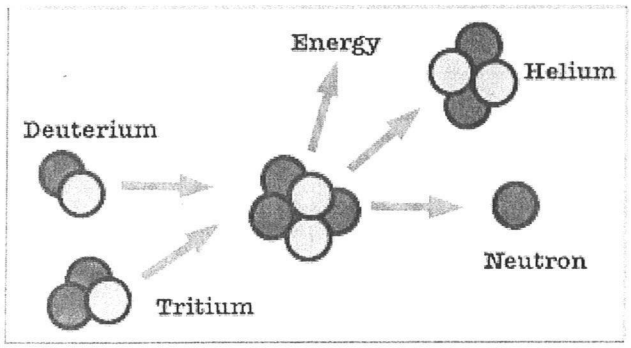


In nuclear fission reactions (also called radioactive decay), a neutron is aimed at the nucleus of a large, unstable atom, like uranium, thorium, or other radioactive elements. The extra mass of the neutron causes the radioactive nucleus to split apart, forming lighter elements, free neutrons, and great quantities of energy. This process causes convection currents that move Earth's tectonic plates, and generate earthquakes and volcanic eruptions.

*Nuclear **Fission**:*

- Source of energy in the core of the Earth that produces heat from the decay of radioactive elements.
- Produces vast quantities of energy.
- Does not produce particulate air pollution like fossil fuels and coal.
- Involves the splitting of harmful radioactive elements.
- Loss of control leads to harmful radiation exposure.
- Produces a radioactive waste product that will need to be stored.

Nuclear f "u" s i o n (combining/f"u"sing two atoms together into one new atom)



During fusion reactions, nuclei collide and fuse, eventually forming nuclei of heavier elements and producing *enormous* amounts of energy. Fusion of hydrogen to helium occurs in the sun and is the source for all external weather related events.

*Nuclear **Fusion**:*

- Source of energy in the Sun that produces heat from the fusing of elements like hydrogen.
- Produces unsurpassed quantities of energy.
- Does not produce particulate air pollution like fossil fuels and coal.
- Does not produce a radioactive waste product that will need to be stored.
- Currently, we lack the technology to maintain reactions as a viable energy source.

****Write Fission or Fusion next to each of the descriptions below:****

1. Generates a large volume of solid radioactive waste. _____

2. Occurs in the core of the Earth. _____

3. The reaction occurs only at extremely high temperatures. _____

4. Earth's source in *internal* energy. (volcanoes, plate motion, geothermal, etc.)

   _____

5. The products of this reaction are *not* radioactive. _____

6. Occurs only in the core of the Sun. _____

7. Earth's source of *external* energy (atmosphere, oceans, weather, plants, etc.).

   _____

8. Also called radioactive decay. _____

9. Responsible for providing heat for the convection in the interior of the Earth.

   _____

10. A potential power source but we lack the technology to maintain the reactions so we are unable to perform these reactions on Earth. _____

11. The one with a "u" in it._____

12. The one with two "i's" in it. _____

13. The one that sounds like "fuse" _____

14. The one that almost rhymes with "split." _____

15. Creates enough energy for the whole Earth (inside and out) _____ and _____.

16. Which one you love the most now ☺. _____

10

NUCLEAR DECAY

Name _____

Predict the products of the following nuclear reactions.

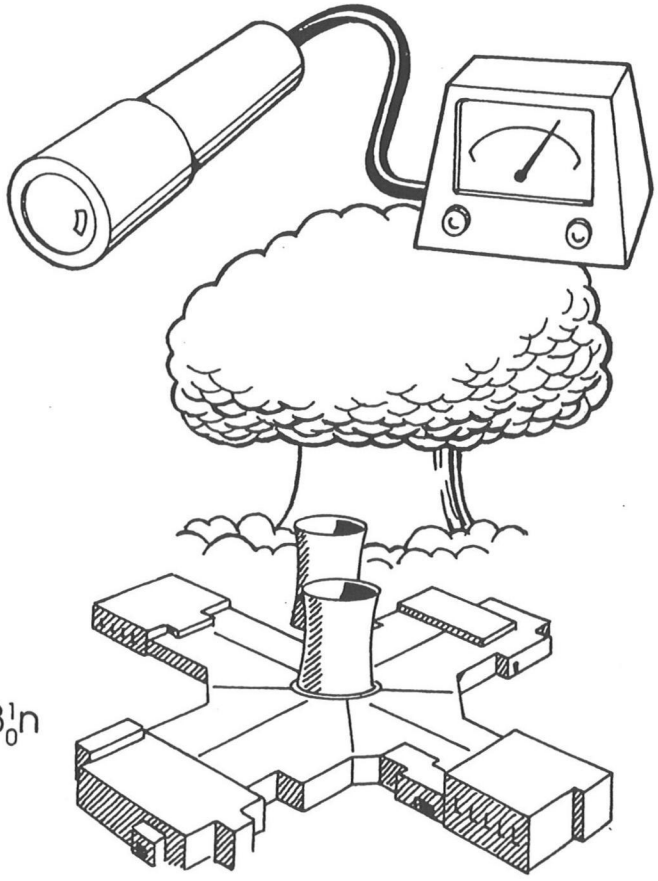
1. $^{42}K \rightarrow {}^{0}_{-1}e$ + _____

2. $^{239}Pu \rightarrow {}^{4}_{2}He$ + _____

3. $^{235}_{92}U \rightarrow$ _____ + $^{231}_{90}Th$

4. $^{1}_{1}H + {}^{3}_{1}H \rightarrow$ _____

5. $^{6}_{3}Li + {}^{1}_{0}n \rightarrow {}^{4}_{2}He$ + _____



6. $^{27}_{13}Al + {}^{4}_{2}He \rightarrow {}^{30}_{15}P$ + _____

7. $^{9}_{4}Be + {}^{1}_{1}H \rightarrow$ _____ + $^{4}_{2}He$

8. $^{37}K \rightarrow {}^{0}_{+1}e$ + _____

9. _____ + $^{1}_{0}n \rightarrow {}^{142}_{56}Ba + {}^{91}_{36}Kr + 3{}^{1}_{0}n$

10. $^{238}_{92}U + {}^{4}_{2}He \rightarrow$ _____ + $^{1}_{0}n$

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HALF-LIFE OF RADIOACTIVE ISOTOPES

Name _____

1. How much of a 100.0 g sample of ^{198}Au is left after 8.10 days if its half-life is 2.70 days?

_____

2. A 50.0 g sample of ^{16}N decays to 12.5 g in 14.4 seconds. What is its half-life?

_____

3. The half-life of ^{42}K is 12.4 hours. How much of a 75$\bar{0}$ g sample is left after 62.0 hours?

_____

4. What is the half-life of ^{99}Tc if a 50$\bar{0}$ g sample decays to 62.5 g in 639,000 years?

_____

5. The half-life of ^{232}Th is 1.4×10^{10} years. If there are 25.0 g of the sample left after 2.8×10^{10} years, how many grams were in the original sample?

_____

6. There are 5.0 g of ^{131}I left after 40.35 days. How many grams were in the original sample if its half-life is 8.07 days?

_____

10

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Name _____

Date _____

Nuclear Chemistry

1. What happens to the mass number and atomic number of an atom that undergoes beta decay?

2. Give the composition of the nucleus of the following isotopes:

$^{64}_{28}Ni$ $^{136}_{53}I$ $^{195}_{79}Au$

3. Complete the following equations:

a. $^{14}_{6}C \rightarrow {}^{0}_{-1}e + ?$

b. $^{241}_{95}Am \rightarrow {}^{4}_{2}He + ?$

c. $^{16}_{7}N \rightarrow {}^{16}_{8}O + ?$

4. Write the nuclear equation for the following radioactive processes.

a. alpha decay of francium – 208

b. beta emission by argon - 37

c. beta capture of beryllium – 7

d. alpha absorption by fluorine – 17

5. Describe the difference between fission and fusion.

13

6. Polonium-214 has a relatively short half-life of 164 seconds. How many seconds would it take for 8.0 g of this isotope to decay to 0.25 g?

7. How many days does it take for 16 g or palladium-103 to decay to 1.0 g? The half-life of palladium-103 is 17 days.

8. By approximately what factor would the mass of a sample of copper-66 decrease in 51 minutes? The half-life of copper-66 is 5.10 min.

9. In 5.49 seconds, 1.20g of argon-35 decays to leave only 0.15g. What is the half-life of argon-35?

Collision Theory

16.1

Q1 Fill in the blanks below using each word once.

energy collide catalyst concentration collision theory

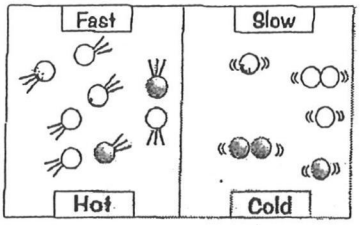
Particles can only react if they (1) _____ with enough (2) _____ for the reaction to take place. This is called the (3) _____ _____. There are four factors that can change the rate of a reaction; temperature, (4) _____, surface area and the use of a suitable (5) _____.

Q2 Fill in the blanks in the text and complete the diagrams below using each word once.

moderate collision faster energy surface area faster catalyst fast
slow particles faster faster more often collision successful slow
fast faster low concentration catalyst present high concentration large surface area

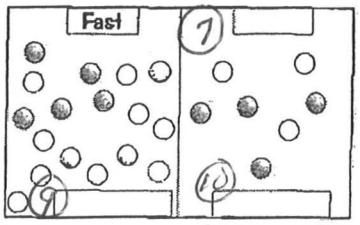
TEMPERATURE

Increasing the temperature will cause the particles to move (1) _____ with more energy. They will therefore collide (2) _____ (3) _____ and with greater (4) _____. These two things mean there are more successful collisions per second and therefore (5) a _____ rate of reaction.



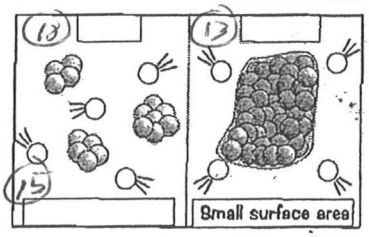
CONCENTRATION

Increasing the concentration of a reactant simply means there are more (6) _____ which may collide and so react. More collisions means a (8) _____ reaction.



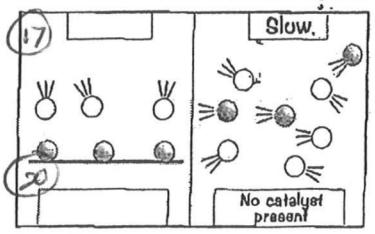
SURFACE AREA

Using a powder instead of a lump means the (11) _____ _____ is greater, which means a greater area of reactant is exposed and so available for a collision. More collisions means a (14) _____ reaction.



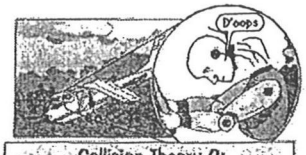
CATALYSTS

Use of a suitable catalyst means that the particles may react even if they collide with only (16) _____ energy. This means more (18) _____ collisions are likely. Some catalysts work because one of the particles is fixed to a surface. This makes the chance of a (19) _____ more likely. More collisions means a (21) _____ reaction.



Q3 Choose the sentence that best describes the collision theory:

- Particles collide at random and always react.
- Collisions between particles often result in a reaction.
- Reacting particles must collide with enough energy in order to react.
- Collisions between molecules are sometimes needed before a reaction occurs.



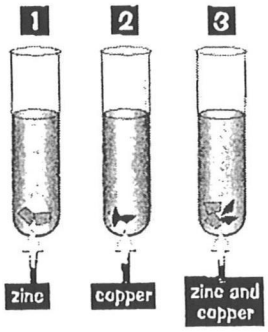
Collision Theory 2:
It's not the falling that hurts, it's the landing.

15

Catalysts

16.1

Q1 The diagrams to the right show how 0.5g of zinc and 0.5g of copper react with dilute sulphuric acid.



a) Does the copper metal react with dilute sulphuric acid?

b) Does zinc react with dilute sulphuric acid?

c) How do zinc and copper together react with dilute sulphuric acid?

d) Describe what copper does to the reaction in tube 3.

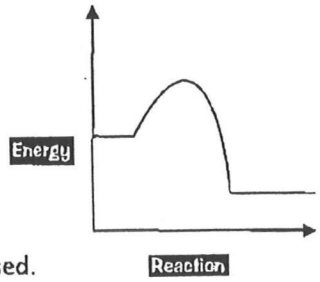
Tube 3 was left for several hours until the reaction was finished. The copper was removed, dried and weighed. Its mass was 0.5g.

e) What does this tell you about the action of copper in speeding up the reaction between zinc and dilute sulphuric acid?

Q2 The graph shows an energy profile for a typical exothermic reaction.

a) Make a copy of the graph and mark on:

the reactants | the products | the activation energy | the energy change of the reaction

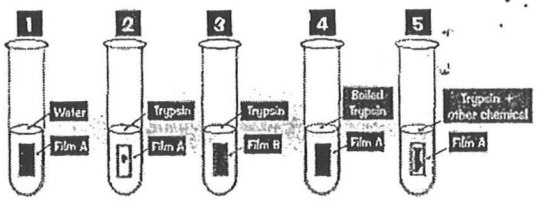


b) Use a different colour to mark the profile of the reaction when catalysed.

Q3 What are the advantages of using catalysts in the industrial manufacture of chemicals?

Q4 The experiment below can be used to investigate enzyme activity.

Trypsin is an enzyme which acts as a catalyst to the breakdown of protein. Photographic film has a protein layer that holds the silver compounds in place (these appear black). Different films use different proteins. If the protein is destroyed this black layer falls off leaving a clear plastic film.



a) Look at the test tubes carefully, then work out what you can say about the following test tube pairs:
i) 2 & 3 ii) 2 & 4 iii) 2 & 5

b) Why was test tube 1 included in the experiment?

16

Chemistry

Date:_____
Name:_____

Oxidation and Reduction Practice

In each of the following equations, indicate the element that has been oxidized and the one that has been reduced. You should also label the oxidation state of each before and after the process:

1) $2\ Na + FeCl_2 \rightarrow 2\ NaCl + Fe$

2) $2\ C_2H_2 + 5\ O_2 \rightarrow 4\ CO_2 + 2\ H_2O$

3) $2\ PbS + 3\ O_2 \rightarrow 2\ SO_2 + 2\ PbO$

4) $2\ H_2 + O_2 \rightarrow 2\ H_2O$

5) $Cu + HNO_3 \rightarrow CuNO_3 + H_2$

6) $AgNO_3 + Cu \rightarrow CuNO_3 + Ag$

17

Oxidation number rules

1. The oxidation number of all free elements is zero (including diatomic molecules).

2. The oxidation number of a monatomic ion (Na^+, Ca^{2+}, Al^{3+}, Cl^-) is equal to the charge of the ion.

3. The oxidation number of hydrogen in most compounds is usually 1+.

4. The oxidation number of oxygen in most compounds is usually 2-.
   Exception- peroxides (Na_2O_2, H_2O_2)

5. The sum of the oxidation numbers of all the atoms in a particle must equa the apparent charge of the particle.
   i.e. in SO_4^{2-}, each oxygen has an oxidation number of 2-, totaling 8-. For SO_4 to have a charge of 2-, the sulfur must have an oxidation number of 6+.
   (-8) + (+6) = -2

6. Group 1A elements have a oxidation numbers of 1+, group 2A have oxidation numbers of 2+, and aluminum has an oxidation number of 3+.