

Chem 108: Lab

Week 12

Sign in

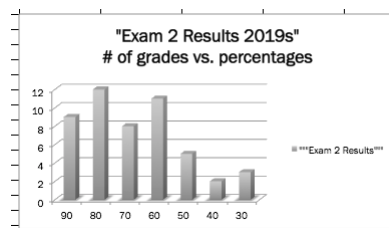
Alcohol Distillation

To do with your Fermentation partner:

Turn in 7-Solution Report form

and

Post Lab Questions



avg	72.3%	%
std dev +/-	17.6	
Normalization	125	

7 Solutions Report pp. 76-80 & Post Lab Questions Due Today

Chem 108 Lab Form

Name: _____

Post Lab Questions: 7 Solutions Problem

<http://chemconnections.org/general/chem120/solutions-mixes.108.html>

1. If the measured concentration of a solution is 0.250 M, what is the mass of solute in 350. mL of a 0.250 M solution of sodium chloride?
2. If the measured concentration of a solution is 0.250 M, what is the mass of solute in 350. mL of a 0.250 M solution of sodium chloride?
3. The following table includes chemical data for the 7 Solutions problem. Complete the table for the chemical data.

Solution	Chemical	Concentration	Volume
1			
2			
3			
4			
5			
6			
7			

4. What was the highest level of error for the 7 Solutions problem?
5. What was the highest level of error for the 7 Solutions problem?
6. What was the highest level of error for the 7 Solutions problem?
7. What was the highest level of error for the 7 Solutions problem?
8. What was the highest level of error for the 7 Solutions problem?

Seven Solutions Post Lab Questions
<http://chemconnections.org/general/chem120/solutions-mixes.108.html>

QUESTION

Solutions: molarity & volume → mass

How many grams of NaCl are contained in 350. mL of a 0.250 M solution of sodium chloride?

- A) 41.7 g
- B) 5.11 g
- C) 14.6 g
- D) 87.5 g
- E) None of these

ANSWER

B) 5.11 g

Seven Solutions Post Lab Questions
<http://chemconnections.org/general/chem120/solutions-mixes.108.html>

Volume (L) times concentration (mol/L) gives moles. Moles are then converted to grams multiplying by the molar mass.

Chemical Reactions

To DO Today

Separating the Ethanol Produced

Fermentation / Distillation pp.63-67



<http://www.piney.com/BabNinkasi.html>



<http://chemconnections.org/general/chem108/Beer-Ninkasi-Dana%20Garves.pdf>

Career ladder
Dana Garves
This bread is more than just a loaf of business around the craft beer boom

Biological Reactions: Enzyme Catalysts
An interest in chemistry

Fermentation / Distillation
Industry experience

Brewing entrepreneur
Garves saw an opportunity in beer distilleries. In 2011, she and a friend started a distillery in the heart of the craft beer boom. The distillery is now a successful business, and Garves is a sought-after speaker at industry events.

A move to the beer world
Garves' career path is a testament to her passion for chemistry and her ability to apply it in the real world. She has worked in various industries, including pharmaceuticals and food processing, before making the move to the beer world.

Energy: Heat: Enthalpy (ΔH)

$\Delta H = \text{J or kJ cal or kcal}$

$\Delta H_{\text{deposition}} = (-)$

$\Delta H_{\text{condensation}} = (-)$

$\Delta H_{\text{solidification}} = (-)$

$\Delta H_{\text{vaporization}} = (+)$

$\Delta H_{\text{fusion}} = (+)$

$\Delta H_{\text{sublimation}} = (+)$

Distillation

<http://chemconnections.org/general/movies/html-sw/oil-refining.swf>

Oil Refining:

<http://science.howstuffworks.com/oil-refining4.htm>

QUESTION

Answer either: A) endothermic, or: B) exothermic for each of the following 5 changes of physical state.

1. Fusion
2. Vaporization
3. Condensation
4. Sublimation
5. Liquid \rightarrow Solid

A) endothermic

Distillation involves heating.

How could distillation be done @ lower temperatures?

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ULVAC vacuum distillation systems are designed for efficient, small-scale manufacturing and are quickly changed over to handle a variety of raw materials.

For fast, low temperature distillation, call 800-890-0300 or email info@ulvac.com.

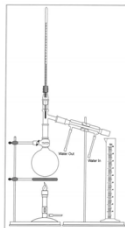
One of many products being sold.

Water : "The Universal" Solvent

The ethanol product is miscible in water and both vaporize when the solution is distilled.

Theoretical & Percent Yield

<http://chemconnections.org/general/movies/html-sw/oil-refining.swf>



Density and Percent Alcohol of the Distillate

While the distillate is cooling weigh a clean dry vial and cap or small beaker and record the mass. Obtain a 20 or 25 mL pipet (each partner should have a vial or small beaker and each partner must use a different volume) and rinse it thoroughly with distilled water. Draw distillate into the pipet until the bulb is about one-third full. Rinse all parts of the pipet with the distillate and return the it to the distillate in the flask. You don't want to discard any alcohol at this point. Rinse the pipet a second time with distillate and return it to the flask. Pipet 20 or 25 mL of distillate (depending on the volume of your pipet) into the weighed vial and cap the vial or into a small beaker. Weigh the vial or beaker and contents and record the mass. If your density and your partner's don't agree within 0.005 g/mL repeat the procedure. When you have two densities that agree, record your partner's density and average them. Determine the percent alcohol to 0.1 % from the table of densities.

The ethanol produced in the fermentation is distilled along with the water used. The liquid collected is ethanol mixed in with the water, which is the solvent. The amount dissolved will be calculated by experimentally determining the solution's density.

What is a solution's concentration?

Solution Concentrations

Concentration is a measure of the amount of solute dissolved.

$$\text{molarity} = M = \frac{\text{moles solute}}{\text{liters solution}}$$

Some other common units include percentage by mass, percentage by volume, (which relates to alcoholic proof), parts per million, parts per billion, and molality. The definition of each provides the basis for calculations with that unit.

$$\% \text{ by mass} = \frac{\text{mass solute}}{\text{mass solution}} \times 100$$

$$\% \text{ by volume} = \frac{\text{volume solute}}{\text{volume solution}} \times 100$$

[Proof = % by volume x 2]

$$\text{parts per million} = \text{ppm} = \frac{\text{mass solute}}{\text{mass solution}} \times 10^6$$

$$\text{parts per billion} = \text{ppb} = \frac{\text{mass solute}}{\text{mass solution}} \times 10^9$$

$$\text{molality} = m = \frac{\text{moles solute}}{\text{kilograms solvent}}$$

Solution Concentrations

- Concentration in mass percent is common.

$$\text{Mass \%} = \frac{\text{Mass solute}}{[\text{Mass solute} + \text{Mass solvent}]} \times 100$$

- What is the mass % of 65.0 g of glucose dissolved in 135 g of water?

$$\text{Mass \%} = \frac{65.0 \text{ g}}{[65.0 + 135] \text{ g}} \times 100 = 32.5 \%$$



% Ethanol from Density

% ethanol by mass	Density (g/mL)	% ethanol by mass	Density (g/mL)	% ethanol by mass	Density (g/mL)
0.0	0.998	35.0	0.945	68.0	0.870
1.0	0.998	36.0	0.943	70.0	0.866
2.0	0.995	37.0	0.941	71.0	0.865
3.0	0.993	38.0	0.939	72.0	0.863
4.0	0.991	39.0	0.937	73.0	0.860
5.0	0.989	40.0	0.935	74.0	0.858
6.0	0.988	41.0	0.933	75.0	0.856
7.0	0.986	42.0	0.931	76.0	0.853
8.0	0.985	43.0	0.929	77.0	0.851
9.0	0.983	44.0	0.927	78.0	0.848
10.0	0.982	45.0	0.925	79.0	0.846
11.0	0.980	46.0	0.923	80.0	0.843
12.0	0.979	47.0	0.920	81.0	0.841
13.0	0.978	48.0	0.918	82.0	0.838
14.0	0.976	49.0	0.916	83.0	0.836
15.0	0.975	50.0	0.914	84.0	0.833
16.0	0.974	51.0	0.912	85.0	0.831
17.0	0.973	52.0	0.909	86.0	0.828
18.0	0.971	53.0	0.907	87.0	0.825
19.0	0.970	54.0	0.905	88.0	0.823
20.0	0.968	55.0	0.903	89.0	0.821
21.0	0.967	56.0	0.900	90.0	0.818
22.0	0.966	57.0	0.898	91.0	0.815
23.0	0.965	58.0	0.896	92.0	0.813
24.0	0.963	59.0	0.893	93.0	0.810
25.0	0.962	60.0	0.891	94.0	0.807
26.0	0.960	61.0	0.889	95.0	0.804
27.0	0.959	62.0	0.887	96.0	0.801
28.0	0.957	63.0	0.884	97.0	0.798
29.0	0.955	64.0	0.882	98.0	0.795
30.0	0.954	65.0	0.879	99.0	0.792
31.0	0.952	66.0	0.877	100.0	0.789
32.0	0.950	67.0	0.875		
33.0	0.949	68.0	0.872		
34.0	0.947				

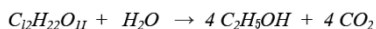
Fermentation - Distillation

65

Calculations

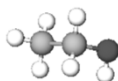
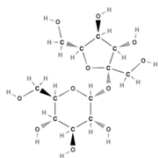
Determination of Percent Yield

From the density, volume, and percent alcohol of the distillate, calculate the actual yield in grams of ethanol. From the balanced equation for the reaction, given in the background, and the mass of sucrose fermented, calculate the theoretical yield. Finally, calculate the percent that the actual yield is of the theoretical.



sucrose

ethanol



Reactant:

Example

Mass, sucrose + container	8.677g
Mass container (Tare)	
Mass, sucrose	21.55g

Simple Distillation:

Temperature Range	°C to °C
Volume of Distillate Collected (mL)	59.2 mL

Density, Mass & Percent Yield of Alcohol in the Distillate:

9.90g / 10.00mL

Volume of pipet (mL)	
Mass of beaker + distillate (grams)	
Mass of beaker (grams)	
Mass of distillate (grams)	
Density (g/mL)	0.990 g/mL
% Percent ethyl alcohol (from Table)	
Total mass of ethyl alcohol produced (calculated)	
% Percent Yield ethyl alcohol (calculated)	

4.5 %
0.990 g/mL

Example
24.55 g
53.2 mL

% ethanol by mass	Density (g/mL)	% ethanol by mass	Density (g/mL)	% ethanol by mass	Density (g/mL)
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31.0	0.952	66.0	0.877	100.0	0.789
32.0	0.950	67.0	0.875		
33.0	0.949	68.0	0.872		

Theoretical Yield Calculation

24.55 g *g (theoretical)*
 $C_{12}H_{22}O_{11} + H_2O \rightarrow 4 C_2H_5OH + 4 CO_2$
sucrose *ethanol*

Molar mass = 342.3 g/mol Molar mass = 46.07 g/mol

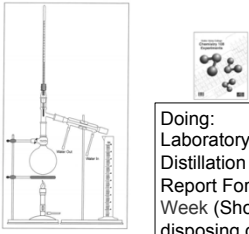
? mol *sucrose* = 24.55 g / 342.3 g/mol ? mol C_2H_5OH = 4 x mol *sucrose*
 = 0.07172 mol = 0.2869 mol

g (theoretical) = mol C_2H_5OH x 46.07 g/mol
 = 13.22 g

? g (actual) = [4.5 %, that is: 4.5/100] x 53.2 mL x 0.990 g/mL
 = 2.33g

% Yield = g (actual) / g (theoretical) x 100 = 17.6 %

Theoretical & Percent Yield

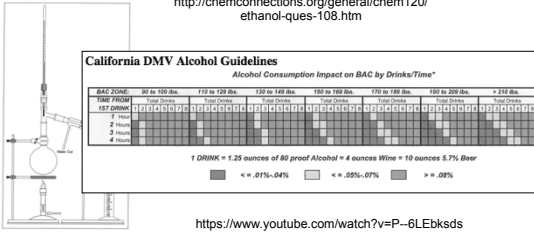


Experimentation:

Doing:
 Laboratory Manual Fermentation-Distillation Procedure pp. 63-64;
 Report Form pp. 66-67; DUE: Next Week (Show Dr. R. distillate before disposing down the drain & have data initialed before leaving lab today.)
 POST LAB Questions DUE: Next Week Pick up Handout

POST LAB Questions DUE: Next Week

<http://chemconnections.org/general/chem120/ethanol-ques-108.htm>



California DMV Alcohol Guidelines
 Alcohol Consumption Impact on BAC by Drinks/Time*

1 DRINK = 1.25 ounces of 80 proof Alcohol = 4 ounces Wine = 10 ounces 5.7% Beer

Legend:
 ■ <= .01%-.04%
 □ <= .05%-.07%
 ■ >= .08%

<https://www.youtube.com/watch?v=P-6LEbksds>

<https://www.centeronaddiction.org/addiction>

DEFINING ADDICTION CHANGES EVERYTHING

WHAT IS ADDICTION?

Addiction is a complex disease, often chronic in nature, which affects the functioning of the brain and body. It also causes serious damage to families, relationships, schools, workplaces and neighborhoods. The most common symptoms of addiction are: loss of control, continued use despite negative consequences, preoccupation with using, failed attempts to quit, tolerance and withdrawal. Addiction can be effectively prevented, treated and managed by healthcare professionals in coordination with family or peer support.

ADDICTION PREVALENCE

40 million Americans ages 12 and older—more than 1 in 7 people—abuse or are addicted to nicotine, alcohol or other drugs. This is more than the number of Americans who have conditions (27 million), diabetes (26 million) or cancer (19 million).

...THIS IS MORE THAN THE NUMBER OF AMERICANS WITH:
 HEART CONDITIONS (27 Million)
 DIABETES (26 Million)
 CANCER (19 Million)

AGES 12 AND OLDER HAVE A SUBSTANCE PROBLEM...

<https://www.centeronaddiction.org/>

POST LAB Questions; Handout

Turn in Next Week

<http://chemconnections.org/general/chem120/ethanol-ques-108.htm>

