

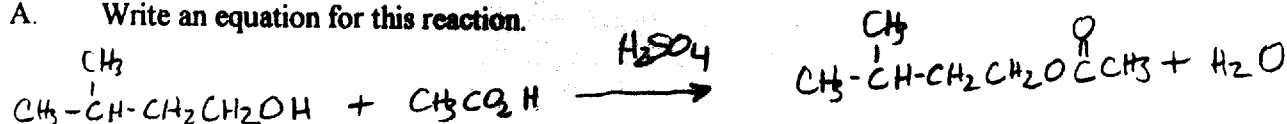
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Name ANS
October 1998

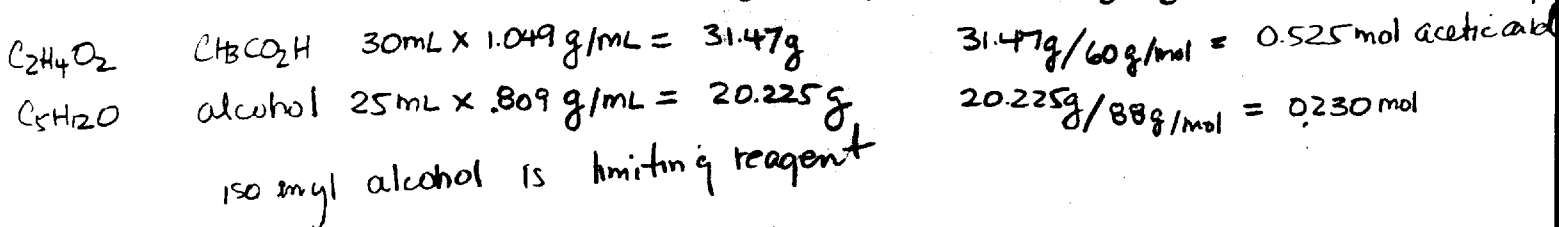
Midterm Exam
Chem 263

1. (20) A student reacted 25 mL of isoamyl alcohol (density 0.809 g/mL) with 30 mL of glacial acetic acid (density 1.049 g/mL) in the presence of 1 mL of concentrated sulfuric acid (density 1.84 g/mL). After quenching the reaction, neutralizing with NaHCO_3 , drying and distilling the isoamyl acetate (density 0.876 g/mL), 25 mL was isolated.

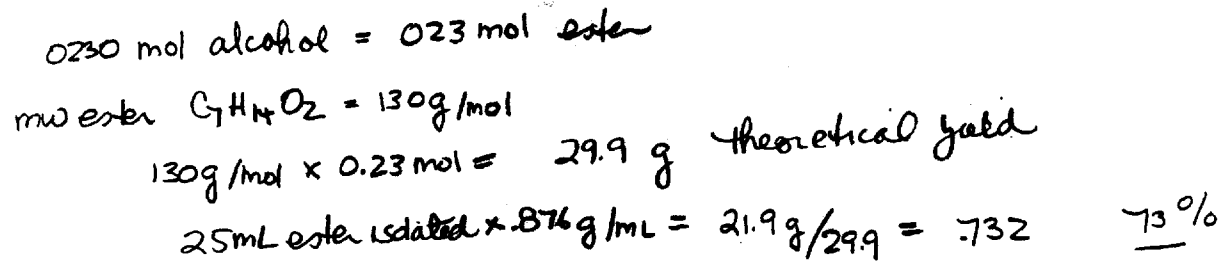
A. Write an equation for this reaction.



B. On the basis of the amounts of reagents used, what is the limiting reagent?



C. Calculate the theoretical yield in grams. What is the % yield?



2. (20) A. Define R_f as used in thin layer chromatography.

ratio of distance traveled by solute / distance traveled by solvent

B. What could you do to increase an R_f value of a particular compound?

use a more polar solvent.

C. What do you suppose will happen if you apply too much sample on a TLC plate?

you will get streaking and poor non reproducible R_f values

D. A student spots an unknown and develops it in CH_2Cl_2 . Only one spot is observed with an R_f value of 0.95. Is the compound a pure sample? What could be done to verify that the sample was or was not pure?

a value of 0.95 suggests that the solvent used is too polar. this value not very diagnostic for the compound. Should use a less polar solvent.

4. (10) In the preparation of aspirin and isoamyl acetate, the organic material is treated with sodium bicarbonate once the reaction was quenched with cold water. Explain the purpose of the bicarbonate treatment in each case.

aspirin the NaHCO_3 dissolves the aspirin and allows the polymer formed which is not soluble to be filtered

isoamyl acetate removes the xs acetic acid and any H_2SO_4 by converting both to H_2O soluble salts

5 (14) A solid substance A is soluble in water to the extent of 1 g/100 mL of solvent at 25 ° C and 10 g/100 mL at the boiling point of the solvent. You have a sample that has 10 g of A and an impurity.

A. assuming that 0.2 g of impurity B is present along with 10 g of A, describe how you could purify A if B is completely insoluble in the solvent. How much A would you recover? Explain.

may possibilities, one suggestion.
① add 100 mL of solvent, heat to boiling, filter hot, let cool
recover 9g of pure A

B. assuming that 0.2 g of impurity B is present along with 10 g of A, describe how you could purify A if B had the same solubility behavior as A in the solvent and B did not have a tendency to get incorporated into the crystals of A. How much A would you recover? Explain.

Dissolve in 100 mL boiling solvent, let cool,
solubility of A is exceeded yielding 9 g pure A.
Solubility of B not exceeded, it remains in solution
Suction filter cool solution

3. (20 pts) A. Define what is meant by a theoretical plate in distillation.

the process of going from liq. to vapor back to liquid

B. How does a simple distillation differ from a fractional distillation?

A simple distillation affords 1 theoretical plate
A fractional distillation affords more than 1
theoretical plate

C. Use the following table to answer the questions below (1 atm = 760 mm)

Temperature ° C	Approximate vapor pressure (mm Hg)	
	Benzene	Toluene
118	12000	1500
108	6000	760
98	3000	380
88	1500	190
78	760	90
68	380	45
58	190	20

1. What is the normal boiling points of toluene and benzene?

benzene 78°C > both op = 760 mm
toluene 108°C

2. Based on the table above, between what two temperatures would a 1:2 mixture of benzene:toluene boil? Give an approximate composition of the vapor in equilibrium with the liquid when the mixture first begins to boil. Show your work.

mol fraction of benzene $\frac{1}{1+2} = 0.33$
mol fraction of toluene $\frac{2}{1+2} = 0.66$

at 88°C, vp of benzene = $.33 \times 1500 = 500$ mm
" " " " toluene = $.66 \times 190 = \frac{125}{625}$

Boiling temp of mixture between 88 and 98°C
probably closer to 88°C

6. (16 pts) A chemist is frequently asked to identify various chemical substances. On the basis of the techniques you have used this semester, which ones would be useful in confirming the identity of a particular substance and which ones would be useful in ascertaining the purity of the chemical substance under investigation. Explain your answer.

Identity

- ① TLC
- ② mp
- ③ bp

purity

- ① TLC (number of spots)
- ② mp range
- ③ bp range