North Carolina Science Olympiad
Food Science (C) Regional Event 2007
(150 points)

I) (49 pts) Natural vitamin C content in fruit varies with growing region, climate, and time of harvest. In the manufacture of fruit juices or purees from fruits such as apples and peaches, vitamin C may be added during the crushing, straining, or pressing processes to prevent enzymatic browning of the raw fruits. It is sometimes added to fortify, or increase, the amount found in drinks.

A testing lab has received samples from a soft drink company that were processed and held 30 days before distribution. They are looking for the best way to process and package high vitamin C fruit drinks so that each drink contains 100 mg vitamin C per serving (248 mL). Assume that the amount of vitamin C degrades at a constant rate. If the amount of vitamin C is found to be below this amount, they need to know how much to add during processing and when best to add it and keep their cost at a minimum. Your task is to test the samples from each process and send a report to the company answering the following questions. You have a standard curve to assist in your calculations.

1) What is the chemical name of vitamin C? _____ (2 pts)
2) What reaction occurred in the test you performed? _____ _____ (4 pts)
3) How did you determine your endpoint? _____ (2 pts)
4) Vitamin C could be used in the food industry for which of the following application(s) (4 pts):
   a) Increase color development in meat products
   b) Prevent oxidative flavor denaturation in soft drinks
   c) Strengthen dough texture
   d) Chelate fatty acids in oils
5) What reaction causes these benefits? (2 pts)
   a) Addition
   b) Reduction
   c) Oxidation
   d) Subtraction
6) Which process and bottle would you recommend the company use? _____ (7 pts)

Vitamin C Test (30 pts)

Materials:

5 small cups
pipettes
Samples

1. Control – no processing, made fresh
2. Add before heating to 200°C, bottling in dark glass bottle
3. Add after heating to 200°C, bottling in dark glass bottle
4. Add before heating to 160°C, bottling in clear glass bottle
5. Add after heating to 160°C, bottling in dark glass bottle

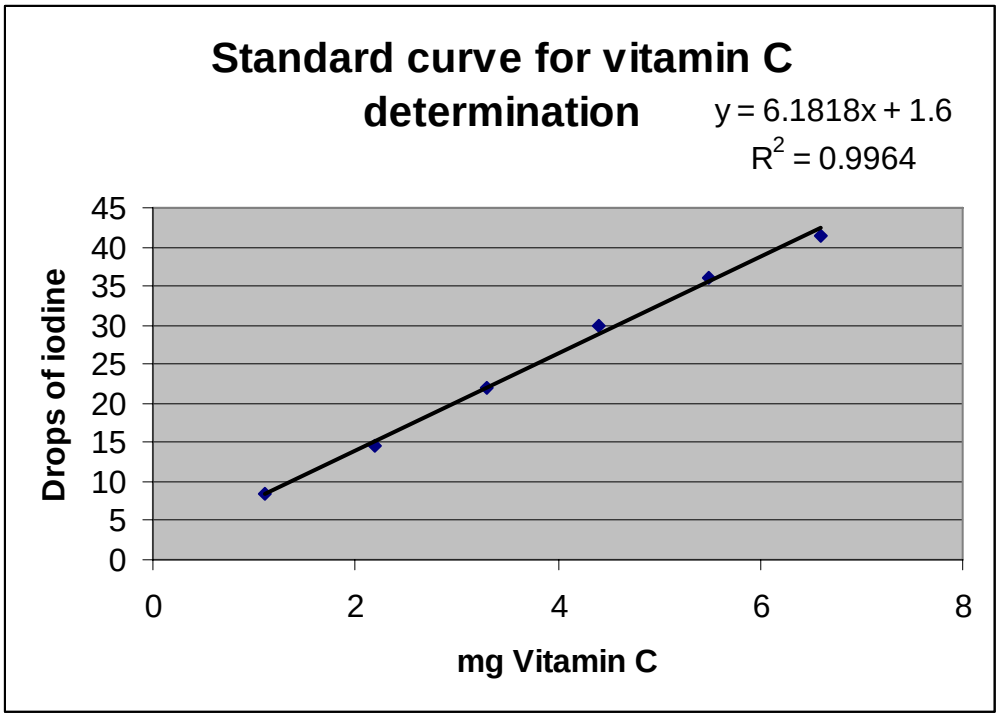
Indicator reagent

Method:

1. Go to a central station and obtain cups and label them as in chart below. Return to bench.
2. To each cup add 9 mL of each sample.
3. Add 10 drops of starch solution to each cup.
4. Use water to fill the cup to ¼ to 1/3 full.
5. Stir to combine.
6. While swirling, add iodine solution drop by drop. Swirl the solution until all evidence of the iodine is gone. The end point is when the solution is completely deep blue.
7. Clean up area by emptying liquids into sink and placing all cups in trash can and wipe down all surfaces.

Drink type	# drops	Concentration (mg/100 mL) (10 pts)	Vitamin C in one serving (10 pts)	% lost during processing and storage (10 pts)
Control				
Type 1				
Type 2				
Type 3				
Type 4				

Standard curve



Participant's names_____

Calculations:

Participant's names_____

II) (10 pts) You work as a food science product developer for a company that makes refrigerated biscuit dough (canned, that you buy in the grocery store and bake at home). Three types of biscuit dough are made at the plant – buttermilk, low-fat and cinnamon raisin.

You have been asked to improve the quality of the buttermilk biscuits and have ordered and used a new the baking powder in the formula. Customers say that after baking, the new formula biscuits are "heavy and gummy" compared to the old formula. You want to find out if they are correct.

1) You test samples cut from old and new formula biscuits using a ruler and scale and average the results. You find the following:

Sample	Width (mm)	Height (mm)	Length (mm)	Weight (grams)	$\frac{\text{}}{(g/cm^3)}$
Old formula	20.0	20.3	20.2	4.11	
New formula	19.8	20.5	20.4	4.49	

a) What test did you run? _____ (1 pt)
b) Find result for test for each set of samples (2 pts/sample). Show work below and put answers in the table above. Points deducted for significant figure errors

2) Your assistant leaves you the following data from testing:

Sample	Original weight (g)	Dry weight (g)	$\frac{\text{}}{(\%)}$
Old formula	20.85	6.67	
New formula	25.26	4.08	

a) What test did she run? _____ (1 pt)
b) Find results for each set of samples (2 pts/sample). Show your work below and fill in the last column of the table. Points deducted for significant figure errors.

II) (10 pts) The structure of a lipid has a large influence on its melting point.

1) List 2 structural factors that influence a lipid's melting point (2 pts).

_____ _____

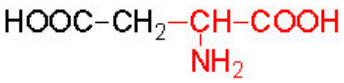
2) Rank the following fatty acids in decreasing melting point (#1-highest melting point; #4-lowest melting point) (8 pts).
a) _____Oleic acid, trans isomer (18:1)
b) _____Oleic acid, cis isomer (18:1)
c) _____Linolenic acid (18:3)
d) _____Steric acid (18:0)

III) (10) True of False

IV) (16 pts) Identify the following type of structure as carbohydrate, protein or lipid and then give the correct name for each item.

Type Name

Participant's names_____

a) 

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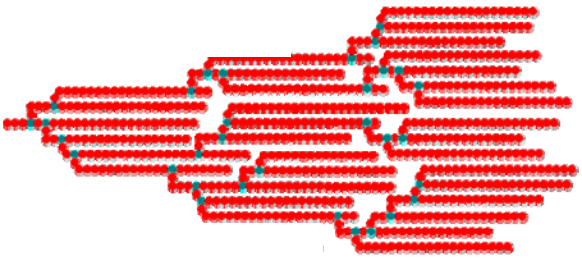
b) 

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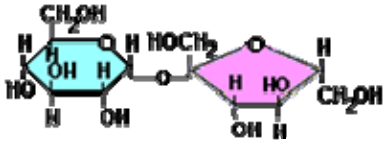
c) 

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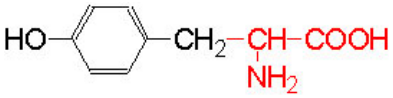
d) 

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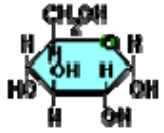
e) 

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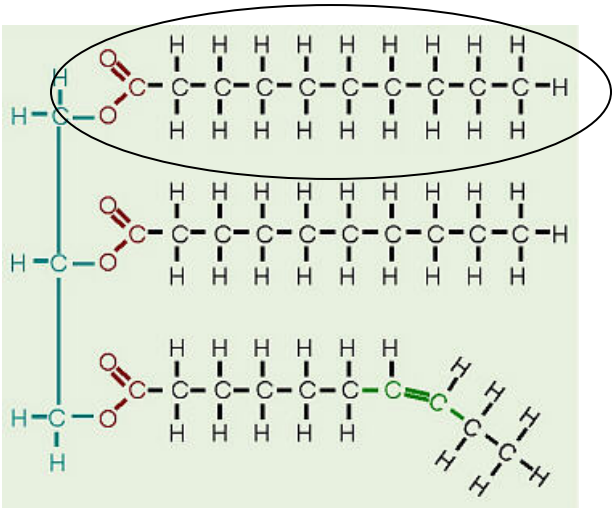
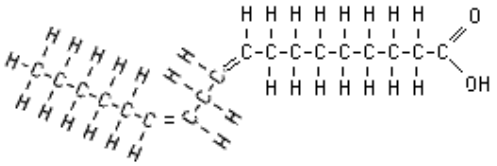
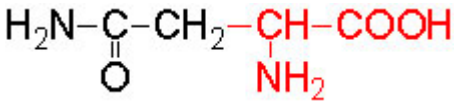
f) 

_____ _____

(name only the portion circled)

g)  _____ _____

h)  _____ _____

V) (55 points) A new processing plant opened with a complete line of pie filling base mixes, used with fruit and/or flavorings to make pies in specialty bakeries at grocery stores. They make special bases for diabetics who need to control their carbohydrate intake, and have low calorie and high protein as well as their regular base mix. You are the quality control manager at the plant, and get a frantic phone call one afternoon. Someone has made a big mistake, putting all the dry filling base mixes into unlabeled containers! The products are:

Grandma's Finest –old fashioned pie filling made with all-natural ingredients including food starch and sugars
Slim and Trim –for weight-conscious consumers that contains starch, and sugar alcohols
Di-lectible – for diabetics contains protein and sugar alcohols
Pro ten contains proteins, starch and sugars

Your job is to figure out how to label all the containers correctly! You have at your disposal all the needed equipment and reagents for the Biuret, qualitative Benedict's, and Iodine tests. Each test has instructions. You are free to use as many or as few tests as needed to find the right labels for the filling bases. To make your job easier, the bases have been partially hydrated. You will need to dilute your samples before further testing.

There are central stations where you will find items for the following tests. All solutions are found at each bench station. Please label all glassware with sample identifier and your initials. Please wear protective eyewear and aprons. DO NOT TASTE ANY SAMPLES.

Results Table

Participant's names_____

After tests, please record results in individual test sheets, then complete the following table and questions, then tell us which label is correct:

	Biuret	Benedict's	Iodine	Correct label for beverage (20 pts)
Sample #	**Pos (+), Neg (-)**	**-/+**	**-/ +**	
U1				
U2				
U3				
U4				

1. What component did the Biuret test measure? _____ (3 pts)
2. What metal salt is used in the Biuret reagent to form a complex? _____ (3 pts)
3. What component does the Benedict's Test meaure? _____ (3 pts)
4. Did the sugar alcohols react to the Benedict's test? _____ (3 pts)
5. Explain why or why not. _____ _____ (7 pts)
6. What metal salt is used in the Benedict's test?_____ (3 pts)
7. What component did the Iodine Test measure?_____ (3 pts)
8. How many experiments did you run? _____
   Why?_____
   _____
   10 pts

Biuret Test

Materials:

4 cups
4 teaspoons
pipettes
Unknown pie filling bases
Biuret reagent ****must wear glasses/goggles, apron and gloves to handle!

Method:

1. Go to a central station and obtain cups. Return to bench.
2. Place 5 cc (1 spoonful) of each sample into cups. Add 60 mL (¼ cup) of water to dilute each sample.
3. From the Biuret bottle, add 1 pipette (1 mL) of Biuret solution to each labeled cup with plastic pipette. Gently swirl contents of cup.
4. Wait 10 minutes.
5. Observe and record results in the table.
6. Clean up area by emptying liquids into waste container (DO NOT PUT IN SINK), place all cups in trash and wipe down all surfaces.

Results of Biuret Test

Cup/Sample	Color After Addition of Biuret Solution to Sample	Positive or Negative Result
Unknown 1		
Unknown 2		
Unknown 3		
Unknown 4		

Benedicts's Test

Materials:
4 cups
Styrofoam container
Styrofoam cup
Unknown drink mix bases
Benedicts's Solution
Hot water
pipettes

Method:
1. Go to a central station and obtain cups. Label cups 1-4 with marker. Return to bench.
2. Place 5 cc (1 spoonful) of each sample into cups. Add 60 mL (¼ cup) of water to dilute each sample.
3. Add 5 cc Benedict's solution to each unknown.
4. From hot water dispenser, fill Styrofoam cup ½ full of hot water and carry to bench space.
5. At bench, pour hot water into container. Place cups containing sample in container of hot water and wait for 5 minutes.
6. Remove cups for observation.
7. Observe and record results in the following table.
8. Place waste in designated container and dispose of Styrofoam in trash can.
9. Pour water down sink.

Results of Benedict's Test

Test Tube/Sample	Color of Solution	Positive or Negative Result
Unknown 1		
Unknown 2		
Unknown 3		
Unknown 4		

Iodine Test

Materials:
4 cups
pipettes
Unknown pie filling bases
Iodine Solution

Method:

1. Obtain cups at central station.
2. Return to bench.
3. With plastic pipettes, pipette 10 mLs each unknown solution into corresponding cup.
4. Add 5drops iodine to test cup for each unknown. Do not shake or swirl.
5. Observe and record results in the following table under step 1.
6. Place waste in designated container and dispose of glassware in glass box.

Results of Iodine Test

Test Tube/Sample	Color of Solution	Positive or Negative Result
Unknown 1		
Unknown 2		
Unknown 3		
Unknown 4		