

SI Chemistry - Full Discipline Demo

Extraction and Analysis of Casein

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Chemistry - Full Discipline Demo
Course	SI Chemistry - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

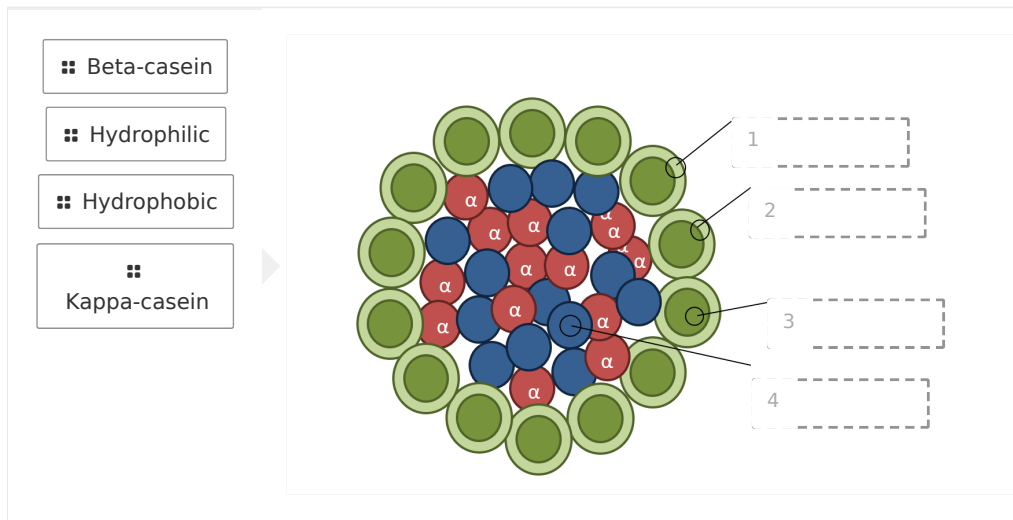
Match each term to the best definition.

Casein	Enzyme that makes milk curdle	1
Chymosin	Major milk protein	2
Hydrophilic	Nonpolar compound	3
Hydrophobic	Water loving	4
Micelle	Small bundles	5

Correct answers:

1 Chymosin 2 Casein 3 Hydrophobic 4 Hydrophilic 5 Micelle

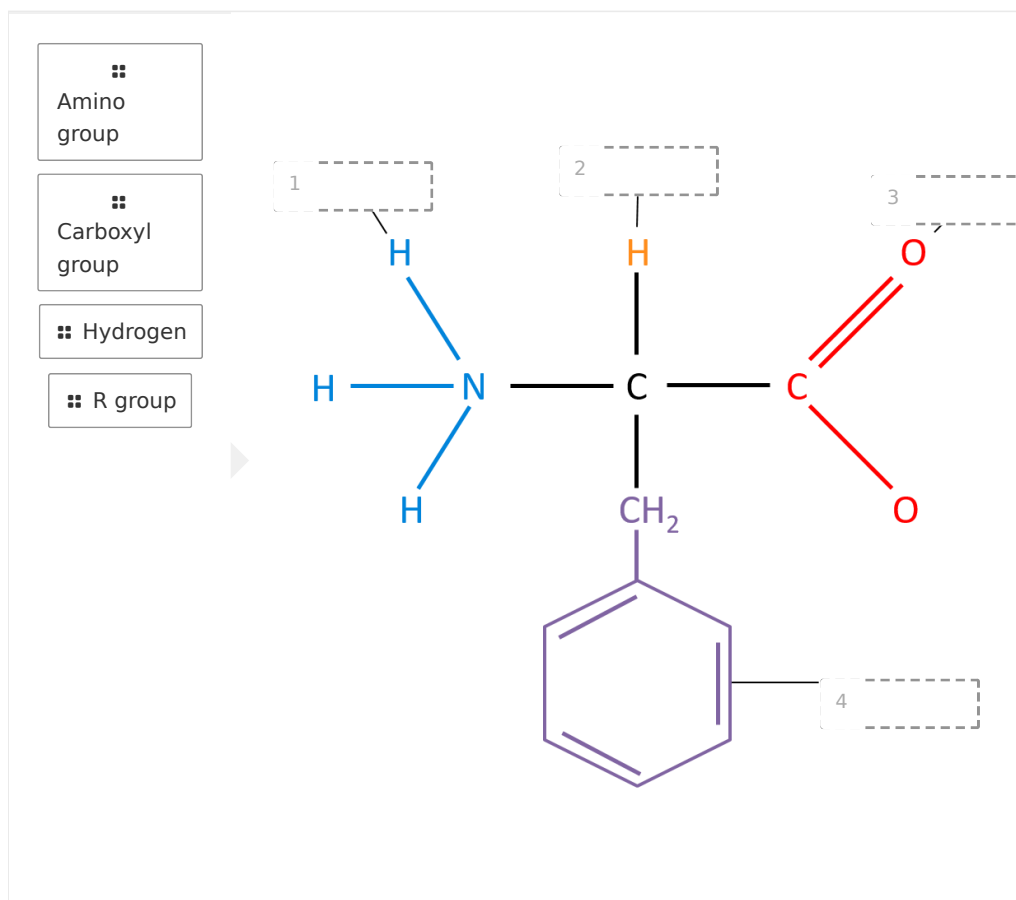
Label the diagram of the casein micelle.



Correct answers:

1 Hydrophilic 2 Hydrophobic 3 Kappa-casein 4 Beta-casein

Label the features of the amino acid.



Correct answers:

1 Amino group 2 Hydrogen 3 Carboxyl group 4 R group

Exploration

Casein is a lipid component of milk.

☐ True

☒ False



Micelles are bundles in which there is a hydrophobic interior that is ____, and a hydrophilic exterior that is ____.

- ☐ nonpolar and does not mix well with water; polar and mixes well with water ✓
 - ☐ nonpolar and mixes well with water; polar and does not mix well with water
 - ☐ polar and does not mix well with water; nonpolar and mixes well with water
 - ☐ polar and mixes well with water; nonpolar and does not mix well with water
-

Kappa-casein molecules are resistant to precipitation in milk because they have a hydrophobic exterior.

- ☐ True
 - ☐ False ✓
-

The primary structure of a protein is simply a chain of amino acids from one end to the other of the protein.

- ☐ True ✓
 - ☐ False
-

When an acid is added to milk, the pH drops, casein denatures into a precipitate, and the milk curdles.

- ☐ True ✓
 - ☐ False
-

Chymosin functions by breaking the bond between two amino acids in ____.

- ☐ alpha-casein molecules
 - ☐ beta-casein molecules
 - ☐ kappa-casein molecules ✓
-

Exercise 1

Compare the results from Data Tables 1 and 3. Were there any differences in the amount of protein in the curds versus the milk? When a greater amount of protein is present, the Biuret reagent will be an even deeper shade of purple.

The curds contained a greater concentration of protein.

Did the whey test positive for protein? Explain why or why not.

Test tube #2 had some protein present. Apparently some protein still remained in the whey and this is supported by the smaller mass of the curd.

Compare the amount of precipitation (curding) that occurred in the three different trials. Did some methods produce more curds than others? Did a pH change created by the addition of vinegar yield different results than rennet alone?

Vinegar works best in precipitating out the proteins. Rennet alone yielded the least amount of casein extracted from the milk. There did not seem to be much difference between vinegar alone and vinegar + rennet.

Data Table 1: Biuret Results
(SAMPLE ANSWER BELOW)

Reagent	Test Results (Color)
Milk	Purple
Water	Light blue

Data Table 2: Mass of Curds
(SAMPLE ANSWER BELOW)

Sample	Mass of Cheesecloth (g)	Mass of Cheesecloth and Curds (g)	Mass of Curds (g)	Percent of Case

Test Tube #1 Curd	Student answers will vary.		71%
Test Tube #2 Curd			64%
Test Tube #3 Curd			68%

Data Table 3: Curd and Whey Results with Biuret Reagent
(SAMPLE ANSWER BELOW)

Sample Tested	Biuret Result (Color Blue or Purple)
Test Tube #1 Curd	Dark purple
Test Tube #2 Curd	Dark purple
Test Tube #3 Curd	Dark purple
Test Tube #1 Whey	No change
Test Tube #2 Whey	Light purple
Test Tube #3 Whey	No change
Distilled Water	Light blue

Exercise 2

What enzyme does rennet utilize to isolate casein? Why is this enzyme an important component for cheese-making?

Rennet contains the enzyme chymosin. It cleaves two amino acids to break the peptide bond in kappa-casein, resulting in separation of hydrophilic and hydrophobic portions of the molecule. These actions result in the precipitation of casein.

Photo 1: Prepared Cheese
(SAMPLE ANSWER BELOW)





Competency Review

Casein is the major ____ component of milk.

- ☐ zinc
- ☒ protein
- ☐ magnesium
- ☐ lipids



A casein micelle has a hydrophilic exterior and a hydrophobic interior.

- ☒ True ✓
- ☐ False

Because water has polar properties, it mixes well with ____ molecules, which have ____ properties.

- ☒ hydrophilic; polar ✓
- ☐ hydrophilic; nonpolar
- ☐ hydrophobic; polar
- ☐ hydrophobic; nonpolar

____ molecules have a hydrophilic exterior and a hydrophobic interior.

- ☐ Alpha-casein
- ☐ Beta-casein
- ☒ Kappa-casein ✓
- ☐ Delta-casein

Casein forms into micelles, which are bundles of alpha, beta, and kappa molecules.

- ☒ True ✓
- ☐ False

The structure of an amino acid includes ____, ____, and ____ groups all bonded to a single carbon atom.

- ☐ ammonia, carboxyl, H
- ☐ hydroxide, R, amino
- ☒ carboxyl, amino, R ✓

Why is vinegar added to milk when making cheese?

- ☒ The vinegar decreases the pH, causing the casein to denature into a precipitate. ✓
 - ☐ The vinegar adds a sweet flavor to the cheese.
 - ☐ The vinegar increases the pH of the cheese, causing precipitation.
 - ☐ The acid creates micelles, which cause curdling.
-

Why is chymosin used to isolate casein from milk?

- ☐ Chymosin lowers the pH of the milk.
 - ☒ Chymosin breaks a bond between two amino acids in kappa-casein molecules. ✓
 - ☐ Chymosin increases the pH of the milk.
 - ☐ Chymosin forms a bond between two amino acids in kappa-casein molecules.
-

Which solution generates the most curds (based on mass) when added to milk?

- ☐ 2 mL of vinegar
 - ☐ 2 mL of rennet solution
 - ☒ 2 mL of vinegar and 2 mL of rennet solution ✓
 - ☐ All of these solutions generate similar results.
-

Biuret reagent tests for the presence of ____.

- ☐ starches
 - ☐ sugars
 - ☐ curds
 - ☒ proteins ✓
-

What visible results occur when vinegar is added to milk?

- ☐ Milk turns purple.
- ☒ More curds are created.
- ☐ Curds are dissolved.
- ☐ the pH becomes more basic.



Why would a rennet tablet be added to milk during the process of cheese making?

- ☐ Rennet contains calcium.
- ☐ Rennet contains casein.
- ☒ Rennet contains chymosin.
- ☐ Rennet is hydrophobic.



Extension Questions

Meats are excellent sources of protein in the diet and many recipes for cooking meat involve marinating it first. A typical marinade contains three components, each of which serves a very specific purpose: an oil, an acid, and a set of savory ingredients (herbs and spices). The savory ingredients are there to provide additional flavors. The oil has two important roles: to prevent the meat from drying out during cooking and to dissolve the flavor molecules in the herbs and spices, which are mostly nonpolar. What is the purpose of the acid in the marinade?

(SAMPLE ANSWER BELOW)

Acids lower pH and cause proteins to denature. This will change the structure of the fibrous proteins in the meat, making the meat tender. It also allows the flavors of the marinade to penetrate the meat more thoroughly and reduces the cooking time.