

# SOLVENT EXTRACTION

## Worksheet - solvent extraction

1. When the oil and solvent mix after a brief period an equilibrium is set as shown below.



Which of the following factors will result in more oil extracted from the plant matter after equilibrium is established? Explain your reasoning.

- i. Allowing the plant matter to remain in the solvent for a longer period of time before filtering.

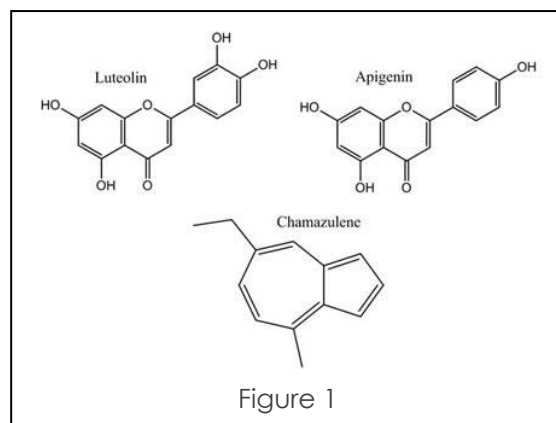
- ii. Heating the solution.

- iii. Adding more solvent (hexane).

- iv. Introducing a blender to reduce the plant matter particle size.

2. Consider the three organic compounds derived from a plant, shown in fig 1. A plant extract mixture contains all three organic compounds.

a. Discuss how each of the four solvents listed below can be used to separate the compounds from the mixture. In your discussion refer to structure and bonding.



i. Hexane

ii. Hexan-1-ol

iii. Ethanol

iv. Water



c. Are the results of the experiment deemed valid? Justify your answer.

d. In what ways was the experiment designed to enhance the reliability and validity of its results?

4. Give three properties of a solvent that are desirable for solvent extraction and explain why.

5. Compare and contrast the separating techniques , solvent extraction and steam distillation by completing the table below.

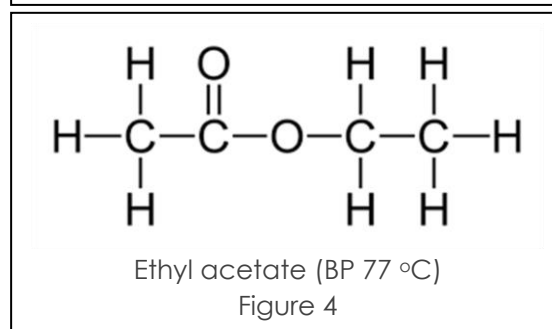
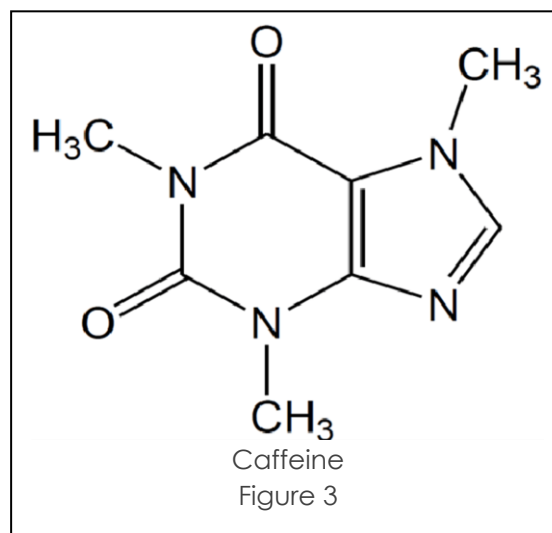
	Steam distillation	Solvent extraction
Type of molecule extracted		
Temperature range		
Solvent required		
Specificity		
Usage		



6. Caffeine is a stimulant found in coffee and its chemical structure is shown in fig.3. Decaffeinated coffee has the caffeine leached out of the coffee powder by solvents. Some of the compounds found in coffee and contribute to flavour are listed in table 1.

Consider two possible solvents ethyl acetate (fig 4) and water.

- a. Which solvent is most polar? Justify your answer use diagrams.



- b. Select a solvent that will have minimum impact on taste but remove caffeine from the coffee granules. Explain your choice with reference to structure and intermolecular bonding.
- c. Which purification method, solvent extraction or steam distillation, will be employed to extract and purify caffeine? Provide a rationale for the chosen method.

Compound found in coffee and contributing to flavour and taste.	Boiling point (°C)	Solubility in water	Solubility in ethyl acetate
Caffeine	235	high	high
Quinic acid	> 200 (But decomposes before this temp)	high	low
Formic acid	101	high	low
Acetic acid	118	high	low
Sucrose	160	high	low

Table 1.

- d. Ethyl acetate occurs naturally during the fermentation of fruit.
- i. Provide balanced chemical equations, states included, for the two reactions that produce the reactants that form ethyl acetate at SLC.  
Reaction 1 is an anaerobic fermentation reaction with glucose ( $C_6H_{12}O_6$ ).

Reaction 2 is an oxidation reaction with the product of reaction 1 and atmospheric oxygen where water and an acid are produced.

- ii. Give the balanced chemical equation for the formation of ethyl acetate, states not included.
- iii. What class of reaction forms ethyl acetate. Circle the appropriate class of reaction, you may circle more than one.  
Redox,                  Condensation,                  Addition,                  Complete combustion
- iv. Justify your selection in iii.



