**Short answer.**

ALL calculations with proper units are required for full credit

Label the following layers as aqueous or organic



Describe 3 types of distillation including their application and limitations.

Briefly describe what 2 things are wrong with the following apparatus



**True/False.**

1. \_\_\_\_\_\_ Pure ethanol can be isolated from a water/ethanol mixture via simple distillation.
2. \_\_\_\_\_\_ An azeotrope will always come to a boil when its vapor pressure reaches 760 mm Hg.
3. \_\_\_\_\_\_ Distilling an azeotrope mixture cannot result in a pure compound
4. \_\_\_\_\_\_ The vapor pressure of an azeotrope equals the sum of its components’ partial pressures.
5. \_\_\_\_\_\_ Dry solvents can be produced by distilling them in the presence of a drying agent
6. \_\_\_\_\_\_ Steam distillation is the co-distillation of a non-volatile inorganic component with water.
7. \_\_\_\_\_\_ A water/dichloromethane mixture could be separated by steam distillation
8. \_\_\_\_\_\_ Steam distillation allows for separation of compounds at temperatures under 100 °C.
9. \_\_\_\_\_\_ Azeotropes are characterized by having multiple boiling points.
10. \_\_\_\_\_\_ An azeotrope of an organic solvent and water will always have a higher boiling point than the organic solvent alone.

**Multiple Choice**

1. Essential oils like eugenol (clove) and limonene (lemon) are best isolated by which method?

1. Simple distillation
2. Fractional distillation
3. Steam distillation
4. Vacuum distillation

2. You have a mixture of two immiscible solvents. When you add a drop of water to the mixture it goes into the upper layer. What is the lower solvent most likely to be?

1. Ethanol
2. Methylene Chloride
3. Hexane
4. Sodium Chloride

3. Which of the following is an example of a fractional distillation?

a) Isolation of separate petroleum products from crude oil

b) Purification of essential oils for perfumes

c) Making tea or coffee

d) Production of hard liquor

4. You are given a mixture of cyclopentane (B.P. = 40 °C) and toluene (B.P. = 110 °C). These solvents:

a) Are best purified through steam distillation

b) Cannot be separated

c) Are best separated by simple distillation

d) Are best separated by fractional distillation

5. Which of the following could be easily separated by simple distillation?

1. Dimethyl formamide (B.P. = 153 °C) and dimethyl sulfoxide (B.P. = 189 °C)
2. Dichloromethane (B.P. = 40 °C) and diethyl ether (B.P. = 35 °C)
3. Pyridine (B.P. = 115 °C) and toluene (B.P. = 110 °C)
4. Ethanol (B.P. = 78 °C) and diethyl ether (B.P. = 35 °C)

6. Which of the following states that the vapor pressure of a mixture is equal to the sum of its partial pressures?

a) Dalton’s Law

b) Le Chatelier's principle

c) Saytzeff’s rule

d) Brønsted-Lowry theory

7. The partial pressure of the components of a mixture are relative to the components’

1. Molecular weight
2. Volumes
3. Mole fraction
4. Temperature

8. 760 mm of mercury is

1. The boiling point of water
2. Standard pressure at sea level
3. Atmospheric pressure
4. The boiling point of an azeotrope

9. Which of the following is purified via distillation?

1. Solvents
2. Starting materials
3. Products of reactions
4. All of the above

10. Which of the following is the most important hazard for toluene?

1. Corrosive
2. Mutagenic
3. Reactive
4. Flammable