ALL calculations with proper units are required for full credit

**Part A.**

1. The solubility of Caffeine in water is 0.6 g/100 mL at 0 °C, 2.2 g/100mL at 25 °C and 67 g/100 mL at 100 °C (3)
2. Calculate the minimum amount of water required to dissolve 23.45 g of caffeine at 25 °C and 100 °C.
3. How much caffeine would you theoretically recover if you recrystallized the solution from 100 °C to 0 °C
4. The partition coefficient of ethanol is 0.5. If you washed a solution of 10 g of ethanol in 20 mL of cyclohexane with 15 mL of water 3 times, how much ethanol would remain in the organic phase? (2)
5. Name the labeled glassware: (2)



1. Briefly describe what 2 things are wrong with the following apparatus (2).



1. Calculate the percent recovery for myristic acid if 1.06 g of myristic acid was recovered from the hydrolysis of 1.50 g of trimystirin: (2)



1. Draw the mechanism for the addition of I2 to 2-butene. (2)



1. Label the following layers as aqueous or organic: (2)



1. Draw a flowchart diagramming the separation of 4-aminobenzoic acid ethyl ester from naphthalene. (2)



1. Name 2 types of distillation and describe their characteristics. (2)
2. Draw the mechanism for the E1 reaction of 1-methyl cyclohexanol. Circle the major product. (2) 

**Part B: True/False.**

1. \_\_\_\_\_\_ During recrystallization, if after 10 min no crystals have formed you should scratch the bottom of the flash to induce crystal formation.
2. \_\_\_\_\_\_ Pure ethanol can be isolated from an ethanol/water mixture by simple distillation.
3. \_\_\_\_\_\_ A compound with a partition coefficient of 3 is more soluble in the organic phase.
4. \_\_\_\_\_\_ E1 reactions are usually in competition with SN1 reactions.
5. \_\_\_\_\_\_ SN2 reactions usually produce a racemic mixture of products.
6. \_\_\_\_\_\_ A Beilstein test will turn the flame orange in the presence of chlorine
7. \_\_\_\_\_\_ Both E1 and SN1 reaction mechanism proceed through a carbocation intermediate.
8. \_\_\_\_\_\_ Sulfuric acid is consumed in the E1 reaction of cyclohexanol to cyclohexene.
9. \_\_\_\_\_\_ In an E2 reaction, the leaving group and adjacent hydrogen must be *anti* to each other.
10. \_\_\_\_\_\_ Bromination of an alkene always gives a meso product.

**Part C: Multiple choice.**

1. A good solvent for recrystallization is one that…
2. Has the opposite polarity of the solute
3. The solute has poor solubility at high temperature and good solubility at low temperature
4. The solute has good solubility at high temperature and poor solubility at low temperature
5. The solute has poor solubility at all temperatures
6. Which of the following is the proper procedure for recrystallization?
7. Heat solvent, add hot solvent to solute to dissolve, recrystallize in ice bath, filter to recover
8. Add solute to solvent, heat solvent to dissolve, recrystallize in ice bath, filter to recover
9. Heat solvent, add solute to hot solvent to dissolve, recrystallize in ice bath, filter to recover
10. Add solute to solvent to dissolve, recrystallize in ice bath, filter to recover
11. What is the best way to remove water from an organic solvent or solution?
12. Vacuum filtration
13. Heat to dryness
14. Add sodium sulfate
15. Add brine
16. Which of the following chemicals is most considered a flammable hazard?
17. Hexane
18. Potassium Hydroxide
19. Methylene Chloride
20. Sodium Sulfate
21. Which of the following is NOT true about a melting point?
22. Should always be reported as single number
23. Begins when the first droplet of liquid is observed
24. Ends when the solid is completely liquid
25. If often depressed by the presence of impurities
26. When a liquid boils, its vapor pressure is:
27. 760 mm Hg
28. Equal to atmospheric pressure
29. Equal to the vapor pressure of water
30. Equal to the mole fraction of water
31. Which of the following would a fat like trimyristin be MOST soluble in?
32. Ethanol
33. Methanol
34. Water
35. Toluene
36. What is the best way to recover sodium acetylsalicylate from an aqueous solution?
37. Ice bath for 10 min and filter to recover
38. Add HCl and filter to recover
39. Heat to dryness
40. Add NaOH and filter to recover
41. Which of the following acids would NOT be extracted into the aqueous phase with saturated NaHCO3
42. Benzoic acid
43. Aspirin
44. Cresol
45. Gallic acid



1. Which carbon has the most acidic protons in 1,3-dibenzoylpropane

a) A

b) B

c) C

d) D



1. The purpose of acid in the SN1 reaction of triphenylmethanol is to
2. Induce precipitation of the product
3. Convert the alcohol to a better leaving group
4. React with the carbocation intermediate
5. Deprotonate the intermediate to form the final product
6. Circle the expected product of the following SN2 reaction:



1. A sample of naphthalene has a depressed melting point and the IR reveals a weak, broad peak at about 3400 cm-1. What is most likely?
2. Ethanol is a contaminant
3. Cyclohexene is a contaminant
4. The sample has been halogenated
5. The sample is a racemic mixture
6. Circle which of the following reactions does **not** go through a carbocation intermediate.



1. Which is true about the E1 reaction of cyclohexanol to cyclohexene?
2. The reaction was irreversible
3. It is a hydrolysis reaction
4. Distillation was required to remove sulfuric acid
5. The product and reactant were in equilibrium with each other
6. Circle which of the following compounds would give a positive permanganate test.



1. The Beilstein test detects the presence of:
   1. Bromine and iodine only.
   2. Chlorine and bromine only.
   3. Chlorine and iodine only.
   4. Chlorine, bromine, and iodine.
2. In the bromination of trans-stilbene, Br2 is generated:

a: *in vivo*

b: *in vitro*

c: *in situ*

d: *in silico*

1. What are the correct stereochemical assignments for the flowing molecule:

a) 5R, 6S

b) 5R, 6R

c) 5S, 6R

d) 5S, 6S



1. Which of the following was an intramolecular reaction:

a) SN2 reaction of 1,3-dibenzoylpropane to form *trans*-1,2-dibenzoyl cyclopropane

b) SN1 reaction of triphenylmethanol to form triphenylmethylbromide

c) SN1 reaction to triphenylmethanol form triphenylmethyl methylether

d) Bromination of *trans*-stilbene to form 1,2-dibromo-1,2-diphenylethane