1. Define the following terms in chromatography (a) longitudinal diffusion (b) column resolution (c) plate height (15%)

2. What is the principle of micellar electrokinetic capillary chromatography? What does it differ from capillary zone electrophoresis? (15%)

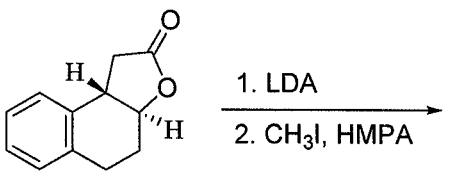
3. Describe the four types of separation mechanism in liquid chromatography and its applications (20%)

4. Please describe some kinds of LC-MS interfaces (20%)

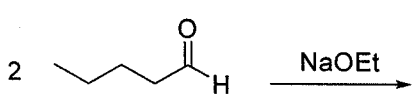
5. Describe the principle of the following detectors in HPLC. (a) evaporative light scattering detector (b) UV detector (c) fluorescence detector (d) refractive index detector (20%)

6. The infrared spectrum of CO shows a vibrational absorption peak at 2170 cm^{-1}. What wavenumber would the corresponding peak for ^{14}CO occur? (10%)

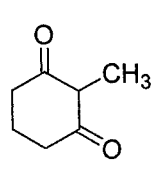
I. Give the major product(s) of the following reactions (60%)

1. 

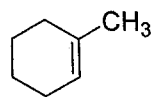
2. $CH_2(CO_2C_2H_5)_2$ + $H_2C{=}C(Ph)CO_2C_2H_5$ $\xrightarrow{NaOEt}$

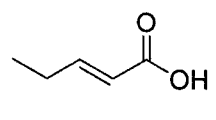
3. 

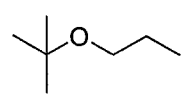
4. $(CH_3)_3CCCH_3$ (O) + PhCHO $\xrightarrow[\text{ethanol-}H_2O]{NaOH}$

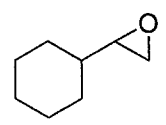
5. 

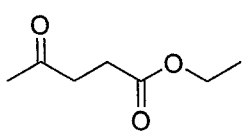
+ $H_2C{=}CHCOCH_3$ $\xrightarrow{KOH}$

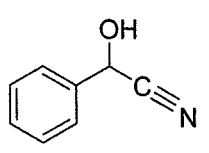
6. 

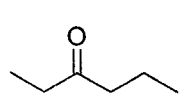
7. 

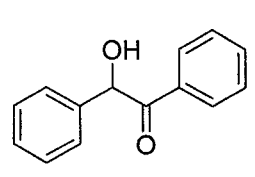
8. 

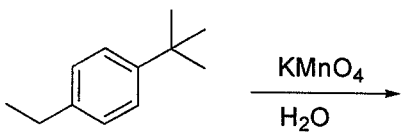
9. 

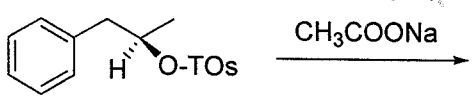
10. 

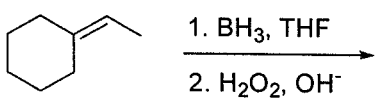
11. 

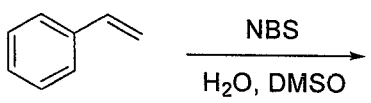
12. 

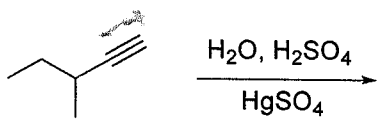
13. 

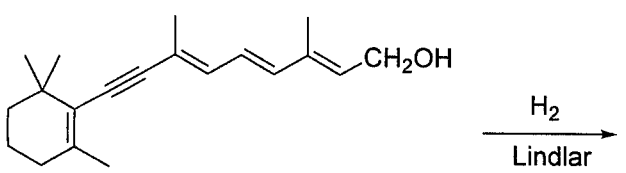
14. 

15. 

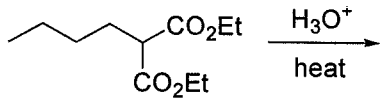
16. 

17. 

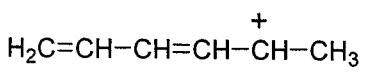
18. 

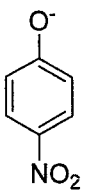


19.

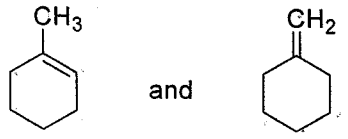
20. 

II. Draw as many resonance structures as you can for the following species: (8%)

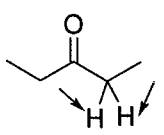
(a) 

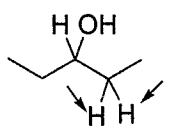
(b) 

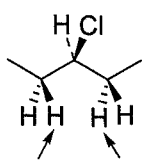
III. How could you use ^{13}C NMR to distinguish between the following pairs of isomers? (5%)



IV. Identify the indicated sets of protons as unrelated, homotopic, enantiotopic, or diastereotopic:

(a) 

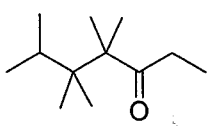
(b) 

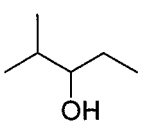
(c) 

(6%)

V. Why alkenes become more stable with increasing substitution? (6%)

VI. What are the masses of the charged fragments produced in the following cleavage pathways?

(a) McLafferty rearrangement of  (4%)

(b) Alpha cleavage of  (4%)

VII. Propose a mechanism for the following reaction: (7%)