

National Exams May 2019

**04-BS-12, Organic Chemistry**

3 hours duration

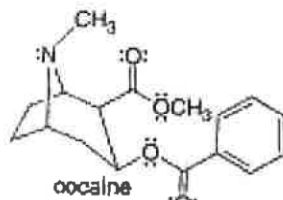
**NOTES:**

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is a CLOSED BOOK EXAM.  
One of two calculators is permitted – any Casio or Sharp approved model.
3. TEN (10) questions constitute a complete exam paper.  
The first 10 questions as they appear in the answer book will be marked.
4. Each question is of equal value.

Question 1:

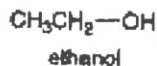
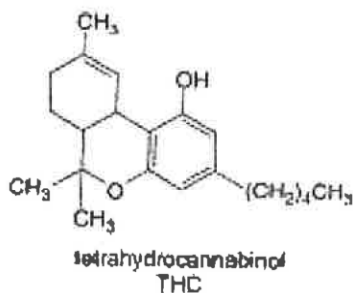
Many drugs are Bronsted-Lowry acids or bases.

- What is the most acidic proton in the analgesic ibuprofen? Draw the conjugate base.
- What is the most basic electron pair in cocaine? Draw the conjugate acid.



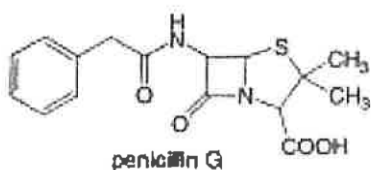
Question 2:

THC is the active component in marijuana and ethanol is the alcohol in alcoholic beverages. Explain why drug screenings are able to detect the presence of THC but not ethanol weeks after these substances have been introduced into the body.



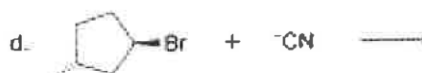
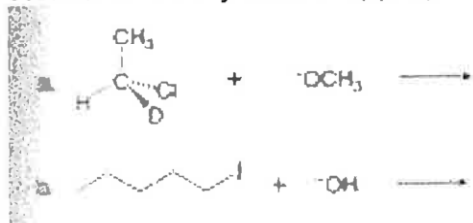
Question 3:

Although penicillin G has two amide functional groups, one is much more reactive than the other. Which amide is more reactive and why?



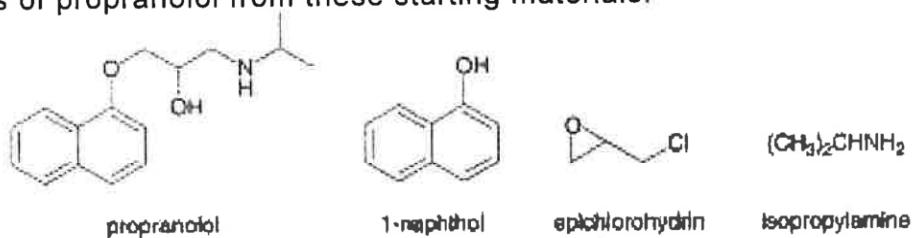
Question 4:

Draw the products of each of these  $\text{S}_{\text{N}}2$  reactions and indicate the stereochemistry where appropriate.



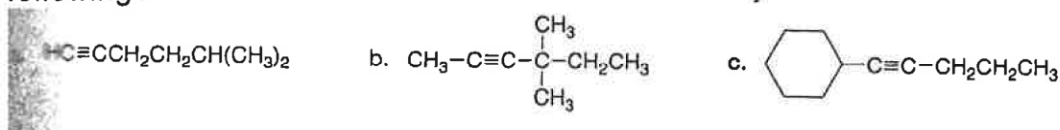
Question 5:

Propranolol, an antihypertensive agent is used in the treatment of high blood pressure, can be prepared from 1-naphthol, epichlorohydrin and isopropylamine using two successive nucleophilic substitution reactions. Devise a stepwise synthesis of propranolol from these starting materials.



Question 6:

What acetylide anion and alkyl halide are needed to synthesize each of the following?



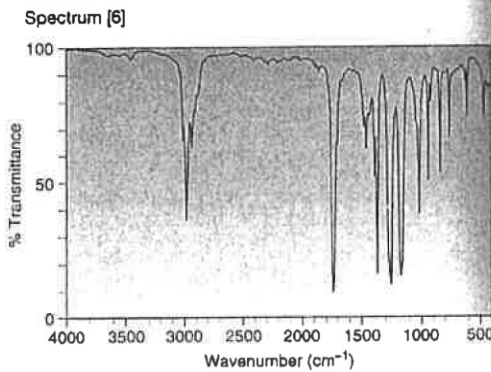
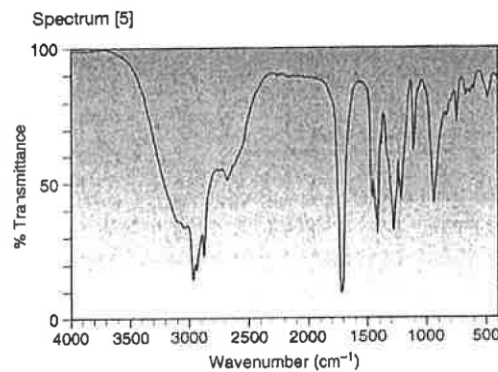
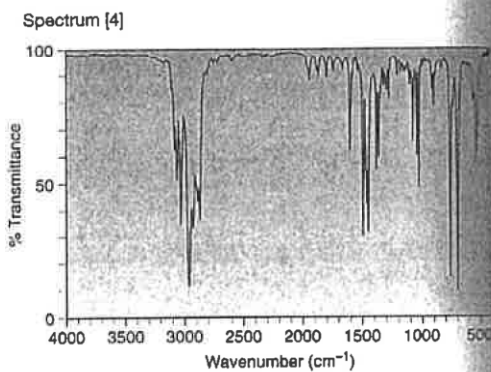
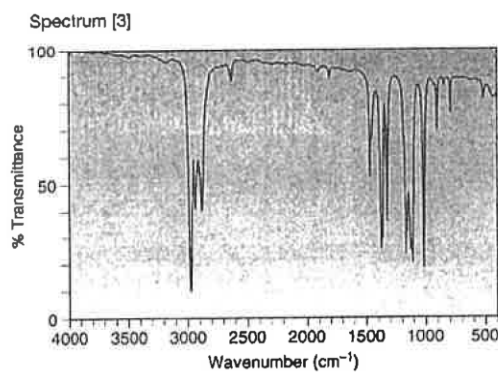
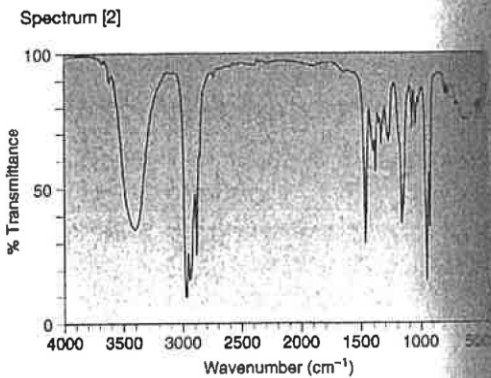
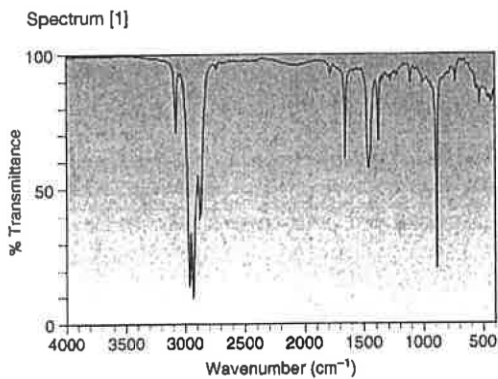
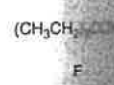
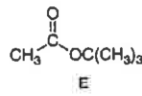
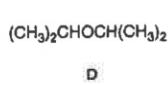
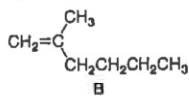
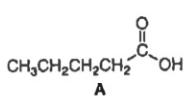
Question 7:

Devise a synthesis of each compound from acetylene and organic compounds containing two carbons or fewer. You may use any other required reagents.



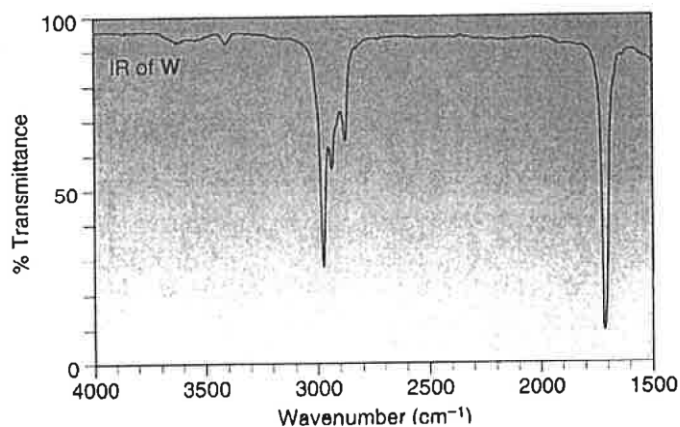
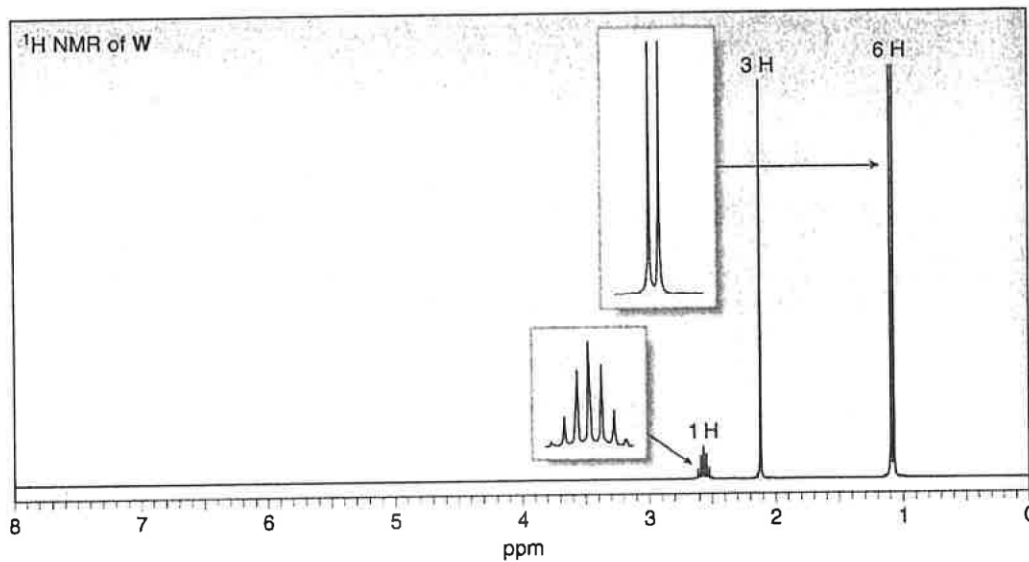
Question 8:

Match each compound to its IR-spectrum. Compound F is  $(\text{CH}_3\text{CH}_2)_3\text{COH}$



Question 9:

Treatment of 2-butanone ( $\text{CH}_3\text{COCH}_2\text{CH}_3$ ) with a strong base followed by  $\text{CH}_3\text{I}$  forms a compound W which gives a molecular ion in its mass spectrum at 86. The IR and  $^1\text{H}$  NMR spectra of W are given below. Explain your reasoning.

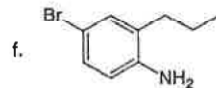
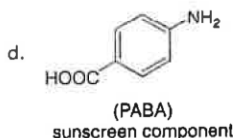
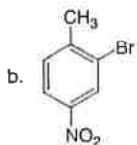
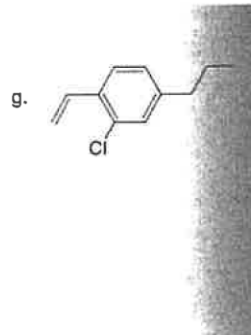
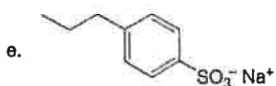
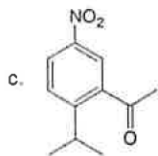
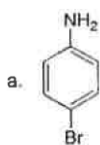


Question 10:

When 3,3-dimethyl-1-butene is treated with HBr alone, the major product is 2-bromo-2,3-dimethylbutane. When the same alkene is treated with HBr and peroxide, the sole product is 1-bromo-3,3-dimethylbutane. Explain these results by referring to the mechanisms.

Question 11:

Synthesize each compound from benzene and any other organic or inorganic reagents.



Question 12:

Explain the following:

- The pKa of p-nitrophenol is lower than the pKa of phenol (7.2 vs 10).
- The pKa of p-nitrophenol is lower than the pKa of m-nitrophenol (7.2 vs 8.3).
- Carboxylic acids A and B are both more acidic than  $\text{CH}_3\text{CH}_2\text{COOH}$

Question 13:

Compound A is a novel poly(ester amide) copolymer that can be used as a bioabsorbable coating for the controlled release of drugs. A is a copolymer of four monomers, two of which are amino acids or amino acid derivatives. The body's enzymes recognize the naturally occurring amino acids in the polymer backbone, allowing for controlled enzymatic breakdown of the polymer and the steady release of an encapsulated drug. Identify the four monomers used to synthesize A and name the two amino acids.

