

National Exams

**04-BS-12, ORGANIC CHEMISTRY**  
**May 2009**

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.
2. Candidates may use any nonprogrammable calculator, ex., a **Casio** or **Sharp** model.
3. **This is a Closed Book Exam. However, candidates are permitted to bring one aid sheet written on both sides.**
4. **ANSWER ALL FIVE (5) QUESTIONS.**

**No. 1 (10 marks total)**

- (a) (5 marks) There are two resonance forms of the nitrate ion. Draw them. Be sure to include any formal charges.
- (b) (5 marks) Which molecule(s) would have a dipole moment greater than zero? (A)  $\text{BeCl}_3$ ; (B)  $\text{BCl}_3$ ; (C)  $\text{CO}_2$ ; (D)  $\text{H}_2\text{O}$ ; (E)  $\text{CCl}_4$

**No. 2 (10 marks total)**

Show all types of hydrogen bonds in an aqueous solution of  $(\text{CH}_3)_2\text{NH}$ . Which is the strongest hydrogen bond?

**No. 3 (10 marks total)**

- (a) (2 marks) Structures that differ only in the position of the electrons are called \_\_\_\_\_.
- (b) (2 marks) Name two of the three types of polyenes (i.e. molecules containing two or more double bonds).
- (c) (2 marks) A substance that can donate a lone pair of electrons is a \_\_\_\_\_ according to \_\_\_\_\_ theory.
- (d) (4 marks) What are the four basic types of organic reactions?

**No. 4 (12 marks total)**

- (i) (6 marks) Briefly explain how each of the following influences the mechanical strength of a semicrystalline polymer and why:
- (a) molecular weight
  - (b) degree of crystallinity; and
  - (c) extent of crosslinking
- (ii) (3 marks) Is it possible to grind up and reuse phenol-formaldehyde? Why or why not?
- (iii) (3marks) Is it possible to grind up and reuse polypropylene? Why or why not?

**No. 5 (12 marks total)**

**(3 marks each)**

At room temperature, which of the following would you expect to be elastomers, which to be thermosetting polymers, and which to be thermoplastic polymers? Justify each choice.

- (a) A random and lightly crosslinked copolymer that has a glass-transition temperature of  $-40^{\circ}\text{C}$ .
- (b) A branched and isotactic polypropylene that has a glass-transition temperature of  $-10^{\circ}\text{C}$ .
- (c) A heavily crosslinked polyethylene that has a glass-transition temperature of  $0^{\circ}\text{C}$ .
- (d) Linear polyvinyl chloride that has a glass-transition temperature of  $100^{\circ}\text{C}$ .