University of Canterbury

End of Year Examination 2006

Prescription Number(s):	CHEM 323 ENCH 443
Paper Title:	Applied Physical Chemistry

Time Allowed: TWO HOURS

Number of pages: FIVE

Answer **ALL** questions.

All questions are of equal value.

TURN OVER

1. (a) Draw a diagram of a basic laser and explain the purpose of the various components.

   (b) Give the two conditions that must be fulfilled in order for laser radiation to be produced.

   (c) List the desirable characteristics of laser radiation (not all of which are available from the same laser).

   (d) Explain how the time-dependence of the output of a pulsed laser may be improved by Q-switching and mode-locking.

   (e) Explain how the wavelength range covered by the output of a narrow-band laser may be decreased by the use of a two-stage oscillator-amplifier configuration and the by the insertion of an etalon.

2. Consider the following statement:

"Cationic copolymerization of isobutene with 1-3 mol % isoprene (2-methyl-1,3-butadiene) is carried out at very low temperatures in methyl chloride solution. The process yields so-called butyl rubber, the architecture of which is then transformed via vulcanization."

(a) Draw the chemical structures of isobutene, polyisobutene and isoprene.

(b) (i) Explain what cationic polymerization is.

(ii) Why is isobutene polymerized this way?

(iii) Why is the process carried out at low temperature?

(c) (i) Explain what copolymerization is.

(ii) What type of copolymer is obtained by copolymerization of isobutene and isoprene? Explain.

(d) (i) Explain what solution polymerization is.

(ii) What are its major advantages and disadvantages?

(e) (i) Explain what vulcanization is.

(ii) What is the architecture transformation that it brings about?

(iii) Why is it useful to carry out this transformation?

(iv) Explain the role of isoprene and why only a low amount of it is necessary.

(f) What are the distinctive features of *free-radical polymerization* of isoprene and how do they arise?

3. Write notes on **FOUR** of the following:

   (a) The Michaelis-Menten mechanism.

   (b) The origin of kinetic isotope effects.

   (c) Explosion limits for the hydrogen-oxygen system.

   (d) Diffusion-limited reactions.

   (e) The stopped-flow method.

   (f) Measurements of reaction rates using fast-flow systems.

END OF PAPER