



“Chemists, engineers and technologists working together.”
“Les chimistes, les ingénieurs et les technologistes travaillant ensemble.”

THE 2012 CANADIAN CHEMISTRY CONTEST
for high school and CEGEP students

PART B – EXTENDED RESPONSE SECTION (90 minutes)

In this section you should respond to **TWO** questions only, writing in the form of scientific essays (for number 1, an experimental description) including any appropriate equations, formulae and diagrams. Some suggestions are made about the direction(s) you could take, but these are not exclusive. Each essay is of equal value, and the quality of **both** responses will be considered in the final competition: you should therefore allocate approximately equal time to each of the subjects you choose. The judging of the responses will be based on both factual accuracy and presentation. A clear, concise and well-organized piece of written work will be rated more highly than a long rambling one that contains the same information.

1) Experiment Design: Determining the K_{sp} of Sodium Chloride

Describe an experiment you could perform to determine the solubility product constant (K_{sp}) of sodium chloride. For this experiment, you are provided with an unlimited supply of pure solid sodium chloride and all standard high school laboratory equipment.

You should begin with an introductory paragraph which outlines the experiment and associated theory and includes an explanation of the following terms: salts, solubility, and solubility product constant. Following this, include a procedure which indicates the required steps, the results that need to be collected and an outline of the required calculations. Given that the actual K_{sp} of sodium chloride is 37.7^1 , indicate the results you would expect to find if your proposed procedure produced very accurate results. You should conclude with a paragraph outlining any problems you may encounter, and applications of determining solubility product constants or molar solubility values in everyday life. Your application examples may be specific to sodium chloride or for the values of other salts.

2) The Importance of Polymers in Everyday Life

In November 2011, the Bank of Canada released a \$100 polymer banknote with plans to release a similar \$50 banknote in March 2012, and lower denominations by 2013. Use your chemical knowledge of polymers to explain the following: (i) why these substances play an important role in everyday life in a variety of contexts; (ii) why the Bank of Canada would choose synthetic polymers to replace paper money; and (iii) how polymers can be formed through addition and condensation reactions (including equations where necessary). Include diagrams, structures and chemical equations to illustrate your points.

¹ Physical Constants of Inorganic Compounds. (1980). Robert Weast, *CRC Handbook of Chemistry and Physics* (60th edition, p.B-125). Boca Raton, Florida: CRC Press Inc.

3) Fundamental Chemical Principles

Throughout your study of Chemistry, you have explored a variety of chemical principles. Identify what you believe to be the three most important chemical principles. You should start with an introductory paragraph describing what a principle is and identifying the three principles you believe are most important in chemistry, follow with at least one descriptive paragraph for each principle highlighting why the principle is fundamental to chemistry with specific examples of the use of the principle, and finish with a concluding paragraph. Include diagrams, structures and chemical equations to illustrate your points.

4) The Effect of Governmental Restrictions on the Canadian High School Chemistry Curriculum

In March 2008, the Canadian government (through the Ministry of Natural Resources) took action to restrict the use and distribution of nine chemicals that can be used to make explosives. Many of these chemicals have likely played a role in the Chemistry program you followed during your high school career. These chemicals are: hydrogen peroxide at a concentration of 30 percent by mass or higher, nitric acid at a concentration of 68 percent by mass or higher, nitromethane, potassium chlorate, potassium perchlorate, sodium chlorate, potassium nitrate, sodium nitrate and ammonium nitrate. When high school teachers order these chemicals today, they need to declare how the chemicals will be used and provide government approved identification. Compliance with the government screening requirements has led many suppliers to eliminate the distribution of these chemicals to high schools.

Most of these chemicals have legitimate and valuable uses within the high school curriculum (and in universities, industries, agricultures and elsewhere). Discuss some of the legitimate uses of these chemicals within the high school curriculum, and identify how the curriculum might be affected if use of these chemicals was banned in high schools. You may want to suggest suitable replacement chemicals for the uses you identify.