Chemical Institute of Canada | ***For Our Future***
Institut de chimie du Canada | ***Pour notre avenir***

THE 2018 CANADIAN CHEMISTRY CONTEST
for High School and CEGEP Students

PART B – EXTENDED RESPONSE SECTION (90 minutes)

Students will answer **TWO** questions as follows: all students **must** answer the experimental design question 1; students have the choice between answering **either** question 2 **or** question 3. For each question, students should write a scientific essay including appropriate equations, formulae and diagrams. Each essay is of equal value. Allocate approximately equal time to each question. Scorers will consider the accuracy and quality of the information and the presentation of the responses. A clear, concise, well-organized piece of written work will be rated more highly than a long rambling one. A scientific calculator is allowed. No phones or communication devices are allowed.

---

1) Experimental Design: Reaction Rates (mandatory question)

The hypochlorite ion OCl^- is important for disinfecting water for drinking, water in pools and for removing stains from clothing. The decomposition of hypochlorite can occur via the two mechanisms below:

Mechanism 1	Mechanism 2
$2ClO^-_{(aq)} \rightarrow 2\,Cl^-_{(aq)} + O_{2\,(g)}$ (very slow)	$2\,CoO_{(s)} + ClO^-_{(aq)} \rightarrow Co_2O_{3\,(s)} + Cl^-_{(aq)}$ (slow) $Co_2O_{3(s)} + ClO^-_{(aq)} \rightarrow Co_2O_3 \cdot ClO^-$ (adsorbed) (fast) $Co_2O_3 \cdot ClO^-$ (adsorbed) $\rightarrow 2CoO_{(s)} + Cl^-_{(aq)} + O_{2\,(g)}$ (fast)

Transition metal compounds are good catalysts for the decomposition of the hypochlorite ion. Design an experiment based on either mechanism to determine the conditions that would lead to the fastest decomposition of sodium hypochlorite in solution. Start your lab procedure with an introduction that demonstrates your understanding of the factors that would affect the rate of this reaction. In your laboratory design, provide a materials list and a clear, numbered, step-by-step procedure. Provide tables of observation to demonstrate how you would collect your data to assess the conditions which would lead to the fastest rate of decomposition. Identify possible sources of error and how you would minimize them. Assume you have access to all glassware and equipment found in a typical high school laboratory.

2) Organic Chemistry

Many students in Canada study Organic Chemistry. The study of organic chemistry focuses primarily on carbon, hydrogen, oxygen and nitrogen. Why is organic chemistry important if it is based on only 4 of the 118 elements on the periodic table? In your answer, demonstrate an understanding of the central concepts in organic chemistry. Highlight some interesting characteristics of several functional groups and their chemical properties. Highlight trends in the physical properties of different groups of organic compounds, why differences in physical properties exist and how the physical and chemical properties of organic compounds can be applied to everyday life.

3) Chemistry

Linus Pauling (1901-1994) was the recipient of the 1954 Nobel Prize in Chemistry and the 1962 Nobel Peace Prize. He worked enthusiastically on determining the nature of chemical bonds, the structure of molecules and crystals, and he introduced the concepts of electronegativity, hybridization, resonance as well as many fundamental concepts in molecular biology. He also worked tirelessly trying to prevent nuclear testing during the Cold War. He stated: “every aspect of the world today – even politics and international relations – is affected by chemistry”. Discuss the importance of chemistry today in solving and influencing some of the world’s biggest problems. Use two or three specific examples of the influence of chemistry in your discussion.