

1. **DESCRIPTION:** Teams will complete one or more tasks and answer a series of questions involving the Science processes of chemistry focused in the areas of equilibrium and **chemical reactions/stoichiometry**.

**A TEAM OF UP TO:** 2

**EYE PROTECTION:** #4

**APPROX. TIME:** 50 min.

## 2. EVENT PARAMETERS:

- a. **Students:** Each student must bring **safety equipment** and a writing implement and may bring a non-programmable, non-graphing calculator, and one 8.5" by 11" two sided page of notes containing information in any form from any source.

- b. **Supervisors:** must provide reagents/glassware/references that are needed for the tasks (e.g., Periodic Table, table of standard reduction potentials, any constants needed, etc.).

- c. **Safety Requirements:** Students must wear the following or they will not be allowed to participate: closed-toed shoes, ANSI Z87 indirect vent chemical splash goggles (see [www.soinc.org](http://www.soinc.org)), pants or skirts that cover the legs to the ankles, and additionally a long sleeved lab coat that reaches the wrists and the knees or a long sleeved shirt that reaches the wrists with a chemical apron that reaches the knees. Chemical gloves are optional, **but recommended**. Students who unsafely remove their safety clothing/goggles or are observed handling any of the material or equipment in a hazardous/unsafe manner (e.g., tasting or touching chemicals or flushing solids down a drain and not rinsing them into a designated waste container provided by the supervisor) will be **penalized** or disqualified from the event.



3. **THE COMPETITION:** The competition will consist of a series of tasks similar to those in first year high school courses. These tasks could include hands-on activities, questions about each topic, interpretation of experimental data (graphs, diagrams, etc.), and/or observation of an experiment set up & running. Supervisors are encouraged to use computers or calculators with sensors/probes. Students may be asked to collect data using probe ware that has been set up & demonstrated by the Supervisor. Or the supervisor may provide students with data sets collected by such sensors/probes following demonstration of the data collection. Data will be presented in a tabular and/or graphic format & students will be expected to interpret the data. Students should be aware that nomenclature, formula writing & Stoichiometry are essential tools of chemistry & may always be included in the event. Stoichiometry includes mole conversions & percentage yield. For purposes of nomenclature & formula writing, students are expected to know the symbols & charges for the following ions: nitrate, carbonate, phosphate, acetate, sulfate, ammonium, bicarbonate & hydroxide. Students should know how to use the "ite" form of anion (one less oxygen than the "ate" form). Students should be able to use the periodic table to obtain the charge for monatomic ions (e.g.,  $\text{Na}^+$ ,  $\text{S}^{2-}$ ).

## 4. SAMPLE QUESTIONS:

- a. **Equilibrium:** Students should be able to write equilibrium reactions, predict the direction of a reaction using Le Châtelier's Principle, calculate an equilibrium constant and use equilibrium constants to determine concentrations. Tasks will be chosen from the following 1) Use a titration/data of a weak acid/base with a strong acid/base to calculate an equilibrium constant. 2) Investigate an equilibrium reaction and determine what happens when it is stressed. 3) Construct/use a standard absorption curve to determine an equilibrium constant. 4) Use a calorimeter to predict a curve. 5) **Verify gas laws**. 6) At state & national levels, knowledge/application of equilibrium to separate chemicals may be included.

- b. **Chemical Reactions/Stoichiometry:** Students will complete experimental tasks and answer questions related to classification of reaction type, balancing reactions (including predicting products of double replacement reactions, solubility, oxidation-reduction, total ionic and net ionic equations), and reaction prediction.

5. **SCORING:** Equilibrium: 50% & **Chemical Reactions/Stoichiometry:** 50%. Time may be limited at each task, but will not be used as a tiebreaker or for scoring. Ties will be broken by pre-selected questions.

**Recommended Resources:** All reference and training resources including the **Chem/Phy Sci CD (CPCD)** are available on the Official Science Olympiad Store or Website at [www.soinc.org](http://www.soinc.org)