

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 **Aqueous Solutions** and Acids & Bases.

**A TEAM OF UP TO:** 2

**EYE PROTECTION:** C

**APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**

- a. Each participant must bring safety equipment (e.g., goggles, lab coat, apron), a writing implement, and may bring a **stand-alone calculator of any type**.
- b. Each **participant** may bring one 8.5" x 11" sheet of paper, **which may be** in a sheet protector **sealed by tape** or laminated, with information on both sides in any form and from any source along with any or all of the items listed as Recommended Lab Equipment for Division C Chemistry Events, posted on [soinc.org](http://soinc.org). Teams not bringing these items will be at a disadvantage, as they are not provided.
- c. Participants must wear goggles, an apron or a lab coat and have skin covered from the neck down to the wrist and toes. Gloves are optional, but if the host requires a specific type they will notify teams. **Pants should be loose fitting; if the host has more specific guidelines they will notify teams in advance of the tournament.** Shoulder length or longer hair must be tied back. Participants removing safety clothing/goggles or unsafely handling materials or equipment will be penalized or disqualified.
- d. Supervisors will provide any required reagents, additional glassware, and/or references that are needed for the tasks (e.g., Periodic Table, table of standard reduction potentials, any constants needed).

3. **THE COMPETITION:**

- a. 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 on listed topics, interpretation of data (e.g., graphs, diagrams, tables), or observation of an established and running experiment.
- b. Teams may be asked to collect data using a probeware set-up demonstrated by the Supervisor(s). Following a demonstration of the sensors/probes, participants may be given data sets to interpret.
- c. Nomenclature, formula writing, & stoichiometry (mole conversions & percentage yield) are essential tools of chemistry & may be included in the event. Participants are expected to know the symbols & charges for: nitrate, carbonate, phosphate, acetate, sulfate, ammonium, bicarbonate, & hydroxide. Participants should know how to use the "ite" form of anion (one less oxygen than the "ate" form). With a periodic table, participants should be able to obtain charges for monatomic ions (e.g.,  $\text{Na}^+$ ,  $\text{S}^{2-}$ ).
- d. Participants should understand the following Acid-Base Chemistry concepts:
  - i. Properties & Uses of Common Acids and Bases
    - (1) Acids - ( $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_3\text{PO}_4$ ,  $\text{H}_2\text{CO}_3$ , acetic, and ascorbic acid)
    - (2) Bases - ( $\text{NaOH}$ ,  $\text{KOH}$ ,  $\text{Ca}(\text{OH})_2$ ,  $\text{Mg}(\text{OH})_2$ , and  $\text{NH}_3(\text{aq})$ )
    - (3) Acid/Base indicators and how they are used; pH ranges and color changes will be provided. Questions will not address theories of how indicators work.
  - ii. Acid & Base reactions will be limited to metals, carbonates, bicarbonates, sulfites, bisulfites, oxides, & neutralizations
  - iii. Titrations to determine percent composition, molarity, and/or molecular mass
  - iv. Additional calculations will be limited to  $K_a$ ,  $K_b$ , pH, pOH, and dilution
  - v. **State and Nationals Only:** calculations or questions about buffers
- e. Participants should understand the following about **Aqueous Solutions**:
  - i. **Principles, properties, terms, and definitions concerning aqueous solutions**
  - ii. **Calculate solution concentration given quantities of solute and solvent**
  - iii. **Calculate the amount of material needed to achieve a specific concentration**
  - iv. **Different measurements of concentration (e.g., molarity, molality, mass percentage, and parts per million) and how to calculate each**
  - v. **State and Nationals Only: conversions between concentration units**

4. **SAMPLE QUESTIONS/ACTIVITIES:**

- a. Titrations to determine percent composition, molarity, and/or molecular mass.
- b. Given a pH indicator and the results of a test determine the pH of a solution.
- c. Identify the pH indicator that should be used to monitor the pH change in a given experiment.
- d. **Use freezing point depression to determine the molar mass of a solute.**
- e. **Identify and explain factors that affect solution formation.**
- f. **Determine whether a solution is saturated, unsaturated, or supersaturated.**

5. **SCORING:**

- a. High score wins. Points will be divided evenly between **Aqueous Solutions** and Acids & Bases.
- b. Time may be limited at each task but will not be used as a tiebreaker or for scoring.
- c. Ties will be broken by pre-selected questions.
- d. A penalty of up to 10% may be given if the area is not cleaned up as instructed.
- e. A penalty of up to 10% may be given if a team brings prohibited lab equipment to the event.

**Recommended Resources:** The Science Olympiad store ([store.soinc.org](http://store.soinc.org)) carries the Chem/Phy Sci CD (CPCD); other resources are on the event page at [soinc.org](http://soinc.org).