

## SOUNDS OF MUSIC



See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.



1. **DESCRIPTION:** Teams must construct and tune one device prior to the tournament based on a two-octave 12-tone equal tempered scale and complete a written test on the physics of sound and music concepts.

**A TEAM OF UP TO:** 2

**EYE PROTECTION:** None

**IMPOUND:** No

**APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**

- Each team may bring one three-ring binder of any size containing information in any form and from any source attached using the available rings. Sheet protectors, lamination, tabs and labels are permitted. Participants may remove information or pages for their use during **any part** of the event.
- Each team may also bring writing utensils and two stand-alone calculators of any type for use during any part of the event.
- Teams may bring a personal tuner, which may be an app on their cell phone, for use during set up. Access to an electrical outlet is not guaranteed.
- If testing a stringed device, a team may bring rosin.
- Prior to the competition, teams must tune their device to play **at least** eight notes from a two-octave major scale of the team's choice. A log describing the process of tuning one pitch must be submitted.
- Participants must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on [www.soinc.org](http://www.soinc.org).

3. **CONSTRUCTION PARAMETERS:**

- The device may be constructed of and contain any materials except for the following: electric or electronic components, toys, professional instruments, or parts **taken from or built for toy or professional instruments** (e.g., bells, whistles, mouthpieces, reeds or reed blocks, audio-oscillators, tuning pegs, etc.). The only exception is that strings (**professional** instrumental or otherwise) of any type are permitted.
- The device must be able to play an ascending major scale beginning on any note between F2 and F3 (inclusive), **chosen by the team**. (A4 = 440 Hz) The scale must include an octave jump after the fourth note of the scale. For example, G2, A2, B2, C3, octave jump, D4, E4, F#4, G4
- The device must also be able to play additional pitches within the scale's skipped range in order to play the first four bars of "Twinkle, Twinkle". The song excerpt (attached at the end of the rules) must be played in 15 seconds and must be played within one octave. **The song may include pitches both played and skipped as part of the Pitch Score Test.**
- For a bonus, the device may have one additional pitch (outside of the two octave range) EITHER:
  - At least one octave lower than the lowest note of the required scale in 3.b. (In the example above, G1 or lower),
  - At least one octave higher than the highest note of the required scale in 3.b. (In the example above, G5 or higher).
- The energy to produce the pitches must come from the participants and may not be stored. Participants may not hum or sing to cause the device to produce its pitches.
- Each device must fit within a 60.0 cm x 60.0 cm x 100.0 cm box when brought into the competition area and be moveable by the participants without outside assistance. Devices may become larger once set up.
- Devices must use the same type of sound-producing components for all portions of the competition.**

4. **THE COMPETITION:**

**Part I: Written Test**

- Teams will be given a minimum of 20 minutes to complete a written test consisting of multiple choice, true-false, completion, or calculation questions/problems.
- Unless otherwise requested, answers must be in metric units with appropriate significant figures.
- The test will consist of at least three questions from each of the following areas:
  - General principles of acoustics (e.g., wave theory, Bernoulli Effect)
  - Basic terminology regarding sound, sound production, and related science terms
  - Fundamental elements of musical sound, perception, and resonance
  - The design, function, and construction of the instrument types (e.g., how it makes sound, what determines the pitch, how is volume changed)
  - Notes, scales, solfege, intervals, time signatures, tempos, and associated music terms

**Part II: Device Testing**

- a. Device testing should take place in a room separate from the Part I written test to minimize disruption and to ensure the accuracy of the device readings.
- b. Devices will be evaluated on their ability to produce accurate pitches. A recommended pitch measuring software program is available on the event page at [soinc.org](http://soinc.org).
- c. Teams will have two minutes to set up their device. During the two minutes, teams may use their personal tuner, including a cell phone app, to adjust the pitches on their device. One participant may continue working on the written test if not needed to play or set up the device.
- d. At the end of the two minutes, the team's tuner must be put away. Failure to do so will result in a construction violation. No further alterations of the device are allowed other than those that would occur naturally while playing different pitches (such as covering different holes with fingers or moving a slide).
- e. Once the device is ready, or the two-minute set-up period has expired, the participants will begin their Pitch Score Test:
  - i. Participants will inform the Event Supervisor which major scale they are playing and what note they will start on. Participants must know the octave number of their starting pitch.
  - ii. Participants will play one pitch at a time, holding it for a duration of 3 seconds as indicated by signals from the Event Supervisor. For devices with a quick decay time, multiple attacks on the pitch are allowed (e.g., striking a bar with a mallet or plucking a string multiple times). The pitch measurement will be the average value during the 3 seconds. Participants will wait until the Supervisor records the measured pitch frequency and indicates that they may proceed before playing the next note in the sequence.
  - iii. The microphone may be moved as close as necessary to the device to register the pitch. If a pitch is so soft that it cannot register on the measurement equipment, the device scores zero for that Individual Pitch Score or Bonus.
  - iv. If the device is unable to play some of the required pitches, the participants must notify the Event Supervisor before playing the first note which pitches in the sequence will be skipped. Otherwise it will be assumed that the participants are playing the next note in the scale sequence. Points will be awarded per note.
- f. Once the Pitch Score Test is completed the participants will conduct their Song Score Test.
  - i. No alterations of the device are allowed between the Pitch and Song Score tests.
  - ii. Participants will select a starting note from the range encompassed by the pitch test scale.
  - iii. Participants must play the "Twinkle, Twinkle" song excerpt within 15 seconds.
  - iv. The Song Score test is scored based on ability to play the song within the time and the Event Supervisor's perception of the rhythmic and pitch accuracy of the song.
- g. Teams may also try to play a Bonus Pitch. This may be before or after the Song Score Test.
  - i. No alterations of the device are allowed.
  - ii. Participants will indicate what their Bonus Pitch is.
  - iii. Participants will play the pitch for 3 seconds as required by 4.Part II.e.ii.-iii..
  - iv. Bonus points will be awarded based on the accuracy of the pitch.
- h. The Event Supervisor will review with the teams the Part II data recorded on their scoresheet.
- i. Teams filing an appeal regarding Part II must leave their device in the competition area.

**5. SCORING:**

- a. High score wins. A complete scoring rubric is available on the Sounds of Music page on [soinc.org](http://soinc.org)
- b. The Final Score = TS + LS + PS + SS + Bonus;
  - i. Test Score (TS) = (Part I score / Highest Part I score for all teams) x 45 points
  - ii. Log Score (LS) = max of 10 points
  - iii. Pitch Score (PS) = (Sum of IPS for the Device / Highest IPS Sum for all teams) x 36 points  
 IPS (Individual Pitch Score for each pitch) =
    - (1) C (cents) = abs (cents off the target frequency).
    - (2) IPS for skipped pitches = 0
    - (3) The IPS score varies by tournament level:
      - a. Regionals: If  $C \leq 10$ ,  $IPS = 4.5$ ; If  $C > 10$ ,  $IPS = 5 - 0.05 \times C$
      - b. States: If  $C \leq 7$ ,  $IPS = 4.5$ ; If  $C > 7$ ,  $IPS = 5 - 0.1 \times C$
      - c. Nationals: If  $C \leq 3$ ,  $IPS = 4.5$ ; If  $C > 3$ ,  $IPS = 5 - 0.2 \times C$
    - (4) The minimum IPS score is 0 no matter the level of the tournament.



- iv. Song Score (SS) = (Device Song Score / Highest Device Song Score of all teams) x 9 points
- v. Bonus – max of 5 points
- c. The log must track the iterations of calibrating one pitch on the device. The Log Score (LS) points will be assigned as follows (**partial points may be awarded**):
  - i. 2 points – For a list of materials used in the device
  - ii. 2 points – For including data comparing pitch accuracy to changes made to an appropriate design element (e.g., pitch vs length of tubing) in order to tune one pitch
  - iii. 2 points – For including at least 5 data points in tuning the one pitch
  - iv. 2 points – For proper labeling (e.g., title, team name, units, team number)
  - v. 2 points – For including a labeled picture showing how to play different pitches (e.g., a fingering chart)
  - vi. LS = 0 if no device is brought to the event
- d. The Device Song Score points will be assigned as follows (**partial points may be awarded**):
  - i. 3 points – Rhythmic accuracy
  - ii. 3 points – Pitch accuracy
  - iii. 3 points – Was the song played within 15 seconds from the start of playing
- e. The Bonus will be assigned as indicated:
  - i. Regional Level – 5 points, if the played pitch is within 10 cents of the selected pitch. Otherwise zero points
  - ii. State Level – 5 points, if the played pitch is within 7 cents of the selected pitch. Otherwise zero points
  - iii. National Level – 5 points, if the played pitch is within 3 cents of the selected pitch. Otherwise zero points
- f. If a team violates any COMPETITION rules, their IPS values will be multiplied by 0.9 when calculating the scores.
- g. If any CONSTRUCTION violation(s) are corrected during the Part II setup period, the IPS values will be multiplied by 0.7 when calculating the scores.
- h. Teams that are disqualified for unsafe operation, do not bring a device, or whose device does not meet construction parameters at the end of their setup time receive zero points for their **PS, SS, and Bonus** scores. Teams will be allowed to compete in Part I.
- i. Ties will be broken using the following categories in the listed order:
  - i. Best PS
  - ii. Best SS
  - iii. Best TS
  - iv. Questions on the written test

**“Twinkle, Twinkle” excerpt:**

Note that the excerpt may be transposed into an appropriate key. The time signature for this piece should be 4/4.



**Recommended Resources:** The Science Olympiad Store ([store.soinc.org](http://store.soinc.org)) carries the Sounds of Music Video Download and Chem/Phy Science CD; other resources are on the event page at [soinc.org](http://soinc.org).

**GENERAL RULES**

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.

**GENERAL RULES, CODE OF ETHICS, AND SPIRIT OF THE PROBLEM**

The goal of competition is to give one's best effort while displaying honesty, integrity, and good sportsmanship. Everyone is expected to display courtesy and respect - see Science Olympiad Pledges. Teams are expected to make an honest effort to follow the rules and the spirit of the problem (not interpret the rules so they have an unfair advantage). Failure by a participant, coach, or guest to abide by these codes, accepted safety procedures, or rules below, may result in an assessment of penalty points or, in rare cases, disqualification by the tournament director from the event, the tournament, or future tournaments.

1. Actions and items (e.g., tools, notes, resources, supplies, electronics, etc.) are permitted, unless they are explicitly excluded in the rules, are unsafe, or violate the spirit of the problem.
2. While competing in an event, participants may not leave without the event supervisor's approval and must not receive any external assistance. All electronic devices capable of external communication as well as calculator applications on multipurpose devices (e.g., laptop, phone, tablet) are not permitted unless expressly permitted in the event rule or by an event supervisor. Cell phones, if not permitted, must be turned off. At the discretion of the event supervisor, participants may be required to place their cell phones in a designated location.
3. Participants, coaches and other adults are responsible for ensuring that any applicable school or Science Olympiad policy, law, or regulation is not broken. All Science Olympiad content such as policies, requirements, clarifications/changes and FAQs on [www.soinc.org](http://www.soinc.org) must be treated as if it were included in the printed rules.
4. All pre-built devices presented for judging must be constructed, impounded, and operated by one or more of the 15 current team members unless stated otherwise in the rules. If a device has been removed from the event area, appeals related to that device will not be considered.
5. Officials are encouraged to apply the least restrictive penalty for rules infractions - see examples in the Scoring Guidelines. Event supervisors must provide prompt notification of any penalty, disqualification or tier ranking.
6. State and regional tournament directors must notify teams of any site-dependent rule or other rule modification with as much notice as possible, ideally at least 30 days prior to the tournament.

**COVID-19 PANDEMIC RULES MODIFICATIONS**

**The COVID-19 pandemic requires that some general modifications be made to the Event Rules listed in this manual in order to permit Science Olympiad competitions to continue in a way that reflects best public health, disease prevention, and personal safety practices. The modifications listed here will be in effect for all Science Olympiad competitions, regardless of level (e.g., Invitational, Regional, State, National), or type (e.g., In-Person, Satellite SO, mini SO). As the pandemic is evolves, these modifications may be amended or rescinded according to local conditions. If changes are made, the Tournament Director for the affected tournament will make an announcement to all participating teams as soon as possible.**

1. **If not already allowed, each individual participant can have a personal set of reference materials (e.g., binders, single sheets of paper), calculator, or other academic resource as specified in the specific event rule for use during the competition to facilitate social distancing, isolation, and to prevent resource sharing. Personal sets of resource materials must meet all the criteria established in the specific event rule. This does not apply to Recommended Lab Equipment for Division B or Division C Chemistry Events or tool kits for Build Events.**
2. **Given local conditions, participants may not be able to be in the same location as their partner during competition. Tournaments will allow designated partners to compete from separate locations and competing teams will only need one device for Build or Hybrid with Build Events.**
3. **At the discretion of the Tournament Director, portions of Hybrid Events containing hands-on activities as well as Build and Lab Events may be dropped from the tournament or be conducted as trial events.**
4. **At the discretion of the Tournament Director and Event Supervisors, completion time may be used as a tiebreaker for Core Knowledge and other events where a written or online test is used.**



**For Event Supervisors Only - Do Not Post**  
**CHEMISTRY RECOMMENDED LAB EQUIP.**

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.

Each team may bring any or all of the items listed below for use in Division C Chemistry Events requiring laboratory equipment. Teams not bringing these items will be at a disadvantage as Event Supervisors will not provide Recommended Lab Equipment. A penalty of up to 10% may be given if a team brings prohibited lab equipment to the event.

Item & Expected Use	Likely to be used in:			
	Chemistry Lab	Forensics	Environmental Chemistry	Materials Science
<b>Box</b> - Containing all of the kit materials	X	X	X	X
<b>10 ml Graduated Cylinder</b> - Measuring volumes	X		X	
<b>25 ml Graduated Cylinder</b> - Measuring volumes	X		X	
<b>100 ml Graduated Cylinder</b> - Measuring volumes	X		X	
<b>50 ml Beakers</b> - Doing reactions, developing chromatograms	X	X	X	X
<b>100 ml Beakers</b> - Doing reactions, developing chromatograms	X	X	X	X
<b>250 ml Beakers</b> - Doing reactions, developing chromatograms	X	X	X	X
<b>400 ml Beakers</b> - Doing reactions, developing chromatograms	X	X	X	X
<b>50 ml Erlenmeyer Flasks</b> - Doing reactions	X		X	
<b>125 ml Erlenmeyer Flasks</b> - Doing reactions	X		X	
<b>250 ml Erlenmeyer Flasks</b> - Doing reactions	X		X	
<b>Test Tubes</b> - Mix Chemicals, heat chemicals	X	X	X	X
<b>Test Tube Brush</b> - Clean Test Tubes	X	X	X	X
<b>Test Tube Holder</b> - Holds test tubes for heating	X	X	X	
<b>Test Tube Rack</b> - Hold Test Tubes	X	X	X	X
<b>Spot Plates</b> - For semi-micro scale reactions, testing solubility, pH	X	X	X	
<b>Petri Dishes</b> - Doing reactions, developing chromatograms	X	X	X	X
<b>Slides</b> - To put hairs, crystals, or fibers on for use with a microscope		X		
<b>Cover Slips</b> - To cover & prevent items from coming off slides		X		
<b>Droppers</b> - Add small amounts of liquids to reactions	X	X	X	X
<b>Spatulas or spoons</b> - Getting small amounts of solids out of containers	X	X	X	X
<b>Metal Tongs, Forceps, or Tweezers</b> - Holding & retrieving objects	X	X	X	X
<b>Stirring Rods</b> - Stirring mixtures	X	X	X	X
<b>Thermometer</b> - Determining the temperature of a solution	X	X	X	
<b>pH or Litmus paper</b> - Test acidity or alkalinity of solution	X	X	X	
<b>Hand Lens</b> - Magnification of small items for identification		X		
<b>Flame Loop</b> - For identification of ions in a compound		X		
<b>Cobalt Blue Glass</b> - To filter out any sodium that might contaminate flame test from hands		X		
<b>Filter Paper</b> - Filter solids from liquids	X		X	
<b>Funnel</b> - Hold Filter Paper	X		X	
<b>9V battery</b> - Electrolysis	X		X	X
<b>Alligator Clip Wires</b> - Connecting meters to metals	X		X	X
<b>Nail</b> - Electrolysis	X		X	X
<b>Piece of Cu metal</b> - Electrolysis	X		X	X
<b>Piece of Zn metal</b> - Electrolysis	X		X	X
<b>Multimeter</b> - Measuring current, voltage, and resistivity	X		X	X
<b>9V or less Battery Conductivity Tester</b> - Determining ionic strength of solution	X	X	X	X
<b>Calipers-mechanical, not digital</b> - Measuring lengths very precisely	X			X
<b>Paper Towels</b> - Cleaning	X	X	X	X
<b>Pencil</b> - Writing, Marking Chromatogram		X		
<b>Ruler</b> - Measuring lengths		X		
<b>Magnets</b> - For extraction and identification of iron filings	X	X	X	X



# For Event Supervisors Only - Do Not Post CALCULATOR CLASS DESCRIPTIONS

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.

The following document was prepared to offer some guidance to teams as they select calculators for use in different Science Olympiad events. By no means are the calculators listed here inclusive of all possible calculators; instead they are offered as common examples. The decisions of the event supervisors will be final.

## Class I - Stand-alone non-graphing, non-programmable, non-scientific 4-function or 5-function calculators

are the most basic type of calculators and often look like the one shown to the right. These calculators are limited to the four basic mathematics functions and sometimes square roots. These calculators can often be found at dollar stores.



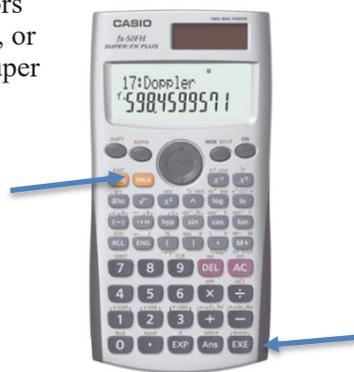
**Class II - Stand-alone non-programmable, non-graphing calculators** look like the calculator to the right or simpler. There are hundreds of calculators in this category but some common examples include: CASIO FX-260, Sharp EL-501, and TI-30X.



**Class III- Stand-alone, programmable, graphing calculators and stand-alone non-graphing, programmable calculators**, often look like the calculator shown on the right. Some examples are: Casio 975 0/9850/9860, HP 40/50/PRIME, and TI 83/84/89/NSPIRE/VOYAGE.

To identify a stand-alone non-graphing, programmable calculators are look for the presence of the 'EXE' button, the 'Prog' button, or a 'file' button. Examples include but are not limited to: Casio Super FXs, numerous older Casio models, and HP 35S. A calculator of this type with the buttons labeled is shown to the right.

PROG Button



EXE Button



**Class IV - Calculator applications on multipurpose devices** (e.g., laptop, phone, tablet, watch) are not allowed unless expressly permitted in the event rule.



**EYE PROTECTION GUIDE**

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.

This resource was created to help teams comply with the Science Olympiad Policy on Eye Protection adopted on July 29, 2015 and posted on the Science Olympiad Website ([soinc.org](http://soinc.org)).

**Participant/Coach Responsibilities:** Participants are responsible for providing their own protective eyewear. Science Olympiad is unable to determine the degree of hazard presented by equipment, materials and devices brought by the teams. Coaches must ensure the eye protection participants bring is adequate for the hazard. All protective eyewear must bear the manufacturer's mark Z87. At a tournament, teams without adequate eye protection will be given a chance to obtain eye protection if their assigned time permits. If required by the event, participants will not be allowed to compete without adequate eye protection. This is **non-negotiable**.

**Corresponding Standards:** Protective eyewear used in Science Olympiad must be manufactured to meet the American National Standards Institute (ANSI) standard applicable at its time of manufacture. The current standard is ANSI/ISEA Z87.1-2015. Competitors, coaches and event supervisors are not required to acquire a copy of the standard. The information in this document is sufficient to comply with current standards. Water is not a hazardous liquid and its use does not require protective eyewear unless it is under pressure or substances that create a hazard are added.

**Compliant Eyewear Categories:** If an event requires eye protection, the rules will identify one of these three categories. Compliance is simple as ABC:

**CATEGORY A**

- Description: Non-impact protection. They provide basic particle protection only
- Corresponding ANSI designation/required marking: Z87
- Examples: Safety glasses; Safety spectacles with side shields; and Particle protection goggles (these seal tightly to the face completely around the eyes and have direct vents around the sides, consisting of several small holes or a screen that can be seen through in a straight line)

**CATEGORY B**

- Description: Impact protection. They provide protection from a high inertia particle hazard (high mass or velocity)
- Corresponding ANSI designation/required marking: Z87+
- Example: High impact safety goggles

**CATEGORY C**

- Description: Indirect vent chemical/splash protection goggles. These seal tightly to the face completely around the eyes and have indirect vents constructed so that liquids do not have a direct path into the eye (or no vents at all). If you are able to see through the vent holes from one side to the other, they are NOT indirect vents
- Corresponding ANSI designation/required marking: Z87 (followed by D3 is the most modern designation but, it is not a requirement)
- Example: Indirect vent chemical/splash protection goggles

**Examples of Non-Compliant Eyewear:**

- Face shields/visors are secondary protective devices and are not approved in lieu of the primary eye protection devices below regardless of the type of vents they have.
- Prescription Glasses containing safety glass should not be confused with safety spectacles. "Safety glass" indicates the glass is made to minimize shattering when it breaks. Unless these glasses bear the Z87 mark they are not approved for use.

**Notes:**

1. A goggle that bears the Z87+ mark and is an indirect vent chemical/splash protection goggle will qualify for all three Categories A, B & C
2. VisorGogs do not seal completely to the face, but are acceptable as indirect vent chemical/splash protection goggles