

# 2024 National Science Bowl®

## Official Academic Competition Rules

### 1. Eligibility Requirements

- 1-1. Each competing team consists of 4 or 5 student members. (Only 4 will be playing at any time.) To be eligible to compete, a high school student must be enrolled for the current school year in grades 9, 10, 11, or 12 at the team's school, and be born between **April 30, 2004, and April 25, 2014, inclusive**. To be eligible to compete, a middle school student must be enrolled for the current school year in grades 6, 7, or 8 at the team's school, and be born between **September 1, 2008, and April 25, 2014, inclusive**. A student is limited to at most 3 years of middle school competition and at most 4 years of high school competition. A student may not compete in both the middle school and high school events in the same year.

**The National Science Bowl® is a school-based competition.** Teams of home-schooled students will be considered to belong to a school as long as each student can provide one of the following items:

- a) Dated copy of a letter of intent to homeschool from the parent to the state or county in which the student resides;
- b) Copy of the current membership ID to a homeschool association; or
- c) Dated proof of purchase of curriculum for the current academic school year.

All students on a home-schooled team must live within the geographic boundaries of the team's assigned regional event.

**All team members must attend the same school.** No club teams (community groups, non-school-based teams) will be approved.

- 1-2. No school may compete in more than one regional competition. No student may compete on more than one team. Coaches must be approved by the schools their teams represent and must be at least 18 years old. No student or coach may compete in or attend more than one regional competition, except that high school students or coaches may attend middle school competitions and vice versa. Each regional coordinator will determine if more than one team from a middle or high school will be allowed to participate in that regional. No more than 3 teams from one middle or high school may compete in a regional event. If a student attends two schools, such as a neighborhood school and a specialty school, that are both participating in regional Science Bowl competitions, then the student must compete on the neighborhood school's team.

Each school is assigned to a unique regional competition. To advance to the National Finals, a school must participate in its assigned regional event. A school may request to compete in a different regional event from the one to which it is assigned, but such a team will NOT qualify for the National Finals if it should win the competition. Instead, the highest-placing team that is assigned to the geographic area of the regional event would qualify for the National Finals.

- 1-3. The winning team from each qualifying regional competition is eligible to be invited to the National Science Bowl® Finals held in the Washington, DC area on **April 25 – April 29, 2024**. In the case that 1) the school of the winning team is not assigned to the geographic area of the regional competition as detailed on the NSB webpage (<https://science.osti.gov/wdts/nsb/Regional-Competitions/>) or 2) fewer than 4 players from the first-place team can attend and participate in all National Science

Bowl® Finals activities, the invitation will be extended instead to the next-highest-place team from the geographic area and having at least 4 players who can attend.

To be eligible for the National Science Bowl® Finals, a student must have competed at the regional competition on the team that attends the National Science Bowl® Finals.

- 1-4. Within 2 weeks after its regional competition or by **March 15, 2024** (whichever comes first), the winning team's coach is required to inform the National Science Bowl® Coordinator of its availability to participate at the National Science Bowl® Finals. During this time of the school year, students are participating in a variety of activities and academic events that may conflict with their participation in the National Science Bowl® Finals (including, but not limited to, state or national athletic or academic tournaments, proms, International Baccalaureate, Advanced Placement, the USAMO, and SAT exams). In the interest of safety, continuity, and maximizing the educational value of the complete National Science Bowl® Finals experience, the National Science Bowl® requires students and coaches to take part in **ALL** of its events and activities. Therefore, **no waivers will be granted** or special arrangements made for students to participate in any conflicting activities or exams. If team members are involved in these pursuits, the students will need to determine which activities or events are in their best interests and make their selections within 2 weeks after their regional competition or by **March 15, 2024** (whichever comes first). All teams must arrive and depart on the designated dates and participate in all events as scheduled throughout the duration of the National Finals. If fewer than 4 students from the invited regional team are able to participate in all activities at all scheduled times, another team from their regional will be invited to replace them. All team members (students and coach) must travel together to and from the National Finals.

## 2. Competition Structure

- 2-1. Regional competitions have the option of choosing their tournament style, e.g., only double or single elimination, only round robin, or a combination of both. In round robin formats, numbers of wins, losses, and ties may be used to eliminate teams from further championship contention, but the scores themselves will NOT be used to eliminate teams. When all teams involved in a tie will advance to an elimination tournament, scores or procedures such as coin flips may be used as a tiebreaker for seeding purposes. (See Rule 9 below regarding tiebreakers at regional competitions.)
- 2-2. The National Science Bowl® Finals will use a round robin tournament format with 8 divisions for the preliminary rounds. Teams will be placed in divisions by drawing lots, with the number of teams per division as equal as possible. The number of teams in each division will depend on the number of teams participating in the competition. Each team will play every other team in its division. At the end of each round robin match, regardless of the overall score, 2 points are awarded for a win, one point for a tie, and zero points for a loss. The top 4 teams from each of the 8 round robin divisions will advance to the seeded double elimination tournament. (See also Rule 10.)

## 3. The Questions

- 3-1. Two types of questions will be used: **toss-up** questions, worth 4 points, and **bonus** questions, worth 10 points. A toss-up question may be answered by any of the 4 members of either team that are actively competing. A team answering a toss-up question correctly will always have an opportunity to answer a bonus question; the other team is ineligible. Non-verbal communication among team members is allowed on toss-up questions, and both verbal and non-verbal communication is allowed

on bonus questions. (See Rule 4-2.) The question categories for both middle school and high school are Biology, Chemistry, Earth and Space Science, Energy, Mathematics, and Physics.

- 3-2. No team will have more than one opportunity to answer a toss-up question. If neither team answers a toss-up correctly, the moderator will proceed to the next toss-up question.
- 3-3. Questions are either **multiple-choice** or **short-answer**. A player may answer a multiple-choice question with either the letter answer (W, X, Y or Z) or the verbal answer; however, if the verbal answer is given, it must be exactly as indicated in the question or as read by the moderator. However, when the choices are mathematical expressions that would be conventionally written in symbols, common alternate expressions of the answer shall be accepted. For example, “square root of 2” and “square root 2” would both be accepted; “sine x” and “sine of x” would both be accepted. The only acceptable answer to a multiple-choice question will be the best of the 4 choices indicated in the question; in the event that more than one of the 4 choices is equally correct, then any of the correct choices will be acceptable. The official list of conventions used regarding questions and answers is contained in the appendix at the end of these Rules.
- 3-4. Once read in its entirety, a question will not be re-read.
- 3-5. For toss-up questions, the first player on either team to activate the lock-out buzzer system (or “buzz in”) earns the right to answer the question, except that no player may buzz in until AFTER the moderator has identified the subject area of the question. If a player buzzes in prior to the reading of the subject area, the moderator will inform the player that they have buzzed in too soon, and may add time back to the clock, if necessary, with the player remaining eligible to buzz in.
- 3-6. If the buzzer system demonstrably malfunctions during the play of a toss-up question for which both teams are still eligible, and the officials cannot ascertain which of two players on opposing teams was first to attempt to buzz in, the game clock will be paused, the question will be discarded, and the buzzer system will be repaired or replaced. (If the two players are on the same team, the officials will decide which should be recognized to complete play of the question.) When play is ready to resume, the next toss-up question will be offered to both teams. If this situation occurs on the last question of the round, the officials will obtain a replacement toss-up question.
- 3-7. On any toss-up or bonus question, the first response given, as determined by the officials, is the only one that counts. However, if a player gives both a letter answer and a scientific answer to a multiple-choice question, both parts must be correct. Any prefacing, intermediate, or subsequent remarks that do not directly answer the question, such as “my answer is” or repeating the question, will be considered delaying the game and counted as an incorrect answer. (Note: a very short “um”, “er”, or vocal stumble is acceptable, provided the officials do not consider it delaying the game.) The officials may interrupt a player in the process of giving an incorrect answer at any time, so as to continue the flow of the game.
- 3-8. If the first team’s answer to a toss-up question is wrong and the question was completely read, the other team is given the opportunity to answer it. The second team is allowed another 5 seconds to buzz in after the moderator indicates the answer is wrong or that a blurt or verbal communication has occurred. (See Rules 4-1 and 4-2.)

3-9. The answer to a bonus question must come from the team's captain. The moderator must ignore an answer from anyone other than the captain on the bonus question. If the moderator inadvertently responds to someone other than the captain while indicating whether an answer is correct, or to the captain before the answer is being given, the officials will replace the game time used in that bonus, and the next bonus question will be read to the team playing the bonus. If this situation occurs on the last question of the round, the officials will obtain a replacement bonus question.

3-10. The team that is not playing a bonus question or that has lost its opportunity at a toss-up question **must not distract** the opposing team while it hears and answers the question. If the non-playing team engages in behavior that is visually, verbally, or audibly distracting, the opposing team will be awarded the following:

- a) For toss-up questions: 4 points for the toss-up question, the option of having 20 additional seconds run off the clock, and the opportunity to answer the bonus question. The moderator will then proceed to the next toss-up.
- b) For bonus questions: 10 points for the bonus question and the option of having 40 additional seconds run off the clock. The moderator will then proceed to the next toss-up.

Deliberately buzzing during questions for the opposing team will be called a distraction. However, during each round, each team will be allowed one "accidental" buzz during questions for the opposing team. The first accidental buzz by a team during a game will not extend the period the opposing team is allotted to play its toss-up or bonus question. All subsequent accidental buzzes by that team during questions will be called distractions.

#### 4. Verbal Recognition & Communication

4-1. The only player who may answer a toss-up question is the one who has buzzed in first. Before answering a toss-up question, the team member who has buzzed in must be **verbally recognized** by the recognizer, moderator, or question judge using their player designation, e.g., A-2, B-3, A-captain, etc. (Before the match, the official who will be recognizing players will be identified.) If the player that has buzzed in answers or otherwise speaks before being recognized, it is termed a **blurt**. (Involuntary sounds such as sneezes will be ignored.) The moderator will not indicate whether the answer was correct or not, and no points will be awarded, but the blurting team will be ineligible to answer the toss-up question. The toss-up question is then offered to the opposing team, if still eligible. If the question has not been completely read, the question will be reread in its entirety, and the opposing team will have an opportunity to answer the toss-up question, and, if correct, an opportunity to answer the bonus question. (See also Rule 6-2.)

4-2. On toss-up questions, team members may communicate with each other **quietly and non-verbally (e.g., in writing or by hand-signals)**. **They may not, however, audibly communicate verbally, mouth words or use audible signals such as tapping. If these proscribed communications occur at any point during play of a question**, or if any team member gives an answer without buzzing in, the moderator will not indicate whether the answer given was correct or not, and the team loses the right to answer the toss-up question. The question is then offered to the opposing team, if still eligible.

4-3. If both teams are eligible to answer a toss-up question, a player has buzzed in, and a player from the opposing team gives an answer, the answer of the second player will be treated as audible verbal

communication, as in Rule 4-2. If the team of the player who incorrectly answers was ineligible for the toss-up question, this is treated as a distraction. (See Rule 3-10a.) If the action of an opposing team player answering happens near the end of a half, the officials may put time back on the clock, if necessary.

- 4-4. If the moderator inadvertently gives the answer to a toss-up question without giving either team a chance to respond, the moderator will proceed to the next toss-up question. If this situation occurs on the last question of a round, the officials will obtain a replacement toss-up question.
- 4-5. On a toss-up question, after an incorrect answer, a blurt, or verbal communication, if the moderator inadvertently gives the answer before allowing the second team to respond, the next toss-up question will be read to the second team in place of the inadvertently-answered question. If this situation occurs on the last question of a round, the officials will obtain a replacement toss-up question.
- 4-6. On a toss-up question, if the moderator inadvertently recognizes a player other than the one who buzzed in, the player who buzzed in will be allowed to answer as though they had been correctly recognized. If the player who was inadvertently recognized answers the question and is from the same team as the player who buzzed in, it will be considered audible verbal communication as in Rule 4-2. If the player who was inadvertently recognized answers the question and is from the opposing team from the player who buzzed in, it will be treated as in Rule 4-3.

## 5. Timing

- 5-1. The match is played until either the time expires or all toss-up questions (and earned bonuses for correct toss-ups) have been read. Regional competitions will have two 8-minute halves with a 2-minute break. Halves at the National Science Bowl® Finals will be 10 minutes with a 2-minute break. Each half begins with a toss-up question. Note: At the National Science Bowl® Finals, some of the double elimination rounds will contain visual bonus questions. The rounds containing visual bonus questions will have two 12-minute halves with a 2-minute break. At the National Finals, Double Elimination Rounds Ten and Eleven will have 5-minute breaks.
- 5-2. After reading a toss-up question, the officials will allow 5 seconds for the 2 teams to respond before proceeding to the next toss-up question. Timing will begin after the moderator has completed reading the toss-up question, including all choices on a multiple-choice question.
- 5-3. A player who has buzzed in on a toss-up question must answer the question promptly after being verbally recognized by the moderator or question judge. After recognizing a player, the moderator will allow for a natural pause (up to 2 seconds), but if the moderator determines that stalling has occurred, it will be treated as a wrong answer.
- 5-4. After a team member has answered a toss-up question correctly, the team will be given the opportunity to answer a bonus question. The team will have 20 seconds for its captain to begin to give its answer to the bonus question; timing will begin after the moderator has completed reading the bonus question, including all choices on a multiple-choice question. Note: On visual bonus questions, the team will have 30 seconds for its captain to begin to give its answer to the visual bonus question.

- 5-5. On a bonus question, the signal “5 SECONDS” will be given by the timekeeper after 15 seconds of the allowed 20 seconds have elapsed. Additionally, the timekeeper will indicate the end of the 20-second bonus period by saying “TIME.” If the team captain has not begun the response before the timekeeper calls “TIME,” the answer does not count. If the team captain has begun the response, they may complete the answer, but must proceed through it without stalling. Note: On visual bonus questions at the National Science Bowl® Finals, the signal “5 SECONDS” will be given by the timekeeper after 25 seconds of the allowed 30 seconds have elapsed.
- 5-6. If a toss-up question is begun before time expires in a half, that question will be finished under the usual rules of play, including the bonus if the toss-up is answered correctly. The half is then over. A question will be considered to have been begun if the subject area has been completely read. The second half will begin with the first toss-up question not read in the first half.

### Summary of Timing – Regional Events

Type of Question	Time Allowed
Toss-up	Teams have 5 seconds to buzz in after question is read. If no team has buzzed in, Timer will say “TIME”.
Toss-up: Buzz in after Toss-up has been read	Player buzzing in must answer within natural pause (up to 2 seconds) after being recognized. If not, Moderator will call a stall.
Bonus	Team gets 20 seconds to discuss. After 15 seconds, Timer will announce “5 seconds”. If no answer after 20 seconds, Timer will say “TIME”.
End of Game	Each half is 8 minutes*. At 8 minutes*, Timer will say “Half” or “Game” as soon as the last question is completed. A question that is begun before time expires will be completed, but no more toss-ups will be read in that half. <i>*10 minutes at the National Finals</i>

### 6. Scoring

- 6-1. Toss-up questions are worth 4 points, and bonus questions are worth 10 points.
- 6-2. If a toss-up question is **interrupted** (that is, not completely read by the moderator), the player is recognized, and the answer is correct, the team will receive 4 points. For any other circumstance (such as a wrong answer, a blurt, or audible communication), 4 points will be added to the opposing team’s score. If the opposing team is still eligible for the toss-up, it will have the toss-up question re-read from the beginning, be given an opportunity to answer it, and, if correct, have an opportunity to answer the bonus question.
- 6-3. The “double interrupt”. If a toss-up question is interrupted and a team incurs a penalty as in the previous rule, 4 points are added to the opposing team’s score. The moderator will then proceed to re-read the question from the beginning. However, if the opposing team buzzes in at any time before the re-reading is completed and subsequently incurs a penalty as in the previous rule, 4 points will be added to the first team’s score, and the moderator will proceed to the next toss-up question. (Note that this is the only situation in which both teams gain points on a question.)

6-4. For games that occur in the elimination tournaments, if the score is tied at the end of the match, a series of 5 toss-up questions will be used to break the tie. ALL usual toss-up rules are in effect during tie-breakers. There are no bonuses or game clock during tiebreakers. If the teams are still tied after the 5 questions, additional 5-question tiebreaker matches will be played until the tie is broken.

**Summary of Scoring**

Type of Question	Points Awarded
Correct Toss-up (or distraction by non-playing team)	+4 points & eligible for bonus question
Incorrect Toss-up	+0 points
Correct Bonus (or distraction by non-playing team)	+10 points
Incorrect Bonus	+0 points
Interrupted Toss-up: - Correct Answer	+4 points & eligible for bonus question
- Incorrect Answer or any other circumstance	+4 points to opposing team
Blurt/Communication: - Unrecognized Toss-up (Blurt)	+0 points, but team is disqualified from answering the toss-up
- Audible Verbal Communication among players	
- Answer before buzzing in	
Any of these by buzzing team on interrupted toss-up:	+4 points to opposing team

**7. Challenges**

7-1. Challenges must be made before the moderator begins the next question (**that is, reads the question's scientific category**), or, for the last question of a half, within 3 seconds of the end of that half. No challenges may be made during the play of a question. All challenges must come from the 4 members of each team who are actively competing. The fifth team member, coach, and others associated with a team must not become involved in challenges or their discussion. If anyone associated with a team, other than the 4 active team members, initiates or discusses a challenge, the team will have the challenge ruled against it. All decisions of the judges are final. Note: Regardless of subsequent questions having begun, issues involving scoring errors or game clock management can be initiated by anyone in the room, until the game officially ends, three seconds after the final question is over. If such issues can be resolved, they may be corrected by the officials.

7-2. Challenges may be made either to scientific content (i.e., whether an answer is scientifically correct or not) or to the administration of the rules (i.e., whether the rules are being correctly interpreted and applied). Challenges may NOT be made to judgment calls by the officials, including, but not

limited to, whether a question has been interrupted, whether 5 seconds have elapsed before a player buzzes in on a toss-up, whether 20 seconds have elapsed before a captain begins answering a bonus, whether the non-playing team has engaged in distracting behavior during a question, whether a half has expired before a new toss-up question begins, whether a stall or blurt has occurred, whether players have audibly verbally communicated during a toss-up, whether a player has given a first response, whether an answer has been pronounced correctly, whether an answer to a multiple-choice question is exact, whether a verbal answer to a short-answer list question is sufficient, whether time should be added back to the clock, whether a buzzer system has malfunctioned (and, if so, whether the first player to buzz in can be identified), or whether a non-playing audience member has shouted an answer, including whether the shouter is associated with one of the 2 teams.

- 7-3. Challenges to scientific content will be limited to 2 unsuccessful challenges per team per round, including tiebreaker questions. Successful challenges do not count against this limit. After the second unsuccessful challenge for a team during a round, that team will not be allowed any further challenges to scientific content during that round. Challenges to rules may be made at any time a question is not in play; however, whether a scientific challenge has been made and whether it has been successful are judgment calls, and may not be challenged, as per Rule 7-2.
- 7-4. Should a question or challenge arise during a match, the match and the clock will be stopped until the question is resolved. Once the question has been resolved, the match will continue from that point. Should the officials decide that some game time was lost due to the interruption in play, an appropriate amount of time will be put back on the clock.
- 7-5. If a team's answer to a toss-up question is judged incorrect, and they wish to challenge the ruling on the basis of scientific content, but the opposing team is still eligible for the toss-up, the first team must hold its challenge until after the opposing team has completed its toss-up opportunity. The first team should then state its challenge before the next bonus or toss-up question is begun. If the challenge is denied, play will proceed as usual from the end of the second team's answer. If the challenge is upheld, the second team's answer will be disregarded, as will any scoring for either team due to the second team's answer, and the time lost since the first team's answer was disallowed will be put back on the clock. The first team will then be awarded 4 points and have the opportunity to answer the bonus question.
- 7-6. If a team's answer to a toss-up question is judged correct, the opposing team challenges the ruling, and the challenge is upheld, the first team's answer will be treated as incorrect. If the second team is still eligible to answer the toss-up question, it will be read the next toss-up question. If this situation occurs on the last question of a round, the officials will obtain a replacement toss-up question.

## 8. Miscellaneous Rules

- 8-1. **Substitutions** may be made only at the beginning of a half or tiebreaker round. If a team has 5 players, any 4 players may play during any half or tiebreaker round. Teams may switch captains, but only at the beginning of a half or tiebreaker round.
- 8-2. No one in the audience may communicate with players during the match; communication will result in ejection from the competition room. The officials may clear the room of coaches, substitutes, and spectators if communication is suspected. If someone in the audience shouts out an answer, and the



team with which the shouter is associated can be determined, that team will forfeit the match. If the shouter cannot be determined by the officials to be associated with either team, the room will be cleared of everyone other than the officials and the eight players currently playing; the officials will add time back to the clock, and the question will be replaced with the next toss-up or bonus (whichever is appropriate). If this occurs on the last question of a round, one additional toss-up and/or bonus question will be obtained to finish the game. Note: at the National Finals, the room will not be cleared during Double Elimination Rounds Ten and Eleven.

- 8-3. Prior to each match, the two team coaches will introduce themselves to each other and will sit together toward the back of the competition room.
- 8-4. No notes may be brought to the competition table. Nothing may be written before the clock starts. Scratch paper will be provided at the beginning of each match and collected at half-time and at the conclusion of the match.
- 8-5. Calculators, electronic devices, banner pens, periodic tables or other charts, etc. are not permitted during play. The team of a player using such items during play will be disqualified from the tournament.
- 8-6. Coaches, non-playing team members, and spectators must not write down the questions or answers the moderator reads or use any electronic recording or transmitting device, including but not limited to digital cameras, cell phones, or computers during the match. Coaches will be provided with a team score sheet to track the number of questions answered by each individual player on their team. No one else in the competition room is permitted to write or make notes of any kind during the active competition (other than the competing players). If this occurs, the individual(s) will be asked to leave the competition room.
- 8-7. No cell phones or electronic devices may be used by players, coaches, substitutes, or spectators once the match has started, including during the break between the two halves. If any electronic device is audible during the match, the person possessing the device must leave the room for the rest of the match, and the device may be subject to confiscation for the remainder of the tournament.
- 8-8. *At all times, players and coaches should conduct themselves with honor, respect, and good sportsmanship.* The Tournament Director may disqualify any player, coach, or team engaging in conduct judged to be detrimental to the National Science Bowl.

## **9. Rules for the End of Round Robin Tournaments at Regional Events**

- 9.1. At regional events at the end of round robin play, teams will be assigned 2 points for each win, 1 point for each tie, and 0 points for each loss to decide which teams advance in the competition. If needed, a tie-breaking procedure in the following order will be used to determine advancing teams:
  - (i) Head-to-head won/loss record involving all teams tied for the advancing places. If this separates a group of two or more teams from the rest of the tied teams, the head-to-head record will be reapplied in the smaller group. Ties that cannot be resolved in this fashion will be broken using tiebreaker matches (see below). Once tiebreaker matches have begun, head-to-head results will no longer apply.

- (ii) If 2 teams are tied, they will play a 5 toss-up question tiebreaker match as per Rule 6-4.
- (iii) If more than two teams are tied, each team, in separate rooms, will be given the same series of five toss-up questions (no bonus questions will be used during this segment of the competition). The usual five seconds will be allowed for a competitor to buzz in after the question is completely read. There are no interrupt penalties (but also no reason to interrupt since all five questions will be read completely). Teams will be scored on the basis of +1 for each correct answer, -1 for each incorrect answer, and 0 for each unanswered question, blurt, or audible verbal communication. If two or more teams are still tied, procedure (ii) or (iii), as appropriate, will be used until the advancing teams are determined.

9.2. Under no circumstances will game scores themselves (as opposed to numbers of wins, losses, and ties) be used to eliminate teams from competition.

## **10. Rules for the End of Round Robin Tournaments at the National Finals**

- 10-1. Double elimination tournaments will include 32 teams: the top 4 teams from each of the 8 divisions. At the end of round robin play, teams will be assigned 2 points for each win, 1 point for each tie, and 0 points for each loss to decide which 4 teams from each division advance in the competition.
- 10-2. For middle school teams, in the event of ties for the 4 positions from each round robin division qualifying for the double elimination tournament, the following tiebreaking procedures will be used in the following order:
- (i) Head-to-head won/loss record involving all teams tied for places 1-4. If this separates a group of two or more teams from the rest of the tied teams, the head-to-head record will be reapplied in the smaller group. Ties that cannot be resolved in this fashion will be broken using tiebreaker matches (see below). Once tiebreaker matches have begun, head-to-head results will no longer apply.
  - (ii) If 2 teams are tied, they will play a 5 toss-up question tiebreaker match as per Rule 6-4.
  - (iii) If more than two teams are tied, each team, in separate rooms, will be given the same series of five toss-up questions (no bonus questions will be used during this segment of the competition). The usual five seconds will be allowed for a competitor to buzz in after the question is completely read. There are no interrupt penalties (but also no reason to interrupt since all five questions will be read completely). Teams will be scored on the basis of +1 for each correct answer, -1 for each incorrect answer, and 0 for each unanswered question, blurt, or audible verbal communication. If two or more teams are still tied, procedure (ii) or (iii), as appropriate, will be used until the advancing teams are determined.
- 10-3. For high school teams, in the event of ties for the 4 positions from each round robin division qualifying for the double elimination tournament, the rankings of the teams in the Division Team Challenge will be used as the tiebreaker.

## APPENDIX – Question Conventions

A-1 The following conventions will be followed for all questions, unless the question specifies otherwise:

- a) Gravitational acceleration and factors related to motion – Gravitational acceleration on Earth should be assumed to be  $9.8 \text{ m/sec}^2$  or  $32 \text{ ft/sec}^2$ , dependent on whether the question is stated in terms of metric or English units, respectively. Questions involving gravitational acceleration will be assumed to have a setting near the surface of Earth. Non-specified factors affecting motion such as wind resistance, friction, etc. should be ignored.
- b) Other physical constants – The speed of light  $c$  will be assumed to be 300,000,000 meters/second or 186,000 miles/sec, dependent on whether the question is stated in terms of metric or English units, respectively. The speed of sound on Earth will be assumed to be 340 meters/second or 1125 feet/second, dependent on whether the question is stated in terms of metric or English units, respectively. Absolute zero will be assumed to be  $-273$  degrees Celsius or  $-460$  degrees Fahrenheit.  
**The magnetic permeability in a vacuum will be assumed to be  $4\pi$  times  $10^{-7}$  henries per meter.**
- c) Mathematical systems – Numbers will be assumed to be in base 10. Geometry will be assumed to be Euclidean. Arguments of trigonometric functions will be assumed to be in radian units. Bases of logarithms will be specified, except possibly in cases where the base is irrelevant.
- d) Equally likely probabilities – In probability problems involving an object such as a coin or die, the object should be considered fair, i.e., each possible outcome is equally likely. Common objects used in probability problems will be assumed to be standard, such as coins (2-sided), dice (6-sided), and cards (52 in a deck with jacks, queens, and kings as face cards).
- e) Functions – Functions will be considered as functions of real numbers, with the domain considered to be the largest possible subset of the real numbers and the range considered to be the smallest possible subset of the real numbers for the corresponding domain.
- f) **Non-equality of mathematical objects – When a question states that there are a certain number of objects (e.g., “three points”), they will be considered to be actually different from each other.**
- g) **For visual bonus questions at the National Science Bowl® Finals, figures may or may not be drawn to scale.**

A-2 The following conventions will be followed regarding the form of an answer to a short answer question, unless the question specifies otherwise:

- a) Numerical answers – All numerical answers must be given in exact and simplest form.
  - i. Answers that are integers must be expressed in integer form (e.g.,  $2^3$  should be expressed as 8).
  - ii. Fractions and ratios that are part of answers must be in lowest terms. Fractions with absolute values greater than 1 may be expressed as either improper fractions or mixed fractions, and answers must not contain negative exponents (e.g.,  $\frac{12}{20}x^{-4}$  should be expressed as  $\frac{3}{5x^4}$ ).

- iii. Answers that contain irrational numbers must be exact rather than approximate (e.g., the area of a circle of radius 3 should be expressed as  $9\pi$ ).
  - iv. Answers containing radicals must express the radical part in simplest rationalized radical form (e.g.,  $\frac{8}{\sqrt[3]{32}}$  must be expressed as  $2\sqrt[3]{2}$ ).
  - v. Answers that involve a trigonometric angle  $\theta$  must satisfy  $0 \leq \theta < 2\pi$  in radians or  $0 \leq \theta < 360$  in degrees.
  - vi. Answers that are non-real complex numbers must be expressed in  $a + bi$  form; if either  $a$  or  $b$  is 0, stating the 0 term is optional. If trigonometric (polar) form is requested, the magnitude must be positive and the angle  $\theta$  must satisfy  $0 \leq \theta < 2\pi$  in radians or  $0 \leq \theta < 360$  in degrees.
  - vii. Answers that are vectors must be expressed using the unit vectors  $i, j,$  and  $k$  (e.g.,  $4i + 3j + 2k$ ). If a coefficient is 0, that term may be omitted (e.g.,  $4i + 0j + 2k$  may be expressed as  $4i + 2k$ ). **However, pronunciations such as “i-hat” will also be acceptable.**
  - viii. Answers that are polynomials must be expressed in standard polynomial form, with terms in order of decreasing degree and variables in alphabetical order (e.g.,  $(x + 3)^2$  is expressed as  $x^2 + 6x + 9$  and  $(3a + 2b)^2$  is expressed as  $9a^2 + 12ab + 4b^2$ ).
  - ix. If the factored form of a polynomial is requested, the polynomial must be factored completely over the integers (e.g.,  $x^3 + x^2 - 2x - 2$  is factored as  $(x^2 - 2)(x + 1)$ ).
  - x. Equations must be solved over the real numbers (e.g., the solutions of  $x^4 - 9 = 0$  are  $\pm\sqrt{3}$ ).
  - xi. Numerals in bases other than 10 should be pronounced as individual digits (e.g., 234 base 6 should be pronounced as “two-three-four”). However, pronunciations such as “two hundred thirty-four” in the previous example will also be acceptable.
  - xii. Answers must not be expressed in scientific notation unless it is specifically requested. Answers must not be expressed as repeating decimals, but rather as fractions.
  - xiii. Answers that are decimals must be pronounced by stating the individual digits (e.g., 0.24 should be pronounced as “point-two-four” and not “twenty-four hundredths”).
- b) Balancing chemical equations – The coefficients of a balanced chemical equation must be integers with no common integer factor greater than 1.
- c) Chemical nomenclature – **Answers involving chemical substances must avoid ambiguity, and may use the International Union of Pure and Applied Chemistry (IUPAC) preferred nomenclature, the IUPAC systematic nomenclature, or, when there are no isomers, chemical formulas. Examples: CO<sub>2</sub> is acceptable for carbon dioxide. Ethanol and ethyl alcohol are each acceptable, but C<sub>2</sub>H<sub>6</sub>O is not. For the divalent copper cation, Cu<sup>2+</sup>, copper two plus, and copper (II) are each acceptable, but copper ion is not.**
- d) Biological classification – An answer that is the name of a biological taxonomic classification may be the scientific name or a synonymous common name (e.g., Arthropoda or arthropods).
- e) Short answer questions with multiple answers – When a short answer question asks for multiple answers, the answers may be given simply in the respective order in which they were asked or by identifying which is which (e.g., “What are the smallest and largest prime numbers less than 10” could be answered as “2 and 7” or as “largest is 7 and smallest is 2”, but not as “7 and 2”).
- f) Answers to short-answer list questions – In questions that give a list of choices and ask for all choices

that satisfy a certain property, the choices will be numbered. Either the verbal names or the numbers will be acceptable. The verbal names need only be sufficient to allow the officials to distinguish between the choices. This includes indicating the position of a choice in the list (e.g., “next to last”, “the last one”, etc.), **or saying “all” or “none”**.

- g) Answers that are named conceptual entities – When the answer to a question is a law, principal, equation, constant, or other named conceptual entity, the answer must be the name of the conceptual entity rather than a description of it (e.g., “Newton’s Second Law” rather than “ $F = ma$ ”, and “speed of light” or “ $c$ ” rather than “300 million meters per second”).
- h) Units – Units do not need to be stated in numerical answers; however, if they are stated, they must be correct and equivalent to the units requested. If a question asks for a physical quantity without specifying the units requested, the answer will be interpreted in the appropriate combination of SI base units or equivalent named SI derived units, such as meters, seconds, kilograms, joules, etc. Similarly, if a question does not specify the units of a provided quantity, they should be assumed to be in the appropriate combination of SI base units (e.g., time  $t = 2$  is in seconds).
- i) Answers that are a person’s name – For answers that are a person’s name, the last name alone is sufficient (e.g., “Einstein” for “Albert Einstein”); however, if the first name is given, it must be correct.**
- j) Numbers representing measurements – In a question, a phrase such as “to the nearest unit” means that the answer must be rounded to the nearest integer multiple of that unit (e.g., one meter to the nearest inch is 39, one inch to the nearest tenth of a centimeter is 2.5, and one mile to the nearest hundred feet is 5,300). Numbers provided in a question should be assumed to be exact, and thus have no effect on the number of significant digits required in the answer.
- k) Significant digits – Answers that are required to be expressed to a certain number of significant digits (or significant figures) must be in integer or decimal form.