

# 2025 Texas Science Bowl Invitational

## Round Robin 3



## Authors

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### TOSS UP

1) CHEMISTRY *Short Answer* What is the name of the technique that measures a compound's concentration by shining light through a solution in a cuvette and comparing absorbance to a standard curve?

ANSWER: Spectrophotometry [ACCEPT: Colorimetry]

### BONUS

1) CHEMISTRY *Short Answer* How many unpaired electrons are in the ground state of gas phase chromium?

ANSWER: 6

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### TOSS UP

2) BIOLOGY *Multiple Choice* ATP is made of which of the following sugars?

- W) Glucose
- X) Galactose
- Y) Ribose
- Z) Xylose

ANSWER: Y) Ribose

### BONUS

2) BIOLOGY *Short Answer* Identify all of the following three extracellular matrix proteins that have transmembrane regions:

- 1) Integrin
- 2) Fibronectin
- 3) Collagen

ANSWER: 1 only

### TOSS UP

3) PHYSICS *Short Answer* A ball is kicked from the ground at 50 meters per second at some angle above the horizontal. In degrees, what should this angle be to maximize the total distance traveled?

ANSWER: 45

### BONUS

3) PHYSICS *Short Answer* A 5-kilogram ball moves right at 5 meters per second, and it collides with a block sliding left at 7 meters per second. The ball bounces back at 2 meters per second, and the block bounces back at 3 meters per second. What is the block's mass in kilograms?

ANSWER: 3.5

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### TOSS UP

4) EARTH AND SPACE *Short Answer* What body in the Solar System is the most volcanically active?

ANSWER: Io

### BONUS

4) EARTH AND SPACE *Multiple Choice* Which of the following types of unconformities is characterized by rock layers overlying older igneous or metamorphic rocks?

- W) Disconformity
- X) Nonconformity
- Y) Paraconformity
- Z) Angular unconformity

ANSWER: X) Nonconformity

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### TOSS UP

5) MATH *Multiple Choice* How many different regular polygons can tile the plane?

- W) 1
- X) 2
- Y) 3
- Z) 4

ANSWER: Y) 3

### BONUS

5) MATH *Short Answer* In a town, there are 35 Red people and 65 Green people. Greg then sorts these people into 20 groups of 5 people each. What is the maximum possible number of groups which have a majority of Red people?

ANSWER: 11

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### TOSS UP

6) CHEMISTRY *Short Answer* What is the hybridization of carbon in benzene?

ANSWER:  $sp^2$

### BONUS

6) CHEMISTRY *Multiple Choice* Given the exothermic reaction  $2A_{(g)} + B_{(g)} \rightarrow A_2B_{(g)}$  in a closed vessel, which of the following will shift the reaction to the right?

- 1) Increasing the temperature
- 2) Addition of inert gas
- 3) Decreasing the volume of the vessel

ANSWER: 3 only

### TOSS UP

7) BIOLOGY *Multiple Choice* Which of the following components in an EKG corresponds to ventricular repolarization?

- W) P wave
- X) PR segment
- Y) QRS complex
- Z) T wave

ANSWER: Z) T wave

### BONUS

7) BIOLOGY *Short Answer* Aryan is observing a plant that is anchored to the trunk of a tree. Identify all of the following three characteristics of the plant that would support the hypothesis that it has a commensalistic relationship with the host tree:

- 1) It completely lacks chlorophyll pigment
- 2) It taps into the host plant's mycorrhizal associations
- 3) It has broad leaves to capture water and minerals from the rain

ANSWER: 3 only

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### TOSS UP

8) PHYSICS *Multiple Choice* A spring has an amplitude  $A$  and total energy  $E$ . If the spring is now pulled to an amplitude of  $3A$ , what is its new total energy in terms of  $E$ ?

- W)  $E/9$
- X)  $E/3$
- Y)  $3E$
- Z)  $9E$

ANSWER: Z)  $9E$

### BONUS

8) PHYSICS *Multiple Choice* A string is attached to a wall at one end. If a wave pulse is sent towards the wall, what will happen to the pulse?

- W) The pulse will come back with the same amplitude and direction
- X) The pulse will come back with the same amplitude, but flipped
- Y) The pulse will completely vanish
- Z) The pulse will come back in the same direction, but with a halved amplitude

ANSWER: X) The pulse will come back with the same amplitude, but flipped

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### TOSS UP

9) EARTH AND SPACE *Short Answer* Aragonite, a polymorph of the mineral calcite, has what chemical formula?

ANSWER:  $\text{CaCO}_3$

### BONUS

9) EARTH AND SPACE *Multiple Choice* On which of the following regions of a Hertzsprung-Russell diagram would you find red giants?

- W) Upper right
- X) Upper left
- Y) Lower right
- Z) Lower left

ANSWER: W) Upper right

### TOSS UP

10) MATH *Short Answer* How many positive integers less than 100 contain a 4 as a digit?

ANSWER: 19

### BONUS

10) MATH *Short Answer* What is the constant in the expansion of  $(x+2/x)^4$ ?

ANSWER: 24

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### TOSS UP

11) CHEMISTRY *Short Answer* What term describes a mixture in which one substance is dispersed evenly throughout another, with particle sizes between those of true solutions and suspensions, such as milk or fog?

ANSWER: Colloid

### BONUS

11) CHEMISTRY *Short Answer* Given Planck's constant as  $6.6 \times 10^{-34}$  Joule-seconds and the speed of light as  $3.0 \times 10^8$  meters per second, to two significant figures, how many Joules of energy are in a 6.0 nanometer photon of light?

ANSWER:  $3.3 \times 10^{-17}$

### TOSS UP

12) BIOLOGY *Multiple Choice* Which of the following best describes the mechanism of natural selection?

- W) Individuals evolve to better adapt to the environment over a short period of time
- X) Individuals evolve to better adapt to the environment over a long period of time
- Y) Populations evolve to better adapt to the environment over a short period of time
- Z) Populations evolve to better adapt to the environment over a long period of time

ANSWER: Z) Populations evolve to better adapt to the environment over a long period of time

### BONUS

12) BIOLOGY *Multiple Choice* Edwin is observing the effects of lead poisoning, which results in an impairment of the sodium potassium pump. Which of the following best describes the immediate consequence of such an occurrence?

- W) The membrane potential will increase
- X) The membrane potential will decrease
- Y) Sodium ion concentration inside the cell will decrease
- Z) Potassium ion concentration outside the cell will decrease

ANSWER: W) The membrane potential will increase

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### TOSS UP

13) PHYSICS *Short Answer* In 1948, the Celsius scale was modified to be defined about what state of water in which all three phases co-exist in thermodynamic equilibrium?

ANSWER: Triple point

### BONUS

13) PHYSICS *Short Answer* An open container is filled to a height of 1.5 meters with water. If the density of water is 1 gram per milliliter, what is the absolute pressure at the bottom of the container in Pascals to 3 significant figures?

ANSWER: 116,000

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### TOSS UP

14) EARTH AND SPACE *Short Answer* What star, commonly referred to as the “North Star” due to its proximity to the North Celestial Pole, is the brightest star in the constellation Ursa Minor?

ANSWER: Polaris

### BONUS

14) EARTH AND SPACE *Short Answer* Identify all of the following three minerals that can scratch fluorite:

- 1) Corundum
- 2) Gypsum
- 3) Calcite

ANSWER: 1 only

### TOSS UP

15) MATH *Short Answer* What is the special name for a Taylor series that is centered at  $x = 0$ ?

ANSWER: Maclaurin Series

### BONUS

15) MATH *Short Answer* Consider a cube with side length 5. A unit sphere is placed into the cube such that the cube completely contains the sphere. Let  $R$  be the region of all possible centers of this sphere. What is the ratio of the volume of  $R$  to the volume of the larger cube?

ANSWER: 27/125

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### TOSS UP

16) CHEMISTRY *Short Answer* What component of a galvanic cell allows the flow of ions to maintain electrical neutrality while preventing the mixing of the two solutions in the half-cells?

ANSWER: Salt Bridge

### BONUS

16) CHEMISTRY *Short Answer* In the molecule formed when ammonia reacts with boron trifluoride, what type of bond is formed between the nitrogen atom in ammonia and the boron atom in boron trifluoride?

ANSWER: Dative bond [ACCEPT: Coordinate covalent bond]

### TOSS UP

17) BIOLOGY *Short Answer* In phagocytosis, the cell engulfs a food particle by extending certain arm-like projections of the cell membrane to envelope the food particle. What is the name of these structures?

ANSWER: Pseudopodia

### BONUS

17) BIOLOGY *Multiple Choice* Identify all of the following three processes that are carried out by the smooth ER:

- 1) Storage of calcium ions
- 2) Detoxification of harmful compounds
- 3) Metabolism of carbohydrates

ANSWER: All

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### TOSS UP

18) PHYSICS *Short Answer* In an AC circuit, what quantity combining resistance and reactance represents the opposition to current flow?

ANSWER: Impedance

### BONUS

18) PHYSICS *Multiple Choice* If a thermodynamic reversible process is isothermal, the entropy change is the ratio between what quantity and temperature?

- W) Change in heat
- X) Change in internal energy
- Y) Change in enthalpy
- Z) Change in pressure

ANSWER: W) Change in heat

### TOSS UP

19) EARTH AND SPACE *Multiple Choice* Which of the following features is not formed by glacial activity?

- W) V-shaped valley
- X) Moraine
- Y) Cirque
- Z) Kettle lake

ANSWER: W) V-shaped valley

### BONUS

19) EARTH AND SPACE *Multiple Choice* Which of the following planets has the largest core in proportion to the size of the rest of its layers?

- W) Mercury
- X) Venus
- Y) Jupiter
- Z) Saturn

ANSWER: W) Mercury

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### TOSS UP

20) MATH *Short Answer* If 3 hearts are worth 4 clubs, and 3 clubs are worth 7 spades, then how many hearts are worth 28 spades?

ANSWER: 9

### BONUS

20) MATH *Short Answer* Ben is planning a road trip from Texas to Arkansas. He has a Tesla which costs 30 cents per kilowatt-hour, with a mileage of 4 miles/kwh. If the trip to Arkansas is 500 miles one-way, how expensive is the round trip in dollars?

ANSWER: 75

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