

2025 Texas Science Bowl Invitational

Double Elimination 1



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TOSS UP

1) EARTH AND SPACE *Short Answer* What is the oxidation state of silicon in the mineral amethyst?

ANSWER: +4

BONUS

1) EARTH AND SPACE *Short Answer* Order the following three quantities in terms of increasing mass:

- 1) One solar mass
- 2) Chandrasekhar [*chan-druh-SAY-kar*] limit
- 3) Tolman-Oppenheimer-Volkoff [*TOHL-muhn OH-pen-high-muhr VOHL-kawf*] limit

ANSWER: 1, 2, 3

TOSS UP

2) CHEMISTRY *Short Answer* What metal is used to reduce other metal oxides in thermite reactions?

ANSWER: Aluminum

BONUS

2) CHEMISTRY *Multiple Choice* Why do SN1 reactions occur faster with tertiary alkyl halides than with secondary or primary alkyl halides?

- W) Tertiary alkyl halides have more electronegative leaving groups.
- X) Tertiary alkyl halides have carbocations [*carbo-CAT-ions*] stabilized by three alkyl groups.
- Y) Tertiary alkyl halides have weaker carbon-halogen bonds.
- Z) Tertiary alkyl halides have less steric hindrance during nucleophilic attack.

ANSWER: X) Tertiary alkyl halides have carbocations stabilized by three alkyl groups.

TOSS UP

3) MATH *Short Answer* When the Sun makes a 60 degree angle with the horizontal, the length of the shadow of a pole is 3 feet. What will be the length of the shadow of the pole when the Sun makes a 30 degree angle with the horizontal?

ANSWER: 9

BONUS

3) MATH *Short Answer* On an 8 by 8 chessboard, how many rectangles can be drawn such that all of its sides lie on edges of cells on the chessboard? Consider congruent rectangles in different locations to be different.

ANSWER: 1296

TOSS UP

4) PHYSICS *Short Answer* By the Equipartition [*eh-kwee-par-TIH-shin*] Theorem, what is the adiabatic [*ay-dee-a-BA-tick*] index of a non-linear triatomic gas?

ANSWER: 4/3

BONUS

4) PHYSICS *Multiple Choice* Which of the following statements about far-field multi-slit experiments is true?

- W) It is assumed that the distance between the slits is much smaller than their width.
- X) The interference pattern intensity is linearly proportional to the number of slits.
- Y) The interference pattern is created due to the path length differences between the light sources.
- Z) The Young-Laplace [*young la-PLAHS*] equation governs the interference pattern.

ANSWER: Y) The interference pattern is created due to the path length differences between the light sources.

TOSS UP

5) BIOLOGY *Multiple Choice* Which of the following hormones inhibits thyroid hormone synthesis?

- W) TRH
- X) TSH
- Y) T4
- Z) Estrogen

ANSWER: T4

BONUS

5) BIOLOGY *Multiple Choice* Which of the following best describes light transduction in photoreceptors?

- W) In the presence of light, sodium channels open, depolarizing the photoreceptor and increasing its release of glutamate.
- X) In the presence of light, potassium channels close, depolarizing the photoreceptor and increasing its release of glutamate.
- Y) In the presence of light, sodium channels close, hyperpolarizing the photoreceptor and decreasing its release of glutamate.
- Z) In the presence of light, potassium channels open, hyperpolarizing the photoreceptor and decreasing its release of glutamate.

ANSWER: Y) In the presence of light, sodium channels close, hyperpolarizing the photoreceptor and decreasing its release of glutamate.

TOSS UP

6) EARTH AND SPACE *Short Answer* Order the following three gases in Mars' atmosphere from least to most abundant:

- 1) Carbon dioxide
- 2) Argon
- 3) Nitrogen

ANSWER: 2, 3, 1

BONUS

6) EARTH AND SPACE *Short Answer* Identify all of the following three organisms that can compose siliceous [*suh-LISH-us*] ooze:

- 1) Diatoms
- 2) Foraminifera [*for-uh-min-IF-er-uh*]
- 3) Radiolarians [*ray-dee-oh-LAIR-ee-ans*]

ANSWER: 1 and 3 only

TOSS UP

7) CHEMISTRY *Multiple Choice* Which of the following atoms has the highest first ionization energy?

- W) Boron
- X) Carbon
- Y) Nitrogen
- Z) Oxygen

ANSWER: Nitrogen

BONUS

7) CHEMISTRY *Multiple Choice* Which of the following nuclei cannot be detected by nuclear magnetic resonance spectroscopy?

- W) Hydrogen-1
- X) Carbon-12
- Y) Fluorine-19
- Z) Phosphorous-31

ANSWER: Carbon-12

TOSS UP

8) MATH *Multiple Choice* In a single-elimination bracket, the probability of Victor winning a given match is always $1/3$. If the bracket starts with a total of 8 people, including Victor, what is the probability that Victor wins the entire bracket?

W) $1/6561$

X) $1/243$

Y) $1/81$

Z) $1/27$

ANSWER: $1/27$

BONUS

8) MATH *Short Answer* Suppose p , q , and r are the roots to the cubic polynomial $x^3 + 5x^2 - x + 7$. What is $p^2 + q^2 + r^2$?

ANSWER: 27

TOSS UP

9) PHYSICS *Short Answer* If the Earth were 3 times heavier with the same radius, by what factor would the escape velocity increase by?

ANSWER: $\sqrt{3}$

BONUS

9) PHYSICS *Multiple Choice* A block is sitting on a ramp with a coefficient of static friction of 0.55. In degrees, which is closest to the maximum angle the ramp can be elevated before the block begins sliding?

W) 10

X) 20

Y) 30

Z) 40

ANSWER: Y) 30

TOSS UP

10) BIOLOGY *Multiple Choice* Which of the following forms of microscopy would be most appropriate for visualizing the morphology and diversity of trichomes [*TRY-kohms*] on the surface of a leaf?

- W) Transmission Electron
- X) Scanning Electron
- Y) Nomarski [*no-MAR-skee*]
- Z) Darkfield

ANSWER: X) Scanning Electron

BONUS

10) BIOLOGY *Short Answer* How many unique histone proteins are found in a single nucleosome?

ANSWER: 4

TOSS UP

11) EARTH AND SPACE *Short Answer* Flux melting at a convergent boundary is primarily caused by the addition of what volatile to the mantle wedge?

ANSWER: Water

BONUS

11) EARTH AND SPACE *Multiple Choice* An astronomer observes star Alpha from Earth in January and again in July. If the angle subtended at star Alpha by the Earth's position in January and July is 0.4 arcseconds, what is the distance to the star in parsecs?

- W) 2
- X) 2.5
- Y) 4
- Z) 5

ANSWER: Z) 5

TOSS UP

12) CHEMISTRY *Short Answer* How many electrons in a ground state gas-phase Beryllium atom have the quantum number $l = 0$?

ANSWER: 4

BONUS

12) CHEMISTRY *Short Answer* How many degrees of unsaturation is in the following compound with the chemical formula $C_6H_{12}N_2Br_4$?

ANSWER: 0

TOSS UP

13) MATH *Short Answer* Music is hard to master. Consider the formula $S = \log_2(T)$ [READ: S equals log base 2 of T], where S is musician skill and T is time in years. If Dylan's skill is currently 4, how many more years will it take for him to double his skill?

ANSWER: 240

BONUS

13) MATH *Short Answer* Let $f(x)$ be the number of factors of x . What is $f(f(60^3))$ [READ: f of f of 60 cubed]?

ANSWER: 10

TOSS UP

14) PHYSICS *Short Answer* A blackbody with temperature T emits X Joules of energy in one second. If a second blackbody with the same area emits $81X$ Joules per second, in terms of T what is its temperature?

ANSWER: $3T$

BONUS

14) PHYSICS *Short Answer* An unknown EMF source produces a 3-Amp current through a 3.25-Ohm resistor and a 4-Amp current through a 2.25-Ohm resistor. What is the internal resistance in Ohms?

ANSWER: 0.75

TOSS UP

15) BIOLOGY *Short Answer* Identify all of the following three plant structures that can act as both sugar sinks and sources:

- 1) Tubers
- 2) Leaves
- 3) Pneumatophores [*new-MA-tuh-fohrs*]

ANSWER: 1 and 2 only

BONUS

15) BIOLOGY *Multiple Choice* Michael and Ryan are first cousins. On a hiking trip, Ryan slips off a ledge, and if Michael attempts to save him, he has an equal chance of dying or succeeding. Ryan plans to have three children while Michael doesn't plan to have any. Using Hamilton's rule, what is the coefficient of relatedness between Michael and Ryan and should Michael try to save Ryan?

- W) 0.25; Michael should not try to save Ryan.
- X) 0.125; Michael should not try to save Ryan.
- Y) 0.25; Michael should try to save Ryan.
- Z) 0.125; Michael should try to save Ryan.

ANSWER: X) 0.125; Michael should not try to save Ryan.

TOSS UP

16) EARTH AND SPACE *Multiple Choice* In the cross-section of an ophiolite [*AH-fee-oh-lite*] sequence, which of the following features would typically be found at the highest elevation?

- W) Sheeted dikes
- X) Peridotite [*puhr-IH-duh-tite*]
- Y) Layered gabbro [*GAB-row*]
- Z) Pillow lavas

ANSWER: Z) Pillow lavas

BONUS

16) EARTH AND SPACE *Multiple Choice* Which of the following geologic features is most likely to result in a radial drainage pattern?

- W) An area with extensively fractured bedrock
- X) An area with alternating layers of weak and resistant bedrock
- Y) An isolated volcanic cone
- Z) A relatively flat and uniform surface

ANSWER: Y) An isolated volcanic cone

TOSS UP

17) CHEMISTRY *Short Answer* What is the formal charge of the nitrogen atom in the cyanide ion?

ANSWER: 0

BONUS

17) CHEMISTRY *Short Answer* Rank the following 3 unit cells in packing efficiency from least to greatest

- 1) Simple cubic
- 2) Face Centered cubic
- 3) Body Centered cubic

ANSWER: 1, 3, 2

TOSS UP

18) MATH *Short Answer* An equilateral triangle and a regular hexagon are inscribed inside the same circle. What is the ratio of the area of the triangle to the area of the hexagon?

ANSWER: $\frac{1}{2}$

BONUS

18) MATH *Short Answer* How many ways are there to tile a 2 by 4 grid using only 1 by 2 tiles assuming rotations and reflections are different and the tiles can be rotated?

ANSWER: 5

TOSS UP

19) PHYSICS *Short Answer* By name or number, identifying which of the following four fundamental forces act over infinite range:

- 1) Strong
- 2) Weak
- 3) Electromagnetic
- 4) Gravity

ANSWER: 3 and 4 only

BONUS

19) PHYSICS *Multiple Choice* A solid 10 kilogram disk with radius 1 meter is spinning on a table. Which of the following will slow the angular speed of the disk down the most, assuming the angular momentum stays conserved?

- W) Placing a 10 kilogram mass at the center
- X) Increasing the radius of the disk by 50%
- Y) Tripling the mass of the disk
- Z) Adding two 3 kilogram masses at opposite ends

ANSWER: Y) Tripling the mass of the disk

TOSS UP

20) BIOLOGY *Short Answer* What waxy aliphatic [*al-ih-FAT-ik*] polyester forming the casparian [*cas-PAIR-ee-in*] strip prevents apoplastic [*a-po-PLAS-tic*] entry into the vascular cylinder?

ANSWER: Suberin

BONUS

20) BIOLOGY *Short Answer* Order the following three brain meninges [*muh-NIN-jeez*] in order from outermost to innermost:

- 1) Arachnoid mater [*uh-RAK-noid MAY-ter*]
- 2) Pia mater [*PEE-uh MAY-ter*]
- 3) Dura mater [*DOO-ruh MAY-ter*]

ANSWER: 3, 1, 2

TOSS UP

21) EARTH AND SPACE *Multiple Choice* In the cross-section of an ophiolite sequence, which of the following features would typically be found at the highest elevation?

- W) Sheeted dikes
- X) Peridotite
- Y) Layered gabbro
- Z) Pillow lavas

ANSWER: Z) Pillow lavas

BONUS

21) EARTH AND SPACE *Multiple Choice* Which of the following geologic features is most likely to result in a radial drainage pattern?

- W) An area with extensively fractured bedrock
- X) An area with alternating layers of weak and resistant bedrock
- Y) An isolated volcanic cone
- Z) A relatively flat and uniform surface

ANSWER: Y) An isolated volcanic cone

TOSS UP

22) CHEMISTRY *Short Answer* What is the name of the series of spectral lines in the hydrogen atom that correspond to electronic transitions from higher energy levels to the second energy level, resulting in the emission of light in the visible spectrum?

ANSWER: Balmer Series

BONUS

22) CHEMISTRY *Short Answer* How many isomers does the compound $\text{C}_2\text{H}_2\text{Br}_2$ have?

ANSWER: 3

TOSS UP

23) MATH *Multiple Choice* Consider the graph of $x/|x|$. Which of the following best describes the graph at $x = 0$?

- W) Continuous
- X) Removable Discontinuity
- Y) Infinite Discontinuity
- Z) Jump Discontinuity

ANSWER: Z) Jump Discontinuity

BONUS

23) MATH *Short Answer* A "squary" number is a number such that all pairs of consecutive digits form a perfect square. What is the largest possible "squary" number?

ANSWER: 81649

TOSS UP

24) PHYSICS *Short Answer* Named after a botanist, what type of motion describes the random motion of particles in a medium, which describes why a fluid at thermal equilibrium has no preferred direction of flow?

ANSWER: Brownian motion

BONUS

24) PHYSICS *Short Answer* Water has an enthalpy of fusion of 334 Joules per gram. If 3800 Joules of heat are inputted into a 10 gram block of ice at 0 degrees Celsius, what will its final temperature be to the nearest degree Celsius?

ANSWER: 11

TOSS UP

25) BIOLOGY *Short Answer* What large fat globules formed in intestinal epithelial cells carry fatty acids, phospholipids, and cholesterol through the lymphatic system?

ANSWER: Chylomicrons

BONUS

25) BIOLOGY *Short Answer* What group of plant hormones, known to support auxin in establishing apical dominance, most directly promotes recognition of the plant by symbiotic fungi?

ANSWER: Strigolactones