

2025 Texas Science Bowl Invitational

Round Robin 2



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TOSS UP

1) CHEMISTRY *Short Answer* Order the following three compounds in increasing magnitude of lattice energy:

- 1) Lithium fluoride
- 2) Sodium chloride
- 3) Magnesium Oxide

ANSWER: 2, 1, 3

BONUS

1) CHEMISTRY *Short Answer* 88 grams of propane are completely combusted. To the nearest integer, how many grams of water are generated?

ANSWER: 144

TOSS UP

2) EARTH AND SPACE *Multiple Choice* During which of the following geologic periods did the highest levels of coal formation occur?

- W) Cambrian
- X) Ordovician
- Y) Devonian
- Z) Carboniferous

ANSWER: Z) Carboniferous

BONUS

2) EARTH AND SPACE *Multiple Choice* Which of the following statements is not true regarding P-waves?

- W) They are longitudinal waves
- X) They can travel through the outer core
- Y) They do not have a shadow zone
- Z) They are faster than S-waves

ANSWER: Y) They do not have a shadow zone

TOSS UP

3) BIOLOGY *Short Answer* When a substrate enters the active site, the enzyme changes shape slightly due to the formation of weak bonds between the substrate and amino acids of the active site, which ensures a tighter enzyme-substrate complex. This observation best supports what model of enzyme action?

ANSWER: Induced fit

BONUS

3) BIOLOGY *Short Answer* Tall plants have large shoot masses that require a strong anchoring root system to prevent toppling. What type of root system, consisting of one main vertical root, do these plants have?

ANSWER: Taproot system

TOSS UP

4) MATH *Short Answer* What is the sum of the squares of the solutions to the polynomial $x^2 - 3x - 28$?

ANSWER: 65

BONUS

4) MATH *Short Answer* How many 1s are in the binary representation of the hexadecimal number C25?

ANSWER: 5

TOSS UP

5) PHYSICS *Short Answer* An object is undergoing freefall in an abyss of infinite depth. Under air resistance, what term describes the velocity the object will asymptotically approach?

ANSWER: Terminal velocity [ACCEPT: Terminal]

BONUS

5) PHYSICS *Multiple Choice* A block is attached to a horizontal spring and exhibits simple harmonic motion. At what spring state is the kinetic energy of the block maximized?

- W) Complete compression
- X) Equilibrium
- Y) Maximum stretch
- Z) The block never has kinetic energy

ANSWER: X) Equilibrium

TOSS UP

6) CHEMISTRY *Multiple Choice* An unknown metal is dissolved in an aqueous solution. A solution of dilute hydrochloric acid is added dropwise, causing white clouds to form in the solution. Which of the following could be the identity of the unknown metal?

- W) Sodium
- X) Copper
- Y) Iron
- Z) Silver

ANSWER: Z) Silver

BONUS

6) CHEMISTRY *Multiple Choice* In the reaction between boron trifluoride and ammonia, which of the following is true?

- W) Boron trifluoride is a Brønsted base, and ammonia is a Brønsted acid
- X) Boron trifluoride is a Brønsted acid, and ammonia is a Brønsted base
- Y) Boron trifluoride is a Lewis base, and ammonia is a Lewis acid
- Z) Boron trifluoride is a Lewis acid, and ammonia is a Lewis base

ANSWER: Z) Boron trifluoride is a Lewis acid, and ammonia is a Lewis base

TOSS UP

7) EARTH AND SPACE *Multiple Choice* Which of the following is closest to the temperature of the Sun's photosphere in Kelvin?

- W) 5,000
- X) 10,000
- Y) 50,000
- Z) 100,000

ANSWER: W) 5,000

BONUS

7) EARTH AND SPACE *Short Answer* White dwarfs are supported against gravitational collapse by what force?

ANSWER: Electron Degeneracy Pressure

TOSS UP

8) BIOLOGY *Short Answer* Cyclic AMP, inositol triphosphate, and diacylglycerol all play what type of role in cellular signaling pathways due to their ability to diffuse rapidly throughout the cell and amplify signals?

ANSWER: Second messengers [ACCEPT: Secondary messengers]

BONUS

8) BIOLOGY *Short Answer* A rare autosomal recessive trait is only found expressed in your father and your spouse's mother. What is the probability that only one of your two kids expresses the trait?

ANSWER: 3/8

TOSS UP

9) MATH *Multiple Choice* A twin prime is a prime number that is either 2 more or 2 less than another prime number. Which of the following is not a twin prime?

- W) 47
- X) 59
- Y) 71
- Z) 103

ANSWER: W) 47

BONUS

9) MATH *Short Answer* There are 4 houses in a line, and a painter wants to paint each house as one of 4 colors. However, he does not want any 2 consecutive houses to be the same color. How many ways are there to paint the houses in this way?

ANSWER: 108

TOSS UP

10) PHYSICS *Short Answer* A ball attached to a string is swung in a circle at a constant speed of 20 meters per second. If its acceleration is 40 meters per second squared, what is the radius in meters of the ball's revolution?

ANSWER: 10

BONUS

10) PHYSICS *Multiple Choice* Aidan places a candle 30 centimeters left of a convex lens, and an image forms 10 centimeters right of the lens. In centimeters, what is the focal length of the lens?

- W) 5
- X) 7.5
- Y) 10
- Z) 15

ANSWER: X) 7.5

TOSS UP

11) CHEMISTRY *Multiple Choice* Mixing aqueous solutions of which of the following compounds will NOT make a buffer solution

- W) Ammonia and ammonium chloride
- X) Hydrochloric acid and sodium chloride
- Y) Acetic acid and sodium acetate
- Z) Carbonic acid and sodium bicarbonate

ANSWER: X) Hydrochloric acid and sodium chloride

BONUS

11) CHEMISTRY *Multiple Choice* Which of the following is closest to the bond order of the N-O bond in a nitrate ion?

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

ANSWER: X) 4/3

TOSS UP

12) EARTH AND SPACE *Multiple Choice* As basaltic magma cools, which of the following minerals would crystallize out the last?

- W) Olivine
- X) Pyroxene
- Y) Biotite
- Z) Quartz

ANSWER: Z) Quartz

BONUS

12) EARTH AND SPACE *Short Answer* Solar granules are convective cells located on what layer of the Sun?

ANSWER: Photosphere

TOSS UP

13) BIOLOGY *Short Answer* The mammary glands secrete milk in a positive feedback loop in which more stimuli leads to greater milk secretion. What hormone circulating in the bloodstream triggers this positive feedback loop?

ANSWER: Oxytocin

BONUS

13) BIOLOGY *Multiple Choice* Which of the following is true about promoters and enhancers?

- W) Promoters usually bind to activators, while enhancers usually bind to RNA polymerase
- X) Promoters are usually trans-acting, while enhancers are usually cis-acting
- Y) Promoters and enhancers are both capable of regulating multiple genes
- Z) Promoters and enhancers are both usually located near the 5' end of a gene

ANSWER: Y) Promoters and enhancers are both capable of regulating multiple genes

TOSS UP

14) MATH *Short Answer* In a committee of 8 people, there are 8 jobs that need to be assigned to exactly one person. No person can take more than 1 job. How many ways are there for these people to take a job?

ANSWER: 40,320

BONUS

14) MATH *Short Answer* On triangle ABC, Carl draws the perpendicular bisectors of AB, BC, and CA. Surprisingly, these 3 lines all intersect at a single point. What is the name for this special point where the perpendicular bisectors intersect?

ANSWER: Circumcenter

TOSS UP

15) PHYSICS *Short Answer* A ball is dropped from a height of 10 meters and hits the ground in time t . If the ball is instead dropped from a height of 20 meters, how long does it take for the ball to hit the ground?

ANSWER: $t\sqrt{2}$

BONUS

15) PHYSICS *Short Answer* An electron is moving in the positive-x direction, acted on by both an electric and magnetic field. The electric field is oriented in the positive-y direction. In what direction does the magnetic field have to be oriented for the electron to move with no net acceleration?

- W) Positive-x
- X) Positive-y
- Y) Positive-z
- Z) Negative-z

ANSWER: Y) Positive-z

TOSS UP

16) CHEMISTRY *Short Answer* Identify all of the following 3 intermolecular forces present between ammonia molecules:

- 1) London Dispersion Forces
- 2) Dipole-dipole
- 3) Hydrogen bonding

ANSWER: All

BONUS

16) CHEMISTRY *Short Answer* To 2 significant digits, what is the pH of a buffer with 1.0 M ammonia and 0.01 M ammonium nitrate? The pKa of ammonia is approximately 9.2

ANSWER: 11

TOSS UP

17) EARTH AND SPACE *Short Answer* What type of lake is formed when a meander in a river is cut off from the main channel due to sediment deposition?

ANSWER: Oxbow Lake

BONUS

17) EARTH AND SPACE *Multiple Choice* Which of the following is the most influential feature in determining the lifespan of a star?

- W) Mass
- X) Metallicity
- Y) Temperature
- Z) Radial velocity

ANSWER: W) Mass

TOSS UP

18) BIOLOGY *Short Answer* Identify all of the following three cell junctions the allow the passage of small molecules between cells:

- 1) Gap junctions
- 2) Tight junctions
- 3) Plasmodesmata

ANSWER: 1 and 3 only

BONUS

18) BIOLOGY *Multiple Choice* Which of the following molecules is not produced in the stroma of a chloroplast during photosynthesis?

- W) Oxygen gas
- X) NADPH
- Y) ATP
- Z) G3P

ANSWER: W) Oxygen gas

TOSS UP

19) MATH *Short Answer* Which of the following numbers is not found in the Fibonacci sequence?

- W) 34
- X) 57
- Y) 144
- Z) 233

ANSWER: X) 57

BONUS

19) MATH *Short Answer* How many factors does 2025^5 have?

ANSWER: 231

TOSS UP

20) PHYSICS *Short Answer* What principle states that changing the pressure anywhere in an incompressible fluid will evenly disperse the change?

ANSWER: Pascal's Principle

BONUS

20) PHYSICS *Short Answer* An equilateral triangle has a point charge of strength $+Q$ at each vertex. The electrostatic force between any pair of points is F . What is the magnitude of the net force on one point as a result of the other two?

ANSWER: $F\sqrt{3}$
