2025 Texas Science Bowl Invitational

Double Elimination 2



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TOSS UP

1) PHYSICS *Short Answer* [redacted]

[redacted]

In Farads, what is the equivalent capacitance of a circuit that contains a 6-Farad and 3-Farad capacitor in series?

ANSWER: 2

BONUS

1) PHYSICS *Short Answer* A ball's velocity on the x-axis can be modeled as $v(t) = 2t + 4$ [READ: *v of t equals 2 t plus 4*], where t is in seconds and v is in m/s. If the object is at $x = 1$ meter at $t = 1$ second, where is it at $t = 5$ in meters?

ANSWER: 41, [ACCEPT: 41]

TOSS UP

2) BIOLOGY *Multiple Choice* To which sensory system in humans do otoliths belong?

W) Auditory
X) Vestibular
Y) Gustatory
Z) Olfactory

ANSWER: X) Vestibular

BONUS

2) BIOLOGY *Multiple Choice* Alice is observing a seed of a certain plant and notices that it does not possess a scutellum [*skoo-TELL-um*]. Which of the parts of a seed would he be LEAST likely to find in this plant?

W) Hypocotyl [*high-poh-KAW-tul*]
X) Radicle [*RAD-ih-kul*]
Y) Coleoptile [*KOH-lee-oh-pile*]
Z) Cotyledon [*KAW-tuh-lee-dun*]

ANSWER: Y) Coleoptile

TOSS UP

3) CHEMISTRY *Short Answer* Rank the following three types of radioactive particles in terms of their ability to penetrate materials in increasing penetration power.

1) Alpha particles
2) Beta particles
3) Gamma rays

ANSWER: 1, 2, 3

BONUS

3) CHEMISTRY *Short Answer* Given that the enthalpy of formation for hydrogen peroxide and water is -187 and -286 kilojoules per mole, respectively, calculate the enthalpy change in kilojoules per mole for the dissociation of 2 mole of hydrogen peroxide into 2 mole of water and 1 mole of oxygen gas.

ANSWER: -198

TOSS UP

4) MATH *Multiple Choice* Let S be the set of points $(-1, 4)$, $(3, 2)$, $(6, 1)$, $(4, 4)$, and $(4, 0)$. Let R be the smallest convex region that contains all the points of S. Which point in S is not on the outer boundary of R?

W) $(-1, 4)$
X) $(3, 2)$
Y) $(6, 1)$
Z) $(4, 4)$

ANSWER: X) $(3, 2)$

BONUS

4) MATH *Multiple Choice* Which of the following numbers cannot be written as the sum of 2 squares?

W) 61
X) 85
Y) 153
Z) 172

ANSWER: Z) 172

TOSS UP

5) EARTH AND SPACE *Short Answer* Identify all of the following three igneous structures that are discordant.

1) Sill
2) Dike
3) Stock

ANSWER: 2 and 3 only

BONUS

5) EARTH AND SPACE *Multiple Choice* Which of the following statements regarding the tropopause is false?

W) The height of the tropopause is greatest during the wintertime
X) The height of the tropopause is greatest over equatorial regions
Y) Strong updrafts can cause the top of a thunderstorm to exceed the tropopause
Z) The tropopause is at a higher elevation than the free convective layer

ANSWER: W) The height of the tropopause is greatest during the wintertime

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TOSS UP

6) PHYSICS *Multiple Choice* A pendulum is oscillating naturally due to gravity at a frequency f. If Sam grabs the pendulum and shakes it back and forth, he can maximize the pendulum's possible frequency at frequency w. What is the ratio between w and f?

W) 0
X) 1
Y) 2
Z) 4

ANSWER: X) 1

BONUS

6) PHYSICS *Short Answer* Rank the following 3 materials at room temperature in increasing order of refractive index.

1) Benzene
2) Sapphire
3) Air

ANSWER: 3, 1, 2

TOSS UP

7) BIOLOGY *Short Answer* How many stop codons are present in the mRNA transcribed from the trp operon in E. coli?

ANSWER: 5

BONUS

7) BIOLOGY *Short Answer* Identify all of the following three hormones which would act to directly increase the osmolarity of blood.

1) Angiotensin I [*AN-jee-oh-TEN-sin one*]
2) Aldosterone [*AL-doh-STEHR-own*]
3) Vasopressin [*va-suh-PRESS-in*]

ANSWER: None

TOSS UP

8) CHEMISTRY *Short Answer* What term describes alloys of mercury with other metals?

ANSWER: Amalgam

BONUS

8) CHEMISTRY *Short Answer* When a solution of ammonium sulfate is mixed with barium hydroxide, which of the following is formed?

1) Evolution of a gas
2) Formation of a colored precipitate
3) Formation of a colorless precipitate

ANSWER: 3 only

TOSS UP

9) MATH *Multiple Choice* How many 0's are at the end of 200 choose 100?

W) 0
X) 1
Y) 49
Z) 50

ANSWER: X) 1

BONUS

9) MATH *Short Answer* 2 frogs and 3 toads want to sit in a line. However, frogs do not want to sit next to each other. How many ways are there for these frogs and toads to sit in a line? Assume that frogs and toads are all distinct.

ANSWER: 72

TOSS UP

10) EARTH AND SPACE *Short Answer* Order the following three rocks in terms of increasing iron concentration.

1) Diorite
2) Peridotite [*pur-IH-duh-tite*]
3) Granite

ANSWER: 3, 1, 2

BONUS

10) EARTH AND SPACE *Short Answer* Identify all of the following three statements regarding stellar lifetimes that are true.

1) Stars typically spend most of their time on the main-sequence
2) Stars with a greater mass typically have a shorter lifetime
3) Red dwarfs have the shortest lifetime of any main-sequence star

ANSWER: 1 and 2 only

TOSS UP

11) PHYSICS *Short Answer* Identify all of the following particles that are hadrons.

1) Neutron
2) Antineutrino
3) Gluon

ANSWER: 1 only

BONUS

11) PHYSICS *Short Answer* A fixed rope has mass 0.1 kilograms and length 2 meters. In Newtons, what is the tension if the wave has 6 nodes and vibrates at 75 Hertz?

ANSWER: 180

TOSS UP

12) BIOLOGY *Short Answer* Identify all of the following three plant groups that reproduce by alternation of generations.

1) Monilophytes
2) Hornworts
3) Angiosperms

ANSWER: All

BONUS

12) BIOLOGY *Short Answer* After the imbibition [*im-bi-BISH-un*] of water into the seed, gibberellin stimulates the synthesis of alpha amylase to break down stored starch. What thin outer layer of the endosperm is responsible for the secretion of alpha amylase and other digestive enzymes in response to gibberellin signaling?

ANSWER: Aleurone layer

TOSS UP

13) CHEMISTRY *Short Answer* What term describes achiral compounds that contain chiral centers?

ANSWER: Meso Compound

BONUS

13) CHEMISTRY *Short Answer* For a compound with the chemical formula C4H8O, which of the following functional groups could be present?

1) Primary Alcohol
2) Secondary Alcohol
3) Aldehyde

ANSWER: All

TOSS UP

14) MATH *Multiple Choice* What is the minimum number of colors needed to color a tree graph of 2025 nodes such that no 2 adjacent nodes have the same color?

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

ANSWER: X) 2

BONUS

14) MATH *Short Answer* What is the side length of the smallest square that can fit 5 non-overlapping unit squares? Express your answer in simplified radical form.

ANSWER: $2 + \frac{\sqrt{2}}{2}$

TOSS UP

15) EARTH AND SPACE *Multiple Choice* Which of the following sediments would make the best aquitard?

W) Clay
X) Silt
Y) Sand
Z) Gravel

ANSWER: W) Clay

BONUS

15) EARTH AND SPACE *Short Answer* An asteroid orbits the Sun with a period of 8 years and an eccentricity of 0.5. What is the distance in AU between the Sun and the asteroid at perihelion?

ANSWER: 2

TOSS UP

16) PHYSICS *Multiple Choice* Water is flowing through a pipe at a speed of 20 meters per second. Then, it enters a wider region that slows it to 15 meters per second. Which is closest to the resulting increase in water pressure?

W) 100 millipascals
X) 100 pascals
Y) 100 kilopascals
Z) 100 megapascals

ANSWER: Y) 100 kilopascals

BONUS

16) PHYSICS *Multiple Choice* A negatively-charged electroscope consists of a conducting knob attached to two thin conducting sheets. A negatively-charged rod begins close to the knob. When the rod touches the knob, how does the angle between the sheets change?

W) Goes to zero
X) Decreases, but stays positive
Y) Doesn't change
Z) Increases

ANSWER: Z) Increases

TOSS UP

17) BIOLOGY *Short Answer* For many amphibians, gas exchange takes place on the skin as well as the lungs. What term best describes this type of gas exchange circuit?

ANSWER: Pulmocutaneous

BONUS

17) BIOLOGY *Multiple Choice* Which of the following best describes cortical rotation in amphibian development?

W) The grey crescent forms opposite to the sperm entry point, indicating the future dorsal side of the embryo.

X) The grey crescent forms opposite to the sperm entry point, indicating the future ventral side of the embryo.

Y) The grey crescent forms at the sperm entry point, indicating the future dorsal side of the embryo.

Z) The grey crescent forms at the sperm entry point, indicating the future ventral side of the embryo.

ANSWER: W) The grey crescent forms opposite to the sperm entry point, indicating the future dorsal side of the embryo.

TOSS UP

18) CHEMISTRY *Short Answer* Which of the following 3 compounds dissolves endothermically?

1) Ammonium sulfate
2) Sulfuric acid
3) Sodium hydroxide

ANSWER: 1

BONUS

18) CHEMISTRY *Short Answer* Rank the following compounds in increasing basicity.

1) Sodium acetylide
2) Sodium methoxide
3) Sodium hydride

ANSWER: 2, 1, 3

TOSS UP

19) MATH *Short Answer* Let $f(x)$ be a cubic polynomial. What is the positive difference between the degrees of $f(f(f(x)))$ and $(f(x))^3$?

ANSWER: 18

BONUS

19) MATH *Multiple Choice* The Manhattan distance between 2 points in 2D space is defined as the sum of the positive difference of the x values and the positive difference of the y values. If a random point is selected in 2D space, what is the expected value of the Manhattan distance to the closest lattice point?

W) 3/8
X) 1/2
Y) 5/8
Z) 3/4

ANSWER: X) 1/2

TOSS UP

20) EARTH AND SPACE *Multiple Choice* Which of the following types of volcanoes are most prevalent on Venus?

W) Shield
X) Cinder cone
Y) Stratovolcano
Z) Lava domes

ANSWER: W) Shield

BONUS

20) EARTH AND SPACE *Multiple Choice* Which of the following minerals is not a sulfide?

W) Galena
X) Cinnabar
Y) Pyrite
Z) Barite

ANSWER: Z) Barite

TOSS UP

21) PHYSICS *Multiple Choice* Which of the following properties of EM waves is false?

W) The magnitude of the electric and magnetic fields differ by a factor of c, the speed of light.
X) EM waves carry energy, which is evenly split between its electric and magnetic fields.
Y) The magnetic and electric fields are always perpendicular to each other.
Z) The propagation of the wave always travels at the speed of light everywhere.

ANSWER: Z) The propagation of the wave always travels at the speed of light everywhere.

BONUS

21) PHYSICS *Short Answer* A gas is compressed from 5 Liters at 100,000 Pascals to 2 Liters at 200,000 Pascals, such that pressure varies linearly with volume. In kilojoules, what is the magnitude of work done?

ANSWER: 450

TOSS UP

22) BIOLOGY *Multiple Choice* What type of epithelial tissue lines the small intestine?

W) Simple cuboidal
X) Pseudostratified columnar
Y) Stratified cuboidal
Z) Simple columnar

ANSWER: Z) Simple columnar

BONUS

22) BIOLOGY *Short Answer* What is the term for a muscular contraction that is constant in tension despite a change in length?

ANSWER: Isotonic (DO NOT ACCEPT: Isometric)

TOSS UP

23) CHEMISTRY *Short Answer* Treatment of a secondary alcohol with potassium dichromate produces what functional group?

ANSWER: Ketone

BONUS

23) CHEMISTRY *Short Answer* Given the unbalanced equation $I^- + MnO_4{}^- \longrightarrow IO^- + MnO_2$ under basic conditions, what is the coefficient of the iodide ion when balanced with the lowest whole number coefficients?

ANSWER: 3

TOSS UP

24) MATH *Multiple Choice* Which of the following best describes the function $f(x) = -x^3 + 2x^2$ at $x = 1$?

W) Increasing, concave up
X) Increasing, concave down
Y) Decreasing, concave up
Z) Decreasing, concave down

ANSWER: X) Increasing, concave down

BONUS

24) MATH *Multiple Choice* Mike applies to 50 reach colleges. The probability of getting accepted to each college is 2%. Which of the following is closest to the percent chance that Mike will get accepted to at least one reach college?

W) 50
X) 60
Y) 70
Z) 80

ANSWER: X) 60

TOSS UP

25) EARTH AND SPACE *Short Answer* During a geological survey, Winston discovers a sample of chert containing coccolithophore fossils embedded within. This discovery implies that the rock was deposited above which boundary, below which calcareous shells typically dissolve?

ANSWER: Carbonate Compensation Depth (ACCEPT: CCD)

BONUS

25) EARTH AND SPACE *Short Answer* A meandering stream turns right. Identify all of the following three statements that are true.

1) The maximum surface velocity will be found near the cut bank
2) The cut bank will form on the outside of the stream turn
3) The cut bank is a depositional feature

ANSWER: 1 and 2 only
