

ROUND 1

TOSS-UP

1) Earth and Space – *Short Answer* What term is used to describe the point on the surface, below which an earthquake originates?

ANSWER: EPICENTER

BONUS

1) Earth and Space – *Multiple Choice* You are traveling west by jet and cross three time zone boundaries. If your watch reads 3:00 p.m. when you arrive, to what time should you reset it?

- W) 12:00 noon
- X) 6:00 p.m.
- Y) 12:00 midnight
- Z) 6:00 a.m.

ANSWER: W) 12:00 NOON

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### TOSS-UP

2) Biology – *Short Answer* What type of leukocytes, characterized by their CD4 receptors, secrete cytokines [*sigh-toe-kines*] that activate nearby B and T cells?

ANSWER: HELPER T CELLS

### BONUS

2) Biology – *Short Answer* What is the term used to describe a virus that attacks bacteria?

ANSWER: BACTERIOPHAGE (ACCEPT: PHAGE)

**TOSS-UP**

3) Math – *Short Answer* Where is the derivative of the function  $f(x) = 2x^2 + 5x - 3$  equal to zero?

Answer: AT  $x = -5/4$  (ALSO ACCEPT  $x = -1.25$  OR  $-1\frac{1}{4}$ )

**BONUS**

3) Math – *Short Answer* If the line tangent to the graph of the function  $f(x)$  at the point (1, 3) passes through the point (-1.5, -2), then what is value of the derivative of  $f(x)$  when  $x = 1$ ?

ANSWER: 2



**TOSS-UP**

4) Energy – *Multiple Choice* If the frequency of a wave is decreased, which of the following changes must occur for the wave to maintain a constant velocity?

- W) The period must decrease
- X) The wavelength must increase
- Y) The amplitude must increase
- Z) The amplitude must decrease

ANSWER: X) THE WAVELENGTH MUST INCREASE

**BONUS**

4) Energy – *Short Answer* What is the process in plant metabolism in which Rubisco adds oxygen instead of carbon dioxide into the carbon intermediate of the Calvin Cycle, thus reducing photosynthetic efficiency?

ANSWER: PHOTORESPIRATION

### TOSS-UP

5) Chemistry – *Short Answer* What name is given to the thermodynamic state function equal to the sum of internal energy and the product of pressure and volume, whose difference in a chemical reaction is equal to the isobaric heat transfer accompanying the reaction, and which is symbolized by the letter H?

ANSWER: ENTHALPY

### BONUS

5) Chemistry – *Multiple Choice* Which of the following statements regarding stoichiometry [*stoh-kee-om-et-ree*] is not true?

- W) Calculating a stoichiometric ratio of reagents assumes the reaction goes to completion
- X) Volume ratios can be substituted for molar ratios in calculations for gas phase reactions
- Y) Percent yield is the ratio of theoretical yield to empirical yield for a reaction
- Z) Limiting reagent calculations require knowledge of the molar masses of all reactant species

ANSWER: Y) PERCENT YIELD IS THE RATIO OF THEORETICAL YIELD TO EMPIRICAL YIELD FOR A REACTION



### TOSS-UP

6) Physics – *Short Answer* The electric potential at a point due to a unit positive charge is found to be V. If the distance between the charge and the point is quadrupled, what is the new value of the electric potential?

ANSWER: V/4

### BONUS

6) Physics – *Multiple Choice* Which of the following statements is not true regarding light?

- W) The energy of light increases as frequency increases
- X) Refraction occurs when a beam of light travels between mediums with different indices of refraction
- Y) Light can be thought of as a self-propagating electromagnetic wave
- Z) Diffraction arises due to the wave-like properties of light, but interference is due to the particle-like properties of light

ANSWER: Z) DIFFRACTION ARISES DUE TO THE WAVE-LIKE PROPERTIES OF LIGHT, BUT INTERFERENCE IS DUE TO THE PARTICLE-LIKE PROPERTIES OF LIGHT

**TOSS-UP**

7) Earth and Space – *Short Answer* What extremely luminous explosion of radiation occurs from the death of a massive star?

ANSWER: SUPERNOVA

**BONUS**

7) Earth and Space – *Short Answer* What greenhouse gas has the greatest abundance in the atmosphere?

ANSWER: WATER VAPOR



**TOSS-UP**

8) Biology – *Short Answer* When a phylogenetic tree has the fewest number of evolutionary events possible, it is said to embody what principle of simplicity?

ANSWER: PARSIMONY

**BONUS**

8) Biology – *Short Answer* What phenomenon involves the injection of double-stranded RNAs turning off the expression of genes with the same sequence as the RNA?

ANSWER: RNA INTERFERENCE

### TOSS-UP

9) Energy – *Short Answer* What is the SI unit commonly used to measure electrical resistance?

ANSWER: OHM

### BONUS

9) Energy – *Short Answer* What law in physical chemistry, important in reaction thermodynamics, states that the total enthalpy change of a reaction is the sum of the enthalpy changes of each step of the reaction?

ANSWER: HESS'S LAW



### TOSS-UP

10) Math – *Short Answer* If one side of a right triangle is 14 inches and its opposite angle is 30 degrees, what is the diameter of the circle circumscribed around this triangle?

ANSWER: 28

### BONUS

10) Math – *Short Answer* A particle's position is defined by the equation  $x(t) = 2t^3 - 15t^2 + 24t - 60$ . At what times  $t$  is the particle at rest?

ANSWER:  $t = 1$  AND 4

### TOSS-UP

11) Chemistry – *Multiple Choice* Ceramic materials typically belong to what class of solid structure?

- W) Network solid
- X) Ionic solid
- Y) Molecular solid
- Z) Metallic solid

ANSWER: W) NETWORK SOLID

### BONUS

11) Chemistry – *Short Answer* Consider the reaction of nitrogen dioxide with molecular oxygen to form dinitrogen pentoxide. If the rate of consumption of oxygen gas is 1 liter per minute, what is the rate, in liters per minute, of disappearance of nitrogen dioxide gas?

ANSWER: 4

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TOSS-UP

12) Physics – *Multiple Choice* What is the name of the principle that states that an object, partly or completely, submerged in a fluid will experience a buoyant force equal to the weight of the fluid the object displaces?

- W) Newton
- X) Bernoulli
- Y) Pascal
- Z) Archimedes

ANSWER: Z) ARCHIMEDES

BONUS

12) Physics – *Multiple Choice* Which of the following statements is NOT true regarding a wheel rolling along a surface?

- W) If the wheel is rolling smoothly, the only friction acting on it is static friction
- X) When rolling down a ramp, the force of static friction on the wheel is directed down the ramp
- Y) When rolling on a flat surface, the force of static friction on the wheel is directed in the opposite direction as the motion of the wheel
- Z) For a wheel rolling down a ramp, the normal force is perpendicular to the ramp

ANSWER: X) WHEN ROLLING DOWN A RAMP, THE FORCE OF STATIC FRICTION ON THE WHEEL IS DIRECTED DOWN THE RAMP

TOSS-UP

13) Earth and Space – *Short Answer* What force is primarily responsible for the collapse of molecular clouds into stars?

ANSWER: GRAVITY

BONUS

13) Earth and Space – *Multiple Choice* Native to Asia, the Burmese python was brought to the United States for sale as a pet. Owners released their Burmese pythons into the wild of the Florida Everglades, creating ecological problems in that habitat. Which best describes the Burmese Python?

- W) Non-competitive species
- X) Invasive species
- Y) Keystone species
- Z) Primary succession

ANSWER: X) INVASIVE SPECIES

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**TOSS-UP**

14) Math – *Short Answer* In what quadrants does the graph of the equation  $y = -2x - 3$  lie?

ANSWER: II, III, AND IV (ACCEPT: SECOND, THIRD, AND FOURTH OR ALL BUT FIRST)

**BONUS**

14) Math – *Short Answer* Assuming  $x$  is a value for which the denominator is defined, simplify the fraction with numerator  $6x^2 + 4x - 2$  and denominator  $12x^2 - 4x$ .

ANSWER:  $(x + 1)/(2x)$

### TOSS-UP

15) Chemistry – *Multiple Choice* Which of the following elemental substances is not at standard state?

- W) Diamond at 25 degrees Celsius and one atmosphere
- X) Rhombic sulfur at 25 degrees Celsius and one atmosphere
- Y) Gaseous dioxygen at 25 degrees Celsius and one atmosphere
- Z) Gaseous neon at 25 degrees Celsius and one atmosphere

ANSWER: W) DIAMOND AT 25 DEGREES CELSIUS AND ONE ATMOSPHERE

### BONUS

15) Chemistry – *Multiple Choice* Metallic sodium will react with water to form sodium hydroxide and hydrogen gas. What type of reaction is this?

- W) Synthesis
- X) Decomposition
- Y) Single displacement
- Z) Double displacement

ANSWER: Y) SINGLE DISPLACEMENT

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TOSS-UP

16) Biology – *Short Answer* What neurotransmitter is released by motor neurons at the neuromuscular junction?

ANSWER: ACETYLCHOLINE [*uh-see-tul-koe-leen*]

BONUS

16) Biology – *Multiple Choice* Which of the following is a monosaccharide?

- W) Sucrose
- X) Galactose [*guh-lac-tohs*]
- Y) Maltose
- Z) Lactose

ANSWER: X) GALACTOSE

TOSS-UP

17) Energy – *Short Answer* What is the name of the prediction in classical physics that incorrectly proposed that an ideal black body at thermal equilibrium will emit increasingly higher frequencies of radiation with infinite power?

ANSWER: ULTRAVIOLET CATASTROPHE (ACCEPT: RAYLEIGH-JEANS CATASTROPHE)

BONUS

17) Energy – *Short Answer* What is the primary energy carrier that is synthesized in the Krebs Cycle and is one of the most common reducing agents in the cell?

ANSWER: NADH OR NICOTINAMIDE ADENINE DINUCLEOTIDE (DO NOT ACCEPT: NAD+)



TOSS-UP

18) Physics – *Multiple Choice* The lines in the visible region of the hydrogen spectrum are known as the:

- W) Balmer series
- X) Lyman series
- Y) Paschen series
- Z) Bohr series

ANSWER: W) BALMER SERIES

BONUS

18) Physics – *Short Answer* Color confinement refers to the inability to find what two particles in isolation?

ANSWER: QUARKS, GLUONS

TOSS-UP

19) Earth and Space – *Short Answer* What prefix describes clouds found in the middle altitude range?

ANSWER: ALTO

BONUS

19) Earth and Space – *Short Answer* What gravitationally bound systems of matter, classified by the Hubble sequence, are the basic units of the Universe?

ANSWER: GALAXIES



TOSS-UP

20) Biology – *Short Answer* What immunoglobulin class is the largest antibody present in the human circulatory system?

ANSWER: IgM

BONUS

20) Biology – *Multiple Choice* A scientist isolates a small amount of DNA from a Tyrannosaur fossil. Which of the following would be most useful for increasing the amount of DNA with which the scientist has to work?

- W) RFLP analysis
- X) Polymerase chain reaction
- Y) Southern blotting
- Z) SDS-PAGE

ANSWER: X) POLYMERASE CHAIN REACTION

TOSS-UP

21) Math – *Short Answer* If $f(x)$ equals the cube root of open parenthesis $x + 8$ close parenthesis, what is f inverse of 6?

ANSWER: 208

BONUS

21) Math – *Short Answer* What is the sum of all the distinct prime factors of 15 factorial?

ANSWER: 41



TOSS-UP

22) Chemistry – *Short Answer* What laboratory instrument, containing gradations that increase from top to bottom, is used to deliver precise quantities of titrant to the analyte in a titration?

ANSWER: BURETTE (ACCEPT: BURET)

BONUS

22) Chemistry – *Short Answer* If you have 50 milliliters of a 0.75 molar solution of NaCl, how much water, in milliliters, should you add to dilute the NaCl concentration to 0.25 molar?

ANSWER: 100

TOSS-UP

23) Physics – *Short Answer* A 100 milliwatt laser delivers 2.50×10^{17} photons per second. Expressing your answer in scientific notation with one significant figure, how much energy in joules does each photon deliver?

ANSWER: 4×10^{-19}

BONUS

23) Physics – *Short Answer* Radiation dose equivalents are measured in what SI unit?

ANSWER: SIEVERTS