

## ROUND 3

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### TOSS-UP

1) BIOLOGY *Multiple Choice* Female insects usually lay their eggs near which of the following?

- W) Light
- X) Shade
- Y) Food
- Z) Water

ANSWER: Y) FOOD

### BONUS

1) BIOLOGY *Multiple Choice* Which of the following biological molecules most directly enables the structural compartmentalization required for cellular respiration and photosynthesis [*foh-tuh-SIN-thuh-sis*]?

- W) Amino acids
- X) Phospholipids [*fos-foh-LIP-ids*]
- Y) Glycogen [*GLY-kuh-juhn*]
- Z) Cholesterol

ANSWER: X) PHOSPHOLIPIDS

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### TOSS-UP

2) PHYSICS *Short Answer* Which Greek scientist discovered that, when an object is immersed in a fluid, there is a buoyant force acting upward on the object equal to the weight of the displaced fluid?

ANSWER: ARCHIMEDES

### BONUS

2) PHYSICS *Multiple Choice* Which of the following is true for a cyclist applying her brakes while traveling west on a straight path?

- W) Her acceleration is zero
- X) She accelerates to the east
- Y) She accelerates to the west
- Z) She accelerates both to the east and the west

ANSWER: X) SHE ACCELERATES TO THE EAST

### TOSS-UP

3) CHEMISTRY *Multiple Choice* In which of the following ways would oxygen's electrons fill the 3 p subshells?

- W) 1 pair, 2 unpaired
- X) 1 pair, 1 unpaired
- Y) 2 pairs
- Z) 3 pairs

ANSWER: W) 1 PAIR, 2 UNPAIRED

### BONUS

3) CHEMISTRY *Short Answer* What gaseous organic compound is made when ethanol is heated in a concentrated solution of sulfuric acid?

ANSWER: ETHYLENE (ACCEPT: ETHENE)

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### TOSS-UP

4) EARTH AND SPACE *Short Answer* Mechanical weathering is one type of weathering, what is the other?

ANSWER: CHEMICAL (ALSO ACCEPT BIOLOGICAL)

### BONUS

4) EARTH AND SPACE *Multiple Choice* For the June solstice, which of the following statements is NOT true?

- W) The northern hemisphere experiences the day with the longest period of sunlight
- X) There are 24 hours of sunlight in the Arctic Circle
- Y) Earth is further from the Sun than it is at the winter solstice
- Z) The Sun is directly overhead at noon in the Arctic Circle

ANSWER: Z) THE SUN IS DIRECTLY OVERHEAD AT NOON IN THE ARCTIC CIRCLE

**TOSS-UP**

5) MATH *Short Answer* How many distinct diagonals does a pentagon have?

ANSWER: 5

**BONUS**

5) MATH *Short Answer* The polynomial  $p(x) = x^4 + 5x^3 - 2x^2 - 24x$  has a zero at  $x = 2$ . Factor  $p$  completely.

ANSWER:  $x(x - 2)(x + 3)(x + 4)$

*[NOTE: EXPRESSIONS IN ANSWER CAN BE IN ANY ORDER]*

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**TOSS-UP**

6) ENERGY *Multiple Choice* Which of the following describes the purpose of the ground connection on a common power outlet?

- W) Provide a zero potential reference
- X) Remove excess heat from the transmission system
- Y) Give a low resistance path for short circuits to travel through
- Z) Act as a small current source to prevent corrosion

ANSWER: Y) GIVE A LOW RESISTANCE PATH FOR SHORT CIRCUITS TO TRAVEL THROUGH

**BONUS**

6) ENERGY *Short Answer* If a solar panel produces energy directly proportional to the flux of incident photons, what is the best orientation it can have, relative to the line from the Earth to the Sun?

ANSWER: PERPENDICULAR (ACCEPT: ORTHOGONAL)

### TOSS-UP

7) BIOLOGY *Multiple Choice* Which of the following statements is NOT true about spike moss?

- W) They do not have true roots
- X) They have a well-developed vascular system
- Y) They are widely distributed in all parts of the world
- Z) Their leaves are spore-bearing

ANSWER: X) THEY HAVE A WELL-DEVELOPED VASCULAR SYSTEM

### BONUS

7) BIOLOGY *Short Answer* What is the term for the organic substance that consists of a dendritic network polymer of phenylpropene units and binds the cells, fibers, and vessels that constitute wood?

ANSWER: LIGNIN

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### TOSS-UP

8) PHYSICS *Multiple Choice* Pascal's law governs the actions of forces in which of the following?

- W) Gases
- X) Solids
- Y) Incompressible fluids
- Z) A vacuum

ANSWER: Y) INCOMPRESSIBLE FLUIDS

### BONUS

8) PHYSICS *Short Answer* What current, in amperes, is carried in a lightning stroke that lasts 0.5 seconds and transfers 100 coulombs of charge?

ANSWER: 200

**TOSS-UP**

9) CHEMISTRY *Short Answer* In a flame test on an unknown compound, the flame is violet. What element is likely to be in the compound?

ANSWER: POTASSIUM (ACCEPT: RUBIDIUM, CESIUM)

**BONUS**

9) CHEMISTRY *Multiple Choice* Which of the following anhydrous compounds has the lowest melting point?

- W) Aluminum chloride
- X) Calcium chloride
- Y) Copper (II) chloride
- Z) Lead (III) chloride

ANSWER: W) ALUMINUM CHLORIDE

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**TOSS-UP**

10) EARTH AND SPACE *Short Answer* What term is used to describe the advance of desert conditions into formerly non-desert areas?

ANSWER: DESERTIFICATION

**BONUS**

10) EARTH AND SPACE *Multiple Choice* The Intertropical Convergence Zone is NOT characterized by which of the following?

- W) Divergence
- X) Uplift
- Y) High cloud cover
- Z) Heavy precipitation

ANSWER: W) DIVERGENCE

**TOSS-UP**

11) MATH *Short Answer* What is the surface area of a cube with volume 8?

ANSWER: 24

**BONUS**

11) MATH *Short Answer* In terms of  $x$  and in standard polynomial form, what is the volume of a right rectangular prism with dimensions  $(x + 4)$ ,  $(x + 1)$ , and  $(x + 6)$ ?

ANSWER:  $x^3 + 11x^2 + 34x + 24$

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**TOSS-UP**

12) ENERGY *Multiple Choice* Which of the following uses stored electricity and is required to get a gasoline-powered car's engine going?

- W) Catalytic converter
- X) Starter motor
- Y) Fuel rail
- Z) Alternator

ANSWER: X) STARTER MOTOR

**BONUS**

12) ENERGY *Short Answer* Most coals of the softer varieties are forms of which of the three major rock types?

ANSWER: SEDIMENTARY

### TOSS-UP

13) BIOLOGY *Multiple Choice* Which of the following best describes blood?

- W) It is a specialized type of cell found in blood vessels
- X) It is a type of cell formed in the bone marrow
- Y) It is a kind of connective tissue in which red and white blood cells are suspended in plasma
- Z) It is a kind of epithelial tissue [*ep-uh-THEE-lee-ah*]

ANSWER: Y) IT IS A KIND OF CONNECTIVE TISSUE IN WHICH RED AND WHITE BLOOD CELLS ARE SUSPENDED IN PLASMA

### BONUS

13) BIOLOGY *Short Answer* Valproic acid and trapoxin are inhibitors of what class of enzymes that regulate gene expression by altering chromatin accessibility?

ANSWER: HDAC (ACCEPT: HISTONE DEACETYLASES; DO NOT ACCEPT: HAT)

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### TOSS-UP

14) EARTH AND SPACE *Multiple Choice* Which of the following statements about the Moon best describes why we only see one side of the Moon from Earth?

- W) It does not rotate
- X) It has a side that is always dark
- Y) It does not revolve
- Z) It has the same period for rotation and revolution

ANSWER: Z) IT HAS THE SAME PERIOD FOR ROTATION AND REVOLUTION

### BONUS

14) EARTH AND SPACE *Multiple Choice* Which of the following elements CANNOT be a source of fuel in nuclear fusion?

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

ANSWER: W) IRON

### TOSS-UP

15) BIOLOGY *Multiple Choice* Which of the following statements best describes the thermodynamic effect of an enzyme on the reaction it catalyzes?

- W) The energy level of the reactants is decreased in the presence of the enzyme
- X) The activation energy of the reaction is decreased
- Y) The activation energy of the reaction is increased
- Z) The  $\Delta G$  [**delta-G**] between products and reactants is decreased

ANSWER: X) THE ACTIVATION ENERGY OF THE REACTION IS DECREASED

### BONUS

15) BIOLOGY *Short Answer* What recessive, life-threatening disorder affects the cells that produce mucus, sweat, and digestive juices, rendering secretions thick and sticky?

ANSWER: CYSTIC FIBROSIS (ALSO ACCEPT CF OR MUCOVISCIDOSIS)

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### TOSS-UP

16) PHYSICS *Short Answer* The two leaves of an electroscope repel each other and stand out at an angle. What force balances the electrical force so the leaves don't stand out farther?

ANSWER: GRAVITY

### BONUS

16) PHYSICS *Short Answer* A block of wood, when floating in water, displaces 300 cubic centimeters of water. When completely submerged, the block displaces 400 cubic centimeters of water. What is the specific gravity of the block?

ANSWER: 0.75



### TOSS-UP

17) CHEMISTRY *Multiple Choice* A nitrogen atom present in the backbone of a polypeptide **[pol-ee-PEP-tyd]** is part of which of the following functional groups?

- W) A primary amine
- X) A secondary amine
- Y) A tertiary amine **[TER-shee-er-ee]**
- Z) An amide

ANSWER: Z) AN AMIDE

### BONUS

17) CHEMISTRY *Multiple Choice* Which of the following is the final product of purine metabolism excreted in the urine?

- W) Urea
- X) Uric acid
- Y) Ammonia
- Z) Ammonium

ANSWER: X) URIC ACID

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### TOSS-UP

18) EARTH AND SPACE *Short Answer* What is the most common element in Earth's crust?

ANSWER: OXYGEN

### BONUS

18) EARTH AND SPACE *Multiple Choice* Which of the following is NOT a characteristic of the mixed layer of the ocean?

- W) Relatively stratified in the vertical
- X) In direct contact with the atmosphere
- Y) Stirred by winds and convection
- Z) Varied depth with latitude and season

ANSWER: W) RELATIVELY STRATIFIED IN THE VERTICAL

### TOSS-UP

19) MATH *Short Answer* For what values of  $x$  is the function  $f(x) = \frac{x^2}{x^2 - 4x + 4}$  [if of  $x$  equals the fraction with numerator  $x$  squared and denominator  $x$  squared minus 4  $x$  plus 4] NOT defined?

ANSWER: 2

### BONUS

19) MATH *Multiple Choice* Which of the following inequalities has NO solutions?

W)  $7x + 4 > 3$

X)  $|x - 1| > -10$  [the absolute value of the quantity  $x$  minus 1 is greater than negative 10]

Y)  $|x + 3| < -2$  [the absolute value of the quantity  $x$  plus 3 is less than negative 2]

Z)  $-100x + 5 \geq 8$

ANSWER: Y)  $|x + 3| < -2$

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### TOSS-UP

20) ENERGY *Short Answer* What energy barrier must a chemical reaction pass in order to proceed?

ANSWER: ACTIVATION ENERGY

### BONUS

20) ENERGY *Short Answer* One proposed geoengineering mechanism that could be used to mitigate increased atmospheric carbon dioxide levels is called iron seeding and involves spreading large quantities of iron over the surface of the ocean. What is the name of the organism that would grow as a result, leading to carbon sequestration [see-kwes-TRAY-shuhn]?

ANSWER: PLANKTON (ACCEPT: PHYTOPLANKTON)

### TOSS-UP

21) BIOLOGY *Multiple Choice* Which of the following choices is NOT a source of new genetic combinations?

- W) Mitosis [*my-TOH-sis*]
- X) Fertilization
- Y) Mutation
- Z) Meiosis [*meye-OH-sis*]

ANSWER: W) MITOSIS

### BONUS

21) BIOLOGY *Multiple Choice* Which of the following parts of B and T cells bind to antigens?

- W) Variable region
- X) Heavy chain
- Y) Alpha chain only
- Z) Disulfide bridge

ANSWER: W) VARIABLE REGION

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### TOSS-UP

22) PHYSICS *Short Answer* What force does a charged particle moving through a magnetic field experience that is perpendicular to the direction the particle is traveling?

ANSWER: LORENTZ (ACCEPT: MAGNETIC FORCE)

### BONUS

22) PHYSICS *Short Answer* What is the mass, in kilograms, of a 2 kilogram rock on a planet with a gravitational acceleration of 8.2 meters per second squared?

ANSWER: 2

### TOSS-UP

23) CHEMISTRY *Short Answer* At  $-78^{\circ}$  Celsius, dry ice changes directly from a solid to a gas. What is this process called?

ANSWER: SUBLIMATION

### BONUS

23) CHEMISTRY *Multiple Choice* Which of the following is the formula for n-Octadecanoic acid?

- W)  $C_6H_{12}O_6$
- X)  $C_{18}H_{36}COOH$
- Y)  $C_{17}H_{35}COOH$
- Z)  $C_{16}H_{32}COOH$

ANSWER: Y)  $C_{17}H_{35}COOH$

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### TOSS-UP

24) EARTH AND SPACE *Short Answer* In what compass direction would the magnetic north pole of your compass point during a period in which the Earth's magnetic field was reversed?

ANSWER: SOUTH

### BONUS

24) EARTH AND SPACE *Multiple Choice* Which of the following best describes why Neptune is blue?

- W) A sub-surface ocean below a layer of ice
- X) Absorption of light by methane in its atmosphere
- Y) Blue-shifted due to its orbit
- Z) Hydrocarbon haze

ANSWER: X) ABSORPTION OF LIGHT BY METHANE IN ITS ATMOSPHERE

**TOSS-UP**

25) MATH *Short Answer* If  $\ln(x^3) = 6$  [*natural log of the quantity x cubed equals 6*], what is  $\ln(x^2)$  [*the natural log of the quantity x squared*]?

ANSWER: 4

**BONUS**

25) MATH *Short Answer* If  $f(x) = 4x^3 - 4x^2 + 10$ , then what is  $f(-2)$  [*f of negative 2*]?

ANSWER: -38