

## ROUND 6A

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### TOSS-UP

1) BIOLOGY *Multiple Choice* Where is the most likely place to find an animal that is an osmoconformer [**oz-moh-kuhn-FOHR-mer**]?

- W) Marine environment
- X) High desert
- Y) Fresh water lakes and streams
- Z) Damp tropical forest

ANSWER: W) MARINE ENVIRONMENT

### BONUS

1) BIOLOGY *Short Answer* The large intestine is made of six parts starting with the cecum [**SEE-kuhm**] and ending with the rectum. Name the other four parts, in order from the cecum to the rectum.

ANSWER: ASCENDING COLON, TRANSVERSE COLON, DESCENDING COLON, SIGMOID COLON (DO NOT ACCEPT: LEFT (SPLENIC) COLIC FLEXURE OR RIGHT (HEPATIC) COLIC FLEXURE)

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### TOSS-UP

2) CHEMISTRY *Short Answer* What is the property that is generally said to be possessed by a substance if that substance has non-superimposable mirror images?

ANSWER: CHIRALITY (ACCEPT: OPTICAL ACTIVITY)

### BONUS

2) CHEMISTRY *Multiple Choice* If the principal quantum number of an electron within an atom is 4, which of the following is an allowed value of the orbital angular momentum quantum number  $\ell$ ?

- W) -2
- X) 0
- Y)  $\frac{1}{2}$
- Z) 4

ANSWER: X) 0

**TOSS-UP**

3) MATH *Multiple Choice*. If  $\int_2^5 f(x)dx = 18$  [**the integral from 2 to 5 of f of x dx equals 18**], then  $\int_2^5 (f(x) + 4) dx =$  [**the integral from 2 to 5 of the quantity f of x plus 4 dx equals**]

- W) 18
- X) 22
- Y) 25
- Z) 30

ANSWER: Z) 30

**BONUS**

3) MATH *Short Answer* A ladder is standing vertically against a wall. Suddenly, the bottom of the ladder slides 6 feet away from the wall, which causes the top of the ladder to slide 2 feet down the wall. How tall is the ladder in feet?

ANSWER: 10

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**TOSS-UP**

4) PHYSICS *Short Answer* What is the term used to describe a process that exchanges no heat energy with its environment?

ANSWER: ADIABATIC

**BONUS**

4) PHYSICS *Short Answer* An object undergoing constant acceleration travels 5 meters in 3 seconds. Assuming that acceleration stays constant and that the initial velocity of the object was zero, how far in meters will the object travel in a total of 12 seconds?

ANSWER: 80

### TOSS-UP

5) EARTH AND SPACE *Multiple Choice* Which of the following rankings of U.S. states by highest frequency of earthquakes (highest to lowest) is accurate?

- W) Alaska, California, Nevada, Oregon
- X) California, Hawaii, Alaska, Nevada
- Y) Hawaii, Alaska, California, Oregon
- Z) Nevada, Alaska, Hawaii, California

ANSWER: W) ALASKA, CALIFORNIA, NEVADA, OREGON

### BONUS

5) EARTH AND SPACE *Short Answer* According to Birkhoff's theorem, what is the only static, spherically symmetric solution to the Einstein field equations?

ANSWER: SCHWARZSCHILD BLACK HOLE (ACCEPT: SCHWARZSCHILD METRIC OR SCHWARZSCHILD SOLUTION)

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### TOSS-UP

6) CHEMISTRY *Short Answer* Identify all of the following three compounds that are network solids at room temperature: 1) Sodium chloride; 2) Carbon dioxide; 3) Silicon dioxide.

ANSWER: 3 (ACCEPT: SILICON DIOXIDE)

### BONUS

6) CHEMISTRY *Multiple Choice* Which of the following is one of the factors that determine the bonding between atoms in a solid?

- W) Atomic radius of the atoms
- X) Environmental conditions
- Y) Atomic mass of the atoms
- Z) Magnitude of the electronegativities of the atoms

ANSWER: Z) MAGNITUDE OF THE ELECTRONEGATIVITIES OF THE ATOMS

### TOSS-UP

7) BIOLOGY *Multiple Choice* If you were a farmer that wanted to promote the ripening of your fruit crop, which of the following hormones would be best to use?

- W) Auxins [**AWK-sins**]
- X) Cytokinins [**sy-tuh-KY-nins**]
- Y) Gibberellins [**jib-uh-REL-ins**]
- Z) Ethylene [**eth-uh-leen**]

ANSWER: Z) ETHYLENE

### BONUS

7) BIOLOGY *Multiple Choice* In horses, the genotype little-B little-B causes early embryonic lethality. The A locus behaves as a classic Mendelian gene. If two horses with identical genotypes AaBb [**big-A, little-A, big-B, little-B**] mate, what is the expected phenotypic ratio of their offspring?

- W) 9:3:3:1 [**read as nine to three to three to one**]
- X) 3:1:1 [**read as three to one to one**]
- Y) 9:3:1 [**read as nine to three to one**]
- Z) 3:1 [**read as three to one**]

ANSWER: Z) 3:1

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### TOSS-UP

8) ENERGY *Short Answer* Lighting products often come with a rating that reflects the temperature of an ideal black body if it were to emit the same hue as that of the lighting product. What is this rating known as?

ANSWER: COLOR TEMPERATURE

### BONUS

8) ENERGY *Multiple Choice* Which of the following countries has the highest percentage of its electricity produced by nuclear power?

- W) Japan
- X) France
- Y) United States
- Z) Russia

ANSWER: X) FRANCE

### TOSS-UP

9) EARTH AND SPACE *Multiple Choice* Which of the following changes has the potential to reduce the damage expected to be done by a hurricane with a particular Saffir-Simpson rating?

- W) Increased formal and informal education for the public about hurricane safety
- X) Reduction in the amount of paved surfaces
- Y) Construction of sea walls around coastal cities
- Z) More rigorous building codes for robust construction of frame houses in coastal regions

ANSWER: Z) MORE RIGOROUS BUILDING CODES FOR ROBUST CONSTRUCTION OF FRAME HOUSES IN COASTAL REGIONS

### BONUS

9) EARTH AND SPACE *Short Answer* At what distance, in parsecs, does the absolute magnitude of a star equal its apparent magnitude?

ANSWER: 10

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### TOSS-UP

10) MATH *Multiple Choice* Which of the following is true for a nonzero matrix in reduced row echelon [**ESH-uh-lon**] form?

- W) All elements are zero
- X) The first non-zero element is equal to -1
- Y) There are no leading 0's
- Z) There is a leading 1

ANSWER: Z) THERE IS A LEADING 1

### BONUS

10) MATH *Short Answer* If the line tangent to the graph of the function  $f(x)$  [**f of x**] at the point (1, 3) passes through the point (-2, -6), then what is the value of the derivative of  $f(x)$  when  $x = 1$ ?

ANSWER: 3

### TOSS-UP

11) BIOLOGY *Multiple Choice* Relating to photosynthesis, which of the following is not a direct product of light reactions?

- W) NADPH [**N-A-D-P-H**]
- X) O<sub>2</sub>
- Y) Rubisco [**roo-BIS-koh**]
- Z) ATP

ANSWER: Y) RUBISCO

### BONUS

11) BIOLOGY *Short Answer* What is the maximum number of ATP molecules synthesized by NAD and FADH<sub>2</sub> [**N-A-D and F-A-D-H two**], respectively, in the mitochondrial [**my-tuh-KON-dree-uhl**] electron transport chain?

ANSWER: 3 AND 2

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### TOSS-UP

12) CHEMISTRY *Short Answer* According to VSEPR [**ves-per**] theory, what is the electron-pair geometry for a compound with a molecular geometry that is square planar?

ANSWER: OCTAHEDRAL

### BONUS

12) CHEMISTRY *Multiple Choice* Which of the following types of photons would be absorbed by an electron transitioning from the n=2 level to the n=3 level in a hydrogen atom?

- W) Infrared
- X) Visible
- Y) Ultraviolet
- Z) X-ray

ANSWER: X) VISIBLE

### TOSS-UP

13) PHYSICS *Short Answer* The Heisenberg Uncertainty Principle states that the product of the uncertainty of position and the uncertainty of momentum must be greater than the reduced form of what constant?

ANSWER: PLANCK CONSTANT

### BONUS

13) PHYSICS *Short Answer* A spring with spring constant  $k = 200$  Newtons per meter with a 0.5 kilogram mass attached is released from rest at  $x = 0.02$  meters. In meters per second, what is the magnitude of the maximum velocity attained by the mass?

ANSWER: 0.4 (ACCEPT: 2/5)

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### TOSS-UP

14) EARTH AND SPACE *Multiple Choice* Which of the following is NOT a notable characteristic of North Atlantic Deep Water?

- W) Vertical temperature minimum
- X) Two vertical oxygen maxima
- Y) Vertical salinity maximum
- Z) Vertical nutrient minimum

ANSWER: W) VERTICAL TEMPERATURE MINIMUM

### BONUS

14) EARTH AND SPACE *Multiple Choice* Which of the following geologic conditions is an environment for clay formation?

- W) Shearing fault
- X) Volcanic deposits
- Y) Folded orogenies [*oh-ROJ-uh-nees*]
- Z) Blueschist metamorphism [*BLOO-shist*]

ANSWER: X) VOLCANIC DEPOSITS

### TOSS-UP

15) BIOLOGY *Multiple Choice* In the case of disruptive selection on tail length in monkeys, which of the following would you expect?

- W) Most monkeys have medium tails
- X) Few monkeys have medium tails
- Y) Most monkeys have long tails
- Z) Few monkeys have long tails

ANSWER: X) FEW MONKEYS HAVE MEDIUM TAILS

### BONUS

15) BIOLOGY *Multiple Choice* Which of the following glia are normally only found in the peripheral nervous system?

- W) Oligodendrocytes [*OL-i-goh-DEN-ruh-syts*]
- X) Ependymal cells [*uh-PEN-duh-muhl*]
- Y) Schwann cells
- Z) Astrocytes

ANSWER: Y) SCHWANN CELLS

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### TOSS-UP

16) MATH *Multiple Choice* Which of the following points lies inside the circle defined by the equation  $x^2 + y^2 = 25$  [*x squared plus y squared equals twenty-five*]?

- W) (3, 4)
- X) (4, -3)
- Y)  $(4, 2\sqrt{2})$  [*four, two times the square root of two*]
- Z)  $(4, 3\sqrt{2})$  [*four, three times the square root of two*]

ANSWER: Y)  $(4, 2\sqrt{2})$

### BONUS

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

ANSWER: 28



### TOSS-UP

17) ENERGY *Multiple Choice* Natural gas systems are the greatest source of U.S. anthropogenic **[an-thruh-puh-JEN-ik]** methane emissions. What metabolic process, occurring in the rumens of domesticated animals, results in the second-greatest source of methane emissions?

- W) Photosynthesis
- X) Lactation
- Y) Fermentation
- Z) The Krebs cycle

ANSWER: Y) FERMENTATION

### BONUS

17) ENERGY *Short Answer* Which U.S. government body regulates nuclear power production in this country?

ANSWER: U. S. NUCLEAR REGULATORY COMMISSION (ACCEPT: NUCLEAR REGULATORY COMMISSION OR NRC)

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### TOSS-UP

18) CHEMISTRY *Short Answer* While iodine can be used to test for starch, it is not iodine that is responsible for the resultant color observed. State the ion that is responsible for the observed color.

ANSWER: TRIIODIDE

### BONUS

18) CHEMISTRY *Multiple Choice* The Monsanto process is the major industrial technique used to produce what molecule?

- W) Sulfuric acid
- X) Hydrochloric acid
- Y) Acetic acid
- Z) Nitric acid

ANSWER: Y) ACETIC ACID

### TOSS-UP

19) BIOLOGY *Multiple Choice* All of the following are major metabolic consequences of obesity except:

- W) Decreased lipid storage in the liver
- X) Increased insulin resistance
- Y) Reduction in HDL lipoprotein production
- Z) High blood glucose levels

ANSWER: W) DECREASED LIPID STORAGE IN THE LIVER

### BONUS

19) BIOLOGY *Multiple Choice* An inability of body cells to receive adequate amounts of oxygen may indicate a malfunction of:

- W) Neutrophils [**NOO-truh-fils**]
- X) Erythrocytes [**ih-RITH-ruh-syts**]
- Y) Lymphocytes [**LIM-fuh-syts**]
- Z) Leukocytes [**LOO-kuh-syts**]

ANSWER: X) ERYTHROCYTES

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### TOSS-UP

20) PHYSICS *Short Answer* The wheels of a rollercoaster car are attached to the track so that they cannot lose contact. The car approaches a loop with a radius of 20 meters. What is the minimum speed, to the nearest meter per second, required for the car to make it all the way around the loop?

ANSWER: 28

### BONUS

20) PHYSICS *Multiple Choice* Which of the following statements is NOT true regarding entropy?

- W) Statistically, entropy is always increasing in the universe
- X) Entropy is a function of state and obeys Hess's Law
- Y) Isolated systems evolve towards states of maximum entropy
- Z) Entropy can only be defined macroscopically

ANSWER: Z) ENTROPY CAN ONLY BE DEFINED MACROSCOPICALLY

### TOSS-UP

21) ENERGY *Multiple Choice* The Clean Air Act Amendments established rules on a variety of pollutants. Since 1990, by what approximate amount have ambient sulfate concentrations decreased in most regions of the U.S.?

- W) 10%
- X) 25%
- Y) 50%
- Z) 90%

ANSWER: Y) 50%

### BONUS

21) ENERGY *Short Answer* Consider 1.0 moles of an ideal gas undergoing isobaric expansion from 273 to 373 Kelvin. Assuming that the ideal gas constant is 8.314 Joules per mole kelvin, how much work, in joules to the nearest tenth, is done by the gas?

ANSWER: 831.4

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### TOSS-UP

22) MATH *Short Answer*. For  $x \leq 0$  [***x less than or equal to zero***], for what values of  $x$  does the inequality  $x + 1 < x^2 + 1$  [***x plus one is less than x squared plus one***] not hold?

ANSWER:  $x = 0$  (ACCEPT: 0)

### BONUS

22) MATH *Short Answer* Consider a single elimination basketball tournament in which 100 teams enter. In the first round, 28 teams are given a bye and the remaining teams are paired off to play. After each round, the remaining teams are paired off in the next round. How many matches are played in the first 3 rounds?

ANSWER: 84

### TOSS-UP

23) CHEMISTRY *Multiple Choice* Which of the following is NOT one of the central tenets of Valence Bond Theory?

- W) Whenever possible, a bond involving  $p$  or  $d$  electrons will orient in the direction that minimizes overlap
- X) The extent of the overlap depends on the shapes and directions of the orbitals
- Y) The  $p$  and  $d$  orbitals have more electron density in one direction than in the other
- Z) All orbitals of the same type have the same energy

ANSWER: W) WHENEVER POSSIBLE, A BOND INVOLVING P OR D ELECTRONS WILL ORIENT IN THE DIRECTION THAT MINIMIZES OVERLAP

### BONUS

23) CHEMISTRY *Short Answer* If 35 liters of neon gas at 77 degrees Celsius are cooled at constant pressure, the volume drops to 10 liters. What is the final temperature of the gas, in degrees Celsius?

ANSWER: -173 DEGREES CELSIUS