

ROUND 3A

TOSS-UP

1) Biology – *Short Answer* What term is used to describe the composite of an organism's observable characteristics and traits?

ANSWER: PHENOTYPE

BONUS

1) Biology – *Short Answer* What specific cell type in the stomach is responsible for production of pepsinogen?

ANSWER: CHIEF CELLS

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### TOSS-UP

2) Energy – *Multiple Choice* Which of the following fuels is used in peaker power plants?

- W) Coal
- X) Natural gas
- Y) Water
- Z) Uranium

ANSWER: X) NATURAL GAS

### BONUS

2) Energy – *Short Answer* How many watts are consumed by a motor running at 220 volts and drawing 7 amps?

ANSWER: 1540

### TOSS-UP

3) Math – *Multiple Choice* Molly picks 4 coins out of her purse. Which of the following cannot be the total value, in cents, of the four coins?

- W) 15
- X) 16
- Y) 25
- Z) 45

ANSWER: W) 15

### BONUS

3) Math – *Short Answer* A band produces an album with 14 songs. The band picks one of these songs to be released in April, a different one to be released in May, and a different one to be released in June. In how many different ways can this be done?

ANSWER: 2184

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TOSS-UP

4) Chemistry – *Short Answer* What is the pH of a solution of hydrochloric acid that is initially 0.1 molar but is diluted 100-fold?

ANSWER: 3

BONUS

4) Chemistry – *Multiple Choice* Which of the following is not an assumption or result of the kinetic molecular theory of gases?

- W) Gas particles occupy negligible volume
- X) Gas particles conserve energy during collisions
- Y) Pressure is dependent on attractive forces between particles
- Z) Temperature is proportional to the average kinetic energy for a particle

ANSWER: Y) PRESSURE IS DEPENDENT ON ATTRACTIVE FORCES BETWEEN PARTICLES

TOSS-UP

5) Earth and Space – *Multiple Choice* Which of the following choices is an example of a transform plate boundary?

- W) Marianas Trench
- X) San Andreas Fault
- Y) Great Rift Valley
- Z) Ural Mountains

ANSWER: X) SAN ANDREAS FAULT

BONUS

5) Earth and Space – *Multiple Choice* Which of the following surfaces has the lowest albedo?

- W) Ice
- X) Desert Sand
- Y) Ocean
- Z) Tundra

ANSWER: Y) OCEAN



TOSS-UP

6) Physics – *Short Answer* What is the general shape of a wave generated by an object undergoing simple harmonic oscillation?

ANSWER: SINUSOID (ACCEPT: SINUSOIDAL, SINE)

BONUS

6) Physics – *Short Answer* What type of circuit, containing both an inductor and capacitor, is characterized by oscillating current and charge?

ANSWER: LC CIRCUIT (ACCEPT: RESONANT CIRCUIT, TUNED CIRCUIT, TANK CIRCUIT)

TOSS-UP

7) Energy – *Short Answer* When rubber is vulcanized in order to make it more durable, what element is added to the rubber?

ANSWER: SULFUR

BONUS

7) Energy – *Short Answer* Identify all of the following five compounds that are products of glycolysis: 1) Pyruvate; 2) NAD⁺; 3) ATP; 4) H₂O; 5) CO₂.

ANSWER: 1, 3, 4

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### TOSS-UP

8) Biology – *Multiple Choice* Which of the following is most similar in structure to the basal body of a eukaryotic flagellum [*fluh-jel-um*]?

- W) Centriole
- X) Cilium
- Y) Bacterial flagellum
- Z) Intermediate filament

ANSWER: W) CENTRIOLE

### BONUS

8) Biology – *Short Answer* What generic group of transport proteins facilitates the diffusion of water across membranes?

ANSWER: AQUAPORIN

### TOSS-UP

9) Chemistry – *Short Answer* Identify all of the following three statements concerning periodic trends in chemistry that are true: 1) atomic radius increases as you go down a group; 2) sodium fluoride has more ionic character than sodium bromide; 3) electronegativity increases as you go down a group.

ANSWER: 1, 2

### BONUS

9) Chemistry – *Multiple Choice* Silicon can be doped with which of the following to produce a p-type semiconductor?

- W) Oxygen
- X) Aluminum
- Y) Carbon
- Z) Phosphorus

ANSWER: X) ALUMINUM

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TOSS-UP

10) Math – *Multiple Choice* If star is a binary operation on a subset of the real numbers, for which of the following definitions is star commutative?

- W) $a \text{ star } b = a - b$
- X) $a \text{ star } b = a/b$
- Y) $a \text{ star } b =$ the fraction with numerator $a + b$ and denominator a times b
- Z) $a \text{ star } b = a^2 - b^2$

ANSWER: Y) $a \text{ star } b =$ THE FRACTION WITH NUMERATOR $a + b$ AND DENOMINATOR a TIMES b

BONUS

10) Math – *Multiple Choice* Consider the following two statements: 1) If A and B, then C; 2) Not C. Which of the following conclusions follows from these statements?

- W) Not A and not B
- X) Not A or not B
- Y) If A, then C
- Z) If not C, then not B

ANSWER: X) NOT A OR NOT B

TOSS-UP

11) Earth and Space – *Multiple Choice* Which of the following glacial features can result from calving?

- W) Drumlins
- X) Icebergs
- Y) Striations
- Z) Moraines

ANSWER: X) ICEBERGS

BONUS

11) Earth and Space – *Multiple Choice* Which of the following statements is NOT true regarding the moon?

- W) The dividing line between darkness and light on the moon is called the terminator
- X) The moon is tidally locked to the Earth
- Y) Maria are mostly composed of basaltic minerals
- Z) Many moon rock samples are sedimentary

ANSWER: Z) MANY MOON ROCK SAMPLES ARE SEDIMENTARY



TOSS-UP

12) Physics – *Short Answer* The decay of radium directly results in the production of what noble element?

ANSWER: RADON

BONUS

12) Physics – *Short Answer* Identify all of the following three changes that would increase the capacitance of a parallel plate capacitor: 1) Increasing the distance between the plates; 2) Decreasing the area of the plates; 3) Changing to a dielectric with a lower permittivity.

ANSWER: NONE OF THEM

TOSS-UP

13) Biology – *Multiple Choice* Which of the following tissues would contain a chondrocyte?

- W) Hyaline cartilage
- X) Areolar connective tissue
- Y) Pseudostratified ciliated columnar epithelium
- Z) Compact bone

ANSWER: W) HYALINE CARTILAGE

BONUS

13) Biology – *Multiple Choice* Which of the following traits does NOT make Eukarya distinct from Archaea and Bacteria?

- W) Presence of a nucleosome structure
- X) Presence of 80S rather than 70S ribosomes
- Y) Meiotic [*my-oh-tic*] chromosome segregation
- Z) Use of methionine [*meth-eye-oh-noon*] as initiator tRNA

ANSWER: Z) USE OF METHIONINE AS INITIATOR tRNA

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### TOSS-UP

14) Chemistry – *Multiple Choice* Which of the following values for oxygen will be larger than the corresponding value for boron?

- W) Atomic radius
- X) Ionization energy
- Y) Melting point
- Z) Metallic character

ANSWER: X) IONIZATION ENERGY

### BONUS

14) Chemistry – *Short Answer* What allotrope of sulfur contains irreducible units of S<sub>8</sub> rings and is the most stable allotrope at room temperature and atmospheric pressure?

ANSWER: RHOMBIC SULFUR

### TOSS-UP

15) Math – *Short Answer* At his latest basketball game, LeBron attempted only 3-pointers and 2-pointers. He was successful on 20% of his 3 pointers and 30% of his 2-pointers. If LeBron attempted 30 shots, how many points did he score?

ANSWER: 18

### BONUS

15) Math – *Short Answer* What is the value of the infinite expression  $2$  times the square root of 2 times the fourth root of 2 times the eighth root of 2 times the sixteenth root of 2, and so on, where the index of each root is doubled to obtain the next one?

ANSWER: 4

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TOSS-UP

16) Earth and Space – *Multiple Choice* What is the term for the lowest temperature that can be attained by evaporating water into the air?

- W) Minimum temperature
- X) Wind chill temperature
- Y) Wet bulb temperature
- Z) Dry bulb temperature

ANSWER: Y) WET BULB TEMPERATURE

BONUS

16) Earth and Space – *Multiple Choice* In South Africa sedimentary rocks of Archean age have been found with rounded pyrite pebbles, which are not found in sedimentary rocks today. What is the most likely reason for this?

- W) Pyrite is no longer formed on Earth's surface
- X) Liquid water was not present during the Archean
- Y) Atmospheric oxygen levels were very low in the Archean
- Z) Atmospheric pressure was lower in the Archean

ANSWER: Y) ATMOSPHERIC OXYGEN LEVELS WERE VERY LOW IN THE ARCHEAN

TOSS-UP

17) Physics – *Short Answer* The statement that all points on a wave front will serve as point sources for secondary waves is based on what principle or theory?

ANSWER: HUYGENS' PRINCIPLE (ACCEPT: HUYGENS-FRESNEL)

BONUS

17) Physics – *Short Answer* An Olympic diver with mass 60 kilograms dives off of a 5 meter board and has a kinetic energy of 12,000 joules just prior to hitting the pool. What is the speed in meters per second of the diver entering the water?

ANSWER: 20

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### TOSS-UP

18) Chemistry – *Multiple Choice* Which of the following metals will not readily react with cold water to generate hydrogen gas and the corresponding metal hydroxide due to the existence of a nonreactive metal oxide layer coating the metal?

- W) Lithium
- X) Calcium
- Y) Aluminum
- Z) Rubidium

ANSWER: Y) ALUMINUM

### BONUS

18) Chemistry – *Multiple Choice* A 100 gram sample of a pure compound is found to contain 3.22 moles of carbon, 16.1 moles of hydrogen, and 3.22 moles of nitrogen by elemental analysis. Which of the following statements must be true?

- W) The chemical formula of the sample is  $C_2H_{10}N_2$
- X) The empirical formula of the sample is  $CH_5N$
- Y) The chemical formula of the sample is  $CH_5N$
- Z) The empirical formula of the sample is  $C_2H_{10}N_2$

ANSWER: X) THE EMPIRICAL FORMULA OF THE SAMPLE IS  $CH_5N$

**TOSS-UP**

19) Energy – *Multiple Choice* Which of the following changes to a system would always increase the rate of enzymatic catalysis in a human cell?

- W) Decrease the body temperature
- X) Decrease the pH of the cell
- Y) Increase substrate concentration
- Z) Increase enzyme concentration

ANSWER: Z) INCREASE ENZYME CONCENTRATION

**BONUS**

19) Energy – *Short Answer* Identify all of the following three statements that are true regarding lithium-ion batteries: 1) Lithium-ion batteries are rechargeable; 2) Lithium-ion batteries are replacing lead-acid batteries in lighter vehicles such as golf carts; 3) In lithium-ion batteries, oxygen diffuses from the cathode to the anode.

ANSWER: 1, 2



**TOSS-UP**

20) Math – *Short Answer* An exam has 5 equally-weighted true/false questions. How many distinct ways are there to score an 80% on the exam?

ANSWER: 5

**BONUS**

20) Math – *Short Answer* Let  $f(x) = x^2 + e^x$  and  $g(x) = 1/x^2$ . Determine  $g$  prime of  $f$  prime of zero.

ANSWER: -2

### TOSS-UP

21) Physics – *Multiple Choice* Which of the following subatomic particles will NOT be noticeably deflected when traveling perpendicular to an external magnetic field?

- W) Proton
- X) Electron
- Y) Neutron
- Z) Positron

ANSWER: Y) NEUTRON

### BONUS

21) Physics – *Short Answer* The plunger of a water-filled hypodermic syringe is pushed in at a constant speed of 1 millimeter per second. If the diameter of the syringe's needle is one tenth that of the barrel, how fast, in millimeters per second, does water shoot out of the needle?

ANSWER: 100

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### TOSS-UP

22) Biology – *Short Answer* What cellular organelles are derived from the Golgi apparatus and contain hydrolytic [*high-droh-lit-ic*] digestive enzymes?

ANSWER: LYSOSOMES

### BONUS

22) Biology – *Short Answer* Microphylls are found in what group of plants?

ANSWER: LYCOPHYTES

### TOSS-UP

23) Earth and Space – *Multiple Choice* What is one possible evolutionary adaptation that animals may have acquired to sense seismic activity?

- W) Vibration triggered early warning responses
- X) Heightened sensitivity to light
- Y) Heightened sensitivity to temperature changes along the fault plane
- Z) Air pressure sensitivity

ANSWER: W) VIBRATION TRIGGERED EARLY WARNING RESPONSES

### BONUS

23) Earth and Space – *Multiple Choice* Which of the following is closest to the average number of years between reversals of the polarity of Earth's magnetic field?

- W) 200,000
- X) 2 million
- Y) 20 million
- Z) 200 million

ANSWER: W) 200,000