

## MIDDLE SCHOOL - ROUND 4A

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### TOSS-UP

- 1) Earth and Space – *Short Answer* Discovered in the early 1600s, the four Galilean **[gal-ih-LAY-en]** moons orbit what planet?

ANSWER: JUPITER

### BONUS

- 1) Earth and Space – *Multiple Choice* Which of the following types of stars is expected to last for the longest time in its current stage of stellar evolution?

- W) Red giant
- X) Blue supergiant
- Y) Yellow dwarf
- Z) Red dwarf

ANSWER: Z) RED DWARF

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### TOSS-UP

- 2) Life Science – *Multiple Choice* In humans, olfactory receptors are primarily located in which of the following locations?

- W) Mouth
- X) Lungs
- Y) Nose
- Z) Ears

ANSWER: Y) NOSE

### BONUS

- 2) Life Science – *Short Answer* What is the term for the process by which bacteria divide into two cells?

ANSWER: BINARY FISSION

## **TOSS-UP**

3) Physical Science – *Short Answer* What is the chemical symbol for the element chlorine?

ANSWER: Cl

## **BONUS**

3) Physical Science – *Short Answer* Identify all of the following four quantities that are conserved during the electrolysis of water: 1) Moles of reagents [*ree-AY-jents*]; 2) Mass; 3) Energy; 4) Entropy.

ANSWER: 2, 3

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## **TOSS-UP**

4) Energy – *Short Answer* Scientists at SLAC National Accelerator Lab used energetic X-rays to punch electrons out of water molecules. The water goes through a phase transition from liquid to an electrically charged gas, also known as what?

ANSWER: PLASMA

## **BONUS**

4) Energy – *Short Answer* Geochemists at Pacific Northwest National Lab are studying the mixing between groundwater and river water. This phenomenon can only occur when what specific level, the upper surface of the zone of saturation, is at the surface of a river bed?

ANSWER: WATER TABLE

## **TOSS-UP**

5) Math – *Short Answer* What is the greatest integer less than or equal to the log base 5 of 1234?

ANSWER: 4

## **BONUS**

5) Math – *Short Answer* Solve the following equation for  $x$ :  $x^2 + 6x - 216 = 0$ .

ANSWER: -18, 12 (must give both answers)

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## **TOSS-UP**

6) Earth and Space – *Short Answer* Chalcopyrite [**kalka-PIE-rite**] is the primary ore of what element commonly used to produce wire?

ANSWER: COPPER

## **BONUS**

6) Earth and Space – *Short Answer* Identify all of the following three rock types that typically contain clay minerals: 1) Igneous; 2) Metamorphic; 3) Sedimentary.

ANSWER: 3

## **TOSS-UP**

7) Life Science – *Short Answer* What hormone is secreted by the beta cells of the pancreas in response to increased levels of blood sugar?

ANSWER: INSULIN

## **BONUS**

7) Life Science – *Short Answer* In a plant's root tip, what type of cell division would one expect to be nearly constantly occurring?

ANSWER: MITOSIS

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## **TOSS-UP**

8) Energy – *Short Answer* Scientists at Argonne National Lab are building 3D structures of proteins associated with infectious diseases. What technique do they use with the Advanced Photon Source to determine these crystal structures?

ANSWER: X-RAY CRYSTALLOGRAPHY

## **BONUS**

8) Energy – *Short Answer* Scientists at Brookhaven National Lab are studying the structure of the replisome **[REH-plih-sohm]** within the cell's nucleus. The replisome forms in order to synthesize what molecule?

ANSWER: DNA

## **TOSS-UP**

9) Earth and Space – *Short Answer* What is the name for the spherical region around a black hole past which no information can be transmitted to an outside observer?

ANSWER: EVENT HORIZON (ACCEPT: SCHWARZSCHILD RADIUS)

## **BONUS**

9) Earth and Space – *Multiple Choice* In which of the following parts of the Milky Way is the solar system located?

- W) Core
- X) Spiral arm
- Y) Between spiral arms
- Z) Galactic halo

ANSWER: X) SPIRAL ARM

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## **TOSS-UP**

10) Physical Science – *Short Answer* What is the term for an object's tendency to resist changes in its motion?

ANSWER: INERTIA

## **BONUS**

10) Physical Science – *Multiple Choice* A recipe calls for 5 cups of flour. A baker measures and adds a quantity of flour to a mixing bowl 5 times. Afterward, the quantity of flour in the bowl is measured and determined to be 5 cups. If the same thing happens on repeated attempts to make the recipe, which of the following is a correct description of the baker's measurements?

- W) Neither accurate nor precise
- X) Accurate, but not precise
- Y) Precise, but not accurate
- Z) Both accurate and precise

ANSWER: Z) BOTH ACCURATE AND PRECISE

## **TOSS-UP**

11) Math – *Short Answer* Simplify the following expression:  $10 - 2 \times 3$

ANSWER: 4

## **BONUS**

11) Math – *Short Answer* Mary decorates cookies at a rate of 20 per hour and John decorates them at a rate of 15 per hour. If John has a two-hour head start and they both then work continuously, after how many hours from the time she starts will Mary have decorated the same number of cookies as John?

ANSWER: 6

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## **TOSS-UP**

12) Energy – *Short Answer* Scientists at Fermi National Accelerator Lab have been developing a next-generation lens to replace octupole magnets that are used to focus proton beams in particle accelerators. These magnets are a circular arrangement of how many magnets?

ANSWER: EIGHT

## **BONUS**

12) Energy – *Short Answer* Scientists at Idaho National Lab have developed a new method to refine biodiesel. The solvent in this method is composed of a high-pressure phase of what molecule in which carbon is in its +4 oxidation state?

ANSWER: CARBON DIOXIDE (ACCEPT: CO<sub>2</sub>)

### **TOSS-UP**

13) Physical Science – *Short Answer* Given that the chemical formula of glucose is C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>, what is its empirical formula?

ANSWER: CH<sub>2</sub>O

### **BONUS**

13) Physical Science – *Short Answer* At STP, how much volume, in liters, does 4 moles of an ideal gas occupy?

ANSWER: 89.6

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### **TOSS-UP**

14) Life Science – *Short Answer* A certain cell's primary responsibility is to produce a hormone for the rest of the body. To what organ system does this cell most likely belong?

ANSWER: ENDOCRINE

### **BONUS**

14) Life Science – *Short Answer* What type of ecological succession typically happens after a forest fire?

ANSWER: SECONDARY SUCCESSION

## **TOSS-UP**

15) Earth and Space – *Short Answer* The Modified Mercalli [**mayr-CAH-lee**] scale is used to measure the intensity of what?

ANSWER: EARTHQUAKES

## **BONUS**

15) Earth and Space – *Short Answer* How many high tides and how many low tides occur at a location with a semidiurnal [**SEM-EE-dye-URN-al**] tidal pattern each lunar day?

ANSWER: TWO HIGH TIDES AND TWO LOW TIDES

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## **TOSS-UP**

16) Math – *Short Answer* Julie brings 24 candy bars to class and divides them so that each of her classmates receives an equal share of  $\frac{3}{4}$  of a bar. How many classmates does Julie have?

ANSWER: 32

## **BONUS**

16) Math – *Short Answer* What is the least common multiple of 14, 15, and 18?

ANSWER: 630

## **TOSS-UP**

17) Physical Science – *Multiple Choice* Your friend rubs a balloon on your head and your hair sticks to the balloon due to static electricity. This occurs because which of the following particles has been exchanged between your hair and the balloon?

- W) Electrons
- X) Protons
- Y) Neutrons
- Z) Quarks

ANSWER: W) ELECTRONS

## **BONUS**

17) Physical Science – *Short Answer* A particle is moving with a horizontal velocity of 12 meters per second and a vertical velocity of –5 meters per second. In meters per second, what is its speed?

ANSWER: 13

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## **TOSS-UP**

18) Life Science – *Short Answer* A small subset of a population of organisms might migrate to another location, resulting in their descendants having different allele frequencies than the larger population from which the migrants came. What is the term for this effect?

ANSWER: FOUNDER EFFECT

## **BONUS**

18) Life Science – *Short Answer* You measure someone’s pulse for 10 seconds and feel 15 beats. What is the person’s heart rate as measured in beats per minute?

ANSWER: 90

## **TOSS-UP**

19) Math – *Short Answer* A triangle has two angles measuring 32 and 77 degrees, respectively. What is the degree measure of the third angle?

ANSWER: 71

## **BONUS**

19) Math – *Short Answer* Your electric car has a range of 310 miles on a full battery. If you start driving with 18% of your battery drained, to the nearest mile, how far can you drive before the battery dies?

ANSWER: 254

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## **TOSS-UP**

20) Physical Science – *Short Answer* For a standing wave, what is the term for points of maximum displacement?

ANSWER: ANTINODES

## **BONUS**

20) Physical Science – *Short Answer* To two significant figures and in amperes, how much current will a 100-watt light bulb draw from a 120-volt power supply?

ANSWER: 0.83

### **TOSS-UP**

21) Earth and Space – *Short Answer* What theory is the most accepted scientific viewpoint regarding the origin of the universe from an infinitely dense and hot point?

ANSWER: BIG BANG

### **BONUS**

21) Earth and Space – *Short Answer* While observing a total solar eclipse, in what part of the eclipse shadow do you observe this event?

ANSWER: UMBRA

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### **TOSS-UP**

22) Life Science – *Short Answer* What type of fossil, due to its wide geographic distribution and short period of existence, is used by scientists to compare the relative age of other fossils?

ANSWER: INDEX FOSSIL

### **BONUS**

22) Life Science – *Short Answer* What group of pathogens possesses nucleic acids but not ribosomes?

ANSWER: VIRUSES

## **TOSS-UP**

23) Math – *Short Answer* What is the multiplicative inverse of  $-11/5$ ?

ANSWER:  $-5/11$

## **BONUS**

23) Math – *Short Answer* From the Earth, you measure a change in the Moon's position of 18 degrees over two hours. Assuming the Moon is 380,000 kilometers away from the Earth, and rounding your answer to the nearest ten thousand, then, from your point of view, how many kilometers does it seem that the Moon has moved during your observation?

ANSWER: 120,000