

MIDDLE SCHOOL - ROUND 4A

TOSS-UP

1) Earth and Space – *Short Answer* What is the term for a body that is so massive that light and information cannot escape its gravitational pull?

ANSWER: BLACK HOLE

BONUS

1) Earth and Space – *Multiple Choice* What parameter of a planet's orbit is a measure of how closely the orbit approximates a perfect circle?

- W) Inclination
- X) Semi-major axis
- Y) Radial velocity
- Z) Eccentricity

ANSWER: Z) ECCENTRICITY

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### TOSS-UP

2) Life Science – *Short Answer* What element composes the largest percentage of the dry weight of a human being?

ANSWER: CARBON

### BONUS

2) Life Science – *Short Answer* What specialized type of adipose tissue is found in mammalian infants and is solely used for heat production?

ANSWER: BROWN FAT

**TOSS-UP**

3) Physical Science – *Short Answer* What vector quantity includes both the speed of an object and the direction of its motion?

ANSWER: VELOCITY

**BONUS**

3) Physical Science – *Short Answer* A solid composed of an unknown material has a mass of 10 grams and a volume of 4.6 centimeters cubed. To two significant figures and in grams per centimeters cubed, what is the density of this solid?

ANSWER: 2.2

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TOSS-UP

4) Energy – *Short Answer* What type of nuclear-energy-producing reaction uses hydrogen isotopes like deuterium [*doo-TEER-ee-um*] and tritium [*TRIH-tee-um*]?

ANSWER: FUSION (ACCEPT: NUCLEAR FUSION)

BONUS

4) Energy – *Short Answer* Scientists across the nation use the Advanced Light Source to study the structures of various samples. At what national lab is this facility located?

ANSWER: LAWRENCE BERKELEY NATIONAL LAB (ACCEPT: LBNL)

TOSS-UP

5) Math – *Short Answer* Round 5,137.58 to the nearest ten.

ANSWER: 5,140

BONUS

5) Math – *Short Answer* A rhombus has diagonals of length 9 and 32. What is its area?

ANSWER: 144

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**TOSS-UP**

6) Earth and Space – *Multiple Choice* Materials that compose the Earth's crust have densities that are different from the bulk density of the Earth. Which of the following is closest to the average density, in grams per cubic centimeter, of Earth's continental crust?

- W) 2.7
- X) 3.3
- Y) 4.5
- Z) 5.5

ANSWER: W) 2.7

**BONUS**

6) Earth and Space – *Multiple Choice* The geologic time scale is divided into eons, eras, periods, epochs [*EH-puks*], and ages. Which of the following best describes how geologic time is divided in the Phanerozoic Eon?

- W) Divisions are based on time periods of equal length
- X) Divisions are based on evidence of paleoclimates
- Y) Divisions are based on domination by groups of major fauna
- Z) Divisions are based on domination by major rock types

ANSWER: Y) DIVISIONS ARE BASED ON DOMINATION BY GROUPS OF MAJOR FAUNA

**TOSS-UP**

7) Life Science – *Short Answer* What molecule is used as the energy currency of the cell due to its high-energy phosphorous-oxygen bonds?

ANSWER: ADENOSINE TRIPHOSPHATE (ACCEPT: ATP)

**BONUS**

7) Life Science – *Short Answer* What specific energetic aspect of a reaction do enzymes reduce?

ANSWER: ACTIVATION ENERGY (ACCEPT: TRANSITION STATE)



**TOSS-UP**

8) Energy – *Short Answer* Scientists at Oak Ridge National Lab are studying the properties of the nuclide nickel-78. If nickel has atomic number 28, how many neutrons does nickel-78 have?

ANSWER: 50

**BONUS**

8) Energy – *Short Answer* Scientists at SLAC [*slack*] are developing low-cost water-purification devices that generate hydrogen peroxide using solar energy, oxygen, and what other molecule?

ANSWER: WATER (ACCEPT: H<sub>2</sub>O)

**TOSS-UP**

9) Earth and Space – *Multiple Choice* Assuming all locations have similar weather conditions, at which of the following locations would you expect a barometer to yield the highest reading?

- W) Key West, Florida
- X) Denver, Colorado
- Y) Chicago, Illinois
- Z) Nashville, Tennessee

ANSWER: W) KEY WEST, FLORIDA

**BONUS**

9) Earth and Space – *Multiple Choice* Oceanic crust ranges in age from newly formed to about 200 million years old. In what area of the ocean floor would you find the oldest crust?

- W) Along the rift valley
- X) Along a continental coastline
- Y) Within the abyssal plain
- Z) Adjacent to an atoll

ANSWER: X) ALONG A CONTINENTAL COASTLINE

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TOSS-UP

10) Physical Science – *Multiple Choice* Kate sips some juice and notices that it is sour. What can she reasonably hypothesize about the juice?

- W) It likely contains an acid
- X) It likely contains a base
- Y) It would likely neutralize with acetic acid
- Z) It would likely neutralize with muriatic acid

ANSWER: W) IT LIKELY CONTAINS AN ACID

BONUS

10) Physical Science – *Short Answer* A carbohydrate contains 15 oxygen atoms. How many hydrogen atoms does it contain?

ANSWER: 30

TOSS-UP

11) Math – *Short Answer* What is the volume of a right rectangular prism with dimensions 3 by 4 by 7?

ANSWER: 84

BONUS

11) Math – *Short Answer* A horse on the outer edge of a circular carousel is 40 feet from the center of rotation. A horse on the inner edge is 15 feet from the center. During a ride of 8.5 rotations, to the nearest hundred feet, how much further in linear distance will the outer horse travel than the inner horse?

ANSWER: 1300

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**TOSS-UP**

12) Energy – *Multiple Choice* Scientists at Lawrence Berkeley National Laboratory have built an observatory to study how rocks fracture, a process that influences greenhouse gas emissions, impacts groundwater, and induces seismicity[*size-MIH-sih-tee*]. In particular, this research is most relevant to the harvesting of what energy resource?

- W) Shale gas
- X) Crude oil
- Y) Geothermal energy
- Z) Cellulosic [*sell-yoo-LOW-sik*] ethanol

ANSWER: W) SHALE GAS

**BONUS**

12) Energy – *Short Answer* Researchers at Lawrence Berkeley National Lab have been studying dendrite formation, a process that limits rechargeable battery life, in next-generation lithium manganese nickel oxide cathodes. These dendrites are primarily composed of what element?

ANSWER: LITHIUM

**TOSS-UP**

13) Physical Science – *Multiple Choice* Which of the following is an example of a chemical change?

- W) Cutting a piece of paper
- X) Boiling water
- Y) Dissolving table salt in water
- Z) Burning toast

ANSWER: Z) BURNING TOAST

**BONUS**

13) Physical Science – *Short Answer* Rank the following three substances in order of increasing viscosity: 1) Honey; 2) Cold water; 3) Hot water.

ANSWER: 3, 2, 1



**TOSS-UP**

14) Life Science – *Short Answer* The structural stability of bone is due to the presence of a highly-mineralized form of what protein?

ANSWER: COLLAGEN

**BONUS**

14) Life Science – *Short Answer* What type of mimicry [*MIH-mik-kree*] is demonstrated by the nonvenomous snake eel, which looks like the highly venomous banded sea snake?

ANSWER: BATESIAN MIMICRY

**TOSS-UP**

15) Earth and Space – *Short Answer* What is the distance, in astronomical units to the nearest whole number, from the Earth to the Sun?

ANSWER: ONE

**BONUS**

15) Earth and Space – *Multiple Choice* Which of the following lengths, in kilometers, is closest to the average distance covered by a single minute of latitude on Earth's surface?

- W) 2
- X) 20
- Y) 50
- Z) 100

ANSWER: W) 2



**TOSS-UP**

16) Math – *Short Answer* If a line is perpendicular to the line with equation  $y = -3x + 4$  at the point (1, 1), what is the slope of the perpendicular line?

ANSWER: 1/3

**BONUS**

16) Math – *Short Answer* Identify all of the following 4 numbers that are divisible by 9: 1) 128; 2) 469; 3) 504; 4) 738.

ANSWER: 3 AND 4 (ACCEPT: 504 AND 738)

**TOSS-UP**

17) Physical Science – *Short Answer* For any given element, the quantity of what particle is specified by its atomic number?

ANSWER: PROTONS

**BONUS**

17) Physical Science – *Short Answer* Identify all of the following three statements that are true of speed and velocity: 1) The average speed always equals the average velocity; 2) The average speed always equals the magnitude of the average velocity; 3) If a particle's position-versus-time graph is a horizontal line, then both its speed and velocity are zero.

ANSWER: 3

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TOSS-UP

18) Life Science – *Multiple Choice* Which of the following structures can be found in an *E. coli* cell?

- W) Endoplasmic reticulum [*reh-TIK-yoo-lum*]
- X) Ribosome
- Y) Mitochondrion
- Z) Nucleus

ANSWER: X) RIBOSOME

BONUS

18) Life Science – *Short Answer* You are looking at a cytological [*sigh-toh-LAW-jih-kul*] map of a chromosome, which has several points indicated on it. To what do each of these points correspond?

ANSWER: GENE (ACCEPT: LOCATION OF A GENE, LOCUS, LOCI)

TOSS-UP

19) Math – *Short Answer* Find the product of the following two radical expressions: $6\sqrt{3}$ times $4\sqrt{3}$.

ANSWER: 72

BONUS

19) Math – *Short Answer* At how many points do the graphs of the following equations intersect? $4x + y = 1$ and $x + 3$ close parenthesis squared plus $y - 3$ close parenthesis squared = 9

ANSWER: 2

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**TOSS-UP**

20) Physical Science – *Short Answer* A body is moving with constant acceleration. In meters per second squared, what is the magnitude of this acceleration if it moves 4 meters in the first second, 7 meters in the next, and 10 meters in the one after that?

ANSWER: 3

**BONUS**

20) Physical Science – *Short Answer* To two significant figures and in newtons, what is the weight of a block on Earth's surface that has a mass of 0.40 kilograms?

ANSWER: 3.9

**TOSS-UP**

21) Earth and Space – *Multiple Choice* Which of the following is closest to the percentage of the Moon’s surface that is illuminated by the Sun during Third Quarter?

- W) 25%
- X) 50%
- Y) 75%
- Z) 100%

ANSWER: X) 50%

**BONUS**

21) Earth and Space – *Short Answer* Identify all of the following three stellar spectral types that can be found in the main sequence: 1) A; 2) G; 3) M.

ANSWER: ALL



**TOSS-UP**

22) Life Science – *Short Answer* A geneticist has stained the chromosomes of a normal adult human cell to create a karyotype [*KAIR-ee-oh-type*]. How many autosomal [*auto-SOHM-al*] chromosomes does she see?

ANSWER: 44

**BONUS**

22) Life Science – *Short Answer* What condition associated with infection during pregnancy with cytomegalovirus [*sigh-toh-MEG-ah-loh-virus*] and Zika virus is characterized by smaller-than-normal head size in infants?

ANSWER: MICROCEPHALY (ACCEPT: LISENCEPHALY)

**TOSS-UP**

23) Math – *Short Answer* If a right triangle has an exterior angle of measure 165 degrees, what is the degree measure of the larger of its acute interior angles?

ANSWER: 75

**BONUS**

23) Math – *Short Answer* Giving your answer in slope-intercept form, what is the equation of the line that contains the points  $(-2, 3)$  and  $(14, -5)$ ?

ANSWER:  $y = (-1/2)x + 2$  (ACCEPT:  $y = -0.5x + 2$ )