

## MIDDLE SCHOOL - ROUND 14A

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### TOSS-UP

1) Earth and Space – *Short Answer* What is the term for sediment with a particle size less than 2 microns?

ANSWER: CLAY

### BONUS

1) Earth and Space – *Multiple Choice* Which of the following correctly describes the typical progression from dead organic matter to coal?

W) Peat, lignite, bituminous [*bih-TOOM-in-us*], anthracite [*AN-thrah-site*]

X) Lignite, peat, bituminous, anthracite

Y) Lignite, bituminous, peat, anthracite

Z) Peat, bituminous, anthracite, lignite

ANSWER: W) PEAT, LIGNITE, BITUMINOUS, AND ANTHRACITE

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### TOSS-UP

2) Physical Science – *Short Answer* Chlorine has an atomic mass of 35.45. Given that chlorine has two naturally-occurring isotopes, chlorine-35 and chlorine-37, then, to the nearest whole number, what percentage of chlorine atoms have a mass number of 35.45?

ANSWER: ZERO

### BONUS

2) Physical Science – *Short Answer* To the nearest gram, what is the mass of two moles of carbon dioxide?

ANSWER: 88

**TOSS-UP**

3) Math – *Short Answer* What is the slope of a line perpendicular to the line with equation  $7x - 4y = -28$ ?

ANSWER:  $-4/7$

**BONUS**

3) Math – *Short Answer* A fence is built along the perimeter of a 200-foot-by-300-foot rectangular field. Posts are placed at the four corners and every 5 feet thereafter. How many posts are required?

ANSWER: 200

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**TOSS-UP**

4) Life Science – *Short Answer* In eukaryotes [*YOO-care-ee-oats*], DNA and histones are organized into what structures?

ANSWER: CHROMOSOMES

**BONUS**

4) Life Science – *Short Answer* What type of microscopy [*my-CRAW-scah-pee*] involves the use of a laser, photomultiplier detector, and a pinhole that ensures elimination of out-of-plane light emitted by the sample?

ANSWER: CONFOCAL

**TOSS-UP**

5) Energy – *Short Answer* Researchers at the Joint BioEnergy Institute are studying ionic liquids as a solvent to break down cellulose before biofuel production. They recently demonstrated that carbon dioxide can be used to lower the cost of the process by reversibly controlling what aspect of the solvent?

ANSWER: pH (ACCEPT: ACIDITY OR BASICITY)

**BONUS**

5) Energy – *Multiple Choice* In 2015, scientists at the National Renewable Energy Lab devised a process to derive adipic [*ah-DIP-ik*] acid from lignin. Adipic acid is used to make what material?

- W) Nylon
- X) Plastic
- Y) Fiberglass
- Z) Acrylic

ANSWER: W) NYLON

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**TOSS-UP**

6) Earth and Space – *Short Answer* What open star cluster located in Taurus is also known as Subaru or the Seven Sisters?

ANSWER: PLEIADES

**BONUS**

6) Earth and Space – *Short Answer* Identify all of the following four types of telescopes that utilize mirrors: 1) Newtonian; 2) Galilean [*gal-ih-LAY-en*]; 3) Cassegrain [*KASS-eh-gren*]; 4) Schmidt-Cassegrain.

ANSWER: 1, 3 AND 4

**TOSS-UP**

7) Physical Science – *Short Answer* For a given system, what is the term for the frequency at which a forced oscillation onto a system will result in maximal energy delivered?

ANSWER: RESONANT

**BONUS**

7) Physical Science – *Short Answer* Identify all of the following three waves that contain transverse modes of oscillation: 1) Water; 2) Light; 3) Sound.

ANSWER: 1 AND 2

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**TOSS-UP**

8) Energy – *Multiple Choice* DOE researchers recently were able to capture a 3D sequence of the water-splitting reaction of photosynthesis in action. The oxygen atoms released by this step are eventually incorporated by photosynthesis into what molecule?

- W) Carbon dioxide
- X) Oxygen gas
- Y) G3P
- Z) Glucose

ANSWER: X) OXYGEN GAS

**BONUS**

8) Energy – *Short Answer* Scientists on the Dzero [*dee-zero*] experiment at Fermilab announced that they have discovered the decay pathways that result in the creation of what quark, the heaviest one known?

ANSWER: TOP QUARK

**TOSS-UP**

9) Math – *Short Answer* In triangle A-B-C, angle A measures 43 degrees and angle B measures 112 degrees. What is the degree measure of one of the exterior angles formed at vertex C?

ANSWER: 155

**BONUS**

9) Math – *Short Answer* Given the prime factorizations of the following two numbers, what is their greatest common divisor?  $2^5$  times  $5^2$  times 7 and  $2^2$  times  $3^3$  times 5 times  $7^2$

ANSWER: 140

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**TOSS-UP**

10) Earth and Space – *Short Answer* What principle of relative dating states that younger rocks are found on top of older rocks?

ANSWER: SUPERPOSITION

**BONUS**

10) Earth and Space – *Short Answer* The first amphibians appeared during the Devonian [*deh-VOH-nee-an*] period. What eon and era was this?

ANSWER: EON: PHANEROZOIC; ERA: PALEOZOIC

**TOSS-UP**

11) Life Science – *Short Answer* The Komodo dragon is a part of what phylum [*FYE-lum*]?

ANSWER: CHORDATA [*kor-DAH-tah*]

**BONUS**

11) Life Science – *Short Answer* Identify all of the following three statements that are true of biomes:

1) Oceanic pelagic [*peh-LAJ-ik*] biomes [*BY-ohms*] are the largest biomes, by area, on the Earth; 2) In pelagic zones, there is little photosynthesis compared to deciduous [*deh-SID-yoo-us*] forests; 3) Intertidal zones have high oxygen levels relative to other oceanic biomes.

ANSWER: 1 AND 3

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**TOSS-UP**

12) Math – *Short Answer* What is 49 times 16?

ANSWER: 784

**BONUS**

12) Math – *Short Answer* Solve the following equation for  $x$ : the square root of open parenthesis  $3x + 1$  close parenthesis =  $x - 3$

ANSWER: 8 (DO NOT ACCEPT: 1)

**TOSS-UP**

13) Energy – *Short Answer* Researchers at SLAC [*slack*] are developing solar-based methods of fertilizer production via the SUNCAT project. This project's goal is to create a sustainable source of fertilizer to deliver what specific element to plants?

ANSWER: NITROGEN

**BONUS**

13) Energy – *Short Answer* Scientists at SLAC [*slack*] are developing methods to extract uranium from the largest reservoir of uranium, which is also completely untapped. Where is this untapped uranium most likely to be found?

ANSWER: OCEANS (ACCEPT: SEA WATER)

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**TOSS-UP**

14) Life Science – *Multiple Choice* Which of the following organisms has most of its genes organized into operons?

- W) Human
- X) Bird
- Y) E. coli
- Z) Yeast

ANSWER: Y) E. COLI

**BONUS**

14) Life Science – *Multiple Choice* For a certain uncatalyzed reaction, a chemist observes that the rate of the reaction appears to double with every 10-kelvin increase in temperature. The chemist then adds a human enzyme that is known to increase the reaction rate one million-fold within its effective temperature and does the same experiment. Which of the following will they likely observe at some stage in the experiment?

- W) The reaction rate doubles every 10 kelvin increase in temperature over all temperature ranges
- X) The reaction rate more than doubles every 10 kelvin increase in temperature over all temperature ranges
- Y) The reaction rate more than doubles every 10 kelvin increase until a certain temperature, then begins to decrease
- Z) The reaction rate less than doubles every 10 kelvin increase in temperature over all temperature ranges

ANSWER: Y) THE REACTION RATE MORE THAN DOUBLES EVERY 10 KELVIN INCREASE UNTIL A CERTAIN TEMPERATURE, THEN BEGINS TO DECREASE

**TOSS-UP**

15) Math – *Short Answer* A fair 12-sided die has faces numbered with the integers from 1 through 12. If it is rolled once, what is the probability that the result is a multiple of 5?

ANSWER: 1/6

**BONUS**

15) Math – *Short Answer* A flower bed is formed in the shape of a 150-degree sector of a circle of radius 6 feet. To the nearest foot, what is the perimeter of the flower bed?

ANSWER: 28

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**TOSS-UP**

16) Earth and Space – *Short Answer* Heavy-element fusion in a star must end at what element, due to its inability to be used as fuel?

ANSWER: IRON

**BONUS**

16) Earth and Space – *Short Answer* In Kepler's model of planetary motion, the orbital period of a planet is proportional to what power of the planet's average distance from the Sun?

ANSWER: 1.5

**TOSS-UP**

17) Physical Science – *Short Answer* What is the chemical formula for ferric oxide?

ANSWER: Fe<sub>2</sub>O<sub>3</sub>

**BONUS**

17) Physical Science – *Short Answer* How many moles of oxygen gas are required to completely combust a mole of ethane?

ANSWER: 3.5 (ACCEPT: 7/2, 3½)

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**TOSS-UP**

18) Life Science – *Multiple Choice* Which of the following organisms exhibits radial symmetry?

- W) Human
- X) Nautilus
- Y) Sea star
- Z) Fluke

ANSWER: Y) SEA STAR

**BONUS**

18) Life Science – *Multiple Choice* Baroreceptors in the human brain are responsible for monitoring which of the following quantities?

- W) CSF acidity
- X) Position and stretching of smooth muscles
- Y) Blood pressure
- Z) Relative position of the head with respect to gravity

ANSWER: Y) BLOOD PRESSURE

**TOSS-UP**

19) Earth and Space – *Short Answer* Variable stars will pulsate in size due to the ionized form of what element acting as a compressible spring?

ANSWER: HELIUM

**BONUS**

19) Earth and Space – *Short Answer* Solar eclipses follow the Saros cycle, which is approximately 18 years long. In lunar months, the cycle is exactly how long?

ANSWER: 223



**TOSS-UP**

20) Physical Science – *Short Answer* The explosive power of TNT is due to the presence of what functional group?

ANSWER: NITRO (ACCEPT: NO<sub>2</sub>)

**BONUS**

20) Physical Science – *Short Answer* Identify all of the following three statements that are true of organic chemistry: 1) Only living organisms can produce organic compounds; 2) Monosaccharides are the building blocks of peptides; 3) Alcohols contain hydroxyl groups.

ANSWER: 3

**TOSS-UP**

21) Life Science – *Short Answer* During what phase of mitosis does the nucleus re-form around each set of chromosomes?

ANSWER: TELOPHASE

**BONUS**

21) Life Science – *Short Answer* Identify all of the following three cell types that secrete collagen:

1) Monocyte [*MAWN-oh-site*]; 2) Fibroblast; 3) Erythrocyte [*eh-RITH-roh-site*].

ANSWER: 2



**TOSS-UP**

22) Math – *Short Answer* Evaluate  $\log_{10} 250 + \log_{10} 40$ .

ANSWER: 4

**BONUS**

22) Math – *Short Answer* Using the origin as center, the point with coordinates  $(-1, 2)$  is dilated by a factor of 3, and then the result is rotated by 90 degrees counterclockwise. What are the coordinates of the final image point?

ANSWER:  $(-6, -3)$

### TOSS-UP

23) Physical Science – *Multiple Choice* Which of the following separation techniques utilizes a moving phase and a stationary phase to separate the components of a mixture?

- W) Distillation
- X) Chromatography
- Y) Reverse osmosis
- Z) Filtration

ANSWER: X) CHROMATOGRAPHY

### BONUS

23) Physical Science – *Short Answer* Certain substances such as bismuth, antimony, tin, and copper are repelled by magnetic fields. What is this property called?

ANSWER: DIAMAGNETISM