

## MIDDLE SCHOOL - ROUND 15A

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### TOSS-UP

1) Energy – *Short Answer* Researchers at Lawrence Berkeley National Lab have developed covalent [*koh-VAY-lent*] organic frameworks capable of partially reducing CO<sub>2</sub> to what compound used in the production of fuels, pharmaceuticals, and plastics?

ANSWER: CARBON MONOXIDE (ACCEPT: CO)

### BONUS

1) Energy – *Multiple Choice* Researchers at Ames Lab are examining flexible solar cells using electron paramagnetic resonance, a technique that allows examinations of unpaired electrons. Which of the following structures can be studied using this technique?

- W) Free radicals
- X) Nitrogen gas
- Y) Glucose
- Z) Alkanes

ANSWER: W) FREE RADICALS

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### TOSS-UP

2) Earth and Space – *Short Answer* Identify all of the following three processes that are considered net sinks of carbon dioxide: 1) Calcite precipitation; 2) Respiration; 3) Photosynthesis.

ANSWER: 1 AND 3

### BONUS

2) Earth and Space – *Multiple Choice* An endorheic [*endo-REE-ik*] lake lacks which of the following features?

- W) Fish
- X) Confining aquitard
- Y) River outlets
- Z) Annual turnover cycle

ANSWER: Y) RIVER OUTLETS

**TOSS-UP**

3) Life Science – *Multiple Choice* Which of the following human organs has the largest mass?

- W) Kidneys
- X) Spleen
- Y) Lungs
- Z) Pancreas

ANSWER: Y) LUNGS

**BONUS**

3) Life Science – *Short Answer* Identify all of the following three structures that are considered plant organs: 1) Tracheids [*TRAY-kee-ids*]; 2) Roots; 3) Leaves.

ANSWER: 2 AND 3

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**TOSS-UP**

4) Physical Science – *Short Answer* What SI unit is equivalent to one joule divided by one watt?

ANSWER: SECOND

**BONUS**

4) Physical Science – *Short Answer* A stationary spring with spring constant of 10 kilograms per second squared pushes horizontally against a 2-kilogram brick on the floor. The spring is able to be compressed up to 40 centimeters without the brick moving. To the nearest tenth, what is the coefficient of static friction between the brick and the floor?

ANSWER: 0.2

**TOSS-UP**

5) Earth and Space – *Short Answer* What hydrogen-containing compound comprises the upper-most cloud layers on Jupiter?

ANSWER: AMMONIA (ACCEPT: NH<sub>3</sub>, DO NOT ACCEPT: AMMONIUM)

**BONUS**

5) Earth and Space – *Short Answer* Identify all of the following three statements that are true of stellar spectroscopy [*spek-TRAW-scuh-pee*]: 1) Spectral emission lines are typically narrow; 2) Emission lines can be used to identify elements in the Sun; 3) Emission lines correspond to electron energy level transitions.

ANSWER: ALL

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**TOSS-UP**

6) Math – *Multiple Choice* Which of the following translations changes the graph of  $y = x^2$  into that of  $y = \text{open parenthesis } x + 4 \text{ close parenthesis squared minus } 6$ ?

- W) 6 units down and 4 units to the left
- X) 6 units down and 4 units to the right
- Y) 6 units up and 4 units to the left
- Z) 6 units up and 4 units to the right

ANSWER: W) 6 UNITS DOWN AND 4 UNITS TO THE LEFT

**BONUS**

6) Math – *Short Answer* Two runners each run a 200-meter race at a constant pace, finishing in 23 and 26 seconds, respectively. To the nearest whole number, how many meters separate them when the winner finishes?

ANSWER: 23

**TOSS-UP**

7) Energy – *Short Answer* What is the oxidant in a zinc-air battery?

ANSWER: OXYGEN

**BONUS**

7) Energy – *Multiple Choice* Scientists at Argonne National Lab have been using Bragg coherent diffraction imaging to probe the structures of nanometer-sized crystals. What part of the electromagnetic spectrum is used for this imaging?

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

ANSWER: W) X-RAY

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**TOSS-UP**

8) Earth and Space – *Short Answer* In what era did the supercontinent Pangaea [*pan-JEE-ah*] break up?

ANSWER: MESOZOIC

**BONUS**

8) Earth and Space – *Short Answer* Place the following three reef types in increasing order of age:

- 1) Fringing; 2) Atoll [*at-OHLL*]; 3) Barrier.

ANSWER: 1, 3, 2

**TOSS-UP**

9) Physical Science – *Short Answer* What is the term for a substance that slows down a chemical reaction?

ANSWER: INHIBITOR

**BONUS**

9) Physical Science – *Short Answer* Identify all of the following three molecules that are aromatic:  
1) Benzene; 2) Cyclohexane; 3) Hexane.

ANSWER: 1

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**TOSS-UP**

10) Energy – *Multiple Choice* A collaboration between Harvard University and Argonne National Lab researchers is studying peptidoglycan [*peptihdo-GLY-can*] breakdown. Which of the following enzymes catalyzes this process?

- W) Amylase [*AM-ill-ace*]
- X) Peptidase [*PEP-tihd-ace*]
- Y) Lysozyme [*LYE-soh-zime*]
- Z) Catalase

ANSWER: Y) LYSOZYME

**BONUS**

10) Energy – *Multiple Choice* Researchers at Ames National Lab discovered a zinc-platinum catalytic particle that achieves what desirable pairing of physical properties?

- W) Low surface area, low volume
- X) High surface area, low volume
- Y) Low surface area, high volume
- Z) High surface area, high volume

ANSWER: X) HIGH SURFACE AREA, LOW VOLUME

**TOSS-UP**

11) Math – *Short Answer* Convert two-five in base 7 to base 10.

ANSWER: 19

**BONUS**

11) Math – *Short Answer* A rhombus has sides of length 10 and largest angle of measure 120 degrees. What is its area?

ANSWER:  $50\sqrt{3}$

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**TOSS-UP**

12) Life Science – *Multiple Choice* Over hundreds of years, a population of black worms slowly stratifies into a group of ground-dwelling worms and a group of tree-dwelling worms. What type of isolation is observed here?

- W) Behavioral isolation
- X) Temporal isolation
- Y) Habitat isolation
- Z) Gametic [*gah MEE-tic*] isolation

ANSWER: Y) HABITAT ISOLATION

**BONUS**

12) Life Science – *Short Answer* Identify all of the following three molecules that are produced by glycolysis [*glye-KAWL-eh-sis*]: 1) Pyruvate [*pie-ROO-vate*]; 2) ATP; 3) NADH.

ANSWER: ALL

**TOSS-UP**

13) Physical Science – *Short Answer* Galena, pyrite, and cinnabar are all metal ores that contain what nonmetal element?

ANSWER: SULFUR

**BONUS**

13) Physical Science – *Multiple Choice* When measuring liquid in a buret [*byur-ET*], your eyes should be at the same height as the top of the liquid for accurate measurement. This is a best practice to correct for what?

- W) Concave meniscus
- X) Convex meniscus
- Y) Parallax
- Z) Preventing the formation of bubbles

ANSWER: Y) PARALLAX

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**TOSS-UP**

14) Math – *Short Answer* In a right triangle, what is the sine of an angle with a cosine of one-third the square root of 5?

ANSWER: 2/3

**BONUS**

14) Math – *Short Answer* What number must be added to the polynomial  $2x^2 + 14x$  to complete the square?

ANSWER: 49/2 (ACCEPT: 24½ , 24.5)

**TOSS-UP**

15) Earth and Space – *Short Answer* The Japanese used a powerful weather force to send balloons with bombs across the Pacific to the US during WWII. This relied on what strong westerly air current located near the tropopause?

ANSWER: THE JET STREAM

**BONUS**

15) Earth and Space – *Multiple Choice* Local water table levels vary over time in response to a variety of factors. Which of the following statements best describes the cause of the formation of a "cone of depression?"

- W) Pumping rate exceeds recharge rate in an aquifer
- X) Water flows out of the aquifer into a gaining stream
- Y) Permeability [*pur-mee-ah-BIL-ih tee*] decreases due to a drought
- Z) A flowing artesian well remains uncapped for a long period of time

ANSWER: W) PUMPING RATE EXCEEDS RECHARGE RATE IN AN AQUIFER



**TOSS-UP**

16) Life Science – *Short Answer* What kingdom, originally described by Carl Woese [*wohz*], contains many extremophile [*extreme-oh-file*] prokaryotes [*PRO-care-ee-oats*]?

ANSWER: ARCHAEA (ACCEPT: ARCHEABACTERIA)

**BONUS**

16) Life Science – *Multiple Choice* Sharks have repeated rows of identical teeth that are shed throughout their lives. Which of the following best categorizes their teeth?

- W) Heterodont [*HET-ur-oh-dawnt*]
- X) Hypsodont [*HIP-soh-dawnt*]
- Y) Homodont
- Z) Diphyodont [*dye-FYE-oh-dawnt*]

ANSWER: Y) HOMODONT



**TOSS-UP**

17) Physical Science – *Short Answer* What general type of reaction involves the reaction of an acid with a base to form water and salt?

ANSWER: NEUTRALIZATION

**BONUS**

17) Physical Science – *Short Answer* Identify all of the following three terms that can always be used to describe a compound with a carbon-carbon double bond: 1) Saturated; 2) Alkene; 3) Polymer.

ANSWER: 2

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**TOSS-UP**

18) Earth and Space – *Multiple Choice* Which of the following **MUST** be true of an H-two region?

- W) It contains large specks of dust
- X) It is close to one or more hot stars
- Y) It is close to one or more cold stars
- Z) It is neutral in charge

ANSWER: X) IT IS CLOSE TO ONE OR MORE HOT STARS

**BONUS**

18) Earth and Space – *Multiple Choice* The r- and s-processes can occur in the cores of massive stars, enabling them to do what?

- W) Create nuclei [*NEW-klee-eye*] heavier than iron
- X) Generate electron degeneracy pressure
- Y) Create more protons to support the core
- Z) Fuse elements such as silicon

ANSWER: W) CREATE NUCLEI HEAVIER THAN IRON

**TOSS-UP**

19) Life Science – *Short Answer* What is the term for the post-translational modification of an amino acid residue by a kinase [*KYE-nayse*]?

ANSWER: PHOSPHORYLATION

**BONUS**

19) Life Science – *Short Answer* Gram-positive bacteria are so named because they show up purple under a Gram stain. What polymer in their cell wall causes them to turn purple?

ANSWER: PEPTIDOGLYCAN [*peptihdo-GLY-can*]

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**TOSS-UP**

20) Math – *Short Answer* What is the degree of the product of the three binomials  $x + 3$ ,  $x^5 + x^3$ , and  $x^4 - 4$ ?

ANSWER: 10

**BONUS**

20) Math – *Short Answer* Given the arithmetic sequence with first three terms  $-10, -4, 2$ , what is the 118th term?

ANSWER: 692

**TOSS-UP**

21) Physical Science – *Short Answer* What is the ratio of the intensity of an 80-decibel sound to that of a 40-decibel sound?

ANSWER: 10,000 (ACCEPT: 10,000 TO 1)

**BONUS**

21) Physical Science – *Short Answer* The speed of waves on a 6-meter string fixed at both ends is 5 meters per second. In hertz, what is the frequency of the third harmonic?

ANSWER: 5/4 (ACCEPT: 1.25)

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**TOSS-UP**

22) Math – *Short Answer* If two similar triangles have a scale factor of  $\frac{3}{5}$ , and a side of the larger has length 8, what is the length of the corresponding side of the smaller triangle?

ANSWER:  $\frac{24}{5}$  (ACCEPT: 4.8, 4  $\frac{4}{5}$ )

**BONUS**

22) Math – *Short Answer* What is the units digit of 3 to the 2018<sup>th</sup> power?

ANSWER: 9

### TOSS-UP

23) Life Science – *Short Answer* What method for identifying protein structures involves the interpretation of diffraction patterns of proteins in the solid state?

ANSWER: X-RAY CRYSTALLOGRAPHY (ACCEPT: X-RAY DIFFRACTION, DO NOT ACCEPT: X-RAY)

### BONUS

23) Life Science – *Multiple Choice* Which of the following does NOT occur during prometaphase [*pro-MEHTA-phase*]?

W) The nuclear membrane dissolves

X) Chromatids [*CROW-mah-tids*] arrive at opposite cell poles

Y) Kinetochores [*kin-EHT-oh-cores*] form as proteins attached to centromeres [*SEN-troh-meers*]

Z) Microtubules [*micro-TUBE-yules*] attach to kinetochores

ANSWER: X) CHROMATIDS ARRIVE AT OPPOSITE CELL POLES