

## MIDDLE SCHOOL - ROUND 16A

---

### TOSS-UP

1) Energy – *Short Answer* Researchers at Oak Ridge National Lab found that exposing a solution of guanidine [**GWAH-nih-deen**] to air resulted in the formation of carbonate crystals, indicating absorption of what atmospheric compound?

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

### BONUS

1) Energy – *Short Answer* Researchers at Lawrence Berkley National Lab are using the Advanced Light Source to study how a group of highly porous organic materials can capture heavy metal cations [**CAT-eye-onz**] and sequester them away. What is the term for this large group of compounds?

ANSWER: METAL-ORGANIC FRAMEWORKS (ACCEPT: MOFs)

~~~~~

### TOSS-UP

2) Physical Science – *Short Answer* Capacitance describes the ratio of the electric charge stored in a capacitor to what quantity?

ANSWER: VOLTAGE (ACCEPT: ELECTRIC POTENTIAL)

### BONUS

2) Physical Science – *Short Answer* A 4-kilogram block moving at 3 meters per second collides elastically with a 2-kilogram block at rest. In meters per second, what is the final velocity of the lighter block?

ANSWER: 4

**TOSS-UP**

3) Earth and Space – *Short Answer* What measure of angular distance is the celestial equivalent of latitude?

ANSWER: DECLINATION

**BONUS**

3) Earth and Space – *Short Answer* Identify all of the following three statements that are true of gas giants in our solar system: 1) They have a lower density than terrestrial planets; 2) They have a slower rotational period than terrestrial planets; 3) They all have rings.

ANSWER: 1 AND 3

~~~~~  
**TOSS-UP**

4) Life Science – *Multiple Choice* Which part of a dicot [*DYE-kawt*] seed has the greatest concentration of carbohydrates?

- W) Cotyledon [*kaw-til-EE-dun*]
- X) Seed coat
- Y) Endosperm
- Z) Epicotyl [*EH-pih-caw-dil*]

ANSWER: Y) ENDOSPERM

**BONUS**

4) Life Science – *Short Answer* Identify all of the following three amino acids that, when found on the surface of a protein, increase its water solubility: 1) Arginine [*AR-jih-neen*]; 2) Isoleucine [*eye-so-LOO-seen*]; 3) Valine [*VAIL-een*].

ANSWER: 1

**TOSS-UP**

5) Physical Science – *Short Answer* What are the chemical formulas for the products of the autoprotolysis of water?

ANSWER:  $\text{H}_3\text{O}^+$  and  $\text{OH}^-$  (IN ANY ORDER, DO NOT ACCEPT:  $\text{H}^+$ )

**BONUS**

5) Physical Science – *Multiple Choice* In any given row of the periodic table, which of the following families typically has the largest neutral atomic radius?

- W) Alkali metals
- X) Alkaline earth metals
- Y) Halogens
- Z) Noble gases

ANSWER: W) ALKALI METALS

~~~~~  
**TOSS-UP**

6) Math – *Short Answer* The measure of an exterior angle of a regular polygon is 15 degrees. How many sides does the polygon have?

ANSWER: 24

**BONUS**

6) Math – *Multiple Choice* Which of the following is a factor of the polynomial  $2x^3 - 7x^2 - 10x + 24$ ?

- W)  $x + 1$
- X)  $x + 2$
- Y)  $x + 3$
- Z)  $x + 4$

ANSWER: X)  $x + 2$

### TOSS-UP

7) Earth and Space – *Multiple Choice* What astronomical term is used to describe the high-luminosity end of the observed main-sequence stars in a given cluster?

- W) Main-sequence threshold mass
- X) Main-sequence turnoff point
- Y) Main-sequence temperature limit
- Z) Main-sequence horizontal branch

ANSWER: X) MAIN-SEQUENCE TURNOFF POINT

### BONUS

7) Earth and Space – *Short Answer* What type of spiral galaxy has an active galactic nucleus that is highly luminous and has a uniquely specific spectrum?

ANSWER: SEYFERT GALAXY

~~~~~

### TOSS-UP

8) Energy – *Multiple Choice* DOE researchers have been studying metastable materials, such as diamond. These materials are not thermodynamically stable but take a long time to be converted to more stable forms. Which of the following best explains why?

- W) The products have higher delta G values
- X) The products have lower delta G values
- Y) The activation energy for conversion is very high
- Z) The activation energy for conversion is very low

ANSWER: Y) THE ACTIVATION ENERGY FOR CONVERSION IS VERY HIGH

### BONUS

8) Energy – *Multiple Choice* Scientists at SLAC [*slack*] are studying excited state proton transfers by using light produced in the Linac [*LIH-nak*] Coherent Light Source to excite molecules of 2-thiopyridone [*two-thigh-oh-PEER-id-own*]. Their observations are most relevant to what system?

- W) DNA damage by ultraviolet light
- X) Lightfastness of textile dyes
- Y) Buffering by organic bases
- Z) Acidity of superacids

ANSWER: W) DNA DAMAGE BY ULTRAVIOLET LIGHT

**TOSS-UP**

9) Math – *Short Answer* Besides itself, what is the largest integer factor of 459?

ANSWER: 153

**BONUS**

9) Math – *Short Answer* A bag contains 13 different mini candy bars. How many different sets of 3 of them can be selected?

ANSWER: 286

~~~~~  
**TOSS-UP**

10) Life Science – *Multiple Choice* A scientist discovers a new single-cell organism that can concurrently produce mRNA from DNA and read the mRNA to produce protein. What is the likeliest classification of this organism?

- W) Fungi [*fun-jī*]
- X) Bacteria
- Y) Protozoa
- Z) Algae [*AL-jee*]

ANSWER: X) BACTERIA

**BONUS**

10) Life Science – *Short Answer* Algae [*AL-jee*] do not have distinct organs like plants do, but brown algae possess a root-like structure used to attach to surfaces. What is the name for this structure?

ANSWER: HOLDFAST

**TOSS-UP**

11) Earth and Space – *Short Answer* Identify all of the following three rock types that may contain the mineral quartz: 1) Igneous; 2) Sedimentary; 3) Metamorphic.

ANSWER: ALL

**BONUS**

11) Earth and Space – *Multiple Choice* Which of the following minerals will NEVER fizz and release CO<sub>2</sub> as a result of applying hydrochloric acid?

- W) Calcite
- X) Aragonite
- Y) Dolomite
- Z) Anhydrite

ANSWER: Z) ANHYDRITE

~~~~~  
**TOSS-UP**

12) Energy – *Multiple Choice* Which of the following is not a contributor to increased power generation from a wind turbine?

- W) Greater hub height
- X) Onshore location
- Y) Greater rotor diameter
- Z) Offshore location

ANSWER: X) ONSHORE LOCATION

**BONUS**

12) Energy – *Short Answer* Identify all of the following three terms that apply to a Leclanche [*lah-KLAN-shay*] zinc-carbon battery: 1) Secondary cell; 2) Dry cell; 3) Rechargeable.

ANSWER: 2

**TOSS-UP**

13) Math – *Short Answer* A polyhedron has 5 faces. Identify all of the following 3 types of polyhedra it could be: 1) Regular polyhedron; 2) Prism; 3) Pyramid

ANSWER: 2 AND 3

**BONUS**

13) Math – *Short Answer* What is the area of a triangle with sides of length 9, 9, and 8?

ANSWER:  $4\sqrt{65}$

~~~~~  
**TOSS-UP**

14) Life Science – *Multiple Choice* Mammals became dominant after a mass extinction at the end of what period?

- W) Devonian [*deh-VOH-nee-an*]
- X) Permian [*PURR-mee-en*]
- Y) Triassic
- Z) Cretaceous [*creh-TAY-shus*]

ANSWER: Z) CRETACEOUS

**BONUS**

14) Life Science – *Short Answer* You bang your elbow by accident, and your whole forearm begins to tingle. What nerve is responsible for you "hitting your funny bone?"

ANSWER: ULNAR NERVE

### TOSS-UP

15) Earth and Space – *Short Answer* Different colors of light have slightly different indices of refraction, resulting in slightly different focal points. What is the adjective for the aberration that arises due to this physical phenomenon?

ANSWER: CHROMATIC

### BONUS

15) Earth and Space – *Short Answer* Identify all of the following three statements that are true of Cepheid [*SEF-ee-id*] variables: 1) Most Cepheid variables are less than ten solar masses; 2) Longer-period Cepheid stars are more luminous than shorter-period Cepheid stars; 3) The fastest known Cepheid star has a period of 3 years.

ANSWER: 2

~~~~~

### TOSS-UP

16) Physical Science – *Multiple Choice* A student is preparing 500 milliliters of a 6-millimolar solution of copper (II) sulfate. Which of the following pieces of glassware would be best for the most precise measurement of 500 milliliters of this solution?

- W) Volumetric flask
- X) Erlenmeyer flask
- Y) Graduated cylinder
- Z) Beaker

ANSWER: W) VOLUMETRIC FLASK

### BONUS

16) Physical Science – *Short Answer* Nitrogen dioxide gas reacts with fluorine gas to form nitryl fluoride,  $\text{FNO}_2$ . What is the sum of the coefficients of this balanced chemical reaction?

ANSWER: FIVE

**TOSS-UP**

17) Life Science – *Multiple Choice* Which of the following is NOT a commonly-used model organism?

- W) *Drosophila melanogaster* [*droh-SAWF-il-ah mel-AH-no-gas-tur*]
- X) *Mus musculus*
- Y) *Caenorhabditis elegans* [*SEE-nor-hab-dye-tis el-eh-GANS*]
- Z) *Homo habilis* [*HAA-beh-lis*]

ANSWER: Z) HOMO HABILIS

**BONUS**

17) Life Science – *Multiple Choice* Which of the following locations in a chloroplast has the highest acidity?

- W) Granum
- X) Thylakoid [*THIGH-la-koid*] lumen
- Y) Stroma
- Z) Intermembrane space

ANSWER: X) THYLAKOID LUMEN

~~~~~  
**TOSS-UP**

18) Math – *Short Answer* Solve the following equation for  $x$ : open absolute value  $x - 6$  close absolute value equals 7.

ANSWER: -1, 13 (must give both answers)

**BONUS**

18) Math – *Short Answer* A right circular cone has volume 72. A second cone has one-third the radius and 6 times the height of the first. What is the volume of the second cone?

ANSWER: 48

**TOSS-UP**

19) Earth and Space – *Multiple Choice* Working in the field you encounter a series of fossil-rich sedimentary layers. You identify: paradoxides [*para-DOX-ih-dees*] trilobites, mucrospirifer [*mah-kroh-SPEER-ih-fur*] brachiopods [*BRAK-ee-oh-pods*], horn corals, and crinoids [*CRY-noyds*]. You recognize them as index fossils representing what era of geologic time?

- W) Precambrian
- X) Paleozoic [*PAY-leo-ZO-ik*]
- Y) Mesozoic [*MEH-zoh-ZOH-ik*]
- Z) Cenozoic [*SEN-oh-ZOH-ik*]

ANSWER: X) PALEOZOIC

**BONUS**

19) Earth and Space – *Short Answer* Identify all of the following three comparisons of hurricanes and tornadoes that are true: 1) In the Northern Hemisphere, hurricanes and tornados both rotate clockwise; 2) Tornadoes typically require a significant temperature gradient to form, while hurricanes do not; 3) The maximum sustained wind speeds of the strongest observed tornadoes are greater than those of the strongest observed hurricanes.

ANSWER: 2 AND 3

~~~~~  
**TOSS-UP**

20) Physical Science – *Short Answer* For a concave mirror, what is the term for the point through which all rays parallel to the optical axis are reflected?

ANSWER: FOCAL POINT

**BONUS**

20) Physical Science – *Short Answer* Identify all of the following three statements that are true of magnetism: 1) Magnetic fields are produced by stationary and moving charges; 2) Magnetic fields cannot exert forces on moving charges; 3) A wire with a current traveling through it generates a magnetic field.

ANSWER: 3

**TOSS-UP**

21) Math – *Short Answer* A group of 12 people took a trivia test. Jack’s score of 55 ranked him 7th on the list, right after Jill. If the median of all scores was 61.5, what was Jill’s score?

ANSWER: 68

**BONUS**

21) Math – *Short Answer* Six different 4-digit numbers can be formed from the digits 2, 2, 3, 3. What is the sum of those 6 numbers?

ANSWER: 16,665

~~~~~  
**TOSS-UP**

22) Life Science – *Short Answer* A scientist has fluorescently labelled enzymes of the Calvin cycle. To what organelle does the color localize?

ANSWER: CHLOROPLAST

**BONUS**

22) Life Science – *Short Answer* Antidiuretic [*anti-dye-yur-EH-tic*] hormone acts by stimulating the production of water channels in the kidney. What are these channels called?

ANSWER: AQUAPORINS

### TOSS-UP

23) Physical Science – *Multiple Choice* In commercial bronze, which of the following terms best describes the copper?

- W) Alloy
- X) Mixture
- Y) Solute
- Z) Solvent

ANSWER: Z) SOLVENT

### BONUS

23) Physical Science – *Short Answer* What catalyzed process is used to create ammonia from hydrogen and nitrogen gas?

ANSWER: HABER PROCESS (ACCEPT: HABER-BOSCH)