

## MIDDLE SCHOOL - ROUND 8A

---

### TOSS-UP

1) Physical Science – *Short Answer* The backwards recoil of firing an air-rifle is best attributable to the conservation of what quantity?

ANSWER: MOMENTUM

### BONUS

1) Physical Science – *Short Answer* If the fundamental frequency of a guitar string is 260 hertz, what is the frequency, in hertz, of the second harmonic?

ANSWER: 520

~~~~~

### TOSS-UP

2) Earth and Space – *Multiple Choice* Which of the following best explains why the moon appears red during a total lunar eclipse?

- W) Reflection off other planetary surfaces
- X) Scattering by dust in lunar orbit
- Y) Refraction through the Earth's atmosphere
- Z) Blackbody emission of light

ANSWER: Y) REFRACTION THROUGH THE EARTH'S ATMOSPHERE

### BONUS

2) Earth and Space – *Short Answer* Identify all of the following three models of the solar system that are geocentric: 1) Copernican [*koh-PER-nah-can*]; 2) Ptolemaic [*Tall-eh-MAY-ik*]; 3) Tychonic [*tee-KAWN-ik*].

ANSWER: 2 AND 3

**TOSS-UP**

3) Math – *Short Answer* The temperature at 9 AM was 67 degrees Fahrenheit. If the temperature rose 3 degrees per hour, what was the temperature, in degrees Fahrenheit, at 3 PM?

ANSWER: 85

**BONUS**

3) Math – *Short Answer* What is  $16/35$  minus  $12/25$ ?

ANSWER:  $-4/175$

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

4) Energy – *Short Answer* DOE researchers recently demonstrated the creation of a 2D transistor by etching molybdenum [*muh-LIB-den-um*] selenide [*SELL-en-ide*] into a pre-existing sheet of a 2D conductor. What is the common name of the conductor they used?

ANSWER: GRAPHENE

**BONUS**

4) Energy – *Short Answer* SLAC [*slack*] scientists shined high-energy X-ray laser pulses into various solid samples, resulting in the ejection of high-energy electrons. These ultra-high intensity pulses last for only 1 femtosecond. Expressing your answer as 10 raised to a power, how many femtoseconds are in one second?

ANSWER:  $10^{15}$

**TOSS-UP**

5) Life Science – *Short Answer* What domain of life is the kingdom Animalia classified under?

ANSWER: EUKARYA

**BONUS**

5) Life Science – *Multiple Choice* A hospital technician centrifuges a vial of blood and notices a very thin milky white layer between two large layers. What can be found in these layers?

- W) Plasma
- X) Red blood cells
- Y) Bacteria
- Z) Leukocytes

ANSWER: Z) LEUKOCYTES

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

6) Earth and Space – *Multiple choice* Which of these minerals would scratch all of the others?

- W) Fluorite
- X) Orthoclase
- Y) Gypsum
- Z) Calcite

ANSWER: X) ORTHOCLASE

**BONUS**

6) Earth and Space – *Multiple Choice* What is the term for the maximum slope angle that a pile of loose sediment can sustain without falling or rolling downward?

- W) Interior angle
- X) Exterior angle
- Y) Angle of consolidation
- Z) Angle of repose

ANSWER: Z) ANGLE OF REPOSE

**TOSS-UP**

7) Energy – *Short Answer* Researchers at Brookhaven National Lab, through the Daya [*DIE-ah*] Bay collaboration, are studying the particles that carry away about 5 percent of the energy released when uranium atoms in a fission reactor split. What particles are they studying?

ANSWER: NEUTRINOS (ACCEPT: ANTI-NEUTRINOS)

**BONUS**

7) Energy – *Short Answer* DOE scientists have developed a method to visualize electric fields with a camera that uses a one-atom-thick semiconductor as a sensor. This semiconductor is composed of what element?

ANSWER: CARBON

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

8) Math – *Short Answer* What is the multiplicative inverse of  $-3/2$ ?

ANSWER:  $-2/3$

**BONUS**

8) Math – *Short Answer* To the nearest whole number, what temperature in degrees Celsius is equivalent to 125 degrees Fahrenheit?

ANSWER: 52

**TOSS-UP**

9) Earth and Space – *Multiple Choice* Which of the following is an example of diagenesis [*dye-ah-JEN-eh-sis*]?

- W) Heating and compaction of sediment
- X) Chemical conversion of dinitrogen gas to fixed nitrogen
- Y) Reawakening of a dormant volcano
- Z) Formation of an new iceberg

ANSWER: W) HEATING AND COMPACTION OF SEDIMENT

**BONUS**

9) Earth and Space – *Short Answer* By definition, mafic rocks and minerals are rich in what two elements?

ANSWER: MAGNESIUM AND IRON

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

10) Life Science – *Short Answer* In what organelle do the reactions of the citric acid cycle occur?

ANSWER: MITOCHONDRION (ACCEPT: MITOCHONDRIA)

**BONUS**

10) Life Science – *Multiple Choice* A newborn baby was found to have 47 chromosomes. What is the term for this disorder?

- W) Chromosomal inversion
- X) Chromosomal deletion
- Y) Aneuploidy [*AN-yoo-ploy-dee*]
- Z) Chromosomal translocation

ANSWER: Y) ANEUPLOIDY

**TOSS-UP**

11) Energy – *Multiple Choice* Analysts at Los Alamos National Laboratory have shown how to minimize environmental impacts by refracturing shale gas wells. Which of the following is not an environmental benefit of refracturing?

- W) Fewer wells need to be drilled
- X) Natural gas is more efficiently removed from each well
- Y) Carbon dioxide is deposited in a form of carbon sequestration
- Z) Natural gas does not release harmful byproducts

ANSWER: Z) NATURAL GAS DOES NOT RELEASE HARMFUL BYPRODUCTS

**BONUS**

11) Energy – *Short Answer* At the Fermilab Tevatron [*TEHV-ah-trawn*], one of the most common types of collisions resulting in the creation of top quarks resulted in the creation of a top-quark-anti-top-quark pair. What fundamental force mediates the creation of this quark-anti-quark pair?

ANSWER: STRONG (ACCEPT: STRONG NUCLEAR)

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

12) Physical Science – *Short Answer* Hydrocarbons are primarily composed of what two elements?

ANSWER: CARBON AND HYDROGEN (IN ANY ORDER)

**BONUS**

12) Physical Science – *Short Answer* How many molecules of hydrogen gas are generated when 2 molecules of water are decomposed to form hydrogen gas and oxygen gas?

ANSWER: 2

**TOSS-UP**

13) Math – *Short Answer* Expressing your answer to the nearest hundred, find the following sum:  $733 + 840 + 362$ .

ANSWER: 1900

**BONUS**

13) Math – *Short Answer* *Short Answer* What is the area of an equilateral triangle with sides of length 22?

ANSWER:  $121\sqrt{3}$

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

14) Life Science – *Short Answer* A biologist creates an artificial phospholipid [*faws-foe-lipid*] bilayer that contains no transmembrane proteins. Identify all of the following three elements that can be encountered exactly halfway between the two layers: 1) Phosphorous; 2) Oxygen; 3) Hydrogen.

ANSWER: 3

**BONUS**

14) Life Science – *Short Answer* What molecule is the carbon source in the Calvin cycle?

ANSWER:  $\text{CO}_2$  (ACCEPT: CARBON DIOXIDE)

**TOSS-UP**

15) Physical Science – *Short Answer* How many lone pairs of electrons are present in the Lewis diagram of a water molecule?

ANSWER: 2

**BONUS**

15) Physical Science – *Short Answer* Identify all of the following three statements that are true for a gas-containing cylinder as the piston is depressed: 1) The volume decreases; 2) The gas particles collide more often; 3) The pressure decreases.

ANSWER: 1 AND 2

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

16) Math – *Short Answer* What is the average of the following 3 numbers? 6, 8, 13

ANSWER: 9

**BONUS**

16) Math – *Short Answer* A right triangle has leg lengths 2 and 5. A similar triangle has its shorter leg of length 6. To the nearest integer, what is the length of the hypotenuse in the larger triangle?

ANSWER: 16

**TOSS-UP**

17) Life Science – *Short Answer* In the cell membrane, which of the four biological macromolecule classes can be found as hormones and are also used to store energy?

ANSWER: LIPIDS (ACCEPT: FATS, OILS)

**BONUS**

17) Life Science – *Multiple Choice* What type of mammalian muscle is under voluntary control?

- W) Smooth muscle
- X) Skeletal muscle
- Y) Cardiac muscle
- Z) Rough muscle

ANSWER: X) SKELETAL MUSCLE

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

18) Earth and Space – *Multiple Choice* Which of the following is the nearest large spiral galaxy to Earth?

- W) Triangulum [*try-AYNG-yoo-lum*] Galaxy
- X) Large Magellanic [*MAH-jeh-LAN-ik*] Cloud
- Y) Sombrero Galaxy
- Z) Andromeda [*ann-DRAW-meh-dah*] Galaxy

ANSWER: Z) ANDROMEDA GALAXY

**BONUS**

18) Earth and Space – *Short Answer* Identify all of the following three stars that are part of the main sequence: 1) The Sun; 2) Sirius; 3) Proxima Centauri [*sen-TORR-ee*].

ANSWER: ALL

**TOSS-UP**

19) Math – *Short Answer* What is the degree measure of an angle that is the supplement of a 43-degree angle?

ANSWER: 137

**BONUS**

19) Math – *Short Answer* Solve the following equation for  $x$  over the negative real numbers:  $x^4 + 4x^2 - 45 = 0$

ANSWER:  $-\sqrt{5}$

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

20) Physical Science – *Multiple Choice* When making homemade ice cream, salt is added to crushed ice surrounding the cream mixture. Which of the following does NOT occur when the salt is added to the ice?

- W) The freezing temperature of the cream mixture is lowered
- X) The freezing temperature of the ice is lowered
- Y) The temperature of the system is lowered
- Z) Some of the ice is melted

ANSWER: W) THE FREEZING TEMPERATURE OF THE CREAM MIXTURE IS LOWERED

**BONUS**

20) Physical Science – *Short Answer* Identify all of the following three actions that can increase the rate of a reaction: 1) Increasing the temperature; 2) Decreasing the concentration of reactants; 3) Increasing the surface area of the reactants.

ANSWER: 1 AND 3

**TOSS-UP**

21) Earth and Space – *Short Answer* The "Ring of Fire" occurs due to subduction of oceanic plates around the border of which ocean basin?

ANSWER: PACIFIC

**BONUS**

21) Earth and Space – *Short Answer* If you are living at 30 degrees North latitude, in what two months will you experience days and nights of equal length?

ANSWER: MARCH, SEPTEMBER

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

22) Life Science – *Multiple Choice* Which of the following does not demonstrate external radial symmetry?

- W) Sea anemones [*ah-NEM-oh-neeZ*]
- X) Jellyfish
- Y) Coral
- Z) Eels

ANSWER: Z) EELS

**BONUS**

22) Life Science – *Short Answer* What organs do spiders use to spin silk?

ANSWER: SPINNERETS

### **TOSS-UP**

23) Physical Science – *Short Answer* What physical property of a sound wave corresponds to its volume?

ANSWER: AMPLITUDE

### **BONUS**

23) Physical Science – *Short Answer* Identify all of the following three statements that are true of work and machines: 1) Power is a measure of the rate at which work is done; 2) A wedge is a combination of inclined planes; 3) Mechanical advantage is always greater than or equal to one.

ANSWER: 1 AND 2