

## MIDDLE SCHOOL - ROUND 9A

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### TOSS-UP

1) Physical Science – *Short Answer* A kilocalorie equals 4,184 of what SI derived unit for energy?

ANSWER: JOULE

### BONUS

1) Physical Science – *Short Answer* Identify all of the following three reactions that are exothermic: 1) Burning gasoline; 2) Water vapor condensing; 3) Melting ice.

ANSWER: 1, 2

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### TOSS-UP

2) Math – *Short Answer* What is the log base 5 of 1/25?

ANSWER: -2

### BONUS

2) Math – *Short Answer* Solve the following equation for  $x$  over the negative integers:  
 $x^4 - 28x^2 + 75 = 0$

ANSWER: -5

### TOSS-UP

3) Energy – *Short Answer* Scientists at Oak Ridge National Lab are studying how plants respond to extreme weather events, like heat waves. In times of high ambient temperature, plants will close stomata [*stow-MAH-tah*] to conserve what?

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

### BONUS

3) Energy – *Short Answer* Scientists at Idaho National Lab are developing new methods to quickly charge electric vehicles. What type of battery, the most common used in modern electric vehicles, is being charged?

ANSWER: LITHIUM-ION (ACCEPT: LI-ION, LIB)

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### TOSS-UP

4) Earth and Space – *Multiple Choice* Which of the following will be the next stage in the evolution of the Sun?

- W) Supernova
- X) Red giant
- Y) Stellar nebula
- Z) White dwarf

ANSWER: X) RED GIANT

### BONUS

4) Earth and Space – *Multiple Choice* An astronomer is observing a gas cloud and notes several infrared spectral lines. These spectral lines could allow the astronomer to infer what?

- W) The elemental composition of the cloud
- X) The chemical bonds present in the cloud
- Y) The rate of collision of the molecules in the cloud
- Z) The ionization state of the atoms in the cloud

ANSWER: X) THE CHEMICAL BONDS PRESENT IN THE CLOUD

### TOSS-UP

5) Physical Science – *Short Answer* What is the adjective for the type of interference that occurs when two waves cancel each other out?

ANSWER: DESTRUCTIVE

### BONUS

5) Physical Science – *Short Answer* Identify all of the following three statements that are true of the astronauts aboard the International Space Station: 1) They are massless; 2) They are in free-fall; 3) They experience Earth's gravity.

ANSWER: 2 AND 3

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### TOSS-UP

6) Life Science – *Multiple Choice* Which of the following animals has been observed to communicate via a dance language, including maneuvers such as the waggle dance?

- W) Chimpanzee
- X) Peacock
- Y) Honeybee
- Z) Hyena

ANSWER: Y) HONEYBEE

### BONUS

6) Life Science – *Multiple Choice* Which of the following is a major function of the large intestine?

- W) Mechanically breaking down food
- X) Chemically breaking down food
- Y) Absorbing nutrients
- Z) Absorbing water

ANSWER: Z) ABSORBING WATER

**TOSS-UP**

7) Math – *Short Answer* How many integers are there from –8 to 5, inclusive?

ANSWER: 14

**BONUS**

7) Math – *Short Answer* What is the area of a rhombus with diagonals of length 24 and 28?

ANSWER: 336

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**TOSS-UP**

8) Life Science – *Short Answer* A stroke is most commonly caused when blood flow is cut off in what organ in the body?

ANSWER: BRAIN

**BONUS**

8) Life Science – *Multiple Choice* To what phylum [*FYE-lum*] does baker's yeast belong?

- W) Ascomycota [*az-koh-my-KOH-dah*]
- X) Basidiomycota [*bah-sid-ee-oh-my-KAW-dah*]
- Y) Zygomycota [*zye-go-my-KAW-dah*]
- Z) Glomeromycota [*glo-mair-oh-my-KAW-dah*]

ANSWER: W) ASCOMYCOTA

**TOSS-UP**

9) Earth and Space – *Multiple Choice* The Eurasian plate and the Indian plate meet at what type of plate boundary?

- W) Divergent
- X) Ocean-ocean convergent
- Y) Ocean-continent convergent
- Z) Continent-continent convergent

ANSWER: Z) CONTINENT-CONTINENT CONVERGENT

**BONUS**

9) Earth and Space – *Short Answer* Identify all of the following three quantities that typically decrease in a stream from headwaters to mouth: 1) Water velocity; 2) Water discharge; 3) Stream channel width.

ANSWER: NONE OF THEM

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**TOSS-UP**

10) Math – *Short Answer* What is 40% of 50 plus 40% of 40?

ANSWER: 36

**BONUS**

10) Math – *Short Answer* What is the surface area of a regular square pyramid with slant height 4 whose base has sides of length 7?

ANSWER: 105

### TOSS-UP

11) Physical Science – *Multiple Choice* Which of the following is closest to the distance, in meters, between the electron and proton in the neutral hydrogen atom?

- W)  $10^{-16}$
- X)  $10^{-13}$
- Y)  $10^{-10}$
- Z)  $10^{-7}$

ANSWER: Y)  $10^{-10}$

### BONUS

11) Physical Science – *Short Answer* You take an object and reduce its absolute temperature in half. To the nearest degree Celsius, what temperature will the object approach if you repeatedly perform this procedure?

ANSWER:  $-273$

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### TOSS-UP

12) Energy – *Multiple Choice* Scientists at the DOE Ames Research Laboratory have been using advanced TEM to map nanocrystal magnetic fields formed in bacteria in liquids. What mineral is present in these bacteria?

- W) Gypsum
- X) Magnetite
- Y) Calcite
- Z) Mica [*MY-kah*]

ANSWER: X) MAGNETITE

### BONUS

12) Energy – *Short Answer* Researchers at Oak Ridge National Lab are using new methods to study proteins that are soluble in water but cannot be crystallized. All such flexible proteins fall into what larger class of proteins that often have spherical shapes and usually have functional roles within the cell?

ANSWER: GLOBULAR PROTEINS (ACCEPT: SPHEROPROTEINS)

**TOSS-UP**

13) Math – *Short Answer* If the height of a square pyramid is multiplied by 9, by what factor must the area of the base be multiplied so that the volume remains constant?

ANSWER: 1/9

**BONUS**

13) Math – *Short Answer* What is the units digit of 8 to the 2019<sup>th</sup> power?

ANSWER: 2

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**TOSS-UP**

14) Life Science – *Short Answer* Colonization of plant roots by a fungus can allow increased capture of nutrients from the soil. What is the name for this symbiotic structure?

ANSWER: MYCORRHIZA (MYCORRHIZAE)

**BONUS**

14) Life Science – *Short Answer* In a dicot leaf, what is the layer of tissue responsible for most photosynthesis and carbon dioxide absorption?

ANSWER: PALISADE MESOPHYLL

### TOSS-UP

15) Physical Science – *Multiple Choice* Which of the following pieces of glassware would be LEAST useful for measuring a given volume of liquid?

- W) Test tube
- X) Graduated cylinder
- Y) Erlenmeyer flask
- Z) Burette

ANSWER: W) TEST TUBE

### BONUS

15) Physical Science – *Short Answer* An ice cube has a density of 0.92 grams per milliliter and a volume of 400 cubic centimeters. If the ice cube is floating in water, then, in cubic centimeters, what volume of the cube will be sticking out of the water?

ANSWER: 32

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### TOSS-UP

16) Earth and Space – *Multiple Choice* Which of the following locations would you study if you wanted to collect a sample of atmospheric carbon dioxide from one thousand years ago?

- W) Sea floor sediment
- X) Glacier ice
- Y) Sand dunes
- Z) Ocean water

ANSWER: X) GLACIER ICE

### BONUS

16) Earth and Space – *Short Answer* Rank the following three sediment grain sizes in order of increasing porosity: 1) Clay; 2) Sand; 3) Gravel.

ANSWER: 3, 2, 1



### TOSS-UP

17) Energy – *Multiple Choice* Scientists at SLAC National Accelerator Laboratory are using new imaging modalities [*moh-DAHL-ih-teez*] to study DNA damage. In particular, they are studying damage to DNA caused by what region of the EM spectrum that is divided into A, B, and C ranges?

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

ANSWER: Y) ULTRAVIOLET

### BONUS

17) Energy – *Short Answer* Researchers at Pacific Northwest National Lab used new proteomics methods to study blood markers in patients with cirrhosis. Cirrhosis [*sur-OH-sis*] is a disease in which scar tissue is laid down in what human organ?

ANSWER: LIVER

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### TOSS-UP

18) Life Science – *Short Answer* During muscular contraction, myosin [*MY-oh-sin*] is cross-linked to what other protein in order to shorten the muscle filament?

ANSWER: ACTIN

### BONUS

18) Life Science – *Multiple Choice* Which of the following groups of animals is able to respire significant amounts of oxygen from their skins?

- W) Fishes
- X) Amphibians
- Y) Reptiles
- Z) Birds

ANSWER: X) AMPHIBIANS

**TOSS-UP**

19) Math – *Short Answer* What is the  $x$ -intercept of the line with equation  $5x - 3y = -30$ ?

ANSWER:  $(-6, 0)$  (ACCEPT:  $-6, x = -6$  AND  $y = 0$ )

**BONUS**

19) Math – *Short Answer* If an arithmetic sequence has third term 16 and seventh term 44, what is its 19<sup>th</sup> term?

ANSWER: 128

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**TOSS-UP**

20) Earth and Space – *Short Answer* The Cassini division is associated with what planet?

ANSWER: SATURN

**BONUS**

20) Earth and Space – *Multiple Choice* Which of the following is closest to the temperature, in kelvins, at which hydrogen fusion will commence in a young star?

- W) 10,000
- X) 100,000
- Y) 1 million
- Z) 10 million

ANSWER: Z) 10 million

### TOSS-UP

21) Life Science – *Short Answer* Serum and plasma are derived from what substance in the body?

ANSWER: BLOOD

### BONUS

21) Life Science – *Short Answer* Identify all of the following three structures that are part of the digestive tract: 1) Pharynx *[fair-inx]*; 2) Larynx; 3) Esophagus.

ANSWER: 1, 3

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### TOSS-UP

22) Physical Science – *Short Answer* The statement "if two gas samples have the same pressure, temperature, and volume, they contain the same number of particles" is a form of what gas law named for its discoverer?

ANSWER: AVOGADRO'S LAW

### BONUS

22) Physical Science – *Short Answer* In the balanced equation for the reaction of oxygen and iron to produce ferric oxide, what is the coefficient of the iron?

ANSWER: 4

**TOSS-UP**

23) Earth and Space – *Short Answer* What is the most common element in emission nebulas?

ANSWER: HYDROGEN

**BONUS**

23) Earth and Space – *Short Answer* Giving your answer to one significant digit, what is the average albedo of the moon?

ANSWER: 0.1