

MIDDLE SCHOOL - ROUND 5A

TOSS-UP

1) Physical Science – *Short Answer* What is the term for a substance that is dissolved in a solvent?

ANSWER: SOLUTE

BONUS

1) Physical Science – *Short Answer* Consider the reaction of nitrogen gas with hydrogen gas to form ammonia. In the balanced form of this chemical equation, what is the sum of the coefficients?

ANSWER: 6

TOSS-UP

2) Earth and Space – *Short Answer* An observer in a spaceship notes that the star she is traveling towards appears slightly bluer than it was when she was at rest. What term describes this decrease in apparent wavelength?

ANSWER: BLUESHIFT (ACCEPT: DOPPLER EFFECT)

BONUS

2) Earth and Space – *Short Answer* The Local Group is a set of more than 54 of what astronomical structures?

ANSWER: GALAXIES

TOSS-UP

3) Math – *Short Answer* In a right triangle, one leg has length 9 and one angle measures 45 degrees. What is the length of the hypotenuse?

ANSWER: $9\sqrt{2}$

BONUS

3) Math – *Short Answer* A factory says that a 100% rate at its packing station is 250 units per day. Last week, Kim's rates for 5 days were 58%, 67%, 64%, 75%, and 56%. What was the average daily number of units packed by Kim during those 5 days?

ANSWER: 160

TOSS-UP

4) Energy – *Short Answer* Researchers at Lawrence Berkeley National Lab have developed a new method to chemically add synthetic tags to proteins. These tags are added to the side chains of what class of compounds that are the monomers that compose proteins?

ANSWER: AMINO ACIDS

BONUS

4) Energy – *Short Answer* Scientists at Oak Ridge National Lab have been studying glaucoma drugs, which are drugs designed to treat a disease of what human organ?

ANSWER: EYE

TOSS-UP

5) Earth and Space – *Short Answer* What is the name for the process that turns shale into slate?

ANSWER: METAMORPHISM

BONUS

5) Earth and Space – *Multiple Choice* What type of drainage pattern is commonly found associated with volcanoes?

- W) Trellis
- X) Dendritic [*den-DRIH-dik*]
- Y) Rectangular
- Z) Radial

ANSWER: Z) RADIAL

TOSS-UP

6) Life Science – *Short Answer* What is the predominant organ that sits within the pericardial cavity?

ANSWER: HEART

BONUS

6) Life Science – *Short Answer* What theory posits that chloroplasts and mitochondria were originally ingested microorganisms?

ANSWER: ENDOSYMBIOTIC THEORY (ACCEPT: ENDOSYMBIOSIS, SYMBIOGENESIS)

TOSS-UP

7) Energy – *Multiple Choice* Ames National Lab scientists are developing nanoparticles that replace the catalyst in fuel cells. This catalyst is composed of what expensive element?

- W) Iron
- X) Platinum
- Y) Palladium [*pah-LAY-dee-um*]
- Z) Zinc

ANSWER: X) PLATINUM

BONUS

7) Energy – *Short Answer* Researchers at Oak Ridge National Lab have been studying a mixture of aluminum, cerium, and magnesium due to its high strength. This can best be classified as what type of solid mixture?

ANSWER: ALLOY

TOSS-UP

8) Earth and Space – *Short Answer* What is the second most common gas in the atmosphere of Jupiter?

ANSWER: HELIUM (ACCEPT: He)

BONUS

8) Earth and Space – *Multiple Choice* In years, which of the following is closest to the age of the solar system?

- W) 5 thousand
- X) 5 million
- Y) 5 billion
- Z) 5 trillion

ANSWER: Y) 5 BILLION

TOSS-UP

9) Math – *Short Answer* Simplify the fraction with numerator x^4y^7 and denominator x^2y^{-5} .

ANSWER: x^2y^{12}

BONUS

9) Math – *Short Answer* If p and q are consecutive odd integers, identify all of the following four numbers that are always even: 1) $p + q$; 2) pq ; 3) $2p + 4q$; 4) open parenthesis $p + q$ close parenthesis squared.

ANSWER: 1, 3, 4 (ACCEPT: ALL BUT 2)

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**TOSS-UP**

10) Life Science – *Short Answer* Identify all of the following three statements that are TRUE of vaccines: 1) Vaccines can only be used to prevent viral diseases; 2) Some vaccines require multiple injections; 3) The measles-mumps-rubella vaccine is linked to the development of autism.

ANSWER: 2 (DO NOT ACCEPT: 3)

**BONUS**

10) Life Science – *Multiple Choice* Which of the following is an example of a gymnosperm?

- W) Corn
- X) Ginkgo
- Y) Broccoli
- Z) Daffodil

ANSWER: X) GINKGO

### TOSS-UP

11) Physical Science – *Short Answer* How many neutrons does an atom of carbon-14 contain?

ANSWER: 8

### BONUS

11) Physical Science – *Short Answer* What is the mechanical advantage of a pulley system containing 5 rope segments pulling on the load?

ANSWER: 5

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### TOSS-UP

12) Energy – *Short Answer* Researchers at Lawrence Berkeley National Lab are studying a special type of photosynthesis described as anoxygenic [*an-ox-ih-JEN-ik*]. This means that it does not produce what molecule?

ANSWER: OXYGEN (ACCEPT: O<sub>2</sub>, DIOXYGEN)

### BONUS

12) Energy – *Short Answer* Researchers at Oak Ridge National Lab are studying ferromagnetic materials like bismuth manganese chromates. What is the lightest element on the periodic table that is ferromagnetic in its standard state?

ANSWER: IRON

### TOSS-UP

13) Life Science – *Short Answer* Choanocytes [*koh-ANNOH-sites*] are a type of specialized cell associated with what animals that have no true tissues?

ANSWER: SPONGES (ACCEPT: PORIFERANS)

### BONUS

13) Life Science – *Short Answer* A biologist crosses a plant with red flowers with a plant with white flowers. The offspring plants all have pink flowers. What type of genetic interaction is being demonstrated here?

ANSWER: INCOMPLETE DOMINANCE

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### TOSS-UP

14) Math – *Short Answer* Express the fraction  $15/8$  as a decimal.

ANSWER: 1.875

### BONUS

14) Math – *Short Answer* Four to the 64th power divided by 64 to the 4th power equals 2 to what power?

ANSWER: 104

### TOSS-UP

15) Physical Science – *Short Answer* A chemist dips a penny into a hot solution composed of zinc and sodium hydroxide, which causes the penny to turn a silvery color. What aspect of a redox reaction did the zinc undergo when the penny was dipped into the solution?

ANSWER: REDUCTION

### BONUS

15) Physical Science – *Short Answer* What is 30 degrees Celsius expressed in degrees Fahrenheit?

ANSWER: 86

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### TOSS-UP

16) Life Science – *Short Answer* What is the term for viruses that exclusively infect bacteria?

ANSWER: BACTERIOPHAGE (ACCEPT: PHAGE)

### BONUS

16) Life Science – *Short Answer* Identify all of the following three processes that are considered negative feedback loops: 1) Blood-clotting cascade; 2) Thermoregulation; 3) Blood glucose control.

ANSWER: 2, 3



**TOSS-UP**

17) Math – *Short Answer* What is the leading coefficient of the polynomial  $-x^4 + 2x^3 - 4x + 9$ ?

ANSWER: -1

**BONUS**

17) Math – *Short Answer* Express the following in scientific notation rounded to two significant digits: the fraction with numerator  $4.7 \times 10^5$  and denominator  $8.3 \times 10^{-2}$ .

ANSWER:  $5.7 \times 10^6$

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**TOSS-UP**

18) Earth and Space – *Short Answer* What greenhouse gas is responsible for the greatest proportion of Earth's greenhouse warming?

ANSWER: WATER (ACCEPT: WATER VAPOR)

**BONUS**

18) Earth and Space – *Multiple Choice* Which of the following best describes a stream's capacity?

- W) Maximum load of solid particles a stream can carry per unit time
- X) Maximum size of the sediment grains transported
- Y) Maximum water discharge
- Z) Minimum water discharge that would produce flooding

ANSWER: W) MAXIMUM LOAD OF SOLID PARTICLES A STREAM CAN CARRY PER UNIT TIME

### TOSS-UP

19) Physical Science – *Multiple Choice* Which of the following phenomena describes a beam of light entering a glass of water and bending from its original path?

- W) Diffraction
- X) Refraction
- Y) Dispersion
- Z) Reflection

ANSWER: X) REFRACTION

### BONUS

19) Physical Science – *Short Answer* A 100-gram arrow completely pierces through a 1-kilogram target and leaves with half of its original speed. If the target is now moving at 1.5 meters per second, then in meters per second, what was the original speed of the arrow?

ANSWER: 30

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### TOSS-UP

20) Life Science – *Short Answer* What is the term for different forms of a gene?

ANSWER: ALLELES

### BONUS

20) Life Science – *Short Answer* Identify all of the following four structures that would typically be found in a bacterial cell: 1) Cell wall; 2) Nucleus; 3) Mitochondrion; 4) Ribosome.

ANSWER: 1, 4

**TOSS-UP**

21) Math – *Short Answer* What is  $300 + 500 - 555$ ?

ANSWER: 245

**BONUS**

21) Math – *Short Answer* What is the area of a square with the same perimeter as a circle of radius 8?

ANSWER:  $16\pi^2$

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**TOSS-UP**

22) Physical Science – *Short Answer* When ultraviolet light is shined on a zinc plate, electrons are ejected with a kinetic energy dependent on the frequency of the light. What is the name of this phenomenon, first explained by Einstein in 1905?

ANSWER: PHOTOELECTRIC EFFECT

**BONUS**

22) Physical Science – *Short Answer* A ball is thrown horizontally off the top of a 320-meter cliff with an initial velocity of 1 meter per second. Assuming the ground below the cliff is flat, then to the nearest whole meter, how far away from the base of the cliff will the ball land?

ANSWER: 8

### **TOSS-UP**

23) Earth and Space – *Short Answer* The Sun is constantly shedding its corona by expelling it outward into the solar system. What is the term for this stream of particles?

ANSWER: SOLAR WIND

### **BONUS**

23) Earth and Space – *Short Answer* What is the theoretical endpoint of stellar evolution for a low-mass star, such as our Sun, that has cooled enough that it no longer emits light?

ANSWER: BLACK DWARF