

Middle School  
Set 5

TOSS-UP

1) Earth and Space – *Short Answer* The Gaia [*GUY-ah*] spacecraft is measuring the positions of Milky Way stars by measuring the apparent shift in stars against a distant background. What is the term for this method?

ANSWER: PARALLAX

BONUS

1) Earth and Space – *Short Answer* Rank the following three objects in our solar system by increasing average density: 1) Saturn; 2) Pluto; 3) Halley's Comet.

ANSWER: 3, 1, 2

---

## TOSS-UP

2) Energy – *Short Answer* Researchers at Argonne National Lab are studying the protein Nsp15, which is found in the viruses that cause SARS, MERS, and COVID-19. What subfamily are these viruses part of?

ANSWER: CORONAVIRUS (ACCEPT: ORTHOCORONAVIRINAE)

## BONUS

2) Energy – *Short Answer* Scientists at Lawrence Livermore National Lab are studying the BCC crystal structure of metallic iron. When iron forms at ambient temperatures, how many iron atoms are there in this unit cell?

ANSWER: 2

---

## TOSS-UP

3) Life Science – *Multiple Choice* Which of the following events is least likely to be associated with initiation of seed germination?

- W) Seed coat abrasion
- X) Water absorption
- Y) Respiratory restriction
- Z) Light and temperature modulation


ANSWER: Y) RESPIRATORY RESTRICTION

## BONUS

3) Life Science – *Multiple Choice* Which of the following is NOT a component of the innate immune system?

- W) Neutrophil
- X) Basophil
- Y) Natural killer cell
- Z) Antibody

ANSWER: Z) ANTIBODY



## TOSS-UP

4) Math – *Short Answer* Let  $a$  be the number 4 times  $10^9$ . Expressing your answer in scientific notation with one significant figure, what is the square root of  $a$ ?

ANSWER: 6 TIMES  $10^4$

## BONUS

4) Math – *Short Answer* What is the radius of the circle with equation  $x^2 + y^2 + 12x - 6y + 16 = 0$ ?

ANSWER:  $\sqrt{29}$

## TOSS-UP

5) Physical Science – *Multiple Choice* What SI unit measures the same quantity as the US measure of weight, the pound?

- W) Newton
- X) Kilogram
- Y) Joule
- Z) Candela [*can-DELL-ah*]

ANSWER: W) NEWTON

## BONUS

5) Physical Science – *Short Answer* Consider the reaction of 3 moles of phosphoric acid with 2 moles of sodium hydroxide. To the nearest gram, how much water will be produced by this reaction?

ANSWER: 36

## TOSS-UP

6) Earth and Space – *Multiple Choice* Which of the following elements required to support life on Earth lacks a significant atmospheric cycling component?

- W) Sulfur
- X) Nitrogen
- Y) Phosphorus
- Z) Carbon

ANSWER: Y) PHOSPHORUS

## BONUS

6) Earth and Space – *Multiple Choice* Which of the following best describes the epicenters of earthquakes associated with mid-ocean ridge spreading centers?

- W) Ultra deep focus
- X) Deep focus
- Y) Intermediate focus
- Z) Shallow focus

ANSWER: Z) SHALLOW FOCUS

## TOSS-UP

7) Energy – *Short Answer* Scientists at Lawrence Livermore National Lab are developing a preparation to generate active immunity in people against the bacterium that causes rabbit fever. What is the term for this type of preparation?

ANSWER: VACCINE (ACCEPT: VACCINATION)

## BONUS

7) Energy – *Multiple Choice* Scientists at Argonne National Lab are building synthetic photonic crystals. Which of the following is an example of a natural photonic crystal?

- W) Diamond
- X) Corundum
- Y) Iridescent opal
- Z) Ruby

ANSWER: Y) IRIDESCENT OPAL

## TOSS-UP

8) Life Science – *Multiple Choice* Which of the following types of molecules is not generally composed of a long chain of monomers?

- W) Fatty acid
- X) Protein
- Y) DNA
- Z) Starch

ANSWER: W) FATTY ACID

## BONUS

8) Life Science – *Short Answer* Consider a cross between two plants that are heterozygous [*hetero-ZYE-gus*] for a certain monogenic trait. What percentage of the offspring of this cross will also be heterozygous for this trait?

ANSWER: 50 (ACCEPT: 50%)

---



TOSS-UP

9) Math – *Multiple Choice* Which of the following is not a root of the polynomial  $x^3 + x^2 - 2x$ ?

W) -2

X) -1

Y) 0

Z) 1

ANSWER: X) -1

BONUS

9) Math – *Short Answer* To the nearest degree, what is the measure of an exterior angle in a regular polygon with 39 sides?

ANSWER: 9 (do not accept: 189)

TOSS-UP

10) Physical Science – *Multiple Choice* Which of the following molecules has a pyramidal [*peer-uh-MIH-dul*] geometry?

- W) Methane
- X) Water
- Y) Carbon dioxide
- Z) Ammonia

ANSWER: Z) AMMONIA

BONUS

10) Physical Science – *Short Answer* Rank the following three regions of the electromagnetic spectrum in terms of increasing frequency: 1) Infrared; 2) Radio; 3) Gamma.

ANSWER: 2, 1, 3

## TOSS-UP

11) Earth and Space – *Short Answer* The Spitzer Space Telescope operates at wavelengths between 3.6 and 160 microns. What region of the electromagnetic spectrum is this?

ANSWER: INFRARED (ACCEPT: IR)

## BONUS

11) Earth and Space – *Short Answer* What is the term for the asteroids locked into one-to-one orbital resonance with Jupiter?

ANSWER: TROJANS

---

## TOSS-UP

12) Energy – *Short Answer* Scientists at Los Alamos National Lab are studying nanocrystalline materials that fluoresce when exposed to a wide range of wavelengths of light. What is the term for these materials?

ANSWER: QUANTUM DOTS

## BONUS

12) Energy – *Short Answer* Scientists at Lawrence Berkeley National Lab are studying the processes by which the brain continuously reshapes itself throughout life. What is the term for this process?

ANSWER: PLASTICITY (ACCEPT: NEUROPLASTICITY, NEURAL PLASTICITY)

## TOSS-UP

13) Life Science – *Multiple Choice* The tracheal system in insects includes many small external openings on the sides of their bodies. What function does this system serve?

- W) Respiration
- X) Reproduction
- Y) Digestion
- Z) Locomotion

ANSWER: W) RESPIRATION

## BONUS

13) Life Science – *Multiple Choice* After a forest fire, annual plants will begin growing in the burnt area fairly quickly. Which of the following best explains why?

- W) Forest fires do not usually kill all of the local trees
- X) Forest fires expose bare rock, which is a good substrate for annual plant growth
- Y) As a climax community, forests cannot be destroyed
- Z) Forest fires do not destroy the topsoil, which supports plant growth

ANSWER: Z) FOREST FIRES DO NOT DESTROY THE TOPSOIL, WHICH SUPPORTS PLANT GROWTH

TOSS-UP

14) Math – *Short Answer* How many faces does an octagonal pyramid have?

ANSWER: 9

BONUS

14) Math – *Short Answer* According to Descartes' [*day-KARTZ*] rule of signs, what are the possible numbers of negative real zeroes the polynomial  $x^5 + 3x^4 - 3x^3 - 2x^2 + 7x - 12$  may have?

ANSWER: 2 AND 0 (must give both answers)

---

## TOSS-UP

15) Physical Science – *Short Answer* For an incandescent lightbulb, if the temperature of the coil were doubled, by what value would the peak frequency of emission be multiplied?

ANSWER: 2

## BONUS

15) Physical Science – *Short Answer* A certain engine operates from a hot reservoir with a temperature of 500 kelvins and a cold sink with a temperature of 300 kelvins. As a percentage, what is the Carnot [*CAR-noh*] efficiency of this engine?

ANSWER: 40%