

MIDDLE SCHOOL - ROUND 3A

TOSS-UP

1) Math – *Multiple Choice* Four points are all equidistant from a fifth point. Which of the following types of figures must contain the four points?

- W) Circle
- X) Sphere
- Y) Square
- Z) Rectangle

ANSWER: X) SPHERE

BONUS

1) Math – *Short Answer* If two coplanar concentric circles have radii of 5 and 11, respectively, what is the area of the region between them?

ANSWER: 96π

TOSS-UP

2) Life Science – *Multiple Choice* In the tri-nomen Canis lupis familiaris, Canis refers to what taxonomic rank?

- W) Family
- X) Genus
- Y) Species
- Z) Subspecies

ANSWER: X) GENUS

BONUS

2) Life Science – *Short Answer* The two strands of DNA are held together by hydrogen bonds between what components of the DNA?

ANSWER: BASES (ACCEPT: NITROGENOUS BASES)

TOSS-UP

3) Physical Science – *Short Answer* What subatomic particles can be found in a cloud around the nucleus?

ANSWER: ELECTRONS

BONUS

3) Physical Science – *Short Answer* The alloy brass is composed of copper and what other metal?

ANSWER: ZINC

TOSS-UP

4) Energy – *Short Answer* Argonne National Lab scientists are studying a class of mixtures in which one substance is uniformly distributed, but not dissolved, in another substance. What is the name for this general class of mixtures?

ANSWER: COLLOID

BONUS

4) Energy – *Short Answer* DOE scientists have been studying vanadium dioxide, a material that can conduct electricity without conducting heat. This material is also well-known for acting as a metallic conductor ONLY above 67 degrees Celsius. Below that temperature, it behaves as what type of electric material?

ANSWER: INSULATOR

TOSS-UP

5) Earth and Space – *Multiple Choice* Which of the following is a mineral?

- W) Gabbro
- X) Muscovite
- Y) Breccia [**BREH-chah**]
- Z) Andesite

ANSWER: X) MUSCOVITE

BONUS

5) Earth and Space – *Short Answer* Place the following three minerals in order of decreasing hardness:

- 1) Quartz; 2) Corundum [**core-UN-dum**]; 3) Apatite.

ANSWER: 2, 1, 3

TOSS-UP

6) Physical Science – *Short Answer* What effect occurs when the observer of a sound wave is moving relative to the source of the sound?

ANSWER: DOPPLER EFFECT (ACCEPT: DOPPLER SHIFT)

BONUS

6) Physical Science – *Short Answer* Protons and neutrons are made up of still smaller particles, called what?

ANSWER: QUARKS

TOSS-UP

7) Energy – *Short Answer* DOE researchers are studying how global temperature increases affect the upper altitude limit of Engelmann spruce. What is the term for the upper altitude limit at which trees can grow?

ANSWER: TREE LINE

BONUS

7) Energy – *Multiple Choice* Researchers at SLAC [*slack*] are developing zeolite catalysts for methanol production. Which of the following statements best explains why zeolites are such effective catalysts?

- W) They are very electron-poor
- X) They are made from nonmetals
- Y) They have a lot of pores
- Z) They are very dense

ANSWER: Y) THEY HAVE A LOT OF PORES

TOSS-UP

8) Life Science – *Short Answer* A disaccharide, such as lactose, is composed of how many simple sugar subunits?

ANSWER: 2

BONUS

8) Life Science – *Short Answer* What chambers of the human heart are responsible for pumping blood out of the heart and into the rest of the body?

ANSWER: VENTRICLES (ACCEPT: LEFT AND RIGHT VENTRICLES)

TOSS-UP

9) Earth and Space – *Short Answer* SN 1987A was what type of cosmic event?

ANSWER: SUPERNOVA (ACCEPT: TYPE-TWO SUPERNOVA, DO NOT ACCEPT: TYPE-ONE SUPERNOVA)

BONUS

9) Earth and Space – *Short Answer* Identify all of the following three planets that have an axial tilt greater than that of Earth: 1) Mercury; 2) Mars; 3) Jupiter.

ANSWER: 2

TOSS-UP

10) Physical Science – *Short Answer* What type of bond is formed between sodium and chlorine in table salt?

ANSWER: IONIC

BONUS

10) Physical Science – *Short Answer* Rank the following three substances in increasing order of pH:
1) Milk; 2) Vinegar; 3) Ammonia.

ANSWER: 2, 1, 3

TOSS-UP

11) Math – *Short Answer* What is the leading coefficient of the polynomial $x^5 - 2x^3 - 4x + 6$?

ANSWER: 1

BONUS

11) Math – *Short Answer* A squirrel runs 11 meters north, 7 meters west, and then 4 meters north? To the nearest whole meter, how far is the squirrel from its original starting point?

ANSWER: 17

TOSS-UP

12) Life Science – *Multiple Choice* Some inhibitors, rather than competing with the substrate at the active site, bind to a distal site on the enzyme to inhibit activity. What type of inhibition is this?

- W) Competitive
- X) Co-factor
- Y) Feedback
- Z) Allosteric [*al-loh-STAIR-ic*]

ANSWER: Z) ALLOSTERIC

BONUS

12) Life Science – *Short Answer* What phase of mitosis is marked by the sister chromatids traveling in opposite directions away from the metaphase plate?

ANSWER: ANAPHASE

TOSS-UP

13) Physical Science – *Short Answer* What is the term for the substance that is dissolved when forming a solution?

ANSWER: SOLUTE

BONUS

13) Physical Science – *Short Answer* Identify all of the following three statements that are true of the phases of matter: 1) In solids, atoms vibrate in place; 2) Boiling and evaporation are both types of vaporization; 3) A two-liter glass of ice water has the same thermal energy as a one-liter glass of ice water.

ANSWER: 1 AND 2

TOSS-UP

14) Math – *Short Answer* Rounded to the nearest whole number, what is pi squared?

ANSWER: 10

BONUS

14) Math – *Short Answer* If two exterior angles of a triangle are 135 degrees and 120 degrees, what is the degree measure of the interior angle not adjacent to either of the given exterior angles?

ANSWER: 75

TOSS-UP

15) Earth and Space – *Short Answer* Subduction zones are associated with what type of plate boundary?

ANSWER: CONVERGENT

BONUS

15) Earth and Space – *Short Answer* What are the two most abundant elements in Earth's crust?

ANSWER: OXYGEN AND SILICON

TOSS-UP

16) Math – *Short Answer* What is the square of the binomial $x - 8$?

ANSWER: $x^2 - 16x + 64$

BONUS

16) Math – *Short Answer* The total volume of 3 identical tanks that are circular cylinders is 540π . If the height of one tank is 5, what is its radius?

ANSWER: 6

TOSS-UP

17) Life Science – *Multiple Choice* In what part of the digestive tract are nutrients primarily absorbed into the bloodstream?

- W) Stomach
- X) Small intestine
- Y) Large intestine
- Z) Pancreas

ANSWER: X) SMALL INTESTINE

BONUS

17) Life Science – *Multiple Choice* What is the largest terrestrial biome, characterized by large populations of coniferous [*koh-NIH-fur-us*] trees?

- W) Chaparral [*shap-ah-RAL*]
- X) Tundra
- Y) Taiga [*TYE-gah*]
- Z) Tropical rainforest

ANSWER: Y) TAIGA

TOSS-UP

18) Energy – *Short Answer* Reverse osmosis, capacitive deionization [*dee-eye-on-ih-ZAY-shun*], and forward osmosis are all examples of what process that makes seawater drinkable?

ANSWER: DESALINATION

BONUS

18) Energy – *Short Answer* DOE researchers have used advanced imaging methods to visualize how the structural fibers in the cytosol of a cell connect the nucleus to the extracellular matrix. What is the general term for these fibers that give structure to the inside of the cell?

ANSWER: CYTOSKELETON

TOSS-UP

19) Math – *Short Answer* An item is originally priced at 20 dollars. Discounts are based on the current marked price. In three consecutive sales, the price is reduced by 10%, then 10%, and then 50%. In dollars and cents, what is the final price of the item?

ANSWER: \$8.10

BONUS

19) Math – *Short Answer* What is the area of a right triangle with hypotenuse of length 9 and one leg of length 4?

ANSWER: $2\sqrt{65}$

TOSS-UP

20) Earth and Space – *Multiple Choice* Relative to the Sun, in which of the following directions is Sirius located on a Hertzsprung-Russell diagram?

- W) Up and left
- X) Up and right
- Y) Down and left
- Z) Down and right

ANSWER: W) UP AND LEFT

BONUS

20) Earth and Space – *Multiple Choice* Which of the following best describes the shape of the Milky Way galaxy?

- W) Elliptical
- X) Barred spiral
- Y) Spiral
- Z) Irregular

ANSWER: X) BARRED SPIRAL

TOSS-UP

21) Physical Science – *Multiple Choice* Amino acids all contain an amine group and what other group?

- W) Hydroxyl
- X) Ketone
- Y) Aldehyde
- Z) Carboxyl

ANSWER: Z) CARBOXYL

BONUS

21) Physical Science – *Short Answer* Identify all of the following three compounds that consist of only carbon, hydrogen, and oxygen: 1) Glucose; 2) Ethanol; 3) Acetic acid.

ANSWER: ALL

TOSS-UP

22) Life Science – *Short Answer* What nerve in the human body is responsible for carrying signals from retinal photoreceptors to the brain?

ANSWER: OPTIC NERVE

BONUS

22) Life Science – *Short Answer* Pyelonephritis [*pie-eh-loh-nef-RIT-us*], or inflammation of the kidney, can occur from an ascending urinary tract infection. Place the following three locations in chronological order of the route the bacteria takes: 1) Kidney; 2) Bladder; 3) Urethra [*yur-EE-thrah*].

ANSWER: 3, 2, 1

TOSS-UP

23) Earth and Space – *Multiple Choice* Which of the following would NOT contribute to sea level rise?

- W) Land subsidence
- X) Thermal expansion of seawater
- Y) Melting of sea ice
- Z) Melting of continental glaciers

ANSWER: Y) MELTING OF SEA ICE

BONUS

23) Earth and Space – *Short Answer* Order the three layers of the atmosphere in order of decreasing altitude: 1) Stratosphere; 2) Mesosphere; 3) Thermosphere.

ANSWER: 3, 2, 1