

MIDDLE SCHOOL - ROUND 13A

TOSS-UP

1) Math – *Multiple Choice* Which of the following describes the lines represented by the equations $5x - 6y = 30$ and $10x + 12y = 60$?

- W) They are parallel
- X) They are skew
- Y) They intersect at exactly one point
- Z) They are the same line

ANSWER: Y) THEY INTERSECT AT EXACTLY ONE POINT

BONUS

1) Math – *Short Answer* To the nearest integer, what is the geometric mean of 6 and 55?

ANSWER: 18

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**TOSS-UP**

2) Earth and Space – *Multiple Choice* Which of the following distances is NOT approximately equal to one light year?

- W) 0.3 parsecs
- X) 9.5 petameters
- Y) 3.2 giga-lightseconds
- Z) 5.9 teramiles

ANSWER: Y) 3.2 GIGA-LIGHTSECONDS

**BONUS**

2) Earth and Space – *Short Answer* Identify all of the following three particles that are freely found in solar wind: 1) Protons; 2) Neutrons; 3) Electrons.

ANSWER: 1 AND 3

**TOSS-UP**

3) Physical Science – *Short Answer* For an inelastic collision, identify all of the following three quantities that are conserved: 1) Momentum; 2) Kinetic energy; 3) Total energy.

ANSWER: 1 AND 3

**BONUS**

3) Physical Science – *Short Answer* Identify all of the following three changes that would change the magnitude of the force between two point charges: 1) Reversing the sign of one of the charges; 2) Increasing the distance between the charges; 3) Doubling the first charge and halving the second charge.

ANSWER: 2

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TOSS-UP

4) Life Science – *Multiple Choice* A cell is undergoing mitosis and has its paired chromatids [*CROW-mah-tids*] aligned at the center of the cell. In what stage of mitosis is the cell?

- W) Telophase
- X) Prophase
- Y) Metaphase
- Z) Interphase

ANSWER: Y) METAPHASE

BONUS

4) Life Science – *Multiple Choice* In healthy mammals, which of the following is least likely to be filtered out of the bloodstream by the glomerulus [*glo-MAIR-yoo-lus*]?

- W) Albumin [*al-BYOO-min*]
- X) Urea
- Y) Water
- Z) Potassium

ANSWER: W) ALBUMIN

TOSS-UP

5) Energy – *Short Answer* Rice paddies are flooded fields. Due to microscopic organisms in this swampy environment, rice paddies contribute nearly 20% of all global emissions of what greenhouse gas?

ANSWER: METHANE (ACCEPT: CH₄)

BONUS

5) Energy – *Short Answer* DOE scientists have been studying pathogenicity in bacteria, which is known to be correlated with DNA supercoiling. To visualize the DNA coiling with HU proteins, the researchers used light from what range of the electromagnetic spectrum?

ANSWER: X-RAY

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**TOSS-UP**

6) Earth and Space – *Multiple Choice* Which of the following sets of conditions is most conducive to ductile deformation of rock?

- W) High pressures and high temperatures
- X) High pressures and low temperatures
- Y) Low pressures and high temperatures
- Z) Low pressures and low temperatures

ANSWER: W) HIGH PRESSURES AND HIGH TEMPERATURES

**BONUS**

6) Earth and Space – *Short Answer* Assuming Pratt isostasy [*eye-SAW-stah-see*] and giving your answer in kilometers, calculate the height of a mountain range with a mean crustal density of 2500 kilograms per cubic meter if it is in isostatic equilibrium with an adjacent, sea-level plain that is 20 kilometers thick and has a density of 2700 kilograms per cubic meter?

ANSWER: 1.6

### TOSS-UP

7) Physical Science – *Short Answer* According to valence bond theory, how many electrons are being shared between two atoms of fluorine in diatomic fluorine gas?

ANSWER: TWO

### BONUS

7) Physical Science – *Short Answer* Identify all of the following four molecules that are polar: 1) CH<sub>4</sub>; 2) NH<sub>3</sub>; 3) H<sub>2</sub>O; 4) HF.

ANSWER: 2, 3, 4

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TOSS-UP

8) Math – *Short Answer* Solve the following equation for x : 5 to the power open parenthesis $x + 2$ close parenthesis = $1/25$

ANSWER: -4

BONUS

8) Math – *Short Answer* What is the volume in liters of a circular cylindrical container with a radius of 30 centimeters and a height of 1.1 meters?

ANSWER: 99π

TOSS-UP

9) Life Science – *Multiple Choice* The human hip is an example of what type of joint?

- W) Ball-and-socket
- X) Saddle
- Y) Hinge
- Z) Pivot

ANSWER: W) BALL-AND-SOCKET

BONUS

9) Life Science – *Short Answer* Identify all of the following three options that are examples of qualitative data: 1) Nick's body temperature is 99 degrees Fahrenheit; 2) Kevin walks slowly; 3) Kate can lift a maximum of 40 pounds.

ANSWER: 2

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**TOSS-UP**

10) Energy – *Multiple Choice* Scientists using the Advanced Photon Source have solved the structure of the glucagon [*GLUE-kah-gon*] receptor, providing a potential therapeutic target for what disease?

- W) Breast cancer
- X) Tay-Sachs [*saks*] disease
- Y) Cystic fibrosis
- Z) Diabetes mellitus

ANSWER: Z) DIABETES MELLITUS

**BONUS**

10) Energy – *Short Answer* Researchers at Pacific Northwest National Lab are studying the dependence of mouse embryo implantation on the levels of what tumor-suppressor gene often lost in cancers, which is named for the molar mass of its protein product?

ANSWER: p53

**TOSS-UP**

11) Earth and Space – *Short Answer* Which of the terrestrial planets has the largest atmospheric pressure at its surface?

ANSWER: VENUS

**BONUS**

11) Earth and Space – *Short Answer* Identify all of the following four planets that currently have active plate tectonics [*tek-TAWN-iks*]: 1) Mercury; 2) Venus; 3) Earth; 4) Mars.

ANSWER: 3

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TOSS-UP

12) Life Science – *Multiple Choice* What happens to the population of white blood cells when a bacterial infection occurs?

- W) Increases
- X) Decreases
- Y) Stays the same
- Z) Shifts to red blood cells

ANSWER: W) INCREASES

BONUS

12) Life Science – *Multiple Choice* FAD [*F.A.D.*] is a cofactor derived from what vitamin?

- W) A
- X) B
- Y) E
- Z) K

ANSWER: X) B

TOSS-UP

13) Math – *Short Answer* Assuming a gravitational force equal to that on the surface of the Earth, what integer is closest to the weight in pounds of a 6-kilogram mass?

ANSWER: 13

BONUS

13) Math – *Short Answer* What is the remainder when the polynomial $x^3 + 2x^2 + x - 7$ is divided by $x + 4$?

ANSWER: -43

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**TOSS-UP**

14) Energy – *Multiple Choice* Researchers at Brookhaven National Lab are developing sodium-ion batteries as a potential replacement for lithium-ion batteries. However, like lithium-ion batteries, they lose capacity over hundreds of charge cycles. Which of the following best explains the reason for loss in capacity?

- W) Sodium ions get oxidized to sodium metal over time
- X) Sodium ions escape the battery enclosure during recharging
- Y) Irreversible side reactions occur slowly over time
- Z) Sodium ions get reduced to sodium metal over time

ANSWER: Y) IRREVERSIBLE SIDE REACTIONS OCCUR SLOWLY OVER TIME

**BONUS**

14) Energy – *Multiple Choice* Argonne National Lab researchers are studying iridium [*ih-RID-ee-um*] oxide nanoparticles as a catalyst for the water-splitting reaction. Which of the following has the highest concentration of iridium?

- W) Meteorites
- X) Earth's crust
- Y) Earth's mantle
- Z) Earth's lithosphere

ANSWER: W) METEORITES

**TOSS-UP**

15) Physical Science – *Short Answer* According to the Lewis theory of acids and bases, a base is a species that can donate what?

ANSWER: ELECTRONS (ACCEPT: ELECTRON PAIR)

**BONUS**

15) Physical Science – *Short Answer* What is the formal charge on the central nitrogen atom in nitrous oxide, which has the formula N<sub>2</sub>O?

ANSWER: +1 (ACCEPT: 1)

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TOSS-UP

16) Earth and Space – *Multiple Choice* Which of the following best describes the watershed of the Mississippi River?

- W) The land west of the Rocky Mountains
- X) The land between the Rocky and Appalachian Mountains
- Y) The land between the Sierra Nevada and Rocky Mountains
- Z) The land east of the Appalachian Mountains

ANSWER: X) THE LAND BETWEEN THE ROCKY AND APPALACHIAN MOUNTAINS

BONUS

16) Earth and Space – *Short Answer* Identify all of the following three glacial features that consist of sorted, layered sediments: 1) Kames; 2) Eskers; 3) Drumlins.

ANSWER: 1 AND 2

TOSS-UP

17) Life Science – *Multiple Choice* Which of the following types of enzymes would most likely be involved in changing glucose-6-phosphate to glucose-1-phosphate?

- W) Isomerase [*eye-SAW-mer-ase*]
- X) Phosphatase [*FAWS-fa-tase*]
- Y) Kinase [*KYE-nayse*]
- Z) Ligase [*LYE-gase*]

ANSWER: W) ISOMERASE

BONUS

17) Life Science – *Short Answer* Reflexes are mediated by what major structure in the central nervous system?

ANSWER: SPINAL CORD

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**TOSS-UP**

18) Math – *Short Answer* What is the following sum of three fractions:  $\frac{1}{5} + \frac{1}{9} + \frac{1}{45}$ ?

ANSWER:  $\frac{1}{3}$

**BONUS**

18) Math – *Short Answer* A circle has an area of 49. What is its circumference?

ANSWER:  $14\sqrt{\pi}$

**TOSS-UP**

19) Physical Science – *Short Answer* What type of wave is composed of two equally-sized waves that move in opposite directions and interfere continuously with each other?

ANSWER: STANDING

**BONUS**

19) Physical Science – *Short Answer* On a graph of force versus displacement, what quantity is best represented by the area underneath the curve?

ANSWER: WORK



**TOSS-UP**

20) Earth and Space – *Short Answer* What greenhouse gas can comprise up to 4 percent of the Earth's atmosphere?

ANSWER: WATER (ACCEPT: WATER VAPOR)

**BONUS**

20) Earth and Space – *Short Answer* Identify all of the following three items that will influence rock weathering rate: 1) Rock composition; 2) Presence of cracks; 3) Local precipitation.

ANSWER: ALL

**TOSS-UP**

21) Life Science – *Short Answer* Deoxygenated blood enters the human heart in what chamber?

ANSWER: RIGHT ATRIUM

**BONUS**

21) Life Science – *Short Answer* Identify all of the following three molecules that are proteins:

1) Keratin; 2) Casein [*KAY-seen*]; 3) Insulin.

ANSWER: ALL

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TOSS-UP

22) Math – *Short Answer* The radius of a sphere is multiplied by 8. By what factor is its surface area multiplied?

ANSWER: 64

BONUS

22) Math – *Short Answer* A certain medication has a 60% success rate of curing people who have a specific illness. If three people with the illness are selected at random and take the medicine, what is the probability that exactly two of the three people will be cured?

ANSWER: 54/125 (ACCEPT: 0.432 or 43.2%)

TOSS-UP

23) Physical Science – *Multiple Choice* Which of the following metals has the most similar valence electron configuration to silver?

- W) Iridium
- X) Rhodium
- Y) Titanium
- Z) Gold

ANSWER: Z) GOLD

BONUS

23) Physical Science – *Short Answer* Order the following four substances by increasing length of the alkanes that typically compose them: 1) Kerosene; 2) Asphalt; 3) Natural gas; 4) Gasoline.

ANSWER: 3, 4, 1, 2