

MIDDLE SCHOOL - ROUND 17A

TOSS-UP

1) Energy – *Multiple Choice* Researchers at Pacific Northwest National Lab are studying the process of aberrant O-linked glycosylation [*glye-kaw-sil-AY-shun*] that occurs in some neurodegenerative diseases. In this process, sugars are linked to proteins through oxygen atoms. Which of the following best describes when this process occurs in cells?

- W) During transcription
- X) After transcription but before translation
- Y) During translation
- Z) After translation

ANSWER: Z) AFTER TRANSLATION

BONUS

1) Energy – *Multiple Choice* Scientists at Oak Ridge National Lab have designed a fuel rod cladding alloy made of iron, chromium, and aluminum to replace current zirconium alloys. Which of the following is the best description of the functionality of the fuel rod cladding?

- W) Maximal absorption of neutrons
- X) Minimal absorption of neutrons
- Y) Low thermal conductivity
- Z) Low melting temperature

ANSWER: X) MINIMAL ABSORPTION OF NEUTRONS

TOSS-UP

2) Math – *Short Answer* Find the value of the following expression: open parenthesis $11^3 - 22$ close parenthesis divided by 11.

ANSWER: 119

BONUS

2) Math – *Short Answer* What is the radius of the circle with equation $x^2 + y^2 - 8y - 65 = 0$?

ANSWER: 9

TOSS-UP

3) Life Science – *Short Answer* The ureters connect the kidneys to what other organ?

ANSWER: BLADDER (ACCEPT: URINARY BLADDER)

BONUS

3) Life Science – *Short Answer* What class of hormones is characteristically composed of 4 carbon rings and is usually lipid-soluble?

ANSWER: STEROIDS

TOSS-UP

4) Physical Science – *Short Answer* What is the term for the energetic barrier a reaction must overcome in order to get started?

ANSWER: ACTIVATION ENERGY

BONUS

4) Physical Science – *Short Answer* What is the chemical formula for copper(I) [*copper-one*] oxide?

ANSWER: Cu_2O

TOSS-UP

5) Earth and Space – *Short Answer* Rank the following three solar system objects in terms of increasing density: 1) Neptune; 2) Saturn; 3) Uranus.

ANSWER: 2, 3, 1

BONUS

5) Earth and Space – *Short Answer* Order the following four stars from lowest to highest absolute magnitude: 1) The Sun; 2) Sirius; 3) Rigel [*RYE-jel*]; 4) Proxima Centauri.

ANSWER: 3, 2, 1, 4

TOSS-UP

6) Energy – *Short Answer* Researchers at SLAC National Accelerator Lab are using ultrashort pulses of an X-ray laser to make videos of molecular reactions in real time. The pulses of photons produced by the laser last 100 attoseconds. Expressing your answer in seconds as 10 raised to the nearest integer power, what is the duration of these pulses?

ANSWER: 10^{-16}

BONUS

6) Energy – *Short Answer* Researchers at Ames Laboratory recently filed for two patents for a new type of refrigeration technology that could save as much as 30% in energy usage, since, rather than using a heat engine, it uses materials that cool in response to external magnetic fields. What is the term for this type of material?

ANSWER: CALORIC (ACCEPT: MAGNETOCALORIC)

TOSS-UP

7) Math – *Short Answer* What is the length of a 20-degree arc of a circle with circumference 24?

ANSWER: $\frac{4}{3}$ (ACCEPT: $1 \frac{1}{3}$)

BONUS

7) Math – *Short Answer* How many three-digit integers are multiples of 37?

ANSWER: 25

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**TOSS-UP**

8) Life Science – *Multiple Choice* Which of the following is an example of a biotic factor?

- W) Soil type
- X) Weather
- Y) Insolation
- Z) Mushroom diversity

ANSWER: Z) MUSHROOM DIVERSITY

**BONUS**

8) Life Science – *Multiple Choice* Which of the following pairs of organisms best demonstrates the concept of mutualism?

- W) Hoverflies and wasps
- X) Mycorrhiza and plants
- Y) Hermit crabs and snails
- Z) Cows and grass

ANSWER: X) MYCORRHIZA AND PLANTS

### TOSS-UP

9) Physical Science – *Multiple Choice* Suppose a basketball is thrown upward by a student standing on Earth, with a velocity of 10 meters per second. Which of the following must also be TRUE at this instant?

- W) Earth recoils at 10 meters per second downward
- X) Earth recoils at 10 meters per second upward
- Y) Earth recoils at an imperceptibly slow speed downward
- Z) Earth recoils at an imperceptibly slow speed upward

ANSWER: Y) EARTH RECOILS AT AN IMPERCEPTIBLY SLOW SPEED DOWNWARD

### BONUS

9) Physical Science – *Short Answer* Given that you have one mole of each of the following three substances at 4 degrees Celsius, rank them in terms of increasing temperature change when 100 calories of energy is transferred into them: 1) Copper; 2) Nitrogen gas kept at constant volume; 3) Borosilicate glass.

ANSWER: 1, 3, 2

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### TOSS-UP

10) Earth and Space – *Short Answer* What outermost part of the sun is visible to the naked eye only during a total solar eclipse?

ANSWER: CORONA

### BONUS

10) Earth and Space – *Short Answer* Identify all of the following three bodies in the solar system that are believed to be volcanically active: 1) Mercury; 2) Io; 3) Mars.

ANSWER: 2

### TOSS-UP

11) Energy – *Multiple Choice* Many of today's electronic devices are made with Rare Earth Elements, or REEs. Because the US lacks a domestic production capability, scientists at Idaho National Laboratory are interested in identifying ways to recapture REEs from discarded high-tech devices. Which of the following is an REE that you would expect to find in a typical cell phone?

W) Neodymium [*neo-DYE-mee-um*]

X) Cesium

Y) Lithium

Z) Promethium [*pro-MEE-thee-um*]

ANSWER: W) NEODYMIUM

### BONUS

11) Energy – *Short Answer* Scientists at Oak Ridge National Lab are studying new therapies for glaucoma, a disease that damages what nerve that carries visual information from the eye?

ANSWER: OPTIC NERVE (ACCEPT: CRANIAL NERVE 2, CN 2)

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### TOSS-UP

12) Math – *Short Answer* The point  $(4, -3)$  is reflected across the  $y$ -axis, and the resulting point is then translated 8 units upward. What are the coordinates of the final image point?

ANSWER:  $(-4, 5)$  (ACCEPT:  $x = -4$  AND  $y = 5$ )

### BONUS

12) Math – *Short Answer* What is the coefficient of the  $ab^2$  term in the binomial expansion of open parenthesis  $5a - 8b$  close parenthesis cubed?

ANSWER: 960

### TOSS-UP

13) Life Science – *Multiple Choice* Plants are comprised of three main non-reproductive organs. Which of the following choices correctly summarizes these three organs?

- W) Flowers, roots, stems
- X) Stems, roots, leaves
- Y) Stems, flowers, leaves
- Z) Roots, stems, shoots

ANSWER: X) STEMS, ROOTS, LEAVES

### BONUS

13) Life Science – *Short Answer* Identify all of the following four structures whose musculature is primarily composed of smooth muscle: 1) Heart; 2) Stomach; 3) Artery; 4) Bicep.

ANSWER: 2, 3

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### TOSS-UP

14) Earth and Space – *Short Answer* What is the term for the change in temperature for a given change in depth within Earth's interior?

ANSWER: GEOTHERM (ACCEPT: GEOTHERMAL GRADIENT)

### BONUS

14) Earth and Space – *Short Answer* Identify all of the following three statements that are TRUE of permafrost: 1) Building roads over permafrost has no impact on the soil because roads are relatively narrow; 2) Thawing permafrost produces unstable ground that may undergo severe frost heaving; 3) Building structures on stilts helps keep permafrost from thawing.

ANSWER: 2, 3

**TOSS-UP**

15) Math – *Short Answer* What are the smallest and largest integers that satisfy the following absolute value inequality: the absolute value of open parenthesis  $x - 6$  close parenthesis is less than 4?

Answer: 3 AND 9 (must give both answers)

**BONUS**

15) Math – *Short Answer* A 5-digit palindrome has 3 different digits and is divisible by 6. What is the largest such number?

ANSWER: 89,598

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TOSS-UP

16) Life Science – *Short Answer* Blood that leaves the right ventricle will most likely visit what organ before entering the left atrium?

ANSWER: LUNG

BONUS

16) Life Science – *Short Answer* The light-dependent reactions of photosynthesis primarily serve to synthesize ATP and what other high-energy molecule for the Calvin cycle?

ANSWER: NADPH

TOSS-UP

17) Earth and Space – *Multiple Choice* Which of the following tectonic plates does not share a plate boundary with the North American Plate?

- W) African Plate
- X) Cocos Plate
- Y) Nazca Plate
- Z) Juan de Fuca [*WAHN-de-FOO-ka*] Plate

ANSWER: Y) NAZCA PLATE

BONUS

17) Earth and Space – *Multiple Choice* Earth's perihelion [*peh-ree-HEEL-yun*] is closest in time to which of the following?

- W) Vernal equinox in the Northern Hemisphere
- X) Vernal equinox in the Southern Hemisphere
- Y) Winter solstice in the Northern Hemisphere
- Z) Winter solstice in the Southern Hemisphere

ANSWER: Y) WINTER SOLSTICE IN THE NORTHERN HEMISPHERE

TOSS-UP

18) Physical Science – *Multiple Choice* Which of the following is an example of a compound with an ionic bond?

- W) Carbon tetrachloride [*tetrah-KLOOR-ide*]
- X) Phosphorous trichloride [*try-KLOOR-ide*]
- Y) Sodium sulfide
- Z) Methane

ANSWER: Y) SODIUM SULFIDE

BONUS

18) Physical Science – *Multiple Choice* Gay-Lussac's [*LOO-saks*] Law would be most useful for determining temperature changes of a gas in which of the following situations?

- W) Within a sealed soda can
- X) Within a cloud
- Y) Within a teapot
- Z) Within a balloon as it is filled

ANSWER: W) WITHIN A SEALED SODA CAN

TOSS-UP

19) Math – *Short Answer* For the function f of $x = 4x - 7$, what is f inverse of 17?

ANSWER: 6

BONUS

19) Math – *Short Answer* In a particular year, if May 8 is on a Monday, on what day of the week is August 18?

ANSWER: FRIDAY

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**TOSS-UP**

20) Life Science – *Multiple Choice* Which of the following best describes the earliest fish in the fossil record?

- W) Jawed with soft bodies
- X) Jawed with armored bodies
- Y) Jawless with soft bodies
- Z) Jawless with armored bodies

ANSWER: Z) JAWLESS WITH ARMORED BODIES

**BONUS**

20) Life Science – *Multiple Choice* Two species,  $A$  and  $B$ , have a predator-prey relationship. Which of following best describes the graphs of their populations vs. time?

- W) When the graph of species  $A$  has a positive slope, the graph of species  $B$  has a positive slope
- X) When the graph of species  $A$  has a positive slope, the graph of species  $B$  has a negative slope
- Y) When the graph of species  $A$  has a positive slope, the graph of species  $B$  is uncorrelated
- Z) When the graph of species  $A$  is at a maxima, the graph of species  $B$  is at a maxima

ANSWER: X) WHEN THE GRAPH OF SPECIES  $A$  HAS A POSITIVE SLOPE, THE GRAPH OF SPECIES  $B$  HAS A NEGATIVE SLOPE

**TOSS-UP**

21) Physical Science – *Multiple Choice* Which of the following quantities is zero for a falling object that has reached terminal velocity?

- W) Velocity
- X) Speed
- Y) Net displacement
- Z) Net force

ANSWER: Z) NET FORCE

**BONUS**

21) Physical Science – *Multiple Choice* Which of the following constants relates the temperature of a particle to its most probable energy?

- W) Planck's constant
- X) Newton's constant
- Y) Avogadro's constant
- Z) Boltzmann's constant

ANSWER: Z) BOLTZMANN'S CONSTANT

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TOSS-UP

22) Earth and Space – *Short Answer* According to Stefan's Law, doubling the temperature of a black body results in its total energy radiated being multiplied by what factor?

ANSWER: 16

BONUS

22) Earth and Space – *Short Answer* Identify all of the following three statements that are TRUE of losing streams: 1) Water will tend to flow from the stream to the underlying groundwater system; 2) The water table is above the top of the stream; 3) Losing streams are common in karst topography.

ANSWER: 1, 3

TOSS-UP

23) Physical Science – *Short Answer* An amine is characterized by what element that usually possesses a lone pair in compounds?

ANSWER: NITROGEN

BONUS

23) Physical Science – *Short Answer* Identify all of the following three types of compounds whose molecular formula is always the same as its empirical formula: 1) Ionic; 2) Molecular covalent; 3) Metallic.

ANSWER: NONE OF THEM