

MIDDLE SCHOOL - ROUND 12A

TOSS-UP

1) Math – *Short Answer* If \log base 4 of x is 2.5, what is x ?

ANSWER: 32

BONUS

1) Math – *Short Answer* What is the y -coordinate of the y -intercept of the line with slope $-4/5$ that contains the point $(-3, 8)$?

ANSWER: $28/5$ (ACCEPT $5\ 3/5$, 5.6)

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### TOSS-UP

2) Earth and Space – *Short Answer* What is the name for the southern-most latitude for which it is possible for the Sun to be at the zenith?

ANSWER: TROPIC OF CAPRICORN

### BONUS

2) Earth and Space – *Short Answer* Order the following four objects in the night sky in increasing order of brightness: 1) Venus; 2) Uranus; 3) Sirius; 4) Andromeda [*ann-DRAW-meh-dah*] Galaxy.

ANSWER: 2, 4, 3, 1

**TOSS-UP**

3) Physical Science – *Multiple Choice* For an object falling in the presence of air resistance, which of the following quantities will asymptotically approach a non-zero constant?

- W) Position
- X) Velocity
- Y) Acceleration
- Z) Force

ANSWER: X) VELOCITY

**BONUS**

3) Physical Science – *Short Answer* An object remains in uniform circular motion while having its velocity doubled and its radius of revolution tripled. By what factor is its centripetal acceleration multiplied?

ANSWER: 4/3

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TOSS-UP

4) Energy – *Multiple Choice* Scientists at the Joint Genome Institute recently conducted epigenetic sequencing of fungi [*fun-ji*]. Which of the following is primarily measured in epigenetic analysis?

- W) Methylation on DNA bases
- X) Quantity of RNA transcripts
- Y) Sequences of various genes
- Z) Quantity of various proteins

ANSWER: W) METHYLATION ON DNA BASES

BONUS

4) Energy – *Short Answer* Scientists at SLAC [*slack*] are working on improving the sensitivity of what interferometer [*inter-feer-AW-meh-ter*] that was responsible for the first detection of gravitational waves?

ANSWER: LASER INTERFEROMETER GRAVITATIONAL-WAVE OBSERVATORY (ACCEPT: LIGO, ALIGO)

TOSS-UP

5) Life Science – *Multiple Choice* Which of the following kingdoms contains organisms that directly produce methane as a byproduct of metabolism?

- W) Bacteria
- X) Archaea [*ar-KEE-ah*]
- Y) Fungi [*fun-ji*]
- Z) Animalia

ANSWER: X) ARCHAEA

BONUS

5) Life Science – *Short Answer* Identify all of the following three stages of meiosis [*my-OH-sis*] that are marked by the synapsis [*sih-NAP-sis*] of homologous [*ha-MAWL-uh-gus*] chromosomes: 1) Prophase I; 2) Prophase II; 3) Metaphase II.

ANSWER: 1



TOSS-UP

6) Earth and Space – *Multiple Choice* Which of the following is an effect of El Niño on the southern United States' climate?

- W) An increase in tornadoes
- X) Fewer rainfalls
- Y) Drier winters
- Z) Warmer winters

ANSWER: W) AN INCREASE IN TORNADOES

BONUS

6) Earth and Space – *Short Answer* Identify all of the following three statements that are true of rock types: 1) Granite and andesite are chemically equivalent; 2) Gabbro and basalt [*bah-SALT*] are chemically equivalent; 3) Gabbro is an extrusive rock.

ANSWER: 2

TOSS-UP

7) Math – *Multiple Choice* A triangle has two sides of length 6 and 11. Which of the following is NOT possible for the length of the third side?

- W) 6
- X) 11
- Y) 16
- Z) 17

ANSWER: Z) 17

BONUS

7) Math – *Short Answer* Evaluate $3 \log_2 8 + 4 \log_3 81 - \frac{1}{2} \log_4 4096$.

ANSWER: 22



TOSS-UP

8) Physical Science – *Short Answer* Evangelista Torricelli is famous for inventing what tool that measures atmospheric pressure?

ANSWER: BAROMETER

BONUS

8) Physical Science – *Short Answer* Identify all of the following three properties that are typical of nonmetals: 1) Ductile; 2) Poor electrical conductance; 3) Form basic oxides.

ANSWER: 2

TOSS-UP

9) Energy – *Short Answer* Scientists at Lawrence Livermore National Laboratory have developed a laser-based tabletop device to measure carbon-14 concentrations. Biological samples must be homogenized, dried, and combusted before they are measured. In what compound does the spectrometer measure the carbon-14 abundance?

ANSWER: CARBON DIOXIDE (ACCEPT: CO₂)

BONUS

9) Energy – *Multiple Choice* Scientists at Lawrence Berkeley National Lab recently published a study on the distribution of dust in the Milky Way. Which of the following best explains how they can detect the dust?

- W) Interstellar dust easily scatters red light, so stars seen through it appear bluer than expected
- X) Interstellar dust easily scatters blue light, so stars seen through it appear redder than expected
- Y) The dust generates photons
- Z) The gravitational effects of the dust are measurable

ANSWER: X) INTERSTELLAR DUST EASILY SCATTERS BLUE LIGHT, SO STARS SEEN THROUGH IT APPEAR REDDER THAN EXPECTED

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**TOSS-UP**

10) Earth and Space – *Multiple Choice* Which of the following is closest to the number of astronomical units from the Earth to Proxima Centauri?

- W) 3 times ten to the 5<sup>th</sup>
- X) 3 times ten to the 6<sup>th</sup>
- Y) 3 times ten to the 7<sup>th</sup>
- Z) 3 times ten to the 8<sup>th</sup>

ANSWER: W) 3 TIMES TEN TO THE 5th

**BONUS**

10) Earth and Space – *Short Answer* Identify all of the following three statements that are true of Earth's magnetic field: 1) It is responsible for blocking gamma radiation from the Sun; 2) It is responsible for the formation of the Van Allen belts; 3) Its strength is tens of microteslas at Earth's surface.

ANSWER: 2 AND 3

### TOSS-UP

11) Life Science – *Multiple Choice* Having a single ventricle limits oxygen delivery for a three-chambered heart. Which of the following animals has a three-chambered heart?

- W) Mouse
- X) Eagle
- Y) Chimpanzee
- Z) Frog

ANSWER: Z) FROG

### BONUS

11) Life Science – *Short Answer* Elastin is a protein that is most commonly found in which of the four general classes of human tissue?

ANSWER: CONNECTIVE

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TOSS-UP

12) Energy – *Multiple Choice* Researchers at Argonne National Lab Chemical Sciences and Engineering Division are studying the decomposition of H_2CO into H_2 and CO . If they are specifically examining the hydrogen-carbon bond stretching and breaking, what type of structure are they examining?

- W) Product
- X) Second order
- Y) Transition state
- Z) Intermediate

ANSWER: Y) TRANSITION STATE

BONUS

12) Energy – *Short Answer* Scientists at Los Alamos National Lab recently discovered that optical phonons [*FOH-nawns*] in some 2D lattices condense into what phase of ultracold matter composed of particles with integer spins?

ANSWER: BOSE-EINSTEIN CONDENSATE

TOSS-UP

13) Earth and Space – *Multiple Choice* What is the general term for an erosional or non-depositional surface between strata of different ages?

- W) Unconformity
- X) Fault
- Y) Cross bedding
- Z) Syncline

ANSWER: W) UNCONFORMITY

BONUS

13) Earth and Space – *Short Answer* Identify all of the following three statements that are true of erosion and soil: 1) Eroded materials are deposited at new locations by a process called weathering; 2) Humus is the gravel-like covering above the bedrock; 3) A soil horizon is a distinct layer within a cross section of the soil.

ANSWER: 3



TOSS-UP

14) Math – *Short Answer* If a number is increased by 60%, by what percent is its square increased?

ANSWER: 156

BONUS

14) Math – *Short Answer* One angle of an isosceles triangle measures 74 degrees. In degrees, what are the possible measures of the smallest angle of the triangle?

ANSWER: 32 AND 53

TOSS-UP

15) Life Science – *Short Answer* For each gene, what is the maximum number of different alleles [*ah-LEELZ*] a human can inherit?

ANSWER: TWO

BONUS

15) Life Science – *Short Answer* Identify all of the following three steps of aerobic respiration that produce carbon dioxide: 1) Glycolysis [*glye-KAWL-eh-sis*]; 2) Krebs cycle; 3) Oxidative phosphorylation [*faws-four-il-AY-shun*].

ANSWER: 2

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**TOSS-UP**

16) Physical Science – *Multiple Choice* Which of the following substances contains a covalent bond?

- W) Dichlorine
- X) Argon
- Y) Sodium chloride
- Z) Neon

ANSWER: W) DICHLORINE

**BONUS**

16) Physical Science – *Short Answer* What group of elements possesses a stable outer energy level?

ANSWER: 18 (ACCEPT: NOBLE GASES)

**TOSS-UP**

17) Math – *Short Answer* The point (–4, 7) is reflected over the y-axis. In what quadrant does the reflected point lie?

ANSWER: 1 (ACCEPT: FIRST)

**BONUS**

17) Math – *Short Answer* How many edges does a regular dodecahedron have?

ANSWER: 30

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TOSS-UP

18) Life Science – *Short Answer* What fluid bathes the inside of a joint capsule and lubricates movement?

ANSWER: SYNOVIAL FLUID

BONUS

18) Life Science – *Multiple Choice* A macrophage [**MACRO-fayj**] engulfs a bacterial cell and then creates molecules that trigger itself to migrate to the lymph node. What type of signaling is this?

- W) Endocrine [**EN-doh-krin**]
- X) Neuroendocrine [**NOOR-oh-en-doh-krin**]
- Y) Paracrine [**para-krin**]
- Z) Autocrine [**auto-krin**]

ANSWER: Z) AUTOCRINE

TOSS-UP

19) Physical Science – *Multiple Choice* Which of the following quantities related to a light wave increases with increasing energy carried by each photon?

- W) Amplitude
- X) Speed
- Y) Wavelength
- Z) Frequency

ANSWER: Z) FREQUENCY

BONUS

19) Physical Science – *Short Answer* Identify all of the following three statements that are true of electrical devices: 1) Transformers convert alternating current to direct current; 2) Household electrical outlets provide alternating current; 3) Batteries produce direct current.

ANSWER: 2 AND 3

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**TOSS-UP**

20) Math – *Short Answer* What is the  $x$ -intercept of the line with equation  $5x - 4y = -40$ ?

ANSWER:  $(-8, 0)$  (ACCEPT:  $-8$ )

**BONUS**

20) Math – *Short Answer* The graph of the line with equation  $y = -3x + 4$  is reflected through the  $x$ -axis. What is the slope-intercept equation of the reflected line?

ANSWER:  $y = 3x - 4$

**TOSS-UP**

21) Earth and Space – *Short Answer* What is the chemical formula of the mineral quartz?

ANSWER: SiO<sub>2</sub>

**BONUS**

21) Earth and Space – *Short Answer* What scale is used to measure the intensity of an earthquake based on its damage?

ANSWER: MODIFIED MERCALLI (ACCEPT: MODIFIED MERCALLI INTENSITY INDEX)



**TOSS-UP**

22) Physical Science – *Short Answer* What is the general term for compounds used in titrations that react with acids or bases to produce a color change?

ANSWER: INDICATORS

**BONUS**

22) Physical Science – *Short Answer* Identify all of the following three terms that can be used to describe methanol: 1) Covalent; 2) Polar; 3) Ionic.

ANSWER: 1 AND 2

### TOSS-UP

23) Life Science – *Short Answer* In plants, light-dependent oxidative phosphorylation [*faws-four-il-AY-shun*] takes place in what organelle?

ANSWER: CHLOROPLAST

### BONUS

23) Life Science – *Short Answer* What family of enzymes is responsible for synthesizing new DNA during replication?

ANSWER: DNA POLYMERASES (ACCEPT: POLYMERASES)