

## ROUND 3A

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### TOSS-UP

1) MATH *Multiple Choice* If it takes you 50 minutes to walk uphill 2 miles to school but only 30 minutes to walk back, which of the following is your average speed, in miles per hour, for the round trip?

- W) 3
- X) 3.5
- Y) 4
- Z) 4.5

ANSWER: W) 3

### BONUS

1) MATH *Short Answer* If  $a_1 = 3$  [**a sub one equals three**] and  $a_n = 5 + 2a_{n-1}$  [**a sub n equals five plus two a sub quantity n minus 1**] for all integers n greater than 1, what is the value of  $a_3$  [**a sub three**]?

ANSWER: 27

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### TOSS-UP

2) BIOLOGY *Multiple Choice* Which of the following groups of organisms would contain the most biomass productivity in a trophic pyramid?

- W) Primary Producers
- X) Primary Consumers
- Y) Detritivores [**de-TRY-tuh-vohrs**]
- Z) Tertiary Consumers

ANSWER: W) PRIMARY PRODUCERS

### BONUS

2) BIOLOGY *Short Answer* What is the only multicellular animal without a permanent gut cavity?

ANSWER: SPONGE (ACCEPT: PORIFERAN, PORIFERA, or PLACOZOA)

### TOSS-UP

3) CHEMISTRY *Multiple Choice* Which of the following scientists is credited with discovering electrons and calculating their mass to charge ratio?

- W) J.J. Thomson
- X) Robert Millikan
- Y) Ernest Rutherford
- Z) Neils Bohr

ANSWER: W) J.J. THOMSON

### BONUS

3) CHEMISTRY *Short Answer* What gas law was used by its formulator to approximate the absolute zero temperature through extrapolation of the temperature axis until the value for gas volume equaled zero?

ANSWER: CHARLES'S LAW

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### TOSS-UP

4) PHYSICS *Short Answer* What physical constant is the magnitude of electric charge per mole of electrons?

ANSWER: FARADAY CONSTANT

### BONUS

4) PHYSICS *Short Answer* How many baryons [**BAR-ee-ons**] and leptons, respectively, are found in a single alpha particle?

ANSWER: FOUR AND ZERO

### TOSS-UP

5) EARTH AND SPACE *Short Answer* Joints are often formed in igneous [**IG-nee-uhs**] rocks, such as basalt, during what stage of the rock's development?

ANSWER: COOLING

### BONUS

5) EARTH AND SPACE *Multiple Choice* What type of volcanic vent is Wizard Island, the only resurgent dome of Crater Lake that breaks the surface of the water line?

- W) Shield volcano
- X) Fissure
- Y) Cinder cone
- Z) Stratovolcano

ANSWER: Y) CINDER CONE

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### TOSS-UP

6) BIOLOGY *Multiple Choice* Which of the following forms of nitrogen cannot be directly utilized by plants?

- W) Ammonia
- X) Ammonium
- Y) Nitrogen gas
- Z) Nitrite

ANSWER: Y) NITROGEN GAS

### BONUS

6) BIOLOGY *Multiple Choice* Which of the following was NOT a component of the Miller-Urey [**MILL-er YOO-ree**] experiment test conditions for the chemical origins of life?

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

ANSWER: W) CARBON DIOXIDE

### TOSS-UP

7) ENERGY *Multiple Choice* At what point in time is a CFL's [**C-F- elz**] energy consumption greatest, compared to its light output?

- W) Right after being turned on
- X) After being on for 15 minutes
- Y) Right after being turned off
- Z) After being turned off for 15 minutes

ANSWER: W) RIGHT AFTER BEING TURNED ON

### BONUS

7) ENERGY *Short Answer* Since 2007 all cars and trucks in the US have been produced to be able to use what specific ethanol fuel blend?

ANSWER: E15 (ACCEPT: 15% ETHANOL)

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### TOSS-UP

8) CHEMISTRY *Short Answer* Name the two common crystalline forms of carbon.

ANSWER: GRAPHITE AND DIAMOND (ACCEPT: AND CARBON (IV))

### BONUS

8) CHEMISTRY *Multiple Choice* Which of the following neutral ground state atoms has the lowest first ionization energy?

- W) Nitrogen
- X) Oxygen
- Y) Fluorine
- Z) Neon

ANSWER: X) OXYGEN

**TOSS-UP**

9) PHYSICS *Short Answer* Unpolarized light is passed through a single polarizing filter. What fraction of the intensity of the light emerges from the filter?

ANSWER: 1/2

**BONUS**

9) PHYSICS *Multiple Choice* If 15 joules of work are required to move 3.0 coulombs of charge between two points, what is the potential difference in volts between these two points?

- W) 3
- X) 5
- Y) 15
- Z) 45

ANSWER: X) 5

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**TOSS-UP**

10) BIOLOGY *Short Answer* Huntington disease is caused by the sequence CAG [**C-A-G**] repeated between 37-100 times, rather than the normal 9-35 times. What type of mutation is this?

ANSWER: INSERTION

**BONUS**

10) BIOLOGY *Multiple Choice* Which of the following statements about cystic fibrosis is NOT true?

- W) It is an autosomal recessive disease
- X) It affects the lungs, sweat glands and digestive system
- Y) It is one of the most common fatal genetic disorders in the United States
- Z) Most infants born with this disorder are unlikely to live beyond their first year

ANSWER: Z) MOST INFANTS BORN WITH THIS DISORDER ARE UNLIKELY TO LIVE BEYOND THEIR FIRST YEAR

### TOSS-UP

11) EARTH AND SPACE *Multiple Choice* Which of the following rocks can be biogenic?

- W) Schist [**SHIST**]
- X) Basalt
- Y) Limestone
- Z) Gabbro

ANSWER: Y) LIMESTONE

### BONUS

11) EARTH AND SPACE *Short Answer* What is the name of the geologic event recorded in sedimentary rocks showing the landward migration of the ocean's shoreline?

ANSWER: TRANSGRESSION

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### TOSS-UP

12) CHEMISTRY *Multiple Choice* Lipstick is known to be a suspension of high molecular weight hydrocarbons, waxes, and other ingredients. Which of the following choices does NOT describe lipstick composition?

- W) Castor oil may be a dispersing agent
- X) Beeswax is sometimes used as a stiffening agent
- Y) Metal ions such as Nickel(II) [**nickel two**] are the basis for lipstick dyes
- Z) Carbon soot is typically used as a coloring agent

ANSWER: Z) CARBON SOOT IS TYPICALLY USED AS A COLORING AGENT

### BONUS

12) CHEMISTRY *Short Answer* Identify all of the following three chemical species that likely have a negative enthalpy of formation: 1) carbon monoxide; 2) nitrogen monoxide; 3) sodium bromide.

ANSWER: 1 AND 3 (ACCEPT: CARBON MONOXIDE AND SODIUM BROMIDE)

### TOSS-UP

13) MATH *Multiple Choice* Which of the following statements is true for the radius  $r$ , height  $h$ , and volume  $V$  of a right circular cylinder?

- W) If both  $r$  and  $h$  are doubled,  $V$  is doubled
- X) If  $r$  is increased by 2,  $V$  is increased by 4
- Y) If  $r$  is doubled and  $h$  is halved,  $V$  is quadrupled
- Z) If  $r$  is doubled and  $h$  is divided by 4,  $V$  remains the same

ANSWER: Z) IF  $r$  IS DOUBLED AND  $h$  IS DIVIDED BY 4,  $V$  REMAINS THE SAME

### BONUS

13) MATH *Multiple Choice* If  $f(x)$  [**f of x**] is a twice differentiable function where for all real numbers  $f'(x)$  [**f prime of x**] is less than 0 and  $f''(x)$  [**f double prime of x**] is less than 0, with  $f(4) = 12$  [**f of four equals twelve**] and  $f(5) = 9$  [**f of five equals nine**], which of the following is a possible value for  $f(6)$  [**f of six**]?

- W) 3
- X) 6
- Y) 9
- Z) 12

ANSWER: W) 3

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### TOSS-UP

14) ENERGY *Short Answer* What is the term used to describe the medium in nuclear reactors that is used to reduce the speed of fast neutrons?

ANSWER: MODERATOR

### BONUS

14) ENERGY *Short Answer* Aside from any impurities, what is the co-product resulting from biodiesel production that is produced in far greater quantities than it is currently used?

ANSWER: GLYCERIN

### TOSS-UP

15) BIOLOGY *Short Answer* What is a form of asexual reproduction in which young develop from unfertilized eggs?

ANSWER: PARTHENOGENESIS

### BONUS

15) BIOLOGY *Multiple Choice* Some plants are able to adapt to normally toxic levels of metals in soil by absorbing and storing high concentrations of the metals within themselves. By doing this, these plants are able to detoxify the surrounding soil. Restoration ecologists use these plants as a form of:

- W) Bioremediation, to remove harmful substances from the environment
- X) Bioremediation, to add helpful plant life to the environment
- Y) Biological augmentation, to add helpful plant life to the environment
- Z) Biological augmentation, to remove harmful substances from the environment

ANSWER: W) BIOREMEDIATION, TO REMOVE HARMFUL SUBSTANCES FROM THE ENVIRONMENT

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### TOSS-UP

16) CHEMISTRY *Short Answer* What is the chemical formula of the most stable ionic compound that forms between aluminum and sulfur?

ANSWER:  $\text{Al}_2\text{S}_3$  (DO NOT ACCEPT: ALUMINUM SULFIDE)

### BONUS

16) CHEMISTRY *Short Answer* If a random element is picked from period 5 on the periodic table, what is the probability that the element will have a high energy electron in the d orbital?

ANSWER: 8 / 9 (ACCEPT: 88 8/9%)



**TOSS-UP**

17) MATH *Short Answer* In statistical testing, what term describes the default position, that there is no relationship between the two measured phenomena?

ANSWER: NULL HYPOTHESIS

**BONUS**

17) MATH *Multiple Choice* Consider a criminal trial in which the defendant is innocent until proven guilty. If the jury rejects the null hypothesis when the defendant is innocent, which of the following has occurred?

- W) The jury made the right decision
- X) The jury committed a type I error
- Y) The jury committed a type II error
- Z) The jury committed a type III error

ANSWER: X) THE JURY COMMITTED A TYPE I ERROR

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**TOSS-UP**

18) PHYSICS *Short Answer* To the nearest whole decibel, a doubling of sound intensity is equal to an increase of how many decibels?

ANSWER: 3

**BONUS**

18) PHYSICS *Short Answer* Indicate, by number, all of the following quantities that would change if the radius of the Earth decreases but the mass remains the same: 1) length of day; 2) kinetic energy of rotation; 3) length of year.

ANSWER: 1 AND 2

### TOSS-UP

19) EARTH AND SPACE *Multiple Choice* Which of the following major U.S. rivers flows north?

- W) Snake River
- X) Connecticut River
- Y) Missouri River
- Z) Sacramento River

ANSWER: W) SNAKE RIVER

### BONUS

19) EARTH AND SPACE *Multiple Choice* What are the two main factors that cause sound to travel such great distances in the SOFAR [**SOH-fahr**] channel?

- W) Temperature and salinity
- X) Pressure and salinity
- Y) Pressure and temperature
- Z) Temperature and latitude

ANSWER: Y) PRESSURE AND TEMPERATURE

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### TOSS-UP

20) CHEMISTRY *Short Answer* Gypsum wallboard, commonly known as drywall, is a laminar, composite material composed of front and back paper with a hydrated gypsum core. What is the chemical formula for the hydrated gypsum?

ANSWER:  $\text{CaSO}_4 \cdot 2 \text{H}_2\text{O}$  (DO NOT ACCEPT: CALCIUM SULFATE AND 2 MOLECULES OF WATER)

### BONUS

20) CHEMISTRY *Short Answer* Molecule A, with oxidation number +1 [**plus one**], and Molecule B, with oxidation number -2 [**minus two**], undergo a metathesis [**muh-THAT-uh-sis**] reaction. After the reaction, what are their oxidation numbers?

ANSWER: MOLECULE A: +1; MOLECULE B: -2

**TOSS-UP**

21) BIOLOGY *Short Answer* In prokaryotic [**proh-Kr-ee-OT-ik**] DNA replication, what enzyme is responsible for unwinding the DNA double helix?

ANSWER: HELICASE

**BONUS**

21) BIOLOGY *Short Answer* A man is born with webbed fingers and toes. His wife and their daughter do not have webbed fingers and toes. If webbed digits are a dominant trait, what fraction of this couple's children would be expected to have webbed digits?

ANSWER:  $\frac{1}{2}$

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**TOSS-UP**

22) ENERGY *Multiple Choice* Which of the following regions of the United States has the greatest amount of installed wind power capacity?

- W) West coast
- X) Midwest
- Y) New England
- Z) Southeast

ANSWER: X) MIDWEST

**BONUS**

22) ENERGY *Short Answer* Most renewable electricity generation worldwide is generated by what form of renewable energy?

ANSWER: HYDROELECTRICITY (ACCEPT: HYDROPOWER )

### TOSS-UP

23) EARTH AND SPACE *Multiple Choice* Which of the following lava characteristics does NOT affect the lava's viscosity?

- W) Gas amount
- X) Temperature
- Y) Gas composition
- Z) Silica content

ANSWER: Y) GAS COMPOSITION

### BONUS

23) EARTH AND SPACE *Short Answer* Anticlines are usually found in conjunction with what other type of fold?

ANSWER: SYNCLINE