

## ROUND 4A

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### TOSS-UP

1) EARTH AND SPACE *Multiple Choice* Which of the following minerals is formed by evaporation?

- W) Amphibole [**AM-fuh-bohl**]
- X) Gypsum
- Y) Olivine [**OL-uh-veen**]
- Z) Plagioclase [**PLAY-jee-uh-klays**]

ANSWER: X) GYPSUM

### BONUS

1) EARTH AND SPACE *Multiple Choice* Proxima Centauri [**PROK-suh-muh sen-TAWR-y**], the closest star to the sun, is nearest which of the following distances from the sun?

- W) 4 light-years
- X) 400 light-years
- Y) 4 million light-years
- Z) 4 billion light-years

ANSWER: W) 4 LIGHT-YEARS

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### TOSS-UP

2) BIOLOGY *Multiple choice* What is the organ, found in birds and some invertebrates, that is used to temporarily store food, but also aids in preliminary digestion?

- W) Liver
- X) Gizzard
- Y) Crop
- Z) Cloaca [**kloh-AY-kuh**]

ANSWER: Y) CROP

### BONUS

2) BIOLOGY *Multiple Choice* Which of the following statements is NOT true of an *r*-selected species?

- W) The mother produces a large number of eggs that suffer heavy predation
- X) The mother reaches sexual maturity early in life
- Y) The parents provide long-term care for the offspring
- Z) The species is more successful in unstable environments

ANSWER: Y) THE PARENTS PROVIDE LONG-TERM CARE FOR THE OFFSPRING

### TOSS-UP

3) MATH *Multiple Choice* For a car traveling at a speed of  $s$  miles per hour, the fuel consumption of the car,  $C(s)$  [**C of S**], is measured in gallons per mile. What are the units of  $\int_a^b C(s)ds$  [**the integral from A to B of C of S d S**]?

- W) Gallons
- X) Gallons per hour
- Y) Miles per hour per gallon
- Z) Gallons per mile per hour

ANSWER: X) GALLONS PER HOUR

### BONUS

3) MATH *Short Answer* If the average of a set of 20 numbers is 15 and the average of another set of 15 numbers is 22, what is the average of all 35 numbers?

ANSWER: 18

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### TOSS-UP

4) ENERGY *Multiple Choice* Which of the following elements has the largest 2<sup>nd</sup> ionization energy?

- W) Boron
- X) Oxygen
- Y) Sodium
- Z) Lithium

ANSWER: Z) LITHIUM

### BONUS

4) ENERGY *Short Answer* As anthropogenic greenhouse gas emissions, specifically carbon dioxide, accumulate in the atmosphere, what is anticipated to happen to ocean pH and temperature?

ANSWER: OCEAN pH WILL DECREASE (ACCEPT: BECOME MORE ACIDIC) AND TEMPERATURE WILL INCREASE.

### TOSS-UP

5) PHYSICS *Short Answer* Indicate, by number, all of the following three quantities that would change for a wave of light entering water from the air: 1) frequency; 2) wavelength; 3) velocity.

ANSWER: 2 AND 3

### BONUS

5) PHYSICS *Short Answer* By what factor is the energy required to increase the speed of a car from rest to 10 meters per second multiplied to find the energy required to increase the speed of the same car from 10 meters per second to 20 meters per second?

ANSWER: 3

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### TOSS-UP

6) CHEMISTRY *Short Answer* State the oxidation number for nitrogen in the molecule magnesium nitride.

ANSWER: 3- (ACCEPT: THREE MINUS, NEGATIVE 3)

### BONUS

6) CHEMISTRY *Multiple Choice* Fats and oils contain what functional group?

- W) Ester
- X) Ether
- Y) Halide [**HAL-yd**]
- Z) Ketone

ANSWER: W) ESTER

### TOSS-UP

7) EARTH AND SPACE *Multiple Choice* The Sierra Nevada Mountains are composed primarily of granite. Considering that granite is an intrusive rock, how could it become visible at the surface of the Earth?

- W) Intrusive rock forms on the surface
- X) The granite was metamorphosed
- Y) The surrounding material eroded away
- Z) Granites undergo two stage cooling

ANSWER: Y) THE SURROUNDING MATERIAL ERODED AWAY

### BONUS

7) EARTH AND SPACE *Multiple Choice* A typical speed for a lithospheric plate is which of the following per year?

- W) 3 millimeters
- X) 3 centimeters
- Y) 3 meters
- Z) 3 kilometers

ANSWER: X) 3 CENTIMETERS

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### TOSS-UP

8) ENERGY *Multiple Choice* In the Northern Hemisphere, to minimize direct summer sunlight from entering a home through its windows, in what direction should most windows be facing?

- W) North
- X) East
- Y) South
- Z) West

ANSWER: W) NORTH

### BONUS

8) ENERGY *Multiple Choice* In most climates, which of the following is a concern with heat pump hot water heater technology?

- W) Water temperature
- X) Tank size
- Y) Cold air exhaust
- Z) Energy consumption

ANSWER: Y) COLD AIR EXHAUST

### TOSS-UP

9) MATH *Short Answer* Express the repeating decimal 0.131313... as a fraction.

ANSWER: 13/99

### BONUS

9) MATH *Short Answer* If  $1/x^3 - 1/x^2 - 1/x - 1 = 0$  [**one over x cubed minus one over x squared minus one over x minus one equals zero**], then find the value of  $x^3 + x^2 + x + 1$  [**x cubed plus x squared plus x plus one**]

ANSWER: 2

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### TOSS-UP

10) PHYSICS *Multiple Choice* In electrostatics, which of the following must be true of a conductor?

- W) It has zero net charge
- X) It can only carry negative charge
- Y) The electric field on its surface is zero
- Z) The electric field inside it is zero

ANSWER: Z) THE ELECTRIC FIELD INSIDE IT IS ZERO

### BONUS

10) PHYSICS *Short Answer* While fishing, you see a fish swimming near your boat that appears to be 1.5 meters under the surface of the water. Given that the index of refraction of water is 1.3, what is its true depth, in meters, to one significant figure?

ANSWER: 2

### TOSS-UP

11) BIOLOGY *Multiple Choice* Which of the following is a characteristic of monocots, but NOT eudicots **[yoo-dy-KOTSJ]**?

- W) Scattered stem vascular bundles
- X) Taproot
- Y) Flower parts in multiples of four or five
- Z) Netted leaf venation

ANSWER: W) SCATTERED STEM VASCULAR BUNDLES

### BONUS

11) BIOLOGY *Multiple Choice* Chlorosis in plants can be caused by a deficiency in which of the following nutrients?

- W) Zinc
- X) Phosphorous
- Y) Iron
- Z) Calcium

ANSWER: Y) IRON

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### TOSS-UP

12) CHEMISTRY *Short Answer* What type of redox reaction involves the simultaneous oxidation and reduction of a singular species?

ANSWER: DISPROPORTIONATION

### BONUS

12) CHEMISTRY *Short Answer* What are the bond angle, in degrees, and the molecular geometry, respectively, in the sulfate ion?

ANSWER: 109.5, TETRAHEDRAL

**TOSS-UP**

13) MATH *Short Answer* Set  $W$  contains all positive integers that are the differences of the squares of two positive integers. What is the least element of  $W$ ?

ANSWER: 3

**BONUS**

13) MATH *Short Answer* A band releases an album with 14 songs. In how many ways can they select a different song to release as a single each month for three consecutive months?

ANSWER: 2184

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**TOSS-UP**

14) PHYSICS *Multiple Choice* In order for a process to have no change in entropy, which of the following properties must it possess?

- W) Spontaneous
- X) Reversible
- Y) Endothermic
- Z) Exothermic

ANSWER: X) REVERSIBLE

**BONUS**

14) PHYSICS *Short Answer* Assume the speed of sound in air is 344 meters per second, and a string vibrates at 20 Hertz. To the nearest tenth of a meter, what is its wavelength?

ANSWER: 17.2

### TOSS-UP

15) EARTH AND SPACE *Short Answer* What is the name for the ultramafic igneous **[IG-nee-uhs]** rock that is composed almost totally of olivine **[OL-uh-veen]**?

ANSWER: DUNITE

### BONUS

15) EARTH AND SPACE *Multiple Choice* Which of the following transport agents is generally associated with creating the most poorly sorted sediment deposits?

- W) Wind
- X) Ocean waves
- Y) Rivers
- Z) Glaciers

ANSWER: Z) GLACIERS

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### TOSS-UP

16) CHEMISTRY *Multiple Choice* Which of the following is an insoluble base?

- W) Lithium hydroxide
- X) Potassium hydroxide
- Y) Magnesium hydroxide
- Z) Barium hydroxide

ANSWER: Y) MAGNESIUM HYDROXIDE

### BONUS

16) CHEMISTRY *Short Answer* Ammonia gas reacts with oxygen gas to form nitrogen dioxide and water. If the rate of appearance of water is 36 moles per liter per minute, then to two significant figures, what is the rate of disappearance of ammonia in moles per liter per minute?

ANSWER: 24



### TOSS-UP

17) BIOLOGY *Short Answer* You perform an experiment where you isolate chromatin from sea urchin sperm cells, then partially digest with micrococcal nuclease [*my-kruh-KOK-kuhl NOO-klee-ays*]. When you purify the DNA away from the chromatin proteins and run your DNA on a gel, you find that your DNA fragments have lengths that are multiples of 260 base pairs. What organizational element of chromatin leads to this digestion pattern?

ANSWER: NUCLEOSOME

### BONUS

17) BIOLOGY *Multiple Choice* In which of the following populations would you expect genetic drift to show the strongest effect?

- W) Large island group of penguins
- X) Small colony of zoo penguins
- Y) All Emperor penguins on Antarctica
- Z) All penguins on Antarctica

ANSWER: X) SMALL COLONY OF ZOO PENGUINS

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### TOSS-UP

18) ENERGY *Short Answer* What equation of electrochemistry can be used to determine the equilibrium reduction potential based on the standard reduction potential, temperature, activity, and reaction quotient?

ANSWER: NERNST EQUATION

### BONUS

18) ENERGY *Multiple Choice* Which of the following electricity generation methods has low fixed cost and high operating cost?

- W) Wind
- X) Natural gas
- Y) Solar
- Z) Hydroelectric

ANSWER: X) NATURAL GAS

### TOSS-UP

19) EARTH AND SPACE *Short Answer* Divergent boundaries often have small boundaries of another sort associated with them. What kind of boundary would this be?

ANSWER: TRANSFORM

### BONUS

19) EARTH AND SPACE *Multiple Choice* What is the location of the moon at the new moon stage?

- W) Between the earth and the sun
- X) On the opposite side of the earth from the sun
- Y) On the opposite side of the sun from the earth
- Z) To the side of a line between the earth and the sun

ANSWER: W) BETWEEN THE EARTH AND THE SUN

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### TOSS-UP

20) MATH *Multiple Choice* In the expansion of  $(2x - y)^5$  [**two x minus y quantity raised to the fifth power**], what is the coefficient of the  $x^3y^2$  [**x cubed y squared**] term?

- W) -80
- X) -8
- Y) 8
- Z) 80

ANSWER: Z) 80

### BONUS

20) MATH *Short Answer* Invert the following two by two matrix:  $\begin{bmatrix} 3 & 1 \\ 1 & 3 \end{bmatrix}$  [**first row three, one, second row one, three**]

ANSWER:  $\begin{bmatrix} 3/8 & -1/8 \\ -1/8 & 3/8 \end{bmatrix}$

### TOSS-UP

21) BIOLOGY *Multiple Choice* Animals excrete various forms of nitrogenous [*ny-TROJ-uh-nuhs*] wastes that are mainly the result of the catabolism of which of the following?

- W) Cellulose and triglycerides [*try-GLIS-uh-ryds*]
- X) Proteins and nucleic acids
- Y) Glycolipids and glycerol
- Z) Starches and proteins

ANSWER: X) PROTEINS AND NUCLEIC ACIDS

### BONUS

21) BIOLOGY *Short Answer* In the human body, what two hormones regulate the level of calcium in the blood?

ANSWER: PARATHYROID HORMONE AND CALCITONIN (ACCEPT: THYROCALCITONIN)

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### TOSS-UP

22) CHEMISTRY *Multiple Choice* Which of the following correctly identifies the effect that the presence of an uncompetitive inhibitor has on a Lineweaver - plot?

- W)  $K_m$  [*K-M*] and  $V_{max}$  [*V max*] are raised, and the ratio  $K_m/V_{max}$  [*K-M over V max*] increases
- X)  $K_m$  and  $V_{max}$  are raised, and the ratio  $K_m/V_{max}$  is unchanged
- Y)  $K_m$  and  $V_{max}$  are lowered, and the ratio  $K_m/V_{max}$  is unchanged
- Z)  $K_m$  and  $V_{max}$  are lowered, and the ratio  $K_m/V_{max}$  decreases

ANSWER: Y)  $K_M$  AND  $V_{MAX}$  ARE LOWERED, RATIO  $K_M/V_{MAX}$  IS UNCHANGED

### BONUS

22) CHEMISTRY *Short Answer* What is the pH of a 0.001 molar solution of sodium hydroxide?

ANSWER: 11

### TOSS-UP

23) PHYSICS *Short Answer* Two point charges,  $Q_1$  and  $Q_2$  [**Q one and Q two**], that have charges of +10 [**plus ten**] Nanocoulombs and -10 [**minus ten**] Nanocoulombs, respectively, are placed at two vertices of an equilateral triangle. If a third charge,  $Q_3$  [**Q three**], of +5 [**plus five**] Nanocoulombs is placed at the third vertex, what is the potential energy associated with  $Q_3$ ?

ANSWER: ZERO

### BONUS

23) PHYSICS *Multiple Choice* Which of the following statements is correct regarding the phenomenon of redshift with respect to a light source?

- W) It occurs when a light source is moving away from the observer
- X) It occurs when a light source is moving towards the observer
- Y) It only occurs when a light source is accelerating away from the observer
- Z) It only occurs when a light source is accelerating towards the observer

ANSWER: W) IT OCCURS WHEN A LIGHT SOURCE IS MOVING AWAY FROM THE OBSERVER