

ROUND 4A

TOSS-UP

1) Earth and Space – *Multiple Choice* Which of the following geologic eons lasted the longest?

- W) Hadean
- X) Archean [*ar-KEE-en*]
- Y) Proterozoic [*proh-tair-oh-ZOH-ik*]
- Z) Phanerozoic [*fah-NAIR-oh-zoh-ik*]

ANSWER: Y) PROTEROZOIC

BONUS

1) Earth and Space – *Short Answer* Identify all of the following three factors that threaten California's water supplies: 1) Slow reservoir recharge rates; 2) High agricultural water consumption; 3) Strike-slip faults intersecting major aqueducts.

ANSWER: ALL OF THEM

~~~~~

### TOSS-UP

2) Biology – *Multiple Choice* In what organ are dietary fats primarily absorbed?

- W) Small intestine
- X) Large intestine
- Y) Stomach
- Z) Liver

ANSWER: W) SMALL INTESTINE

### BONUS

2) Biology – *Multiple Choice* Sepals, petals, and which of the following provide the most complete description for the floral parts that could be found in a single flower of a monoecious plant species?

- W) Stamens and carpels
- X) Filaments
- Y) Carpels
- Z) Pistils

Answer: Z) PISTILS

**TOSS-UP**

3) Chemistry – *Multiple Choice* O<sub>2</sub> and O<sub>3</sub> are considered what type of molecules?

- W) Allotropes
- X) Structural isomers
- Y) Isotopes
- Z) Geometrical isomers

ANSWER: W) ALLOTROPES

**BONUS**

3) Chemistry – *Multiple Choice* If we assume that the bond order in carbon monoxide is three, which of the following correctly gives the formal charges on carbon and oxygen?

- W) 0 on both carbon and oxygen
- X) +1 on carbon and -1 on oxygen
- Y) -1 on carbon and +1 on oxygen
- Z) +2 on carbon and -2 on oxygen

ANSWER: Y) -1 ON CARBON AND +1 ON OXYGEN

~~~~~

TOSS-UP

4) Energy – *Short Answer* Order the following three lightbulb technologies from least to most efficient: 1) Light-emitting diode; 2) Incandescent; 3) Compact fluorescent.

ANSWER: 2, 3, 1

BONUS

4) Energy – *Short Answer* Coal gas was largely used for municipal lighting and heating before it was supplanted by what fuel source?

ANSWER: NATURAL GAS

TOSS-UP

5) Physics – *Multiple Choice* A rock on the end of a string is being swung in a circle above a child's head. The string breaks. Neglecting gravity, in what direction does the acceleration of the rock now point?

- W) Tangent to the circle
- X) Inwards towards the center of the circle
- Y) Outwards away from the center of the circle
- Z) The acceleration is now zero

ANSWER: Z) THE ACCELERATION IS NOW ZERO

BONUS

5) Physics – *Short Answer* What is the most malleable element at STP?

ANSWER: GOLD



TOSS-UP

6) Math – *Short Answer* What is the midpoint of the segment with endpoints (1, 6) and (5, -2)?

ANSWER: (3, 2)

BONUS

6) Math – *Short Answer* Solve the following system of two equations in two unknowns: $x^2 + y^2 = 2$ and $x + y = 2$.

ANSWER: (1, 1) (ACCEPT: $x = 1$ and $y = 1$)

TOSS-UP

7) Physics – *Multiple Choice* Light traveling in a vacuum hits a refractive material at an angle of 60 degrees from the normal. If it travels through the material at an angle of 30 degrees from the normal, which of the following is the refractive index of the material?

- W) Square root of 3 divided by 2
- X) Square root of 3
- Y) 2
- Z) 2 times the square root of 2

ANSWER: X) SQUARE ROOT OF 3

BONUS

7) Physics – *Short Answer* How many lumens does an isotropic source of 1 candela emit into the upper half plane?

ANSWER: 2π

~~~~~

### TOSS-UP

8) Chemistry – *Short Answer* Part of the reason that graphene demonstrates such high mechanical strength is that the carbon atoms are in what hybridization state?

ANSWER:  $SP^2$

### BONUS

8) Chemistry – *Short Answer* Order the following three gases from slowest to fastest in terms of their rate of effusion at 25 degrees Celcius: 1) Helium; 2) Argon; 3) Neon.

ANSWER: 2, 3, 1

**TOSS-UP**

9) Math – *Short Answer* Specifying whether your answer is open or closed, what is the interval of angles in degrees whose terminal sides are in the second quadrant?

ANSWER: THE OPEN INTERVAL FROM 90 TO 180

**BONUS**

9) Math – *Multiple Choice* Which of the following base 2 sums is the largest?

- W)  $1 + 1111$  [one plus one one one one]
- X)  $100 + 1001$  [one zero zero plus one zero zero one]
- Y)  $110 + 1000$  [one one zero plus one zero zero zero]
- Z)  $111 + 111$  [one one one plus one one one]

ANSWER: W)  $1 + 1111$



**TOSS-UP**

10) Energy – *Multiple Choice* Which of the following is NOT an advantage of green roofs?

- W) Improved waterproofing
- X) Improved lifespan of roof
- Y) Reduced heating costs
- Z) Reduced cooling costs

ANSWER: W) IMPROVED WATERPROOFING

**BONUS**

10) Energy – *Multiple Choice* Which of the following is NOT a desirable quality in the material used to coat nuclear fuel rods?

- W) Corrosion resistant
- X) High neutron absorption
- Y) High hardness
- Z) Low reactivity to water

ANSWER: X) HIGH NEUTRON ABSORPTION

**TOSS-UP**

11) Biology – *Multiple Choice* Which of the following structures is referred to as our body’s internal gyroscope?

- W) Inner ears
- X) Eyes
- Y) Outer ears
- Z) Nose

ANSWER: W) INNER EARS

**BONUS**

11) Biology – *Multiple Choice* Heartwood and sapwood consist of which of the following?

- W) Bark
- X) Secondary xylem
- Y) Periderm
- Z) Secondary phloem

ANSWER: X) SECONDARY XYLEM



**TOSS-UP**

12) Earth and Space – *Multiple Choice* Which of the following best describes the relationship between the ages of the Earth, the Sun, and the Universe?

- W) The Universe is about 3 times as old as the Sun, which is about 3 times as old as the Earth
- X) The Universe is the same age as the Sun, which is about 3 times as old as the Earth
- Y) The Universe is about 3 times as old as the Sun and the Earth, which are the same age
- Z) The Universe, the Earth, and the Sun are all the same age

ANSWER: Y) THE UNIVERSE IS ABOUT 3 TIMES AS OLD AS THE SUN AND THE EARTH, WHICH ARE THE SAME AGE

**BONUS**

12) Earth and Space – *Short Answer* You are in a Northern Hemisphere region experiencing zonal air flow with a low pressure system to your north. Which direction would you need to face if you wanted to place your back to the oncoming wind?

ANSWER: EAST

**TOSS-UP**

13) Biology – *Multiple Choice* What material typically constitutes the cell wall in fungi?

- W) Cellulose
- X) Peptidoglycan
- Y) Pectin
- Z) Chitin

ANSWER: Z) CHITIN

**BONUS**

13) Biology – *Multiple Choice* Which of the following is NOT an example of a stone fruit?

- W) Almond
- X) Coconut
- Y) Cherry
- Z) Apple

ANSWER: Z) APPLE



**TOSS-UP**

14) Physics – *Multiple Choice* Which of the following is the equivalent resistance, in ohms, of a circuit in which a 5 ohm resistor is connected in series to two 4 ohm resistors which are connected in parallel?

- W) 10/7
- X) 40/13
- Y) 7
- Z) 13

ANSWER: Y) 7

**BONUS**

14) Physics – *Short Answer* A man drops a 10 kilogram rock from the top of a building of height 180 meters. If you assume the acceleration due to gravity is 10 meters per second squared, what is the speed, in meters per second, of the rock just before it hits the ground?

ANSWER: 60

**TOSS-UP**

15) Earth and Space – *Short Answer* What is the nearest galaxy cluster?

ANSWER: VIRGO

**BONUS**

15) Earth and Space – *Multiple Choice* Which of the following is most directly associated with Andean-type plate margins?

- W) Volcanic arcs
- X) Extensional faulting
- Y) Rift valleys
- Z) Hot spot activity

ANSWER: W) VOLCANIC ARCS



**TOSS-UP**

16) Math – *Short Answer* What is the limit as  $x$  approaches 3 of the function with numerator  $x - 3$  and denominator  $x^2 - 9$ ?

ANSWER: 1/6

**BONUS**

16) Math – *Short Answer* Special water for a 600-liter aquarium is only sold in 35-liter containers. What is the minimum number of these 35-liter containers you would need to buy to be able to completely fill the tank?

ANSWER: 18 (DO NOT ACCEPT: 17 1/7 or 120/7)



**TOSS-UP**

17) Chemistry – *Multiple Choice* The bond angle in  $\text{NH}_3$  is closest to which of the following degree values?

- W) 90
- X) 110
- Y) 120
- Z) 180

ANSWER: X) 110

**BONUS**

17) Chemistry – *Multiple Choice* D orbitals can overlap to form sigma, pi, or delta bonds. Which of these types of d-d bonds is strongest?

- W) Sigma
- X) Pi
- Y) Delta
- Z) They are equally strong

ANSWER: W) SIGMA



**TOSS-UP**

18) Energy – *Short Answer* The Athabasca oil sands, the largest bitumen deposit in the world, are located in what country?

ANSWER: CANADA

**BONUS**

18) Energy – *Short Answer* Syngas, produced from coal gasification, is made up primarily of what two gases?

ANSWER: CARBON MONOXIDE AND HYDROGEN

**TOSS-UP**

19) Math – *Short Answer* Given  $f(x) = 3x - 5$  and  $g(x) = 4x$ , what is  $f$  of  $g$  of  $x$ ?

ANSWER:  $12x - 5$

**BONUS**

19) Math – *Short Answer* What is the least common multiple of the first four composite numbers?

ANSWER: 72

~~~~~

TOSS-UP

20) Chemistry – *Multiple Choice* An atom is sp^3 [**S-P-3**] hybridized. Which of the following is NOT a possible molecular geometry about this atom?

- W) Bent
- X) Trigonal pyramidal
- Y) Tetrahedral
- Z) Trigonal bipyramidal

ANSWER: Z) TRIGONAL BIPYRAMIDAL

BONUS

20) Chemistry – *Short Answer* What region of the electromagnetic spectrum would be able to excite an electron from a 1s orbital to a 2p orbital in a helium atom?

ANSWER: ULTRAVIOLET (ACCEPT: UV)

TOSS-UP

21) Biology – *Multiple Choice* Which of the following describes antibody-dependent cell-mediated cytotoxicity?

- W) An invertebrate host defense mechanism
- X) Achieved via the classical complement pathway
- Y) Mediated by Fc receptors on NK cells and myeloid leukocytes
- Z) The primary cytotoxic pathway mediated by T cells

ANSWER: Y) MEDIATED BY FC RECEPTORS ON NK CELLS AND MYELOID LEUKOCYTES

BONUS

21) Biology – *Multiple Choice* Which of the following is NOT a biogenic amine?

- W) Dynorphin [*dye-NOR-fin*]
- X) Norepinephrine [*NOR-eh-pih-NEH-frin*]
- Y) Dopamine
- Z) Histamine

ANSWER: W) DYNORPHIN

~~~~~

### TOSS-UP

22) Physics – *Multiple Choice* A student at the edge of a merry-go-round travels along an arc of length 6.28 meters as the ride completes a  $\pi/4$  angular rotation. To the nearest meter, what is the radius of the ride?

- W) 2
- X) 4
- Y) 8
- Z) 16

ANSWER: Y) 8

### BONUS

22) Physics – *Short Answer* An object is placed 10 centimeters from a thin lens with a focal length of 2 centimeters. With a negative sign meaning an inverted image, what is the magnification of this system?

ANSWER: -1/4 (ACCEPT: -.25)

### TOSS-UP

23) Earth and Space – *Multiple Choice* Which of the following phenomena is a buildup of ocean water that is pushed towards land by a hurricane?

- W) Tsunami
- X) Surge tide
- Y) Storm surge
- Z) Rogue wave

ANSWER: Y) STORM SURGE

### BONUS

23) Earth and Space – *Short Answer* What element is the second most abundant in the Earth's crust, but is NOT commonly found on Earth in its elemental form?

ANSWER: SILICON