ROUND 5 – December 20

TOSS-UP

1) *Biology* SHORT ANSWER Name the phenomenon by which the binding of one oxygen molecule to a molecule of hemoglobin increases that hemoglobin molecule’s affinity for oxygen.

ANSWER: COOPERATIVITY

BONUS

1) *Biology* MULTIPLE CHOICE Topoisomerases are molecules that can best be described as which of the following?

W) proteins that function in DNA replication and chromatin folding

X ) small, non-coding RNAs

Y ) transcription factors

Z ) allosteric inhibitors of the enzyme phosphofructokinase

ANSWER: W) PROTEINS THAT FUNCTION IN DNA REPLICATION AND CHROMATIN FOLDING

TOSS-UP

2) *Chemistry* SHORT ANSWER A sample of potassium chlorate is heated. What gas will be produced?

ANSWER: OXYGEN (ACCEPT: O2; DO NOT ACCEPT: O)

BONUS

2) *Chemistry* SHORT ANSWER By number, identify all of the following five species that would have a larger radius than the sulfide ion, S2–:

1. O2–

2. O

3. S

4. Mg2+

5. Ca2+

ANSWER: none

TOSS-UP

3) *Physics* MULTIPLE CHOICE Which of the following choices gives a correct unit for absolute sound intensity?

W) joules

X ) watts

Y ) watts per square meter

Z ) watts per cubic meter

ANSWER: Y) WATTS PER SQUARE METER

BONUS

3) *Physics* SHORT ANSWER An orange is dropped from the 102nd floor of the Empire State Building, a height of 381 meters above the ground. Ignoring air resistance, how many seconds later, to the nearest second, does the orange land on the ground?

ANSWER: 9 seconds

TOSS-UP

4) *Math* SHORT ANSWER What term refers to the probability of correctly rejecting the null hypothesis of a statistical test?

ANSWER: the POWER of the test

BONUS

4) *Math* SHORT ANSWER A particle traveling along the *x*-axis has its position given by the equation *x*(*t*) = *t*3 – 2, where time *t* is measured in seconds and position *x*(*t*) is measured in centimeters. Give the particle’s instantaneous acceleration, with correct units, at time *t* = 3.5 seconds.

ANSWER: 21 CENTIMETERS PER SECOND SQUARED

TOSS-UP

5) *Biology* SHORT ANSWER By number, arrange the following four components of the mammalian nephron according to the order in which the filtrate passes through them, beginning with the component through which the filtrate passes first:

1. collecting duct

2. Bowman’s capsule

3. ascending limb of the Loop of Henle

4. descending limb of the Loop of Henle

ANSWER: 2, 4, 3, 1

BONUS

5) *Biology* MULTIPLE CHOICE Which of the following statements is MOST accurate?

W) An influx of Na+ ions into a nerve cell would cause membrane hyperpolarization.

X ) Membrane depolarization is associated with inhibitory postsynaptic potentials.

Y ) An excitatory postsynaptic potential would occur when Cl– ions flow into a nerve cell.

Z ) The K+ ion concentration inside a nerve cell exceeds the K+ concentration outside the cell.

ANSWER: Z) THE K+ ION CONCENTRATION INSIDE A NERVE CELL EXCEEDS THE K+ CONCENTRATION OUTSIDE THE CELL.

TOSS-UP

6) *Chemistry* MULTIPLE CHOICE Which of the following processes proceeds with a decrease in the entropy of the relevant system?

W) the sublimation of dry ice

X ) the dimerization of nitrogen dioxide

Y ) the dissolution of soda ash in water

Z ) the decomposition of ozone into molecular oxygen

ANSWER: X) THE DIMERIZATION OF NITROGEN DIOXIDE

BONUS

6) *Chemistry* SHORT ANSWER By number, order the following three chemical species in terms of increasing standard reduction potential:

1. MnO4–

2. H2O

3. Ag+

ANSWER: 2, 3, 1

TOSS-UP

7) *Physics* MULTIPLE CHOICE Consider the nuclear reaction $$ $\rightarrow $ $$ +$ $. What is$$?

W) a neutron

X ) a neutrino

Y ) a positron

Z ) an electron

ANSWER: Z) AN ELECTRON

BONUS

7) *Physics* SHORT ANSWER The frequency of a light wave is 5.00 $×$ 1014 Hz. To one significant figure and in scientific notation, give the wavelength of this light wave in nanometers.

ANSWER: 6 $×$ 102 NANOMETERS

TOSS-UP

8) *Math* MULTIPLE CHOICE Which of the following best describes the graph of $x^{2}+y^{2}=(x+y)^{2}$ ?

W) one point

X ) one line

Y ) two intersecting lines

Z ) two parallel lines

ANSWER: Y) TWO INTERSECTING LINES

BONUS

8) *Math* SHORT ANSWER A certain triangle has one side with length 25 meters and another side with length 8 meters. This triangle also has an area of 100 square meters. The length of the triangle’s third side in meters is equal to the positive square root of what integer?

ANSWER: 689

TOSS-UP

9) *Earth and Space* SHORT ANSWER Name one of the two most abundant metal elements in the mineral dolomite.

ANSWER: CALCIUM or MAGNESIUM

BONUS

9) *Earth and Space* MULTIPLE CHOICE Which of the following would be considered an Aeolian process?

W) erosion caused by wind

X ) orogenic folding

Y ) cycles of convection currents in the asthenosphere

Z ) chemical weathering of limestone

ANSWER: W) EROSION CAUSED BY WIND

TOSS-UP

10) *Energy* MULTIPLE CHOICE After the United States, what country is the world’s second-largest producer of ethanol fuels?

W) Canada

X ) Brazil

Y ) China

Z ) Australia

ANSWER: X) BRAZIL

BONUS

10) *Energy* MULTIPLE CHOICE As of the most recent reports, what is the only US state in which oil is used as the primary source of fuel for electrical generation?

W) California

X ) Texas

Y ) Alaska

Z ) Hawaii

ANSWER: Z) HAWAII