ROUND 12A

TOSS-UP

1) CHEMISTRY *Multiple Choice* Which of the following gases has the slowest rate of effusion?

W) Hydrogen
X) Helium
Y) Oxygen
Z) Neon

ANSWER: Y) OXYGEN

BONUS

1) CHEMISTRY *Short Answer* The electrolysis of water is endothermic, requiring 286 kilojoules of energy to decompose one mole of water at 25°C. Given that the enthalpy of formation of hydrogen peroxide is -136 kilojoules per mole, what is the standard enthalpy in kilojoules for the decomposition of one mole of hydrogen peroxide into water and oxygen?

ANSWER: -150

_____

TOSS-UP

2) BIOLOGY *Multiple Choice* The arrector pili *[pee-LEE]* muscle has what function when a mammal is cold?

W) Inducing shivering
X) Speeding metabolism
Y) Increasing the depth of the air insulation barrier
Z) Vasoconstriction

ANSWER: Y) INCREASING THE DEPTH OF THE AIR INSULATION BARRIER

BONUS

2) BIOLOGY *Multiple Choice* Someone has carelessly tossed several sets of human vertebrae into a single box. You are trying to sort out the mess and have counted 20 lumbar, 48 thoracic, and 26 cervical vertebrae. It's now clear you are missing some bones. How many bones are you missing, and what type of vertebrae are they?

W) 4 lumbar
X) 2 thoracic
Y) 2 cervical
Z) 4 thoracic

ANSWER: Y) 2 CERVICAL

TOSS-UP

3) ENERGY *Short Answer* Indicate, by number, all of the following statements that must be true for an object to be in static equilibrium *[ee-kwuh-LIB-ree-uhm]*: 1) All forces are balanced; 2) All torques are balanced; 3) Their pressures are the same.

ANSWER: 1 AND 2

BONUS

3) ENERGY *Multiple Choice* The buildup of heavier elements in the nuclear fusion processes in stars is limited to elements below what isotope?

W) Iron-56
X) Iron-58
Y) Nickel-62
Z) Lead-82

ANSWER: W) IRON-56

TOSS-UP

4) EARTH AND SPACE *Multiple Choice* Which of the following best describes the accretion properties of the supermassive black hole at the center of the Milky Way?

W) Not accreting a detectable amount of matter
X) Accreting an unusually small amount of matter
Y) Accreting an average amount of matter
Z) Accreting an unusually large amount of matter

ANSWER: X) ACCRETING AN UNUSUALLY SMALL AMOUNT OF MATTER

BONUS

4) EARTH AND SPACE *Multiple Choice* Which of the following mountain ranges in the state of Oregon is an accreted terrain?

W) Wallowa Mountains
X) Cascade Volcano Range
Y) Steens Mountains
Z) Hart Mountains

ANSWER: W) WALLOWA MOUNTAINS

TOSS-UP

5) MATH *Short Answer* How many ways are there to get exactly 25 heads results from 26 consecutive fair coin tosses?

ANSWER: 26

BONUS

5) MATH *Short Answer* A set of three positive consecutive integers has a product 33 times their sum. What is the largest element in the set?

ANSWER: 11

―――――――――――――――――――――――――――――――――

TOSS-UP

6) BIOLOGY *Short Answer* Name the type of reproduction in which the eggs hatch inside the female body and the embryo is retained for protection?

ANSWER: OVOVIVIPARITY (ACCEPT: OVOVIVIPAROUS; DO NOT ACCEPT: VIVIPARY)

BONUS

6) BIOLOGY *Short Answer* What region of the human brainstem is commonly thought to be responsible for the control of cardiac, respiratory, and other autonomic functions and is connected to the thalamus via the pons?

ANSWER: MEDULLA (ACCEPT: MEDULLA OBLONGATA)

TOSS-UP

7) CHEMISTRY *Multiple Choice* What choice best describes the type of reaction that is catalyzed by lyases *[ly-AYS-es]*?

W) Transfer of functional groups
X) Mediate isomerization *[eye-so-muh-ri-ZAY-shuhn]*
Y) Addition to double bonds
Z) Formation of bonds with ATP cleavage

ANSWER: Y) ADDITION TO DOUBLE BONDS

BONUS

7) CHEMISTRY *Short Answer* A neutral coordination compound is composed of a complex ion bound to a potassium cation *[KAT-eye-uhn]*. The complex ion contains a central cobalt ion bound to two ammonia ligands and four chloride ligands. What is the oxidation number of the cobalt ion?

ANSWER: THREE PLUS

TOSS-UP

8) PHYSICS *Short Answer* What is the resistance of a resistor that has a 20 milliampere current when connected across the terminals of a 1.5 volt battery?

ANSWER: 75 OHMS

BONUS

8) PHYSICS *Multiple Choice* A light ray passes from air (n = 1.00) to the cornea (n = 1.33) of the eye. If the angle of incidence is 30°, which of the following is true of the angle of refraction?

W) Less than 30°
X) Equal to 30°
Y) Between 30° and 45°
Z) Equal to 45°

ANSWER: W) LESS THAN 30°

TOSS-UP

9) EARTH AND SPACE *Short Answer* What is the name of the landform found west of the current Yellowstone Hotspot that was made as the North American Plate moved southwest over the hotspot?

ANSWER: SNAKE RIVER PLAIN

BONUS

9) EARTH AND SPACE *Multiple Choice* Which of the following best approximates the number of separate cinder cones located on the flanks of Newberry Volcano?

W) 4
X) 40
Y) 400
Z) 4000

ANSWER: Y) 400

_____

TOSS-UP

10) BIOLOGY *Short Answer* Identify the food test used to detect the presence of a reducing sugar by the addition of a solution containing sodium carbonate, sodium citrate, and copper sulphate.

ANSWER: BENEDICT'S TEST

BONUS

10) BIOLOGY *Multiple Choice* You are conducting an experiment that involves incubating a heat-insensitive enzyme with its substrate, while slowly increasing the temperature of the test tube. The concentration of the substrate is much higher than the concentration of the enzyme. Can you use the Michaelis-Menten *[mi-KAY-lis MEN-tuhn]* equation to model the enzyme kinetics of this reaction, and why or why not?

W) Yes, because the conditions are changing
X) No, because the conditions are changing
Y) Yes, because the enzyme activity remains unchanged
Z) No, because the enzyme activity remains unchanged

ANSWER: X) NO, BECAUSE THE CONDITIONS ARE CHANGING

TOSS-UP

11) MATH *Multiple Choice* If A and B are integers, consider the 2 by 2 matrix with first row 2, A and second row B, 3. For how many different values of A can the matrix be singular?

W) 2
X) 4
Y) 8
Z) 10

ANSWER: Y) 8

BONUS

11) MATH *Short Answer* If A = 20° and B = 25° *[A equals twenty degrees and B equals twenty-five degrees]*, what is the value of $(1 + \tan A)(1 + \tan B)$ *[open parenthesis one plus tangent of A close parenthesis times the quantity one plus tangent of B]*?

ANSWER: 2

TOSS-UP

12) ENERGY *Short Answer* In the U.S., ethanol is produced by a fermentation process involving corn. What is the cool season legume that can be used to produce biodiesel?

ANSWER: SOYBEANS

BONUS

12) ENERGY *Short Answer* Rank the following light bulb types in terms of luminous efficiency (that is, watts required to generate the same amount of lumens), from MOST efficient to LEAST efficient: incandescent, compact fluorescent, halogen, LED.

ANSWER: LED, COMPACT FLUORESCENT, HALOGEN, INCANDESCENT

TOSS-UP

13) CHEMISTRY *Short Answer* Identify all of the following three techniques that could be used to determine the size of an unknown compound: 1) affinity chromatography; 2) mass spectrometry; 3) electron paramagnetic resonance.

ANSWER: 2 (ACCEPT: MASS SPECTROMETRY)

BONUS

13) CHEMISTRY *Multiple Choice* Which of the following qualitative organic tests is NOT matched correctly to a functional group for which it predominantly tests?

W) Biuret test and amides *[by-yuh-RET]*
X) Lucas reagent and alcohols
Y) Tollens' reagent and carboxylic acids
Z) Benedict's test and reducing sugars

ANSWER: Y) TOLLENS' REAGENT AND CARBOXYLIC ACIDS

TOSS-UP

14) BIOLOGY *Short Answer* Sodium dodecyl *[duh-DES-uhl]* sulfate is a detergent often used to dissolve molecules. In SDS-PAGE, what type of molecule is SDS used to dissolve?

ANSWER: PROTEINS

BONUS

14) BIOLOGY *Multiple Choice* Beriberi is caused by deficiency in which of the following vitamins?

W) Thiamine *[THY-uh-min]*
X) Retinol
Y) Ascorbic Acid
Z) Cobalamin *[koh-BAL-uh-min]*

ANSWER: W) THIAMINE

TOSS-UP

15) EARTH AND SPACE *Short Answer* What is the form of equilibrium *[ee-kwuh-LIB-ree-uhm]* between pressure and gravity in a stellar interior?

ANSWER: HYDROSTATIC EQUILIBRIUM (ACCEPT: HYDROSTATIC)

BONUS

15) EARTH AND SPACE *Multiple Choice* Which of the following represents a metasomatic change from a protolith?

W) Granite to phyllite *[FIL-yt]*
X) Limestone to marble
Y) Shale to gneiss *[NYS]*
Z) Limestone to skarn

ANSWER: Z) LIMESTONE TO SKARN

_____

TOSS-UP

16) ENERGY *Multiple Choice* Catalysts do not get consumed in reactions; however, platinum in hydrogen fuel cells can become inactive when poisoned by which of the following compounds?

W) Nitrogen
X) Hydrogen
Y) Hydrogen peroxide
Z) Carbon monoxide

ANSWER: Z) CARBON MONOXIDE

BONUS

16) ENERGY *Multiple Choice* Which of the following statements is false about photovoltaic cells?

W) N-type silicon is doped with phosphorus
X) Phosphorus gives the silicon a positive character, and the tendency to attract electrons
Y) P-type silicon is doped with boron
Z) Boron gives the silicon a positive character, and the tendency to attract electrons

ANSWER: X) PHOSPHORUS GIVES THE SILICON A POSITIVE CHARACTER, AND THE TENDENCY TO ATTRACT ELECTRONS

TOSS-UP

17) MATH *Short Answer* What is the absolute value of the difference between the sum of the first 2014 even counting numbers and the first 2014 odd counting numbers?

ANSWER: 2014

BONUS

17) MATH *Multiple Choice.* If y is a function of x such that $dy/dx = x/y$ *[the derivative of y with respect to x equals x divided by y]* and $y(3) = 4$ *[y of three equals four]*, then which of the following equations is true?

W) $x^2 + y^2 = 25$ *[x squared plus y squared equals twenty-five]*
X) $y - x = 1$ *[y minus x equals one]*
Y) $y^2 - x^2 = 49$ *[y squared minus x squared equals forty-nine]*
Z) $y^2 - x^2 = 7$ *[y squared minus x squared equals seven]*

ANSWER: Z) $y^2 - x^2 = 7$

_____

TOSS-UP

18) PHYSICS *Multiple Choice* If Z = atomic number and A = mass number, the radius of an approximately spherical nucleus *[NOO-klee-uhs]* is proportional to which of the following?

W) Z^3
X) $A^{1/3}$
Y) A^3
Z) $Z^{1/3}$

ANSWER: X) $A^{1/3}$

BONUS

18) PHYSICS *Multiple Choice* Light travelling through air strikes a transparent material of index of refraction $n = 2$ at an angle of 30° relative to the normal to the surface, and is then refracted an angle θ *[theta]*. What is the value of sin(θ) *[sine theta]* to two significant figures?

W) 0.10
X) 0.25
Y) 0.66
Z) 1.0

ANSWER: X) 0.25

TOSS-UP

19) BIOLOGY *Multiple Choice* Moths are nocturnal, have a good sense of smell, and are also pollinators of a variety of plant species, many of which have evolved to better suit the needs of their primary pollinators. Which of the following traits would you expect to find in flowers of moth-pollinated plants?

W) Heavy, musky odors
X) Dangling flowers
Y) Large, red flowers
Z) Blue or purple flowers

ANSWER: W) HEAVY, MUSKY ODORS

BONUS

19) BIOLOGY *Multiple Choice* If you lower the intracellular levels of fructose 2, 6 biphosphate, what will happen to the rate of gluconeogenesis *[gloo-koh-nee-uh-JEN-uh-sis]* and glycolysis *[gly-KOL-uh-sis]*, respectively?

W) Gluconeogenesis speeds up, glycolysis slows down
X) Gluconeogenesis slows down, glycolysis speeds up
Y) Gluconeogenesis and glycolysis both slow down
Z) Glycolysis speeds up and gluconeogenesis halts

ANSWER: W) GLUCONEOGENESIS SPEEDS UP, GLYCOLYSIS SLOWS DOWN

TOSS-UP

20) CHEMISTRY *Multiple Choice* Which of the following statements concerning chemical kinetics is NOT true?

W) Catalysts of a reaction can appear in the reaction's rate law
X) The reciprocal of concentration versus time will be linear for a first order reaction
Y) For a reaction, the equilibrium constant is the forward rate constant over the reverse rate constant
Z) The half-life of a zero-th order reaction is proportional to initial concentration of the reactant

ANSWER: X) THE RECIPROCAL OF CONCENTRATION VERSUS TIME WILL BE LINEAR FOR A FIRST ORDER REACTION

BONUS

20) CHEMISTRY *Multiple Choice* Which of the following species has an unpaired electron, according to the VSEPR *[ves-per]* model?

W) IF_3 *[I-F-3]*
X) IF_5 *[I-F-5]*
Y) $[BrF_5]^-$ *[negative charge on B-R-F-5]*
Z) $[BrF_3]^{2-}$ *[negative two charge on B-R-F-3]*

ANSWER: Y) $[BrF_5]^-$

21) MATH *Multiple Choice* In order to find the average size of families in a particular town, a surveyor took a simple random sample of individuals and asked each of them how many people were in his or her family. Which of the following is TRUE regarding the surveyor's findings?

W) The surveyor's calculated average will likely be greater than the actual average
X) The surveyor's calculated average will likely be less than the actual average
Y) The surveyor's calculated average will likely be equal to the actual average
Z) It is equally likely that the surveyor's calculated average will be less than or greater than the actual average

ANSWER: W) THE SURVEYOR'S CALCULATED AVERAGE WILL LIKELY BE GREATER THAN THE ACTUAL AVERAGE

BONUS

21) MATH *Multiple Choice* Let $x = 0.123456789101112\ldots99$ ***[x equal zero point one, two, three, four, five, six, seven, eight, nine, one, zero, one, one, one, two, continuing on through nine, nine]***, where the decimal digits are obtained by writing the integers 1 through 99 in order. What digit is in the 99th decimal place?

W) 3
X) 4
Y) 5
Z) 6

ANSWER: X) 4

_____

TOSS-UP

22) PHYSICS *Short Answer* What group of subatomic particles, known to be emitted by the reactions that take place in the Sun, were recently confirmed to oscillate between three flavors, explaining the discrepancy between expected and observed numbers of these particles emitted by the Sun?

ANSWER: NEUTRINOS

BONUS

22) PHYSICS *Short Answer* An ideal refrigerator absorbs heat at -23°C and exhausts it at 27°C. What is its coefficient of performance?

ANSWER: 5

TOSS-UP

23) EARTH AND SPACE *Multiple Choice* Which of the following minerals are present in pelitic rocks, resulting from the metamorphism of aluminous sedimentary rocks such as shales and mudrocks?

W) Sphalerite *[SFAL-uh-ryt]*
X) Calcite
Y) Quartz
Z) Garnet

ANSWER: W) SPHALERITE

BONUS

23) EARTH AND SPACE *Multiple Choice* Which of the following best describes cataclastic metamorphism?

W) Ultrahigh pressures generated by impact with an extra-terrestrial body
X) High temperature alteration accompanied by moderate pressures in the presence of hydrothermal fluids
Y) Mechanical deformation that can result from rocks sliding along a shear zone
Z) Shallow burial with temperatures exceeding 300°C, similar to diagenesis *[dy-uh-JEN-uh-sis]*

ANSWER: Y) MECHANICAL DEFORMATION THAT CAN RESULT FROM ROCKS SLIDING ALONG A SHEAR ZONE