

ROUND 7A

TOSS-UP

1) CHEMISTRY *Multiple Choice* A sloppy chemist forgets to label two beakers. One contains barium chloride solution, and the other contains magnesium chloride solution. The chemist decides to add a third solution to each beaker in order to distinguish the two. Which of the following reagents would form a precipitate in only one of the two beakers?

- W) Sodium sulfate
- X) Sodium carbonate
- Y) Silver nitrate
- Z) Ammonium chloride

ANSWER: W) SODIUM SULFATE

BONUS

1) CHEMISTRY *Short Answer* Rank, by name or number, the following three molecules or polyatomic ions from the one containing oxygen atoms in the least negative oxidation state, to the one containing oxygen atoms in the most negative oxidation state: 1) ozone, 2) peroxide, 3) oxygen gas.

ANSWER: 3, 1, 2 (ACCEPT: OXYGEN GAS, OZONE, PEROXIDE)

TOSS-UP

2) BIOLOGY *Short Answer* In photorespiration, ribulose biphosphate carboxylase [**RY-byoo-lays bis-fos-FAYT kahr-BOK-suh-layz**] binds what molecule instead of carbon dioxide?

ANSWER: OXYGEN

BONUS

2) BIOLOGY *Multiple Choice* Which of the following would you NOT expect to experience during fasting or starvation?

- W) Increase in ketone body formation
- X) Decrease in plasma fatty acid levels
- Y) Depletion of glycogen [**GLY-kuh-juhn**]
- Z) Increased use of ketones for ATP production in the brain

ANSWER: X) DECREASE IN PLASMA FATTY ACID LEVELS

TOSS-UP

3) ENERGY *Short Answer* What is the SI [**S-I**] unit used to measure capacitance, or the ability of a body to store an electrical charge?

ANSWER: FARAD

BONUS

3) ENERGY *Multiple Choice* Which of the following foods has the highest energy density?

- W) Lean meat of a rabbit
- X) Cell wall of celery
- Y) Pericarp of an apple
- Z) Butter churned from milk

ANSWER: Z) BUTTER CHURNED FROM MILK

TOSS-UP

4) EARTH AND SPACE *Short Answer* Over a 720 minute period, through what angle in degrees does the Earth rotate?

ANSWER: 180

BONUS

4) EARTH AND SPACE *Multiple Choice* Which of the following measures of natural disasters reflects only properties associated with the natural phenomenon and not damage to the human built environment?

- W) Moment Magnitude Scale
- X) Fujita Scale
- Y) Modified Mercalli Scale
- Z) Saffir-Simpson Scale

ANSWER: W) MOMENT MAGNITUDE SCALE

TOSS-UP

5) MATH *Short Answer* What is the smallest possible value for the sum of a positive number and its own reciprocal?

ANSWER: 2

BONUS

5) MATH *Multiple Choice* If $a^2 - 2ab + b^2 = x$, [**A squared minus two A B plus B squared equals x**] where a is an odd integer and b is an even integer, which of the following **MUST** be true about x ?

- W) x is a prime number
- X) x is divisible by 3
- Y) x is an even perfect square
- Z) x is an odd perfect square

ANSWER: Z) x IS AN ODD PERFECT SQUARE

TOSS-UP

6) BIOLOGY *Short Answer* What general class of animal tissue is characterized by the presence of collagen?

ANSWER: CONNECTIVE

BONUS

6) BIOLOGY *Multiple Choice* Which of the following steroid hormones is the precursor to all of the others listed in the answer choices?

- W) Estrone
- X) Testosterone
- Y) Progesterone
- Z) Androstenedione [**an-druh-steen-DY-ohn**]

ANSWER Y) PROGESTERONE

TOSS-UP

7) CHEMISTRY *Multiple Choice* You take an IR **[I-R]** spectrum that has a long, broad peak just below 3000 inverse centimeters. Which of the following is the likely identification of the molecule?

- W) Nonane **[NO-nayn]**
- X) Methylcyclopentane **[meth-uhl-sy-kluh-PEN-tan]**
- Y) Hexene
- Z) Pentanol

ANSWER: Z) PENTANOL

BONUS

7) CHEMISTRY *Multiple Choice* Which of the following compounds is most thermodynamically unstable?

- W) Nitrogen trifluoride
- X) Nitrogen trichloride
- Y) Nitrogen tribromide
- Z) Nitrogen triiodide

ANSWER: Z) NITROGEN TRIIODIDE

TOSS-UP

8) PHYSICS *Short Answer* How much energy, in joules, does a circuit containing a 9 volt battery and a 6 ohm resistor dissipate over 8 seconds?

ANSWER: 108

BONUS

8) PHYSICS *Short Answer* If the radius of a body is smaller than its Schwarzschild radius, the body becomes what?

ANSWER: BLACK HOLE

TOSS-UP

9) EARTH AND SPACE *Multiple Choice* Which of the following statements is true about kaolinite **[KAY-uh-luh-nyt]**?

- W) It has an inosilicate structure **[in-uh-SIL-i-kayt]**
- X) It has a high cation exchange capacity **[KAT-eye-uhn]**
- Y) It is a magnesium-rich silicate
- Z) It is a non-expanding clay

ANSWER: Z) IT IS A NON-EXPANDING CLAY

BONUS

9) EARTH AND SPACE *Multiple Choice* Which of the following meteorological sensors is not part of the suite of sensors on the Mars Rover Curiosity?

- W) Anemometer
- X) Thermometer
- Y) Barometer
- Z) Psychrometer

ANSWER: Z) PSYCHROMETER

TOSS-UP

10) BIOLOGY *Multiple Choice* Which of the following animal cell junctions is most similar in function to plant cell plasmodesmata **[plaz-muh-des-MUH-tuh]**?

- W) Gap junction
- X) Tight junction
- Y) Desmosome
- Z) Adherens junction

ANSWER: W) GAP JUNCTION

BONUS

10) BIOLOGY *Short Answer* Luke Skywalker is looking for evidence about whether Darth Vader was his father. Luke has blood type A, and medical records show that his mother had blood type AB. What are all the possible blood types that Luke's father could be?

ANSWER: TYPES A, B, O, AB (SAYING "TYPES" IS NOT NECESSARY)

TOSS-UP

11) MATH *Short Answer*. Determine $\lim_{x \rightarrow 0} \frac{x+1}{x}$. [*the limit as x approaches zero of quantity x plus one divided by x*]

ANSWER: THE LIMIT DOES NOT EXIST (ACCEPT: NON-EXISTANT; DO NOT ACCEPT: INFINITY)

BONUS

11) MATH *Multiple Choice* Consider a circle in which a square is inscribed. Inscribed within that square is another circle. If the innermost circle has circumference of 12π , what is the area of the outermost circle?

- W) 64π
- X) 72π
- Y) 88π
- Z) 96π

ANSWER: X) 72π

TOSS-UP

12) ENERGY *Multiple Choice* What is the power generated by a circuit with a total current of 6 amperes running through two resistors in parallel, of 2 and 6 ohms?

- W) 40 Watts
- X) 54 Watts
- Y) 66 Watts
- Z) 70 Watts

ANSWER: X) 54 WATTS

BONUS

12) ENERGY *Short Answer* Consider a Carnot engine operating between two reservoirs [**REZ-er-vwahrs**] of different temperatures. If the temperatures in Kelvin of both reservoirs are doubled, by what factor is the efficiency multiplied?

ANSWER: ONE

TOSS-UP

13) CHEMISTRY *Multiple Choice* Which of the following would be the most appropriate S_N2 [S- N- two] leaving group?

- W) Hydroxyl
- X) O-Trifluoromethanesulfonate [try-FLOOR-oh-METH-ayn-SUHL-fuh-nayt]
- Y) O-Ethyl
- Z) O-Acyl

ANSWER: X) O-TRIFLUOROMETHANESULFONATE

BONUS

13) CHEMISTRY *Multiple Choice* What is a chief difference between an electrolytic cell and a galvanic cell?

- W) Galvanic cells convert electrical energy into chemical energy, electrolytic cells convert chemical energy into electrical energy
- X) Galvanic cells spontaneously produce an electrical current; an external voltage must be applied to an electrolytic cell
- Y) Oxidation occurs at the anode for a galvanic cell and at the cathode for an electrolytic cell
- Z) Reduction occurs at the anode for a galvanic cell and at the cathode for an electrolytic cell

ANSWER: X) GALVANIC CELLS SPONTANEOUSLY PRODUCE AN ELECTRICAL CURRENT; AN EXTERNAL VOLTAGE MUST BE APPLIED TO AN ELECTROLYTIC CELL

TOSS-UP

14) BIOLOGY *Multiple Choice* Which of the following animals transfers oxygen to blood via a process called countercurrent exchange?

- W) Goldfish
- X) Tarantula
- Y) Hummingbird
- Z) Mole

ANSWER: W) GOLDFISH

BONUS

14) BIOLOGY *Multiple Choice* In a human, breathing air with too much carbon dioxide would lead to all of the following except:

- W) A reduction in oxygen carrying capacity
- X) A decrease in oxygen affinity for hemoglobin
- Y) Facilitation of oxygen to tissues
- Z) A rightward shift of the oxygen equilibrium curve

ANSWER: W) A REDUCTION IN OXYGEN CARRYING CAPACITY

TOSS-UP

15) EARTH AND SPACE *Multiple Choice* Which of the following is responsible for auroras occurring mainly in the polar regions?

- W) The moon
- X) Low temperatures
- Y) The geomagnetic field
- Z) The earth's equatorial bulge

ANSWER: Y) THE GEOMAGNETIC FIELD

BONUS

15) EARTH AND SPACE *Short Answer* Below the carbonate compensation depth, what sort of deep ocean ooze can no longer form?

ANSWER: CALCAREOUS OOZE (ACCEPT: CALCIUM CARBONATE OOZE)

TOSS-UP

16) ENERGY *Multiple Choice* In an adiabatic [*ad-ee-uh-BAT-ik*] process, in which direction does heat flow between the system and surroundings?

- W) Out of the system
- X) Into the system
- Y) No heat flow into or out of the system
- Z) Through the system's boundaries

ANSWER: Y) NO HEAT FLOW INTO OR OUT OF THE SYSTEM

BONUS

16) ENERGY *Short Answer* In a solar power tower system, what are the names of the mirrors that focus sunlight onto a pipe located at the focal line, heating up fluid inside and producing steam that drives a turbine?

ANSWER: PARABOLIC TROUGH

TOSS-UP

17) MATH *Short Answer* A car leaves its original location traveling due west at a speed of 60 miles per hour and arrives at its destination in 3 hours. Later that day, the car returns to its original location. At what speed, in miles per hour, did it travel to cover the same distance in 2 hours?

ANSWER: 90 MILES PER HOUR

BONUS

17) MATH *Short Answer*. Simplify: $\frac{\log_b(b^a)^b}{\log_a(a^b)^a}$. **[quantity log in base b of b raised to the power of a raised to the power of b divided by quantity log in base a of a raised to the power of b, raised to the power of a]**

ANSWER: 1

TOSS-UP

18) PHYSICS *Multiple Choice* Two objects collide in a perfectly inelastic collision. Which of the following quantities is not conserved in the collision?

- W) Kinetic energy
- X) Momentum
- Y) Potential energy
- Z) Total energy

ANSWER: W) KINETIC ENERGY

BONUS

18) PHYSICS *Short Answer* A Carnot **[kahr-NOH]** engine takes 2000 joules of heat from a reservoir at 500 kelvin, does some work, and then discards some heat to a reservoir **[REZ-er-*vwahr*]** at 300 kelvin. How much heat, in joules, is discarded by the Carnot engine?

ANSWER: 1200 JOULES (DO NOT ACCEPT: -1200)

TOSS-UP

19) BIOLOGY *Multiple Choice* What disadvantage does the presence of introns and exons give eukaryotes [**yoo-KAR-ee-ohts**] when compared to other organisms?

- W) The ability to produce more proteins from the same primary transcript
- X) Greater stability during reproduction
- Y) Lower error rate during replication
- Z) Mutations are harder to detect

ANSWER: Z) MUTATIONS ARE HARDER TO DETECT

BONUS

19) BIOLOGY *Multiple Choice* Over time, a large mountain range forms, separating two populations of squirrels for multiple generations. Which of the following pairs of terms best describes this speciation event?

- W) Anagenesis and allopatric speciation [**an-uh-JEN-uh-sis**]
- X) Cladogenesis and allopatric speciation [**klad-uh-JEN-uh-sis**]
- Y) Anagenesis and sympatric speciation
- Z) Cladogenesis and sympatric speciation

ANSWER: X) CLADOGENESIS AND ALLOPATRIC SPECIATION

TOSS-UP

20) CHEMISTRY *Multiple Choice* Lithium dialkylcuprates [**dy-AL-kuh-KUHP-rayts**] can be used in carbon-carbon bond-forming reactions and are usually known as what named reagent?

- W) Grignard
- X) Gilman
- Y) Wittig
- Z) Birch

ANSWER: X) GILMAN

BONUS

20) CHEMISTRY *Short Answer* Identify the enzyme that cleaves the first peptide bond at the C-terminal end of a peptide or protein and the organ where the enzyme is synthesized.

ANSWER: CARBOXYPEPTIDASE; PANCREAS

TOSS-UP

21) MATH *Short Answer* Differentiate the following expression with respect to x , provided x is not 0: $\frac{x}{|x|}$ [***x over the quantity the absolute value of x***].

ANSWER: 0

BONUS

21) MATH *Multiple Choice* If $f(x) = \frac{1+x}{x}$ [***f of x equals the fraction with numerator one plus x and denominator x***], which of the following is equivalent to $f(x)$?

W) $f(-x)$ [***f of negative x***]

X) $f\left(\frac{1}{x}\right)$ [***f of the quantity one divided by x***]

Y) $f\left(-\frac{1}{x}\right)$ [***f of the quantity negative one divided by x***]

Z) $\frac{1}{x}f\left(\frac{1}{x}\right)$ [***the fraction with numerator f of the quantity one divided by x and denominator x***]

ANSWER: Z) $\frac{1}{x}f\left(\frac{1}{x}\right)$

TOSS-UP

22) PHYSICS *Short Answer* The statement that all points on a wavefront will serve as point sources for secondary wavelets is based on what principle?

ANSWER: HUYGENS PRINCIPLE (ACCEPT: HUYGENS-FRESNEL PRINCIPLE)

BONUS

22) PHYSICS *Short Answer* Identify all of the following three statements that are true of the cosmic microwave background radiation: 1) The temperature of the radiation can be approximated by a black body; 2) The thermal black body spectrum is at a temperature of approximately 6 Kelvin; 3) The radiation is strongest in the radio and microwave regions of the electromagnetic spectrum.

ANSWER: 1 AND 3 (ACCEPT: THE TEMPERATURE OF THE RADIATION CAN BE APPROXIMATED WITH A BLACK BODY AND THE RADIATION IS STRONGEST IN THE RADIO AND MICROWAVE REGIONS OF THE ELECTROMAGNETIC SPECTRUM)

TOSS-UP

23) EARTH AND SPACE *Multiple Choice* Which of the following is true about the Labrador Sea Water mass (LSW)?

- W) It is formed in the western Labrador Sea in the late spring
- X) It travels south along the western edge of the North Atlantic Basin
- Y) It has decreased in temperature in recent decades
- Z) It does not enter the subtropical gyre of the North Atlantic

ANSWER: X) IT TRAVELS SOUTH ALONG THE WESTERN EDGE OF THE NORTH ATLANTIC BASIN

BONUS

23) EARTH AND SPACE *Multiple Choice* Which of the following volcanic hazards occurred from Mount Nyiragongo [**nee-ir-uh-GON-goh**] in 1977, killing 70 people in nearby villages?

- W) Eruption of a pyroclastic flow [**py-ruh-KLAS-tik**]
- X) Draining of a lava lake
- Y) Eruption of a noxious gas cloud
- Z) Creation of a large lahar

ANSWER: X) DRAINING OF A LAVA LAKE