

ROUND ROBIN ~ ROUND 6

TOSS UP

1. CHEMISTRY *Multiple Choice* For which of the following processes is the change in entropy negative?

- W) Water freezing
- X) Dry ice sublimation
- Y) Salt dissolving in water
- Z) Gasoline burning

ANSWER: W) WATER FREEZING

BONUS

1. CHEMISTRY *Short Answer* The pressure of a mixture of three gases in a fixed volume container is 300 kilopascals. If the number of nitrogen molecules is three times the number of hydrogen molecules and the number of oxygen molecules is two times the number of hydrogen molecules, what are the partial pressures of the three gases?

ANSWER: N₂ = 150; H₂ = 50; O₂ = 100

TOSS UP

2. BIOLOGY *Short Answer* During the formation of a peptide bond between two amino acids, what molecule is formed as a byproduct?

ANSWER: WATER (ACCEPT: H₂O)

BONUS

2. BIOLOGY *Multiple Choice* How might fertilizer runoff from a farm affect a nearby lake?

- W) The lake will become depleted of oxygen
- X) Secchi **[SEK-ee]** depth will increase
- Y) Algae will become less abundant
- Z) Organic matter will decrease

ANSWER: W) THE LAKE WILL BECOME DEPLETED OF OXYGEN

TOSS UP

3. ENERGY *Multiple Choice* Which of the following is NOT an advantage of using ethanol over gasoline for internal combustion engines?

- W) High octane rating
- X) High thermal efficiency
- Y) High compression rating
- Z) High energy density

ANSWER: Z) HIGH ENERGY DENSITY

BONUS

3. ENERGY *Multiple Choice* Which of the following are the two primary products of combustion of methane gas in increasing order of molar amount?

- W) Water vapor and carbon dioxide
- X) Carbon monoxide and water vapor
- Y) Carbon dioxide and water vapor
- Z) Carbon monoxide and carbon dioxide

ANSWER: Y) CARBON DIOXIDE AND WATER VAPOR

TOSS UP

4. EARTH AND SPACE *Multiple Choice* Which of the following groups of elements comprises the greatest proportion of the Earth's continental crust?

- W) Oxygen, silicon, aluminum
- X) Hydrogen, iron, silicon
- Y) Oxygen, iron, carbon
- Z) Carbon, aluminum, magnesium

ANSWER: W) OXYGEN, SILICON, ALUMINUM

BONUS

4. EARTH AND SPACE *Short Answer* If a Kuiper **[KY-per]** belt object has an orbit with a semi-major axis of 64 AU, what is its orbital period in years?

ANSWER: 512

TOSS UP

5. PHYSICS *Multiple Choice* Capacitance is inversely related to which of the following properties of a plate capacitor?

- W) Area of plates
- X) Distance between plates
- Y) Dielectric constant
- Z) Absolute permittivity

ANSWER: X) DISTANCE BETWEEN PLATES

BONUS

5. PHYSICS *Short Answer* A figure skater goes into a spin with her arms outstretched, having a moment of inertia of 2.5 kilogram meters squared and an angular velocity of 5 radians per second. If the skater pulls her arms in and reduces her moment of inertia to 1.5 kilogram meters squared, what is her final angular velocity to the nearest radian per second?

ANSWER: 8

TOSS UP

6. MATH *Short Answer* If $f(x) = \frac{x^2-9}{x-3}$ [**f of x equals the fraction with numerator x squared minus 9 and denominator x minus 3**], what is the limit of $f(x)$ as x approaches 3?

ANSWER: 6

BONUS

6. MATH *Short Answer* If oranges are piled in a pyramid with 1 orange on the top layer, 4 oranges in the second layer, 9 oranges in the third layer, and 16 oranges in the fourth layer, how many oranges will be needed to make a pile with 10 layers?

ANSWER: 385

TOSS UP

7. CHEMISTRY *Multiple Choice* Which of the following is NOT a state function?

- W) Pressure
- X) Work
- Y) Temperature
- Z) Internal energy

ANSWER: X) WORK

BONUS

7. CHEMISTRY *Short Answer* What volume, in milliliters, of a 12.0 molar hydrochloric acid stock solution would you use to make 0.50 liters of a 6.00 molar hydrochloric acid solution?

ANSWER: 250

TOSS UP

8. BIOLOGY *Multiple Choice* Which of the following is NOT a likely reason for decreased success of bird populations in small, fragmented habitats?

- W) Fewer food resources
- X) Increased nest parasitism
- Y) Increased area to edge ratio of habitat
- Z) Decreased suitable habitat area for territories

ANSWER: Y) INCREASED AREA TO EDGE RATIO OF HABITAT

BONUS

8. BIOLOGY *Multiple Choice* Proto-oncogenes [**ONG-kuh-jeens**] are frequently mutated in cancer cells. Which of the following best explains how a mutation in a proto-oncogene could change the protein it encodes and lead to cancer?

- W) The normal protein inhibits cell division, and the mutated protein is either turned off or non-functional
- X) The normal protein stimulates cell division, and the mutated protein is either turned off or non-functional
- Y) The normal protein inhibits cell division, and the mutated protein is either over expressed or can't be deactivated
- Z) The normal protein stimulates cell division, and the mutated protein is either over expressed or can't be deactivated

ANSWER: Z) THE NORMAL PROTEIN STIMULATES CELL DIVISION, AND THE MUTATED PROTEIN IS EITHER OVEREXPRESSED OR CAN'T BE DEACTIVATED

TOSS UP

9. ENERGY *Multiple Choice* Which of the following is the immediate use of glucose produced by photosynthesis?

- W) To capture light
- X) To form fats and lipids
- Y) To be consumed by heterotrophs
- Z) An energy source for cellular respiration

ANSWER: Z) AN ENERGY SOURCE FOR CELLULAR RESPIRATION

BONUS

9. ENERGY *Multiple Choice* Which of the following elements has the greatest number of stable isotopes?

- W) Lead
- X) Plutonium
- Y) Uranium
- Z) Hydrogen

ANSWER: W) LEAD

TOSS UP

10. EARTH AND SPACE *Multiple Choice* A shallow-water wave with a speed of 600 kilometers per hour and a period of 15 minutes is most likely which of the following types of wave?

- W) Tsunami
- X) Capillary
- Y) Tide
- Z) Wind

ANSWER: W) TSUNAMI

BONUS

10. EARTH AND SPACE *Short Answer* When a strong convective cell forms and there is a sufficient amount of supercooled water and ice crystals, what phenomenon can occur?

ANSWER: HAILSTORM (ACCEPT: HAIL)

TOSS UP

11. PHYSICS *Multiple Choice* The 2011 Nobel Prize in Physics was awarded for the demonstration of which of the following properties of the expansion of the universe?

- W) It is speeding up
- X) It is slowing down
- Y) It will reverse itself
- Z) It is constant

ANSWER: W) IT IS SPEEDING UP

BONUS

11. PHYSICS *Short Answer* A wheel spinning at a rate of 20 revolutions per minute slows steadily to a stop in a time of 30 seconds. If the wheel has a radius of 0.5 meters, through what distance to the nearest meter does a point on the rim travel during this time?

ANSWER: 16

TOSS UP

12. MATH *Multiple Choice* Evaluate $\cos\left(-\frac{14\pi}{3}\right)$.

- W) $-\frac{1}{2}$
- X) $\frac{1}{2}$
- Y) $\frac{\sqrt{3}}{2}$
- Z) $-\frac{\sqrt{3}}{2}$

ANSWER: W) $-\frac{1}{2}$

BONUS

12. MATH *Short Answer* Evaluate $\arctan(\tan 3\pi/4)$ [*arctangent of the tangent of the quantity 3 pi over 4*].

ANSWER: $-\pi/4$

TOSS UP

13. CHEMISTRY *Multiple Choice* A pure enantiomeric sample that rotates plane-polarized light to the right is called which of the following?

- W) Levorotary [**lee-vuh-ROH-tawr-ee**]
- X) Dextrorotary [**dek-stroh-ROH-tawr-ee**]
- Y) Meso [**ME-zoh**]
- Z) Optically inactive

ANSWER: X) DEXTROROTARY

BONUS

13. CHEMISTRY *Multiple Choice* When an aqueous solution of copper (II) bromide is electrolyzed, which of the following colors will occur at the anode?

- W) Red brown
- X) Greenish red
- Y) Dark blue
- Z) No color change

ANSWER: W) RED BROWN

TOSS UP

14. BIOLOGY *Multiple Choice* Which of the following nucleotide bases is a purine?

- W) Cytosine [**SY-tuh-seen**]
- X) Uracil [**YOOR-uh-sil**]
- Y) Adenine [**AD-n-een**]
- Z) Thymine

ANSWER: Y) ADENINE

BONUS

14. BIOLOGY *Multiple Choice* Which of the following is NOT a specific adaptation to reduce desiccation in intertidal organisms?

- W) Presence of a holdfast
- X) Covering with shell fragments
- Y) Living in a dense group
- Z) Highly ridged shell coverings

ANSWER: W) PRESENCE OF A HOLDFAST

TOSS UP

15. EARTH AND SPACE *Short Answer* The convergence of what type of atmospheric circulation cell at the intertropical convergence zone results in strong atmospheric heating and precipitation near the equator?

ANSWER: HADLEY

BONUS

15. EARTH AND SPACE *Multiple Choice* Which of the following was the moment magnitude of the 2010 Chilean earthquake that was caused by the subduction of the Nazca Plate underneath the South American Plate?

- W) 6.8
- X) 7.8
- Y) 8.8
- Z) 9.8

ANSWER: Y) 8.8

TOSS UP

16. PHYSICS *Short Answer* What is the potential difference in volts for a simple circuit with a current of 6 amperes and three 10 ohm resistors in series?

ANSWER: 180

BONUS

16. PHYSICS *Short Answer* Vectors \mathbf{F} and \mathbf{R} are given by, respectively, $2\mathbf{i}$ minus $3\mathbf{j}$ and \mathbf{i} plus $4\mathbf{j}$. What is the cross product $\mathbf{R} \times \mathbf{F}$ [\mathbf{R} cross \mathbf{F}]?

ANSWER: $-11\mathbf{k}$

TOSS UP

17. MATH *Short Answer* If $\int_0^5 f(x)dx = 10$ [**the integral from 0 to 5 of f of x dx equals 10**] and $\int_0^2 f(x)dx = 12$ [**the integral from 0 to 2 of f of x dx equals 12**], then what is the value of $\int_2^5 f(x)dx$ [**the integral from 2 to 5 of f of x dx**]?

ANSWER: -2

BONUS

17. MATH *Short Answer* Providing an exact answer, solve the following equation for x :
 $e^x(8 - e^x) = 16$ [**e to the x times the quantity 8 minus e to the x equals 16**].

ANSWER: NATURAL LOG OF 4

TOSS UP

18. CHEMISTRY *Short Answer* A straight line is produced in the graph of the natural log of the concentration of a substance versus the time that the substance reacts. An experimenter can definitively say what about the reaction, with respect to this substance?

ANSWER: IT IS FIRST ORDER

BONUS

18. CHEMISTRY *Multiple Choice* At a constant temperature, a syringe containing 20.0 milliliters of air at 1 atmosphere of pressure is pulled out so that the volume inside the syringe is increased to 40.0 milliliters. The total pressure of the gases inside the syringe decreases to approximately 0.5 atmospheres. Which of the following best explains this observation?

- W) Gay-Lussac's Law
- X) Charles's Law
- Y) Boyle's Law
- Z) Avogadro's Law

ANSWER: Y) BOYLE'S LAW

TOSS UP

19. BIOLOGY *Multiple Choice* Which of the following would NOT be important for a typical cell dividing by binary fission?

- W) DNA is replicated
- X) The nuclear envelope disintegrates
- Y) Cytoplasm and its content is divided between daughter cells
- Z) New cell wall is formed between the developing daughter cells

ANSWER: X) THE NUCLEAR ENVELOPE DISINTEGRATES

BONUS

19. BIOLOGY *Multiple Choice* Which of the following is NOT an advantage for the coral in the coral-zooxanthellae [*zoh-uh-zan-THEL-ee*] symbiosis?

- W) Increased growth
- X) Increasing calcification
- Y) Protection from predators
- Z) Relatively constant supply of reduced carbon

ANSWER: Y) PROTECTION FROM PREDATORS

TOSS UP

20. ENERGY *Multiple Choice* Which of the following is the best approximation of the amount of energy in megaelectron-volts released from a single uranium-235 fission reaction?

- W) 7
- X) 215
- Y) 235
- Z) 238

ANSWER: X) 215

BONUS

20. ENERGY *Multiple Choice* Elements from which of the following sections of the periodic table have the highest ionization energies?

- W) Periods 2 and 3 of Group 1
- X) Periods 2 and 3 of Group 17
- Y) Periods 5 and 6 of Group 17
- Z) Periods 6 and 7 of Group 1

ANSWER: X) PERIODS 2 AND 3 OF GROUP 17

TOSS UP

21. EARTH AND SPACE *Short Answer* What is the primary type of nuclear fusion reaction that takes place in a 1.5 solar mass main sequence star?

ANSWER: CNO CYCLE

BONUS

21. EARTH AND SPACE *Multiple Choice* Which of the following is the energy source of stars on the horizontal branch of stellar evolution?

- W) Core hydrogen burning
- X) Shell hydrogen burning
- Y) Core helium burning
- Z) Shell helium burning

ANSWER: Y) CORE HELIUM BURNING

TOSS UP

22. PHYSICS *Multiple Choice* An unpolarized electromagnetic plane wave is incident on a linear polarizer whose transmission axis is parallel to the y -axis. After passing through the polarizer, which of the following best describes the oscillation direction of the magnetic field?

- W) Along the positive and negative x -axis
- X) Along the positive and negative y -axis
- Y) A direction pointing in either the 1st or 3rd quadrant
- Z) A direction pointing in either the 2nd or 4th quadrant

ANSWER: W) ALONG THE POSITIVE AND NEGATIVE X-AXIS

BONUS

22. PHYSICS *Short Answer* A 5 kilogram object moves with a velocity $v = 2t^2 + 2$ meters per second where t is in seconds. What is the net force on the object in newtons after 2 seconds?

ANSWER: 40

TOSS UP

23. MATH *Short Answer* Evaluate $\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} \tan x \, dx$ [***the integral from negative pi over 4 to pi over 4 of tangent of x dx***].

ANSWER: 0

BONUS

23. MATH *Short Answer* Solve the following equation for x over the real numbers: $\log_2(x + 5) - \log_2(x - 1) = 2$ [***log base 2 of open parenthesis x plus 5 close parenthesis minus log base 2 of the quantity x minus 1 equals 2***].

ANSWER: $x = 3$

TOSS UP

24. CHEMISTRY *Short Answer* A sample of ethyl ether has a boiling point of 35 degrees Celsius, whereas a sample of butanol has a boiling point of 120 degrees Celsius. To what intermolecular force can this discrepancy be attributed?

ANSWER: HYDROGEN BONDING

BONUS

24. CHEMISTRY *Multiple Choice* A balloon expands isothermally from 1.0 to 10.0 liters against a constant external pressure of 7.0 atmospheres. The work in liter atmospheres performed by the system is which of the following?

- W) -63
- X) +63
- Y) -70
- Z) +70

ANSWER: X) +63

TOSS UP

25. BIOLOGY *Short Answer* Cacti have adapted to dry environments by closing their stomata during the day and opening them at night to reduce water loss. What is the name of the photosynthesis adaptation that incorporates this strategy?

ANSWER: CAM (ACCEPT: CRASSULACEAN ACID METABOLISM)

BONUS

25. BIOLOGY *Multiple Choice* Which of the following statements about seagrass is NOT true?

- W) Rhizomes grow horizontally in the sediment
- X) Seagrass systems tend to be depositional environments
- Y) Seagrass does not reproduce sexually
- Z) Seagrass can be found in both tropical and temperate habitats

ANSWER: Y) SEAGRASS DOES NOT REPRODUCE SEXUALLY