

ROUND ROBIN ~ ROUND 11

TOSS UP

1. CHEMISTRY *Short Answer* If 23.90 grams of water have a heat capacity of 100 joules per Kelvin, how many joules of thermal energy are required to raise the temperature of this water from 290 Kelvin to 295 Kelvin?

ANSWER: 500

BONUS

1. CHEMISTRY *Multiple Choice* Which of the following substances is soluble in carbon tetrachloride?

- W) Formaldehyde [*for-MAL-duh-hyd*]
- X) Bromine
- Y) Ammonia
- Z) Sodium chloride

ANSWER: X) BROMINE

TOSS UP

2. BIOLOGY *Short Answer* What is the name of the white blood cells that develop into macrophages and dendritic cells?

ANSWER: MONOCYTES (ACCEPT: MONOCELLULAR LEUCOCYTES)

BONUS

2. BIOLOGY *Multiple Choice* Which of the following human vitamin or mineral requirement is NOT matched correctly with its symptoms of deficiency?

- W) Vitamin B12 and beriberi [*BER-ee-BER-ee*]
- X) Vitamin C and scurvy
- Y) Vitamin A and blindness, impaired immunity, and skin disorders
- Z) Vitamin K and defective blood clotting

ANSWER: W) VITAMIN B12 AND BERIBERI

TOSS UP

3. ENERGY *Multiple Choice* How many Btus are required to raise 3 pounds of water from 60° Fahrenheit to 130° Fahrenheit?

- W) 63
- X) 70
- Y) 210
- Z) 390

ANSWER: Y) 210

BONUS

3. ENERGY *Multiple Choice* If my current annual heating bill is \$900 and my old furnace has an efficiency rating of 75%, which of the following best approximates my new bill if I install a 95% efficient furnace?

- W) \$675
- X) \$690
- Y) \$710
- Z) \$840

ANSWER: Y) \$710

TOSS UP

4. EARTH AND SPACE *Multiple Choice* All except which of the following are factors that could lead to the mechanical weathering of rocks?

- W) Wind abrasion
- X) Chelation [**kee-LAY-shuhn**]
- Y) Freezing and melting of water
- Z) Penetration by plant roots

ANSWER: X) CHELATION

BONUS

4. EARTH AND SPACE *Multiple Choice* The metallicity of globular clusters is generally which of the following?

- W) Less than that of the Sun
- X) Comparable to that of the Sun
- Y) Greater than that of the Sun
- Z) Too variable between globular clusters to make any definitive conclusions

ANSWER: W) LESS THAN THAT OF THE SUN

TOSS UP

5. PHYSICS *Multiple Choice* When a ray of light traveling through the air reflects off the surface of a puddle of pure water, it undergoes which of the following changes in phase?

- W) 360°
- X) 180°
- Y) 90°
- Z) 0°

ANSWER: X) 180°

BONUS

5. PHYSICS *Short Answer* A force displaces an object. The force vector is $3\mathbf{i}$ plus $2\mathbf{j}$ plus \mathbf{k} newtons and the displacement vector is $2\mathbf{i}$ plus $6\mathbf{j}$ minus $5\mathbf{k}$ meters. Find the work done in joules.

ANSWER: 13

TOSS UP

6. MATH *Multiple Choice* Solve the following equation for x : $(x - 9)^{\frac{2}{3}} = 16$ [***the quantity x minus 9 to the power of two thirds equals 16***].

- W) 73
- X) ± 73
- Y) 73 and -55
- Z) $-\frac{64}{9}$

ANSWER: Y) 73 AND -55

BONUS

6. MATH *Short Answer* Giving your answer with r positive and theta in radians, what are the equivalent polar coordinates to the rectangular coordinates $(-3\sqrt{3}, -3)$?

ANSWER: $(6, 7\pi/6)$

TOSS UP

7. CHEMISTRY *Short Answer* Cocaine has a tertiary amine group with a pK_b of 5.6. What is the pK_a of cocaine's conjugate acid in an aqueous solution at 25° Celsius?

ANSWER: 8.4

BONUS

7. CHEMISTRY *Short Answer* What are the names of the following four acids: 1) HNO_2 , 2) H_2S , 3) HIO_4 , 4) $H_2Cr_2O_7$?

ANSWER: 1) NITROUS ACID, 2) HYDROSULFURIC ACID (ACCEPT: HYDROGEN SULFIDE), 3) PERIODIC ACID, 4) DICHROMIC ACID

TOSS UP

8. BIOLOGY *Short Answer* In a frog blastula, the animal pole is composed of which one of the three embryonic germ layers?

ANSWER: ECTODERM

BONUS

8. BIOLOGY *Short Answer* Identify all of the following four reactions performed by marine organisms that would require oxygen: 1) sulfur oxidation, 2) nitrification, 3) photosynthesis, 4) nitrogen fixation.

ANSWER: 1, 2 (ACCEPT: SULFUR OXIDATION, NITRIFICATION)

TOSS UP

9. ENERGY *Multiple Choice* Approximately how many square miles of photovoltaic panels would be required to provide power for the entire U.S. during daylight hours?

- W) 2,500
- X) 10,000
- Y) 40,000
- Z) 100,000

ANSWER: X) 10,000

BONUS

9. ENERGY *Multiple Choice* At 120 volts, which of the following is the approximate amperage through a circuit that consists of resistors of 5 ohms, 10 ohms, and 20 ohms in series, followed by the same resistors in parallel?

- W) 3.16
- X) 3.42
- Y) 4.66
- Z) 35

ANSWER: W) 3.16

TOSS UP

10. EARTH AND SPACE *Multiple Choice* Which of the following statements about the greenhouse effect is NOT true?

- W) Anthropogenic activities have contributed to an increase in greenhouse gases, especially carbon dioxide, compared to pre-industrial levels
- X) Greenhouse gases efficiently trap ultraviolet radiation to warm the Earth's lower atmosphere
- Y) The global warming potential for each greenhouse gas is different
- Z) The greenhouse effect is a natural process without which the Earth's temperature would be at least 25° Celsius colder

ANSWER: X) GREENHOUSE GASES EFFICIENTLY TRAP ULTRAVIOLET RADIATION TO WARM THE EARTH'S ATMOSPHERE

BONUS

10. EARTH AND SPACE *Short Answer* What is the coolest spectral class of stars around which H II regions are generally seen?

ANSWER: B

TOSS UP

11. PHYSICS *Multiple Choice* Which of the following is true about the magnetic field inside an ideal infinite solenoid?

- W) It increases linearly as the radius of the solenoid increases
- X) It is zero
- Y) It is uniform
- Z) It decreases continuously along its axis

ANSWER: Y) IT IS UNIFORM

BONUS

11. PHYSICS *Short Answer* An ambulance is approaching the scene of an accident with a speed of 30 meters per second. Its siren has a frequency of 1500 hertz. Providing your answer with two significant figures, find the frequency in hertz of the siren heard by a stationary person waiting for the ambulance, given that the speed of sound is 340 meters per second.

ANSWER: 1600

TOSS UP

12. MATH *Short Answer* Express i^{443} in simplest form.

ANSWER: -i

BONUS

12. MATH *Short Answer* Solve the system of equations: $x + y = 1$, and $x^2 + 3y^2 = 21$.

ANSWER: $(-3/2, 5/2)$, $(3, -2)$

TOSS UP

13. CHEMISTRY *Multiple Choice* Uranium-235 can be used in nuclear power plants. If this isotope is at sub-critical mass and is bombarded by a neutron, which of the following is most likely to occur?

- W) The result depends on the amount of uranium and temperature
- X) An explosion
- Y) A controllable source of energy will be formed
- Z) No reaction

ANSWER: Y) A CONTROLLABLE SOURCE OF ENERGY WILL BE FORMED

BONUS

13. CHEMISTRY *Short Answer* What is the electron configuration of an atom of gallium in the ground state?

ANSWER: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^1$ (ACCEPT: THE LAST THREE IN ANY ORDER; [Ar] $4s^2 3d^{10} 4p^1$)

TOSS UP

14. BIOLOGY *Short Answer* What is the term for the cell that produces hydrochloric acid in the human stomach?

ANSWER: PARIETAL (ACCEPT: OXYNTIC)

BONUS

14. BIOLOGY *Multiple Choice* Which of the following statements is NOT true regarding ticks and transmitted diseases?

- W) Female black legged ticks are only slightly better at transmitting Lyme disease than their male counterparts
- X) The disease-causing agent in Lyme disease is the bacterium *Borrelia burgdorferi* [**buh-REL-ee-uh boorg-dor-FE-ree**]
- Y) The dog tick serves as a vector for *Rickettsia rickettsia*, the causative agent of Rocky Mountain Spotted Fever
- Z) The Lone Star Tick serves as a vector for disease-causing *Rickettsia*

ANSWER: W) FEMALE BLACK LEGGED TICKS ARE ONLY SLIGHTLY BETTER AT TRANSMITTING LYME DISEASE THAN THEIR MALE COUNTERPARTS

TOSS UP

15. EARTH AND SPACE *Multiple Choice* On what day of the year does local sidereal time coincide with local mean time?

- W) Autumnal equinox
- X) January 1
- Y) Vernal equinox
- Z) Summer solstice

ANSWER: W) AUTUMNAL EQUINOX

BONUS

15. EARTH AND SPACE *Multiple Choice* Which of the following are the three main factors that control the type and rate of mass wasting that might occur at the Earth's surface?

- W) Adhesion, slope stability, and overburden thickness
- X) Slope gradient, slope consolidation, and water
- Y) Slope gradient, cohesion, and lithology
- Z) Water, adhesion, and construction

ANSWER: X) SLOPE GRADIENT, SLOPE CONSOLIDATION, AND WATER

TOSS UP

16. PHYSICS *Multiple Choice* Which of the following actions would increase the magnetic force between two parallel current-carrying wires?

- W) Decreasing the length of both wires
- X) Decreasing the current flowing through either of the two wires
- Y) Decreasing the distance between them
- Z) Increasing the distance between them

ANSWER: Y) DECREASING THE DISTANCE BETWEEN THEM

BONUS

16. PHYSICS *Short Answer* A water hose has inner radius 4 centimeters and its nozzle radius is 1 centimeter. The speed of water inside the hose is 3 meters per second. Find the speed of water coming out of the nozzle in meters per second.

ANSWER: 48

TOSS UP

17. MATH *Short Answer* Expressing your answer in interval notation, what is the largest possible real domain of the function: $f(x) = \frac{\sqrt{x^2-16}}{|x+9|}$ **[f of x equals the fraction with numerator, the square root of the quantity x squared minus 16, and denominator the absolute value of the quantity x plus 9]?**

ANSWER: $(-\infty, -9) \cup (-9, -4] \cup [4, \infty)$

[NOTE: NEED NOT USE UNIONS, BUT MUST CLEARLY INDICATE THAT -9 IS NOT INCLUDED, WHILE ± 4 ARE]

BONUS

17. MATH *Short Answer* In square centimeters and in terms of pi, find the area of a circle with an inscribed triangle with side lengths of 10 centimeters, 24 centimeters, and 26 centimeters.

ANSWER: 169π

TOSS UP

18. CHEMISTRY *Multiple Choice* How do bases interact with the π^* **[pi star]** orbital of ketones and aldehydes **[AL-duh-hyds]?**

- W) Deprotonation at the alpha position
- X) 1, 2 addition
- Y) 1, 2 substitution
- Z) Deprotonation at the beta position

ANSWER: W) DEPROTONATION AT THE ALPHA POSITION

BONUS

18. CHEMISTRY *Short Answer* Rank the following four ions in order of increasing size for the dominant ionic form: 1) fluoride, 2) chloride, 3) sodium, 4) magnesium.

ANSWER: 4, 3, 1, 2 (ACCEPT: MAGNESIUM, SODIUM, FLUORIDE, CHLORIDE)

TOSS UP

19. BIOLOGY *Multiple Choice* If a bacterium that is sensitive to the antibiotic ampicillin becomes resistant to that antibiotic, it would be an example of which of the following?

- W) Microevolution
- X) Macroevolution
- Y) Speciation
- Z) Extinction

ANSWER: W) MICROEVOLUTION

BONUS

19. BIOLOGY *Multiple Choice* While looking through a microscope at a few drops of water squeezed out of a fist full of moss, you notice an eight-legged animal that has claws. Which of the following is the most likely identity of this organism?

- W) Daphnia
- X) Rotifer
- Y) Tardigrade
- Z) Collembola

ANSWER: Y) TARDIGRADE

TOSS UP

20. ENERGY *Multiple Choice* Which of the following elements is a main component of fuels because its oxidation releases a large amount of thermal energy?

- W) Sulfur
- X) Nitrogen
- Y) Carbon
- Z) Hydrogen

ANSWER: Y) CARBON

BONUS

20. ENERGY *Short Answer* By number, identify all of the following four statements that accurately describe the processes involved in aerobically producing ATP: 1) Although prokaryotic [*proh-KAR-ee-oh-tik*] cells lack mitochondria [*my-tuh-KON-dree-uh*] and cristae [*KRIS-tuh*], they use a proton pump to produce ATP; 2) Energy is liberated when the chemical bond between ATP and its phosphate subgroup is formed; 3) Oxygen is used in the last step of aerobic respiration to produce water; 4) Chemiosmosis produces more ATP molecules than oxidative phosphorylation [*FOS-fer-uh-lay-shuhn*].

ANSWER: 1 AND 3

TOSS UP

21. CHEMISTRY *Short Answer* Calomel is an important reference electrode. In a calomel electrode, what salt solution is used to maintain constant ionic strength?

ANSWER: POTASSIUM CHLORIDE (ACCEPT: KCl, SODIUM CHLORIDE, NaCl)

BONUS

21. CHEMISTRY *Short Answer* How many structural isomers are there for a compound with the formula C_7H_{16} ?

ANSWER: 9

TOSS UP

22. PHYSICS *Multiple Choice* An airplane traveling faster than the speed of sound passes over a stationary observer on the ground. When does the observer hear the sonic boom?

- W) Only before the plane breaks the sound barrier
- X) When the plane is directly overhead
- Y) After the plane has passed by
- Z) As the plane is approaching the area

ANSWER: Y) AFTER THE PLANE HAS PASSED BY

BONUS

22. PHYSICS *Multiple Choice* During the formation of planets in the solar system, a spinning gas disk started to contract due to gravitational forces. Which of the following was an ensuing effect regarding this gas disk?

- W) It rotated faster
- X) It disintegrated due to gravitational forces
- Y) It bulged out to form spheres
- Z) It stopped rotating

ANSWER: W) IT DISK ROTATED FASTER

TOSS UP

23. MATH *Short Answer* Solve the following equation over the complex numbers:
 $(x + 3)^2 + 16 = 0$.

ANSWER: $-3 \pm 4i$

BONUS

23. MATH *Short Answer* Determine the value of the following: $\sum_{n=1}^{17} (3n - 5)$ [***the summation as n goes from 1 to 17 of the quantity 3n minus 5***].

ANSWER: 374

TOSS UP

24. EARTH AND SPACE *Multiple Choice* Which of the following dominates in the innermost kiloparsec of a galaxy?

- W) Hot gas
- X) Stars
- Y) The galaxy's supermassive black hole
- Z) Dark matter

ANSWER: X) STARS

BONUS

24. EARTH AND SPACE *Multiple Choice* Why does Eureka, California generally have a smaller yearly temperature range than Omaha, Nebraska even though they are both at 41 degrees north latitude?

- W) Land is a poor absorber and a poor conductor of heat energy
- X) Land changes temperature rapidly, due to its high specific heat and lack of transparency
- Y) Ocean water is a good absorber and a good conductor of heat energy
- Z) Ocean water changes temperature slowly, due to the high specific heat and transparency of water

ANSWER: Z) OCEAN WATER CHANGES TEMPERATURE SLOWLY, DUE TO THE HIGH SPECIFIC HEAT AND TRANSPARENCY OF WATER

TOSS UP

25. BIOLOGY *Multiple Choice* Which of the following animals possesses a kidney that hosts unusually long and elaborate loops of Henle?

- W) Kangaroo rat
- X) Siren salamander
- Y) Black-billed magpie
- Z) Great white shark

ANSWER: W) KANGAROO RAT

BONUS

25. BIOLOGY *Multiple Choice* If you have an alien population and the green skin phenotype is always inherited with the menacing horns phenotype, the genes that code for these phenotypes would be classified as which of the following?

- W) Recombinant
- X) Hardy-Weinberg
- Y) Mendelian [*men-DEE-lee-uhn*]
- Z) Linked

ANSWER: Z) LINKED