

ROUND ROBIN ~ ROUND 10

TOSS UP

1. BIOLOGY *Multiple Choice* Which of the following pairs of animals each possesses a gizzard?

- W) A bird and an alligator
- X) A shark and a hippopotamus
- Y) A bird and an echidna [*i-KID-nuh*]
- Z) A teleost and a Llama [*TEL-ee-ost*]

ANSWER: W) A BIRD AND AN ALLIGATOR

BONUS

1. BIOLOGY *Multiple Choice* During replication, which of the following enzymes is needed to seal a single phosphodiester [*fos-foh-dy-ES-tuhr*] bond?

- W) Ligase
- X) Phosphatase [*FOS-fuh-tays*]
- Y) DNA polymerase [*POL-uh-muh-rays*]
- Z) Gyrase [*JY-rays*]

ANSWER: W) LIGASE

TOSS UP

2. CHEMISTRY *Short Answer* Acetyl-CoA [*CO-A*] carboxylase-1 alpha, a fatty acid synthesis regulatory enzyme, functions to carboxylate Acetyl-CoA. What is the name of the newly formed carboxylated product?

ANSWER: MALONYL-CoA

BONUS

2. CHEMISTRY *Multiple Choice* Which of the following protons will appear farthest downfield in the ^1H [*Proton*]-NMR spectrum?

- W) Alkane
- X) Alkene
- Y) Alkyne
- Z) Aromatic

ANSWER: Z) AROMATIC

TOSS UP

3. MATH *Short Answer* Factor the following polynomial completely over the real numbers:
 $2x^5 - 32x$.

ANSWER: $2x(x^2 + 4)(x + 2)(x - 2)$

BONUS

3. MATH *Short Answer* A series is defined recursively. If $a_1 = -2$ and $a_n = 3 + (a_{n-1})^{n-1}$ [**a sub n equals 3 plus open parenthesis a sub the quantity n minus 1 close parenthesis to the power of the quantity n minus 1**], determine the value of a_4 .

ANSWER: 67

TOSS UP

4. PHYSICS *Multiple Choice* Which of the following is NOT correct?

- W) All planets travel in elliptical orbits with the Sun at the center of the ellipse
- X) The period of a simple pendulum is independent of the mass of the bob
- Y) Gravitational force is a conservative force
- Z) The kilowatt-hour is a unit of energy

ANSWER: W) ALL PLANETS TRAVEL IN ELLIPTICAL ORBITS WITH THE SUN AT THE CENTER OF THE ELLIPSE

BONUS

4. PHYSICS *Multiple Choice* There are crossed electric and magnetic fields given, respectively, by 5.0×10^6 newtons per coulomb in the x direction and 0.5 tesla in the y direction. A proton traveling in the positive z direction experiences zero resultant force due to these fields. Which of the following is the speed of the proton in meters per second?

- W) 10^7
- X) 2.5×10^6
- Y) 10^6
- Z) 10^{-7}

ANSWER: W) 10^7

TOSS UP

5. EARTH AND SPACE *Short Answer* Due to radar-bright reflections received by the Very Large Array, what substance is believed to exist in polar craters on Mercury?

ANSWER: ICE (ACCEPT: WATER ICE; DO NOT ACCEPT: WATER)

BONUS

5. EARTH AND SPACE *Multiple Choice* Which of the following statements is NOT accurate about the similarities between Earth and Saturn's largest moon, Titan?

- W) Both feature liquid lakes and clouds
- X) Both are sculpted by wind, rain, volcanoes, and tectonic processes
- Y) Both possess a thick atmosphere
- Z) Their atmospheres contain very similar nitrogen concentrations

ANSWER: Z) THEIR ATMOSPHERES CONTAIN VERY SIMILAR NITROGEN CONCENTRATIONS

TOSS UP

6. ENERGY *Multiple Choice* Which of the following correctly matches the major energy source and fuel for most stars?

- W) Nuclear fission and hydrogen
- X) Nuclear fission and helium
- Y) Nuclear fusion and hydrogen
- Z) Nuclear fusion and helium

ANSWER: Y) NUCLEAR FUSION AND HYDROGEN

BONUS

6. ENERGY *Short Answer* By number, identify all of the following three statements that correctly indicate advantages of the high energy phosphate system: 1) It produces energy at a slow rate but for a long duration; 2) Its rate of recovery is relatively rapid; 3) It can produce large amounts of energy in a short amount of time.

ANSWER: 2 AND 3

TOSS UP

7. BIOLOGY *Multiple Choice* Which of the following animals does NOT belong in the phylum Mollusca [**FY-luhm muh-LUHS-kuh**]?

- W) Giant squid
- X) Geoduck [**GOO-ee-duck**]
- Y) Cuttlefish
- Z) Salp

ANSWER: Z) SALP

BONUS

7. BIOLOGY *Multiple Choice* In a histological preparation stained with Hematoxylin [**hee-muh-TOK-suh-lin**] and Eosin [**EE-uh-sin**], the nucleus, cytoplasm, and collagen would be rendered, respectively, which of the following colors?

- W) Blue, pink, blue
- X) Pink, blue, pink
- Y) Blue, pink, pink
- Z) Pink, pink, blue

ANSWER: Y) BLUE, PINK, PINK

TOSS UP

8. CHEMISTRY *Short Answer* An atom of an unknown element has 33 electrons. What is the likely ratio of the numbers of atoms of that element to calcium when in an ionic compound?

ANSWER: 2:3

BONUS

8. CHEMISTRY *Multiple Choice* The Henderson-Hasselbalch equation can provide the percent dissociation of a weak acid. When the pH is equal to pK_a , the weak acid is which of the following?

- W) 99% dissociated
- X) 75% dissociated
- Y) 50% dissociated
- Z) 25% dissociated

ANSWER: Y) 50% DISSOCIATED

TOSS UP

9. MATH *Short Answer* Solve the following equation for x on the interval $0 \leq x < 2\pi$:
 $4\cos^2x - 1 = 0$

ANSWER: $\pi/3, 2\pi/3, 4\pi/3, 5\pi/3$

BONUS

9. MATH *Short Answer* If $8^{x+y} = 16$ [**8 to the power of the quantity x plus y equals 16**], determine the slope-intercept form of the equation satisfied by points with coordinates (x, y) .

ANSWER: $y = -x + 4/3$

TOSS UP

10. PHYSICS *Multiple Choice* A force of 10 newtons compresses a spring to 5.0 centimeters from its equilibrium position. How far in centimeters can a force of 5.0 newtons stretch the same spring?

- W) 0.50
- X) 2.5
- Y) 10.0
- Z) 25

ANSWER: X) 2.5

BONUS

10. PHYSICS *Short Answer* A ball is launched straight up with a speed of 30 meters per second. Given the magnitude of the acceleration due to gravity as 10 meters per second squared, how far in meters is the ball displaced from its launching point after 4 seconds?

ANSWER: 40

TOSS UP

11. EARTH AND SPACE *Multiple Choice* Which of the following shapes would the pure parallactic motion of a star on the celestial equator describe?

- W) Ellipse
- X) Line
- Y) Circle
- Z) Parabola

ANSWER: W) ELLIPSE

BONUS

11. EARTH AND SPACE *Multiple Choice* Approximately which of the following in Kelvin is the surface temperature of a G-type star?

- W) 2000
- X) 4000
- Y) 6000
- Z) 8000

ANSWER: Y) 6000

TOSS UP

12. BIOLOGY *Multiple Choice* There are over 50,000 known invasive species in North America. Which of the following species is NOT invasive to North America?

- W) Nutria
- X) Rosy boa
- Y) Round goby
- Z) Zebra mussel

ANSWER: X) ROSY BOA

BONUS

12. BIOLOGY *Short Answer* You desire to separate cellular components by homogenization followed by differential centrifugation whereby components separate out based on their coefficient of sedimentation measured in Svedbergs or S values. Components with larger S values will sediment out first. Arrange the following four choices from highest to lowest S value: 1) mitochondrion [*my-tuh-KON-dree-uhn*], 2) intact cell, 3) endoplasmic reticulum [*EN-duh-plaz-mik ri-TIK-yuh-luhm*], 4) nucleus.

ANSWER: 2, 4, 1, 3 (ACCEPT: INTACT CELL, NUCLEUS, MITOCHONDRION, ENDOPLASMIC RETICULUM)

TOSS UP

13. CHEMISTRY *Multiple Choice* According to the Clausius **[KLOU-zee-uhs]** inequality, the derivative of entropy is greater than or equal to the derivative of heat, divided by temperature. When is the equal case true?

- W) For an irreversible change
- X) For a reversible change
- Y) For temperatures greater than 273 Kelvin
- Z) For temperatures less than or equal to 273 Kelvin

ANSWER: X) FOR A REVERSIBLE CHANGE

BONUS

13. CHEMISTRY *Short Answer* Providing your answer in scientific notation, calculate the rate of decomposition in molar per second, using appropriate significant figures, if the concentration difference is 0.10 molar over a 20.0 second interval.

ANSWER: 5.0×10^{-3}

TOSS UP

14. MATH *Short Answer* Solve the following expression when $x = 4$: $(\frac{x^3}{9})^{-1/2}$ **[open parenthesis, x cubed over 9, close parenthesis, to the negative 1/2 power].**

ANSWER: $x = 3/8$

BONUS

14. MATH *Short Answer* Express the following complex number in simplest $a + bi$ form:
 $5i^{13} + 6i^{12} - 7i^{10} + 3i$.

ANSWER: $13 + 8i$

TOSS UP

15. PHYSICS *Short Answer* A solid sphere, a solid cylinder, and a hoop are rolled down an inclined plane without slipping. Given that they have identical masses and diameters, what object reaches the bottom of the ramp first?

ANSWER: SPHERE

BONUS

15. PHYSICS *Multiple Choice* The ground state energy of the hydrogen atom is -13.6 electron volts. Which of the following is the energy, in electron volts, of the second excited state of hydrogen?

- W) 3.4
- X) 1.5
- Y) -1.5
- Z) -3.4

ANSWER: Y) -1.5

TOSS UP

16. EARTH AND SPACE *Short Answer* What is the only planet in our solar system with a permanent bulge due to tidal forcing?

ANSWER: MERCURY

BONUS

16. EARTH AND SPACE *Multiple Choice* Detections of Population III stars are very controversial. It is believed that they are so difficult to detect because they are which of the following?

- W) Very short-lived and so can only be seen at high redshifts
- X) Very low-mass and are therefore very faint
- Y) Heavily obscured by dust
- Z) Only visible in millimeter wavelengths

ANSWER: W) VERY SHORT-LIVED AND SO CAN ONLY BE SEEN AT HIGH REDSHIFTS

TOSS UP

17. ENERGY *Multiple Choice* About how many Btus does a therm of natural gas have?

- W) 100,000
- X) 1 million
- Y) 10 million
- Z) 100 million

ANSWER: W) 100,000

BONUS

17. ENERGY *Short Answer* Given $h = 6.62 \times 10^{-34}$ joule seconds and providing your answer in scientific notation, calculate the number of photons in 6.62 joules of radiation energy of frequency 10^{12} hertz.

ANSWER: 1×10^{22}

TOSS UP

18. BIOLOGY *Multiple Choice* Which of the following organisms is NOT matched correctly with its main form of nitrogen excretion?

- W) Squirrel and urea
- X) Sparrow and uric acid
- Y) Planaria and ammonia
- Z) Land snail and urea

ANSWER: Z) LAND SNAIL AND UREA

BONUS

18. BIOLOGY *Short Answer* Sheep serve as a definitive host for sheep liver flukes. What animal serves as the intermediate host?

ANSWER: SNAIL (ACCEPT: AQUATIC SNAIL)

TOSS UP

19. CHEMISTRY *Multiple Choice* When mixed at a molar ratio of 3 to 1, which of the following solution mixtures is a buffer system?

- W) Hydrochloric acid and sodium chloride
- X) Acetic acid and sodium hydroxide
- Y) Potassium hydroxide and phosphoric acid
- Z) Perchloric acid and ammonia

ANSWER: X) ACETIC ACID AND SODIUM HYDROXIDE

BONUS

19. CHEMISTRY *Multiple Choice* Which of the following is NOT true with respect to reaction mechanisms?

- W) Fast, reversible steps may be present
- X) Fast, nonreversible steps are never present
- Y) The elementary reactions sum to give the overall reaction
- Z) The slow step is sometimes the first step

ANSWER: X) FAST, NONREVERSIBLE STEPS ARE NEVER PRESENT

TOSS UP

20. MATH *Short Answer* Providing your answer as a fraction in simplest form, what is the probability of drawing a heart or a king from a standard playing deck of cards?

ANSWER: 4/13

BONUS

20. MATH *Short Answer* If the recursive sequence t_n is defined by $t_1 = 3$ and $t_n = -5 + 3t_{n-1}$, what is the value of t_6 ?

ANSWER: 124

TOSS UP

21. PHYSICS *Multiple Choice* A glass rod with index of refraction n is submersed in an oil bath. Which of the following indices of refraction should the oil have in order to render the rod optically invisible?

- W) Less than n
- X) Greater than n
- Y) The same as n
- Z) None; it's impossible

ANSWER: Y) THE SAME AS n

BONUS

21. PHYSICS *Short Answer* As a planet travels around a star in an elliptical orbit, identify all of the following four quantities related to the planet that are conserved: 1) angular momentum; 2) total energy; 3) angular velocity; 4) kinetic energy.

ANSWER: 1, 2 (ACCEPT: ANGULAR MOMENTUM AND TOTAL ENERGY)

TOSS UP

22. EARTH AND SPACE *Multiple Choice* Three seconds after the Big Bang, which of the following dominated the energy content of the universe?

- W) Dark energy
- X) Baryonic matter
- Y) Dark matter
- Z) Radiation

ANSWER: Z) RADIATION

BONUS

22. EARTH AND SPACE *Multiple Choice* A major problem solved during the 1990s was the solar neutrino problem, in which only one-third the predicted number of neutrinos from the Sun were observed. Which of the following was its resolution?

- W) Solar astronomers discovered that the solar core is smaller than was thought
- X) Solar astronomers discovered a new nuclear reaction in the Sun's core
- Y) Physicists discovered that neutrino flavors oscillate as they travel from the Sun
- Z) Neutrino detectors were less sensitive than thought

ANSWER: Y) PHYSICISTS DISCOVERED THAT NEUTRINO FLAVORS OSCILLATE AS THEY TRAVEL FROM THE SUN

TOSS UP

23. ENERGY *Multiple Choice* When comparing the amount of food energy taken in to the energy available to do work, about how efficient is a human?

- W) 15%
- X) 25%
- Y) 35%
- Z) 45%

ANSWER: X) 25%

BONUS

23. ENERGY *Short Answer* If a gallon of gasoline costs \$3.50, how much will you save each year if you have a car getting 40 miles per gallon compared to a car getting 20 miles per gallon if you drive 20,000 miles per year?

ANSWER: \$1,750

TOSS UP

24. BIOLOGY *Multiple Choice* Which of the following exhibits viviparity?

- W) Salt cedars
- X) Cord grass
- Y) Mangroves
- Z) Eelgrasses

ANSWER: Y) MANGROVES

BONUS

24. BIOLOGY *Short Answer* Name all of the following four cell types that are examples of immature red blood cells: 1) promyelocyte [*proh-mee-UH-luh-syt*], 2) basophilic erythroblast [*ih-RITH-ruh-blast*], 3) pro-eosinophilic [*(pro) ee-uh-sin-uh-FIL-ik*] cell, 4) normoblast.

ANSWER: 2, 4 (ACCEPT: BASOPHILIC ERYTHROBLAST, NORMOBLAST)

TOSS UP

25. CHEMISTRY *Multiple Choice* A particular molecule of XeF_4 displays 3 IR bands and 3 Raman bands at completely different energies. Based on this information, which of the following is its VSEPR structure?

- W) Tetrahedral
- X) Octahedral
- Y) Square planar
- Z) See-saw

ANSWER: Y) SQUARE PLANAR

BONUS

25. CHEMISTRY *Short Answer* Thirty-two grams of oxygen gas are reacted with 10 grams of hydrogen gas to form water. If all of the oxygen is consumed, how many grams of excess hydrogen remain?

ANSWER: 6