

## ROUND ROBIN ~ ROUND 9

---

### TOSS UP

1. PHYSICS *Multiple Choice* Which of the following is the unit of the product of resistance and capacitance?

- W) Farad
- X) Ohm
- Y) Mho
- Z) Second

ANSWER: Z) SECOND

### BONUS

1. PHYSICS *Multiple Choice* For photons traveling through a vacuum, a photon in the ultraviolet spectrum has which of the following characteristics, compared to a photon in the infrared spectrum?

- W) Longer wavelength
- X) Same speed
- Y) Lower frequency
- Z) Half the energy

ANSWER: X) SAME SPEED

---

### TOSS UP

2. ENERGY *Short Answer* What is the term for the system of power generation in which solar energy is converted to heat that drives a steam turbine?

ANSWER: CONCENTRATED SOLAR POWER (ACCEPT: CSP; DO NOT ACCEPT: SOLAR POWER)

### BONUS

2. ENERGY *Short Answer* By number, rank the following four electricity generating resources in terms of capital cost per megawatt-hour from least to greatest: 1) hydropower, 2) nuclear, 3) conventional coal, 4) natural gas.

ANSWER: 4, 3, 1, 2

### TOSS UP

3. CHEMISTRY *Multiple Choice* Which of the following species does NOT have at least two equally favorable resonance structures?

- W) C<sub>6</sub>H<sub>6</sub>
- X) NO<sub>2</sub><sup>-</sup>
- Y) CO<sub>2</sub>
- Z) SO<sub>2</sub>

ANSWER: Y) CO<sub>2</sub>

### BONUS

3. CHEMISTRY *Multiple Choice* For a given reaction,  $\Delta H$  [**delta H**] is positive and  $\Delta S$  [**delta S**] is negative. In which of the following temperature limits is the reaction spontaneous?

- W) Not spontaneous at any temperature
- X) Spontaneous at only high temperatures
- Y) Spontaneous at only low temperatures
- Z) Spontaneous at all temperatures

ANSWER: W) NOT SPONTANEOUS AT ANY TEMPERATURE

---

### TOSS UP

4. MATH *Short Answer* Providing your answer in simplest form, what is  $\sec(11\pi/6)$  [**secant of 11 pi over 6**]?

ANSWER:  $\frac{2\sqrt{3}}{3}$

### BONUS

4. MATH *Short Answer* Each exterior angle of a regular polygon has a measure of 10°. What is the sum, in degrees, of the measures of the interior angles of the polygon?

ANSWER: 6120°

### TOSS UP

5. EARTH AND SPACE *Multiple Choice* In which of the following reservoirs in the hydrologic cycle do water molecules have the shortest water residence time?

- W) Atmosphere
- X) Aquifer **[AK-wuh-fer]**
- Y) Ocean
- Z) River

ANSWER: W) ATMOSPHERE

### BONUS

5. EARTH AND SPACE *Short Answer* What is the Hubble classification for disk galaxies with very little gas and poorly defined spiral arms?

ANSWER: S0 (ACCEPT: SB0)

---

### TOSS UP

6. BIOLOGY *Short Answer* Which fatty structure in the forehead of a toothed whale appears to focus and direct outgoing sound waves?

ANSWER: MELON (ACCEPT: SPERMACETI ORGAN)

### BONUS

6. BIOLOGY *Multiple Choice* Following a stroke that affects the left cerebral hemisphere in an elderly female patient, the patient has halting speech, poor articulation and loss of the ability to write. The patient can still read and understand speech. A PET scan would reveal damage to which of the following parts of the brain?

- W) Wernicke's area
- X) Amygdala **[uh-MIG-duh-luh]**
- Y) Broca's area
- Z) Thalamus **[THAL-uh-muhs]**

ANSWER: Y) BROCA'S AREA

### TOSS UP

7. PHYSICS *Multiple Choice* When a clay pigeon breaks into pieces after being shot, which of the following can be said about the shape of the trajectories of these pieces of clay?

- W) They are always elliptical
- X) They are always parabolic
- Y) They are always hyperbolic
- Z) They may be any of elliptical, parabolic, or hyperbolic depending on the speed of the components

ANSWER: X) THEY ARE ALWAYS PARABOLIC

### BONUS

7. PHYSICS *Short Answer* A 1000 kilogram car moving with a speed of 6 meters per second collides perfectly inelastically with 2000 kilogram truck that is at rest. What is the change in kinetic energy in joules during this collision?

ANSWER: 12,000

---

### TOSS UP

8. CHEMISTRY *Multiple Choice* Which of the following substances would you expect to have the highest molar entropy at standard conditions?

- W) Argon gas
- X) Butane gas
- Y) Sulfur dioxide gas
- Z) Gaseous water

ANSWER: X) BUTANE GAS

### BONUS

8. CHEMISTRY *Short Answer* According to the VSEPR model, what is the molecular geometry of xenon **[ZEE-non]** tetrafluoride?

ANSWER: SQUARE PLANAR

**TOSS UP**

9. MATH *Short Answer* Express the following in simplest form, with variables raised only to positive powers:  $(4x^5y^{-3})^{-2}$  [**open parenthesis 4x to the fifth y to the power of negative 3 close parenthesis to the power of negative 2**]

ANSWER:  $\frac{y^6}{16x^{10}}$

**BONUS**

9. MATH *Short Answer* A regular decagon with a perimeter of 40 units has an area of  $40k$  square units. Find its apothem.

ANSWER:  $2k$

---

**TOSS UP**

10. EARTH AND SPACE *Multiple Choice* Which of the following contains most of the angular momentum about the Sun in the solar system?

- W) Jupiter
- X) The Kuiper belt
- Y) The Sun
- Z) Neptune

ANSWER: W) JUPITER

**BONUS**

10. EARTH AND SPACE *Short Answer* What is the name of the classification system used to rate a hurricane's intensity?

ANSWER: SAFFIR-SIMPSON HURRICANE SCALE (ACCEPT: SAFFIR-SIMPSON)

### TOSS UP

11. BIOLOGY *Multiple Choice* Elevated levels of AST and ALT, which are transaminases, often indicate there is a problem with which of the following organs?

- W) Liver
- X) Pancreas
- Y) Kidneys
- Z) Heart

ANSWER: W) LIVER

### BONUS

11. BIOLOGY *Short Answer* Identify all of the following four digestive enzymes that are produced by the human pancreas: 1) carboxypeptidase [*kahr-bok-see-PEP-ti-days*], 2) lactase, 3) chymotrypsin [*ky-moh-TRIP-sin*], 4) amylase [*AM-uh-lays*].

ANSWER: 1, 3, 4

---

### TOSS UP

12. CHEMISTRY *Short Answer* A mass of hot copper with a heat capacity of 2.0 joules per Kelvin is dropped into the same volume of water and loses 80 joules of thermal energy. The final temperature of the copper is 295 Kelvin. What was its initial temperature in Kelvin?

ANSWER: 335

### BONUS

12. CHEMISTRY *Multiple Choice* Which of the following tends to crystallize in a simple cubic unit cell?

- W) Polonium
- X) Copper
- Y) Aluminum
- Z) Iron

ANSWER: W) POLONIUM

### TOSS UP

13. PHYSICS *Multiple Choice* A 10 kilogram box is moving with a speed of 5 meters per second along a level surface. If the coefficient of kinetic friction between the box and the surface is 0.1 and the coefficient of static friction between the box and the surface is 0.2, which of the following is the frictional force in newtons that acts on the box, given that the acceleration due to gravity is 9.8 meters per second squared?

- W) 1.0
- X) 2.0
- Y) 9.8
- Z) 19.6

ANSWER: Y) 9.8

### BONUS

13. PHYSICS *Short Answer* Three 300-microfarads capacitors are connected in series to a 12 volt battery. What is the energy stored in one of these capacitors in microjoules after the circuit has reached steady state?

ANSWER: 2400

---

### TOSS UP

14. ENERGY *Multiple Choice* An air compressor is about 20% efficient in converting electricity to compressed air. Where does the majority of the remaining 80% of the electricity go?

- W) It doesn't go anywhere, it stays in the motor
- X) It turns into thermal energy
- Y) It turns into sound
- Z) It turns into vibration

ANSWER: X) IT TURNS INTO THERMAL ENERGY

### BONUS

14. ENERGY *Multiple Choice* As more zero variable cost generators are added to an electric power market, how would you expect the average cost of power in the entire market to change?

- W) It would increase
- X) It would decrease
- Y) There would be no change
- Z) It would fluctuate

ANSWER: X) IT WOULD DECREASE

### TOSS UP

15. CHEMISTRY *Multiple Choice* Free radical polymerization can be initiated in several different ways. Peroxides and azo compounds frequently act as which of the following types of initiator?

- W) Thermal
- X) Photochemical
- Y) Ionizing
- Z) Redox

ANSWER: W) THERMAL

### BONUS

15. CHEMISTRY *Short Answer* A buffer solution is 0.05 molar in lactic acid and 0.5 molar in sodium lactate. If the pKa of lactic acid is 3.85, what is the pH of this solution?

ANSWER: 4.85

---

### TOSS UP

16. MATH *Short Answer* Providing your answer in simplest form, what is the cotangent of  $x$ , if  $\cos(x) < 0$ ,  $\sin(x) > 0$ , and  $x$  has reference angle  $\pi/6$ ?

ANSWER:  $-\sqrt{3}$

### BONUS

16. MATH *Multiple Choice* Which of the following represents the solution in degrees of the equation  $4\sin^2x = 1$  in the open interval from  $0^\circ$  to  $180^\circ$ ?

- W)  $30^\circ$
- X)  $30^\circ, 60^\circ$
- Y)  $30^\circ, 150^\circ$
- Z)  $60^\circ, 120^\circ$

ANSWER: Y)  $30^\circ, 150^\circ$



### TOSS UP

17. EARTH AND SPACE *Multiple Choice* Photographs taken by ground cameras and NASA's polar satellite show evidence of magnetic field lines connecting Earth's upper atmosphere directly to the Sun. Scientists believe that solar wind particles flow along these lines, providing energy for which of the following phenomena to occur?

- W) Halo effect
- X) Rainbow
- Y) Auroral light
- Z) Solar flare

ANSWER: Y) AURORAL LIGHT

### BONUS

17. EARTH AND SPACE *Short Answer* What is the polymorph of graphite that is formed in Earth's mantle?

ANSWER: DIAMOND

---

### TOSS UP

18. BIOLOGY *Short Answer* What phylum within the animal kingdom is characterized by having no symmetry and no true tissues?

ANSWER: PORIFERA

### BONUS

18. BIOLOGY *Short Answer* What is the name of the gland in insects that produces juvenile hormone?

ANSWER: CORPUS ALLATUM (ACCEPT: CORPORA ALLATA)

### TOSS UP

19. PHYSICS *Multiple Choice* A mass is suspended from the ceiling by two ropes. Rope 1 makes a larger angle with the horizontal than Rope 2 does. Which of the following statements is true about the tension in the ropes?

- W) The tensions in the ropes are equal
- X) The tension in Rope 1 is greater than the tension in Rope 2
- Y) The tension in Rope 2 is greater than the tension in Rope 1
- Z) The tension in Rope 2 is zero

ANSWER: X) THE TENSION IN ROPE 1 IS GREATER THAN THE TENSION IN ROPE 2

### BONUS

19. PHYSICS *Short Answer* A 5 microcoulomb charge is uniformly distributed in a 1-meter diameter sphere. Given that the coulomb constant is  $9 \times 10^9$  newton meters squared per coulomb squared, what is the electric field in newtons per coulomb at a radius of 0.25 from the center of the sphere?

ANSWER: 0

---

### TOSS UP

20. ENERGY *Multiple Choice* Which of the following produces wind energy?

- W) The Earth's rotation
- X) Uneven heating of the Earth's surface
- Y) Movement of the tectonic plates
- Z) The Moon's gravitational pull

ANSWER: X) UNEVEN HEATING OF THE EARTH'S SURFACE

### BONUS

20. ENERGY *Multiple Choice* Assuming similar wind velocity and turbine swept area, of the following places, where would you anticipate the largest power output from a wind turbine?

- W) Denver
- X) Nebraska
- Y) Rhode Island
- Z) West Texas

ANSWER: Y) RHODE ISLAND

### TOSS UP

21. BIOLOGY *Short Answer* What is the term for the unique, chitinous **[KY-tin-ous]**, tooth-like, feeding structure found in many mollusks **[MOL-uhskz]**?

ANSWER: RADULA

### BONUS

21. BIOLOGY *Short Answer* Identify all of the following four parts of the human body in which you would find simple cuboidal epithelium **[KYOO-boid-uhl ep-uh-THEE-lee-uhm]**: 1) thyroid gland, 2) bronchioles **[BRONG-kee-ohlz]**, 3) kidney, 4) lining of arteries.

ANSWER: 1, 3 (ACCEPT: THYROID GLAND, KIDNEY)

---

### TOSS UP

22. CHEMISTRY *Multiple Choice* Which of the following compounds is insoluble in water?

- W) Potassium acetate
- X) Aluminum sulfide
- Y) Lithium carbonate
- Z) Magnesium bromide

ANSWER: X) ALUMINUM SULFIDE

### BONUS

22. CHEMISTRY *Short Answer* Place the following four molecules in order from lowest to highest entropy of vaporization: 1) hydrogen chloride, 2) ammonia, 3) water, 4) hydrogen fluoride.

ANSWER: 4, 1, 2, 3 (ACCEPT: HYDROGEN FLUORIDE, HYDROGEN CHLORIDE, AMMONIA, WATER)

### TOSS UP

23. MATH *Multiple Choice* Which of the following represents an equivalent value for  $\log_{10} \sqrt{1000}$  [**log base 10 of the square root of 1000**]?

- W)  $10^{\frac{3}{2}}$  [**10 to the power of three halves**]
- X)  $10^{\frac{2}{3}}$  [**10 to the power of two thirds**]
- Y)  $3/2$
- Z)  $2/3$

ANSWER: Y)  $3/2$

### BONUS

23. MATH *Multiple Choice* Which of the following represents a simplified form of:  $\sin x + \frac{\cos^2 x}{\sin x}$  [**sine of x plus the fraction with numerator cosine squared of x and denominator sine of x**]?

- W)  $\csc x$  [**cosecant of x**]
- X)  $\sec x$  [**secant of x**]
- Y)  $\cos^2 x$  [**cosine squared of x**]
- Z) 1

ANSWER: W)  $\csc x$

---

### TOSS UP

24. EARTH AND SPACE *Short Answer* Patterns of paleomagnetism along seafloor spreading centers support plate tectonic theory and are based on what process that occurs, on average, every 200,000 to 250,000 years?

ANSWER: POLAR REVERSAL (ACCEPT: MAGNETIC REVERSAL)

### BONUS

24. EARTH AND SPACE *Multiple Choice* Which of the following best approximates the percentage of solar-type binary stellar systems?

- W) 0.1%
- X) 1%
- Y) 10%
- Z) 50%

ANSWER: Z) 50%

### TOSS UP

25. BIOLOGY *Multiple Choice* Which of the following animals uses a vomeronasal organ?

- W) Crocodile
- X) Garter snake
- Y) Toad
- Z) House fly

ANSWER: X) GARTER SNAKE

### BONUS

25. BIOLOGY *Short Answer* Name all of the following four amino acids that would have a net positive charge in Tris glycine buffer at pH 8.6: 1) glycine [**GLY-seen**], 2) alanine [**AL-uh-nin**], 3) lysine [**LY-seen**], 4) arginine [**AHR-juh-neen**].

ANSWER: 3, 4 (ACCEPT: LYSINE, ARGININE)