

## ROUND ROBIN ~ ROUND 4

---

### TOSS UP

1. PHYSICS *Multiple Choice* A ray of light is moving through a vacuum at an angle of  $60^\circ$  from the vertical, when it enters an oil with a horizontal surface where the ray is bent so that it makes an angle of  $30^\circ$  with the vertical. Which of the following best represents the index of refraction of the oil?

- W) 0.5
- X) 1.0
- Y) 1.7
- Z) 2.0

ANSWER: Y) 1.7

### BONUS

1. PHYSICS *Short Answer* A communications satellite is orbiting the Earth at a speed of 3000 meters per second. What would be the orbital speed in meters per second of a similar satellite that is 4 times as far from the center of the Earth as the first satellite?

ANSWER: 1500

---

### TOSS UP

2. ENERGY *Multiple Choice* If a 1.5 megawatt turbine were to operate at its annual average all the time, about how many homes could it fully supply?

- W) 3
- X) 100
- Y) 330
- Z) 550

ANSWER: Y) 330

### BONUS

2. ENERGY *Short Answer* If you are driving 60 miles per hour and your car gets 30 miles per gallon, how many Btus **[B-T-USE]** of energy are you using per hour if gas contains 125,000 Btus per gallon?

ANSWER: 250,000

### TOSS UP

3. CHEMISTRY *Multiple Choice* Which of the following is the IUPAC name for the acid with the following formula:  $\text{CH}_3\text{CO}_2\text{H}$ ?

- W) Formic acid
- X) Butyric acid [*byoo-TIR-ik*]
- Y) Propionic acid [*proh-pee-ON-ik*]
- Z) Ethanoic acid

ANSWER: Z) ETHANOIC ACID

### BONUS

3. CHEMISTRY *Multiple Choice* Which of the following is the energy in joules of a photon with a frequency of  $1.00 \times 10^6$  gigahertz?

- W)  $6.63 \times 10^{-19}$
- X)  $6.63 \times 10^{-28}$
- Y)  $6.63 \times 10^{-34}$
- Z)  $6.63 \times 10^{-49}$

ANSWER: W)  $6.63 \times 10^{-19}$

---

### TOSS UP

4. MATH *Short Answer* How many prime numbers less than 50 have a 3 as the units digit?

ANSWER: 4

### BONUS

4. MATH *Short Answer* If six geese in a gaggle produce 66 eggs in 6,666 days, what is the average number of days it takes a single goose to lay an egg?

ANSWER: 606

### TOSS UP

5. EARTH AND SPACE *Multiple Choice* Upon which of the following is the Southern Oscillation Index based?

- W) The observed sea level pressure difference between Darwin and Tahiti
- X) The sea surface temperature between Darwin and Tahiti
- Y) The ozone levels at Toronto and Montreal
- Z) The amount of conduction at the equator

ANSWER: W) THE OBSERVED SEA LEVEL PRESSURE DIFFERENCE BETWEEN DARWIN AND TAHITI

### BONUS

5. EARTH AND SPACE *Multiple Choice* Which of the following are three general categories of map projections?

- W) Cylindrical, conic, azimuthal [*az-uh-MUTH-uhl*]
- X) Conformal, spherical, transverse
- Y) Equidistant, conic, stereographic
- Z) Cylindrical, oblique, grid

ANSWER: W) CYLINDRICAL, CONIC, AZIMUTHAL

---

### TOSS UP

6. BIOLOGY *Multiple Choice* Which of the following is NOT a direct adaptation for flight in birds?

- W) Air sacs
- X) Large surface area on sternum
- Y) Hollow bones
- Z) Fused hand bones

ANSWER: W) AIR SACS

### BONUS

6. BIOLOGY *Short Answer* Name all of the following four bones that are part of the human foot: 1) stylohyoid [*sty-loh-HY-oid*], 2) calcaneus [*kal-KAY-nee-uhs*], 3) metacarpals, 4) femur.

ANSWER: 2

### TOSS UP

7. PHYSICS *Short Answer* A 5 kilogram mass is oscillating on a spring with a spring constant of 20 newtons per meter. What is the frequency of the oscillation of this mass in radians per second?

ANSWER: 2

### BONUS

7. PHYSICS *Short Answer* A 200 microfarad parallel plate capacitor is connected to a 6 volt battery. Once the capacitor is fully charged, it is disconnected from the battery and a dielectric is inserted between the plates with a dielectric constant of 5. Expressed as a decimal, what is the new voltage across the capacitor?

ANSWER: 1.2

---

### TOSS UP

8. CHEMISTRY *Multiple Choice* Which of the following is an example of a disaccharide [**dy-SAK-uh-ryd**]?

- W) Glucose
- X) Sucrose
- Y) Cellulose
- Z) Glycogen [**GLY-kuh-juhn**]

ANSWER: X) SUCROSE

### BONUS

8. CHEMISTRY *Short Answer* How many milliliters of 0.1 molar sulfuric acid must be titrated with 20 milliliters of 0.5 molar sodium hydroxide in order reach the equivalence point?

ANSWER: 50

### TOSS UP

9. MATH *Short Answer* The length of each edge of a cube is decreased by 40%. To the nearest ten percent, by what percent does the volume of the cube decrease?

ANSWER: 80%

### BONUS

9. MATH *Short Answer* Today, my daughter is  $\frac{1}{3}$  of my age. Five years ago, she was  $\frac{1}{4}$  of my age then. How old is my daughter?

ANSWER: 15

---

### TOSS UP

10. EARTH AND SPACE *Multiple Choice* Which of the following is another term for the euphotic [**yoo-FOH-tik**] zone of the ocean?

- W) Dark side
- X) Sunlit zone
- Y) Twilight zone
- Z) Abyssal plain

ANSWER: X) SUNLIT ZONE

### BONUS

10. EARTH AND SPACE *Multiple Choice* Which of the following minerals is a silicate mineral?

- W) Calcite
- X) Halite
- Y) Olivine
- Z) Galena [**guh-LEE-nuh**]

ANSWER: Y) OLIVINE

### TOSS UP

11. BIOLOGY *Multiple Choice* Which of the following processes is a form of anaerobic respiration that occurs in skeletal muscles after strenuous exercise?

- W) Alcohol fermentation
- X) Lactic acid fermentation
- Y) Pentose-phosphate pathway
- Z) Glycogenesis [*gly-kuh-JEN-uh-sis*]

ANSWER: X) LACTIC ACID FERMENTATION

### BONUS

11. BIOLOGY *Multiple Choice* Which of the following organisms is NOT matched to its anatomical structure for excreting salt?

- W) Fish and gill
- X) Shark and rectal gland
- Y) Whale and ocular salt gland
- Z) Seabird and nostril salt gland

ANSWER: Y) WHALE AND OCULAR SALT GLAND

---

### TOSS UP

12. CHEMISTRY *Multiple Choice* Which of the following is the characteristic feature of a metallic crystal?

- W) The metallic bond is directional
- X) The positive ion is free to move
- Y) The bonding forces are weak
- Z) The valence electrons are only loosely held and can move to neighboring atoms

ANSWER: Z) THE VALENCE ELECTRONS ARE ONLY LOOSELY HELD AND CAN MOVE TO NEIGHBORING ATOMS

### BONUS

12. CHEMISTRY *Short Answer* Consider the complete combustion of propane in oxygen. Providing your answer to two significant figures, if 32 grams of oxygen are consumed in the reaction, how many grams of carbon dioxide are produced?

ANSWER: 26

### TOSS UP

13. PHYSICS *Multiple Choice* A proton enters a uniform magnetic field that is oriented perpendicular to the motion of the proton. Which of the following will NOT affect the radius of the circular path in which the proton moves?

- W) The velocity of the proton
- X) The magnitude of the magnetic field
- Y) The momentum of the proton
- Z) The position of the proton in the magnetic field

ANSWER: Z) THE POSITION OF THE PROTON IN THE MAGNETIC FIELD

### BONUS

13. PHYSICS *Short Answer* A long wire is carrying 10 amperes of current. Providing your answer in scientific notation, what is the magnetic field in teslas due to the wire at a radial distance of 2 meters from the center of the wire?

ANSWER:  $1 \times 10^{-6}$

---

### TOSS UP

14. ENERGY *Short Answer* To the nearest 10%, what is the approximate efficiency of commercially available high performance solar cells?

ANSWER: 20%

### BONUS

14. ENERGY *Short Answer* If a solar panel produces 200 watts of power, the energy is used to charge a battery with 80% efficiency, and the battery discharges with 80% efficiency, what percentage of the power is lost in the storage process?

ANSWER: 36%

### TOSS UP

15. CHEMISTRY *Multiple Choice* In electroplating, the object to be electroplated is placed at which of the following?

- W) The anode
- X) The cathode
- Y) Either the anode or cathode
- Z) The salt bridge

ANSWER: X) THE CATHODE

### BONUS

15. CHEMISTRY *Multiple Choice* Which of the following compounds exhibits hydrogen bonding and can act as a Lewis base?

- W) Ozone
- X) Ammonia
- Y) Cesium fluoride
- Z) Hydrogen fluoride

ANSWER: X) AMMONIA

### TOSS UP

16. MATH *Short Answer* What integer between 50 and 90 is four times as far from 50 as it is from 90?

ANSWER: 82

### BONUS

16. MATH *Short Answer* Divide the polynomial  $x^3 - x - 6$  by  $x - 2$ .

ANSWER:  $x^2 + 2x + 3$

### TOSS UP

17. EARTH AND SPACE *Multiple Choice* Which of the following cities is on the North American tectonic plate?

- W) Los Angeles
- X) San Diego
- Y) San Francisco
- Z) Santa Cruz

ANSWER: Y) SAN FRANCISCO

### BONUS

17. EARTH AND SPACE *Short Answer* What is the name of the metamorphic rock that is dominantly composed of hornblende?

ANSWER: AMPHIBOLITE

---

### TOSS UP

18. BIOLOGY *Multiple Choice* A field assistant takes a tissue sample from a dead mouse and forgets to label the sample with the type of tissue collected. In the lab, she needs to correct her oversight. The tissue is striated and has intercalated disks between cells. Which of the following samples does the field assistant have?

- W) Liver
- X) Heart
- Y) Skeletal muscle
- Z) Brain

ANSWER: X) HEART

### BONUS

18. BIOLOGY *Multiple Choice* Which of the following groups consists only of strictly vegetarian marine mammals?

- W) Sirenians [**sy-REE-nee-uhns**]
- X) Pinnipeds [**PIN-uh-peds**]
- Y) Cetaceans [**si-TAY-shuhns**]
- Z) Fissipeds [**FIS-uh-peds**]

ANSWER: W) SIRENIANS

**TOSS UP**

19. PHYSICS *Short Answer* A long wire carrying a 3 ampere current is placed in a magnetic field of 1 tesla so that a straight 2 meter segment of the wire makes an angle of  $30^\circ$  with the field direction. What is the magnitude of the force in newtons on the wire segment?

ANSWER: 3

**BONUS**

19. PHYSICS *Short Answer* A charge of +1 nanocoulombs is placed at the origin, and a charge of +4 nanocoulombs is placed 10 centimeters away. Providing your answer in centimeters to the nearest tenth, at what distance from the origin is the electric field zero?

ANSWER: 3.3

---

**TOSS UP**

20. ENERGY *Short Answer* If a heat pump can use 1 Btu of electricity to move 4 Btus of cooling, how many Btus of electricity are needed to provide 100 Btus of cooling?

ANSWER: 25

**BONUS**

20. ENERGY *Short Answer* If you have one pound each of natural gas, dry wood, and coal, which has the greatest amount of energy content?

ANSWER: NATURAL GAS

### TOSS UP

21. BIOLOGY *Multiple Choice* Which of the following interactions is an example of commensalism?

- W) Ants living in acacia [**uh-KAY-shuh**] thorns, feeding on protein bodies produced by the tree and attacking herbivores that attempt to eat acacia leaves
- X) Two species of barnacle occupying different tidal regions on rocky shores
- Y) Ticks attaching to deer and feeding off their blood
- Z) Cattle egrets following water buffalo to feed on insects scared out of grass by the buffalo

ANSWER: Z) CATTLE EGRETS FOLLOWING WATER BUFFALO TO FEED ON INSECTS SCARED OUT OF GRASS BY THE BUFFALO

### BONUS

21. BIOLOGY *Multiple Choice* Which of the following characteristics is least common to see in non-migratory abyssopelagic [**uh-bis-uh-pe-LAJ-ik**] zone fish species ?

- W) Swim bladder
- X) Hermaphroditism [**hur-MAF-ruh-day-tiz-uhm**]
- Y) Small eyes
- Z) Large mouths

ANSWER: W) SWIM BLADDER

### TOSS UP

22. CHEMISTRY *Multiple Choice* All except which of the following are true for rubidium fluoride?

- W) It has a high boiling point
- X) It dissolves in aqueous ammonia [**AY-kwee-uhs**]
- Y) It conducts electricity in the solid state
- Z) It is an electrolyte

ANSWER: Y) IT CONDUCTS ELECTRICITY IN THE SOLID STATE

### BONUS

22. CHEMISTRY *Short Answer* A sample of an ideal gas is placed in a sealed container of fixed volume. The gas is heated from 25.0° Celsius to 45.0° Celsius. Identify all of the following four factors that will increase: 1) the pressure of the gas, 2) the average kinetic energy of the gas, 3) the density of the gas, 4) the intermolecular forces.

ANSWER: 1 AND 2 (ACCEPT: THE PRESSURE OF THE GAS, THE AVERAGE KINETIC ENERGY OF THE GAS)

### TOSS UP

23. MATH *Multiple Choice* What is the radian equivalent of  $96^\circ$ ?

W)  $\frac{2\pi}{15}$

X)  $\frac{4\pi}{15}$

Y)  $\frac{8\pi}{15}$

Z)  $\frac{23\pi}{15}$

ANSWER: Y)  $\frac{8\pi}{15}$

### BONUS

23. MATH *Short Answer* Solve the inequality  $-3 + |3 - 6x| < 2$  [**negative 3 plus the absolute value of the quantity 3 minus 6x is less than 2**].

ANSWER:  $-1/3 < x < 4/3$  (ACCEPT: THE OPEN INTERVAL FROM -1/3 TO 4/3)

---

### TOSS UP

24. EARTH AND SPACE *Short Answer* What chemical associated with volcanic eruptions can get into the stratosphere and cause a dampening of the Sun's rays?

ANSWER: SULFURIC ACID (ACCEPT: SULFUR, SULFUR DIOXIDE, HYDROGEN SULFIDE, SULFATE)

### BONUS

24. EARTH AND SPACE *Multiple Choice* Based on the current northwest movement of the Pacific plate, which of the following Hawaiian islands is the youngest?

W) Kauai [**kah-oo-AH-ee**]

X) Maui

Y) Hawaii

Z) Oahu

ANSWER: Y) HAWAII

### TOSS UP

25. BIOLOGY *Short Answer* What protein is often found in the red muscles of fish that are strong swimmers?

ANSWER: MYOGLOBIN

### BONUS

25. BIOLOGY *Multiple Choice* Which of the following types of lipid modification connects proteins to cytosolic membrane surfaces and is reversible?

- W) Palmitoylation [*pal-mi-toi-LAY-shuhn*]
- X) Prenylation [*pre-NIL-ay-shuhn*]
- Y) Myristoylation [*may-ruh-stoi-LAY-shuhn*]
- Z) Acylation [*as-uh-LAY-shuhn*]

ANSWER: W) PALMITOYLATION