

ROUND ROBIN ~ ROUND 8

TOSS UP

1. EARTH AND SPACE *Multiple Choice* Which of the following are two optical factors that reduce atmospheric transparency?

- W) Reflectivity and absorption
- X) Reflectivity and conduction
- Y) Absorption and convection
- Z) Advection and precipitation

ANSWER: W) REFLECTIVITY AND ABSORPTION

BONUS

1. EARTH AND SPACE *Short Answer* Arrange the following four layers of the Earth in order from the Earth's surface to its center: 1) liquid core, 2) lithosphere, 3) asthenosphere, 4) solid core.

ANSWER: 2, 3, 1, 4 (ACCEPT: LITHOSPHERE, ASTHENOSPHERE, LIQUID CORE, SOLID CORE)

TOSS UP

2. BIOLOGY *Multiple Choice* A scorpionfish demonstrates which of the following types of coloration?

- W) Cryptic
- X) Disruptive
- Y) Aposematic
- Z) Countershading

ANSWER: W) CRYPTIC

BONUS

2. BIOLOGY *Short Answer* What is the term for the specialized communal fishing behavior used by humpback whales?

ANSWER: BUBBLE NETTING (BUBBLE NET FEEDING, BUBBLE CLOUDS, LUNGE FEEDING, TRUMPET CALLING)

TOSS UP

3. MATH *Short Answer* If $y = -x^2$, what is the slope of the tangent line to the graph at $x = 4$?

ANSWER: -8

BONUS

3. MATH *Short Answer* Evaluate $\sum_{k=1}^{30} (3k + 2)$ **[the summation from k equals 1 to 30 of the quantity 3 k plus 2].**

ANSWER: 1455

TOSS UP

4. PHYSICS *Short Answer* Given the speed of light in a vacuum to be 3×10^8 meters per second, what is the index of refraction for a medium where the speed of light is found to be 2.5×10^8 meters per second?

ANSWER: 1.2

BONUS

4. PHYSICS *Short Answer* What is the exact speed in meters per second of an object with a mass of 2 kilograms, executing simple harmonic motion with amplitude of 2 meters, at the end of a spring with a spring constant of 8 newtons per meter, when the displacement of the object is half the maximum amplitude?

ANSWER: $2\sqrt{3}$

TOSS UP

5. ENERGY *Multiple Choice* Which of the following sectors consumes the most energy in the US?

- W) Motor vehicle transportation
- X) Commercial and residential buildings
- Y) Air travel
- Z) Electronics

ANSWER: X) COMMERCIAL AND RESIDENTIAL BUILDINGS

BONUS

5. ENERGY *Multiple Choice* On a per gram basis, why do carbohydrates contain less energy than hydrocarbons?

- W) Carbohydrates contain oxygen and hydrocarbons do not
- X) Carbohydrates cannot be burned and hydrocarbons can
- Y) Hydrocarbons come from fossilized animals and plants but carbohydrates come from live or recently dead plants and animals
- Z) Carbohydrates can be eaten but hydrocarbons cannot

ANSWER: W) CARBOHYDRATES CONTAIN OXYGEN AND HYDROCARBONS DO NOT

TOSS UP

6. CHEMISTRY *Multiple Choice* Two reactants are mixed in a bomb calorimeter and a reaction occurs. The temperature of the calorimeter rises. Which of the following statements regarding the reaction is true?

- W) The reaction is absorbing thermal energy
- X) The reaction is endothermic
- Y) The reaction is releasing thermal energy
- Z) The reaction energy is equal to $q\Delta T$

ANSWER: Y) THE REACTION IS RELEASING THERMAL ENERGY

BONUS

6. CHEMISTRY *Short Answer* Determine the entropy change, including sign, in joules per mole Kelvin when one mole of nitrogen gas is added to hydrogen gas to form ammonia gas. Assume standard molar entropies to be 192 for dinitrogen, 131 for dihydrogen, and 193 for ammonia.

ANSWER: -199

TOSS UP

7. EARTH AND SPACE *Multiple Choice* Which of the following is NOT useful for dating extremely old fossils?

- W) Potassium-40
- X) Carbon-14
- Y) Uranium-238
- Z) Thorium-232

ANSWER: X) CARBON-14

BONUS

7. EARTH AND SPACE *Short Answer* What is the wavelength in kilometers of a shallow-water wave with a speed of 600 kilometers per hour and period of 15 minutes?

ANSWER: 150

TOSS UP

8. BIOLOGY *Multiple Choice* The demographic transition model helps explain why which of the following occurs?

- W) Birth rates fall before death rates
- X) Death rates fall before birth rates
- Y) Development requires large populations
- Z) Industrialization begets large populations

ANSWER: X) DEATH RATES FALL BEFORE BIRTH RATES

BONUS

8. BIOLOGY *Multiple Choice* Which of these alternative breeding strategies results in an individual indirectly passing on its genes?

- W) Young male birds display in a lek with an older, unrelated male who takes all the copulations
- X) Young female birds sneak an egg into another female's nest to be incubated
- Y) Non-breeding helpers are unrelated to offspring of a breeding pair
- Z) Non-breeding helpers are full siblings to offspring of a breeding pair

ANSWER: Z) NON-BREEDING HELPERS ARE FULL SIBLINGS TO OFFSPRING OF A BREEDING PAIR

TOSS UP

9. MATH *Multiple Choice* If $|x| > -5$ **[the absolute value of x greater than negative 5]** is graphed on a number line, which of the following could describe its graph?

- W) Segment
- X) Ray
- Y) Line
- Z) Two opposite rays, not sharing a common endpoint

ANSWER: Y) LINE

BONUS

9. MATH *Short Answer* Find the x-coordinates of every point on the graph of $f(x) = x^3 + 3x^2 - 9x + 3$ where the tangent line is horizontal.

ANSWER: 1 AND -3

TOSS UP

10. PHYSICS *Multiple Choice* An object is placed 20 centimeters in front of a positive lens with a focal length of 10 centimeters. Which of the following kinds of image will be produced behind this lens?

- W) Upright and virtual
- X) Upright and real
- Y) Inverted and virtual
- Z) Inverted and real

ANSWER: Z) INVERTED AND REAL

BONUS

10. PHYSICS *Short Answer* A person weighs 300 pounds on a scale. Given g as 9.8 meters per second squared, find the person's weight in newtons to two significant figures.

ANSWER: 1300

TOSS UP

11. CHEMISTRY *Multiple Choice* If equal quantities by mass of gases A, B, C, and D are added to a closed container of fixed volume, and the total pressure in the container is 760 torr, the partial pressure of A is which of the following?

- W) 25% of the total pressure
- X) Dependent on the size of the container
- Y) Directly related to its mole fraction
- Z) A function of its molar mass

ANSWER: Y) DIRECTLY RELATED TO ITS MOLE FRACTION

BONUS

11. CHEMISTRY *Short Answer* At 25° Celsius, the standard reduction potential of Fe^{3+} to Fe^{2+} is +0.77 volts. Providing your answer to two significant figures, what is the potential, in volts, of a platinum electrode dipped in a solution of 0.0005 molar Fe^{3+} and 0.05 molar Fe^{2+} ?

ANSWER: 0.89

TOSS UP

12. BIOLOGY *Short Answer* What compound is the final nitrogenous waste product that is excreted by humans?

ANSWER: UREA

BONUS

12. BIOLOGY *Multiple Choice* Hundreds of fossils of an extinct quail species are found on a small Pacific island. The fossil femur is longer than that of modern quails from the mainland, and the fossil ulna is shorter. Why might these differences exist between the extinct quail and modern specimens?

- W) The extinct quail was adapted to jumping higher because of a higher concentration of predators on islands
- X) The extinct quail was likely evolving flightlessness
- Y) The extinct quail fossils were from juveniles
- Z) The extinct quail was a hybrid between the mainland species and another, so far undiscovered, island species

ANSWER: X) THE EXTINCT QUAIL WAS LIKELY EVOLVING FLIGHTLESSNESS

TOSS UP

13. EARTH AND SPACE *Multiple Choice* Scientific investigations in the Gulf of Mexico have documented a large area of the Louisiana continental shelf with seasonally-depleted oxygen levels. Which of the following is the term for this oxygen depletion?

- W) Barotrauma
- X) Hypoxia
- Y) Hyperbaria
- Z) The bends

ANSWER: X) HYPOXIA

BONUS

13. EARTH AND SPACE *Short Answer* What is the term for the apparent contradiction between an eternal, infinite universe and the observation that the night sky is dark?

ANSWER: OLBER'S PARADOX

TOSS UP

14. BIOLOGY *Short Answer* In the evolutionary tree of life, wings in birds and butterflies are an example of what kind of structures?

ANSWER: HOMOPLASIES (ACCEPT: ANALOGOUS STRUCTURES; HOMOPLASTIC STRUCTURES)

BONUS

14. BIOLOGY *Multiple Choice* Why is treatment of carbon monoxide poisoning with an oxygen mask NOT effective?

- W) Carbon monoxide binds up oxygen
- X) Carbon monoxide has a higher affinity for hemoglobin than oxygen does
- Y) The pressure at which the oxygen is delivered is approximately 25% higher than the effective pressure
- Z) Carbon monoxide changes the binding site of hemoglobin, making it unsuitable for binding oxygen

ANSWER: X) CARBON MONOXIDE HAS A HIGHER AFFINITY FOR HEMOGLOBIN THAN OXYGEN DOES

TOSS UP

15. CHEMISTRY *Multiple Choice* A nimble minded Science Bowl contestant makes a concentrated solution of sodium hydroxide which she adds to a solution of potassium permanganate. The permanganate ion reacts to form which of the following?

- W) MnO_4^{2-}
- X) MnO_4^-
- Y) Mn_2O_3
- Z) Mn^{2+}

ANSWER: W) MnO_4^{2-}

BONUS

15. CHEMISTRY *Short Answer* Transition metals can have iodine atoms as ligands; however, the iodine atom is quite large in size. Based on this information, what is the point group of titanium (IV) iodide?

ANSWER: T_d (ACCEPT: TETRAHEDRAL)

TOSS UP

16. MATH *Short Answer* An acute angle has a measure of $2a + 2b$. What is the difference between the degree measures of the supplement and complement of that angle?

ANSWER: 90

BONUS

16. MATH *Short Answer* What is the sum of the first 50 terms of the arithmetic sequence with second term 35 and fourth term 55?

ANSWER: 13,500

TOSS UP

17. PHYSICS *Multiple Choice* A small marble is placed at the bottom of a hemispherical bowl. When the marble is displaced a small amount from the center, it oscillates about the bottom of the bowl. Which of the following changes would increase the period of oscillation of the marble?

- W) Using a marble of larger mass
- X) Using a marble of smaller mass
- Y) Using a bowl of larger radius
- Z) Using a bowl of smaller radius

ANSWER: Y) USING A BOWL OF LARGER RADIUS

BONUS

17. PHYSICS *Multiple Choice* A current of 100 milliamperes flows through an ohmic circuit element across which the potential drop is 5 volts. Which of the following is the resistance in ohms?

- W) 50
- X) 20
- Y) 0.2
- Z) 0.05

ANSWER: W) 50

TOSS UP

18. ENERGY *Multiple Choice* On average, which of the following consumes the most electricity in an office building?

- W) Space heating
- X) Air cooling
- Y) Lighting
- Z) Office equipment

ANSWER: Y) LIGHTING

BONUS

18. ENERGY *Multiple Choice* Which of the following is NOT a way of storing energy?

- W) Pumping water into a water tower on a hill
- X) Dynamic braking on a diesel-electric locomotive
- Y) Formation of NADPH in photosynthesis
- Z) Storing molten salt

ANSWER: X) DYNAMIC BRAKING ON A DIESEL-ELECTRIC LOCOMOTIVE

TOSS UP

19. CHEMISTRY *Multiple Choice* Consider the following reaction:

$\text{Cl}_2 \text{ (g)} + 2\text{NaOH} \text{ (aq)} \rightarrow \text{NaOCl} \text{ (aq)} + \text{H}_2\text{O} \text{ (l)} + \text{NaCl} \text{ (aq)}$. Which of the following is true?

- W) This is a disproportionation reaction
- X) The oxidation number of the oxygen changes
- Y) The oxidation number of the sodium changes
- Z) The oxidation number of the chlorine remains constant

ANSWER: W) THIS IS A DISPROPORTIONATION REACTION

[(G) = GAS; (AQ) = AQUEOUS; (L) = LIQUID]

BONUS

19. CHEMISTRY *Short Answer* What is the electron count for $\text{Pd}(\text{PPh}_3)_2\text{Br}_2$?

ANSWER: 16

TOSS UP

20. EARTH AND SPACE *Multiple Choice* Which of the following is a metamorphic rock?

- W) Serpentinite *[suh-**pen-TUH-nyt**]*
- X) Diorite
- Y) Syenite *[SY-uh-nyt]*
- Z) Dunite

ANSWER: W) SERPENTINITE

BONUS

20. EARTH AND SPACE *Multiple Choice* Which of the following is a Secchi *[SEK-ee]* disk used to measure?

- W) pH
- X) Conductivity
- Y) Turbidity
- Z) Salinity

ANSWER: Y) TURBIDITY

TOSS UP

21. BIOLOGY *Multiple Choice* Which of the following organisms does NOT undergo alternation of generations in its life cycle?

W) *Polytrichum* moss [*pol-ee-TRIK-uhm*]

X) Diatom

Y) *Laminaria* brown algae

Z) Fern

ANSWER: X) DIATOM

BONUS

21. BIOLOGY *Multiple Choice* In a countercurrent exchange system, arteries and veins are located near one another, allowing the transfer of arterial heat energy to the cooler venous blood. Conservation of heat energy through this system decreases the need for additional energy to warm the chilled venous blood. Which of the following best illustrates the greatest need for heat conservation using a countercurrent blood flow?

W) Stomachs of beluga whales

X) Ears of Asian elephants

Y) Flippers of Atlantic dolphins

Z) Breast muscles of Canadian geese

ANSWER: Y) FLIPPERS OF ATLANTIC DOLPHINS

TOSS UP

22. MATH *Short Answer* No three points of a particular set of 4 points are collinear. How many lines are determined by pairs of those points?

ANSWER: 6

BONUS

22. MATH *Short Answer* If $\sin \theta + \cos \theta = \frac{1}{3}$ [*sine of theta plus cosine of theta equals one third*], find $\sin 2\theta$.

ANSWER: $-\frac{8}{9}$

TOSS UP

23. PHYSICS *Multiple Choice* A torsional pendulum consists of a disk suspended from a torsional spring. The torsional pendulum is set into oscillation when the disk is displaced through a small angle. Which of the following changes would increase the frequency oscillation of the torsional pendulum?

- W) Decrease the moment of inertia of the disk
- X) Increase the moment of inertia of the disk
- Y) Decrease the torsional spring constant of the spring
- Z) Decrease the angle through which the disk was displaced

ANSWER: W) DECREASE THE MOMENT OF INERTIA OF THE DISK

BONUS

23. PHYSICS *Short Answer* An object floats with 10% of its volume below the surface of the water in a pond. Find the average density of the object in kilograms per cubic meter.

ANSWER: 100

TOSS UP

24. ENERGY *Multiple Choice* About how many tons of coal is required to produce the same amount of electricity produced by a typical power plant in one year?

- W) 250,000
- X) 500,000
- Y) 1 million
- Z) 4 million

ANSWER: Z) 4 MILLION

BONUS

24. ENERGY *Short Answer* By number, rank the following four choices in order of increasing potential to impact climate change in the next 20 years: 1) CFC-12, 2) methane, 3) carbon dioxide, 4) nitrous oxide.

ANSWER: 3, 2, 4, 1

TOSS UP

25. CHEMISTRY *Multiple Choice* A DoE researcher runs a redox reaction for a Daniell cell: $\text{Cu}^{2+}_{(\text{aq})} + \text{Zn}_{(\text{s})} \rightarrow \text{Zn}^{2+}_{(\text{aq})} + \text{Cu}_{(\text{s})}$. Given that the equilibrium constant for this reaction is 1.65×10^{37} at 25 degrees Celsius, the E^0 [**E naught**] and the ΔG^0 [**delta G zero**] for this reaction are which of the following?

- W) Both positive
- X) Both negative
- Y) Both zero
- Z) E^0 is positive and ΔG^0 is negative

ANSWER: Z) E^0 IS POSITIVE AND ΔG^0 IS NEGATIVE

[(AQ) = AQUEOUS; (S) = SOLID]

BONUS

25. CHEMISTRY *Multiple Choice* In free radical polymerization [**pol-lim-er-uh-ZAY-shuhn**], many different substituents can be employed to stabilize the chain end radical. All except which of the following are strong stabilizers of the radical?

- W) CN
- X) C_6H_5
- Y) OCH_3
- Z) CO_2CH_3

ANSWER: Y) OCH_3