ROUND 8

TOSS-UP

1) BIOLOGY *Short Answer* Indicate the name of the common and treatable condition that occurs when a person's eyeball is longer than normal and the lens focuses distant objects in the front of the retina.

ANSWER: MYOPIA (ACCEPT: NEARSIGHTEDNESS)

BONUS

1) BIOLOGY *Multiple Choice* Quorum **[KWOHR-uhm]** sensing in bacteria occurs when bacteria "sense" other bacteria. Which of the following triggers this phenomenon to occur?

W) Number of bacteria
X) Density of bacteria
Y) Production and detection of autoinducers
Z) Bacterial fission

ANSWER: Y) PRODUCTION AND DETECTION OF AUTOINDUCERS

TOSS-UP

2) PHYSICS *Short Answer* What type of particle mediates the strong nuclear force?

ANSWER: GLUON

BONUS

2) PHYSICS *Short Answer* A car with a mass of 1100 kilograms moves at 24 meters per second. What is the magnitude of the braking force, in newtons, needed to bring the car to a halt in 20 seconds?

ANSWER: 1320

TOSS-UP

3) CHEMISTRY *Short Answer* What is the standard molar enthalpy of formation, in kilojoules per mole, for hydrogen gas?

ANSWER: 0

BONUS

3) CHEMISTRY *Short Answer* Name all of the following five compounds that are soluble in water: 1) sodium sulfate, 2) lead (II) iodide, 3) barium chloride, 4) iron (II) hydroxide, 5) calcium sulfate.

ANSWER: 1, 3 (ACCEPT: SODIUM SULFATE, BARIUM CHLORIDE)

TOSS-UP

4) EARTH AND SPACE *Multiple Choice* Liquid water can store more heat energy than an equal amount of any other naturally occurring substance because liquid water has which of the following characteristics?

W) It expands when cooled
X) It has its greatest density at 4° Celsius
Y) It has higher specific heat
Z) It can be changed into a solid or a gas

ANSWER: Y) IT HAS HIGHER SPECIFIC HEAT

BONUS

4) EARTH AND SPACE *Multiple Choice* Which of the following factors has the greatest influence on the weathering rate of Earth's surface bedrock?

W) Regional climate
X) Angle of insolation
Y) Age of the bedrock
Z) Local air pressure

ANSWER: W) REGIONAL CLIMATE

5) MATH *Short Answer* If $g(u) = \int_{0}^{u}(\sec^2 t)\,dt$ **[g of u equals the integral from 0 to u of secant squared of t dt]**, find $g'(u)$ **[g prime of u]**.

ANSWER: $\sec^2 u$

BONUS

5) MATH *Short Answer* Factor completely the expression: $5rs + 25r - 3s - 15$.

ANSWER: $(s + 5)(5r - 3)$

TOSS-UP

6) ENERGY *Multiple Choice* Which of the following will NOT usually increase the gas mileage of gasoline cars manufactured since the early 1980s?

W) Driving at or below 60 miles per hour on the freeway
X) Using cruise control
Y) Replacing clogged air filters
Z) Using overdrive gears

ANSWER: Y) REPLACING CLOGGED AIR FILTERS

BONUS

6) ENERGY *Short Answer* A solar cell is an electrical device that converts light energy directly into electricity. What is the term for this conversion process?

ANSWER: PHOTOVOLTAIC EFFECT (DO NOT ACCEPT: PHOTOELECTRIC EFFECT)

TOSS-UP

7) BIOLOGY *Multiple Choice* As could be detected clinically during a functional magnetic resonance image, which of the following parts of the brain would be activated when a person is faced with a fearful situation?

W) Neocortex
X) Hippocampus *[hip-uh-KAM-puhs]*
Y) Amygdala *[uh-MIG-duh-luh]*
Z) Superior colliculi *[ko-LI-kyoo-lee]*

ANSWER: Y) AMYGDALA

BONUS

7) BIOLOGY *Multiple Choice* Indicate where action potentials are generated in a myelinated *[MY-uh-luh-nay-tid]* post-synaptic cell.

W) Axon hillock
X) Dendrites
Y) Neuron nucleus
Z) Schwann cell

ANSWER: W) AXON HILLOCK

TOSS-UP

8) PHYSICS *Short Answer* If a 0.20 kilogram apple fell 7.0 meters, hitting Newton's head, given acceleration due to gravity as 10 meters per second squared, what was the change in potential energy in joules?

ANSWER: 14

BONUS

8) PHYSICS *Short Answer* Taking the acceleration due to gravity to be 10 meters per second squared, what kinetic coefficient of friction will exert a force of 20 newtons on a 4 kilogram object as it moves over a horizontal surface?

ANSWER: 0.5

9) CHEMISTRY *Short Answer* What subshell is defined by an electron with quantum numbers $n = 3$ and $l = 2$ *[ell equals 2]*?

ANSWER: 3d

BONUS

9) CHEMISTRY *Short Answer* In a titration experiment, how many grams of sodium hydroxide are needed to neutralize 25 milliliters of a 0.1 molar hydrogen chloride solution?

ANSWER: 0.1

TOSS-UP

10) EARTH AND SPACE *Short Answer* Which planet takes more time to complete one rotation on its axis than to complete one revolution around the Sun?

ANSWER: VENUS

BONUS

10) EARTH AND SPACE *Multiple Choice* A major belt of asteroids is located between Mars and Jupiter. Which of the following is the approximate average distance in millions of kilometers between the Sun and this major asteroid belt?

W) 110
X) 220
Y) 390
Z) 850

ANSWER: Y) 390

11) MATH *Short Answer* How many terms does the binomial expansion of $(x^2 + 2y^3)^{20}$ *[open parenthesis x squared plus 2 y cubed close parenthesis to the power of 20]* contain?

ANSWER: 21

BONUS

11) MATH *Multiple Choice* Which of the following functions has an oblique asymptote?

W) $f(x) = (x^5 + 1)/(x^4 + 3x^2 + 2)$ *[f of x equals open parenthesis x to the fifth plus 1 close parenthesis over open parenthesis x to the fourth plus 3 x squared plus 2 close parenthesis]*

X) $f(x) = (x^2 + 1)/(x^3 - x^2 - 1)$ *[f of x equals open parenthesis x squared plus 1 close parenthesis over open parenthesis x cubed minus x squared minus 1 close parenthesis]*

Y) $f(x) = (4x^2 + x + 1)/x^2$ *[f of x equals open parenthesis 4 x squared plus x plus 1 close parenthesis over x squared]*

Z) $f(x) = x^5/(x^2 - 1)$ *[f of x equals x to the fifth over open parenthesis x squared minus 1 close parenthesis]*

ANSWER: W) $f(x) = (x^5 + 1)/(x^4 + 3x^2 + 2)$

TOSS-UP

12) ENERGY *Short Answer* What is the term for a facility that integrates biomass conversion processes and equipment to produce fuels, power, and chemicals from biomass?

ANSWER: BIOREFINERY

BONUS

12) ENERGY *Short Answer* Name all of the following five products that have been made with green algae: 1) biodiesel, 2) methane, 3) ethanol, 4) gasoline, 5) biogasoline.

ANSWER: 1, 2, 3, 5 (ACCEPT: BIODIESEL, METHANE, ETHANOL, BIOGASOLINE)

13) MATH *Short Answer* Given $f(x) = x + 1$ and $g(x) = 3x$, what is $f(g(x))$ *[f of g of x]*?

ANSWER: $3x + 1$

BONUS

13) MATH *Short Answer* If $g(b) = 6b^3 - 4b^2 + b + 4b^{-1}$ *[g of b equals 6 b cubed minus 4 b squared plus b plus 4 b to the negative 1]*, what is $g'(b)$ *[g prime of b]*?

ANSWER: $18b^2 - 8b + 1 - 4b^{-2}$ (ACCEPT: $18b^2 - 8b + 1 - \frac{4}{b^2}$)

TOSS-UP

14) EARTH AND SPACE *Multiple Choice* Which of the following is the name given to soil that forms over millions of years from weathering of crystalline bedrock?

W) Advanced
X) Mature
Y) Transported
Z) Parent

ANSWER: X) MATURE

BONUS

14) EARTH AND SPACE *Multiple Choice* Which of the following is unlikely, given the Moon's current orbital plane?

W) Solar eclipses visible from Earth
X) The Moon passing directly over the poles
Y) Lunar eclipses visible from Earth
Z) Variations in the lunar path across the sky

ANSWER: X) THE MOON PASSING DIRECTLY OVER THE POLES

TOSS-UP

15) BIOLOGY *Multiple Choice* Which of the following senses is most important to the behavior of most spiders?

W) Audition
X) Olfaction
Y) Mechanoreception
Z) Polarized light vision

ANSWER: Y) MECHANORECEPTION

BONUS

15) BIOLOGY *Multiple Choice* Which of the following parts of a nerve cell acts as a resistor?

W) Ion channels
X) Cytoplasm
Y) Plasma membrane
Z) Mitochondria *[my-tuh-KON-dree-uh]*

ANSWER: W) ION CHANNELS

TOSS-UP

16) PHYSICS *Short Answer* A current of 4 milliamperes flows when a resistor is connected across a 12-volt battery. What is the resistance of this resistor in ohms?

ANSWER: 3000

BONUS

16) PHYSICS *Short Answer* Two asteroids that are 10,000 kilometers apart attract each other with a gravitational force of *F*. If the two asteroids move further away from each other to a distance of 20,000 kilometers apart, what will the gravitational force be in terms of *F*?

ANSWER: ¼ *F* (ACCEPT: 0.25F)

17) CHEMISTRY *Multiple Choice* Which of the following molecules is an alkane?

W) C_4H_8
X) C_3H_8
Y) C_2H_2
Z) C_2H_5OH

ANSWER: X) C_3H_8

BONUS

17) CHEMISTRY *Short Answer* Of the following five solutions, name all that are nonelectrolytic: 1) acetone; 2) glucose; 3) acetic acid; 4) nitric acid; 5) ammonia.

ANSWER: 1, 2 (ACCEPT: ACETONE, GLUCOSE)

TOSS-UP

18) EARTH AND SPACE *Multiple Choice* The metamorphism of a sandstone rock will cause the rock to do which of the following?

W) Melt
X) Contain more fossils
Y) Become denser
Z) Occupy a greater volume

ANSWER: Y) BECOME DENSER

BONUS

18) EARTH AND SPACE *Multiple Choice* Which of the following pairs of minerals could be contained in the rocks gabbro and granite?

W) Calcite and dolomite *[py-ROK-seen]*
X) Mica *[MY-kuh]* and amphibole *[AM-fuh-bohl]*
Y) Orthoclase and olivine
Z) Plagioclase *[PLAY-jee-uh-klays]* and nepheline *[NEF-uh-lin]*

ANSWER: X) MICA AND AMPHIBOLE

19) MATH *Multiple Choice* Which of the following is an identity?

W) $\cos(2x) = 2\cos(x)$ *[cosine of 2x equals 2 cosine of x]*
X) $\sin(2x) = 2\sin(x)\cos(x)$ *[sine of 2 x equals 2 sine of x cosine of x]*
Y) $\cos(x + y) = \cos(x) + \cos(y)$ *[cosine of the quantity x plus y equals cosine of x plus cosine of y]*
Z) $\sin(x - y) = \sin(x) - \sin(y)$ *[sine of the quantity x minus y equals sine of x minus sine of y]*

ANSWER: X) $\sin(2x) = 2\sin(x)\cos(x)$

BONUS

19) MATH *Short Answer* For Valentine's Day, Adam bought several dozen roses and several dozen carnations. The roses cost $15 per dozen, and the carnations cost $8 per dozen. Adam bought a total of 17 dozen flowers and paid a total of $192. How many dozen roses did he buy?

ANSWER: 8

TOSS-UP

20) ENERGY *Short Answer* What is the term for the process during the thermodynamic cycle in which a fluid or gas changes volume or pressure without any heat exchange between it and its surrounding environment?

ANSWER: ADIABATIC

BONUS

20) ENERGY *Multiple Choice* Which of the following statements about carbon sequestration is false?

W) Costs of carbon sequestration programs increase due to integration
X) Iron fertilization in the ocean encourages phytoplankton growth, which removes additional carbon from the atmosphere
Y) The use of cover crops between planting seasons could remove carbon from the atmosphere
Z) Peat bogs are excellent for carbon storage

ANSWER: W) COSTS OF CARBON SEQUESTRATION PROGRAMS INCREASE DUE TO INTEGRATION

TOSS-UP

21) BIOLOGY *Multiple Choice* Which of the following animal species is usually NOT considered gregarious *[gri-GAIR-ee-uhs]*?

W) Leopards
X) Harbor seals
Y) Brown-headed cowbirds
Z) Nile crocodiles

ANSWER: W) LEOPARDS

BONUS

21) BIOLOGY *Short Answer* What name is used both for the breathing aperture *[AP-er-cher]* on arthropods *[AHR-thruh-pods]* and the nasal opening of whales?

ANSWER: SPIRACLES (ACCEPT: SPIRACULUM)

TOSS-UP

22) PHYSICS *Multiple Choice* A wheel with moment of inertia m is mounted horizontally to a frictionless axle. At time $t = 0$ the initial angular speed is ω. A constant torque Q is applied to the wheel, bringing it to a stop in time t. Which of the following is the average power required to dissipate the wheel's energy in this time?

W) $m\omega/2t$
X) $m\omega^2/2t$
Y) $m\omega/t$
Z) $m\omega/Q$

ANSWER: X) $m\omega^2/2t$

BONUS

22) PHYSICS *Short Answer* A pole vaulter wishes to clear a bar 5 meters above her center of mass. Given an ideal pole and launch, assuming her mass is uniformly distributed, and given 10 meters per second squared as the acceleration due to gravity, how fast must she run in meters per second?

ANSWER: 10

TOSS-UP

23) CHEMISTRY *Multiple Choice* Which of the following chemicals is least likely to hydrogen bond with water?

W) Benzene
X) Water
Y) Ammonia
Z) Formic acid

ANSWER: W) BENZENE

BONUS

23) CHEMISTRY *Short Answer* A sample containing sulfuric acid requires 10 milliliters of 0.6 molar sodium hydroxide to reach the equivalence point during a titration. Providing your answer as a decimal to three places, how many moles of sulfuric acid were in the sample?

ANSWER: 0.003

TOSS-UP

24) EARTH AND SPACE *Multiple Choice* Extremely small crystal grains in an igneous *[IG-nee-uhs]* rock are an indication that the crystals formed in which of the following ways?

W) Under high pressure
X) Over a short period of time
Y) From an iron-rich magma
Z) Deep below the surface of the Earth

ANSWER: X) OVER A SHORT PERIOD OF TIME

BONUS

24) EARTH AND SPACE *Short Answer* What quantity is used to compare the speed of light in different mediums?

ANSWER: THE REFRACTIVE INDEX

TOSS-UP

25) BIOLOGY *Short Answer* What is the name for the boundary between two or more ecological communities?

ANSWER: ECOTONE

BONUS

25) BIOLOGY *Multiple Choice* Which of the following correctly describes the path of a newly synthesized secreted protein?

W) Rough endoplasmic reticulum *[en-duh-PLAZ-mik ri-TIK-yuh-luhm]*, vesicles*[VES-i-kuhls]*, Golgi apparatus, vesicles, plasma membrane
X) Golgi apparatus, vesicles, rough endoplasmic reticulum, vesicles, plasma membrane
Y) Smooth endoplasmic reticulum, vesicles, Golgi apparatus, plasma membrane
Z) Golgi apparatus, vesicles, smooth endoplasmic reticulum, plasma membrane

ANSWER: W) ROUGH ENDOPLASMIC RETICULUM, VESICLES, GOLGI APPARATUS, VESICLES, PLASMA MEMBRANE