

ROUND 1

TOSS-UP

1) BIOLOGY *Multiple Choice* Which of the following processes results in a net reduction in the amount of atmospheric carbon dioxide?

- W) Photosynthesis [*foh-tuh-SIN-thuh-sis*]
- X) Fossil fuel use
- Y) Respiration
- Z) Decomposition

ANSWER: W) PHOTOSYNTHESIS

BONUS

1) BIOLOGY *Multiple Choice* Photosynthesis requires water as a reactant. Oxygen atoms from the water end up in which of the following product molecules?

- W) Molecular oxygen
- X) Water
- Y) Glucose
- Z) ATP

ANSWER: W) MOLECULAR OXYGEN

TOSS-UP

2) EARTH AND SPACE *Multiple Choice* Which of the following is NOT an example of a native element?

- W) Platinum
- X) Ruby
- Y) Gold
- Z) Diamond

ANSWER: X) RUBY

BONUS

2) EARTH AND SPACE *Short Answer* What celestial phenomenon results from the movement of charged particles interacting with the Earth's magnetosphere?

ANSWER: AURORA BOREALIS (ACCEPT: AURORA AUSTRALIS, NORTHERN LIGHTS, SOUTHERN LIGHTS, AURORA)

TOSS-UP

3) PHYSICS *Multiple Choice* If an ideal gas performs work on its surroundings, then which of the following must be true?

- W) Its pressure increases
- X) Its volume increases
- Y) Its temperature increases
- Z) Its internal energy decreases

ANSWER: X) ITS VOLUME INCREASES

BONUS

3) PHYSICS *Multiple Choice* A 90 kilogram fullback running north at 10 meters per second is tackled by a 120 kilogram linebacker running south at 4 meters per second in a perfectly inelastic collision. Which of the following is the velocity in meters per second of the players after the collision?

- W) 3 south
- X) 3 north
- Y) 2 south
- Z) 2 north

ANSWER: Z) 2 NORTH

TOSS-UP

4) MATH *Multiple Choice* For all real numbers, the expression $\sqrt{x^2 - 4x + 4}$ [the square root of the quantity x squared minus $4x$ plus 4] equals which of the following?

- W) $x - 2$
- X) $x - 2x + 2$
- Y) $|x - 2|$ [the absolute value of the quantity x minus 2]
- Z) $x + 2$

ANSWER: Y) $|x - 2|$

BONUS

4) MATH *Short Answer* What are the coordinates of the vertex of the graph of $y = 2x^2 + 8x - 3$?

ANSWER: (-2, -11)

TOSS-UP

5) CHEMISTRY *Multiple Choice* Which of the following types of structures describes a beta sheet?

- W) Primary
- X) Secondary
- Y) Tertiary [**TER-shee-er-ee**]
- Z) Quaternary [**KWOT-er-ner-ree**]

ANSWER: X) SECONDARY

BONUS

5) CHEMISTRY *Short Answer* What is the oxidation state of bromine in the compound bromous acid?

ANSWER: +3

TOSS-UP

6) ENERGY *Multiple Choice* When traveling at the same speed, which of the following fission products has the greatest kinetic energy?

- W) A neutron
- X) An alpha particle
- Y) A beta particle
- Z) A positron

ANSWER: X) AN ALPHA PARTICLE

BONUS

6) ENERGY *Short Answer* Name all of the following four choices that are types of coal: 1) lignite, 2) bituminous [**by-TOO-muh-nuhs**], 3) dolomite, 4) anthracite [**AN-thruh-syt**].

ANSWER: 1, 2, 4 (ACCEPT: LIGNITE, BITUMINOUS, ANTHRACITE)

TOSS-UP

7) BIOLOGY *Short Answer* What is the commercially important gelatinous **[juh-LAT-n-uhs]** substance that is produced by *Gelidium amansii*?

ANSWER: AGAR

BONUS

7) BIOLOGY *Multiple Choice* Which of the following molecules does NOT act as an electron shuttle?

- W) NAD+
- X) Cytochrome C
- Y) Pyruvate **[py-ROO-vayt]**
- Z) Coenzyme Q

ANSWER: Y) PYRUVATE

TOSS-UP

8) EARTH AND SPACE *Short Answer* What are the two most abundant dissolved gases released by magma?

ANSWER: WATER VAPOR (ACCEPT: WATER) AND CARBON DIOXIDE

BONUS

8) EARTH AND SPACE *Multiple Choice* Which of the following form elements heavier than iron?

- W) Black holes
- X) Supernovas
- Y) Meteor impacts
- Z) Star formation

ANSWER: X) SUPERNOVAS

TOSS-UP

9) PHYSICS *Multiple Choice* Which of the following will double the power dissipated by a resistor?

- W) Doubling the voltage across the resistor
- X) Decreasing the voltage to one half of the original value
- Y) Increasing the voltage by a factor of the square root of 2
- Z) Decreasing the voltage by a factor of the square root of 2

ANSWER: Y) INCREASING THE VOLTAGE BY A FACTOR OF THE SQUARE ROOT OF 2

BONUS

9) PHYSICS *Short Answer* Given c as 3×10^8 meters per second, what is the wavelength in meters to the nearest tenth of a radio wave with a frequency of 94.7 megahertz?

ANSWER: 3.2

TOSS-UP

10) MATH *Multiple Choice* The equation $-3 + |-2x - 5| = k$ [**negative 3 plus the absolute value of the quantity negative 2x minus 5 equals k**] has no solution if k equals which of the following?

- W) -5
- X) -3
- Y) 0
- Z) 7

ANSWER: W) -5

BONUS

10) MATH *Multiple Choice* Which of the following statements is NOT true?

- W) $\cos(-x) = \cos(x)$ [**cosine of negative x equals cosine of x**]
- X) $\tan(-x) = \tan(x)$ [**tangent of negative x equals tangent of x**]
- Y) The amplitude of $y = -2 \cos(t)$ is equal to 2
- Z) The range of $y = -5 \sin(t)$ is $[-5, 5]$ [**the closed interval from negative 5 to 5**]

ANSWER: X) $\tan(-x) = \tan(x)$

TOSS-UP

11) CHEMISTRY *Short Answer* How many moles of carbon dioxide are produced from the combustion of 5 moles of hydrogen?

ANSWER: 0

BONUS

11) CHEMISTRY *Multiple Choice* Which of the following is NOT a component of a phospholipid [**fos-foh-LIP-id**]?

- W) Water
- X) Glycerol
- Y) Fatty acid
- Z) Phosphate group

ANSWER: W) WATER

TOSS-UP

12) ENERGY *Multiple Choice* Which of the following power types demonstrates large scale temporary storage of energy?

- W) Coal
- X) Chemical
- Y) Hydroelectric
- Z) Wind

ANSWER: Y) HYDROELECTRIC

BONUS

12) ENERGY *Short Answer* The insides of vacuum chambers are frequently mirrored; what form of heat transfer does this prevent?

ANSWER: RADIATIVE (ALSO ACCEPT RADIATION OR THERMAL RADIATION)

TOSS-UP

13) BIOLOGY *Short Answer* Motion of the basilar membrane stimulates what cell type that initiates the transmission of a signal to the brain?

ANSWER: INNER HAIR (ALSO ACCEPT STEREOCILIA OR HAIR CELLS)

BONUS

13) BIOLOGY *Multiple Choice* The basilar membrane in the cochlea [**KOK-lee-uh**] is differentially sensitive to which of the following aspects of sound?

- W) Amplitude
- X) Direction
- Y) Frequency
- Z) Bandwidth

ANSWER: Y) FREQUENCY

TOSS-UP

14) EARTH AND SPACE *Multiple Choice* Which of the following is a term specifically given to water that replenishes an aquifer?

- W) Recharge
- X) Discharge
- Y) Hydraulic
- Z) Permeable

ANSWER: W) RECHARGE

BONUS

14) EARTH AND SPACE *Multiple Choice* Which of the following is the most commonly accepted theory for the creation of Earth's moon?

- W) The Earth collided with a large proto-planet
- X) The Earth captured a proto-planet due to gravity
- Y) The Earth rotated too fast and spun off a large piece
- Z) The Earth and the Moon condensed together

ANSWER: W) THE EARTH COLLIDED WITH A LARGE PROTO-PLANET

TOSS-UP

15) PHYSICS *Multiple Choice* Which of the following particles has an electric charge of zero?

- W) Electron
- X) Quark
- Y) Gluon
- Z) Muon

ANSWER: Y) GLUON

BONUS

15) PHYSICS *Short Answer* A swimming pool water pump draws about 4.2 amperes when connected to 240 volts. If energy costs 10 cents per kilowatt hour, what is the bill to the nearest cent for running the pump continuously for 1 day?

ANSWER: \$2.42 (ACCEPT: 242 CENTS)

TOSS-UP

16) MATH *Short Answer* If the graph of the function f lies in quadrant IV, then in which quadrant does the graph of the inverse of f lie?

ANSWER: II (ACCEPT: 2 OR SECOND)

BONUS

16) MATH *Short Answer* What is the period of the function $f(x) = \sin((\pi/6)x + \pi/4)$ **[f of x equals the sine of the quantity pi over 6 times x plus pi over 4]**?

ANSWER: 12

TOSS-UP

17) CHEMISTRY *Multiple Choice* Which of the following metals commonly forms cations **[KAT-eye-uhns]** with differing charges?

- W) Strontium
- X) Rubidium
- Y) Calcium
- Z) Chromium

ANSWER: Z) CHROMIUM

BONUS

17) CHEMISTRY *Multiple Choice* Which of the following is the most common linkage between successive monomers in cellulose?

- W) Alpha-1, 4
- X) Alpha-1, 6
- Y) Beta-1, 4
- Z) Beta-1, 6

ANSWER: Y) BETA-1, 4

TOSS-UP

18) ENERGY *Multiple Choice* One of the criticisms of ground-mount solar farms is the amount of space they occupy. A new solar system was recently announced called "floatovoltaics," because it is a floating solar farm. Which of the following is NOT a potential benefit of this system?

- W) Reducing evaporation
- X) Reducing algae growth
- Y) Short-term profitability
- Z) Increasing solar panel power production

ANSWER: Y) SHORT-TERM PROFITABILITY

BONUS

18) ENERGY *Short Answer* When Iodine-131 is ingested, which organ most readily absorbs it and can potentially be damaged by it?

ANSWER: THYROID

TOSS-UP

19) BIOLOGY *Multiple Choice* Which of the following is an incorrect descriptor of DNA replication?

- W) Semi-conservative
- X) Discontinuous on the lagging strand and continuous on the leading strand
- Y) High-fidelity
- Z) Repetitive

ANSWER: Z) REPETITIVE

BONUS

19) BIOLOGY *Multiple Choice* Which of the following is NOT a cellular structure that functions to increase surface area and maximize the performance of cellular processes?

- W) Pili [**pee-LEE**]
- X) Microvilli [**my-kroh-VIL-eye**]
- Y) Cisternae [**si-STUR-nee**]
- Z) Cristae [**KRIS-tuh**]

ANSWER: W) PILI

TOSS-UP

20) EARTH AND SPACE *Multiple Choice* Which of the following factors does NOT directly impact the climate of a geographic location?

- W) Elevation
- X) Ocean currents
- Y) Longitude
- Z) Latitude

ANSWER: Y) LONGITUDE

BONUS

20) EARTH AND SPACE *Multiple Choice* Of the history of the universe, which of the following best represents the period of time Earth has existed?

- W) Since the beginning
- X) The last one-third
- Y) The last one-hundredth
- Z) The last one-thousandth

ANSWER: X) THE LAST ONE-THIRD

TOSS-UP

21) PHYSICS *Multiple Choice* A spinning skater draws her arms in closer to her body to rotate faster. Which of the following conservation principles is being applied?

- W) Rotational kinetic energy
- X) Torque
- Y) Angular momentum
- Z) Energy

ANSWER: Y) ANGULAR MOMENTUM

BONUS

21) PHYSICS *Short Answer* An object with a moment of inertia of 2 kilogram meters squared about its axis of rotation makes 6 revolutions per minute. A second stationary object is now gently placed on the first so that the combined moment of inertia about the spin axis is 4 kilogram meters squared. What is the spin rate in revolutions per minute of the composite object?

ANSWER: 3

TOSS-UP

22) MATH *Multiple Choice* Which of the following is an equivalent form of $2/(3 + i)$ [**2 over the quantity 3 plus i**]?

- W) $(3 - i)/4$ [**open parenthesis 3 minus i, close parenthesis, over 4**]
- X) $(3 - i)/5$ [**open parenthesis 3 minus i, close parenthesis, over 5**]
- Y) $(4 - i)/4$ [**open parenthesis 4 minus i, close parenthesis, over 4**]
- Z) $(4 - i)/5$ [**open parenthesis 4 minus i, close parenthesis, over 5**]

ANSWER: X) $(3 - i)/5$

BONUS

22) MATH *Multiple Choice* Which of the following points is on the graph of the inverse of the function $f(x) = 10^{x+2}$ [**f of x equals 10 to the power of the quantity x plus 2**]?

- W) (100, 0)
- X) (0, 100)
- Y) (10, 0)
- Z) (0, 10)

ANSWER: W) (100, 0)

TOSS-UP

23) CHEMISTRY *Short Answer* What is the term for a product generated in one step of a reaction mechanism that is consumed as a reactant in another step?

ANSWER: REACTION INTERMEDIATE (ACCEPT: REACTIVE INTERMEDIATE OR INTERMEDIATE)

BONUS

23) CHEMISTRY *Short Answer* Several years ago, scientists announced that they had succeeded in getting a nucleus of calcium-48 to fuse with a nucleus of plutonium-244. The combined nucleus is a nucleus of what element?

ANSWER: UNUNQUADIUM (ACCEPT: ELEMENT 114; UUQ, FLEROVIUM, OR FL)

TOSS-UP

24) EARTH AND SPACE *Multiple Choice* Which of the following is the definition of dew point?

- W) The ratio of actual water vapor compared to saturated water vapor in the air
- X) The ratio of liquid water to water vapor in the air
- Y) The temperature at which the air is saturated with water vapor
- Z) The temperature at which water evaporates into the air

ANSWER: Y) THE TEMPERATURE AT WHICH THE AIR IS SATURATED WITH WATER VAPOR

BONUS

24) EARTH AND SPACE *Short Answer* What phenomenon is recorded in the changing orientation of iron-bearing minerals on the surface of the oceanic crust?

ANSWER: MAGNETIC POLE REVERSAL (ACCEPT: FLIPPED/ALTERNATING MAGNETIC FIELD)

TOSS-UP

25) BIOLOGY *Multiple Choice* In which of the following locations would a spliceosome [**SPLY-see-uh-sohm**] be found?

- W) Nucleus [**NOO-klee-uhs**]
- X) Cytoplasm
- Y) Plasma membrane
- Z) Endosome

ANSWER: W) NUCLEUS

BONUS

25) BIOLOGY *Short Answer* Identify all of the following five structures which can be found on paramecia [**par-uh-MEE-see-uh**]: 1) oral groove, 2) cilia, 3) contractile vacuoles, 4) flagella, 5) trichocysts [**TRIK-uh-sists**].

ANSWER: 1, 2, 3, 5 (ACCEPT: ORAL GROOVE, CILIA, CONTRACTILE VACUOLES, TRICHOCYSTS)