

ROUND 4

TOSS-UP

1) CHEMISTRY *Multiple Choice* Which of the following transition metals has the smallest atomic radius?

- W) Nickel
- X) Iron
- Y) Scandium
- Z) Cadmium

ANSWER: W) NICKEL

BONUS

1) CHEMISTRY *Short Answer* Consisting of a fatty acid chain attached through an amide linkage to sphingosine [**SFING-guh-seen**], what is the fundamental structural unit common to all sphingolipids?

ANSWER: CERAMIDE

TOSS-UP

2) EARTH AND SPACE *Short Answer* What is the naturally occurring radioactive isotope of carbon called?

ANSWER: CARBON-14 (ACCEPT: C-14)

BONUS

2) EARTH AND SPACE *Short Answer* Based on the Spitzer Space Telescope observatory program, infrared emission from most galaxies comes primarily from three sources. Name two of them.

ANSWER: STARS, INTERSTELLAR GAS, DUST (ACCEPT: INTERSTELLAR DUST)

TOSS-UP

3) PHYSICS *Short Answer* An alpha particle consists of what types and numbers of subatomic particles?

ANSWER: TWO PROTONS AND TWO NEUTRONS

BONUS

3) PHYSICS *Multiple Choice* The rotor of a helicopter blade turns at an angular speed of 5 revolutions per second, which is approximately which of the following in radians per second?

- W) 22
- X) 31
- Y) 35
- Z) 40

ANSWER: X) 31

TOSS-UP

4) ENERGY *Multiple Choice* In 1859, drilling first began in the U.S. for which of the following energy resources?

- W) Coal
- X) Oil
- Y) Natural gas
- Z) Geothermal energy

ANSWER: X) OIL

BONUS

4) ENERGY *Short Answer* In what kind of electrochemical cell would copper and zinc plates be lowered into a sulfuric acid solution in order to generate an electric current?

ANSWER: VOLTAIC (ACCEPT: GALVANIC; DO NOT ACCEPT BATTERY)

TOSS-UP

5) BIOLOGY *Multiple Choice* Which of the following terms is used to describe a structure that is similar in different species of organisms, because the species share a common ancestor that was the source of the structure?

- W) Homologous [*huh-MOL-uh-guhs*]
- X) Convergent
- Y) Analogous [*uh-NAL-uh-guhs*]
- Z) Divergent

ANSWER: W) HOMOLOGOUS

BONUS

5) BIOLOGY *Multiple Choice* Which of the following is an example of an ectoparasite [*ek-toh-PAR-uh-syt*]?

- W) Tapeworm
- X) Hookworm
- Y) Nematode
- Z) Louse

ANSWER: Z) LOUSE

TOSS-UP

6) MATH *Multiple Choice* A certain radioactive element decays over time according to the equation $y = R (1 / 2)^{x/300}$ [*y equals R times one half to the power of the quantity x over 300*], where R equals the number of grams that were present initially and x equals time in years. If 1000 grams were present initially, how many grams will remain after 900 years?

- W) 62.5
- X) 125
- Y) 250
- Z) 500

ANSWER: X) 125

BONUS

6) MATH *Short Answer* If $-4x - 9y - 3z = -10$ and $-5a - 9b = -6$, then what is $-9b - 15z - 45y - 20x - 5a$?

ANSWER: -56

TOSS-UP

7) CHEMISTRY *Short Answer* In carbon dioxide, what is the formal charge on the central atom?

ANSWER: 0

BONUS

7) CHEMISTRY *Multiple Choice* Good nucleophiles [*noo-klee-uh-FYLS*], which promote substitution instead of elimination reactions, tend to be which of the following?

- W) Weak bases
- X) Strong bases
- Y) Weak acids
- Z) Strong acids

ANSWER: W) WEAK BASES

TOSS-UP

8) EARTH AND SPACE *Short Answer* The presence of what molecule causes temperatures to increase with increasing altitude in the stratosphere?

ANSWER: OZONE (ACCEPT: O₃)

BONUS

8) EARTH AND SPACE *Multiple Choice* At which of the following locations would an observer find the greatest force due to the Earth's gravity?

- W) North Pole
- X) Tropic of Cancer
- Y) Tropic of Capricorn
- Z) Equator

ANSWER: W) NORTH POLE

TOSS-UP

9) PHYSICS *Multiple Choice* Which of the following wave types does not exhibit polarization?

- W) Gravitational
- X) X-ray
- Y) Acoustic
- Z) Visible light

ANSWER: Y) ACOUSTIC

BONUS

9) PHYSICS *Short Answer* Identify all of the following three choices that may define the phase velocity of a wave: 1) frequency, 2) period, 3) wavelength.

ANSWER: ALL (ACCEPT: 1, 2, 3)

TOSS-UP

10) ENERGY *Multiple Choice* Nuclear power plants and coal fired plants have which of the following operations in common?

- W) Both give off smoke from a stack
- X) Both heat water to become steam
- Y) Both use moderators to control energy output
- Z) Both use water to control heat build-up

ANSWER: X) BOTH HEAT WATER TO BECOME STEAM

BONUS

10) ENERGY *Multiple Choice* Which of the following types of coal is metamorphic?

- W) Lignite
- X) Anthracite [**AN-thruh-syt**]
- Y) Bituminous [**by-TOO-muh-nuhs**]
- Z) Sub-bituminous

ANSWER: X) ANTHRACITE

TOSS-UP

11) BIOLOGY *Multiple Choice* The proboscis [**proh-BOS-kis**] is used primarily by invertebrates to perform which of the following functions?

- W) Egg fertilization
- X) Excavation
- Y) Feeding
- Z) Defense

ANSWER: Y) FEEDING

BONUS

11) BIOLOGY *Multiple Choice* Which of the following pollinators is a member of the order Lepidoptera [**lep-i-DOP-ter-uh**]?

- W) Lesser long-nosed bats
- X) Fritillary butterflies [**FRIT-l-er-ee**]
- Y) Green bottle flies
- Z) Blue orchard bees

ANSWER: X) FRITILLARY BUTTERFLIES

TOSS-UP

12) MATH *Short Answer* The perimeters of two similar figures have a ratio of 5:7. What is the ratio of their areas?

ANSWER: 25:49 (ACCEPT: 25/49)

BONUS

12) MATH *Short Answer* After 40 times at bat, BJ has 9 hits. What is the least number of hits he would need in his next 30 times at bat so that he has hits in at least 31% of his total at-bats?

ANSWER: 13

TOSS-UP

13) EARTH AND SPACE *Short Answer* Which two planets in our solar system are considered ice giants?

ANSWER: URANUS AND NEPTUNE

BONUS

13) EARTH AND SPACE *Short Answer* Cellulases [*sel-yuh-LAY-ses*], a group of enzymes that break down cellulose, such as is found in the walls of plants, are being used in the production of which alternative fuel?

ANSWER: ETHANOL

TOSS-UP

14) BIOLOGY *Multiple Choice* Which of the following organelles within the eukaryotic [*yoo-KAR-ee-oh-tik*] cell functions as the digestive system of the cell, serving both to degrade material taken up from outside the cell and to digest obsolete components of the cell itself?

W) Lysosome

X) Golgi apparatus

Y) Smooth endoplasmic reticulum [*EN-duh-plaz-mik ri-TIK-yuh-luhm*]

Z) Rough endoplasmic reticulum

ANSWER: W) LYSOSOME

BONUS

14) BIOLOGY *Short Answer* By number, order the following five stages of animal development from earliest to latest: 1) gastrulation, 2) organogenesis, 3) fertilization, 4) gametogenesis, 5) cleavage.

ANSWER: 4, 3, 5, 1, 2

TOSS-UP

15) CHEMISTRY *Multiple Choice* Which of the following carbohydrates will most easily dissolve in water?

- W) Glycogen [**GLY-kuh-juhn**]
- X) Starch
- Y) Maltose [**MOHL-tohs**]
- Z) Cellulose

ANSWER: Y) MALTOSE

BONUS

15) CHEMISTRY *Short Answer* What adjective describes a mixture that has equal amounts of left- and right-handed enantiomers [**i-NAN-tee-uh-mers**] of a chiral [**KY-ruhl**] molecule?

ANSWER: RACEMIC (ACCEPT: RACEMATES)

TOSS-UP

16) EARTH AND SPACE *Multiple Choice* Which of the following is NOT necessary for a cloud to form?

- W) Saturated air
- X) Water vapor
- Y) High altitude
- Z) High humidity

ANSWER: Y) HIGH ALTITUDE

BONUS

16) EARTH AND SPACE *Multiple Choice* Which of the following is NOT a symptom of desertification?

- W) Lowering of the water table
- X) Decreased rate of erosion
- Y) Increased salinity in natural waters and soils
- Z) Progressive destruction of vegetation

ANSWER: X) DECREASED RATE OF EROSION

TOSS-UP

17) PHYSICS *Short Answer* A person standing on a scaffold lowers an object with a weight of 250 newtons by means of a rope, at constant speed. If the weight of the rope is negligible, what is the force in newtons that the person exerts on the rope?

ANSWER: 250

BONUS

17) PHYSICS *Short Answer* Relative to the ground, how many joules of potential energy does a 1000 newton boulder have at the top of a 5 meter ledge, relative to the bottom of the ledge and given g as 10 meters per second squared?

ANSWER: 5000

TOSS-UP

18) ENERGY *Multiple Choice* Which of the following is a product from a hydrogen fuel reaction?

- W) Water
- X) Carbon dioxide
- Y) Methane
- Z) Nitrogen

ANSWER: W) WATER

BONUS

18) ENERGY *Short Answer* What value is used to describe the heat resistance of home insulation?

ANSWER: R-VALUE

TOSS-UP

19) BIOLOGY *Multiple Choice* Which of the following types of genes violates Mendel's principle of independent assortment?

- W) Linked
- X) Codominant
- Y) Dominant
- Z) Epistatic

ANSWER: W) LINKED

BONUS

19) BIOLOGY *Short Answer* Name an allosteric [*al-uh-STER-ik*] inhibitor of pyruvate [*py-ROO-vayt*] kinase.

ANSWER: ATP (ACCEPT: ADENOSINE TRIPHOSPHATE, ALANINE OR ACETYL-CoA)

TOSS-UP

20) MATH *Short Answer* If a person walks 4 miles due north, 6 miles due east, then 4 miles due north, how far in miles is the person displaced from his or her original position?

ANSWER: 10

BONUS

20) MATH *Short Answer* In a standard deck of cards with no jokers, providing your answer as a fraction in lowest terms, what is the probability of picking a card that is black or a number less than 10 (which includes aces)?

ANSWER: 11/13

TOSS-UP

21) CHEMISTRY *Short Answer* According to valence bond theory, what is the hybridization of the central atom of methane?

ANSWER: sp^3

BONUS

21) CHEMISTRY *Short Answer* A lab performs atomic spectroscopy, usually using a flame as an excitation source. However, flames only ionize a very small percentage of the atoms, so the lab wants to find a better excitation source. Name a common source that could be used to solve this problem.

ANSWER: PLASMA (ACCEPT: PLASMA EMISSION, INDUCTIVELY COUPLED PLASMA SOURCE, OR ICP)

TOSS-UP

22) EARTH AND SPACE *Multiple Choice* Which of the following is NOT evidence that liquid water was once present on Mars?

- W) Large flood channels
- X) Sedimentary layering
- Y) Sand dunes
- Z) Eroded craters

ANSWER: Y) SAND DUNES

BONUS

22) EARTH AND SPACE *Short Answer* What is the typical adjective used to describe a volcano that is not currently erupting but is considered likely to do so in the future?

ANSWER: DORMANT

TOSS-UP

23) PHYSICS *Multiple Choice* An unpowered open truck is coasting horizontally with a constant velocity along a frictionless track underneath a grain bin when grain falls vertically into the truck, partly filling it as it moves along. Which of the following will happen to the horizontal momentum of the truck with the accumulating grain?

- W) It will decrease
- X) It will increase
- Y) It will stay the same
- Z) It will first increase and then decrease

ANSWER: Y) IT WILL STAY THE SAME

BONUS

23) PHYSICS *Short Answer* A mass is suspended by two springs of equal length connected in parallel. The mass stretches the springs by a distance A beyond their equilibrium length. The springs are rearranged to be connected in series, so that now the mass stretches the springs by a distance B beyond their equilibrium length. By number, identify which of the following is true: 1) A is greater than B, 2) A is less than B, 3) A and B are the same distance.

ANSWER: 2

TOSS-UP

24) MATH *Multiple Choice* The lines $y = (a - 5)x + 5$ [**y equals open parentheses a minus 5 close parentheses x plus 5**] and $y = -2x + 7$ are perpendicular if a equals which of the following?

- W) $-2/9$
- X) $9/2$
- Y) 5
- Z) $11/2$

ANSWER: Z) $11/2$

BONUS

24) MATH *Short Answer* For a function $f(x)$, suppose that you know that $f(-1) = -2$ and that $f(3) = 2$. What would you need to know about f in order to invoke the Intermediate Value Theorem to conclude that there is at least one zero of f on $[-1, 3]$ [**the closed interval from negative 1 to 3**]?

ANSWER: f IS CONTINUOUS ON $[-1, 3]$ (ACCEPT: f IS CONTINUOUS ON THE INTERVAL)

TOSS-UP

25) BIOLOGY *Multiple Choice* Which of the following examples describes a postzygotic reproductive barrier that creates or enforces reproductive isolation?

- W) Two closely-related species of garter snakes live in the same area, but one lives mainly in water while the other lives mainly on land
- X) Two species of closely-related skunks have different mating seasons
- Y) Two species of closely-related snails have morphological differences that prevent successful inter-species mating
- Z) Two species of closely related equines may successfully mate to produce offspring, but the offspring is sterile

ANSWER: Z) TWO SPECIES OF CLOSELY RELATED EQUINES MAY SUCCESSFULLY MATE TO PRODUCE OFFSPRING, BUT THE OFFSPRING IS STERILE

BONUS

25) BIOLOGY *Multiple Choice* Which of the following is true of the twenty common amino acids?

- W) They contain a primary amine and secondary alcohol
- X) They contain a primary amide and a primary alcohol
- Y) They contain a primary amine and a primary carboxyl group
- Z) They contain a secondary amine and a primary carboxyl group

ANSWER: Y) THEY CONTAIN A PRIMARY AMINE AND A PRIMARY CARBOXYL GROUP