

ROUND 11

TOSS-UP

1) MATH *Multiple Choice* A quadrilateral may be inscribed in a circle if and only if which of the following is true?

- W) It is a rectangle
- X) It is a square
- Y) It is equilateral
- Z) Its opposite angles are supplementary

ANSWER: Z) ITS OPPOSITE ANGLES ARE SUPPLEMENTARY

BONUS

1) MATH *Short Answer* If the range of the set of five numbers {4, 3, x, 9, and 8} is 12, what are the possible values of x?

ANSWER: 15 AND -3

TOSS-UP

2) GENERAL SCIENCE *Short Answer* By name or number, identify all of the following five animals that are odd-toed ungulates: 1) horse, 2) zebra, 3) onager, 4) alpaca, 5) tapir.

ANSWER: HORSE, ZEBRA, ONAGER, AND TAPIR (ACCEPT: 1, 2, 3, AND 5)

BONUS

2) GENERAL SCIENCE *Short Answer* All the nitrogenous bases from a DNA molecule are removed. Of the nitrogenous base molecules, 27% were guanine (read as: GWAH-noon) molecules. Approximately what percentage of the nitrogenous base molecules were thymine molecules?

ANSWER: 23%

TOSS-UP

3) EARTH AND SPACE SCIENCE *Short Answer* What is the name of the large oceanic circulation system that moves cold salty water from the surface to the bottom of the ocean near Greenland?

ANSWER: NORTH ATLANTIC DEEP OCEAN CURRENT (ACCEPT: THERMOHALINE CIRCULATION, GREAT OCEAN CONVEYER)

BONUS

3) EARTH AND SPACE SCIENCE *Short Answer* Unlike algae in lakes, marine algae are more likely to grow rapidly after what element is added to their natural environment?

ANSWER: IRON

TOSS-UP

4) GENERAL SCIENCE *Multiple Choice* Which of the following elements would be the MOST metallic?

- W) Iron
- X) Copper
- Y) Titanium
- Z) Germanium

ANSWER: Y) TITANIUM

BONUS

4) GENERAL SCIENCE *Short Answer* An object with a mass of 5 kilograms travels around a horizontal circle with a radius of 2 meters at a speed of 3 meters per second in the counterclockwise direction. In meters per second squared, what is the centripetal acceleration, in terms of both magnitude and direction, when the direction of the velocity is north?

ANSWER: 4.5 WEST

TOSS-UP

5) LIFE SCIENCE *Short Answer* Name the biome characterized by low precipitation, variable temperatures, and soils rich in minerals but poor in organic material.

ANSWER: DESERT

BONUS

5) LIFE SCIENCE *Multiple Choice* Which of the following statements best describes the primary difference between animal centrosomes and plant centrosomes?

- W) Plant centrosomes have a rough exterior made of cellulose
- X) Animal centrosomes use microfilaments
- Y) Plant centrosomes do not have centrioles
- Z) Animal centrosomes are in the cytoplasm

ANSWER: Y) PLANT CENTROSOMES DO NOT HAVE CENTRIOLES

TOSS-UP

6) GENERAL SCIENCE *Multiple Choice* Which of the following is an example of analogous structures resulting from convergent evolution?

- W) Feathers on a bird to feathers on a dinosaur
- X) Forelimbs on a human to forelimbs on a chimpanzee
- Y) Flippers on a dolphin to forelimbs on a human
- Z) Webbed feet on a duck to webbed feet on a frog

ANSWER: Z) WEBBED FEET ON A DUCK TO WEBBED FEET ON A FROG

BONUS

6) GENERAL SCIENCE *Short Answer* A certain isotope of oxygen is unstable and emits a positron to form a stable isotope of another atom. Name the element produced.

ANSWER: NITROGEN

TOSS-UP

7) MATH *Multiple Choice* Which of the following best represents the sum of the reciprocals of all positive integers?

- W) 2
- X) $\pi^2/6$
- Y) 9
- Z) Infinity

ANSWER: Z) INFINITY

BONUS

7) MATH *Multiple Choice* A cylindrical tin can has a diameter of 4 inches and a height of 5 inches. Approximately how much more volume, in cubic inches, would it have if the diameter were increased to 6 inches?

- W) 63
- X) 79
- Y) 141
- Z) 157

ANSWER: X) 79

TOSS-UP

8) PHYSICAL SCIENCE *Short Answer* What is the chemical formula for iron (III) oxide?

ANSWER: Fe₂O₃

BONUS

8) PHYSICAL SCIENCE *Multiple Choice* Which of the following kinds of reaction does the following equation exemplify: $\text{CH}_2\text{S} + 6 \text{F}_2 \rightarrow$ (read as: yields) $\text{CF}_4 + 2 \text{HF} + \text{SF}_6 + \text{heat}$?

- W) Acid-base
- X) Phase change
- Y) Oxidation reduction
- Z) Double displacement

ANSWER: Y) OXIDATION REDUCTION

TOSS-UP

9) LIFE SCIENCE *Short Answer* What is the term for the wave of muscular contractions that propels food down the esophagus (read as: i-SOH-fah-guhs)?

ANSWER: PERISTALSIS

BONUS

9) LIFE SCIENCE *Multiple Choice* Which of the following is a relatively short fragment of DNA created on the lagging strand during DNA replication?

- W) DNA polymerase
- X) Okazaki fragment
- Y) Thymine dimer
- Z) Flap endonuclease

ANSWER: X) OKAZAKI FRAGMENT

TOSS-UP

10) GENERAL SCIENCE *Short Answer* A hormone enters the blood stream and binds to specific receptors; what is the general name for a cell that expresses the receptor for a given hormone?

ANSWER: TARGET CELL

BONUS

10) GENERAL SCIENCE *Short Answer* For a certain trait, there are three alleles, A, B, and C, and each locus contains 2 alleles. The frequency of allele A is 0.4 and the frequency of allele B is 0.1. What percentage of the population has either allele B or allele C present in their genome?

ANSWER: 84%

TOSS-UP

11) MATH *Multiple Choice* The line with equation $y = -3x + 10$ has points in every quadrant EXCEPT:

- W) I
- X) II
- Y) III
- Z) IV

ANSWER: Y) III

BONUS

11) MATH *Short Answer* How many vertices and edges, respectively, does a regular octahedron have?

ANSWER: VERTICES = 6, EDGES = 12

TOSS-UP

12) EARTH AND SPACE SCIENCE *Multiple Choice* Which of the following is at the base of the hydrothermal vent community food chain?

- W) Symbiotic phytoplankton
- X) Chemosynthetic archaea
- Y) Marine snow
- Z) Photosynthetic bacteria

ANSWER: X) CHEMOSYNTHETIC ARCHAEA

BONUS

12) EARTH AND SPACE SCIENCE *Short Answer* What is the term for the sequences of rocks that make up the ocean floor and are composed from top to bottom of pillow basalts, sheeted dikes, gabbro, and peridotite (read as: peh-RI-doh-tyt)?

ANSWER: OPHIOLITE (ACCEPT: OPHIOLITE SERIES)

TOSS-UP

13) PHYSICAL SCIENCE *Multiple Choice* Which of the following groups consists entirely of allotropes of carbon?

- W) Lonsdaleite (read as: loh-z-day-LEET), graphene, and fullerene
- X) Crystal, diamond, and graphite
- Y) Graphite, graphene, and crystal
- Z) Fullerene, lonsdaleite (read as: loh-z-day-LEET), and alamosite

ANSWER: W) LONSDALEITE, GRAPHENE, AND FULLERENE

BONUS

13) PHYSICAL SCIENCE *Short Answer* Providing your answer in scientific notation with two significant digits, a coulomb of charge is equal to the electrical charge of how many electrons?

ANSWER: 6.2×10^{18}

TOSS-UP

14) ENERGY *Multiple Choice* The U.S. Energy Information Administration is projecting that primary energy consumption of which of the following energy sources will grow by more than 4% per year between 2007 and 2035?

- W) Coal
- X) Natural gas
- Y) Nuclear
- Z) Liquid biofuels

ANSWER: Z) LIQUID BIOFUELS

BONUS

14) ENERGY *Short Answer* What country has the world's largest offshore wind farm?

ANSWER: UNITED KINGDOM

TOSS-UP

15) MATH *Short Answer* What is the product of complex numbers $(2 + 3i)(2 - 3i)$ (read as: the quantity 2 plus 3 i times the quantity 2 minus 3 i)?

ANSWER: 13

BONUS

15) MATH *Short Answer* Sue leaves for school at 7 a.m., walking at a rate of 4 miles per hour. Her sister, Mary, leaves home at 7:30 a.m., riding her bike at a rate of 8 miles per hour. At what time will Mary meet up with Sue?

ANSWER: 8:00 a.m.

TOSS-UP

16) EARTH AND SPACE SCIENCE *Short Answer* What is the name for the layer of the ocean in which temperature changes rapidly with depth?

ANSWER: THERMOCLINE

BONUS

16) EARTH AND SPACE SCIENCE *Short Answer* What is the process by which physical and chemical changes occur in a sediment after it has been deposited and buried?

ANSWER: DIAGENESIS

TOSS-UP

17) PHYSICAL SCIENCE *Multiple Choice* Which of the following is a substance that can accept a pair of electrons from another substance?

- W) Brønsted acid
- X) Brønsted base
- Y) Lewis acid
- Z) Arrhenius base

ANSWER: Y) LEWIS ACID

BONUS

17) PHYSICAL SCIENCE *Multiple Choice* Which of the following states that no two electrons can have the same four quantum numbers?

- W) Pauli exclusion principle
- X) Aufbau principle
- Y) Hund's rule
- Z) Heisenberg uncertainty principle

ANSWER: W) PAULI EXCLUSION PRINCIPLE

TOSS-UP

18) EARTH AND SPACE SCIENCE *Multiple Choice* A crystal's habit that is plant-like in shape is called which of the following?

- W) Dendritic
- X) Bladed
- Y) Massive
- Z) Reniform

ANSWER: W) DENDRITIC

BONUS

18) EARTH AND SPACE SCIENCE *Short Answer* By name or number, identify all of the following four choices that can appear as silicate mineral structures: 1) single chain, 2) double chain, 3) sheet, 4) three-dimensional framework.

ANSWER: SINGLE CHAIN, DOUBLE CHAIN, SHEET, THREE-DIMENSIONAL FRAMEWORK
(ACCEPT: 1, 2, 3, AND 4 OR ALL)

TOSS-UP

19) ENERGY *Short Answer* What three-dimensional figure has the minimum surface area for a given volume, thus minimizing the leakage of neutrons in fission reactions?

ANSWER: SPHERE

BONUS

19) ENERGY *Short Answer* A wind turbine obtains its power input by converting the force of the wind into a torque acting on the rotor blades. Name two of the three variables that affect the amount of energy transferred from the wind to the rotor.

ANSWER: (ACCEPT TWO) DENSITY OF THE AIR, ROTOR (ACCEPT: BLADE) AREA, WIND SPEED

TOSS-UP

20) LIFE SCIENCE *Short Answer* With which protein does actin associate in order to produce a muscular contraction?

ANSWER: MYOSIN

BONUS

20) LIFE SCIENCE *Short Answer* What adjective is used to describe fungi which appear to use the pigment melanin to convert gamma radiation into chemical energy for growth?

ANSWER: RADIOTROPHIC

TOSS-UP

21) MATH *Short Answer* If each side of a rectangle is decreased by 10%, by what percentage is the area decreased?

ANSWER: 19%

BONUS

21) MATH *Short Answer* The lengths of three sides of a triangle are represented by $2x + 5$, $5x + 3$, and $4x + 9$. Providing your answer as an improper fraction in simplest form, if the perimeter is 50 units, what is the length of the shortest side?

ANSWER: 31/11

TOSS-UP

22) LIFE SCIENCE *Multiple Choice* Which of the following is NOT one of the events that occurs during translation?

- W) Binding to a promoter
- X) Termination
- Y) Initiation
- Z) Elongation

ANSWER: W) BINDING TO A PROMOTER

BONUS

22) LIFE SCIENCE *Short Answer* What is the term for the durable process by which a cell directs the secretory vesicles to excrete their contents through the cell membrane?

ANSWER: EXOCYTOSIS (ACCEPT: REVERSE PINO-CYTOSIS)

TOSS-UP

23) ENERGY *Multiple Choice* In the United States, where is spent nuclear fuel currently stored?

- W) At a nuclear waste facility in Prairie Island, Minnesota
- X) At a nuclear waste facility in Yucca Mountain, Nevada
- Y) At a nuclear waste facility in Waterford, Connecticut
- Z) In temporary storage at nuclear power plants around the country

ANSWER: Z) IN TEMPORARY STORAGE AT NUCLEAR POWER PLANTS AROUND THE COUNTRY

BONUS

23) ENERGY *Short Answer* A 5 kilogram mass is held against a spring, compressing it by 1 meter; the spring constant is 500 newtons per meter. What is the maximum speed, in meters per second, the mass can achieve when the spring decompresses?

ANSWER: 10

TOSS-UP

24) PHYSICAL SCIENCE *Multiple Choice* Which of the following BEST describes a cathode ray?

- W) A device that emits light through a process of optical amplification based on the stimulated emission of photons
- X) An electrode through which electric current flows out of a polarized electrical device
- Y) A stream of electrons observed in vacuum tubes
- Z) An electrode through which electric current flows into a polarized electrical device

ANSWER: Y) A STREAM OF ELECTRONS OBSERVED IN VACUUM TUBES

BONUS

24) PHYSICAL SCIENCE *Short Answer* A projectile is fired from a gun at an angle of 45° with respect to the horizontal. Given that g is 10 meters per second squared, what is the magnitude and direction of the acceleration, in meters per second squared, of the projectile when it reaches its maximum height?

ANSWER: 10 DOWNWARDS

TOSS-UP

25) LIFE SCIENCE *Multiple Choice* Which of the following is NOT a cartilaginous fish?

- W) Skate
- X) Eel
- Y) Ray
- Z) Shark

ANSWER: X) EEL

BONUS

25) LIFE SCIENCE *Multiple Choice* Which of the following makes 3-dimensional protein studies difficult?

- W) Proteins never fold properly outside their native cell
- X) Chaperonins are required for some proteins to fold
- Y) Proteins lose their 3D structure once you remove them from the cell
- Z) Contaminating chaperonins will degrade proteins

ANSWER: X) CHAPERONINS ARE REQUIRED FOR SOME PROTEINS TO FOLD