TOSS-UP

1) Energy — Short Answer  Researchers at DOE recently used the SLAC [slack] Synchrotron [SINK-row-trawn] Radiation Light Source to solve the structure of the Lassa virus glycoprotein bound to a human neutralizing antibody. What particles did they use from this source to image the protein complex?

ANSWER: PHOTONS (ACCEPT: X-RAYS)

BONUS

1) Energy — Short Answer  The first nuclear-generated electricity in the United States was located at what DOE lab?

ANSWER: ARGONNE NATIONAL LAB (ACCEPT: ANL)

TOSS-UP

2) Earth and Space — Multiple Choice  Which of the following is NOT commonly used to describe mineral luster?

W) Dull  
X) Metallic  
Y) Resinous  
Z) Conchoidal [kon-KOI-dal]

ANSWER: Z) CONCHOIDAL

BONUS

2) Earth and Space — Short Answer  Cinnabar is an ore of what element?

ANSWER: MERCURY
TOSS-UP

3) Life Science – Short Answer Which of the three classes of muscle tissue is responsible for vasodilation \textit{[vay-zoh-dye-LAY-shun]} and constriction?

ANSWER: SMOOTH

BONUS

3) Life Science – Short Answer Keratins and lamins, known for their mechanical strength, belong to what class of cytoskeletal \textit{[SIGH-toh-skeletal]} filament?

ANSWER: INTERMEDIATE FILAMENT

TOSS-UP

4) Math – Multiple Choice If an angle of $x$ degrees and an angle of $y$ degrees are complementary, which of the following is NOT a possible value of $y$ minus $x$?

W) 0
X) 45
Y) –45
Z) 100

ANSWER: Z) 100

BONUS

4) Math – Short Answer To the nearest whole number, how many minutes would it take for a car traveling at 30 miles per hour to go 3,500 yards?

ANSWER: 4
TOSS-UP

5) Physical Science  –  Short Answer  What type of thermal energy transfer is mediated by electromagnetic waves?

ANSWER: RADIATION

BONUS

5) Physical Science  –  Short Answer  Rank the following four electromagnetic waves in decreasing order of wavelength: 1) X-rays; 2) Visible light; 3) Radio; 4) Infrared.

ANSWER: 3, 4, 2, 1

TOSS-UP

6) Earth and Space  –  Short Answer  During which of the lunar phases can a lunar eclipse occur?

ANSWER: FULL

BONUS

6) Earth and Space  –  Short Answer  Sunlight takes approximately 8 minutes to reach Earth. What integer power of 10 is nearest the number of meters in one astronomical unit?

ANSWER: 11 (ACCEPT: 10^{11})
TOSS-UP

7) Energy – Short Answer Researchers at the Pacific Northwest National Laboratory are working to make longer-lasting lithium batteries by using silicon as an electrode. The electrodes of lithium-ion batteries are typically made of what material?

ANSWER: GRAPHITE (ACCEPT: CARBON)

BONUS

7) Energy – Short Answer Bioethanol is often treated with molecular [moh-LEK-yoo-lur] sieves [sivs] or zeolites before it is mixed with gasoline to make E10. What substance is being removed from the ethanol during this treatment?

ANSWER: WATER (ACCEPT: H₂O)

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TOSS-UP

8) Math – Short Answer When flipping a coin 4 times, what is the probability that all 4 results are the same?

ANSWER: 1/8 (ACCEPT: 0.125, 12.5%, 12 1/2 %)

BONUS

8) Math – Short Answer A school has 5m – 13 students in its science club, and 2m + 41 students in its band. If there are more students in the science club than in band, what is the smallest possible value of m?

ANSWER: 19
TOSS-UP

9) Life Science – Short Answer  What group of organisms gives birth or lays watertight eggs and includes chickens, lizards, and humans?

ANSWER: AMNIOTES

BONUS

9) Life Science – Multiple Choice  A new vertebrate organism is discovered. It reproduces by laying an amniotic [am-nee-AWT-ik] egg. It also produces milk. Which of the following terms best classifies this animal?

W) Aves [AY-veez]
X) Monotrema [mono-TREH-mah]
Y) Marsupialia [mar-soop-ee-AY-lee-ah]
Z) Eutheria [yoo-THEER-ee-ah]

ANSWER: X) MONOTREMA

TOSS-UP

10) Physical Science – Short Answer  What two-carbon carboxylic acid is the main solute in vinegar?

ANSWER: ACETIC ACID (ACCEPT: ETHANOIC ACID)

BONUS

10) Physical Science – Short Answer  How many lone pairs of electrons are present in the Lewis diagram of carbon dioxide?

ANSWER: 4
TOSS-UP

11) Earth and Space – Multiple Choice Which of the following blows from west to east over Kansas and Tennessee?

W) Trade winds  
X) Jet stream  
Y) Prevailing easterlies  
Z) Prevailing westerlies

ANSWER: Z) PREVAILING WESTERLIES

BONUS

11) Earth and Space – Short Answer Valley glaciers can scoop out deep depressions called cirques [surks], which meet at a sharp ridge called what?

ANSWER: ARÊTE

TOSS-UP

12) Math – Short Answer What is the least common multiple of 5, 7, and 30?

ANSWER: 210

BONUS

12) Math – Short Answer What is the degree measure of each interior angle of a regular 45-sided polygon?

ANSWER: 172
TOSS-UP

13) Life Science – Short Answer  What is the term for the process of programmed cell death?

ANSWER: APOPTOSIS [AY-pah-TOW-sis]

BONUS


W) Law of independent assortment
X) Law of dominance
Y) Law of segregation of alleles [ah-LEELZ]
Z) Law of meiosis [my-OH-sis]

ANSWER: Y) LAW OF SEGREGATION OF ALLELES

TOSS-UP

14) Physical Science – Short Answer  For water, rank the following three phases of matter in terms of increasing distance between individual particles: 1) Gas; 2) Liquid; 3) Solid.

ANSWER: 2, 3, 1

BONUS

14) Physical Science – Short Answer  In an atom, what is the maximum number of electrons the third energy level can hold?

ANSWER: 18
TOSS-UP

15) Earth and Space – Multiple Choice Which of the following is closest to the ratio of the energy released by a magnitude 5 earthquake to that of a magnitude 4 earthquake?

W) 10  
X) 16  
Y) 32  
Z) 64

ANSWER: Y) 32

BONUS

15) Earth and Space – Multiple Choice Which of the following does NOT affect weathering rates for a rock?

W) Parent material  
X) Climate  
Y) Fracture density  
Z) Soil texture

ANSWER: Z) SOIL TEXTURE

TOSS-UP

16) Life Science – Short Answer In what part of the cell does glycolysis [glye-KAWL-eh-sis] occur?

ANSWER: CYTOPLASM (ACCEPT: CYTOSOL)

BONUS

16) Life Science – Multiple Choice What structures are responsible for delivering amino acids to the ribosome [RYE-beh-sohm]?

W) mRNA  
X) dsRNA  
Y) tRNA  
Z) polymerase [paw-LIM-er-ace]

ANSWER: Y) tRNA
TOSS-UP

17) Math – Short Answer  What is the slope-intercept equation of the line through the origin that contains the point (6, −24) ?

ANSWER:  \( y = -4x \) (ACCEPT: \( y = -4x + 0 \))

BONUS

17) Math – Short Answer  A pyramid with 18 edges has how many faces?

ANSWER: 10

TOSS-UP

18) Energy – Multiple Choice  At the Environmental Molecular Sciences Laboratory, part of the Pacific Northwest National Laboratory, scientists are examining the formation of soot using jet fuel. How is soot formed?

W) Complete combustion of hydrocarbon fuels
X) Partial combustion of hydrocarbon fuels
Y) Wildfires
Z) Release of methane by livestock

ANSWER: X) PARTIAL COMBUSTION OF HYDROCARBON FUELS

BONUS

18) Energy – Short Answer  When uranium is inside a nuclear fuel rod, it is a compound in the form of black pellets. What is its chemical formula?

ANSWER: UO\(_2\)
**TOSS-UP**

19) Physical Science – *Short Answer*  
What physical principle is used to determine the buoyant force acting on a body?

**ANSWER: ARCHIMEDES' PRINCIPLE**

**BONUS**

19) Physical Science – *Short Answer*  
Identify all of the following three statements that are true of waves:  
1) Light cannot travel through a vacuum; 2) Sound cannot travel through a vacuum; 3) Sound waves travel faster than light waves.

**ANSWER: 2**

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**TOSS-UP**

20) Earth and Space – *Short Answer*  
The 21-centimeter hydrogen radiation line is detectable in what part of the electromagnetic spectrum?

**ANSWER: RADIO**

**BONUS**

20) Earth and Space – *Short Answer*  
Arrange the following three features of the solar system in order of increasing distance from the Sun: 1) Ceres *[SEER-eez]*; 2) Heliopause; 3) The farthest extent of the Oort *[ort]* cloud.

**ANSWER: 1, 2, 3**
TOSS-UP

21) Math — Short Answer  If the product of two binomials is $h^2 + 10h - 144$ and one factor is $h - 8$, what is the other factor?

ANSWER: $h + 18$

BONUS

21) Math — Short Answer  Giving your answer in base 8, what is ONE-SEVEN base 8 times FIVE-SIX base 8?

ANSWER: ONE-TWO-SIX-TWO (ACCEPT: 1262)

TOSS-UP

22) Life Science — Short Answer  Identify all of the following four vitamins that are fat soluble: 1) Vitamin A; 2) Vitamin C; 3) Vitamin D; 4) Vitamin B6.

ANSWER: 1 AND 3

BONUS

22) Life Science — Short Answer  What cells in the pancreas are the primary producers of the hormone insulin and are attacked by the immune system in type I diabetes?

ANSWER: BETA ISLET CELLS (ACCEPT: ISLET CELLS, BETA CELLS)
TOSS-UP

23) Physical Science – Short Answer  The rate of a chemical reaction is related to the minimum energy required to get the reaction going. What is the term for this energy?

ANSWER: ACTIVATION ENERGY

BONUS

23) Physical Science – Short Answer  Identify all of the following three acids that are considered weak acids: 1) Hydrochloric acid; 2) Acetic acid; 3) Ascorbic acid.

ANSWER: 2 AND 3