TOSS-UP

1) General Science – Short Answer  What energy in a nucleus is equivalent to the mass defect?

ANSWER: BINDING ENERGY

BONUS

1) General Science – Short Answer  Identify all of the following three diseases that are considered autoimmune disorders: 1) Lupus; 2) Acquired Immune Deficiency Syndrome; 3) Multiple Sclerosis.

ANSWER: 1 AND 3

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TOSS-UP

2) Life Science – Multiple Choice  What organ in the human body is responsible for storing glucose in the form of glycogen?

W) Pancreas
X) Kidney
Y) Liver
Z) Spleen

ANSWER: Y) LIVER

BONUS

2) Life Science – Multiple Choice  A scientist performs a Gram stain on an unknown strain of bacteria and observes that the bacteria are stained purple. What does this indicate about the bacteria?

W) Their nuclei are high in collagen
X) Their cell walls contain large amounts of peptidoglycan
Y) Their cell walls are surrounded by lipotoxins
Z) They contain membrane bound organelles

ANSWER: X) THEIR CELL WALLS CONTAIN LARGE AMOUNTS OF PEPTIDOGLYCAN
**TOSS-UP**

3) Math – *Multiple Choice*  Three identical circular plates sit at the very edge of a small square table. The plates are all tangent to each other, have collinear centers, and exactly fit the length of the table. The circumference of each plate is $12\pi$ inches. How many inches long is the table?

W) 36  
X) 72  
Y) $36\pi$  
Z) $72\pi$

ANSWER: W) 36

**BONUS**

3) Math – *Short Answer*  Find the surface area of a square pyramid whose base has sides of length 4 and a slant height of 6.

ANSWER: 64

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**TOSS-UP**

4) Earth and Space – *Multiple Choice*  What was the heaviest element produced during the big bang nucleosynthesis?

W) Hydrogen  
X) Helium  
Y) Lithium  
Z) Beryllium

ANSWER: Y) LITHIUM

**BONUS**

4) Earth and Space – *Short Answer*  What is the term for the small, atmospheric particles onto which water vapor condenses to form clouds?

ANSWER: CONDENSATION NUCLEI (ACCEPT: CLOUD CONDENSATION NUCLEI, CCN)
TOSS-UP

5) Physical Science – Multiple Choice  Compared to cooler air, warm air can hold:

W) More water vapor
X) Less water vapor
Y) The same amount of water vapor
Z) Less water vapor, depending upon the humidity

ANSWER: W) MORE WATER VAPOR

BONUS

5) Physical Science – Multiple Choice  Two electrons can occupy the same orbital if what value is different?

W) Principal quantum number
X) Angular momentum quantum number
Y) Magnetic quantum number
Z) Spin quantum number

ANSWER: Z) SPIN QUANTUM NUMBER

TOSS-UP

6) General Science – Multiple Choice  Which of the following is typically used to sterilize laboratory glassware:

W) Dishwasher
X) Freeze dryer
Y) Autoclave
Z) Centrifuge

ANSWER: Y) AUTOCLAVE

BONUS

6) General Science – Short Answer  What paradox, first published in 1826, suggested that in a static universe, the night sky would appear to be perpetually bright?

ANSWER: OLBER’S PARADOX
**TOSS-UP**

7) Physical Science – *Short Answer*  How many hydrogen atoms are contained in dichlorodifluoromethane?

**ANSWER:** ZERO

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**BONUS**

7) Physical Science – *Short Answer*  What term is used to describe the electrons in the highest energy level of an atom?

**ANSWER:** VALENCE

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**TOSS-UP**

8) Math – *Short Answer*  Determine the area of an equilateral triangle with side length square root of 3.

**ANSWER:** \( \frac{3 \times \text{sqrt} \_3}{4} \)

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**BONUS**

8) Math – *Short Answer*  Sam places 2 red shirts and one green shirt in a bag.  He places 3 blue pairs of shorts and one brown pair of shorts in a separate bag.  He also places 3 pairs of white socks in a third bag.  If he draws once from each bag, what is the probability that he will create a red, white, and blue outfit?

**ANSWER:** 50% (ACCEPT: \( \frac{1}{2} \))
TOSS-UP

9) Life Science – *Multiple Choice*  Unlike eutherians, both monotremes and marsupials are associated with which of the following?

W) No nipples  
X) Embryonic development outside the uterus  
Y) Egg laying  
Z) Found in Australia and Africa

ANSWER: X) EMBRYONIC DEVELOPMENT OUTSIDE THE UTERUS

BONUS

9) Life Science – *Multiple Choice*  Which of the following functional groups is possessed by alcohols?

W) Carbonyl  
X) Thiol [*thigh-ol*]  
Y) Hydroxyl [*high-drok-sil*]  
Z) Ketone

ANSWER: Y) HYDROXYL

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TOSS-UP

10) Energy – *Multiple Choice*  Raw natural gas contains approximately 5 percent of which of the following gases?

W) Octane  
X) Propane  
Y) Butanol  
Z) Methane

ANSWER: X) PROPANE

BONUS

10) Energy – *Short Answer*  Adding hydrogen gas to compressed natural gas reduces the emission of pollutants that contain oxygen and what other element?

ANSWER: NITROGEN
TOSS-UP

11) Earth and Space – Multiple Choice  Reverse and normal faults are both examples of what general type of fault?

W) Strike-slip fault
X) Dip-slip fault
Y) Transform fault
Z) Conservative fault

ANSWER: X) DIP-SLIP FAULT

BONUS

11) Earth and Space – Multiple Choice  Over the Earth’s history, ice ages have occurred approximately how often?

W) Every 2 million years
X) Every 20 million years
Y) Every 200 million years
Z) Every 2 billion years

ANSWER: Y) EVERY 200 MILLION YEARS

TOSS-UP

12) Physical Science – Multiple Choice  A ball is swinging in a circle on a string in the absence of gravity. When the string length is doubled at the same velocity, the force on the string will be:

W) Doubled
X) Quadrupled
Y) Halved
Z) Quartered

ANSWER: Y) HALVED

BONUS

12) Physical Science – Short Answer  Which of Kepler’s laws states that a satellite’s angular momentum is conserved as it orbits?

ANSWER: SECOND
TOSS-UP

13) Earth and Space – Short Answer  What law relates the distance between the Milky Way and another galaxy to the speed that galaxy is receding from us?

ANSWER: HUBBLE'S LAW

BONUS

13) Earth and Space – Short Answer  What is the specific name for the theory that gravity is just a curvature of spacetime?

ANSWER: GENERAL RELATIVITY  (DO NOT ACCEPT: RELATIVITY or SPECIAL RELATIVITY)

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TOSS-UP

14) General Science – Short Answer  An Atwood machine can be used to measure what fundamental force?

ANSWER: GRAVITY

BONUS

14) General Science – Multiple Choice  What can analog signals do that digital signals cannot do?

W) Carry only discrete values  
X) Transmit binary data  
Y) Transmit information  
Z) Have a continuum of values

ANSWER: Z) HAVE A CONTINUUM OF VALUES
TOSS-UP

15) Math – Short Answer  What is the greatest integer less than or equal to the square root of 500?

ANSWER: 22

BONUS

15) Math – Short Answer  Your fully charged cell phone is good for 8 hours. How many minutes remain after using 40% of the battery?

ANSWER: 288

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TOSS-UP

16) Life Science – Short Answer  Certain diseases, like hemophilia, are mostly contracted by men and inherited from their carrier mothers. On what specific chromosome do the genes for these diseases reside?

ANSWER: X CHROMOSOME

BONUS

16) Life Science – Short Answer  Tapeworms are part of what phylum?

ANSWER: PLATYHELMINTHES
**TOSS-UP**

17) Energy – *Short Answer*  Order the following three types of light bulbs from least efficient to most efficient: 1) LED; 2) Incandescent; 3) Compact fluorescent.

ANSWER: 2, 3, 1

**BONUS**

17) Energy – *Short Answer*  Identify all of the following three statements that are true about propane and its usage for energy: 1) it is a comparatively clean burning fossil fuel; 2) it is supplied to local propane dealers at distribution terminals; 3) it is used to heat asphalt for highway construction and repairs.

ANSWER: 1 AND 3

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**TOSS-UP**

18) Life Science – *Short Answer*  Aside from neurons, what other general type of cells are found in the nervous system?

ANSWER: GLIAL CELLS (ACCEPT: NEUROGLIA, GLIA)

**BONUS**

18) Life Science – *Multiple Choice*  Which of the following would be least likely to diffuse through the plasma membrane of a cell?

W) Estradiol  
X) Cholesterol  
Y) Water  
Z) Fibrinogen

ANSWER: Z) FIBRINOGEN
TOSS-UP

19) Earth and Space – Multiple Choice  What quantity is a measure of the amount of light that a star emits that reaches the Earth?

W) Absolute magnitude
X) Luminosity
Y) Temperature
Z) Apparent magnitude

ANSWER: Z) APPARENT MAGNITUDE

BONUS

19) Earth and Space – Short Answer  The Very Large Array is a set of telescopes designed to capture what type of radiation?

ANSWER: RADIO WAVES

TOSS-UP

20) Math – Short Answer  In terms of real numbers $p$ and $q$, for what value of $x$ is the function $-x^2 + px + q$ maximized?

ANSWER: $p/2$

BONUS

20) Math – Short Answer  Mary went shopping in two stores with her birthday gift money. In the first store, she spent three-fourths of what she had plus $3. In the second store, she spent two-thirds of what was left plus $2. She then had $5 left. How many dollars did she begin with?

ANSWER: 96
TOSS-UP

21) Energy – Multiple Choice  Which of the following fuels has an octane rating of greater than 100?

W) n-heptane  
X) Isopentane  
Y) Hexane  
Z) Propane  

ANSWER: Z) PROPANE

BONUS

21) Energy – Short Answer  What rating, similar to octane ratings for gasoline, is used to indicate the combustion speed of diesel fuel?

ANSWER: CETANE NUMBER

TOSS-UP

22) Physical Science – Short Answer  What quantum number determines the shape of an electron’s orbital?

ANSWER: AZIMUTHAL (ACCEPT: ANGULAR MOMENTUM; L)

BONUS

22) Physical Science – Short Answer  For the decomposition of gaseous N₂O₄ to form two gaseous NO₂ molecules, identify all of the following three changes that would shift the equilibrium to the products: 1) Addition of helium gas; 2) Removal of NO₂; 3) Isothermal compression of the container.

ANSWER: 2
TOSS-UP

23) General Science – Short Answer  What products are formed from the reaction of sodium hydroxide and hydrochloric acid?

ANSWER: WATER AND SALT (ACCEPT: H₂O AND NaCl)

BONUS

23) General Science – Short Answer  What series of techniques is used for separating mixtures of gases, liquids, or dissolved substances and has variations such as thin layer, column, and liquid?

ANSWER: CHROMATOGRAPHY