1) PHYSICAL SCIENCE  Short Answer  In which direction does the vector of centripetal (read as: sehN-TRI-pehl-tahl) acceleration point in uniform circular motion?

ANSWER: TOWARD THE CENTER OF THE CIRCLE

BONUS

1) PHYSICAL SCIENCE  Short Answer  If an object in uniform circular motion has a centripetal acceleration of 2 meters per second squared and is moving in a circle with a radius of 2 meters, what is its velocity in meters per second?

ANSWER: 2

____________________________________________________________________

2) GENERAL SCIENCE  Short Answer  How many carbon atoms are in a molecule of propanol?

ANSWER: 3

BONUS

2) GENERAL SCIENCE  Multiple Choice  Which of the following substances would be least likely to dissolve in water?

W) Polar compound  
X) Nonpolar compound  
Y) Ionic compound  
Z) Salt

ANSWER: X) NONPOLAR COMPOUND
3) LIFE SCIENCE  Multiple Choice  During which stage of mitosis do the chromosomes line up in the center of the nucleus?

W) Anaphase  
X) Prophase  
Y) Interphase  
Z) Metaphase

ANSWER: Z) METAPHASE

BONUS

3) LIFE SCIENCE  Short Answer  During what stage of meiosis does crossing over take place?

ANSWER: PROPAISE ONE

TOSS-UP

4) EARTH AND SPACE SCIENCE  Multiple Choice  Which of the following choices is NOT a condition required for the formation of a thunderstorm?

W) Humid air in low- to mid-troposphere  
X) Atmospheric instability  
Y) Relatively low temperatures  
Z) A source of uplift

ANSWER: Y) RELATIVELY LOW TEMPERATURES

BONUS

4) EARTH AND SPACE SCIENCE  Short Answer  What is the name for an elongated cluster of thunderstorm cells that is accompanied by a continuous gust front at the line’s leading edge?

ANSWER: SQUALL LINE
TOSS-UP

5) GENERAL SCIENCE  Short Answer  According to its nutrition facts, a candy bar contains 100 calories. Giving your answer to the nearest hundred, what would the equivalent be in joules?

ANSWER:  418,400 (ACCEPT: 418,000)

BONUS

5) GENERAL SCIENCE  Short Answer  Giving your answer to the nearest thousand, how many joules of energy are required to raise the temperature of 2 kilograms of water by 3 degrees Celsius?

ANSWER:  25,000

TOSS-UP

6) ENERGY  Short Answer  What type of device converts heat energy into mechanical work?

ANSWER:  HEAT ENGINE

BONUS

6) ENERGY  Multiple Choice  Which of the following devices exemplifies a reverse heat engine?

W) Diesel engine
X) Electrical generator
Y) Refrigerator
Z) Steam engine

ANSWER:  Y) REFRIGERATOR
TOSS-UP

7) GENERAL SCIENCE  *Multiple Choice*  Which of the following is not an example of a cartilaginous (read as: kahr-ti-LAH-ji-nehs) fish?

W) Longnose skate  
X) Pink salmon  
Y) Tiger shark  
Z) Sting ray  

ANSWER: X) PINK SALMON

BONUS

7) GENERAL SCIENCE  *Short Answer*  What is the adjective for a fish that is born in fresh water, swims to salt water, and returns to fresh water to spawn?

ANSWER: ANADROMOUS

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TOSS-UP

8) PHYSICAL SCIENCE  *Multiple Choice*  Which of the following could be used to neutralize an acid spill?

W) Hydrogen sulfide  
X) Calcium oxide  
Y) Water  
Z) Bromine  

ANSWER: X) CALCIUM OXIDE

BONUS

8) PHYSICAL SCIENCE  *Short Answer*  According to the Lewis definition of an acid, what can a Lewis acid accept from a Lewis base?

ANSWER: AN ELECTRON PAIR (ACCEPT: ELECTRONS)
TOSS-UP

9) EARTH AND SPACE SCIENCE  Short Answer  About what percentage of worldwide rainfall occurs in the tropics?

W) 14%
X) 45%
Y) 66%
Z) 85%

ANSWER: Y) 66%

BONUS

9) EARTH AND SPACE SCIENCE  Multiple Choice  The Tropical Rainfall Measuring Mission (TRMM) satellite was launched in 1997 with the primary mission of measuring rainfall from space using passive microwave and active radar sensors. Which of the following is NOT a benefit of TRMM?

W) Increased understanding of the water cycle
X) Increased understanding of the heat release associated with rainfall
Y) Increased understanding of contrails
Z) Better likelihood of accurate climate models

ANSWER: Y) INCREASED UNDERSTANDING OF CONTRAILS

TOSS-UP

10) MATH  Short Answer  What is the integer value that is equal to log 5 + log 2?

ANSWER: 1

BONUS

10) MATH  Short Answer  What is the volume of a rectangular pyramid in cubic meters if the length of the base is 3.5 meters, the width of the base is 4 meters and the height of the pyramid is 6 meters?

ANSWER: 28
11) PHYSICAL SCIENCE  *Multiple Choice*  Which of the following quantities is always conserved in an inelastic collision?

W) Kinetic energy  
X) Mechanical energy  
Y) Momentum  
Z) Impulse  

**ANSWER:** Y) MOMENTUM  

**BONUS**

11) PHYSICAL SCIENCE  *Short Answer*  The linear momentum of a particle is directly proportional to which two quantities?

**ANSWER:** MASS AND VELOCITY  

| ______________________________________________________________________ |

**TOSS-UP**

12) LIFE SCIENCE  *Short Answer*  Give the name currently used for the heterogeneous group of fungi in which scientists have never observed sexual reproduction.

**ANSWER:** IMPERFECT FUNGI (ACCEPT: DEUTEROMYCOTA)  

**BONUS**

12) LIFE SCIENCE  *Short Answer*  Name the best known product made from organisms classified as imperfect fungi.

**ANSWER:** PENICILLIN
TOSS-UP

13) MATH  Short Answer  What is the sum of all positive integer factors of 6?

ANSWER: 12

BONUS

13) MATH  Short Answer  Assuming all functions are defined, and expressing your answer in simplest form, evaluate \( \frac{n^2 + 7n - 8}{(n - 1)} \times \frac{n^2 - 4}{(n^2 + 6n - 16)} \)

Read as: open parenthesis \( n \) squared plus 7 \( n \) minus 8 close parenthesis over open parenthesis \( n \) minus 1 close parenthesis times the quantity open parenthesis \( n \) squared minus 4 close parenthesis over open parenthesis \( n \) squared plus 6 \( n \) minus 16 close parenthesis.

ANSWER: \( n + 2 \)

TOSS-UP

14) ENERGY  Short Answer  In a four stroke internal combustion engine, during which stroke is the energy transformed from chemical potential energy to kinetic energy?

ANSWER: POWER

BONUS

14) ENERGY  Short Answer  A car’s radiator is an example of a component that transfers heat generated within a solid material to a fluid medium. What is such a component called?

ANSWER: A HEAT SINK
TOSS-UP

15) PHYSICAL SCIENCE  Multiple Choice  When alkali metals such as sodium are placed in water, a gaseous substance is produced. What is this gas?

W) Water vapor  
X) Oxygen  
Y) Hydrogen  
Z) Carbon dioxide

ANSWER: Y) HYDROGEN

BONUS

15) PHYSICAL SCIENCE  Multiple Choice  Which of the following is NOT a transition metal?

W) Aluminum  
X) Zinc  
Y) Copper  
Z) Manganese

ANSWER: W) ALUMINUM

TOSS-UP

16) MATH  Short Answer  How many positive factors does the number 1051 have?

ANSWER: 2

BONUS

16) MATH  Short Answer  In right triangle ABC, angle A = 60°, angle C = 90°, and side AB = 10 centimeters. What is the length of side BC in centimeters?

ANSWER: $5\sqrt{3}$
17) LIFE SCIENCE  *Short Answer*  Since the 1970's, what have scientists observed about the size of global amphibian population?

**ANSWER:** THEY HAVE DECLINED

**BONUS**

17) LIFE SCIENCE  *Multiple Choice*  Which of the following correctly matches an order of amphibians and its characteristics?

W) Squamata: legs, clawed toes and external ears  
X) Anura: long bodies and tails  
Y) Apoda: tentacles and fishlike scales  
Z) Urodela: no tails, can jump

**ANSWER:** Y) APODA: TENTACLES AND FISHLIKE SCALES

18) ENERGY  *Short Answer*  What chemical reaction is necessary to convert the chemical energy from fossil fuels into useable forms of energy such as electricity?

**ANSWER:** COMBUSTION (ACCEPT: OXIDATION)

**BONUS**

18) ENERGY  *Multiple Choice*  Which of the following is the typical shape of a charged particle’s path in a magnetic field?

W) Elliptical  
X) Circular  
Y) Parabolic  
Z) Hyperbolic

**ANSWER:** X) CIRCULAR
19) EARTH AND SPACE SCIENCE  Short Answer  If Jupiter is approximately 5 times further from the Sun than the Earth, what fraction of the intensity of light does it receive relative to the Earth?

ANSWER: 1/25

BONUS

19) EARTH AND SPACE SCIENCE  Multiple Choice  If you see the Moon in the western sky just above the setting Sun, what is the Moon’s phase?

W) New moon
X) Full moon
Y) Gibbous
Z) Waxing crescent

ANSWER: Z) WAXING CRESCENT

20) MATH  Short Answer  What are the $x$-intercepts for the function $f(x) = x^2 - x - 12$?

ANSWER: (4, 0) AND (-3, 0) (ACCEPT: 4 AND -3)

BONUS

20) MATH  Short Answer  Find the reference angle to angle $A = \frac{21\pi}{8}$

\[
\frac{3\pi}{8}
\]

ANSWER: \[
\frac{3\pi}{8}
\]
TOSS-UP

21) LIFE SCIENCE  Multiple Choice  The similarities between the lungs of a reptile and the air bladder of a fish can be described, in evolutionary terms, as:

W) Homologous (read as: hōe-MOH-loh-gehs) structures
X) Erroneous structures
Y) Vestigial structures
Z) Inert structures

ANSWER: W) HOMOLOGOUS STRUCTURES

BONUS

21) LIFE SCIENCE  Short Answer  The similarities between the wings of a bat and the wings of a dragonfly can be described, in evolutionary terms, as what type of structures?

ANSWER: ANALOGOUS

TOSS-UP

22) GENERAL SCIENCE  Multiple Choice  The intramolecular bonds that hold together an individual water molecule can be classified as which of the following?

W) Polar covalent
X) Nonpolar covalent
Y) Hydrogen bonds
Z) Ionic bonds

ANSWER: W) POLAR COVALENT

BONUS

22) GENERAL SCIENCE  Short Answer  What type of bonds are the main intermolecular forces that allow water molecules to undergo cohesion?

ANSWER: HYDROGEN BONDS
23) EARTH AND SPACE SCIENCE  *Multiple Choice*  Which north or south latitude experiences the greatest variation in sun exposure over the course of the year?

W) 0°
X) 30°
Y) 60°
Z) 90°

**ANSWER:** Z) 90°

**BONUS**

23) EARTH AND SPACE SCIENCE  *Short Answer*  What geological feature is responsible for the dark spots on the moon?

**ANSWER:** SOLID POOLS OF LAVA (ACCEPT: BASALTIC LAVA)

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24) MATH  *Multiple Choice*  Which of the following is true about the function $y = \frac{6}{5}x^3 + 4$?

W) The function is odd
X) The function is even
Y) The function is positive
Z) The function is neither odd nor even

**ANSWER:** Z) THE FUNCTION IS NEITHER ODD NOR EVEN

**BONUS**

24) MATH  *Short Answer*  What is the radius in units of a cone with a volume of $384\pi$ cubic units and a height of 8 units?

**ANSWER:** 12
TOSS-UP

25) EARTH AND SPACE SCIENCE  Multiple Choice  Marcellus shale occurs in the subsurface under several states. Which of the following is NOT one of them?

W) Indiana  
X) Ohio  
Y) Pennsylvania  
Z) West Virginia

ANSWER:  W) INDIANA

BONUS

25) EARTH AND SPACE SCIENCE  Short Answer  Recently, deposits of which natural resource were found in the Marcellus shale of the Appalachian Basin?

ANSWER:  NATURAL GAS