**TOSS-UP**

1) Biology – *Short Answer* Commonly caused by a virus in the United States, this sickness entails inflamed alveoli in the lungs, an excess of fluid or pus in the air sacs, high fever, and difficulty breathing. It can also be caused by the bacterium *Streptococcus pneumoniae* and thus requires antibiotics to be treated. What infection is this?

ANSWER: PNEUMONIA

**BONUS**

1) Biology – *Short Answer* Unlike Cartilaginous Fish such as sharks, Bony fish do not rely on their pectoral fins to stay afloat. Instead, they possess a structure theorized to have an evolutionary relationship with the lung and allows the fish to maintain buoyancy. What is the name of this structure?

ANSWER: SWIM BLADDER

**TOSS-UP**

2) Chemistry – *Short Answer* Name the effect that will decrease the solubility of silver chloride in a solution of sodium chloride.

ANSWER: COMMON ION EFFECT

**BONUS**

2) Chemistry – *Multiple Choice* For which of the following titrations will phenolphthalein be an appropriate choice of indicator?

W) HCl and NaOH
X) NaOH and acetic acid
Y) HCl and sodium acetate
Z) NaOH and H2SO4

ANSWER: X

**TOSS-UP**

3) Physics – *Multiple Choice* Which of the following is closest to the percentage of cosmic rays that are composed of a single proton?

W) 90%
X) 75%
Y) 50%

Z) 15%

ANSWER: W) 90%

**BONUS**

3) Physics – *Short Answer* What is the term for cosmic rays which are nuclei of elements heavier than helium?

ANSWER: HZE IONS

**TOSS-UP**

4) Math – *Short Answer* Find the second derivative of the following function: $y=x^4+x^2$

ANSWER: $12x^2+2$

**BONUS**

4) Math – *Short Answer* Find dy/dx of the following expression. $x^3+y=0$.

ANSWER: $-3x^2$

**TOSS-UP**

5) Earth and Space – *Short Answer* What is the term for the weathering process of sand grains in which they bounce along the ground due to the wind?

ANSWER: SALTATION

**BONUS**

5) Earth and Space – *Multiple Choice* Which of the following is a mafic, extrusive igneous rock?

W) Basalt
X) Gabbro
Y) Granite
Z) Rhyolite

ANSWER: W) BASALT

**TOSS-UP**

6) Energy – *Short Answer* What is the name for the phenomenon that allows solar panels to function, in which light energy is converted to electrical energy?

ANSWER: Photovoltaic effect

**BONUS**

6) Energy – *Multiple Choice* Which of the following best explains the difference between the photovoltaic effect and the photoelectric effect?

W) The photoelectric effect involves the emission of electrons while the photovoltaic effect does not.
X) The photoelectric effect generates an electric current while the photovoltaic effect does not.
Y) The photoelectric effect only occurs in vacuums while the photovoltaic effect does not.
Z) The photoelectric effect occurs when a substance is exposed to light while the photovoltaic effect occurs when a substance is exposed to current.

ANSWER: W) The photoelectric effect involves the emission of electrons while the photovoltaic effect does not.

**TOSS-UP**

7) Biology – *Short Answer* A virus also known as Rubeola commonly causes a high fever, runny nose, dry cough, sensitivity to light, as well as tiny white dots on the inner lining of the cheek known as Koplik's Spots to form. While uncommon in the United States currently, outbreaks still occur in other portions of the world. What is the other name of this virus?

ANSWER: MEASLES

**BONUS**

7) Biology – *Multiple Choice* Down Syndrome, also known as Trisomy 21, is caused by abnormal cell division that results in a zygote containing three copies of chromosome 21 as opposed to two. This abnormal division occurs during Anaphase 1 of Meiosis. What is the common name for this Chromosomal mutation?

W) Deletion
X) Duplication
Y) Inversion
Z) Nondisjunction

ANSWER: Z

**TOSS-UP**

8) Chemistry – *Short Answer* Calculate the molality of dissolving 90g of fructose in 1 L of water assuming that the molar mass of fructose is 180g/mol.

ANSWER: 0.5

**BONUS**

8) Chemistry – *Short Answe*r Calculate the freezing point of a 3 molal solution of calcium chloride. Assuming K_f (READ: K sub f) is 1.9. Assume Give your answer in Celsius.

ANSWER: -17.1

**TOSS-UP**

9) Physics – *Short Answer* What is the term for a short burst of localized wave action that travels as a unit?

ANSWER: WAVE PACKET

**BONUS**

9) Physics – *Multiple Choice* Which of the following is the term for optic media in which the phase velocity of a wave depends on the frequency?

W) Achromatic media
X) Absorptive media
Y) Dispersive media
Z) Propagative media

ANSWER: Y) DISPERSIVE MEDIA

**TOSS-UP**

10) Math – *Short Answer* Find the inverse function for the function $f(x)=x^2-3$

ANSWER: $f^{-1}(x) = \sqrt{x+3}$

**BONUS**

10) Math – *Short Answer* Compute the following two limits.
A) Lim as x approaches 0 of sin(x)/x
B) Lim as x approaches 1 of the fraction with numerator (x-1) and denominator ($\sqrt{x} - 1$)

ANSWER: A) 1 B) 2

**TOSS-UP**

11) Earth and Space – *Short Answer* What is the chemical formula of quartz?

ANSWER: SI O2

**BONUS**

11) Earth and Space – *Short Answer* What is the term for a salt flat created by eroded salts that were carried to an alluvial fan that has dried up, leaving the salt behind?

ANSWER: PLAYA

**TOSS-UP**

12) Energy – *Multiple Choice* Which of the following is not an advantage of thorium nuclear reactors over Uranium nuclear reactors?

W) Thorium is much more abundant in Earth than Uranium.
X) Thorium reactors have lower start - up costs than Uranium reactors.
Y) Thorium reactors are more stable than Uranium reactors.
Z) Thorium reactors produce less nuclear waste than Uranium reactors.

ANSWER: X) Thorium reactors have lower start - up costs than Uranium reactors.

**BONUS**

12) Energy – *Short Answer* In 1989, Martin Fleischmann and Stanley Pons reported a nuclear phenomenon, which was believed to be a more feasible alternative to the extremely costly and inefficient process of nuclear fusion. However, after multiple similar experiments, scientists discovered that the results were not replicable, and this theory lost all support. Provide the name of this hypothesized alternative process to nuclear fusion.

ANSWER: Cold fusion

**TOSS-UP**

13) Biology – *Multiple Choice* What is the resting potential of a cell?

W) -50 mV
X) -70 mV
Y) -100 mV
Z) 30 mV

ANSWER: X

**BONUS**

13) Biology – *Short Answe*r Sound waves in the ear cause the tympanic membrane to vibrate which then causes movement in the ossicles. The movement of the ossicles then causes this structure to vibrate, which leads to movement of fluid in the Cochlea. What structure is this?

ANSWER: OVAL WINDOW

**TOSS-UP**

14) Chemistry – *Short Answer* What law relates a gas's pressure and its solubility?

ANSWER: HENRY'S LAW

**BONUS**

14) Chemistry – *Multiple Choice* Which of the following dissolve endothermically?

W) Sulfuric acid
X) Sodium hydroxide
Y) Calcium chloride
Z) Ammonium nitrate

ANSWER: Z

**TOSS-UP**

15) Physics – *Multiple Choice* Which of the following is not one of Kepler's laws?

W) The redshifts in the spectra of distant galaxies are proportional to their distance
X) A line segment joining a planet and the Sun sweeps out equal areas during equal intervals of time
Y) The orbit of a planet is an ellipse with the Sun at one of the two foci
Z) The square of a planet's orbital period is proportional to the cube of the semi-major of its orbit

ANSWER: W) THE REDSHIFTS IN THE SPECTRA OF DISTANT GALAXIES ARE PROPORTIONAL TO THEIR DISTANCE

**BONUS**

15) Physics – *Short Answer* What scientist was the first to make an estimation of Hubble's constant?

ANSWER: GEORGES LEMAITRE

**TOSS-UP**

16) Math – *Short Answer* In a normal distribution, what percent of values lie within one standard deviation of the mean. Round to the nearest whole number.

ANSWER: 68

**BONUS**

16) Math – *Short Answer* What is the z-score of a value of 99 in a normally distributed dataset with median 73 and standard deviation 7. Give your answer as a decimal to two decimal places.

ANSWER: 3.71

**TOSS-UP**

17) Earth and Space – *Multiple Choice* In which corner of the H-R diagram would you find an M dwarf?

W) Top-left
X) Bottom-left
Y) Bottom-right
Z) Top-right

ANSWER: X) BOTTOM-LEFT

**BONUS**

17) Earth and Space – *Multiple Choice* In which direction would you have to go from the sun to reach a star of spectral class G and luminosity 5 times that of the sun on the H-R diagram?

W) Up
X) Down
Y) Left
Z) Right

ANSWER: W) UP

**TOSS-UP**

18) Energy – *Short Answer* What type of hydroelectric system utilizes two water reservoirs at different elevations to create power.

ANSWER: Pumped - storage hydropower

**BONUS**

18) Energy – *Short Answer* What state in the United States of America has the largest hydropower generation capacity?

ANSWER: Washington

**TOSS-UP**

19) Biology – *Short Answe*r A stack of thylakoids in a chloroplast is known as what?
ANSWER: GRANUM

**BONUS**

19) Biology– *Short* Answer Responsible for acute and precise central vision, this part of the eye, typically located at the center, has the highest concentration of retinal cones. What is the correct name for this section of the eye?

ANSWER: FOVEA

**TOSS-UP**

20) Chemistry – *Multiple Choice* Carbon 14 undergoes which of the following types of radioactive decay.

W) Alpha
X) Beta Plus
Y) Beta Minus
Z) Gamma

ANSWER: Y

**BONUS**

20) Chemistry – *Multiple Choice* Which of the following is not considered a "magic number" for the atomic mass of a nucleon?

W) 20
X) 52
Y) 82
Z) 114

ANSWER: X

**TOSS-UP**

21) Physics – *Multiple Choice* Which of the following electrical components converts alternating to direct current?

W) Transformer
X) Rectifier
Y) Capacitor
Z) Diode

ANSWER: X) RECTIFIER

**BONUS**

21) Physics – *Short Answer* The average DC output voltage of a single-phase half-wave rectifier is equal to the peak AC voltage divided by what constant?

ANSWER: PI

**TOSS-UP**

22) Math – *Short Answer* Convert the following polar equation to rectangular coordinates. $r = sin(\theta)$

ANSWER: $x^2+y^2=y$ (ACCEPT EQUIVALENT FORMS)

**BONUS**

22) Math – *Short Answer* Convert the parametric equation below to polar coordinates. $x=t^2$ and $y=t$.

ANSWER: $r * sin(\theta) = \sqrt{r * cos(\theta)}$

**TOSS-UP**

23) Earth and Space – *Short Answer* The Hawaiian islands are almost entirely composed of what rock?

ANSWER: BASALT

**BONUS**

23) Earth and Space – *Short Answer* What is the term for a large undersea mountain that does not reach the sea surface?

ANSWER: SEAMOUNT