TOSS-UP

1) CHEMISTRY *Short Answer* The concept of absolute zero was established from extrapolation using which gas law?

ANSWER: CHARLES LAW

# BONUS

1) CHEMISTRY *Multiple Choice* If the distance between two dipoles is tripled, by what factor does the attraction between them decrease?:

W) 3 times

X) 9 times

Y) 12 times

Z) 27 times

ANSWER: Z) 27 TIMES

# TOSS-UP

2) PHYSICS *Short Answer* Which famous scientist is known for discovering curium, fermium, and einsteinium?

ANSWER: GLENN SEABORG (Accept: SEABORG)

# BONUS

2) PHYSICS *Short Answer* Name this system of mechanics, proposed in 1833, that arose from Langrangian mechanics and provided a new and equivalent way of looking at classical mechanics that provided deeper insights, allowing for a connection between classical mechanics and quantum mechanics?

ANSWER: HAMILTONIAN MECHANICS

**TOSS-UP**

3) BIOLOGY *Short Answer* When genes undergo duplication and then accumulate so many mutations that they become inactive, they are called what?

ANSWER: PSUEDOGENES

# BONUS

3) BIOLOGY *Short Answer* Which type of gene is commonly known as a “selfish gene” and functions by being reverse transcribed back into the genome?

ANSWER: RETROTRANSPOSON

# TOSS-UP

4) ASTRONOMY *Multiple Choice* Supernovae occur in the Milky Way approximately every how many years?

W) 5 years

X) 20 years

Y) 50 years

Z) 100 years

ANSWER: Y) 50 YEARS

# BONUS

4) ASTRONOMY *Short Answer* Stars above the Tolman-Oppenheimer-Volkoff limit generally undergo which type of supernova?

ANSWER: TYPE II SUPERNOVA

**TOSS-UP**

5) MATH *Short Answer* Which two sets cannot be categorized as open or closed?

ANSWER: OPEN SET AND NULL SET

# BONUS

5) MATH *Multiple Choice* Which of the following is an approximation of the sine of 45 degrees?

W) 1.42

X) .71

Y) .87

Z) .50

ANSWER: X) .71

# TOSS-UP

6) EARTH SCIENCE *Multiple Choice* Most fossil resin dates from what period?

w) Silurian

x) Hadean

y) Devonian

z) Tertiary

ANSWER: Z) TERTIARY

# BONUS

6) EARTH SCIENCE *Short Answer* The Age of Reptiles followed which mass extinction event?

ANSWER: PERMIAN-TRIASSIC (Accept: PERMIAN)

**TOSS-UP**

7) GENERAL SCIENCE *Multiple Choice* The presence of a secondary palate allows for what ability in humans?

W) presence of olfactory pits

X) chewing

Y) the ability to roll the tongue

Z) swallowing while breathing

ANSWER: Z) SWALLOWING WHILE BREATHING

# BONUS

7) GENERAL SCIENCE *Short Answer* Name all of the following extant orders: Placodontia, Pleiosauria, and Sphenodontia

ANSWER: SPHENODONTIA

# TOSS-UP

8) EARTH SCIENCE *Short Answer* Three degrees of change in latitude causes as much climate change as how many feet of elevation?

ANSWER: 1000 FEET

# BONUS

8) EARTH SCIENCE *Short Answer* Snow that persists for an entire year is known as what?

ANSWER: FIRN

**TOSS-UP**

9) CHEMISTRY *Short Answer*  Calculate the formal charge on the center sulfur in the thiosulfate ion, which has an overall charge of -2.

ANSWER: PLUS ONE

# BONUS

9) CHEMISTRY *Short Answer* Name this compound, also known as Mohr’s salt, that is commonly used for standardization of potassium permanganate and other reactive species.

ANSWER: FERROUS AMMONIUM SULFATE

# TOSS-UP

10) PHYSICS *Multiple Choice* If the absolute temperature of the filament of a lamp were doubled, the energy radiated per second by the filament would increase by a factor of what?

ANSWER: 16 (SIXTEEN)

# BONUS

10) PHYSICS *Short Answer* Order the following 4 kinds of light bulbs from most efficient to least efficient: glass halogen, 60 Watt Tungsten incandescent, monochromatic 555 nm source

ANSWER: 60 WATT TUNGSTEN INCANDESCENT, GLASS HALOGEN, 555 NM SOURCE

**TOSS-UP**

11) BIOLOGY *Short Answer* Which immunoglobulin protein is responsible for activating the complement system during an initial infection by a bacteria?

ANSWER: IMMUNOGLOBULIN M (Accept: IgM)

# BONUS

11) BIOLOGY *Short Answer* Zeatin is the most commonly found form of what plant hormone family?

ANSWER: CYTOKININS

# TOSS-UP

12) ASTRONOMY *Short Answer* Name all of the following that would normally be observed using a radio telescope: pulsars, planetary nebulae, supernovae, and black holes.

ANSWER: PULSARS AND SUPERNOVAE

# BONUS

12) ASTRONOMY *Multiple Choice* Atmospheric Cherenkov telescopes are meant to indirectly detect what?

W) ultraviolet light

X) auroras

Y) solar flares

Z) high energy gamma rays

ANSWER: Z) HIGH ENERGY GAMMA RAYS

**TOSS-UP**

13) MATH *Short Answer* Find the derivative of the function: log 3X

ANSWER: NATURAL LOG OF 3 DIVIDED BY X (  )

# BONUS

13) MATH *Short Answer* In the study of calculus, who is responsible for the prime notation of expressing functions and their derivatives?

ANSWER: JOSEPH-LOUIS LAGRANGE (Accept: LAGRANGE)

# 

# TOSS-UP

14) EARTH SCIENCE *Short Answer* Which glacial structures, similar to drumlins, are formed when glaciers retreat over an area that contains a particularly hard rock core?

ANSWER: CRAG

# BONUS

14) EARTH SCIENCE *Multiple Choice* Which of the following glacial landforms is created by a braided stream flowing from the front end of a glacier?

W) eskers

X) kames

Y) moraines

Z) outwash fans

ANSWER: Z) OUTWASH FAN

**TOSS-UP**

15) GENERAL SCIENCE *Multiple Choice* Which of the following diseases is caused by a deficiency in calciferol, or vitamin D?

W) pellagra

X) xerophthalmia (pronounce: zeer-op-thal-me-uh)

Y) osteomalacia (pronounce: ost-ee-oh-ma-lay-she-ah)

Z) tetany

ANSWER: Y) OSTEOMALACIA

# BONUS

15) GENERAL SCIENCE *Short Answer* Name the scientist who proposed that there was no conservation of photons, and, along with Einstein, predicted a new state of matter in the 1920s.

ANSWER: SATYENDRA NATH BOSE (Accept: BOSE)

# TOSS-UP

16) ASTRONOMY *Multiple Choice* Which of the following astronomers is famous for, among other accomplishments, discovered 13 comets and publishing a catalogue of deep sky objects in the late 1700s?

W) Pierre Laplace

X) Nicolaus Copernicus

Y) Charles Messier

Z) Henry Draper

ANSWER: Y) CHARLES MESSIER

# BONUS

16) ASTRONOMY *Short Answer* What celestial group of objects are divided into various types using the Trumpler classification?

ANSWER: OPEN CLUSTERS

**TOSS-UP**

17) CHEMISTRY *Multiple Choice*  The Lennard-Jones potential is used to describe which of the following types of interactions?:

W) dipole-dipole

X) dipole-induced dipole

Y) ion-dipole

Z) dispersion forces

ANSWER: Z) DISPERSION FORCES

# BONUS

17) CHEMISTRY *Short Answer* Which law states that the energy change for any chemical or physical reaction is independent of the pathway taken to complete the process and only the initial and final states are of any importance?

ANSWER: HESS’S LAW

# TOSS-UP

18) PHYSICS *Multiple Choice* Which of the following quantities which is measured in multiples of h-bar, can be used to correct for flaws in Schrodinger’s equation and Bohr’s formula

W) magnetic number

X) spin

Y) color

Z) isospin

ANSWER: X) SPIN

# BONUS

18) PHYSICS *Short Answer* Name this effect for which the maximum energy involved is given by the equation h x f – phi and it only occurs if h x f is greater than the work function.

ANSWER: PHOTOELECTRIC EFFECT (Accept: HERTZ EFFECT)

**TOSS-UP**

19) BIOLOGY *Short Answer* Which eukaryotic organelle is characterized by the presence of the enzyme catalase?

ANSWER: PEROXISOMES

# BONUS

19) BIOLOGY *Short Answer* Which neurotransmitter is responsible for the production of the action potential that causes the sarcoplasmic reticulum to release calcium ions in mammals?

ANSWER: ACETYLCHOLINE

# TOSS-UP

20) ASTRONOMY *Multiple Choice* Where on a Hertzsprung-Russel diagram would you find a blue supergiant?

W) top right

X) top left

Y) bottom right

Z) bottom left

ANSWER: X) TOP LEFT

# BONUS

20) ASTRONOMY *Short Answer* What is the term for a white dwarf that has cooled so much that it no longer emits significant heat or light?

ANSWER: BLACK DWARF

**TOSS-UP**

21) MATH *Short Answer* What is the number 26 in base eight?

ANSWER: 32

# BONUS

21) MATH *Short Answer* Which theorem states that all integers can be written as the product of primes?

ANSWER: FUNDAMENTAL THEOREM OF ARITHMETIC

# TOSS-UP

22) GENERAL SCIENCE *Multiple Choice* Mill’s theorem states that the floor of the exponential function A3n is what?

W) real number

X) real function

Y) prime number

Z) integer

ANSWER: Y) PRIME NUMBER

# BONUS

22) GENERAL SCIENCE *Multiple Choice* Which of the following elements is neither metal nor nonmetal?:

W) Sulfur

X) Chlorine

Y) Iridium

Z) Arsenic

ANSWER: Z) ARSENIC

**TOSS-UP**

23) CHEMISTRY *Multiple Choice* Which of the following elements cannot participate in hydrogen bonding?

W) Fluorine

X) Chlorine

Y) Nitrogen

Z) Oxygen

ANSWER: X) CHLORINE

# BONUS

23) CHEMISTRY *Short Answer* What is the molecular geometry of the RnCl2O22- ion?

ANSWER: SQUARE PLANAR

# TOSS-UP

24) PHYSICS *Short Answer* Name this quark which is approximately the size of a rhenium nucleus, was originally named the truth quark, and was the last quark to be discovered.

ANSWER: TOP QUARK

# BONUS

24) PHYSICS *Short Answer* The creation of a potential difference across a conducter by a perpendicular magnetic field is due to what effect?

ANSWER: HALL EFFECT

**TOSS-UP**

25) BIOLOGY *Multiple Choice* Which type of eukaryotic cell is unique in that their cytoskeletal network contains spectrin and ankyrin, are produced through the work of EPO, lack nuclei, and contain hemoglobin?

W) Monocytes

X) Erythrocytes

#### Y) Phagocytes

Z) Chondrocytes

ANSWER: X) ERYTHROCYTES

# BONUS

25) BIOLOGY *Short Answer* One of the major differences between hemidesmosomes and focal adhesions is that hemidesmosomes are attached to intermediate filaments, while focal adhesions are attached to what?

ANSWER: MICROFILAMENTS (Accept: ACTIN FILAMENTS)