TOSS-UP

1) Chemistry *Short Answer* Name all of the following 3 compounds which contain Arsenic:
1) Paris Green 2) Lewisite 3) Roxarsone.

ANSWER: All

BONUS

1) Chemistry *Multiple Choice* The Haber process has a **Δ**H (delta H) value of approximately how many kJ/M ***[kilojoules per mole]***:

W) -55 to -65
X) -65 to -75
Y) 85 to 95
Z) -85 to -95

ANSWER: Z) -85 to -95

TOSS-UP

2) Earth and Space *Multiple Choice* Clays of Iridium are most commonly found near which landforms:

W) Impact craters
X) River deltas
Y) Shield volcanoes
Z) Pyroclastic flows

ANSWER: W) Impact Craters

BONUS

2) Earth and Space *Short Answer* By name or number list all of the following 4 periods that are a part of the Paleozoic Era: 1) Devonian; 2) Siderian; 3) Neogene; 4) Carboniferous.

ANSWER: 1 AND 4

TOSS-UP

3) Physics *Short Answer* What law of electromagnetism describes the magnetic field generated by a constant electric current, named after two French Scientists?

ANSWER: Biot-Savart Law

BONUS

3) Physics *Multiple Choice* Which of the following gases would have the largest root mean square velocity:

W) Helium gas at 200 Kelvin
X) Carbon tetrachloride at 400 Kelvin
Y) Hydrogen gas at 200 Kelvin
Z) Helium gas at 20 Kelvin

ANSWER: Y) Hydrogen gas at 200 Kelvin

TOSS-UP

4) Math *Multiple Choice* Which of the following is the approximate degree measure of theta when changing the point (-28,21) into polar coordinates:

W) 127
X) 143
Y) 233
Z) 323

ANSWER: X) 143

BONUS

4) Math – *Multiple Choice* Given that $\log_{10}2 \approx 0.30$ and $\log_{10}e \approx 0.43$, which of the following powers of ten is closest in value to 20! ***[20 factorial]***?

W) 10^{15}
X) 10^{18}
Y) 10^{21}
Z) 10^{24}

ANSWER: X) 10^{18}

TOSS-UP

5) Biology *Short Answer* What fat-soluble secosteroid, also known as calciferol, helps bones absorb Phosphorus and Calcium?

ANSWER: Vitamin D (Accept: Vitamin D2)

BONUS

5) Biology *Short Answer* By name or number, name all of the following that good sources of Vitamin D: 1) Sunlight 2) Fish Oils 3) Egg Yolk 4) Common Nuts

ANSWER: 1) Sunlight 2) Fish Oils 3) Egg Yolk (Accept: All but 4)

TOSS-UP

6) Physics *Multiple Choice* The tau particle, along with three types of neutrinos are part of the lepton family. What are the other two particles that are classified as leptons?

W) Meson and Proton
X) Electron Neutrino and Muon
Y) Electron and Muon
Z) Electron and Tau Neutrino

ANSWER: Y) Electron and Muon

BONUS

6) Physics *Multiple Choice* What vector represents the energy of an electromagnetic wave?

W) Jefimenko Vector
X) Poynting Vector
Y) London Vector
Z) Lorenz Vector

ANSWER: X) Poynting Vector

TOSS-UP

7) Chemistry *Multiple Choice* Which of the following reactions adds an alkyl group to a benzene ring?

W) Friedel-Crafts Acylation
X) Suzuki Coupling
Y) Friedel-Crafts Alkylation
Z) Birch Reduction

ANSWER: Y) Friedel-Crafts Alkylation

BONUS

7) Chemistry *Short Answer* Within 10 grams, what is the mass of oxygen that reacts with 9.61 grams of propane?

ANSWER: 349 grams (Accept any value within 10 grams)

TOSS-UP

8) Math *Multiple Choice* Which of the following is equivalent to $\sin(43°)\cos(47°) + \sin(47°)\cos(43°)$:

W) $\cos(40°)$
X) $\sin(50°)$
Y) $\sin(90°)$
Z) $\cos(90°)$

ANSWER: Y) $\sin(90°)$

BONUS

8) Math *Short Answer* What is 53 choose 3?

ANSWER: 23426

TOSS-UP

9) Earth and Space *Short Answer* Uranus and what other planet exhibit retrograde rotation?

ANSWER: Venus

BONUS

9) Earth and Space *Multiple Choice* Which of the following is NOT associated with La Niña:

W) Southeasterly Trade Winds weaken
X) Upwelling off South America nearly ceases
Y) Australia experiences increased precipitation
Z) The Eastern Pacific warms

ANSWER: Y) Australia experiences increased precipitation

TOSS-UP

10) Chemistry *Short Answer* Rank the following bonds in order of increasing bond length:
1) Iodine-Iodine 2) Fluorine-Bromine 3) Fluorine-Fluorine 4) Bromine-Iodine

ANSWER: 3) Fluorine-Fluorine, 2) Fluorine-Bromine, 4) Bromine-Iodine, 1) Iodine-Iodine (Accept: 3,2,4,1)

BONUS

10) Chemistry *Multiple Choice* Which of the following is true of the Diels-Alder reaction, in which a conjugated diene and a substituted alkene react to form a cyclohexene derivative?

W) Its standard enthalpy and entropy of reaction are both positive
X) It occurs via a concerted mechanism
Y) It exhibits poor regioselectivity
Z) It proceeds through antarafacial interactions

ANSWER: X) IT OCCURS VIA A CONCERTED MECHANISM

TOSS-UP

11) Biology *Short Answer* What is the term for a malignant tumor of connective or other non epithelial tissue?

ANSWER: Sarcoma

BONUS

11) Biology *Multiple Choice* Ingesting which animal would provide the largest amount of Polonium-210:

W) Moth
X) Scallop
Y) Goat
Z) Cow

ANSWER: X) Scallop

TOSS-UP

12) Math *Short Answer* Compute the determinant of the two by two matrix, from left to right, with first row 2, -3 and second row 4,15.

ANSWER: 42

BONUS

12) Math *Short Answer* What is the equation of the plane that has a normal line with equation: x=4+5t, y=5+6t, z=6-7t and that passes through the point (-1,1,2)?

ANSWER: 5(x+1) + 6(y-1) - 7(z-2)=0 or 5x + 6y - 7z = -13 (Accept any other equivalent answers)

TOSS-UP

13) Biology *Multiple Choice* What is the name of the bacterial infection that causes a grey or white patch to develop in the throat, and is sometimes referred to as Bull's neck?

W) Pneumonia
X) Chlamydia
Y) Diphtheria
Z) Tonsillitis

ANSWER: Y) Diphtheria

BONUS

13) Biology – *Multiple Choice* Which of the following would most likely be used to treat a patient with myasthenia gravis?

W) Acetylcholinesterase inhibitors
X) Beta-lactam antibiotics
Y) Corticosteroids
Z) Proton-pump inhibitors

ANSWER: W) ACETYLCHOLINESTERASE INHIBITORS

TOSS-UP

14) Physics *Short Answer* What antiparticle is produced in beta-plus decay?

ANSWER: Positron

BONUS

14) Physics *Multiple Choice* Which of the following is the approximate momentum of an electromagnetic wave with energy of 9000 Joules?

W) 10^{-5}
X) $3*10^{-5}$
Y) 10^{-6}
Z) $7*10^{-7}$

ANSWER: X) $3*10^{-5}$

TOSS-UP

15) Earth and Space *Multiple Choice* Which of the following is a coarse-grained basaltic rock?

W) Diorite
X) Basalt
Y) Peridotite
Z) Gabbro

ANSWER: Z) Gabbro

BONUS

15) Earth and Space *Multiple Choice* When does a first quarter moon rise?
W) Sunrise
X) Sunset
Y) Noon
Z) Midnight

ANSWER: Y) Noon

TOSS-UP

16) Chemistry *Short Answer* What is the bond order of O_2^+ ***[O two plus]***?

ANSWER: 2.5

BONUS

16) Chemistry *Multiple Choice* Which of the following is NOT accurate about the molecular orbital diagram for dioxygen?

W) The pi 2p electrons are filled up before the sigma 2p electrons
X) The pi 2p electrons are filled up after the sigma 2p electrons
Y) The sigma 2p star orbitals are not filled
Z) Dioxygen is predicted to be paramagnetic

ANSWER: W) The pi 2p electrons are filled up before the sigma 2p electrons

TOSS-UP

17) Math *Multiple Choice* Which of the following is an antiderivative of $\sin(x)e^{-\cos(x)}$ ***[sine of x times e to the negative cosine of x]***:

W) $12e + e^{-\cos(x)}$ ***[12 e plus e to the negative cosine of x]***
X) $e^{-\sin(x)}$ ***[e to the negative sine of x]***
Y) $i^{-\sin(ex)}$***[i to the negative sine of e times x]***
Z) $528e^{-\cos(\sin(x))}$***[528 e to the negative cosine of sine of x]***

ANSWER: W) $12e + e^{-\cos(x)}$ ***[12 e plus e to the negative cosine of x]***

BONUS

17) Math *Short Answer* Compute the cross product of the vectors -i + 3j - 7k and 2i - 7k + 5j.

ANSWER: 14i - 21j - 11k (Accept <14,-21,-11> or any equivalent answers)

TOSS-UP

18) Physics *Short Answer* For a lens of focal length 20 cm, what will be the image distance, in centimeters, for an object 30 cm from the lens? Assume the thickness of the lens is negligible.

ANSWER: 60

BONUS

18) Physics *Multiple Choice* Alice and Bob, who both weigh the same, are holding onto either end of a rope suspended over an ideal pulley. Alice begins to climb up the rope, but suddenly loses her grip and begins falling. However, she grabs the rope just before hitting the ground, stopping her fall. Bob clutches his end the rope the entire time. Which of the following describes the movement of Bob as Alice climbs the rope and immediately after Alice grabs the rope, respectively?

W) No movement; Downward
X) Upward; No movement
Y) Upward; Upward
Z) No movement; No movement

ANSWER: X) UPWARD; NO MOVEMENT

TOSS-UP

19) Biology *Short Answer* What are the names of the 2 distinct sides of the Cisternae, in terms of thickness, in the Golgi Apparatus?

ANSWER: Cis and Trans

BONUS

19) Biology *Multiple Choice* What is the name of the region in prokaryotes in which DNA is mainly concentrated?

W) Nucleozone
X) Nucleoid
Y) Nucleus
Z) Nucleotide

ANSWER: X) Nucleoid

TOSS-UP

20) Earth and Space *Multiple Choice* What form of mass wasting is responsible for the tilting of headstones in old graveyards?

W) Landslides
X) Rockslides
Y) Bioturbation
Z) Creep

ANSWER: Z) CREEP

BONUS

20) Earth and Space *Multiple Choice* In which of the following soil horizons are you likely to find a large concentration of leached particles?

W) O Horizon
X) A Horizon
Y) B Horizon
Z) E Horizon

ANSWER: Y) B Horizon