

TOSS-UP

1) CHEMISTRY *Short Answer* What is the molecular formula of sulfur dioxide?

ANSWER: SO₂

BONUS

1) CHEMISTRY *Short Answer* What is the chemical formula, including any charge, of the phosphate ion?

ANSWER: PO₄³⁻

TOSS-UP

2) EARTH AND SPACE *Short Answer* What is the name for the type of reverse fault which has a dip angle of less than 45 degrees?

ANSWER: Thrust Fault

BONUS

2) EARTH AND SPACE *Short Answer* Order the following 3 minerals in order from first to last to crystallize

1. Olivine
2. Amphibole
3. Muscovite

ANSWER: 1 2 3

TOSS-UP

3) BIOLOGY *Short Answer* What specific enzyme do β lactams target?

ANSWER: Transpeptidase

BONUS

3) BIOLOGY *Short Answer* What is the term for specialized motor cells in leaves that are responsible for rapid contraction and loss of turgor pressure

ANSWER: Pulvini

TOSS-UP

4) MATH *Short Answer* What is the indefinite integral of $\ln(x)$? (*Gideon*)

ANSWER: $x\ln(x) - x + C$

BONUS

4) MATH *Short Answer* What is the indefinite integral of $\cos^3(x)$? (*Gideon*)

ANSWER: $\sin(x) - \sin^3(x)/3 + C$

TOSS-UP

5) PHYSICS *Short Answer* If the electric field along the x axis is defined as $E(x) = 3x$, what is the total amount of work done by the electric field if a particle is moved from $x = 6$ to $x = 10$ and back to $x = 6$?

ANSWER: 0

BONUS

5) CATEGORY *Short Answer* What is the integral of jerk with respect to time?

ANSWER: Acceleration

TOSS-UP

6) CHEMISTRY *Short Answer* Crystalline solids have a defined unit cell structure with long range order, and are exemplified by table salt. What type of solids do not have a defined unit cell structure, and display short range order, and are exemplified by glass?

ANSWER: Amorphous solids

BONUS

6) CHEMISTRY *Short Answer* What element has an atomic number of 31?

ANSWER: Gallium

TOSS-UP

7) MATH *Short Answer* Expressing your answer as a common fraction, what is the height of a prism with base area 39 and volume 15?

ANSWER: $\frac{5}{13}$

BONUS

7) MATH *Short Answer* When rolling two standard 6-sided number cubes, what is the probability that the sum of the two results will be a factor of 12?

ANSWER: $\frac{1}{3}$

TOSS-UP

8) BIOLOGY *Short Answer* Taq polymerase is derived from what bacterial species?

ANSWER: *Thermus Aquaticus*

BONUS

8) BIOLOGY *Multiple Choice* Damage to which of the following structures of the Limbic System would lead to anterograde amnesia?

- W) Amygdala
- X) Hippocampus
- Y) Fornix
- Z) Olfactory Bulb

ANSWER: Hippocampus

TOSS-UP

9) EARTH AND SPACE *Short Answer* Indicate, by name or number all of the following 3 planets that are jovian.

- 1) Mercury
- 2) Earth
- 3) Venus

ANSWER: none

BONUS

9) EARTH AND SPACE *Short Answer* What is the primary component of most condensation nuclei?

ANSWER: DMS (Dimethyl Sulfide)

TOSS-UP

10) MATH *Short Answer* In scientific notation and with one significant figure, what is the sum of the first billion natural numbers?

ANSWER: 5×10^{17}

BONUS

10) MATH *Short Answer* What is the measure of the angle formed by the hands of an analog clock at 4:22?

ANSWER: 1

TOSS-UP

11) CHEMISTRY *Short Answer* What is the term for a reaction that releases heat to its environment and therefore feels warm?

ANSWER: Exothermic

BONUS

11) CHEMISTRY *Multiple Choice* Which of the following compounds would be the most acidic in water?

W) CO₂

X) NH₃

Y) NaOH

Z) H₂SO₄

ANSWER: Z) H₂SO₄

TOSS-UP

12) EARTH AND SPACE *Short Answer* A thunderstorm has strong updrafts creating a giant tower. What is the name for the part of the cumulonimbus cloud which gets stopped by the tropospheric temperature inversion?

ANSWER: Anvil

BONUS

12) EARTH AND SPACE *Short Answer* Order the following 3 clouds in order of decreasing base height:

1. Cumulonimbus
2. Tule
3. stratocumulus

ANSWER: 3 1 2

TOSS-UP

13) BIOLOGY *Short Answer* What is the electron shuttle between Complex I and III?

ANSWER: Ubiquinone, [Also Accept Coenzyme Q]

BONUS

13) BIOLOGY *Multiple Choice* Oh No! While recovering from his spinal wound, Bobby was shot in the head while spending time in a field hospital. If he now cannot recognize the faces of his fellow soldiers, which association nucleus was most likely damaged?

- W) Frontal Association Nucleus
- X) Temporal Association Nucleus
- Y) Occipital Association Nucleus
- Z) Parietal Association Nucleus

ANSWER: X) Temporal Association Nucleus

TOSS-UP

14) MATH *Short Answer* For every English assignment that she receives, Kira has an 80% probability of remembering to write her name on the paper. If she receives a total of 50 assignments over her freshman year, what is the expected number of papers on which she will forget to write her name?

ANSWER: 10

BONUS

14) MATH *Short Answer* It takes Daniel 2 hours to write 5 DOE questions, while it takes Danny 3 hours to write 5 DOE questions. If they work together to write questions, how many questions can they write in 1 whole day?

ANSWER: 100

TOSS-UP

15) BIOLOGY *Multiple Choice* Which of the following fungi causes ergotism in some plants
W) Claviceps Purpurea
X) Cryphonectria Parasitica
Y) Fruisana Circinatum
Z) Rhizopus Stolonifer

ANSWER: W) Claviceps Purpurea

BONUS

15) BIOLOGY *Short Answer* What is the term for the relationship where a fungi lives within the leaf of a plant

ANSWER: Endophyte

TOSS-UP

16) CHEMISTRY *Multiple Choice* Which group of biomolecules have a secondary structure consisting of alpha helices and beta sheets?

W) Nucleic acids

X) Lipids

Y) Carbohydrates

Z) Proteins

ANSWER: Z) Proteins

BONUS

16) CHEMISTRY *Short Answer* Answer the following three questions about the exposure of a triene to ultraviolet radiation:

1. What type of pericyclic reaction will the triene undergo?
2. Is the reaction disrotatory, conrotatory, or neither?
3. How many sigma and pi bonds are gained, respectively?

ANSWER: Electrocyclic rearrangement, conrotatory, +1 and -1

TOSS-UP

17) MATH *Short Answer* How many distinct ways are there to arrange the letters of the word “energy”?

ANSWER: 360

BONUS

17) MATH *Short Answer* If rotations are not considered to be distinct, how many ways are there for 8 people to be seated around a square table, where each side can fit two people?

ANSWER: 10080

TOSS-UP

18) BIOLOGY *Short Answer* The influx of what ion into the axoplasm initiates the granulation of synaptic vesicles?

ANSWER: Ca²⁺

BONUS

18) BIOLOGY *Short Answer* What B vitamin is involved in the synthesis of Coenzyme A?

ANSWER: Pantothenate [Also Accept Vitamin B5]

TOSS-UP

19) EARTH AND SPACE *Short Answer* What is the name for the general process where oceanic crust is pushed upon continental crust?

ANSWER: Obduction

BONUS

19) EARTH AND SPACE *Short Answer* Give, by name or number, all of the following 3 statements which are true about the crust?

1. Oceanic crust is less dense than continental crust
2. Oceanic crust is generally older at the mid ocean ridge
3. Continental crust is isostatically adjusted higher than oceanic crust

ANSWER: ALL

TOSS-UP

20) CHEMISTRY *Short Answer* What is the charge of a hydride anion?

ANSWER: -1

BONUS

20) CHEMISTRY *Short Answer* An octahedral complex with a metal center Mⁿ⁺ has ammonia ligands, which are then substituted with water ligands. Taking the water ligands to be along the z

axis and the ammonia ligands to lie in the xy plane, identify all orbitals that will increase in energy.

ANSWER: d_{z^2} , d_{xz} , d_{yz}

TOSS-UP

21) CHEMISTRY *Short Answer* Identify all of the following three that are neutral elements:

1. Deuterium
2. Fluorine
3. Fluoride

ANSWER: 1, 2 only

BONUS

21) CHEMISTRY *Short Answer* What functional group, characterized by a carbon carbon double bond between the alpha and beta carbons, is used in the Stork synthesis as an alternative to Michael additions?

ANSWER: Enamine

TOSS-UP

22) PHYSICS *Short Answer* If the mass of a satellite is doubled, by what factor will its orbital velocity increase if it stays in the same orbit?

ANSWER: 1

BONUS

22) PHYSICS *Short Answer* What quantity is defined as the cross product of the force applied and the position vector?

ANSWER: Torque

TOSS-UP

23) BIOLOGY *Short Answer* Order the following from smallest to largest cecum size?

- I) Lion
- II) Human
- III) Cow

ANSWER: 1 2 3

BONUS

23) BIOLOGY *Short Answer* What condition describes a lack of blood flow to an afflicted region?

ANSWER: Ischemia

TOSS-UP

24) MATH *Short Answer* What is $\log 8 + 3\log 5$?

ANSWER: 3

BONUS

24) MATH *Short Answer* The Lambert W function is defined as the inverse of what function of z, where z is a complex number?

ANSWER: ze^z

TOSS-UP

25) EARTH AND SPACE *Multiple Choice* Which of the following orogenies is associated with the Rocky mountain range?

W) Alleghenian

X) Taconian

Y) Laramide

Z) Greenville

ANSWER: Y) Laramide

BONUS

25) EARTH AND SPACE *Multiple Choice* Riegel Shears are associated with which of the following faults?

- W) Left Lateral Strike slip fault
- X) Right Lateral Strike slip fault
- Y) Oblique Slip Fault
- Z) Thrust fault

ANSWER: X