

ROUND 8A

TOSS-UP

1) Chemistry – *Multiple Choice* Which of the following compounds does NOT have an adequate octet-rule-satisfying Lewis structure representation?

- W) Nitrogen dioxide
- X) Sulfur dioxide
- Y) Carbon dioxide
- Z) Oxygen difluoride

ANSWER: W) NITROGEN DIOXIDE

BONUS

1) Chemistry – *Multiple Choice* Which of the following types of hydrocarbons are saturated?

- W) Alkanes
- X) Alkenes
- Y) Alkynes
- Z) Aromatic hydrocarbons

ANSWER: W) ALKANES

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### TOSS-UP

2) Earth and Space – *Multiple Choice* Which of the following gases is most likely to escape from a planet's atmosphere?

- W) Hydrogen
- X) Helium
- Y) Methane
- Z) Ammonia

ANSWER: W) HYDROGEN

### BONUS

2) Earth and Space – *Short Answer* What geologic era began following the Cretaceous-Paleogene [*PAY-leo-jeen*] extinction?

ANSWER: CENOZOIC

**TOSS-UP**

3) Energy – *Short Answer* What initiative, created in 2000, encourages green building by promoting sustainability in construction and utility-efficient operations and maintenance?

ANSWER: LEED (ACCEPT: LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN)

**BONUS**

3) Energy – *Short Answer* After about 3 years in a nuclear reactor producing electricity, 1/3 of the fuel is removed and replaced. What is the term for fuel taken from the reactor?

ANSWER: SPENT FUEL



**TOSS-UP**

4) Math – *Multiple Choice* Given sets A and B with A intersect B = the set containing the element 5, which of the following must be true?

- W) Set A may be the empty set
- X) Set A contains at least one element
- Y) Set B contains at most one element
- Z) Sets A and B have the same number of elements

ANSWER: X) SET A CONTAINS AT LEAST ONE ELEMENT

**BONUS**

4) Math – *Short Answer* Expressing your answer in terms of m, evaluate the function  $f(x) = 4x^2 - 9x + 11$  when x is  $m - 7$ .

ANSWER:  $4m^2 - 65m + 270$

**TOSS-UP**

5) Biology – *Short Answer* What term best describes a plant that has parallel leaf veins, fibrous roots, and flowers with parts in threes?

ANSWER: MONOCOT (ACCEPT: MONOCOTYLEDON)

**BONUS**

5) Biology – *Multiple Choice* Which of the following human cell types do NOT perform aerobic respiration?

- W) Red blood cells
- X) Heart muscle cells
- Y) Hair cells
- Z) Outer skin cells

ANSWER: W) RED BLOOD CELLS

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TOSS-UP

6) Physics – *Short Answer* What is the name for the change in the direction of propagation of light when it passes from one transparent material to another?

ANSWER: REFRACTION

BONUS

6) Physics – *Short Answer* Generally, every time energy is converted from one form to another, there is less energy available to do useful work. What is the name of the law that states this?

ANSWER: SECOND LAW OF THERMODYNAMICS

TOSS-UP

7) Math – *Short Answer* What is the sum of the two vectors $7\mathbf{i} + 3\mathbf{j}$ and $2\mathbf{i} - 5\mathbf{j}$?

ANSWER: $9\mathbf{i} - 2\mathbf{j}$

BONUS

7) Math – *Short Answer* The perimeters of two squares differ by 16 inches and their areas differ by 96 square inches. What is the perimeter, in inches, of the larger square?

ANSWER: 56



TOSS-UP

8) Physics – *Multiple Choice* Which of the following constants is fundamentally related to the speed of light?

- W) Gravitation constant
- X) Permeability of free space
- Y) Planck constant
- Z) Boltzmann constant

ANSWER: X) PERMEABILITY OF FREE SPACE

BONUS

8) Physics – *Short Answer* What is the equivalent resistance, in ohms to the nearest tenth, of a set of 4 parallel resistors in series with another set of 5 parallel resistors if all of the resistors have a resistance of 10 ohms?

ANSWER: 4.5 (ACCEPT: $9/2$, $4\frac{1}{2}$)

TOSS-UP

9) Biology – *Short Answer* What plant hormone mediates phototropism?

ANSWER: AUXIN

BONUS

9) Biology – *Multiple Choice* Which of the following is NOT a location where bile is either stored or travels to after it is made?

- W) Gall bladder
- X) Cystic duct
- Y) Pancreatic duct
- Z) Duodenum

ANSWER: Y) PANCREATIC DUCT



TOSS-UP

10) Earth and Space – *Short Answer* Identify all of the following three conditions that can cause metamorphism of rocks: 1) High temperature; 2) High acidity; 3) High pressure.

ANSWER: 1, 3 (ACCEPT: HIGH TEMPERATURE, HIGH PRESSURE)

BONUS

10) Earth and Space – *Multiple Choice* The United States has the highest frequency of tornado occurrences of the world's nations. To the nearest order of magnitude, how many tornadoes touch down in the United States each year?

- W) One hundred
- X) One thousand
- Y) Ten thousand
- Z) One hundred thousand

ANSWER: X) ONE THOUSAND

TOSS-UP

11) Chemistry – *Short Answer* James Chadwick observed a type of radiation consisting of neutrally charged particles during his experiments with beryllium. What particles make up this radiation?

ANSWER: NEUTRONS

BONUS

11) Chemistry – *Short Answer* What compounds, examples of which include glyceraldehyde [*gkih-ser-AL-de-hide*] and mannose, are formally polyhydroxy [*polly-high-DROX-ee*] ketones with empirical formula CH_2O and are the basic energy, storage, and structural molecules of life?

ANSWER: CARBOHYDRATES (ACCEPT: SUGARS, MONOSACCHARIDES; DO NOT ACCEPT: POLYSACCHARIDES)

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### TOSS-UP

12) Energy – *Multiple Choice* Which of the following sources of energy is derived from the gravity fields of the Sun and the Moon?

- W) Solar
- X) Ocean thermal
- Y) Wind
- Z) Ocean tidal

ANSWER: Z) OCEAN TIDAL

### BONUS

12) Energy – *Multiple Choice* Which of the following best explains why nickel-cadmium batteries are being replaced by other types of batteries?

- W) Cadmium is a heavy metal pollutant
- X) They are not rechargeable
- Y) They do not have a consistent terminal voltage
- Z) They rapidly lose the ability to store charge

ANSWER: W) CADMIUM IS A HEAVY METAL POLLUTANT

**TOSS-UP**

13) Physics – *Multiple Choice* Which of the following types of electromagnetic energy has the shortest wavelengths?

- W) X-rays
- X) AM radio
- Y) Infrared
- Z) Visible

ANSWER: W) X-RAYS

**BONUS**

13) Physics – *Short Answer* If objects A and B have masses of 10 kilograms and 20 kilograms, respectively, and object A is traveling at 50 meters per second in the positive  $x$  direction while object B is traveling at 30 meters per second in the negative  $x$  direction, what is the linear momentum of the resultant system in kilogram-meters per second after a perfectly inelastic collision?

ANSWER: 100 IN THE NEGATIVE X DIRECTION (ACCEPT: -100; -100 IN THE POSITIVE X DIRECTION)



**TOSS-UP**

14) Math – *Short Answer* What is the distance between the points (0, 1) and (2, 3)?

ANSWER:  $2\sqrt{2}$

**BONUS**

14) Math – *Short Answer* What is the sum from  $n = 0$  to 2016 of the cosine of open parenthesis  $\pi$  times  $n$  divided by 2 close parenthesis?

ANSWER: 1

### TOSS-UP

15) Chemistry – *Multiple Choice* Which of the following molecules can exist in boat and chair configurations?

- W) Benzene
- X) Cyclohexane [*sye-kloh-HEX-ane*]
- Y) Cyclopentadiene [*sye-kloh-penta-DYE-een*]
- Z) Napthalene [*NAP-thah-leen*]

ANSWER: X) CYCLOHEXANE

### BONUS

15) Chemistry – *Multiple Choice* Which of the following correctly explains why concentration cells have a standard cell potential of 0 volts?

- W) According to the Nernst equation, the standard cell potential is cancelled out by the concentration dependent term
- X) At standard conditions, all cells have a standard cell potential of 0 volts
- Y) Standard cell potentials are measured with all species at equal concentrations
- Z) Concentration cells are used as a standard, so their standard cell potential is arbitrarily set to 0

ANSWER: Y) STANDARD CELL POTENTIALS ARE MEASURED WITH ALL SPECIES AT EQUAL CONCENTRATIONS

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TOSS-UP

16) Energy – *Multiple Choice* The price of which of the following fuels has the greatest impact on the cost of electricity?

- W) Nuclear
- X) Oil
- Y) Coal
- Z) Natural Gas

ANSWER: Z) NATURAL GAS

BONUS

16) Energy – *Short Answer* What is the name of the strategy that makes use of both electrical and thermal output from an electricity generator to greatly increase efficiency?

ANSWER: COMBINED HEAT AND POWER (ACCEPT: COGENERATION)

TOSS-UP

17) Earth and Space – *Multiple Choice* Which of the following is the mechanism by which strain energy is released during earthquakes?

- W) Elastic rebound
- X) Solution-collapse
- Y) Hydrostatic pressure
- Z) Volcanic degassing

ANSWER: W) ELASTIC REBOUND

BONUS

17) Earth and Space – *Multiple Choice* Which of the following is a NOT a way in which scientists test the reliability of computer models of future climate?

- W) Comparing model predictions of recent past climate to observed records
- X) Comparing model predictions of distant past climate to proxy records
- Y) Checking for consistency between the outputs of many differently constructed models
- Z) Confirming that models have accurately predicted local weather events each year

ANSWER: Z) CONFIRMING THAT MODELS HAVE ACCURATELY PREDICTED LOCAL WEATHER EVENTS EACH YEAR.

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### TOSS-UP

18) Biology – *Short Answer* Ced-3 and ced-4 are genes likely involved in what cell process?

ANSWER: APOPTOSIS (ACCEPT: PROGRAMMED CELL DEATH)

### BONUS

18) Biology – *Multiple Choice* In the human skull, which of the following bones does NOT contain a sinus?

- W) Frontal
- X) Sphenoid [*SFEE-noyd*]
- Y) Maxillae [*MAX-il-eye*]
- Z) Lacrimal

ANSWER: Z) LACRIMAL

**TOSS-UP**

19) Math – *Short Answer* What is the fourth term in the series given by the sum from  $n = 0$  to infinity of the fraction with numerator 1 and denominator 2 to the  $n^{\text{th}}$  power?

ANSWER:  $1/8$

**BONUS**

19) Math – *Short Answer* Evaluate  $11^2 + 21^2 + 31^2$ .

ANSWER: 1523



**TOSS-UP**

20) Earth and Space – *Multiple Choice* Which of the following minerals is a crystalline form of silicon dioxide?

- W) Mica
- X) Quartz
- Y) Calcite
- Z) Feldspar

ANSWER: X) QUARTZ

**BONUS**

20) Earth and Space – *Short Answer* Order the following four color classifications of stars from least to greatest surface temperatures: 1) Yellow; 2) Blue; 3) Red; 4) White.

ANSWER: 3, 1, 4, 2 (ACCEPT: RED, YELLOW, WHITE, BLUE)

### TOSS-UP

21) Physics – *Multiple Choice* Which of the following leptons has the largest mass?

- W) Electron neutrino
- X) Muon
- Y) Muon neutrino
- Z) Tauon

ANSWER: Z) TAUON

### BONUS

21) Physics – *Multiple Choice* What is the SI derived unit for electrical conductance?

- W) Henry
- X) Siemens
- Y) Weber
- Z) Tesla

ANSWER: X) SIEMENS

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TOSS-UP

22) Chemistry – *Multiple Choice* Which of the following is an example of a molecular solid?

- W) Silicon
- X) Iodine
- Y) Diamond
- Z) Graphite

ANSWER: X) IODINE

BONUS

22) Chemistry – *Short Answer* What organic functional group can be found at the N terminus of a protein and consists of a nitrogen atom bonded to one or more carbon atoms?

ANSWER: AMINE

TOSS-UP

23) Biology – *Multiple Choice* Which of the following receptors could NOT be found on the surface of a cell?

- W) Laminar receptor
- X) Ion-channel coupled receptor
- Y) Tyrosine [**TIE-row-seen**] kinase receptor
- Z) G-protein coupled receptor

ANSWER: W) LAMINAR RECEPTOR

BONUS

23) Biology – *Short Answer* What system, widely dispersed in eukaryotes, is sometimes used for a similar immune function as the CRISPR[*crisper*]/Cas9 system, and also used for endogenous gene regulation?

ANSWER: RNAI (ACCEPT: RNA INTERFERENCE, RISC-SIRNA, SIRNA, MICRO RNA)