

ROUND 16A

TOSS-UP

1) Earth and Space – *Short Answer* Galena is a sulfide ore of what metal element?

ANSWER: LEAD

BONUS

1) Earth and Space – *Multiple Choice* When do eclipses of the sun occur?

- W) Full moon
- X) Anytime
- Y) New moon
- Z) First or last quarter

ANSWER: Y) NEW MOON

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### TOSS-UP

2) Biology – *Multiple Choice* In which of the following organisms would one most likely find nematocysts?

- W) Jellyfish
- X) Octopus
- Y) Sponge
- Z) Sea cucumber

ANSWER: W) JELLYFISH

### BONUS

2) Biology – *Short Answer* Identify all of the following four embryonic brain regions that develop from the forebrain: 1) Telencephalon; 2) Mesencephalon; 3) Metencephalon; 4) Diencephalon.

ANSWER: 1 AND 4

**TOSS-UP**

3) Math – *Short Answer* What is the integer part of the log base 3 of 2015?

ANSWER: 6

**BONUS**

3) Math – *Short Answer* Convert 291 in base 10 to base 6.

ANSWER: 1203



**TOSS-UP**

4) Energy – *Multiple Choice* What component is required for a gasoline combustion engine but is unnecessary for a diesel engine?

- W) Air filter
- X) Exhaust pipe
- Y) Piston
- Z) Spark plug

ANSWER: Z) SPARK PLUG

**BONUS**

4) Energy – *Multiple Choice* On average, across the United States, what energy source accounts for more than half of homes' heating and cooling costs?

- W) Natural Gas
- X) Electricity
- Y) Fuel Oil
- Z) Liquid Petroleum Gas

ANSWER: W) NATURAL GAS

### TOSS-UP

5) Chemistry – *Multiple Choice* Three metals, A, B, and C, have reduction potentials of their +2 cations such that A has the greatest reduction potential and C has the least. Which of the following is true?

- W) A reduces B<sup>2+</sup>
- X) A reduces B
- Y) B<sup>2+</sup> reduces C<sup>2+</sup>
- Z) C reduces B<sup>2+</sup>

ANSWER: Z) C REDUCES B<sup>2+</sup>

### BONUS

5) Chemistry – *Short Answer* A student performs combustion analysis on a compound X containing carbon, hydrogen, and oxygen to determine its molecular formula. Given the molar mass is 76, if she combusts 1 mole of X in excess oxygen and observes 2 moles of CO<sub>2</sub> gas and 2 moles of H<sub>2</sub>O gas as products, what is the molecular formula?

ANSWER: C<sub>2</sub>H<sub>4</sub>O<sub>3</sub>

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TOSS-UP

6) Physics – *Multiple Choice* Photons and gluons are classified as which of the following types of particles?

- W) Lepton
- X) Hadron
- Y) Meson
- Z) Boson

ANSWER: Z) BOSON

BONUS

6) Physics – *Multiple Choice* Which of the following is the sole variable that must be equal among different photons in order for electromagnetic radiation to be considered coherent?

- W) Frequency
- X) Direction
- Y) Phase
- Z) Polarization

ANSWER: Y) PHASE

TOSS-UP

7) Earth and Space – *Short Answer* Some scholars believe that Algol was recognized as a variable star in ancient times. Other than possibly Algol, what was the first known variable star?

ANSWER: MIRA (ACCEPT: OMICRON CETI, O CETI)

BONUS

7) Earth and Space – *Short Answer* What are the units used to measure helicity?

ANSWER: METERS SQUARED PER SECONDS SQUARED

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### TOSS-UP

8) Biology – *Short Answer* What is the general name for enzymes that catalyse reactions that involve the transfer of a phosphate group from ATP?

ANSWER: KINASES

### BONUS

8) Biology – *Multiple Choice* Which of the following is not a behavior generally associated with cancerous cells?

- W) They induce angiogenesis [*an-gee-oh-gen-uh-sis*]
- X) They produce telomerase [*tel-aw-mer-ayse*]
- Y) They cannot stop cell division
- Z) They cannot proliferate when not adherent to substrate

ANSWER: Z) THEY CANNOT PROLIFERATE WHEN NOT ADHERENT TO SUBSTRATE

### TOSS-UP

9) Energy – *Short Answer* What type of styrofoam device is used in school laboratories to quantitatively collect data to calculate the heat released by chemical reactions and physical changes at constant-pressure?

ANSWER: COFFEE-CUP CALORIMETER (DO NOT ACCEPT: CALORIMETER)

### BONUS

9) Energy – *Multiple Choice* Which of the following is not an advantage of photovoltaic power sources?

- W) Low noise generation
- X) Low pollution
- Y) Low manufacturing costs
- Z) Low operating costs

ANSWER: Y) LOW MANUFACTURING COSTS

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TOSS-UP

10) Math – *Short Answer* If the radius of a sphere is doubled, by what percent does the volume increase?

ANSWER: 700

BONUS

10) Math – *Short Answer* What is the smallest positive angle, in degree measure, between the vectors $i + 2j + 3k$ and $2i - 3j - k$?

ANSWER: 120

TOSS-UP

11) Chemistry – *Multiple Choice* After ammonia is added to an unknown solution, a light blue precipitate forms. After adding more ammonia and stirring, the blue precipitate dissolves to form a royal blue solution. The initial solution most likely contains which of the following?

- W) Zinc
- X) Copper
- Y) Chromium
- Z) Manganese

ANSWER: X) COPPER

BONUS

11) Chemistry – *Short Answer* A complex ion has a coordination number of 4 and exhibits cis-trans isomerism. What must the geometry of this ion be?

ANSWER: SQUARE PLANAR



TOSS-UP

12) Physics – *Short Answer* A train at rest has a length of 100 meters. At what speed, in terms of the speed of light, c , must it approach a tunnel of length 60 meters so that an observer at rest with respect to the tunnel will see that the entire train is in the tunnel at one time?

ANSWER: 0.8

BONUS

12) Physics – *Multiple Choice* Which of the following medical applications makes use of x-rays?

- W) Computed Tomography
- X) Magnetic Resonance Imaging
- Y) Positron Emission Tomography
- Z) Ultrasound

ANSWER: W) COMPUTED TOMOGRAPHY

TOSS-UP

13) Earth and Space – *Short Answer* What is the term for the theoretical boundary separating the regions of the solar nebula where terrestrial planets and gas giants form?

ANSWER: FROST LINE (ACCEPT: SNOW LINE, ICE LINE)

BONUS

13) Earth and Space – *Short Answer* Name all the planets that exhibit a full range of phases as viewed from Earth.

ANSWER: MERCURY AND VENUS



TOSS-UP

14) Math – *Short Answer* If you roll 2 six-sided dice, what is the probability that the product of the two numbers is prime?

ANSWER: 1/6

BONUS

14) Math – *Short Answer* What is the tens digit in the sum from $n = 6$ to 2015 of n factorial?

ANSWER: 6

TOSS-UP

15) Chemistry – *Multiple Choice* Which of the following one-to-one solutions of liquids would be expected to show the most deviation from Raoult's Law's prediction of vapor pressure?

- W) A mixture of water and ethanol
- X) A mixture of pentane and hexane
- Y) A mixture of water and cyclohexanol
- Z) A mixture of acetone and chloroform

ANSWER: W) A MIXTURE OF WATER AND ETHANOL

BONUS

15) Chemistry – *Short Answer* A student prepares a solution of sodium chloride in water at 25 degrees Celsius. Name all of the following three properties of the solution that would be unchanged if the solution was heated to 80 degrees Celsius: 1) Molarity; 2) Molality; 3) Volume.

ANSWER: 2



TOSS-UP

16) Biology – *Multiple Choice* The Edinger-Westphal nucleus consists of parasympathetic neurons that control pupillary reflexes. Which of the following neurotransmitters do Edinger-Westphal neurons most likely release?

- W) Epinephrine
- X) Norepinephrine
- Y) Glutamine
- Z) Acetylcholine

ANSWER: Z) ACETYLCHOLINE

BONUS

16) Biology – *Short Answer* What phylum of gram-negative bacteria includes Rhizobia, Nitrosomonas, and E. coli?

ANSWER: PROTEOBACTERIA

TOSS-UP

17) Energy – *Multiple Choice* What was the primary reason that US and European markets adopted E85 as the maximum blend to be used in flexible fuel vehicles?

- W) Higher ethanol blends are too expensive
- X) Higher ethanol blends are unable to ignite in cold weather
- Y) Higher ethanol blends cannot be safely stored
- Z) Higher ethanol blends release more CO₂ into the atmosphere through deforestation than they conserve

ANSWER: X) HIGHER ETHANOL BLENDS ARE UNABLE TO IGNITE IN COLD WEATHER

BONUS

17) Energy – *Short Answer* What physical quantity, derived from the Stefan-Boltzmann equation, is defined as the energy radiated by a body at a particular temperature divided by the energy radiated by a black body at the same temperature?

ANSWER: EMISSIVITY



TOSS-UP

18) Physics – *Multiple Choice* If a nonzero net torque is applied from an external source onto a frictionless rotating device, which of the following statements is NOT true?

- W) The rotational velocity at some time t can be equal to zero after the torque begins.
- X) The final total rotational energy of the system can be greater than the total work done by the net torque.
- Y) The total momentum of the device is constant before and after the torque is applied.
- Z) Any gravitational potential energy gained by the device due to rotation is lost upon completion of a full revolution.

ANSWER: Y) THE TOTAL MOMENTUM OF THE DEVICE IS CONSTANT BEFORE AND AFTER THE TORQUE IS APPLIED.

BONUS

18) Physics – *Short Answer* In beta minus decay of a neutron into a proton, electron, and an antineutrino, what massive particle is emitted by the neutron that decays into the electron and the antineutrino?

ANSWER: W MINUS BOSON

TOSS-UP

19) Earth and Space – *Multiple Choice* What is the optical depth of the solid Earth at visible wavelengths?

- W) Zero
- X) Much greater than one
- Y) Much less than one
- Z) One

ANSWER: X) MUCH GREATER THAN ONE

BONUS

19) Earth and Space – *Short Answer* The most violent earthquake ever recorded in the United States occurred in what state?

ANSWER: ALASKA



TOSS-UP

20) Biology – *Short Answer* What cellular substructures, characterized by their dynamic instability, go through growing phases known as “rescue” and shrinking phases known as “catastrophe?”

ANSWER: MICROTUBULES

BONUS

20) Biology – *Short Answer* What law of muscle contraction states that the stroke volume of the heart increases in response to an increase in the volume of blood filling the heart?

ANSWER: FRANK-STARLING LAW (ACCEPT: STARLING’S LAW, FRANK-STARLING’S LAW OF THE HEART, STARLING’S LAW OF THE HEART)

TOSS-UP

21) Math – *Short Answer* What is the minimum distance between the graph of $y = x + 1$ and the origin?

ANSWER: SQUARE ROOT OF 2 OVER 2

BONUS

21) Math – *Short Answer* A box contains 10 red marbles and 5 black marbles. A marble is randomly selected from the box. If the marble is red, it is returned to the box. If the marble is black, it and 3 additional black marbles are put in the box. Then a second marble is randomly selected. What is the probability that the second marble selected is black?

ANSWER: 10/27

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### TOSS-UP

22) Chemistry – *Short Answer* Rank the following three compounds from the lowest to the highest molecular mass: 1) Iron(II) phosphate; 2) Iron(III) phosphate; 3) Aluminum phosphate.

ANSWER: 3, 2, 1

### BONUS

22) Chemistry – *Short Answer* Identify all of the following three organic functional groups that contain carbon atoms in an  $sp^2$  hybridization state: 1) Alkynes; 2) Esters; 3) Carboxylic acids.

ANSWER: 2 AND 3

### TOSS-UP

23) Physics – *Short Answer* Identify all of the following 4 charge distributions in which the electric field magnitude is equal to zero at the given point:

1) Any point above an infinite sheet of charge with uniform charge per unit area; 2) Inside a cylinder, when the cylinder is infinitely conducting with a radius  $R$  and charge per unit length  $\lambda$ ; 3) A point which is a distance  $R$  from an infinite wire, with charge per unit length  $\lambda$ ; 4) A point inside a conducting sphere of radius  $R$ , with charge  $q$  on the surface.

ANSWER: 2, 4

### BONUS

23) Physics – *Short Answer* When a superconductor is exhibiting the Meissner effect, it is said to perfectly exhibit what property?

ANSWER: DIAMAGNETISM