

## TOSS-UP

1) CHEMISTRY *Multiple Choice* In one molecule of aluminum hydroxide, how many hydroxide ions are there?

W) 1

X) 2

Y) 3

Z) more information is needed

ANSWER: Y) 3

## BONUS

1) CHEMISTRY *Multiple Choice* In very basic solutions,  $\text{Al}(\text{OH})_3$  can react with the hydroxide in solution to produce  $\text{Al}(\text{OH})_4^-$  (read as: Al O H four, one minus). What is the specific name for this kind of ion?

W) hyper-polyatomic ion

X) complex ion

Y) coordination ion

Z) dissolution ion

ANSWER: X) complex ion

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TOSS-UP

2) MATH *Short Answer* Derik must prepare a code consisting of four single-digit numbers in succession. If the first digit must be even, the second digit must be odd, and the third and fourth digits can be any single-digit number, how many possible codes can Derik prepare?

ANSWER: 2500

## BONUS

2) MATH *Multiple Choice* Which of the following theorems states that the complex numbers are algebraically closed?

W) Fundamental Theorem of Algebra

X) Fundamental Theorem of Calculus

Y) Fundamental Theorem of Polynomials

Z) Abel-Ruffini Theorem

ANSWER: W) Fundamental Theorem of Algebra

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TOSS-UP

3) BIOLOGY *Short Answer* Which of the following is/are a part of a triacylglycerol?

I. Fatty acid

II. Glycerol

III. Choline

ANSWER: I, II

## BONUS

3) BIOLOGY *Short Answer* What is the process of the separation of cellular components through centrifugation called?

ANSWER: Cell fractionation

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**TOSS-UP**

4) EARTH & SPACE *Multiple Choice* Which of the following constellations can only be seen in the southern hemisphere?

- W) crux
- X) orion
- Y) canis major
- Z) cassiopeia

ANSWER: W

**BONUS**

4) EARTH & SPACE *Multiple Choice* Which of the following is most likely to form a neutron star after dying?

- W) brown dwarf
- X) giant star exceeding 20 solar masses
- Y) giant star between 8-20 solar masses
- Z) medium star between 0.5-8 solar masses

ANSWER: Y

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**TOSS-UP**

5) PHYSICS *Short Answer* The product of voltage and charge gives rise to what quantity?

ANSWER: ENERGY

**BONUS**

5) PHYSICS *Multiple Choice* A neutron star repels its immense gravity from collapsing the star into its core through what force?

- W) Proton radiation
  - X) Thermonuclear pressure
  - Y) Hydrostatic pressure
  - Z) Electron degeneracy pressure
- ANSWER: Z) Electron degeneracy pressure

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**TOSS-UP**

6) CHEMISTRY *Multiple Choice* In standard conventions, atomic number is represented with the letter Z, short for a non-English word. What language does this non-English word come from?

- W) French
  - X) German
  - Y) Italian
  - Z) Spanish
- ANSWER: X) German (Atomzahl)

**BONUS**

6) CHEMISTRY *Short Answer* Of the 118 elements of the periodic table, how many occur naturally on Earth?

ANSWER: 94

**TOSS-UP**

7) MATH *Short Answer* Daniel, James, Vivek, Cheenu, and Jinwoo must all be seated at a round table with the condition that James must sit next to Daniel. Two seatings are considered the same if you can rotate one to get the other. In how many ways can these 5 people be seated?

ANSWER: 48

**BONUS**

7) MATH *Short Answer* Chanseo plays a game of “Whose man’s” with Daniel. In this game, there is a pile of 2017 men, and Chanseo and Daniel take turns taking 1, 2, 3, or 4 men out of the pile. The person who takes the last man wins. If Chanseo goes first, how many men should he take to guarantee his victory, assuming optimal play from both sides?

ANSWER: 2

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**TOSS-UP**

8) BIOLOGY *Short Answer* What are organisms which cannot survive in the presence of oxygen and carry out only fermentation or anaerobic respiration called?

ANSWER: Obligate anaerobes

**BONUS**

8) BIOLOGY *Short Answer* Name the mosquito which is the vector of the dengue fever.

ANSWER: Aedes aegypti

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**TOSS-UP**

9) EARTH & SPACE *Multiple Choice* From which of the following cloud types are you most likely to spot a tornado?

W) cumulus

X) nimbostratus

Y) lenticular

Z) cumulonimbus

ANSWER: Z

**BONUS**

9) EARTH & SPACE *Multiple Choice* What atmospheric processes generate precipitation by supercooling and supersaturation?

W) Strasburg process

X) Fujita process

Y) Bergeron process

Z) Torricelli process

ANSWER: Y

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**TOSS-UP**

10) PHYSICS *Multiple Choice* What are things that fall into a black hole known as?

W) Particulate matter

- X) Singularity
- Y) Information
- Z) Degenerate

ANSWER: Y) INFORMATION

**BONUS**

10) PHYSICS *Short Answer* Black holes stemmed from the results of what theory of spacetime?

ANSWER: GENERAL RELATIVITY (do not accept: special)

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**TOSS-UP**

11) CHEMISTRY *Short Answer* Given that xenon is element 54, how many protons, neutrons, and electrons are there in an atom of Xe-136?

ANSWER: 54 protons, 82 neutrons, 54 electrons

**BONUS**

11) CHEMISTRY *Short Answer* On November 28, 2016, element 118, formerly known as ununoctium, received an official name from IUPAC which was in dedication to a Russian nuclear physicist. What is the official name of element 118?

ANSWER: Oganessian

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**TOSS-UP**

12) MATH *Short Answer* Let  $P(x) = x^4 - x^3 + x^2 - x + 1$ . What is the value of  $P(-1)$ ?

ANSWER: 5

**BONUS**

12) MATH *Multiple Choice* Consider the graphs  $y = \sin(x)$  and  $y = \cos(x)$ . At how many points do these graphs intersect each other between  $x=0$  and  $x=2\pi$ ?

- W) 0
- X) 1
- Y) 2
- Z) 4

ANSWER: Y) 2

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**TOSS-UP**

13) BIOLOGY *Short Answer* By name or number, identify all of the following features that are involved in Hardy-Weinberg Equilibrium

- I. No Natural Selection
- II. Large Populations
- III. Small Populations

ANSWER: I and II

**BONUS**

13) BIOLOGY *Short Answer* The trait of common sense is dominant and has an allele frequency of 0.6. What percentage of a certain population is heterozygous for common sense?

ANSWER: 48%

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**TOSS-UP**

14) EARTH & SPACE *Multiple Choice* What law states that strata is deposited in layers that get older with increasing depth?

W) Law of lateral continuity

X) law of original horizontality

Y) law of superposition

Z) law of uniformitarianism

ANSWER: Y

**BONUS**

14) EARTH & SPACE *Short Answer* What 19th century geologist is known as the Father of Geology?

ANSWER: James Hutton

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**TOSS-UP**

15) PHYSICS *Short Answer* Which of the following implies spontaneity in any process in all temperatures except absolute zero, under standard conditions?

W) delta G greater than 0

X) delta H less than 0, delta S less than 0

Y) Equilibrium constant K is greater than 1

Z) delta H is greater than zero, delta S is greater than zero

ANSWER: Y) Equilibrium constant K is greater than 1

**BONUS**

15) PHYSICS *Short Answer* What is the adjective that describes a wall that freely allows heat to pass through it?

ANSWER: DIATHERMIC

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**TOSS-UP**

16) CHEMISTRY *Short Answer* If the pressure of a rigid container is 12 atm at 500K, what will the pressure of the container be at 125K?

ANSWER: 3 atm

**BONUS**

16) CHEMISTRY *Short Answer* To three decimal places, how many atmospheres is 1843 torr?

ANSWER: 2.425

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**TOSS-UP**

17) MATH *Short Answer* In the LexSciBowl currency system, ten C's are equal to 7 D's. Expressing your answer as a proper fraction in simplest terms, how many D's are equal to 13 C's?

ANSWER: 130/7

**BONUS**

17) MATH *Multiple Choice* Which of the following is true about the infinite series

$1 + 1/2 + 1/3 + 1/4 + \dots$ ?

W) It converges to 2

X) It converges to  $\pi/2$

Y) It converges to  $3\pi/2$

Z) It diverges

ANSWER: Z) It diverges

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**TOSS-UP**

18) BIOLOGY *Multiple Choice* What is the name for the plant hormone that is responsible for controlling stomatal pore opening as well as maintaining seed dormancy?

W) Absciscic Acid

X) Ethylene

Y) Auxin

Z) Gibberellin

ANSWER: W) Absciscic Acid

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**BONUS**

18) BIOLOGY *Multiple Choice* Snigdha was walking down to the park and she finds a very strange, orange plant. It has four petals and when she pulls it out of the ground, she notices that it has a taproot. What type of angiosperm is this plant?

ANSWER: Eudicot

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**TOSS-UP**

19) EARTH & SPACE *Multiple Choice* Which of the following statements is true of atmospheric circulation?

W) cyclones rotate in a clockwise direction in the northern hemisphere

X) anticyclones rotate in a counterclockwise direction in the northern hemisphere

Y) cyclones converge aloft

Z) anticyclones form areas of high pressure

ANSWER: Z

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**BONUS**

19) EARTH & SPACE *Short Answer* By name or by number, order the following minerals from hardest to softest:

1. Feldspar

2. Calcite

3. Quartz

ANSWER: 3, 1, 2

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**TOSS-UP**

20) PHYSICS *Short Answer* Three 1 Ohm resistors are connected in parallel. Given that the current in the circuit is 3 Amperes, what is the voltage of the circuit?

ANSWER: 1 V

**BONUS**

20) PHYSICS *Multiple Choice* Which of the following elementary particles is responsible for mediating the nuclear weak force?

W) Photon

X) Electron

Y) Gluon

Z) W and Z bosons

ANSWER: Z) W and Z bosons

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**TOSS-UP**

21) CHEMISTRY *Short Answer* A flask containing 0.4 moles of nitrogen gas and 1.6 moles of oxygen gas has a pressure of 8 atm. What is the partial pressure of oxygen gas in the flask?

ANSWER: 6.4 atm

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**BONUS**

21) CHEMISTRY *Short Answer* 1 L of gas was collected at 27 degrees C. The total pressure in the container was 30 atm. How many moles of gas were collected? Report the answer to three decimal points.

ANSWER: 1.219 moles of gas

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**TOSS-UP**

22) MATH *Short Answer* Chanseo can solve 1 problem in 40 minutes and Anka can solve 40 problems in 1 minute. How many problems can they solve, working together, in 80 minutes?

ANSWER: 3202

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**BONUS**

22) MATH *Short Answer* Compute the cross product of the two vectors  $\langle 3, 1, 2 \rangle$  and  $\langle -1, 0, 2 \rangle$ .

ANSWER:  $\langle 2, -8, 1 \rangle$

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**TOSS-UP**

23) BIOLOGY *Multiple Choice* Which of the following epithelial tissues is most likely to be found in kidney tubules?

W) Cuboidal epithelium

X) Simple columnar epithelium

Y) Simple squamous epithelium

Z) Stratified squamous epithelium

ANSWER: W) Cuboidal epithelium

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**BONUS**

23) BIOLOGY *Multiple Choice* Which of the following is an accessory fruit?

W) Apple

X) Pineapple

Y) Raspberry

Z) Pea

ANSWER: W) Apple

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**TOSS-UP**

24) EARTH & SPACE *Multiple Choice* Which of the following forms of mass wasting is most likely to occur following a volcanic eruption?

W) liquefaction

X) lahar

Y) nuee ardente

Z) solifluction

ANSWER: W

**BONUS**

24) EARTH & SPACE *Short Answer* What is the term for a fan-shaped mass of sediment deposited as the flow of a river decreases in velocity?

ANSWER: Alluvial fan

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**TOSS-UP**

25) PHYSICS *Multiple Choice* Which of the following describes the equation for the flight time of a projectile in parabolic motion, if  $v$  = initial velocity and  $\theta$  = the angle of launch from the ground?

W)  $2v\sin\theta/g$

X)  $2v\cos\theta/g$

Y)  $v\sin\theta/g$

Z)  $v\cos\theta/g$

ANSWER: W)  $2v\sin\theta/g$

**BONUS**

25) PHYSICS *Short Answer* List the constituents of the proton

ANSWER: Up quark, down quark

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