

**TOSS-UP**

1) CHEMISTRY *Multiple Choice* The product of an acid-base neutralization yields:

W) HCl and water

X) salt and water

Y) O<sub>2</sub> and water

Z) CO<sub>2</sub> and water

ANSWER: X) salt and water

**BONUS**

1) CHEMISTRY *Short Answer* What are the parent acid and base of the salt NH<sub>4</sub>Cl?

ANSWER: Acid – HCl, Base – NH<sub>3</sub>

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**TOSS-UP**

2) MATH *Short Answer* Suppose an angle theta lies in the first quadrant. If sine of theta is equal to 3/5, then what is the value of cosine of theta?

ANSWER: 4/5

**BONUS**

2) MATH *Short Answer* Factor completely the polynomial  $x^3 - 3x^2 + x - 3$  over the integers.

ANSWER:  $(x^2 + 1)(x - 3)$

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**TOSS-UP**

3) BIOLOGY *Short Answer* What part of the chloroplast does the Calvin cycle take place in?

ANSWER: Stroma

**BONUS**

3) BIOLOGY *Short Answer* You're tracking blood flow in Trump's heart. By name or number, put the following parts of his cardiovascular system in chronological order of blood flow.

Assume that at the moment, the blood is in the right atrium.

I. Left Ventricle

II. Aorta

III. Pulmonary Artery

ANSWER: III, I, II

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**TOSS-UP**

4) EARTH & SPACE *Short Answer* What is the name of the supercontinent that Alfred Wegener proposed in his theory of continental drift?

ANSWER: Pangaea

**BONUS**

4) EARTH & SPACE *Multiple Choice* What type of plate boundary created the Himalayan mountains?

W. Transform

X. Convergent

Y. Invergent  
Z. Divergent  
ANSWER: X.

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**TOSS-UP**

5) PHYSICS *Short Answer* What is the power of a circuit with a current of 10 Amperes and a resistance of 2 Ohms?  
ANSWER: 200 Watts

**BONUS**

5) PHYSICS *Multiple Choice* Which of the following is false regarding Einstein's special relativity?  
W) The speed of light does not change  
X) The mass of an object increases as its velocity increases  
Y) The relative time of an object slows down as its velocity increases  
Z) The length of an object increases out as its velocity increases  
ANSWER: Z) The length of an object increases as its velocity increases

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**TOSS-UP**

6) CHEMISTRY *Short Answer* What is the common name for the following two compounds: CH<sub>4</sub>, NH<sub>3</sub>:  
ANSWER: Methane, ammonia

**BONUS**

6) CHEMISTRY *Multiple Choice* Muriatic acid is the common name for what acid?  
W) Nitric acid  
X) Bromic acid  
Y) Hydrofluoric acid  
Z) Hydrochloric acid  
ANSWER: Z) Hydrochloric acid

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**TOSS-UP**

7) MATH *Short Answer* Every 10 minutes, Chanseo eats half of his current supply of kimchi. If he starts with 40 pounds of kimchi, how much will he have eaten in 20 minutes?  
ANSWER: 30 (pounds)

**BONUS**

7) MATH *Short Answer* Given that log base 5 of 2 is 0.43, evaluate log base 5 of 8 to the nearest hundredth.  
ANSWER: 1.29

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**TOSS-UP**

8) BIOLOGY *Multiple Choice* Which of the following groups of plants does NOT have vascular tissue?

W) Ferns  
X) Cycads  
Y) Monocots  
Z) Mosses  
ANSWER: Z) Mosses

**BONUS**

8) BIOLOGY *Short Answer* What is the term that describes the leaves of ferns?  
ANSWER: Fronds

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**TOSS-UP**

9) EARTH & SPACE *Multiple Choice* Which of the following soil horizons is considered the “topsoil”?  
W. C  
X. A  
Y. B  
Z. E  
ANSWER: X.

**BONUS**

9) EARTH & SPACE *Short Answer* What term describes the organic components of the soil?  
ANSWER: Humus

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**TOSS-UP**

10) PHYSICS *Short Answer* A ball is kicked with a force of 1000 Newtons. If the ball had a mass of 25 kilograms, what is the acceleration of the ball after it is kicked?  
ANSWER: 40 m/s<sup>2</sup>

**BONUS**

10) PHYSICS *Short Answer* After kicking the 25 kilogram ball with a force of 1000 Newtons, how far will the ball have traveled after 10 seconds?  
ANSWER: 2000 meters

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**TOSS-UP**

11) CHEMISTRY *Multiple Choice* The pH of a lemon is closest to:  
W) 2  
X) 5  
Y) 8  
Z) 11  
ANSWER: W) 2

**BONUS**

11) CHEMISTRY *Short Answer* By name or number, identify all the following gases that contribute to acid rain.

1. SO<sub>2</sub>
2. NO<sub>2</sub>
3. CO<sub>2</sub>
4. NO

ANSWER: ALL

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**TOSS-UP**

12) MATH *Short Answer* Find the value of  $61^2 - 60^2$

ANSWER: 121

**BONUS**

12) MATH *Short Answer* Define the binary operation *circle* as  $a \text{ circle } b = a^b - b^a$ . Evaluate  $20 \text{ circle } 17$  plus  $17 \text{ circle } 20$ .

ANSWER: 0

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**TOSS-UP**

13) BIOLOGY *Short Answer* What is the scientific term for cytoplasm-filled projections in amoeba?

ANSWER: Pseudopodia

**BONUS**

13) BIOLOGY *Multiple Choice* Which of the hormones is incorrectly matched with the gland/organ it's secreted by?

W) Melatonin - Pineal Gland

X) Insulin - Pancreas

Y) Epinephrine - Adrenal Gland

Z) Thyroxine - Anterior Pituitary gland

ANSWER: Z) Thyroxine - Anterior Pituitary gland

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**TOSS-UP**

14) EARTH & SPACE *Multiple Choice* Which of the following planets has a density less than that of water?

W. Jupiter

X. Saturn

Y. Uranus

Z. Neptune

ANSWER: X

**BONUS**

14) EARTH & SPACE *Short Answer* The outer four planets of our solar system are also known as what?

ANSWER: Gas Giants (Accept: Jovian planets)

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**TOSS-UP**

15) PHYSICS *Short Answer* In thermodynamics, what is the ideal heat engine with the highest possible efficiency called?

ANSWER: Carnot engine

**BONUS**

15) PHYSICS *Multiple Choice* When an object is released on top of a building, its distance traveled after  $t$  seconds is:

W)  $9.8 \cdot t$

X)  $\frac{1}{2} \cdot 9.8 \cdot t^2$

Y)  $9.8 \cdot t^2$

Z)  $\frac{1}{2} \cdot 9.8 \cdot t^2$

ANSWER:

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**TOSS-UP**

16) CHEMISTRY *Multiple Choice* In Rutherford's experiment which rejected the "plum pudding" model of the atom, the foil that was used was made from what element?

W) tin

X) gold

Y) silver

Z) zinc

ANSWER: X) gold

**BONUS**

16) CHEMISTRY *Multiple Choice* In Rutherford's experiment, the scattering pattern of alpha particles were measured. Which of the following best describes the alpha particle?

W) Helium nucleus

X) Carbon nucleus

Y) Nitrogen nucleus

Z) Oxygen nucleus

ANSWER: W) Helium nucleus

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**TOSS-UP**

17) MATH *Short Answer* What is the degree of the polynomial  $p(x) = x^7 + 4034x^2 - 2017$ ?

ANSWER: 7

**BONUS**

17) MATH *Short Answer* Find the average of the first 2017 odd numbers.

ANSWER: 2017

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**TOSS-UP**

18) BIOLOGY *Short Answer* What are the proteins responsible for DNA packaging in chromatin called?

ANSWER: Histones

**BONUS**

18) BIOLOGY *Short Answer* What is the largest gland in the human body?

ANSWER: Liver

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**TOSS-UP**

19) EARTH & SPACE *Multiple Choice* What type of moraine forms as the result of the merging of two glaciers?

W. Terminal moraine

X. Lateral moraine

Y. Medial moraine

Z. Ground moraine

ANSWER: Y

**BONUS**

19) EARTH & SPACE *Multiple Choice* Which of the following describes a rock with different origins than the surrounding bedrock?

W. Erratic

X. Unconformity

Y. Outlier

Z. Discontinuity

ANSWER: W

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**TOSS-UP**

20) PHYSICS *Multiple Choice* Who published in his 1905 paper that the mass, length, and the relative time of an object changes when its speed changes?

W) Isaac Newton

X) Paul Dirac

Y) Enrico Fermi

Z) Albert Einstein

ANSWER: Z) Albert Einstein

**BONUS**

20) PHYSICS *Short Answer* When shining light through vacuum into another substance at a 60 degree angle, the path of light deflects into a 30 degree angle. What is the index of refraction of the substance?

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

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**TOSS-UP**

21) CHEMISTRY *Multiple Choice* A 100 g block of iron metal and a container filled with 100 g of water are both given 4000 kJ of heat. Which substance had the higher temperature increase and why?

W) Iron, because solids always heat up faster

X) Iron, because it has a smaller specific heat capacity

Y) Water, because liquids always heat up faster

Z) Water, because it has a smaller specific heat capacity

ANSWER: X) Iron, because it has a smaller specific heat capacity

**BONUS**

21) CHEMISTRY *Short Answer* How much heat, in kJ, was put into a 400 g block of copper that saw a temperature increase from 25 C to 46 C? The specific heat capacity of copper is  $0.38 \text{ J C}^{-1} \text{ g}^{-1}$ . Report your answer to three decimal points.

ANSWER: 3.192 kJ

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**TOSS-UP**

22) MATH *Short Answer* Evaluate the geometric mean of the following set of numbers: 3, 6, 12.

ANSWER: 6

**BONUS**

22) MATH *Multiple Choice* Suppose a complex number  $z$  is a root of some polynomial with rational coefficients in the complex numbers. Then  $z$  is said to be:

W) Tensor

X) Transcendental

Y) Poisson

Z) Algebraic

ANSWER: Z) Algebraic

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**TOSS-UP**

23) BIOLOGY *Short Answer* Name the two male scientists usually credited with figuring out the double helix shape of DNA.

ANSWER: Watson and Crick

**BONUS**

23) BIOLOGY *Short Answer* What structure/tube connects the middle ear to the pharynx?

ANSWER: Eustachian tube

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**TOSS-UP**

24) EARTH & SPACE *Multiple Choice* What is the layer of the ocean below which the rate of calcium carbonate dissolving increases dramatically?

W) Pycnocline

X) Lysocline

Y) Calcium Compensation Depth

Z) Halocline

ANSWER: X) Lysocline

**BONUS**

24) EARTH & SPACE *Short Answer* What is the rock formed when limestone becomes a metamorphic rock?

ANSWER: Marble

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**TOSS-UP**

25) PHYSICS *Multiple Choice* A violinist plays a note at 440 hertz while a nearby trumpet player plays a note also at 440 hz. They are clearly distinguishable from each other. Which of the following properties of sound is most responsible for their differences?

W) Amplitude

X) Frequency

Y) Period

Z) Quality

ANSWER: Z) Quality

**BONUS**

25) PHYSICS *Short Answer* A rope attached to a wall is shaken periodically so that it produces a standing wave. Given that the rope is vibrating at its first overtone, how many nodes are there?

ANSWER: 3

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