

TOSS-UP

1) CHEMISTRY *Multiple Choice* What is the correct name for the following: NO_3^- (read as: N O three, one minus)

W) nitrogen oxide

X) mononitrogen trioxide

Y) nitrogen trioxide

Z) nitrate

ANSWER: Z) nitrate

BONUS

1) CHEMISTRY *Short Answer* Aqueous AgNO_3 reacts with aqueous K_2CrO_4 and precipitation is observed. What is the formula for the precipitate?

ANSWER: Ag_2CrO_4

TOSS-UP

2) MATH *Short Answer* Express the base-10 number 512 in base 8.

ANSWER: 1000

BONUS

2) MATH *Short Answer* Find the number of distinct complex numbers z satisfying $z^{2017} = 2017$.

ANSWER: 2017

TOSS-UP

3) BIOLOGY *Short Answer* What is the scientific name for Vitamin B_3 ?

ANSWER: Niacin

BONUS

3) BIOLOGY *Multiple Choice* Which of the following enzymes is responsible for the breakdown of dietary fat molecules in humans?

W) Pepsin

X) Salivary Amylase

Y) Pancreatic Amylase

Z) Pancreatic Lipase

ANSWER: Z) Pancreatic Lipase

TOSS-UP

4) EARTH & SPACE *Multiple Choice* Which of the following biomes has the highest productivity?

W) estuary

X) taiga

Y) desert

Z) savannah

ANSWER: W

BONUS

4) EARTH & SPACE *Multiple Choice* Which of the following igneous rocks is extrusive?

W) gabbro

X) peridotite

Y) diorite

Z) andesite

ANSWER: Z

TOSS-UP

5) PHYSICS *Short Answer* A soybean in space crashes perpendicularly into a wall at a velocity of 20 m/s. It collides with the wall elastically, bouncing off in the opposite direction. What is the resultant velocity of this soybean?

ANSWER: -20 m/s

BONUS

5) PHYSICS *Short Answer* A helium-4 nucleus has how many protons and how many neutrons?

ANSWER: 2, 2 respectively

TOSS-UP

6) CHEMISTRY *Short Answer* How many carbons, hydrogens, and oxygens respectively compose one molecule of glucose?

ANSWER: 6 carbon, 12 oxygen, 6 oxygen

BONUS

6) CHEMISTRY *Short Answer* How many carbons, hydrogens, and oxygens respectively compose one molecule of table sugar?

ANSWER: 12 carbon, 22 oxygen, 11 oxygen

TOSS-UP

7) MATH *Short Answer* Find the distance between the points (-1,1,-1,1) and (1,-1,1,-1).

ANSWER: 4

BONUS

7) MATH *Short Answer* Calculate the area under the curve $y=x$ between $x=3$ and $x=7$.

ANSWER: 20

TOSS-UP

8) BIOLOGY *Multiple Choice* During what stage of the cell cycle does DNA replication occur in?

W) G1

X) M

Y) G2

Z) S

ANSWER: Z) S

BONUS

8) BIOLOGY *Multiple Choice* Spindle fibers, which are involved in cell division are made of what protein?

W) Tubulin

X) Myosin

Y) Actin

Z) Keratin

ANSWER: W) Tubulin

TOSS-UP

9) EARTH & SPACE *Multiple Choice* Which of the following is NOT true about the sun?

W) highest temperature occurs in the corona

X) it fuses hydrogen by the CNO cycle

Y) it possesses a radiative core

Z) it is a G2 star

ANSWER: Z

BONUS

9) EARTH & SPACE *Short Answer* What constellation does Polaris belong to?

ANSWER: Ursa Minor

TOSS-UP

10) PHYSICS *Multiple Choice* If the wave properties of a particle are difficult to observe, it is probably due to the particle's

W) Small size

X) Large mass

Y) Low momentum

Z) High charge

ANSWER: X) Large mass

BONUS

10) PHYSICS *Short Answer* Which theoretical physicist took the first color photograph?

ANSWER: James Maxwell

TOSS-UP

11) CHEMISTRY *Short Answer* What are the products of a complete combustion reaction?

ANSWER: CO₂, H₂O

BONUS

11) CHEMISTRY *Short Answer* Balance and give the coefficients of the following reaction:

CH₄ + O₂ -> H₂O + CO₂

ANSWER: 1 CH₄ + 2 O₂ -> 2 H₂O + 1 CO₂

TOSS-UP

12) MATH *Short Answer* If a circle has a diameter of 16π , what is its circumference expressed in terms of π ?

ANSWER: $16\pi^2$

BONUS

12) MATH *Short Answer* In Lexington Science Bowl, there are 4 teams: A, B, C, and D, and each person can only be on one team. Suppose that Chanseo has a 100% chance to make at least one team. If he has a $\frac{3}{5}$ chance of making D team, $\frac{1}{20}$ chance of making C, and $\frac{1}{100}$ chance of making B, what is his chance of making A team?

ANSWER: $\frac{17}{50}$

TOSS-UP

13) BIOLOGY *Short Answer* What is the scientific term for gaps in the myelin sheath of myelinated axons?

ANSWER: Node of Ranvier

BONUS

13) BIOLOGY *Multiple Choice* Which of the following vitamins is incorrectly paired with its symptom of deficiency?

W) B_1 - rickets

X) E - degeneration of nervous system

Y) K - problems in clotting of blood

Z) A - night blindness

ANSWER: W) B_1 - rickets

TOSS-UP

14) EARTH & SPACE *Short Answer* What is the name of Pluto's moon?

ANSWER: Charon

BONUS

14) EARTH & SPACE *Short Answer* What gas makes up most of the Venusian atmosphere?

ANSWER: CO_2

TOSS-UP

15) PHYSICS *Multiple Choice* Which phenomenon is best explained by the particle nature of light?

W) The Doppler Effect

X) Polarization

Y) The Photoelectric Effect

Z) Interference

ANSWER: Y) The Photoelectric Effect

BONUS

15) PHYSICS *Multiple Choice* According to the quantum theory of light, the energy of light is carried in discrete units called

W) Alpha particles

X) Photoelectrons

Y) Protons

Z) Photons

ANSWER: Z) Photons

TOSS-UP

16) CHEMISTRY *Multiple Choice* The type of reaction where oxidation numbers do not change is

W) synthesis

X) decomposition

Y) single replacement

Z) double replacement

ANSWER: Z) double replacement

BONUS

16) CHEMISTRY *Short Answer* Give the oxidation numbers of each atom in the compound $K_2Cr_2O_7$.

ANSWER: K (+1), Cr (+6), O (-2)

TOSS-UP

17) MATH *Multiple Choice* Let x be a nonzero real number. Which of the following is always positive?

W) the floor function of x

X) the ceiling function of x

Y) $x^2 - 1$

Z) the absolute value of x

ANSWER: Z) the absolute value of x

BONUS

17) MATH *Short Answer* Solve the following equation for real x : $(x-3)^2=25$. [**the quantity x minus three squared equals 25**]

ANSWER: $x=-2$, $x=8$

TOSS-UP

18) BIOLOGY *Short Answer* What is the scientific term for the system of small tubes in the outer region of human bone that allows blood vessels and nerves to pass through it?

ANSWER: Haversian Canal System (ACCEPT: Osteon)

BONUS

18) BIOLOGY *Multiple Choice* Which of the following is NOT true of Collenchyma?

W) It consists of living cells

- X) Its cells are filled with cytoplasm
Y) Its cell wall thickening is uniform
Z) Its cell lumen is wider than that of sclerenchyma
ANSWER: Y) Its cell wall thickening is uniform
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TOSS-UP

- 19) EARTH & SPACE *Short Answer* What is the closest star to the sun?

ANSWER: Proxima Centauri

BONUS

- 19) EARTH & SPACE *Short Answer* What is the name of the supermassive black hole in the middle of the Milky Way?

ANSWER: Sagittarius A* (must say: sagittarius a STAR)

TOSS-UP

- 20) PHYSICS *Short Answer* What does SI stand for?

ANSWER: Systeme Internationale

BONUS

- 20) PHYSICS *Short Answer* What is the wavelength for a wave traveling at 5 m/s with a frequency of 2 hertz?

ANSWER: 2.5 meters

TOSS-UP

- 21) CHEMISTRY *Short Answer* What is the ionic charge of a chromium ion with 20 electrons, given that chromium is element 24?

ANSWER: 4+

BONUS

- 21) CHEMISTRY *Short Answer* By name or number, rank the following compounds by increasing oxidation number of chromium.

1. K_2CrF_6
2. CrCl_2
3. K_2CrO_4

ANSWER: 2, 1, 3

TOSS-UP

- 22) MATH *Short Answer* Add the following two fractions, expressing your answer as an improper fraction in lowest terms: $\frac{8}{9}$, $\frac{2}{5}$.

ANSWER: $\frac{58}{45}$

BONUS

- 22) MATH *Short Answer* While flipping 5 fair coins, find the probability that exactly two of them come up heads.

ANSWER: $\frac{5}{16}$

TOSS-UP

23) BIOLOGY *Short Answer* Name any one of two scientists credited with the cell theory.

ANSWER: Schleiden (ACCEPT: Schwann)

BONUS

23) BIOLOGY *Multiple Choice* Erythropoiesis refers to the production of:

W) White blood cells

X) Granulocytes

Y) Blood Plasma

Z) Red blood cells

ANSWER: Z) Red blood cells

TOSS-UP

24) EARTH & SPACE *Short Answer* The Saros cycle is related to what astronomical phenomena?

ANSWER: lunar eclipses

BONUS

24) EARTH & SPACE *Multiple Choice* What is the chemical formula for magnetite?

W) Fe_2O_3

X) Fe_3O_4

Y) CuFeS_2

Z) MgO

ANSWER: X

TOSS-UP

25) PHYSICS *Multiple Choice* What is commonly used in a rectifier to convert alternating current to direct current?

W) Translator

X) Diode

Y) Solenoid

Z) Tesla

ANSWER: X) Diode

BONUS

25) PHYSICS *Short Answer* What does the acronym MASER stand for?

ANSWER: Microwave amplification by stimulated emission of radiation
