

TOSS-UP

1) Math — *Short Answer* What is the coefficient of x^2 in the expansion of open parenthesis $5x - 6$ close parenthesis squared?

ANSWER: 25

BONUS

1) Math — *Short Answer* What is the volume of a right rectangular prism, or box, with dimensions 3 by 9 by 19?

ANSWER: 513

TOSS-UP

2) Physics — *Multiple Choice* Which of the following modes of heat transfer is responsible for the heating of Earth's surface by the sun?

- W) Radiation
- X) Evaporation
- Y) Conduction
- Z) Convection

ANSWER: W) RADIATION

BONUS

2) Physics — *Multiple Choice* Which of the following laws could be used to calculate the current flowing through a resistor when it is connected to a battery?

- W) Coulomb's law
- X) Ohm's law
- Y) Faraday's law
- Z) Gauss's law

ANSWER: X) OHM'S LAW

TOSS-UP

3) Biology — *Multiple Choice* The action of the sodium-potassium pump is an example of which of the following types of transport?

- W) Active transport
- X) Cotransport
- Y) Simple diffusion
- Z) Facilitated diffusion

ANSWER: W) ACTIVE TRANSPORT

BONUS

3) Biology — *Short Answer* Decarboxylation [*dee-car-box-ill-AY-shun*] occurs in two steps of the citric acid cycle. What gaseous molecule is released during these steps?

ANSWER: CARBON DIOXIDE (ACCEPT: CO₂)



TOSS-UP

4) Chemistry — *Short Answer* What is the chemical formula of ammonia?

ANSWER: NH_3

BONUS

4) Chemistry — *Multiple Choice* Neon has an atomic mass of 20.19 amu. Which of the following explains why this is?

W) Each atom of neon has a mass of 20.19 amu

X) Neon likely has a true atomic mass of 20 amu, but mass spectrometry is not precise enough to determine its exact mass

Y) Neon can have a variable number of protons and therefore a range of masses

Z) Neon has three naturally abundant isotopes, but the most common is neon-20

ANSWER: Z) NEON HAS THREE NATURALLY ABUNDANT ISOTOPES, BUT THE MOST COMMON IS NEON-20

TOSS-UP

5) Earth and Space — *Multiple Choice* Which of the following nuclear reactions is the dominant source of energy in the Sun?

- W) Fission
- X) Fusion
- Y) Alpha decay
- Z) Beta decay

ANSWER: X) FUSION

BONUS

5) Earth and Space — *Multiple Choice* Hubble's law relates the distance to a galaxy to what other characteristic?

- W) Luminosity [*loo-min-AW-sih-tee*]
- X) Mass
- Y) Velocity
- Z) Angular momentum

ANSWER: Y) VELOCITY

TOSS-UP

6) Energy — *Multiple Choice* Scientists supported by the Department of Energy are using machine learning to classify bound systems of stars into spiral, elliptical, or irregular. What is the term for these systems?

- W) Nebulae [*NEB-yoo-lee*]
- X) Galaxies
- Y) Superclusters
- Z) Globular [*GLAW-byoo-lur*] clusters

ANSWER: X) GALAXIES

BONUS

6) Energy — *Multiple Choice* Researchers at Oak Ridge National Lab are developing microbes that turn waste into the organic acid itaconic [*IT-AH-CONIC*] acid. Which of the following pH ranges best describes an aqueous solution of one-molar itaconic acid?

- W) Less than 1
- X) Between 1 and 7
- Y) Between 7 and 13
- Z) Greater than 13

ANSWER: X) BETWEEN 1 AND 7

TOSS-UP

7) Math — *Short Answer* What is the multiplicative inverse of -6 ?

ANSWER: $-1/6$

BONUS

7) Math — *Short Answer* What is the quotient $6 \frac{3}{8}$ divided by $2 \frac{5}{6}$?

ANSWER: $2 \frac{1}{4}$ (ACCEPT: $9/4$, 2.25)

TOSS-UP

8) Physics — *Short Answer* Alex is riding his bicycle at a speed of 3 meters per second. If he accelerates in the same direction as his motion at 2 meters per second squared for 2 seconds, then, in meters per second, what is his final speed?

ANSWER: 7

BONUS

8) Physics — *Multiple Choice* Which of the following types of decay occurs when a neutron is converted into a proton and an electron?

- W) Alpha
- X) Beta
- Y) Gamma
- Z) Delta

ANSWER: X) BETA

TOSS-UP

9) Biology — *Short Answer* What taxonomic rank is shared by a group of species that are closely related, and is part of an organism's binomial name?

ANSWER: GENUS (ACCEPT: GENERA)

BONUS

9) Biology — *Short Answer* What is the term for the maximum number of individuals in a species that an environment can support?

ANSWER: CARRYING CAPACITY

TOSS-UP

10) Chemistry — *Multiple Choice* What is the term for mixtures that are not uniform throughout?

W) Homogeneous

X) Heterogeneous [*hetero-JEE-nee-us*]

Y) Solution

Z) Dissolved

ANSWER: X) HETEROGENEOUS

BONUS

10) Chemistry — *Short Answer* To the nearest degree Celsius, what temperature is absolute zero?

ANSWER: -273

TOSS-UP

11) Earth and Space — *Short Answer* Which type of seismic wave would arrive first at a seismometer recording a distant earthquake?

ANSWER: P-WAVE

BONUS

11) Earth and Space — *Multiple Choice* Crater Lake is not really a crater, but a remnant of what igneous structure?

- W) Cinder cone
- X) Lava dome
- Y) Caldera [*call-DAIR-ah*]
- Z) Parasitic cone

ANSWER: Y) CALDERA

TOSS-UP

12) Energy — *Multiple Choice* Lawrence Berkeley National Lab researchers use high-energy charged particles to generate materials with unique properties. What is the term for a particle or molecule that has an electric charge?

- W) Hydride
- X) Electrode
- Y) Enantiomer [*en-AN-tee-oh-mur*]
- Z) Ion

ANSWER: Z) ION

BONUS

12) Energy — *Short Answer* Brookhaven National Lab scientists are using low-energy ion-scattering spectroscopy to examine the surfaces of bismuth vanadate [*VAN-ah-date*] electrodes used for the water-splitting reaction. This technique involves bombarding the analyte with atoms that consist of 2 protons, 2 neutrons, and 1 electron. What atomic species does this represent?

ANSWER: HELIUM PLUS (ACCEPT: SINGLY IONIZED HELIUM, He^+ ; do not accept: helium)

TOSS-UP

13) Math — *Short Answer* If the perimeter of a triangle is 31, and the lengths of two of its sides are 12 and 13, what is the length of its third side?

ANSWER: 6

BONUS

13) Math — *Short Answer* Give one of the linear factors of $x^2 + 11x - 80$.

ANSWER: $x - 5$ OR $x + 16$ (must give at least one)

TOSS-UP

14) Physics — *Multiple Choice* If the mass of an object is doubled, by what factor is its gravitational potential energy multiplied?

- W) $1/4$
- X) $1/2$
- Y) 2
- Z) 4

ANSWER: Y) 2

BONUS

14) Physics — *Multiple Choice* A photovoltaic cell converts between two different kinds of energy. Which of the following are the input and output forms of energy, respectively?

- W) Electric, chemical
- X) Chemical, thermal
- Y) Mechanical, radiant
- Z) Radiant, electric

ANSWER: Z) RADIANT, ELECTRIC



TOSS-UP

15) Biology — *Short Answer* What cellular organelle is responsible for post-translational modification of secreted proteins?

ANSWER: GOLGI (ACCEPT: GOLGI BODY, GOLGI APPARATUS, GOLGI COMPLEX)

BONUS

15) Biology — *Multiple Choice* Antibiotics are completely ineffective at treating the causative agent of which of the following diseases?

- W) Strep throat
- X) Syphilis
- Y) Influenza
- Z) Tuberculosis

ANSWER: Y) INFLUENZA

TOSS-UP

16) Chemistry — *Multiple Choice* What type of reaction is $\text{Na}_2\text{S} + 2\text{HCl}$ yields $2\text{NaCl} + \text{H}_2\text{S}$ an example of?

- W) Double replacement
- X) Single replacement
- Y) Decomposition
- Z) Combustion

ANSWER: W) DOUBLE REPLACEMENT

BONUS

16) Chemistry — *Multiple Choice* Which of the following substances has the highest heat of vaporization?

- W) Ethanol
- X) Water
- Y) Mercury
- Z) Hexane

ANSWER: X) WATER

TOSS-UP

17) Earth and Space — *Short Answer* On what planet is the solar system's largest volcano?

ANSWER: MARS

BONUS

17) Earth and Space — *Multiple Choice* Mars's seasonal polar ice caps are primarily composed of what molecule?

- W) Carbon monoxide
- X) Carbon dioxide
- Y) Methane
- Z) Water

ANSWER: W) CARBON DIOXIDE

TOSS-UP

18) Energy — *Multiple Choice* Brookhaven National Lab scientists are studying how sunlight can cause trace gases in the atmosphere to form aerosol particles, which can then seed the formation of clouds. What is the term for these particles?

- W) Fusion nuclei
- X) Condensation nuclei
- Y) Liquid crystal seeds
- Z) Soot

ANSWER: X) CONDENSATION NUCLEI

BONUS

18) Energy — *Multiple Choice* Argonne National Lab researchers are studying the release of carbon dioxide from the largest permafrost region found at temperate latitudes. Which of the following locations are they studying?

- W) Appalachian Mountains
- X) Tibetan Plateau
- Y) Great Plains
- Z) Sahara Desert

ANSWER: X) TIBETAN PLATEAU

Before we leave, let's confirm the team's score. What score does the Official Scorekeeper have? And what is the final score in the Chat Box? Does anyone disagree?

I'd like to remind the Scorekeeper to submit the official scoresheet. Best of luck to the team and thanks for competing in today's event.