

TOSS-UP

1) Earth and Space — *Multiple Choice* What is the name of the point directly overhead for an observer viewing the night sky?

- W) Zenith
- X) Nadir **[NAY-der]**
- Y) Horizon
- Z) Ecliptic

ANSWER: W) ZENITH

BONUS

1) Earth and Space — *Short Answer* Identify all of the following three planets that have rings: 1) Jupiter; 2) Neptune; 3) Uranus.

ANSWER: ALL

TOSS-UP

2) Energy — *Short Answer* Scientists at SLAC National Accelerator Laboratory are studying particles called tetraquarks. How many constituent quarks are in a tetraquark?

ANSWER: 4

BONUS

2) Energy — *Multiple Choice* Scientists at Fermi National Accelerator Lab working on the Dark Energy Survey have measured a cosmological quantity to be 0.776, with a standard error of 0.017. Assuming normality, which of the following best describes their claim?

- W) The value of the quantity definitely lies between 0.759 and 0.793
- X) Throughout the universe, the value of the quantity fluctuates between 0.759 and 0.793
- Y) With a probability of 68%, the value of the quantity lies between 0.759 and 0.793
- Z) Their instruments recorded a value of 0.776, but they know the instrument can make errors of up to 0.017

ANSWER: Y) WITH A PROBABILITY OF 68%, THE VALUE OF THE QUANTITY LIES BETWEEN 0.759 AND 0.793

TOSS-UP

3) Math — *Short Answer* What is the leading coefficient of the polynomial $6x^3 - 2x^2 + 7x - 9$?

ANSWER: 6

BONUS

3) Math — *Short Answer* A restaurant offers a combo consisting of the diner's choice of a soda, an appetizer, an entrée, and a dessert, to be selected from 6 kinds of soda, 4 appetizers, 7 entrees, and 3 desserts. How many combos are possible?

ANSWER: 504

TOSS-UP

4) Physics — *Multiple Choice* Which of the following types of quantities appears in a free-body diagram?

- W) Energy
- X) Force
- Y) Momentum
- Z) Acceleration

ANSWER: X) FORCE

BONUS

4) Physics — *Multiple Choice* The specific gravity of a substance is most directly related to which of the following properties?

- W) Density
- X) Volume
- Y) Mass
- Z) Moment of inertia *[in-UR-shah]*

ANSWER: W) DENSITY

TOSS-UP

5) Biology — *Multiple Choice* Looking at a picture of all of the chromosomes in a cell can help in the identification of mutations and abnormalities. What is this type of picture called?

- W) Pedigree
- X) DNA fingerprint
- Y) Genotype
- Z) Karyotype

ANSWER: Z) KARYOTYPE

BONUS

5) Biology — *Short Answer* What is the term for the middle portion of the arthropod body to which the wings are usually attached?

ANSWER: THORAX

TOSS-UP

6) Chemistry — *Multiple Choice* Mendeleev [*mendah-LAY-ev*] organized the elements according to their reactivity. Which of the following elements would be grouped with lithium?

- W) Magnesium
- X) Chlorine
- Y) Sodium
- Z) Calcium

ANSWER: Y) SODIUM

BONUS

6) Chemistry — *Short Answer* What is the empirical formula of the compound formed by aluminum and chlorine?

ANSWER: AlCl_3

TOSS-UP

7) Earth and Space — *Multiple Choice* Gas giant planets are primarily composed of what two elements?

- W) Hydrogen and nitrogen
- X) Hydrogen and helium
- Y) Helium and nitrogen
- Z) Hydrogen and oxygen

ANSWER: X) HYDROGEN AND HELIUM

BONUS

7) Earth and Space — *Multiple Choice* A lunar eclipse will occur when which of the following happens?

- W) The moon blocks light from the sun
- X) The side of the moon facing Earth is completely dark
- Y) The full moon moves through Earth's shadow
- Z) The moon is fully lit by the sun

ANSWER: Y) THE FULL MOON MOVES THROUGH EARTH'S SHADOW

TOSS-UP

8) Energy — *Multiple Choice* Scientists at Princeton Plasma Physics Lab are studying B fields in plasma. What is the more common term for a B field?

- W) Electric field
- X) Magnetic field
- Y) Strong field
- Z) Weak field

ANSWER: X) MAGNETIC FIELD

BONUS

8) Energy — *Multiple Choice* Scientists at Brookhaven National Lab are studying the element that is most abundant by mass in Earth's core. What is this element?

- W) Oxygen
- X) Silicon
- Y) Magnesium
- Z) Iron

ANSWER: Z) IRON

TOSS-UP

9) Math — *Short Answer* What is the equation of the horizontal line that passes through the point with coordinates (4, 6)?

ANSWER: $y = 6$ (ACCEPT: $y - 6 = 0$)

BONUS

9) Math — *Short Answer* Evaluate the following expression:
12 plus 6 times 3 minus 7.

ANSWER: 23

TOSS-UP

10) Physics — *Multiple Choice* What is the SI base unit of temperature?

- W) Kelvin
- X) Celsius
- Y) Fahrenheit
- Z) Rankine

ANSWER: W) KELVIN

BONUS

10) Physics — *Short Answer* What is the term for a process in which two or more atomic nuclei are combined to form a single atomic nucleus?

ANSWER: NUCLEAR FUSION (ACCEPT: FUSION)

TOSS-UP

11) Biology — *Short Answer* In Earth's history, there have been several instances in which a sizable fraction of the species on Earth have suddenly died out. What is the term for these events?

ANSWER: MASS EXTINCTIONS (ACCEPT: EXTINCTION EVENT, BIOTIC CRISIS)

BONUS

11) Biology — *Multiple Choice* A biologist identifies a new unicellular species lacking a nucleus that can undergo both transcription and translation concurrently on the same strand of mRNA. Which of the following groups of organisms could this cell be a member of?

- W) Plants
- X) Protozoa
- Y) Fungi
- Z) Bacteria

ANSWER: Z) BACTERIA

TOSS-UP

12) Chemistry — *Multiple Choice* What term is used to describe the number density of water vapor in the air?

- W) Condensation
- X) Humidity
- Y) Salinity
- Z) Telemetry *[tel-EM-eh-tree]*

ANSWER: X) HUMIDITY

BONUS

12) Chemistry — *Multiple Choice* Which of the following molecules has a tetrahedral geometry?

- W) Methane
- X) Water
- Y) Carbon dioxide
- Z) Hydrogen sulfide

ANSWER: W) METHANE

TOSS-UP

13) Earth and Space — *Multiple Choice* Which of the following units is not used to measure atmospheric pressure?

- W) Pounds
- X) Millibars
- Y) Kilopascals
- Z) Atmospheres

ANSWER: W) POUNDS

BONUS

13) Earth and Space — *Multiple Choice* What is the name of the ductile **[DUK-til]** region of Earth's mantle that is solid but is so mechanically weak that it can flow?

- W) Lithosphere
- X) Asthenosphere **[ass-THEN-oh-sfeer]**
- Y) Hot spot
- Z) Moho

ANSWER: X) ASTHENOSPHERE

TOSS-UP

14) Energy — *Multiple Choice* Researchers at SLAC National Accelerator Lab are using an x-ray free-electron laser to study changes molecules undergo when interacting with light. Which of the following biological processes depends most strongly on the interaction of light with molecules?

- W) Respiration
- X) Mitosis
- Y) Citric acid cycle
- Z) Photosynthesis

ANSWER: Z) PHOTOSYNTHESIS

BONUS

14) Energy — *Multiple Choice* Scientists at SLAC National Accelerator Laboratory are studying new ways to measure the Hubble constant. Which of the following best describes what the Hubble constant represents?

- W) Rate of expansion of the universe
- X) Ideal mirror angle for telescopes
- Y) Number of stars in the Milky Way
- Z) Velocity required to enter Earth orbit

ANSWER: W) RATE OF EXPANSION OF THE UNIVERSE

TOSS-UP

15) Math — *Short Answer* If a right triangle has an exterior angle of measure 170 degrees, what is the degree measure of the larger of its acute interior angles?

ANSWER: 80

BONUS

15) Math — *Short Answer* If f of $x = x^3 - 3x^2 - 7x + 4$, what is f of -2 ?

ANSWER: -2

TOSS-UP

16) Physics — *Multiple Choice* Which of the following sets of laws describes how planets orbit stars?

- W) Kirchoff's **[KEER-koffs]** laws
- X) Amonton's **[AM-on-tuns]** laws
- Y) Maxwell's laws
- Z) Kepler's laws

ANSWER: Z) KEPLER'S LAWS

BONUS

16) Physics — *Multiple Choice* Which of the following is closest to the speed of light in kilometers per second?

- W) 100,000
- X) 200,000
- Y) 300,000
- Z) 400,000

ANSWER: Y) 300,000

TOSS-UP

17) Biology — *Short Answer* What organelles in plant cells contain chlorophyll?

ANSWER: CHLOROPLASTS

BONUS

17) Biology — *Short Answer* The chordae tendineae [**KOR-day tendin-EE-ah**], which are colloquially known as the heartstrings, attach what set of structures within the heart to the heart wall?

ANSWER: VALVES (ACCEPT: ATRIOVENTRICULAR VALVES)

TOSS-UP

18) Chemistry — *Multiple Choice* Which of the following elements is NOT a metalloid [*MET-ah-loid*]?

- W) Silicon
- X) Germanium [*jer-MAYN-ee-um*]
- Y) Carbon
- Z) Tellurium [*te-LOOR-ee-um*]

ANSWER: Y) CARBON

BONUS

18) Chemistry — *Multiple Choice* You dip a piece of pH paper into a one-molar solution of hydrochloric acid. What color does it turn?

- W) Yellow
- X) Indigo
- Y) Red
- Z) Green

ANSWER: Y) RED

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.