

ROUND 11

TOSS-UP

1) PHYSICS *Multiple Choice* Which of the following is an example of antimatter?

- W) Electron
- X) Photon
- Y) Graviton
- Z) Positron

ANSWER: Z) POSITRON

BONUS

1) PHYSICS *Short Answer* Name the two things that together constitute about 95% of the universe.

ANSWER: DARK MATTER AND DARK ENERGY

TOSS-UP

2) ENERGY *Multiple Choice* Below what approximate temperature, in degrees Fahrenheit, does natural gas become a liquid?

- W) -260°
- X) -100°
- Y) 0°
- Z) 5°

ANSWER: W) -260°

BONUS

2) ENERGY *Multiple Choice* Natural gas is often stored and transported as a liquid because:

- W) It is less flammable as a liquid
- X) It takes up less space as a liquid
- Y) Pipelines cannot transport gas
- Z) Liquid natural gas does not smell as bad

ANSWER: X) IT TAKES UP LESS SPACE AS A LIQUID

TOSS-UP

3) MATH *Short Answer* What are the complex roots of the equation $(x + 2)^2 = -1$?

ANSWER: $-2 + i$ AND $-2 - i$ (ACCEPT: $-2 \pm i$)

BONUS

3) MATH *Short Answer* A car drives 100 miles. For 20% of the time, the car drives at a constant speed of 45 miles per hour. For the remainder of the time, the car drives at a constant speed of 20 miles per hour. How many hours does the entire trip take? Round your answer to the nearest hour.

ANSWER: 4

TOSS-UP

4) ENERGY *Multiple Choice* How does the production of propane from natural gas compare to propane production from oil in the United States?

- W) More propane is produced from oil than from natural gas
- X) More propane is produced from natural gas than oil
- Y) Propane production from natural gas and oil is about equal
- Z) Propane is not produced from natural gas or oil

ANSWER: Y) PROPANE PRODUCTION FROM NATURAL GAS AND OIL IS ABOUT EQUAL

BONUS

4) ENERGY *Multiple Choice* Which of the following expresses a challenge or challenges facing the use of hydrogen technology in vehicles?

- W) Fuel cells produce polluting emissions
- X) The technology required to carry thousands of gallons of water is not practical
- Y) There are high costs for fuel cells and hydrogen production technologies
- Z) The well to wheel efficiency for hydrogen is less than 1%

ANSWER: Y) THERE ARE HIGH COSTS FOR FUEL CELLS AND HYDROGEN PRODUCTION TECHNOLOGIES

TOSS-UP

5) EARTH AND SPACE *Multiple Choice* Approximately what percentage of water on Earth is fresh water?

- W) 3%
- X) 7%
- Y) 10%
- Z) 15%

ANSWER: W) 3%

BONUS

5) EARTH AND SPACE *Multiple Choice* What type of lake is very clear with few fish and not many plants?

- W) Eutrophic (read as: yuh-TRŌE -fik)
- X) Oligotrophic
- Y) Mesotrophic
- Z) Phototrophic

ANSWER: X) OLIGOTROPHIC

TOSS-UP

6) BIOLOGY *Short Answer* What is the term for an RNA virus that is replicated in a host cell via reverse transcriptase to produce DNA, which is then inserted in the host genome?

ANSWER: A RETROVIRUS

BONUS

6) BIOLOGY *Multiple Choice* During the reverse transcription process, a deficiency in which of the following enables retroviruses to mutate quickly?

- W) Stop codons
- X) Cytosine (read as: SY-toh-seen)
- Y) Proofreading
- Z) DNA

ANSWER: Y) PROOFREADING

TOSS-UP

7) MATH *Multiple Choice* Evaluate the following expression: $\frac{(n-2)!}{(n-3)!}$ (read as: the quantity n minus 2 factorial divided by the quantity n minus 3 factorial).

- W) $n - 3$
- X) $n - 2$
- Y) n
- Z) 1

ANSWER: X) $n - 2$

BONUS

7) MATH *Multiple Choice* If $f(x) = 2x - 1$ and $f(g(-2)) = 7$ (read as: f of g of negative 2 equals 7), which of the following could be $g(x)$?

- W) $-x^2$
- X) $2x$
- Y) $2x^2$
- Z) $|4x + 4|$ (read as: the absolute value of $4x$ plus 4)

ANSWER: Z) $|4x + 4|$

TOSS-UP

8) EARTH AND SPACE *Multiple Choice* Which of the following does NOT explain why many optical observatories are built at higher altitudes in the mountains?

- W) Less twinkling from the atmosphere
- X) Less light pollution
- Y) Less cloudiness
- Z) Convenient access for scientists

ANSWER: Z) CONVENIENT ACCESS FOR SCIENTISTS

BONUS

8) EARTH AND SPACE *Multiple Choice* What is the source of the annual Perseid (read as: PER-seed-id) and Leonid meteor showers?

- W) Comets
- X) The Earth passing through an asteroid belt
- Y) Early solar system debris
- Z) Deorbiting cold war era satellites

ANSWER: W) COMETS

TOSS-UP

9) MATH *Short Answer* What is the area of a square if the length of its diagonal is $7\sqrt{2}$?

ANSWER: 49

BONUS

9) MATH *Multiple Choice* What transformation is represented by the multiplication of $\begin{bmatrix} x \\ y \end{bmatrix}$ by $\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$ (read as: the 2 by 1 matrix x, y by the 2 by 2 matrix row 1: 1, 0; row 2: 0, -1)?

- W) Reflection through the x-axis
- X) Reflection through the y-axis
- Y) Reflection through the line $y = x$
- Z) Reflection through the origin

ANSWER: W) REFLECTION THROUGH THE X-AXIS

TOSS-UP

10) CHEMISTRY *Multiple Choice* Which of the following substances can behave as either a Lewis acid or a Lewis base?

- W) Ammonia
- X) Hydrochloric Acid
- Y) Sodium Hydroxide
- Z) Acetic Acid

ANSWER: W) AMMONIA

BONUS

10) CHEMISTRY *Multiple Choice* Of the following 1.0 molar solutions, which will have the highest pH?

- W) Hydrochloric acid
- X) Hydrocyanic acid
- Y) Acetic acid
- Z) Sulfuric acid

ANSWER: X) HYDROCYANIC ACID

TOSS-UP

11) PHYSICS *Short Answer* What is the name for linear and circular devices that boost beams of particles to high energies before the particles are made to collide with each other or with stationary objects.

ANSWER: ACCELERATOR (ACCEPT: PARTICLE ACCELERATOR) (DO NOT ACCEPT: NAMES OF SPECIFIC ACCELERATORS SUCH AS CYCLOTRON, LHC, SNS)

BONUS

11) PHYSICS *Multiple Choice* Two electric charges are separated by a distance d . What happens to the force if the distance is halved?

- W) It doubles
- X) It quadruples
- Y) It is halved
- Z) It remains the same

ANSWER: X) IT QUADRUPLES

TOSS-UP

12) EARTH AND SPACE *Multiple Choice* Which of these characteristics does NOT indicate that an area was likely glaciated in the past?

- W) A V-shaped valley
- X) Erratics in a valley
- Y) A lateral moraine at the side of a valley
- Z) A cirque lake at the top of a valley

ANSWER: W) A V-SHAPED VALLEY

BONUS

12) EARTH AND SPACE *Multiple Choice* Karst topography is generally formed in regions with which type of rock?

- W) Shale
- X) Obsidian
- Y) Metamorphic
- Z) Limestone

ANSWER: Z) LIMESTONE

TOSS-UP

13) BIOLOGY *Short Answer* What are the four stages of mitosis?

ANSWER: PROPHASE, METAPHASE, ANAPHASE, AND TELOPHASE

BONUS

13) BIOLOGY *Multiple Choice* A sperm cell is found to have 18 chromosomes. How many molecules of DNA were present during Metaphase I of the cell cycle?

- W) 18
- X) 36
- Y) 72
- Z) 144

ANSWER: Y) 72

TOSS-UP

14) CHEMISTRY *Multiple choice* Which of the following elements is the least reactive?

- W) Xenon
- X) Lithium (read as: LI-thee-uhm)
- Y) Aluminum
- Z) Iodine

ANSWER: W) XENON

BONUS

14) CHEMISTRY *Multiple Choice* What is the oxidation number of tin in the following formula: $(\text{NH}_4)_2\text{SnCl}_6$?

- W) -4
- X) -2
- Y) +2
- Z) +4

ANSWER: Z) +4

TOSS-UP

15) BIOLOGY *Multiple Choice* Students are given an organism and asked to create an experiment to determine whether it is ectothermic. They vary room temperature and record whether the body temperature of the organism changes. Which result would be consistent with an ectothermic organism?

- W) The organism's body temperature would not vary with room temperature
- X) The organism's body temperature would vary inversely with room temperature
- Y) The organism's body temperature would vary with room temperature
- Z) The organism's body temperature would only vary when the room temperature increased

ANSWER: Y) THE ORGANISM'S BODY TEMPERATURE WOULD VARY WITH ROOM TEMPERATURE

BONUS

15) BIOLOGY *Multiple Choice* A student wants to know if drinking caffeinated coffee before an exam increases performance. To test this hypothesis, the student gives half the class caffeinated coffee and half of the class decaffeinated coffee. What is the independent variable?

- W) The students
- X) Exam performance
- Y) Caffeine consumption prior to exam
- Z) There is no independent variable

ANSWER: Y) CAFFEINE CONSUMPTION PRIOR TO EXAM

TOSS-UP

16) PHYSICS *Short Answer* What principle states that the more precisely we know the location of a particle, the less precisely we know its momentum?

ANSWER: HEISENBERG UNCERTAINTY PRINCIPLE (ACCEPT: UNCERTAINTY PRINCIPLE)

BONUS

16) PHYSICS *Short Answer* In addition to the mutual uncertainties of position and momentum, which other set of mutual uncertainties did Heisenberg discover?

ANSWER: ENERGY AND TIME

TOSS-UP

17) EARTH AND SPACE *Multiple Choice* Uranus is most similar in size and composition to what other planet?

- W) Mars
- X) Jupiter
- Y) Saturn
- Z) Neptune

ANSWER: Z) NEPTUNE

BONUS

17) EARTH AND SPACE *Multiple Choice* Uranus is unique among the planets in our solar system because:

- W) It has a highly elliptical orbit, and is occasionally further from the Sun than Neptune
- X) It is the only outer planet with an icy shell
- Y) Its rotational axis is nearly parallel with its orbital plane
- Z) It orbits the Sun in a clockwise direction, opposite all other planets

ANSWER: Y) ITS ROTATIONAL AXIS IS NEARLY PARALLEL WITH ITS ORBITAL PLANE

TOSS-UP

18) MATH *Short Answer* What is the range of the set {4, 3, 7, 9, and 8}?

ANSWER: 6

BONUS

18) MATH *Short Answer* If 1543 is the n^{th} term of the arithmetic sequence that begins -7, -2, 3, what is the value of n ?

ANSWER: 311

TOSS-UP

19) BIOLOGY *Multiple Choice* Homologous structures in animals are evidence supporting evolutionary theory, because these structures:

- W) Perform similar functions, but do not share the same basic structure
- X) Can differ in appearance between animals, but are modifications of the same basic structure
- Y) Are produced by identical genes, which reside in all animals that share the homologous structure
- Z) Appear identical in all animals that share the homologous structure

ANSWER: X) CAN DIFFER IN APPEARANCE BETWEEN ANIMALS, BUT ARE MODIFICATIONS OF THE SAME BASIC STRUCTURE

BONUS

19) BIOLOGY *Multiple Choice* What do the human appendix and the python pelvic spurs have in common?

- W) They are both homologous
- X) They are both analogous
- Y) They are both monophyletic organs
- Z) They are both vestigial organs

ANSWER: Z) THEY ARE BOTH VESTIGIAL ORGANS

TOSS-UP

20) PHYSICS *Multiple Choice* A magnet would NOT attract which of the following substances?

- W) Aluminum
- X) Iron
- Y) Cobalt
- Z) Gadolinium

ANSWER: W) ALUMINUM

BONUS

20) PHYSICS *Multiple Choice* On what object does the magnetic force act in an electromagnetic motor?

- W) Brush
- X) Wire
- Y) Bearing
- Z) Commutator

ANSWER: X) WIRE

TOSS-UP

21) CHEMISTRY *Multiple Choice* What is the name for a chemical bond that involves sharing the electrons between two non-metals?

- W) Ionic
- X) Polar
- Y) Covalent
- Z) Electric

ANSWER: Y) COVALENT

BONUS

21) CHEMISTRY *Multiple Choice* In a lead battery, which of the following changes are occurring?

- W) Lead loses electrons while hydrogen gains electrons
- X) Lead oxide loses electrons while hydrogen gains electrons
- Y) Lead loses electrons while lead oxide gains electrons
- Z) Lead gains electrons while lead oxide loses electrons

ANSWER: Y) LEAD LOSES ELECTRONS WHILE LEAD OXIDE GAINS ELECTRONS

TOSS-UP

22) CHEMISTRY *Multiple Choice* In the notation $3d^2$, the 2 refers to:

- W) The energy level of the electrons
- X) The number of electrons in the orbital 3d
- Y) The number of d orbitals in the energy level 3
- Z) The total number of electrons in the $n = 3$ shell

ANSWER: X) THE NUMBER OF ELECTRONS IN THE ORBITAL 3d.

BONUS

22) CHEMISTRY *Short Answer* What is the maximum number of electrons that can be held in the fourth quantum energy level?

ANSWER: 32

TOSS-UP

23) MATH *Multiple Choice* Which of the following equations describes a parabola that has a vertex at (-2,3)?

W) $y = -2(x + 2)^2 - 3$

X) $y = -2(x + 2)^2 + 3$

Y) $y = -2(x - 2)^2 - 3$

Z) $y = -2(x - 2)^2 + 3$

ANSWER: X) $y = -2(x + 2)^2 + 3$

BONUS

23) MATH *Short Answer* What is the equation for the axis of symmetry for the function $f(x) = -x^2 + 2x + 3$?

ANSWER: $x = 1$

TOSS-UP

24) ENERGY *Short Answer* Which photosynthetic process is most associated with anabolism?

ANSWER: CALVIN CYCLE

BONUS

24) ENERGY *Short Answer* Chlorophyll pigments contain which metal ion at the center of their chlorine ring?

ANSWER: MAGNESIUM (ACCEPT: Mg^{2+})

TOSS-UP

25) EARTH AND SPACE *Short Answer* The two largest ice sheets on Earth are well known: the Antarctic and Greenland ice sheets. On which continent can the third largest ice sheet be found?

ANSWER: SOUTH AMERICA

BONUS

25) EARTH AND SPACE *Short Answer* There are concerns that melting ice in Greenland might further influence climate by altering oceanic circulation patterns. One possible effect would be lower temperatures in Northern Europe. Name the current serving as an important transporter of heat that would have to be altered for this to occur?

ANSWER: THE GULF STREAM (ACCEPT: NORTH ATLANTIC DRIFT)