

ROUND 17

TOSS-UP

1) BIOLOGY *Multiple Choice* White-nose fungus is rapidly spreading across the United States. Which of the following events is least likely to occur as a result of its spread?

- W) Fruit prices will increase
- X) Insect populations will increase
- Y) Small flying mammals will die
- Z) Troglobite populations will increase

ANSWER: Z) TROGLOBITE POPULATIONS WILL INCREASE

BONUS

1) BIOLOGY *Short Answer* What are structures that connect parts of a fungus, providing a conduit for the sharing and transport of resources?

ANSWER: RHIZOMORPHS (read as: ry-ZÖE-mohrfs)

TOSS-UP

2) MATH *Short Answer* Find $\lim_{x \rightarrow \infty} \left(\frac{x^2 + 10}{7x^2 - 5} \right)$ (read as: the limit as x approaches infinity of the quantity x squared plus 10 over the quantity 7 x squared minus 5)

ANSWER: 1/7

BONUS

2) MATH *Short Answer* Find the equation of the line in slope intercept form of the tangent to $y = 3x^2 - 2x + 4$ at $x = 1$.

ANSWER: $y = 4x + 1$

TOSS-UP

3) EARTH AND SPACE *Short Answer* TEX86 is a lipid-based paleothermometer (read as: pay-lee-ōe-thehr-MOH-meh-tehr) which can reconstruct ancient seawater temperatures. It is based on the temperature sensitivity of marine microorganisms in which archaeal phylum?

ANSWER: CRENARCHAEOTA (read as: kren arr kee ah tah)

BONUS

3) EARTH AND SPACE *Multiple Choice* The TEX86 paleothermometer (read as: pay-ley-ōe-thehr-MOH-meh-tehr), measured from the abundance of crenarchaeal (read as: kren arr kee ah tah) lipids in marine sediments, depends on the relative abundance of which class of lipids?

W) Tetraethers

X) Long-chain alkenones (read as: AHL-kee-nōens)

Y) Sterols

Z) Fatty acid methyl esters

ANSWER: W) TETRAETHERS

TOSS-UP

4) MATH *Short Answer* Find $\lim_{x \rightarrow \infty} e^{-x}$ (read as: the limit as x approaches infinity of e to the negative x)

ANSWER: 0

BONUS

4) MATH *Short Answer* A particle moves so its position s in kilometers at time t in hours can be expressed as $s(t) = 6t^2 + 25$. After 5 hours, what is its speed in kilometers per hour and its acceleration in kilometers per hour squared, respectively?

ANSWER: SPEED: 60, ACCELERATION: 12

TOSS-UP

5) CHEMISTRY *Multiple Choice* Which of the following ionic solids has the highest melting point?

- W) Sodium chloride
- X) Potassium chloride
- Y) Magnesium oxide
- Z) Zinc oxide

ANSWER: Y) MAGNESIUM OXIDE

BONUS

5) CHEMISTRY *Multiple Choice* Which of the following is the strongest nucleophile (read as: NUH-klee-oh-fyl) as measured in methanol?

- W) Iodide
- X) Hydroxide
- Y) Ammonia
- Z) Fluoride

ANSWER: W) IODIDE

TOSS-UP

6) PHYSICS *Short Answer* The recommended gauge tire pressure in the front tires of a Hummer is 26 psi. Estimate, to the nearest whole number, this pressure in atmospheres.

ANSWER: 2

BONUS

6) PHYSICS *Multiple Choice* As a drill digs a hole to the center of the planet, what are the changes in pressure and gravitational acceleration?

- W) Pressure and gravitational acceleration both decrease
- X) Pressure and gravitational acceleration both increase
- Y) Pressure decreases and gravitational acceleration increases
- Z) Pressure increases and gravitational acceleration decreases

ANSWER: Z) PRESSURE INCREASES AND GRAVITATIONAL ACCELERATION DECREASES

TOSS-UP

7) EARTH AND SPACE *Short Answer* Which one or ones of the following household items has, at some point in the history of its production, contained mercury: 1) fluorescent light bulb, 2) fishing lure, 3) golf ball, and/or 4) soap?

ANSWER: FLUORESCENT LIGHTBULB, FISHING LURE, GOLF BALL, AND SOAP
(ACCEPT: 1, 2, 3, 4, OR ALL)

BONUS

7) EARTH AND SPACE *Multiple Choice* What pair of natural phenomena contribute the most to the release of interstitial water from sediment into lake water columns?

- W) Wind and temperature
- X) Wind and current
- Y) Current and salinity
- Z) Current and temperature

ANSWER: X) WIND AND CURRENT

TOSS-UP

8) BIOLOGY *Short Answer* What are the two principle protein structures that make up the cytoskeleton?

ANSWER: MICROFILAMENTS AND MICROTUBULES

BONUS

8) BIOLOGY *Multiple Choice* Which of the following most closely approximates the number of protein-coding genes in the fruit fly genome?

- W) 3,000
- X) 6,000
- Y) 12,000
- Z) 24,000

ANSWER: Y) 12,000

TOSS-UP

9) CHEMISTRY *Multiple Choice* Which of the following is NOT a polyprotic acid?

- W) Carbonic acid
- X) Formic acid
- Y) Oxalic acid
- Z) Phosphoric acid

ANSWER: X) FORMIC ACID

BONUS

9) CHEMISTRY *Multiple Choice* In a pressure-volume diagram of an isothermal expansion, what is represented by the area underneath the curve?

- W) Change in pressure
- X) Change in volume
- Y) Work done by the gas
- Z) Work done on the gas

ANSWER: Y) WORK DONE BY THE GAS

TOSS-UP

10) BIOLOGY *Multiple Choice* Which of the following is not a cell that participates in the vertebrate innate immune response?

- W) Neutrophil (read as: NUH-troh-fil)
- X) Macrophage
- Y) NK Cell
- Z) T Cell

ANSWER: Z) T CELL

BONUS

10) BIOLOGY *Multiple Choice* Which of the following molecules is not a component of the vertebrate innate immune response?

- W) α -Defensin
- X) Granzyme
- Y) Perforin
- Z) IgE

ANSWER: Z) IgE

TOSS-UP

11) PHYSICS *Short Answer* Name this growing field of physics, based on the use of lasers to slow atoms and molecules, that may lead to quantum computers, precision measurement devices, and new states of matter.

ANSWER: ULTRACOLD PHYSICS

BONUS

11) PHYSICS *Short Answer* David observes that his heart beats 60.0 times per minute from his own frame of reference. If David gets into a rocket and flies away from Earth fast enough so that his heartbeat appears to occur half as frequently as observed from Earth, how fast is the rocket traveling in terms of c , expressing your answer as a decimal rounded to the nearest tenth.

ANSWER: 0.9 c

TOSS-UP

12) EARTH AND SPACE *Multiple Choice* Which of the following locations has the highest annual productivity driven by coastal upwelling?

- W) North America, along the eastern coast of Maine
- X) Africa, along the northern coast of Egypt
- Y) South America, along the southeastern coast of Brazil
- Z) Asia, along the western coast of India

ANSWER: W) NORTH AMERICA, ALONG THE EASTERN COAST OF MAINE

BONUS

12) EARTH AND SPACE *Multiple Choice* During an El Niño period, sea surface temperatures along the west coasts of North and South America are relatively warm and upwelling is suppressed. What effect does this generally have on fish catches along these coasts during El Niño winters?

- W) Fish catches increase
- X) Fish catches decrease
- Y) Fish catches are unaffected
- Z) Fish catches increase followed by a sudden decrease

ANSWER: X) FISH CATCHES DECREASE

TOSS-UP

13) MATH *Short Answer* Cosine is positive and sine is negative in which quadrant?

ANSWER: FOUR (ACCEPT: FOURTH)

BONUS

13) MATH *Short Answer* If a librarian has 10 different books to give away and she promised 4 books to Tom, 5 books to Pat, and 1 book to Julie, how many ways can she distribute the books?

ANSWER: 1260

TOSS-UP

14) ENERGY *Multiple Choice* The average adult radiates heat energy at approximately the same rate as which of the following wattages of a light bulb?

- W) 10
- X) 50
- Y) 100
- Z) 200

ANSWER: Y) 100

BONUS

14) ENERGY *Short Answer* What is the maximum kinetic energy in joules an object can have if it is connected to a cord that can support up to 10 newtons of tension while the object swings in a 1 meter radius circular path?

ANSWER: 5

TOSS-UP

15) CHEMISTRY *Multiple Choice* Of the following functional groups, which does NOT contain a carbonyl group?

- W) Amide (read as: AH-myd)
- X) Amine (read as: AH-meen)
- Y) Acetyl chloride
- Z) Carboxylic acid

ANSWER: X) AMINE

BONUS

15) CHEMISTRY *Short Answer* What is the acid anhydride of phosphoric acid?

ANSWER: TETRAPHOSPHORUS DECAOXIDE (ACCEPT: P_4O_{10})

TOSS-UP

16) PHYSICS *Multiple Choice* The displacement-time graph of a body that starts from rest and moves away from the origin with constant acceleration appears as which of the following?

- W) A curved line whose slope is increasing in time
- X) A curved line whose slope is decreasing in time
- Y) A straight line with zero slope
- Z) A straight line with non-zero slope

ANSWER: W) A CURVED LINE WHOSE SLOPE IS INCREASING IN TIME

BONUS

16) PHYSICS *Short Answer* James is working for a detective agency and his assignment is to photograph the pages of a top secret physics paper. James' tiny camera has the film located 2.10 centimeters behind the lens, and he must fill the entire piece of 1.00 centimeter film with the picture of the 25 centimeter tall document. How close in centimeters must James be to the paper's pages to get a clear image on the film? Provide your answer as a decimal rounded to the nearest tenth.

ANSWER: 52.5

TOSS-UP

17) CHEMISTRY *Short Answer* If an ideal gas, with an initial volume of 30 liters and an initial pressure of 2 pascals, undergoes isothermal contraction and shrinks to a final volume of 10 liters, then what is the final pressure of this gas in pascals?

ANSWER: 6

BONUS

17) CHEMISTRY *Short Answer* Name the mineral whose deficiency in humans causes growth retardation, delayed sexual maturation, infection susceptibility, and diarrhea, contributing to the death of about 800,000 children worldwide per year.

ANSWER: ZINC

TOSS-UP

18) MATH *Short Answer* The coordinates of Vertex A of triangle ABC are (6, -3). The triangle undergoes a translation of (-8, 14). If the original Vertex B is 6 units to the left of vertex A, what are the coordinates of Vertex B after the translation?

ANSWER: (-8, 11)

BONUS

18) MATH *Short Answer* What is cosine of 15° in simplified radical form?

ANSWER: $\frac{\sqrt{2}+\sqrt{6}}{4}$ (ACCEPT: $\frac{\sqrt{6}+\sqrt{2}}{4}$)

TOSS-UP

19) ENERGY *Multiple Choice* Which of the following would NOT be an effective way to reduce the amount of generated electrical power lost as heat in transmission lines?

- W) Increase transmission voltage
- X) Decrease transmission voltage
- Y) Use superconducting wires
- Z) Use transformers

ANSWER: X) DECREASE TRANSMISSION VOLTAGE

BONUS

19) ENERGY *Short Answer* What is the amount of heat Q produced when an electric current I flows through a resistance R during a time interval t?

ANSWER: $Q = I^2 R t$

TOSS-UP

20) EARTH AND SPACE *Short Answer* What biological process in the nitrogen cycle describes the conversion of ammonia to nitrates?

ANSWER: NITRIFICATION (DO NOT ACCEPT: NITROGEN FIXATION)

BONUS

20) EARTH AND SPACE *Short Answer* What organisms are thought to be responsible for the nitrification process in the mesopelagic (read as: meh-zoh-peh-LAH-jik) zone?

ANSWER: ARCHAEA (read as: AHR-kee-ah) (ACCEPT: CRENARCHAEOTA)

TOSS-UP

21) PHYSICS *Multiple Choice* According to the kinetic theory of ideal gases, the molecules of an ideal gas in a container do which of the following?

- W) Collide with the wall of the container and bounce back
- X) Collide with the container wall and stick to it
- Y) Undergo collision among themselves and with the container wall, until their speed reduces to zero
- Z) Remain fixed until the container is opened

ANSWER: W) COLLIDE WITH THE WALL OF THE CONTAINER AND BOUNCE BACK

BONUS

21) PHYSICS *Short Answer* An astronaut drops a tool while working on Europa. The tool falls 10 meters and takes 5.0 seconds to fall. What is the acceleration in meters per second squared due to gravity on Europa? Provide your answer as a decimal to the nearest tenth.

ANSWER: 0.8 (ACCEPT: -0.8)

TOSS-UP

22) ENERGY *Short Answer* Name the weakly radioactive isotope of the element hydrogen that occurs both naturally and during the operation of nuclear power plants, has a half-life of 12.3 years and emits a weak beta particle.

ANSWER: TRITIUM (ACCEPT: H-3)

BONUS

22) ENERGY *Multiple Choice* Which of the following types of radioactive waste would most likely be considered intermediate level, requiring special shielding during handling, burial or disposal deep underground?

- W) Protective clothing
- X) Irradiated fuel
- Y) Chemical sludges
- Z) Tools

ANSWER: Y) CHEMICAL SLUDGES

TOSS-UP

23) MATH *Multiple Choice* How many different ways are there to seat 4 people in a room that has 10 seats?

- W) 720
- X) 3,240
- Y) 5,040
- Z) 151,200

ANSWER: Y) 5,040

BONUS

23) MATH *Short Answer* How many vertices and edges, respectively, does a regular icosahedron have?

ANSWER: VERTICES = 12, EDGES = 30

TOSS-UP

24) ENERGY *Short Answer* Non thermal plasma jets are composed of ionization waves, known as “plasma bullets”, propagating at high velocities. What is the general geometrical shape of a plasma bullet?

ANSWER: DONUT (ALSO ACCEPT: TOROIDAL)

BONUS

24) ENERGY *Short Answer* If plasma is placed inside a magnetic mirror machine, particles which are moving parallel or nearly parallel to the direction of the magnetic field are not trapped. What is this region called in velocity space?

ANSWER: LOSS CONE

TOSS-UP

25) EARTH AND SPACE *Short Answer* Pluto belongs to a diffuse ring of icy objects that extends outward from the orbit of Neptune. What is this ring of icy objects called?

ANSWER: THE KUIPER (read as: KY-per) BELT (ACCEPT: EDGEWORTH-KUIPER BELT)

BONUS

25) EARTH AND SPACE *Multiple Choice* The International Astronomical Union recently downgraded Pluto from a planet to a dwarf planet. Which of the proposed criteria for a planet does Pluto now fail to meet?

W) It must have an orbit

X) It must orbit the Sun

Y) It must have the gravitational force to shape itself into a sphere

Z) It must have cleared its orbit of other debris

ANSWER: Z) IT MUST HAVE CLEARED ITS ORBIT OF OTHER DEBRIS