

## ROUND 4

### TOSS-UP

19) BIOLOGY Multiple Choice Which of the following statements is NOT true about lichen [LY-kuhn]?

- W) It is a composite organism
- X) It is composed of algae and moss
- Y) It is hardy and slow-growing
- Z) It usually reproduces asexually

ANSWER: X) IT IS COMPOSED OF ALGAE AND MOSS

### BONUS

19) BIOLOGY Short Answer Many angiosperms flower at the same time every year, even though they may have started growing at different times. Their flowering is a response to the changing length of day and night. What is the name of this phenomenon?

ANSWER: PHOTOPERIODISM (ACCEPT: PHOTOPERIODICITY)

### TOSS-UP

3) PHYSICS Multiple Choice The electron transitions responsible for the generation of light have durations on the order of  $10^{-8}$  seconds. Which of the following best represents the natural linewidth in hertz of the resulting visible light?

- W)  $10^{-8}$
- X) 3
- Y) 108
- Z) 1016

ANSWER: Y) 108

### BONUS

3) PHYSICS Multiple Choice Which of the following types of thermometer is based on the difference in the voltage induced by a temperature gradient in two metals?

- W) Beckman
- X) Silicon band gap
- Y) Thermistor
- Z) Thermocouple

ANSWER: Z) THERMOCOUPLE

### TOSS-UP

20) ENERGY Multiple Choice What does it mean when a wind generator has a cut-in speed of 3 meters per second?

- W) It won't produce any power unless the wind speed is lower than 3 meters per second
- X) It will stop producing power at 3 meters per second to protect itself from breaking
- Y) It will produce the maximum power at 3 meters per second
- Z) It won't produce any power unless the wind speed is higher than 3 meters per second

ANSWER: Z) IT WON'T PRODUCE ANY POWER UNLESS THE WIND SPEED IS HIGHER THAN 3 METERS PER SECOND

### BONUS

20) ENERGY Short Answer Nuclides, such as U-235 and Pu-239, are often used as fuel in light water nuclear reactors. These isotopes are considered both fissile and fissionable because they are capable of undergoing fission after capturing what type of neutrons?

ANSWER: THERMAL (ACCEPT: SLOW)

TOSS-UP

24) BIOLOGY Short Answer What is the common name of the unicellular organism that has the following characteristics: 1) it has chloroplasts and can make its own food; 2) it can also ingest food from its environment; 3) it usually lives in ponds or puddles; 4) it moves by a flagellum; 5) it has an eyespot that detects light.

ANSWER: EUGLENA

BONUS

24) BIOLOGY Multiple Choice The gram stain can be used to distinguish between different prokaryotes [proh-KAR-ee-ohts] based on which of the following?

W) Glucose metabolism

X) Flagella

Y) Lactose metabolism

Z) Cell wall morphology

ANSWER: Z) CELL WALL MORPHOLOGY

TOSS-UP

8) EARTH AND SPACE Short Answer What type of event marks the end of major geologic eras such as the Paleozoic and Mesozoic?

ANSWER: MASS EXTINCTION (ACCEPT: MAJOR EXTINCTION)

BONUS

8) EARTH AND SPACE Short Answer What seismologic feature led scientists to identify the Earth's liquid outer core?

ANSWER: S-WAVE SHADOW ZONE

TOSS-UP

8) ENERGY Short Answer Neutrons in fission reactors are categorized based on their origin. What term describes neutrons emitted directly from a fission event, rather than from a subsequent or unrelated decay event?

ANSWER: PROMPT

BONUS

8) ENERGY Short Answer How much heat energy in BTUs is needed to heat 200 pounds of water from 50 degrees to 130 degrees Fahrenheit?

ANSWER: 16,000

TOSS-UP

23) PHYSICS Short Answer Three masses are arranged at the vertices of an equilateral triangle and are connected by springs along the edges of the equilateral triangle. How many normal modes for vibration does this mass-spring system have?

ANSWER: THREE

BONUS

23) PHYSICS Short Answer When a charged particle moves in a dielectric medium at a speed greater than the speed of light in that medium, what kind of radiation do the atoms in the medium emit?

ANSWER: CHERENKOV

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TOSS-UP

15) CHEMISTRY Multiple Choice Identify which of the following types of copolymer [koh-POL-uh-mer] would be represented by a molecule with the linkage pattern FGGFFFGFG?

W) Statistical

X) Block

Y) Graft

Z) Alternating

ANSWER: W) STATISTICAL

BONUS

15) CHEMISTRY Multiple Choice Which of the following is true about benzene?

W) The carbons are alternately  $sp^2$  and  $sp^3$  hybridized

X) The carbon atoms are all  $sp^2$  hybridized with an unhybridized p orbital

Y) Some of the carbon atoms exhibit tetrahedral geometries

Z) The carbon atoms are all  $sp^3$  hybridized

ANSWER: X) THE CARBON ATOMS ARE ALL  $SP^2$  HYBRIDIZED WITH AN UNHYBRIDIZED P ORBITAL

TOSS-UP

22) MATH Short Answer What is the value of  $i^4$ ?

ANSWER: 1

BONUS

22) MATH Multiple Choice The hyperbola with equation  $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$  possesses which of the following characteristics?

W) It opens left and right and has asymptotes  $y = \frac{b}{a}x$  and  $y = -\frac{b}{a}x$

X) It opens up and down and has asymptotes  $y = x$  and  $y = -x$

Y) It opens left and right and has asymptotes  $y = x$  and  $y = -x$

Z) It opens up and down and has asymptotes  $y = x$  and  $y = -x$

ANSWER: X) IT OPENS UP AND DOWN AND HAS ASYMPTOTES  $y = x$  AND  $y = -x$

#### TOSS-UP

6) MATH Multiple Choice Which of the following is NOT an even function?

W)  $\cos x$

X)  $\cos(x^2)$

Y)  $\sin x$

Z)  $\sin(x^2)$

ANSWER: Y)  $\sin x$

#### BONUS

6) MATH Short Answer Given that  $x$  and  $y$  are real numbers, solve for  $x$  and  $y$ :

$$2y + ix = 4 + x - i.$$

ANSWER:  $x = -1$ ;  $y = 3/2$

#### TOSS-UP

17) CHEMISTRY Short Answer What is the term that describes the temperature at which ferromagnetic materials no longer exhibit spontaneous magnetization?

ANSWER: CURIE (ACCEPT: CURIE POINT)

#### BONUS

17) CHEMISTRY Short Answer What isotope will be formed when oxygen-19 undergoes beta minus decay?

ANSWER: FLUORINE-19 (ACCEPT: F-19)

#### TOSS-UP

13) BIOLOGY Multiple Choice Which of the following organ systems is responsible for the secretion of hormones?

W) Endocrine

X) Reproductive

Y) Circulatory

Z) Immune

ANSWER: W) ENDOCRINE

#### BONUS

13) BIOLOGY Short Answer In an area originally devoid of life, what is the name for the first community to become established?

ANSWER: PIONEER (DO NOT ACCEPT: FOUNDER)

#### TOSS-UP

16) ENERGY Multiple Choice Which of the following statements about coal is true?

W) Over 50% of the coal mined in the United States is bituminous [by-TOO-muh-nuhs]

X) Lignite [LIG-nyt] has the highest energy content of all coal varieties

Y) Anthracite [AN-thruh-syt] contains approximately 25% carbon

Z) Lignite has a very low moisture content

ANSWER: W) OVER 50% OF THE COAL MINED IN THE UNITED STATES IS BITUMINOUS  
BONUS

16) ENERGY Short Answer The United States utilizes two different types of commercial nuclear power plants: BWRs and PWRs. What is the full term for which BWR is the abbreviation?

ANSWER: BOILING WATER REACTOR

TOSS-UP

8) EARTH AND SPACE Short Answer What type of event marks the end of major geologic eras such as the Paleozoic and Mesozoic?

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TOSS-UP

4) MATH Multiple Choice The equation  $-mx + 1 = 13 - 4(x + 3)$  [negative m x plus 1 equals 13 minus 4 times the quantity x plus 3] is an identity if m equals which of the following?

W) -4

X) -1

Y) 1

Z) 4

ANSWER: Z) 4

BONUS

4) MATH Multiple Choice If  $f(x) = -2x^2 + 8x - 4$ , which of the following is true?

W) f is not a one to one function

X) The graph of f opens upward

Y) The graph of f has no x-intercept

Z) The maximum value of f(x) is -4

ANSWER: W) f IS NOT A ONE TO ONE FUNCTION

TOSS-UP

24) CHEMISTRY Short Answer In the balanced equation  $2Ag^+ + Cu$  [yields]  
 $2Ag + Cu^{2+}$ ,  
what is the reducing agent?

ANSWER: COPPER (DO NOT ACCEPT: COPPER 2+)

BONUS

24) CHEMISTRY Multiple Choice Converting carbon dioxide to carbon monoxide through reduction would be effective method for reducing harmful levels of atmospheric carbon dioxide. However, this conversion is very difficult for which of the following reasons?

- W) There is a limited supply of rhenium in the world
- X) Not all steps of the reduction have been completely determined
- Y) The final step takes an extremely long time
- Z) The carbon dioxide is too difficult to harness

ANSWER: W) THERE IS A LIMITED SUPPLY OF RHENIUM IN THE WORLD

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ANSWER: X) IT OPENS UP AND DOWN AND HAS ASYMPTOTES  $y = \frac{b}{a}x$  AND  $y = -\frac{b}{a}x$

TOSS-UP

12) EARTH AND SPACE Short Answer What is the boundary between the troposphere and the stratosphere called?

ANSWER: TROPOPAUSE

BONUS

12) EARTH AND SPACE Multiple Choice Which of the following stellar reactions releases the most energy?

W) Hydrogen to helium

X) Helium to oxygen

Y) Oxygen to silicon

Z) Silicon to iron

ANSWER: W) HYDROGEN TO HELIUM

TOSS-UP

17) PHYSICS Short Answer What is the mathematical relationship between the period of a wave and the frequency of a wave?

ANSWER: INVERSE (ACCEPT: INVERSELY PROPORTIONAL)

BONUS

17) PHYSICS Short Answer If a radio station broadcasts with a wavelength of 2.5 meters, what is the frequency of the radio station in megahertz, given the speed of light as  $3 \times 10^8$  meters per second?

ANSWER: 120

TOSS-UP

12) EARTH AND SPACE Multiple Choice Which of the following processes leads directly to the formation of topsoil and subsoil in the A and B horizons?

W) Erosion and deposition

X) Erosion and leaching

Y) Weathering and leaching

Z) Weathering and deposition

ANSWER: Y) WEATHERING AND LEACHING

BONUS

12) EARTH AND SPACE Short Answer Taking the value of the Hubble constant to be 75 kilometers per second per megaparsec, if a galaxy is observed with a recessional velocity of 50 kilometers per second, what is its distance, in kiloparsecs, to two significant figures?

ANSWER: 670

TOSS-UP

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