

## ROUND 8

### TOSS-UP

15) CHEMISTRY Multiple Choice Which of the following is an aldehyde [AL-duh-hyd]?

W) C<sub>11</sub> H<sub>20</sub>

X) C<sub>5</sub> H<sub>11</sub> OH

Y) C<sub>5</sub> H<sub>11</sub> CHO

Z) C<sub>5</sub> H<sub>11</sub> NH<sub>2</sub>

ANSWER: Y) C<sub>5</sub> H<sub>11</sub> CHO

### BONUS

15) CHEMISTRY Short Answer Which one of the following five metals would react the least with dilute hydrochloric acid: 1) lead, 2) chromium, 3) manganese, 4) nickel, 5) gold?

ANSWER: 5 (ACCEPT: GOLD)

### 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

16) MATH Short Answer If the graph of  $y = (x - 2)^2 - 3$  [y equals open parenthesis x minus 2 close parenthesis squared minus three] is translated 5 units up and 2 units to the right, what is the vertex of the new parabola obtained?

ANSWER: (4, 2)

### BONUS

16) MATH Short Answer Solve \_\_\_\_\_ for x in standard form.

ANSWER: \_\_\_\_\_ i

### TOSS-UP

5) CHEMISTRY Multiple Choice How many total atoms are contained within a body-centered orthorhombic [ohr-thuh-ROM-bik] unit cell?

W) 2

X) 3

Y) 4

Z) 6

ANSWER: W) 2

BONUS

5) CHEMISTRY Short Answer In kilojoules per mole to the nearest whole number, what is the total bond energy for ethane, assuming that the carbon-hydrogen bond energy is 413 kilojoules per mole and the carbon-carbon bond energy is 348 kilojoules per mole?

ANSWER: 2826

TOSS-UP

2) BIOLOGY Multiple Choice Which of the following is the mechanism of action of most insecticides?

W) Blocking oxygen intake

X) Disrupting nerve function

Y) Preventing digestion

Z) Stopping DNA synthesis

ANSWER: X) DISRUPTING NERVE FUNCTION

BONUS

2) BIOLOGY Short Answer What is the general name for integral membrane proteins that directly couple the energy of ATP hydrolysis to the movement of molecules against their concentration gradient?

ANSWER: PRIMARY ACTIVE TRANSPORTERS (ALSO ACCEPT: DIRECT ACTIVE TRANSPORT; DO NOT ACCEPT: ACTIVE TRANSPORTERS, SECONDARY ACTIVE TRANSPORTERS)

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TOSS-UP

6) MATH Multiple Choice Which of the following best represents the conversion of the rectangular coordinates (3, 4) into polar coordinates?

W) (5, 37o)

X) (37o, 5)

Y) (5, 53o)

Z) (53o, 5)

ANSWER: Y) (5, 53o)

BONUS

6) MATH Short Answer Evaluate

[the integral from the square

root of 2

to the 3 times the square root of 2 of the quantity  $3x^2 + 6x$ ] in simplest radical form.

ANSWER:

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ANSWER: Y)  $C_5H_{11}CHO$

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TOSS-UP

21) BIOLOGY Multiple Choice Which of the following choices is NOT a source of new genetic combinations?

W) Mitosis [my-TOH-sis]

X) Fertilization

Y) Mutation

Z) Meiosis [meye-OH-sis]

ANSWER: W) MITOSIS

BONUS

21) BIOLOGY Multiple Choice Which of the following parts of B and T cells bind to antigens?

W) Variable region

X) Heavy chain

Y) Alpha chain only

Z) Disulfide bridge

ANSWER: W) VARIABLE REGION

TOSS-UP

3) PHYSICS Multiple Choice If an ideal gas performs work on its surroundings, then which of the following must be true?

W) Its pressure increases

X) Its volume increases

Y) Its temperature increases

Z) Its internal energy decreases

ANSWER: X) ITS VOLUME INCREASES

BONUS

3) PHYSICS Multiple Choice A 90 kilogram fullback running north at 10 meters per second is tackled by a 120 kilogram linebacker running south at 4 meters per second in a perfectly inelastic collision. Which of the following is the velocity in meters per second of the players after the collision?

W) 3 south

X) 3 north

Y) 2 south

Z) 2 north

ANSWER: Z) 2 NORTH

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TOSS-UP

16) EARTH AND SPACE Multiple Choice Which of the following surface ocean currents transports warm water to higher latitudes?

W) Labrador Current

X) Falidand Current

Y) Gulf Stream

Z) West Wind Drift

ANSWER: Y) GULF STREAM

BONUS

16) EARTH AND SPACE Multiple Choice Which of the following internal layers of the Earth allows for isostasy [eye-SOS-tuh-see] of the crust?

W) Outer core

X) Inner core

Y) Asthenosphere

Z) Lithosphere

ANSWER: Y) ASTHENOSPHERE

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16) MATH Short Answer Solve \_\_\_\_\_ for x in standard form.

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TOSS-UP

12) MATH Multiple Choice Given that a second degree polynomial function  $f(x)$  has a zero at  $x = 3$  with multiplicity 2, which of the following is true?

W) The graph of  $f(x)$  crosses the y-axis at 3

X) As x approaches infinity,  $f(x)$  approaches infinity

Y) The graph of  $f(x)$  crosses the x-axis at 3

Z) The graph of  $f(x)$  touches but does not cross the x-axis at 3

ANSWER: Z) THE GRAPH OF  $f(x)$  TOUCHES BUT DOES NOT CROSS THE x-AXIS AT 3

BONUS

12) MATH Short Answer Expressing your answer in simplest form, find the derivative with respect to x of  $y = \frac{x^3}{x^2 - 8}$  [the fraction with numerator x cubed minus 8 and denominator x minus 2] for all values for which y is defined.

ANSWER:  $y' = 2x + 2$  (ACCEPT:  $2x + 2$ )

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TOSS-UP

23) PHYSICS Multiple Choice A wire of radius A carries a uniform current I. The total magnetic energy per unit length contained within the wire is which of the following?

W) Proportional to A<sup>2</sup>

X) Proportional to A

Y) Independent of A

Z) Zero

ANSWER: Y) INDEPENDENT OF A

BONUS

23) PHYSICS Multiple Choice The period of a mass bouncing on a spring is measured in the reference frame of an observer as T. If the system were instead moving past the observer with a velocity of 0.8c, which of the following is closest to the period she would observe?

W) 0.44T

X) 0.6T

Y) 1.7T

Z) 1.9T

ANSWER: Y) 1.7T

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TOSS-UP

10) ENERGY Multiple Choice Nuclear power plants and coal fired plants have which of the following operations in common?

W) Both give off smoke from a stack

X) Both heat water to become steam

Y) Both use moderators to control energy output

Z) Both use water to control heat build-up

ANSWER: X) BOTH HEAT WATER TO BECOME STEAM

BONUS

10) ENERGY Multiple Choice Which of the following types of coal is metamorphic?

W) Lignite

X) Anthracite [AN-thruh-syt]

Y) Bituminous [by-TOO-muh-nuhs]

Z) Sub-bituminous

ANSWER: X) ANTHRACITE

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Y) The graph of  $f(x)$  crosses the x-axis at 3

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ANSWER: Z) THE GRAPH OF  $f(x)$  TOUCHES BUT DOES NOT CROSS THE x-AXIS AT 3

BONUS

12) MATH Short Answer Expressing your answer in simplest form, find the derivative with respect to  $x$  of  $y =$

minus 8 and denominator  $x$

[the fraction with numerator  $x$  cubed

minus 2] for all values for which y is defined.

ANSWER:  $y^{\text{TM}} = 2x + 2$  (ACCEPT:  $2x + 2$ )

#### TOSS-UP

9) PHYSICS Multiple Choice A source travelling towards us at  $(3/5)c$  emits photons in a direction perpendicular to its velocity. If the source emits photons with energy of 0.5 electron volts in its own rest frame, which of the following energies, in electron volts, do the photons have in our rest frame?

W) 0.3

X) 0.4

Y) 0.5

Z) 0.6

ANSWER: X) 0.4

#### BONUS

9) PHYSICS Short Answer An unknown particle with rest energy of 1 mega-electron volt is traveling with a speed of  $(3/5)c$  along the x-axis in our rest frame when it decays into two photons, also travelling along the x-axis. What are the energies of the photons in mega-electron volts?

ANSWER: 0.25 (ACCEPT:  $\hat{A}^{1/4}$ ) AND 1

#### TOSS-UP

13) BIOLOGY Short Answer Motion of the basilar membrane stimulates what cell type that initiates the transmission of a signal to the brain?

ANSWER: INNER HAIR (ALSO ACCEPT STEREOCILIA OR HAIR CELLS)

#### BONUS

13) BIOLOGY Multiple Choice The basilar membrane in the cochlea [KOK-lee-uh] is differentially sensitive to which of the following aspects of sound?

W) Amplitude

X) Direction

Y) Frequency

Z) Bandwidth

ANSWER: Y) FREQUENCY

#### TOSS-UP

16) EARTH AND SPACE Multiple Choice Which of the following causes basal sliding of glaciers?

W) Melting of basal ice due to heat from friction as the glacier moves along bedrock

X) Changes in gravity as the glacier increases in mass

Y) Differences in the amount of friction linked to variable surface conditions under the glacier

Z) Decrease in friction due to melting from pressure of overlying ice

ANSWER: Z) DECREASE IN FRICTION DUE TO MELTING FROM PRESSURE OF OVERLYING ICE



**BONUS**

16) EARTH AND SPACE Multiple Choice Which of the following drives the volcanism on Jupiter's moon, Io?

W) Solar radiation

X) Plate tectonics

Y) Meteor impacts

Z) Tidal forces

ANSWER: Z) TIDAL FORCES

**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