

## ROUND 9

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### TOSS-UP

1) CHEMISTRY *Multiple Choice* Ceramic materials have all but which of the following properties?

- W) Low density
- X) High thermal expansion
- Y) High ductility
- Z) High corrosion resistance

ANSWER: Y) HIGH DUCTILITY

### BONUS

1) CHEMISTRY *Short Answer* What is the ground state electron configuration of iron in iron (III) sulfate?

ANSWER:  $[\text{Ar}]3d^5$

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### TOSS-UP

2) EARTH AND SPACE *Multiple Choice* Which of the following circumstances is linked most closely with the formation of sand dunes?

- W) Drying of a lake
- X) Transgression of the sea
- Y) Folded mountain formation
- Z) Heavy glacial erosion

ANSWER: W) DRYING OF A LAKE

### BONUS

2) EARTH AND SPACE *Short Answer* During which era did the initial opening of the present-day Atlantic Ocean most likely occur?

ANSWER: MESOZOIC

### TOSS-UP

3) PHYSICS *Short Answer* A bicycle wheel undergoes constant angular acceleration for time  $t$ . Identify all of the following three choices at which the average acceleration equals the instantaneous acceleration: 1)  $0.5t$ , 2)  $0.67t$ , 3)  $0.707t$ .

ANSWER: ALL (ACCEPT 1, 2, 3)

### BONUS

3) PHYSICS *Short Answer* What is the average force in newtons exerted on a 25 gram egg by a bed sheet if the egg hits the sheet at 4 meters per second and takes 0.2 seconds to stop, given acceleration due to gravity as 10 meters per second squared?

ANSWER: 0.5

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### TOSS-UP

4) ENERGY *Short Answer* A commercial scale gas atomizer will soon be developed in order to produce fine powder of what element, known for its strength, light weight, biocompatibility, and resistance to corrosion?

ANSWER: TITANIUM

### BONUS

4) ENERGY *Short Answer* Biodiesel is made through a chemical process called transesterification [***trans-uh-ster-uh-fi-KAY-shuhn***]. Vegetable oil and methanol react to form biodiesel and what other byproduct?

ANSWER: GLYCERIN (ACCEPT: GLYCEROL)

### TOSS-UP

5) BIOLOGY *Short Answer* What is the term for the hypothesized process by which eukaryotes [**yoo-KAR-ee-ohts**] evolved a photosynthetic [**foh-tuh-SIN-thuh-tik**] organelle?

ANSWER: ENDOSYMBIOSIS

### BONUS

5) BIOLOGY *Multiple Choice* Which of the following is NOT an example of energy coupling?

- W) An ion releases energy as it travels through an ion channel down its concentration gradient
- X) A kinase hydrolyzes ATP for energy to catalyze a reaction
- Y) A transport molecule uses energy from one molecule going down its concentration gradient to power transport of another molecule up its gradient
- Z) As protons move down their concentration gradient, ATP synthase gathers energy to catalyze the synthesis of ATP

ANSWER: W) AN ION RELEASES ENERGY AS IT TRAVELS THROUGH AN ION CHANNEL DOWN ITS CONCENTRATION GRADIENT

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### TOSS-UP

6) MATH *Short Answer* In the three by three matrix,  $\begin{bmatrix} -2 & 2 & 0 \\ 4 & 1 & -5 \\ 8 & 3 & 7 \end{bmatrix}$  [**such that row one**

**contains negative 2, 2, and 0; row two contains 4, 1, and negative 5; row three contains 8, 3, and 7**], which is the  $a_{(2,3)}$  [**x sub 2, 3**] element?

ANSWER: -5

### BONUS

6) MATH *Short Answer* If the squared length of the diagonal of one face of a cube is 162, what is the surface area in square units of the cube?

ANSWER: 486

### TOSS-UP

7) CHEMISTRY *Multiple Choice* Which of the following statements is true about alkenes [**AL-keens**] and alkynes [**AL-kyns**]?

- W) Both are unsaturated compounds
- X) Both can undergo hydrogenation to lose hydrogens
- Y) Both can undergo oxygenation to lose oxygens
- Z) Both have carbon-carbon double bonds

ANSWER: W) BOTH ARE UNSATURATED COMPOUNDS

### BONUS

7) CHEMISTRY *Short Answer* Name all of the following five substances which are classified as strong electrolytes: 1) carbonic acid; 2) hydrogen fluoride; 3) sodium chloride; 4) acetic acid; 5) hydrochloric acid.

ANSWER: 3, 5 (ACCEPT: SODIUM CHLORIDE, HYDROCHLORIC ACID)

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### TOSS-UP

8) EARTH AND SPACE *Multiple Choice* Which of the following sedimentary rocks is most likely to be changed to slate during regional metamorphism?

- W) Shale
- X) Conglomerate
- Y) Dolostone [**DO-luh-stohn**]
- Z) Breccia [**BRECH-ee-uh**]

ANSWER: W) SHALE

### BONUS

8) EARTH AND SPACE *Multiple Choice* Which of the following describes a rock that is metamorphic and shows signs of foliation?

- W) It has bands of coarse intergrown crystals of various sizes
- X) It has particles of 0.01 centimeters to 1.0 centimeters cemented together
- Y) It has intergrown crystals less than 0.1 centimeter in size
- Z) It has intergrown crystals, mostly 2.0 centimeters in size

ANSWER: W) IT HAS BANDS OF COARSE INTERGROWN CRYSTALS OF VARIOUS SIZES

### TOSS-UP

9) PHYSICS *Multiple Choice* Four particles are moving from north to south through a region with magnetic field directed from west to east. Which of the following particles bends downward?

- W) Alpha
- X) Beta
- Y) Neutron
- Z) Graviton

ANSWER: X) BETA

### BONUS

9) PHYSICS *Short Answer* Forty-five joules of energy are added to a quantity of ideal gas, and the gas expands and does 34 joules of work. What is the change in internal energy of the gas, in joules?

ANSWER: 11

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### TOSS-UP

10) ENERGY *Short Answer* What is the name for the layer in the center of a fuel cell which separates the anode and cathode and allows positive ions through but not electrons?

ANSWER: ELECTROLYTE (ACCEPT: MEMBRANE)

### BONUS

10) ENERGY *Short Answer* Regular gasoline with an octane rating of 87 has the same anti-knock qualities as a mixture with what percentages of iso-octane and heptane, respectively?

ANSWER: ISO-OCTANE = 87%; HEPTANE = 13%

### TOSS-UP

11) BIOLOGY *Multiple Choice* Which of the following animals is considered a keystone species of the kelp forests of the Aleutian **[uh-LOO-shuhn]** Islands ecosystem?

- W) Sea urchin
- X) Sea otter
- Y) Killer whale
- Z) Alaskan fur seals

ANSWER: X) SEA OTTER

### BONUS

11) BIOLOGY *Short Answer* What scientific term describes strategies, such as black widow coloration, used by some animals to alert or warn other animals of their presence and potential danger?

ANSWER: APOSEMATISM (ACCEPT: APOSEMATIC)

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### TOSS-UP

12) MATH *Multiple Choice* Which of the following equations is that of a line perpendicular to  $3x - 7y = 5$ ?

- W)  $3x + 7y = 10$
- X)  $7x + 3y = 10$
- Y)  $7x - 3y = 10$
- Z)  $3x - 7y = 10$

ANSWER: X)  $7x + 3y = 10$

### BONUS

12) MATH *Short Answer* What is the multiplicity of the zero 1 in the polynomial  $p(x) = x^4 + x^3 - 9x^2 + 11x - 4$ ?

ANSWER: 3

### TOSS-UP

13) EARTH AND SPACE *Multiple Choice* In general, the probability of flooding decreases when there is an increase in the amount of which of the following?

- W) Precipitation
- X) Infiltration
- Y) Runoff
- Z) Snow melt

ANSWER: X) INFILTRATION

### BONUS

13) EARTH AND SPACE *Multiple Choice* Which of the following is the age of the most abundant surface bedrock in the Finger Lakes region of New York State?

- W) Cambrian
- X) Devonian
- Y) Pennsylvanian
- Z) Permian

ANSWER: X) DEVONIAN

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### TOSS-UP

14) BIOLOGY *Short Answer* Cutaneous [*kyoo-ATY-nee-uhs*] sensation to the palm of the hand and thumb is provided primarily by which nerve?

ANSWER: MEDIAN

### BONUS

14) BIOLOGY *Short Answer* By number, identify all of the following five characteristics that apply to the iris plant: 1) floral parts in multiples of four or five, 2) root system with a central tap root, 3) parallel venation on leaves, 4) vascular bundles in stem arranged in a ring, 5) one cotyledon [*kat-uhl-EED-uhn*].

ANSWER: 3, 5

### TOSS-UP

15) CHEMISTRY *Multiple Choice* Which of the following elements does NOT commonly form simple ions?

- W) Silicon
- X) Oxygen
- Y) Lead
- Z) Sulfur

ANSWER: W) SILICON

### BONUS

15) CHEMISTRY *Short Answer* How many total carbons are in the organic compound 1, 1-dichloro-3-ethyl-2,4 dimethylpentane [*dy-METH-uhl-PEN-tayn*]?

ANSWER: 9

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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

### TOSS-UP

17) PHYSICS *Multiple Choice* When a tennis racket hits a tennis ball, how do the forces on each object compare?

- W) The force on the tennis ball has a greater magnitude than the force on the racket
- X) The force on the racket has a greater magnitude than the force on the ball
- Y) The magnitude of the force on each object is the same
- Z) The forces depend on the level of impact

ANSWER: Y) THE MAGNITUDE OF THE FORCE ON EACH OBJECT IS THE SAME

### BONUS

17) PHYSICS *Short Answer* A wave with a frequency of 40 hertz has a wavelength of 2.5 meters. What is the phase velocity in meters per second?

ANSWER: 100

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### TOSS-UP

18) ENERGY *Multiple Choice* Which of the following conditions is NOT required to form coal?

- W) A stagnant and stable water level
- X) Heat and pressure over a long period of time
- Y) An equal supply of both vegetation and sediment
- Z) A plant accumulation rate equaling land subsidence rate

ANSWER: Y) AN EQUAL SUPPLY OF BOTH VEGETATION AND SEDIMENT

### BONUS

18) ENERGY *Short Answer* Why, aside from making it possible to push more energy through a line in a given unit of time, is power transmitted at higher voltages over longer distances?

ANSWER: TO REDUCE TRANSMISSION LOSS (ACCEPT: TO REDUCE DISSIPATION, TO REDUCE ENERGY LOSS)

### TOSS-UP

19) BIOLOGY *Short Answer* Damage to which human brain region results in anomalous circadian [*uh-NOM-uh-luhs sur-kay-dee-uhn*] rhythms?

ANSWER: HYPOTHALAMUS

### BONUS

19) BIOLOGY *Multiple Choice* Which of the following is true regarding osmoregulation in a freshwater fish?

- W) Osmotic water loss occurs over body surface and via gills
- X) Nitrogenous wastes are excreted primarily in the form of uric acid
- Y) Copious amount of urine hypotonic to the blood is excreted
- Z) Excess salt is excreted from gills

ANSWER: Y) COPIOUS AMOUNT OF URINE HYPOTONIC TO THE BLOOD IS EXCRETED

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### TOSS-UP

20) MATH *Short Answer* In terms of a, b, c, and d, what is the slope of the line  $3ax + 2by = cd$ ?

ANSWER:  $-3a/2b$

### BONUS

20) MATH *Multiple Choice* Which of the following points lies in the solution set for the system of two inequalities:  $2y - x \geq -6$  and  $2y - 3x < -6$ ?

- W) (-4, -1)
- X) (3, 1)
- Y) (0, -3)
- Z) (4, 3)

ANSWER: X) (3, 1)

### TOSS-UP

21) CHEMISTRY *Multiple Choice* In titration, which of the following is most commonly used as an acid-base indicator in the pH 8 to pH 10 range?

- W) Phenolphthalein [*fee-knoll-THAY-lean*]
- X) Cresol red
- Y) Bromthymol blue
- Z) Methyl orange

ANSWER: W) PHENOLPHTHALEIN

### BONUS

21) CHEMISTRY *Short Answer* To what total volume in milliliters would 100 milliliters of an 80% ethanol solution by volume need to be diluted to obtain a 20% solution by volume?

ANSWER: 400

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### TOSS-UP

22) EARTH AND SPACE *Short Answer* Of the 8 planets in the solar system, which one likely has the lowest escape velocity with respect to its own gravity?

ANSWER: MERCURY

### BONUS

22) EARTH AND SPACE *Short Answer* The following four particles A, B, C, and D are of equal volume and are dropped into a column filled with water. Particle A is flat with a density of 2.5 grams per cubic centimeter. Particle B is flat with a density of 3.0 grams per cubic centimeter. Particle C is round with a density of 2.5 grams per cubic centimeter, and particle D is round with a density of 3.0 grams per cubic centimeter. Which particle would usually settle most rapidly?

ANSWER: PARTICLE D

### TOSS-UP

23) PHYSICS *Short Answer* Sue and Ben are 5 and 10 meters, respectively, away from a balloon when it pops loudly. Sue's sound pressure meter recorded a level of 80 decibels. What did Ben's identical meter record in decibels to the nearest decibel?

ANSWER: 74

### BONUS

23) PHYSICS *Multiple Choice* A current-carrying wire changes diameter from larger to smaller gauge. In which of the following locations would the current be greater?

- W) Larger section
- X) Smaller section
- Y) At the location where the wire changes diameter
- Z) It would be the same at all points

ANSWER: Z) IT WOULD BE THE SAME AT ALL POINTS

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### TOSS-UP

24) BIOLOGY *Short Answer* Name the genus of mosquito that most frequently serves as the vector for the debilitating dengue [**DENG-gay**] fever.

ANSWER: Aedes

### BONUS

24) BIOLOGY *Short Answer* Indicate, respectively, the term to describe the stage in which two genetically different nuclei occur in the same cell, and the principal kingdom in which the stage occurs as a normal part of the organism's life cycle.

ANSWER: STAGE = HETEROKARYOTIC; KINGDOM = FUNGI

### TOSS-UP

25) MATH *Short Answer* How many points of intersection do the graphs of the functions  $f(x) = x^2$  and  $g(x) = 2^x$  have?

ANSWER: 3

### BONUS

25) MATH *Short Answer* Evaluate the following:  $\int_0^2 \frac{1}{t} e^{-\ln t} dt$  [*the integral from 0 to 2 of 1 over t times e to the power of the natural log of t dt*].

ANSWER: 2