

## ROUND 5

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### TOSS-UP

1) MATH *Short Answer* What is the degree of the polynomial:  $(x - 3)^3 (x - 7)^4$  [**open parenthesis x minus 3 close parenthesis cubed times open parenthesis x minus 7 close parenthesis to the power of 4**]?

ANSWER: 7

### BONUS

1) MATH *Multiple Choice* If  $x$  is an angle such that  $\tan(x) = 5/12$  and  $\pi < x < 3\pi/2$ , then  $\sec(x)$  [**secant of x**] is equal to which of the following?

- W)  $-13/12$
- X)  $-13/5$
- Y)  $13/5$
- Z)  $13/12$

ANSWER: W)  $-13/12$

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### TOSS-UP

2) BIOLOGY *Multiple Choice* Which of the following describes the bonds found in one molecule of water?

- W) Hydrogen
- X) Nonpolar covalent
- Y) Polar covalent
- Z) Ionic

ANSWER: Y) POLAR COVALENT

### BONUS

2) BIOLOGY *Short Answer* Name the stage of translation during which peptide bond formation occurs.

ANSWER: ELONGATION

### TOSS-UP

3) PHYSICS *Multiple Choice* In a series-connected string of holiday lights, which of the following is most likely to occur if one bulb gets shorted without breaking the filament?

- W) All other bulbs will go out
- X) The current in the string will increase
- Y) The current in the string will decrease
- Z) The current in the string will remain unchanged

ANSWER: X) THE CURRENT IN THE STRING WILL INCREASE

### BONUS

3) PHYSICS *Short Answer* If a car goes from zero to 20 meters per second in 8 seconds, providing your answer to the nearest tenth, what is its average acceleration in meters per second squared?

ANSWER: 2.5

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### TOSS-UP

4) EARTH AND SPACE *Multiple Choice* Which of the following is generated from temperature changes in the atmosphere?

- W) Latent heat
- X) Sensible heat
- Y) Potential temperature
- Z) Irradiate heat

ANSWER: X) SENSIBLE HEAT

### BONUS

4) EARTH AND SPACE *Short Answer* What kind of black hole can be described entirely by its mass?

ANSWER: SCHWARZSCHILD

### TOSS-UP

5) CHEMISTRY *Multiple Choice* Which of the following gases is NOT one of the major causes of the greenhouse effect?

- W) Carbon dioxide
- X) Nitrous oxide
- Y) Methane
- Z) Carbon monoxide

ANSWER: Z) CARBON MONOXIDE

### BONUS

5) CHEMISTRY *Short Answer* In a titration experiment, 6.0 milliliters of a 0.05 molar monoprotic weak acid are titrated with 0.10 molar sodium hydroxide. How much base in milliliters will it take to reach the half-equivalence point?

ANSWER: 1.5

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### 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

7) BIOLOGY *Short Answer* Which taxonomic kingdom of organisms has cell walls of chitin **[KY-tin]**?

ANSWER: FUNGI

### BONUS

7) BIOLOGY *Multiple Choice* Hardy-Weinberg equilibrium is based on the assumption that allele frequencies in a population are stable. Which of the following conditions would be most likely to contribute to the stability of allele frequencies?

- W) Very large population
- X) Migration of individuals into or out of a population
- Y) Mutations
- Z) Natural selection

ANSWER: W) VERY LARGE POPULATION

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### TOSS-UP

8) ENERGY *Multiple Choice* Which of the following energy resources is the most energy efficient, meaning very little of the energy created is transferred to the surroundings unused?

- W) Coal
- X) Biofuel
- Y) Oil
- Z) Hydrogen fuel cells

ANSWER: Z) HYDROGEN FUEL CELLS

### BONUS

8) ENERGY *Multiple Choice* Which of the following statements is true about pure biodiesel, or B100?

- W) B100 has higher carbon dioxide emissions compared to petrodiesel
- X) B100 is more toxic than petrodiesel
- Y) Glycerin **[GLIS-er-in]** is a key byproduct created during biodiesel production
- Z) B100 contains a small amount of petroleum

ANSWER: Y) GLYCERIN IS A KEY BYPRODUCT CREATED DURING BODIESEL PRODUCTION

### TOSS-UP

9) PHYSICS *Multiple Choice* An object of mass  $m$  sits on a flat table. The Earth pulls on the object with force  $mg$ . Which of the following is the corresponding reaction force?

- W) The table pushing down on the floor with force  $mg$
- X) The object pushing down on the table with force  $mg$
- Y) The object pulling upward on the Earth with force  $mg$
- Z) The table pushing up on the object with force  $mg$

ANSWER: Y) THE OBJECT PULLING UPWARD ON THE EARTH WITH FORCE  $mg$

### BONUS

9) PHYSICS *Short Answer* A projectile is fired from a gun at an angle of  $45^\circ$  with respect to the horizontal. Given 9.8 meters per second squared as the acceleration due to gravity, and neglecting air resistance, what are the magnitude and direction of the acceleration of the projectile when it reaches its maximum height?

ANSWER: 9.8 METERS PER SECOND SQUARED, DOWNWARD (ACCEPT: -9.8 METERS PER SECOND SQUARED)

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### TOSS-UP

10) EARTH AND SPACE *Multiple Choice* Which of the following is the term for the hygroscopic [**hy-gruh-SKOP-ik**] atmospheric particles that are precursors to clouds?

- W) Stratospheric aerosols
- X) Cloud condensation nuclei
- Y) Aqueous particles [**AY-kwee-uhs**]
- Z) Stratospheric condensation nuclei

ANSWER: X) CLOUD CONDENSATION NUCLEI

### BONUS

10) EARTH AND SPACE *Multiple Choice* Which of the following does the far side of the Moon possess in greater quantity when compared to the near side of the Moon?

- W) Maria
- X) Regolith [**REG-uh-lith**]
- Y) Impact craters
- Z) Aurora

ANSWER: Y) IMPACT CRATERS

### TOSS-UP

11) CHEMISTRY *Multiple Choice* Which of the following adjectives describes the reaction of a strong base with a strong acid?

- W) Precipitation
- X) Synthesis
- Y) Redox
- Z) Neutralization

ANSWER: Z) NEUTRALIZATION

### BONUS

11) CHEMISTRY *Multiple Choice* Which of the following is NOT a strong acid?

- W) Nitric acid
- X) Perchloric acid
- Y) Formic acid
- Z) Hydroiodic acid

ANSWER: Y) FORMIC ACID

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### TOSS-UP

12) BIOLOGY *Multiple Choice* For ions or polar molecules to pass across a plasma membrane in passive transport, the molecules must move in which of the following ways?

- W) Down an electrochemical gradient
- X) Up an electrochemical gradient
- Y) Through a pump
- Z) With a chaperone molecule

ANSWER: W) DOWN AN ELECTROCHEMICAL GRADIENT

### BONUS

12) BIOLOGY *Multiple Choice* Symmetry in animal taxonomy describes which of the following?

- W) How the animals are related
- X) Similarities in anatomy of different species
- Y) Patterns of animal behavior
- Z) How the parts of an animal are arranged around a point or an axis

ANSWER: Z) HOW THE PARTS OF AN ANIMAL ARE ARRANGED AROUND A POINT OR AN AXIS

### TOSS-UP

13) EARTH AND SPACE *Multiple Choice* Construction of habitable structures on the Moon hinges upon the discovery of which of the following vital resources on the Moon?

- W) Carbon
- X) Helium
- Y) Water
- Z) Iron

ANSWER: Y) WATER

### BONUS

13) EARTH AND SPACE *Multiple Choice* The Sun's magnetic field, also called the interplanetary magnetic field, extends to at least which of the following?

- W) 0.5 au
- X) Neptune
- Y) Pluto
- Z) Asteroid belt

ANSWER: Y) PLUTO

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### TOSS-UP

14) MATH *Short Answer* What are the solutions to  $x^2 - 5x + 6 = 0$ ?

ANSWER: 2 AND 3

### BONUS

14) MATH *Short Answer* Find an equation of the graph that results from reflecting the graph of  $y = \sqrt{x}$  over the  $y$ -axis, and then shifting the graph 3 units to the left.

ANSWER:  $y = \sqrt{-(x + 3)}$  (ACCEPT:  $y = \sqrt{-x - 3}$ )

### TOSS-UP

15) BIOLOGY *Short Answer* What disease occurs when blood vessel walls harden and blood passage is decreased or fully blocked?

ANSWER: ARTERIOSCLEROSIS (ACCEPT MYOCONDITIS)

### BONUS

15) BIOLOGY *Short Answer* Name the fat soluble vitamin that is a component of visual pigments in vertebrates.

ANSWER: VITAMIN A (ACCEPT: RETINOL)

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### 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

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

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### TOSS-UP

18) EARTH AND SPACE *Multiple Choice* Which of the following is true of galaxies that are more distant from us?

- W) They are moving away faster
- X) They are expanding more
- Y) They are generally larger
- Z) They possess more heavy elements

ANSWER: W) THEY ARE MOVING AWAY FASTER

### BONUS

18) EARTH AND SPACE *Multiple Choice* The Sun has already completed nearly one half of its main sequence stage. Which of the following will occur next?

- W) White dwarf
- X) Red giant
- Y) Pulsar
- Z) Neutron star

ANSWER: X) RED GIANT

**TOSS-UP**

19) CHEMISTRY *Short Answer* When baking cupcakes, a common ingredient used to make the batter rise is baking soda. What is the gas produced that causes the batter to rise?

ANSWER: CARBON DIOXIDE (ACCEPT: CO<sub>2</sub>)

**BONUS**

19) CHEMISTRY *Short Answer* What is the conjugate acid of the acetate ion?

ANSWER: ACETIC ACID (ACCEPT: ETHANOIC ACID)

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**TOSS-UP**

20) MATH *Short Answer* Convert 420 degrees to radians as an improper fraction in terms of pi.

ANSWER:  $7\pi/3$

**BONUS**

20) MATH *Short Answer* The midpoint of segment AB is (1.5, -3). The coordinates of point A are (7, -5); what are the coordinates of point B?

ANSWER: (-4, -1)

### TOSS-UP

21) BIOLOGY *Short Answer* What biome is characterized by dense evergreen shrubs and small trees, usually in the Mediterranean region of the world?

ANSWER: CHAPARRAL (ACCEPT SHRUBLANDS, SCRUB, BRUSH)

### BONUS

21) BIOLOGY *Multiple Choice* Which of the following processes is MOST under the influence of prolactin?

- W) Growth and maturation of the uterine lining [*YOO-ter-in*]
- X) Lactation
- Y) Follicular maturation in the ovaries
- Z) Stimulation of uterine contractions

ANSWER: X) LACTATION

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### TOSS-UP

22) ENERGY *Multiple Choice* Which of the following is an example of a secondary energy source?

- W) Coal
- X) Electricity
- Y) Solar
- Z) Nuclear

ANSWER: X) ELECTRICITY

### BONUS

22) ENERGY *Short Answer* A water heater uses 4 kilowatts of electricity for 8 hours. To the nearest cent, how much does it cost to operate if the cost of electricity in your area is 10 cents per kilowatt hour?

ANSWER: \$3.20

### TOSS-UP

23) PHYSICS *Multiple Choice* A massless, rigid, insulating rod of length  $R$  is attached at one end to a wall by a hinge so that it is free to swing vertically. The other end of the rod is attached to a sphere of mass  $m$  with charge  $-Q$ . If the rod and sphere are released in a horizontal position, which of the following electric fields is required to maintain the horizontal position of the rod?

- W)  $mg/Q$ , down
- X)  $mg/Q$ , up
- Y)  $mgQ/R$ , down
- Z)  $mgR/Q$ , up

ANSWER: W)  $mg/Q$ , DOWN

### BONUS

23) PHYSICS *Multiple Choice* The majority of helium originating in the dust cloud that formed the Earth has since evaporated into space. Most present-day terrestrially available helium comes from which of the following?

- W) Nuclear fusion reactors
- X) A by-product of nuclear fission
- Y) Harvested from the ionosphere
- Z) Radioactive decay of heavier elements

ANSWER: Z) RADIOACTIVE DECAY OF HEAVIER ELEMENTS

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### TOSS-UP

24) CHEMISTRY *Short Answer* In the balanced equation  $2\text{Ag}^+ + \text{Cu} \rightarrow [\text{yields}] 2\text{Ag} + \text{Cu}^{2+}$ , 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

### **TOSS-UP**

25) EARTH AND SPACE *Multiple Choice* Compared to felsic igneous rocks, mafic igneous rocks contain greater amounts of which of the following elements?

- W) Iron
- X) Aluminum
- Y) Potassium
- Z) Silicon

ANSWER: W) IRON

### **BONUS**

25) EARTH AND SPACE *Short Answer* Name the components that create the two distinct tails of a comet.

ANSWER: IONS AND DUST