

ROUND 8A

TOSS-UP

1) Biology – *Multiple Choice* In green plants, energy is stored mainly in which of the following forms?

- W) Cellulose
- X) Starch
- Y) Glucose
- Z) ATP

ANSWER: X) STARCH

BONUS

1) Biology – *Short Answer* What sheet of muscle separates the thoracic and abdominopelvic cavities?

ANSWER: DIAPHRAGM

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### TOSS-UP

2) Earth and Space – *Multiple Choice* The earliest known single-celled life forms on Earth belong to which of the following taxonomic groups?

- W) Fungi
- X) Protoctista
- Y) Plantae
- Z) Monera

ANSWER: Z) MONERA

### BONUS

2) Earth and Space – *Short Answer* What is the chief commercial ore of aluminum?

ANSWER: BAUXITE

**TOSS-UP**

3) Math – *Multiple Choice* A differentiable function  $f$  has domain the closed interval from  $-3$  to  $4$  and range the closed interval from  $5$  to  $12$ . If  $f$  prime of  $x$  is greater than  $0$  for all  $x$  in the domain, what is  $f$  of  $-3$ ?

- W)  $-3$
- X)  $4$
- Y)  $5$
- Z)  $12$

ANSWER: Y)  $5$

**BONUS**

3) Math – *Short Answer* How many two-digit positive integers do NOT have  $5$  or  $6$  as a digit?

ANSWER:  $56$



**TOSS-UP**

4) Energy – *Short Answer* Methyl-tertiary-butyl-ether [*methil-ter-shee-air-ee-byu-til-eethur*], abbreviated MTBE, replaced lead in gasoline due to several environmental benefits. In order to raise octane rating in current gasoline, what has subsequently replaced MTBE?

ANSWER: ETHANOL

**BONUS**

4) Energy – *Multiple Choice* Which of the following is the best estimate of the electricity consumption of a petascale [*PEH-tah-scale*] supercomputer today?

- W)  $8$  kilowatts
- X)  $80$  kilowatts
- Y)  $8$  megawatts
- Z)  $80$  megawatts

ANSWER: Y)  $8$  MEGAWATTS

### TOSS-UP

5) Chemistry – *Multiple Choice* Which of the following is an example of an ionic compound?

- W) Methane
- X) Chlorine dioxide
- Y) Dinitrogen trioxide
- Z) Calcium sulfide

ANSWER: Z) CALCIUM SULFIDE

### BONUS

5) Chemistry – *Short Answer* What is the geometry of sulfur tetrafluoride [*tetrah-FLOOR-ide*]?

ANSWER: SEESAW

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TOSS-UP

6) Physics – *Short Answer* A proton is traveling counterclockwise in a circle in the $x = 0$ plane. In what direction is its magnetic field vector?

ANSWER: POSITIVE X

BONUS

6) Physics – *Short Answer* What is the adjective for the type of materials that will create an induced magnetic field opposite to an externally applied magnetic field?

ANSWER: DIAMAGNETIC

TOSS-UP

7) Earth and Space – *Short Answer* Most long-period comets are thought to originate from what region in the solar system?

ANSWER: OORT CLOUD

BONUS

7) Earth and Space – *Short Answer* In 1943, a volcano suddenly appeared in a corn field in the village of Paricutin and began erupting lava bombs and ash. What type of volcano was this?

ANSWER: CINDER CONE (ACCEPT: SCORIA CONE)

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**TOSS-UP**

8) Chemistry – *Short Answer* What quantity, in milliliters, of a 0.5 molar solution of sulfuric acid would be required to neutralize 30 mL of a 0.1 molar solution of sodium hydroxide?

ANSWER: 3

**BONUS**

8) Chemistry – *Short Answer* Identify all of the following three statements that are TRUE of ideal concentration cells:  
1) They obey the Nernst equation; 2) At equilibrium, they have a positive redox **[*REE-dox*]** potential; 3) They have a positive standard redox potential.

ANSWER: 1

### TOSS-UP

9) Biology – *Multiple Choice* Which of the following types of tissue do monocot roots possess at their center that dicot roots do not?

W) Xylem

X) Pith

Y) Collenchyma [*koh-LEN-kimma*]

Z) Trichomes

ANSWER: X) PITH

### BONUS

9) Biology – *Short Answer* Identify all of the following three processes that are considered active transport: 1) Uptake of glucose via channels; 2) Sodium-calcium exchange; 3) Mucus secretion.

ANSWER: 2 AND 3

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TOSS-UP

10) Physics – *Short Answer* What type of circuits, which include types such as high-pass and low-pass filters, are composed of a resistor and a capacitor?

ANSWER: RC CIRCUIT

BONUS

10) Physics – *Short Answer* An object's position x as a function of time t is: x of t equals t cubed minus t squared plus $3t$ plus 5 . What is the object's acceleration at time 2 ?

ANSWER: 10

TOSS-UP

11) Energy – *Multiple Choice* Which of the following weather conditions and times of year is best for achieving efficient energy conversion in a solar thermal plant?

- W) Partly cloudy day in fall
- X) Rainy day in spring
- Y) Partly sunny day in winter
- Z) Overcast day in summer

ANSWER: W) PARTLY CLOUDY DAY IN FALL

BONUS

11) Energy – *Multiple Choice* Which of the following accounts for the largest proportion of total US domestic energy production?

- W) Natural gas
- X) Petroleum
- Y) Coal
- Z) Nuclear

ANSWER: W) NATURAL GAS

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**TOSS-UP**

12) Math – *Short Answer* What is the period of the function with equation  $y = 4 \sin(\pi(7x + 3) + 2)$ ?

ANSWER:  $2\pi/7$  (ACCEPT:  $(2/7)\pi$ )

**BONUS**

12) Math – *Short Answer* What is the area in the first quadrant between the graphs of  $y = 4x$  and  $y = x^3$ ?

ANSWER: 4

**TOSS-UP**

13) Physics – *Multiple Choice* A mass on a spring oscillates at a frequency of 200 hertz, creating a low-pitch sound. Which of the following can be done to increase the frequency of the sound produced?

- W) Increase the mass
- X) Use a stiffer spring
- Y) Approach the mass-spring system at a high speed
- Z) Remove the air in the room

ANSWER: X) USE A STIFFER SPRING

**BONUS**

13) Physics – *Short Answer* Identify all of the following three particles that are leptons:

- 1) Neutrino; 2) Gluon; 3) Positron.

ANSWER: 1 AND 3

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TOSS-UP

14) Biology – *Short Answer* In collies, what neurotransmitter is released by somatic motor neurons to induce muscle contraction?

ANSWER: ACETYLCHOLINE

BONUS

14) Biology – *Multiple Choice* With which of the following is protein binding to a TATA [*TAH-tah*] box activity associated?

- W) DNA replication
- X) Transcription
- Y) Translation
- Z) Elongation

ANSWER: X) TRANSCRIPTION

TOSS-UP

15) Math – *Short Answer* In what quadrants does the graph of the equation $y = 4x - 3$ lie?

ANSWER: 1, 3, AND 4 (ACCEPT: FIRST, THIRD, AND FOURTH or ALL BUT SECOND)

BONUS

15) Math – *Short Answer* What is the least common multiple of 14, 16, and 18?

ANSWER: 1008

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**TOSS-UP**

16) Energy – *Short Answer* DOE scientists recently published a paper in which nanoscale circuitry [*sur-cah-tree*] was developed by printing a carbon-based semiconductor on a germanium [*jer-MAYN-ee-um*] surface. What allotrope of carbon are the semiconductors based on?

ANSWER: GRAPHENE

**BONUS**

16) Energy – *Short Answer* What is the only baseload electrical power source in the US that is virtually carbon neutral, and supplies 20% of baseload electrical power?

ANSWER: NUCLEAR POWER (ACCEPT FISSION, URANIUM)

### TOSS-UP

17) Chemistry – *Multiple Choice* Consider the reaction of two moles of hydrogen gas and one mole of oxygen gas to generate two moles of steam. Which of the following statements is TRUE?

- W) Delta H is greater than delta U
- X) Delta H is less than delta U
- Y) Delta H is equal to delta U
- Z) Delta H is greater than delta U at high temperatures, but less at low temperatures

ANSWER: X) DELTA H IS LESS THAN DELTA U

### BONUS

17) Chemistry – *Short Answer* Identify all of the following three diatomic [*dye-ah-TOM-ik*] molecules that MO theory predicts to be stable: 1) Li<sub>2</sub>; 2) Be<sub>2</sub>; 3) B<sub>2</sub>.

ANSWER: 1 AND 3

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TOSS-UP

18) Earth and Space – *Multiple Choice* We see the same side of the moon here on Earth all the time due to what effect?

- W) Lagrange point
- X) Gravitational lensing
- Y) Tidal locking
- Z) Asynchronous spin

ANSWER: Y) TIDAL LOCKING

BONUS

18) Earth and Space – *Multiple Choice* What layer of the Earth's atmosphere varies in depth with the time of day and reflects radio waves long distances?

- W) Photosphere
- X) Stratosphere
- Y) Troposphere
- Z) Ionosphere

ANSWER: Z) IONOSPHERE

TOSS-UP

19) Chemistry – *Short Answer* The hormone estrogen contains five stereocenters. How many stereoisomers of estrogen are possible?

ANSWER: 32

BONUS

19) Chemistry – *Short Answer* Identify all of the following three techniques that could separate enantiomers [*en-AN-tee-oh-mirz*] in a racemic [*ray-SEEM-ik*] mixture of a chiral amine [*KYE-ruhl ah-MEEN*]: 1) Chiral chromatography [*crow-mah-TAW-grah-fee*]; 2) Crystallization with acetic acid; 3) Crystallization with plus tartaric acid.

ANSWER: 1 AND 3 (ACCEPT: CHIRAL CHROMATOGRAPHY AND CRYSTALLIZATION WITH PLUS TARTARIC ACID)

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### TOSS-UP

20) Earth and Space – *Short Answer* What is the second brightest star in the night sky?

ANSWER: CANOPUS

### BONUS

20) Earth and Space – *Short Answer* What famous lake was formed as a result of the collapse of Mount Mazama?

ANSWER: CRATER LAKE

**TOSS-UP**

21) Math – *Short Answer* What is  $6^2 - 2^6$ ?

ANSWER: -28

**BONUS**

21) Math – *Short Answer* Solve the following equation for x over the negative integers:  $x^3 + 5x^2 - 4x - 20 = 0$

ANSWER: -2 AND -5 (must give both answers)

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TOSS-UP

22) Biology – *Short Answer* Rickets is caused by a deficiency of what vitamin?

ANSWER: VITAMIN D

BONUS

22) Biology – *Short Answer* Identify all of the following three molecules that are exocrine [*EX-oh-krin*] products:

1) EGF; 2) Amylase; 3) ADH.

ANSWER: 2

TOSS-UP

23) Physics – *Short Answer* An engine does 15 joules of work while exhausting 35 joules of waste heat. What is the percent efficiency of the engine?

ANSWER: 30

BONUS

23) Physics – *Short Answer* In classical mechanics, impulse can be calculated by finding the area under the curve on a graph of force versus what quantity?

ANSWER: TIME