

**ROUND 6  
TOSS-UP**

1) PHYSICS *Short Answer* What is the resulting electrical potential, in volts, when a charge of 12 coulombs is applied to a 1 farad capacitor?

ANSWER: 12

**BONUS**

1) PHYSICS *Multiple Choice* Which of the following is NOT true:

W) the magnetic field associated with the current on a straight long wire is inversely proportional to the distance from the wire

X) Kirchoff's first rule has to do with the accounting of total charges entering and leaving a junction per unit time

Y) superconducting quantum interference devices, or SQUID's, are based on the Josephson Effect

Z) resistance and voltage are the two most common parameters used to characterize a resistor

ANSWER: Z) RESISTANCE AND VOLTAGE ARE THE TWO MOST COMMON PARAMETERS USED TO CHARACTERIZE A RESISTOR

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**TOSS-UP**

2) CHEMISTRY *Multiple Choice* Which of the following is NOT a colligative property:

W) vapor pressure lowering

X) osmotic pressure

Y) boiling point elevation

Z) color of solution

ANSWER: Z) COLOR OF SOLUTION

**BONUS**

2) CHEMISTRY *Multiple Choice* Which of the following is a type of colloid that is classified as a sol at room temperature:

W) gelatin

X) milk

Y) whipped cream

Z) marshmallow

ANSWER: W) GELATIN

(Solution: sol is a solid dispersed in a liquid)

### TOSS-UP

3) BIOLOGY *Multiple Choice* Which of the following tissues is MOST directly responsible for the increased diameter of a tree trunk from year to year:

- W) apical meristem
- X) pericycle
- Y) vascular cambium
- Z) pith

ANSWER: Y) VASCULAR CAMBIUM

### BONUS

3) BIOLOGY *Short Answer* Name all of the following 3 metabolic processes which directly require oxygen: glycolysis; alcohol fermentation; electron transport system

ANSWER: ELECTRON TRANSPORT SYSTEM

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### TOSS-UP

4) MATH *Short Answer* Convert log base 4 of 53 into a base 10 expression:

ANSWER:  $\frac{\log 53}{\log 4}$  (ACCEPT:  $\frac{\log_{10} 53}{\log_{10} 4}$ )

### BONUS

4) MATH *Short Answer* Consider a 6-sided irregular polygon whose perimeter is 100 centimeters. If 4 of the sides have a length of 7 centimeters each, what is the length, in centimeters, of each of the remaining two sides if they are congruent?

ANSWER: 36

(Solution:  $100 - 28 = 72$ ;  $72/2 = 36\text{cm}$ )

**TOSS-UP**

5) EARTH SCIENCE *Multiple Choice* Which of the following is a man-made coastal structure that causes coastal erosion by blocking oceanic longshore drift:

- W) jetty
- X) barrier island
- Y) atoll
- Z) fringing reef

ANSWER: W) JETTY

**BONUS**

5) EARTH SCIENCE *Short Answer* Used as a way to categorize rivers and streams, what is the term for the volume of water flowing through the cross-section of a channel over a given period of time?

ANSWER: DISCHARGE (ACCEPT: DISCHARGE RATE)

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**TOSS-UP**

6) GENERAL SCIENCE *Multiple Choice* Case hardening is a process through which:

- W) the surface of a metal is hardened
- X) the metal is hardened completely through
- Y) the hardness of a metal is determined
- Z) metals are shaped or formed

ANSWER: W) THE SURFACE OF A METAL IS HARDENED

**BONUS**

6) GENERAL SCIENCE *Multiple Choice* The oil used with an oil-immersion objective in compound light microscopes takes advantage of what optical phenomenon to improve magnification:

- W) chromatic coherence
- X) index of refraction
- Y) polarization
- Z) dispersion

ANSWER: X) INDEX OF REFRACTION

### TOSS-UP

7) ASTRONOMY *Multiple Choice* Which of the following is NOT true:

- W) the rotation of the Sun's surface is faster at the equator than at the poles
- X) the apparent magnitude of an RR Lyrae depends most on its distance from the Earth
- Y) Venus appears its largest to nighttime observers when it is in its full phase
- Z) a star's light curve typically plots brightness verses time

ANSWER: Y) VENUS APPEARS ITS LARGEST TO NIGHTTIME OBSERVERS WHEN IT IS IN ITS FULL PHASE

### BONUS

7) ASTRONOMY *Multiple Choice* Which of the following techniques would you most directly be using if you were analyzing a Balmer and Lyman series:

- W) astrolabe measurements
- X) spectroscopy
- Y) nuclear fission
- Z) bolometric analysis

ANSWER: X) SPECTROSCOPY

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### TOSS-UP

8) PHYSICS *Multiple Choice* Which of the following is the strongest spectral line in the visible region of the hydrogen spectrum:

- W) red Balmer line
- X) orange Lyman line
- Y) green Paschen line
- Z) blue Brackett line

ANSWER: W) RED BALMER LINE

### BONUS

8) PHYSICS *Multiple Choice* Which of the following has the highest vapor pressure at standard temperature and pressure:

- W) mercury
- X) ethyl alcohol
- Y) methyl alcohol
- Z) acetone

ANSWER: Z) ACETONE

### TOSS-UP

9) CHEMISTRY *Multiple Choice* According to the Arrhenius theory, an Arrhenius acid is any substance that does which of the following in a chemical reaction:

- W) donates a pair of electrons
- X) accepts a pair of electrons
- Y) produces  $H^+$  ions in aqueous solution
- Z) produces  $OH^-$  ions in aqueous solution

ANSWER: Y) PRODUCES  $H^+$  IONS IN AQUEOUS SOLUTION

### BONUS

9) CHEMISTRY *Short Answer* If you were to evaporate 1 liter or kilogram of water, how many calories of latent heat are stored in the vapor?

ANSWER: 540,000 (ACCEPT:  $5.4 \times 10^5$ )

(Solution: lat heat<sub>vap</sub> = 540cal/g)

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### TOSS-UP

10) BIOLOGY *Short Answer* During meiosis, how many chromatids are in a chromosomal tetrad?

ANSWER: 4

### BONUS

10) BIOLOGY *Multiple Choice* Which of the following is NOT true of nucleated mammalian cells:

- W) mast cells contain large amounts of histamine
- X) the golgi apparatus processes proteins for exocytosis
- Y) microtubules are components in cilia
- Z) all the DNA in a nucleated cell is in the nucleus

ANSWER: Z) ALL THE DNA IN A HUMAN NUCLEATED CELL IS IN THE NUCLEUS

(Solution: mitochondrial DNA is present)

**TOSS-UP**

11) MATH *Short Answer* Solve the following equation for  $x$ :  
 $x^2 - 20x + 19 = 0$

ANSWER: 19 AND 1

**BONUS**

11) MATH *Short Answer* Express the following radical in its simplest radical form:  
 $-2\sqrt{(80a^2b^4c^3)}$

ANSWER:  $-8ab^2c\sqrt{5c}$

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**TOSS-UP**

12) EARTH SCIENCE *Multiple Choice* Which of the following is NOT true about Earth's history:

- W) the Ordovician Period predates the Silurian Period
- X) we currently live in the Cenozoic Era
- Y) we currently live in the Pleistocene Epoch
- Z) the Holocene Epoch began about 10,000 years ago

ANSWER: Y) WE CURRENTLY LIVE IN THE PLEISTOCENE EPOCH

**BONUS**

12) EARTH SCIENCE *Multiple Choice* Which of the following is the global wind system that most influences weather in the U.S.:

- W) prevailing westerlies
- X) tropical easterlies
- Y) trade winds
- Z) polar easterlies

ANSWER: W) PREVAILING WESTERLIES

**TOSS-UP**

13) GENERAL SCIENCE *Short Answer* One metric ton equals how many grams?

ANSWER: ONE MILLION (ACCEPT:  $1 \times 10^6$  or  $10^6$ )

**BONUS**

13) GENERAL SCIENCE *Short Answer* Gout in humans is the result of the precipitation of what substance in joints?

ANSWER: URIC ACID (ACCEPT: LITHIC ACID or TRIKETOPURINE)

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**TOSS-UP**

14) ASTRONOMY *Short Answer* With reference to the Sun's position in the sky, when does a full Moon set?

ANSWER: WHEN THE SUN RISES

**BONUS**

14) ASTRONOMY *Short Answer* In a Newtonian telescope, how many degrees is the secondary mirror tilted in reference to the primary?

ANSWER: 45

### TOSS-UP

15) PHYSICS *Multiple Choice* If 1000 pounds is applied to a spring with spring constant of 100 pounds per inch on top of a hydraulic piston, how many pounds of force is transferred to the piston:

- W) 1,000
- X) 900
- Y) 100
- Z) zero

ANSWER: W) 1,000

### BONUS

15) PHYSICS *Multiple Choice* If the atomic mass of carbon-12 is exactly 12 atomic mass units, why is the atomic mass of carbon not exactly 12 when listed on the Periodic Table:

- W) the mass deficit
- X) neutrons are not the same mass as protons
- Y) it adds the mass of the electrons
- Z) the presence in nature of about 1.1% carbon-13

ANSWER: Z) THE PRESENCE IN NATURE OF ABOUT 1.1% CARBON-13

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### TOSS-UP

16) CHEMISTRY *Short Answer* How many carbon and hydrogen atoms are in a cyclopentane molecule?

ANSWER: CARBON = 5; HYDROGEN = 10

### BONUS

16) CHEMISTRY *Short Answer* What is the systematic IUPAC name for the following acid:  
HClO

ANSWER: HYPOCHLOROUS ACID



**TOSS-UP**

17) BIOLOGY *Short Answer* What specific part of any member of the *Anthophyta* produces pollen?

ANSWER: STAMEN (ACCEPT: ANTHER)

**BONUS**

17) BIOLOGY *Short Answer* Which one of the following 4 plant groups is phenotypically and phylogenetically LEAST related to the others: ferns; liverworts; hornworts; mosses

ANSWER: FERNS

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**TOSS-UP**

18) MATH *Short Answer* Subtract the following complex numbers, giving your answer in standard form:  $(11 - 4i) - (-3 + 3i)$

ANSWER:  $14 - 7i$

**BONUS**

18) MATH *Short Answer* Solve the following inequality for  $x$ , giving your answer in fractional form:  $\frac{1}{3}x + \frac{2}{3} < \frac{5}{6}x - 2$

ANSWER:  $x > \frac{16}{3}$  (ACCEPT:  $x > 5\frac{1}{3}$ )

**TOSS-UP**

19) EARTH SCIENCE *Multiple Choice* The time interval between the generation of P and S waves from its arrival at a seismometer is BEST translated as:

- W) the magnitude of the earthquake
- X) the distance to the epicenter
- Y) the wave height of a potential tsunami
- Z) the distance to the nearest fault zone

ANSWER: X) THE DISTANCE TO THE EPICENTER

**BONUS**

19) EARTH SCIENCE *Multiple Choice* Which of the following is NOT true:

- W) sea levels dropped during the Pleistocene glaciation making the Bering Strait a land bridge
- X) large animals such as the mastodon and dire wolves became extinct at the end of the Pleistocene
- Y) the Holocene may be an interglacial stage
- Z) recent ice ages are thought to be controlled by uniformitarian cycles

ANSWER: Z) RECENT ICE AGES ARE THOUGHT TO BE CONTROLLED BY UNIFORMITARIAN CYCLES

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**TOSS-UP**

20) GENERAL SCIENCE *Short Answer* What substance made of several fibrous materials was widely used in the 20<sup>th</sup> century for its heat resistant properties but is now banned because it can cause lung cancer when inhaled?

ANSWER: ASBESTOS

**BONUS**

20) GENERAL SCIENCE *Short Answer* What is the medical term for the type of lung cancer specifically associated with asbestosis?

ANSWER: MESOTHELIOMA

**TOSS-UP**

21) ASTRONOMY *Short Answer* What planet is never more than 28° from the Sun in the evening sky?

ANSWER: MERCURY

**BONUS**

21) ASTRONOMY *Multiple Choice* At 8:00 AM in early August of 2006 in New York, the Moon could be seen low in the western sky. What phase was it most likely in:

- W) waxing crescent
- X) just past new
- Y) a few days past full
- Z) first quarter

ANSWER: Y) A FEW DAYS PAST FULL

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**TOSS-UP**

22) PHYSICS *Short Answer* How many nodes are there in the first overtone in a standing wave of a vibrating guitar string?

ANSWER: 3

**BONUS**

22) PHYSICS *Short Answer* If  $g = 9.8$  meters per second squared, to the first decimal place and in newtons, how many newtons of force are required to keep a 500 kilogram slab of granite moving across a horizontal surface at constant speed if there is a kinetic frictional coefficient of 0.10 between the surface and the slab?

ANSWER: 490

(Solution:  $0.1 \times 500\text{kg} \times 9.8\text{m/s}^2 = 490\text{N}$ )

**TOSS-UP**

23) CHEMISTRY *Multiple Choice* Organic compounds that contain double bonds are said to be:

- W) saturated
- X) unsaturated
- Y) unable to undergo cis-trans isomerization
- Z) unable to undergo addition reactions

ANSWER: X) UNSATURATED

**BONUS**

23) CHEMISTRY *Short Answer* Arrange the following 4 elements in order of increasing atomic radii: lithium; oxygen; potassium; sodium

ANSWER: OXYGEN; LITHIUM; SODIUM; POTASSIUM

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**TOSS-UP**

24) BIOLOGY *Short Answer* Which one of the following 4 animal groups is LEAST closely related to the others: brachiopods; gastropods; cephalopods; bivalves

ANSWER: BRACHIOPODS

**BONUS**

24) BIOLOGY *Short Answer* From the OUTSIDE to the INSIDE, name the 3 embryonic germ layers in mammals:

ANSWER: ECTODERM; MESODERM; ENDODERM

### TOSS-UP

25) CHEMISTRY *Multiple Choice* Which of the following is NOT true:

- W) actinides are characterized by occupying the f-block of the periodic table
- X) lanthanides are characterized by occupying the d-block of the periodic table
- Y) alkali metals are the most reactive of all metallic elements
- Z) actinides are metals

ANSWER: X) LANTHANIDES ARE CHARACTERIZED BY OCCUPYING THE D-BLOCK OF THE PERIODIC TABLE

### BONUS

25) CHEMISTRY *Short Answer* In standard chemical nomenclature, what is the complete electron configuration for the sodium ion,  $\text{Na}^+$ ?

ANSWER:  $1s^2 2s^2 2p^6$  (ACCEPT:  $1s^2 2s^2 2p^6 3s^0$ )