

ROUND 2

TOSS-UP

1) Earth and Space – *Multiple Choice* What type of drainage is created inside a landslide where there is no discernible pattern to the drainage?

- W) Annular
- X) Radial
- Y) Deranged
- Z) Trellis

ANSWER: Y) DERANGED

BONUS

1) Earth and Space – *Short Answer* When large-scale space has zero curvature, its geometry is referred to by what adjective?

ANSWER: FLAT

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### TOSS-UP

2) Energy – *Multiple Choice* Which of the following is the most abundant greenhouse gas in the atmosphere?

- W) Oxygen
- X) Water vapor
- Y) Carbon dioxide
- Z) Methane

ANSWER: X) WATER VAPOR

### BONUS

2) Energy – *Multiple Choice* Until the close of the Industrial Revolution in the mid-1800's, what was the primary energy source for most of the world?

- W) Coal
- X) Wood
- Y) Dung
- Z) Natural gas

ANSWER: X) WOOD

**TOSS-UP**

3) Physics – *Multiple Choice* Which of the following is characterized by the lack of a distinct melting point?

- W) Sodium bicarbonate
- X) Quartz
- Y) Stainless steel of a known composition
- Z) Glass

ANSWER: Z) GLASS

**BONUS**

3) Physics – *Short Answer* What is the electric charge of the particle that carries the electromagnetic force?

ANSWER: ZERO

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TOSS-UP

4) Chemistry – *Multiple Choice* In degrees, which of the following is closest to the bond angle between hydrogen atoms in ammonia?

- W) 92
- X) 108
- Y) 123
- Z) 180

ANSWER: X) 108

BONUS

4) Chemistry – *Multiple Choice* Which of the following is true of carbon-14?

- W) It undergoes beta decay to form nitrogen-14
- X) It is generated in the atmosphere when protons strike nitrogen-14 atoms
- Y) It undergoes zero-order decay to carbon-13
- Z) It is the predominant isotope of carbon found in fossil fuels

ANSWER: W) IT UNDERGOES BETA DECAY TO FORM NITROGEN-14

TOSS-UP

5) Math – *Multiple Choice* As x increases from $-\pi$ to π , how does the value of cosine x change?

- W) always decreases
- X) always increases
- Y) decreases then increases
- Z) increases then decreases

ANSWER: Z) INCREASES THEN DECREASES

BONUS

5) Math – *Short Answer* If the fourth power of the complex number $2 + bi$ equals -64 , what are the possible values of b ?

ANSWER: 2, -2 (ACCEPT: ± 2)

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### TOSS-UP

6) Biology – *Multiple Choice* Which of the following types of bonds link monomers together in a polypeptide?

- W) Glycosidic [*glye-koh-SIH-dik*]
- X) Ester
- Y) Amide [*AM-ide*]
- Z) Ether [*EE-thur*]

ANSWER: Y) AMIDE

### BONUS

6) Biology – *Multiple Choice* Which of the following statements is true of plant cells, but not animal cells?

- W) They can exhibit polyploidy [*PAUL-ee-ploy-dee*]
- X) They use a cell plate to divide sister cells in cytokinesis
- Y) They use channels to allow transfer of ions between cells
- Z) They have specialized organelles that likely evolved through endosymbiosis

ANSWER: X) THEY USE A CELL PLATE TO DIVIDE SISTER CELLS IN CYTOKINESIS

### TOSS-UP

7) Chemistry – *Multiple Choice* Which of the following compounds is INSOLUBLE in water?

- W) Copper(I) chloride
- X) Ammonium chromate
- Y) Sodium silicate
- Z) Strontium [*STRAWNCH-ee-um*] chloride

ANSWER: W) COPPER(I) CHLORIDE

### BONUS

7) Chemistry – *Short Answer* Consider a metal with atomic radius 1 angstrom, which crystallizes in a conventional fcc unit cell. To one decimal place and in angstroms, what is the unit cell edge length of the fcc lattice?

ANSWER: 2.8

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TOSS-UP

8) Biology – *Multiple Choice* The thumb's opposability can be attributed to what type of synovial joint?

- W) Pivot joint
- X) Saddle joint
- Y) Hinge joint
- Z) Condylloid joint

ANSWER: X) SADDLE JOINT

BONUS

8) Biology – *Multiple Choice* Oswald Avery found that an "infectious principle" could be transferred from dead, virulent streptococcus bacteria to living, avirulent bacteria, causing them to become virulent. Which of the following is NOT true of this infectious principle?

- W) This material can be separated from protein in an ultracentrifuge [*ultra-SEN-trih-fyooj*]
- X) RNA-digesting enzymes have no effect on the activity of this material
- Y) Performing a hydrophobic [*high-droh-FOH-bik*] extraction removes the material from water
- Z) DNase [*D.N. ace*] destroys all activity of this material

ANSWER: Y) PERFORMING A HYDROPHOBIC EXTRACTION REMOVES THE MATERIAL FROM WATER

TOSS-UP

9) Physics – *Short Answer* What quantum mechanical principle states that no two fermions can possess the same quantum numbers?

ANSWER: PAULI EXCLUSION PRINCIPLE

BONUS

9) Physics – *Multiple Choice* A sample of an ideal gas has a volume of 1 cubic meter at standard temperature and pressure. Which of the following is closest to the number of molecules in the sample?

W) 2.5 times 10 to the 24th

X) 2.7 times 10 to the 25th

Y) 3.0 times 10 to the 25th

Z) 3.7 times 10 to the 25th

ANSWER: X) 2.7 TIMES 10 TO THE 25TH

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**TOSS-UP**

10) Math – *Short Answer* In what logarithm base is the log of 1/27 equal to -3?

ANSWER: 3

**BONUS**

10) Math – *Short Answer* Evaluate the integral from 0 to  $\pi/3$  of sine  $3x$   $dx$ .

ANSWER: 2/3

### TOSS-UP

11) Energy – *Multiple Choice* Which of the following is closest to the percent of the world's electricity that is supplied by nuclear power plants?

- W) 2
- X) 15
- Y) 30
- Z) 50

ANSWER: X) 15

### BONUS

11) Energy – *Multiple Choice* According to predictions by the Department of Energy, which of the following is closest to the percentage of U.S. gasoline and diesel use that could be replaced using biofuels from agricultural and forestry waste?

- W) 10
- X) 30
- Y) 70
- Z) 99

ANSWER: X) 30

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TOSS-UP

12) Earth and Space – *Multiple Choice* What type of high strain metamorphism occurs when two fault blocks rub together, breaking up rock during shearing?

- W) Hydrothermal
- X) Regional
- Y) Contact
- Z) Cataclastic

ANSWER: Z) CATACLASTIC

BONUS

12) Earth and Space – *Short Answer* Our sun produces over 90% of its energy via what specific nuclear reaction chain?

ANSWER: PROTON-PROTON CHAIN (ACCEPT: P-P CHAIN)

TOSS-UP

13) Energy – *Short Answer* DOE researchers have been studying an allotrope of phosphorus with regard to electrical and thermal conductivity and have found that it demonstrates properties similar to graphite. What is the common name of this allotrope?

ANSWER: BLACK PHOSPHORUS (ACCEPT: PHOSPHORENE)

BONUS

13) Energy – *Short Answer* The Spallation Neutron Source is a user facility at Oak Ridge National Lab that can be used to investigate molecular structure. One method of increasing contrast in neutron spallation experiments is by replacing some protium hydrogen atoms with what?

ANSWER: DEUTERIUM (ACCEPT: HEAVY HYDROGEN)

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### TOSS-UP

14) Biology – *Short Answer* Sea urchins and sand dollars belong to what phylum [*FYE-lum*]?

ANSWER: ECHINODERMATA

### BONUS

14) Biology – *Multiple Choice* Cryptonephridia [*kripto-neh-FRID-ee-ah*] can be found in the excretory systems of which of the following organisms?

- W) Desert rats
- X) Mealworm beetle larvae
- Y) Horned lizards
- Z) Goldfish

ANSWER: X) MEALWORM BEETLE LARVAE

### TOSS-UP

15) Math – *Short Answer* The sum of two consecutive prime numbers is 30. What is the larger of the two numbers?

ANSWER: 17

### BONUS

15) Math – *Short Answer* A right circular cylinder has height 9 and diameter 14. What is its surface area?

ANSWER:  $224\pi$

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TOSS-UP

16) Chemistry – *Multiple Choice* Which of the following statements concerning hydrogen bonding is NOT true?

- W) Amines [*ah-MEENS*] can act as hydrogen bond donors and acceptors
- X) Ethers can form hydrogen bonds with each other
- Y) The salicylate [*sah-LIH-sil-ate*] anion [*AN-eye-on*] is stabilized by intramolecular hydrogen bonding
- Z) Hydrogen sulfide cannot engage in hydrogen bonding

ANSWER: X) ETHERS CAN FORM HYDROGEN BONDS WITH EACH OTHER

BONUS

16) Chemistry – *Short Answer* Rank the following four atoms in order of increasing atomic radius:

- 1) Lithium; 2) Fluorine [*FLOOR-een*]; 3) Sodium; 4) Chlorine.

ANSWER: 2, 4, 1, 3 (ACCEPT: FLUORINE, CHLORINE, LITHIUM, SODIUM)

TOSS-UP

17) Physics – *Short Answer* What type of elementary particle is thought not to exist in isolation because of color confinement?

ANSWER: QUARKS

BONUS

17) Physics – *Short Answer* What adjective is used to describe the magnetic properties of materials that have unpaired electrons and tend to be attracted by external magnetic fields?

ANSWER: PARAMAGNETIC



TOSS-UP

18) Earth and Space – *Short Answer* Identify all of the following four rocks that would be classified as foliated metamorphic rocks: 1) Gneiss; 2) Marble; 3) Quartzite; 4) Phyllite.

ANSWER: 1, 4 (ACCEPT: GNEISS AND PHYLLITE)

BONUS

18) Earth and Space – *Multiple Choice* Which of the following is NOT an example of hydrogenous sediments?

- W) Manganese nodules
- X) Evaporites
- Y) Siliceous ooze
- Z) Metal sulfides

ANSWER: Y) SILICEOUS OOZE

TOSS-UP

19) Physics – *Short Answer* A standing wave is produced on a string fixed at both ends. What is the number of antinodes minus the number of nodes?

ANSWER: -1

BONUS

19) Physics – *Short Answer* A metal rod expands when heated. Identify all of the following 4 properties of the rod that would affect its fractional change in length: 1) Original length; 2) Mass; 3) Temperature change; 4) Material composition.

ANSWER: 3 AND 4



TOSS-UP

20) Math – *Short Answer* What is the slope of a line perpendicular to the line with equation $2x + 3y = 7$?

ANSWER: $3/2$ (ACCEPT: 1.5, $1\ 1/2$)

BONUS

20) Math – *Short Answer* Express the base-8 number five-zero-four in base 16.

ANSWER: ONE-FOUR-FOUR

TOSS-UP

21) Earth and Space – *Short Answer* Rank the following three magma types from least to greatest in terms of silica content: 1) Andesitic; 2) Rhyolitic; 3) Basaltic.

ANSWER: 3, 1, 2

BONUS

21) Earth and Space – *Multiple Choice* Which of the following best explains the dryness of the Atacama desert?

- W) It is located in the rain shadow of the Andes
- X) It is primarily located in the horse latitudes
- Y) Low pressure over the Pacific prevents raincloud formation
- Z) Warm Pacific waters carry away rain clouds

ANSWER: W) IT IS LOCATED IN THE RAIN SHADOW OF THE ANDES

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### TOSS-UP

22) Chemistry – *Short Answer* What is the IUPAC name of the smallest aromatic alcohol?

ANSWER: PHENOL

### BONUS

22) Chemistry – *Short Answer* Identify all of the following three statements that are characteristic of an SN2 reaction:  
1) The reaction occurs with inversion; 2) The reaction does not occur with tertiary [*TUR-shee-ary*] alkyl [*AL-kil*] halides [*HAY-lides*]; 3) The reaction is faster with alkyl fluorides than with alkyl iodides.

ANSWER: 1 AND 2

### TOSS-UP

23) Biology – *Short Answer* To what phylum [*FYE-lum*] do most mushrooms belong?

ANSWER: BASIDIOMYCOTA

### BONUS

23) Biology – *Short Answer* Identify all of the following three organisms that are platyhelminths [*plat-ih-HELL-minths*]: 1) Octopus; 2) Hookworm; 3) Liver fluke.

ANSWER: 3