

### ROUND 3

#### TOSS-UP

13) EARTH AND SPACE Multiple Choice Which of the following classes of stars does NOT have radiative zones?

W) A

X) G

Y) M

Z) O

ANSWER: Y) M

#### BONUS

13) EARTH AND SPACE Multiple Choice Under which of the following circumstances does ocean depth affect ocean wave motion?

W) When ocean depth falls below half the wavelength of a wave

X) When the ocean wave has a period exceeding 20 seconds

Y) When the ocean waves are impacted by tides

Z) When the ocean floor has high relief, regardless of the depth

ANSWER: W) WHEN OCEAN DEPTH FALLS BELOW HALF THE WAVELENGTH OF A WAVE

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#### TOSS-UP

6) MATH Multiple Choice A certain radioactive element decays over time according to the equation  $y = R \cdot \left(\frac{1}{2}\right)^x$  of the quantity  $y$  over

300], where  $R$  equals the number of grams that were present initially and  $x$  equals time in years.

If 1000 grams were present initially, how many grams will remain after 900 years?

W) 62.5

X) 125

Y) 250

Z) 500

ANSWER: X) 125

BONUS

6) MATH Short Answer If  $-4x - 9y - 3z = -10$  and  $-5a - 9b = -6$ , then what is  $-9b - 15z - 45y - 20x - 5a$ ?

ANSWER: -56

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TOSS-UP

20) EARTH AND SPACE Short Answer The North Star today is Polaris. In the time of the Babylonians, it was Thuban. What is the reason for this change?

ANSWER: PRECESSION OF THE EQUINOXES (ACCEPT: PRECESSION OR AXIAL PRECESSION)

BONUS

20) EARTH AND SPACE Short Answer What kind of telescope mount requires motion along only one axis to track a celestial object?

ANSWER: EQUATORIAL

TOSS-UP

17) CHEMISTRY Short Answer What element has the following four characteristics: 1) it occurs naturally only in combination with other elements in minerals; 2) it is used primarily as a hardening agent in alloys; 3) its dust is highly toxic, and 4) it is an alkaline [AL-kuh-lyn] earth metal.

ANSWER: BERYLLIUM

BONUS

17) CHEMISTRY Short Answer Identify all of the following four compounds that are ionic: 1)

sodium sulfate, 2) methane, 3) ammonium chloride, 4) beryllium iodide.

ANSWER: 1 AND 3 (ACCEPT: SODIUM SULFATE AND AMMONIUM CHLORIDE)

TOSS-UP

8) EARTH AND SPACE Short Answer The presence of what molecule causes temperatures to increase with increasing altitude in the stratosphere?

ANSWER: OZONE (ACCEPT: O<sub>3</sub> )

BONUS

8) EARTH AND SPACE Multiple Choice At which of the following locations would an observer find the greatest force due to the Earth's gravity?

W) North Pole

X) Tropic of Cancer

Y) Tropic of Capricorn

Z) Equator

ANSWER: W) NORTH POLE

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

TOSS-UP

7) BIOLOGY Multiple Choice Which of the following is true of enzymes?

W) They increase the activation energy of metabolic reactions

X) They have active sites that bind to specific substrate molecules

Y) They are made of chitin [KY-tin] protein

Z) They generally act on a variety of substrate molecules

ANSWER: X) THEY HAVE ACTIVE SITES THAT BIND TO SPECIFIC SUBSTRATE MOLECULES

BONUS

7) BIOLOGY Multiple Choice Which of the following branches of science deals with study of the life and phenomena of inland standing waters, especially lakes and ponds?

W) Limnology [lim-NOL-uh-jee]

X) Hydrology

Y) Ichthyology [ik-thee-OL-uh-jee]

Z) Ecology

ANSWER: W) LIMNOLOGY

TOSS-UP

1) BIOLOGY Multiple Choice Which of the following processes results in a net reduction in the amount of atmospheric carbon dioxide?

W) Photosynthesis [foh-tuh-SIN-thuh-sis]

X) Fossil fuel use

Y) Respiration

Z) Decomposition

ANSWER: W) PHOTOSYNTHESIS

BONUS

1) BIOLOGY Multiple Choice Photosynthesis requires water as a reactant. Oxygen atoms from the water end up in which of the following product molecules?

W) Molecular oxygen

X) Water

Y) Glucose

Z) ATP

ANSWER: W) MOLECULAR OXYGEN

TOSS-UP

8) ENERGY Multiple Choice Which of the following is NOT a potential source of biogas?

W) Landfills

X) Sewage treatment plants

Y) Automobile engine

Z) Animal waste

ANSWER: Y) AUTOMOBILE ENGINE

BONUS

8) ENERGY Multiple Choice The presence of which of the following traits is required for the creation of all oil traps?

W) Anticline

X) Syncline

Y) Impermeable layer

Z) Fault

ANSWER: Y) IMPERMEABLE LAYER

TOSS-UP

15) CHEMISTRY Multiple Choice Which of the following is an aldehyde [AL-duh-hyd]?

W) C<sub>11</sub> H<sub>20</sub>

X) C<sub>5</sub> H<sub>11</sub> OH

Y) C<sub>5</sub> H<sub>11</sub> CHO

Z) C<sub>5</sub> H<sub>11</sub> NH<sub>2</sub>

ANSWER: Y) C5 H11 CHO

BONUS

15) CHEMISTRY Short Answer Which one of the following five metals would react the least with dilute hydrochloric acid: 1) lead, 2) chromium, 3) manganese, 4) nickel, 5) gold?

ANSWER: 5 (ACCEPT: GOLD)

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ANSWER: EQUATORIAL

TOSS-UP

6) ENERGY Multiple Choice Which of the following describes the purpose of the ground connection on a common power outlet?

W) Provide a zero potential reference

X) Remove excess heat from the transmission system

Y) Give a low resistance path for short circuits to travel through

Z) Act as a small current source to prevent corrosion

ANSWER: Y) GIVE A LOW RESISTANCE PATH FOR SHORT CIRCUITS TO TRAVEL THROUGH

BONUS

6) ENERGY Short Answer If a solar panel produces energy directly proportional to the flux of incident photons, what is the best orientation it can have, relative to the line from the Earth to the Sun?

ANSWER: PERPENDICULAR (ACCEPT: ORTHOGONAL)

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TOSS-UP

3) CHEMISTRY Short Answer Providing your answer as a decimal, what is the bond order for the oxygen-oxygen bonds in ozone?

ANSWER: 1.5

BONUS

3) CHEMISTRY Short Answer Which of the following is the local VSEPR geometry of a triply-bonded alkyne carbon?

W) Tetrahedral

X) Trigonal planar

Y) Linear

Z) Bent

ANSWER: Y) LINEAR

TOSS-UP

11) CHEMISTRY Multiple Choice Which of the following compounds would be insoluble in an aqueous [AY-kwee-uhs] solution?

W) Calcium carbonate

X) Sodium nitrate

Y) Ammonium hydroxide

Z) Potassium perchlorate

ANSWER: W) CALCIUM CARBONATE

BONUS

11) CHEMISTRY Multiple Choice Which of the following accurately depicts the hybridization [HY-bri-dy-zay-shuhn] of each atom in the molecule krypton difluoride?

W) Krypton:  $sp^3$ ; each fluorine:  $sp^3$

X) Krypton:  $sp^3d$ ; each fluorine:  $sp^3$

Y) Krypton:  $sp^3d^2$ ; each fluorine:  $sp^2$

Z) Krypton:  $sp^3d$ ; each fluorine:  $sp^2$

ANSWER: X) KRYPTON:  $sp^3d$ ; EACH FLUORINE:  $sp^3$

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TOSS-UP

5) PHYSICS Multiple Choice The acceleration of an object that is in free fall in a vacuum is which of the following?

W) Proportional to the mass of the object

X) Proportional to the inverse of the mass of the object

Y) Independent of the mass of the object

Z) Equal to the product of force and mass

ANSWER: Y) INDEPENDENT OF THE MASS OF THE OBJECT

BONUS

5) PHYSICS Short Answer What is the name of the phenomenon that explains why the surface of water might look like a mirror when viewed from underwater?

ANSWER: TOTAL INTERNAL REFLECTION (ACCEPT: REFRACTION PAST THE CRITICAL ANGLE)

TOSS-UP

8) PHYSICS Multiple Choice Pascal's law governs the actions of forces in which of the following?

W) Gases

X) Solids

Y) Incompressible fluids

Z) A vacuum

ANSWER: Y) INCOMPRESSIBLE FLUIDS

BONUS

8) PHYSICS Short Answer What current, in amperes, is carried in a lightning stroke that lasts 0.5 seconds and transfers 100 coulombs of charge?

ANSWER: 200

TOSS-UP

22) MATH Short Answer If two 6-sided fair dice are rolled, providing your answer as a fraction in lowest terms, what is the probability that both numbers will be even?

ANSWER:  $\frac{1}{4}$

4

BONUS

22) MATH Short Answer Mary travels for 110 miles averaging 55 miles per hour and for 150 miles averaging 50 miles per hour. What is Mary's average speed in miles per hour for the trip?

ANSWER: 52

TOSS-UP

20) EARTH AND SPACE Multiple Choice Given the current climatic conditions on Earth, at

which of the following locations would a glacier most likely form?

W) 0° latitude at an elevation of 6,000 meters

X) 15° N latitude at an elevation of 4,000 meters

Y) 30° N latitude at an elevation of 3,000 meters

Z) 45° N latitude at an elevation of 1,000 meters

ANSWER: W) 0° LATITUDE AT AN ELEVATION OF 6,000 METERS

BONUS

20) EARTH AND SPACE Multiple Choice The analysis of which of the following fossil types from ancient vertebrates provides important information about the diet and biota of ancient environments?

W) Tracks

X) Coprolite

Y) Burrows

Z) Fulgurite [FUHL-gyuh-ryt]

ANSWER: X) COPROLITE

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6) ENERGY Short Answer What is the term for a device used to determine or measure the presence of electrostatic charges?

ANSWER: ELECTROSCOPE

BONUS

6) ENERGY Short Answer What is the efficiency of an appliance whose useful energy output is 5 joules and wasted energy is 20 joules?

ANSWER: 20%