

LEGIT LIGHTNING ROUND 1

TOSS-UP

1) CHEMISTRY *Multiple Choice* In the molecular orbital diagram for the carbon monoxide molecule, which of the following best describes the relative positions of the bonding and antibonding molecular orbitals?

- W) The bonding orbitals are closer to oxygen, while the antibonding orbitals are closer to carbon.
- X) The bonding orbitals are closer to carbon, while the antibonding orbitals are closer to oxygen.
- Y) The bonding and antibonding orbitals are both equidistant from carbon and oxygen.
- Z) The bonding orbital is located above the antibonding orbital.

ANSWER: W) THE BONDING ORBITALS ARE CLOSER TO OXYGEN, WHILE THE ANTIBONDING ORBITALS ARE CLOSER TO CARBON

TOSS-UP

2) BIOLOGY *Multiple Choice* What is another name for 1,4-dichlorobenzene?

- W) cis-dichlorobenzene
- X) meta-dichlorobenzene
- Y) ortho-dichlorobenzene
- Z) para-dichlorobenzene

ANSWER: Z) PARA-DICHLOROBENZENE

TOSS-UP

3) PHYSICS *Short Answer* What law states that the total intensity of radiation emitted by a heated black body is directly proportional the temperature raised to the fourth power?

ANSWER: STEFAN-BOLTZMANN LAW

TOSS-UP

4) ENERGY *Multiple Choice* The Department of Energy's "sunshot" initiative aims to drop the total costs of utility scale solar energy systems by 75% by what year?

W) 2015

X) 2020

Y) 2030

Z) 2040

ANSWER: X) 2020

TOSS-UP

5) MATH *Short Answer* Calculate the indefinite integral of $(\ln x)/x$.

ANSWER: $((\ln x)^2)/2$

TOSS-UP

6) EARTH AND SPACE SCIENCE *Short Answer* What are the beads of visible light around the rim of the moon at the beginning and end of a total solar eclipse commonly referred to as?

ANSWER: BAILY'S BEADS

TOSS-UP

7) PHYSICS *Short Answer* Name the four fundamental interactions.

ANSWER: ELECTROMAGNETIC, GRAVITATION, STRONG NUCLEAR, WEAK NUCLEAR

TOSS-UP

8) BIOLOGY *Multiple Choice* Which of the following phylum contains douglas fir?

- W) gnetophyta
- X) coniferophyta
- Y) ginkgophyta
- Z) cycadophyta

ANSWER: X) CONIFEROPHYTA

TOSS-UP

9) CHEMISTRY *Multiple Choice* Which of the following is an electrophile?

- W) ammonia
- X) aluminum chloride
- Y) trimethylphosphine
- Z) dimethylsulfide

ANSWER: X) ALUMINUM CHLORIDE

TOSS-UP

10) MATH *Short Answer* Solve the following system of equations for x and y:
 $2x - 4y = 10$, $4x + 2y = 20$

ANSWER: $x=5$, $y=0$

TOSS-UP

11) EARTH AND SPACE SCIENCE *Short Answer* Quartz is made of silicon and oxygen arranged in what shape?

ANSWER: TETRAHEDRON

TOSS-UP

12) ENERGY *Multiple Choice* According to statistics from the US Department of Energy, utilizing the excess heat from industrial processes could lead to about what percent increase in efficiency?

- W) 5%
- X) 20%
- Y) 35%
- Z) 50%

ANSWER: X) 20%

TOSS-UP

13) MATH *Short Answer* Any term in the Fibonacci sequence, n , can be represented by the sum of the $n-1$ and $n-2$ terms. If the 12th term and 13th term in the Fibonacci sequence are 144 and 233 respectively, what is the 15th term in the sequence.

ANSWER: 610

TOSS-UP

14) BIOLOGY *Multiple Choice* Which of the following types of plant cells function in supporting elements in the plant with thick secondary walls that are usually strengthened by lignin?

- W) parenchyma cells
- X) collenchyma cells
- Y) sclerenchyma cells
- Z) water-conducting cells

ANSWER: Y) SCLERENCHYMA CELLS

TOSS-UP

15) CHEMISTRY *Multiple Choice* Which of the following best explains why hydrofluoric acid is a weak acid?

- W) Fluorine is the most electronegative element, so it pulls all the electrons from hydrogen.
- X) Fluorine hydrogen bonds with hydronium ions and forms ion pairs.
- Y) Fluorine is an extremely small atom and as a result remains extremely close to hydrogen.
- Z) Fluorine has a very high first ionization energy, so it does not want to become an ion.

ANSWER: X) FLUORINE HYDROGEN BONDS WITH HYDRONIUM IONS AND FORMS ION PAIRS

TOSS-UP

16) EARTH AND SPACE SCIENCE *Multiple Choice* What features, usually appearing as linear mounds of till, are formed by the deposition of material from a glacier and are exposed after the glacier has retreated?

- W) drumlins
- X) glacial valleys
- Y) moraines
- Z) aretes

ANSWER: Y) MORAINES

TOSS-UP

17) ENERGY *Short Answer* Order the following values from least to greatest: standard enthalpy of sublimation of water, standard enthalpy of fusion of water, standard enthalpy of vaporization of water, standard enthalpy of hydrogen-oxygen bond in water

ANSWER: STANDARD ENTHALPY OF FUSION OF WATER, STANDARD ENTHALPY OF VAPORIZATION OF WATER, STANDARD ENTHALPY OF SUBLIMATION OF WATER, STANDARD ENTHALPY OF HYDROGEN-OXYGEN BOND IN WATER

TOSS-UP

18) PHYSICS *Short Answer* If displacement x of a massless object on a spring that exhibits simple harmonic motion can be represented by $x = x(\text{not}) \sin((\omega)(t) + \alpha)$, given that $x(\text{not}) \times \omega = v(\text{not})$, what equation can be used to represent the velocity of this object?

ANSWER: $v = v(\text{not}) \cos((\omega)(t) + \alpha)$

TOSS-UP

19) MATH *Multiple Choice* Your friend, Venkatanarasimharajuvaripeta Rajgopalan wants to play a game with you. He has a jar filled with 20 chips. 2 of these chips are red, 3 of these chips are blue, and 15 of these chips are green. If you draw a red chip, he pays you \$10. If you draw a blue chip, he pays you \$5. If you draw a green chip, you pay him \$2. What is the expected value in this game?

W) +\$0.25

X) -\$0.25

Y) +\$0.50

Z) +\$0.75

ANSWER: W) +\$0.25

TOSS-UP

20) CHEMISTRY *Short Answer* What unusual type of bond is exhibited in the diborane molecule?

ANSWER: 3 CENTER, 2 ELECTRON BONDING (3 C, 2 E BONDING)

TOSS-UP

21) BIOLOGY *Short Answer* What is the term is defined as the evolutionary history of a species or group of species?

ANSWER: PHYLOGENY

TOSS-UP

22) PHYSICS *Multiple Choice* Which of the following gives an expression for the wave disturbance when a monochromatic spherical wave passes through an opening in an opaque screen?

- W) Green's Theorem
- X) Kirchhoff's diffraction formula
- Y) Kirchhoff integral theorem
- Z) Huygens-Fresnel principle

ANSWER: X) KIRCHHOFF'S DIFFRACTION FORMULA

TOSS-UP

23) EARTH AND SPACE SCIENCE *Short Answer* On the Mohs hardness scale, the hardness of a fingernail falls in between the hardness of what two minerals?

ANSWER: GYPSUM AND CALCITE

TOSS-UP

24) ENERGY *Multiple Choice* Which of the following four countries was the world's top oil producers in 2009?

- W) United States
- X) Saudi Arabia
- Y) Russia
- Z) Iran

ANSWER: Y) RUSSIA

TOSS-UP

25) EARTH AND SPACE SCIENCE *Short Answer* What is the ratio of iron atoms in magnetite to hematite?

ANSWER: 3 TO 2