

ROUND 14A

TOSS-UP

1) EARTH AND SPACE *Multiple Choice* Which of the following is characteristic of orthochemical carbonate rocks but not of allochemical carbonate rocks?

- W) Fossils from other locations
- X) Intraclasts within a micrite matrix
- Y) Ooids in a sparry calcite matrix
- Z) Clear, granular carbonate

ANSWER: Z) CLEAR, GRANULAR CARBONATE

BONUS

1) EARTH AND SPACE *Short Answer* Sirius is the brightest star in the sky at night, with an apparent magnitude of about -1, and the Sun is the brightest star in the sky during the day, with an apparent magnitude of about -26. Expressing your answer as a power of 10, approximately how many times as bright does the Sun appear in the sky compared to Sirius?

ANSWER: 10^{10} (ACCEPT: 10 BILLION)

TOSS-UP

2) BIOLOGY *Multiple Choice* Which of the following plant hormones is manufactured primarily in the shoot tips, in embryos, and in parts of developing flowers and seeds?

- W) Auxins [**AWK-sins**]
- X) Cytokinins [**sy-tuh-KY-nins**]
- Y) Gibberellins [**jib-uh-REL-ins**]
- Z) Ethylene

ANSWER: W) AUXINS

BONUS

2) BIOLOGY *Multiple Choice* What is the most immediate role for the protons produced from water photolysis [**foh-TOL-uh-sis**] during photosynthesis?

- W) React with oxygen to make water
- X) Acidify the mitochondrial matrix and provide fuel for chemiosmosis
- Y) Contribute to the proton gradient in the thylakoid and ultimately provide energy to make ATP
- Z) Combine with carbon dioxide during sugar synthesis

ANSWER: Y) CONTRIBUTE TO THE PROTON GRADIENT IN THE THYLAKOID AND ULTIMATELY PROVIDE ENERGY TO MAKE ATP

TOSS-UP

3) MATH *Multiple Choice* While eating out, you and your friend both tip the server 2 dollars. Your tip is 10% of your bill, while your friend's is 20%. What is the difference, in dollars, between your bills?

- W) 2
- X) 4
- Y) 5
- Z) 10

ANSWER: Z) 10

BONUS

3) MATH *Short Answer* What is the smallest positive number other than 3 that, when divided by 4, 5, 6, or 7, has a remainder of 3?

ANSWER: 423

TOSS-UP

4) ENERGY *Short Answer* What form of petroleum deposit, abundant in Canada and Venezuela, contains naturally occurring mixtures of sand, clay, water, and a dense and extremely viscous form of petroleum?

ANSWER: OIL SANDS

BONUS

4) ENERGY *Multiple Choice* According to a study at Argonne National Laboratories, what is the net energy gain or loss, expressed as a ratio, from producing a gallon of ethanol from corn?

- W) -0.95
- X) + 1.0
- Y) +1.1
- Z) +1.3

ANSWER: Z) +1.3

TOSS-UP

5) PHYSICS *Short Answer* What fundamental physical constant is a baseline that gives the value of the absolute dielectric **[dy-i-LEK-trik]** constant of a classical vacuum?

ANSWER: PERMITTIVITY CONSTANT (ACCEPT: PERMITTIVITY OF FREE SPACE OR VACUUM PERMITTIVITY)

BONUS

5) PHYSICS *Multiple Choice* A cord making a 60° angle with the floor pulls on a crate with a tension of 100 newtons along a 10 meter distance. How much work, in joules, is done on the crate by the pulling cord?

- W) 0
- X) 50
- Y) 500
- Z) 5000

ANSWER: Y) 500

TOSS-UP

6) CHEMISTRY *Multiple Choice* Consider the dissociation of weak hydrofluoric acid into fluoride and hydronium ions, and a solution in which this reaction is at equilibrium **[ee-kwuh-LIB-ree-uhm]**. Which of the following additions would shift the equilibrium to the right?

- W) Calcium fluoride
- X) Sulfuric acid
- Y) Ammonia
- Z) Ammonium chloride

ANSWER: Y) AMMONIA

BONUS

6) CHEMISTRY *Short Answer* Place the following four molecules in order from lowest to highest melting point: 1) NaF, 2) CH₄, 3) F₂, 4) Ca.

ANSWER: F₂, CH₄, Ca, NaF (ACCEPT: 3, 2, 4, 1)

TOSS-UP

7) EARTH AND SPACE *Short Answer* The most distant quasar known has a redshift of $z = 6$. Its emission is dominated by the Lyman alpha hydrogen line, which has a laboratory wavelength of 1216 angstroms. To two significant figures, and in angstroms, what is the wavelength of the Lyman alpha line observed in the quasar?

ANSWER: 7300

BONUS

7) EARTH AND SPACE *Multiple Choice* Which of the following statements about limestone and dolostone is true?

W) The primary cation **[KAT-eye-uhn]** present in dolostone is magnesium, while in limestone, it is calcium

X) Both limestone and dolostone have high solubility in HCL, making them difficult to distinguish in the field

Y) Dolostone's primary mineral compound has two CO_3^{2-} anions while limestone's primary mineral compound has only one CO_3^{2-} anion

Z) Unlike limestone, which is composed primarily of the mineral calcite, dolostone is considered both a rock and a mineral

ANSWER: Y) DOLOSTONE'S PRIMARY MINERAL COMPOUND HAS TWO CO_3^{2-} ANIONS WHILE LIMESTONE'S PRIMARY MINERAL COMPOUND HAS ONLY ONE CO_3^{2-} ANION

TOSS-UP

8) ENERGY *Multiple Choice* Which of the following elements is part of the cladding and used as a corrosion-resistant alloy to coat pellets of uranium dioxide prior to fuel rod production?

W) Cadmium

X) Zirconium

Y) Titanium

Z) Silver

ANSWER: X) ZIRCONIUM

BONUS

8) ENERGY *Short Answer* Indicate all of the following three statements that are true of biodiesel: 1) Biodiesel has better lubricating properties and much higher cetane **[SEE-tayn]** ratings than today's lower sulfur diesel fuels; 2) Animal fats, algae, and soybean oil are all used to produce biofuels; 3) A biodiesel blend with 80% petroleum diesel is labeled B80.

ANSWER: 1 AND 2 (ACCEPT: BIODIESEL HAS BETTER LUBRICATING PROPERTIES AND MUCH HIGHER CETANE RATINGS THAN TODAY'S LOWER SULFUR DIESEL FUELS AND ANIMAL FATS, ALGAE, AND SOYBEAN OIL ARE ALL USED TO PRODUCE BIOFUELS)

TOSS-UP

9) MATH *Short Answer* Identify all of the following three logical conclusions that follow from the statement “all A are B”: 1) All B are A; 2) If C is A, then C is also B; 3) If C is not A, then C is not B.

ANSWER: 2 ONLY (ACCEPT: IF C IS A, THEN C IS ALSO B)

BONUS

9) MATH *Short Answer* Dylan has a stamp collection. When Michael asked how many stamps he had, Dylan replied, “When I count by twos, threes, fours, fives, and sixes, there is always one stamp left over, but if I count by sevens, then there are none left over.” What is the fewest number of stamps Dylan might have?

ANSWER: 301

TOSS-UP

10) PHYSICS *Short Answer* How many seconds does it take for a solid cylinder to go from 10 radians per second to 70 radians per second if the moment of inertia is 50 kg meters squared and a torque of 200 newton meters is applied?

ANSWER: 15

BONUS

10) PHYSICS *Multiple Choice* If an object immersed in water experiences a buoyant force of 19.6×10^3 newtons, assuming that the density of water is 1000 kilograms per meter cubed, what is the immersed volume of the object?

- W) 2.0 m^3
- X) 1.0 m^3
- Y) 2.0 cm^3
- Z) 1.0 cm^3

ANSWER: W) 2.0 m^3

TOSS-UP

11) BIOLOGY *Multiple Choice* Which of the following is NOT an example of negative feedback?

- W) Excess ATP inhibiting phosphofructokinase [*fohs-foh-frook-toh-KY-nays*]
- X) High blood glucose causing insulin release
- Y) Secretion of cortisol inhibiting ACTH release
- Z) Release of platelet activating factor during clotting

ANSWER: Z) RELEASE OF PLATELET ACTIVATING FACTOR DURING CLOTTING

BONUS

11) BIOLOGY *Short Answer* Identify all of the following four hormones that are released by the pituitary gland: 1) growth hormone; 2) prolactin; 3) cortisol; 4) epinephrine [*e-puh-NE-frin*].

ANSWER: 1 AND 2 (ACCEPT: GROWTH HORMONE AND PROLACTIN)

TOSS-UP

12) CHEMISTRY *Multiple Choice* In chemical kinetics, which of the following types of reactions has a half-life that is directly proportional to the initial reactant concentration?

- W) Zero order
- X) First order
- Y) Second order
- Z) Third order

ANSWER: W) ZERO ORDER

BONUS

12) CHEMISTRY *Short Answer* Providing your unitless answer to two significant figures, determine the bond order of N_2^+ .

ANSWER: 2.5

TOSS-UP

13) MATH *Short Answer* What is the maximum possible number of intersection points of a circle and a square?

ANSWER: EIGHT

BONUS

13) MATH *Short Answer* The positive integers 60, 72, and n have the property that the product of any two of them is divisible by the third. What is the smallest possible value of n ?

ANSWER: 30

TOSS-UP

14) PHYSICS *Short Answer* What is the principle quantum number of the only orbital of the hydrogen atom that has no angular dependence?

ANSWER: 1

BONUS

14) PHYSICS *Multiple Choice* A room has a uniform magnetic field of 0.5 tesla, directed into the floor. A 2.0-meter copper rod parallel to the floor and with one end pointed toward you is moving to the right with a speed of 100 meters per second. What is the motional electromotive force in volts, and which end (near or far) is at higher potential?

- W) 25.0, far
- X) 25.0, near
- Y) 100.0, far
- Z) 100.0, near

ANSWER: Y) 100.0, FAR

TOSS-UP

15) EARTH AND SPACE *Multiple Choice* Which of the following metamorphic rocks results from shallow depth, low pressure contact metamorphism affiliated with a large igneous **[IG-nee-uhs]** intrusion?

- W) Slate
- X) Gneiss **[NYS]**
- Y) Hornfels
- Z) Blueschist

ANSWER: Y) HORNFELS

BONUS

15) EARTH AND SPACE *Multiple Choice* The ocean floor near a midocean ridge has which of the following patterns of magnetization?

- W) The same constant magnetization on both sides
- X) Strips of alternate magnetization on both sides
- Y) It is magnetized in one direction on one side and in the opposite direction on the other side
- Z) It has no pattern of magnetization

ANSWER: X) STRIPS OF ALTERNATE MAGNETIZATION ON BOTH SIDES

TOSS-UP

16) CHEMISTRY *Multiple Choice* Which of the following statements portrays waxes inaccurately?

- W) Many waxes are natural products
- X) Waxes help plants eliminate excess water
- Y) Paraffin waxes do not contain ester functional groups
- Z) Ear wax contains both phospholipids and esters of cholesterol

ANSWER: X) WAXES HELP PLANTS ELIMINATE EXCESS WATER

BONUS

16) CHEMISTRY *Short Answer* Assume that 1 mole of each of the following three salts is dissolved in 1 liter of water. By name or number, give the three solutions from the one with the lowest freezing point to the one with the highest freezing point: 1) aluminum sulfate; 2) calcium nitrate; 3) sodium fluoride.

ANSWER: 1, 2, 3 (ACCEPT: IN THE ORDER THEY WERE PRESENTED)

TOSS-UP

17) BIOLOGY *Multiple Choice* Which of the following is an organic dietary requirement that is only needed in small amounts?

- W) Vitamins
- X) Minerals
- Y) Enzymes
- Z) Coenzymes

ANSWER: W) VITAMINS

BONUS

17) BIOLOGY *Short Answer* Identify all of the following four molecules that are known to act as second messengers: 1) cyclic AMP; 2) diacylglycerol [*dy-as-il-GLY-se-rohl*]; 3) glycine [*GLY-seen*]; 4) serotonin.

ANSWER: 1 AND 2 (CYCLIC AMP AND DIACYLGLYCEROL)

TOSS-UP

18) ENERGY *Multiple Choice* Which of the following types of fuel cell is most commonly used in vehicles?

- W) Alkaline
- X) Polymer electrolyte membrane
- Y) Solid oxide
- Z) Phosphoric acid

ANSWER: X) POLYMER ELECTROLYTE MEMBRANE

BONUS

18) ENERGY *Short Answer* Compounds such as luminol and luciferin demonstrate what property upon oxidation, which can be understood as a ground state reactant becoming a singlet excited product, which then emits a photon as it transitions back to the ground state?

ANSWER: CHEMILUMINESCENCE

TOSS-UP

19) EARTH AND SPACE *Multiple Choice* Why does dolostone weather to a brownish colored rock?

- W) Iron occurs in small amounts, replacing some of the magnesium in dolomite
- X) Copper ions replace magnesium in dolostone as groundwater permeates the rock
- Y) Aluminum ions replace the calcium in the dolomite compounds, and there is a reaction between aluminum and the remaining magnesium ions
- Z) Magnesium ions replace the calcium ions in dolostone compounds

ANSWER: W) IRON OCCURS IN SMALL AMOUNTS, REPLACING SOME OF THE MAGNESIUM IN DOLOMITE

BONUS

19) EARTH AND SPACE *Multiple Choice* Blue-green algae produces mats that trap and bind microcrystalline carbonates as incoming tides sweep over the sand, producing what kind of carbonate rock structure?

- W) Crystalline veins
- X) Laminations
- Y) Ripples and cross-bedding
- Z) Styolites

ANSWER: X) LAMINATIONS

TOSS-UP

20) MATH *Short Answer* If you think of the fingers on your hand as being 10 binary digits (0 if the finger is down and 1 if the finger is up), then what is the biggest base 10 number you can count to on your fingers?

ANSWER: 1023

BONUS

20) MATH *Short Answer* Which of the following is not an antiderivative for $\sin x \cos x$ [**sine of x times cosine of x**]?

- W) $\frac{\sin^2 x}{2}$ [**one-half sine squared of x**]
- X) $-\frac{(\cos^2 x)}{2}$ [**negative one-half cosine squared of x**]
- Y) $\frac{(\sin 2x)}{4}$ [**one-fourth sine of two x**]
- Z) $-\frac{(\cos 2x)}{4}$ [**negative one-fourth cosine of two x**]

ANSWER: Y) $\frac{\sin 2x}{4}$

TOSS-UP

21) BIOLOGY *Short Answer* What hormone, secreted from pinealocytes [*pin-ee-A-loh-syt*], is thought to be responsible for the regulation of the body's circadian [*sur-KAY-ee-uhn*] rhythms?

ANSWER: MELATONIN

BONUS

21) BIOLOGY *Multiple Choice* If the ambient temperature drops 10 degrees Celsius, what would happen to the body temperature of a rabbit and a snake, respectively?

- W) It would drop linearly for the rabbit and exponentially for the snake
- X) It would stay the same for the rabbit and drop linearly for the snake
- Y) It would stay the same for the rabbit and drop exponentially for the snake
- Z) It would drop linearly for the rabbit and for the snake

ANSWER: X) IT WOULD STAY THE SAME FOR THE RABBIT AND DROP LINEARLY FOR THE SNAKE

TOSS-UP

22) CHEMISTRY *Short Answer* What type of reduction reaction generally employs a metal such as ruthenium, platinum, nickel, or palladium as a catalyst, and is used to transform alkenes [*AL-kayns*] to alkanes in a chamber pressurized with hydrogen gas?

ANSWER: HYDROGENATION

BONUS

22) CHEMISTRY *Short Answer* The approximate molar mass of copper is 63.6 grams per mole. Given that a copper electrode must be oxidized into copper (II) ions to plate one mole of silver (I) ions onto a silver electrode, give the reduction of mass, in grams, of the copper electrode, as well as the number of moles of electrons that have flowed from the copper to the silver electrode to plate one mole of silver.

ANSWER: 31.8 GRAMS COPPER; ONE MOLE OF ELECTRONS

TOSS-UP

23) PHYSICS *Multiple Choice* Unstable particles muons [**MYOO-ons**], pions [**PY-ons**], kaons, and sigmas have half-life times in the range of which of the following?

W) 10^{-6} to 10^{-23} seconds

X) 10^{-1} to 10^{-3} seconds

Y) 10 to 1 seconds

Z) 10^{-1} to 10^{-8} seconds

ANSWER: W) 10^{-6} TO 10^{-23} SECONDS

BONUS

23) PHYSICS *Short Answer* Nuclear magnetic resonance, electron spin resonance spectroscopy, and Mossbauer spectroscopy are all based on what physical effect that is associated with the splitting of spectral lines in the presence of a magnetic field?

ANSWER: ZEEMAN EFFECT