MHS Set 2 Round 3 MRRR

Buzzer test + Ice breaker question: What is your favorite restaurant?

TOSS-UP

1) Physics – *Short Answer* Identify all of the following that are conserved in an inelastic collision. 1) Linear Momentum; 2) Kinetic Energy; 3) Total Energy

ANSWER: 13

BONUS

1) Physics – *Short Answer* The A string of a violin has a fundamental frequency of 440 hertz. What is the second overtone of this frequency?

ANSWER: 1320

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TOSS-UP

2) Earth and Space - *Multiple Choice* - According to Steno's Laws of Stratigraphy, if a layer of granite is approximately 100,000 years old, a layer of bedrock underlying it would be which of the following relative to the granite, assuming no unconformities?

W) The same age as the granite
X) Older than the granite
Y) Younger than the granite
Z) Impossible to tell

ANSWER: X) Older than the granite

BONUS

2) Earth and Space - *Short Answer* Natural chalk cliff sides in France along the English Channel correspond with what famous landform on the other side of the waterway, indicating that it was once connected?

ANSWER: THE WHITE CLIFFS OF DOVER
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TOSS-UP

3) Chemistry – *Short Answer* Identify all of the following 3 elements, that when used to dope a semiconductor, produces a p-type semiconductor: 1) Nitrogen; 2) Phosphorus; 3) Germanium

ANSWER: NONE

BONUS

3) Chemistry – *Short Answer* Order the following 3 steps in balancing a redox reaction from first to last: 1) Add water molecules to the side missing excessive oxygens; 2) Add the two half-reactions together; 3) Split the unbalanced equation into two half-reactions.

ANSWER: 3,1,2

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TOSS-UP

4) Biology – *Short Answer* The S in 70s ribosomes represents a non-SI unit for the sedimentation coefficient. What does the S stand for?

ANSWER: SVEDBERGS

BONUS

4) Biology – *Multiple Choice* Which of the following is NOT true of gram-negative bacteria?

W) They do not retain the Crystal Violet stain.
X) They have 2 rings in their basal body for flagella structure.
Y) They have a thin amount of peptidoglycan.
Z) They generally do not form endospores.

ANSWER: X) THEY HAVE 2 RINGS IN THEIR BASAL BODY FOR FLAGELLA STRUCTURE.
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TOSS-UP

5) Math – *Short Answer* If f(x)=2x+3 and g(x)=2x, what is f(g(3))?

ANSWER: 15

BONUS

5) Math – *Short Answer* Identify all of the following numbers that are irrational. 1) Square root of 2; 2) Log of 50; 3) Square root of 6

ANSWER: All (ACCEPT: 1, 2, 3)

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TOSS-UP

6) Physics – *Short Answer* A particle is thrown horizontally off a cliff at a speed of 10 meters per second. If it takes 4 seconds to hit the ground, how far does it travel horizontally?

ANSWER: 40

BONUS

6) Physics – *Short Answer* If the electric field at a point 4 meters away from a point charge is E, what is the electric field at a point 8 meters away from the point charge?

ANSWER: E/4
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TOSS-UP

7) Earth and Space - *Multiple Choice* - What is the name for the structure that forms when an oceanic volcano has partially submerged, and is surrounded by a coral reef?

W) Atoll
X) Guyot (Pronounced Gee-oh)
Y) Barrier Reef
Z) Seamount

ANSWER: Y) BARRIER REEF

BONUS

7) Earth and Space - *Multiple Choice* - The presence of thin, rope-like formations of cooled magma indicate the presence of which of the following magma types?

W) A'a (Pronounced ah-ah)
X) Andesitic
Y) Rhyolitic
Z) Pahoehoe (Pronounced Pa-hoy-hoy, please be mature about this one)

ANSWER: Z) Pahoehoe

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TOSS-UP

8) Energy – *Multiple Choice* Researchers at Brookhaven national lab are monitoring intermediates in the conversion of carbon dioxide into formate. What is the oxidation state of carbon in formate?

W) +1
X) +2
Y) +3
Z) +4

ANSWER: X) +2

BONUS

8) Energy – *Short Answer* Researchers at Pacific Northwest national lab are studying the properties of water at temperatures below 273 Kelvin. What is the general term for fluids that are cooled below their freezing point, due to the lack of a nucleus at which a crystal structure can form?

ANSWER: SUPERCOOLED
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TOSS-UP

9) Biology – *Multiple Choice* In a cross between two BbCc *(pronounced: "Big B little b, Big C little c)* parents, where big B is black fur, and big C is straight fur, which of the following will be the fraction of offspring with black coat color and straight fur.

W) 1/16
X) 9/16
Y) 3/4
Z) 15/16

ANSWER: X) 9/16

BONUS

9) Biology – *Short Answer* Identify which of the following 4 statements describes primary, secondary, tertiary, or quaternary protein structure: 1) Arrangement of multiple folded protein units; 2) Individual amino acid sequence; 3) The three-dimensional shape of the polypeptide in space; 4) Hydrogen bond interaction between amino and carboxyl groups.

ANSWER: 1 QUATERNARY, 2 PRIMARY, 3 TERTIARY, 4 SECONDARY

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TOSS-UP

10) Math – *Short Answer* What is the area of a triangle with sides of length 5, 5, and 6?

ANSWER: 12

BONUS

10) Math – *Multiple Choice* For which of the following values of x is the function $ln(x)$ NOT defined?

W) 0
X) 0.5
Y) 1
Z) π

ANSWER: W) 0
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TOSS-UP

11) Physics – *Multiple Choice* When the electric field strength in an insulating material such as air becomes too great, the material undergoes dielectric breakdown and becomes a conductor. In air, this is realized as sparks. Which of the following in volts per meter is closest to the electric field strength at which air breaks down and becomes electrically conductive?

W) 3 V/m
X) $3*10^2$ V/m
Y) $3*10^4$ V/m
Z) $3*10^6$ V/m

ANSWER: Z) $3*10^6$ V/m

BONUS

11) Physics – *Short Answer* A ball is thrown with speed 10m/s at an angle of 45 degrees with respect to the ground. Rounded to the nearest integer, how far, in meters, will the ball travel before hitting the ground again?

ANSWER: 10

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TOSS-UP

12) Earth and Space - *Short Answer* What form of telescope utilizes one large primary mirror in conjunction with a diagonal secondary mirror, and are often cumbersome to use based on their sheer scale?

ANSWER: NEWTONIAN TELESCOPE

BONUS

12) Earth and Space - *Multiple Choice* - A sidereal drive moves a telescope in which way to counteract the rotation of Earth?

W) Northward
X) Eastward
Y) Southward
Z) Westward

ANSWER: Z) WESTWARD
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TOSS-UP

13) Energy – *Multiple Choice* Researchers at the Joint Genome Institute are studying polyploid genomes in various organisms. What kingdom of organisms are they likely studying?

W) Animalia
X) Fungi
Y) Bacteria
Z) Plantae

ANSWER: Z) PLANTAE

BONUS

13) Energy – *Short Answer* Researchers at Ames national lab are using selective hydrogenation to reduce nitrate into ammonia. What is the term for the microbially facilitated process in which nitrates are reduced into compounds such as nitrogen gas or nitrous oxide?

ANSWER: DENITRIFICATION

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TOSS-UP

14) Chemistry – *Multiple Choice* When fugacity is set equal for two different phases at equilibrium from the Lewis-Randall rule, what is derived?

W) Raoult's Law
X) Henry's Law
Y) Van't Hoff Equation
Z) Integrated Rate Law

ANSWER: W) RAOULT'S LAW

BONUS

14) Chemistry – *Multiple Choice* What conformation around carbon 2 and carbon 3 of butane would be the most stable?

W) Antiperiplanar
X) Synperiplanar
Y) Anticlinal
Z) Gauche

ANSWER: W) ANTIPERIPLANAR
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TOSS-UP

15) Math – *Multiple Choice* What is the value of (8+15i)(8-15i)?

W) 289
X) 225
Y) 64
Z) 16

ANSWER: W) 289

BONUS

15) Math – *Short Answer* What is the sum of all complex roots of the equation $x^3 + x^2 - 14x - 24 = 0$?

ANSWER: -1

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TOSS-UP

16) Physics – *Multiple Choice* Identify all of the following colors that have a larger wavelength than orange. 1) Red; 2) Blue; 3) Violet

ANSWER: 1 (ACCEPT: RED)

BONUS

16) Physics – *Short Answer* What principle in optics states that light always takes the path of least time?

ANSWER: FERMAT'S PRINCIPLE
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TOSS-UP

17) Chemistry - *Multiple Choice* Which of the following particles has the lowest mass?

W) Beta minus particle
X) Beta plus particle
Y) Gamma particle
Z) Alpha particle

ANSWER: Y) GAMMA PARTICLE

BONUS

17) Chemistry – *Short Answer* What quantity equals the integral from T1 to T2 of the heat capacity divided by temperature times dT?

ANSWER: ENTROPY (ACCEPT: DELTA S)

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TOSS-UP

18) Biology – *Short Answer* The deficiency of what element characterizes a plant that has leaf tips curling downwards, and necrotic spots appear along the margin.

ANSWER: PHOSPHORUS

BONUS

18) Biology – *Short Answer* Starting from the front of the skull where your face is and going back to the back of your skull, order the following 3 lobes in the order you would encounter them: 1) Parietal; 2) Occipital; 3) Temporal

ANSWER: 3, 1, 2
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TOSS-UP

19) Earth and Space - *Short Answer* What type of well requires no pumping for water to arrive at the surface from an aquifer?

ANSWER: Artesian Well

BONUS

19) Earth and Space - *Multiple Choice* - Of the following, the stratopause marks which boundary?

W) Top of stratosphere to bottom of mesosphere
X) Top of troposphere to bottom of stratosphere
Y) Top of stratosphere to bottom of thermosphere
Z) Top of troposphere to bottom of mesosphere

ANSWER: W) Top of stratosphere to bottom of mesosphere

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TOSS-UP

20) Math – *Multiple Choice* What is the value of the second derivative of $y(x) = 4x^3 - 6x + 9$ at $x=3$?

W) 24
X) 36
Y) 48
Z) 72

ANSWER: Z) 72

BONUS

20) Math – *Short Answer* Which of the following is a root of the equation $\log_9(3x^2 - 4x) = \log_3 x$?

W) 0
X) 1
Y) 2
Z) 3
ANSWER: Y) 2
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TOSS-UP

21) Biology – *Short Answer* What two hormones, released by the anterior pituitary gland, work together in the reproductive system, and are named gonadotropins.

ANSWER: FSH AND LH (ACCEPT: FOLLICLE STIMULATING HORMONE AND LUTEINIZING HORMONE)

BONUS

21) Biology – *Multiple Choice* The suprachiasmatic nucleus is responsible for the regulation of what process in humans?

W) Sleep
X) Digestion
Y) Secretion
Z) Blinking

ANSWER: W) SLEEP

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TOSS-UP

22) Chemistry – *Short Answer* Order the following 4 molecular orbitals from least to greatest energy for the compound F_2: 1) Sigma Star; 2) Sigma; 3) Pi Star; 4) Pi

ANSWER: 1, 3, 2, 4

BONUS

22) Chemistry – *Short Answer* Identify all of the following 3 compounds that have a non-zero bond order: 1) H_2^+; 2) He_2^{2+}; 3) B_2

ANSWER: ALL
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TOSS-UP

23) Energy – *Short Answer* Researchers at Lawrence Berkeley national lab are converting lignin found in paper into other useful organic molecules. Lignin is typically found in what specific part of a plant cell?

ANSWER: CELL WALL

BONUS

23) Energy – *Short Answer* Researchers at the Joint Genome Institute are studying the evolution of chloroplasts throughout Earth's history. The chloroplast likely originated from what general class of photosynthesizing organisms?

ANSWER: CYANOBACTERIA