MHS Set 2 Round 5 EDER

Buzzer test + Ice breaker question: What is your favorite motif? ;)

TOSS-UP

1) Physics – *Short Answer* What property of a material, used in the speed of sound calculations for solids, measures a material's resistance to compression?

ANSWER: YOUNG'S MODULUS

BONUS

1) Physics – *Short Answer* Rounded to the nearest tenth and in meters, what is the total horizontal distance travelled when an object is thrown at a speed of 10 meters per second with an angle 45 degrees to the horizontal?

ANSWER: 10.2

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TOSS-UP

2) Earth and Space - *Short Answer* Coming from the Greek for "mountain," what is the term used to describe the process of mountain building?

ANSWER: OROGENY

BONUS

2) Earth and Space - *Multiple Choice* Joints in rock structures, often found in mountains, are a sign of what type of rock deformation?

W) Brittle Deformation
X) Fracture
Y) Plastic Deformation
Z) Ductile Deformation

ANSWER: W) BRITTLE DEFORMATION
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TOSS-UP

3) Chemistry – *Short Answer* The band gap is defined as the difference in energy between the conductance band, and what other band?

ANSWER: VALANCE BAND

BONUS

3) Chemistry – *Short Answer* The Stefan-Boltzmann law states that the total intensity of radiation emitted over all wavelengths is equal to the Boltzmann constant times temperature to what power?

ANSWER: 4

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TOSS-UP

4) Biology – *Short Answer* What enzyme is used to phosphorylate fructose-6-phosphate in glycolysis to produce fructose-1,6-bisphosphate.

ANSWER: PHOSPHOFRUCTOKINASE (ACCEPT: PFK)

BONUS

4) Biology – *Short Answer* Which of the following best explains the difference between a nucleotide and a nucleoside:

W) Nucleotides have a nitrogenous base on carbon 1, while nucleosides do not.
X) Nucleotides have a phosphate group on carbon 5, while nucleosides do not.
Y) Nucleotides have a purine base on carbon 1, while nucleosides have pyrimidine base.
Z) Nucleotides have either purine or pyrimidine base on carbon 1, while nucleosides have neither.

ANSWER: X) NUCLEOTIDES HAVE A PHOSPHATE GROUP ON CARBON 5, WHILE NUCLEOSIDES DO NOT.
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TOSS-UP

5) Math – *Short Answer* What is the probability that when two fair six sided dice are rolled, their values are equivalent?

ANSWER: 1/6

BONUS

5) Math – *Short Answer* What is the largest prime factor of 561?

ANSWER: 17

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TOSS-UP

6) Physics – *Short Answer* A block with a mass of 5 kilograms with an initial speed of 4 meters per second comes to a stop on a surface with a coefficient of static friction of 0.2. How much work, in joules, is done by friction on the block?

ANSWER: -40

BONUS

6) Physics – *Short Answer* A circuit is composed of a 6 volt battery with 2 resistors in parallel with resistances of 4 and 6 ohms. What is the power, in watts, dissipated by the 4 ohm resistor as a current flows through the circuit?

ANSWER: 9
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TOSS-UP

7) Earth and Space - *Multiple Choice* - The major difference between a quasar and a blazar is:
W) Temperature
X) Angle observed
Y) Massiveness
Z) Absolute Magnitude

ANSWER: X) ANGLE OBSERVED

BONUS

7) Earth and Space - *Multiple Choice* - Which of the following are not features of blackholes?

W) Accretionary Radius
X) Accretion Disks
Y) Astrophysical Jets
Z) Event Horizon

ANSWER: W) ACCRETIONARY RADIUS

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TOSS-UP

8) Energy – *Multiple Choice* Scientists at Lawrence Berkeley National Lab are studying interactions of the Higgs field and Higgs boson with other fields and particles. They observed the Higgs boson decaying into a pair of what particles that share every property with the electron except mass which is 200 times greater?
W) antiproton
X) W- boson
Y) pion
Z) muon

ANSWER: Z) MUON

BONUS

8) Energy – *Short Answer* Researchers at Argonne National Lab are developing machine learning algorithms. What is the name for machine learning that attempts to find patterns from unlabeled data?

ANSWER: UNSUPERVISED LEARNING
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TOSS-UP

9) Biology – *Short Answer* Hydrochloric acid, or HCl, is secreted by what specialized cell in the stomach?

ANSWER: PARIETAL CELLS

BONUS

9) Biology – *Short Answer* Identify all of the following 3 vitamins that are considered B vitamins: 1) Niacin; 2) Phylloquinone; 3) Retinol

ANSWER: 1 ONLY

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TOSS-UP

10) Math – *Short Answer* What is the limit as x approaches 0 of the fraction with numerator cosine of x and denominator 2 minus e to the x?

ANSWER: 1

BONUS

10) Math – *Short Answer* What is the volume of the figure generated when a right triangle with sides of length 6 and 8 is revolved around its shorter side?

ANSWER: 128π
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TOSS-UP

11) Physics – *Multiple Choice* Which of the following quantities has a value of 0 for an electron?

W) Mass
X) Charge
Y) Spin
Z) Strangeness

ANSWER: Z) STRANGENESS

BONUS

11) Physics – *Short Answer* What is the angular momentum, in kilogram meters squared per second, of a solid disk with mass 10 kilograms and radius 5 meters, rotating with an angular frequency of 7 inverse seconds?

ANSWER: 875

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TOSS-UP

12) Earth and Space - *Multiple Choice* - Which of the following time periods is the oldest?

W) Silurian
X) Quaternary
Y) Jurrasic
Z) Ordovician

ANSWER: Z) ORDOVICIAN

BONUS

12) Earth and Space - *Short Answer* What relatively short event, when compared to the geologic timescale, led to a drastic increase in the diversity of life and species?

ANSWER: CAMBRIAN EXPLOSION (ACCEPT: CAMBRIAN RADIATION)
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TOSS-UP

13) Energy – *Short Answer* Researchers at Sandia National Labs are using computer simulations to increase the safety of American nuclear stockpiles. One class of simulation technique they use, which was also used during the designing of the original nuclear bombs, consists of plugging in random parameters to equations and seeing what the result is. What is the name for this class of simulation methods?

ANSWER: MONTE CARLO

BONUS

13) Energy – Multiple Choice Researchers at the Joint Genome Institute are studying artificial photosynthesis in order to more effectively remove carbon dioxide from the atmosphere. Which of the following enzymes is utilized in the process of photosynthesis?

W) Hexokinase
X) Rubisco
Y) Phospholipase C
Z) Helicase

ANSWER: X) RUBISCO

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TOSS-UP

14) Chemistry – *Multiple Choice* In the singlet state, which of the following statements is true?

W) Electrons have an overall net spin of ½ or -1/2
X) Electron spins are paired
Y) It is a two-level system
Z) Molecular oxygen exists in a singlet state.

ANSWER: X) ELECTRON SPINS ARE PAIRED

BONUS

14) Chemistry – *Multiple Choice* Consider a reaction for which, at high temperatures, where Gibbs Free Energy is negative. If the reaction system is at equilibrium under standard conditions, and then the temperature of the system is raised by 50 K, which of the following statements will be true?

W) The reaction will become non-spontaneous at this temperature.
X) The activation energy will be increased at this temperature.
Y) The ΔH^o (standard change in enthalpy) and ΔS^o (... entropy) for this reaction are negative.
Z) The Reaction quotient will be smaller than the equilibrium constant.

ANSWER: Z) REACTION QUOTIENT WILL BE SMALLER THAN THE EQUILIBRIUM CONSTANT

15) Math – *Short Answer* What is 125 squared?
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TOSS-UP

ANSWER: 15625

BONUS

15) Math – *Short Answer* What are the last two digits of 12 times 7 to the 2020th power?

ANSWER: 12

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TOSS-UP

16) Physics – *Multiple Choice* Which of the following materials has the greatest dielectric constant?

W) Air
X) Water
Y) Quartz
Z) Polyvinyl chloride

ANSWER: X) WATER

BONUS

16) Physics – *Short Answer* Order the following three reversible processes in order of increasing work done on the surroundings: 1) Reversible adiabatic expansion; 2) Reversible isothermal expansion; 3) Reversible isobaric expansion

ANSWER: 1, 2, 3
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TOSS-UP

17) Chemistry – *Short Answer* The decomposition of hydrogen peroxide can be described as what type of reaction, defined as when one substance is both oxidized and reduced in the reaction.

ANSWER: DISPROPORTIONATION

BONUS

17) Chemistry – *Multiple Choice* For the reaction: CuCl(s)+I-(aq) is in equilibrium with CuI(s) + Cl-(aq), what is the equilibrium constant? Given that the solubility constant for CuCl and CuI is 1.9*10^-7, and 5.1*10^-12 respectively.

W) 8.4*10^-2
X) 2.3*10^-6
Y) 3.7*10^4
Z) 4.4*10^14

ANSWER: Y) 3.7*10^4

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TOSS-UP

18) Biology – *Multiple Choice* Which of the following enzymes is produced by eukaryotes, but not by prokaryotes?

W) DNA Polymerase
X) RNA Polymerase
Y) Peptidyl Transferase
Z) Telomerase

ANSWER: Z) TELOMERASE

BONUS

18) Biology – *Short Answer* Ulnar polydactyly is an autosomal dominant trait. In a population at Hardy-Weinberg equilibrium, the gene for polydactyly makes up 20% of the gene pool. What percentage of the population is heterozygous for the polydactyly gene?

ANSWER: 32%
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TOSS-UP

19) Earth and Space - *Short Answer* What is the vast, flat, and featureless bottom of parts of the ocean called?

ANSWER: ABYSSAL PLAIN

BONUS

19) Earth and Space - *Short Answer* Made of small pieces of clay and microscopic plankton shells, what layer covers the ocean floor, ranging from 0.6 to 2.5 kilometers in thickness?

ANSWER: PELAGIC SEDIMENT

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TOSS-UP

20) Math – *Short Answer* Given that a polynomial of degree 4 has roots $3 + \sqrt{23}$ and $7 - \sqrt{21}$, how many positive roots does it have?

ANSWER: 3

BONUS

20) Math – *Short Answer* What is the area of a triangle with sides of length 7, 8, and 11?

ANSWER: $2\sqrt{195}$
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TOSS-UP

21) Biology – *Short Answer* Chlorophyll b and carotenoids are classified as what and are found in photosynthetic organisms and work with chlorophyll a to expand the action spectrum of the organism?

ANSWER: ACCESSORY PIGMENTS

BONUS

21) Biology – *Short Answer* When ATP loses both phosphates to produce AMP, what other molecule is created with formula $P_2O_4^{-4}$

ANSWER: PYROPHOSPHATE

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TOSS-UP

22) Chemistry – *Multiple Choice* Which of the following reaction conditions would be least favorable thermodynamically?

W) Negative enthalpy, negative entropy
X) NegativeGibbs free energy
Y) Positive enthalpy, positive entropy
Z) Positive enthalpy, negative entropy

ANSWER: Z) POSITIVE ENTHALPY, NEGATIVE ENTROPY

BONUS

22) Chemistry – *Short Answer* Order the following 3 compounds from smallest to largest Van't Hoff factor: 1) Glucose; 2) Magnesium Oxide; 3) Sodium Sulfate

ANSWER: 1, 2, 3
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TOSS-UP

23) Energy – *Short Answer* Researchers as SLAC national laboratory are looking for a replacement of silicon chips in data storage. Silicon belongs to what general class of materials, characterized by a band gap of intermediate size?

ANSWER: SEMICONDUCTORS

BONUS

23) Energy – *Short Answer* Researchers at Ames laboratory are studying the cleavage of carbon-oxygen bonds in the hydroporation of esters and epoxides. What is the oxidation state of oxygen in these two functional groups?

ANSWER: –2