CSBL ROUND 2

TOSS-UP

1) Biology – *Multiple Choice* A typical precursor messenger RNA (pre-mRNA) that is spliced contains regions of exons and introns. Which portion of spliced pre-mRNAs is excised out?

W) Exon
X) PolyA Tail
Y) 5' Cap
Z) Intron

ANSWER: Z) Intron

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BONUS

1) Biology – *Short Answer* Identify all of the following that the spliceosome contains:

I - RNA
II - Proteins
III - DNA
IV - Carbohydrates

Answer: I and II

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TOSS-UP

2) Chemistry – *Short Answer* Giving your answer as a power of 10, what is the wavelength of a gamma ray?

ANSWER: -12

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BONUS

2) Chemistry – *Multiple Choice* A molecule which has an octahedral molecular geometry will have how many atoms attached to its central atom:

W) 4
X) 6
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Y) 8
Z) 10

ANSWER: X) 6

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TOSS-UP

3) Physics – *Multiple Choice* Which fundamental force is responsible for friction?

W) Gravity
X) Electromagnetic force
Y) Strong nuclear force
Z) Weak nuclear force

ANSWER: X) ELECTROMAGNETIC FORCE

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BONUS

3) Physics – *Multiple Choice* Photons are the carriers of the electromagnetic force, what is the spin of a photon?

W) 0
X) 1/2
Y) 1
Z) 3/2

ANSWER: Y) 1

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TOSS-UP

4) Earth and Space – *Short Answer* Identify ALL of the following minerals that are stronger than Fluorite on the Mohs Hardness Scale:

I. Calcite
II. Gypsum
III. Orthoclase
IV. Apatite

ANSWER: III AND IV (Fluorite = 4; Calcite = 3; Gypsum = 2; Orthoclase = 6; Apatite = 5)
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BONUS

4) Earth and Space – *Multiple Choice* Which of the following minerals has NO planes of cleavage?

W) Hornblende
X) Olivine
Y) Biotite
Z) Muscovite

ANSWER: X) OLIVINE

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TOSS-UP

5) Math – *Short Answer* How many degrees are in $\frac{\pi}{2}$ radians?

ANSWER: 90 DEGREES

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BONUS

5) Math – *Short Answer* If $0 \leq \theta \leq \pi$ and $\cos(\theta) = \sin(\theta)$, what is θ?

ANSWER: $\frac{\pi}{4}$ RADIANS

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TOSS-UP

6) Energy – *Multiple Choice* Scientists at SLAC National Accelerator Lab are studying the formation of semiconductors using 2D perovskites layered with other 2D materials. Which of the following is a good semiconductor?

W) Molybdenum
X) Vanadium
Y) Selenium
Z) Germanium

ANSWER: Z) GERMANIUM
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BONUS

6) Energy – *Short Answer:* Scientists at Thomas Jefferson Lab are studying proton-neutron interactions in Calcium-48. Calcium-48 is unique because it undergoes what extremely rare radioactive decay process?

ANSWER: DOUBLE BETA DECAY (DO NOT ACCEPT: BETA DECAY)

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TOSS-UP

7) Biology – *Multiple Choice* The ABO system of blood types concludes that there are the following blood types for individuals: A, B, AB, and O. What kind of inheritance is exhibited by ABO blood type determination?

W) Codominance
X) Dominant-Recessive
Y) Incomplete Dominance
Z) Sex-Linked

ANSWER: W) CODOMINANCE

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BONUS

7) Biology – *Short Answer* A boy named Tommy is born with the blood type of B. If Tommy's mother has an AB blood type, then which blood type, if any, can his father conclusively NOT have?

ANSWER: NONE

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TOSS-UP

8) Chemistry – *Short Answer* How many atoms are saturated carbons bound to in organic molecules?

ANSWER: 4

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BONUS

8) Chemistry – *Multiple Choice* How many hydrogens does the compound 3-methylpentane have?

W) 1
X) 5
Y) 14
Z) 21

ANSWER: Y) 14

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TOSS-UP

9) Physics – *Short Answer* What is the acceleration in the x-direction of a projectile launched at an angle of 30^{o} with initial velocity 20 m/s?

ANSWER: 0

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BONUS

9) Physics – *Short Answer* A projectile is launched off the ground at a 45 degree angle with initial velocity 15 m/s. Assuming g = 10 m/s^2, how far does it travel horizontally?

ANSWER: 22.5 METERS

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TOSS-UP

10) Earth and Space – *Multiple Choice* On the H-R Diagram, main sequence stars generally run between what two corners?

W) Top Left to Bottom Right
X) Top Right to Bottom Left

Y) Top Left to Bottom Left
Z) Top Right to Bottom Right

ANSWER: W) TOP LEFT TO BOTTOM RIGHT

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BONUS

10) Earth and Space – *Multiple Choice* The Chandrasekhar (**read as Chan-druh-Say-cur)** Limit is the Upper Limit for the mass of which of the following?

W) Neutron Star
X) Main Sequence Star
Y) Brown Dwarf
Z) White Dwarf

ANSWER: Z) WHITE DWARF

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TOSS-UP

11) Math – *Multiple Choice* Which of the following is NOT true of the parabola $y = x^2 - 5x + 6$

W) It opens up
X) It has a zero at x = 2
Y) It has a zero at x = 3
Z) Its vertex is at (5,6)

ANSWER: Z) ITS VERTEX IS AT (5,6)

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BONUS

11) Math – *Short Answer* Identify all of the following limits that go to 0.

I. $\lim_{x \to \infty} \left(\frac{x}{e^x}\right)$

II. $\lim_{x \to 0} (x)$

III. $\lim_{x \to 0} (\ln(x))$
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ANSWER: I AND II

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TOSS-UP

12) Energy – *Multiple Choice* Scientists at Argonne National Laboratory discovered three elements combined are a good superionic conductor. Which of the following sets of properties best describes superionic conductors?

W) High Ionic Conductivity and High Thermal Conductivity
X) High Ionic Conductivity and Low Thermal Conductivity
Y) Low Ionic Conductivity and High Thermal Conductivity
Z) Low Ionic Conductivity and Low Thermal Conductivity

ANSWER: X) HIGH IONIC CONDUCTIVITY AND LOW THERMAL CONDUCTIVITY

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BONUS

12) Energy – *Multiple Choice* The DOE reports what percent increase in the price of electricity from 2019 to 2020 in cents per kilowatt hour?

W) 1.2%
X) 1.5%
Y) 1.8%
Z) 2.0%

ANSWER: X) 1.5%

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TOSS-UP

13) Biology – *Short Answer* Plants need a variety of nutrients to survive and perform daily functioning tasks. For example, if plants lack magnesium, they will suffer from *chlorosis*. What color do the leaves of a plant turn when it suffers from *chlorosis*?

ANSWER: YELLOW

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BONUS

13) Biology – *Short Answer* Identify all of the following parts that are contained in a single carpel of a flowering plant: 1) Stigma, 2) Anther, 3) Ovule

ANSWER: 1 AND 3

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TOSS-UP

14) Chemistry – *Short Answer* What is the pH of a solution with pOH of 8?

ANSWER: 6

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BONUS

14) Chemistry – *Short Answer:* Identify all of the following which are strong electrolytes: 1) $HC_2H_3O_2$, 2) NaCl, 3) HF?

ANSWER: 2 ONLY

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TOSS-UP

15) Physics – *Short Answer* Identify all of the following forces present during freefall.

I. Gravity
II. Normal force
III. Friction

ANSWER: I ONLY

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BONUS

15) Physics – *Short Answer* A box starts at the origin, then is pulled to (4, 3), then to (5, 6), then back to the origin. What is the displacement of the box during this time?

ANSWER: 0

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TOSS-UP

16) Earth and Space – *Multiple Choice* Which of the following drainage patterns is most commonly found on volcanic cones?

W) Dendritic
X) Rectangular
Y) Radial
Z) Trellis

ANSWER: Y) RADIAL

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BONUS

16) Earth and Space – *Short Answer* What is the term for layers of till that are created by glacial deposition?

ANSWER: MORAINE (ACCEPT SPECIFIC TYPES OF MORAINE (EX: LATERAL, MEDIAL); DO NOT ACCEPT: OUTWASH PLAIN)

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TOSS-UP

17) Math – *Short Answer* It takes Amy 20 minutes to paint a fence, and it takes Kyle 30 minutes to paint the same fence. Working together, how long does it take them to paint the fence?

ANSWER: 12 MINUTES

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BONUS

17) Math – *Short Answer* When Joy leaves for school at 7:00 and drives at a constant speed of 40 mph, she arrives at 8:09. How far is her house from school?

ANSWER: 46 MILES

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TOSS-UP

18) Energy – *Multiple Choice* Researchers at the Pacific Northwest National Laboratory are trying to understand how a fundamental ubiquitous organic polymer is broken down by microbes. Which of the following polymers, which makes up the cell walls of fungi, are the researchers studying the catabolism of?

W) Glycogen
X) Amylopectin
Y) Chitin
Z) DNA

ANSWER: Y) CHITIN

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BONUS

18) Energy – *Multiple Choice* To determine the identity of Chitin catabolizing enzymes, researchers used chitin and non-chitin substances treated with the soil bacterium *C. japonicus*. By probing and enriching for involved proteins, the researchers could detect the protein's identities. Which of the following techniques would they have likely used to determine the protein identities?

W) X-Ray Crystallography
X) Mass Spectroscopy
Y) Western Blot
Z) Eastern Blot

ANSWER: X) MASS SPECTROSCOPY

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TOSS-UP

19) Biology – *Short Answer* Identify ALL of the following basic tissue systems that are present in plants: 1) Dermal tissue system, 2) Vascular Tissue System, 3) Ground Tissue System, 4) Xylem Tissue System

ANSWER: 1, 2, AND 3

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BONUS
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19) Biology – *Multiple Choice* What do primary and secondary growth do, respectively, in woody plants?

W) Germination; Budding
X) Lengthens roots and shoots; Budding
Y) Lengthens roots and shoots; increases diameter
Z) Germination; increases diameter

ANSWER: Y) LENGTHENS ROOTS AND SHOOTS; INCREASES DIAMETER

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TOSS-UP

20) Chemistry – *Multiple Choice* Which of these metals does NOT produce a reddish flame in a flame test?

W) Lithium
X) Strontium
Y) Cesium
Z) Rubidium

ANSWER: Y) CESIUM

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BONUS

20) Chemistry – *Short Answer* Carbon dioxide has a boiling point of -57° Celsius, whereas sulfur dioxide has a boiling point of -10° Celsius. This difference is most likely due to the fact that sulfur dioxide exhibits which intermolecular force, while carbon dioxide does not?

ANSWER: DIPOLE-DIPOLE (ALSO ACCEPT: DIPOLE FORCE)

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TOSS-UP

21) Physics – *Short Answer* A car is travelling in the positive x-direction at a constant speed of 20 m/s, while a train accelerates in the positive x-direction uniformly from rest at 5 m/s^2. Assuming the car and train start at the same location, how long will it take for the train to pass the car?

ANSWER: 8 s

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BONUS

21) Physics – *Short Answer* What is the work done on the train, which has a mass of 2,000,000 kg, during the first 8 seconds?

ANSWER: 1,600,000 kJ (ACCEPT: 1,600,000,000 J, 1.6 * 10^9 J)

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TOSS-UP

22) Earth and Space – *Multiple Choice* Which of the following best describes M87, which has the first black hole nucleus to be directly imaged?

W) Spiral
X) Elliptical
Y) Lenticular
Z) Irregular

ANSWER: X) ELLIPTICAL

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BONUS

22) Earth and Space – *Short Answer* Order the following steps during the formation of the universe:

I. Inflation
II. Recombination
III. Nucleosynthesis
IV. Singularity

ANSWER: IV, I, III, II

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TOSS-UP

23) Math – *Short Answer* What are the real roots of the function $f(x) = x^4 - 16$?

ANSWER: 2 AND -2

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BONUS

23) Math – *Short Answer* What are the vertical asymptote(s) of the function f(x) = $\frac{x}{x^2 - 9}$

ANSWER: x = 3 AND x = -3