ROUND 2

TOSS-UP

1) Math – *Short Answer* If 30% of 40 equals 20% of x, and x% of y equals 60, what is y?

ANSWER: 100

BONUS

1) Math – *Short Answer* Let S denote a set with 4 elements and P denote the set of all subsets of S. To the nearest ten thousand, how many subsets does P have?

ANSWER: 70,000

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TOSS-UP

2) Biology – *Short Answer* Which of the following amino acids are capable of forming disulfide bridges, contributing to the tertiary structure of a protein?

1) Proline
2) Glycine
3) Cysteine
4) Methionine

ANSWER: 3 ONLY

BONUS

2) Biology – *Short Answer* The diffusion of H+ ions down their electrochemical gradient into the cell drives the cellular uptake of sucrose in plant cells. Which of the following would decrease the rate of sucrose uptake in plant cells?

1) Increased extracellular pH
2) Decreased extracellular pH
3) Increased intracellular pH
4) Decreased intracellular pH

ANSWER: 1 AND 4
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TOSS-UP

3) Earth and Space – *Short Answer* What is the name of the scale that is used to measure intensity of tornadoes?

ANSWER: FUJITA SCALE [SP]

BONUS

3) Earth and Space – *Multiple Choice* A stream's capacity is a measure of which of the following?

W) Erosion rate
X) Water discharge rate
Y) Maximum transportable particle load
Z) Maximum transportable particle size

ANSWER: Y) MAXIMUM TRANSPORTABLE PARTICLE LOAD [SP]

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TOSS-UP

4) Physics – *Multiple Choice* The field inside a charged conducting shell is proportional to what value?

W) Distance from the center of the shell
X) Distance from the surface of the shell
Y) Mass of the shell
Z) The field is zero

ANSWER: Z) The field is zero

BONUS

4) Physics – *Short Answer* A 4-kilogram mass is attached to a 12-kilogram mass via a massless, ideal rod of length 3 meters. Given that the system is allowed to rotate about its center of mass, what is its moment of inertia in kilograms meters squared?

ANSWER: 27

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TOSS-UP

5) Chemistry – *Multiple Choice* What is the electron configuration of Iron 3?

W) [Ar] 3d5
X) [Ar] 4s1 3d4
Y) [Ar] 4s2 3d3
Z) [Ar] 3d6

Answer: W) [Ar] 3d5

BONUS

5) Chemistry -- *Short Answer* What is not a possible magnetic quantum number for an electron in ground state Iron 3?

W) -3
X) -2
Y) 1
Z) -1

Answer: W) -3

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TOSS-UP

6) Biology – *Short Answer* What structure found within the flagella acts as a molecular universal joint transmitting the torque produced by the basal body to the flagellar filament?

ANSWER: HOOK

BONUS

6) Biology – *Multiple Choice* Which of the following best defines an orthologous gene?

W) Genes which have been separated due to gene duplication events

X) Genes which have remained the same along an evolutionary lineage
Y) Genes which have been separated due to speciation
Z) Genes which share the same common ancestor, but have changed in function over time

ANSWER: Y) GENES WHICH HAVE BEEN SEPARATED DUE TO SPECIATION

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TOSS-UP

7) Earth and Space – *Short Answer* In some parts of the Sahara and Arabian deserts, sand dunes that are formed by variable wind directions are found. What is the name of this type of dune?

ANSWER: STAR DUNES [SP]

BONUS

7) Earth and Space – *Short Answer* Arrange the following three layers of the sun by increasing temperature: 1) Radiative zone; 2) Photosphere; 3) Corona

ANSWER: 2, 3, 1 [SP]

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TOSS-UP

8) Math – *Short Answer* What is the maximum area of a rectangle with perimeter 24?

ANSWER: 36

BONUS

8) Math – *Multiple Choice* What is the left endpoint Riemann sum with 4 subintervals of <u>f of x equals x squared</u> over the interval <u>0 to 2, inclusive</u>?
W) 13/4
X) 15/4
Y) 17/4
Z) 19/4

ANSWER: X) 15/4

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TOSS-UP

9) Chemistry -- *Multiple Choice* Which of the following compounds act as electrophiles?

W) NaOH
X) NH_3
Y) BF_3
Z) OH^-

ANSWER: Y) BF_3

BONUS

9) Chemistry – *Short Answer* [] Order the electron affinities of the following four elements from highest to lowest: 1) Oxygen; 2) Sulfur; 3) Selenium; 4) Tellurium.

ANSWER: 2, 3, 4, 1

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TOSS-UP

10) Physics – *Short Answer* Nuclear reactors often use water to cool fuel. What is the name of the radiation emitted by charged particles that go faster than the speed of light in a certain medium such as water?

ANSWER: Cherenkov Radiation

BONUS

10) Physics – *Short Answer* A capacitor of capacitance 67 farad is held with a voltage difference of 14 volts. How much charge is stored in the capacitor?

ANSWER: 938, 938 C

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TOSS-UP

11) Physics – *Short Answer* The speed of light is the fastest anything can go in the universe. When an incident light wave enters another medium, which of the following values remains constant?
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1) Frequency
2) Wavelength
3) Speed
4) Intensity

ANSWER: Frequency and Intensity, 1 and 4

BONUS

11) Physics – *Short Answer* Einstein demonstrated the particle nature of light and won his Nobel Prize in Physics using what principle?

ANSWER: Photoelectric Effect

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TOSS-UP

12) Biology – *Multiple Choice* Which of the following extremophiles are incorrectly matched to their environmental tolerances?

W) Osmophiles - high osmotic pressure
X) Piezophiles - low temperature
Y) Xerophiles - low humidity
Z) Radiophiles - high radiation

ANSWER: X) PIEZOPHILES - LOW TEMPERATURE

BONUS

12) Biology – *Short Answer* Which of the following factors do NOT affect the rate of reaction of an enzyme?

1) Temperature
2) pH
3) Substrate concentration
4) Enzyme concentration

ANSWER: NONE

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TOSS-UP

13) Earth and Space – *Short Answer* What area on the H-R diagram are variable stars found?

ANSWER: INSTABILITY STRIP [SP]

BONUS

13) Earth and Space – *Multiple Choice* Which of the following is closest to the period of a RR Lyrae variable?

W) 12 minutes
X) 12 hours
Y) 12 days
Z) 120 days

ANSWER: X) 12 HOURS [SP]

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TOSS-UP

14) Chemistry – *Short Answer* How many sigma bonds are in the molecule CH3CHCCHCH3?

Answer: 12

BONUS

14) Chemistry - *Short Answer:* How many sigma and pi bonds, respectively, are there in the chemical compound C_6H_{10}?

Answer: 14 Sigma bonds, 2 pi bonds

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TOSS-UP

15) Math – *Short Answer* What is the period of the function f of x equals cosine of 3 times x plus sine of 6 times x?

ANSWER: 2pi/3

BONUS

15) Math – *Short Answer* What is the term for the measure of the maximum rate of change of a function in any given direction?

ANSWER: Gradient

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TOSS-UP

16) Biology – *Short Answer* A new species arises as an allopolyploid from humans and chimpanzees, who have a diploid chromosome number of 48. What is the diploid number for the human-chimpanzee?

ANSWER: 94

BONUS

16) Biology – *Short Answer* Ravi waters his plants with hydrochloric acid, causing the soil pH to reach dangerously low levels, below 4. Toxic elements begin to dissolve in the soil due to heavily increased solubility at lower pHs stunting root growth, interfere with nutrient uptake, and cause crop failure. What is the main element responsible for this phenomenon?

ANSWER: ALUMINUM (ACCEPT: MANGANESE)

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TOSS-UP

17) Earth and Space – *Short Answer* What is the name of the small dark nebulae which are regions of star formation?

ANSWER: BOK GLOBULES [SP]

BONUS

17) Earth and Space – *Short Answer* Quasars are an example of extremely strong active galactic nuclei that we can detect here on earth. What is it called when a quasar's relativistic jet is angled towards us?

ANSWER: BLAZAR [SP]

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TOSS-UP
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18) Physics – *Short Answer* Order the following types of radiation in increasing wavelength: 1) Ultraviolet, 2) Gamma, 3) Microwave.

ANSWER: Gamma, Ultraviolet, Microwave, or 2, 1, 3

BONUS

18) Physics – *Multiple Choice* A cannon can shoot a projectile with a speed of 21 meters per second. What is the maximum range the projectile can reach if the projectile starts and lands at the same height?

W) 21 meters
X) 45 meters
Y) 90 meters
Z) 144 meters

ANSWER: X) 45 Meters

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TOSS-UP

19) Math – *Short Answer* A perfect number is a positive integer that equals the sum of its positive factors, excluding itself. Identify all of the following integers that are perfect numbers:

1) 6
2) 12
3) 28
4) 32

ANSWER: 1 and 3 ONLY

BONUS

19) Math – *Short Answer* Suppose x and y are positive reals such that $\frac{x}{y} + \frac{y}{x} = xy = 4$. Find the value of $x^3 + y^3$.

ANSWER: $24\sqrt{6}$

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TOSS-UP

20) Chemistry – *Short Answer* Identify all of the following 4 atoms that have unpaired electrons in their ground state electronic configuration: 1) Lithium 2) Oxygen 3) Barium 4) Gold.
Answer: 1,2, AND 4

BONUS

20) Chemistry – *Short Answer* Identify all of the following 4 ions that are isoelectronic to Vanadium 3+ 1) Titanium 2+ 2) Manganese 5+ 3) Iron 2+ 4) Chromium 2+
Answer: 1 & 2 Only

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