ROUND 11

TOSS-UP

1) Chemistry -- *Short Answer* Shlok was drinking too much diet coke which contains aspartame as an artificial sweetener. Aspartame is made of amino acids linked with what type of bonds?

Answer: Amide (Accept: Peptide)

BONUS

1) Chemistry -- *Short Answer* After completing the cinnamon challenge, Shlok inhaled one mole of cinnamaldehyde with an IUPAC name of 3-phenyl prop-2-enal. How many grams of cinnamaldehyde did he inhale to the nearest whole number

Answer: 109 grams

TOSS-UP

2) Physics – *Multiple Choice* The effect of electric fields inducing magnetic fields was initially missed by Faraday's experiments. This happened because the displacement current in slow moving currents is zero after what operation?

W) Gradient
X) Divergence
Y) Curl
Z) Laplacian

ANSWER: Y) Curl

BONUS

2) Physics – *Short Answer* Assume the speed of light is 5 meters per second. In an inertial frame, an electric field of magnitude 45 volts per meter pointing in the z direction and no magnetic field is observed. What is the magnitude of the magnetic field in the inertial frame moving 3 meters per second in the y direction relative to the original frame?

ANSWER: 6.75, 6.75 T

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TOSS-UP

3) Biology – *Multiple Choice* Which of the following cannot be true regarding a human cell containing 23 autosomes and a Y chromosome?

W) The cell may be either from or give rise to an individual with down syndrome
X) It could be an adipocyte
Y) The cell could be a sperm cell
Z) The cell is a product of euploidy

ANSWER: X) IT COULD BE AN ADIPOCYTE

BONUS

3) Biology – *Short Answer* Phospholipase C cleaves PIP2 into DAG and IP3, which binds to an IP3-gated calcium channel causing an influx of calcium from the ER. If Phospholipase C was missing in the human ovum, which of the following would NOT occur?

1) The cortical reaction would not occur
2) The secondary oocyte would remain arrested in metaphase II
3) The fast block to polyspermy would not occur
4) The slow block to polyspermy would not occur

ANSWER: 3

TOSS-UP

4) Earth and Space – *Short Answer* What is the name of the hypothetical future universe where the expansion of the universe overpowers all attractive forces?

ANSWER: THE BIG RIP [SW]

BONUS

4) Earth and Space – *Multiple Choice* Which of the following terms best describes a form of energy that possesses negative kinetic energy and predicts the Big Rip if it exists?

W) Dark Fluid
X) Quintessence
Y) Chameleon Particles

Z) Phantom Energy

ANSWER: Z) PHANTOM ENERGY [SW]

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5) Math – *Multiple Choice* If a sample has a mean of 30, median of 28, and a unique mode of 26, which of the following could describe the distribution of data values in the sample?
W) Unimodal and Symmetric
X) Bimodal and Right skewed
Y) Unimodal and Right skewed
Z) Unimodal and Left skewed

ANSWER: Y) Unimodal and Right skewed

BONUS

5) Math – *Short Answer* In 1908, William Gosset, a statistician and quality control inspector working for the Guinness brewing company realized that existing statistical techniques were not applicable to the small sample sizes he worked with. As a result, he developed what probability distribution that can be used for small sample sizes and approaches the normal distribution as the sample size increases?

ANSWER: t-distribution (ACCEPT: Student's t-distribution, Student's distribution, Gosset's t-distribution)

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TOSS-UP

6) Math – *Short Answer* What is the name of the solid generated by rotating the graph of open parenthesis x minus 6 close parenthesis squared plus y squared equals 25 around the y-axis?

ANSWER: Torus (ACCEPT: Toroid, Doughnut)

BONUS

6) Math – *Short Answer* A hypersphere is a higher dimensional generalization of the set of all points at a fixed distance from a central point. The volume of a six-dimensional hypersphere of radius *r* is pi cubed over 6 times r raised to the power of six. What is the surface area of a six-dimensional hypersphere with radius 2?

ANSWER: 32pi^3

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TOSS-UP

7) Earth and Space – *Short Answer* What is the name of the celestial object formed when an aging giant (star) expels its outer layers in a series of surges?

ANSWER: PLANETARY NEBULA [SP]

BONUS

7) Earth and Space – *Multiple Choice* Which of the following is the term for the region with stars and star clusters but no dust or gasses above or below the galactic plane?
W) Galactic Corona
X) Galactic Halo
Y) Central Bulge
Z) Disk Component

ANSWER: X) GALACTIC HALO [SP]

TOSS-UP

8) Biology – *Short Answer* Which of the following four hormones are not produced by the corpus luteum in the beginning weeks of pregnancy?

1) Progesterone
2) Estrogen
3) Relaxin
4) HCG

ANSWER: 4 ONLY, HCG

BONUS
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8) Biology – *Multiple Choice* Which of the following is not an essential amino acid in humans?

W) Threonine
X) Tyrosine
Y) Lysine
Z) Leucine

ANSWER: X) TYROSINE

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TOSS-UP

9) Physics – *Multiple Choice* The Taylor Expansion of any potential function near a minimum often shows what kind of relationship between potential and position?

W) Linear
X) Quadratic
Y) Cubic
Z) Exponential

ANSWER: X) QUADRATIC

BONUS

9) Physics – Short Answer Kevin measures the length of the wire to be 16 meters with an uncertainty of 0.4 meters. What is the uncertainty of the square root of the length?

ANSWER: 1/20 meters or 0.05 meters

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TOSS-UP

10) Chemistry – *Short Answer* After undergoing hydrobromation, 1 methyl-cyclohexene gets a hydroxide group attached to it. In what configuration is this hydroxide group relative to the methyl group?

ANSWER: Anti (Accept: Trans)

BONUS

10) Chemistry – *Short Answer* What is the precipitate that results from a permanganate ion getting reduced in acidic solution?

Answer: Manganese Dioxide

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TOSS-UP

11) Earth and Space – *Short Answer* Identify which of the following four minerals has a sheet-like silicate structure? 1) Biotite 2) Muscovite 3) Microcline 4) Talc

ANSWER: 1, 2, 4 [SW]

BONUS

11) Earth and Space – *Multiple Choice* Large, euhedral crystals of muscovite embedded in an igneous rock are indicative of which of the following environments?

W) Quick cooling time at high temperatures

X) Quick cooling time at low temperatures

Y) Slow cooling time at high temperatures

Z) Slow cooling time at low temperatures

ANSWER: Z [SW]

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TOSS-UP

12) Chemistry – *Short Answer* What is the first step that must occur in the conversion of 2-hexanol to 3 bromo hexane?

ANSWER: Proton Transfer

BONUS

12) Chemistry – *Multiple Choice* To get the Hoffman product in an E2 reaction, what type of reagent must be used?

W) Polar aprotic solvent
X) Ester
Y) Sterically hindered Base
Z) It is impossible to get a Hoffman product via E2

ANSWER: Y) Sterically hindered Base

TOSS-UP

13) Biology – *Short Answer* What additional 3rd lobe of the thyroid gland projects from the isthmus and is said to be present in up to half of the population?

ANSWER: PYRAMIDAL LOBE (ACCEPT: LOBE OF LALOUETTE)

BONUS

13) Biology – *Multiple Choice* What anatomical landmark separates the foregut which receives its blood supply from the celiac branch from the midgut which receives blood from the superior mesenteric artery?

ANSWER: MAJOR DUODENAL PAPILLA (ACCEPT: PAPILLA OF VATER)

TOSS-UP

14) Math – *Multiple Choice* Which of the following types of matrices are singular?
W) Orthogonal
X) Diagonal with non-zero entries
Y) Identity
Z) Non-invertible

ANSWER: Z) NON-INVERTABLE

BONUS

14) Math – *Short Answer* In graph theory, a connected graph is one where any two nodes are reachable by traversing the edges of the graph. For a graph of 6 nodes such that all pairs of nodes are connected by an edge, at most how many edges can be removed such that it remains connected?

ANSWER: 10

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TOSS-UP

15) Physics – *Multiple Choice* Assume the astronaut's mass is much less than the ISS' mass, which in turn is much smaller than Earth's mass. An astronaut's jumps out of the ISS, towards Earth. Which of the following will be the astronaut's fate? The space suit can keep the astronaut alive for a few hours in space.

W) Fall to Earth and burn up
X) Float away from Earth and die of asphyxiation
Y) Stay in Earth's orbit and die of radiation exposure
Z) Crash into the ISS and die on impact

ANSWER: Z) Crash into ISS and die on impact

BONUS

15) Physics – Short Answer The moment of inertia of a flat uniform equilateral triangle with side length x and mass m about the axis going through the center of mass and perpendicular to the plane of the triangle is I. The moment of inertia of the triangle about one of the vertices of the triangle is greater than I by what factor times x squared times m?

ANSWER: 1/3

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TOSS-UP

16) Math – *Short Answer* Mr. Rasco likes to use his random number generator to call on students in his AP Stats class. How many different ways are there for Mr. Rasco to call on two not necessarily distinct students of his twenty-student third period class if the order in which he calls on them does not matter?

ANSWER: 210

BONUS

16) Math – *Short Answer* Name all of the following four instances where the linearity of expectation for random variables holds:
1) The two random variables are independent
2) The two random variables are not independent
3) The covariance of the two random variables is zero
4) The covariance of the two random variables is nonzero

ANSWER: 1, 2, 3, 4 or ALL OF THEM

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TOSS-UP

17) Earth and Space – *Multiple Choice* In which geologic period did the Deccan Traps erupt?

W) Cretaceous
X) Permian
Y) Triassic
Z) Holocene

ANSWER: W) CRETACEOUS [SP]

BONUS

17) Earth and Space – *Short Answer* Star A has an absolute magnitude of 4, while star B has an absolute magnitude of -6. If star B's radius is five times that of star A, then to the nearest tenth, by what factor is star B's temperature larger than star A's temperature?

ANSWER: 4.5 [SP]

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TOSS-UP

18) Chemistry – *Short Answer* Order the following three compounds by increasing boiling point: 1) 1-methylcyclohexanol; 2) cyclohexanol; 3) *n*-heptanol.

ANSWER: 1, 2, 3

BONUS

18) Chemistry – *Short Answer* Identify all of the following three compounds that are aromatic: 1) Cyclopentadiene; 2) Pyridine; 3) Naphthalene.

ANSWER: 2 AND 3

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TOSS-UP

19) Physics – *Short Answer* Liquid water is poured into a fish tank. Initially, the water's temperature at the bottom and top of the tank is 4 degrees Celsius and 0 degrees Celsius, respectively. Choose all of the following four processes of how heat is transferred from the bottom of the tank to the top. 1) Convection, 2) Conduction, 3) Radiation

ANSWER: 1, 2 Only

BONUS

19) Physics – Short Answer A certain circular loop has a radius of 37 meters. A cart weighs 500 kilograms. Given that the cart can just barely reach the top of the loop, what is the normal force on the cart at the bottom of the loop?

ANSWER: 24,500, 24,500 N

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TOSS-UP

20) Biology – *Short Answer* Which neuroepithelial multiciliated and viliated glial cells line the brain’s ventricular system and spinal cord’s central canal?

ANSWER: EPENDYMAL CELLS

BONUS

20) Biology – *Multiple Choice* Ravi stared at the solar eclipse, burning the rods and cones in his eyes. What leading cause of preventable blindness is characterized by damage to the retina and can be caused by prolonged exposure to bright lights, such as a total solar eclipse not at totality?

ANSWER: RETINOPATHY (ACCEPT: SOLAR RETINOPATHY)