**2024 SMH Invitational Cup - ROUND ROBIN 5**

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**TOSSUP**

1) Biology – *Multiple Choice* In which of the following types of cells would you find the highest density of lysosomes?
W) neuron
X) epidermal cell
Y) macrophage
Z) cardiomyocyte

ANSWER: Y) macrophage [SO]

**BONUS**

1) Biology – *Short Answer* Identify all of the following three statements which are true of the nuclear envelope: 1) the nuclear lamina is a lipid bilayer, 2) the nuclear lamina is composed of actin microfilaments, 3) RNA is too large to pass through the nuclear envelope.

ANSWER: NONE [SO]

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**TOSSUP**

2) Chemistry – *Multiple Choice* A precipitation reaction is an example of which of the following types of reaction?
W) Single displacement
X) Double displacement
Y) Synthesis
Z) Decomposition

ANSWER: X) Double displacement [CZ]

**BONUS**

2) Chemistry – *Short Answer* Unlike other alkenes, a benzene ring is not very susceptible to hydrogenation. This stability is due to what property, often displayed in conjugated cyclic systems?

ANSWER: Aromaticity [CZ]

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**TOSSUP**

3) Physics – *Short Answer* What is the name for fluids with non-constant viscosities, such as ketchup and blood?

ANSWER: non-newtonian [SO]

**BONUS**

3) Physics – *Short Answer* What law states that the direction of current induced by a changing magnetic field is such that the total change in magnetic field is minimized?

ANSWER: Lenz's law (ACCEPT: Faraday's law) [SO]

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**TOSSUP**

4) Earth and Space – *Multiple Choice* Which of the following is NOT a way in which hurricanes can cause flooding?
W) Increased wind velocity
X) Increased rainfall
Y) Decreased local pressure
Z) Increased water density

ANSWER: Z) Increased water density [SO]

**BONUS**

4) Earth and Space – *Short Answer* Hornfels is a common indicator of the occurrence of what type of metamorphism?

ANSWER: Contact [PB]

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**TOSSUP**

5) Math – *Short Answer* Identify all of the following 3 quadrilaterals that must have at least one pair of parallel sides.
1) Rhombus
2) Kite
3) Trapezoid

ANSWER: 1, 3 [RG]

**BONUS**

5) Math – *Short Answer* A triangle has vertices at the points (1,3), (4,7), and (3,2). What are the coordinates of the centroid of the triangle?

ANSWER: (8/3, 4) [RG]

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**TOSSUP**

6) Biology – *Multiple Choice* Which of the following sequences is the start codon in eukaryotes?

W) UAG
X) GUA
Y) AUG
Z) AGU

ANSWER: Y) AUG [SO]

**BONUS**

6) Biology – *Short Answer* When gull chicks are presented with a red item, they instinctively pick at it. This is an example of what type of behavioral response, an innate response to a sign stimulus?

ANSWER: FIXED ACTION PATTERN [SO]

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**TOSSUP**

7) Chemistry – *Short Answer* Brønsted-Lowry acids and bases react through the exchange of what subatomic particle?

ANSWER: protons or H+ [CZ]

**BONUS**

7) Chemistry – *Multiple Choice* Metals, such as iron, corrode easily into oxides. This is due to what property?
W) High reduction potential
X) Low reduction potential
Y) High acidity
Z) Low acidity

ANSWER: X) Low reduction potential [CZ]

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**TOSSUP**

8) Physics – *Multiple Choice* A half-charged capacitor is put in a circuit with a resistor. Which of the following describes the charge on the capacitor as a function of time?
W) increasing and linear
X) decreasing and linear
Y) increasing and exponential
Z) decreasing and exponential

ANSWER: Z) decreasing and exponential [SO]

**BONUS**

8) Physics – *Short Answer* A 3-kilogram block and a 5-kilogram block are next to each other on a frictionless plane. A force with magnitude 4 newtons acts horizontally on the 3-kilogram block, pushing both blocks along the surface. What is the magnitude of the force exerted on the 5-kilogram block by the 3-kilogram block?

ANSWER: 2.5 [SO]

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**TOSSUP**

9) Earth and Space – *Multiple Choice* The magma which cooled to fill lunar maria had composition most similar to magma from which of the following locations on Earth?
W) Continental hot spot
X) Mid-ocean ridge
Y) Subduction zone
Z) Continent-continent convergent boundary

ANSWER: X) Mid-ocean ridge [SO]

**BONUS**

9) Earth and Space – *Short Answer* Identify all of the following three fusion reactions that take place in the Sun: 1) Proton-proton chain; 2) CNO cycle; 3) Triple alpha process.

ANSWER: 1 and 2 [PB]

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**TOSSUP**

10) Math – *Multiple Choice* The parabola y = x^2 is shifted 2 units to the right and 3 units up. Which of the following points is on the resulting parabola?
W) (1,0)
X) (2,2)
Y) (3,4)
Z) (4,6)

ANSWER: Y) (3,4) [RG]

**BONUS**

10) Math – *Short Answer* How many positive integer factors does 7! [read: 7 factorial] have?

ANSWER: 60 [RG]

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**TOSSUP**

11) Biology – *Multiple Choice* Two gametes with haploid number n equals 3 fertilize each other. After meiosis II has concluded, what are the number of daughter cells and the number of chromatids per daughter cell, respectively?

W) 2, 3
X) 2, 6
Y) 4, 3
Z) 4, 6

ANSWER: Y) 4, 3 [SO]

**BONUS**

11) Biology – *Short Answer* After homologous chromosomes separate from each other slightly during the latter half of Prophase I, points of crossing over become visible. What is the name for these locations, where chromosomes are physically linked?

ANSWER: chiasmata [SO]

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**TOSSUP**

12) Chemistry – *Multiple Choice* Which of the following best describes Bohr's model of the atom?
W) A diffuse sphere of positive charge with embedded electrons
X) Small solid spheres with no charge
Y) Electrons in discrete orbits around a small central nucleus
Z) A nucleus surrounded by electron waves

ANSWER: Y) Electrons in discrete orbits around a small central nucleus [CZ]

**BONUS**

12) Chemistry – *Short Answer* Katie, a metallurgist, is trying to convert 1 mole of Fe2O3 into pure iron metal. How many moles of electrons must Katie add to her Fe2O3 to do this?

ANSWER: 6 [SO]

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**TOSSUP**

13) Physics – *Short Answer* An object's position as a function of time is given by the equation x of t equals 5t - 2. In meters per second squared and to 1 significant figure, what is the acceleration of the object at t = 6?

ANSWER: 0 [SO]

**BONUS**

13) Physics – *Short Answer* Minghao generates a mechanical wave by flinging a string from one end. On his first try, Minghao flings the string up and down half a meter. On his second try, Minghao flings the string up and down an entire meter. What is the ratio of the intensity of the second wave to the intensity of the first wave?

ANSWER: 4:1 (ACCEPT: 4) [DL]

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**TOSSUP**

14) Earth and Space – *Short Answer* Pluto orbits around an external barycenter because it acts as one member of a binary system with what moon?

ANSWER: Charon [PB]

**BONUS**

14) Earth and Space – *Short Answer* Order the following three locations in a spiral galaxy in order of increasing average star metallicity.

1) Spiral Arms

2) Central Bulge
3) Halo

ANSWER: 321 [AS]

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**TOSSUP**

15) Math – *Multiple Choice* Which of the following shapes has the most lines of symmetry?
W) Kite
X) Square
Y) Regular pentagon
Z) Trapezoid

ANSWER: Y) Regular pentagon [CZ]

**BONUS**

15) Math – *Short Answer* A value in a data set that has more than 1 element is doubled. Identify all of the following 3 ways in which the standard deviation could change:
1) Increase
2) Decrease
3) Stay the same

ANSWER: ALL [RG]

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**TOSSUP**

16) Biology – *Multiple Choice* Which of the following statements is true about arteries and veins?
W) veins have valves, while arteries do not
X) the walls of veins are thicker than those of arteries

Y) all veins have lower O2 concentrations compared to arteries
Z) arteries have lower blood pressure than veins

ANSWER: W) veins have valves, while arteries do not [SO]

**BONUS**

16) Biology – *Short Answer* Order the following three chemical signallers by increasing molecular size: 1) aldosterone, 2) insulin, 3) carbon monoxide.

ANSWER: 312 [SO]

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**TOSSUP**

17) Chemistry – *Multiple Choice* Kavya is making fireworks and launches a yellow and red fireworks over the city. Salts of which of the following metals could she NOT be using?
W) Barium
X) Strontium
Y) Sodium
Z) Lithium

ANSWER: W) Barium [CZ]

**BONUS**

17) Chemistry – *Short Answer* Bradford assays use spectrophotometry to determine the concentration of proteins in a solution. What law do Bradford assays rely on to determine concentration?

ANSWER: Beer-Lambert law [CZ]

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**TOSSUP**

18) Physics – *Multiple Choice* Working in one-dimensional space, Phoebe places a point charge with charge 1 coulomb at the origin and another point charge with charge 4 coulombs at x equals 6. At which of the following values of x could a charge be placed such that it does not accelerate?
W) -2
X) 0
Y) 2
Z) 4

ANSWER: Y) 2 [SO]

**BONUS**

18) Physics – *Short Answer* Identify all of the following three descriptors that are accurate regarding the force exerted by an ideal spring: 1) obeys the inverse-square law, 2) nonconservative, 3) can cause simple harmonic motion.

ANSWER: 3 only [SO]

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**TOSSUP**

19) Earth and Space – *Multiple Choice* The conservation of angular momentum is logically equivalent to which of the following natural laws?
W) Newton's second law
X) Newton's third law
Y) Kepler's second law
Z) Kepler's third law

ANSWER: Y) Kepler's second law [PB]

**BONUS**

19) Earth and Space – *Short Answer* Identify all of the following three types of faults that are dip-slip faults: 1) normal, 2) reverse, 3) strike-slip.

ANSWER: 1 and 2 [SO]

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**TOSSUP**

20) Math – *Multiple Choice* Rohan is playing a bio-only science bowl packet and therefore guesses on every question. If he has a one-half probability of getting each question correct, which of the following distributions best represents the number of questions he got correct?

W) Normal

X) Poisson

Y) Uniform

Z) Binomial

ANSWER: Z) Binomial [RG]

**BONUS**

20) Math – *Short Answer* Identify all of the following 3 integers n such that n factorial is divisible by n+1: 1) 4, 2) 5, 3) 6.

ANSWER: 2 ONLY [RG]

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