

WISC Round 3

TOSS-UP

- 1) Physics – *Short Answer* What principle in fluid dynamics states that at points along a horizontal streamline, higher pressure regions have lower fluid speed and lower pressure regions have higher fluid speed? [SA]

ANSWER: BERNOULLI'S PRINCIPLE

BONUS

- 1) Physics – *Short Answer* Identify all of the following three statements that are true about Bernoulli's equation: 1) It implies that the sum of pressure and total energy density must be equal at all points in the flow; 2) It can be derived using the conservation of momentum; 3) The equation only works if we assume there are no dissipative forces. [SA]

ANSWER: 1 AND 3



TOSS-UP

- 2) Biology – *Short Answer* What ribosomal tRNA binding site carries the tRNA molecule that contains the next amino acid to be added to the polypeptide chain?

ANSWER: A SITE (ACCEPT: AMINOACYL SITE)

BONUS

- 2) Biology – *Short Answer* Order the following four parts of a C4 leaf from most to least interior: 1) Mesophyll; 2) Vascular tissue; 3) Bundle sheath; 4) Stomata.

ANSWER: 2, 3, 1, 4 (ACCEPT: VASCULAR TISSUE, BUNDLE SHEATH, MESOPHYLL, STOMATA)

TOSS-UP

3) Earth and Space – *Short Answer* What phenomenon causes the gas tail of a comet to point more directly away from the sun compared to the dust tail? [JI]

ANSWER: SOLAR WIND (DO NOT ACCEPT: WIND)

BONUS

3) Earth and Space – *Short Answer* What phenomenon occurs when light from a distant source passes by a massive, nearby object, distorting the light in the process? [JI]

ANSWER: GRAVITATIONAL LENSING

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**TOSS-UP**

4) Math – *Short Answer* Numbers a and b are multiplicative inverses. Given that the sum of their squares is 18, what is the absolute difference between a and b? [SA]

ANSWER: 4

**BONUS**

4) Math – *Short Answer* There are two numbers a and b such that  $ab = 2$  and  $a + b = 5$ . Find the value of  $a^3 + b^3$ . [SA]

ANSWER: 95

## **TOSS-UP**

5) Chemistry – *Multiple Choice* Under which of the following conditions will a reaction always be spontaneous? [SA]

- W) Negative change in enthalpy and negative change in entropy
- X) Negative change in enthalpy and positive change in entropy
- Y) Positive change in enthalpy and negative change in entropy
- Z) Positive change in enthalpy and positive change in entropy

ANSWER: X) Negative change in enthalpy and positive change in entropy

## **BONUS**

5) Chemistry – *Short Answer* A reaction has a standard change in Gibbs free energy of -12 kilojoules at 300 Kelvins. Assuming R is equal to 8 Joules per mole Kelvin, what is the exact value of the equilibrium constant? [SA]

ANSWER:  $e^5$



## **TOSS-UP**

6) Energy – *Short Answer* Researchers at Pacific Northwest National Lab have created two prominent software packages that can simulate the electronic structure of molecules. If an observed molecule has a square planar molecular geometry, what is the hybridization of the central atom of this molecule? [JI]

ANSWER: SP3D2 (ACCEPT: D2SP3)

## **BONUS**

6) Energy – *Short Answer* Researchers at Pacific Northwest National Lab have discovered that ettringite, a mineral found in cement, can be used to contain hazardous, nuclear waste. Ettringite belongs to what class of minerals, which also contains minerals such as anhydrite and gypsum? [JI]

ANSWER: SULFATES

## **TOSS-UP**

7) Physics – *Multiple Choice* An Atwood machine consists of what simple machine? [SA]

- W) Lever
- X) Wedge
- Y) Pulley
- Z) Inclined plane

ANSWER: Y) PULLEY

## **BONUS**

7) Physics – *Short Answer* Assuming the acceleration due to gravity is 10 meters per second squared, what is the tension in the frictionless rope of an Atwood machine that consists of a 4 kilogram mass on one side and a 6 kilogram mass on the other side? [AT]

ANSWER: 48 NEWTONS

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## **TOSS-UP**

8) Biology – *Short Answer* Water in a plant xylem is subjected to a negative pressure potential. What process that occurs in the leaves of the plant is responsible for this effect? [CJ]

ANSWER: TRANSPiration

## **BONUS**

8) Biology – *Multiple Choice* Which of the following is considered a multiple fruit? [CJ]

- W) Peas
- X) Raspberries
- Y) Pineapples
- Z) Lemons

ANSWER: Y) PINEAPPLES

## **TOSS-UP**

9) Earth and Space – *Multiple Choice* Which of the following is the term for the slow, gradual, downhill motion of soil over time on a gentle slope? [JI]

- W) Subsidence
- X) Creep
- Y) Landslide
- Z) Soil crawl

ANSWER: X) CREEP

## **BONUS**

9) Earth and Space – *Short Answer* Order the following three eons from earliest to latest: 1) Proterozoic; 2) Archean; 3) Phanerozoic. [JI]

ANSWER: 2, 1, 3 (ARCHEAN, PROTEROZOIC, PHANEROZOIC)



## **TOSS-UP**

10) Math – *Multiple Choice* Which of the following polynomials does NOT have a real root? [SA]

- W)  $x^2 - 12x + 30$
- X)  $x^2 - 10x + 24$
- Y)  $x^2 - 20x + 120$
- Z)  $x^2 - 24x + 144$

ANSWER: Y)  $x^2 - 20x + 120$

## **BONUS**

10) Math – *Short Answer* A basketball team currently has 40% win rate. If they win their next 10 games, their win rate goes up to 70%. How many games has the team played so far? [SA]

ANSWER: 10

## **TOSS-UP**

11) Chemistry – *Short Answer* By name or number, order the following three metals in terms of increasing reactivity: 1) Calcium; 2) Zinc; 3) Copper. [SA]

ANSWER: 3, 2, 1 (ACCEPT: COPPER, ZINC, CALCIUM)

## **BONUS**

11) Chemistry – *Multiple Choice* A Grignard reagent always contains which of the following elements? [JI]

- W) Lithium
- X) Magnesium
- Y) Iodine
- Z) Platinum

ANSWER: X) MAGNESIUM

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## **TOSS-UP**

12) Energy – *Short Answer* Researchers at Pacific Northwest National Lab are studying how connected moments in quantum computing may be used to help research in chemistry and material sciences. Quantum computers use what basic unit of quantum information? [JI]

ANSWER: QUBIT (ACCEPT: QUANTUM BIT)

## **BONUS**

12) Energy – *Multiple Choice* Scientists at Pacific Northwest National Lab are researching how to manage ecosystem restoration in order to maximize the efficiency and benefits of restoration projects. If such a project took place in a kelp forest ecosystem where much of the kelp has been eaten, changing the population of which of the following organisms would have the most desirable long term effect? [JI].

- W) Adding kelp
- X) Removing sea urchins
- Y) Adding sea otters
- Z) Removing sea snails

ANSWER: Y) ADDING SEA OTTERS

## **TOSS-UP**

13) Physics – *Short Answer* Identify all of the following four quantities that are scalars:  
1) Work; 2) Kinetic energy; 3) Power; 4) Torque. [AT]

ANSWER: 1, 2, AND 3

## **BONUS**

13) Physics – *Multiple Choice* A spherical concave mirror has a focal length of 10 centimeters. An object is placed 9 centimeters in front of it. Which of the following is true about the image of the object in the mirror? [AT]

- W) Real, upright, and larger than the object
- X) Real, inverted, and smaller than the object
- Y) Virtual, upright, and larger than the object
- Z) Real, inverted, and larger than the object

ANSWER: Z) REAL, INVERTED, AND LARGER THAN THE OBJECT

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## **TOSS-UP**

14) Biology – *Short Answer* What hormone, released by the walls of the stomach, stimulates the secretion of hydrochloric acid to form a solution that promotes digestion?

ANSWER: GASTRIN

## **BONUS**

14) Biology – *Multiple Choice* The genus Rhizopus, commonly known as the bread mold, is a part of which of the following major groups of fungi?

- W) Chytrids (Pronounce Kaitrids)
- X) Glomeromycetes
- Y) Zygomycetes
- Z) Ascomycetes

ANSWER: Y) ZYGOMYCETES

### **TOSS-UP**

15) Earth and Space – *Multiple Choice* What type of galaxy, denoted S0 (s-zero), is considered to be an intermediate between spiral and elliptical galaxies? [JI]

- W) Barred spiral
- X) Irregular
- Y) Transition
- Z) Lenticular

ANSWER: Z) LENTICULAR

### **BONUS**

15) Earth and Space – *Short Answer* A glitch, or sudden change in rotational frequency, in a pulsar is thought to occur because of what phenomenon, which is a sudden adjustment in the crust of a neutron star? [JI]

ANSWER: STARQUAKE



### **TOSS-UP**

16) Math – *Short Answer* How far is each focus of the ellipse  $\frac{x^2}{16} + \frac{y^2}{25} = 1$  located from the center? [SA]

ANSWER: 3

### **BONUS**

16) Math – *Multiple Choice* Which of the following statements is incorrect about the hyperbola  $\frac{x^2}{25} - \frac{y^2}{144} = 1$ ? [SA]

- W) The length of the transverse axis is 10.
- X) The distance between the foci is 26.
- Y) One of the asymptotes has slope 5/12.
- Z) The absolute distance between a focus and its closest vertex is 8.

ANSWER: Y) ONE OF THE ASYMPTOTES HAS SLOPE 5/12.

## **TOSS-UP**

17) Chemistry – *Short Answer* What is the principal quantum number of a valence electron in a ground state calcium atom? [JI]

ANSWER: 4

## **BONUS**

17) Chemistry – *Multiple Choice* What is the bond order of the sulfur-oxygen bond in the sulfite ion? [JI]

- W) 1
- X) 4/3
- Y) 3/2
- Z) 5/3

ANSWER: X) 4/3

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## **TOSS-UP**

18) Energy – *Short Answer* Scientists at INRS are studying what carbon allotrope that consists of a monolayer of atoms arranged in a hexagonal honeycomb lattice and is highly electrically conductive? [SA]

ANSWER: GRAPHENE (DO NOT ACCEPT: GRAPHITE)

## **BONUS**

18) Energy – *Multiple Choice* Scientists at INRS are trying to modify graphene to create a bandgap in it. Which of the following statements is incorrect regarding bandgaps? [SA]

- W) Insulators have the largest bandgaps.
- X) Bandgap is the energy difference between the valence band and the conduction band.
- Y) Tin has a larger bandgap than silicon.
- Z) Antibonding orbitals form the conduction band.

ANSWER: Y) TIN HAS A LARGER BANDGAP THAN SILICON.

## **TOSS-UP**

19) Physics – *Short Answer* Captain Falcon and Sonic line up for a race. When the signal is given, Captain Falcon speeds off at 15 meters per second, and Sonic goes at a leisurely acceleration of 5 meters per second squared. After how long will Captain Falcon and Sonic meet again? [AT]

ANSWER: 6 SECONDS

## **BONUS**

19) Physics – *Multiple Choice* A 1 kilogram ball is held in the air by two strings connected to the ceiling, each one making a 60 degree angle with the ceiling. If one of the strings is removed and the system is allowed to come to equilibrium, the tension in the remaining string increases by approximately how many newtons? [SA]

- W) 4.1
- X) 4.9
- Y) 5.7
- Z) 6.5

ANSWER: W) 4.1



## **TOSS-UP**

20) Biology – *Multiple Choice* Which of the following disorders is NOT autoimmune?

- W) Myasthenia gravis
- X) Rheumatoid arthritis
- Y) Type 2 Diabetes
- Z) Vasculitis

ANSWER: Y) TYPE 2 DIABETES

## **BONUS**

20) Biology – *Short Answer* Order the following three regions by increasing carbon dioxide concentration per unit volume: 1) The atmosphere; 2) Pulmonary arteries; 3) Alveolar spaces.

ANSWER: 1, 3, 2 (THE ATMOSPHERE, ALVEOLAR SPACES, PULMONARY ARTERIES)

### **TOSS-UP**

21) Earth and Space – *Multiple Choice* Which of the following types of faults is responsible for the creation of horst and graben terrain? [JI]

- W) Reverse
- X) Transform
- Y) Normal
- Z) Convergent

ANSWER: Y) NORMAL

### **BONUS**

21) Earth and Space – *Short Answer* What term refers to the collection of rock fragments and debris that accumulates at the base of a cliff or mountain? [JI]

ANSWER: SCREE (ACCEPT: TALUS, COLLUVIUM)



### **TOSS-UP**

22) Math – *Multiple Choice* A number x has its digits reversed, and let this new number be y. If the absolute difference between x and y is 54, then which of the following could be x? [SA]

- W) 17
- X) 83
- Y) 92
- Z) 47

ANSWER: W) 17

### **BONUS**

22) Math – *Short Answer* A triangle has all integer side lengths. Given that two of the side lengths are the two largest perfect cubes under 100, how many possible integer values can the third side length take? [SA]

ANSWER: 53

### **TOSS-UP**

23) Chemistry – *Multiple Choice* Beer's law states that the absorbance of a solution is proportional to its molar absorptivity, path length, and what other property? [JI]

- W) Temperature
- X) Volume
- Y) Density
- Z) Concentration

ANSWER: Z) CONCENTRATION

### **BONUS**

23) Chemistry – *Short Answer* To the nearest whole number, how many grams of water are produced in the complete combustion of 8 grams of methane? [JI]

ANSWER: 18 GRAMS