Round 4

TOSSUP

1) BIOLOGY *Short Answer* Name this organ which contains nephrons which may be classified as either juxtamedullary or cortical.

ANSWER: KIDNEY

BONUS

1) BIOLOGY *Short Answer* Which of the following bones is not located in the human wrist?

W) Scaphoid bone
X) Sphenoid bone
Y) Lunate bone
Z) Trapezium bone

ANSWER: X) SPHENOID BONE

TOSSUP

2) CHEMISTRY *Multiple Choice* The activity series of the chemical elements is experimentally derived through observations of which of the following?

W) Solubility in water
X) Electronegativity
Y) Specific gravity
Z) Reduction potential

ANSWER: Z) REDUCTION POTENTIAL

BONUS

2) CHEMISTRY *Short Answer* The standard reduction potential of what element's electrode is defined to be zero at all temperatures?

ANSWER: HYDROGEN (ACCEPT: H)

TOSSUP

3) MATH *Multiple Choice* In how many ways can Safi choose 4 of his 8 friends to give a single AirPod to each?

W) 24
X) 70
Y) 252
Z) 1680

ANSWER: X) 70

BONUS

3) MATH *Short Answer* How many people must be in a room to ensure that at least two of them have the same birthday? Assume it is not a leap year.

ANSWER: 366

TOSSUP

4) EARTH AND SPACE *Multiple Choice* Which of these is not a type of rock?

W) Metamorphic
X) Sedimentary
Y) Igneous
Z) Cyleptic

ANSWER: Z) CYLEPTIC

BONUS

4) EARTH AND SPACE *Multiple Choice* Which of the following minerals is not associated with the correct rating on Mohs scale of hardness?

W) Quartz - 7
X) Calcite - 3
Y) Corundum - 9
Z) Fluorite - 5

ANSWER: Z) FLUORITE - 5

TOSSUP

5) PHYSICS *Short Answer* What term describes the final speed of an object free falling once resistance prevents further acceleration?

ANSWER: TERMINAL VELOCITY

BONUS

5) PHYSICS *Short Answer* A block of mass 2 kg is initially at rest at the top of an inclined plane which makes an angle of 30 degrees to the horizontal and is 5 feet tall. The block then slides down the ramp. Assuming no friction and the magnitude of g is 10 meters per second squared, what is the magnitude of the force that pulls the block down the ramp?

ANSWER: 10 N

TOSSUP

6) ENERGY *Multiple Choice* Which of the following is the correct reason that car exhaust contains nitrogen oxides?

W) Gasoline contains nitrogen impurities.
X) The high temperatures cause nitrogen gas to react with oxygen gas.
Y) Organic matter gets caught in the engine.
Z) Car exhaust does not actually contain any nitrogen oxides.

Answer: X) THE HIGH TEMPERATURES CAUSE NITROGEN GAS TO REACT WITH OXYGEN GAS

BONUS

6) ENERGY *Multiple Choice* Which of the following is the correct explanation for why element burning in stars cannot produce elements heavier than iron?

W) More energy goes into making elements heavier than iron than is released.
X) No star possesses enough gravity to produce iron.
Y) Any star that has enough mass to produce heavier elements does not live long enough.
Z) Iron has the lowest binding energy per nucleon of all the elements.

Answer: W) MORE ENERGY GOES INTO MAKING ELEMENTS HEAVIER THAN IRON THAN IS RELEASED.

TOSSUP

7) CHEMISTRY *Short Answer* Gibbs free energy is directly related to enthalpy and which other thermodynamic quantity that measures the level of disorder in a system?

ANSWER: ENTROPY

BONUS

7) CHEMISTRY *Multiple Choice* Which of the following represents the equation for Gibbs Free Energy?

W) $\Delta G = \Delta H - T\Delta S$ (PRONOUNCE: DELTA G EQUALS DELTA H MINUS T DELTA S)
X) $\Delta G = T\Delta S - 2\Delta H$
Y) $\Delta G = \Delta H*T - \Delta S$
Z) $\Delta G = (\Delta H*T*\Delta S)/2$

ANSWER: W) $\Delta G = \Delta H - T\Delta S$

TOSSUP

8) BIOLOGY *Multiple Choice* Which of the following animals is believed to have existed earliest?

W) Bats
X) Elephants
Y) Giant tortoise
Z) Jawless fish

ANSWER: Z) JAWLESS FISH

BONUS

8) BIOLOGY *Multiple Choice* Which of the following plasmid DNA sequences is palindromic? (READ SLOWLY)

W) 5' (READ: FIVE PRIME) - CTTGCGTA - 3' (READ: THREE PRIME)
X) 5' - ATGAAGTA - 3'
Y) 5' - CTAGCTAG - 3'
Z) 5' - CATGGTAC - 3'

ANSWER: Y) 5' - CTAGCTAG - 3'

TOSSUP

9) PHYSICS *Multiple Choice* Which of the following is not a Hadron?

W) pion
X) neutron
Y) neutrino
Z) hyperon

ANSWER: Y) NEUTRINO

BONUS

9) PHYSICS *Multiple Choice* The position of a ball thrown up can be modeled by the equation $x(m) = -3t^2 +6t +2$ = (READ: NEGATIVE THREE T SQUARED PLUS 6 T PLUS TWO). What is its velocity after 1 second?

W) 2 m/s
X) -1 m/s
Y) 1 m/s
Z) 0 m/s

ANSWER: Z) 0 METERS PER SECOND

TOSSUP

10) MATH *Short Answer* Define the n-tornado to be the product of the first n primes. What is the value of the 4-tornado divided by the 2-tornado?

ANSWER: 35

BONUS

10) MATH *Short Answer* 3 coins are flipped simultaneously. What is the probability that two of the coins show heads and the other shows tails?

ANSWER: 3/8

TOSSUP

11) EARTH AND SPACE *Short Answer* Name the galaxy which contains the most recently imaged black hole.

ANSWER: MESSIER 87 (ACCEPT: M87)

BONUS

11) EARTH AND SPACE *Multiple Choice* Which of the following statements is true for Saturn and Jupiter?

W) Both rotate faster than the Earth.
X) Both rotate slower than the Earth.
Y) Their periods of rotation are linked to their period of revolution.
Z) Only one rotates rapidly while the other rotates very slowly.

ANSWER: W) BOTH ROTATE FASTER THAN THE EARTH.

TOSSUP

12) BIOLOGY *Multiple Choice* Which of the following is not a function of smooth endoplasmic reticulum?

W) Toxin degradation in the liver
X) Calcium ion storage
Y) Hormone synthesis in brain cells
Z) Hemoglobin synthesis

ANSWER: Z) HEMOGLOBIN SYNTHESIS

BONUS

12) BIOLOGY *Multiple Choice* Which of the following cells certainly does not have plasmodesmata?

W) A fish cell
X) A flower cell
Y) An algal cell
Z) A tree cell

ANSWER: W) A FISH CELL

TOSSUP

13) ENERGY *Short Answer* What are all the products of a hydrogen fuel cell?

ANSWER: WATER, HEAT, ELECTRICITY

BONUS

13) ENERGY *Short Answer* What term refers to the semipermeable membrane that acts as an electrical insulator and is placed between hydrogen and oxygen gas in the fuel cell?

ANSWER: PROTON-EXCHANGE MEMBRANE (ACCEPT: POLYMER-ELECTROLYTE MEMBRANE)

TOSSUP

14) CHEMISTRY *Multiple Choice* Which of the following molecules has a bond order of 2?

W) B_2
X) N_2
Y) O_2
Z) F_2

ANSWER: Y) O_2

BONUS

14) CHEMISTRY *Short Answer* Assuming that the atomic mass of carbon is 12, hydrogen is 1, and oxygen in 16, find the percent by mass of carbon in glucose.

ANSWER: 40%

TOSSUP

15) PHYSICS *Multiple Choice* Young's and Davisson-Germer's double slit experiments BEST shows which quantum phenomenon?

W) Heisenberg uncertainty
X) Particle nature of light
Y) Quantum tunneling
Z) Wave nature of light

ANSWER: Z) WAVE NATURE OF LIGHT

BONUS

15) PHYSICS *Short Choice* A ball is thrown horizontally off a cliff at 5 m/s. At the same time, another ball is dropped off a cliff of equal height but 15 meters away from the first. After how many seconds will the two balls hit each other?

ANSWER: 3 SECONDS

TOSSUP

16) BIOLOGY *Short Answer* The transfer of atoms of this element to oxygen in the process of cellular respiration results in a release of energy.

ANSWER: HYDROGEN

BONUS

16) BIOLOGY *Multiple Choice* What is the final electron acceptor in the process of cellular respiration in mammals?

W) Oxygen
X) Nitrogen
Y) Carbon
Z) Hydrogen

ANSWER: W) OXYGEN

TOSSUP

17) ENERGY *Multiple Choice* A solid copper sphere has a total charge of plus one Coulomb. Where on the sphere does the charge reside?

W) The charge is evenly spread throughout the sphere
X) The charge is at the center of the sphere
Y) The charge is on the outer surface of the sphere
Z) The charge lies outside of the sphere

Answer: Y) The charge is on the outer surface of the sphere

BONUS

17) ENERGY *Short Answer* Which of the following devices is the most efficient at energy conversion?

W) Fluorescent light
X) Incandescent light
Y) Fuel cell
Z) Internal combustion engine

Answer: Y) Fuel cell

TOSSUP

18) EARTH AND SPACE *Multiple Choice* Which of the following is not a layer of the atmosphere?

W) Exosphere
X) Thermosphere
Y) Endosphere
Z) Mesosphere

ANSWER: Y) ENDOSPHERE

BONUS

18) EARTH AND SPACE *Short Answer* Name all of the following statements about the atmosphere that are correct.

1) Most meteors burn up in the thermosphere.
2) Airplanes fly in the stratosphere.
3) Most weather occurs in the mesosphere.
4) As altitude increases, the temperature decreases in the mesosphere.

ANSWER: 2 and 4

TOSSUP

19) MATH *Short Answer* Find the second derivative of the equation $f(x) = 5x^4 + 3x^2 + 5$

ANSWER: $60x^2 + 6$

BONUS

19) MATH *Multiple Choice* Which of the following regular polygons has an interior angle measure not divisible by 5?

W) Square
X) Regular Pentagon
Y) Regular Hexagon
Z) Regular Octagon

ANSWER: X) REGULAR PENTAGON

TOSSUP

20) CHEMISTRY *Short Answer* What is the VSEPR (Pronounced “Vesper”) shape for methane?

ANSWER: TETRAHEDRAL (ACCEPT: TETRAHEDRON OR EQUIVALENTS)

BONUS

20) CHEMISTRY *Multiple Choice* Which of the following could not be a molecular geometry of a molecule with lone pair electrons?

W)Trigonal Pyramidal
X) Square Planar
Y) Square Pyramidal
Z) Trigonal Bipyramidal

ANSWER: Z) TRIGONAL BIPYRAMIDAL

TOSSUP

21) MATH *Multiple Choice* If the first day of a month is on a Tuesday and the month has 30 days, on what day will the last day of the month be?

W) Monday
X) Tuesday
Y) Wednesday
Z) Friday

ANSWER: Y) WEDNESDAY

BONUS

21) MATH *Short Answer* What is the orthocenter of a triangle with vertices at (0, 6), (4, 6), and (1, 3)?

ANSWER: (1, 5)

TOSSUP

22) PHYSICS *Short Answer* Which law of thermodynamic states that if two thermodynamic systems are in thermal equilibrium with a third, then they are in thermal equilibrium with each other?

ANSWER: ZEROTH LAW OF THERMODYNAMICS

BONUS

22) PHYSICS *Short Answer* Name the three identities of an image produced by an object at two times the focus distance of a converging lens.

ANSWER: REAL, INVERTED, AND SAME SIZE

TOSSUP

23) EARTH AND SPACE *Short Answer* What is the result of upwelling, the replacement of outgoing surface water with colder underlying water, in terms of change in primary productivity?

ANSWER: INCREASED PRIMARY PRODUCTIVITY

BONUS

23) EARTH AND SPACE *Multiple Choice* In which zone of the ocean is the amount of light insufficient for organisms to perform photosynthesis?

W) Photic zone
X) Intertidal zone
Y) Profundal zone
Z) Aphotic zone

ANSWER: Z) APHOTIC ZONE