BASIS PEORIA SCIENCE BOWL

DOUBLE ELIMINATION ROUND 6

TOSS-UP

1) Biology – *Multiple Choice* Which of the following hormones is not secreted by the anterior pituitary gland?

W) Thyroid - stimulating hormone
X) Prolactin
Y) Antidiuretic hormone
Z) Follicle - stimulating hormone

ANSWER: Y) Antidiuretic hormone

BONUS

1) Biology – *Short Answer* What pituitary hormone stimulates the adrenal cortex to produce cortisol in response to stress?

ANSWER: Adrenocorticotropic hormone (ACTH)

TOSS-UP

2) Chemistry – *Short Answer* What is the oxidation state of carbon in carbon monoxide?

ANSWER: +2

BONUS

2) Chemistry – *Short Answer* What are the formal charges of carbon and oxygen respectively in carbon monoxide?

ANSWER: -1, +1

TOSS-UP

3) Physics – *Short Answer* What is the value of the electric field at the center of a ring of uniform charge density?

ANSWER: ZERO

BONUS

3) Physics – *Short Answer* Find the total capacitance of three 10 Farad capacitors connected in series.

ANSWER: 10/3 (ACCEPT: 3.33)

TOSS-UP

4) Math – *Multiple Choice* What is the term for the type of asymptote found in a hyperbola, where the asymptote is parallel to neither the x or y axis?

ANSWER: OBLIQUE ASYMPTOTE (ACCEPT: SLANT ASYMPTOTE)

BONUS

4) Math – *Short Answer* A sphere's radius is increasing at a rate of 2 cm/sec. In terms of pi and in centimeters cubed per second, how fast is the sphere's volume increasing when the radius is 3 cm?

ANSWER: 72π cm^3/sec

TOSS-UP

5) Earth and Space – *Short Answer* What spectral class of stars is unique due to the extremely high carbon-to-oxygen ratio in their envelopes?

ANSWER: C (ACCEPT: CARBON STARS)

BONUS

5) Earth and Space – *Short Answer* What class of supergiant stars is characterized by their very high surface temperatures and relative stability compared to other supergiant stars?

ANSWER: WOLF-RAYET STARS

TOSS-UP

6) Energy – *Short Answer* In fuel cells, what particle passes from the anode to the cathode?

ANSWER: Proton

BONUS

6) Energy – *Multiple Choice* What is the approximate electrical efficiency of a Proton Exchange Membrane Fuel Cell?

W) 20%
X) 30%
Y) 40%
Z) 50%

ANSWER: Z) 50%

TOSS-UP

7) Biology – *Short Answer* What is the name for the system that divides the cerebral cortex into 52 regions based on cytoarchitectonic differences.

ANSWER: Brodmann areas

BONUS

7) Biology – *Short Answer* Provide the name for Brodmann area 22, which contains motor neurons that are responsible for the comprehension of speech.

ANSWER: Wernicke's area

TOSS-UP

8) Chemistry – *Short Answer* What term is used to describe cyclic and planar organic compounds such as benzene which contain a system of delocalized pi electrons?

ANSWER: AROMATIC

BONUS

8) Chemistry – *Short Answer* Answer the following questions about benzene.

A) How many pi electrons are in benzene?
B) What is the bond order of the C-C bonds in benzene?

ANSWER: 6, 1.5

TOSS-UP

9) Physics – *Multiple Choice* Which of the following best describes Gauss's Law of Magnetism?

W) The electric flux through a closed surface is proportional to the enclosed charge.
X) The electromotive force in a closed path is equal to the negative of the change in magnetic flux inside the path.
Y) Magnetic monopoles do not exist.
Z) The line integral of a magnetic field over a closed loop is proportional to the current inside the loop.

ANSWER: Y

BONUS

9) Physics – *Multiple Choice* Answer the following questions about units. A) What are the units of magnetic flux? B) What are the units of inductance? C) What are the units of dipole moment?

ANSWER: A) Weber B) Henry C) Debye

TOSS-UP

10) Math – *Multiple Choice* Which of the following is a three-dimensional coordinate system that specifies point positions by the distance from a chosen reference axis, the direction from the axis relative to a chosen reference direction, and the distance from a chosen reference plane perpendicular to the axis?

W) Cylindrical coordinates
X) Spherical coordinates
Y) Cartesian coordinates
Z) Curvilinear coordinates

ANSWER: W) CYLINDRICAL COORDINATES

BONUS

10) Math – *Multiple Choice* Assuming that $\sin(37) = \frac{3}{5}$ and $\cos(37) = \frac{4}{5}$, convert the cylindrical coordinate $(5, 37^{o}, 6)$ to Cartesian coordinates.

ANSWER: (4, 3, 6)

TOSS-UP

11) Earth and Space – *Short Answer* A spectral line of a galaxy is emitted with a wavelength of 100 nm. A telescope on Earth measures the wavelength of the line to be 140 nm. What is the redshift of this galaxy?

ANSWER: 0.4

BONUS

11) Earth and Space – *Short Answer* A certain galaxy cluster has a redshift $z = 0.01$. Assuming Hubble's constant to be 70 km/s/Mpc, what is the distance to the cluster in megaparsecs? Answer with two significant figures and assume that the cluster has no peculiar motion.

ANSWER: 43

TOSS-UP

12) Energy – *Multiple Choice* Which of the following would decrease the resistance of a wire

W) Increasing the length of the wire
X) Increasing the temperature of the wire
Y) Decreasing the radius of the wire
Z) Decreasing the length of the wire

ANSWER: Z) Decreasing the length of the wire

BONUS

12) Energy – *Short Answer* Three resistors are hooked up in a parallel circuit with resistances of 3, 4, and 6. Calculate the total resistance of the circuit rounded to the hundredths place

ANSWER: 1.33

TOSS-UP

13) Biology – *Multiple Choice* A serous membrane is a smooth tissue membrane consisting of 2 layers, a visceral membrane and a parietal membrane. What are these layers made up of?

W) Mesoderm
X) Ectoderm
Y) Neural crest
Z) Endoderm

ANSWER: W) Mesoderm

BONUS

13) Biology – *Short Answer* Which serous membrane lines the abdominal cavity?

ANSWER: Peritoneum (Accept: Parietal peritoneum)

TOSS-UP

14) Chemistry – *Short Answer* What is the term for a chemical species such as BF3 which contains an empty orbital and thus has an affinity for an electron pair. The term was coined by famous chemist Gilbert N. Lewis.

ANSWER: LEWIS ACID

BONUS

14) Chemistry – *Short Answer* What is the term for a chemical product that is the product of direct addition between two or more distinct molecules. This product is often formed from the reaction of a lewis acid and lewis base.

ANSWER: ADDUCT

TOSS-UP

15) Physics – *Short Answer* A solenoid with a current of 3 A produces a magnetic field of 6 Teslas. What is the magnetic field strength when the solend receives a current of 12 A.

ANSWER: 24

BONUS

15) Physics – *Short Answer* What is the magnetic force on a point charge of 3 C moving at an angle of 30 degrees to a magnetic field of 60 Teslas?

ANSWER: 90

TOSS-UP

16) Math – *Multiple Choice* Which of the following is the term for a geometrical operation in which each vertice of a polygon or polyhedron is replaced with a corresponding edge or face?

W) Rectification
X) Duality
Y) Truncation
Z) Tessellation

ANSWER: Y) TRUNCATION

BONUS

16) Math – *Short Answer* An idealized soccer ball is in the shape of what Archimedean solid?

ANSWER: TRUNCATED ICOSAHEDRON

TOSS-UP

17) Earth and Space – *Multiple Choice* Kepler's second law is a direct consequence of what other law?

W) Conservation of energy
X) Conservation of angular momentum
Y) Newton's law of universal gravitation

Z) Newton's second law

ANSWER: X) CONSERVATION OF ANGULAR MOMENTUM

BONUS

17) Earth and Space – *Short Answer* Which ancient astronomer devised the original version of the modern apparent magnitude scale?

ANSWER: HIPPARCHUS

TOSS-UP

18) Energy – *Multiple Choice* Which of the following types of batteries uses sulfuric acid as one of its electrolytes?

W) Vanadium Redox
X) Zinc Bromide
Y) Polysulfide Bromide
Z) Lithium Ion

ANSWER: W) Vanadium Redox

BONUS

18) Energy – *Short Answer* In a flow battery, a difference in electric potential between the positive and negative end is created, which is known as cell voltage. What is the name of the equation used to calculate cell voltage?

ANSWER: Nernst Equation

TOSS-UP

19) Biology – *Multiple Choice* Where in the human brain is the pineal gland located?

W) Subthalamus
X) Thalamus
Y) Hypothalamus
Z) Epithalamus

ANSWER: Z) Epithalamus

BONUS

19) Biology – *Short Answer* The epithalamus is part of what larger structure deep in the brain, which includes the subthalamus, thalamus, epithalamus, and hypothalamus? This structure is one of the main secondary vesicles during early brain development.

ANSWER: Diencephalon

BONUS

20) Chemistry – *Short Answer* Answer the following questions about dimers.

A) In diborane, what special type of bond is found in the center of the molecule?
B) What compound of aluminum and chlorine commonly dimerizes?
C) What pericyclic organic reaction is the mechanism for dimerization of cyclopentadiene?

ANSWER: BENT BOND, Al2Cl6, Diels-Alder Reaction (ACCEPT 3c2e bond or BANANA BOND)

TOSS-UP

20) Chemistry – *Short Answer* What gaseous electronegative halogen can be found in the mineral cryolite?

ANSWER: Fluorine

TOSS-UP

21) Physics – *Short Answer* What type of product between charge velocity and magnetic field is used to find the direction of the magnetic force?

ANSWER: CROSS PRODUCT

BONUS

21) Physics – *Short Answer* Torque on a magnetic dipole in a magnetic field is equal to the cross product of the magnetic field and what property of the dipole?

ANSWER: DIPOLE MOMENT

TOSS-UP

22) Math – *Short Answer* What is the term for the algebraic technique used to convert a quadratic equation of the form $ax^2 + bx + c$ to the form $a(x - h)^2 + k$ for some values of h and k?

ANSWER: COMPLETING THE SQUARE

BONUS

22) Math – *Multiple Choice* Which of the following is the equation of the parabola with x-intercepts of 3 and -1 and a y-intercept of -6?

W) $y = 2x^2 - 4x - 6$
X) $y = x^2 - 2x - 3$
Y) $y = 2x^2 + 4x - 6$
Z) $y = x^2 + 2x$

ANSWER: W) $Y = 2X^2 - 4X - 6$

TOSS-UP

23) ESS– *Short Answer* The mineral aragonite is the crystalline form of what chemical compound?

ANSWER: CaCO3

BONUS

23) ESS– *Short Answer* The honey color of calcium carbonate comes from impurities of what ion?

ANSWER: Fe2+