CK ROUND 1

TOSS-UP

1) Chemistry – *Short Answer* Calcium carbide reacts with water to form calcium hydroxide and what gas?

ANSWER: ACETYLENE (ACCEPT: ETHYNE; C_2H_2)

BONUS

1) Chemistry – *Multiple Choice* An alkyne is treated with sodium metal in a solution of liquid ammonia. Which of the following products is most likely to form?

W) Alkane
X) Alcohol
Y) Cis-alkene
Z) Trans-alkene

ANSWER: Z) TRANS-ALKENE

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

2) Physics – *Multiple Choice* A 1000-kilogram car is traveling on a frictionless road at 20 meters per second to the right when it collides perfectly inelastically with a 2000-kilogram truck traveling 30 meters per second to the left. Which of the following statements is true regarding the collision?

W) Only momentum was conserved
X) Only kinetic energy was conserved
Y) Both kinetic energy and momentum were conserved
Z) Neither momentum nor kinetic energy were conserved

ANSWER: W) ONLY MOMENTUM WAS CONSERVED

BONUS

2) Physics – *Short Answer* Identify all of the following three changes that would increase the period of a pendulum's swing: 1) Increasing the length of the string; 2) Decreasing the mass of the bob; 3) Releasing the pendulum from a higher point.

ANSWER: 1 ONLY
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

3) Biology – *Short Answer* Adenylyl cyclase is an integral membrane protein activated by G-proteins to catalyze the formation of what molecule?

ANSWER: cAMP (ACCEPT: CYCLIC AMP)

BONUS

3) Biology – *Short Answer* Identify all of the following three cells types that are considered leukocytes: 1) Macrophages; 2) Lymphocytes; 3) Erythrocytes.

ANSWER: 1 AND 2

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

4) Math – *Short Answer* What is the x-intercept of the line with equation $3y - 2x = 8$?

ANSWER: $(-4, 0)$

BONUS

4) Math – *Short Answer* What is the volume in of a right circular cone with a diameter of 6 and a slant height of 5?

ANSWER: 12π
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

5) Earth and Space – *Multiple Choice* Which of the following locations could be a site of intraplate volcanism?

W) Yellowstone
X) Hawaii
Y) East African rift
Z) Andes Mountains

ANSWER: W) YELLOWSTONE

BONUS

5) Earth and Space – *Short Answer* What is the name for the region on an H-R diagram where Cepheid and other variable stars are located due to their tendency to pulsate?

ANSWER: INSTABILITY STRIP

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

6) Chemistry – *Multiple Choice* Which of the following is FALSE regarding black bodies?

W) The energy of radiation emitted by a black body is quantized
X) All black bodies preferentially absorb low-wavelength radiation
Y) The intensity of radiation emitted from a black body is proportional to the fourth power of its temperature
Z) Increasing the temperature of a black body shifts its maximum intensity to lower wavelengths

ANSWER: X) ALL BLACK BODIES PREFERENTIALLY ABSORB LOW-WAVELENGTH RADIATION

BONUS

6) Chemistry – *Short Answer* Both $AlCl_3$ and ICl_3 dimerize to form Al_2Cl_6 and I_2Cl_6, respectively. Identify all of the following three ways in which these latter structures differ: 1) Hybridization of central atoms; 2) Geometry of molecule; 3) Connectivity of atoms.

ANSWER: 1 AND 2
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

7) Math – *Short Answer* If $f(x) = 3x^2 - 2x + 5$, what is f prime of 3?

ANSWER: 16

BONUS

7) Math – *Short Answer* A fair coin is flipped five times. What is the probability that it does not land on heads once after all five tosses?

ANSWER: 1/32

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

8) Biology – *Multiple Choice* What is the name given to the tall vertical root found in vascular plants that is responsible for anchoring plants in the soil?

W) Primary root
X) Lateral root
Y) Rhizome
Z) Taproot

ANSWER: Z) TAPROOT

BONUS

8) Biology – *Short Answer* Identify all of the following three features that appear at some stage during the embryonic development of all chordates: 1) Dorsal nerve cord; 2) Post-anal tail; 3) Vertebral column.

ANSWER: 1 AND 2
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

9) Earth and Space – *Short Answer* When high-energy particles from the solar wind hit the Earth's atmosphere, they can become captured by the Earth's magnetic field. This results in the formation of what zones?

ANSWER: VAN ALLEN BELTS

BONUS

9) Earth and Space – *Multiple Choice* When moist air has an environmental lapse rate between 5 and 10 degrees Celsius per 1,000 meters, it is said to exhibit which of the following?

W) Absolute stability
X) Absolute instability
Y) Conditional instability
Z) Temperature inversion

ANSWER: Y) CONDITIONAL INSTABILITY

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

10) Physics – *Multiple Choice* What quantity is defined as the measure of how resistant to compression a substance is?

W) Young's modulus
X) Bulk modulus
Y) Shear modulus
Z) Reynold's number

ANSWER: X) BULK MODULUS

BONUS

10) Physics – *Short Answer* What thermodynamic state function is defined as the maximum useful work that can be obtained from a system under conditions of constant temperature and volume?

ANSWER: HELMHOLTZ FREE ENERGY
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

11) Biology – *Multiple Choice* Which of the following are homologous genes resulting from gene duplication?

W) Paralogous genes
X) Orthologous genes
Y) Divergent genes
Z) Xenologous genes

ANSWER: W) PARALOGOUS GENES

BONUS

11) Biology – *Short Answer* Identify all of the following three types of cell junctions that are present in animal cells: 1) Desmosomes; 2) Gap junctions; 3) Plasmodesmata.

ANSWER: 1 AND 2

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

12) Physics – *Short Answer* What is the time constant, in seconds, of an RC circuit consisting of two 3-ohm resistors in series with a 6-millifarad capacitor?

ANSWER: 0.036

BONUS

12) Physics – *Short Answer* Spin magnetic dipole moments of electrons are roughly equal to what physical constant?

ANSWER: BOHR MAGNETON
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

13) Chemistry – *Multiple Choice* Which of the following bonds has the smallest bond dissociation energy?

W) H-F
X) H-Cl
Y) H-Br
Z) H-I

ANSWER: Z) H-I

BONUS

13) Chemistry – *Short Answer* What is the change in the oxidation number of manganese when it is reduced to Mn^{2+} from permanganate in acidic solution?

ANSWER: –5

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

14) Math – *Short Answer* How many points of intersection are there between the curves of $y = x^2$ and $y =$ *e* to the *x*?

ANSWER: 1

BONUS

14) Math – *Short Answer* The radius of a sphere is increased by a factor of 3. If the surface area of the new sphere is now 108π, what was the original volume of the sphere?

ANSWER: 36π
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

15) Earth and Space – *Multiple Choice* Danish geologist Nicolaus Steno is credited with recognizing that the oldest strata form at the bottom of a sequence of sedimentary rocks. What is the name given to his discovery?

W) Principle of original horizontality
X) Principle of cross-cutting relationships
Y) Law of superposition
Z) Law of disconformity

ANSWER: Y) LAW OF SUPERPOSITION

BONUS

15) Earth and Space – *Short Answer* Main-sequence stars with masses greater than 1.1 times that of our Sun possess a high enough temperature to fuse hydrogen into helium using what process?

ANSWER: CNO CYCLE

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

16) Chemistry – *Short Answer* Order the following three functional groups in order of increasing pKa: 1) Carboxylic acid; 2) Ketone; 3) Alcohol.

ANSWER: 1, 3, 2

BONUS

16) Chemistry – *Multiple Choice* Which of the following statements is true regarding azeotropes?

W) Positive azeotropes boil at lower temperatures than either of their constituents
X) Positive azeotropes result from more favorable intermolecular interactions
Y) Azeotropes can be separated using fractional distillation
Z) A 96% ethanol and 4% water solution forms a negative azeotrope

ANSWER: W) POSITIVE AZEOTROPES BOIL AT LOWER TEMPERATURES THAN EITHER OF THEIR CONSTITUENTS
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

17) Physics – *Short Answer* Identify all of the following three waves that are considered longitudinal: 1) Electromagnetic waves; 2) Sound waves; 3) Seismic P-waves.

ANSWER: 2 AND 3

BONUS

17) Physics – *Multiple Choice* Regions in a crystal where the alignment of atomic dipoles is uniform are called which of the following?

W) Magnetic zones
X) Magnetic domains
Y) Curie regions
Z) Gaussian belts

ANSWER: X) MAGNETIC DOMAINS

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

18) Biology – *Multiple Choice* Which of the following types of microscopy uses ultra-thin specimens to study the internal structure of cells?

W) Scanning electron microscopy
X) Transmission electron microscopy
Y) Fluorescence microscopy
Z) Super-resolution microscopy

ANSWER: X) TRANSMISSION ELECTRON MICROSCOPY

BONUS

18) Biology – *Multiple Choice* Sickle cell disease is caused when a single glutamic acid in hemoglobin is substituted by which of the following?

W) Lysine
X) Aspartic acid
Y) Valine
Z) Glycine

ANSWER: Y) VALINE
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

19) Math – *Short Answer* What is the greatest prime factor of 140?

ANSWER: 7

BONUS

19) Math – *Short Answer* What is the magnitude of the vector $-2\boldsymbol{i} + 5\boldsymbol{j} + \boldsymbol{k}$?

ANSWER: $\sqrt{30}$

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

20) Earth and Space – *Multiple Choice* Assuming all other properties remain constant, when the radius of a star is halved, its total luminosity decreases by which of the following factors?

W) 2
X) 4
Y) 8
Z) 16

ANSWER: W) 4

BONUS

20) Earth and Space – *Multiple Choice* A magnitude 4.6 earthquake releases approximately how much more energy than a magnitude 2.6 earthquake?

W) 30
X) 130
Y) 510
Z) 1000

ANSWER: Z) 1000
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~