**TOSS UP**

1. BIOLOGY *Short Answer* Denote by name or number all of the following actions which would occur if glucose receptors in the CNS were to detect lower levels of plasma glucose.  
   1. Increase in epinephrine secretion  
   2.Decreased activity of sympathetic nervous system.  
   3. Increased gluconeogenesis  
   4. Increased Skeletal muscle glycogenolysis  
     
   ANSWER: 1, 3, 4

**BONUS**

1. BIOLOGY *Short Answer* What class of antidepressant drugs are the most widely used antidepressant drugs and include Prozac, Paxil, and Zoloft. As their name suggests, these drugs stop reuptake of specific neurotransmitters at presynaptic terminals.ANSWER: SSRI, selective serotonin reuptake inhibitors

**TOSS UP**

1. PHYSICS *Short Answer* If a pendulum has a mass M, a length L, and a period of 10 seconds, what would be the new period of the pendulum if the length of the string quadrupled and mass was halved?ANSWER: 20 seconds

**BONUS**

1. PHYSICS *Short Answer* Denote by name or number all of the following 4 statements which are true of magnetism.  
   1. When magnetic field lines are far apart, the field magnitude is large.  
   2. One Tesla is equal to one Newton per Ampere Meter.   
   3. A straight segment of a conductor carrying current I in a uniform magnetic field B experiences a force F that is parallel to B.   
   4. A SQUID is a very sensitive magnetometer used to measure extremely weak magnetic fields, based on superconducting loops containing Josephson junctions.ANSWER: 2 and 4

**TOSS UP**

1. CHEMISTRY *Multiple Choice* Which of the following molecules is the most basic?  
   W) (CH3)3COH  
   X) (CH3)2CHOH  
   Y) (CH3)CH2OH  
   Z) CH3OH  
     
   ANSWER: W) (CH3)3COH

**BONUS**

1. CHEMISTRY *Short Answer* Which of the following reactions necessarily inverts the stereochemistry of the compound? SN1, SN2, E2 EliminationANSWER: SN2 only

**TOSS UP**

1. EARTH AND SPACE SCIENCE *Short Answer* What is the type of fog that forms as moist air flows up along an elevated plain, hill, or mountain?ANSWER: upslope fog

**BONUS**

1. EARTH AND SPACE SCIENCE *Short Answer* What is the name of the type of cloud that may be seen above the troposphere, characterized by its soft pearly look, forming in in the stratosphere at altitudes above 30 km.ANSWER: nacreous clouds

**TOSS UP**

1. MATH *Short Answer* The amount of water in a bucket decreases by 20%. By what percentage must the amount of water increase to reach its original value?  
     
   ANSWER: 25%

**BONUS**

1. MATH *Multiple Choice* Which of the following numbers is closest to 1.813?  
   W) 37/23  
   X) 34/19  
   Y) 29/16  
   Z) 33/19ANSWER: Y) 29/16

**TOSS UP**

1. ENERGY *Short Answer* Denote by name or number, which 2 of the following 4 characteristics of pressurized water reactors distinguish them from others.  
   1. Coolant loop separation from the steam system  
   2. Usage of water as a primary coolant and moderator  
   3. High pressure inside the primary coolant loop  
   4. A large positive thermal coefficient of reactivityANSWER: 1 and 3

**BONUS**

1. ENERGY *Short Answer* The cylindrical pellets of uranium dioxide used to create fuel rods are coated in a corrosion resistant metal alloy, made primarily of what element?ANSWER: zirconium

**TOSS UP**

1. BIOLOGY *Short Answer* What class of sugar derivative, can be prepared by the mild reduction, with NaBH4 or similar agents, of the carbonyl groups of aldoses and ketoses, and are designated by the suffix –itol.   
     
   ANSWER: SUGAR ALCOHOLS

**BONUS**

1. BIOLOGY *Short Answer* The regulatory effects of citrate and palmitoyl-CoA are dependent on the phosphorylation state of what enzyme, which catalyzes the committed step in fatty acid biosynthesis?ANSWER: Acetyl coa carboxylase

**TOSS UP**

1. PHYSICS *Short Answer* An unknown substance was shown to have a half-life of 5.0 seconds. If you observe 12.5 g of the substance after 15.0 seconds, how much of the substance was there initially?ANSWER: 100 grams

**BONUS**

1. PHYSICS *Short Answer* What was the name of the experiment conducted in the early 1900’s, in which electrons of 5 eV were directed at a surface of nickel where a single crystal had been grown and were scattered by it. This lead to the determination of the wavelength, which was then seen to agree with the de Broglie formula. ANSWER: DAVISSON GERMER EXPERIMENT

**TOSS UP**

1. CHEMISTRY *Short Answer* What is the oxidation state of sulfur in HSO4-?  
     
   ANSWER: +6

**BONUS**

1. CHEMISTRY *Short Answer* How many H-NMR peaks would an individual expect to see in chlorobenzene?ANSWER: 3

**TOSS UP**

1. EARTH AND SPACE SCIENCE *Multiple Choice* In order to find the Richter magnitude of an earthquake, you must draw a line on a Richter scale between which 2 of the following 4 values?  
   1. The time interval between the P and S waves.  
   2. The distance between the P and S waves.  
   3. The amplitude on the seismograph.  
   4. The depth of the epicenterANSWER: 2 and 3

**BONUS**

1. EARTH AND SPACE SCIENCE *Short Answer* Order the following 7 regions of the Earth’s interior from outermost to innermost.  
   1. Lower Mantle  
   2. Upper Mantle  
   3. Inner Core  
   4. Crust  
   5. Lithosphere  
   6. Outer Core  
   7. AsthenosphereANSWER: crust, lithosphere, asthenosphere, upper mantle, lower mantle, outer core, inner core

**TOSS UP**

1. MATH *Short Answer* Which of the following numbers is prime?  
   W) 259  
   X) 359  
   Y) 249  
   Z) 323  
     
   ANSWER: x) 359

**BONUS**

1. MATH *Short Answer* Find the integral of the function x^3(ln5x)dx.ANSWER: (x4/4) ln5x – (1/16)x4 + C

**TOSS UP**

1. ENERGY *Short Answer* What unit of energy is defined as the amount of heat needed to raise the temperature of one pound of water one degree Fahrenheit?ANSWER: british thermal unit or btu

**BONUS**

1. ENERGY *Short Answer* In a power tower solar power system, what are the names of the mirrors that focus sunlight onto a pipe located at the focal line, heating up fluid inside, and producing steam which drives a turbine?ANSWER: parabolic troughs

**TOSS UP**

1. BIOLOGY *Short Answer* Give the major type of RNA which is produced by the following 3 enzymes: RNA Pol. I, RNA Pol. II, RNA Pol. III  
     
   ANSWER: rRNA, mrna, trna

**BONUS**

1. BIOLOGY *Short Answer* Name the method of protein separation described here: A solution of ampholytes is first electrophoresed through the gel. The migration of these substances in an electric field establishes a pH gradient in the tube. Then a protein mixture is applied to the gel, and electrophoresis is resumed. As the protein molecules move down the gel, they experience the pH gradient and migrate to a position corresponding to their respective pIs. At its pI, a protein has no net charge and thus moves no farther.ANSWER: ISOEleCTRONIC FOCUSING

**TOSS UP**

1. PHYSICS *Short Answer* What is the name of the phenomenon in which there is a production of a voltage difference across an electrical conductor, transverse to an electric current in the conductor and a magnetic field perpendicular to the current.ANSWER: HALL EFFECT

**BONUS**

1. PHYSICS *Short Answer* The equation that states that constructive interference will occur between two x rays when 2dsin(theta)=n(lambda) is known as what condition?ANSWER: Bragg condition

**TOSS UP**

1. CHEMISTRY *Multiple Choice* Upon reaction with a strong base, methanol becomes deprotonated to a methoxide anion. If it is then reacted with a butyl ester, which of the following will be one of the products of the reaction?  
   W) Methyl Ester  
   X) Ethyl Ester  
   Y) Propyl Ester  
   Z) Butyl Ester  
     
   ANSWER: W) Methyl ester

**BONUS**

1. CHEMISTRY *Short Answer* A polar solid matrix is used for thin layer chromatography. If a nonpolar compound is spotted onto the solid matrix, compare the speed of travel of the compound in the following solvents, from slowest to fastest.  
   1. Diethyl Ether  
   2. Hexane  
   3. MethanolANSWER: 3, 1, 2

**TOSS UP**

1. EARTH AND SPACE SCIENCE *Short Answer* About how many years long is the sunspot cycle?ANSWER: 11

**BONUS**

1. EARTH AND SPACE SCIENCE *Short Answer* If the stars in a binary system are close together, the telescope, limited by diffraction and seeing, reveals only a single point of light. What stellar system does this describe?ANSWER: spectroscopic binary system

**TOSS UP**

1. MATH *Short Answer* How many degrees does the minute hand of a clock rotate in 2 hours and 40 minutes?  
     
   ANSWER: 960

**BONUS**

1. MATH *Short Answer* Give the volume of the solid generated by revolving the region bounded by the graph y=lnx, the x axis, and the lines x=1 and x=e, about the y axis. ANSWER: (½)pi (e^2+1)

**TOSS UP**

1. ENERGY *Short Answer* All cars and trucks in the US, since 2007, have been produced to be able to use what form of ethanol fuel blend?ANSWER: e15

**BONUS**

1. ENERGY *Short Answer* Most companies pursuing algae as a source of biofuels are pumping nutrient-laden water through plastic or borosilicate glass tubes that are exposed to sunlight. What is the name of the device being used in his algae fuel production process?ANSWER: photobioreactor

**TOSS UP**

1. BIOLOGY *Short Answer* What is the common name of the group of organisms found in the protist phylum Acrasiomycota?  
     
   ANSWER: CELLULAR SLIME MOLDS

**BONUS**

1. BIOLOGY *Short Answer* Classify all of the following cells as either part of plant epidermal, ground, or vascular tissue: guard cells, sclereids, trichomes, root hairs, sieve tube elements. ANSWER: Epidermal, Ground, epidermal, epidermal, vascular

**TOSS UP**

1. PHYSICS *Short Answer* Order the four fundamental interactions from greatest to least in relative strength, when measured from very small distances. ANSWER: strong, electromagnetic, weak, gravity

**BONUS**

1. PHYSICS *Short Answer* What is the name of the now obsolete device, invented by Ernest Lawrence, and once used for particle physics research, which consists of two hollow electrodes called D’s, with a gap between them, placed in the uniform magnetic field between the poles of a cylindrical magnet. ANSWER: cyclotron

**TOSS UP**

1. CHEMISTRY *Short Answer* Arrange the following substances in terms of increasing molar entropy at standard room temperature and pressure: Ca(s), Cl2(g), Cl2(l), CaCl2(s)  
     
   ANSWER: Ca(s), CaCl2(s), Cl2(l), Cl2(g)

**BONUS**

1. CHEMISTRY *Multiple Choice* The transformation of 2-methylbutene to 2-ethylbutane requires a transformation from:  
   W) An sp orbital to an sp3 orbital  
   X) An sp3 orbital to an sp2 orbital  
   Y) An sp2 orbital to an sp3 orbital  
   Z) An sp3 orbital to an sp orbitalANSWER: Y) An sp2 orbital to an sp3 orbital

**TOSS UP**

1. EARTH AND SPACE SCIENCE *Short Answer* If the wavelength of light emitted by a star is 600 nanometers, but an observer from earth sees it at 750 nanometers, what is the red shift? ANSWER: 0.25

**BONUS**

1. EARTH AND SPACE SCIENCE *Short Answer* Denote by name or number all of the following 4 statements which is or are true of Hubble’s law.   
   1. V=Hd is the equation derived from the law.   
   2. The Hubble Parameter is approximately 70.4 km/s/MegaParsec.  
   3. It is considered the first observational basis for the expanding space paradigm.  
   4. The universe is expanding at a constant rate ANSWER: 1, 2, and 3

**TOSS UP**

1. MATH *Short Answer* Solve for x, in the equation x+1=3  
     
   ANSWER: x=2

**BONUS**

1. MATH *Short Answer* The statement “If Jill misses the bus, she will be late” is true. Which other statement must be true?W) If Jill does not miss the bus, she will not be late  
   X) If a student misses the bus, he or she will be late  
   Y) Jill is late because she missed the bus  
   Z) If Jill is not late, she did not miss the bus

ANSWER: Z) if jill is not late, she did not miss the bus

**TOSS UP**

1. ENERGY *Short Answer* Denote by name or number all of the following statements which is or are true of biodiesel when compared to diesel.   
   1. It reduces sulfur oxide emissions  
   2. It reduces nitrogen oxide emissions  
   3. It reduces carbon monoxide emissions  
   4. It increases particulate emissions.ANSWER: 1 and 3

**BONUS**

1. ENERGY *Short Answer* Order the following four types of coal from greatest to least in the percentage that they make up of total US coal mining.   
   1. Subbituminous  
   2. Anthracite  
   3. Lignite  
   4. BituminousANSWER: 1, 4, 3, 2

**TOSS UP**

1. BIOLOGY *Short Answer* Classify each of the following 3 disorders as either sex linked or autosomal, and either recessive or dominant: Tay-Sachs Disease, Duchenne Muscular Dystrophy, Hypercholesterolemia.   
     
   ANSWER: Autosomal Recessive, sex linked recessive, autosomal dominant

**BONUS**

1. BIOLOGY *Short Answer* What special class of helix-turn-helix motifs, of which 50 of the proteins which have been analyzed share nearly identical sequences, plays a critical role in development in a wide variety of eukaryotic organisms? ANSWER: HOMEODOMAIN