TOSS-UP

BIOLOGY *Short Answer* Give by name or number all of the following four choices that are correct regarding helper T cells.

1. They are activated by polysaccharide fragments.
2. They bear surface CD4 molecules
3. When activated, they secrete cytokines
4. They function in cell mediated and humoral responses.

ANSWER: 2,3,4

BONUS

BIOLOGY *Short Answer* List all of the following three choices that is correct of nerves.

1. Depolarization of the membrane rapidly opens the activation gate, and slowly closes the inactivation gate
2. After the membrane is depolarized, potassium ion channels will open before sodium ion channels
3. The length of the axon affects the speed with which the action potential is conducted.

ANSWER: 1, 2

TOSS-UP

CHEMISTRY *Short Answer* Give the name for the liquid crystal structure that is distinguishable by sheets of parallel molecules rotated relative to their neighbors, resulting in a helical structure.

ANSWER: Cholesteric Phase

BONUS

CHEMISTRY *Short Answer* Calculate the molar mass of a polymer chain, if you are given that the chain has a degree of polymerization of 7000, and its repeating unit has a molar mass of 30g.

ANSWER: 2.1\*105g/mol

TOSS-UP

PHYSICS *Multiple Choice* Which of the statements is false regarding fluid motion?

W) Swiftly moving fluids exert less pressure than slower moving fluids

X) when a fluid is at rest, all portions of the fluid are in static equilibrium with each otherwith respect to the observer

Y) At the same depth, all molecules of a fluid will have the same pressure

Z) A pressure applied to an enclosed fluid will decrease as the distance from the source increases

ANSWER: Z) A pressure applied to an enclosed fluid will decrease as the distance from the source increases

BONUS

PHYSICS *Short Answer* Pipe B, with length L, and pipe A, with length 2 L have two open ends. What harmonic of pipe B will have the same frequency of the fundamental of pipe A?

ANSWER: Second harmonic

TOSS-UP

EAS *Short Answer* Give the name for the phenomenon, occurring mainly in giant stars, where a sudden loss of mass can take place via one of these events. Approximately 200,000 years apart, eruptions in the helium fusion shell cause variations in temperature, which destabilizes the triple alpha process, leading to an energy output approximately a million times the luminosity of the sun.

ANSWER: Thermal Pulse

BONUS

EAS *Short Answer* Which of the following three choices is/are a major threat to the taiga today?

1. The appearance of parasites such as the spruce budworm that can decimate native tree populations.
2. The cycle of fires that sweep the taiga every 70-100 years
3. The reappearance of lichens in regions of the taiga

ANSWER: 1

TOSS-UP

ENERGY *Short Answer* In order to prevent engine knocking, most vehicles today have engines that are designed to burn gasoline through this process.

ANSWER: Deflagration

BONUS

ENERGY *Short Answer* Give all of the following four statements that is true of hydroelectric power.

1. Sand bars and riverbanks downstream of a dam commonly show signs of rapid erosion, due to cyclic discharges from the dam.
2. In tropical regions, dam reservoirs are a major emitter of methane, due to the anaerobic decomposition of plant material in the reservoir.
3. Plants can quickly ramp up production in order to meet fluctuating demands.
4. The major advantage of hydroelectric power is the elimination of fuel needs and the quick payoff that it can make.

ANSWER: All 4

TOSS-UP

BIOLOGY *Multiple Choice* Which structure or compartment is not part of the apoplast?

W) The lumen of a xylem vessel

X) The lumen of a sieve tube

Y) The cell wall of mesophyll cell

Z) An extracellular air space

ANSWER: X) The lumen of a sieve tube

BONUS

BIOLOGY *Short Answer* Classify the following 3 organisms as photoautotrophs, chemoautotrophs, photoheterotrophs or chemoheterotrophs.

1. Rhodobacter
2. Fungi
3. Cyanobacteria

ANSWER: Photoheterotroph, chemoheterotroph, photoautotroph

TOSS-UP

CHEMISTRY *Short Answer* Identify the molecularity of the following two reactions.

1. C2N2-> CN+ CN
2. NO2+NO2->NO+NO3

ANSWER: 1- Unimolecular 2- bimolecular

BONUS

CHEMISTRY *Short Answer* Calculate the distance between two layers of a crystal lattice, if you are given that constructive interference occurs at 60 degrees and x-ray of wavelength 200 pm is used in the experiment.

ANSWER: 200 pm

TOSS-UP

PHYSICS *Short Answer* In lasers, voltages can sometimes be used to put more electrons in the excited state rather than the ground state. In this process, stimulated emission will occur before spontaneous emission.

ANSWER: Population Inversion

BONUS

PHYSICS *Short Answer* A tuning fork with a frequency of 440 Hz is played simultaneously with a fork with a frequency of 437 Hz. How many beats will be heard over a period of 10 seconds?

ANSWER: 30 beats

TOSS-UP

EAS *Short Answer* Name this classification of galaxy, which is characterized by small, highly luminous nuclei, broad emission lines of highly ionized gases, suggesting high velocities of the gases.

ANSWER: Seifert Galaxies

BONUS

EAS *Short Answer* Supernova remnants can merge to form these objects. Often hundreds of parsecs across, these objects can spew hot gas high above the galactic plane in a galactic fountain.

ANSWER: Superbubble

TOSS-UP

ENERGY *Short Answer* In this class of nuclear reactor, the water which passes over the reactor core acts as a moderator. Coolant does not flow to the turbine, but is contained in a pressurized primary loop, which produces steam in the secondary loop, driving the turbine. Its advantage is that a fuel leak in the core would not pass any radioactive contaminants to the turbine and condenser.

ANSWER: Pressurized Water Reactors

BONUS

ENERGY *Short Answer* A problem regarding nuclear power sometimes occurs via this event, in which the core of a nuclear reactor is shut down temporarily due to the buildup of short lived nuclear poisons. Give the name for this event, in which the natural decay of Iodine 135 into Xenon 135 acts as a strong neutron absorber, shutting down fission.

ANSWER: Xenon poisoning, Iodine pit, xenon pit, reactor slagging