TOSS-UP

BIOLOGY *Short Answer* On the cellular level in plants, newly produced enzymes break down chlorophyll, DNA, RNA and other chemical components. During this process, it is also common to observe a burst of ethylene in conjunction with the programmed deaths of certain cells, or the entire plant.

ANSWER: Senescence

BONUS

BIOLOGY *Multiple Choice* Which of the following would most likely occur if the repressor of an inducible operon were mutated so that it could not bind the operator?

W) Irreversable binding of repressor to promoter

X) Reduced transcription of the operon’s genes

Y) Continuous transcription of the operon’s genes

Z) Buildup of substrate for the pathway controlled by the operon

ANSWER: Y) Continuous transcription of the operon’s genes

TOSS-UP

CHEMISTRY *Short Answer* The reaction between CO2 and H2O yielding H2CO3 can best be described as a

W) Lewis Base becoming a Bronsted Acid

X) Lewis Acid becoming a Bronsted Acid

Y) Lewis Base becoming a Bronsted Base

Z) Lewis Base becoming a Bronsted Base

ANSWER: X) Lewis Acid becoming a Bronsted Acid

BONUS

CHEMISTRY *Short Answer* In the reaction 2NO (g) + O2 (g) -> 2NO2, the reaction rate increases by a factor of 4 when the NO concentration is doubled. When both O2 and NO are doubled, the reaction rate increases by a factor of 8. What are the reaction orders, and the units of the rate constant k for the overall reaction in terms of L, mol, and seconds?

ANSWER: Second order to NO, first order in O2, L2 mol-2 s-1

TOSS-UP

PHYSICS Short Answer: The focal length of a concave mirror is 2 meters. An object is

positioned 8 meters in front of the mirror. Give the magnitude of the distance where the image is formed.

ANSWER: 8/3 Meters

BONUS

PHYSICS *Short Answer* Which of the following 4 is or are false about waves?

1) In a longitudinal wave, the section that is disturbed by the passing of the wave move perpendicular to the wave motion

2) In a transverse wave, the medium moves perpendicular to the direction of wave motion

3) A spring in harmonic motion is an example of a pressure wave

4) Solitons are examples of longitudinal waves

ANSWER: 1 and 4

TOSS-UP

EARTH AND SPACE *Multiple Choice:* A specialized form of concordant igneous intrusion that is characterized by a dome in the country rock and a nearly planar floor is called a

W) Dyke

X) laccolith

Y) batholith

Z) stock

ANSWER: X) Laccolith

BONUS

EARTH AND SPACE *Short Answer* In giant stars, a sudden loss of mass can take place via one of these events. Approximatly 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

TOSS-UP

ENERGY *Multiple Choice* In petroleum, what percentage of its mass is composed of carbon?

W) 30-40%

X) 50-60%

Y) 70-80%

Z) 80-90%

ANSWER: Z) 80-90%

BONUS

ENERGY Short Answer This type of reactor is being used in fusion energy research. It incorporates a container in which a helical magnetic field is used to confine super-heated plasma.

ANSWER: Tokamak

TOSS-UP

BIOLOGY *Short Answer* Located in the pancreas, these structures have alpha cells, and beta cells that produce glucagon and insulin respectively. Name these structures that help to preserve homeostasis between glucagon and insulin.

ANSWER: Islets of Langerhans

BONUS

BIOLOGY *Multiple Choice* Which of the following 4 does not occur in a signal conduction pathway?

1) Stimulation of receptor by relay molecule

2) Production of secondary messenger such as cGMP

3) Activation of protein kinases

4) Phosphorylation of protein kinases

ANSWER: 1) Stimulation of receptor by relay molecule

TOSS-UP

CHEMISTRY *Short Answer* Which of the following four choices is correct regarding the collision theory of reactions?

1. Collision frequency is dependent on the cross section of the collision.
2. Collision frequency is dependent on the mean relative speed of the molecules.
3. The mean relative frequency increases with respect to the square root of the temperature.
4. If a reaction is endothermic in the forward direction, the activation energy is lower for the forward reaction than the reverse reaction.

ANSWER: 1,2,3

BONUS

CHEMSITRY *Short Answer* Identify the class of colloid that the following three examples belong to.

1. Muddy Water
2. Styrofoam
3. Mayonaise

ANSWER: 1- Sol 2- foam 3- emulsion

TOSS-UP

PHYSICS *Short Answer* This phenomenom is the scattering of a photon by a free charged particle. It results in a decrease in the energy of the photon. Conversely, the inverse of this process can also occur.

ANSWER: Compton Scattering

BONUS

PHYSICS Multiple Choice: For an electromagnetic wave traveling in a vacuum, if the magnitude

of the intensity of the E field is zero, the magnitude of the intensity of the B field is:

W) the square root of 2 times the positive maximum

X) the negative maximum

Y) the positive maximum

Z) zero

ANSWER: Z) zero

TOSS-UP

EARTH AND SPACE *Multiple Choice* Name with of the following is not a method of determining the approximate mass of a galaxy?

W) Cluster Method

X) Rotation Curve Method

Y) Luminosity Variation Method

Z) Velocity Dispersion Method

ANSWER: Y) Luminosity Variation Method

BONUS

EARTH AND SPACE *Short Answer* This term is given to the region of water that is neither close to the bottom nor near the shore. It is affected by light intensity, pressure, temperature, salinity and the supply of dissolved oxygen and nutrients. Derived from the Greek for “open water”, life here decreases with depth.

ANSWER: Pelagic Zone

TOSS-UP

ENERGY *Multiple Choice* Which of the following is not a part of the Carnot Cycle, when it is acting as part of a heat engine?

W) Isentropic expansion of gas, leading to the gas’s temperature decreasing

X) Reversible isothermal expansion of the gas

Y) Reversible adiabatic compression of the gas

Z) Reversible adiabatic expansion of the gas

ANSWER: Y) Reversible adiabatic compression of the gas

BONUS

ENERGY *Short Answer* Which of the following 4 is or are not major advantages of algae based fuels over fossil fuels?

1) It is relatively harmless to the environment if spilled

2) It is a relatively cost efficient fuel source

3) The growth rate is extremely short

4) It can produce much more fuel per area of crop than other competing crops

ANSWER: 3) It is a relatively cost efficient fuel source