BIOLOGY *Short Answer* Gametophytes are typically anchored by these structures, which can either be long, tubular single cells, or filaments of cells. Unlike roots, these are not composed of tissues.

ANSWER: Rhizoids

CHEMISTRY *Multiple Choice* Which of the following liquid crystal structures would be the most useful in an LCD display?

W) Thermotropic Crystals

X) Nematic Phase

Y) Lyotropic Crystals

Z) Cholesteric Phase

ANSWER: X) Nematic Phase

PHYSICS *Short Answer* This principle is used in determining how much energy is associated with each kind of motion of a complex molecule. It states that each velocity component has an average associated kinetic energy of ½ kT (k is Boltzmann constant).

ANSWER: Equipartition of Energy

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

BIOLOGY *Multiple Choice* This class of immunoglobulin is released triggers release from mast cells, and is usually present in blood in low concentrations. It is also associated with an allergic response.

W) IgM

X) IgA

Y) IgD

Z) IgE

ANSWER: Z) IgE

CHEMISTRY *Short Answer* Calculate the work done in Joules, by 0.5 L of a gas expanding against a pressure of 1.2 atm, given that no heat is exchanged with the surroundings, and give 1 L atm = 101 J.

ANSWER: -60.8 J

PHYSICS Short Answer: A converging thin lens has a focal length of 27 centimeters. An object

is placed 9 centimeters from the lens. Where is the image of this object formed?

ANSWER: 13.5 Centimeters on the object side of the lens

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

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

CHEMISTRY *Multiple Choice* One is given that the graph of a reaction has a slope of –k, the rate constant, and has a rate directly proportional to the concentration of substance. What else is true about this reaction?

W) The half life of the reaction is ln2/k.

X) The half-life is 1/k times concentration.

Y) The plot of the graph is linear when concentration is plotted versus time.

Z) The plot of the graph is linear when 1/concentration is plotted against time.

ANSWER: W) The half life of the reaction is ln2/k.

PHYSICS *Short Answer* Calculate the shear strain on an object if a 2 meter in dimensions cube is shifted 0.5 meters.

ANSWER: 0.25

EARTH AND SPACE *Short Answer* Calculate the combined expected mass of a binary star system, given that the two stars are 2 astronomical units apart, and have an orbital period of 3 years.

ANSWER: 8/9 Solar Masses

BIOLOGY *Short Answer* Taking up 0.01% of dry mass in a plant, this micronutrient is primarily used in the water splitting step of photosynthesis, and helps to regulate water balance.

ANSWER: Chlorine Ion

CHEMISTRY *Short Answer* The frequency fireflies flash in different temperatures has been shown to follow this behavior.Give the name for the behavior that is given to a reaction that is a straight line when k, the rate constant is plotted against 1/T.

ANSWER: Arrhenius Behavior

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

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

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

W) Stimulation of receptor by relay molecule

X) Production of secondary messenger such as cGMP

Y) Activation of protein kinases

Z) Phosphorylation of protein kinases

ANSWER: W) Stimulation of receptor by relay molecule

CHEMISTRY *Short Answer* Of the following two pairs, determine which has the stronger conjugate acid or base in water.

1. Conjugate Base: HF, HIO3
2. Conjugate Acid: NO2-, CN-

ANSWER: HF, NO2-

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) zero

X) the negative maximum

Y) the positive maximum

Z) the square root of 2 times the positive maximum

ANSWER: W) Zero

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

BIOLOGY *Short Answer* To maintain a sense of gravity and balance, most invertebrates rely on these sensory organs. A common type consists of a layer of receptor cells surrounding a chamber.

ANSWER: Stathocysts

CHEMISTRY *Multiple Choice* Which of the following can ONLY be considered as a Lewis base per the definition?

W) H2O

X) CO

Y) NH3

Z) BF3

Answer: Z) BF3

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

positioned 8 meters in front of the mirror. Where is the image of this object formed?

ANSWER: 8/3 Meters

EARTH AND SPACE *Short Answer* This model attempts to explain how the spiral arms of a galaxy are stable structures. Spiral arms are considered to be dynamically stable regions of compression. Gas clouds can collide with the arms, and trigger the formation of stars.

ANSWER: Density Wave Theory

CHEMISTRY *Short Answer* Common examples of this class of polymer include Dacron, or Terylene. They are commonly formed by linking together monomers that have a carboxylic acid group with another monomer with a hydroxyl group.

Answer: Condensation Polymer