1. Biology Multiple Choice- A leaf miner caterpillar is an example of which of the following?

**W.** Bulk feeder

**X.** Suspension feeder

**Y.** Substrate feeder

**Z.** Fluid feeder

**ANSWER:** Y

Bonus Biology Short Answer- What is the name of the action when rabbits and rodents ingest their own feces to extract nutrients?

**ANSWER:** Coprophagy

1. Earth Science Short Answer- Denote all of the following four statements that are true.
2. Transverse dunes can reach a maximum height of 30 meters
3. Barchan dunes can reach a maximum length of 300 meters from point to point
4. Longitudinal dunes can reach a length of 100 kilometers long
5. Parabolic dunes can reach a maximum height of 50 meters

**ANSWER:** 2 and 3

Bonus Earth Science Short Answer- Wind can carry fine lightweight particles such s silt for long distances. What is the name of accumulations of these windblown silt?

**ANSWER**: Loess

1. Astro Short Answer- What gas primarily composes the atmosphere of Io, Titan, and Triton?

**ANSWER:** Sulfur dioxide

Bonus Astro Short Answer- Denote all of the following that is incorrect about the moons of Jupiter.

1. Europa has a primitive surface and is dotted with impact craters
2. Callisto has a huge, multi-ringed basin called Valhalla which contains twenty to thirty mountainous rings of up to 3000 kilometers
3. Ganymede is the largest of Jupiter’s moons and has a crust of about 90% rock
4. Io has at least eleven active volcanoes (whose structure is primarily conic) that produce its sodium cloud

**ANSWER:** 1, 3, and 4

1. Chemistry Short Answer- In 1828, Friedrich Wohler disproved the vital-force theory by isolating what organic substance?

**ANSWER:** Urea

Bonus Chemistry Multiple Choice- In compounds with a tetrahedral shape, what is the bond angle?

**W.** 90⁰

**X.** 115.5⁰

**Y.** 109.5⁰

**Z.** 106⁰

**ANSWER:** Y

1. Physics Short Answer- What is the name of the hypothetical medium that light traveled through? This was believed by physicists in the 19th century

**ANSWER:** Ether

Bonus Physics Short Answer- Suppose a spacecraft moving past the earth fires a beam of light straight ahead. If we were to measure the speed of this light based of an observer using relative velocities, which postulate would this contradict?

**ANSWER:** Einstein’s second postulate

1. Energy Short Answer- What is the name of the process in which syngas, a mixture of hydrocarbons, is converted to a diesel substitute?

**ANSWER:** Fischer-Tropsch process

Bonus Energy Multiple Choice- Which of the following statements is incorrect about acetone-butanol-ethanol (ABE) fermentation?

**W.** ABE fermentation uses bacterial fermentation that produced acetone during World War II

**X.** The first biologic production of butanol was performed by Pasteur in 1905

**Y.** This process produces the solvents in a ratio of 3-6-1

**Z.** Examples of in-situ product recovery systems include gas stripping, adsorption, and pervaporation

**ANSWER:** X

1. Biology Short Answer- Denote all of the following four statements that is not true about plant hormones.
2. Cytokinins slow againg down by inhibiting RNA and protein synthesis and inhibiting the mobilization of surrounding tissues
3. Brassinosteroids were thought to be a type of auxin when discovered
4. Abscisic acid (ABA) can be washed out in heavy rains or inactivated through intense light and cold
5. Senescence is accompanied by a burst of auxins

**ANSWER:** 1 and 4

Bonus Biology Short Answer- Denote all of the following four statements that is a role of ethylene in cells.

1. Triple response
2. Leaf abscission
3. Flowering in the pineapple family
4. Fruit ripening

**ANSWER:** All of them

1. Math Short Answer- Given that log[base 10](3) = .477, what is the log[base 10] of 300?

**ANSWER:** 2.477

Bonus Math Multiple Choice- The trigonometric function cos(2A) is equal to which of the following relationships?

**W.** [cos(A)]2-[sin(A)]2 (read: cosine squared of angle A minus the sine squared of angle A)

**X.** 1- [sin(A)]2 (read: one minus the sine squared of A)

**Y.** 2[sin(A)][cos(A)] (read: 2 times the sine of A times the cosine of A)

**Z.** [sin(A)]2-[cos(A)]2 (read: sine squared of angle A minus the cosine squared of angle A)

1. Earth Science Multiple Choice- Which of the following is not a characteristic of Karst topography?

**W.** Sinkholes

**X.** Extensively jointed limestone formations

**Y.** Lack of surface streams

**Z.** Flat land without hills

**ANSWER:** Z

Bonus Earth Science Short Answer- What state contains the costliest beach “nourishment” project to date, using half a million dump-truck loads of sand?

**ANSWER:** New Jersey

1. Astro Short Answer- What is the length of the wavelength of a low-energy photon emitted when an electron flips over. This occurs when both a proton and an electron’s spins are aligned.

**ANSWER:** 21 cm

Bonus Astro Short Answer- What is the name of the critical size for an object to be dense enough to trap light?

**ANSWER:** Schwarzchild radius

1. Chemistry
2. Energy Short Answer- Denote all of the following that is true about biofuels?
3. Brazil and the United States combined makes up around 95% of the world’s ethanol production
4. Transesterification is used to convert polyesters into biodiesel
5. Green diesel used for agricultural purposes is dyed in Italy, to determine if a person is using the cheaper diesel in other application
6. Oxygenated fuels, or bio ethers, are compounds that enhance octane rating and engine performance

**ANSWER:** 4

Bonus Energy Short Answer- What is the name of the material left behind after sugarcane or sorghum stalks are crushed to extract their juice? It is used as a biofuel and in the manufacture of paper products.

**ANSWER:** Bagasse

1. Bonus Biology Short Answer- What is the name for plasma that has had its clotting factors removed?

**ANSWER:** Serum

Biology Short Answer- Denote all of the following that is correctly paired with its function in clotting.

1. Fibrinogen- adheres to collagen fibers as emergency protection
2. Thrombin- converts fibrin to fibrinogen
3. Platelets- releases clotting factors that convert prothrombin to thrombin
4. Fibrin- forms final clot

**ANSWER:** 3 and 4

1. Earth Science Multiple Choice- Which of the following statements about mass movement is false?

**W.** Slumps commonly leave jagged scars on slopes

**X.** Avalanches can occur when snow melts and refreezes into an icy crust. Snow can accumulate onto this crust and slide down the slope as an avalanche

**Y.** A mudflow is a swift mixture of mud and water. It is caused when melt water fills the spaces between sediments and allow them to slide down a slope.

**Z.** Rock falls produced a cone-shaped pile of coarse debris, called talus, at the base of the slope

**ANSWER:** W

Bonus Earth Science Short Answer- What is the name of the downhill movement of loose, water-logged materials that occur in regions of permafrost?

**ANSWER:** Solifluction

1. Physics Short Answer- Denote all of the following four lamps that is correctly paired with its color.
2. Mercury-arc lamps- bright green light
3. Sodium-vapor lamps- orange-yellow light
4. Hydrogen lamp- bright red light
5. Helium- pinkish light

**ANSWER:** 2 and 4

Bonus Physics Short Answer- What element is used in lasers for repairing detached retinas? It produces a blue-green light which is absorbed by red pigments in the retina.

**ANSWER:** Argon

1. Astro Multiple Choice- Which of the following would happen if the sun shrank down to its Schwarzchild radius?

**W.** The force of gravity between the sun and the star would increase

**X.** The force of gravity between the sun and the star would decrease

**Y.** The Earth’s orbit would be shorter due to the smaller volume of the sun

**Z.** Nothing would change

**ANSWER:** Z

Bonus Astro Short Answer- What is the name of the satellite launched in 1970 designed to observe x-ray sources, which are good indicators of black holes?

**ANSWER:** Uhuru

1. Chemistry Short Answer- What is the name of the process when fats or oils are hydrolyzed with NaOH to make soap?

**ANSWER:** Saponification

Bonus Chemistry Short Answer- Denote all of the following that is true concerning lipids?

1. Glycolypids contain a long-chain alcohol called sphingosine
2. The body synthesizes about three grams of cholesterol per day
3. Fats account for about a quarter to a half of our caloric intake
4. Saturated fats account towards atherosclerosis more than trans fats do

**ANSWER:** 1 and 3

1. Energy Short Answer- What is the name of the appropriate size for raw biomass in which it can be used?

**ANSWER:** Hogfuel

Bonus Energy Short Answer- Arrange the following countries, from least to greatest, based of how much renewable energy it produces.

China

Russia

Japan

United States

**ANSWER:** Japan, Russia, US, China (3, 2, 4, 1)

1. Math Multiple Choice- Assuming a year in a dog’s life is equivalent to 7 years of a human’s life, what is 1 hour of a dog’s life approximately equivalent to in a human’s life?

**W.** 3.5 hours

**X.** 7 hours

**Y.** 5 hours

**Z.** 4.5 hours

**ANSWER:** X

Bonus Math Short Answer- Which of the following is the mathematical term for a radical that expresses an irrational number?

**ANSWER:** Surd

1. Biology Short Answer- Denote of the following elements that is not a micronutrient of plants.
2. Copper
3. Molybdenum
4. Sulfur
5. Boron

**ANSWER:** 3

Bonus Biology Multiple Choice- Which of the following explains why chlorosis is seen first in older leaves?

**W.** Iron is relatively mobile and shunted to young leaves, so a deficient plant would show signs in older leaves first

**X.** Iron is relatively immobile and is retained in older leaves

**Y.** Magnesium is relatively immobile and is retained in older leaves

**Z.** Magnesium is relatively mobile and shunted to young leaves, so a deficient plant would show signs in older leaves first

**ANSWER:** Z