1. PHYSICS *Short Answer*- What is the name of the phenomenon that is analogous to the effect when there is a transverse deflection of an electron beam in a magnetic field in vacuum?

ANSWER: HALL EFFECT

PHYSICS *Short Answer*- During the Hall Effect, materials conduct through what process?

ANSWER: HOLE CONDUCTION

1. MATH *Multiple Choice*- What is the definite integral of the area in the first quadrant of revolved around the vertical line x = 1 from x = 1 to x = 5?

W) 32π/3

X) 16 π/3

Y) 32 π

Z) 16 π

ANSWER: W

MATH *Short Answer*- A circle intersects with a triangle, such that the intercepted arc is 1/3 of the circumference of the circle. If the distance between the center of the circle and the center of the triangle is 7, then what is the radius of the circle?

ANSWER: 7

1. BIOLOGY *Multiple Choice*- Which of the following is the name of the inflammatory mediator that is produced when enzymes act on arachidonic acid, creating these compounds?

W) Leukotrienes

X) Prostaglandins

Y) Histamine

Z) Erythines

ANSWER: X

BIOLOGY *Multiple Choice*- Which of the following is the term for when phagocytes squeeze through gaps in a blood vessel to enter tissues? This occurs when they follow chemotactic compounds in search of inflamed tissues.

W) Chemotaxis

X) Margination

Y) Diapedesis

Z) Edema

ANSWER: Y

1. ENERGY *Short Answer*- What is the name of the building that houses the drilling tools in a drilling rig?

ANSWER: DERRICK

ENERGY *Multiple Choice*- Order the following four products of oil from least percentage to most percentage?

Liquefied Petroleum Gases, Diesel, Heating Oil, Gasoline

ANSWER: 3, 1, 2, 4 (ACCEPT: HEATING OIL, LIQUEFIED PETROLEUM GASES, DIESEL, GASOLINE

1. CHEMISTRY *Short Answer*- What type of isomerism occurs when one or more ligands are exchanged between a cationic complex and an anionic complex?

ANSWER: COORDINATION ISOMERS

CHEMISTRY *Short Answer*- What are the name ligands that can attach themselves through atoms of different elements, in a linkage isomer?

ANSWER: AMBIDENTATE

1. EARTH AND SPACE SCIENCE *Multiple Choice*- Which of the following is the best approximation of how long it has been since the universe began to expand?

W) 1.7 x 108 YEARS

X) 1.7 x 109 YEARS

Y) 1.7 x 1010 YEARS

Z) 1.7 x 1011 YEARS

ANSWER: Y

EARTH AND SPACE SCIENCE *Multiple Choice*- If the observed cosmological density is greater than the critical density, then the universe is

W) Spherical and open

X) Hyperbolic and open

Y) Spherical and closed

Z) Hyperbolic and closed

ANSWER: Y

1. PHYSICS *Short Answer*- What is the name of the experiment performed in the 19th century that confirmed Gauss’s Law? A charged metal ball would touch the surface of a charged container and the ball will become uncharged.

ANSWER: FARADAY’S ICE-PAIL EXPERIMENT

PHYSICS *Short Answer*- Which electrostatic generator, based off the principals of the Faraday ice-pail experiment uses a charged belt rather than a charged conducting sphere. This causes a rapid accumulation of charge and electric field.

ANSWER: VAN DE GRAAF ELECTROSTATIC GENERATOR

1. MATH *Short Answer*- List all of the possible numbers n, for which a circle can intersect a triangle n times.

ANSWER: 1, 2, 3, 4, 5, 6

MATH *Multiple Choice*- Jack and Saaket are running a race of 100 meters. In the first race, Jack gives Saaket a head start of ten meters and is beaten by twenty seconds. In the second race, Saaket gives Jack a head start of twenty meters and beats him by ten seconds. What is Jack’s speed in meters per second?

ANSWER: 4 M/S

1. BIOLOGY *Short Answer*- What type of small forms of RNA, similar to miRNAs, that are formed from long double-stranded RNA molecules, rather than a single hairpin?

ANSWER: SMALL INTERFERING RNAS

BIOLOGY *Short Answer*- Denote all of the following three statements that is true about gene expression.

1: The interference caused by siRNAs is called RNA interference

2: If miRNA binds completely to a mRNA, then translation is blocked

3: The dicer contains about 400 nucleotide pairs

ANSWER: 1 ONLY

1. ENERGY *Short Answer*- What is the name of the process involving the temperature difference between the ocean’s surface and depths that can potentially produce more energy than tidal, wave, and wind energy combined?

ANSWER: OCEAN THERMAL ENERGY CONVERSION (ACCEPT: OTEC)

ENERGY *Short Answer*- What state produces the most lignite, produces the most natural gas, and is one of the top three energy producing states?

ANSWER: TEXAS

1. CHEMISTRY *Short Answer*- Denote all of the following three statements that are true about electrolysis.

1: Electroplating is the electrolytic deposition of a thin film of metal on an object

2: Faraday’s law states that the number of moles of product formed by an electric current is stoichiometrically equivalent to the number of moles of electrons supplied

3: A sacrificial cathode protects an iron pipeline by supplying electrons to prevent oxidation

ANSWER:1 AND 2

CHEMISTRY *Short Answer*- What process is used for the commercial production of magnesium metal from molten magnesium chloride?

ANSWER: DOW PROCESS

1. EARTH AND SPACE SCIENCE *Short Answer*- What are the two types of ways that interstellar dust makes itself known?

ANSWER: REDDENING AND EXTINCTION

EARTH AND SPACE SCIENCE *Short Answer*- Denote all of the following three statements that are true about interstellar dust

1: Dust can emit infrared like a blackbody radiator

2: A dark cloud is an interstellar cloud that contains so much dust it blots out the light of stars

3: To account for reddening, astronomers have developed the concept of core-mantle grains

ANSWER: 1 AND 2

1. PHYSICS *Short Answer*- What is the common name of the BCS theory, proposed by Bardeen, Cooper, and Schrieffer, that earned the Nobel Prize in 1972.

ANSWER: SUPERCONDUCTIVITY

PHYSICS *Short Answer*- The key to the theory of superconductivity is an interaction between pairs of conduction electrons. These pairs are called what?

ANSWER: COOPER PAIRS

1. MATH *Short Answer*- A hiker walking at a constant rate of 4 miles per hour is passed by a cyclist travelling in the same direction along the same path at a constant rate of 24 miles per hour. The cyclist stops to wait for the hiker 6 minutes after passing her, while the hiker continues to walk at her constant rate. How many minutes must the cyclist wait until the hiker catches up?

W) 10

X) 20

Y) 30

Z) 40

ANSWER: Y

MATH *Multiple Choice*- One night a certain motel rented ¾ of it rooms, including 2/3 of its air conditioned rooms. If 3/5 of its rooms were air conditioned, which of the following is the percentage of the rooms that were NOT rented that are air conditioned?

W) 20%

X) 35%

Y) 60%

Z) 80%

ANSWER: Z

1. BIOLOGY *Multiple Choice*- Which of the following is the name of the center of a stem?

W) Interstem

X) Cortex

Y) Primary xylem

Z) Pith

ANSWER: Z

BIOLOGY *Short Answer*- The name of cells in a meristem that remain as sources of new cells is called the initials. What is the name of the new cells displaced from the meristem?

ANSWER: DERIVATIVES

1. ENERGY *Multiple Choice*- Which one of the following sectors consumes the most biomass?

W) Residential

X) Commercial

Y) Transportation

Z) Industrial

ANSWER: Z

ENERGY *Short Answer*- Denote all of the following three statements that is true about biomass.

1: The majority of landfill gas is not used for energy

2: The largest source of biomass is wood and wood waste, comprising about eighty percent

3: Power plants that burn garbage for energy are called waste-to-energy plants

1. CHEMISTRY *Multiple Choice*- Which of the following is the name for the constant 85 J x K-1 x mol-1?

W) Boltzmann

X) Trouton

Y) Stern

Z) Meyer

ANSWER: X

CHEMISTRY *Short Answer*- In a Michaelis-Menten mechanism of enzyme reaction, the overall rate law is equal to k2[E]0[S]/(KM + [S]). The KM is equal to?

W) (k2 + k1)/k1’

X) (k1 + k1’)/k2

Y) (k2 + k1’)/k1

Z) k1’/(k1 + k2)

ANSWER: Y

1. EARTH AND SPACE SCIENCE *Short Answer*- Who was the scientist who observed in 1659 that Saturn is surrounded by a thin flat ring that does not touch the body of the planet?

ANSWER: HUYGENS

EARTH AND SPACE SCIENCE *Short Answer*- What is the name of the gap in the single ring of Saturn?

ANSWER: CASSINI’S DIVISION

1. PHYSICS *Short Answer*- The discovery of what object would cause sweeping implications for theoretical physics in magnetism? Although isolate positive and negative charges exist, there is no evidence that this exists.

ANSWER: MAGNETIC MONOPOLE

PHYSICS *Multiple Choice*- Which of the following four statements is false about magnetism?

W) Two parallel conductors carrying current in the same direction attract each other

X) The constriction of a conductor is called the pinch effect

Y) The equations of Biot and Savart can be used to find the magnetic field

Z) Gauss’s law has a consequence that magnetic field lines always form open loops and have end points

ANSWER: Z

1. MATH *Short Answer*- A square wall is covered with square tiles. There are 19 tiles along one diagonal. How many tiles are there on the whole wall?

ANSWER: 361

MATH *Short Answer*- In the xy-coordinate system, what is the slope of the line that goes through the origin and is equidistant to the two point P= (11, 1) and Q= (7, 7)? Give your answer as a decimal to two decimal places.

ANSWER: .44

1. BIOLOGY *Short Answer*- In charophytes, what is the name of the layer of durable polymer that prevents zygotes from drying out?

ANSWER: SPOROPOLLENIN

BIOLOGY *Short Answer*- An embryo during alteration of generations sometimes have what specialized cells that enhance nutrient transfer from parent to embryo through wall ingrowths?

ANSWER: PLACENTAL TRANFER CELLS

1. ENERGY *Short Answer*- Considerably more efficient than room-and-pillar mining, this coal mining method uses special machines to allow mined-out areas to collapse in a controlled manner.

ANSWER: LONGWALL MINING

ENERGY *Multiple Choice*- Which of the following is true about coal?

W) Anthracite contains about 8000 Btu per pound

X) Coal is mainly consumed in the industry sector

Y) Wyoming is the top coal producing state

Z) Coke, an impure carbon residue, is used in smelting metals

ANSWER: Y

1. CHEMISTRY *Short Answer*- When the chemical equation Ag(NH3)2+(aq) + Cl-(aq) + H3O+(aq) yields AgCl(s) + NH4+(aq) + H2O(l) is balanced, what is the ratio between Ag(NH3)2+ and NH4+?

ANSWER: 1:2

CHEMISTRY *Short Answer*- If H2Cl2(s) and NH3(aq) are reacted together, then what is the positive and negative aqueous ions produced, respectively?

ANSWER: NH4+ AND CL-

1. EARTH AND SPACE SCIENCE *Short Answer*- What is the name of the basic model for pulsars, a rotating magnetic neutron star?

ANSWER: LIGHTHOUSE MODEL

EARTH AND SPACE SCIENCE *Short Answer*- In the Gum Nebula, after the Vela supernova explosion, all that is left is the remnant. Pictures show green light coming from the gas remains. What element is this caused by?

ANSWER: OXYGEN

1. MATH *Multiple Choice*- If 9 is a factor of 2x, then which of the following may NOT be an integer?

W) 6x/54 +2x/3

X) (4x-18)/9

Y) (81-4x2)/81

Z) (2x-3)/3

ANSWER: W

MATH *Short Answer*- Five mobsters go to the theater to watch a movie. One of the mobsters, Sid, is an informer, and he’s afraid that another member, Daniel, is on to him. Sid, wanting to keep Daniel in his sights, insists on standing behind Daniel in line at the concession stand, though not necessarily right behind. How many ways can the five arrange themselves such that Frankie’s requirement is satisfied?

ANSWER: 60