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Science Bowl Questions: Assorted Round 5

1. Toss-up: Chemistry: Multiple Choice: Which molecular orbitals for homonuclear diatomic molecules are degenerate?

W. π molecular orbitals

X. σ molecular orbitals

Y. π molecular orbitals and σ molecular orbitals

Z. neither π molecular orbitals nor σ molecular orbitals

ANSWER: W

Bonus: Chemistry: Multiple Choice: Using the Molecular Orbital Theory for predicting the bond strengths for Be2, Be2+, and Be2-, which one of the following is true?

W. Be2+ is more stable than Be2, and Be2 is more stable than Be2-

X. Be2- is more stable than Be2, and Be2 is more stable than Be2+

Y. Be2+ and Be2- are both more stable than Be2

Z. Be2 is more stable than either Be2+ or Be2-

ANSWER: Y

1. Toss-up: Chemistry: Multiple Choice: What is the strongest acid of the following?

W. HOI

X. HOBr

Y. HOCl

Z. All are equivalent

ANSWER: Y

Bonus: Chemistry: Short Answer: Given that a 12 M Hypochlorous acid solution is prepared in the laboratory, what is the approximate [H+] Hydrogen Ion concentration of the solution? The Acid Dissociation Constant for Hypochlorous acid is 3.00 \* 10-8.

ANSWER: 6.0 \* 10-4M

1. Toss-up: Chemistry: Multiple Choice: The compounds [Cr(H2O)6]Cl3 and [CrCl3(H2O)3]●3H2O are examples of:

W. diastereoisomers

X. enantiomers

Y. ionization isomers

Z. linkage isomers

ANSWER: Y

Bonus: Chemistry: Short Answer: Give the formula for the following coordination compound: dicholorobis(ethylenediamine)platinum(IV) nitrate.

ANSWER: [Pt(en)2Cl2](NO3)2

1. Toss-up: Chemistry: Multiple Choice: The reaction of an alcohol at 180°C with sulfuric acid as a catalyst to produce an alkene and a water molecule is which of the following types of reactions?

W. Oxidation Reaction

X. Hydrogenation Reaction

Y. Elimination Reaction

Z. Dehydroxyfication

ANSWER: Y

Bonus: Chemistry: Short Answer: In the reaction of HBr with propene, two products, 1-bromopropane, and 2-bromopropane are expected to be produced, yet only 2-bromopropane is present in significant amounts. What is the name of the rule that predicts this occurrence by stating that the hydrogen on the H-Br will more likely attach to the double-bonded carbon with the most hydrogens attached?

ANSWER: Markonikov’s Rule

1. Toss-up: Physics: Short Answer: What is the name of the constant present in an RC circuit that is a measure of how quickly a capacitor becomes charged and is a function of the capacitance and resistance of the circuit?

ANSWER: Time Constant

Bonus: Physics: Multiple Choice: Gauss’s Law for electric charges predicts that the electrical potential a distance r from a single point charge Q in a vacuum is proportional to Q and inversely proportional to r. What is the constant of proportionality?

W. ε0

X. 1/4πε0

Y. μ0

Z. 1/4πμ0

ANSWER: X

1. Toss-up: Physics: Multiple Choice: The amount of polarization in a reflected beam depends on the angle, varying from no polarization at normal incidence to 100% polarization at the polarizing angle, related to the index of refraction of the two materials. What is the name of the equation relating the polarizing angle to the index of refraction?

W. Polarizing Angle Equation

X. Lens Equation

Y. Brewster’s Equation

Z. Huygens Principle

ANSWER: Y

Bonus: Physics: Short Answer: What type of lens combination, sometimes called the “color corrected lens”, can eliminate chromatic aberration for any two colors by the use of two lenses made of different materials with different indices of refraction and dispersion?

ANSWER: Achromatic Doublet

1. Toss-up: Physics: Multiple Choice: What is the name of a plot that illustrates the linear relationship between atomic number and where λ is the wavelength of X-rays emitted by atoms as electrons from upper states drop to fill vacated low states?

W. Rydberg Plot

X. Heisenberg Plot

Y. Plank Plot

Z. Moseley Plot

ANSWER: Z

Bonus: Physics: Short Answer: What was the name of the principle proposed by the famous physicist Niels Bohr that stated that in any given experiment, we must use either the wave or the photon theory of light, but not both?

ANSWER: Principle of Complementarily

1. Toss-up: Physics: Multiple Choice: If an object is moving at a velocity v relative to a stationary observer, which of the following is true?

W. The length of the object is measured to be longer than when it is at rest

X. The length of the object is measured to be shorter than when it is at rest

Y. The length of the object does not vary with its speed

Z. Whether the object expands or contracts is dependent on the value of v

ANSWER: X

Bonus: Physics: Short Answer: If a magnetic field of 1 T is perpendicular to a circuit that contains a resistor of 5 Ohms and a sliding bar of length 0.25 m and velocity 1 m/s, find the current flowing through the circuit.

ANSWER: 1/20 Ampere

1. Toss-up: Biology: Multiple Choice: Which of the following is a type of post-transcriptional regulation of genes that occurs at the RNA-processing lever, in which different RNA molecules are produced from the same transcript depending of the position of RNA splicing?

W. Alternative RNA splicing

X. Differential RNA splicing

Y. Proteasomic RNA splicing

Z. RNA Degradiation

ANSWER: W

Bonus: Biology: Short Answer: What is the name of the phenomenon that explains flexible base paring at the codon position in a tRNA anticodon by allowing a base U at the third position to pair with either an G or an A?

ANSWER: Wobble

1. Toss-up: Biology: Multiple Choice: What is the name given to the smaller organism in a symbiotic relationship?

W. host

X. parasite

Y. symbiont

Z. mutualist

ANSWER: Y

Bonus: Biology: Short Answer: What is the name for the process in which genes are transferred from one genome to another through mechanisms such as exchange of transposable elements and plasmids, viral infection, and perhaps fusions of organisms?

ANSWER: Horizontal Gene Transfer

1. Toss-up: Biology: Multiple Choice: Which of the following pieces of DNA in bacteria allows the bacterium to form sex pili and donate DNA during conjugation?

W. R Factor

X. C Factor

Y. S Factor

Z. F Factor

ANSWER: Z

Bonus: Biology: Multiple Choice: Which of the following inorganic substances are never used by chemoautotrophs are reducing agents?

W. Water

X. Hydrogen Sulfide

Y. Iron (II)

Z. Manganese (II)

ANSWER: W

1. Toss-up: Biology: Short Answer: What is the name of slits in the bodies of chordates with notochords that allowed water entering the mouth to exit through the body without entering the digestive tract?

ANSWER: Pharyngeal Slits

Bonus: Biology: Multiple Choice: Which of the following are slender, soft-bodied vertebrates with prominent eyes controlled by numerous muscles? At the anterior end of the their mouth, they have a set of barbed hooks made of dental tissues that are mineralized.

W. Gnathostomes

X. Lancelates

Y. Conodonts

Z. Tunicates

ANSWER: Y

1. Toss-up: Math: Multiple Choice: If f’(x) is negative throughout an entire open interval (a,b) and f(a) is a maximum, then which of the following cannot be f(b)?

W. Point of Inflection

X. Minimum

Y. Maximum

Z. Root

ANSWER: Y

Bonus: Math: Short Answer: A pendulum of 10meter length is hanging downward when a prankster above it begins to pull the massless rope upwards by 0.5 m/s. Assuming no friction and g=10 m/s^2, find the rate of change of period of the pendulum in terms of π when the length of rope is 2.5m.

ANSWER: -1/10 π

1. Toss-up: Math: Multiple Choice: What is the name of the hyperbolic trigonometric function curve that is made by a boat when a man with a rope walks in a vertical line in the direction the boat is pointed and the boat moves in the vertical direction as well as closer to the man?

W. Catenary

X. Quadratic Curve

Y. Tractrix

Z. Tricuspoid

ANSWER: Y

Bonus: Math: Short Answer: If, in five years, Sally’s age is thrice that of John’s age, and Sally’s and John’s age add up to 30 right now, what is the difference between Sally’s Age and John’s age?

ANSWER: 20 years

1. Toss-up: Math: Multiple Choice: Which of the following sets is a systematic difference set for the sets {1,2,3,4,5} and {1,4,6,8}?

W. {1,2,3,4,5,6,8}

X. {2,3,5,6,8}

Y. {2,3,5}

Z. {1,4}

ANSWER: Z

Bonus: Math: Multiple Choice: Which theory of abstract algebra stated below would most directly deal with the probably of finding the number of permutations of a rubix’s cube, along with its solution?

W. Set Theory

X. Group Theory

Y. Ring Theory

Z. Topography

ANSWER: X

1. Toss-up: Math: Multiple Choice: Which of the following the antiderivative of tan(x)?

W.

X.

Y.

Z.

ANSWER: Y

Bonus: Math: Short Answer: Let y represent the temperature, in degrees °F, of a room which is kept at a constant 60°. Using Newton’s Law of Cooling, which states that the rate of change of temperature of the object is proportional to the temperature of the object minus that of the room, solve for the temperature of the object as a function of time, if k is the proportionality constant.

ANSWER: y = 60 + Ce^kt

1. Toss-up: ERSC: Multiple Choice: Which of the following mineral is responsible for much of the enrichment of ores due to weathering underground due to its content of sulfur, which dissolves to for sulfuric acid, a powerful chemical weathering agent?

W. Chalcopyrite

X. Pyrite

Y. Cinnabar

Z. Galena

ANSWER: X

Bonus: ERSC: Multiple Choice: Which of the following minerals is not found in solution after the chemical weathering of amphiboles by carbonic acid?

W. Potassium Ion

X. Silica

X. Calcium Ion

Z. Magnesium Ion

ANSWER: W

1. Toss-up: ERSC: Short Answer: What is the name of the soils that occupy the central portion of a soil-texture diagram and where no single soil particle type dominates over the other two?

ANSWER: Loam

Bonus: ERSC: Multiple Choice: What type of unusual glaciers occupy broad lowlands at the bases of steep mountains and form when one or more valley glaciers emerge from the confining walls of mountain valleys?

W. Alpine Glaciers

X. Continental Glacier

Y. Coastline Glacier

Z. Piedmont Glacier

ANSWER: Z

1. Toss-up: ERSC: Short Answer: What is the word that is used to describe layers of rock that have been deposited essentially without interruption?

ANSWER: Conformable

Bonus: ERSC: Multiple Choice: What is the name of the process where masses of warm and cool air collide, producing a front; the cooler denser air acts as a barrier over which the warmer, less-dense air rises?

W. Frontal Lifting

X. Orographic Lifting

Y. Frontal Wedging

Z. Orographic Wedging

ANSWER: Y

1. Toss-up: Astro: Multiple Choice: In neutrino astronomy, scientists use underground testing facilities for measuring and detecting solar neutrino flux. Which of the following observatories is one used for measuring neutrino flux?

W. COBE

X. XMM Neutrino Observatory

Y. SAGE

Z. TRACE

ANSWER: Y

Bonus: Astro: Short Answer: What is the name of a class of galaxies with nuclei that produce spectral line emission from highly ionized gas? They are a subclass of active galactic nuclei and were discovered in 1943.

ANSWER: Seyfert Galaxies

1. Toss-up: Astro: Short Answer: What is the name of a rotating, circumstellar disk surrounding a newly formed star of gas and dust and that may be considered an accretion disk?

ANSWER: Protoplanetary Disk

Bonus: Astro: Multiple Choice: What is the name of the theory of the universe that states that the nascent universe passed through a phase of exponential expansion that was driven by a negative-pressure vacuum energy density?

W. Cosmic Expansion

X. Cosmic Inflation

Y. Big Chill

Z. Dark Energy Theory

ANSWER: X

1. Toss-up: Astro: Multiple Choice: Which of the following best illustrates a HII region in space?

W. An Interstellar cloud consisting of neutral, atomic hydrogen

X. A cloud of glowing gas and plasma where new star formation is taking place

Y. An interstellar region of extremely low density where molecular hydrogen exists

Z. A rock-populated region surrounding a large star

ANSWER: X

Bonus: Astro: Short Answer: Name the galaxy Messier 33, which is present in the constellation Triangulum.

ANSWER: Pinwheel Galaxy, Triangulum Galaxy

1. Toss-up: GENSCI: Short Answer: Researchers studying autism believe that a potentially harmful ingredient in childhood vaccines could impart child brain function and contribute to autism. What is the name of this chemical?

ANSWER: Thimerosal

Bonus: GENSCI: Short Answer: What ionic solid is the main active ingredient of bleach?

ANSWER: Sodium Hypochlorite (NaClO)

1. Toss-up: GENSCI: Multiple Choice: What is an SI derived base unit used for measuring the rate of an absorbed dose of radiation per second?

W. Gray/second

X. Watt/Steradian

Y. Coloumb/Kilogram

Z. Katal/ Cubic Meter

ANSWER: W

Bonus: GENSCI: Multiple Choice: The Siemens, an SI unit used for electrical conductance, is the combination of which of the following SI base units?

W. m2 kg s-3

X. cd s2

Y. kg s-2 A-1

Z. m-2 kg-1 s3 A2

ANSWER: Z

1. Toss-up: GENSCI: Multiple Choice: What gluon must a green quark absorb to become a red quark?

W. red gluon

X. red-green gluon

Y. red-antigreen gluon

Z. green-antired gluon

ANSWER: Y

Bonus: GENSCI: Short Answer: Name all three leptons which are not neutrinos.

ANSWER: Electron, Muon, Tauon