Sriram Pendyala

Science Bowl

Assorted Science Bowl Questions 9: 25 Toss-ups and Bonuses

1. Toss-up: Chemistry: Multiple Choice: Which of the following molecular geometries is most closely associated with the shape of the Ni(CN)42- coordination compound?

W. Tetrahedral

X. Square planar

Y. Octahedral

Z. See-saw

ANSWER: X

Bonus: Chemistry: Multiple Choice: Fluoride ion ranks low in the spectrochemical series and produces a weak crystal field in complex ions. Based on this information, predict the number of unpaired electrons in CoF63-, given that the Co3+ ion has

W. 0

X. 2

Y. 3

Z. 4

ANSWER: Z

1. Toss-up: Chemistry: Multiple Choice: Which of the following statements about equilibrium is false in the endothermic reaction of hydrogen and iodine vapors to create hydrogen iodide vapor?

W. If the system is heater, the right side is favored

X. If the pressure on the system is increased by changing the volume, the left side is favored

Y. Adding more H2 increases the equilibrium constant

Z. Removing HI as it forms forces the equilibrium to the right

ANSWER: Y

Bonus: Chemistry: Multiple Choice: The reaction of gaseous nitrogen and hydrogen to produce ammonia is exothermic. If so, why do these gases react at temperatures in excess of 900 degrees C in the Haber process?

W. To favor ammonia as a product

X. Because ammonia is removed as soon as it is formed

Y. To increase the rate of reaction

Z. To decrease the amount of energy released when the reaction occurs

ANSWER: Y

1. Toss-up: Chemistry: Multiple Choice: In any cubic lattice an atom lying at the corner of a unit cell is shared equally by how many unit cells?

W. 4

X. 8

Y. 12

Z. 16

ANSWER: X

Bonus: Chemistry: Short Answer: What is the specific name of the unit cell which contains both cations and anions of valence 1, where the cation is at the center of the cell and the anions are at the corners?

ANSWER: CsCl unit cell

1. Toss-up: Chemistry: Multiple Choice: Which of the following is true of a real gas but not of an ideal gas?

W. Expansion into vacuum adiabatically lowers temperature

X. Expansion against external pressure adiabatically lowers temperature

Y. All gas particles have no volume

Z. Cannot be cooled down to absolute zero

ANSWER: W

Bonus: Chemistry: Multiple Choice: For an endothermic process, which of the following four statements must be TRUE?

1. wmax = delta(G)
2. delta(S)surr is greater than zero
3. delta(G) and delta(S) cannot both be negative
4. delta(G) and delta(S) are both positive

W. all are true

X. none are true

Y. 1 and 3

Z. 1, 2, and 4

ANSWER: Y

1. Toss-up: Biology: Multiple Choice: Which of the following describes E. coli prokaryotic cells that have been doused with a buffer of CaCl2 and MgCl2 and are ready to participate in a transformation?

W. Conjugation-ready

X. Competent

Y. Isolated

Z. RNA-ready

ANSWER: X

Bonus: Biology: Short Answer: What thermostable DNA polymerase, originally isolated in Thermophilic archea, is used to amplify short segments of DNA at high temperatures in the Polymerase Chain Reaction method?

ANSWER: Taq Polymerase

1. Toss-up: Biology: Multiple Choice: What class of the phylum Cnidaria contains most corals, sea anemones, and sea fans, and other sessile animals where the medusa stage is completely absent?

W. Anthozoa

X. Hydrozoa

Y. Cubozoa

Z. Scyphozoa

ANSWER: W

Bonus: Biology: Short Answer: What phylum of invertebrates contains only 110 species of velvet worms, and originated during the Cambrian explosion, originally thriving in the ocean, but by some point succeeding to colonizing land?

ANSWER: Onychophora

1. Toss-up: Biology: Short Answer: By the 1930s, Japanese scientists had determined that the fungus caused hyperelongation of rise stems by secreting a chemical. What is the name of these plant hormones, which also stimulate pollen development, pollen tube growth, fruit growth, and seed development and germination?

ANSWER: Gibberellins

Bonus: Biology: Multiple Choice: Which of the following steps is not part of the triple response that enables a rising shoot to avoid an obstacle?

W. A slowing of stem elongation

X. A curvature that allows the stems to grow horizontally

Y. The release of ethylene gas when the rising shoot touches an obstacle

Z. A thinning of the stem to allow bending

ANSWER: Z

1. Toss-up: Biology: Multiple Choice: Which of the hormones is not paired correctly with its target?

W. FSH and LH - Testes and Ovaries

X. GH – Liver, bones, and other tissues

Y. MSH – Melanocytes

Z. ADH – Adrenal Cortex

ANSWER: Z

Bonus: Biology: Short Answer: What type of pathogens are defined as those that are transferred from other animals to humans, either through direct contact with an infected animal or by means of an intermediate species, often called a vector?

ANSWER: Zoonotic Pathogens

1. Toss-up: ERSC: Short Answer: In North America, this type of climate extends from near the US-Canadian border northward as a narrow belt into southern Alaska, and involves the prevalence of maritime air masses, involving mild winters and cool summers.

ANSWER: Marine West Coast Climate

Bonus: ERSC: Multiple Choice: What is the 3-letter Koppen classification for low-latitude dry deserts, such as the Sahara?

W. BSh

X. BSk

Y. BWh

Z. BWk

ANSWER: Y

1. Toss-up: ERSC: Multiple Choice: Sinuous, sharp-edged ridges commonly project above the surroundings of a glacier, and originate from the enlargement of cirques produced by plucking and frost action. What are these structures?

W. Horns

X. Arêtes

Y. Troughs

Z. Kettles

ANWER: X

Bonus: ERSC: Short Answer: What is the name of a prehistoric proglacial lake in western Montana that existed as the Pleistocene ice age was drawing to a close between about 15,000 and 13,000 years ago?

ANSWER: Lake Missoula

1. Toss-up: ERSC: Multiple Choice: Which of the following silicate minerals is not rich in Iron and/or Magnesium and is not classified as a dark silicate?

W. Biotite Mica

X. Muscovite Mica

Y. Olivine

Z. Amphibole

ANSWER: X

Bonus: ERSC: Multiple Choice: What is the name of the banded variety of chert, a name used for a number of dense, hard rocks made of microcrystalline quartz? This type of rock is characterized by its fineness of grain and brightness of color.

W. Flint

X. Jasper

Y. Agate

Z. Coquina

ANSWER: Y

1. Toss-up: ERSC: Multiple Choice: Nodules made up mostly of this metal element are found on the ocean floor and are forms of rock concretions.

W. Iron

X. Copper

Y. Nickel

Z. Manganese

ANSWER: Z

Bonus: ERSC: Short Answer: What kind of tidal pattern, common along the Atlantic Coast of the US, consists of 2 high tides and 3 low tides each tidal day, with the two high and low tides about the same height?

ANSWER: Semidiurnal Tidal Pattern

1. Toss-up: Physics: Multiple Choice: Out of the following four compounds/mixtures, which has the largest dielectric constant at 25 degrees C and 1 atm?

W. Vacuum

X. Air

Y. Polystyrene

Z. Ethanol

ANSWER: Z

Bonus: Physics: Multiple Choice: Given that a capacitor with capacitance 2 microF holds a charge of 1 mC between its plates, what is the energy stored in the capacitor?

W. 5 10-4 J

X. 0.25 J

Y. 0.5 J

Z. 500 J

ANSWER: X

1. Toss-up: Physics: Multiple Choice: Assuming ideal conditions and no atomic rotation, what is the high temperature limit for the constant-volume heat capacity of He gas?

W. R

X. 2R

Y. 3/2 R

Z. 5/2 R

ANSWER: Y

Bonus: Physics: Short Answer: Assuming ideal conditions and no atomic rotation, what is the high temperature limit for the adiabatic constant gamma, or the ratio of specific heats, of He gas?

ANSWER: 5/3

1. Toss-up: Physics: Multiple Choice: What is the name of the series of Hydrogen atom emission lines whose home base level is n=1?

W. Lyman series

X. Balmer series

Y. Paschen series

Z. Rydberg series

ANSWER: W

Bonus: Physics: Multiple Choice: Which of the following is the best quantum-mechanical definition of the Bohr radius in the Hydrogen atom?

W. The radius of orbit for the electron in the hydrogen atom

X. The radius which forms a sphere region where the electron is 90% of the time

Y. The most likely radius of orbit for the electron

Z. The outer boundary of the orbit of the electron

ANSWER: Y

1. Toss-up: Physics: Short Answer: If an object is dropped from a building 144 feet above the ground, what is the amount of time it will drop before it hits the ground, rounded to the nearest whole number?

ANSWER: 3 seconds

Bonus: Physics: Short Answer: In engineering, large masses are usually represented in a logarithmic scale, such that we talk about ln (M) rather than M itself. If the natural logarithm of the mass of a rocket decreases from 30 to 25 due to exhaust gases which were moving at 1000 m/s, what is the change in the velocity of the rocket?

ANSWER: 5000 m/s

1. Toss-up: Math: Multiple Choice: Pat has *s* grams of strawberries and uses 40 percent of the strawberries to make pies, each of which requires *p*grams. The rest of the strawberries are used to make pints of jam, each of which requires *j* grams. Which of the following gives the number of pints of jam Pat can make?

W. 2s/5p

X. 2s/5j

Y. 3s/5p

Z. 3s/5j

ANSWER: Y

Bonus: Math: Short Answer: Points A and B are on the surface of a sphere that has a volume of 36 π cubic feet. What is the greatest possible length, in feet, of the geodesic line segment AB?

ANSWER: 3π

1. Toss-up: Math: Multiple Choice: Which of the following could be an antiderivative of the function f(x) = 1/x?

W. 5ln(x)

X. ln(x+5)

Y. ln(5x)

Z. 1/5x

ANSWER: Y

Bonus: Math: Multiple Choice: What is the slope of the tangent line to the hyperbola 4y2 – 9x2 = 16 at the point on the hyperbola where the x coordinate is 1 and the y coordinate is positive?

W. 4/5

X. 7/8

Y. 8/9

Z. 9/10

ANSWER: Z

1. Toss-up: Math: Multiple Choice: The quantity 12100 is not divisible by which of the following numbers?

W. 18

X. 24

Y. 30

Z. 36

ANSWER: Y

Bonus: Math: Short Answer: There are 3 roads from Plattsville to Ocean Heights and 4 roads from Ocean Heights to Bay Cove. If Martina drives from Plattsville to Bay Cove and back, passes through Ocean Heights in both directions, and does not travel any road twice, how many different routes for the trip are possible?

ANSWER: 72

1. Toss-up: Astro: Multiple Choice: Cepheid variable stars are stars whose rotational period is dependent on their mass. Once their rotation is known, the luminosity of the Cepheid star can be found, which is then most commonly used to predict what?

W. Mass

X. Distance

Y. Brightness

Z. Metallicity

ANSWER: X

Bonus: Astro: Short Answer: The photo taken by Hubble in 1995 of the Eagle Nebula elucidated the process by which stars form. On the photo, one can see large spires, possibly up to 60 lightyears in length, which contain small pockets of star formation. What were the protruding spires named?

ANSWER: Pillars of Creation (Accept Rishi’s Wong)

1. Toss-up: Astro: Short Answer: What are the names of the small Texas-sized particles that are numerous small, bright markings dotting the photosphere of the sun?

ANSWER: Granules

Bonus: Astro: Multiple Choice: What are huge, cloudlike structures, which have the appearance of hanging motionless for days at a time, consisting of concentrations of chromospheric gases, that are seen jutting out of the Sun?

W. Quiescent Prominences

X. Eruptive Prominences

Y. Quiescent Solar Flares

Z. Sun Spots

ANSWER: W

1. Toss-up: Astro: Multiple Choice: What is the name of the true period of the Moon’s revolution around the Earth, which takes about 27.3 days?

W. Synodic month

X. Synaptic month

Y. Lunar month

Z. Sidereal month

ANSWER: Z

Bonus: Astro: Short Answer: What is the greatest total number of combined total lunar and solar eclipses that could possibly occur in one year on Earth?

ANSWER: Seven