Sriram Pendyala

Science Bowl

Assorted Science Bowl Round 8: 25 Toss-ups and Bonuses

1. Toss-up: Chemistry: Multiple Choice: Which one of the four following gases would have the highest average molecular speed at 298 K and 1 bar of pressure?

W. O2

X. N2

Y. CH4

Z. CO2

ANSWER: Y

Bonus: Chemistry: Short Answer: A tank containing both HF and HBr gases developed a leak the size of a small pinhole. Assuming ideal behavior, which gas will effuse faster and by what factor, rounded to the closest integer whole number, will it effuse faster?

ANSWER: HF, 2 times as fast as HBr

1. Toss-up: Chemistry: Multiple Choice: Which of the following substances does not form additional hydroxide ions when placed in water?

W. Ionic hydrides

X. Ionic metal oxides

Y. ionic nitrides

Z. nonmetal oxides

ANSWER: Z

Bonus: Chemistry: Multiple Choice: When an ionic hydride, such as sodium hydride, or NaH, is dissolved in water, what are the final products of the dissolution reaction?

W. Na+ and H-

X. Na+, H+, and H2O

Y. Na+, H2, and OH-

Z. Na+, OH-, and H2O

ANSWER: Y

1. Toss-up: Chemistry: Short Answer: What is the molecular geometry and hybridization of the molecule XeO4, assuming all double bonds and no lone pairs on the Xenon atom.

ANSWER: Tetrahedral, sp3

Bonus: Chemistry: Multiple Choice: Using molecular orbital theory, determine the bond order between the two oxygen molecules in the theoretical molecule O2-.

W. 0.5

X. 1

Y. 1.5

Z. 2.0

ANSWER: Y

1. Toss-up: Chemistry: Multiple Choice: Which of the following alcohols will form an alkyl chloride and water upon reaction with strong hydrochloric the fastest at 100 °C?

W. tertiary-butyl alcohol

X. secondary-butyl alcohol

Y. 1-butanol

Z. methanol

ANWER: W

Bonus: Chemistry: Short Answer: Using Zaitsev's rule for regioselectivity, determine the main end product of the reaction of 2-butanol and sulfuric acid at 100 °C to form an alkene by dehydrogenation.

ANSWER: 2-butene

1. Toss-up: Biology: Multiple Choice: In animals whose eggs contain relatively little yolk, the blastocoel is centrally located, and the cleavage furrow passes all the way through the cells. What is the name for this general cleavage pattern seen in frogs, echinoderms, and most chordates?

W. gray crescent cleavage

X. holoblastic cleavage

Y. meroblastic cleavage

Z. gastrulatory cleavage

ANSWER: X

Bonus: Biology: Short Answer: What are the two layers, seperated by the blastocoel, of the blastoderm, which lies atop the yolk mass in a chick embyro?

ANSWER: Epiblast and Hypoblast

1. Toss-up: Biology: Short Answer: What is the name for the resistance cells that some bacteria develop when an essential nutrient is lacking, which is composed of a thick, protective coat that helps them survive in the soil for years?

ANSWER: Endospore

Bonus: Biology: Multiple Choice: What is the name of an ecological relationship between two species where one species benefits while the other is not harmed or helped in any significant way?

W. Mutualism

X. Parasitism

Y. Commensalism

Z. Remedianism

ANSWER: Y

1. Toss-up: Biology: Multiple Choice: In some plants, including grasses, a few leaf cells are produced by areas of meristematic tissue separated from the apical meristem. What is the name for these areas, which remain at the base of leaf blades and stem internodes?

W. intercalary meristems

X. apical meristems

Y. pericyclic meristems

Z. internodal meristems

ANSWER: W

Bonus: Biology: Short Answer: What plant hormone can be produced by almost all plant cells, and may be transported in the phloem or xylem? It inhibits growth, promotes stomatal closure during drought stress, seed dormancy, and leaf senescence.

ANSWER: Abscisic Acid (ABA)

1. Toss-up: Biology: Short Answer: Activated B cells or T cells amplify the response of the binding of an antigen receptor to its specific antigen by dividing many times, produced two types of clones by clonal selection. What are these two types of cells?

ANSWER: Effector Cells and Memory Cells

Bonus: Biology: Multiple Choice: Axons of ganglion cells form the optic nerves that transmit sensations from the eyes to the brain. The two optic nerves from both of the eyes meet at what brain structure near the center of the base of the cerebral cortex?

W. optic chiasm

X. lateral geniculate nuclei

Y. vitreous humor

Z. parietal lobe

ANSWER: W

1. Toss-up: ERSC: Multiple Choice: Beaches may consists of one or more of these, which are relatively flat platforms often composed of sand that are adjaced to coastal dunes or cliffs and marked by a change in slope at the seaward edge.

W. shorlines

X. groins

Y. beach faces

Z. berms

ANSWER: Z

Bonus: ERSC: Short Answer: What are the names given to structures, such as groins, breakwaters, and seawalls, that are built to protect the coast from erosion or to prevent the movement of sand along a beach?

ANSWER: Hard Stabilization

1. Toss-up: ERSC: Short Answer: What type of front forms when an active cold front overtakes a warm front, and wedges the warm front upward, and occurs in a region between the advancing cold air and the air over which the warm air is gliding?

ANSWER: Occluded Front

Bonus: ERSC: Multiple Choice: The formation of this, a vertical cylinder of rotating air about 3-10 kilometers across, occurs in the updraft of a severe thunderstorm and often precedes tornado formation by 30 minutes or so.

W. suction vortex

X. tropical depression

Y. mesocyclone

Z. instability region

ANSWER: Y

1. Toss-up: ERSC: Multiple Choice: What coarse detrital sedimentary rock is composed of angular fragments classified as gravel-sized particles?

W. Conglomerate

X. Breccia

Y. Sandstone

Z. Chert

ANSWER: X

Bonus: ERSC: Short Answer: What metamorphic rock, which has medium to coarse grain size, is produced by metamorphism of Phyllite and is dominated by micas, exhibiting a scaly foliation, but no compositional banding?

ANSWER: Schist

1. Toss-up: Physics: Short Answer: An engineer drills a hole at the center of the disk, and then fastens a bar through this hole. Unfortunately, he finds that he has drilled a hole a little bit off center on the disk, but the bar is still perpendicular to the disk. What theorem must he use to find the new rotational inertia of the disk, given he knows the distance of his drilled hole from the center?

ANSWER: Parallel-Axis Theorem

Bonus: Physics: Short Answer: Using the parallel axis theorem, find the rotational inertia of a disk with a radius 2 meters and mass 1 kilogram, given that the axis of rotation is 0.5 meters from the center of the disk, and parallel to the a line passing through the center that is perpendicular with the disk.

ANSWER: 2.25 kg m2

1. Toss-up: Physics: Multiple Choice: Which of the following statements of the Second Law of Thermodynamics is equivalent to the statement: "There can be no ideal or perfect refrigerator."?

W. Kelvin Statement

X. Carnot Statement

Y. Boltzmann Statement

Z. Clausius Statement

ANSWER: Z

Bonus: Physics: Short Answer: For an ideal monatomic gas, find the adiabatic expansion factor, also called the ratio of specific heats, assuming the equipartition theorem holds true for all temperatures.

ANSWER: 5/3

1. Toss-up: Physics: Multiple Choice: Imagine an electric dipole with charges *+q* and *-q* placed at a distance *d* from each other. How does the electric potential vary with distance from the dipole, assuming all distances are much greater than *d*?

W. it does not vary

X. inversely with the distance

Y. inversely with the square of the distance

Z. inversely with the cube of the distance

ANSWER: Y

Bonus: Physics: Short Answer: For an electron, the magnitude of any measured *z* axis magnetic dipole component of its spin can be written as an integer multiple of this number, which is denoted as the fundamental unit of magnetic moment in quantum electrodynamics.

ANSWER: Bohr Magnetron

1. Toss-up: Physics: Multiple Choice: Assuming baryon number is conserved in the Standard Model of Particle Physics, what is the baryon number for a quark?

W. 0

X. 1/3

Y. 1/2

Z. 1

ANSWER: X

Bonus: Physics: Short Answer: What is the name of the quantum mechanical phenomenon theorized in the 1950's which accounted for discrepancies between observed numbers of neutrinos flowing through the Earth and theories about the solar interior, which stated that the probability of measuring a particular flavor for a neutrino varied periodically as it propagates, and is a violation of the original Standard Model?

ANSWER: Neutrino Oscillation

1. Toss-up: Astro: Multiple Choice: In 1929, Edwin P. Hubble established a connection between the apparent speed of recession *v* of a galaxy and its distance *r* from us. Given that *H* is the Hubble constant, which of the following equations holds the most true?

W. *v = Hr*

X. *v = r/H*

*Y. v = H2r*

Z. *v = Hr2*

ANSWER: W

Bonus: Astro: Short Answer: If we assume that the rate of expansion of the universe is constant, then we can estimate the age *T* of the universe. Give an equation for *T* as a function of *H* given that a galaxy has been receding from out location at a speed *v* since the universe began.

ANSWER: *T = 1/H*

1. Toss-up: Astro: Multiple Choice: By which of the following periods of time after the Big Bang do theorists expect the formation of low mass nuclei, such as 2H, 3He, 4He, and 7Li, as well as plenty of radiation in the form of photons, but a still opaque universe because light cannot travel far without interacting with a nucleus?

W. 10-43 seconds

X. 10-4 seconds

Y. 1 minute

Z. 400,000 years

ANSWER: Y

Bonus: Astro: Short Answer: In 2003, the WMAP mission provided many of the images of the cosmic background radiation. The detector on WMAP detected that the spots in the image subtend an angle of about 1°. What did scientists conclude about the universe using this information?

ANSWER: It was flat

1. Toss-up: Astro: Multiple Choice: Which of the following is most likely to form most of the interstellar medium in the Milky Way?

W. Molecular Hydrogen Clouds

X. H II regions

Y. Cold Neutral Medium

Z. Coronal Gas

ANSWER: Z

Bonus: Astro: Short Answer: What type of hydrogen is the main component of H II gas clouds in space?

ANSWER: Ionized atomic hydrogen

1. Toss-up: Astro: Short Answer: What moon of Jupiter, which is about the size of Mercury, is the third largest moon, by mass, in the solar system and the second largest, by mass, in the Jovian system, and is the only Jovian moon that does not participate it orbital resonance?

ANSWER: Callisto

Toss-up: Astro: Short Answer: What is the name for Europa's most striking surface features, which are a series of dark streaks crisscrossing the entire globe?

ANSWER: Lineae

1. Toss-up: Math: Multiple Choice: Which of the following functions could be an antiderivative of the function f(x) = 2 + 3x2?

W. 6x

X. 1 + 2x + 3x3

Y. 2x + x3 + 1/4

Z. x + x3

ANSWER: Y

Bonus: Math: Short Answer: Find the definite integral of the function f(x) = ln(x) from the endpoints x=1 to x=e.

ANSWER: 1

1. Toss-up: Math: Short Answer: Factor the following polynomial expression and solve over the integers only: 2x2 + 3x +1 = 0

ANSWER: x = -1

Bonus: Math: Multiple Choice: Which of the following theorems states that any integer greater than 1 can be written as a unique product of prime numbers?

W. Fundamental Theorem of Arithmetic

X. Fundamental Theorem of Algebra

Y. Fundamental Theorem of Calculus

Z. Fermat's Last Theorem

ANSWER: W

1. Toss-up: Math: Short Answer: Given that , find f’(x) and f’’(x).

ANSWER: ,

Bonus: Math: Short Answer: What is the name of the hyperbolic cosine curve that is formed when a cable is suspended between two towers?

ANSWER: Catenary

1. Toss-up: GENSCI: Multiple Choice: Recently, a group of three American biologists won the 2009 Nobel Prize for Medicine:

W. for their discovery of how chromosomes are protected by telomeres and the enzyme telomerase

X. for their discovery of HIV

Y. for their discovery of human papilloma viruses causing cervical cancer

Z. for their studies of the structure and function of the ribosome

ANSWER: W

Bonus: GENSCI: Short Answer: What protein, which exhibits fluorescence when exposed to blue light, was the discovery for which Tsien, Shimomura, and Chalfie, two Americans and one Japanese scientist, won the Nobel Prize in Chemistry for 2008?

ANSWER: GFP (Green Fluorescent Protein)

1. Toss-up: GENSCI: Multiple Choice: What element produces a characteristic green color in a flame test and is used in fireworks to display green?

W. Sodium

X. Cesium

Y. Barium

Z. Manganese

ANSWER: Y

Bonus: GENSCI: Short Answer: Name two metal elements from the periodic table that produce a distinctive red color in a flame test.

ANSWER: Accept ANY 2 of the following: Strontium, Calcium, Rubidium, Lithium

1. Toss-up: GENSCI: Short Answer: What is the commercial name for Sodium Thiosulfate, which is used in the film industry?

ANSWER: Hypo

Bonus: GENSCI: Multiple Choice: Hypo is placed on photographic film to dissolve what chemical originally present on the film, developing the picture?

W. Silver Chlorate

X. Silver Chloride

Y. Silver Bromide

Z. Silver Iodide

ANSWER: Y