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Science Bowl Questions: Assorted Round 4: (25 Toss-ups, 25 Bonuses)

1. Toss-up: Chemistry: Multiple Choice: Which of the following is a measure of the sum of kinetic and potential energies of each particle in the system?

W. G, the Gibbs Free Energy

X. H, the Enthalpy

Y. T, the Temperature

Z. E, the Internal Energy

ANSWER: Z

Bonus: Chemistry: Short Answer: Assuming constant volume, what would be the pressure of gas inside of a cylinder if the gas existed at a pressure of 10 atm when the temperature was 400 K but was heated by 200 K?

ANSWER: 15 atmospheres (atm)

1. Toss-up: Chemistry: Multiple Choice: The majority of hydrogen produced in the United States is produced by reacting methane with water to form carbon monoxide and diatomic hydrogen gas. In said reaction, how is the rate of disappearance of methane related to the appearance of hydrogen gas?

W.

X.

Y.

Z.

ANSWER: X

Bonus: Chemistry: Short Answer: The decomposition of ammonia to nitrogen and hydrogen can only occur at a measurable rate on a tungsten filament at 800 °C and high pressures of ammonia. What is the order of the reaction with respect to ammonia?

ANSWER: Zero

1. Toss-up: Chemistry: Multiple Choice: The increased viscosity of molten sulfur at 160 – 195 °C is due to the

W. melting of S8 rings to give discrete S8 units

X. merging of the S8 rings to give interlocking S8 rings

Y. opening of the S8 rings to give smaller S8 units

Z. opening of the S8 rings which then polymerize into long chains

ANSWER: Z

Bonus: Chemistry: Short Answer: What metal is extracted from the crust by use of the Mond Process?

ANSWER: Nickel

1. Toss-up: Chemistry: Multiple Choice: The organic compound group of acetals have which of the following functional groups?

W. one –OH group and one –OR group

X. one –CO group and one –OR group

Y. two –OR groups

Z. two –CO groups

ANSWER: Y

Bonus: Chemistry: Short Answer: What type of organic compound is produced when a ketone undergoes a hydrogenation reaction?

ANSWER: Secondary Alcohol

1. Toss-up: Physics: Multiple Choice: For all elastic compounds, we can say that a given force in a certain direction placing stress on an object will be proportional to the change of length of the object in that direction. What is the name of the limit up to where the above law is a good approximation for many common materials?

W. Elastic Limit

X. Proportional Limit

Y. Breaking Point

Z. Plastic Limit

ANSWER: X

Bonus: Physics: Short Answer: What is the name of the region of object deformation that is in between the elastic limit and its breaking point? If object deformation is in this region, the object will not return to its original length after the removal of the external force.

ANSWER: Plastic Region

1. Toss-up: Physics: Multiple Choice: The statement “There can be no perfect refrigerator” is a direct consequence of which of the following interpretations of the second law of thermodynamics?

W. Kelvin-Planck statement of second law of thermodynamics

X. Carnot statement of the second law of thermodynamics

Y. Clausius statement of the second law of thermodynamics

Z. Boltzmann statement of the second law of thermodynamics

ANSWER: Y

Bonus: Physics: Short Answer: Given that the Stefan-Boltzmann constant is 6.0 \* 10-8 W/m2 K4, calculate the average power emitted from a sphere of material of emissivity 0.5 with surface area 1 m2 if the sphere is at 300 K and the room is at 200 K.

ANSWER: 195 W

1. Toss-up: Physics: Multiple Choice: Which of the following laws predicts that a changing electric flux will produce a magnetic field?

W. Gauss’s Law for Electricity

X. Gauss’s Law for Magnetism

Y. Faraday’s Law of Electromagnetic Induction

Z. Ampere’s Law

ANSWER: Z

Bonus: Physics: Short Answer: Science Olympiad 2008 has returned to haunt Edward and Larry. Before a capacitor is discharged, the voltage across the plates is measured to be 10 V. When the capacitor is discharged, it releases electrical energy used to power the motion of an electric car, weighing 2 kg, up a ramp. Larry measures the change in height of the car to be one meter, but does not know the capacitance of the capacitor. Given that g=10 m/s2, what is the capacitance of the capacitor if no energy is lost?

ANSWER: 2/5 Farad

1. Toss-up: Physics: Multiple Choice: According to the Standard Model of Particle Physics, what is the name of a baryonic particle that contains a strange quark, but no charm quarks or bottom quarks?

W. Hyperon

X. Pion

Y. Meson

Z. Xion

ANSWER: W

Bonus: Physics: Short Answer: In electron capture, a proton captures a high-speed electron to form a neutron. What other particle, a type of neutrino, is radiated in electron capture?

ANSWER: electron neutrino

1. Toss-up: Biology: Multiple Choice: What is the name of the Biological Principle that states that biologists should investigate the simplest explanation that is consistent with the fact?

W. Maximum Simplicity

X. Maximum Likelihood

Y. Maximum Probability

Z. Maximum Parsimony

ANSWER: Z

Bonus: Biology: Short Answer: What is the name of science of using computational methods to analyze and store biological data?

ANSWER: Bioinformatics

1. Toss-up: Biology: Multiple Choice: What is the name of prokaryotes that can use oxygen as a metabolic acceptor but can also carry out anaerobic respiration in an anaerobic environment?

W. Facultative Aerobes

X. Obligate Anaerobes

Y. Facultative Anaerobes

Z. Obligate Aerobes

ANSWER: Y

Bonus: Biology: Short Answer: What are the names of protists that have delicate, intricately symmetrical internal skeletons generally made out of silica and have pseudopodia that radiated from the central body?

ANSWER: Radiolarians

1. Toss-up: Biology: Multiple Choice: What are the names of fungi which lack septa?

W. Ectomycorrhizal

X. Coenocytic

Y. Opisthokont

Z. Nonseptate

ANSWER: X

Bonus: Biology: Short Answer: What is the name of the process in fungi where haploid nuclei contributed by two parents fuse, producing diploid cells, which are then restored to haploid by meiosis?

ANSWER: karyogamy

1. Toss-up: Biology: Multiple Choice: What is the name of the immune process where antibodies bound to antigens present a readily recognized structure for macrophages and therefore increase phagocytosis?

W. neutralization

X. complementation

Y. membrane attack

Z. opsonization

ANSWER: Z

Bonus: Biology: Short Answer: What is the protein present on the surfaces of most cytotoxic T cells that enhances the interaction between a target cell and a cytotoxic T cell?

ANSWER: CD8

1. Toss-up: Math: Multiple Choice: Which of the following is the derivative of the hyperbolic cosine of x?

W. sinh(x)

X. –sinh(x)

Y. –cosh(x)

Z. cosh(x)

ANSWER: W

Bonus: Math: Short Answer: Find the following summation: .

ANSWER: 45/2 or 22 and ½

1. Toss-up: Math: Multiple Choice: Which of the following trigonometric substitutions must be used to find an integral containing ?

W. x=6 sin(u)

X. x=sqrt(6) sin(u)

Y. x=sqrt(6) tan(u)

Z. x=sqrt(6) sec(u)

ANSWER: X

Bonus: Math: Short Answer: Use L’Hopital’s Rule to find .

ANSWER: Zero

1. Toss-up: Math: Multiple Choice: Sally, John’s little sister, says to John one day, “You know, eight years ago, you were twice my age right now.” John remarks back, “Eight years ago, you weren’t even born!” Which of the following values could be the sum of Sally’s and John’s age?

W. Eight

X. Seventeen

Y. Thirty-Three

Z. Sixty Four

ANSWER: X

Bonus: Math: Short Answer: Every morning, Farmer Brown counts the number of legs that he sees in his farm to verify that all the animals are present. Farmer Brown always counts 284 legs in one of his pens that contains cows and chickens. Later in the day, Farmer Brown 59.8 pounds of feed to the cow and chicken pen – each cow eats 1 pound of feed and each chicken eats 3 tenths of a pound of feed. How many animals are in the cow/chicken pen?

ANSWER: 99

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: Find the Maclaurin Polynomials P2 and P3 for .

ANSWER :

1. Toss-up: ERSC: Short Answer: When Bowen was researching the crystallization of magma, what did he observe to be the first mineral to crystallize from magma?

ANSWER: Olivine

Bonus: ERSC: Short Answer: What is the name of the process that involves the formation of one or more secondary magmas from a single parent magma?

ANSWER: Magmatic Differentiation

1. Toss-up: ERSC: Multiple Choice: Which of the following is an example of intraplate volcanism?

W. Andes

X. Ring of Fire

Y. Hawaii

Z. Appalachian

ANSWER: Y

Bonus: ERSC: Multiple Choice: What is produced by the rapid decompression melting of the heat of a mantle plume?

W. Volcanic Trail

X. Hot Spots

Y. Flood Basalts

Z. Laccoliths

ANSWER: Y

1. Toss-up: ERSC: Short Answer: What is the name of a mineral that transmits light but not an image clearly enough to be seen?

ANSWER: Translucent

Bonus: ERSC: Multiple Choice: Some minerals, such as quartz, fracture to produce smooth, curved surfaces resembling broken glass. What are these fractures called?

W. Glassy Fracture

X. Splintery Fracture

Y. Fibrous Fracture

Z. Conchoidal Fracture

ANSWER: Z

1. Toss-up: Astro: Multiple Choice: What is the name of the most general stationary black hole known that has both charge and angular momentum?

W. Reissner-Nordstrom Metric

X. Kerr-Newman Metric

Y. Schwarzchild Metric

Z. Hawking Metric

ANSWER: X

Bonus: Astro: Short Answer: What is the name of a black hole that has been stripped of its event horizon and contains an unshielded singularity that is visible outside the ergosphere?

ANSWER: Naked Singularity

1. Toss-up: Astro: Multiple Choice: Which of the following locations on a HR diagram would be most close to the position of Proxima Centuari?

W. Top Right

X. Bottom Right

Y. Top Left

Z. Bottom Left

ANSWER: X

Bonus: Astro: Short Answer: Name the corner closest to the position of Spica on an HR diagram, as well as the constellation that it is present in.

ANSWER: Top Left, Virgo

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 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 processes 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 dubbed?

ANSWER: Pillars of Creation