Niskayuna Winter Invitational Single Elimination 2

TOSS-UP

1) PHYSICS – *Short Answer*—A 4 ohm resistor and an 8 ohm resistor are connected in parallel. In fractional form, what is the total resistance of this combination in ohms?

ANSWER: 8/3

BONUS

1) PHYSICS – *Short Answer*—By name or number, identify all of the following that are conserved in a series circuit: 1) voltage, 2) resistance, 3) current

ANSWER: 3 ONLY

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TOSS-UP

2) CHEMISTRY – *Short Answer*—How many carbon atoms are present in the organic crown ether 15-crown-5?

ANSWER: 10

BONUS

2) CHEMISTRY – *Short Answer*—According to molecular orbital theory, how many bonding electrons are present in a molecule of F_2?

ANSWER: 10
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TOSS-UP

3) ENERGY – *Short Answer*—The TNM system, standing for tumor, node and metastasis is the most common staging system used for cancer. Under this system, what stage would be assigned to a lung tumor that has metastasized to the larynx?

ANSWER: IV

BONUS

3) ENERGY – *Multiple Choice*—PET scans are a common form of imaging used to diagnose cancers. Which of the following best describes how a PET scan works?
W) A narrow beam of x-rays is aimed, and a computer compiles slices of these images to form an image
X) Magnets are used to force protons to align with a magnetic field. Radio waves are then turned on, moving protons out of their original position, and off again, upon which they return to their original position and send back a radio signal, creating an image
Y) Sound waves are sent throughout the body, where they bounce off structures and return, creating an image
Z) Radioactive glucose is injected, where it will circulate and be absorbed in higher quantities by cells undergoing more metabolic activity, forming an image based on uptake of the radioactive glucose

ANSWER: Z) RADIOACTIVE GLUCOSE IS INJECTED, WHERE IT WILL CIRCULATE AND BE ABSORBED IN HIGHER QUANTITIES BY CELLS UNDERGOING MORE METABOLIC ACTIVITY, FORMING AN IMAGE BASED ON UPTAKE OF THE RADIOACTIVE GLUCOSE

TOSS-UP

4) EARTH AND SPACE – *Short Answer*—Alluvial fans are common features at the base of valleys. Along the base of cliffs, alluvial fans often merge together, creating a linear and continuous slope of sediment. What is the term given to this feature?

ANSWER: BAJADAS

BONUS

4) EARTH AND SPACE – *Multiple Choice*—Which of the following types of dunes would be most likely to form in areas with abundant sand and a strong wind constantly blowing in one direction?
W) barchan
X) star
Y) parabolic
Z) longitudinal

ANSWER: Z) LONGITUDINAL

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TOSS-UP

5) MATH – *Short Answer*—If a square is drawn with a side on each side of a right triangle with legs of 5 and 9, what is the sum of the area of the three squares?

ANSWER: 212

BONUS

5) MATH – *Short Answer*—Find $\sum_{n=1}^{\infty} \frac{n}{2^n}$. (READ AS: The sum from n equals one to infinity of the fraction with numerator n and denominator two to the power of n.)

ANSWER: 2
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TOSS-UP

6) BIOLOGY – *Short Answer*—One of the primary functions of the kidneys is to stimulate red blood cell production through a hormone produced by renal peritubular cells. What is the name of this hormone?

ANSWER: ERYTHROPOIETIN

BONUS

6) BIOLOGY – *Multiple Choice*—Which of the following direct physiological effects of kidney failure would likely not be seen in someone suffering from end-stage renal disease?
W) Brittle bones due to calcium loss
X) Anemia due to low RBC production
Y) Hypotension due to failure to retain water
Z) Edema

ANSWER: Y) HYPOTENSION DUE TO FAILURE TO RETAIN WATER

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TOSS-UP

7) PHYSICS – *Multiple Choice*—A car travels along a straight road with an initial velocity of 30 meters per second and comes to rest after covering a distance of 50 meters due to a constant deceleration. What is the magnitude of the deceleration in meters per second squared?
W) 3
X) 6
Y) 9
Z) 12

ANSWER: Y) 9

BONUS

7) PHYSICS – *Short Answer*—A ball is launched from a 20 meter tall building with a velocity of 40 meters per second at an angle of 30 degrees with respect to the horizontal. Given that the acceleration due to gravity is 10 meters per second squared, how much time, in seconds, does it take for the ball to reach the ground?

ANSWER: 2
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TOSS-UP

8) CHEMISTRY – *Multiple Choice*—Which of the following would you expect to be the pH of the resulting solution of a titration between hydroiodic acid and aluminum hydroxide?

W) 5
X) 7
Y) 9
Z) 11

ANSWER: W) 5

BONUS

8) CHEMISTRY – *Short Answer*—In a Daniell Cell, what metal is used as a reduction agent?

ANSWER: ZINC

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TOSS-UP

9) ENERGY – *Multiple Choice*—Scientists working on Fermilab's Muon g-2 experiment released the world's most precise measurement yet of the anomalous magnetic moment of the muon. Which of the following is closest to how large muons are relative to electrons?
W) 10
X) 50
Y) 100
Z) 200

ANSWER: Z) 200

BONUS

9) ENERGY – *Short Answer*—For the first time since the discovery of X-rays in 1895, scientists at Argonne National Lab have successfully performed x-ray spectroscopy on a single atom. Elemental types and chemical states of an iron and a terbium atom were simultaneously determined using X-rays from what source of electromagnetic radiation?

ANSWER: SYNCHROTRON LIGHT SOURCE
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TOSS-UP

10) EARTH AND SPACE – *Short Answer*—By name or number, order the following three deep waters in order of increasing temperature: 1) North Atlantic Deep Water, 2) Antarctic Bottom Water, 3) Antarctic Intermediate Water

ANSWER: 2, 1, 3

BONUS

10) EARTH AND SPACE – *Multiple Choice*—Lake Moreau in upstate New York is an example of a dimictic lake in which relatively uniform temperatures in the spring and fall allow mixing twice a year. Which of the following is not true about dimictic lakes?
W) In both winter and summer, a warmer layer forms in the upper portions of the lake while the lower layers remain colder
X) The spring overturn is generally much shorter than the fall overturn due to a shorter period in which temperatures in the lake remain uniform
Y) The spring overturn is driven by a combination of the wind and solar convection
Z) Dimictic lakes are typically deeper than polymictic lakes

ANSWER: W) IN BOTH WINTER AND SUMMER, A WARMER LAYER FORMS IN THE UPPER PORTIONS OF THE LAKE WHILE THE LOWER LAYERS REMAIN COLDER

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TOSS-UP

11) MATH – *Multiple Choice*—What is the sum of the coefficients of the trinomial expansion of (3a+b+2c)^4

ANSWER: 1296

BONUS

11) MATH – *Short Answer*—What is an equation of the line tangent to the equation y=$\frac{x^2+5x+6}{x-3}$ at x=1?

ANSWER: $y + 6 = \frac{-11}{4}(x - 1)$ (ACCEPT: $y = \frac{-11}{4}x - \frac{13}{4}$)
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TOSS-UP

12) BIOLOGY – *Multiple Choice*—After a thorough examination of all members of your Science Bowl team, your captain determines that there are too many generalists, who do not specialize in any particular topic. Your captain has every member pick a topic and begin to study it extensively, abandoning other topics. Which of the following forms of selection is exhibited by your captain?
W) Disruptive
X) Balancing
Y) Directional
Z) Stabilizing

ANSWER: W) DISRUPTIVE

BONUS

12) BIOLOGY – *Short Answer*—Your captain is also concerned about the retention rates for new members of Science Bowl. Your captain notes that in the beginning of every season, few members stay past the first few practices, where the greatest proportion of members drop out. However, members that stay past those first few practices tend to have much better retention rates, often staying for the entire season. What type of survivorship curve is exhibited in this case?

ANSWER: III

TOSS-UP

13) PHYSICS – *Multiple Choice*—Which of the following is the power, in watts, exerted by the engine of a 1500 kg car moving at a constant speed of 5 m/s facing a resistance force of 1200N?

W) 6,000
X) 8,000
Y) 10,000
Z) 12,000

ANSWER: W) 6,000

BONUS

13) PHYSICS – *Short Answer*— A 5 kilogram block moving east at 8 m/s strikes a 15 kilogram block at rest. If the two blocks stick together, calculate the block's final velocity.

ANSWER: 2 m/s

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TOSS-UP

14) CHEMISTRY – *Short Answer*—If in the reaction A+B -> C, the plot of ln[A]t versus t is a straight line, what would be the rate law for this reaction, assuming the rate constant is k?

ANSWER: k*[A] (READ AS: K TIMES THE CONCENTRATION OF A)

BONUS

14) CHEMISTRY – *Short Answer*—In a given balloon, if hydrogen gas effuses at a rate of 24 mol/sec, what will be the rate of effusion of oxygen gas?

ANSWER: 6 MOL/SEC
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TOSS-UP

15) ENERGY – *Short Answer*—By name or number, rank the following three hydrocarbon products in order of increasing viscosity: 1) gasoline, 2) kerosene, 3) lubricating oil

ANSWER: 1, 2, 3

BONUS

15) ENERGY – *Multiple Choice*—In hydrocarbon traps, caprocks are responsible for ensuring that hydrocarbons do not migrate to the surface. Which of the following characteristics of a rock would make for the best possible caprock?
W) Low permeability, low porosity
X) Low permeability, high porosity
X) High permeability, low porosity
Z) High permeability, high porosity

ANSWER: W) LOW PERMEABILITY, LOW POROSITY

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TOSS-UP

16) EARTH AND SPACE – *Multiple Choice*—Which of the following is an alternative name for luminous blue variable stars?
W) W Virginis variable
X) S Doradus variable
Y) RR Lyrae variable
Z) flare star

ANSWER: X) S DORADUS VARIABLE

BONUS

16) EARTH AND SPACE – *Multiple Choice*—Which of the following defines the main difference between type II cepheid variable stars and classical cepheid variable stars?
W) type II cepheids are population I stars while classical cepheids are population II stars
X) type II cepheids have variable periods while classical cepheids have regular periods
Y) type II cepheids are less luminous than classical cepheids
Z) type II cepheids are in a binary system while classical cepheids are solitary

ANSWER: Y) TYPE II CEPHEIDS ARE LESS LUMINOUS THAN CLASSICAL CEPHEIDS
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TOSS-UP

17) MATH – *Multiple Choice* — If an equilateral triangle of side length 8 is placed inside an equilateral triangle of side length 12, what is the ratio of the area of the smaller equilateral triangle to the area within the larger triangle but not inside the smaller triangle?

W) 4/9
X) 4/5
Y) 5/4
Z) 9/4

ANSWER: X) 4/5

BONUS

17) MATH – *Short Answer*—If $y \geq \frac{x}{2} + 7$ and $x \geq \frac{y}{2} + 7$, find the minimum value of x + y.

ANSWER: 28

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TOSS-UP

18) BIOLOGY – *Short Answer*—The surface of tree bark often aids in gas exchange. In these cases the bark will have small areas where the cork is raised to allow contact with the outside air. What are these areas of the tree called?

ANSWER: LENTICELS

BONUS

18) BIOLOGY – *Multiple Choice*—Plants with many prickles on its twigs will have an increased amount of which of the following types of tissue?
W) Dermal
X) Ground
Y) Vascular
Z) Cambium

ANSWER: W) DERMAL
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TOSS-UP

19) MATH – *Short Answer*—Evaluate $\int_{-3}^{3}(x^{2023}+2x+\cos x\cdot\sin x)\mathrm{d}x$. (READ AS: The definite integral from negative three to three of x to the two–thousand-twenty-third power plus two x plus cosine x times sine of x, d x).

ANSWER: 0

BONUS

19) MATH – *Short Answer*—A 3 digit number is considered camel-like if its hundreds digit is less than its tens digit, but larger than its units digit. How many camel-like numbers are there?

ANSWER: 120

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TOSS-UP

20) BIOLOGY – *Short Answer*—By name or number, which of the following amino acids would you expect eukaryotic protein methylation to occur? 1) lysine, 2) arginine, 3) histidine

ANSWER: ALL

BONUS

20) BIOLOGY – *Short Answer*—In gluconeogenesis, amino acids can be converted into intermediates of the Krebs cycle. What name is given to amino acids such as leucine and lysine that get converted into acetyl CoA?

ANSWER: KETOGENIC
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