BASH



Double Elimination 1

TOSS-UP

1. Energy *Multiple Choice* Students at Montgomery Blair are electrocuting themselves with an RLC circuit. When the voltage across the inductor in an RLC circuit is at a maximum, which of the following describes the voltage across the capacitor?

W) It is at a maximum
X) It is at a minimum
Y) It is zero
Z) It cannot be determined

ANSWER: X) IT IS AT A MINIMUM

BONUS

1. Energy *Multiple Choice* Students at Amador Valley are observing Edwin He, who has been speaking incoherently. Edwin has recently been hit in the head after forcing BASH staff to write "not stock", but BASH staff isn't sure where he was hit. Edwin appears to be speaking fluidly, although he doesn't realize his speech is incomprehensible. Which of the following locations best identifies the most likely area for this damage to have occurred?

W) Frontal lobe
X) Parietal lobe
Y) Occipital lobe
Z) Temporal lobe

ANSWER: Z) TEMPORAL LOBE

TOSS-UP

2. Earth and Space *Short Answer* The ground is trembling outside Yunyi's house. At first, he thinks Evan is approaching, but when he looks outside, he sees sand boils erupting from the ground and realizes that his house is sinking. This is because of what earthquake-associated phenomenon, where soil loses its cohesion and begins to flow?

ANSWER: LIQUEFACTION

BONUS

2. Earth and Space *Multiple Choice* Edwin has been fishing at the pier for the past 24 hours, and has witnessed two high tides of different heights. Which of the following places could he be?

W) Miami, Florida
X) Bay of Fundy, Nova Scotia
Y) Coney Island, New York
Z) Venice, California

ANSWER: Z) VENICE, CALIFORNIA

TOSS-UP

3. Chemistry *Short Answer* When tert-butoxide is used as a strong base in an E2 reaction, what type of product is favored in the reaction, resulting in the least substituted alkene?

ANSWER: HOFMANN PRODUCT

BONUS

3. Chemistry *Multiple Choice* A certain chemical reaction has equilibrium constant K and standard cell potential E. If the stoichiometric coefficients of all reactants and products are doubled, what are the new equilibrium constant and cell potential, respectively?

W) 2K, E

X) K, 2E

Y) K, E^2

Z) K^2, E

ANSWER: Z) K^2, E

TOSS-UP

4. Physics *Multiple Choice* A spring is cut in half and the two halves are placed next to each other. By what factor is the effective spring constant multiplied by?

W) 1

X) 2

Y) 4

Z) 8

ANSWER: Y) 4

BONUS

4. Physics *Short Answer* To one significant figure and in meters, what is the horizontal distance traveled by a projectile thrown at 10 meters per second at an angle of 75 degrees above the vertical?

ANSWER: 5

TOSS-UP

5. Math *Multiple Choice* The set of solutions to the equation floor of x + floor of the quantity 2x is equal to 10 can be written as an interval. What is the length of the interval?

W) 0.25

X) 0.5

Y) 0.75

Z) 1

ANSWER: X) 0.5

BONUS

5. Math *Short Answer* Two triangles exist on the coordinate plane with vertices on lattice points such that they have equal area. If the second triangle has 3 less lattice points in its interior, how many more lattice boundary points does it have?

ANSWER: 6

TOSS-UP

6. Biology *Short Answer* What hormone secreted during the first trimester of pregnancy acts similarly to luteinizing hormone by stimulating the secretion of progesterone and estrogen?

ANSWER: HUMAN CHORIONIC GONADOTROPIN (ACCEPT: hCG)

BONUS

6. Biology *Multiple Choice* Which of the following best describes the pseudostratified columnar epithelium in the lungs?

W) Thin layer of cells permeable to the diffusion of gas
X) Specialized cells important for the secretion of defensive enzymes fighting against microbes
Y) Ciliated cells that sweep mucus out of the lungs
Z) Multilayered cells that regenerate rapidly to guard against abrasion

ANSWER: Y) CILIATED CELLS THAT SWEEP MUCUS OUT OF THE LUNGS

TOSS-UP

7. Earth and Space *Short Answer* Order the following three planets by increasing orbital eccentricity:

1) Mercury
2) Earth
3) Mars

ANSWER: 2, 3, 1 [EZ]

BONUS

7. Earth and Space *Short Answer* An accretion disk forms on a white dwarf in a binary star system when mass transfers between the two stars at what Lagrange point?

ANSWER: L1

TOSS-UP

8. Chemistry *Short Answer* Ritwik adds a sample of nitrous acid to water and notices that nitric oxide and nitric acid form. This is an example of what specific type of reaction, where an element in one oxidation state is both reduced and oxidized to form two new oxidation states?

ANSWER: DISPROPORTIONATION

BONUS

8. Chemistry *Short Answer* Rohan places a 25-gram sample of a metal with heat capacity one joule per gram-Kelvin at temperature 100 degrees Kelvin into a 50 milliliter beaker of water with heat capacity 4 joules per gram-Kelvin at 10 degrees Kelvin. To one significant figure and in Kelvin, what is the final temperature of this mixture at equilibrium?

ANSWER: 20

TOSS-UP

9. Physics *Short Answer* Order the following three speeds of gas molecules following a Maxwell-Boltzmann distribution from lowest to highest:

1) Most probable speed

2) Root-mean-square speed

3) Average speed

ANSWER: 1, 3, 2

BONUS

9. Physics *Short Answer* An incompressible fluid is flowing through a pipe with a diameter of 4 centimeters at a speed of 7 meters per second. If the pipe suddenly contracts to a new diameter of 2 centimeters, then in meters per second, what is the new speed of the fluid?

ANSWER: 28

TOSS-UP

10. Math *Short Answer* Identify all of the following three statements which are true about the harmonic numbers:

1) They approach infinity

2) The difference between adjacent harmonic numbers approaches 0

3) Their product approaches infinity

ANSWER: ALL

BONUS

10. Math *Short Answer* The hyperfactorial of n is 1 to the power of 1 times 2 to the power of 2 all the way till n to the power of n. How many trailing zeros are at the end of the factorial of the hyperfactorial of 3?

ANSWER: 25

TOSS-UP

11. Biology *Short Answer* Order the following three organelles by when they first appeared during the evolution of eukaryotic cells:

1) Mitochondrion
2) Chloroplast
3) Endoplasmic reticulum

ANSWER: 3, 1, 2

BONUS

11. Biology *Multiple Choice* The loss of an electrochemical gradient in which of the following ions across the plasma membrane of a companion cell would most dramatically impair transport of sugars into sieve tube elements?

W) Hydrogen
X) Sodium
Y) Potassium
Z) Calcium

ANSWER: W) HYDROGEN

TOSS-UP

12. Energy *Short Answer* Students at Amador Valley are studying sorting algorithms. Identify all of the following three sorting algorithms that have a worst case complexity of $O(n^2)$:

1) Bubble sort

2) Merge sort

3) Quicksort

ANSWER: 1 AND 3

BONUS

12. Synergy *Short Answer* Ritwik is testing out new materials for bonesaw creation. If he wants to be able to scratch the deposited minerals on the collagen matrix within bones, identify all of the following three minerals that he can use to make his saw:

1) Fluorite

2) Topaz

3) Microcline

ANSWER: 2 AND 3

TOSS-UP

13. Earth and Space *Short Answer* Identify all of the following four geologic folds that have their oldest rock layers at the center when eroded to ground level:

1) Syncline
2) Anticline
3) Dome
4) Basin

ANSWER: 2 AND 3

BONUS

13. Earth and Space *Short Answer* Precipitation often starts its fall as ice crystals before melting in a warm layer of air in the lower atmosphere. The degree of melting depends on the thickness of this warm layer. Order the following three forms of precipitation by increasing thickness of the warm layer they pass through:

1) Rain
2) Freezing rain
3) Sleet

ANSWER: 3, 2, 1

TOSS-UP

14. Chemistry *Short Answer* Order the following three ligands in order of increasing denticity:

1) Chloride

2) EDTA

3) Oxalate

ANSWER: 1, 3, 2

BONUS

14. Chemistry *Multiple Choice* A certain solution has a 1-molar concentration of a weak acid. If the concentration of the acid were doubled, what would happen to the pH of the solution and the percent ionization of the acid, respectively?

W) Increase, increase

X) Increase, decrease

Y) Decrease, increase

Z) Decrease, decrease

ANSWER: Z) DECREASE, DECREASE

TOSS-UP

15. Physics *Multiple Choice* If the amplitude of a simple harmonic oscillator is doubled, by what factor is the maximum velocity multiplied by?

W) 1/2

X) 1

Y) 2

Z) 4

ANSWER: Y) 2

BONUS

15. Physics *Multiple Choice* The electric field of a uniformly charged rod is E at a distance d away from the rod. If the linear charge density of the rod is multiplied by 2, what is the electric field of the rod at a distance 2d from the rod?

W) E/2

X) E

Y) 2E

Z) 4E

ANSWER: X) E

TOSS-UP

16. Math *Short Answer* How many subsets of the set {1,2,3,4,5,6,7} contain exactly two even integers?

ANSWER: 48

BONUS

16. Math *Short Answer* What is the sum of the reciprocals of the divisors of 36?

ANSWER: 91/36

TOSS-UP

17. Biology *Short Answer* Identify all of the following three scenarios that could result from crossing over happening between misaligned homologs:

1) A gene is duplicated on one chromosome

2) Only one functional copy of a gene remains in the individual

3) Robertsonian translocation

ANSWER: 1 AND 2

BONUS

17. Biology *Multiple Choice* The protective shell or skeleton of which of the following organisms would be least affected by ocean acidification?

W) Corals

X) Sea stars

Y) Diatoms

Z) Forams

ANSWER: Y) DIATOMS

TOSS-UP

18. Earth and Space *Short Answer* Order the following three Milankovitch cycles in order of increasing period:

1) Precession
2) Eccentricity
3) Obliquity

ANSWER: 1, 3, 2

BONUS

18. Earth and Space *Multiple Choice* Which of the following moons has the least eccentric orbit?

W) Titan
X) Ganymede
Y) Triton
Z) Deimos

ANSWER: Y) TRITON

TOSS-UP

19. Chemistry *Short Answer* Rohan the magician synthesizes an element that has only two electrons in the 2p subshell, but is diamagnetic. What rule does this element most directly violate?

ANSWER: HUND'S RULE

BONUS

19. Chemistry *Short Answer* A certain chemical reaction has a standard change in enthalpy of 100 kilojoules per mole and a standard change in entropy of 250 joules per mole Kelvin. To 1 significant figure and in Kelvins, at what temperature does this reaction first become spontaneous?

ANSWER: 400

TOSS-UP

20. Physics *Short Answer* In semiconductor physics, the band gap separates the valence band from what other band consisting of freely-moving electrons?

ANSWER: CONDUCTION BAND

BONUS

20. Physics *Short Answer* If the damping constant for a damped spring-mass system takes on a certain value, the system will go to equilibrium in the shortest amount of time without oscillation. What is the term for this type of damping?

ANSWER: CRITICAL DAMPING

TOSS-UP

21. Math *Multiple Choice* If three dice are rolled, what is the probability the maximum number rolled is a 3?

W) 7/216

X) 11/216

Y) 5/72

Z) 19/216

ANSWER: Z) 19/216

BONUS

21. Math *Short Answer* Two circles with radius 4 have centers A and B respectively, and each circle's center lies on the other circle. The circles intersect at X and Y. Calculate the area of quadrilateral AXBY.

ANSWER: 8sqrt(3)

TOSS-UP

22. Biology *Multiple Choice* Which of the following actions would not be stimulated by the sympathetic nervous system?

W) Constriction of bronchioles

X) Dilation of the pupil

Y) Glycogenolysis

Z) Activation of the adrenal medulla

ANSWER: W) CONSTRICTION OF BRONCHIOLES

BONUS

22. Biology *Short Answer* Order the following three steps in the replicative cycle of HIV from earliest to latest starting when HIV first binds to CD4 receptors:

1) A capsid assembles around the viral genome

2) A provirus is integrated into the host

3) Reverse transcriptase is synthesized from the host genome

ANSWER: 2, 3, 1

TOSS-UP

23. Energy *Short Answer* Students at Amador Valley are studying alloys. Identify all of the following alloys that are considered heterogeneous:

1) Brass
2) Bronze
3) Steel

ANSWER: NONE

BONUS

23. Synergy *Multiple Choice* Gaurav is conducting a chemistry experiment. He has 27 cups in a line, each containing 100 mL of a liquid. The first cup has a pH of 1 and each subsequent cup has a pH 0.5 units higher than the previous one. He dilutes each cup by adding 900 mL of pure water to each one. For each cup, he re-measures the pH and calculates the change in pH from the original. He plots the magnitude of all the changes in pH in a histogram. Which of the following shapes does the histogram possess?

W) Skewed left
X) Skewed right
Y) Approximately normal
Z) Approximately uniform

ANSWER: W) SKEWED LEFT
