BASH



Round Robin 5

TOSS-UP

1. Energy *Short Answer* Students at Amador Valley are learning how to correctly perform systematic samples. Given a large enough sample size, identify all of the following three scenarios in which a systematic random sample might lead to significant bias:

1) The participants are lined up alternating in gender
2) The participants are lined up in height order
3) The participants are lined up in age order

ANSWER: 1 ONLY

BONUS

1. Energy *Multiple Choice* Students at Montgomery Blair High school love positivity, which is why they love positive gene regulation. Which of the following methods of gene regulation would be something the students adore?

W) Allolactose binding to the lac operon repressor
X) Tryptophan binding to the trp operon repressor
Y) cAMP binding to the CRP protein
Z) cGMP binding to the CRP protein

ANSWER: Y) CAMP BINDING TO THE CRP PROTEIN

TOSS-UP

2. Earth and Space *Short Answer* Order the following three types of volcanoes by increasing average flank steepness:

1) Cinder cone
2) Stratovolcano
3) Shield volcano

ANSWER: 3, 2, 1

BONUS

2. Earth and Space *Short Answer* Identify all of the following three statements about a typical mid-latitude cyclone in the US that are true:

1) It moves with upper-level winds from west to east
2) It rotates clockwise
3) It forms a stationary front just before dissipating

ANSWER: 1 ONLY

TOSS-UP

3. Chemistry *Multiple Choice* Katherine has 1 gram of various nitrogen oxides and wishes to burn them. Which of the following nitrogen oxides would yield the most nitrogen gas when 1 gram is burned?

W) N_2O

X) NO

Y) N_2O_2

Z) N_2O_5

ANSWER: W) N_2O

BONUS

3. Chemistry *Short Answer* Katherine combusts 2 liters of benzene in excess oxygen and collects the resulting gas that forms. Given that all the products are in the gas phase, what is the combined volume of all the gas that she collects?

ANSWER: 18

TOSS-UP

4. Physics *Short Answer* A planet orbiting around a star in a circular orbit has kinetic energy 200 Joules. In Joules, what is the potential energy of the system?

Answer: -400

BONUS

4. Physics *Multiple Choice* Three charged particles A, B, and C are in a plane. The magnitude of the electric force between A and B is 1 Newton and the magnitude of the electric force between A and C is 0.2 Newtons. In Newtons, which of the following could be the magnitude of the net electric force on A from B and C?

W) 0.5

X) 0.7

Y) 0.9

Z) 1.4

ANSWER: Y) 0.9

TOSS-UP

5. Math *Short Answer* Identify all of the following three numbers which are squarefree:

1) 2023

2) 2024

3) 2025

ANSWER: NONE

BONUS

5. Math *Short Answer* How many distinct permutations of the word BANANA start and end with a different letter?

ANSWER: 44

TOSS-UP

6. Biology *Short Answer* When an elk migrates permanently from sea level to higher elevations, it adjusts to the lower oxygen levels over the course of several days by breathing more deeply and excreting more alkaline urine. What term best describes this shift in homeostasis in response to a sustained environmental change?

ANSWER: ACCLIMATIZATION (ACCEPT: ACCLIMATION)

BONUS

6. Biology *Multiple Choice* A remote population of humans recently had a large malaria outbreak. As avid biology enthusiasts, they know they can utilize genetics and the sickle cell anemia allele to improve their malaria resistance. Which of the following strategies should they employ?

W) Forced outbreeding to increase heterozygosity
X) Forced outbreeding to increase homozygosity
Y) Forced inbreeding to increase heterozygosity
Z) Forced inbreeding to increase homozygosity

ANSWER: W) FORCED OUTBREEDING TO INCREASE HETEROZYGOSITY

TOSS-UP

7. Earth and Space *Short Answer* Order the following three gases by increasing abundance in Venus' atmosphere:

1) Nitrogen
2) Sulfuric acid
3) Carbon dioxide

ANSWER: 2, 1, 3

BONUS

7. Earth and Space *Short Answer* Identify all of the following three statements that are true of eclipses:

1) A partial or total lunar eclipse occurs every full moon
2) Annular eclipses are caused by the eccentricities of the Moon's and Earth's orbits
3) The Solar cycle is the period for occurrences of eclipses

ANSWER: 2 ONLY

TOSS-UP

8. Chemistry *Multiple Choice* Evan is naming two organic compounds and identifies them as 1-butanol and 2-butanol. Which of the following best describes the relationship between these two compounds?

W) Stereoisomers

X) Geometric isomers

Y) Structural isomers

Z) Identical

ANSWER: Y) STRUCTURAL ISOMERS

BONUS

8. Chemistry *Multiple Choice* Edwin has a solution of unknown cations and adds excess fluoride, but notices no precipitate formation. Which of the following cations could NOT be present in his solution?

W) Na^{+}

X) Pb^{2+}

Y) Ag^{+}

Z) K^{+}

ANSWER: X) Pb^{2+}

TOSS-UP

9. Physics *Short Answer* A rock thrown at a 30-degree angle above the horizontal attains a maximum height of 5 feet. A second rock is thrown from the same initial height and with the same initial speed as the first, but at a 60-degree angle above the horizontal. Assuming negligible air resistance and in feet, what is the maximum height attained by the second rock?

ANSWER: 15

BONUS

9. Physics *Short Answer* A ball is travelling in a vertical loop with radius 20 centimeters. What is the minimum speed that the ball must have at the top of the loop so that it can complete the loop?

ANSWER: 1.4

TOSS-UP

10. Math *Short Answer* Let A and B be two independent events. Identify all of the following three statements that must be true:

1) The probability of both A and B occurring is equal to the product of the probability of A occurring and the probability of B occurring
2) The probability of A occurring given B occurred is equal to the probability of A occurring
3) The probability of A or B occurring is equal to the sum of the probability of A occurring and the probability of B occurring

ANSWER: 1 AND 2

BONUS

10. Math *Short Answer* How many positive integers x are there such that a triangle with sides of length 9, 12, and x is acute?

ANSWER: 7

TOSS-UP

11. Biology *Short Answer* Defensive adaptations such as body armor and sharp spines first appeared during what event in geologic time, characterized by a rapid burst of evolution 540 million years ago?

ANSWER: CAMBRIAN EXPLOSION

BONUS

11. Biology *Multiple Choice* Enhancers can activate the expression of certain genes, despite being thousands of base pairs away. Which of the following best explains why this is possible?

W) Enhancers code for activators that are able to directly bind to the promoter
X) Enhancers trigger a domino effect where activation of closer genes, eventually activates genes farther away
Y) General transcription factors are activated when bound to enhancers, which then dissociate to target a promoter
Z) Mediator proteins can bend the DNA strand to increase the proximity of activators bound to enhancers

ANSWER: Z) MEDIATOR PROTEINS CAN BEND THE DNA STRAND TO INCREASE THE PROXIMITY OF ACTIVATORS BOUND TO ENHANCERS

TOSS-UP

12. Energy *Short Answer* Students at Montgomery Blair are looking at real and generated data. What is the name for the component in a Generative Adversarial Network that is responsible for evaluating and distinguishing between real and generated data?

ANSWER: DISCRIMINATOR

BONUS

12. Energy *Short Answer* Students at Amador Valley are attempting to create a star for a group project. Identify all of the following three conditions they would want to minimize:

1) External magnetic field
2) Temperature of gasses
3) Turbulence

ANSWER: ALL

TOSS-UP

13. Earth and Space *Multiple Choice* Which of the following coastal features is formed through deposition?

W) Tombolo
X) Marine terrace
Y) Sea stack
Z) Sea arch

ANSWER: W) TOMBOLO

BONUS

13. Earth and Space *Short Answer* Identify all of the following 3 factors that, when increased, increase the velocity of a mass movement:

1) The angle of the slope
2) The air content of the moving material
3) The coefficient of kinetic friction of the failure surface

ANSWER: 1 AND 2

TOSS-UP

14. Chemistry *Short Answer* Identify all of the following 3 processes that are exothermic:

1) First electron affinity of fluorine

2) Second electron affinity of fluorine

3) First ionization energy of fluorine

ANSWER: 1 ONLY

BONUS

14. Chemistry *Multiple Choice* Which of the following compounds would evolve a colorless gas with a strong odor when concentrated HCl is added to it?

W) CaF_2

X) BaO

Y) Na_2S

Z) KNO_3

ANSWER: Y) Na_2S

TOSS-UP

15. Physics *Short Answer* If the planet's radius is held constant, to what power of the planet's mass is the escape velocity proportional?

ANSWER: 0.5

BONUS

15. Physics *Multiple Choice* A pendulum is attached to the ceiling of an elevator, which is initially at rest. The pendulum oscillates with a period of 5 seconds. If the elevator begins accelerating downwards at 4.9 meters per second squared, then in seconds, which of the following is closest to the pendulum's new period of oscillation?

W) 3

X) 4

Y) 7

Z) 10

ANSWER: Y) 7

TOSS-UP

16. Math *Short Answer* What is the limit as x approaches 0 of the sine of x over the quantity 3x?

ANSWER: 1/3

BONUS

16. Math *Short Answer* Rohan has a geometric series with first term 1 and sum 4/3. If he multiplies every other term by -1 starting with the 2nd term, what is the sum of his new series?

ANSWER: 4/5

TOSS-UP

17. Biology *Multiple Choice* Lenticels in the bark are analogous to which of the following structures in the leaf?

W) Trichomes

X) Petioles

Y) Cuticles

Z) Stomata

ANSWER: Z) STOMATA

BONUS

17. Biology *Multiple Choice* In RT-PCR, reverse transcriptase synthesizes cDNA from a mRNA template in the 5 prime to 3 prime direction. A DNA primer, however, is required to initiate synthesis of cDNA. Which of the following oligonucleotide primers would reverse transcriptase start from?

W) Poly-A

X) Poly-T

Y) Poly-C

Z) Poly-G

ANSWER: X) POLY-T

TOSS-UP

18. Earth and Space *Short Answer* What is the name of the large eruption of solar plasma from the Sun following a reconnection event?

ANSWER: CORONAL MASS EJECTION

BONUS

18. Earth and Space *Short Answer* Identify all of the following three statements that are true of solar granules:

1) They form in the photosphere
2) The centers of granules are rising
3) Dark regions of granules are hotter

ANSWER: 1 AND 2

TOSS-UP

19. Chemistry *Short Answer* Identify all of the following 3 metal ions that are colored in aqueous solution:

1) Na^{+}

2) Fe^{2+}

3) Zn^{2+}

ANSWER: 2 ONLY

BONUS

19. Chemistry *Short Answer* How many stereoisomers does 4-bromo-3-methyl-2-pentene have?

ANSWER: 4

TOSS-UP

20. Physics *Short Answer* If the inductance and capacitance of an LC circuit are both doubled, by what factor is the oscillation frequency of the circuit multiplied?

Answer: 0.5

BONUS

20. Physics *Short Answer* A statistical system initially has 9 microstates. If the system expands so that it now has 27 microstates, by what factor is the entropy of the system multiplied?

ANSWER: 3/2

TOSS-UP

21. Math *Multiple Choice* How many four-digit positive integers are there such that the sum of their digits is 4?

W) 5

X) 10

Y) 15

Z) 20

ANSWER: Z) 20

BONUS

21. Math *Short Answer* From a group of 6 men and 4 women, a committee of 3 is chosen. How many such committees contain at least two women?

ANSWER: 40

TOSS-UP

22. Biology *Short Answer* Identify all of the following three anterior pituitary hormones that have tropic effects:

1) Prolactin

2) MSH

3) FSH

ANSWER: 3 ONLY

BONUS

22. Biology *Short Answer* Identify all of the following three types of monomers that were created in the Miller-Urey experiment:

1) Monosaccharides

2) Nucleotides

3) Amino acids

ANSWER: 3 ONLY

TOSS-UP

23. Energy *Short Answer* Students at Amador Valley are studying antimatter to annihilate each other. Identify all of the following three properties that the antiproton possesses:

1) Positive charge

2) Integer spin

3) Mass

ANSWER: 3 ONLY

BONUS

23. Synergy *Short Answer* Identify all of the following three ores that contain a diamagnetic metal cation:

1) Galena

2) Malachite

3) Rutile

ANSWER: 1 AND 3
