BASH



Round Robin 3

TOSS-UP

1. Energy *Short Answer* Students at Amador Valley are training their AI. What training difficulty occurs in deep neural networks when gradients shrink exponentially through layers during backpropagation?

ANSWER: VANISHING GRADIENT

BONUS

1. Energy *Short Answer* Students are studying the formation of Amador Valley, which was formed from fluvial erosion. Identify all of the following 3 features that can be found in Amador Valley:

1) Interlocking spurs
2) Hanging valley
3) Point bar

ANSWER: 1 AND 3

TOSS-UP

2. Earth and Space *Multiple Choice* Which of the following igneous features is massive rather than tabular?

W) Dike
X) Sill
Y) Batholith
Z) Pipe

ANSWER: Y) BATHOLITH

BONUS

2. Earth and Space *Short Answer* Identify all of the following three atmospheric circulation cells in which the prevailing winds flow from the west:

1) Northern hemisphere Polar cell
2) Northern hemisphere Hadley cell
3) Southern hemisphere Ferrel cell

ANSWER: 3 ONLY

TOSS-UP

3. Chemistry *Short Answer* Geckos can walk up walls because of what kind of electrostatic attraction, which occurs when electrons are unevenly distributed within each molecule?

ANSWER: LONDON DISPERSION FORCES (ACCEPT: LDF, VAN DER WAALS FORCES)

BONUS

3. Chemistry *Short Answer* The change in entropy of a system is equal to the change in heat added divided by what quantity?

ANSWER: TEMPERATURE

TOSS-UP

4. Physics *Multiple Choice* Which of the following particles has no mass?

W) W boson

X) Photon

Y) Electron

Z) Electron neutrino

ANSWER: X) PHOTON

BONUS

4. Physics *Short Answer* Giving your answer as a percentage, what is the efficiency of an ideal Carnot engine with a hot reservoir at a temperature of 150 Kelvin and a cold reservoir at a temperature of 60 Kelvin?

Answer: 60%

TOSS-UP

5. Math *Short Answer* Identify all of the following three statements that are true about the difference between a complex number and its conjugate:

1) It is always real

2) It is always imaginary

3) It is never real

ANSWER: 2 ONLY

BONUS

5. Math *Short Answer* How many pairs of integers (x,y) satisfy the inequality $|x| + |y| \leq 3$ **[absolute value of x plus absolute value of y is at most 3]**?

ANSWER: 25

TOSS-UP

6. Biology *Short Answer* Digested DNA can encourage cultured plant cells to divide. This is because adenine is the precursor to what class of plant hormones?

ANSWER: CYTOKININS

BONUS

6. Biology *Multiple Choice* Which of the following pathways best describes the intracellular route cortisol takes during its secretion?

W) Rough ER to Golgi apparatus to plasma membrane

X) Smooth ER to Golgi apparatus to plasma membrane

Y) Rough ER to plasma membrane

Z) Smooth ER to plasma membrane

ANSWER: Z) SMOOTH ER TO PLASMA MEMBRANE

TOSS-UP

7. Earth and Space *Short Answer* Saturn's E ring is replenished by the cryovolcanism of which of Saturn's moons?

ANSWER: ENCELADUS

BONUS

7. Earth and Space *Multiple Choice* Which of the following best describes how the positions of sunspots move over the course of the solar cycle?

W) From east to west
X) From west to east
Y) From the poles to the equator
Z) From the equator to the poles

ANSWER: Y) FROM THE POLES TO THE EQUATOR

TOSS-UP

8. Chemistry *Multiple Choice* Which of the following elements has a green flame color?

W) Barium

X) Rubidium

Y) Strontium

Z) Iron

ANSWER: W) BARIUM

BONUS

8. Chemistry *Short Answer* How many major resonance structures does the sulfate anion, or SO_4^{2-}, have?

ANSWER: 6

TOSS-UP

9. Physics *Multiple Choice* A current-carrying wire produces a magnetic field with strength B at a distance R away from the wire. In terms of B, what is the strength of the magnetic field at a distance 2R away from the wire?

W) 4B

X) 2B

Y) B/2

Z) B/4

ANSWER: Y) B/2

BONUS

9. Physics *Short Answer* In ohms, what is the equivalent resistance of a 1-ohm and 2-ohm resistor connected in parallel, which is then connected to a 3-ohm resistor in series?

ANSWER: 11/3

TOSS-UP

10. Math *Short Answer* In a regular polygon, the sum of the interior angles is 1440. What is the measure of each interior angle?

ANSWER: 144

BONUS

10. Math *Short Answer* The ratio of the number of diagonals to the number of sides in a regular polygon is 7. How many sides does the polygon have?

ANSWER: 17

TOSS-UP

11. Biology *Short Answer* Identify all of the following three organs that glucagon primarily acts upon:

1) Liver
2) Smooth muscles
3) Stomach

ANSWER: 1 ONLY

BONUS

11. Biology *Multiple Choice* The condition cor pulmonale, characterized by hypertension in the pulmonary circulation of humans, would most likely cause hypertrophy of which of the following chambers of the heart?

W) Left ventricle
X) Left atrium
Y) Right ventricle
Z) Right atrium

ANSWER: Y) RIGHT VENTRICLE

TOSS-UP

12. Energy *Multiple Choice* Students at Amador Valley have no academic potential, so they turn to electric potential. In an electric circuit, what best describes the direction of electron flow in terms of electric potential?

W) Low potential to high potential
X) High potential to low potential
Y) Maintains the same potential
Z) Depends on the magnitude of current

ANSWER: W) LOW POTENTIAL TO HIGH POTENTIAL

BONUS

12. Energy *Short Answer* Students at Amador Valley might get a 1 on their AP Statistics test. What is the ratio of the population standard deviation to the sample standard deviation when the list has size 9?

ANSWER: 2sqrt(2)/3

TOSS-UP

13. Earth and Space *Short Answer* When one cut bank of a meandering stream migrates far enough downstream, it can merge with the cut bank ahead of it, pinching off the meander in between. This stagnant meander becomes what feature?

ANSWER: OXBOW LAKE

BONUS

13. Earth and Space *Multiple Choice* Fulgurites are a type of rock formed when lightning melts and fuses soil, which recools rapidly. Given this, which of the following would you expect to have the closest crystal structure to a fulgurite made of pure silica?

W) Olivine
X) Biotite
Y) Quartz
Z) Obsidian

ANSWER: Z) OBSIDIAN

TOSS-UP

14. Chemistry *Short Answer* Order the following three cubic lattice types in order of increasing packing efficiency:

1) Face-centered cubic
2) Simple cubic
3) Body-centered cubic

ANSWER: 2, 3, 1

BONUS

14. Chemistry *Short Answer* The boiling point of the hydrogen halides generally increases down the halogen group, with the exception of hydrogen fluoride. What phenomenon in hydrogen fluoride causes this exception?

ANSWER: HYDROGEN BONDING

TOSS-UP

15. Physics *Multiple Choice* How many up quarks are in a neutron?

W) 0

X) 1

Y) 2

Z) 3

Answer: X) 1

BONUS

15. Physics *Short Answer* Olivia walks to the park at a speed of 2 mph. She walks back along the same path, but taking twice the time. What is her average speed for the round trip?

ANSWER: 4/3

TOSS-UP

16. Math *Short Answer* How many nonempty subsets of the first 10 positive integers have an even sum?

ANSWER: 511

BONUS

16. Math *Short Answer* If the log base 2 of x + the log base 4 of x + the log base 8 of x is 11, then what is x?

ANSWER: 64

TOSS-UP

17. Biology *Short Answer* Identify all of the following three statements that are true about the xylem:

1) Minerals are transported with water in the xylem
2) Water is forced up the xylem primarily by high water pressure in the roots
3) A more humid climate would favor water transport in the xylem

ANSWER: 1 ONLY

BONUS

17. Biology *Short Answer* Ritwik is investigating the inheritance pattern of the leg color trait in fruit flies, which has two alleles: wild-type black legs and mutant white legs. He crosses a true-breeding white-legged female with a true-breeding black-legged male and observes that all offspring have white legs. Identify all of the following three inheritance patterns he can reasonably rule out as not possible:

1) X-linked recessive
2) X-linked dominant
3) Y-linked

ANSWER: 1 AND 3

TOSS-UP

18. Earth and Space *Short Answer* Order the following three hydrogen spectral line series in increasing energy of emitted photons:

1) Balmer

2) Paschen

3) Lyman

ANSWER: 2, 1, 3

BONUS

18. Earth and Space *Short Answer* For a blackbody, the wavelength of maximum emission is proportional to its temperature raised to what power?

ANSWER: -1

TOSS-UP

19. Chemistry *Multiple Choice* Which of the following nitrogen-containing compounds contains a nitrogen atom in the highest oxidation state?

W) Nitric acid

X) Nitrous acid

Y) Nitric oxide

Z) Nitrous oxide

ANSWER: W) NITRIC ACID

BONUS

19. Chemistry *Short Answer* If the initial half-life of the first-order decomposition of compound X is 15 seconds, then what is the half-life of the reaction, in seconds, after 75% of X has decomposed?

ANSWER: 15

TOSS-UP

20. Physics *Short Answer* Two resistors with resistances 1-ohm and 2-ohm are connected in parallel in a circuit. If the potential difference across the 1-ohm resistor is 5 volts, then in volts, what is the potential difference across the 2-ohm resistor?

ANSWER: 5

BONUS

20. Physics *Short Answer* A mass oscillating on a spring has a period of 10 seconds. The spring is then cut in half, and one piece is reattached to the original mass. What is the new period of the spring-mass system?

ANSWER: 5sqrt(2)

TOSS-UP

21. Math *Short Answer* Order the following three functions from least to greatest as n approaches infinity:

1) e^n

2) $n!$

3) n^2

ANSWER: 3, 1, 2

BONUS

21. Math *Short Answer* The tangent line to a function f(x) at x = 1 is given by y = 2x - 3. What is the tangent line to the function f(x)/2 + 3 at x = 1?

ANSWER: y=x+3/2

TOSS-UP

22. Biology *Short Answer* The synaptonemal complex holds nonsister chromatids together, allowing cleaved DNA from homologs to join at what sites on the chromosomes where crossing over takes place?

ANSWER: CHIASMATA

BONUS

22. Biology *Multiple Choice* Charophytes **[KARE-oh-fites]** are the closest living ancestor of plants evident by how they share certain distinctive traits. Which of the following characteristics would charophytes possess that other algaes would not share?

W) Forming colonies with organisms of the same species
X) Using chlorophyll a for photosynthesis
Y) Possessing a multicellular holdfast to anchor to the seafloor
Z) Producing a durable polymer called sporopollenin to protect the zygote from drying out

ANSWER: Z) PRODUCING A DURABLE POLYMER CALLED SPOROPOLLENIN TO PROTECT THE ZYGOTE FROM DRYING OUT

TOSS-UP

23. Energy *Multiple Choice* Students at Amador Valley notice many parallels between Ritwik and Lebron James. Parallelism can also be found in leaf venation. If a flower has parallel leaf venation, which of the following characteristics would it also possess?

W) Floral organs in multiples of four
X) Pollen grain with one opening
Y) Taproot system
Z) No pith in the roots

ANSWER: X) POLLEN GRAIN WITH ONE OPENING

BONUS

23. Synergy *Multiple Choice* If the system is defined as a set section of the blood vessel lumen, which of the following will most directly increase the entropy of the system?

W) Stimulating receptors that bind to nitric oxide
X) Stimulating receptors that bind to angiotensin II
Y) Stimulating receptors that bind to insulin
Z) Stimulating receptors that bind to calcitonin

ANSWER: W) STIMULATING RECEPTORS THAT BIND TO NITRIC OXIDE
