2025 Iolani Science Bowl Invitational
Round Robin 1

Tossup

1) Physics - *Short Answer* What is the radial acceleration, in meters per second squared, of an object undergoing uniform circular motion in a circle with radius 5 meters and speed 5 meters per second?

Answer: 5 [RE]

Bonus

1) Physics - *Short Answer* Identify all of the following three conditions in which mechanical energy is conserved. I. An aircraft taking off; II. A perfectly inelastic collision; III. A launched ball bouncing off a wall at its peak and returning to its launch point;

Answer: III only [RE]

Tossup

2) Chemistry - *Multiple Choice* Which of the following atoms would require the most energy to remove an electron from?

W) Gallium
X) Aluminum
Y) Silicon
Z) Carbon

Answer: Z) CARBON [AI]

Bonus

2) Chemistry - *Short Answer* Rank the following three orbitals in order of increasing energy.
I. 3d;
II. 4s;
III. 4p.

Answer: II, I, III: 4s, 3d, 4p [AI]

Tossup

3) Biology [Early RR] - *Short Answer* Identify all of the following four macromolecule classes that contain significant amounts of sulfur: I. Proteins; II. Carbohydrates; III. Lipids; IV. Nucleic Acids

Answer: I only

Bonus

3) Biology [Early RR] - *Short Answer*: When joining two amino acids in a peptide bond to form a polymer, what molecule is produced?

Answer: WATER (ACCEPT: H2O)

Tossup

4) Energy - *Short Answer* What is 5 XOR [X-or] 3?

Answer: 6 [MS]

Bonus

4) Energy - *Short Answer* Often, data has patterns to it that allow us to create a version of it using less bits than the original data. What is the process of creating these versions called?

Answer: COMPRESSION [MS]

Tossup

5) Earth and Space [RR] - *Short Answer* What is the term for the area surrounding a star in which liquid water can exist?

Answer: HABITABLE ZONE (Accept: GOLDILOCKS ZONE) [AI]

Bonus

5) Earth and Space [RR] - *Multiple Choice* One would expect the largest habitable zone to be found around what spectral class of star?

W) O
X) A
Y) F
Z) M

Answer: W) O [AI]

Tossup

6) Math [RR] - *Short Answer* A paper airplane is descending at a rate of 2 m/s. How long, in seconds, will it take the airplane to descend 54 meters?

Answer: 27 seconds [HK]

Bonus

6) Math [RR] - *Short Answer* Brennan is 4 years older than Hee. If the sum of their ages is 20, what is the sum of twice Brennan's age and three times Hee's age?

Answer: 48 [HK]

Tossup

7) Physics - *Short Answer* A string is wrapped around a pulley and is used to lift a 50 newton block at constant speed. In newtons, what is the force pulling on the pulley?

Answer: 100 NEWTONS [RE]

Bonus

7) Physics - *Multiple Choice* An adiabatic process is best defined in which there is zero of which of the following?

W) Heat exchanged with environment
X) Change in temperature
Y) Change in entropy|
Z) Change in pressure

Answer: W) HEAT EXCHANGED WITH ENVIRONMENT [RE]

Tossup

8) Chemistry - *Short Answer* Identify all of the following three processes that decrease the entropy of a system? I. sublimation; II. freezing; III. separation.

Answer: II and III [AI]

Bonus

8) Chemistry - *Multiple Choice* Compound A is undergoing a reaction which has a first-order rate law with respect to A. Initially, the concentration of A is 0.500 M. After 20 seconds, its concentration is 0.250 M. What will be the molar concentration of A after 40 seconds have passed?

W) 0.000
X) 0.125
Y) 0.200
Z) 0.500

Answer: X) 0.125 [AI]

Tossup

9) Biology [Early RR] - *Multiple Choice* Which of the following cellular elements would not be typically found in a bacterium?

W) Ribosomes
X) DNA
Y) Plasma Membrane
Z) Nucleus

Answer: Z) NUCLEUS

Bonus

9) Biology [Early RR] - *Multiple Choice* Organisms with cells that contain a nucleus, such as animals and plants, fall into which domain?

W) Bacteria
X) Archaea
Y) Eukarya
Z) Protista

Answer: Y) EUKARYA

Tossup

10) Energy - *Short Answer* In statistics, what theorem states that the normalized distribution of a sample mean converges to the normal distribution as the number of samples approaches infinity?

Answer: CENTRAL LIMIT THEOREM [MS]

Bonus

10) Energy - *Multiple Choice* In which of the following data structures is there always a unique path between two nodes?

W) Complete Graph
X) Tree
Y) Bipartite Graph
Z) Multigraph

Answer: X) TREE [MS]

Tossup

11) Earth and Space - *Short Answer* What rock makes up the majority of oceanic tectonic plates?

Answer: BASALT [AI]

Bonus

11) Earth and Space - *Multiple Choice* Which of the following metamorphic rocks exhibits foliation?

W) Marble
X) Quartzite
Y) Phyllite
Z) Anthracite

Answer: Y) PHYLLITE [AI]

Tossup

12) Math [RR] - *Short Answer* How many integers, x, satisfy the inequality pi < x+2 < 3pi

Answer: 6 [HK]

Bonus

12) Math [RR] - *Short Answer* Brennan pays $2 for a $1.50 banana. How many ways are there to make change from 4 nickels, 3 dimes, and 2 quarters?

Answer: 4 [RE]

Tossup

13) Physics - *Short Answer* Identify all of the following three changes to a cylindrical copper resistor which would increase its resistance? I. Decreasing its temperature; II. Increasing its length; III. Increasing its cross sectional area.

Answer: II only [RE]

Bonus

13) Physics - *Short Answer* Giving your answer clearly, in an RLC circuit, what circuit element does each letter correspond to?

Answer: R = RESISTOR; L = INDUCTOR; C = CAPACITOR [RE]

Tossup

14) Chemistry - *Short Answer* Identify all of the following three salts that create an acidic solution? I. Sodium carbonate; II. Lithium bromide; III. Ammonium chlorate.

Answer: III only [AI]

Bonus

14) Chemistry - *Multiple Choice* Which of the following solutions would have the highest boiling point?
W) 0.1 molar sodium phosphate
X) 0.1 molar sodium bromide
Y) 0.2 molar sodium oxalate
Z) 0.3 molar sucrose

Answer: Y) 0.2 MOLAR LITHIUM OXALATE [AI]

Tossup

15) Biology [Early RR] - *Short Answer* How many chromosomes does Brennan, a typical healthy human, have per somatic cell?

Answer: 46

Bonus

15) Biology [Early RR] - *Multiple Choice* Which of the following best describes the results of a typical meiotic event?

W) 2 daughter cells with n chromosomes
X) 2 daughter cells with 2n chromosomes
Y) 4 daughter cells with n chromosomes
Z) 4 daughter cells with 2n chromosomes

Answer: Y) 4 DAUGHTER CELLS WITH N CHROMOSOMES

Tossup

16) Energy - *Multiple Choice* Machine learning often requires parallel processing. Which of the following parts of a computer is best suited for parallel processing?

W) CPU
X) GPU
Y) RAM
Z) SSD

Answer: X) GPU [MS]

Bonus

16) Energy - *Short Answer* Which of the following three statements about arrays and lists are true? I. The length of arrays can be changed II. The length of lists can be changed III. Arrays can be indexed.

Answer: II and III [MS]

Tossup

17) Earth and Space [RR] - *Multiple Choice* Given that the star Arcturus is a red giant, which of the following is the most reasonable estimate for its mass?

W) 0.01 solar masses
X) 1 solar mass
Y) 10 solar masses
Z) 100 solar masses

Answer: X) 1 SOLAR MASS [AE]

Bonus

17) Earth and Space [RR] - *Short Answer* How many Lagrange [luh-graan-ge] points does the Sun-Jupiter system have?

Answer: 5 [AE]

Tossup

18) Math [RR] - *Short Answer* The probability of flipping heads on an unfair coin is ⅔. What is the probability that you first flip heads on the third flip?

Answer: 2/27 [HK]

Bonus

18) Math [RR] - *Short Answer* What is the difference between the mean and the median of the numbers 1, 4, 7, 10, 13, 16, 19, and 22?

Answer: 0 [HK]

Tossup

19) Physics - *Short Answer* Identify all of the following three thermodynamic processes that are correctly matched with their description. I. Isobaric - volume held constant ; II. Isochoric - pressure held constant; III. Adiabatic - temperature held constant.

Answer: NONE [AE]

Bonus

19) Physics - *Multiple Choice* Four objects are rolling at 5 meters per second on a flat surface. Which of these objects has the greatest total kinetic energy?

W) Solid cylinder
X) Solid sphere
Y) Hollow sphere
Z) Hoop

Answer: Z) HOOP [AE]

Tossup

20) Chemistry - *Multiple Choice* Which of the following elements is most likely to form a cation with a +3 charge?

W) Aluminum
X) Sodium
Y) Calcium
Z) Chlorine

Answer: W) ALUMINUM [EC]

Bonus

20) Chemistry - *Multiple Choice* What is the oxidation state of chromium in potassium dichromate with chemical formula $K_2Cr_2O_7$?

W) +2
X) +3
Y) +6
Z) +10

Answer: Y) +6 [EC]

Tossup

21) Biology [Late RR] - *Multiple Choice* Brennan uses CRISPR-Cas to add GFP to be under the control of the lac operon in *E. coli*. In which of the following conditions would you expect the most fluorescence from Brennan's *E. coli*?

W) Low Lactose, Low cAMP
X) Low Lactose, High cAMP
Y) High Lactose, Low cAMP
Z) High Lactose, High cAMP

Answer: Z) HIGH LACTOSE, HIGH cAMP

Bonus

21) Biology [Late RR] - *Multiple Choice* In the flower *Brennus heeus,* color is controlled by two genes, A and B. Having a dominant A allele yields red flowers, and homozygous recessive gene A flowers are white. However, if a flower is homozygous recessive for gene B, then no pigment will be produced and the flower will be white, regardless of the alleles in gene A. In the cross between two double heterozygous parents, what is the expected ratio of red to white flowers?

W) 12:4
X) 13:3
Y) 9:7
Z) 15:1

Answer: Y) 9:7

Tossup

22) Energy - *Multiple Choice* Which of the following types of machine learning models is best suited for image data?

W) Feedforward Neural Network
X) Convolutional Neural Network
Y) Recurrent Neural Network
Z) Transformer

Answer: X) CONVOLUTIONAL NEURAL NETWORK [MS]

Bonus

22) Energy - *Short Answer* The training process for machine learning models relies on iteratively modifying the weights based on what vector operator?

Answer: GRADIENT

Tossup

23) Earth and Space - *Multiple Choice* What is the minimum number of seismic stations needed to pinpoint the epicenter of an earthquake?

W) 4
X) 3
Y) 2
Z) 1

Answer: X) 3 [AI]

Bonus

23) Earth and Space - *Short Answer* What specific term is used to describe the deposited ridges of sediment formed along the side of a glacier?

Answer: LATERAL MORAINE (Must specify lateral) [AI]

Tossup

24) Math [RR] - *Short Answer* If there are 5 more than twice as many yellow beads as there are blue beads, what is the minimum total number of beads there can be if there must be at least one bead of each type?

Answer: 8 [HK]

Bonus

24) Math [RR] - *Short Answer* If $x+2y=10$, $y+2z=20$, and $z+2x=30$, what is the value of $2x+y+3z$?

Answer: 50 [HK]
