2025 Iolani Science Bowl Invitational
Round Robin 2

Tossup

1) Physics - *Short Answer* The first harmonic of an open pipe is 100 Hz. The length of the pipe is halved. What is the frequency of the second harmonic of the new pipe?

Answer: 400 HZ [AE]

Bonus

1) Physics - *Short Answer* What is the Carnot [car-noh] efficiency of an engine whose hot reservoir temperature is 1200 Kelvin and cold reservoir temperature is 400 K?

Answer: 2/3 [AE]

Tossup

2) Chemistry - *Short Answer* In which type of reaction does a hydrocarbon react with oxygen to produce carbon dioxide and water?

Answer: COMBUSTION [EC]

Bonus

2) Chemistry - *Multiple Choice* Which of the following best describes a disproportionation reaction?

W) The same substance is both oxidized and reduced.
X) A metal reacts with a nonmetal to form a compound.
Y) One reactant gains electrons while another loses electrons.
Z) A compound breaks into two or more substances.

Answer: W) THE SAME SUBSTANCE IS BOTH OXIDIZED AND REDUCED [EC]

Tossup

3) Biology [Early RR] - *Short Answer* Instead of thymine, what base is used in RNA molecules?

Answer: URACIL

Bonus

3) Biology [Early RR] - *Multiple Choice* Which of the following is the largest organ in the human body?

W) Brain
X) Skin
Y) Liver
Z) Large Intestine

Answer: X) SKIN

Tossup

4) Energy - *Short Answer* What machine learning activation function, commonly used in binary classification, is a specific kind of a logistic curve that outputs values between 0 and 1?

Answer: SIGMOID [MS]

Bonus

4) Energy - *Multiple Choice* The cost for most large language model APIs is in terms of "dollars per token." Most tokens are what?
W) Characters
X) Words
Y) Sentences
Z) Responses

Answer: X) WORDS [MS]

Tossup

5) Earth and Space [RR] - *Multiple Choice* Which of the following is the most commonly accepted explanation for the formation of Earth's moon?

W) Fission Hypothesis
X) Condensation Hypothesis
Y) Capture Hypothesis
Z) Giant Impact Hypothesis

Answer: Z) GIANT IMPACT HYPOTHESIS [AE]

Bonus

5) Earth and Space [RR] - *Short Answer* Order the following three asteroid types from most to least common. I. S-type; II. C-type; III. M-type.

Answer: II, I, III [AE]

Tossup

6) Math [RR] - *Short Answer* The mass of a half-filled water bottle is 2 kg. The mass of the same water bottle fully filled is 3 kg. What is the mass of the water bottle when it is ¾ full?

Answer: 2.5 kg [HK]

Bonus

6) Math [RR] - *Short Answer* How many times does the digit 8 appear from 1 to 148 inclusive?

Answer: 25 [HK]

Tossup

7) Physics - *Short Answer* Identify all of the following three scenarios for which the work done by a force F is 0. I. The magnitude of F is 0; II. F is perpendicular to displacement; III. F is antiparallel to displacement.

Answer: I, II [AE]

Bonus

7) Physics - *Short Answer* Identify all of the following three particles that can be considered bosons. I. Gluon; II. Pion; III. Electron neutrino.

Answer: I only [RE]

Tossup

8) Chemistry - *Multiple Choice* Which of the following molecules has a permanent dipole moment?

W) Carbon dioxide
X) Methane
Y) Water
Z) Benzene

Answer: Y) WATER [EC]

Bonus

8) Chemistry - *Short Answer* Which of the following form network covalent solids? I: Iodine; II: Silicon carbide; III: Aluminum oxide

Answer: II only [EC]

Tossup

9) Biology [Mid RR] - Multiple Choice In PCR, a DNA Polymerase from the bacteria Thermus aquaticus (thur-muhs-uh-kwaa-ti-kuhs) is used to synthesize the new strands. What was the main reason this polymerase was chosen for this procedure?

W) Functional at high temperatures
X) Low error rate
Y) Easy to purify
Z) Low molecular weight

Answer: W) FUNCTIONAL AT HIGH TEMPERATURES

Bonus

9) Biology [Mid RR] - *Short Answer* During which phase of meiosis does crossing over occur?

Answer: PROPHASE I (DO NOT ACCEPT: PROPHASE)

Tossup

10) Energy - *Short Answer* Identify all of the following three sorting algorithms that have time complexity O(nlogn) [O of n log n]? I. Merge Sort; II. Bubble Sort; III. Quick Sort

Answer: 1, 3 [MS]

Bonus

10) Energy - *Multiple Choice* In a feedforward neural network with one hidden layer, how many matrix multiplication operations occur?
W) 0
X) 1
Y) 2
Z) 3

Answer: Y) 2 [MS]

Tossup

11) Earth and Space - *Short Answer* What type of front forms when a warm air mass moves towards a cold air mass, forcing itself up and over the colder air mass?

Answer: WARM FRONT [AI]

Bonus

11) Earth and Space - *Short Answer* What term is used to describe temporary streams that normally form following rain?

Answer: EPHEMERAL [AI]

Tossup

12) Math [RR] - *Short Answer* What is the sum of the factors of 16?

Answer: 31 [HK]

Bonus

12) Math [RR] - *Short Answer* How many ways are there to put 4 different balls in 3 identical boxes, assuming there can't be any empty boxes?

Answer: ~~14~~ 6 [AI] !!!! change to 6 - AI

Tossup

13) Physics - *Multiple Choice* A projectile is launched from a platform 10 meters above the ground under the influence of air resistance. The launch angle that maximizes the projectile's horizontal range is best described by which of the following choices?

W) Greater than 0 degrees, less than 45 degrees
X) 45 degrees
Y) Greater than 45 degrees, less than 90 degrees
Z) 90 degrees

Answer: W) GREATER THAN 0 DEGREES, LESS THAN 45 DEGREES [AE]

Bonus

13) Physics - *Short Answer* Identify all of the following three actions which would double the period of a simple pendulum. I. Quadruple the length; II. Halve gravity; III. Quadruple the mass.

Answer: I [AE]

Tossup

14) Chemistry - *Multiple Choice* Which of the following statements is true about a catalyst?

W) It is consumed during the reaction.
X) It lowers the activation energy of the reaction.
Y) It changes the equilibrium constant.
Z) It increases the enthalpy change of the reaction.

Answer: X) IT LOWERS THE ACTIVATION ENERGY OF THE REACTION [EC]

Bonus

14) Chemistry - *Short Answer* What element has the highest known melting point?

Answer: TUNGSTEN [RE]

Tossup

15) Biology [Mid RR] - *Short Answer* Oxygen rich blood first arrives in what chamber of the heart?

Answer: LEFT ATRIUM

Bonus

15) Biology [Mid RR] - *Multiple Choice* In plants, what is the main driving force of transportation of water from the roots to the leaves?

W) Pressure flow
X) Active transport
Y) Osmosis
Z) Transpiration

Answer: Z) TRANSPIRATION

Tossup

16) Energy - *Multiple Choice* Which of the following data types in Java has the sole purpose of storing a group of constants?

W) Class
X) Abstract Class
Y) Interface
Z) Enum [ee-num]

Answer: Z) ENUM [MS]

Bonus

16) Energy - *Short Answer* Sometimes, large language models will produce incorrect or misleading information and present it as a fact, such as saying that John Backflip invented the backflip. What is this phenomenon called?

Answer: HALLUCINATION [MS]

Tossup

17) Earth and Space [RR] - *Multiple Choice* Stars spend most of their lifespan in what Morgan-Keenan luminosity class?

W) Ib (one-B)
X) II (two)
Y) III (three)
Z) V (five)

Answer: Z) V (FIVE) [AE]

Bonus

17) Earth and Space [RR] - *Short Answer* A star has surface temperature 12,000 Kelvin and radius 1/3 solar radii. To the nearest integer, what is the luminosity of this star, in solar luminosities?

Answer: 2 [AE]

Tossup

18) Math [RR] - *Short Answer* A square and a rectangle have the same perimeter. The side length of the square is 10 units, and the length of the rectangle is 15 units. What is the ratio of the area of the square to the rectangle?

Answer: 4/3 [ChatGPT/AE]

Bonus

18) Math [RR] - *Short Answer* A right triangle has legs of length 14 and 48. What is the area of the circle circumscribed around this triangle?

Answer: 625pi [AE]

Tossup

19) Physics - *Multiple Choice* An electron is placed 1 meter away from an infinite, non-conducting sheet of positive charge. If the electron is moved to 2 meters away from this sheet, by what factor does the force on the electron change?

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

Answer: Y) 1 [AE]

Bonus

19) Physics - *Short Answer* Four identical balls are arranged in a square of side length 5 m. A fifth identical ball is placed at the midpoint of one side length. In meters, how far has the center of mass of the system moved?

Answer: 0.5 METERS [AE]

Tossup

20) Chemistry - *Multiple Choice* What is the hybridization of the carbon atoms in ethyne [eth-eye-ne], C_2H_2?

W) sp
X) sp^2
Y) sp^3
Z) None of these

Answer: W) SP [EC]

Bonus

20) Chemistry - *Multiple Choice* What is the electron geometry of a molecule with five regions of electron density around its central atom?

W) Tetrahedral
X) Trigonal bipyramidal
Y) Octahedral
Z) Linear

Answer: X) TRIGONAL BIPYRAMIDAL [EC]

Tossup

21) Biology [Mid RR] - *Short Answer* Order the following three molecules, from first to last, in the order an electron derived from water would travel through them during the light reactions in a typical thylakoid: I. Photosystem I; II. Photosystem II; III. NADP+

Answer: II, I, III (Photosystem II, Photosystem I, NADP+)

Bonus

21) Biology [Mid RR] - *Short answer* The resting membrane potential in a human neuron is largely established due to the transport of which two ions?

Answer: K+ and Na+ (ACCEPT: SODIUM AND POTASSIUM)

Tossup

22) Energy - *Short Answer* What internet transfer protocol acts as the foundation for data communication on the world wide web, where clients' requests are responded to by the server serving them web pages and other content?

Answer: HYPERTEXT TRANSFER PROTOCOL (accept: HTTP, HTTPS, Hypertext Transfer Protocol Secure) [MS]

Bonus

22) Energy - *Multiple Choice* Hex codes are a common method of representing color in computer science. Which of the following hex codes represents blue?

W) #FFFFFF
X) #FF0000
Y) #00FF00
Z) #0000FF

Answer: Z) #0000FF [MS]

Tossup

23) Earth and Space - *Short Answer* Which of the following formations occurs due to glacial activity? I. Kettle Lake; II. Pingo; III. Drumlin

Answer: I & III [AI]

Bonus

23) Earth and Space - *Multiple Choice* Which scale is used to qualitatively assess damage caused by an earthquake?

W) Richter Scale
X) Modified Mercalli Scale
Y) Rossi–Forel scale
Z) Moment Magnitude Scale

Answer: X) MODIFIED MERCALLI SCALE [AI]

Tossup

24) Math [RR] - *Short Answer* In a class of 20 students, 12 are taking math, 15 are taking science, and 5 are taking neither subject. How many students are taking both math and science?

Answer: 12 [ChatGPT]

Bonus

24) Math [RR] - *Short Answer* If sin(x)=⅖, then what is the value sin(2x)?

Answer: 4sqrt(21)/25 [RE]
