DBHSST ROUND 8

Icebreaker question: What is your favorite soda?

TOSS-UP

1) Physical Science – *Short Answer* Identify all of the following 3 ions that carry a minus 1 charge: 1) Bicarbonate; 2) Phosphate; 3) Acetate.

ANSWER: 1 AND 3 ONLY (ACCEPT: ALL BUT 2) **[NR]**

BONUS

1) Physical Science – *Short Answer* A basic solution is formed by dissolving 1 mole of lithium hydroxide in 10 liters of water. What is the pOH of this solution?

ANSWER: 1 **[NR]**

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TOSS-UP

2) Math – *Multiple Choice* Which of the following functions is considered to be odd?

W) Cosine of x
X) Square root of x
Y) Sine of x
Z) Floor of x

ANSWER: Y) SINE OF X **[NR]**

BONUS

2) Math – *Short Answer* If theta is an angle such that the sine of theta is negative 5/13 and theta is between pi and 3pi/2 radians, what is the value of secant of x?

ANSWER: NEGATIVE 13/12 **[NR]**
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TOSS-UP

3) Life Science – *Multiple Choice* Which of the following actions would salicylic acid and jasmonic acid NOT be involved in?

W) Directional growth in response to touch
X) Systemic acquired resistance
Y) Effector-triggered immunity
Z) Hypersensitive responses

ANSWER: W) DIRECTIONAL GROWTH IN RESPONSE TO TOUCH **[DB]**

BONUS

3) Life Science – *Short Answer* Identify all of the following three actions that the RAAS system would do to counteract a drop in blood volume: 1) Increasing water reabsorption; 2) Increasing Na^+ reabsorption; 3) Increasing vascular tone.

ANSWER: ALL OF THEM **[DB]**

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TOSS-UP

4) Earth and Space – *Short Answer* What term describes the outside curve of a stream channel where erosion occurs at the fastest rate?

ANSWER: CUT BANK **[DB]**

BONUS

4) Earth and Space – *Short Answer* Laterite soils have a characteristic rusty red color due to the intense chemical weathering that weathers away most of the calcite and silica. Instead, what two elements are abundant in laterites?

ANSWER: IRON AND ALUMINIUM **[DB]**
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TOSS-UP

5) Math – *Multiple Choice* Which of the following best describes the asymptotes of the graph of the equation y = x plus 2 over the quantity x squared minus 4?

W) Vertical asymptote at x = negative 2 and no horizontal asymptote
X) Vertical asymptote at x = negative 2 and horizontal asymptote at y = 0
Y) Vertical asymptote at x = 2 and no horizontal asymptote
Z) Vertical asymptote at x = 2 and horizontal asymptote at y = 0

ANSWER: Z) VERTICAL ASYMPTOTE AT X = 2 AND HORIZONTAL ASYMPTOTE AT Y = 0 **[CD]**

BONUS

5) Math – *Short Answer* What is the units digit of 7 to the 55th power times 8 to the 34th power?

ANSWER: 2 **[NR]**

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TOSS-UP

6) Physical Science – *Short Answer* An RC circuit consists of a resistor of resistance 30 ohms and a capacitor of capacitance 2 farads connected in series to a 9-volt battery. What is the time constant, in seconds, of this circuit?

ANSWER: 60 **[CD]**

BONUS

6) Physical Science – *Multiple Choice* An object is placed 5 centimeters in front of a concave mirror with a focal length of 2 centimeters. Which of the following best describes the image produced?

W) Real and upright
X) Real and inverted
Y) Virtual and upright
Z) Virtual and inverted

ANSWER: X) REAL AND INVERTED **[CD]**

7) Energy – *Short Answer* Scientists at Pacific Northwest National Lab are studying the properties of hydrothermal vents in the ocean. Black smokers, one type of hydrothermal vent, mainly emit what class of minerals?
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TOSS-UP

ANSWER: METAL SULFIDES (ACCEPT: SULFIDES) **[DB]**

BONUS

7) Energy – *Short Answer* Scientists at Princeton Plasma Physics Lab are studying the process of star formation in stellar cocoons. Identify all of the following 3 objects that provide evidence for star formation: 1) Herbig-Haro objects; 2) Population II stars; 3) Bok globules.

ANSWER: 1 AND 3 **[DB]**

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TOSS-UP

8) Life Science – *Multiple Choice* Which of the following regions of the vertebrate brain is mainly responsible for processing olfactory input and regulating complex processes?

W) Forebrain
X) Midbrain
Y) Hindbrain
Z) Cerebellum

ANSWER: W) FOREBRAIN **[DB]**

BONUS

8) Life Science – *Short Answer* What type of cell is dependent on signals from helper T cells and utilize toxic proteins to kill cells infected by viruses before the pathogens fully mature?

ANSWER: CYTOTOXIC T CELLS (DO NOT ACCEPT: T CELLS) **[DB]**
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TOSS-UP

9) Earth and Space – *Multiple Choice* Which of the following elements is the third most abundant in the universe?

W) Lithium
X) Beryllium
Y) Carbon
Z) Oxygen

ANSWER: Z) OXYGEN **[NR]**

BONUS

9) Earth and Space – *Multiple Choice* Which of the following nuclear reactions releases the most energy?

W) Hydrogen to helium
X) Helium to beryllium
Y) Beryllium to oxygen
Z) Nitrogen to silicon

ANSWER: W) HYDROGEN TO HELIUM **[NR]**

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TOSS-UP

10) Math – *Multiple Choice* If there is a rectangular prism with length 4, width 12, and height 3, which of the following is the length of the diagonal of the prism?

W) 5 root 5
X) 13
Y) 8 root 3
Z) 15

ANSWER: X) 13 **[NR]**

BONUS

10) Math – *Short Answer* The midpoint of a line AB on the coordinate plane is (1.5, 2). If the coordinates of A are (3, -4), what is the location of point B?

ANSWER: (0, 8) **[NR]**

11) Physical Science – *Short Answer* Hydrogen gas and Helium gas are put in the same container. Hydrogen effuses at some rate a, while Helium effuses at a rate b. What is the ratio of rate a to b?
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TOSS-UP

ANSWER: ROOT 2 **[CD]**

BONUS

11) Physical Science – *Multiple Choice* Which of the following molecules is considered to be paramagnetic?

W) NO_2
X) CO_2
Y) SF_6
Z) CH_4

ANSWER: W) NO_2 **[CD]**

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TOSS-UP

12) Energy – *Short Answer* Scientists at Idaho National Laboratory are studying the origins of the universe. Which two fundamental forces are thought to have split from each other last during the grand unification epoch?

ANSWER: ELECTROMAGNETISM AND WEAK FORCE (ACCEPT: WEAK NUCLEAR FORCE FOR WEAK FORCE) **[CD]**

BONUS

12) Energy – *Short Answer* Scientists at Lawrence Berkeley National Laboratory are studying which forces interact with certain particles. Name all of the following four fundamental forces that affect electrons:

1. Gravity
2. Electromagnetism
3. Strong nuclear force
4. Weak nuclear force

ANSWER: 1, 2, AND 4 **[CD]**
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TOSS-UP

13) Life Science – *Multiple Choice* Which of the following types of intercellular junctions welds adjacent cells together?

W) Plasmodesmata
X) Gap junctions
Y) Tight junctions
Z) Desmosomes

ANSWER: Z) DESMOSOMES **[DB]**

BONUS

13) Life Science – *Short Answer* Innate immune cells dedicated to destroying pathogens in mammals rely on what recognition protein that produces signals to initiate defense responses?

ANSWER: TOLL-LIKE RECEPTORS (ACCEPT: TLR) **[DB]**

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TOSS-UP

14) Earth and Space – *Multiple Choice* Which of the following shoreline features is NOT an erosional feature?

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

ANSWER: W) TOMBOLO **[DB]**

BONUS

14) Earth and Space – *Short Answer* The K-Pg boundary event marked the end of what period, and the beginning of what period, respectively?

ANSWER: CRETACEOUS, PALEOGENE **[DB]**

15) Math – *Short Answer* What is the limit as x approaches infinity of the fraction with numerator e to the x and denominator x factorial?
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TOSS-UP

ANSWER: 0 **[CD]**

BONUS

15) Math – *Short Answer* A six-sided die is unfairly weighted such that the probability of rolling a certain number is directly proportional to its square. What is the probability that a multiple of 3 will be rolled on this die?

ANSWER: 45/91 **[CD]**

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TOSS-UP

16) Physical Science – *Short Answer* What law in physics states that quantum systems must reproduce results from classical physics at sufficiently large scales?

ANSWER: CORRESPONDENCE PRINCIPLE **[CD]**

BONUS

16) Physical Science – *Short Answer* A monatomic gas is held at 0 degrees Celsius, and the average kinetic energy of the molecules of this gas is measured to be K. If instead a diatomic gas is placed under the same conditions, which of the following is closest to its average molecular kinetic energy in terms of K?

W) 3K/2
X) 5K/3
Y) 5K/2
Z) 2K

ANSWER: X) 5K/3 **[CD]**
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TOSS-UP

17) Energy – *Short Answer* Researchers at Lawrence Livermore National Lab are studying the Tobacco mosaic virus and its structure. What is the name of the helical protein shell that encloses the mosaic virus' RNA molecule?

ANSWER: CAPSID **[DB]**

BONUS

17) Energy – *Short Answer* Scientists at Ames National Lab are researching the Bergeron process in clouds near the coasts of Maine to better understand how nor'easters form. What is the specific meteorological term that describes how falling ice crystals collide and combine?

ANSWER: AGGREGATION (DO NOT ACCEPT: COALESCENCE) **[DB]**

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TOSS-UP

18) Life Science – *Short Answer* Nayeon, a singer on the kpop band TWICE, is singing. When she is singing, small jets of air pass through moving vocal cords. What is the name for the measure of volume that describes how much air is inhaled and exhaled with each breath?

ANSWER: TIDAL VOLUME **[DB]**

BONUS

18) Life Science – *Short Answer* Sophie the gardener is growing succulents in her greenhouse. She observes that one of her plants is long, abnormally thin, and white, while her other plants are growing healthily. The long and thin plant is an example of what type of plant that focuses their energy towards growing up against gravity and towards a light source?

ANSWER: ETIOLATED PLANTS **[DB]**
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TOSS-UP

19) Earth and Space – *Short Answer* Star A has a temperature of 5000 K, while star B has a temperature of 15000 K. Given that both stars have the same radius, what is the ratio of the luminosity of star A to star B?

ANSWER: 1/81 **[NR]**

BONUS

19) Earth and Space – *Multiple Choice* In the Hubble tuning fork, which of the following types of galaxies is labeled as S0?

W) Lenticular
X) Barred spiral
Y) Grand design spiral
Z) Elliptical

ANSWER: W) LENTICULAR **[NR]**

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TOSS-UP

20) Math – *Multiple Choice* If a regular polygon has 12 sides, which of the following is equal to the number of diagonals of this polygon?

W) 36
X) 54
Y) 72
Z) 90

ANSWER: X) 54 **[NR]**

BONUS

20) Math – *Short Answer* A jar contains 20 marbles, of which 60% of them are red and the rest of them are green. Gradually, green marbles are added until 60% of the marbles are green. How many marbles are now in the jar?

ANSWER: 30 **[NR]**
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TOSS-UP

21) Physical Science – *Multiple Choice* Which of the following elements is an example of a strong oxidizing agent?

W) Fluorine
X) Calcium
Y) Vanadium
Z) Neon

ANSWER: W) FLUORINE **[NR]**

BONUS

21) Physical Science – *Short Answer* A scientist is determining the products of the decomposition of baking soda. He observes that a gas is produced, and proceeds to conduct a flame test. Once the reaction occurs, the ignited splint is almost immediately extinguished. What is the name of this gas?

ANSWER: CARBON DIOXIDE (ACCEPT: CO2) **[NR]**

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TOSS-UP

22) Earth and Space – *Multiple Choice* The subtropical high pressure belt is most closely located at which of the following latitudes?

W) 0°
X) 15°
Y) 30°
Z) 45°

ANSWER: Y) 30° **[DB]**

BONUS

22) Earth and Space – *Short Answer* Identify all of the following 4 continents that contain regions with the Köppen climate group E: 1) North America; 2) Asia; 3) Africa; 4) Australia.

ANSWER: 1 AND 2 **[DB]**
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TOSS-UP

23) Life Science – *Short Answer* Mast cells are immune cells found in connective tissue. They are responsible for releasing what molecule that triggers the dilation of blood vessels at sites of damage?

ANSWER: HISTAMINE **[DB]**

BONUS

23) Life Science – *Short Answer* Jennie from Blackpink is on a cooking show and must cook an exotic dish containing molluscs. Identify all of the following 4 animals that are in the phylum mollusca: 1) Snails; 2) Centipedes; 3) Lobsters; 4) Octopuses.

ANSWER: 1 AND 4 **[DB]**