DBHSST ROUND 3

Icebreaker question: Are you an early bird or a night owl?

TOSS-UP

1) Physical Science – *Multiple Choice* Which of the following quantities is equal to the amount of energy required to increase 1 gram of water by 1 degree celsius?

W) Specific heat
X) Heat capacity
Y) Joule
Z) Calorie

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

BONUS

1) Physical Science – *Short Answer* What is the molecular geometry of phosphorus pentachloride?

ANSWER: TRIGONAL BIPYRAMIDAL **[CD]**

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TOSS-UP

2) Math – *Multiple Choice* Which of the following polyhedra does not have 6 vertices?

W) Triangular prism
X) Octahedron
Y) Pentagonal pyramid
Z) Cube

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

BONUS

2) Math – *Short Answer* A pair of integers has a sum of 2 and a product of negative fifteen. What is the square of the smaller of the two numbers?

ANSWER: 9 **[NR]**

3) Life Science – *Short Answer* Transpiration rate in plants is often higher during the day when compared to the evening due to the opening of pores on the surface of the leaf that regulate for gas exchange. What is the name of these pores?
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TOSS-UP

ANSWER: STOMATA **[DB]**

BONUS

3) Life Science – *Short Answer* The peripheral nervous system describes the nervous system outside of what two organs?

ANSWER: BRAIN AND SPINAL CORD **[DB]**

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TOSS-UP

4) Earth and Space – *Multiple Choice* When a meteoroid is coming in at fast speeds, it compresses the air in front of it, heating it hugely. In what atmospheric layer do most meteoroids burn up?

W) Troposphere
X) Stratosphere
Y) Mesosphere
Z) Thermosphere

ANSWER: Y) MESOSPHERE **[DB]**

BONUS

4) Earth and Space – *Short Answer* Identify all of the following 3 rocks that could serve as an aquitard: 1) Shale; 2) Gravel; 3) Sand.

ANSWER: 1 ONLY **[DB]**
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TOSS-UP

5) Math – *Short Answer* What theorem states that the number of total roots, including multiplicity, of a polynomial is equal to its degree?

ANSWER: FUNDAMENTAL THEOREM OF ALGEBRA **[CD]**

BONUS

5) Math – *Short Answer* A point in the first quadrant is rotated 180 degrees about the origin, and then reflected across the y-axis. In what quadrant will the transformed point lie?

ANSWER: 4 **[CD]**

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TOSS-UP

6) Physical Science – *Short Answer* An object of mass 5 kilograms initially has a momentum of 16 kilogram meters per second. A constant force is then applied to this body such that after 3 seconds of it being applied, the object now has a momentum of 31 kilogram meters per second. What must be the magnitude, in newtons, of this force?

ANSWER: 5 **[CD]**

BONUS

6) Physical Science – *Short Answer* A bumper car is initially moving at a velocity of positive 5 meters per second when it collides with another bumper car of velocity negative 9 meters per second. If the two cars are of equal mass and stick together after collision, what is the velocity, in meters per second, of the two cars after collision?

ANSWER: -2 **[CD]**
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TOSS-UP

7) Energy – *Multiple Choice* Researchers at Ames National Lab are studying the excitation of the hydrogen atom in the proton-proton chain. When an electron in its smallest and most tightly bound orbit is in its lowest permitted energy level, what name is given to the atom's energy level?

W) Ground state
X) Stable state
Y) Dormant state
Z) Ionic state

ANSWER: W) GROUND STATE **[DB]**

BONUS

7) Energy – *Short Answer* Scientists at Lawrence Livermore National Lab are studying the potential uses of hydrogen fluoride in silicon semiconductor chips. In the synthesis of hydrogen fluoride, 2 hydrogen and 2 fluorine atoms are synthesized, with fluoride transferring an electron to the hydrogen atom. This is an example of what type of chemical reaction which involves the transfer of electrons between two species?

ANSWER: REDOX REACTION (ACCEPT: OXIDATION-REDUCTION REACTION) **[DB]**

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TOSS-UP

8) Life Science – *Multiple Choice* Joe is trying to determine the age of a tree by observing the trunk's rings. Which of the following tissue rings would help Joe determine the age of the tree?

W) Phloem
X) Xylem
Y) Pith
Z) Heartwood

ANSWER: X) XYLEM **[DB]**

BONUS

8) Life Science – *Multiple Choice* Which of the following best describes the purpose of crossing over?

W) Homologous pairs are aligned evenly for cytokinesis
X) Strengthening of chromosomes to ensure safety
Y) Increases the relative frequency of alleles
Z) Ensures genetic variation among offspring

ANSWER: Z) ENSURES GENETIC VARIATION AMONG OFFSPRING **[DB]**
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TOSS-UP

9) Earth and Space – *Multiple Choice* Which of the following laws of planetary motion states that the cube of a planet's distance to the sun is proportional to the square of the planet's orbital period?

W) Kepler's second law
X) Kepler's third law
Y) Newton's first law
Z) Newton's fourth law

ANSWER: X) KEPLER'S THIRD LAW **[NR]**

BONUS

9) Earth and Space – *Multiple Choice* In which of the following constellations would one expect to find the star Pollux?

W) Ursa major
X) Taurus
Y) Gemini
Z) Sagitarrius

ANSWER: Y) GEMINI **[NR]**

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TOSS-UP

10) Math – *Multiple Choice* Which of the following is the largest prime factor of 238?

W) 2
X) 7
Y) 13
Z) 17

ANSWER: Z) 17 **[NR]**

BONUS

10) Math – *Short Answer* How many possible integer side lengths are possible for the third side of a triangle, given that the other two sides are of length 11 and 14?

ANSWER: 21 **[NR]**

11) Physical Science – *Multiple Choice* Which of the following laws states that the entropy of the universe always increases?
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TOSS-UP

W) Newton's Third Law
X) Second Law of Thermodynamics
Y) Huygens Principle
Z) Stefan-Boltzmann Law

ANSWER: X) SECOND LAW OF THERMODYNAMICS **[CD]**

BONUS

11) Physical Science – *Short Answer* Name all of the following 3 statements that must be true of an adiabatic process:

1. The change in heat of the system is zero
2. No net work is done by the system
3. The internal energy of the system decreases

ANSWER: 1 ONLY **[CD]**

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TOSS-UP

12) Energy – *Multiple Choice* Scientists at the Joint Genome Institute have been investigating molecular differences between DNA and RNA. Which of the following best describes DNA and RNA?

W) DNA is single-stranded, while RNA is double-stranded
X) DNA is double-stranded, while RNA is single-stranded
Y) Both DNA and RNA are single-stranded
Z) Both DNA and RNA are double-stranded

ANSWER: X) DNA IS DOUBLE-STRANDED, WHILE RNA IS SINGLE-STRANDED **[CD]**

BONUS

12) Energy – *Short Answer* Scientists at the Joint Genome Institute have been investigating translation of RNA into amino acids. How many nucleotides constitute a codon?

ANSWER: 3 **[CD]**

13) Life Science – *Short Answer* A three-dimensional network formed by microfilaments within the plasma membrane is responsible for cell motility. Within microfilaments, what two proteins interact to cause contractions in muscle cells?

ANSWER: ACTIN AND MYOSIN **[DB]**

BONUS
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TOSS-UP

13) Life Science – *Short Answer* Identify all of the following 4 physiological actions that you observe in a plant whose cells are in a hypertonic solution: 1) Wilting; 2) Cells become flaccid; 3) Cells become turgid; 4) Plasmolysis.

ANSWER: 1, 2, AND 4 **[DB]**

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TOSS-UP

14) Earth and Space – *Short Answer* What type of front forms when two air masses are pushing against each other but neither is powerful enough to move another, forming a motionless boundary?

ANSWER: STATIONARY FRONT **[DB]**

BONUS

14) Earth and Space – *Multiple Choice* Which of the following is NOT true regarding globular clusters?

W) All stars in globular clusters are born at around the same time
X) Stars within globular clusters tend to have heavier elements due to their size
Y) Globular clusters tend to appear red because of their old age
Z) Globular clusters are generally bigger than open clusters

ANSWER: X) STARS WITHIN GLOBULAR CLUSTERS TEND TO HAVE HEAVIER ELEMENTS DUE TO THEIR SIZE **[DB]**
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TOSS-UP

15) Math – *Short Answer* What is the value of 25 modulo 4?

ANSWER: 1 **[CD]**

BONUS

15) Math – *Multiple Choice* Which of the following numbers is coprime to 9?

W) 3
X) 5
Y) 6
Z) 15

ANSWER: X) 5 **[CD]**

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TOSS-UP

16) Physical Science – *Short Answer* What type of interference, commonly used by noise-cancelling headphones, occurs when the resultant wave has a lesser amplitude than either of the interacting waves?

ANSWER: DESTRUCTIVE **[CD]**

BONUS

16) Physical Science – *Short Answer* What is the speed, in meters per second, of a wave with a frequency of 30 hertz and wavelength of 8 meters?

ANSWER: 240 **[CD]**
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TOSS-UP

17) Energy – *Short Answer* Scientists at the USGS are studying how global warming since the end of the Little Ice age has caused substantial glacier ice loss. Some glaciers lose chunks of ice in a process called calving. What is the name for these large pieces of ice that have separated from the glacier?

ANSWER: ICEBERGS **[DB]**

BONUS

17) Energy – *Multiple Choice* Scientists at the University of Chicago are researching cosmic background radiation and how it supports the theory of the Big Bang. This leftover background radiation would be best observed by which of the following telescopes?

W) Compton gamma ray observatory
X) Chandra x-ray observatory
Y) Herschel space observatory
Z) Wilkinson microwave anisotropy probe

ANSWER: Z) WILKINSON MICROWAVE ANISOTROPY PROBE **[DB]**

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TOSS-UP

18) Life Science – *Short Answer* A scientist looking at an animal cell population under a microscope and sees the formation of a cleavage furrow. During what phase of mitosis does the cell create a cleavage furrow?

ANSWER: CYTOKINESIS **[NR]**

BONUS

18) Life Science – *Multiple Choice* Which of the following functions would not be possible in a cell if it lacked centrioles?

W) Synthesis of new proteins
X) Breaking down of carbohydrates
Y) Nuclear division
Z) DNA synthesis

ANSWER: Y) NUCLEAR DIVISION **[NR]**
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TOSS-UP

19) Earth and Space – *Short Answer* What is the name of the quantity that describes the reflectiveness of a celestial object?

ANSWER: ALBEDO **[NR]**

BONUS

19) Earth and Space – *Multiple Choice* Which of the following parameters modifies the wavelength of the blackbody radiation?

W) Luminosity
X) Temperature
Y) Radiated Energy
Z) Surface Area

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

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TOSS-UP

20) Math – *Multiple Choice* Which of the following numbers is the base 10 equivalent of 22 base 4?

W) 6
X) 10
Y) 18
Z) 22

ANSWER: X) 10 **[NR]**

BONUS

20) Math – *Short Answer* What is the name of the point within a triangle that forms from the intersection of the 3 medians of that triangle?

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

21) Physical Science – *Short Answer* A constant force of magnitude 20 newtons is applied to a 10-kilogram box which starts at rest. What is the average speed, in meters per second, of this box during the first 4 seconds of its motion?

ANSWER: 4 **[CD]**

BONUS

21) Physical Science – *Short Answer* Identify all of the following three statements that are true regarding water: 1) It is capable of forming hydrogen bonds with other chemicals; 2) It is a nonpolar substance; 3) The central oxygen atom has three lone pairs.

ANSWER: 1 ONLY **[NR]**

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TOSS-UP

22) Earth and Space – *Multiple Choice* Which of the following rocks is NOT detrital?

W) Chert
X) Shale
Y) Conglomerate
Z) Sandstone

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

BONUS

22) Earth and Space – *Multiple Choice* Which of the following ocean zones describes the area near the shore which extends out to the edge of the continental shelf?

W) Neritic
X) Oceanic
Y) Pelagic
Z) Littoral

ANSWER: Z) LITTORAL **[DB]**
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TOSS-UP

23) Life Science – *Short Answer* According to trophic efficiency, if a caterpillar eats up to 500 joules of energy from plant material, on average, approximately how many joules of energy will be transferred to the secondary consumer that eats the caterpillar?

ANSWER: 50 JOULES **[DB]**

BONUS

23) Life Science – *Multiple Choice* Which of the following statements best describes biomagnification?

W) Population density in an area is amplified due to an influx
X) Condition where a disease spreads faster in a community due a factor such as temperature
Y) Chemical concentration in an organism due to the ingestion of other plants and animals
Z) Process that allows scientists to enlarge a sample of genes

ANSWER: Y) CHEMICAL CONCENTRATION IN AN ORGANISM DUE TO THE INGESTION OF OTHER PLANTS AND ANIMALS **[DB]**