DBHSST ROUND 5

Icebreaker question: What is your favorite season?

TOSS-UP

1) Physical Science – *Short Answer* How many prominent resonance structures are present in a molecule of ozone?

ANSWER: 2 **[NR]**

BONUS

1) Physical Science – *Short Answer* Identify all of the following three statements that are true regarding the nitrate ion: 1) It is the conjugate base of a weak acid; 2) The central nitrogen atom is bonded with 2 oxygen atoms; 3) The nitrate ion carries a minus 1 charge.

ANSWER: 3 ONLY **[NR]**

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TOSS-UP

2) Math – *Multiple Choice* Which of the following triplets does NOT form an acute triangle?

W) 7, 8, 11
X) 8, 11, 15
Y) 10, 15, 17
Z) 11, 12, 16

ANSWER: X) 8, 11, 15 **[NR]**

BONUS

2) Math – *Short Answer* Simplify the following expression: log base 4 of 32 plus log base 3 of 27 plus log base 2 of 4.

ANSWER: 7.5 (ACCEPT: 15/2) **[NR]**
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TOSS-UP

3) Life Science – *Short Answer* What is the process by which contractions in the esophagus push food down into the stomach?

ANSWER: PERISTALSIS **[DB]**

BONUS

3) Life Science – *Short Answer* In some sessile animals, both male and female reproductive systems are present in an individual, allowing any two individuals within that certain species to reproduce as male or female. What term describes this phenomenon?

ANSWER: HERMAPHRODITISM **[DB]**

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TOSS-UP

4) Earth and Space – *Short Answer* Marine snow, a continuous shower of organic matter falling from the ocean's surface to the seafloor, is an important food source for many deep-sea animals. What is the scientific term for the organic dead material that makes up marine snow?

ANSWER: DETRITUS **[DB]**

BONUS

4) Earth and Space – *Multiple Choice* Which of the following pairs of adjectives best describes the main mode of heat transport in the Sun's core and envelope, respectively?

W) Radiative, radiative
X) Radiative, convective
Y) Convective, radiative
Z) Convective, convective

ANSWER: X) RADIATIVE, CONVECTIVE **[DB]**
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TOSS-UP

5) Math – *Short Answer* What is the area of an ellipse defined by the equation x^2 over 49 + y^2 over 64 equals 1?

ANSWER: 56pi **[CD]**

BONUS

5) Math – *Short Answer* What are the coordinates of the vertices of the hyperbola with equation x^2 over 16 minus y^2 over 25 equals 1?

ANSWER: (-4, 0), (4, 0) **[CD]**

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TOSS-UP

6) Physical Science – *Short Answer* What fundamental law, analogous to Newton's Law of Universal Gravitation, states that the magnitude of the electric force between two charges is proportional to the magnitude of the charges and inversely proportional to the square of the distance between them?

ANSWER: COULOMB'S LAW **[CD]**

BONUS

6) Physical Science – *Short Answer* A charged sphere of mass 5 kilograms and net charge 3 coulombs is placed in an electric field of magnitude 8 newtons per coulomb. What is the magnitude of the acceleration, in meters per second squared, of the ball in this electric field?

ANSWER: 24/5 (ACCEPT: 4.8) **[CD]**
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TOSS-UP

7) Energy – *Short Answer* Scientists at Pacific Northwest National Lab are researching the internal processes and the potential volcanic hazards that may occur due to composite cone volcanoes. In some composite cones, a violent type of mudflow composed of pyroclastic material and saturated with water may sometimes form and rapidly flow down steep volcanic slopes. What is the name for this destructive flow?

ANSWER: LAHAR **[DB]**

BONUS

7) Energy – *Short Answer* Scientists at Argonne National Lab are studying how diffusion and effusion affect gas particles using an evacuated chamber. Identify all of the following 3 statements regarding diffusion and effusion that are true: 1) Diffusion will always eventually form a homogenous mixture due to the mixing of particles; 2) Graham's Law states that there is a direct proportion between the effusion rate of a gas and the square root of the mass of its particles; 3) Effusion cannot occur if the hole has a smaller diameter than the molecules' mean free paths.

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

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TOSS-UP

8) Life Science – *Multiple Choice* Which of the following characteristics does NOT describe arthropods?

W) Pharyngeal slits
X) Segmented bodies
Y) Exoskeleton made of chitin
Z) Paired and jointed appendages

ANSWER: W) PHARYNGEAL SLITS **[DB]**

BONUS

8) Life Science – *Multiple Choice* Which of the following types of speciation would a Liger, a cross-breed between a male lion and a tigress that cannot have offspring with other Ligers demonstrate?

W) Reproductive isolation
X) Postzygotic isolation
Y) Allopatric speciation
Z) Sympatric speciation

ANSWER: X) POSTZYGOTIC ISOLATION **[DB]**
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TOSS-UP

9) Earth and Space – *Multiple Choice* Which of the following sediments is NOT a type of hydrogenous sediment?

W) Metal sulfides
X) Manganese nodules
Y) Siliceous ooze
Z) Evaporites

ANSWER: Y) SILICEOUS OOZE **[DB]**

BONUS

9) Earth and Space – *Multiple Choice* Which of the following processes of nucleosynthesis would most likely occur in a star that weighs 1.4 solar masses?

W) Proton-proton chain
X) CNO cycle
Y) Triple alpha process
Z) Lithium burning

ANSWER: X) CNO CYCLE **[NR]**

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TOSS-UP

10) Math – *Multiple Choice* Which of the following postulates can NOT be used to determine if a pair of triangles is congruent?

W) Side-side-side
X) Angle-side-angle
Y) Side-angle-side
Z) Angle-angle-angle

ANSWER: Z) ANGLE-ANGLE-ANGLE **[NR]**

BONUS

10) Math – *Short Answer* Bepsi sells soda cans in boxes of 7 or 17 cans. What is the largest number of cans that cannot be purchased in these box sizes?

ANSWER: 95 **[NR]**

11) Physical Science – *Short Answer* Scientists at Ames National Lab are studying alpha decay. What are the changes in atomic number and atomic mass, respectively, of an atom after it undergoes alpha decay?
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TOSS-UP

ANSWER: -2; -4 **[CD]**

BONUS

11) Physical Science – *Short Answer* Scientists at Lawrence Berkeley National Lab are studying exotic states of matter. What low-energy state of matter consists of bosons cooled to temperatures very close to absolute zero?

ANSWER: BOSE-EINSTEIN CONDENSATE **[CD]**

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TOSS-UP

12) Energy – *Short Answer* Scientists at Pacific Northwest National Lab are studying the microorganisms that reside in hot springs. Specifically, they are studying the Archaean microorganisms that have optimal growth in extreme environmental conditions. What term is given to these organisms that are often found near hot hydrothermal vents in the deep ocean?

ANSWER: EXTREMOPHILES (ACCEPT: THERMOPHILES; DO NOT ACCEPT: HALOPHILES) **[DB]**

BONUS

12) Energy – *Short Answer* Scientists at the Joint Genome Institute are collaborating with Argonne National Lab scientists to research how cyanide affects the binding of substrates to the enzyme, cytochrome c oxidase. Cyanide acts as a mimic that reduces the productivity of the enzyme by preventing the electron transport chain from occurring. In this scenario, what type of enzyme inhibitor would best describe cyanide?

ANSWER: COMPETITIVE INHIBITOR **[DB]**
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TOSS-UP

13) Life Science – *Multiple Choice* Which of the following types of cells is responsible for rebuilding bones in bone remodeling?

W) Osteoblasts
X) Osteoclasts
Y) Osteocytes
Z) Lining cells

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

BONUS

13) Life Science – *Short Answer* What type of plant cells function as supporting elements in plants and are very rigid due to their large amounts of lignin?

ANSWER: SCLERENCHYMA CELLS **[DB]**

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TOSS-UP

14) Earth and Space – *Multiple Choice* Aakaash the seismologist is trying to determine the epicenter of an earthquake. In order to locate the epicenter of an earthquake, how many seismograph stations will he need?

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

ANSWER: Y) 3 **[DB]**

BONUS

14) Earth and Space – *Short Answer* What term is given to all animals in the ocean that are capable of moving independently of ocean currents?

ANSWER: NEKTON **[DB]**
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TOSS-UP

15) Math – *Short Answer* According to Descartes' Rule of Signs, what is the maximum number of positive roots for the function f(x) = x^4 + 3x^3 - 4x^2 + 8x - 6?

ANSWER: 3 **[CD]**

BONUS

15) Math – *Short Answer* According to the rational root theorem, how many possible rational roots are there for the equation x^4 - 2x^3 + 3x^2 + 4x - 18?

ANSWER: 12 **[CD]**

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TOSS-UP

16) Physical Science – *Short Answer* What is the tangential velocity, in meters per second, of a disk with a diameter of 5 meters rotating with an angular speed of 6 radians per second?

ANSWER: 15 **[CD]**

BONUS

16) Physical Science – *Multiple Choice* Kepler's Second Law is most directly equivalent to the conservation of which of the following quantities?

W) Energy
X) Linear Momentum
Y) Angular Momentum
Z) Mass

ANSWER: Y) ANGULAR MOMENTUM **[CD]**
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TOSS-UP

17) Energy – *Short Answer* Scientists at Pacific Northwest National Lab are studying hurricane formation in the Gulf Stream. Hurricanes cannot form within 5 degrees latitude of the equator because of what force that prevents air to rotate?

ANSWER: CORIOLIS EFFECT **[DB]**

BONUS

17) Energy – *Short Answer* Scientists at SLAC National Accelerator Lab are studying solar activity and the Sun-Earth connection. On the sun's surface, prominences composed of ionized gas rise up through the photosphere and into the lower corona. When viewed from above, what dark lines are formed by prominences?

ANSWER: FILAMENTS **[DB]**

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TOSS-UP

18) Life Science – *Short Answer* When tubes of blood are loaded into a centrifuge and components are separated, the cellular elements containing the red blood cells are separated from what ion and protein-containing liquid matrix?

ANSWER: PLASMA **[DB]**

BONUS

18) Life Science – *Short Answer* Identify all of the following 3 actions that chemoreceptors would detect: 1) Changes in pH; 2) Change in blood glucose level; 3) Changes in infrared radiation emitted by nearby objects.

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

19) Earth and Space – *Short Answer* What is the name of the geographic path on the surface of the earth that one must reside in to see a total solar eclipse?

ANSWER: PATH OF TOTALITY **[NR]**

BONUS

19) Earth and Space – *Multiple Choice* A telescope with a magnification 100 times that of the human eye is being used to look at stars in the night sky. Given that the maximum magnitude the naked eye can see in the sky is 6, which of the following will be the highest magnitude star that can be seen by the telescope?

W) 6
X) 11
Y) 16
Z) 21

ANSWER: Y) 16 **[NR]**

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TOSS-UP

20) Math – *Multiple Choice* If the exterior angle of a polygon measures 12 degrees, how many sides does this shape have?

W) 15
X) 20
Y) 30
Z) 40

ANSWER: Y) 30 **[NR]**

BONUS

20) Math – *Short Answer* We are given a rhombus ABCD with AB equals 4 and an angle ABC equals 60 degrees. In simplest radical form, what is the area of the rhombus?

ANSWER: 8 ROOT 3 **[NR]**
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TOSS-UP

21) Physical Science – *Multiple Choice* Which of the following pairs of water-soluble substances will create a buffer solution?

W) Sucrose and sulfuric acid
X) Sodium chloride and nitric acid
Y) Carbonic acid and sodium bicarbonate
Z) Ammonium chloride and glucose

ANSWER: Y) CARBONIC ACID AND SODIUM BICARBONATE **[NR]**

BONUS

21) Physical Science – *Short Answer* According to VSEPR theory, what is the molecular geometry of xenon tetrafluoride?

ANSWER: SQUARE PLANAR **[NR]**

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TOSS-UP

22) Earth and Space – *Multiple Choice* Which of the following types of springs ejects columns of water high into the air due to cool water in underground chambers being heated and subjected to overlying pressure?

W) Hot springs
X) Wells
Y) Artesian springs
Z) Geysers

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

BONUS

22) Earth and Space – *Short Answer* By what process do glaciers move due to overlying pressure, melting the ice below, forming a lubricant?

ANSWER: BASAL SLIDING **[DB]**
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TOSS-UP

23) Life Science – *Short Answer* What type of survivorship curve would humans and elephants, who generally live long lives, demonstrate?

ANSWER: TYPE 1 SURVIVORSHIP CURVE **[DB]**

BONUS

23) Life Science – *Multiple Choice* Which of the following types of learning would involve batesian mimicry?

W) Associative
X) Spatial
Y) Imprinting
Z) Observational

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