SSBT Prelim Round 2

TOSS-UP

1) Earth and Space – *Short Answer* Isostatic rebound is caused by the removal of what geological features?

ANSWER: GLACIERS

***BONUS**

1) Earth and Space – *Short Answer* Identify all of the following 3 landforms that can be formed by glacial activity: 1) Hanging valleys; 2) Fjords; 3) Kettles.

ANSWER: ALL

TOSS-UP

2) Biology – *Short Answer* What term defines structures which are similar in anatomical shape and form, but are different in their function, such as the forelimbs of humans, and the flippers of whales?

ANSWER: HOMOLOGOUS STRUCTURE

BONUS

2) Biology – *Short Answer* What is the name for the condition where heart rate exceeds 100 bpm?

ANSWER: TACHYCARDIA (tack - ah - cardia)

TOSS UP

3) Chemistry – *Multiple Choice* Which of the following gases most closely behaves as an ideal gas at standard temperature and pressure?

W) PH_3

X) HBr

Y) SO_2

Z) N_2

ANSWER: Z) N_2

BONUS

3) Chemistry – *Short Answer* What is the noble gas electron configuration of aluminum?

ANSWER: [Ne] $3s^2$ $3p^1$

TOSS-UP

4) Math – *Short Answer* The altitude of an equilateral triangle measures $5\sqrt{3}$. What is the side length of this triangle?

ANSWER: 10

BONUS

4) Math – *Multiple Choice* Which of the following equations has two distinct real roots?

W) $x^2 - 4x + 4$

X) $4x^2 - 4x + 4$

Y) $x^2 - x + 4$

Z) $x^2 - 4x + 1$

ANSWER: Z) $x^2 - 4x + 1$

TOSS-UP

5) Energy – *Short Answer* Researchers at Lawrence Berkeley National Lab are using standard candles to measure redshift in order to learn more about dark energy and the expansion of the universe. What type of supernovae with known light spectra can be used to measure this shift?

ANSWER: TYPE IA

BONUS

5) Energy – *Multiple Choice Answer* Researchers at the Critical Materials Institute at Ames National Lab are developing more powerful samarium-cobalt magnets. Samarium-cobalt magnets and similar strong magnets are created by adding rare earth metals to elements that naturally display what form of magnetism?

W) Paramagnetism

X) Diamagnetism

Y) Ferromagnetism

Z) Ferrimagnetism

ANSWER: Y) FERROMAGNETISM

TOSS-UP

6) Physics – *Multiple Choice* Which of the following scenarios would decrease resistance in a silver wire?

W) Increasing temperature

X) Increasing length

Y) Using copper instead of silver

Z) Increasing the radius

ANSWER: Z) INCREASING THE RADIUS

BONUS

6) Physics – *Short Answer* A circuit has 3 different resistors that are 2.5, 10, and 30 ohms, where only the 10 and 30 ohm resistors are in parallel. If a 5 volt battery is connected into the system, how much current is passing through the circuit, in amps?

ANSWER: 0.5

TOSS-UP

7) Earth and Space – *Multiple Choice* Which of the following crystal systems includes aragonite, topaz, and anhydrite?

W) Triclinic

X) Cubic

Y) Orthorhombic

Z) Monoclinic

ANSWER: Y) ORTHORHOMBIC

BONUS

7) Earth and Space – *Short Answer* Identify all of the following 3 choices that correctly match the ore and the metal it is mined for: 1) Magnetite and iron; 2) Galena and sulfur; 3) Sphalerite and mercury.

ANSWER: 1 ONLY

TOSS-UP

8) Biology – *Short Answer* Which secondary structure would be most commonly associated with the transmembrane region of a channel protein?

ANSWER: ALPHA HELIX

BONUS

8) Biology – *Short Answer* What is the process by which the F1 subunit of ATP synthase generates ATP from ADP and inorganic phosphate by using the energy released from the facilitated diffusion of protons?

ANSWER: CHEMIOSMOSIS (ACCEPT: OXIDATIVE PHOSPHORYLATION)

TOSS-UP

9) Chemistry – *Short Answer* What term is given to the energy required to begin a spontaneous reaction?

ANSWER: ACTIVATION ENERGY

BONUS

9) Chemistry – *Multiple Choice* Which of the following is insoluble in water?

W) Sodium hydroxide

X) Ammonium nitrate

Y) Silver chloride

Z) Magnesium chloride

ANSWER: Y) SILVER CHLORIDE

TOSS-UP

10) Math – *Multiple Choice* What is the units digit of the number 3^{81}?

W) 1

X) 3

Y) 7

Z) 9

ANSWER: X) 3

BONUS

10) Math – *Short Answer* How many ordered quadruples of nonnegative numbers (a,b,c,d) exist such that they satisfy a + b + c + d = 12?

ANSWER: 455

TOSS-UP

11) Energy – *Short Answer* Researchers at the Department of Energy's Atmospheric Radiation Measurement facility are attempting to measure energy flux across North America. One major driver of change in energy flux is a change in the fraction of incoming energy reflected by a substance, which is given what name?

ANSWER: ALBEDO

BONUS

11) Energy – *Short Answer* Researchers at Lawrence Livermore National Lab are currently developing a large eddy simulation to model turbulence in the atmosphere. These simulations are created by solving what series of differential equations that describe the movement of fluids?

ANSWER: NAVIER-STOKES EQUATIONS

TOSS-UP

12) Physics – *Short Answer* What is the power, in Watts, of a circuit containing a 9 volt battery and a 2 ohm resistor?

ANSWER: 40.5 (ACCEPT: 81/2)

BONUS

12) Physics – *Multiple Choice* Which of the following would increase the capacitance between 2 parallel plates?

W) Increasing the distance between the two plates

X) Decreasing the area of both plates

Y) Increasing the permittivity of the dielectric between the two plates

Z) Increasing the circuit voltage

ANSWER: Y) INCREASING THE PERMITTIVITY OF THE DIELECTRIC BETWEEN THE TWO PLATES

TOSS-UP

13) Earth and Space – *Short Answer* Tropical oceans are typically highly stratified because they contain what thermal boundary, which separates the warm mixed layer from the cold deep layer?

ANSWER: THERMOCLINE

BONUS

13) Earth and Space – *Short Answer* When Mount St. Helens erupted in 1980, glacial water from the mountain mixed with debris to create what dangerous flow of volcanic material?

ANSWER: LAHAR

TOSS-UP

14) Biology – *Multiple Choice* Which of the following enzymes is responsible for relieving strain caused by the overwinding of DNA fragments ahead of the replication fork?

W) Primase

X) Topoisomerase

Y) Helicase

Z) DNA polymerase III

ANSWER: X) TOPOISOMERASE

BONUS

14) Biology – *Short Answer* What is the term which describes a virus who is able to transcribe their RNA genome into a DNA copy, which can then be incorporated into the genome of the host cell?

ANSWER: RETROVIRUS (DO NOT ACCEPT: HIV)

TOSSUP

15) Chemistry – *Multiple Choice* Which of the following conditions is the most desirable condition for an ideal gas?

W) Low pressure and low temperature

X) Low pressure and high temperature

Y) High pressure and low temperature

Z) High pressure and high temperature

ANSWER: X) LOW PRESSURE AND HIGH TEMPERATURE

BONUS

15) Chemistry – *Short Answer* Identify all of the following 3 quantities that are greater for nitrogen than for oxygen: 1) Ionization energy; 2) Atomic radius; 3) Electronegativity.

ANSWER: 1 AND 2

TOSS-UP

16) Math – *Short Answer* What must the side length of a cube be for its volume to have the same value as its surface area?

ANSWER: 6

BONUS

16) Math – *Short Answer* A sequence has first term 1, followed by 2 two's, 3 three's, and so on. What is the 55th term of this sequence?

ANSWER: 10

TOSS-UP

17) Energy – *Short Answer* Researchers at the National Renewable Energy Lab are searching for ways to lower the cost of hydrogen production for fuel cells. Most current hydrogen is produced via what process, which involves the splitting of water into gaseous hydrogen and oxygen?

ANSWER: ELECTROLYSIS

BONUS

17) Energy – *Multiple Choice* Researchers at Sandia National Labs recently created a device for automatic surveillance of arboviruses, viruses whose main vectors for transmission are arthropods. Which of the following diseases is NOT caused by an arbovirus?

W) Dengue fever

X) Influenza

Y) Yellow fever

Z) Zika

ANSWER: X) INFLUENZA

TOSS-UP

18) Physics – *Short Answer* What is the centripetal force in Newtons on an object revolving around a center 4 meters away with mass 8kg and a tangential velocity of 3 m/s?

ANSWER: 18

BONUS

18) Physics – *Short Answer* A spaceship with a length of 100m is flying at 80% of the speed of light relative to an observer. How long in meters does the spaceship appear to the observer?

ANSWER: 60

TOSS-UP

19) Earth and Space – *Short Answer* What astronomical quantity measures the deviation of an orbit from a perfect circle?

ANSWER: ECCENTRICITY

BONUS

19) Earth and Space – *Multiple Choice* Which of the following types of nebulae include H II regions?

W) Planetary

X) Absorption

Y) Reflection

Z) Emission

ANSWER: Z) EMISSION

TOSS-UP

20) Biology – *Short Answer* In eukaryotes, what short nucleotide sequence found in the promoter has shown to be crucial in forming the initiation complex to begin transcription?

ANSWER: TATA BOX

BONUS

20) Biology – *Short Answer* In unicorns, having a white mane is dominant to having a brown mane. Also in unicorns, having a long horn is dominant to having a short and stubby horn. A breeder decides to mate two unicorns who are both heterozygous for a white mane and a long horn. Assuming that unicorns, like humans, are diploids and that these genes are on two different autosomal chromosomes, what fraction of the offspring would have a brown mane and long horns?

ANSWER: 3/16 (ACCEPT: 18.75 %)

TOSS-UP

21) Chemistry – *Short Answer* What is the molecular geometry of ammonia?

ANSWER: TRIGONAL PYRAMIDAL

BONUS

21) Chemistry – *Short Answer* Identify all of the following 3 statements that are true about spontaneous reactions: 1) Spontaneous reactions have a negative Gibbs free energy; 2) Spontaneous reactions increase the entropy of the universe; 3) Spontaneous reactions occur instantaneously.

ANSWER: 1 AND 2

TOSS-UP

22) Math – *Short Answer* An equilateral triangle has area $9\sqrt{3}$ in^2. What is the perimeter of the triangle in inches?

ANSWER: 18

BONUS

22) Math – *Short Answer* How many times does the graph of $\sin(10\pi x)$ intersect the x axis on the closed interval 0 to 5?

ANSWER: 51

TOSS-UP

23) Physics – *Short Answer* A 48 gram cube with uniform density and volume 64cm^3 is placed into a pool of water. What percent of the cube will be submerged at equilibrium?

ANSWER: 75%

BONUS

23) Physics – *Short Answer* A car begins from rest and accelerates from rest at a rate of 4.5 m/s^2 until it has traveled 100 m. In m/s, what is the final velocity of the car?

ANSWER: 30