SSBT Prelim Round 1

TOSS-UP

1) Biology – *Short Answer* What large structure in the nucleus of a cell is the primary site for the assembly of ribosomes?

ANSWER: NUCLEOLUS

BONUS

1) Biology – *Multiple Choice* Which of the following statements is true regarding RNA translation?

W) Prokaryotes and eukaryotes use the same form of methionine as a start codon

X) mRNA first attaches to the large subunit and then the smaller subunit

Y) Amino acids enter from the E site

Z) Eukaryotes form 80s ribosomes while prokaryotes form 70s ribosomes

ANSWER: Z) EUKARYOTES FORM 80S RIBOSOMES WHILE PROKARYOTES FORM 70S RIBOSOMES

TOSS-UP

2) Chemistry – *Multiple Choice* What common method for separating a liquid mixture takes advantage of differences in their boiling points?

W) Distillation

X) Centrifuge

Y) Filtration

Z) Sedimentation

ANSWER: W) DISTILLATION

BONUS

2) Chemistry – *Multiple Choice* Which of the following compounds has the greatest ionic character?

W) Calcium chloride

X) Rubidium iodide

Y) Magnesium iodide

Z) Potassium chloride

ANSWER: Z) POTASSIUM CHLORIDE

TOSS-UP

3) Physics – *Short Answer* A moving block with a mass of 35 kilograms slides on a level surface with a coefficient of kinetic friction of 0.1. Assuming the acceleration due to gravity is 10 m/s^2, what is the magnitude of the frictional force in Newtons?

ANSWER: 35N

BONUS

3) Physics – *Short Answer* Identify by name or number all of the following three statements about friction that are true: 1) The coefficient of static friction is always less than the coefficient of kinetic friction; 2) The force of friction is inversely proportional to the normal force; 3) The maximum force of static friction is the minimum force needed to move an object.

ANSWER: 3 ONLY

TOSS-UP

4) Earth and Space – *Multiple Choice* Which of the following best characterizes lava flows from shield volcanoes such as those found in Hawaii?

W) Basaltic and fast flowing

X) Basaltic and slow flowing

Y) Rhyolitic and fast flowing

Z) Rhyolitic and slow flowing

ANSWER: W) BASALTIC AND FAST FLOWING

BONUS

4) Earth and Space – *Short Answer* By name or number, identity all of the following 3 features that are common along oceanic-continental convergent plate boundaries: 1) Trenches; 2) Island arcs; 3) Mountain ranges.

ANSWER: 1 AND 3

TOSS-UP

5) Math – *Short Answer* If two angles measure 3x+5 and 2x-10 and are supplementary to each other, what is the measure of x in degrees?

ANSWER: 37

BONUS

5) Math – *Short Answer* If r and s are the roots of the polynomial $x^2 - 5x - 15$, what is the value of $r^2 + s^2$?

ANSWER: 55

TOSS-UP

6) Biology – *Short Answer* What process which occurs across all domains of life uses lactic acid as a means of refreshing NAD+ and allowing glycolysis to occur?

ANSWER: FERMENTATION

BONUS

6) Biology – *Short Answer* What group of proteins are used to facilitate protein folding such as BiP in the endoplasmic reticulum?

ANSWER: CHAPERONINS (ACCEPT: HEAT SHOCK PROTEINS OR CHAPERONES)

TOSS-UP

7) Chemistry – *Short Answer* What is the pH of a 0.1 molar solution of hydroiodic ***[hydro-eye-OH-dic]*** acid?

ANSWER: 1

BONUS

7) Chemistry – *Short Answer* To one significant figure in scientific notation, what is the acid dissociation constant of a certain weak acid given that a 0.1 molar solution of this acid has a pH of 3?

ANSWER: 1 x 10^-5 (ACCEPT 10^-5)

TOSS-UP

8) Physics – *Short Answer* A block of mass 1 kilogram slides 5 meters across a frictionless, level surface. In Joules, how much work is done on the block by gravity?

ANSWER: 0

BONUS

8) Physics – *Short Answer* In meters per second, what will be the speed of a 50 kilogram box 10 seconds after it's released from rest down a frictionless inclined plane with an angle of 30 degrees to the horizontal assuming g is 10 m/s^2?

ANSWER: 50

TOSS-UP

9) Earth and Space – *Multiple Choice* Which of the following minerals is not considered a dark silicate mineral?

W) Biotite

X) Olivine

Y) Amphibole

Z) Muscovite

ANSWER: Z) MUSCOVITE

BONUS

9) Earth and Space – *Short Answer* Order the following 3 lava types from most to least viscous: 1) Rhyolitic; 2) Andesitic; 3) Basaltic.

ANSWER: 1, 2, 3

TOSS-UP

10) Math – *Short Answer* Alvin, Bartholomew, and Candice have 5, 50, and 200 dollars in their bank accounts respectively. If their total cash is to be distributed such that each person has the same amount of money, how much money would Alvin receive from the others?

ANSWER: 80

BONUS

10) Math – *Short Answer* How many proper divisors does 7! **[seven factorial]** have?

ANSWER: 59

TOSS-UP

11) Energy – *Multiple Choice* Scientists at Pacific Northwest National Lab are studying the impact of climate change on soil microbes, which decompose organic matter and release nutrients back into the soil. Which of the following soil horizons would soil microbes be most abundant in?

W) O

X) A

Y) B

Z) E

ANSWER: W) O

BONUS

11) Energy – *Short Answer* Researchers at Princeton Plasma Physics Lab are constructing a newly designed fusion reactor, with a cored-apple-like shape that makes cost-effective magnetic fields. Most tokamaks confine plasma using magnetic fields in what shape?

ANSWER: TORUS

TOSS-UP

12) Biology – *Multiple Choice* Which of the following is not a requirement for Hardy-Weinberg equilibrium?

W) Natural selection

X) Large population

Y) No mutations

Z) Random mating

ANSWER: W) NATURAL SELECTION

BONUS

12) Biology – *Short Answer* What is the name of the gaps found in myelinated axons that contain voltage-gated sodium channels and play a role in facilitating the movement of action potentials through the axon?

ANSWER: NODES OF RANVIER (ACCEPT: NEUROFIBRIL NODES)

TOSS UP

13) Chemistry – *Short Answer* What law describes the relationship between gas solubility and the partial pressure of a gas above the solvent?

ANSWER: HENRY'S LAW

BONUS

13) Chemistry – *Multiple Choice* Which of the following statements is not true of the phase diagram of water?

W) Liquid water and ice are in equilibrium at 0°C and 1 atmosphere

X) The slope of the line between the solid and liquid phases is positive

Y) Applying enough pressure to water vapor at -10°C will cause a phase change to ice

Z) The triple point is above 0°C

ANSWER: X) THE SLOPE OF THE LINE BETWEEN THE SOLID AND LIQUID PHASES IS POSITIVE

TOSS-UP

14) Physics – *Multiple Choice* In which of the following scenarios is there no net work done on an electron?

W) The electron moves along an electric field line

X) The electron moves perpendicular to an equipotential line

Y) The electron moves along an equipotential line

Z) Net work must be applied to move the electron

ANSWER: Y) THE ELECTRON MOVES ALONG AN EQUIPOTENTIAL LINE

BONUS

14) Physics – *Short Answer* Aaron and Sharon, with respective weights 700 N and 900 N, are sitting on the ends of a massless seesaw. If the fulcrum is 1 meter away from the midpoint of the seesaw, what is the total length of the seesaw in meters?

ANSWER: 16

TOSS-UP

15) Earth and Space – *Short Answer* By name or number, identify all of the following three particles that are products of the proton-proton chain: 1) Gamma ray; 2) Neutron; 3) Neutrino.

ANSWER: 1 AND 3

BONUS

15) Earth and Space – *Short Answer* Identify all of the following three solar phenomena that are created by the Sun's magnetic field: 1) Solar flares; 2) Sunspots; 3) Coronal mass ejections.

ANSWER: ALL

TOSS-UP

16) Math – *Short Answer* A man can solve math problems at a constant rate of one problem per 7 seconds. If three identical clones join him, how long, in seconds, does it take the four of them to solve 28 problems?

ANSWER: 49

BONUS

16) Math – *Short Answer* If Bob can eat 85 bananas in 1 minute and Stuart can eat 90 bananas in 2 minutes, how many bananas can they eat together in 5 minutes?

ANSWER: 650

TOSS-UP

17) Energy – *Multiple Choice* Researchers at Brookhaven National Labs are building the Electron Ion Collider (EIC) in hopes of discovering more about the distribution of quarks and which of the following particles found in atomic nuclei?

W) Photons

X) Gluons

Y) W bosons

Z) Z bosons

ANSWER: X) GLUONS

BONUS

17) Energy – *Short Answer* Researchers at Fermilab are working on the MAGIS-100 in order to extend the amount of time and the distance one atom can stay in two different states, which is possible due to what fundamental quantum principle?

ANSWER: SUPERPOSITION

TOSS-UP

18) Biology – *Short Answer* What is the name of the chronic autoimmune disorder characterized by the degradation of myelin sheaths in neurons?

ANSWER: MULTIPLE SCLEROSIS (ACCEPT: MS)

BONUS

18) Biology – *Short Answer* In sickle cell anemia patients, what amino acid is incorrectly produced as a result of a point mutation on glutamic acid?

ANSWER: VALINE

TOSS-UP

19) Chemistry – *Multiple Choice* Which of the following changes to an ideal gas in a closed container would NOT lead to an increase in pressure?

W) Increasing number of molecules

X) Increasing average kinetic energy

Y) Increasing temperature

Z) Increasing the volume of the container

ANSWER: Z) INCREASING THE VOLUME OF THE CONTAINER

BONUS

19) Chemistry – *Short Answer* Order the following 3 compounds in order of increasing specific heat capacity: 1) Water; 2) Graphite; 3) Methanol.

ANSWER: 2, 3, 1

TOSS-UP

20) Physics – *Short Answer* Order the following 3 types of radiation in order of decreasing wavelength: 1) Ultraviolet; 2) X-ray; 3) Radio.

ANSWER: 3, 1, 2 (ACCEPT: RADIO, ULTRAVIOLET, X-RAY)

BONUS

20) Physics – *Short Answer* Assuming g is 10 m/s^2, what is the absolute difference in pressure in Pascals between the surface and a point 6 meters below the surface in a fluid with density 500 kg/m^3?

ANSWER: 30000

TOSS-UP

21) Earth and Space – *Short Answer* In what layer of the atmosphere does the aurora borealis occur?

ANSWER: IONOSPHERE (ACCEPT: THERMOSPHERE)

BONUS

21) Earth and Space – *Short Answer* An object becomes a black hole when its radius shrinks below what radius, which is defined as the radius where the object's escape velocity reaches the speed of light?

ANSWER: SCHWARZSCHILD RADIUS

TOSS-UP

22) Math – *Short Answer* How many distinct arrangements of the four letters D, E, E, Z are there such that the two vowels are adjacent?

ANSWER: 6

BONUS

22) Math – *Short Answer* What is the probability of flipping a fair two-sided coin five times and getting exactly two heads?

ANSWER: 5/16

TOSS-UP

23) Energy – *Short Answer* Researchers at Ames National Labs are testing dynamic nuclear polarization (DNP) to study the chemical properties of catalysts, fossil fuels, polymers, and other solids. In particular, DNP uses microwaves to increase sensitivity for what technique that monitors nuclear spin flips of molecules to give more insight into its chemical structure?

ANSWER: NMR SPECTROSCOPY

BONUS

23) Energy – *Multiple Choice* Researchers at Fermilab are currently experimenting with muons to test the predictions of the Standard Model at extreme conditions. However, muons are difficult to measure precisely due to which of the following properties?

W) Short lifetime

X) Lack of charge

Y) Low mass

Z) High reactivity

ANSWER: W) SHORT LIFETIME