Finals

Regulation

(Tossup 1) A mutualistic relationship between these structures and fungi is called Mycorrhizae [My-co-rie-za]. Rhizobia in nodules of these structures help legumes with nitrogen fixation. Edible examples of these structures include beets and carrots. For the point, name these structures that anchor plants to the ground and helps them to absorb water and nutrients.

ANSWER: **root**s

(Tossup 2) A paper by Alpher-Bethe-Gamow explains nucleosynthesis of heavier elements after this event. The theory of this event was opposed by Hoyle's steady-state theory even though Hoyle coined the term for this event. The cosmic microwave background is remnant radiation from this event which caused the universe to undergo rapid inflation. For the point, name this event that occurred at the beginning of the universe.

ANSWER: **Big Bang**

(Tossup 3) The fluoroantimonic one is the strongest known example of these compounds in the world. Arrhenius defined them as increasing hydrogen ion concentration in water, while they are proton donors in the Bronsted-Lowry definition. Varieties of these compounds include nitric, sulfuric and acetic. For the point, name these compounds that have a pH of less than 7.

ANSWER: **acid**s

(Tossup 4) The lysosome receives products from this organelle that are tagged with mannose-6-phosphate. This organelle receives proteins from the ER on its cis face and it is made of stacks called cisternae. Its main function is processing proteins into vesicles for transport. For the point, name this organelle that is named after an Italian scientist.

ANSWER: **Golgi** body (accept **Golgi** apparatus)

(Tossup 5) The most common rare-earth variety of these objects are made of neodymium-iron-boron or samarium-cobalt. Lodestone contains a certain mineral that allows it to behave as one of these objects. The field produced by these objects is measured in Teslas and can be visualized with iron fillings. For the point, name these objects with a north and south pole that can attract certain metals

ANSWER: permanent **magnet**s (accept **magnetic** field; prompt on rare earth metals)

(Tossup 6) Black Mamba venom is known to contain dendrotoxins which interact with the potassium channels of these cells. A famous autoimmune disease associated with these cells results from damage to their myelin sheath lining. These cells have inspired namesake networks that are now commonly implemented in machine learning and artificial intelligence. For the point, name these electrically excitable cells composed of a cell body and an axon, which make up the nervous system.

ANSWER: **Neurons** (accept **nerve cell**; accept **neurone**)

(Tossup 7) This bacteria metabolizes lactose and tryptophan using gene operons. A deadly strain of this bacteria is labelled O157:H7, and outbreaks of that strain have been linked to romaine lettuce. Normally, this bacteria is unharmful and even aids in digestion. For the point, name this bacterium that lives in intestines and like Salmonella, can cause food poisoning.

ANSWER: **E**scherichia **coli**

(Tossup 8) Ernst Hartwig observed the only known Supernova to have occurred in this body. This body was originally classified as a nebula before Edwin Hubble discovered Cepheid variable stars inside of it in 1925. This largest member of the Local Group is predicted to collide with our galaxy in several billion years. For the point, name this closest spiral galaxy to the Milky Way.

ANSWER: **Andromeda** galaxy (accept **M**essier **31**)

(Tossup 9) The rarest naturally occurring element in the Earth's crust is a member of this group of elements. One member of this group of elements is used to kill bacteria in swimming pools. Tennessine and Astatine are members of this group and other members of this group create strong acids with hydrogen – such as hydrochloric acid. Iodine, bromine and chlorine are members of, for the point, what group of elements that are to the left of the group 18 noble gases?

ANSWER: **halogen**s (accept **group 17**; prompt on "chlorine"; prompt on "astatine")

(Tossup 10) Material is rapidly added or removed from one of these structures in a Slug test. Darcy's Law, in combination with the conservation of mass, can determine the flow rate within these structures. The artesian variety of these formations undergo positive pressure and are often made into wells. For the point, name these layers of underground porous rocks which store water.

ANSWER: **aquifer**s

(Tossup 11) The entropy of vaporization is defined as heat of vaporization divided by this quantity. Gibbs free energy is equal to enthalpy minus entropy times this quantity. Increasing this quantity will also increase the pressure of a gas. For the point, name this measure of average kinetic energy, a quantity measured in Kelvin, Celsius, and Fahrenheit.

ANSWER: **temperature**

(Tossup 12) Optical tweezers work by using these devices to exert radiation pressure on atoms. Q-switching and modelocking are ways to produce pulses on the order of femtoseconds with these devices. These devices work by inducing population inversion to create a stream of stimulated emission. For the point, name these devices that produce a concentrated beam of light.

ANSWER: **laser**s (or **light amplification by stimulated emission of radiation**)

(Tossup 13) These compounds can be depicted using Hayworth or Fischer projections, and they have a 1:2:1 ratio of carbon, hydrogen and oxygen. Examples of these compounds in plants include cellulose and starch. Calories primarily come from fats, proteins, and these macromolecules. Glucose, sucrose, and fructose are sweet examples of, for the point, what macromolecule making up most of bread?

ANSWER: **carb**ohydrates (or **sugar**s; accept **polysaccharide**s; accept **monosaccaride**s; anti-prompt on "glucose" with "Can you be less specific?")

(Tossup 14) Within molecules, these regions can be bonding or anti-bonding. The Bohr radius refers to the smallest radius of one of these regions. Mixing of these regions is called hybridization, and the Aufbau principle governs how they are filled. These regions are classified as s, p, d or f. For the point, name this term for the region where electrons are likely to be found around an atom.

ANSWER: **orbital**s

(Tossup 15) After revealing this product, the presenter on this product placed an order for 4,000 lattes to go. Earlier in that presentation on this product, a conference call was held between Jony Ive and Phil Schiller. The 10th version of this product removed touch ID in favor of a facial recognition system. The voice assistant Siri was added in this product's 4th generation. For the point, name this line of smartphones designed by Apple.

ANSWER: **iPhone** (accept specific models)

(Tossup 16) The noctilucent variety of this phenomena forms from ice crystals and is only visible during twilight. The study of this phenomena is known as nephology, and it occurs when saturated air is cooled to its dew point. When they occur at high altitudes, they can form mares' tails, and "contrails" are an artificial example formed by airplanes. Cirrus, stratus and cumulonimbus are varieties of, for the point, what phenomena that takes on a white fluffy shape in the sky?

ANSWER: **cloud**s

(Tossup 17) "Basal drag" is a theory that describes the motion of these objects. These objects include the ancient Farallon whose modern remnants include the Juan de Fuca. Alfred Wegener's theory of continental drift helped establish a model of these objects which can sink into the mantle at subduction zones. These objects come in continental and oceanic types. For the point, name these moving sections of Earth's crust.

ANSWER: **tectonic plates** (accept **plate tectonics**; prompt on partial answers)

(Tossup 18) This disease is characterized by the accumulation of alpha-synuclein in Lewy bodies. L-DOPA is used to treat this disease that is caused by the death of dopamine producing cells. It's named for a British Doctor who wrote about it in *Essay on the Shaking Palsy* This disease's cure is sought out by the Michael J. Fox foundation. For the point, name this disease that is characterized by slowness of movement and tremors.

ANSWER: **Parkinson**'s disease (accept **PD**)

(Tossup 19) A species found in this biome, the common basilisk, is nicknamed the "Jesus Lizard" for its ability to walk on water. The Ituri is an example of this ecosystem home to the okapi also known as the zebra giraffe. This biome accounts for over half of the world's plants and animal species. This type of ecosystem is found throughout much of the Congo River basin in Central Africa. For the point, name this ecosystem characterized by tall broadleaf trees and a high rate of precipitation.

ANSWER: **rainforest**s (accept tropical **rainforest**s; accept Amazon **rainforest** prompt on forest; prompt on tropics; prompt on jungle)

(Tossup 20) This shape is used to represent the D'Alambertian operator. Early mathematicians attempted to construct this shape with equal area to a circle using only a compass and a straight edge. Inheritance ratio in offspring can be determined using a version of this shape named for Punnett. The area of this shape is equal to one of its side lengths times itself. For the point, name this shape of four right angles and four equal side lengths.

ANSWER: **square** (accept **box**; prompt on quadrilateral)

(Tossup 21) The outbursts of luminous blue variables are sometimes mistaken for these events. One version of this event creates zombie stars. White dwarves that surpass the Chandrasekhar limit will undergo this event. One of these events created the Crab Nebula. For the point, name these events, in which huge stars explode.

ANSWER: **supernova**e (accept specific types of supernovae)

(Tossup 22) A facility in Arizona called the VLA [vee-el-ay] uses 27 of these devices, often in tandem, while 18 smaller mirrors will make up the segmented mirror in one of these named for James Webb. A famous one of these devices required the COSTAR module to be installed in 1993 to serve as corrective optics, and the largest refracting type of this device is located at Yerkes Observatory in Wisconsin. For the point, name these devices used for looking at celestial objects.

ANSWER: **Telescope**s (accept **radio telescope** before mirrors)

(Tossup 23) The magnitude of this force is equal to the product of density, volume, and gravity. This force is the result of increasing pressure at lower depths. It was legendarily used by a Greek mathematician to determine if a crown was gold. "Any floating object displaces its own weight of fluid" by this force according to Archimedes' principle. For the point, name this tendency of an object to stay afloat.

ANSWER: **buoyancy** (accept **upthrust**; accept **buoyant** force)

(Tossup 24) This scientist names ten "field equations" that relates his namesake tensor to the stress-energy tensor. This scientist's paper on Brownian motion and his explanation of the photoelectric effect won him the 1921 Nobel prize in Physics. This physicist fixed the speed of light as a constant in all reference frames in his formulation of special relativity. For the point, name this scientist who proposed the famous rest-mass equation E equals m, c squared.

ANSWER: Albert **Einstein**

(Tossup 25) When these objects share an orbit with a planet or moon, they are termed Trojans. The search that resulted in the discovery of the first of these objects was triggered by a prediction made by the Titus-Bode Law, which predicted a planet about 2.8 AU [ay-yu] from the sun. In December 2018, the OSIRIS-REX mission reached Bennu, one of these objects, to collect samples and return them to Earth. For the point, identify these objects, most of which orbit the sun between Mars and Jupiter in a namesake "belt".

ANSWER: **Asteroid**s

(Tossup 26) The coral population in the Indo-Pacific region is harmed by the crown-of-thorns variety of this group. These inverterbrates make up the class Asteroidea and use suction from their tube feet to pull apart mollusk shells. The five limbs of these creatures can regenerate when cut off. For the point, name these spiny creatures that live on ocean floors and whose five outspread arms cause them to resemble items found in the night sky.

ANSWER: **starfish** (or **sea stars**; prompt on Echinoderms; prompt on Echinodermata)

(Tossup 27) The oldest known example of one of these structures on the Wadi Rajil was located in the local town of Jawa. The largest of these structures is the Three Gorges one in Yichang, China. An "arch-gravity" one of these structures impounds Lake Mead on the Nevada, Arizona border, generating a massive amount of hydroelectric power. Beavers construct natural versions of, for the point, what structures that hold back water across a river or lake exemplified by one named for Herbert Hoover.

ANSWER: **dam**s

(Tossup 28) This virus's gp41 and gp120 proteins help target it to CD4 receptors. Opportunistic infections as a result of this virus can cause Kaposi's Sarcoma. The proliferation of this virus is slowed down by drugs like AZT which work by inhibiting this virus's reverse transcriptase. This retrovirus infects helper T cells of the immune system. For the point, name this virus that weakens the immune system and leads to AIDS.

ANSWER: **HI**V (accept**human immunodeficiency** virus; prompt on AIDS before it is read; prompt on acquired immune deficiency syndrome before AIDS is read)

(Tossup 29) Protein structure is stabilized by bridges of this element. The contact process generates a strong, diprotic acid containing this element. One compound of iron and this element is called fool's gold, while oxides of nitrogen and this element are the pollutants that cause acid rain. This element, formerly called brimstone, is responsible for the smell of rotten eggs. For the point, name this yellow element with atomic number 16.

ANSWER: **sulfur**

(Tossup 30) Inge Lehmann discovered that this region was actually split into two distinct parts. The presence of this region causes the P-wave shadow zone observed after an earthquake. This region's upper boundary is named for Gutenberg. The liquid part of this region is responsible for Earth's magnetic field. For the point, name this region of the Earth made up of iron and nickel, beneath the mantle, that has "inner" and "outer" parts.

ANSWER: Earth's **core** (do not accept or prompt on inner core or outer core)

Replacements

(Tossup 31) The "Fate has ordained" speech was prepared for but never delivered during this event. Jim Lovell was replaced by Michael Collins before this event; during this event, Collins was the Command Module pilot. Famous quotations from this mission include "The Eagle has landed" and "one giant leap for mankind". For the point, Buzz Aldrin and Neil Armstrong traveled on what first mission to the moon?

ANSWER: **Apollo 11** (prompt on anything referring to a moon landing or going to the moon)

(Tossup 32) This planet was first visited by Pioneer 10 and more recently by the spacecraft Juno. Comet Shoemaker-Levy 9 collided into this planet in 1994. This planet's moon Io is the most volcanically active body in the solar system, while its moons Europa and Ganymede may have subsurface oceans. The Great Red Spot is on, for the point, which largest planet in the solar system?

ANSWER: **Jupiter**