Round 4

Regulation Tossups

(Tossup 1) At this university's Ryerson Lab, Robert Millikan conducted his oil drop experiment to measure elementary electrical charge. Enrico Fermi built the world's first nuclear reactor under this university's squash court stands. For the point, name this Illinois research university in Hyde Park.

ANSWER: **University of Chicago**

(Tossup 2) The lowered activity of this gland is present in Hashimoto's disease. Parafollicular cells or C cells in this organ secrete calcitonin. The pituitary gland produces TSH to stimulate this other gland in its neuroendocrine axis. Overactivity of this gland can be caused by the autoimmune Graves' disease. Goiter is the swelling of this gland when the body is deficient in period iodine For the point, name this butterfly-shaped gland located in the neck.

ANSWER: **thyroid gland** (do not accept parathyroid gland)

(Tossup 3) The gamma function is a generalization of this function. The terms in Taylor series involve this function in the denominator. This function applied to zero is defined to be one and this function describes the number of permutations of a given set of objects. For the point, multiplying a given integer with each positive integer below it - like 4 times 3 times 2 times 1 - defines what function symbolized by an exclamation point?

ANSWER: **factorial**

(Tossup 4) The longest year by year record of concentrations of this molecule in the middle troposphere is plotted on the Keeling curve. In the atmosphere, this molecule is the major contributor to an effect where the sun's rays are absorbed by the atmosphere rather than reflecting back out into space. The majority of greenhouse emissions are caused by, for the point, what molecule referred to as "dry ice" in solid form?

ANSWER: **carbon dioxide** (accept CO2)

(Tossup 5) The IEEE 802.15.1 was the last standardization of this technology. Jim Kardach developed this technology to allow mobile phones to communicate with computers. This technology works via short-linked radio wave pairing and had its symbol taken from stones at Jelling. For the point, name this technology standard whose name is taken from the Viking Harald's runes referring to the color of a dental feature.

ANSWER: **Bluetooth**

(Tossup 6) A separatory funnel is used to isolate compounds from immiscible types of these substances in liquid-liquid extraction. Since they don't form hydrogen bonds, DMSO and acetone are the "polar aprotic" type of these substances. In aqueous mixtures, water acts as one of these substances and is often called their "universal" type. For the point, name these substances in which a solute dissolves to form a solution.

ANSWER: **solvents** (prompt on liquids before liquid is read)

(Tossup 7) The Fv region of this class of proteins contains the paratope section and loops that make up the complementary determining region. One of these compounds called adalimumab [addAh liMoo mab] is used to treat rheumatoid arthritis; that "monoclonal" type only binds to one epitope. The heavy and light chains of these proteins are arranged into a Y shape. For the point, name these immune system proteins that bind to antigens.

ANSWER: **antibody** (or antibodies)

(Tossup 8) This effect causes a namesake broadening of spectral lines. The Ives-Stillwell experiment tested time dilation predicted by special relativity by measuring this effect on light. The speeds of the source and receiver are used to determine the observed frequency from this effect. For the point, name this effect which causes the pitch of fire truck sirens to descend as they drive away.

ANSWER: **Doppler effect**

(Tossup 9) Users of these systems search for “nonces” in a proof-of-work protocol to earn value in a process called “mining.” One of these systems called Ethereum uses a decentralized virtual machine and the ticker symbol ETH. The first of these systems was invented under the pseudonym Satoshi Nakamoto, and uses a public “blockchain” ledger to track transactions between virtual wallets. Bitcoin is a type of, for the point, what digital “money” systems?

ANSWER: **cryptocurrency** (or cryptocurrencies; accept “Bitcoin” before Ethereum is mentioned; prompt on “currency” or “money”)

(Tossup 10) An abnormally high concentration of iridium suggests a possible interpretation of this event according to the Alvarez hypothesis, which is based on evidence at Mexico’s Chicxulub [CHIK soo LOOB] crater. The Paleogene began after this event. The population of ferns spiked after this event, which may have been caused by a giant asteroid. This event marked the end of the Mesozoic era, which was about 65 million years ago. For the point, name this event that wiped out a group of large reptiles.

ANSWER: **extinction of the dinosaurs** (accept Cretaceous-Paleogene (K-Pg) or Cretaceous-Tertiary (K-T) extinction)

(Tossup 11) Organisms in this class are dying off from infection by chytrid fungus. Caecilians in this class have two tentacles on their heads and resemble snakes, while the other orders of this class are Urodela and Anura. Members of this class may lose their gills after undergoing metamorphosis and may start life as a tadpole. For the point, name this class of larva staged water breathers that transition to land which includes salamanders and frogs.

ANSWER: **Amphibia** (or amphibians)

(Tossup 12) Miller indices are used in the study of these substances, which were studied by Auguste Bravais. Triclinic, orthorhombic, and tetragonal are classifications of these substances, which can be primitive or face-centered. These materials are contrasted with amorphous materials because they have long-range order. For the point, name these solid materials that have repeated units in a lattice structure, such as diamond.

ANSWER: **crystal** (accept crystal system or unit cell before mention)

(Tossup 13) The Allred-Rochow form of this quantity is related to the effective nuclear charge. This dimensionless quantity – symbolized chi [kai] – generally ranges from about 0.7 to 4. One type of this quantity named for Mulliken is calculated as the mean average of electron affinity and first ionization energy. On Pauling's scale for this quantity, fluorine is assigned the highest value. For the point, name this quantity which measures the ability of an atom to attract electrons.

ANSWER: **electronegativity**

(Tossup 14) For this technique, ThermoFisher offers instruments that are customized for its HPLC and hydrophilic interaction variants. The gas form of this technique has higher retention times when the liquid and analyte have similar polarities. In the setup to one form of this technique, the bottom of the stationary phase is placed in water for a period of time. Colors of ink can be separated using, for the point, what technique used for separating mixtures

ANSWER: **chromatography** (accept more specific answers like high performance liquid chromatography; gas chromatography; thin-film chromatography; column chromatography; or paper chromatography)

(Tossup 15) Elements in this group react with magnesium to form Grignard reagents. This group contains the rarest naturally-occurring element in Earth's crust, astatine. This is the only group with elements in solid, liquid, and gas phases at STP. Table salt contains an alkali metal and an element from this group. For the point, name this group with seven valence electrons that includes fluorine and chlorine.

ANSWER: **halogens**

(Tossup 16) Lofti Zadeh introduced the "fuzzy" form of this discipline where variables can take on "degrees of truth." The Boolean form of this discipline uses 0s and 1s alongside operations like AND, OR, and XOR ["X" or]. This five-letter science was grounded by Aristotle in syllogisms such as "All men are mortal. Socrates is a man. Therefore, Socrates is mortal." For the point, name this five-letter science of reasoning and deduction.

ANSWER: **logic** (accept Boolean logic; accept fuzzy logic; accept fuzzy set theory; prompt on "set theory")

(Tossup 17) A SELF-1 gene was recently discovered in a model organism that falls under this broader animal classification. Fire and Mello worked on RNA interference in a model organism under this classification. C. Elegans falls under nematodes which are a part of this broader classification that is divided into segmented and unsegmented variants. Parasitic “round” ones and “tape” ones fall under, for the point, what classification that includes “earth” [this classification] which eat soil?

ANSWER: **worms** (accept Nematodes or Nematoda)

(Tossup 18) When these formations are beneath glaciers, they can cause floods called j ̈okulhlaups [YOur “cool” laops]. Tephra such as lapilli and bombs are produced by these formations. Pahoehoe [pa ho AY ho AY] and ‘a’a [AH AH] can be released from these entities. Olympus Mons is an example of these features on Mars, while Earthly “shield” ones include Mauna Loa. Cinder cones and composite cones are types of, for the point, what formations from which lava can erupt?

ANSWER: **volcanoes** (prompt on mountains)

(Tossup 19) This is the one-letter abbreviation of the amino acid glutamine. The end of a polypeptide opposite the carboxy-terminus is denoted by this letter. Diploid and haploid sets of chromosomes are most commonly written as multiples of this letter. An element symbolized by this letter undergoes “fixation” by rhizobia and is found in amine groups. For the point, name this letter, the chemical symbol for nitrogen.

ANSWER: **N**

(Tossup 20) OPSI is a fatal complication caused by the removal of this organ. The enlargement of this organ is a common symptom of mononucleosis. It’s not the kidney, but corpuscles named after Marcello Malpighi are found in this organ. The marginal zone separates the red and white pulp of this organ. Functions of this organ include storing and creating red blood cells. For the point, name this organ similar to a lymph node that filters and cleans blood.

ANSWER: **spleen**

(Tossup 21) This man and his student Leo Szilard invented a refrigerator with no moving parts. This physicist explained Brownian motion using atomic collisions and he won the Nobel Prize in Physics for his explanation of the photoelectric effect. This scientist formulated the theories of relativity. For the point, name this physicist who formulated the equation E equals m c squared.

ANSWER: **Albert Einstein**

(Tossup 22) The complex quadratic “f-of-z equals z-squared plus c” defines one of these sets. One of these geometric constructs named for Sierpinski is produced by removing an equilateral triangle from each larger iteration. These constructs were first introduced in the paper “How Long Is the Coast of Britain?” by Benoit Mandelbrot. For the point, name these self-similar geometric figures that contain an infinite number of copies of themselves

ANSWER: **fractals** (accept Mandelbrot sets until ‘Sierpinski’ is mentioned)

(Tossup 23) These materials cause the splitting of spectral lines in an effect named for Pieter Zeeman. Particularly strong examples of these entities often contain rare-earth metals like neodymium. The strength of fields created by these objects is measured in Gauss or Teslas and permanent examples are named after iron. For the point, name these objects which possess north and south poles and which can be found in compasses or attached to refrigerators.

ANSWER: **magnets** (accept ferromagnets; accept permanent magnets; accept magnetic fields)

(Tossup 24) A Canon on this field of science proposes eight varieties of equipoise and divides cosmology into earth, water, air, and fire; that text was composed by Avicenna. Imhotep was deified as a god of this field of science. Hippocrates, often considered the founder of the modern form of this science, wrote an oath which states to “first do no harm.” For the point, name this field of science associated with diagnosis and treatment.

ANSWER: **medicine** (prompt on healing)

(Tossup 25) The interior composition of these stars is explored by NASA’s NICER mission. When these stars maintain their angular momentum, they blink beams of radiation at their poles; an effect first noticed by Antony Hewish and Jocelyn Bell who dubbed them “little green men.” Examples of this class of stars include pulsars and magnetars. For the point, name these dense stars made up and named for non-positively charged nucleons.

ANSWER: **neutron stars** (accept pulsars before mentioned)

Extra Question

(Tossup 1) Oceanus Procellarum of this object, part of Flamsteed P, was landed on by the Surveyor 1 probe. Mapping of this object was done by Clementine. This object may have been formed from a collision by Theia, an idea called the giant-impact hypothesis. One of the maria on this object is the Sea of Tranquillity. Chang'e 4 landed on the "dark side" of this object. For the point, name this celestial object that orbits the third planet from the sun.

ANSWER: **Earth's moon** (accept Luna)