

Round 5

1. This structure encodes the common gamma chain, damage to which causes a form of SCID. In one disease, a CCG trinucleotide repeat expands on the FMR1 gene on this construct. Lyonization of these produces Barr bodies in females. Mutations on the dystrophin gene, located at p.21 on this structure, cause Duchenne muscular dystrophy. Turner Syndrome is due to absence of one of these, while Klinefelter's syndrome is caused by an extra one. Some diseases passed down on this construct are color-blindness and hemophilia, and in sex-linked inheritance, most diseases are passed down on this chromosome. Name this chromosome, of which females have two and males have one.

ANSWER: **X chromosome** <SV>

2. One type of these objects is generated in linear time in an on-line method using Ukkonen's algorithm. The Day-Stout-Warren algorithm is used on one type of these objects in order to decrease their height. Kraft's inequality restricts the length of the prefix codeword length for one type of them. These objects can be traversed in pre-order, post-order, and level-order walks, and can be defined recursively. Special self-balancing types of these, such as red-black and AVL, are useful because searching them is usually equally efficient as searching a perfectly balanced one. These objects are defined as connected, undirected, acyclic graphs. Name these objects which are topped by root nodes, which branch off to reach the terminal, or leaf nodes.

ANSWER: **trees** [accept more specific answers throughout]

3. A nebula that seemingly disappeared after one observation, dubbed Struve's Lost Nebula, is located in this constellation. That nebula is close to one star in this constellation that is a prototype for small, young pre-main sequence stars; that star is this constellation's T star. This constellation's alpha star is a red giant with an Arabic name for "follower," as it follows the Pleiades star cluster which is also located in this constellation. That star is named Aldebaran. Its beta star is known as Elnath, which refers to the "butting" of its horns. For 10 points, name this constellation with a name that is Latin for "bull."

ANSWER: **Taurus** <SV>

4. The "charge-time-parity" variety of this property is conserved if every particle has the same mass as its anti-particle, though part of this must be violated due to the significant amounts of baryonic matter in the universe. Salvinorin B ethoxymethyl ether is a hallucinogenic drug sometimes known by this name. Noether's theorem states that each one of these a system possesses leads to a conserved quantity. In biology, this refers to the balanced distribution of duplicate body parts. Identify this property which, in geometry, is possessed by an object that is invariant under a certain transformation.

ANSWER: **symmetry** <AL>

5. When the optical resonator of a laser operates in its TEM₀₀ mode, it emits a profile that is called this man's namesake beam. He showed that a set of cardinal points can be used to describe an optical system. One distribution that takes his namesake form is the Maxwell-Boltzmann distribution. He's not Ampere, but his law for magnetism states that the divergence of the magnetic field is zero. His namesake law for electricity relates enclosed charge to electric field, and both of those laws are part of Maxwell's equations. Identify this German polymath who is the namesake of the normal distribution.

ANSWER: Carl Friedrich **Gauss** <AK>

6. Rifampicin is a medicine used to treat tuberculosis by inhibiting this. The complimentary sequence of a sequence which signals the beginning of this occurs near the 3' end of the 16s rRNA, and is UCCUCC. The eukaryotic equivalent of that sequence is the Kozak sequence, while the sequence itself is known as the Shine-Dalgarno sequence. Sigma factors determine the specific site on DNA where this process begins, while is the binding site of eponymous factors for this process. In another step of this, helicase enzymes "unzip" the double strands of DNA, paving the way for RNA polymerase to add RNA nucleotides to match complimentary DNA nucleotides. For ten points, name this process in which DNA is copied into RNA, contrasted with translation.

ANSWER: **transcription** <AL>

7. A possible cause for the occurrence of the deep-focus ones of these is the phase transition of olivine into a spinel structure. Wadati-Benioff zones are inclined areas in subduction zones in which these occur, and the absolute magnitude of one of these is assessed by the moment magnitude scale. The Gutenberg-Richter law provides a probability distribution for the occurrence of these with respect to magnitude. The apparent magnitude of these phenomena is currently measured using the modified Mercalli scale, but was previously reported by the Richter scale. Identify these events that release seismic waves and cause tsunamis when they occur near large bodies of water.

ANSWER: earthquakes <AK>

8. In 2011, Kurotobi and Murata captured a molecule of this compound in buckminsterfullerene. This compound is produced with methane in the Sabatier process. The protonated form of this compound has a pKa of negative 1.74. When working with redox reactions in an acidic medium, protons and this molecule are added to balance the half reactions. Desiccants like calcium sulfate remove this substance, and a neutralization reaction typically forms a salt and this compound. This compound also forms with carbon dioxide in a combustion reaction. Name this compound often called the “universal solvent,” and whose protonated form is the hydronium ion.

ANSWER: water [accept H₂O until mention, DHMO, or dihydrogen monoxide] <BJ>

9. When this device is connected to a motor to raise a weight, its namesake constant can be given by $2mgh$ divided by voltage squared. The reactance of one of these is inversely proportional to its namesake constant. On a phasor diagram, the current in one of these leads the voltage by 90 degrees. One experiment found that a freely-suspended one of these did not prove the existence of the aether; that was the Trouton-Noble experiment. Concentric conducting shells can construct the spherical type, and the parallel-plate type often has a dielectric inserted between the plates to increase the namesake constant. Name this circuit component that stores energy in an electric field.

ANSWER: capacitor <SV>

10. This man and Donald Bayley created a secure voice communications machine called “Delilah”. The Chinese Room Experiment was developed by John Searle in response to one of this man’s namesake tests. He showed that the halting problem was undecidable. He devised a bombe with Gordon Welchman that found the settings of an Enigma machine. One of this man’s eponymous machines which can perform any computing task is his namesake “complete.” Name this man, whose eponymous test is used to determine if a machine can exhibit behavior indistinguishable from that of a human.

ANSWER: Alan Mathison Turing <AL>

11. This compound and chromium trichloride were used by Hafner and Fischer to synthesize a particular organometallic sandwich compound. DNA extraction sometimes uses a mixture of chloroform and one of this compound’s derivatives for liquid-liquid extraction. When two of these compounds are fused, the product is naphthalene. This compound forms a near-ideal solution when combined with one of its derivatives, toluene, and the hydroxylated version of this compound is phenol. August Kekulé elucidated the structure of this compound. Name this aromatic compound with alternating double and single bonds and formula C₆H₆.

ANSWER: benzene <BJ>

12. Max Wolf discovered 248 of these objects by himself. The malfunctioning Hayabusa project studied one of these called Itokawa. These are categorized by their spectra, most falling under three main types; C-, M-, and S-types. The Titius-Bode law predicted the location of one of these objects at 2.8AU from the Sun. The Trojan types of these do not collide with larger celestial bodies because they can be found orbiting in one of two Lagrangian points of stability. Kirkwood gaps are found in a group of these, and astrographs were used to find these until 1998. Identify these minor planets which are not comets, the largest of which is Ceres.

ANSWER: asteroids <AK>

13. One section of this organ is affected by tropical sprue. *Ascaris lumbricoides* infects this organ, and in infants, a remnant of the omphalomesenteric duct can cause a Meckel's diverticulum of this organ. M cells cover aggregates of lymphoid tissue found in this organ called Peyer's patches. The mesentery suspends this organ from the abdominal cavity. Brunner's glands secrete the alkaline mucus solution that coats the inside of this organ, and those glands are found above the Sphincter of Oddi. In order to stimulate pancreatic production of bile, this organ produces CCK. Celiac disease damages the villi used for nutrient absorption in this organ. Name this organ that contains the duodenum, the ileum, and jejunum.

ANSWER: small intestine <SV>

14. When it is subjected to electromagnetism, a p minus qA squared term replaces the original p squared term. The WKB approximation can be used to approximate solutions to this equation. One extension of this equation describes it in terms of bispinors; that equation, the Dirac equation, is a relativistic version of the Pauli equation, which extends this equation for particles with a spin of $\frac{1}{2}$. It has both time-dependent and time-independent forms that depend on the Hamiltonian. Name this equation which describes how a wavefunction changes with time, the fundamental equation of quantum mechanics.

ANSWER: the Schrodinger equation <SV>

15. Detecting this compound is the primary use of potassium tetraiodomercurate(II), or Nessler's reagent. In the Kjeldahl method, the liberation of two equivalents of this compound takes place after adding sulfuric acid to a sample. Two molecules of this bind to a silver ligand in Tollens' reagent. It is the primary reactant in the Ostwald process. Ruthenium eventually replaced osmium as a catalyst in the primary industrial process used to produce this compound. Fish excrete this compound instead of uric acid as a waste product. Name this compound created in the Haber-Bosch process and often found in fertilizers, with formula NH_3 .

ANSWER: ammonia (accept NH_3 until mentioned) <BJ>

16. Walter Cannon and Hans Selye established the earliest scientific basis for its study. The "viscous" type of this occurs in fluids, while the photoelasticity is a method used to determine the distribution of this. A tensor named after this and energy is the source of the gravitational field in the Einstein field equations and determines the way spacetime curve, and another tensor for this is named for Cauchy. In linguistics, this term refers to the relative emphasis given to different syllables of a word, while in mechanics it refers to the energy particles of a material exert on each other. Name this term, which, in psychology, means a feeling of pressure or strain.

ANSWER: stress <AL>

17. Petroff's law calculates a value associated with this quantity for lightly-loaded bearings. The y-axis of a Moody diagram measures a factor related to this concept, which is calculated in the Darcy-Weisbach equation. The Stribeck curve is used to characterize this between different surfaces and the triboelectric effect is a method of charging objects using this concept. This quantity is equal to the product of normal force and a coefficient symbolized by μ , and it causes damping in simple harmonic oscillators and drag in fluids. Name this force that exists in static and kinetic forms and resists motion.

ANSWER: friction [accept friction factor before mentioned] <AK>

18. The RAND Corporation pursued studies into this due to application to nuclear strategy, and Merrill Flood and Melvin Dresher developed a famous problem within this while at RAND. In this, a "stag hunt" is a situation where one must choose between safety and cooperation. The types of namesake entities include symmetric and zero-sum. Oskar Morgenstern and John von Neumann founded this field of mathematics. One solution concept in this field sees all players making the best choice while accounting for other players; that solution is called Nash equilibrium. Identify this study of strategic decision making, of which the most famous example is the Prisoner's Dilemma.

ANSWER: game theory <AL>

19. He lends his name to an alternate name for deuteranopia, and a period of low solar activity from 1790 to 1830 is called his namesake minimum. He independently discovered the Hadley cell by analyzing his extensive meteorological diary. The basis of stoichiometry was established by his law of multiple proportions. One theory that he is credited with discovering states that the namesake particles cannot be subdivided; though that postulate was incorrect, it was some of the first insights into atomic theory. Name this man, who gives his name to the law of partial pressures and the atomic mass unit.

Answer: John **Dalton** <BJ>

20. There is debate that this phylum should be split up because it is arguably polyphyletic. This phylum, along with arthropods, and other smaller phyla, makes up a larger group called Ecdysozoa. These pseudocoelomates possess only longitudinal muscle cells, which they contract in order to move. Sydney Brenner did extensive work with one member of this phylum, and members of this phylum have four peripheral nerves that run along the length of its body; those nerves create a dense ring near the pharynx and serve as the brain. Name this phylum of roundworms which includes such organisms as *C. elegans* and hookworms.

ANSWER: **nematoda** <BJ>