Round 2

1. NGC 3582 is of interest to astronomers due to the presence of polycyclic aromatic hydrocarbons, which could lead to the emergence of this. The Gosper glider gun was the first pattern to grow indefinitely in a game named after this, which is the most notable cellular automaton. The Miller-Urey experiment proved that spontaneous abiogenesis is a viable theory for the emergence of this, while viruses are generally not considered a form of this due to their need for host cells and lack of metabolism. SETI searches for intelligent forms of this. Identify this characteristic which ceases upon death.
ANSWER: **life** <AL>

2. This man developed a spheron cluster model for the structure of the nucleus. This man's second rule, the electrostatic valence rule, appears in his rules determining the structure of complex ionic crystals; he also names a set of rules to determine the strength of oxoacids. He provided enormous insight into quantum chemistry in his influential textbook *The Nature of the Chemical Bond*, which also explained the nature of orbital hybridization. His proposal for the nature of DNA was a triple helix, and late in life he advocated for administering megadoses of Vitamin C to cure illness. Name this man, whose namesake electronegativity scale assigns fluorine a value of four.
Answer: Linus **Pauling** <BJ>

3. The "Death Star" type of this entity was the first example of one striking its companion with a jet of energy. Energetic varieties of these include the Pea and LIRG types. The luminosity and rate of rotation of these are related by the Tully-Fisher relation. Dark matter is a solution to a problem stemming from their observed rotation curves. Emissions from the radio variety of these are due to synchrotron emission from their cores, which may be the result of their active nuclei. Objects in their halos include globular clusters, and some of these contain supermassive black holes in their centers. Name these entities, the spiral type of which is exemplified by the Milky Way.
ANSWER: **galaxies** <AL>

4. This quantity for a dilute gas is proportional to the square root of molecular mass times temperature by a Chapman-Enskog equation. For an ideal gas it can be calculated by temperature to the three-halves power divided by temperature plus a constant; that equation is Sutherland's equation. For an amorphous material, this quantity is thermally activated. This quantity increases when rheopectic liquids are agitated, and it decreases when thixotropic liquids are agitated. It is in the denominator of the definition of the Reynolds number, and Newtonian fluids have a constant value for this quantity. Name this quantity, measured in poise, for which superfluids have a value of 0.
ANSWER: **viscosity** <SV>

5. Dobzhansky and Muller proposed a chromosomal mechanism for this process, and Haldane's rule implies that hybridization cannot be the cause of this. Many plants undergo this process by becoming polyploid, and that particular phenomenon can be explained by the Wallace effect. Multiple occurrences of this process can happen during adaptive radiation. Geographic isolation and reproductive isolation can both lead to this process, though they lead to the allopatric and sympatric forms, respectively. Name this evolutionary process which results in two or more distinct groups of organisms which cannot interbreed.
ANSWER: **speciation** [accept specific types of speciation] <SV>

6. This concept is used in probability and statistical theory when describing the convergence of a sequence of variables to a certain limit variable. Another use of this in mathematics is to summarize the least significant terms in the error term of the approximation of a function, and this concept was introduced by German mathematicians Edmund Landau and Paul Bachmann. Related to the Theta and Omega notations, lower order terms and constants are disregarded because of their negligibility as n approaches infinity. Name this notation system which compares the efficiency of algorithms in computer science, such as log n for binary search and n log n for merge sort.
ANSWER: **Big-O notation (also accept Big-Omicron notation)** <AK>

7. In a Carnot engine, entering heat times one minus the ratio of the temperatures of the resevoirs is equal to this quantity. It's not a change in volume, but an isochoric process has a value of zero for this quantity. A measure of the reversible amount of this quantity at constant temperature and volume is the Helmholtz free energy. Taking an integral on a PV diagram gives this quantity. In thermodynamics, change in internal energy is equal to heat added plus this quantity. Identify this concept for which the SI unit is Joules and can be calculated by multiplying force and distance.
ANSWER: **work** <AK>

8. Chromium trioxide is diluted with this compound and acetone in a reagent that reduces primary alcohols to carboxylic acids; that compound is the Jones reagent. This compound is reacted with two equivalents of sodium chloride in the initial step of the Leblanc process. Glover towers are used in the lead chamber process, which produces this compound. A vanadium oxide catalyst is used to produce this compound in the contact process, and this compound is also known as "oil of vitriol." This compound, which is found in car batteries, can be formed by reacting sulfur trioxide with water. Identify this diprotic strong acid with formula H2SO4.
ANSWER: **sulfuric acid** [accept **H2SO4** before mentioned] <BJ>

9. This number is believed to be the only odd untouchable number. Along with six, this number makes up the first Ruth-Aaron pair, in which the sums of the prime factors of each number in the pair are equal.. Niels Henrik Abel showed that there is no general algebraic solution to find the roots of polynomials of this degree or higher. This is also the first safe prime and the second Fermat prime. Additionally, this is the number of Platonic solids that exist. Along with one, this is the only number to be for which the nth term of the Fibonacci sequence is equal to n. Name this number, the base of the quinary number system and the number of sides of a pentagon.
ANSWER: **five** <AL>

10. Stengel et al found that in *Pisum satium*, preprotein import into these via translocons is regulated by redox signals. An eponymous peripheral reticulum increases the surface area for transport between the cytoplasm and a fluid containing its namesake DNA. That DNA is usually combined into one large ring, though dinoflagellate algae contain forty plasmids with these genes. The TIC and TOC complexes import proteins into this organelle. The internal stroma fluid contains grana, stacks of thylakoids, the site of photoreduction. Identify this organelle which is the site of photosynthesis and contains chlorophyll.
ANSWER: **chloroplast** <AL>

11. HL Tau 76 was the first variable type of this object discovered. If the mass of its progenitor cannot utilize the triple-alpha process, the helium type of this can form, though none have yet been formed this way. Arthur Eddington predicted that the light from these were subject to redshift because of their enormous density. When one of these forms in a binary star system, accretion of matter onto them from their companion star may result in a Type 1a supernova. As these objects are solely supported by electron degeneracy pressure, they will collapse if they exceed the Chandrasekhar Limit. Name this type of stellar remnant that the sun will eventually form.
ANSWER: **white dwarf** [prompt on "star" or "dwarf star"] <AL>

12. The dioptric form of this is the degree to which an optical system causes light to converge or diverge. This property of a statistical test is the probability the test will not commit a Type II error. The electrical form of this is equal to the integral of the Poynting vector over an area. The volumetric flow rate times pressure gives this in fluid systems. The integral of this quantity yields work, and this word is sometimes used in place of exponent. Name this, the rate at which work is performed or energy converted, with the watt as its SI unit.
ANSWER: **power** <AL>

13. This physicist discovered an effect which causes the ejection of an electron from an atom when an inner shell vacancy is filled; that effect is named for Pierre Auger. The Leibniz Medal was awarded to this physicist for the discovery of a long-lived isotope of protactinium. This physicist used Einstein's $E = mc^2$ to explain the conversion of rest mass into kinetic energy when barium and krypton were formed from uranium. Although Otto Hahn claimed that he was responsible for the discovery of fission, he was unable to explain it without the aid of this physicist, his partner. While Hahn won a Nobel Prize, she did not. Identify this female physicist who discovered nuclear fission.
ANSWER: Lisa **Meitner** <AK>

14. A subgroup of this phylum is considered paraphyletic because of its non-parasitic nature; that subgroup is *Turbellaria*. Another species in this phylum grows large numbers of proglottids, which detach and release eggs. These organisms extract reusable material and send it into other cavities by using flame cells. This phylum is the cause of the second-most devastating parasitic disease, schistosomiasis. Because they lack an internal body cavity, they are classified as acoelomates. Name this phylum of flatworms which includes planaria and tapeworms.
ANSWER: **platyhelminthes** <BJ>

15. The diffusion coefficient in Bohm diffusion is equal to Boltzmann's constant times temperature over 16 times charge times this. The Verdet constant relates this and the angle of rotation due to the Faraday effect. When a charged particle moves through one of these, the force can be given by the charge times the velocity crossed with this. In a solenoid, it is equal to current times turn density times the permeability constant. When using the right-hand-rule for a moving charge, the direction of this is represented by the middle finger, and inductors store their energy in these. Name this type of field measured in tesla, the lines of which one can see when spreading iron filings around a bar magnet.
ANSWER: **magnetic field** [or **B-field**, or **H-field**] <AK>

16. A generalized form of this statement is the DECHEMA model, and it is combined with the Kelvin effect and modeled to generate a Köhler curve. The fugacity and activity coefficients extend it to solutions without zero entropy of mixing. Duhring's rule is a consequence of this law, and solutions that obey this statement at dilute concentrations are termed "ideal." Though it doesn't describe freezing point, the colligative property that this law describes is lowered for higher van't Hoff factors. Azeotropes do not obey this law. Name this law that calculates total vapor pressure as a sum of partial pressures multiplied by mole fractions.
ANSWER: **Raoult's** law <BJ>

17. The Boy surface, cross-cap, and Roman surface are possible parametrizations of surfaces obtained by sewing this to the edge of a disk. Deforming these can create paradromic rings and they have Euler characteristic zero. Tori may be a cut one of these, and cutting a Klein bottle in half produces two of them. The B. F. Goodrich Company patented a conveyor belt in the form of this which lasts twice as long as conventional belts. These are also called twisted cylinders and are surfaces without a boundary. Identify this surface with only one boundary component and one side, which can be produced by half-twisting one end of a strip and attaching the two ends.
ANSWER: **Möbius strip** <AL>

18. It's not Creutzfeldt-Jakob disease, but mutations at codon 178 on the PRNP gene can cause an inherited variant of this disease. Tasimelteon and ramelteon can be used to treat it by acting on the suprachiasmatic nucleus. A 2012 paper published by Dizon and Cheng established the usefulness of the Internet in treating this disease. The pineal gland synthesizes a hormone that affects this disorder; that hormone is melatonin, which helps control circadian rhythms. The transient variety of this disease lasts less than a week and is commonly caused by stress. This condition is often confused with narcolepsy, though narcoleptics tend to get much more sleep than suffers of this condition. Name this condition in which a person has difficulty going to sleep, or cannot sleep at all.
ANSWER: **insomnia** <BJ>

19. This element is the namesake of a doublet at the D1 and D2 lines in the Fraunhofer line spectrum. This element was used as the ligand in an electride salt used as a reducing agent in the original development of the Birch reduction. The metallic form of this element is formed in the Downs process. The carbonate of this element is formed in the Solvay process, and lye is the hydroxide of this element. It produces a bright yellow flame in a flame test, and the bicarbonate of this element is baking soda. Name this alkali metal with atomic number 11, and whose plus-charged ion is bound to the chloride anion in table salt.
ANSWER: **sodium** [accept **Na**] <BJ>

20. The EF and TORRO scales are two systems used to categorize these phenomena. These phenomena are detected using Pulse-Doppler radar, through the analysis of their radial velocities and reflectivity data. Hook echoes are a sign of these approaching, and the deadliest one occurred in the Manikganj District of Bangladesh, taking over 1300 lives. Rapid rotation due to cyclostrophic flow triggers the adiabatic cooling of water vapor, which causes these to become visible. Ground swirl patterns and photogrammetry can also be used to assess the severity of these. Name these rapidly rotating columns of air, types of which include dust devils and waterspouts.
ANSWER: **tornadoes** <AK>