Round 3

1. Common file extensions found in this system are .bz2, .rpm, and .tar. Hard links in this are different from soft links in that they are not shortcuts to other files, and changes made to hard links are applied to all other instances of a file, regardless of filename. A shell is a special program used to communicate with this through text-based commands, and it traces its ancestry to the mainframe operating system MULTICS. Written in the C programming language, the most common desktop environments used with this are GNOME and KDE. Identify this operating system, created by Linus Torvalds in 1991, whose common distributions are Fedora, and Ubuntu.
ANSWER: **Linux (accept specific types of Linux until "desktop environments" is read)** <AK>

2. Sublimation of its surface ice causes a pseudo-anti-greenhouse effect, leading to its surface being about 10 K colder than would otherwise be expected. Despite early enthusiasm, it was quickly proved not to be Planet X due to its apparent magnitude of 15.1. The *New Horizons* spacecraft will be used to study this object and its moons in 2015. In 2006, two new moons of this object were recognized, Nix and Hydra. However, because it shares orbital neighbors with members of the Kuiper belt, that year also saw the IAU strip its designation as a planet. Name this dwarf planet, formerly the ninth planet from the sun.
ANSWER: **Pluto** <AL>

3. Because mass of a polytropic star is independent of density, this man was able to relate the mass of a star with a polytropic index of three to the mass of the sun. With Schonberg, he names the limit on the mass of a non-fusing, isothermal core. The square of the Hartmann number is this man's number, which represents the ration of viscosity to the Lorentz force. One analog of his most famous discovery is named after Oppenheimer, Tolman, and Volkov. One quantity named for this man arises when the gravitational force balances electron degeneracy pressure. Name this Indian-American astrophysicist best known for stating that white dwarfs must have a mass less than about 1.4 solar masses to avoid further collapse.
ANSWER: Subrahmanyan **Chandrasekhar** <AK>

4. One disease of this organ has characteristic wire-loop lesions, while another disease of this organ is often caused by taking expired tetracycline, and is called Fanconi's syndrome. One section of this organ uses slit diaphragms to maintain its function. One enzyme produced in this organ is 1-alpha-hydroxylase, which is responsible for producing the active form of vitamin D. Interstitial fibroblasts in this organ produce erythropoietin. This organs functional unit contains the glomerulus, Bowman's capsule, and the Loop of Henle. That functional unit is acted upon by antidiuretic hormone and is called a nephron. Name this organ that is responsible for cleaning the blood and producing urine.
ANSWER: **kidney** <SV>

5. When converting from spherical to Cartesian coordinates, z is the only coordinate that does not contain this function in its definition. When writing a complex number in polar coordinates, this function is used to determine its imaginary part. Unlike its derivative, the Taylor series of this function utilizes the odd powers of x. An eponymous law relates the side lengths and this function of the angles, though that law may produce an ambiguous case. The derivative of this function is the cosine function. Name this function, which can be defined in a right triangle as opposite over hypotenuse.
ANSWER: **sine** <AL>

6. One of these compounds is effectively used as a catalyst in the Michael addition, in which it creates a carbanion. A carbon-nitrogen double-bond is present in one of these compounds named for Schiff. LDA and potassium tert-butoxide are examples of non-nucleophilic, hindered versions of these compounds which eliminate to give Hoffman products. These compounds cause saponification of lipids and turn phenolphthalein pink. Bronsted-Lowry theory states that these compounds are proton acceptors, whereas the Lewis definition states that these compounds are electron-pair donors. Identify these compounds which have a pH above 7.
ANSWER: **base**s <BJ>

7. The carboxylation of this substance is catalyzed by a biotin-dependent namesake enzyme, and is an example of an anaplerotic reaction. A lack of phosphofructokinase leads to Tarui's disease, in which the inability of fructose-6-phosphate to phosphorylate prevents this compound from being produced. 1,3 bisphoglycerate is one intermediate in the conversion of glyceraldehyde-3-phosphate to this compound. This compound can be used to produce ethanol through fermentation, and to construct the amino acid alanine. Name this compound, the desired product of glycolysis.
ANSWER: **pyruvate** [accept **pyruvic acid**] <AL>

8. Manuel Lemos created a programming language based on XML with this name in 2001. In stars, the level of these is what determines a star's label as Population I, II, or II, with every element which is not hydrogen or helium being considered one of these. "Base" ones of these oxidize easily, and they usually form cations. A mixture of two or more elements with the main component being these is known as an alloy. Magnesium is known as the alkaline earth variety of this. Name this type of substance that conducts both heat and electricity, the transition ones of which inhabit the d-block.
ANSWER: **metal** <AL>

9. Legend has it that in his doctoral thesis, "On the Combinations of Water with Alcohol," this man cracked the chemical code of vodka. Thomas Gold re-popularized a theory that this man argued for, the abiogenic origin of petroleum. Anticipating the problems in his most famous discovery, he gave elements the prefixes aka-, dvi-, and tri-because he was fascinated by Panini. That discovery was vindicated when gallium and germanium were found to fit perfectly into two missing spaces he had reserved for undiscovered elements. Name this chemist who created his own periodic table based upon the masses of each element.
Answer: Dmitri **Mendeleev** <BJ>

10. When this law is applied to the second London equation, the result is a quantity that is the distance in which the magnetic field of a superconductor becomes e times weaker; that is the London penetration depth. If the appropriate symmetry exists in a circuit, then one can use this law in place of the Biot-Savart law. The original formulation of this law only applied to time-independent currents; however, James Maxwell added a term to this equation which corrected for time-varying electric fields, sometimes dubbed the "displacement current." Identify this basic law of electromagnetism, which relates the line integral of the magnetic field to the enclosed current times the permeability constant, named for a Frenchman.
ANSWER: **Amperè's** circuital **law** <SV>

11. The absolute square, also known as the squared norm, is defined as the namesake modulus of one of these, squared. Gerolamo Cardano conceived of these numbers due to a conundrum in the solution in radicals of cubic equations. These are represented by exponents in phasor form, and quaternions are an extension of these. Their namesake plane is also called the Argand plane, and their polar form may utilize the cis function. De Moivre's theorem deals with the exponentiation of this type of number. If one of these numbers is a solution to a polynomial, its namesake conjugate is a solution as well. Name this set of numbers which can be denoted $a + bi$.
ANSWER: **complex numbers** <AL>

12. When the squares of visibility and distinguishability are shown to be less than one, this theory can be proven by the Englert-Greenberger relation. The existence of Arago spots for large molecules proves this, and in 1999, it was proven for C_{60} fullerenes. This was accidentally proven for electrons when they were fired at a nickel target in the Davisson-Germer experiment. The de Broglie wavelength is a mathematical description of this idea, while the double-slit experiment and the photoelectric effect give seemingly different results that are resolved by this. Name this theory that matter exhibits the properties of both the namesake phenomena.
ANSWER: **wave-particle duality** [accept equivalents, prompt on "de Broglie hypothesis" until "wavelength"] <SV>

13. At constant temperature and pressure, this quantity divided by surface area equals surface tension. The partial derivative of this quantity with respect to the number of particles is the chemical potential. One can calculate equilibrium constant by taking e to the negative power of this quantity over RT. This quantity is calculated for isothermal and isobaric processes, unlike a similar quantity named for Helmholtz. The change in this quantity equals "delta H minus T times delta S." If the change in this quantity is negative, a reaction occurs spontaneously. Name this quantity named for an American scientist and symbolized as ΔG.
ANSWER: change in **Gibbs free energy** <BJ>

14. Generation of oxygen through chemical reaction is known as "oxygen" this. The differential type of this in computer science attempts to optimize a solution by iteratively testing a candidate solution. The "stellar" type of this begins with the gravitational collapse of a giant molecular cloud into protostars, and, for the most massive stars, ends with a pair-instability supernova. Lamarck produced a theory of this, while the modern theory of this explains allele frequency changes through natural selection. Name this term, most often used to refer to the change in characteristics of species over generations, and associated with Darwin.
ANSWER: **evolution** <AL>

15. Probes containing both the quencher TAMRA and the fluorophore TET increase the specificity of one version of this technique, and that method is named after PacMan. This technique is used in emulsified droplets before using the 454 technique. One technique analyzes RFLPs after the products of this technique are digested with restriction enzymes. This technique is used for site-directed mutagenesis. This process sees primers attach to DNA in the annealing phase, which follows the denaturation phase and also sees the addition of Taq polymerase. With every cycle, the exponential phase doubles the amount of DNA in this process. Name this process, created by Kary Mullis, that amplifies a small piece of DNA.
ANSWER: **P**olymerase **C**hain **R**eaction <BJ>

16. Birkeland currents are a proposed mechanism for the occurrence of these phenomena. Olof Hiorter and Anders Celsius found evidence suggesting that changes in the Earth's magnetic field were directly related to these. Other possible causes for these include Alfvén waves, and striations in these enhance their likeness to curtains. They occur in their namesake zone, located in a 2500 km radius from the Earth's magnetic poles, while most of their observed effect is due to their namesake electrojets. Identify this natural light display caused by the collision of charged particles into the upper atmosphere.
ANSWER: **aurora** borealis (accept **aurora** australis) <AK>

17. Albert Behnke's studies of deep-sea divers were a precursor to John Lawrence and Stuart Cullen's separate work on this element's clinical use. A liquid form of this element is being used in experiments like ZEPLIN-III, which seeks WIMPs. Four atoms of this element form a divalent cation with gold. It forms an octahedral compound with six atoms of fluorine, and a compound of this element bound to four atoms of fluorine was the first binary group 18 compound discovered. This element appears after iodine on the periodic table, and is used in arc lamps, flash lamps, lasers, and anesthesia. Name this noble gas with atomic number 54 and symbol Xe.
ANSWER: **xenon** [accept **Xe** until mention] <BJ>

18. One notable example of these is part of the AAVSO's Citizen Sky project, and that object is most likely a binary star system surrounded by an opaque disk of dust. That object is Epsilon Aurigae. Many of these occupy the instability strip on the H-R Diagram, and Betelgeuse and Antares are semiregular types of these. Henrietta Levitt established the period-luminosity relationship for a certain type of these. The Mira types of these have a period of more than a year, while RR Lyrae types have a period of less than a day. These are classified using their light curves, and Cepheid ones can be used as standard candles. Identify these stars that display a fluctuating apparent magnitude.
ANSWER: **variable stars** [accept **binary star**s before mentioned, prompt on "stars" before mentioned] <AK>

19. These organisms have a jelly-like substance between two layers of epithelial tissue; that substance is called mesoglea. This phylum lacks a hard skeleton, instead relying on a hydrostatic skeleton. They can reproduce either sexually or asexually; the mode depends mainly on environmental factors. The name of these organisms comes from the specials cells that these organisms use for defense and predation. The young form of this phylum is known as the polyp form, while the adult form is the medusa. Name this phylum that contains organisms such as hydras and jellyfishes.
ANSWER: **cnidaria** <BJ>

20. When given an electron density for a 1-electron system, this quantity is described by the von Weizsacker functional. Two times the average value of this equals a constant times the average of its counterpart by the virial theorem. One can use the virial theorem to derive the equipartition theorem, which gives that this quantity is three-halves times the Boltzmann constant times temperature. This quantity is equal to momentum squared over two times mass. The rotational form of this is equal to one-half times the moment of inertia times the angular velocity squared. Name this quantity which, in translational motion, equals one-half times mass times velocity squared.
ANSWER: **kinetic energy** [prompt on "energy;" do not accept "potential energy"] <SV>