LEDERBERG 2: DAUGHTER CELL
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PACKET 7 – MARIPOSA
THE LAST TOSSUP YOU READ SHOULD HAVE BEEN ON ANSWER: <u>supercritical fluid</u>

1. In 2013, the LHCb experiment measured the delta-A-CP of this particle to be nonzero. It's not the bottom quark, but this particle is just massive enough to be flavor-tagged since its jets don't mix into the QCD background. X(3872) is posited to be a heavy resonance state of this particle, and the standard model Higgs boson decays into one of these and its anti-particle 2.5% of the time. The existence of this particle was posited as a means of suppressing certain flavor-changing neutral currents in K meson decays via the GIM mechanism, and it was previously posited to exist by looking at approximate invariance under SU(4) symmetry by Bjorken and Glashow. D mesons (*) all contain this particle, which has a mass of 1.29 GeV. The existence of this particle was confirmed by finding a resonance at 3.09 GeV at both SLAC and BNL; that simultaneous discovery won Samuel Ting and Burton Richter the Nobel Prize and was called the November Revolution. The J/psi particle is a bound state of this particle and its antiparticle. For 10 points, name this particle, which along with the strange quark makes up the second quark generation.
ANSWER: <u>charm</u> quark [accept <u>J/psi</u> before mention]

2. The bromo-enol type of these compounds are potent inhibitors of calcium-independent phospholipase A2. The quercus one of these compounds is absorbed from whiskey into the wood of barrels, and the Prelog-Djerassi one is a common synthetic test of stereochemical control. Corey's synthesis of prostaglandins has an intermediate consisting of Corey's namesake one of these functional groups with 4-phenyl-benzoate attached. Biological examples of these functional groups include sesquiterpene ones, which include the anti-malarial drug artemisinin, and acylated (*) homoserine ones, which serve as autoinducers in bacterial quorum sensing. Macrocyclic examples of this functional group are found in a class of antibiotics that inhibit the 50S peptidyl-transferase of the bacterial ribosome and which include azithromycin. Gamma and delta ones are the most stable due to ring strain. They can be synthesized by adding peroxyacid to a cyclic ketone in the Bayer-Villiger reaction or by an intermolecular Fischer reaction. For 10 points, name these cyclic esters.
ANSWER: <u>lactone</u> [prompt on "ester", do NOT accept or prompt on "orthoester"; accept <u>macrolides</u>]

3. Gunn and Gott used this structure's X-ray luminosity to put limits on the deceleration parameter and explained its growth using their theory of infall; that paper was the first to use ram-pressure stripping to explain the distribution of its constituents. Redshift quantization was posited by Tifft after he created the first 3D redshift pie chart from observations of this structure, though it was later determined that the line of sight from the earth to this structure contains the first discovered void. This structure contains two gigantic elliptical galaxies, NGC 4889 and NGC 4874 and is located in an asterism called Berenice's (*) Hair. This structure is at the center of, and sometimes names, a structure which includes the Leo Cluster and the Hercules Supercluster, called the Cfa2 Great Wall. When adding up the mass of constituents of this object from luminosity and from their velocities using the virial theorem, Zwicky found that up to 90% of its mass was invisible, leading him to posit the existence of dark matter. For 10 points, name this oft-studied galaxy cluster.
ANSWER: <u>Coma</u> cluster [or <u>Abell 1656</u>]

4. This group has corporate ties to the firm of Extensive Enterprises. It frequently hires the awful poet Major Sebastian Bludd. In a film, this group is revealed to be secretly the brainchild of the Burgess Meredith voiced Golobulus, who leads an ancient group of people living in the Himalayans. This group's elite soldiers are the Crimson Guard and they use robots called B.A.T.S. A ruler of this group was created by (*) Dr. Mindbender and was made from the DNA of the greatest military leaders in history. Its leader typically either wears a hood or a faceless silver mask. This group employs such villains as the Baroness, Zartan, and frequently works with the arms dealer Destro. For 10 points, name this evil group that fights G.I. Joe, which is named for a snake.
ANSWER: <u>Cobra</u> Command

5. A form of this disease common in South Africa is caused by a founder R59W mutation in PPOX; that is it's "variegate" type. A "pseudo" form of this disorder occurs in some people taking naproxen. One form of this disease is caused by mutations in HMB synthase and can be exacerbated by ingesting barbiturates; that form is characterized by polyneuropathy and causes attacks of port-wine-colored urine and abdominal pain treated with 10% glucose infusion. Another form of this disease is caused by mutations in UROD and causes blistering (*) and skin darkening. Beta-carotene can treat a form of this porphyria caused by a mutation in ferrocheletase. This disease comes in acute intermittent and cutanea tarda varieties. Many forms of this disease cause severe skin blistering in sunlight, and these diseases are caused by mutations in a pathway that starts with the synthesis of ALA. Supposed sufferers of one form of it include George III of England and Vlad the Impaler. For 10 points, name this disease whose sufferers are unable to synthesize heme, and which is the basis of vampire legends.
ANSWER: **porphyria**

6. One of these concepts makes a separation between command and processing functionality as an example of loose coupling and is known as "chain-of-responsibility." Not utilizing these concepts can result in concentrating too much functionality as part of an "anti" one of these known as the "god." These solutions are classified as behavioral, structural, or creational, and they arise naturally when (*) developers favor object composition and program to interfaces rather than implementations. Twenty-three of these solutions were described by Gamma, Helm, Johnson, and Vlissides in a namesake book; those authors are known as the "Gang of Four." Examples of these things include the "factory" and the "singleton." For 10 points, name these recurring solutions to common problems in object-oriented programming.
ANSWER: **design pattern**s in object oriented programming [prompt on partial answers]

7. Models for the dispersal of this substance include advection-diffusion models like HAZMAP and FALL3D and particle-tracking models like CANERM and VAFTAD. Turney's density-separation method led to the discovery of the "crypto" type of this substance. Sigurdur Thorarinsson showed that this substance can form a "horizon" with a unique chemical signature, which can in turn work as a (*) chronological marker. When this substance mixes with precipitation, it forms andosols, and this substance can be classified by point of origin as scoria-fall or pumice-fall. If this substance is sufficiently hot, it can fuse into tuff. This substance is divided by size into bombs, ash, or lapilli, the latter of which can form glassy round fragments called Pele's tears. For 10 points, name this substance, a catch-all term from the fragments ejected from a volcano.
ANSWER: **tephra** [anti-prompt on "ash" or "volcanic ash"; accept **pyroclast**ic deposits or **pyroclasts**; prompt on "volcanic ejecta", "the stuff ejected from volcanoes" or similar answers]

8. This molecule is used as a carbon source for chloromethylation reactions, in which it is reacted with an aromatic compound and HCl. In those reactions, a side reaction between this compound and HCl produces highly carcinogenic bis(chloromethyl) ether. A reaction between this compound and ammonia produces the heterocyclic compound hexamethylenetetramine. Bisphenol F is formed by reacting this compound with (*) phenol, and phenolic resins such as Bakelite are produced by continuing that crosslinking reaction. In order to convert compounds to alcohols, this compound can be used as a reducing agent in the crossed variant of the Cannizzaro Reaction. In that reaction, this compound is oxidized to form the simplest carboxylic acid. For 10 points, name this compound produced from methanol by alcohol dehydrogenase, which is a problem in the human body given the common use of this chemical to preserve tissue specimens.
ANSWER: **Formaldehyde**

9. This protein's R31D mutation has an increased affinity for its receptor and was used to crystallize it. One drug used to inhibit this protein is commonly given alongside methotrexate to decrease the formation of HACA antibodies. This protein is cleaved from its membrane-bound form to a 51 kilodalton soluble heterotrimer by a convertase called ADAM17. People taking inhibitors of this protein must have less than 5 millimeters of induration on the Mantoux skin test, because inhibition of this protein can cause reactivation of TB. It's not the fas ligand, but the binding of this protein to its receptor causes the interaction between (*) TRADD and FADD proteins, and leads to the activation of NF-kappa-B and caspase 8. Enteracept is a soluble decoy receptor for this protein, which is directly inhibited by the monoclonal antibodies adalimumab and infliximab; those drugs are used to treat ulcerative colitis and rheumatoid arthritis. For 10 points, name this pro-inflammatory cytokine secreted by macrophages, that got its name from its ability to kill cancer cells.
ANSWER: **TNF**-alpha or [**tumor necrosis factor** alpha, or **cachectin** or **cachexin**]

10. In crystal field theory, this statement can be used to write the crystal field Hamiltonian in terms of both crystal field coefficients and Stevens coefficients. One term on one side of this statement appears within a double bar and has a normalization factor of the square root of quantity 2j plus 1. A particular instance of this result can be used to simplify Slater integrals, which contain the product of three spherical harmonics. Applying this theorem to a vector operator is used to find a statement used, in turn, to derive Lande's formula for the g-factor; that corollary of this theorem is the (*) projection theorem. Gaunt's formula is a particular instance of this theorem, which is most often proven using the definition of a spherical basis. One way of writing this theorem relies on a mathematical device that is invariant under even permutations of its three columns; that is its first namesake's 3j symbols. For 10 points, name this theorem that decomposes matrix elements of certain tensor operators into an orientation-independent component and a Clebsch-Gordon coefficient.
ANSWER: **Wigner-Eckart** theorem [accept **projection** theorem and **Gaunt**'s formula before mention]

11. A sharp increase in this quantity in one location created the "M reflector" feature and is referred to as the Messenian crisis. Parcels with differing values of this quantity undergo a double diffusion process to create a staircase of "fingers" in an effect elucidated by Melvin Stern. Measurement of this quantity uses an IAPSO standard for which this quantity is approximately 35. Glassworts are able to survive in regions in which this quantity is very high, and one method of measuring this quantity is to use silver nitrate to titrate the quantity of (*) halide ions, then multiply by a correction factor. Dissolved oxygen is inversely proportional to this quantity, which is most often measured using conductivity. Along with temperature, changes of this quantity drive oceanic currents via thermohaline circulation. For 10 points, name this quantity which is very high in brine water and low in freshwater, which is the salt content of a body of water.
ANSWER: **salinity** [accept things like "salt content" before the word "salt" is mentioned]

12. Lines at 500.7 nm, and 495.9 nm correspond to forbidden transitions in a doubly-ionized ion of this element, which are commonly found in planetary nebulae. Its not hydrogen, but the ratio of the abundance of this element to iron is larger than the sun's value in stars that have low metallicity, because type II supernovae produce this element more readily than iron. One isotope of this element has a half-life of 122.24 seconds and undergoes beta-plus decay to release 1.73 MeV of energy in a common fusion process. In massive stars, two atoms of this element fuse together to form silicon in this element's namesake burning process, which occurs after the (*) neon-burning process. White dwarves are usually composed of carbon and this element. This element is the third most abundant in both the solar system and the galaxy, and names a fusion cycle along with carbon and nitrogen. For 10 points, name this element which also comprises 21% of the Earth's atmosphere.
ANSWER: **oxygen**

13. These structures are synthesized by a complex containing Nfs1, Isd11, Isu2, and Fxn, called the SDUF complex. A protein that is responsible for binding to these structures acquires extra GAA repeats in Friedrich's Ataxia. These structures can appear in butterfly and diamond configurations. One enzyme has one of these structures in a cubic conformation coordinated to cysteine residues, and uses this structure to transform a (*) prochiral molecule to isocitrate in the first step of the Krebs cycle. This structure is commonly found in Rieske proteins. For 10 points, name these chemical structures found in several proteins involved in the electron-transport chain, like ferredoxin, and in the active site of aconitase, which consist of and are named for two elements.
ANSWER: **iron-sulfur** protein [or **iron-sulfur** clusters]

14. A reaction of this type initiated by a free radical was used by Curran as the last step in hirsutene synthesis. In work by Nicolau, a reaction of this type immediately follows a hydrogenation step during synthesis of endiantric acids. Stork and Eschenmoser proposed that a reaction of this type occurs immediately following the actions of squalene epoxidase during steroid biosynthesis, and that theory was then used by Johnson et. al during their total synthesis of progesterone. Propargyl halides and sodium azide are converted to triazoles in a synthesis of this type developed by (*) Banert. Scott used flash vacuum pyrolysis with a reaction of this type to selectively synthesize C60. Use of this type of reaction allows for a reduction in workup and purification steps, and reactions of this type occur in one pot. For 10 points, name this concept from organic synthesis in which sequential reactions in the synthesis of a molecule occur without addition of reagents or modification of reaction conditions.
Answer: **Cascade** Reactions [prompt on "cyclization" or "one-pot". Accept **Tandem**, **Domino**, or **Sequential** reaction]

15. The collapse of a wavefunction of this type into linear tracks in a cloud chamber is the subject of the Mott problem. A model of ferromagnets with this configuration can be solved exactly in the presence of an external field and has critical exponents independent of geometry when the dimension is greater than four; that model is sometimes named for Berlin and Kac. When using the WKB approximation on a system with this configuration, a constant of one-fourth is added to L times L plus 1 terms; that trick is named for Langer. Any solution to the Einstein Field Equations with this configuration must be static and asymptotically flat according to (*) Birkhoff's theorem. A Newtonian self-gravitating polytropic fluid in this configuration is the subject of the Lane-Emden equation. A magnetized surface of this shape is the only one that doesn't produce non-dipole components, and the plane wave expansion expresses plane waves as sums of waves with this configuration. A Schmidt corrector is often used with mirrors with this shape, and a capacitor of this shape has capacitance equal to its radius. For 10 points, name this shape, which is also the shape of equipotential surfaces around an isolated point charge.
ANSWER: **spherical** [or **sphere** or **spherically symmetric** or **radial**ly symmetric; prompt on "shell"]

16. A functor named for this mathematician can be interpreted as the first group homology group with integral coefficients. A cellular automaton discovered by Bak, Tang, and Wiesenfeld that displays self-organized criticality is a "sandpile model" named for him. This mathematician names a class of theorems showing that various summation methods are regular, i.e., that they give the correct result for convergent series. Grothendieck introduced categories named for this mathematician in his Tohoku paper; those categories are a general setting for homological algebra and allow morphisms and objects to be added. This non-Italian mathematician gave the first complete proof of the insolubility of the quintic by radicals. Groups that satisfy the commutative law and many other mathematical concepts are named for, FTP, what Norwegian mathematician who died at the age of 26, thus making everyone else look like a chump?
ANSWER: Niels Henrik **Abel**

17. Fulton and Rohrlich showed that this phenomenon is charge-independent when hyperbolic paths are considered, which may be a threat to the equivalence principle. Landau and Lifshitz's iterative treatment of this phenomenon eliminates the term for the Schott energy in an equation describing this phenomenon. Considering this phenomenon for a dumbbell-shaped distribution, then taking the limit of the size of the dumbbell to zero, underestimates its magnitude by 50%. The magnitude of this phenomenon in the original derivation is equal to mu sub naught times q squared over six pi c, all times the time derivative of the (*) acceleration. The original derivation of this phenomenon had acausal pre-acceleration solutions, in which the particle would respond to this phenomenon before it existed. For 10 points, name this phenomenon in which a particle's momentum is altered by the radiation it emits, first derived by Abraham and Lorentz.
ANSWER: **radiation reaction** [or **radiation recoil** or **self-force**; accept **Abraham-Lorentz**-Dirac force before mention]

18. Jones et al at Oak Ridge discovered that one neutron-rich isotope of this element is doubly magic, a property shared by its 100 and 132 isotopes. A compound containing this element bonded to alkyl groups is decomposed by AIBN in the second step of the Barton-McCombie decarboxylation. Its dichloride mixed with hydrochloric acid is used to synthesize aldehydes from nitriles in the Stephens synthesis, and this element's tributyl hydride is used to transform halides to the corresponding alkane. A classic example of the inert pair effect is the fact that this element's dichloride is easily (*) oxidized. A palladium-catalyzed reaction similar to the Suzuki coupling uses an alkylated derivative of this element to couple halides or pseudohalides to alkyl groups and is called the Stille reaction. This element, which comes in an alpha, or "gray", and beta, or "white", allotropes, is extracted from the ore cassiterite, and the Meissner effect was first observed in superconductors of this element. For 10 points, name this element which combines with copper to form bronze, with symbol Sn.
ANSWER: **Tin** [or **Sn** before mention]

19. For all-or-none characteristics, this value can be translated from a continuous liability scale by multiplying by z squared times a polynomial of the incidence. This value is equal to the response to selection divided by the strength of selection in an artificial selection experiment. One version of this quantity solely accounts for additive effects. This quantity is commonly derived by taking the formula P equals G plus E, taking the variance of both sides, and setting the covariance term equal to zero. Falconer's formula is used to calculate this quantity in one type of study, in which monozygotic and dizygotic twins are compared for (*) concordance of a particular state. The narrow-sense and broad-sense versions of this quantity are denoted with lowercase and uppercase h-squared, respectively. This value can be inflated when maternal effects or other shared environmental factors are not accounted for. AR Jensen famously stated that this value is 1 for IQ, a result heavily criticized by Stephen Jay Gould. For 10 points, name this parameter which describes how much the genotype influences the phenotype.
ANSWER: **heritability**

20. A divide and conquer approach to calculating *these* starts by storing the extremes and then recurses on the four sub-planes defined by the lines connecting those extremes. An efficient output-sensitive algorithm to calculate these was dubbed the "ultimate planar" one and uses the "marriage-before-conquest" approach. A simple algorithm to calculate these iteratively chooses the point with the smallest angle from horizontal. Algorithms for constructing these include Kirkpatrick-Seidel algorithm and the Jarvis Match, also known as (*) "gift wrapping." These constructs are useful for pattern recognition and collision detection, and they are usually visualized by imagining a rubber band stretching around the input points. For 10 points, name these constructions of a certain shape containing all of a given set of points.
ANSWER: **convex hull** [or **convex envelope**; prompt on "hull" or "envelope"]