LEDERBERG 2: DAUGHTER CELL
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PACKET 3 – KNOTTED3
THE LAST TOSSUP YOU READ SHOULD HAVE BEEN ON ANSWER: **Palladium**

1. At high current density, the transit time in one part of these devices dramatically increases in the Kirk effect. One variety of this device was developed by Jean Hoerni and has a planar configuration with a silicon passivation layer. The transconductance of these devices is proportional to the ratio of the current at the Q-point with the thermal voltage, and the thickness of one part of these devices is typically made shorter than the diffusion length of the electron to prevent recombination. These devices can operate in saturation, cutoff, inverted, or active modes by varying the biasing between its components. These devices, which use two different types of charge carriers and come in (*) PNP and NPN configurations, have an emitter, base and a collector, which each have one lead. These devices, which are most often used as amplifiers, have two interfaces between two different types of semiconductors. For 10 points, name these electronic devices which essentially are composed of two opposing diodes and are often contrasted with field-effect transistors.
ANSWER: **bipolar junction transistor** [or **BJT**; prompt on partial answer; do NOT accept "field-effect transistor", "FET", or "MOSFET"]

2. The regular structure of this substance is maintained through the use of repelling elements called container sites. The superstructure of this substance is assayed by the 4C and Hi-C techniques. The SWI complexes serve to restructure this substance via SANT and SLIDE domains. ATPases that alter its structure include INO80 and NURD, which are known as remodeling complexes. CTCF-binding insulators serve as boundary elements in this substance and serve to direct the action of (*) enhancers. The position effect is caused by one form of this substance spreading, and scaffolding proteins help this substance form a higher-order structure from a 30nm fiber. Coming in a lightly staining "eu" and darkly-staining "hetero" variety, this substance appears as "beads-on-a-string" at the smallest scales, and it consists of histone octamers with DNA wound around them. For 10 points name this long stringy substance that condenses into chromosomes, a nuclear complex of DNA and protein.
ANSWER: **chromatin** [accept **histones** until mention; accept **heterochromatin** or **euchromatin** until mention; prompt on "DNA", "nucleus", the "genome", "chromosomes"]

3. It's not uranyl acetate, but after treatment with glutaraldehyde and washing with a phosphate buffer, tissues are often treated with this compound as a negative stain in electron microscopy. Sodium periodate both regenerates this compound and oxidizes the organic compound when converting alkenes to aldehydes and ketones in the Lemieux-Johnson oxidation. This compound is often neutralized by mixing with corn oil, and exposure to this compound can cause (*) temporary blindness. A potassium derivative of this compound and a chiral amine such as (DHQ)2-PHAL is present in AD-mix beta, an enantioselective reagent mixture for a reaction catalyzed by this compound. In that reaction, two ester-like linkages are broken with a reducing agent such as potassium bisulfite, regenerating this compound, and the overall result is conversion of an alkene to a diol. For 10 points, name this metal oxide that is used as a catalyst in the Upjohn and Sharpless dihydroxylation reactions.
ANSWER: **OsO_4** [or **osmium tetroxide**]

4. This type of astronomy commonly uses arrays of indium antimonide or mercury cadmium telluride as detectors and uses "chopping and nodding" to cut down on background. The J-H-K-K-prime filter set is commonly used in this field. One experiment in this type of astronomy discovered a type of starburst galaxy with luminosity greater than 10 to the 11th L and which are commonly home to hydroxyl megamasers. Paolo Maffei pioneered this type of astronomy, and used it to find the Maffei 1 and 2 galaxies in the Zone of Avoidance. The 2MASS experiment surveyed the sky using the techniques in this field. Background in this type of astronomy often comes from telluric lines, (*) galactic cirrus and the zodiacal light. The IRAS (EYE-ras) satellite was the first to completely image the sky using this technique, which was also the subject of the Spitzer telescope. The sub-millimeter range is a subset of the "far" side of the range studied in this field, which is the range at which most galactic dust glows. This field got its start when William Herschel discovered calorific rays from the sun. For 10 points, name this type of astronomy which studies wavelength ranges between microwave and visible.
ANSWER: **infr**ared astronomy [accept **IR**, **far-IR**, **far-infrared**, **near-IR**, or **near-infrared** astronomy; accept **sub-millimeter** astronomy before mention]

5. This functionality can be used as a stereoselective directing group when using diiodomethane and zinc to form a cyclopropane ring from an alkene. Ketones are enantioselectively converted into a compound of this type using borane and a chiral ox-aza-boro-li-dine catalyst. Tartrates can be used to control stereochemistry when reacting allylic compounds of this type with tert-butyl hydroperoxide and a titanium catalyst to form epoxides with this functionality. An allylic compound of this type can be produced by reacting stoichiometric quantities of an alkene and an (*) aldehyde under high temperature, acidic conditions. These compounds are formed stereoselectively if hydrogen peroxide is used immediately after a hydroboration reaction. Under acidic conditions a carbonyl group can react with a molecule of this type to form a hemiacetal, and a molecule of this type can also react with an alkyl halide to make an ether. For 10 points, name this type of compound which can react with a carboxylic acid to form an ester.
ANSWER: **alcohol** [or **hydroxyl** or R-**OH**. Note: referenced reactions include Simmons-Smith, Corey-Bakshi-Shibata, Sharpless epoxidation, Prins, Williamson ether synthesis, and Fischer esterification]

6. The Cromer forest bed was formed during this period. The Bouri formation in Ethiopia and the Kibish formation are important sources of fossils from this period, the latter of which contained the Omo remains. During this period, North America was home to Miracinonyx trumani. This period is divided into the Gelasian, Calabrian, Ionian, and Tarantian stages. Paul S. Martin developed this era's namesake (*) "overkill" hypothesis, which explained the extinction of its namesake megafauna. The Laurentide ice sheet reached its fullest extent during this period. Among the species that arose during this period are H. heidelbergensis and Neanderthals. For 10 points, name this first epoch of the quaternary period which immediately precedes the Holocene, which occurred between 2.5 million and 11 thousand years ago and saw the early evolution of humans.
ANSWER: **Pleistocene**

7. Given a well-quasi-ordered preorder on sigma, the preorder on these structures of a homeomorphic embedding of sigma is well-quasi-ordered according to Kruskal's theorem about these structures. A data structure of this type uses an associative array on integer keys to point to substructures with square root of n elements, which helps that type of these structures achieve log log n running times for search and deletion; that type of these structures is named for (*) van Emde Boas. Rotations are used to maintain the invariants of a data structure of this type that is usually implemented as "left-leaning" and colors nodes. A recursive definition usually consists of either a value or more of these structures. A connected graph with no cycles is one of these structures. For 10 points, name these structures that come in B and red-black types, groups of which are called forests.
ANSWER: **trees** [prompt on "graphs"]

8. A variant of this disease common in China and Mexico shows anti-GD1a antibodies, while a variant in which anti-GQ1b antibodies are present is named for Miller and Fisher. Molecular mimicry of the lipo-oligo-saccharide of Camphylobacter jejuni can trigger this disease. The CSF of patients with this condition displays a marked increase in protein without an increase in cell count, a phenomenon called (*) albumino-cytologic dissociation. One outbreak of this disease was linked to an influenza vaccine produced in the 1970s. This disease, which is treated via plasmapharesis and IVIG, is an autoimmune reaction to gangliosides. The common AIDP version of this disease results from the death of Schwann cells. For 10 points, name this demyelinating condition which usually causes an ascending paralysis, named for two French neurologists.
ANSWER: Landry-**Guillan-Barre** syndrome [accept **GBS**; accept all of the following before mention: **Miller Fisher** syndrome, **A**cute **m**otor **a**xonal **n**europathy, **A**cute **i**nflammatory **d**emyelinating **p**olyneuropathy; prompt on "demyelination", "paralysis", "ascending paralysis", "neuropathy"]

9. In a review, this scientist wrote that Lily's Limousine is "an embarrassment" that cannot accept credit cards. An image of him features him wearing a shirt labeled "Echo" with a caption apparently referring to masturbation. A photo of him shows him in a t-shirt standing to the right of Natalie Heer in front of a chalkboard. In one confrontation, this man, the "Grand Vizier of Fuckfaces," was told that (*) "everything you touch you destroy," and in an interview with Alan Siegel, he used the word "hearing" in an attempt to evade making a confession. The cousin of Steelers player Cameron Heyward, his last post to date was saying thermodynamics is just as much physics as chemistry. His mental health was "always on the wrong side of unstable" as an undergraduate, but he maintained he competed "in good faith." For 10 points, name this man whose two ICT championships with Harvard were revoked after his cheating was revealed.
ANSWER: Andrew **Watkins**

10. In string theory, S-duality relates a system with one value of this quantity to a system where this quantity is a reciprocal of that value. When calculating amplitudes from Feynman diagrams, the vertex factor is equal, up to sign and a product of i, to the total of *this quantity* for that vertex. One instance of this quantity is the square of the ratio of the electron mass to the Planck mass, and the lifetime of the muon is inversely proportional to the square of one of these quantities named for Fermi. The derivative of this quantity with respect to the natural log of the energy scale gives the factor beta, which is zero for scale-invariant theories and encodes the (*) "running" of this quantity. This quantity in QCD decreases logarithmically with increasing energy, a fact known as asymptotic freedom, while in another theory it blows up at the Landau pole. For the electromagnetic interaction in QED, a dimensionless version of this quantity is equal to approximately 1 over one-hundred thirty-seven and is called the fine-structure constant. For 10 points, give this constant that, for a given theory, characterizes the strength of the interaction.
ANSWER: **coupling** constant

11. An application of a lattice basis reduction theorem resulted in the first efficient algorithm for doing this task and was invented by Lenstra, Lenstra, and Lovasz. Algorithms that do this task can be repurposed to compute discrete logs; one of those algorithms that works for Galois fields is the popular Cantor-Zassenhaus algorithm, which replaced the similar Berlekamp algorithm. This procedure can be done on "square-free" inputs, which have no repetitions. One method of doing this first divides the input by a common denominator before using the (*) Lagrange interpolation formula; that method is named for Kronecker. This procedure is predicated on the fundamental theorem of algebra, which states that expressions of degree n have n roots. For 10 points, name this procedure that takes an expression consisting of variables and coefficients and rewrites it as a product.
ANSWER: **polynomial factorization** [prompt on "factorization"; prompt on "root finding"; prompt on "decomposition"; do not accept "prime factorization"]

12. Grossman and Steele studied ameboid inclusions of this mineral in the Allende meteorite. Pallasite meteorites contain crystals of this mineral, which when exposed to aqueous silica transforms into serpentinite. On the surface, the Goldich dissolution series predicts that this mineral weathers to iddingsite, and elongated crystals of this material create fabrics in the "lattice-preferred orientation", creating a large source of seismic anisotropy in one layer. At a depth of around 410 kilometers, this mineral undergoes a phase transition to the polymorph (*) wadsleyite. The solid solution series for this mineral varies from the magnesium-rich forsterite to the iron-rich fayalite. This mineral is the predominant component of the upper mantle. This mineral, which consists of isolated silicate tetrahedral, often occurs in ultramafic rocks and is present immediately above pyroxene in the discontinuous branch of Bowen's reaction series. For 10 points, name this mineral whose gem-quality version is called peridot and is named for its green color.
ANSWER: **olivine**

13. The collapse and revival of a quantum state via this effect was observed by Schoelkopf et al, and Degert et al induced it via terahertz cycling. The amount of orientational correlation or anisotropy in a liquid solution can be measured using a form of spectroscopy named for this effect. The intensity of this effect can be found by adding a term proportional to the third order susceptibility to the linear susceptibility, then taking the square root of that quantity. Short pulses of light travelling in a medium become self-phase modulated due to this effect, which is also responsible for the shape of spatial (*) solitons. Tubes filled with nitrobenzene or nitrotoluene exhibit this effect quite strongly, and this effect is responsible for cancelling out diffraction in fiber propagation. This effect is heavily suppressed in media without inversion symmetry, and it operates at very high voltages, unlike the linear Pockels effect. For 10 points, name this effect in which the induced birefringence is equal to the square of the incident electric field.
ANSWER: **Kerr** effect

14. Along with the radius of gyration and molecular weight, dynamic light scattering is used to determine this value via a Zimm plot. For a polymer solution, this value is calculated by taking the negative excess change in chemical potential divided by partial specific volume of the solvent times concentration squared, and it is zero at the point where the solvent is just poor enough to cancel the expansion of excluded volume. For a hard sphere potential, this value is equal to two-thirds pi times the radius of the sphere cubed, and for a van der Waals gas it is equal to b minus quantity a over RT. This value, which has units of (*) molar volume and is equal to negative two pi times the integral of r-squared times the Mayer-f function, is dependent only on pairwise interactions between particles. For a real gas, this value is zero at the point where the gas behaves the most like an ideal gas; that point is the Boyle temperature. For 10 points, name this value, which is a temperature-dependent coefficient that appears multiplied to the quadratic term of the virial equation of state.
ANSWER: **second virial** coefficient [accept **B** or **B-sub-2**; prompt on "virial coefficient" or "virial"]

15. This man is sometimes the second namesake of an approximation used in one-dimensional radiative transfer problems that says the forward and backward hemispheres have isotropic radiation intensity; that is named for Schuster and him and is also called the two-flux approximation. This man names a criterion which tells whether a star is stable against convection. The extra time that a signal travels due to the Shapiro delay is proportional to a quantity named for this man. A construct named for this man is guaranteed to be a unique exterior solution thanks to (*) Birkhoff's theorem; that construct sets the cosmological constant equal to zero and is characterized by an event horizon and describes a black hole with no charge or angular momentum. Another quantity named for this man can be found by setting the escape velocity to the speed of light. For 10 points, name this German astrophysicist who names a quantity equal to 2 times G times M over c-squared, which is the size at which matter has to be compressed in order to form a black hole.
ANSWER: Karl **Schwarzschild**

16. Antagonism between the PGC and Torso pathways in this organism separates germ cells from somatic cells. OvoD mutants of this organism are used alongside the FLP-FRT system to screen out non-recombinant germline clones in the DFS method. Enhancers for the tyrosine kinase sev in this organism include sos, which was found by enhancer-suppressor screen. The anterior-posterior axis of this organism is specified by the maternal effect genes (*) hunchback and caudal, which are inhibited via 3' UTR binding of nanos and bicoid, respectively. An important screen for factors important in the development of this organism specifically looked for lethal mutations and was performed by Eric Weischaus and Christine Nusslein-Volhard; that screen found genes like Kruppel and Engrailed. Herman Muller subjected these organisms to X-ray mutagenesis, creating his namesake morphs. For 10 points, name this organism whose mutations include bar eyes and white eyes.
ANSWER: **Drosophila** melanogaster [or **D. Melanogaster**]

17. **For a Fermi gas, this quantity is equal to three-fifths times the number of fermions times epsilon sub F. In the Debye model, this quantity is equal to the product of h-bar, frequency, density of states, and the Bose-Einstein factor, integrated over all frequencies. For a single particle in a gas, this quantity is equal to thermal pressure over density times one over quantity adiabatic index minus 1. Taking a Legendre transform of this quantity gives the Helmholtz free energy. Both volume and entropy serve as (*)** natural variables for this quantity, and the derivative of this quantity with respect to temperature at a constant volume gives the heat capacity. This quantity plus the product of pressure and volume gives the enthalpy, and this quantity is constant for an isolated system. For 10 points, name this quantity, whose change is equal to the sum of the heat transfer to a system and work done on the system according to the first law of thermodynamics.
ANSWER: **internal energy** [or **U**]

18. **Nafion-H is a solid example of these substances which can accelerate the Ritter reaction, and another example of these substances is a cluster compound containing 11 chloride groups bound to carborane. Sommer and Co used p-methoxybenzhydryl to characterize these substances, which sometimes name a form of enzymatic catalysis in which metal ions participate directly. A scale used to characterize these substances was developed with the help of Alden Deyrup and used p-nitroaniline. One of these substances was used to make a methyl doublet disappear when it was used to dissolve a tert-butyl halide; that experiment measured an (*)** NMR spectrum of a stable carbocation and was conducted by George Olah using the "magic" one of these substances. These substances are classified by having a Hammett function less than negative twelve, and examples of them include a mixture of hydrogen fluoride and antimony pentafluoride, which can protonate hydrocarbons. For 10 points, name these substances that are stronger than H2SO4.
ANSWER: **superacid** [prompt on "acid"]

19. **In algebraic geometry, a morphism between schemes is etale if it is both unramified and *this*. Heisuke Hironaka showed that, over a field of characteristic 0, every algebraic variety is birational to a projective variety with this property. Algebraic varieties are said to be *this* if they have no singular points. An integer is said to be *this* if it has no large prime factors. In analysis, mollifiers are used to create sequences of functions with this property. Frolicher spaces attempt to generalize the class of manifolds with this property. A complex-valued function with this property can generate another set of complex-valued functions with this property in a particular way according to Borel's lemma. Every (*)** analytic function has this property, but examples of functions with this property that are not analytic include the Fabius function and bump functions. For 10 points, what is this word describing a function which has derivatives of every order?
ANSWER: **smooth**ness [prompt on "infinitely differentiable" or "differentiable"; accept **flat** before "birational"]

20. **One side effect of one of *these drugs* is diagnosed using the 4T scale and is caused by antibodies to PF4. Another side effect of one of these drugs is a horrific eschar-forming skin necrosis. One class of drugs of this type consists of synthetic pentasaccharides like fondaparinux, while argatroban is the prototype of another class. An overdose of one type of these drugs is treated using protamine sulfate. Several drugs of this type work by forming a ternary complex with AT-III. One drug of this type has several low-molecular weight varieties that are easier to manage, while the effects of another one are monitored using the (*)** international normalized ratio. One drug of this type inhibits an epoxide reductase which transforms vitamin K to its active form and was originally used as a rat poison. For 10 points, name these drugs that include Coumadin and Heparin, which stop hemostasis.
ANSWER: **anticoagulant**s [or **blood thinners**; accept any answer involving **stopping blood clotting**, but do NOT accept "anti-platelet" meds or equivalents or "clot-busting" or "thrombolytic" drugs or equivalents, accept more specific answers like: factor ten-A inhibitors, direct thrombin inhibitors, coumarins, Coumadin, warfarin, heparins, etc]