LEDERBERG 2: DAUGHTER CELL
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PACKET 4 – KRYPTONITE
THE LAST TOSSUP YOU READ SHOULD HAVE BEEN ON ANSWER: <u>anticoagulants</u>

1. List and Houk proposed a transition state containing this functional group in their mechanism of the H-P-E-S-W reaction. Transiently-produced electron-rich versions of this functional group can trigger SOMO organocatalysis, and organocatalysis via this intermediate typically occurs through HOMO activation. List and Barbas proposed that, like aldolase A, their amino-acid-catalyzed reactions proceeded through an intermediate containing this functional group. An important Michael-addition-like reaction generates and then hydrolyzes this functional group in order to synthesize 1,5-dicarbonyls; that alkylation reaction is named for Gilbert (*) Stork. Proline organocatalysis often proceeds via the formation of this functional group. This functional group is synthesized by adding a secondary amine to a carbonyl, and they have a tautomeric relationship with imines. For 10 points, name this functional group which consists of an unsaturated carbon single-bonded to a nitrogen atom.
ANSWER: <u>enamine</u> [do NOT accept "imines" or "amines"; ask them to spell if necessary]

2. An experimental analogue of this phenomenon can be created by firing short laser pulses through a medium with varying refractive index, and was done by Daniele Faccio. The power of this phenomenon is proportional to the constant h-bar times c to the sixth over pi times G-squared times 15360, and the temperature of emission of this phenomenon is equal to 6.4 times 10 to the 6 kelvin over the mass by considering it as a blackbody phenomenon, and sets said temperature proportional to the (*) surface gravity. That effective temperature is the same as that experienced by a uniformly accelerating detector in a vacuum field. A critical mass related to this phenomenon is a sensitive measure of the Hubble time. The original derivation of this phenomenon had particles that had infinite frequency and wavelength less than the Planck length. This phenomenon causes the evaporation of the entities that emit it, and is caused by pair production at the event horizon. For 10 points, name this phenomenon, a form of radiation emitted by a black hole.
ANSWER: <u>Hawking</u> radiation

3. In one language, objects that do this task take on one of several enum values including TESS_CONTROL and TESS_EVALUATION. This process is usually combined with a "diffuse" process that utilizes a cosine law relating intensity and angles named for Lambert. A popular language used for this task is RenderMan, and a reasonably fast method of doing this calculates vertex normals and then interpolates the vertex's value across adjacent faces. Another, generally offline method interpolates the colors themselves rather than normal vectors; those two methods are named for (*) Gouraud and Phong, both of which are more advanced than the "flat" type which is constant for the whole polygon and therefore does not need to repeatedly use the illumination model. For 10 points, name this process in computer graphics by which objects are assigned different levels of lighting.
ANSWER: <u>shading</u> [accept word forms or descriptive answers; prompt on answers about "coloring objects"]

4. One method of performing this task divides the square of the width of a rim by the diffusion coefficient, and is based on Irving Friedman's empirical equation. Obsidian hydration is one method of performing this task, another method of which finds the lengths of etched tracks created by neutrons. Contamination in one method of performing this task can be accounted for by using a Concordia diagram. The Harris matrix approach for performing this task was an extension of another method developed by (*) Flinders Petrie. One widely-used method for performing this task is aided by plotting an isochron. Fission-track methods and seriation are two methods of doing this, and another method comes in rubidium-strontium, potassium-argon, and carbon-14 varieties, whose utility is determined by their half-lives. For 10 points, name this task which is often accomplished by charting the decay of radioactive isotopes, which tries to find the age of a particular layer of rock.
ANSWER: <u>dating</u> [accept reasonable equivalents; accept specific types of dating until they're mentioned]

5. Filtrations in this type of system can be conducted using slight vacuum and a valved piece of glassware connected to two flasks; that apparatus is called a swivel frit. A 5% hydrogen mixture is typically used to regenerate a bed of copper catalyst in one piece of equipment that maintains these conditions. A flask often used in this type of system has a sidearm with a stopcock, and distillations can be carried out under these conditions using a Perkin triangle. Transfers in this type of system can be carried out using a (*) cannula, and a double manifold often used in this type of system is called a Schlenk line. Thick-walled glassware is required to transfer chemicals through an antechamber into one type of equipment maintaining these conditions, which often uses molecular sieves to remove one key contaminant. Many techniques of this type were developed for use with Grignard reagents. For 10 points, glove boxes maintain what type of environment that prevents water and oxygen from interacting with pyrophoric chemicals?
ANSWER: **air-free** [or **inert**, accept **oxygen-free** or **water-free**; accept "in a **glovebox**" before mention; do NOT accept "vacuum"]

6. The parameter product of one of these entities is equal to lambda over pi, and the parameter "M-squared" is found by taking the ratio of the BPP of a given entity with the BPP of one of these. A delay term in the expression governing these entities is equal to negative i times the inverse tangent of a normalized z-coordinate and is called the Guoy shift. At the Rayleigh length, the width of one of these constructs is equal to the square root of two times their width at their narrowest point, which can be specified from the imaginary part of their complex parameter q. The paraxial form of the Helmholtz equation governs these (*) idealized entities, whose governing equation can be combined with a Laguerre polynomial to describe all orders of TEM modes. Diffractive elements can transform them into top-hat or flat-top profiles, and their narrowest point is called their waist. These idealized entities are the lowest-order transverse modes of an ideal optical resonator. For 10 points, name this ideal type of laser beam whose irradiance can be approximated by using a normal distribution.
ANSWER: **Gaussian** beam [prompt on beam, laser, laser beam, ideal laser beam, zero-order laser beam, light beam, transverse mode of a laser, etc]

7. One component of this complex is mutated in the blind-drunk mouse. One protein found in this complex contains an H-a-b-c regulatory domain, whose "closed" conformation is stabilized by Munc18. A cytoplasmic protein that localizes to this complex is inhibited to N-methylamide; that protein is responsible for recycling elements of this complex and is called NSF. Members of this complex are cleaved by tetanospasmin and (*) botulinum toxin; those members are synaptobrevin and SNAP-25. The calcium-sensitive protein synaptotagmin is responsible for triggering a conformational change in this complex, which causes the release of neurotransmitters. These proteins come in v and t varieties, which are present on vesicles and target membranes. For 10 points, name these zipper-like proteins that are responsible for fusing membranes together in vesicular transport.
ANSWER: **SNARE** [or **soluble NSF attachment protein recepto**r]

8. The largest known structure in the universe, the Hercules-Corona Borealis Great Wall, was mapped using these events. The Band function is used to describe the spectra of these objects, and their flux shows a four-part power law distribution with a blackbody tail. One device used to map these events contains the BAT and XRT instruments and is named for its very fast slew rate. These phenomena show a delay between low-energy and high-energy phases known as spectral lag. As these events slow down and fade, they exhibit a power-law decay in their afterglow due to a "jet break". One of these events occurring during the (*) Super Bowl nearly overloaded the EGRET instrument. The Swift mission, BATSE mission and Compton observatory are used to detect them, which may have caused the Ordovician-Silurian extinction. The short-hard ones are believed to be caused by mergers of compact objects, and the collapsar and hypernova models are used to explain their more common long-soft variety. For 10 points, name these energetic events in astrophysics that are named for the high frequency radiation they emit.
ANSWER: **gamma ray bursts** [or **GRB**]

9. When this character was in danger of losing his intelligence, he was cured by a kiss from Infectia. He once dated the librarian Vera Cantor and the poet Bernard writes about this man's feet. Carl Maddicks kidnaps him to cure Maddicks' son, Artie. This character dramatically changes appearance while working at the Brand Corporation. He makes the unethical decision to give information to Mister Sinister during his obsessive attempt to find a cure for the Legacy Virus. This character's "Dark" alter ego was a refugee from the (*) Age of Apocalypse. He broke up with his girlfriend Trish Trilby after being accused of sexual deviancy when he developed a more feline appearance. This character originally simply had big arms and feet as one of Professor Xavier's original students. For 10 points, name this member of the X-Men who typically has blue fur.
ANSWER: **Beast** [accept **Henry**, **Hank**, or **McCoy**]

10. This process is inhibited in culture by 3-methyladenine, and one method of activating this process occurs when galectin-8 binds to NDP52. ULK complexes are responsible for triggering this process, and it is inhibited by the action of Beclin-1 and PI3-Kinase. This process can be assayed for by immunoblotting for the conversion of LC3-I to LC3-II. It's not gluconeogenesis but during starvation, AMP kinase triggers this process, and mTOR inhibits this process when nutrients are plentiful. In yeast, this process is regulated by the (*) ATG proteins. This process is responsible for clearing out mutant htt in patients with Huntington's disease. It results in the creation of a double-membraned vesicle around the targeted organelle, which then fuses with a lysosome. For 10 points, name this process in which a cell eats its own damaged components.
ANSWER: **autophagy** [accept **autophagocytosis**]

11. One set of models of this condition suffer from an over-prediction problem called the "stagnation point anomaly", which can be corrected for using the Kato-Laudner method. The k-epsilon and k-omega constructs are two-equation models of this phenomenon. Heat transfer under this condition can be approximated by the Dittus-Boelter equation. One equation describing materials under this condition uses a universal constant of 0.4 and is based on the first two derivatives of (*) velocity, and Prandtl found a similar logarithmic formula based on a model of momentum transfer. A characteristic feature of this condition disappears at sizes below the Kolmogorov limit. This condition is necessary to apply the Colebrook equation, and the presence of this phenomenon gives rise to the 1.75 term in the Ergun equation. Mixing-length and eddy viscosity models are used to describe, for 10 points, what regime of fluid flow that occurs at high Reynolds numbers?
ANSWER: **turbulence** [or **turbulent flow**; prompt on "high Reynolds number" if anyone says something like that]

12. V is a descendent of u if and only if there is an entirely undiscovered path from u to v at a certain step of this algorithm. A strong relationship between antecedents and descendants and the nesting of intervals as determined by this algorithm is explained by the parenthesis structure of discovery and finishing times in this algorithm. Running this algorithm on a graph and then running it again on the transpose of the graph is one method to find (*) strongly connected components. Unlike a related algorithm, this one can find back edges. This algorithm can be implemented recursively or using a stack, unlike a related algorithm that uses a queue, and this algorithm was developed as a method to solve mazes. For 10 points, name this basic graph algorithm that goes as far as possible along one path before backtracking.
ANSWER: **depth first search** [accept **dfs**; prompt on "search"; do not accept or prompt on "breadth first search" or "bfs"]

13. Horel and Wallace characterized a "train" of these entities called the PNA pattern, and they can induce alternating flows in the Rhines effect. These entities can pushed into forced stationary modes caused by a meridonal velocity field. Equations governing them usually begin by considering the equation d-dt of quantity zeta plus f, all over h, is equal to zero, which is the principle of potential (*) vorticity conservation. The expression for the velocity of these entities contains the difference of the squares of the zonal and meridonal wavenumbers, and is always westward. These entities form the meanders within jet streams, and they can be classified as baroclinic or barotropic depending on their vertical variation. Their namesake parameter is equal to two omega times cosine of the latitude over the mean radius, and is equivalent to the vertical variation in the Coriolis force. For 10 points, name these large waves of air in the atmosphere, named for a Swedish meteorologist
ANSWER: **Rossby** waves

14. It's not Tris, but during immunoprecipitation, a solution of this nucleophile is used to quench the crosslinking reaction. A pH 2.5 solution of this substance can be used to strip western blots. In humans, it is synthesized through the action of serine hydroxymethyltransferase with the help of a folate cofactor, and it is combined with succinyl-CoA in the formation of delta-ALA in the first step of (*) porphyrin synthesis. Strychnine is an antagonist of this molecule's receptor, which is responsible for triggering inhibitory potentials in the spinal cord. This molecule's presence can disrupt the formation of an alpha helix due to its high entropy cost, though with proline it is present very frequently in collagen helices due to its high flexibility. For 10 points, name this only achiral amino acid, the simplest one with a side chain containing only a hydrogen atom.
ANSWER: **glycine** [or **gly** or **G**]

15. Yields from this reaction can be improved using pyridine as a catalyst, and the pyridine-based mechanism bypasses the traditional second cyclic intermediate and avoids use of a work-up step. An alcohol and sodium bicarbonate or para-toluenesulfonic acid can be used in this reaction to produce terminally differentiated products, as discovered by Schreiber. N-methyl oximes will react to form a typical intermediate in this reaction, and that reaction named for Griesbaum has been used to synthesize one class of antimalarial drugs. Typical reactions of this type involve a (*) 1,3-dipolar cycloaddition reaction, the decomposition of that intermediate into a carbonyl compound and a zwitterionic carbonyl oxide, and recombination of those two species to form a 1,2,4-trioxolanes. That mechanism involving two 5-membered ring intermediates was proposed by Criegee. For 10 points, name this type of reaction in which double bonds are cleaved to form carbonyl groups after reacting with the namesake molecule.
ANSWER: **ozonolysis**

16. These structures are improperly separated in the Zebrafish mutants beamter and fss. The boundaries between these entities are specified by Eph-ephrin signaling induced by Tbx6 and MESP2, mutations in which cause spondylocostal dystosis. These structures are specified in an anterior-to-posterior direction by a wave of FGF8 signalling hitting cells with oscillating Notch and Wnt signaling; that is called the clock and wavefront model. They split off from the (*) paraxial mesoderm, and eventually split into the dermatome, sclerotome, and myotome. These structures give rise to the epaxial and hypaxial muscles, the dermis, and the vertebrae after initially forming on either side of the neural tube. For 10 points, name these paired balls of epithelial and mesenchymal cells important in development of the skeletomuscular system.
ANSWER: **somites**

17. In geometry, this equation can be used to give a local formula for the index of an elliptic complex; a paper of Atiyah, Bott, and Patodi took advantage of this fact to provide a new proof of the index theorem. Hamilton's Ricci flow, used in the proof of the Poincare conjecture, is sometimes known as "[this equation] for metrics." One numerical method for solving this partial differential equation discretizes space and uses a (*) finite difference method to approximate partial derivatives; that is the Crank-Nicolson algorithm. Fourier series were introduced to solve the one-dimensional version of this equation, which is a prototypical parabolic PDE. Stating that the time partial derivative of the function under consideration is proportional to the Laplacian, for 10 points, name this equation which describes thermal diffusion.
ANSWER: **heat** equation

18. Three nicotine molecules or three picolinic acid molecules are coordinated to this element in a series of compounds that enhance glucose tolerance. The first Fischer carbene was a complex containing this element bonded to four carbonyl groups, and that complex participates in the Dotz reaction. Six equivalents of a reagent in which this element is bonded to chloride are used in the Takai olefination. It's not sulfur or oxygen, but reagents containing this element often have one of its (*) "esters" as an intermediate. A gentler alternative to one reagent containing this metal was developed by Corey and Suggs and consists of this element bonded to two oxygen and two chlorine atoms, with a pyridinium counterion. Another reagent containing this element is used to transform primary alcohols to carboxylic acids. For 10 points, name this transition metal, whose trioxide is dissolved in sulfuric acid and acetone to create Jones' reagent.
ANSWER: **chromium** [or **Cr**]

19. One term in this equation is written in terms of an expression whose value is negative if its two inputs are odd, positive if its two inputs are even, and zero otherwise. One term in this expression has a coefficient a sub v which is approximately 15.5 MeV and considers nearest and next-nearest neighbor interactions, and another term contains an exponent of A to the two-thirds and is used to model surface interactions. The original form of this equation is unable to recapitulate a sharp cusp due to the T = 0 isospin state called the (*) Wigner energy. Collapsing this equation to a quadratic can be used to find the bottom of the "valley of stability". This formula, which contains volume, asymmetry, and Coloumb terms, is unable to recapitulate the effects of magic numbers, and the value it calculates is maximized around atomic number of 56. For 10 points, name this formula which is based on Gamow's liquid-drop which gives the binding energy of the nucleus.
ANSWER: **semi-empirical mass** formula [or Bethe-**Weizsacker** formula]

20. Temperature deviations leading to this phenomenon are strongly dependent on the decoupling induced by the Wouthuysen-Field coupling. This phenomenon is the most common structural probe of the cold neutral and warm neutral components of the ISM. When this phenomenon takes on a two-horned structure, it is indicative of a rotating gaseous disk. The width of this phenomenon was correlated with absolute magnitude by Tully and Fisher to derive their namesake relation. This phenomenon is used by experiments like PAPER and LOFAR to probe the era between recombination and re-ionization, a time called the (*) "dark ages". The Doppler shift of this phenomenon is commonly used to plot galaxy rotation curves. Originally predicted by van de Hulst and discovered by Ewen and Purcell, this phenomenon has a frequency of about 1420 megahertz and occurs due to a split in the 2S-sub-one-half ground state due to hyperfine interactions. For 10 points, name this radiation emitted by neutral hydrogen atoms, usually named for its wavelength.
ANSWER: **21 cm** line [accept **hydrogen** line before mention; accept Lyman-alpha line before the word "ISM"]