LEDERBERG 2: DAUGHTER CELL
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PACKET 10 – OBERON
THE LAST TOSSUP YOU READ SHOULD HAVE BEEN ON ANSWER: hybrid **incompatibility**

1. One of these proteins is commonly mutated in threonine-286 in endometrial carcinomas, and one of these proteins is activated by an 11 to 14 translocation commonly found in Mantle Cell lymphoma. Gamma herpesviruses encode a viral form of these proteins, which are used to inactivate Rb. Both the Retinoblastoma protein and transcription factor 2-B contain a fold named for this class of proteins. They're not securins, but the APC/C protein complex directs ubiquitination of these proteins. These proteins bind to the PSTAIRE helix of another set of protein, which causes that partner to move its T-loop out of the way of its active site. The HIV (*) Tat protein binds to the T type of these proteins. Proteins like Wee1 and Sic1 are responsible for inhibiting complexes of these proteins and their effectors; one such complex contains one of these proteins bound to p34 and is called the MPF. These proteins have a namesake 5-helix domain, and come in types including A, B, D, and E, the last of which spikes at the G1/S boundary. For 10 points, name these proteins that regulate the progression of the cell cycle.
ANSWER: **cyclin**

2. This man figured out the structure of the antibiotic terramycin using a large piece of cardboard and a pen. Christmasterone was discovered in this man's laboratory as an intermediate in one scheme. In collaboration with Geoffrey Wilkinson and Ernst Otto Fischer, this man posited the sandwich structure for ferrocene. One scheme partly developed by this man used a collaborator's namesake sulfide contraction to transform a tricyclic ketone in one step. That project, which was a collaboration with Albert Eschenmoser, took almost a decade and has (*) 73 steps. One reaction named for this chemist uses iodine and silver acetate to give syn addition to an alkene, unlike the related Prevost reaction, which gives anti addition. One of his syntheses led him to become the first namesake of a set of statements considering the conservation of orbital symmetry to contrast thermal and photochemical control. For 10 points, name this organic chemist who conducted total syntheses of cholesterol and B12, and who is the first namesake of a series of rules governing pericyclic reactions with Hoffman.
ANSWER: Robert Burns **Woodward**

3. The Rijndael schedule allows for the creation of round ones of these tools. An important problem involving these tools was addressed by the Diffie-Hellman protocol, which allowed for the exchange of these things. PGP uses both symmetric and asymmetric types of these things while AES uses only one of these. These things are stored in the .ssh ["dot s s h"] directory, and PKIs match these to identities using (*) certificates. In a popular scheme, one of these things is constructed as the product of two large prime numbers and is published, though the two prime factors themselves are kept secret. For 10 points, name these tools used for RSA that come in public and private forms and are used to encrypt and decrypt messages.
ANSWER: cryptographic **key**s [accept public or private **key**s]

4. This story begins with Alexander Adell and Bertram Lupov having a discussion about running under a tree after getting caught in a rain shower. Later in this story, characters discuss journeying to X-23, and a character named Zee Prime begins collecting interstellar hydrogen. It first begins on May 21, 2061, during a conversation between two attendants of Multivac, and it ends with matter and energy having ended. All through this story, characters receive the message that there is (*) "INSUFFICIENT DATA FOR MEANINGFUL ANSWER," until the final scene in which AC says "LET THERE BE LIGHT!", implicitly recreating the universe. For 10 points, name this Isaac Asimov story in which people continually ask computers the title query, which is "how can the universe's entropy be decreased?"
ANSWER: "The **Last Question**"

5. An experimental confirmation of this phenomenon was done in triangular arrays of lead-tin junctions by Resnick et al. The renormalization group approach to this phenomenon requires using a "flow parameter" to derive normalized stiffness and fugacity equations. The developers of this phenomenon discovered a related melting phenomenon sometimes named for Halperin, Nelson, and Young in which there exists an intermediate hexatic substance. In all systems that undergo this phenomenon, the ratio of the spin-wave stiffness to the temperature of its occurrence is equal to two over pi. The system undergoing this phenomenon is equivalent to a (*) Coulomb gas in which winding number has replaced charge. This phenomenon, which is continuous and therefore has infinite order, can be derived by considering a pair of vortices in a gas binding to and unbinding from each other. For 10 points, name this phase transition that occurs in the two-dimensional XY model of a ferromagnet, in which long range order disappears at high temperatures, named for two physicists.
ANSWER: B**KT** transition [or Berezinskii-**Kosterlitz-Thouless** transition]

6. This disease shares some symptoms with Epstein's syndrome, though usually without the giant platelets. A small microdeletion at the 5' end of one gene associated with this disease increases the chances of diffuse leiomyomatosis. The eyes of sufferers of this disease show dot-and-fleck retinopathy and an irregular thinning of the lens capsule resulting in anterior lenticonus. Tissue from patients affected by this disease is typically negative for anti-GBM antibodies, unlike Goodpasture's syndrome. Affected tissues in this disorder show a (*) basket-weave appearance under electron microscopy. This disorder, which is caused by mutations in alpha-3, alpha-4, or alpha-5 genes of a particular protein and comes in both X-linked and autosomal varieties, is suspected in children who have microscopic hematuria and a family history of hematuria and deafness. For 10 points, name this genetic disease in which the basement membranes of the kidneys are split due to a mutation in fourth isoform of collagen.
ANSWER: **Alport**'s syndrome [or **hereditary nephritis**; prompt on "nephritis"]

7. With Loeb, this man names a test that measures the Ly-alpha forest redshifts at two different times as a probe of the universe's expansion. In a review article, this man called his field the "search for two numbers," one of which is the deceleration parameter, q. This man is the last namesake of a top-down model of galaxy formation in which a cloud collapses into a disk, named for him, Eggen, and Lynden-Bell. He showed that the color-magnitude diagram of globular clusters can be used to interpret the ages of their constituents. He's not de Vaucouleurs, but this scientist added lenticular galaxies to the (*) Hubble Tuning Fork classification scheme. With his advisor, Walter Baade, he used Cepheid variables to show that the Andromeda galaxy was at a different distance than originally believed, leading him to revise the estimate for a certain constant. For 10 points, name this longtime member of the Carnegie Observatory, an American astrophysicist who revised the measurement of Hubble's constant to around 75 kilometers per second per megaparsec.
ANSWER: Allan **Sandage**

8. A method of verifying this effect uses the interference between the oscillations of two cesium atoms fired across a gap and shot with a laser. In the low-field limit, this effect's strength is equal to one minus g h over c-squared; a full treatment shows its strength as the length scale goes to infinity is a factor of negative one, plus one over the square root of one minus the (*) Schwarzchild radius over the body's radius. Walter Adams confirmed this effect by looking at spectral lines of Sirius B. A mylar bag full of helium was used to cut down on scattering in an experiment testing for this phenomenon in which two Mossbauer-active samples of iron-57 were placed on the roof and in the basement of the Jefferson Laboratory at Harvard by Pound and Rebka. For 10 points, name this phenomenon predicted by general relativity in which a large mass changes the frequency of electromagnetic radiation travelling near it.
ANSWER: **gravitational redshift** [prompt on partial answer; also accept **gravitational time dilation**; prompt on partial answer in all cases]

9. **The intensity of these events is measured by a scale that assumes their frequency is proportional to the negative four-fifths of their energy threshold; that is the Palermo scale, which is more complicated than the Torino scale. These events can cause fragments to form suevites, and sites where these events have occurred are characterized by negative Bouguer anomaly and lenses of breccia. Hallmarks of these events include the formation of planar deformation features and (*)** "strewn fields" of tektites, which sometimes include shocked quartz. An event of this type involving the body Theia was believed to have created the moon, while another caused the K-T extinction and created the Chicxulub crater. For 10 points, name these events in which rocks from space collide with other, somewhat larger rocks in space.
ANSWER: **impact** event

10. **Stefan Grimme published a 2008 article insisting that these phenomena do not exist by analyzing how cyclohexane manages to reproduce one example of it. One model of this interaction was studied using "double mutant cycles". Wheeler and Houk's model of this phenomenon manages to correctly explain some substituent effects via direct interaction, and the Hunter-Sanders model of it relies on the interactions of quadrupole moments. In one system, this interaction can produce parallel-displaced, T-shaped, or (*)** sandwich conformations. This sort of interaction allows a molecular tweezer to "catch" buckyballs. It's not hydrogen bonding, but adjacent nucleic acid bases are stabilized by this interaction. An easy system to study this interaction is the benzene dimer. For 10 points, name this type of molecular interaction in which two aromatic rings align and attract each other.
ANSWER: pi-pi **stacking** [or pi **stacking** or aromatic **stacking**]

11. **One pioneer of this technique also recently developed an imaging technique that uses hydrogel to make tissue transparent, called CLARITY. One protein used in this technique was made bistable by mutating cysteine-128, while another has a E159T slash T159C double mutant to increase speed and gain. A series of double-floxed-inverted open-reading-frame-containing AAV vectors were developed by Deisseroth et al for use in this technique. Kreitzer et. al. used this technique to activate direct-pathway medium spiny cells to treat a mouse model of (*)** Parkinson's disease. The proteins used in this technique are either algae-derived halorhodopsin or channelrhodopsin or fusion proteins consisting of a rhodopsin extracellular domain and an adrenergic G-protein-coupled receptor intracellular domain. This technique was demonstrated in a mouse that was compelled to lick when a laser was shone through a fiber optic cable running into its brain. For 10 points, name this technique in which light is used to control populations of cells.
ANSWER: **optogenetics**

12. **This technique is commonly used alongside Pierce's multiplex TMT tags for quantitation. This technique is used after combining the labelled and unlabeled samples together in a SILAC experiment. John Yates and Jimmy Eng developed the standard software for analyzing the results of this technique using database cross-correlation; that software is SEQUEST. The use of this technique on a drop of blood from a heel prick has replaced the use of Guthrie's test in screening infants for inborn errors of metabolism. The output of this technique creates b-type or y-type (*)** ions. This is a common follow-up and confirmatory experiment if PMF fails to identify a sample. Cleavage in this technique is commonly accomplished using collision-induced dissociation, and this technique is commonly used after cutting a band out of an SDS-PAGE gel followed by trypsin digestion. This technique relies on one analyzer to select a single peptide, which is then fragmented and run through a second analyzer. For 10 points, name this technique from proteomics which essentially uses a pair of mass spectrometers in series.
ANSWER: **MS/MS** or **MS2** or **Tandem Mass Spectrometry** [prompt on "mass spec" or "protein mass spec" or "peptide mass spec" throughout; do NOT accept anything with the word "fingerprinting" in it]

13. One theorem about these things states that one form of their motions must be Killing motions; that is a corollary of a theorem that states they only have three degrees of freedom in Minkowski space called the Herglotz-Noether theorem. The most general motion of these objects are called "screw displacements" according to Chasles' theorem, and motions of them are often described using the SE(3) group. A generalization of these objects has the condition that they preserve constant distances in the co-moving frame; that generalization is due to (*) Born and extends them to special relativity. A rotating asymmetric one of these has an angular velocity vector that traces out a polhode and a herpolhode, and during torque-free rotation, the kinetic energy of these objects defines a construct that rolls on the invariant plane without slipping; that construct is Poinsot's ellipsoid. Euler angles are used to describe the motion of these objects. For 10 points, give this name for idealized three-dimensional objects that cannot be deformed.
ANSWER: **rigid body** [or **rigid bodies**; anti-prompt on "rigid rotor"]

14. One ligand in this pathway is retained in the ER in *porcupine* mutants, which have a defective acetyltransferase. One protein found in this pathway is mutated in both Gardner's syndrome and Turcot's syndrome. Coreceptors in one version of this pathway include Knypek and Ror2, and that version of the pathway activates CamKII and PKC. A transcription factor important in one version of this pathway contains a series of armadillo repeats and is triggered for degradation by a complex containing Axin. This pathway's namesake protein triggers the dimerization of LRP and (*) disheveled receptor, which in turn inhibits GSK3 and allows the displacement of the Groucho transcription factor from LEF/TCF by beta-catenin. This pathway's namesake protein binds to Frizzled and is secreted from the Nieuwkoop center to activate the development of dorsal structures. For 10 points, name this signaling pathway important in development, which gets its name partly from a mutation in Drosophila that inhibits wing formation.
ANSWER: **Wnt** pathway

15. This object is surrounded by the "Napoleon's Hat" nebula. The light curve of this object displayed a "freeze-out" phase followed by a tail driven by the radioactive decay of titanium-44, the latter of which was detected by the INTEGRAL observatory. The distance to this object was determined by measuring the angular size of a ring surrounding it; this object is actually surrounded by three rings of gas of unknown origin, knots in which periodically brighten as they (*) collide with ejecta. Terrestrial instruments, including IMB, Baksan, and Kamiokande-II, detected 25 antineutrinos from this object, which marked the beginning of neutrino astronomy. Discovered by Ian Shelton, Oscar Duhalde, and Albert Jones, this phenomenon is found right outside the Tarantula nebula in the Large Magellanic Cloud, and its progenitor was a blue supergiant. For 10 points, name this highly studied core-collapse supernova, named for the year that it was observed.
ANSWER: **SN1987A**

16. They're not prime ideals, but according to the "going up" and "going down" theorems, integral examples of entities have the lying-over and the incomparability property. According to the primitive element theorem, finite separable ones are simple. Adjunction is the process of creating several "sub-" examples of these entities. Those that are both normal and separable are called (*) Galois, and intermediate ones have a bijection with the subgroups of the Galois group according to the first fundamental theorem of Galois theory. A classic example of these entities involves taking the rational numbers and forming a group of numbers of the form a plus b times the square root of C; in this manner the complex numbers can be created from the real numbers. For 10 points, name these objects, which are constructions in which a field is expanded into a larger field.
ANSWER: field **extension** [prompt on "fields"]

17. A value named for this man is proportional to the ratio of the sum of the radii of the A-cation, B-cation, and anion, and is greater than one for hexagonal structures; that value is his namesake tolerance factor. One rule derived by this man can be applied to 3-component compatibility diagrams. This man's study of contact metamorphism in hornfels in Kristiania led to his derivation of the rule that for a rock at equilibrium, the number of (*) phases is equal to or less than the number of components; that is his version of Gibbs' phase rule. One scheme developed by this man divided species into atmophile, lithophile, siderophile, and chalcophile. For 10 points, name this Russian mineralogist and namesake of a mineralogical formula and a classification system, the father of geochemistry.
ANSWER: Victor Moritz **Goldschmidt**

18. This value at some external current J, divided by its value with no external current, gives the generating function for the connected Green's functions of a system. For a low-density system of interacting particles, this value can be approximated as equal to its classical value times the configuration integral. One method of computing the zeros of this mathematical entity was generalized by Elliot Lieb and Alan Sokal of hoax fame; that theorem states that for the Ising model, this expression's zeros are imaginary, and was proven by (*) Lee and Yang. For a single molecule in a box, the translational component of this value is equal to the volume divided by the cube of the de Broglie wavelength. This quantity in one case is equal to e to the power negative beta times energy summed over all microstates, and this value normalizes the probability that a particle is in a particular state in the grand canonical ensemble. The natural logarithm of this quantity times kT is equal to the Helmholtz free energy. For 10 points, name this value symbolized Z, which characterizes how energy is divided between states.
ANSWER: **partition function** [accept **Z** before mention]

19. Perlin and Casu discovered the anomerism dependence of this quantity. One equation used to compute this quantity was modified by Haasnoot, deLeeuw and Altona to include group effects and the beta effect. In HSQC, sequential connectivity of proteins is derived by looking at these values between 15-N and 13-C. Long range versions of this quantity with superscripts 4 or greater become important when considering extended conjugated or aromatic systems. For geminal species, this value increases with ring strain, and one method of calculating vicinal examples of this value sets it equal to a polynomial of the cosine of the (*) torsion angle. This quantity is nonzero for species generating an off-diagonal cross-peak in an E.COSY experiment. This value can be found by finding the distance between peaks in a multiplet. For 10 points, name this value calculated by the Karplus equation, which gives the degree of spin-spin splitting between two non-equivalent nuclei in NMR.
ANSWER: J-**coupling** constant [or **J**-coupling constant or scalar **coupling** constant or spin-spin **coupling** constant; do NOT accept "dipole-dipole coupling", do NOT accept anything with the word "Overhauser"]

20. An efficient algorithm that enumerates these things also defines a Hamiltonian path on a Cayley graph; that algorithm makes insertions in increasing order on odd iterations and in decreasing order on even iterations. A pair of Young tableaux are generated by series of Schensted insertions starting from one of these, denoted sigma. A popular algorithm to generate one of these things uses (*) random number generation of incrementally decreasing range and swaps used elements to the end of the array. The Steinhaus-Johnson-Trotter algorithm gives all possible ones of these, while the Lehmer code mathematically encapsulates all of them, and a random one of these is produced by the Knuth shuffle. For 10 points, name these orderings of a set, of which there are usually n factorial.
ANSWER: **permutation**s of a set