# Round 6

1. The deep varieties of these are driven by temperature gradients and density. The thermohaline type is currently being investigated by a series of underwater robots called Argo, and is caused by a cycle of upwellings and downwellings. Southerly trade winds cause upwellings in the Humboldt one of these, and Taylor caps occur at the surface of the ocean because of the rotating types of these. The Sverdrup measure for magnitude of these is proportional to the curl of wind stress. The OSCAR data set is often used to evaluate the surface type of these. Identify these movements of ocean water, exemplified by the Gulf Stream .
ANSWER: **ocean currents** (accept **ocean circulations**, prompt on "currents") <AK>

2. With a particle in a conservative force field, the partial derivative of the Lagrangian with respect to velocity is equal to this. The wavefunction in terms of this quantity can be obtained from the wavefunction in terms of position via a Fourier transform. The quantum mechanical operator for this is equal to negative i times h-bar times the gradient operator. This concept can be used in a ballistic pendulum to calculate a bullet's velocity after it hits a block. The rotational form of this concept can be found as the product of the moment of inertia and rotational velocity. Name this quantity which is classically defined as mass multiplied by velocity.
ANSWER: **momentum** <AK>

3. **Editor's Note: "alkynes" rhymes with "al-fines"**
Performing hydroboration on these compounds results in anti-Markovnikov addition of a hydroxyl group. Reacting mCPBA with this functional group produces epoxides in the Prilezhaev reaction. When compounds with this functional group also possess an adjacent hydroxyl group, they can tautomerize into ketones. Ziegler-Natta catalysts are used to polymerize these compounds, and a cyclic variety of one of these compounds is produced in the Birch reduction. Hydrogen gas and Lindlar's catalyst form the *cis* version of these compounds from alkynes. They exhibit $sp^2$ hybridization, and the general formula for these compounds is $C_nH_{2n}$. The simplest example of these compounds is ethylene. Name these compounds which contain a carbon-carbon double bond.
ANSWER: **alkene**s [or **olefin**s] <SV>

4. This man proved the Fermat polygonal number theorem for triangular numbers. A theorem stating that a constructible regular n-gon must have "n" equal to a power of two, a Fermat prime, or a product of powers of two and Fermat primes is named for this man and Wantzel. This man produced a proof of the fundamental theorem of algebra as his doctorate. This man made a large contribution to applied mathematics by creating the method of least squares, and was able to determine a shortcut method for summing the integers from one to one hundred on the spot at age ten. Identify this man for whom the normal distribution is named.
ANSWER: Johann Carl Friedrich **Gauss** <AL>

5. The convergence of the carbohydrate, protein, and fat catabolic pathways upon this process suggests that it originated abiogenically. Calcium activates several dehydrogenase complexes in order to increase reaction rate during this process, and Albert Szent-Gyorgi received a 1937 Nobel Prize for discovering a major component of this cycle, fumaric acid. Alpha-ketogluterate is an intermediate in this process, and the escape of protons through the mitochondrial membrane reduces the yield of this process. Name this process that follows glycolysis and yields 30-38 ATP per glucose molecule processed.
ANSWER: **Krebs** cycle [accept **citric acid** cycle] <AL>

6. The gravitational analog of Gauss's Law can be used to find the total mass inside one of these. The sonic type of these occurs when phonons are trapped in a flowing fluid that exceeds the speed of sound, and it can also be used to consider the trans-Planckian problem. The holographic principle can resolve the information paradox regarding these entities. The Kerr-Newman metric describes one type of these, and the no-hair theorem states that they are characterized by mass, charge, and angular momentum. Name these objects, associated with Schwarzschild radii and event horizons, from which light cannot escape.
ANSWER: **black holes** <AK>

7. Nocturnal insects have compound eyes known as this “eyes”. A principle with this name in mathematics states that for a linear homogenous ordinary differential equation, if $y_1(x)$ and $y_2(x)$ are solutions, $y_1(x) + y_2(x)$ is also a solution. The quantum type of this states that a physical system partially exists in all theoretically possible states, but only gives a result corresponding to one configuration when observed. The law of this in geology states that sedimentary layers are deposited in time sequence. Identify this principle which that the net response caused by multiple stimuli is the sum of the responses the stimuli would create individually.
ANSWER: **superposition** <AL>

8. In a developing human embryo, the junction between this organ and the sinus venosus is the crista terminalis. A high concentration of PAI-1 in the blood can indicate a high risk of disease in this organ. A mutation in MYH7 causes a disease of this organ which typically manifests as sudden death in athletic college students. Striated muscle cells in this organ are separated by intercalcated discs. The bundle of His can be found in this organ, and they serve as a midpoint between the AV node and Purkinje fibers. In humans, this organ has two atria, two ventricles, and an aorta. Name this organ that pumps blood throughout the circulatory system.
ANSWER: **heart** <SV>

9. The Fujiwara effect occurs when two of these entities orbit one another and eventually merge. Annular ones of these are not prone to fluctuations in intensity, while the Dvorak technique allows their intensity to be assessed through T-numbers. These entities, which derive energy from the heat of condensation, almost never form in the Southern Atlantic Ocean due to strong wind shear, and do not occur near the equator due to necessity of the Coriolis Effect in their formation. The largest and most intense ever recorded was Tip, though the deadliest was one struck Bhola in 1970. Name this weather phenomenon, the tropical type of which includes hurricanes and typhoons.
ANSWER: **cyclone**s <AL>

10. By Noether’s theorem, gauge invariance of an electromagnetic field is the symmetry that leads to the conservation of this quantity. The sum of the time derivative of the density of this quantity and the divergence of the current density equals zero by the conservation of this quantity. Electric field equals electric force over this quantity. The energy stored in a capacitor is one half times voltage times this quantity, and capacitance is equal to this quantity over voltage. Name this quantity for which an electron has a negative value and a proton has a positive value.
ANSWER: **charge** <SV>

11. Fixed-point combinators are often used in the “anonymous” form of this method. Semidecideable sets are enumerable through this method. In Scheme, a trampoline is often used to implement the “tail” type of this method without growing the stack. A total computable function that lacks the primitive form of this property is named for Ackermann. Often used to define the Catalan numbers and the factorial function, programming languages such as Java and Ruby use iteration instead of this to avoid stack overflows. For 10 points, name this concept used in computer science to write algorithms such as merge sort, in which a function being defined is applied in its definition.
ANSWER: **recursion** <AK>

12. A group led by Robert Holley beat this man in the race to sequencing a tRNA molecule, and his doctoral thesis explained the mechanism behind lysine metabolism in animals. He used his namesake reagent, FDNB, to help create a fingerprint sequence of a molecule he grew attached to after Charles Chibnall inspired him to study it. He proved that proteins have a definite chemical composition by determining the amino acid sequence of insulin. This man is still the only person to receive two Nobel Prizes in Chemistry. Name this man who discovered the dideoxy method of sequencing DNA
Answer: Frederick **Sanger** <BJ>

13. Electromagnetic signal from this phenomenon can be related temperature by the Sakuma-Hattori equation. One law describing this phenomenon states that the peak wavelength of it is inversely proportional to temperature. Another law that governs it states that intensity is a function of temperature to the fourth power. In addition to Wien's displacement law, another law governing this type of radiation was derived by finding the number of moves for standing waves in a cubical cavity. That law, the Rayleigh-Jeans law, experiences an ultraviolet catastrophe, which can be avoided by using Planck's law to describe this type of radiation. Name this type of radiation, exhibited by an object that absorbs all incident electromagnetic radiation.
ANSWER: **black-body radiation** <SV>

14. The tree method is a way to mathematically calculate the values of that this construct gives without actually creating it. This construct is only valid if genes are independent of each other. For a monohybrid cross, there are four sections to this construct, and for a dihybrid cross, there are sixteen. This construct only yields genotypic frequencies. When one performs a test cross with one of these, the result is a 1:1 ratio between homozygous recessive and heterozygous. If heterozygous individuals mate, one of these can be used to show the genotypic frequencies for a dihybrid cross as 9:3:3:1 and for a monohybrid cross as 1:2:1. Identify this visual representation of Mendelian inheritance.
ANSWER: **Punnett Square** (prompt on partial answer) <BJ>

15. One point on these figures can be determined by drawing lines from extouch points to vertices; that point is the Nagel point. One formula describing these figures is a special case of Brahmagupta's Formula where one side is set to zero. Whether points lying on the sides of one of these figures are collinear can be determined by Menelaus' Theorem, which is paired with Ceva's Theorem. The Euler line passes through several points on one of these that isn't a regular polygon. The semiperimeter of one of these figures may be used to calculate the area in Hero's formula, though it may be easier to use one half times base times height. Name this polygon that has three sides.
ANSWER: **triangle**s <AL>

16. *Kimberella* was notably not a member of this group when it existed about 555 million years ago, which means that this lineage and its relative split about 558 million years ago. The early cell divisions of animals under this classification have indeterminate cleavage. All animals which fall under this classification have pharyngeal gill slits, a hollow nerve cord, and a segmented body. The phyla Chordata and Echinodermata are under this classification. Name this classification of animals in which the blastopore develops the anus before the mouth, a classification commonly contrasted with protostomes.
ANSWER: **deuterostome**s [accept **deuterostomata**]<BJ>

17. The hydrated dioxide form of this element is a catalyst in hydrogenation reactions and is called Adams's catalyst. The *cis*- form of one complex containing ammonia, chlorine, and this element as a ligand is an effective chemotherapy drug. Before vanadium oxide was used, this element was the catalyst in the contact process, and it can be a catalyst in the electrolysis of water. It is found in a standard hydrogen electrode, and, like gold, it is dissolved by aqua regia. Name this transition metal appearing below palladium on the periodic table, with atomic number 78 and symbol Pt.
ANSWER: **platinum** [accept **Pt** before mentioned] <BJ>

18. This is the name of a crater found in the Argyre quadrangle on Mars, and this kind of albedo is the fraction of radiation reflected by a body back into space. This kind of graph has arcs that represent a bidirectional flow of information, unlike block and signal-flow diagrams. One of these between a carboxyl group and an amino group can be found in chains of amino acids, and the valence theory of these states that the orbitals of atoms in a particle merge together. Name this concept, also defined as the attraction between particles, exemplified by the ionic, covalent, and hydrogen types.
ANSWER: **bond** <AK>

19. A model named for this man and Ulam describes particles that undergo repeated reflection due to repeated reflection; those particles undergo his namesake acceleration. He is the first namesake of a statistical distribution with a plus one term in the denominator. The Drake equation is an attempt to explain this man's namesake paradox. When a quantum system is perturbed, the transition rate between eigenstates is given by this man's namesake golden rule. He imagined the weak nuclear force to be a result of four particles meeting at one vertex, his namesake interaction, and those particles all have half-integer spin, making them his namesake particles. Name this Italian physicist who is the namesake of a national laboratory in Illinois.
ANSWER: Enrico **Fermi** <AK>

20. A concentrated form of this compound is added to proteins and heated in the xanthoproteic reaction. When mercury is dissolved in this compound and subsequently diluted with water, one can detect the presence of tyrosine with Millon's test. This compound was purified using fractional distillation in the early Birkeland-Eyde process. When this acid is in concentrations above 16 molar, it is referred to as fuming. The most common way to form this compound is by oxidizing the product of the Haber process with a platinum-ruthenium catalyst; that method is known as the Ostwald process. Name this strong acid with chemical formula $HNO_3$.
ANSWER: **nitric acid** [accept **$HNO_3$** until mentioned] <BJ>