Round 2

Bee Round 2

(1) These particles are Compton scattered when they interact with a charged particle. The photoelectric effect takes place when these particles strike a surface. Like the gluon, which carries the strong force, and the Z and W bosons, which carry the weak force, this particle is a gauge boson carrying the electromagnetic force. Because these particles have no mass, they can move at the speed of light. For the point, name these elementary particles, the quanta, or most basic entity, of light.

ANSWER: **photon**

(2) These structures are supported by axonemes with microtubules in a nine-plus-two arrangement. Helicobacter pylori use these structures within mucus, and spermatazoa are equipped with one of these locomotive structures to traverse the reproductive tract. These structures may rotate like a screw or sway from side to side to accomplish their goal. For the point, name these whip-like appendages that allow single-celled organisms to move.

ANSWER: **flagella** (or **flagellum**)

(3) Skerries form at the outflows of these features, whose depth is often deeper than that of the surrounding sea. The world's largest of these features, Scoresby Sund, is found on the eastern coast of Greenland. These features are formed as glaciers carve out a valley on their path to the sea. For the point, name these geographic features, characterized by narrow inlets of water surrounded by steep cliffs, which are prominent on the coastline of Norway.

ANSWER: **fjord**s [f-YORD]

(4) One of these images is generated by plotting qualifying values of the complex equation z squared plus c. The coast of Great Britain was considered one of these images in a 1967 paper that describes fractional dimension. The Menger sponge and Koch snowflake are examples of these images. Graphical images of the Mandelbrot set are common examples of, for the point, what self-similar images whose patterns repeat as one "zooms in"?

ANSWER: **fractal**

(5) Platinum and palladium serve as this type of substance in a converter that scrubs car exhaust for pollutants. These substances make it easier to reach the transition state by lowering the activation energy of a reaction. Enzymes are biological examples of these substances. For the point, give this term for a substance that takes part in a chemical reaction, often making it proceed more quickly, but that is not consumed by the reaction.

ANSWER: **catalyst**

(6) This NASA program included Ann Druyan's brainwaves and Chuck Berry's "Johnny B. Goode" on golden records that were attached on the outside of its probes. One probe launched by this project passed the heliopause in 2012, leaving the solar system. This project succeeded the Mariner program, as its probes were launched in 1977. For the point, name this NASA program whose two probes are currently the farthest human-made objects from Earth.

ANSWER: **Voyager** program (accept **Voyager** 1 and/or 2)

(7) With Gustav Kirchhoff, this scientist was a pioneer in the investigation of the spectra of heated elements, which he used to discover cesium and rubidium. This man asked Peter Desaga to construct him a device with a needle valve to control the intake of gas and throat holes that control the amount of air that would enter; both of those features control the heat of the flame that formed. For the point, name this German chemist who invented a namesake "burner" used in the laboratory.

ANSWER: Robert **Bunsen** (accept **Bunsen** burner)

(8) One formula for kinetic energy sets it equal to the square of this quantity, divided by double the mass. Force is equal to the change in this quantity over time, called the impulse. This quantity is conserved in both elastic and inelastic collisions, unlike kinetic energy which is lost in inelastic collisions. For the point, name this quantity, equal to an object's mass times its velocity, which describes the strength of a moving body.

ANSWER: linear **momentum** (do not accept or prompt angular momentum)

(9) Lugol's solution of this element can disinfect drinking water and is used as a stain in cell microscopy. This element's isotope 131 is radioactive and particularly dangerous when absorbed in the thyroid. Deficiency of this element causes Graves' disease and goiter, so for public health purposes, this element is often added to table salt. This solid halogen is found directly above astatine on the periodic table. For the point, name this chemical element with atomic symbol I.

ANSWER: **iodine**

(10) This statement resulted from Ken Ribet's proving of the epsilon conjecture, combined with work on the Taniyama-Shimura conjecture. This concept is named for a man who claimed he understood it, but simply couldn't fit his proof in the margin of his textbook; this theorem was finally proven centuries later by Sir Andrew Wiles. For the point, name this theorem, which states that changing the exponent in the Pythagorean Theorem from 2 to any larger integer would not work for positive integer bases.

ANSWER: **Fermat's Last** Theorem (prompt on "Fermat's Theorem")

(11) A highly venomous species of this animal in class cubozoa is found off the coast of Australia. These cnidarians [nih-dare-ee-uns] do not have a respiratory system and possess a nerve net, rather than a more standard central nervous system. The Lion's Mane and Umbrella are specific species of this animal, which may travel in blooms. The Medusa is another type of, for the point, what sea creatures known for stinging tentacles?

ANSWER: **jellyfish** (or **Medusozoa**)

(12) Early examples of these systems include VERONICA, which was designed to work with the Gopher protocol. In a paper titled *The Anatomy of [one of these systems]*, the PageRank algorithm is explained by Sergey Brin and Larry Page. These systems read files called "robots.txt" [Robots dot T X T] using crawlers, which then store and organize web pages by key phrases. For the point, name this type of internet technology that helps users find relevant websites, which include Microsoft Bing and Google.

ANSWER: **search engine**s

(13) The existence of Uranus and one of these objects were successfully predicted by the Titius-Bode Law. These objects make up the Hilda family, which exist in a 3-to-2 resonance with Jupiter; Jupiter's Trojans are also this type of object. Vesta is the brightest of these objects as seen from Earth, and the first of these to be discovered has been re-classified as a dwarf planet. For the point, give this term for small, rocky bodies like Ceres, which are commonly found in a belt between Mars and Jupiter.

ANSWER: **asteroid** (or **minor planet**s or **planetoid**s; do not accept or prompt on planet or dwarf planet)

(14) Steam causes the weak "phreatic" type of these events, though those may be precursors to the stronger Plinian type, in which the stratosphere is pierced. These events cause the ejection of tephra, which can be classified by size into lapilli, bombs, or ash. Pyroclastic flows from these events are particularly deadly. For the point, name these often-disastrous events in which lava is often expelled from an active volcano.

ANSWER: volcanic **eruption**

(15) William Klann is credited with promoting this concept, having been inspired by procedures used in Chicago meatpacking plants. This concept was further improved with the installation of conveyor belts in Henry Ford's factory. This process improves efficiency by having specialized workers each complete one step of the job. For the point, give this term for a manufacturing system in which the product is passed from worker to worker.

ANSWER: **assembly line**

(16) According to the no-hair theorem, these things possess only three physical quantities: mass, charge, and angular momentum. If these things rotate, they give off Hawking radiation from near their event horizons, but that radiation is so faint as to be unobservable. The gravitational collapse of massive stars can create, for the point, what regions of space with gravitational pull strong enough to prevent light from escaping?

ANSWER: **black hole**

(17) One of these bodily structures becomes the medial umbilical ligament after its host gives birth, before which it carries blood from the fetus to the placenta. Another of these blood vessels carries deoxygenated blood to the lungs using thick, elastic walls that can harden in atherosclerosis. Most of these blood vessels carry oxygenated blood away from the heart, as exemplified by the aorta. For the point, name these large blood vessels contrasted with veins.

ANSWER: **artery** (or **arteries**; accept **umbilical artery** before "" is read; do not accept or prompt on "veins")

(18) A primary component of antifreeze, ethylene glycol, is this type of compound "twice over," since it has two of this type these compounds' characteristic functional group. These compounds are characterized by a hydroxyl functional group, consisting of a hydrogen bonded to an oxygen bonded to the base hydrocarbon. One of these compounds is formed when yeast process sugar in fermentation. For the point, name this class of organic compounds that includes methanol, ethanol, and a "rubbing" type.

ANSWER: **alcohol** (accept **diol**; accept **ethanol**; accept rubbing **alcohol**)

(19) Radiation is detected in a cloud chamber when this process occurs around the ions in the supersaturated environment. Clouds form via this phase change, as does fog when air cools to the dew point. The white trails left behind by jets, called contrails, are formed when exhausted water vapor undergoes this process. Evaporation is reversed by, for the point, what phase change that occurs when a gas changes into a liquid, as seen on the outside of a glass of ice water on a hot day?

ANSWER: **condensation** (accept word forms)

(20) This value for a complex number is equal to its conjugate divided by the square of its magnitude. The function known by this term has vertical and horizontal asymptotes along the x- and y-axes. Finding this value for a given number can be done by raising the number to the negative first power, an operation that cannot be applied to zero. For the point, give this term for the multiplicative inverse of a number, which is one-half for 2 and, in general, one over n for any non-zero number n.

ANSWER: **reciprocal** (accept **multiplicative inverse** before it is read; prompt on "inverse" before it is read)

(21) This technology uses continuous-wave and pulse systems to judge the frequency shift of a signal that has been reflected from a moving target. This technology, which was developed in World War II based on a 19th century Austrian's discovery, is also used in speed guns to identify speeding cars. For the point, name this type of radar, often used by weather forecasters, which employs a namesake physical effect to observe the motion of thunderstorm cells.

ANSWER: **Doppler** radar (prompt on "radar;" accept **Doppler** effect)

(22) An early result of this discipline was the accidental synthesis of mauve by William Henry Perkin. Typical reactions used in this field are additions, eliminations, substitutions, and rearrangements. This field of chemistry typically focuses on aliphatic and aromatic compounds. Diagrams of molecules in this field do not show hydrogens, and their vertices are assumed to be a certain element. For the point, name this field which studies and synthesizes compounds containing a carbon backbone.

ANSWER: **organic** chemistry

(23) One of this man's theories was verified by Arthur Eddington during a 1919 solar eclipse. This man proposed "light quanta" to explain the photoelectric effect during his Annus Mirabilis. This man proposed that mass causes space to bend and that the speed of light was the same to all observers in the general and special versions of his most famous theory. For the point, name this German scientist who formulated the theory of relativity.

ANSWER: Albert **Einstein**

(24) Accomplishing this feat with a perfect crystal lattice places a system in its ground state. According to the Third Law of Thermodynamics, it is impossible to accomplish this feat within a finite number of operations. Accomplishing this feat would end all vibrational movement in the system. For the point, name this classically-impossible scientific task that would require cooling a system to negative 273.15 degrees Celsius.

ANSWER: achieving **absolute zero** (accept any description of cooling a system until it reaches **absolute zero** or **zero Kelvin**; note that just saying **absolute zero** is acceptable)

(25) The regolith separates this material from bedrock. This material is called loam if it exists in a "2 to 2 to 1" ratio of silt to sand to clay. Hydroponic systems do not use this material, since they replace the vital humus [HYOO-muss] within this material with a liquid nutrient solution to be absorbed, and provide gravel for roots to grow in. For the point, give this term for the mixture of organic matter and minerals, including dirt, that supports plant growth.

ANSWER: **soil** (do not accept or prompt on dirt)

(26) The Orionid meteor shower originates out of this object's debris field. The "dirty snowball" model was supported by observations of this body by the *Vega* and *Giotto* spacecraft. The Bayeux tapestry famously depicts one appearance by this celestial body, which "came in" and "went out" with Mark Twain. For the point, name this comet with an orbital period of 75 years, which made its most recent approach to Earth in 1986.

ANSWER: **Halley's Comet**

(27) Glycolysis occurs in this part of a cell. A tonoplast separates a vacuole's outer layer with this substance and can be used to maintain a cell's acidity. Calcium moves through this substance in order to perform cellular signaling. A cell's organelles are found suspended in this substance, which is mostly made up of water. For the point, name this gel-like substance that fills a cell.

ANSWER: **cytoplasm**

(28) The eccentricity of this shape is always a positive number less than 1. The area of this shape is equal to pi times a times b, where a and b are the semi-minor and semi-major axes. This shape can be drawn by pinning two ends of a string at the desired focal points, then tracing with the string taut. Planetary orbits generally take the shape of, for the point, what conic section that looks like an elongated circle?

ANSWER: **ellipse**

(29) Ethanol is produced along with this gas in the fermentation of glucose. John Haldane described how blood that is low in oxygen has an increased capacity to carry this compound. The blood maintains its pH level with a buffer system that balances this gas, carbonic acid, and bicarbonate. Heavy exposure to this triatomic compound can cause drowsiness, though not as dangerously as a diatomic relative. For the point, name this gas that is exhaled by humans and whose chemical formula is CO_2.

ANSWER: **carbon dioxide** (or **CO_2** before it is read)

(30) This quantity is the second time derivative of position. This quantity is equal to the rate of change of velocity, and according to Newton's second law, mass times this quantity is equal to force. On Earth, the type of this quantity due to gravity is equal to 9.8 meters per second squared. A body moving at constant speed has a zero value for, For the point, what physical quantity that describes the slowing down or speeding up of an object?

ANSWER: linear **acceleration**

(31) This project spent two months carrying out the CANDELS project between 2010 and 2013. STS-61 updated this object by installing the COSTAR system to repair its spherical aberration. The *Columbia* disaster delayed another service mission to this instrument, which will be replaced by one named for James Webb in 2018. The Deep Field images were produced by, for the point, what telescope that was launched into low Earth orbit in 1990?

ANSWER: **Hubble** Space Telescope

(32) The basement membrane separates two layers of this organ, the most prominent part of the integumentary system. In mammals, the erector pili muscles are embedded in this organ and are used to regulate temperature. Keratinocytes make up most of the outer layer of this organ, which includes a layer of subcutaneous fat. For the point, name this largest organ of the human body which holds moisture in and includes the epidermis.

ANSWER: **skin**

(33) This technology, combined with a harsh winter, caused the "Great Die-Up." Joseph Glidden improved the production of this technology, which was removed in the Cutting Wars in Texas and New Mexico. This product was far easier to erect than hedges and far cheaper than lumber fencing. The West was legendarily "tamed" by, for the point, what invention that permitted ranchers to control wandering cattle, a wire with intermittent sharp points?

ANSWER: **barbed wire**

(34) A 96-sided polygon was used to prove that this value is greater than 223 over 71, as calculated by Archimedes. According to legend, the state of Indiana tried to legally round this number down to the nearest whole number. This constant is multiplied by four-thirds in the formula for volume of a sphere. For the point, name this mathematical constant defined as the ratio of any circle's circumference to its diameter, approximately equal to 3.14.

ANSWER: **pi**

(35) Silver iodide is used to promote this phenomenon by adding nucleation sites in a process called "seeding." This phenomenon is prevented on the leeward side of mountain ranges, since warm air rises and condenses as it crosses the ridge. That "shadow" effect takes places in the Sonora and Mojave [moh-HAH-vay] deserts, where this weather phenomenon rarely occurs because the air is not saturated with water vapor. For the point, name this part of the water cycle in which clouds release liquid or solid water.

ANSWER: **precipitation** (prompt on (cloud) seeding before it is read; anti-prompt on any specific types (like snow, rain, hail, etc.) by asking the player "can you be less specific?")

Extra Question

Only read if moderator botches a question.

(36) In humans, this condition is caused by a defective OCA-1 gene and the inability for the body to make tyrosine. Pictures of patients with this condition may show higher degrees of red eye. Plants that exhibit this condition may lack chlorophyll, while humans with this condition cannot express melanin content and are more sensitive to UV rays. For the point, name this condition that causes a lack of pigment in hair and skin.

ANSWER: **albinism** (accept **achromia**, **achromastia**, **acchromatosis**; accept word forms like **albino**)