

## RTO 2015 Round 9

1. **William Hamilton expanded these numbers to form a system called quaternions; other such extensions include Cayley numbers. Their algebraic closure is a consequence of the fundamental theorem of algebra. Uniquely determined by their absolute value and argument, they can be plotted on an Argand diagram. They can be represented in phasor form as powers of  $e$ , and (\*) De Moivre's formula makes them easier to multiply by using their polar form. These numbers were first used by the mathematician Bombelli in the 16th century to solve a cubic equation. Each of these numbers has a conjugate, found by reversing the sign of the imaginary part. FTP name these numbers, comprising a real and an imaginary part, which may be written in  $a+bi$  form.**

### Complex Numbers

2. **Modern machines that perform this process utilize the Peltier effect because they require an ability to transfer heat between two completely different types of materials. This process, in which magnesium ions are often used to decrease error, also requires (\*) DNA primers and a polymerase from the bacteria *Thermus aquaticus* instead of from the normal *E. coli* because it must be able to withstand this process's high temperatures. For ten points, name the process including denaturing, annealing, and elongation, developed by Kary Mullis, that is carried out in a thermal cycler and amplifies DNA *in vitro*.**

### Polymerase Chain Reaction (or PCR)

3. **This theory explains why muons do not decay before reaching the surface of the Earth. The Ehrenfest paradox arises when the motion of a rotating rigid disk is concerned. The theory was first proposed in 1905 in a paper titled (\*) "On the electrodynamics of moving bodies" and displays a correction to Newtonian Physics when speeds near a maximum. One paradox involving this theory is the ladder paradox, in which a ladder's ability to fit inside a space while undergoing Lorentz length contraction is determined by an observer's frame of reference. FTP, name this theory proposed by Albert Einstein that applies only to objects in inertial reference frames, unlike its "general" counterpart.**

### Special Relativity

4. **Multiple minor princes under this dynasty revolted during the Rebellion of the Seven States to prevent further centralization of power. This dynasty was briefly interrupted by the Xin Dynasty, led by Wang Mang. The (\*) Xiongnu and Xianbei repeatedly harassed this dynasty and forced it to pay tribute until Wu Di defeated them. Buddhism first reached China during this dynasty. This dynasty was followed by a period of disunion known as the Three Kingdoms Period. For ten points, name this dynasty which succeeded the Qin (Chin) and established Confucianism as the central state philosophy.**

### Han Dynasty

5. **In this painting, the color of the main subject was chosen to spite his rival, Joshua Reynolds. The subject is in 17th century apparel despite being painted in the second half of the 18th century. This portrait of (\*) Jonathan Buttolph contains a background of mostly green and gold. In his right hand, he is holding a feathered hat, and is standing contrapposto. FTP, name this portrait by Thomas Gainsborough of a young man in a titular cool color.**

### The Blue Boy

6. **This character is described as an excellent swordsman and boxer, but does not care to know anything about Thomas Carlyle. His creator was knighted for service in the Boer war, and this character returned from a (\*) Great Hiatus in “The Adventure of Wisteria Lodge.”** Clay and Archie's attempt to tunnel into a bank is foiled by this figure in a short story where a man is hired to copy the encyclopedia. FTP, name this detective and master of deduction, who was created by Arthur Conan Doyle and whose adventures are narrated by Dr. John Watson.

Sherlock Holmes

7. **In fluid mechanics, this quantity is given by multiplying pressure in pascals times volumetric flow rate in meters cubed per second. In a capacitor, the instantaneous form of this quantity can be found by multiplying capacitance times voltage and the time derivative of voltage. In optics, a quantity with this name is measured in diopters. The electrical form of this quantity can be found by multiplying the (\*) current of the circuit times its potential difference. The mechanical form of this quantity can be the cross product of torque and angular velocity of a shaft. This quantity is the time derivative of work. FTP, name this quantity that is measured in the SI units of watts.**

Power

8. **This time period, in which archaeocyathids built reefs, is famous for preserving *lagerstätten*-the soft body parts of organisms. It was preceded by the Ediacaran period, which had only simple biota; in it, genera such as *Wiwaxia*, *Hallucigenia*, *Opabinia*, and *Anomalocaris* were fossilized in the (\*) Burgess Shale, as were trilobites, which first appeared in this period. FTP, name this period that preceded the Ordovician, was the first in the Paleozoic, and is famous for a large influx of new species in its namesake explosion.**

Cambrian

9. **In one of this man's works, a chest of gold and pearl necklaces lies open on a table while a woman holds the title object. This artist depicted a woman leaning her elbow on a table in “A Girl Asleep,” and a man bends over to touch (\*) a globe in his “The Astronomer.”** After the restoration of one of his paintings in 1994, the subtle color scheme and the intimacy of the girl's gaze toward the viewer have been greatly enhanced. During the restoration, it was discovered that the dark background, today somewhat mottled, was initially intended by the painter to be a deep enamel-like green. FTP name this painter of “Woman with a Balance” who painted a girl with a blue and yellow turban in his “Girl With a Pearl Earring.”

Johannes Vermeer

10. **Examples of these statements include the following: that Suleiman created an army for his father while serving as governor of Crimea; that the War of the Austrian Succession was the last war to see a British king lead an army into battle; that An upside down female violinist is present in *I and the Village*; that Einhard is the biographer of Charlemagne; and that Lenin was transported from Zurich in a sealed train. If you could buy (\*) fractional ownership in a clue company, this is the type of clue you'd have. For ten points, name these clues that are reused so much that people just reflexively buzz on them.**

Stock clues

11. **This country is home to people such as Yma (EE-mah) Sumac, a soprano popular in the 1950s, and Saint Martin de Porres, a former slave born in the 16th century. The incumbent president of this country is Ollanta Humala. Many people in this country speak (\*) Quechua (KAYCH-wah) in addition to Spanish. A popular food from this country is ceviche, a dish made**

with raw fish in citrus juices with peppers. A famous leader of an empire in this area was Atahualpa, who was defeated by Francisco Pizarro in 1532. FTP, name this country that was once home to the Inca.

Republic of Peru

12. **Genera in this family include Anthonomus and Peristoreus. This family was thought to be the largest family in kingdom Animalia in 1998, but it has since been surpassed by both a family in its class, Ichneumonidae, as well as another family in its order, Staphylinidae. This family of insects is defined by small, L-shaped antennae ending with small clubs. *Sitophilus granarius*, the "wheat" types of these insects, are pests of grain kernels, while the "rice" type has a shorter (\*) snout and grows and pupates inside grains of rice. The most notorious of these insects, all in the family Curculionidae, is a species native to Central America that migrated to the United States in the 1920s and later destroyed the cotton industry in the South. For ten points, name the common name of these beetles that include the "giraffe" and "boll" types.**

Weevils or Curculionoidea

13. **Gregory Breit was initially supposed to research fast neutron calculations for this project until he quit because of security concerns. Great Britain first refused to collaborate with the USA, choosing to continue work on its own Tube Alloys project until the American (\*) Development of Substitute Materials project surpassed it in research. Spies such as Klaus Fuchs supplied the Soviet Union with important information regarding the progress of the project. FTP, name this top secret military project, led by Leslie Groves and J. Robert Oppenheimer, tasked with developing the first atomic bomb.**

The Manhattan Project (accept Manhattan Engineer District; accept Development of Substitute Materials until mentioned)

14. **This body of water is home to a species of fish called Golmyanka, which are fed on by namesake seals, also called Nerpa. The largest island in this body of water is Olkhon. Many rivers drain into this body of water including the Barguzin, Uda, and (\*) Selenga rivers. This body's only outflow is the Angara River. This body of water is located in the Republic of Buryatia in the Province of Irkutsk in a five mile deep continental rift. FTP name this Russian lake, the deepest in the world.**

Lake Baikal

15. **This phenomenon can form an Airy disc in a circular region. Equations named for Fraunhofer and Fresnel model the far- and near-field variants of this. The fields formed by this phenomenon in the presence of complementary screens are related by Babinet's principle. This phenomenon is what allows (\*) X-ray crystallography to produce pictures. Young's double-slit experiment employed this phenomenon, and shows the interaction of light waves. FTP, name this process of light in which light bends around objects and openings, not to be confused with refraction.**

Diffraction

16. **The first recorded use of these was 9th century China, where they were used in the "leaf game." Modern versions are based on ones found in Mamluk Egypt, though their court versions had only calligraphy or designs, not (\*) people. The first known European game using these was called Karnöffel, which may have used precursors to the trump ones of these objects used in Tarot. Spanish versions use cups, coins, clubs, and swords for suits, while Italian ones use**

hearts, diamonds, clubs, and spades. FTP, what objects are used in games such as solitaire, poker, and Go Fish?

Playing cards

17. **The actual name for this color came from a battle in the Second War for Italian Independence. This color is not on the visible light spectrum but is a mix of red and blue/violet light. It came from a patent for a new synthetic aniline dye called (\*) fuchsine in 1859 so it is sometimes called fuchsia. Sometimes referred to red-violet, FTP name this color that, in printing, is used with yellow and cyan to produce all colors.**

Magenta (Accept fuchsia before fuchsine is read)

18. **This man wrote under various pseudonyms including Hilarius Bookbinder, Johannes Climacus, and Johannes de silentio. This man described religion as a "leap of faith" and argued that "truth is subjectivity." At one point he broke off his engagement to (\*) Regine Olsen, something thought to have affected his later life, possibly including his most famous work. In this work, he discusses the anxiety felt by Abraham when told to sacrifice Isaac. FTP, name this author of *Either/Or*, *Repetition*, and *Of Fear and Trembling*, a Danish philosopher.**

Søren Aabye Kierkegaard

19. **This word is used as a category of members of the ring of numbers that can be expressed as integrals of algebraic differential forms. The draconic type of this word is the time that elapses between two passages of the object through its ascending node. Along with that use, this word is also used to refer to eras like the (\*) Baroque one, the Carboniferous one, or Picasso's Blue one. This word denotes the reciprocal of frequency, and there are six of these in a Raleigh Charter school day. For ten points, name this word that is also used to refer to a full stop at the end of a sentence.**

Period

20. **In the last movement of Brahms' first symphony, a forte passage for two of these instruments announces the initial modulation to C major. Duets for this instrument and piano include an Elegie by Francis Poulenc, and it's not the violin but Bach's first Brandenburg Concerto calls for two of these instruments, while the other five of those concerti call for none. Along with the clarinet, it represents the title character of (\*) Strauss's *Till Eulenspiegel's Merry Pranks*; Strauss also wrote two concertos for it. One valve on this instrument allows players to switch from the F division to the B-flat division. Mozart composed four concertos for an earlier version of this instrument, three of which represent the wolf in Peter and the Wolf. FTP, name this brass instrument which, despite its common name, isn't really from France.**

French horn

21. **In this book, a mother tells her daughter that when people grow up, fire does not hurt them. Another character explains why some children are named "Mother is supreme" while consoling a man who was lucky to have committed the feminine version of a crime. That crime occurs when he accidentally kills (\*) Ezedu's son. Enoch kills the sacred python and a church in the Evil Forest is burned down because he unmasked and thus killed an egwugwu. Nwoye [nwo-ya] joins the church and Ikemefuna is killed by the main character in, FTP, what novel about Okonkwo by Chinua Achebe.**

Things Fall Apart



## Bonuses – Round 9

1. These particles were first postulated by Pauli to explain how beta decay could conserve energy, angular momentum, and momentum. FTPE,

A. Name these subatomic particles that are released with electrons in beta decay.

### Neutrinos

- B. Neutrinos were thought to have been observed exceeding this limit in 2011, but it was actually the result of faulty machinery.

### Speed of light

- C. This form of electromagnetic radiation occurs when charged particles pass through a medium faster than the speed of light in that medium.

### Cherenkov radiation

2. FTPE name these creatures from Greek mythology.

A. This creature is portrayed as a lion with a tail that ends in a snake's head. The heads of a goat and a dragon also protrude from its back.

### Chimera

- B. Similar to the Egyptian Sphinx, this creature has the body of a lion and a human head. Other aspects of the creature vary from story to story. For example, it may be horned, winged, or both, and it has the tail of either a dragon or a scorpion. This tail may shoot venomous spikes to either paralyze or kill its victims.

### Manticore

- C. This creature was once human, though having an affair with Zeus caused Hera to turn her into a monster that hunts and devours children. She is often depicted as human, always having snakeskin draped over her body.

### Lamia

3. It can exist in various allotropes such as gray, yellow and black, although only the gray form has important use in industry, FTPE

A. Name this highly toxic element that can easily dissolve in groundwater, leading to major contamination problems in the Bengal Basin. Its binary compound with gallium is a notable semiconductor.

### Arsenic

- B. Arsenic is part of a "staircase" on the period table, so it is considered one of these six elements. Other examples of these types of elements include silicon and boron.

### Metalloids (prompt on semimetals)

- C. This process intentionally introduces impurities, such as arsenic, into an extremely pure semiconductor for the purpose of modulating its electrical properties.

**Doping** (other forms acceptable)

4. 2014 saw the most severe outbreak of Ebola in history. For ten points each, answer these questions relating to this virus.

- A. Ebola is in the family *Filoviridae*. Members of this family, including the genera *Ebolavirus* and *Marburgvirus*, cause this type of fever, characterized by excessive bleeding.

**Hemorrhagic** fever

- B. The Ebola virus is categorized into this type of RNA virus because RNA polymerase is needed to translate its RNA *twice* before its genes can be expressed.

**Negative-sense**

- C. This Ebola patient treated in the United States at Emory University Hospital was the first to recover in the United States. Later, he gave blood transfusions to cameraman Ashoka Mukpo and nurse Nina Pham.

Dr. Kent **Brantly**

5. Anyone who loves American cinema should be able to quote from *The Godfather*. Here is an offer you can't refuse. See if you can fill in the blanks in these famous lines from *The Godfather*.

- A. Clemenza tells Rocca, "Leave the BLANK. Take the cannoli."

**gun**

- B. Clemenza tells Sonny Corleone, "It's a Sicilian message. It means Luca Brasi sleeps with the BLANKs."

**fishes**

- C. Don Corleone tells Johnny Fontane, "a man who doesn't spend time with his BLANK can never be a real man."

**family**

6. FTPE, give the cause of death of the given American literary characters

- A. John Proctor

**Hanged**

- B. Captain Ahab

**Drowning** (accept killed by Moby Dick)

- C. Bonnie, Scarlett O'Hara's daughter

**Falling off a horse** (accept equivalents)

7. Answer these questions about named gas laws as if you were Tom Brady's equipment manager, for ten points each.

A. What named gas law would explain why filling the footballs in Miami would result in an overfull ball in Denver at constant temperature?

**Boyle's Law**

- B. What named gas law would explain why filling the balls in Tampa and then taking them to Green Bay would produce the soft ball that Tom likes, at constant pressure?

**Amonton's Law** (Accept **Gay-Lussac's law**)

- C. Many big-time science nerds including Neil Tyson and Bill Nye made a rookie mistake in trying to explain cheating in Deflategate by ignoring ambient pressure. What term is used to indicate the pressure above ambient?

**Gauge Pressure**

8. FTPE answer these questions about trade throughout the ages.

A. Name this series of trade and cultural transmission routes that were central to cultural interaction through regions of the Asian continent connecting the West and East by linking traders, merchants, pilgrims, monks, soldiers, nomads, and urban dwellers from China and India to the Mediterranean Sea during the time of the Han Dynasty to the 1450s.

**Silk Road**

- B. Name this triangular trade route that operated from the late 16th to early 19th centuries, carrying slaves, cash crops, and manufactured goods between West Africa, Caribbean or American colonies and the European colonial powers

**Transatlantic Trade**

- C. Name this road that was a network of caravan paths winding through the mountains of Sichuan, Yunnan and Guizhou in Southwest China. It is also sometimes referred to as the Southern Silk Road.

**Ancient Tea Horse Road** or **Tea Horse Road**

9. For ten points each, name these cars featured in James Bond movies.

A. In *The Spy Who Loved Me*, Bond drove this classic British sports car, modified to travel underwater.

Lotus **Esprit** (pronounce Ess-Spree) S1

- B. Perhaps Bond's most famous car, this was the silver-birch car that Bond drove in *Goldfinger*, and it made a reappearance in *Thunderball*, *GoldenEye*, *Tomorrow Never Dies*, and *Casino Royale*. In *Goldfinger*, this is the car that Bond drives right before he is captured and almost cut in half with a laser.

**Aston Martin DB5** (accept either)



- C. Another Aston Martin, this car was created solely for the upcoming Bond movie *Spectre*. Only 10 will be built.

Aston Martin **DB10**

10. FTPE, name these unifiers of Japan

- A. If he wished for a bird to sing, this man was said to simply wait for it to sing. He defeated Hideyori to establish a namesake shogunate, betraying Hideyori's father who had once been his commander.

**Tokugawa** Ieyasu

- B. If he wished for a bird to sing, this man was said to forcefully make the bird to sing if it did not immediately do so. This man invaded Korea in an attempt to conquer Ming China and also crucified 26 Christians.

**Hideyoshi**

- C. If you were a bird, you'd better sing or this guy would kill you. This samurai daimyo revolutionized Japanese warfare, expanding the use of firearms. He was eventually betrayed and had to commit suicide.

**Oda** Nobunaga

11. FTPE name these deadly paintings.

- A. The title figure in this painting holds a note in his left hand and a quill in his right after being murdered in his bathtub by Charlotte Corday. This work is by Jacques-Louis David (da-VEED).

**Death of Marat**

- B. In this other work of David, shackles appear under the bed that the titular event takes place on, and a guard holds a cup with his right hand while an orange-clad Crito grabs the title person's thigh. That person, a bearded man pointing his index finger up in the air, is about to drink hemlock.

**Death of Socrates**

- C. This painting depicts a besieged king watching impassively as guards carry out his orders to kill his servants, concubines and animals. Name this work by Eugene Delacroix, whose titular figure is supposed to be an Assyrian King.

**Death of Sardanapalus**

12. FTPE, name these empires that ruled Persia.

- A. This empire's capital was at Hamadan or Ecbatana. Herodotus frequently uses its demonym to refer to the Persians.

**Median** Empire (accept **Medes**)

- B. This empire reached its zenith under Mithradates after forcing out the Seleucid Empire. A term referring to a backwards shot comes from the name of this empire.

**Parthian** Empire (accept **Parthia**)

- C. This Empire fought a series of destructive wars with the Byzantines under the leadership of Khosrau II. It was eventually overrun by the Rashidun Caliphate.

**Sassanian** Empire (accept **Sassanids**)

13. For ten points each, name these Holy Roman Emperors.

- A. This ruler presided over the Diet of Worms, and his reign saw the successful Italian Wars waged against France. His rule was the zenith of Habsburg power, encompassing the Spanish Empire, Germany, and large parts of Italy.

**Charles V**

- B. This emperor was the third of the Salian dynasty and died shortly after defeating his son in battle. He is most famous for groveling in the snow during the Investiture Controversy.

**Henry IV**

- C. This Holy Roman Emperor, son of Maria Teresa, was an Enlightened Despot who tried to free serfs and introduce more religious freedom. Sadly, his reforms were overturned when his brother Leopold II succeed him

**Joseph II**

14. FTPE name these rides found in Disney World, Florida.

- A. Name this ride in which passengers streak through a haunted gold-mining town aboard a rollicking runaway mine train.

**Big Thunder Mountain Railroad** (or obvious equivalents)

- B. Name this ride in which passengers go on a rollicking log ride featuring characters and songs from the classic Disney film Song of the South. Each installation begins with a peaceful outdoor float-through that leads to indoor dark ride segments, with a climactic steep drop into a "briar patch" followed by an indoor finale. The drop is 53 feet.

**Splash Mountain**

- C. This is a simulator attraction at Disney California Adventure and Walt Disney World's Epcot park. The ride employs a mechanical lift system, a film presentation on a large concave projection screen, and at certain points artificial scents to simulate flight via a hang glider ride over several California landmarks.

**Soarin'**

15. FTPE, name these SI units.

- A. This unit of power is named for a scientist who greatly improved the steam engine during the Industrial Revolution.

**Watt**

- B. This unit for electrical conductance is named for a German scientist that lends his name to the largest engineering company in Europe as well as a famous science competition.

**Siemens**

- C. This SI base unit is the unit for luminous intensity. A similar sounding light source emits about one of these.

**Candela**

16. For ten points, answer these questions about ancient titles that changed their meanings to carry a negative connotation.

- A. To deal with emergencies, the Roman senate would sometimes appoint someone to this office. Holders included Cincinnatus, who left it voluntarily, and Julius Caesar, who left it rather involuntarily.

**dictator**

- B. Any ancient Greek absolute ruler, such as Peisistratus in Athens or Dionysios in Syracuse, was described by this term; it gained its negative connotation from Plato and Aristotle.

**tyrant**

- C. Though it now has a meaning akin to that of "tyrant," this word originally designated the heir to the Byzantine throne.

**despot**

17. FTPE, answer these questions about a type of substance.

- A. This type of substance changes shape whenever a shear force is applied. They include liquids and gases.

**Fluid**

- B. These equations named after the people who discovered them describe fluid motion. They are derived by applying Newton's second law to fluids.

**Navier-Stokes** equations

- C. In this experiment that shows the occasional difficulty of classifying a substance as a fluid, the namesake substance was put in a funnel and held over a beaker. The substance has released a drop nine times since 1927.

**pitch** drop experiment

18. FTPE, name these Westernized Chinese foods.

- A. This American dish consists of deep-fried chicken thigh dressed with a sweet vinegar sauce and topped with the namesake seed.

**Sesame Chicken** (do not accept General Tso's Chicken, because sesame chicken is a lot sweeter)

- B. This stir-fry dish consists of the namesake meat and flower vegetable, fried and dressed in oyster sauce.

**Beef Broccoli** (accept equivalents)

- C. This dish made of thick wheat-flour noodles is fried, stirred with soy sauce, and added to bok choy in cabbage. Its noodles are soft.

**Lo mein**

19. For ten points each, name these heroes of the Trojan War.

- A. This prince of Troy was doomed to die in battle, but fought regardless. He is the older brother of Paris.

**Hector**

- B. This king of Ithaca is most well known for his idea of the Trojan horse. He took 10 years to get back home from the Trojan war and is considered the cleverest Greek.

**Odysseus**

- C. This king of Argos nearly killed Aeneas, but stabbed Aphrodite when she saved him. He also stabbed Ares later in the battle.

**Diomedes**

20. You gotta know your Latin! FTPE, translate these common Latin phrases or words.

- A. *Carpe Diem*

**seize the day** (accept obvious equivalents)

- B. *Veritas vos liberabit*. This also happens to be the motto of Johns Hopkins University, and appears in the Bible at John chapter eight verse 32.

**The truth will set you free**

- C. *A mari usque ad mare*. This is the national motto of Canada.

**From sea to sea** (accept equivalents)

21. For ten points each, name these famous sieges.

- A. A British army surrendered at this siege after the Battle of the Chesapeake Capes. They were forced to present their surrender to Benjamin Lincoln.

**Yorktown**

- B. The major engagement of the Crimean War, this siege involved the Charge of the Light Brigade at the Battle of Balaklava.

**Sevastopol**

- C. Alexander the Great ended this siege by piling rubble into the ocean to make a causeway. The besieged city, formerly on an island, is to this day a peninsula.

**Tyre**