



1. One version of this statement was issued while standing on one foot by Hillel in lieu of reciting the entire Torah. A lawyer asks a clarifying question about this teaching in the Gospel of Luke, as worded before the phrase "I am the LORD" in Leviticus 18:19, before the parable of the Good Samaritan. In the synoptic Gospels, Jesus calls this precept the second (*) "great commandment" of the law, after loving God. For 10 points, name this Biblical ethical principle of acting the same way they wish others might act.

ANSWER: Golden Rule [or Love your neighbor as yourself; or That which is hateful to you, do not do to another; or ethic of reciprocity; accept "thee," "thy," etc. for "you," "your," etc.]

104-13-75-02101

2. Django Reinhardt's "Mystery Pacific" imitated one of these things and was influenced by Duke Ellington's piece about a "Daybreak" one of these objects. A Harry Warren-Mack Gordon tune about one of these states that, "Read a magazine and then you're in Baltimore." A Jimmy Forrest standard about a "Night" variety of one of these things was covered by James Brown and includes Brown announcing the names of east coast cities. Another Ellington tune discusses (*) taking the "A" one of these in "Sugar Hill way up in Harlem." For 10 points, name this mode of transportation depicted in "Chattanooga Choo-choo."

ANSWER: trains

030-13-75-02102

3. This leader approved Georges Couthon's Law of 22 Prairial. This man worked in conjunction with Saint-Just. A state religion centered on this leader was called the Cult of the Supreme Being. This leader was overthrown and killed during the (*) Thermidorian Reaction, which occurred after he had caused the downfall of Danton, sending Danton to the guillotine. For 10 points, name this leader of the Committee of Public Safety who was the leading force behind many deaths during the Reign of Terror.

ANSWER: Maximilien Francois Marie Isidore de Robespierre

192-13-75-02103

4. As this phenomenon expands, typically the Beveridge curve slopes downward. The Shapiro-Stiglitz model claims this phenomenon will always exist. A similar idea addresses its rate under non-accelerating inflation. According to the Phillips curve, the lower this phenomenon is, the higher the rate of (*) inflation will be. A temporary transition period involving it is called the "frictional" type, while agricultural laborers find themselves vulnerable to the "seasonal" type. For 10 points, identify this economic phenomenon in which people cannot find a job.

ANSWER: unemployment

052-13-75-02104

5. This person names a spiral represented by the polar equation r equals a plus b theta, where a and b are real. This person invented a screw for transferring water from a low-lying body of water into irrigation ditches. After discovering that the volume of water (*) displaced by an object must be equal to the object's volume, he ran through the streets naked shouting "Eureka!" For 10 points, identify this ancient Greek inventor who boasted he could move the world if given a lever and a place to stand.

ANSWER: Archimedes of Syracuse

066-13-75-02105

6. The main character of this novel wants to get to a vaparetto, but is taken elsewhere by a red-eyebrowed man who disappears to avoid the police. One boy in this novel plays with the black-haired Jashu and becomes an object of affection for the main character. Its protagonist falls ill after eating over-ripe strawberries. This novel follows a German man who goes on a (*) vacation to a city during a cholera epidemic and falls in love with the boy Tazio. For 10 points, name this work about the author Gustav von Aschenbach by Thomas Mann.

ANSWER: Death in Venice [or *Der Tod in Venedig*]

023-13-75-02106

7. The bag model explains why these non-bosonic particles cannot be independently observed, which is their property of confinement. These particles were introduced by George Zweig and Murray Gell-Mann. The theory of color charge was first introduced in these particles, which are modeled in QCD. They carry charge in multiples of (*) one-third. A meson consists of one of these particles and its antiparticle. For 10 points, name these subatomic particles, which come in flavors such as up, down, charm, and strange.

ANSWER: quarks

104-13-75-02107

8. The protagonist of this novel says that only one occupation lives their life all the way up and ends the novel by asking a woman, "isn't it pretty to think so?" Another character, Romero, gives the ear of an animal he slays to a woman. The main character of this novel loves Lady (*) Brett Ashley and goes to Pamplona to see the bullfights. That protagonist is named Jake Barnes and suffers from a war wound that impairs his sexual relationships. For 10 points, name this Ernest Hemingway novel about Lost Generation expatriates.

ANSWER: *The Sun Also Rises*

052-13-75-02108

9. One speech by this man mentioned the "brutal solidarity" with which we watch people "burning the huts of a poor village." That speech by this man referred to the United States as "the greatest purveyor of violence in the world today." He gave a speech in the Mason Temple in Memphis titled "I've Been to the Mountaintop." Another speech by this man mentioned the "red hills of Georgia" and differentiates between (*) skin color and character. For 10 points, identify this orator and Civil Rights leader who gave the "I Have a Dream" speech.

ANSWER: Martin Luther King, Jr. [or MLKJ; or Michael King, Jr.]

189-13-75-02109

10. The background of this painting includes a feather duster and a detailed mirror suggesting the presence of the artist and a fourth person. A single lit candle within a chandelier, a dog, and a pair of discarded shoes also serve as significant symbols within this painting, whose central female wears a flowing green dress and holds (*) hands with the central male figure of this painting, which depicts their matrimony. For 10 points, identify this painting by Jan van Eyck depicting the marriage of the title merchant.

ANSWER: *The Arnolfini Wedding* [or *The Arnolfini Portrait*; or *The Arnolfini Marriage* accept other equivalents mentioning Arnolfini and a wedding and/or a double portrait]

189-13-75-02110

11. This deity is not to be confused with a similarly-named giant who offers a challenge to drink the sea out of a horn. After Idunn's abduction, this god sought to recover her from the eagle Thiazi. Currently bound by his son's intestines underneath a venom-dripping snake until Ragnarok, this consort of Angrboda persuaded Hodr to fire a (*) mistletoe-tipped arrow to cause Baldur's death. For 10 points, name this father of Fenrir and Hel, a former ally of Thor and Norse trickster god.

ANSWER: Loki [or Loge]

104-13-75-02111

12. This composer's violin concertos, which were arranged into harpsichord works by J.S. Bach, solidified the *ritornello* as the dominant form of the concerto, and also popularized the fast-slow-fast three movement structure of the genre. In addition to the concerti in *L'estro Armonico*, this composer, who worked for most of this life at a foundling home, also depicted a (*) barking dog and sleeping drunkards in a programmatic piece that includes "L'estate" and "La primavera." For 10 points, name this "Red Priest" who composed *The Four Seasons*.

ANSWER: Antonio Lucio Vivaldi

019-13-75-02112

13. In a speech, this man used the phrases "sixty-six days and counting" and "this used to be something that was not political" while criticizing a political group. He fired Bret Schundler after losing out on Race to the Top grants. He cut approximately one billion dollars from his state's 2012 budget using a line item veto, and defeated (*) Jon Corzine in one election. He lambasted John Boehner and Congress for their handling of Hurricane Sandy funds, which directly affected his state. For 10 points, identify this governor of New Jersey.

ANSWER: Christopher James "Chris" Christie

189-13-75-02113

14. The code word "kolibri" was used as a signal in this event, and Willi Schmid was an accidental casualty in this event. Kurt von Schleicher and Gustav von Kahr were targeted in this event. It sought to do away with supporters of (*) Franz von Papen, who was a major critic of a particular political party. Ernst Rohm was shot in this event, and it targeted members of the SA. For 10 points, identify this June 1934 purge led by Adolf Hitler, in which Hitler targeted potential rivals and opponents in the Nazi party.

ANSWER: Night of the Long Knives [or Nacht der langen Messer; or Operation Hummingbird; accept Rohm-Putsch before Rohm is mentioned]

189-13-75-02114

15. The r-process can occur in one type of these events. Because of the uniform mass at which type Ia of these events occurs, it can be used as a standard candle. Elements heavier than iron-56 are formed during these events. They can occur via (*) core collapse. One of these events observed by the Chinese in 1054 led to the formation of the Crab Nebula. Their remnants include neutron stars and black holes. For 10 points, identify these events in which a star explodes.

ANSWER: supernovas

066-13-75-02115

16. **This lake was once the site of Fort Confidence, used in the 1840s by explorers searching for the missing Sir John Franklin. It has a mining area near Port Radium, which was part of the Eldorado Mine settlement. The mine on this lake prompted a lawsuit from (*) First Nations workers citing discrimination. Its only community is the sparsely populated Deline, which is about 300 miles northwest of Yellowknife. It is the largest lake in its country, edging out the Great Slave Lake. For 10 points, name this largest lake entirely within Canada.**

ANSWER: Great Bear Lake

052-13-75-02116

17. **One of this author's characters works at the Braganze Pickle Factory and is named Mary Pereira. He wrote about a man condemned to wander the Earth in *Grimus*, and he depicted the title assassin, who kills Max Ophuls for carrying on an affair with Boonyi, in (*) *Shalimar the Clown*. Another of his novels follows Saleem Sinai and a group of children who were all born on the night of India's independence. For 10 points, name this Indian author of *Midnight's Children* and *The Satanic Verses*.**

ANSWER: Salman Rushdie [or Ahmed Salman Rushdie]

192-13-75-02117

18. **The Davson-Danielli proposal for this structure was replaced by one by Singer and Nicolson. Integrins and transporters cross this structure, which fuses to vesicles with the aid of SNARE proteins. One model for this structure is the (*) fluid mosaic model. It is imbued with molecules of cholesterol, and it consists of a phospholipid bilayer. For 10 points, name this structure that encloses the organelles of the cell.**

ANSWER: cell membrane [or plasma membrane]

192-13-75-02118

19. **This man wrote a poem that describes "a gown made of the finest wool which from our pretty lambs we pull" and begins with the line, "Come live with me, and be my love." In addition to writing "The Passionate Shepherd to His Love," this man wrote a play in which the slave Ithamore serves the murderous title character, (*) Barabas. He also wrote a play about a scholar who sells his soul to Mephistopheles. For 10 points, name this contemporary of Shakespeare who was stabbed to death after writing *The Jew of Malta* and *Doctor Faustus*.**

ANSWER: Christopher Marlowe

120-13-75-02119

20. **This ruler dispatched an envoy named Peter the Patrician to sign a peace treaty. During his reign, one general won the Battle of Taginae against King Totila. This monarch was challenged by Hypatius, yet was encouraged by a speech delivered by his wife, an actress named Theodora. During his reign, Tribonian compiled the *Corpus Juris Civilis* and his soldiers put down the (*) Nika riots that began during chariot races. For 10 points, name this Byzantine emperor whose reign was marked by the building of the church at Hagia Sophia.**

ANSWER: Justinian I [or Justinian the Great; or Flavius Justinianus; or Petrus Sabbatius; prompt on Justinian]

052-13-75-02120

21. **This neurotransmitter partially acts via the tuberoinfundibular pathway in the arcuate nucleus, and acts on the ventral tegmentum via the mesolimbic and mesocortical pathways. It is broken down by monoamine oxidase and is the immediate precursor to (*) norepinephrine.** One hypothesis states that its antagonists may be used to treat schizophrenia, while its deficiency may lead to Parkinson's disease. For 10 points, identify this neurotransmitter associated with pleasure, and whose precursor is L-dopa.

ANSWER: dopamine

189-13-75-02121

22. **In one story by this man, a boy with a wooden sword tries to yell to his parents within a burning house, but he cannot since he is a deaf-mute. He also wrote about a man who sees a bright flash of white light while imagining meeting his wife at their doorstep. This author of (*) "Chickamauga"** started another story at a hanging, which actually occurs despite the imagined escape of Peyton Farquhar from the Civil War. For 10 points, name this author of *The Devil's Dictionary* and "An Occurrence at Owl Creek Bridge."

ANSWER: Ambrose Bierce [or Ambrose Gwinett Bierce]

104-13-75-02122

23. **This man talked about seeing a teenager in Ohio holding up a sign reading "Bring Us Together." In his book *Six Crises*, he discussed being attacked in Venezuela and engaging in the Kitchen Debate. After losing a bid for governor of California, this man angrily said "this is my last press conference" while telling the press they wouldn't have him "to kick around anymore." Mark Felt helped (*) Carl Bernstein and Bob Woodward under the name "Deep Throat" to investigate one action by this man.** For 10 points, name this President disgraced in the Watergate scandal.

ANSWER: Richard Milhous Nixon

052-13-75-02123



1. Answer some questions about convergence and divergence in calculus, for 10 points each:

[10] In the nth-root test for an infinite series, one takes the nth-root of the series and performs this operation on it as n goes to infinity. This operation is used to find the value that a function approaches.

ANSWER: limit

[10] The ratio test for convergence also involves taking limits, but if the limit equals this value, then the test is indeterminate. In trigonometry, this quantity is equal to the sum of cosine squared of theta plus sine squared of theta.

ANSWER: one [or 1]

[10] If a series satisfies the conditions for the alternating series test, but its absolute value is found to be divergent, then this term is used to describe the convergence of the series, as opposed to being "absolutely convergent."

ANSWER: conditionally convergent

189-13-75-02201

2. This creature was trapped within a Labyrinth constructed by Daedalus. For 10 points each:

[10] Name this half-bull, half-man, who was born out of a tryst Pasiphae had with a cow. Seven boys and seven girls from Athens were sacrificed to him yearly.

ANSWER: the Minotaur

[10] This woman helped Theseus kill the Minotaur by giving him a ball of thread to take with him into the Labyrinth. He subsequently abandoned her on Naxos.

ANSWER: Ariadne

[10] After dumping Ariadne, Theseus married her sister, this woman. After developing a crush on Theseus' son Hippolytus, she accused Hippolytus of raping her and hanged herself.

ANSWER: Phaedra

192-13-75-02202

3. This battle, which took place near Mount Hibraltar, was contemporaneous with the siege of Sevastopol. For 10 points each:

[10] Name this October 1854 battle in which one side formed the Thin Red Line. This battle, which took place during a war named for a particular European peninsula, featured the Charge of the Light Brigade.

ANSWER: Battle of Balaclava

[10] The Battle of Balaclava took place during this war, in which France, Great Britain, and the Ottoman Empire fought with Russia over the namesake Ukrainian peninsula.

ANSWER: Crimean War

[10] This woman's nursing exploits during the Crimean War earned her the nickname "Lady with the Lamp." She ran a hospital at Scutari.

ANSWER: Florence Nightingale

189-13-75-02203

4. One novel in this series describes the failed relationship between Eugenie Grandet and her cousin Charles. For 10 points each:

[10] Name this set of one hundred stories about life in 19th-century France, which includes the novels *Cousin Bette* and *Pere Goriot*.

ANSWER: *The Human Comedy* [or *La Comedie Humaine*]

[10] *The Human Comedy* is a set of works by this French author.

ANSWER: Honore de **Balzac**

[10] Balzac's *Pere Goriot* was influenced by this Shakespeare play about the father of Regan, Goneril, and Cordelia.

ANSWER: **King Lear**

140-13-75-02204

5. This man's brain was the subject of a book by Orin Starn. For 10 points each:

[10] Name this man, the last member of the Yahi tribe. He emerged from the wild near Lassen Peak and was given his basic name by anthropologist Alfred Kroeber.

ANSWER: **Ishi**

[10] Ishi was discovered in this modern day state. He was studied by many anthropologists at a university at Berkeley.

ANSWER: **California**

[10] An earlier American anthropologist before Kroeber was Lewis Morgan, whose *Systems of Consanguinity* introduced terms for relationships within this system, widely studied in anthropology. A "diagram" of it starts with "ego" and uses circles or triangles depending on gender.

ANSWER: **kinship**

052-13-75-02205

6. This composer wrote the jaunty "Tritsch-Tratsch-Polka." For 10 points each:

[10] Name this Austrian composer who also produced *Tales from the Vienna Woods*. In one of his operettas, Dr. Falke is abandoned by his friend while dressed as a bat.

ANSWER: **Johann Strauss the Younger** [or anything to indicate that this is **Strauss II** or **Strauss Jr.**; prompt on **Strauss** or **Johann Strauss**]

[10] Johann Strauss the Younger was known as the king of this type of composition, a ballroom dance in 3/4 time. *The Blue Danube* is an example.

ANSWER: **waltz**

[10] Johann Strauss the Elder may be best known for composing this march, which is named after an Austrian Field Marshal. It traditionally involves clapping and stamping of feet during the rousing chorus.

ANSWER: **Radetzky** March

052-13-75-02206

7. For 10 points each, answer the following about fictional American detectives.

[10] Sam Spade solves a case about a priceless figurine of a bird in this Dashiell Hammett novel first published in 1930.

ANSWER: *The Maltese Falcon*

[10] Raymond Chandler wrote several novels, including *The Big Sleep*, about this hard-boiled private eye character.

ANSWER: Philip **Marlowe** [or **Philip** Marlowe]

[10] This cynical, heavyset character investigates crimes in various Dashiell Hammett works like *Red Harvest*. He is unnamed and works for a detective agency.

ANSWER: The Continental **Op**

052-13-75-02207

8. This artist was wounded in an attempted assassination by feminist Valerie Solanas. For 10 points each:
[10] Name this artist whose Pop Art works include depictions of Campbell's Soup cans and Marilyn Monroe.

ANSWER: Andy **Warhol** [or Andrew **Warhola** Jr.]

[10] Warhol operated this studio in New York City, a hangout for artsy types and the place where he shot many of his films.

ANSWER: The Silver **Factory**

[10] Warhol was a mentor to this graffiti artist, who died of a heroin overdose in 1988. His works include *Untitled (History of the Black People)* and *Irony of Negro Policemen*.

ANSWER: Jean-Michel **Basquiat**

052-13-75-02208

9. The Shenhai Pass is near the eastern terminus of this structure. For 10 points each:

[10] Name this barrier that crosses much of northern China.

ANSWER: **Great Wall** of China [or Wanli **Changcheng**]

[10] Much of what remains of the Great Wall was built during this dynasty, which moved the capital to Beijing under the Yongle emperor.

ANSWER: **Ming** Dynasty

[10] The Yongle emperor moved the capital after having this palace complex built in Beijing.

ANSWER: **Forbidden City** [or **Zijincheng**]

023-13-75-02209

10. When this data structure is one-dimensional, it is sometimes called a vector. For 10 points each:

[10] Identify this data structure in which data is arranged in rows and columns.

ANSWER: **array** [or **table**]

[10] Arrays are indexed according to the arithmetic named for these structures, which can be "dangling."

ANSWER: **pointer**

[10] Arrays of this data type constitute strings.

ANSWER: **char**acters

066-13-75-02210

11. In one of his works, this man analyzed the phrase "thou shalt" in regard to love. For 10 points each:

[10] Name this Danish philosopher who wrote of the Knight of Infinite Resignation and the Knight of Faith as part of a discussion of Abraham's sacrifice of Isaac in his *Fear and Trembling*. He also wrote *Either/Or*.

ANSWER: Soren Aabye **Kierkegaard**

[10] Kierkegaard was a Christian adherent of this school of philosophy, which is notoriously difficult to clearly define. It generally seeks to analyze the nature of being, and was practiced by Jean-Paul Sartre and Martin Heidegger.

ANSWER: **Existentialism** [or **Existentialist** philosophy or other word forms]

[10] Kierkegaard's *Either/Or* includes a section about Johannes, who is described as this kind of person. The section itself is titled "The Diary of" this kind of person, and it chronicles Johannes's wooing and subsequent abandonment of Cordelia.

ANSWER: a **seducer** [accept word forms, or general answers mentioning **seduction**, like "**one who seduces**"; or "The **Seducer's** Diary," or "The Diary of a **Seducer**"]

189-13-75-02211

12. This ruler was defeated by Theodoric I and Flavius Aetius at the Battle of Chalons. For 10 points each:
[10] Name this "Scourge of God" and ruler of the Huns who co-ruled with his brother Bleda until Bleda's death in 445 CE.

ANSWER: **Attila** the Hun

[10] Attila received a letter from this sister of Valentinian III asking to save her from an arranged marriage. That letter from this woman led Attila to demand half the Western Roman Empire as a dowry.

ANSWER: Justa Grata **Honorio**

[10] This Pope convinced Attila to end his 452 CE incursion into Italy.

ANSWER: **Leo I** [or **Leo the Great**; prompt on **Leo**]

186-13-75-02212

13. A key scene in this play occurs when the title character fails to shoot Professor Serebryakov. For 10 points each:

[10] Name this play whose embittered title character spends years managing a rural estate for the professor, his brother-in-law.

ANSWER: **Uncle Vanya** [or **Dyadya Vanya**]

[10] *Uncle Vanya* is a work by this Russian playwright, who also wrote *The Seagull* and *The Cherry Orchard*.

ANSWER: Anton **Chekhov** [or Anton Pavlovich **Chekhov**]

[10] A literary principle inspired by Chekhov is named for one of these objects. The principle, about foreshadowing, is that if you see such an object on stage, it should be used at some point.

ANSWER: **gun** [or obvious equivalents; prompt on **weapon**]

052-13-75-02213

14. This band denounced the overthrow of Salvador Allende, the Bay of Pigs invasion, and the Somoza regime in their song "Washington Bullets." For 10 points each:

[10] Name this British punk band of the 70's and 80's whose most popular songs include "Rock the Casbah" and "Should I Stay or Should I Go."

ANSWER: The **Clash**

[10] This platinum album by The Clash includes the songs "The Guns of Brixton" and "Train in Vain." Its title song states that an English city "is drowning, and I live by the river."

ANSWER: **London Calling**

[10] The Clash influenced a number of other punk rock bands, such as this one behind "American Idiot" and "Boulevard of Broken Dreams."

ANSWER: **Green Day**

080-13-75-02214

15. This architect's work designing art galleries includes the Cy Twombly gallery in Houston and a collaboration with Richard Rogers, the Centre Georges Pompidou in Paris. For 10 points each:

[10] Name this living Italian-born architect who won the 1998 Pritzker Prize.

ANSWER: Renzo **Piano**

[10] Piano designed one of these facilities on a steadily-sinking artificial island in Osaka Bay.

ANSWER: **airports**

[10] Piano's recent projects include The Shard, a glass-coated skyscraper found in this city, home to an iconic tower bridge on the Thames (TEMZ).

ANSWER: **London**

104-13-75-02215

16. This character worships a mountain god named Benamuckee. For 10 points each:

[10] Name this character eventually taught English, who abandons cannibalism and becomes a faithful companion of a certain novel's protagonist.

ANSWER: Man **Friday**

[10] Friday serves what shipwrecked sailor in a work by Daniel Defoe?

ANSWER: Robinson **Crusoe** [or **Robinson** Crusoe; or **Kreutznaer**]

[10] This Defoe work is a fictionalized account of one man's experiences in London in 1665. It was presumably based on the writings of Defoe's uncle and is similar to the diary of Samuel Pepys.

ANSWER: A **Journal of the Plague Year**

052-13-75-02216

17. The far-field and near-field forms of this phenomenon are named for Fraunhofer and Fresnel. For 10 points each:

[10] Identify this phenomenon in which light bends around an obstacle.

ANSWER: **diffraction**

[10] Diffraction is used to partially explain the interference patterns observed in this English scientist's namesake double-slit experiment. He is also the namesake of a modulus equal to stress over strain.

ANSWER: Thomas **Young**

[10] Diffraction is used in a particular type of laboratory technique which studies these materials. Bragg diffraction occurs when diffraction occurs in these materials.

ANSWER: **crystals** [or **crystal lattices**]

189-13-75-02217

18. This document was signed in 1620 on the banks of Cape Cod. For 10 points each:

[10] Name this text, signed by the Pilgrims, that established their allegiance to King James of England while outlining the form of government they would dedicate themselves to in the New World. It is named after their ship.

ANSWER: **Mayflower Compact**

[10] The Mayflower Compact was the governing document for this colony founded in present-day Massachusetts by the Pilgrims.

ANSWER: **Plymouth** Colony

[10] This man recorded the Mayflower Compact in *Of Plymouth Plantation*, and later served as the colony's governor for thirty years.

ANSWER: William **Bradford**

192-13-75-02218

19. This disease's more formal name is "Bovine spongiform encephalopathy." For 10 points each:

[10] Give the common name of this neurodegenerative disease which has resulted in the United Kingdom slaughtering 4.4 million cattle in order to prevent its spreading.

ANSWER: **mad cow** disease

[10] These infectious agents composed of misfolded proteins are responsible for brain diseases like mad cow disease.

ANSWER: **prion**

[10] This doubly-eponymous brain disease, which is invariably fatal, is sometimes called the human form of mad cow disease. It results in the brain tissue developing holes due to prions.

ANSWER: **Creutzfeldt-Jakob** disease [or **CJD**]

052-13-75-02219

20. A common way of ascending this mountain is by using the Polish Glacier route. For 10 points each:

[10] Name this mountain, which can be found in Mendoza, Argentina.

ANSWER: **Aconcagua**

[10] Aconcagua is part of this mountain range which runs through seven South American countries on their western coasts.

ANSWER: **Andes**

[10] This highest mountain in Ecuador has a summit that is the farthest point on the Earth's surface from the Earth's center, thanks to its location on the equatorial bulge.

ANSWER: **Chimborazo**

052-13-75-02220

21. This quantity is approximated using the Bogoliubov inequality. For 10 points each:

[10] Name this thermodynamic quantity equal to the internal energy minus the product of temperature and entropy.

ANSWER: **Helmholtz free energy** [prompt on **free energy**]

[10] Helmholtz free energy is used less frequently than the free energy named for this man, which is equal to enthalpy minus the product of temperature and entropy.

ANSWER: Josiah **Gibbs**

[10] When the change in Gibbs free energy of a reaction is negative, the reaction has this property, meaning it will proceed without any external energy input.

ANSWER: **spontaneity** [or obvious equivalents]

014-13-75-02221