



The Illinois Mathematics and Science Academy of Aurora, IL,



in partnership with Loyola Academy of Wilmette, IL, present

IMSANITY 3

-ROUND 15-

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Tossups

- (1) This artist painted a couple of rosy-cheeked children poring over a book with a red pencil in his *Two Girls Reading in the Garden*. This artist also painted a dark-haired woman wearing a red and white striped skirt, a loose white top, and a red band in her hair in *The Bohemian*. He painted a woman in a white dress rowing with a friend in *Boating on the Seine*, and in another work, this man painted a striped (*) awning under which women in blue dresses and sleeveless men in straw hats enjoy a meal. For ten points, identify this French impressionist painter of *Luncheon of the Boating Party*.

ANSWER: Pierre-Auguste Renoir

- (2) This person wrote, “Don’t tell me what you value, show me your budget, and I’ll tell you what you value”. This man plagiarized from Neil Kinnock in one speech. He called the signing of one bill a “Big F***ing Deal” on live television. This person said that all of Rudy Giuliani’s sentences are just “a noun, a verb, and 9/11.” He labelled an opponent’s claim about defense cuts “a (*) bunch of malarkey” and said that the opposing party wanted to “unchain Wall Street” and “put y’all back in chains”. A former Senator from Delaware, for ten points, name this Vice President under Barack Obama.

ANSWER: Joseph Biden, Jr.

- (3) This man was depicted turning into a pear in a political cartoon by Honoré Daumier. This man’s government returned the ashes of Napoleon to his country. People who did not meet the voting requirements were told to “get rich” by his minister, Francois Guizot. Lafayette embraced this man at the Hotel de Ville after the Three Glorious Days. He was overthrown in the February Revolution of (*) 1848, and his July Monarchy was established after the overthrow of Charles X. For ten points, name this “citizen king” who ruled as “King of the French”.

ANSWER: King Louis-Philippe I (do not accept or prompt on “Louis” or “Philippe”, prompt on “Citizen King” before mention)

- (4) **Although this rule is parameterized by 81 constants, the minor symmetries enable this relation to be expressed in a 6 by 6 matrix using Voigt notation. Two constants named after Lamé are found in this rule’s expression in 3-dimensional materials. More simply, this law is stated in an equation containing Poisson’s ratio and (*) Young’s modulus. This rule fails in materials like rubber, and in other materials, elastic deformation causes this law to only be valid below the yield strength. This law can also be used to calculate the frequency of a system, and one form of it is stated as “stress is proportional to strain”. For ten points, name this law stating that F equals negative k times x , which governs springs.**

ANSWER: Hooke’s Law

- (5) **One character in this novel swears to be faithful to another and is consequently not thrown into the sea. Another returns to the place he lived most of his life with his nephew, a Spanish sailor. One character is enslaved in Salée until he is rescued by a Portuguese captain. When he lectures shipmates after a massacre, the protagonist is abandoned in China, but more faithful characters include a widow who keeps the protagonist’s money safe for 35 years and Xury. The protagonist was based on Alexander (*) Selkirk and spent 17 years alone on an island. For ten points, identify this novel about a marooned castaway who befriends Friday, a work by Daniel Defoe.**

ANSWER: Robinson Crusoe

- (6) **These numbers can be constructed so that each is the set of smaller numbers of this type, starting from the empty set. The input to the Ackermann function is two of these numbers, and this set is the range of the Hamming distance function. This set of numbers is defined by the Peano [“Pee-ah-no”] axioms, and this set is well-ordered as a result of the axiom of induction. In contrast to the difference and quotient, the (*) sum and product of two of these numbers is also in this set. These numbers along with their additive inverses form the set of integers. For ten points, identify this set of numbers abbreviated N .**

ANSWER: natural numbers (accept ordinal numbers before end of second sentence, prompt on “ordinals” until “Peano axioms”, grudgingly accept whole numbers, prompt on “ W ” or on “ N ” until mention)

- (7) One novel set in this country alternates between letters from the author to a young writer and the investigation of cannibalism in Liquorland. An author from this country described the differences in performances of operas seen in childhood. This setting of *The Republic of Wine* and *Village Opera* was the setting of a work that described “I” and “you” in even and odd chapters and also was the setting of the play *Bus Stop*. Another author from this country wrote about a peasant executed for a minor crime despite his “spiritual victories” in (*) *The True Story of Ah Q*. The home of the 2012 Nobel Laureate in Literature and of the author of *Soul Mountain*, for ten points, identify this country, home to Lu Xun, Mo Yan, and Gao Xingjian.

ANSWER: People’s Republic of China

- (8) In the *Lokasenna*, Loki taunts this god for his unfaithfulness, and this god and Thor try to steal a giant kettle from Hymir, which this god is unable to lift. This god is typically depicted with a spear in his left hand, and his namesake rune represents an upright spear. During Ragnarok, this figure will kill and be killed by Garm. After the forging of Gleipnir, this character sacrificed his (*) right hand in order to satisfy and restrain Fenrir. For ten points, name this Norse god of war, glory, and justice who lends his name the second day of our workweek.

ANSWER: Tyr (also accept Tiwaz or Ziu)

- (9) Leonard Dacre was a prominent member of a movement aiming to dethrone this monarch called the Rising of the North. The Auld alliance was ended through the Treaty of Edinburgh, which was signed by this monarch. This monarch was the subject of Regnans in Excelsis, which was issued by the Pope. Gilbert Gifford worked as a double agent to Sir Walsingham in order to protect this ruler from the (*) Babington plot. This ruler knighted a privateer who later raided the city of Cadiz, Sir Francis Drake. For ten points, name this Tudor monarch who was known as the “Virgin Queen”.

ANSWER: Queen Elizabeth I of England or Elizabeth the Great (prompt on Elizabeth, prompt on “Virgin Queen” before mention)

- (10) An important economic region of this country is the Valley of the Roses. The southwestern part of this country includes the Rila mountains, while the south central region is covered by the Rhodope mountains. The largest river in this country is the Iskar, which crosses this country’s most prominent mountain range. That range, which stretches from the Serbian border to the Black Sea, is the Balkan range. The (*) Danube forms this country’s border with Romania. For ten points, name this southeastern European country with capital at Sofia.

ANSWER: Bulgaria

- (11) Prince Ju revolted against his father during this dynasty. That father organized the Zhang Qian to trade with the Yuezhi. The Hanzhong valley was the site of a religious movement started by Zhang Daoling that occurred during this dynasty and was known as the Five Pecks of Rice Rebellion. Wang Mang interrupted this dynasty with the Xin dynasty. The capital of Luoyang was established by the founding emperor of this dynasty, Emperor Gaozu, who founded this dynasty after the fall of the (*) Qin. For ten points, name this dynasty which gives its name to the predominant ethnic group in China.

ANSWER: Han Dynasty

- (12) One leader of this religion emphasized physical and spiritual wellness of the young when he started Mall Akhara, and another stopped married women from being burned to death on the funeral pyre of their husbands. One group in this religion originally consisted of five men who were decapitated and resurrected, the Khalsa. Long hair, a (*) comb, and a metal bracelet are among its “five K’s”. A major leader in this religion was Gobind Singh, and the center of worship is the Golden Temple. Considering the *Adi Granth* as their final guru, for ten points, name this Indian religion founded by Guru Nanak.

ANSWER: Sikhism

- (13) One of these compounds is formed by a reaction between pimeloyl-CoA and alanine. Takaki Kanehiro identified a deficiency of one of these compounds, and further work on it was performed by the winner of the 1929 Nobel Prize in Medicine, Christian Eijkman. This group includes the precursor molecule to coenzyme-A synthesis, while another is the main component of FMN and FAD. Examples include pantothenic acid and biotin, and (*) beriberi can be caused by the deficiency of “number one”, thymine. For ten points, name this class of water-soluble essential vitamins numbered up to 12.

ANSWER: B vitamins (accept B-complex)

- (14) One character in this novel was the star student of Spider Kelly at Princeton, and another character makes a parting gift of a dozen second-rate flies and has his name shortened to Harris. In addition to going on a five-day fishing trip with Bill Gorton, the protagonist introduces a prostitute as his fiance, Georgette Leblanc. One character’s former husband makes her sleep with him on the ground, and she unloads his revolver each night. Besides her romantic entanglements with Mike Campbell and (*) Robert Cohn, Brett Ashley has an affair with Pedro Romero, a bullfighter in Pamplona. For ten points, identify this novel about Jake Barnes, a novel by Ernest Hemingway.

ANSWER: The Sun Also Rises

- (15) Michael Faraday created a red colored one of these substances using gold that has remained stable to the present. These substances are most viscous when uncharged, and they do not follow Gibbs' Phase Rule. A quadruply eponymous theory of these entities describes interactions between double layers of counterions; that theory is abbreviated DLVO, and when subjected to voltages below the zeta potential they undergo (*) flocculation. Blue light scatters in the Tyndall Effect in, for ten points, these substances which consist of continuous and dispersed phases, examples of which include aerosols, emulsions, and gels.

ANSWER: colloids

- (16) This concept was explored in a thought experiment about the Grand Hotel devised by David Hilbert. The ordinal number lowercase omega is the smallest number with this property, and the conjecture that there are no numbers of this type between lowercase omega and capital omega is known as the Continuum Hypothesis. Sets with this property can be put in one-to-one correspondence with a proper subset. Cardinal numbers of this type are represented with the letter (*) aleph, with aleph-null being countable and all others being uncountable. For ten points, name this type of set whose size is larger than any real number.

ANSWER: infinity (accept word forms like "infinite")

- (17) This man directed a comedy in which Ann and David discover that they are not married entitled *Mr. and Mrs. Smith*. This man also directed a film in which a nun causes Judy to fall to her death. A third film sees a character die when the match used to light his cigar ignites a stream of gasoline, which had formed after a man filling his car was attacked by the titular figures. A scene in another film by this director features a transition from a (*) drain to a close-up of an eye after Marion Crane was stabbed to death in the shower of the Bates Motel. For ten points, name this director of *Vertigo*, *The Birds*, and *Psycho*.

ANSWER: Alfred Hitchcock

- (18) One character in this novel wrote *A Treatise on the Possibility of Forming Italy into one General Monarchy* on two of his shirts. After two consecutive fiancés are publicly shamed, Eugénie dresses as a boy and runs away with Louis d'Armilly. The bandit Luigi Vampa captures one character, and the title character, under the name Sinbad the Sailor, saves Morrel and Valentine. Villefort accidentally condemns both his sons to death, and Fernand (*) Mondego commits suicide after his wife, Mercédès, abandons him. For ten points, identify this story about the revenge of Edmond Dantes, a novel by Alexandre Dumas.

ANSWER: The Count of Monte Cristo (or Le Comte de Monte Cristo)

- (19) Ringing bells interrupt the melody of the fifth section of this work, whose main theme is in B minor. This piece was originally scored for two pianos except its last movement, which was scored for solo organ. The first and final movements of this piece are written in 5/4 time, and the final movement features a fade-out effect achieved by a door slowly being closed on a women's chorus in an adjoining room. With movements titled "The Magician" and (*) "The Mystic", for ten points, name this orchestral suite which begins with "Mars, the Bringer of War", written by Gustav Holst.

ANSWER: The Planets

- (20) The validity of this law was upheld in the cases *Hawke v. Smith* and *United States v. Sprague*. A follow-up piece of legislation to this law was written by Wayne Wheeler, included an exception for religious rituals, and was named for the Chairman of the House Judiciary Committee. It set a seven-year time limit for its ratification, and Connecticut and Rhode Island were the only states to reject this amendment, whose enforcement was detailed in the (*) Volstead Act. Repealed by the Twenty-First Amendment, for ten points, identify this amendment which began the Prohibition era.

ANSWER: Eighteenth Amendment to the United States Constitution

- (21) Before this battle, a false transmission about a broken water filter aided codebreakers from Station Hypo who had broken the JN-25 code. Wade McClusky followed the Arashi in order to sink two carriers, preventing the annihilation of the combined task forces of Raymond Spruance and Frank Fletcher. This battle saw the death of Admiral Yamaguchi on board the Hiryu after sinking the USS (*) Yorktown. This battle, which took place during a simultaneous campaign in the Aleutian islands, also saw the USS Enterprise sink the Akagi. For ten points, name this June 1942 battle in World War II which turned the tides in favor of a United States victory against the Japanese.

ANSWER: Battle of Midway

Bonuses

- (1) Answer the following about supporters of the Axis powers during World War II for ten points each.
- [10] This Italian man founded his country's Fascist party and led a successful invasion of Ethiopia. He was executed after he was caught trying to escape Italy following the Allied invasion.
- ANSWER:** Benito Mussolini
- [10] This Norwegian Minister-President supported the Nazi invasion of his country during which he was part of a coup to take power. After the war, he was executed for treason.
- ANSWER:** Vidkun Quisling
- [10] After being pressured by the looming threat of the Soviets, this Regent led his country into an alliance with Hitler's Germany. The Nazis later invaded his country during Operation Margarethe when Miklos Kallay suggested an alliance with the Allies.
- ANSWER:** Miklos Horthy de Nagybanya
- (2) The United States 2012 Olympic team in this sport was coached by Karch Kiraly. For ten points each:
- [10] Identify this sport in which pairs compete to win two sets, with other rules derived from its indoor analog. 4,400 tons of sand were brought in to fill Horse Guards Parade, the London venue for this sport.
- ANSWER:** women's beach volleyball (do not prompt on or accept "volleyball")
- [10] This American duo won its third consecutive gold medal in beach volleyball in 2012. This team has lost only one set during those three Olympic Games.
- ANSWER:** Misty May-Treanor and Kerri Walsh (prompt on a partial answer)
- [10] Misty May-Treanor and Kerri Walsh defeated this other American team in the 2012 Gold Medal Game.
- ANSWER:** Jennifer Kessy and April Ross (prompt on a partial answer)
- (3) Lucy Deane contrives a rowing trip between the main character and Philip Wakem. For ten points each:
- [10] Identify this novel, in which Maggie Tulliver does not elope with Stephen Guest, but is still ignored by her brother until the title river floods and they both drown.
- ANSWER:** The Mill on the Floss
- [10] This author wrote *The Mill on the Floss*, and a "study of provincial life" in which Dorothea Brooke ignores Edward Casaubon's last words and marries Will Ladislaw, *Middlemarch*.
- ANSWER:** George Eliot (or Mary Anne (Marian) Evans)
- [10] George Eliot also wrote this novel, in which the title character redeems the necklace that he saw Gwendolen Harleth pawn.
- ANSWER:** Daniel Deronda

- (4) Common examples of these are snowflakes, diamonds, and table salt. For ten points each:
 [10] Name these solids that exhibit long-range order and symmetry and are composed of a microscopic repeating pattern in all three spatial directions. Glass, although not an example of these, is sometimes referred to by this name.
ANSWER: crystals
 [10] This most efficient packing structure in a crystal occurs when each of the vertices and the centers of its eponymous locations on its unit cell are occupied. It is contrasted with body centered cubic packing.
ANSWER: face centered cubic or cubic close packed
 [10] This is the term for the number of neighbors each atom has in a crystal.
ANSWER: coordination number
- (5) Works in this key include the violin concertos of Brahms and Beethoven, and it includes two sharps in its key signature. For ten points each:
 [10] Name this relative major key of B minor, in which Pachelbel composed a famous Canon.
ANSWER: D major
 [10] This composer wrote twenty symphonies in D Major, including ones titled *Haffner* and *Prague*.
ANSWER: Wolfgang Amadeus Mozart
 [10] This march of Johann Strauss Sr. was also composed in D Major and commemorates the namesake general's victory at Custoza.
ANSWER: Radetzky March
- (6) He wrote about about Amal's death in *The Post Office*. For ten points each:
 [10] Identify this author, better known for his poetry including *Gitanjali*, or *Song Offerings*, who wrote one country's national anthem in *Jana Gana Mana*.
ANSWER: Rabindranath Tagore
 [10] This novel, written by Vikram Seth, concerns the efforts of Rupa Mehra to find a husband for her youngest daughter, Lata.
ANSWER: A Suitable Boy
 [10] Rabindranath Tagore and Vikram Seth both came from this country. Works from this country sometimes use Sanskrit, and literary awards from this country include the Jnanpith Award and Sahitya Akademi Fellowship.
ANSWER: Republic of India

- (7) The Israelites carried this object in a special tent known as the Tabernacle as they wandered the desert. For ten points each:

[10] Name this receptacle adorned with golden cherubim that held the Ten Commandments.

ANSWER: Ark of the Covenant

[10] The Ark was once stolen by these people, who gave it back voluntarily when plagues and rats struck each city it was taken to.

ANSWER: Philistines

[10] After Solomon built the Temple, this room was constructed in order to house the Ark of the Covenant. The High Priest offered sacrifices in this room once per year.

ANSWER: Holy of Holies

- (8) The R-plasmid contains the same genes as the F-plasmid plus another gene conferring antibiotic resistance. For ten points each:

[10] The “F” in F-plasmid stands for fertility because bacteria expressing it have the ability to donate the F-plasmid through this mechanism, which involves a sex pilus.

ANSWER: conjugation

[10] Bacteriophages transfer DNA from one bacterium to another through this mechanism, which occurs when the newly synthesized phages incorporate bacterial DNA into their genome.

ANSWER: transduction

[10] Plasmids are separate from this main portion of the bacterial genome, which appears as lighter than the surrounding cytoplasm in electron micrographs.

ANSWER: nucleoid

- (9) Secretary of Defense Caspar Weinberger resigned in its wake, ostensibly due to his wife’s health. For ten points each:

[10] Name this scandal of the Reagan administration in which arms sales in the Middle East were used to fund a namesake Honduran rebel group.

ANSWER: Iran-Contra Affair (prompt on “Contra” Affair)

[10] The Contras were fighting against this ruling party of Nicaragua, which took its name from the man who led the resistance to United States occupation of Nicaragua in the 1930s.

ANSWER: Sandinistas (or Sandinista National Liberation Front or SNLF or Frente Sandinista de Liberación Nacional or FSLN)

[10] During the Iran-Contra Affair, Oliver North tried to use his good relationship with this Panamanian dictator to help put down the Sandinistas. This dictator was removed in the 1989 United States invasion of Panama.

ANSWER: Manuel Noriega

- (10) The Federal Reserve has been charged to control these two quantities. For ten points each:
[10] Name these two economic quantities depicted in an inverse relationship in the Phillips curve. These two quantities are added to compute the Misery Index.
ANSWER: inflation and unemployment (in either order)
[10] This economist of the Chicago School argued that the Phillips Curve was only accurate as a short-term model. He criticized policies of the Federal Reserve in his book *A Monetary History of the United States*.
ANSWER: Milton Friedman
[10] According to Milton Friedman, inflation results from unemployment being below this level.
ANSWER: Non-Accelerating Inflation Rate of Unemployment or NAIRU or natural rate of unemployment
- (11) The protagonist considers an araucaria plant a symbol of bourgeois cleanliness, criticizes a picture of Goethe, and enters a building marked “For madmen only”. For ten points each:
[10] Identify this novel in which Harry Haller follows the saxophonist Pablo into the Magic Theater and stabs Hermine.
ANSWER: Steppenwolf
[10] *Steppenwolf* was written by this German author who described Kamala’s death by snakebite and Govinda realizing that his friend has become Buddha in *Siddhartha*.
ANSWER: Herman Hesse
[10] In this Hesse novel, set in Castalia, Joseph Knecht takes over a certain position from Thomas van der Trave.
ANSWER: The Glass Bead Game or Magister Ludi
- (12) It declared its independence on May 4th, 1776, two months before any other colony, and it was the last to ratify the Constitution. For ten points each:
[10] Name this state with capital at Providence.
ANSWER: Rhode Island and Providence Plantations
[10] This founder of Rhode Island fled from Massachusetts for religious freedom. He also founded the first Baptist Church at Providence Plantations and was arguably the first abolitionist.
ANSWER: Roger Williams
[10] During the Second Industrial Revolution, this man launched his eponymous rebellion to protest Rhode Island’s policy of granting voting rights only to landowners. He was tried for treason, but was set free.
ANSWER: Thomas Wilson Dorr

- (13) This philosopher argued that everything has a telos, or purpose, and that humanity's telos was eudaimonia, which could be achieved through a virtuous life. For ten points each:
[10] Name this mentor of Alexander the Great and author of *Nicomachean Ethics* and *Poetics*.
ANSWER: Aristotle
[10] This British philosopher updated Aristotle's essay about logic, *Organon*, in his *Novum Organon*.
ANSWER: Sir Francis Bacon
[10] This Bacon work takes place in Bensalem, and describes the ideal college of Solomon's House in the titular utopian community.
ANSWER: The New Atlantis
- (14) Gilgamesh described this goddess as causing the death of Tammuz, the god of the harvest. For ten points each:
[10] Name this Assyrian and Babylonian goddess who demanded entry to the Underworld.
ANSWER: Ishtar
[10] Ishtar was the goddess of this emotion, also ruled by goddesses like Aphrodite.
ANSWER: love
[10] Ishtar's sister Ereshkigal was the consort of this Sumero-Babylonian god who ruled over the netherworld and whose fall from heaven was described in an Akkadian poem.
ANSWER: Nergal
- (15) This concept can be generalized with a metric. For ten points each:
[10] Identify this quantity, whose Euclidean form can be calculated for two points in the plane as the square root of x -one minus x -two squared plus y -one minus y -two squared.
ANSWER: distance
[10] Distances satisfy this property which forbids shortcuts. Formally, it says that the distance from x to z is at most the sum of the distances from x to y and from y to z .
ANSWER: triangle inequality
[10] In contrast to Euclidean distance, this type of distance is computed as the sum of the absolute values of x -one minus x -two and of y -one minus y -two.
ANSWER: taxicab distance (or taxicab metric or taxicab geometry)

- (16) It is the largest painting in the Louvre. For ten points each:
 [10] This painting of a large celebration features lute players in the front while a man on the right pours from a jug of wine. Jesus is seated at the central table in this Paolo Veronese work.
ANSWER: The Wedding at Cana (or The Wedding Feast at Cana)
 [10] In the Louvre, *The Wedding at Cana* hangs opposite this painting by Leonardo da Vinci depicting the titular woman and her enigmatic smile.
ANSWER: Mona Lisa (or La Gioconda or La Joconde)
 [10] After the *Mona Lisa* was stolen in 1911, it was temporarily hung in this gallery in Florence.
ANSWER: Uffizi Gallery (or Galleria degli Uffizi)
- (17) Answer the following about short American poems for ten points each.
 [10] The poem *Sycamore*, which states “Zaccheus he/Did climb the tree/Our Lord to see”, opened this poet’s collection *A Witness Tree*. That collection also featured *The Gift Outright*, which he read at John F. Kennedy’s inauguration.
ANSWER: Robert Lee Frost
 [10] This sixteen-word poem by William Carlos Williams states that “so much depends upon” the title farm implement “glazed with rain water/ beside the white chickens.”
ANSWER: The Red Wheelbarrow
 [10] This poet inserted the parenthetical comment “a leaf falls” into the word “loneliness,” which he spread across nine lines.
ANSWER: Edward Estlin Cummings
- (18) This element produces a 21 cm line that is ubiquitous throughout the universe. For ten points each:
 [10] The Balmer and Lyman series are produced by this element. The individual lines in these series are denoted using Greek letters.
ANSWER: Hydrogen (prompt on “H”)
 [10] The Lyman series specifically is caused by electrons moving to or from this lowest energy state.
ANSWER: ground state
 [10] When an electronic transition from higher to lower energy occurs, these particles are produced. These particles are the quantized units of light.
ANSWER: photons

- (19) Answer the following about attempts to limit free speech in America for ten points each:
- [10] This set of four laws passed in 1798 included one which forbade “false, scandalous, and malicious writing” about the government.
ANSWER: Alien and Sedition Acts (prompt on partial answer, accept in either order)
- [10] This man was arrested in 1918 for violating the Espionage Act with a speech he delivered critical of World War I policies. While in prison, he ran for president as the Socialist Party candidate.
ANSWER: Eugene V. Debs
- [10] In the case of *Tinker v. Des Moines*, several students had been sent home from school for wearing this article of clothing to protest the Vietnam War. To the contrary, the majority decided that “students do not leave their rights at the schoolhouse door.”
ANSWER: black armbands (prompt on “band”)
- (20) They often are found in conjunction with extratropical cyclones. For ten points each:
- [10] Identify these boundaries between masses of air with different properties. These meteorological features often cause rain and thunderstorms in temperate latitudes.
ANSWER: weather fronts
- [10] This kind of front is formed when a cold front overtakes a warm front, producing a boundary between two more similar air masses.
ANSWER: occluded front
- [10] This is the classical explanation for the formation of an extratropical cyclone, with fronts attached to its center. It also explains the warm conveyor belt.
ANSWER: Norwegian cyclone model
- (21) It occurs when the diameter of the pore is significantly smaller than the mean free path of the gas molecules. For ten points each:
- [10] Name this process, undergone by gases, which involves the passage of gas molecules through a small hole into a vacuum. It is contrasted with diffusion.
ANSWER: effusion
- [10] This law, named after a Scottish chemist, states the rate of effusion of a gas is inversely proportional to the square root of the molar mass of the gas.
ANSWER: Graham’s Law
- [10] In order to produce bomb-grade uranium during World War II, chemists at Oak Ridge National Laboratory used effusion to separate these varieties of atoms, examples of which are U-235 and U-238, which have the same number of protons but different numbers of neutrons.
ANSWER: isotopes