



**Question #1: Literature – U.S. Literature**

*10 points*

<p>Mary tells the protagonist of this novel to eat his chicken, but the organic functions of his body had altered. In this novel, Gus devises a plan to rob Blum's delicatessen, and the body of Bessie Mears is disposed of even though there is money in the pocket of her dress. Bessie is killed in this book by the same man who uses a pillow to suffocate Mary Dalton and then decapitates her. The protagonist of this novel, who lives in poverty in Chicago, is Bigger Thomas. Name this novel by Richard Wright.</p>	<p><u><i>Native Son</i></u></p>
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**Question #2: Mathematics – Math Concepts**

*10 points*

<p>The Master Theorem is used to solve recurrence relations that arise when analyzing these mathematical things. George Dantzig developed one of these things named for simplexes and used on linear programming problems. The Church-Turing thesis essentially says that the formal definition of these things is the same as the intuitive definition. These concepts are often presented in pseudocode, and if they take locally optimal actions, they are called greedy. Name this type of formal step-by-step procedure used to solve a problem.</p>	<p><u><b>algorithm(s)</b></u></p>
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### Question #3: Social Studies – World History

10 points

This person was the namesake of a German Marxist organization founded by Rosa Luxembour. This leader's forces used ropes and vines to descend onto Gaius Claber's troops. To avenge the death of his colleague Crixus, this man paired off his prisoners and had them fight each other to the death. He was killed at the Battle of Siler River during the Third Servile War, and his forces were crucified along the Appian Way. Crassus led the effort to stop his forces, but Pompey got the glory. Name this slave who led a revolt against the Roman Empire.

Spartacus

### Question #4: Science – Biology

10 points

Along with a **lactone** ["LACK-tone"], this molecule is formed through the action of **G6PD** [G-"six"-P-D]. This compound allows **glutathione reductase** [GLOO-tah-"THIGH-own" ree-DUK-tayss] to act on the antioxidant glutathione. Two molecules of this compound are formed during the **oxidative** ["OX"-ih-day-tiv] phase of the pentose phosphate pathway. A **ferredoxin** [fair-uh-"DOCK-sin"] in photosystem I [1] forms this compound during the light-dependent reactions of photosynthesis, and it is later used as a reducing agent in the Calvin cycle. Name this **dinucleotide** ["die"-NOO-klee-oh-"tide"] that can be formed by **phosphorylating** [fahss-FOR-ih-lay-ting] **NADH** [N-A-D-H].

NADPH [or **nicotinamide adenine dinucleotide phosphate**; do not prompt on "NAD" or "NADH"]



**Question #5: Literature – British Literature**

10 points

In this play’s prologue, the messenger describes how the soul weeps while the body lies in clay. In this English-language drama, the Lord is referred to as “Adonai”, and Beauty asks whether she should be smothered before leaving. In seeking out Confession, Knowledge points this work’s protagonist towards the House of Salvation. After this play’s protagonist is deserted by Five Wits, he believes that he is completely forsaken, and he learns that when the time comes, only good deeds will be seen by God. Name this medieval morality play.

*The Summoning of*  
*Everyman*

**Question #6: Miscellaneous – Sports**

10 points

The Gleneagles Agreement was violated when this sport was played during a “Springbok Tour” of South Africa. Eric Rush and Jonah Lomu starred in this sport for New Zealand. At the 2015 World Cup in this sport, Richie McCaw was on the team that won the William Webb Ellis Cup. The “sevens” variation of this sport was accepted for the 2016 Rio Olympic Games. In this sport, throwing the ball forward is illegal, and a try is worth five points. When play stops, it can be restarted with a scrum. Name this full-contact sport, a predecessor to football.

**rugby** (union)



**Question #7: Mathematics – Probability**

*10 points per part*

These <b>stochastic</b> [“stow-CAST”-ik] processes are named for a Russian mathematician.		
<b>1</b>	Name these processes that may use matrix multiplication to demonstrate transitions from one state to the next.	<b><u>Markov</u></b> chains or <b><u>Markov processes</u></b>
<b>2</b>	In a transition matrix for a Markov chain, the numbers in each row must add up to this value.	<b><u>one</u></b>
<b>3</b>	A transition matrix in a Markov chain has a top row of 0.6, 0.4 and a bottom row of 0.1, 0.9. If the initial state is given by the column matrix with 0.5 on top and 0.5 on the bottom, what is the probability of the top state after one step?	<b><u>0.35</u></b> [or <b><u>7/20</u></b> or <b><u>35%</u></b> ]

**Question #8: Mathematics – Probability**

*10 points per part*

This mathematical concept is used to model Brownian motion.		
<b>1</b>	Name this process in which the next direction to move is chosen without any pre-existing pattern.	<b><u>random walk</u></b> [accept word forms]
<b>2</b>	If an object goes up half the time and down half the time, what is the probability that it will end up in its original position after four evenly spaced steps?	<b><u>3/8</u></b> [or <b><u>0.375</u></b> ]
<b>3</b>	If an object goes up half the time and down half the time, what is the probability that it will end up exactly one step away from its original position after four evenly spaced steps?	<b><u>0</u></b> [accept answers mentioning that the specified result is <b><u>impossible</u></b> ; do not accept “no answer”]



**Question #9: Social Studies – Geography**

*10 points per part*

This region’s name came from a European folk tale in which its inhabitants were giants.		
<b>1</b>	Name this region in South America with many plateaus. The <b>Mapuche</b> [mah-POO-chay] expanded into this region during <b>araucanization</b> [ah-RAW-kah-nih-ZAY-shun].	<b><u>Patagonia</u></b>
<b>2</b>	This island group just south of Patagonia is where the HMS <i>Sheffield</i> was sunk during a 1982 conflict. Argentinians claim it belongs to them, and call it the <b>Islas Malvinas</b> [EES-lahs mahl-VEE-nahs].	<b><u>Falkland</u></b> Islands or <b><u>Falklands</u></b>
<b>3</b>	Patagonia is separated from Tierra del Fuego by this channel of water. The Evangelistas Lighthouse points eastward travelers to the entrance to it, and the port Punta Arenas, Chile is on it.	<b><u>Strait(s) of Magellan</u></b> [or <b><u>Estrecho(s) de Magallanes</u></b> ]

**Question #10: Social Studies – Geography**

*10 points per part*

The Fulani and the <b>Dogon</b> [DOH-gon] are among this region’s indigenous peoples.		
<b>1</b>	Name this transition region that includes the cities of <b>Dakar</b> [duh-KAHR], <b>Niamey</b> [nee-AH-may], and <b>Bamako</b> [BAH-muh-koe].	<b><u>Sahel</u></b>
<b>2</b>	The Sahel is just south of this desert, the largest by area in the world.	<b><u>Sahara</u></b> Desert
<b>3</b>	The 2010 Sahel famine was worst near this river, which forms the border between its namesake country and <b>Mauritania</b> [mor-uh-TAY-nee-uh].	<b><u>Senegal</u></b> River



**Question #11: Science – Physics**

*10 points per part*

For a block on an inclined surface, the coefficient for the static form of quantity is equal to the tangent of the angle of the incline.		
<b>1</b>	Name this force that opposes motion.	<b><u>friction</u></b> (al force)
<b>2</b>	Friction can cause the buildup of charge in materials that contact in this effect. Static electricity typically is caused by this effect.	<b><u>triboelectric</u></b> effect or <b><u>triboelectricity</u></b>
<b>3</b>	A friction factor used in fluid mechanics is named for this French physicist. That factor, which varies inversely with the Reynolds number, is used in an equation named for this person and Julius Weisbach [“VISE”-bahk]	Henry <b><u>Darcy</u></b>

**Question #12: Science – Physics**

*10 points per part*

For a solid sphere of uniform density, this quantity equals two-fifths times the mass of the sphere times the sphere’s radius squared.		
<b>1</b>	Name this quantity, the rotational analog of mass.	(first mass) <b><u>moment of inertia</u></b> [do not prompt on partial answers]
<b>2</b>	The moment of inertia applies to these kinds of bodies that do not deform. In other words, the distance between any two points in these idealized solids does not change.	<b><u>rigid</u></b> bodies
<b>3</b>	The moment of inertia can be represented as a symmetric matrix. In that representation, the moments of inertia are referred to by this term. This adjective also describes the axes around which those moments of inertia apply.	<b><u>principal</u></b> axes [or <b><u>principal</u></b> moments of inertia]



**Question #13: Literature – World Literature**

10 points per part

The official lyrics to the song “ <b>Guantanamera</b> [GWAHN-tahn-ah-MAIR-ah]” were adapted from one of this writer’s poems.		
<b>1</b>	Name this author of the poetry collection <i>Versos Sencillos</i> [VAIR-sohss sen-SEE-yohss], which contains the poem “A Simple Man am I”.	José <b>Martí</b> (Pérez)
<b>2</b>	José Martí was a strong advocate for the independence of this Caribbean nation. The title of an Enrique Flores-Galbis novel refers to the fact that this country is 90 miles from Florida.	(Republic of) <b>Cuba</b> [or República de <b>Cuba</b> ]
<b>3</b>	Cuba’s <b>Alejo Carpentier</b> [ah-LAY-hoh kar-pen-tee-AIR] used this literary style in the novel <i>The Kingdom of This World</i> , and in the foreword contrasted it with European surrealism. This <b>genre</b> [zhahn-ruh] tells about fantastical events in a matter-of-fact style.	<b>magical realism</b> [or <b>marvelous realism</b> ; accept word forms like <b>magical realist</b> ]

**Question #14: Literature – World Literature**

10 points per part

This novel features a sign writer-turned-journalist who was born with six fingers and was trapped into marrying into the <b>Tulsi</b> [TOOL-see] family.		
<b>1</b>	Name this novel in which Mohan seeks to make a better life by obtaining the title property.	<i>A <b>House for Mr. Biswas</b></i>
<b>2</b>	This Trinidadian author of <i>A House for Mr. Biswas</i> wrote of Salim’s experiences in an African country in <i>A Bend in the River</i> .	V(idiadharr) S(urajsprad) <b>Naipaul</b>
<b>3</b>	Naipaul’s novel <i>In a Free State</i> starts on a boat going to this country, the home of <b>Naguib Mahfouz</b> [na-GEEB mah-FOOZ].	(Arab Republic of) <b>Egypt</b>



### Question #15: Fine Arts – Classical Music & Opera

10 points

A movement from this composer's first symphony, now often played as a separate piece, is called *Blumine* [bloo-MEE-nuh]. That symphony's last movement is labeled "Stormily agitated—Energetic". After his eighth symphony, this composer wrote a piece for two singers with six songs, starting with "The Drinking Song of Earth's Misery". Like Brahms, several of this composer's other early symphonies are considered expressions of the folk poems in *Des Knaben Wunderhorn* [dayss kuh-NAH-bin VOON-dur-"horn"]. Name this composer of "The Song of the Earth", whose eighth symphony is nicknamed—thanks to the large group required to play it—the "Symphony of a Thousand".

Gustav Mahler

### Question #16: Science – Chemistry

10 points

This technique can only analyze transitions that change the dipole moment. Higher-resolution spectra generated from this technique have P and R branches due to rotations. Samples used in this technique are commonly placed on a salt plate. The rule of mutual exclusion states that transitions in *centrosymmetric* [SEN-troh-"symmetric"] molecules cannot be both Raman-active and active in this technique, which makes the two complementary techniques. Peaks in this technique are labeled using wavenumbers, and typically correspond to vibrational normal modes. Part of its output is in the fingerprint region. Name this form of vibrational spectroscopy, which uses a form of light with a longer wavelength than visible light.

IR spectroscopy [or infrared spectroscopy; accept just IR or infrared after "spectroscopy"; prompt on spectroscopy]





**Question #17: Social Studies – U.S. History**

10 points

<p>After this battle, Jesse Elliott was praised for encouraging other Americans to join the fighting, but was criticized for being slow to engage in action himself. William Powell painted another commander in this battle being rowed to the <i>Niagara</i> from the twice-captured <i>Lawrence</i>. This battle was fought near Put-In-Bay following the defeat of the <i>Queen Charlotte</i>. After this battle, William Henry Harrison was sent the message “We have met the enemy, and they are ours” by Oliver Hazard Perry. Name this naval battle of the War of 1812.</p>	<p>Battle of <u>Lake Erie</u></p>
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**Question #18: Literature – World Literature**

10 points

<p>In this work, one man refuses to abandon a dog that accompanied him on an ascent to heaven. One contest within this story required suitors to shoot the eye of a mechanical fish. <b>Dushasana’s [duh-SHAH-suh-nah’s]</b> attempt to disrobe <b>Draupadi [DROW-puh-dee]</b> sparked the conflict at the center of this epic. This poem details the war between the Kauravas and Pandavas, starting with the <b>Adi [AH-dee]</b> Parva and including the <i>Bhagavad-Gita</i>. Name this long ancient Sanskrit epic.</p>	<p><b><i>Mahabharata</i></b> [do not accept “Bhagavad-Gita”]</p>
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**Question #19: Science – Astronomy**

10 points

The two scientists who independently discovered this process also developed a formula unrelated to it that finds atomic properties based on the number of protons and neutrons. In their honor, this can be called the **Bethe-Weizsäcker [BEE-tuh “VISE”-zah-kur]** process. In order, this process emits a gamma ray, positron, gamma ray, gamma ray, positron, and gamma ray. It converts four hydrogen nuclei into a helium nucleus and other particles. Though the proton-proton chain reaction is more common in the Sun, this fusion reaction is more common in larger stars. Name this cycle that uses its three namesake elements as catalysts.

**CNO** cycle [or **carbon-nitrogen-oxygen** cycle; accept more specific answers; accept **Bethe-Weizsäcker** process before it is mentioned]

**Question #20: Social Studies – Economics**

10 points

Jonathan Nitzan and Shimshon Bilcher proposed the differential accumulation theory to explain this phenomenon. Milton Friedman criticized **Keynesian [“CANE”-zee-un]** economics for causing this phenomenon and for its either/or approach to the underlying causes of this phenomenon. When this effect occurs, *both* of the quantities used to measure the misery index are high. Cited as a criticism of the Phillips curve, this phenomenon occurred in the 1970s thanks in part to OPEC instigating a supply shock in the market for oil. Name this phenomenon in which unemployment and inflation are both high.

**stagflation** [accept word forms; do not accept or prompt on “inflation” or “unemployment”]



**Question #21: Literature – U.S. Literature**

*10 points per part*

In this play, Joseph Asagai—who plans to become a doctor and move to Nigeria—is a suitor of <b>Beneatha</b> [buh-NEETH-uh].		
<b>1</b>	Name this play in which tensions come to a head between the protagonist and Beneatha when a \$6,500 investment in a liquor store business is stolen.	<b><i>A Raisin in the Sun</i></b>
<b>2</b>	<i>A Raisin in the Sun</i> is by this African-American author, who also wrote <i>The Sign in Sidney Brustein's Window</i> .	Lorraine (Vivian) <b><u>Hansberry</u></b>
<b>3</b>	In <i>A Raisin in the Sun</i> , this representative of the Clybourne Park Improvement Association fails to convince the Younger family not to relocate to his neighborhood.	<b><u>Karl Lindner</u></b> [accept either]

**Question #22: Literature – U.S. Literature**

*10 points per part*

His father struck it rich in Alaska, while Ben rode African diamonds to wealth.		
<b>1</b>	Name this former subordinate to Howard Wagner, who committed suicide by car crash.	<b><u>Willy Loman</u></b> [prompt on <b><u>Loman</u></b> ]
<b>2</b>	Willy Loman is the protagonist of this Arthur Miller play.	<b><i>Death of a Salesman</i></b>
<b>3</b>	Willy's son Biff had an opportunity to play football in college, but lost interest in his summer school math course after visiting Willy in this city.	<b><u>Boston</u></b> , Massachusetts



**Question #23: Fine Arts – Art History**

10 points per part

In this painter’s <i>Cat and Bird</i> , the bird appears to be in the forehead of the cat, whose face takes up almost the entire painting.		
<b>1</b>	Name this Swiss-German painter who worked closely with <b>Wassily Kandinsky</b> [VAH-sil-ee kan-DIN-skee] at the <b>Bauhaus</b> [rhymes with “cow house”]. Several of his works include moon faces or stick figures.	Paul <b>Klee</b> [“clay”] [be generous with pronunciations]
<b>2</b>	This Paul Klee work shows several birds with open beaks on a hand crank.	<b>Twittering Machine</b> [or Die <b>Zwitscher-Maschine</b> ]
<b>3</b>	Klee joined the Blue Rider movement, which was started by Kandinsky and this artist of <i>Yellow Cow</i> and <i>Fighting Forms</i> .	Franz <b>Marc</b>

**Question #24: Fine Arts – Art History**

10 points per part

This painter combined his love of jazz with his love of New York City in his painting <i>Broadway Boogie-Woogie</i> .		
<b>1</b>	Name this Dutch <i>De Stijl</i> [sh-teel] painter.	Piet <b>Mondrian</b> [MON-dree-ahn]
<b>2</b>	Other than white and grey, what three colors are used in <i>Broadway Boogie-Woogie</i> ? Unlike Mondrian’s earlier works, there is no black.	<b>red, yellow, and blue</b> [any order]
<b>3</b>	Mondrian worked on this painting similar to <i>Broadway Boogie-Woogie</i> but on a tilted canvas. He died before completing it.	<b>Victory Boogie-Woogie</b>



### Question #25: Science – Chemistry

10 points per part

The fractional form of this technique is useful for separating compounds with very similar boiling points.		
1	Name this technique of purifying a liquid by boiling it.	<b>distillation</b> or <b>distilling</b>
2	It is difficult to separate components of one of these mixtures, as their compositions do not change when they boil.	<b>azeotropes</b> [AY-zee-oh-“tropes”]
3	When performing an azeotropic distillation, one of these devices may be used along with a condenser to capture water. This type of trap uses a fractionating column and circulates cooling water.	<b>Dean-Stark</b> apparatus [or <b>Dean-Stark</b> trap]

### Question #26: Science – Chemistry

10 points per part

The first <b>metallocene</b> [meh-TAL-oh-seen] to be analyzed was a complex with a center of this metal.		
1	Name this element that is the primary component of steel and that is coated with zinc in galvanization.	<b>iron</b> [accept <b>Fe</b> ]
2	Name that first metallocene, a sandwich complex whose structure was proposed by Robert Woodward as an iron atom between two <b>cyclopentadienyl</b> [sie-kloe-pen-tuh-DIE-ee-nul] ligands.	<b>ferrocene</b> [“FAIR-oh-seen”]
3	Iron oxide and aluminum are the most common components of this highly exothermic mixture. Steven Zumdahl stopped doing demonstrations after students were injured when a beaker with this chemical exploded.	<b>thermite</b>



**Question #27: Social Studies – U.S. History**

*10 points per part*

In response to this act’s passage, the House of Burgesses approved the Virginia Resolves, the fourth of which outlined opposition to “taxation without representation”.		
<b>1</b>	Name this 1765 act that regulated printed materials in the American colonies to raise money for Great Britain.	<b><u>Stamp Act of 1765</u></b>
<b>2</b>	John Dickinson, who represented this colony, wrote the <i>Declaration of Rights and Grievances</i> as agreed upon at the Stamp Act Congress. Peter <b>Minuit</b> [min-YOO-it] founded New Sweden in this colony.	<b><u>Delaware</u></b>
<b>3</b>	Dickinson also wrote this document issued by the Second Continental Congress, which King George III refused to read. Meant as a critique of ministerial policy, this document led the King to proclaim that the colonies were in a state of rebellion.	<b><u>Olive Branch Petition</u></b>

**Question #28: Social Studies – U.S. History**

*10 points per part*

Also called “Men of Bronze,” two of its members, Henry Johnson and Needham Roberts, were awarded the <b>Croix de Guerre</b> [kroy de gair].		
<b>1</b>	Give the two-word nickname for the 369th Infantry Regiment out of New York that spent more time in combat than any other regiment.	<b><u>Harlem Hellfighters</u></b> [or <b><u>Black Rattlers</u></b> ]
<b>2</b>	The Harlem Hellfighters fought as part of this coalition of U.S. Armed Forces, led by John Pershing, that fought in France during World War I.	<b><u>American Expeditionary Forces</u></b> [accept <b><u>AEF</u></b> ]
<b>3</b>	The Harlem Hellfighters included Bill Robinson, who became a famous dancer using this nickname.	<b><u>Bojangles</u></b>



### Question #29: Mathematics – Math Concepts

10 points

A system has this property if every statement in it can be either proved or disproved. The axiom that in the real numbers, every nonempty subset with an upper bound has a least upper bound means that the real numbers have this property. The number of edges of an undirected graph with this property equals a triangular number. To add a vertex to such a graph and maintain this property, it is necessary to add a number of edges equal to the previous number of **vertices** [VER-tuh-sees]. Such graphs have an edge connecting each pair of vertices. Name this adjective that generally refers to anything that has all of its possible parts.

**completeness** [accept longer answers like **logical completeness** or **logically complete**]

### Question #30: Literature – British Literature

10 points

Immediately prior to this event, its beneficiary was asked “Who watered the wick in Melbourne?”. The manager of a boarding house, Peter, did not attend this event, as he had arranged to play chess with friends. Before this event starts, Lulu shows up with a package. Held at the insistence of a Jew named Goldberg and an Irishman named McCann, this event is kicked off by Meg Boles playing a toy drum. Name this title celebration held for the benefit of Stanley Webber in a play by Harold Pinter.

the **Birth Party** [accept similar answers indicating a **celebration** for a **birthday**; prompt on answers indicating a **celebration** or **party** without specifying the occasion]



### Question #31: Social Studies – World History

10 points

<p>Before taking part in the Armenian genocide, Halil Kut lost control of this city to British troops under Frederick Maude. When this city was first built as al-Mansur’s capital, it was called “the Round City” or <b>Madinat al-Salaam [MAH-dee-not al-sah-LAHM]</b>, which means “City of Peace”. <b>Hulegu [HOO-luh-goo]</b> Khan captured and badly damaged this Abbasid capital in 1258, executing Al-Musta’sim. Firdos Square in this city held a statue that was toppled by Americans in 2003. Its museum was then looted, destroying many Mesopotamian artifacts. Name this national capital located on the Tigris River.</p>	<p><b>Baghdad</b>, Iraq</p>
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### Question #32: Science – Physics

10 points

<p>This quantity’s quantum mechanical operator is negative <math>\hbar^2</math> over <math>2m</math> times the <b>Laplacian [luh-PLAH-see-un]</b>. In <b>Lagrangian [luh-GRAHN-jee-un]</b> mechanics, this quantity is symbolized <math>T</math>, and in the definition of the Lagrangian a quantity symbolized <math>V</math> is subtracted from it. For a photon, this quantity is equal to Planck’s constant times the frequency. This quantity is equal to momentum squared over twice the mass. This quantity is not conserved in inelastic collisions, and is often defined as one-half times mass times speed squared. Name this energy that an object has because of its motion.</p>	<p><b>kinetic energy</b> [prompt on <b>energy</b>; accept just <b>kinetic</b> after “energy”; prompt on <b>KE</b>]</p>
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### Extra Question #1: Fine Arts – Art History

10 points

<p>Several paintings by this artist show the area around his home in <b>Bastide du Jas de Bouffan</b> [bah-steed doo zhah day boo-faw] in southern France. One of his paintings shows four skulls stacked in the shape of a pyramid. Another painting by this artist, in which 14 women are in the foreground in front of arched trees, is nicknamed <i>The Large Bathers</i>. Some of his paintings show Mount <b>Sainte-Victoire</b> [sent veek-twar]. A group of paintings this artist made during the 1890s show men at small tables, and sometimes one man is smoking a pipe. Name this post-Impressionist who painted <i>The Card Players</i>.</p>	<p>Paul <u>Cézanne</u></p>
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### Extra Question #2: Social Studies – U.S. History

10 points

<p>This justice wrote the unanimous opinion by which <i>Martha Lum</i> was excluded from white schools. As Chief Justice, he advocated for legislation to allow the Supreme Court to only issue rulings after writs of <b>certiorari</b> [ser-shee-uh-RAR-ee] were granted. While serving as Secretary of War, this person told Teddy Roosevelt that he would like to be Chief Justice, but Roosevelt encouraged him to run for president instead. He was eventually nominated to the Supreme Court in 1921 upon the death of Edward White, whom he had appointed. Name this Chief Justice, the only one to have also occupied the White House.</p>	<p>William Howard <u>Taft</u></p>
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### Extra Question #3: Mathematics – Math Concepts

*10 points*

One of the integral versions of this theorem sets the integral of a product of functions equal to a function value times the integral of one function. An extended version of this theorem, named for **Cauchy [koh-shee]**, uses two functions rather than one. **Rolle's [“role’s”]** theorem is a special case of this theorem, which is often used to prove the fundamental theorem of calculus, and is itself proved using the Intermediate Value Theorem. Name this theorem stating that somewhere in an interval, a differentiable function’s tangent line has the same slope as the secant line over that interval.

**mean value** theorem [accept **MVT**]

### Extra Question #4: Literature – U.S. Literature

*10 points*

In this story, one character’s “fineness of blood” was compared to “conventional heroes of romance”. A king in this story held that his subjects were “refined and cultured” through exhibitions of valor in the public arena, which always featured either hired wailers or an impromptu wedding. This story calls that king “semi-barbaric”. At this story’s climax, the princess gave a subtle signal for her lover to choose the door on the right. Name this Frank Stockton story in which the conclusion is never revealed.

“The **Lady or the Tiger?**”



**Extra Question #5: Science – Physics**

*10 points*

Laguerre [luh-GAIR] polynomials and the spherical harmonics appear in the wavefunction for this system. A transition in this system produces radiation with a 21-centimeter wavelength that permeates the universe. This system demonstrates energy splitting due to the Lamb shift and fine structure. This object's energy levels can be calculated with the Rydberg formula. This is the only system that fits the Bohr model, though the Bohr model was unable to explain why its spectral lines differed in brightness. Name this system, consisting of one electron orbiting one proton, comprising the simplest element.

**hydrogen** atom [accept **H**]



**Extra Question #6: Literature – U.S. Literature**

*10 points per part*

The detective who solved this woman’s murder did so using only newspaper reports.		
<b>1</b>	Name this “cigar-girl” who was hired by Monsieur Le Blanc to work in a perfume shop. Her body was found after it washed up on the shore.	<u>Marie Roget</u> or <u>Mary Cecilia Rogers</u> [accept any underlined name]
<b>2</b>	“The Mystery of Marie Roget” was written by this author as a follow-up to “The Murders in the Rue Morgue”.	Edgar Allan <u>Poe</u>
<b>3</b>	Marie’s body was eventually found on the shores of this river, across from the Rue Pavée-Saint-André.	<u>Seine</u> River

**Extra Question #7: Literature – U.S. Literature**

*10 points per part*

This title character is scared of “little formless fears” and of the sound of tom-toms.		
<b>1</b>	Name this former Pullman Porter who cultivated the myth that he could only be killed by a silver bullet.	Emperor ( <u>Brutus</u> ) <u>Jones</u> [accept either underlined name]
<b>2</b>	<i>The Emperor Jones</i> was written by this author.	Eugene (Gladstone) <u>O’Neill</u>
<b>3</b>	O’Neill wrote about the Tyrone family in this play.	<u>Long Day’s Journey into Night</u>



**Extra Question #8: Mathematics – Geometry**

*10 points per part*

The ancient Greeks studied problems related to constructing geometric figures with a compass and straightedge.		
<b>1</b>	The three major problems that remained unsolved by the Greeks were to construct a cube with twice the volume of a given cube, construct a square with the same area as a given circle, and to do this to any angle.	<b><u>trisecting</u></b> an angle [accept answers that mean <b><u>dividing by three</u></b> or <b><u>splitting into thirds</u></b> or <b><u>dividing into three</u></b> congruent parts]
<b>2</b>	This 19th-century French mathematician proved cube-doubling and angle-trisecting are sometimes impossible using only a straightedge and compass.	Pierre <b><u>Wantzel</u></b>
<b>3</b>	A ninety degree angle can be trisected by drawing an equilateral triangle. What is the degree measure of each angle of an equilateral triangle?	<b><u>60</u></b> degrees

**Extra Question #9: Mathematics – Geometry**

*10 points per part*

The altitudes of a triangle are the segments from one vertex that form a right angle with the opposite side, which may need to be extended.		
<b>1</b>	The three altitudes of a triangle meet at a single point, which is given this name.	<b><u>orthocenter</u></b>
<b>2</b>	In this type of triangle, two of the three altitudes are outside of the triangle.	<b><u>obtuse</u></b> triangle
<b>3</b>	Find the length of the altitude to the hypotenuse in an isosceles right triangle where each leg is of length twelve.	<b><u>6 root 2</u></b> [accept equivalents such as <b><u>6 radical 2</u></b> and <b><u>6 times the square root of 2</u></b> ]