## Question #1: Science – Chemistry

*10 points*

| | |
|---|---|
| The relative weakness of this effect in some atoms explains lanthanide [LAN-thun-"eyed"] contraction. A set of rules for calculating this effect multiplies by 0.85 for electrons in the $n-1$ orbital if you are measuring electrons in the $s$ and $p$ orbitals. That quantification of this effect, called Slater's rules, gives the difference between the nuclear charge and the effective nuclear charge. This effect explains why it is easier to remove valence electrons than other electrons from an atom. Name this effect in which the inner electrons of an atom cancel some of the positive charge of the nucleus. | (atomic) **shield**ing effect [accept **screening** effect; prompt on **effective nuclear charge** before it is "effective"] |

## Question #2: Literature – Grammar/Usage

*10 points*

| | |
|---|---|
| There are two different ways to order the letters in this language, the more recent one of which is based on the letters' shapes and the other of which is based on Phoenician [foh-NEE-shun]. This language uses diacritical marks such as the *fathah* [faht-hah] for short vowel sounds. Glottal stops in this language are marked with a *hamzah*. Letters with similar shapes in this language are distinguished based on dots above or below. The script used for this language, which is really an *abjad* rather than an alphabet, is also used for Pashto and Urdu. Like Persian and Hebrew, this language is written right-to-left. Name this language used widely in the Middle East. | **Arabic** [or **'arabiyy**ah] |

## Question #3: Social Studies – Religion

*10 points*

| One book by this person consists largely of dialogues between him and Reason, during which Reason asks a lot of questions. This author of *Soliloquies* wrote in another book "Narrow is the mansion of my soul; enlarge Thou it, that Thou mayest enter in." In another book, this person wrote about stealing pears with his friends before he was taught by St. Ambrose. One of his books contrasts the earthly city with the title location while defending Christians after the sack of Rome. Name this fourth- and fifth-century Christian bishop from Hippo, who wrote *The City of God* and *Confessions*. | Saint **Augustine** of Hippo |
|---|---|

## Question #4: Miscellaneous – Technology

*10 points*

| This company used the nickname "Bayrob" for a group of Romanian cybercriminals that it helped locate. In 2016, this company ended its longtime merger with Veritas Technologies. Greg Clark became the CEO of this company when it acquired his former company, Blue Coat Systems in 2016. In 2012, this company took over Verisign to become the largest issuer of SSL certificates; its biggest rivals in that area are Comodo and GoDaddy. Name this corporation that provides malware prevention with its Norton Security suite. | **Symantec** Corporation |
|---|---|

## Question #5: Social Studies – U.S. History

*10 points*

| | |
|---|---|
| This person was the last Confederate Secretary of War; after the Civil War he fled to the Caribbean and then Europe, but eventually returned home to Lexington, Kentucky. He became a U.S. senator in 1861 but was expelled after becoming a brigadier general for the Confederacy. He is the youngest vice president in U.S. history and was used for geographic balance on James Buchanan's ticket. Though John Bell won this person's home state in the election of 1860, this politician got the second-highest electoral vote total. Name this Southern Democratic presidential candidate in 1860. | John C(abell) **Breckinridge** |

## Question #6: Science – Health

*10 points*

| | |
|---|---|
| This type of cancer can be treated with vemurafenib [vem-YUR-uh-FEN-ib], which is marketed as Zelboraf [zel-BOR-af], and it is the deadliest condition treatable by Mohs surgery. Two types of cancer that are sometimes given a name specifically pointing out that they are *not* this type of cancer are squamous-cell carcinoma and basal-cell carcinoma. The ABCDE's, starting with 'A' for "asymmetry", are used to judge whether a mole is caused by this type of cancer. This cancer affects cells in the bottom layer of the epidermis, and is the deadliest type of skin cancer. Name this cancer that starts in the cells that produce skin color pigment. | **melanoma**(s) |

## Question #7: Mathematics – Algebra

*10 points per part*

| | *e* and the square root of 2 are examples of this kind of number. | |
|---|---|---|
| **1** | Name these numbers whose decimal representations never terminate or repeat. | **irrational** numbers or **irrational**s |
| **2** | This mathematician proved that there are more irrational numbers than rational numbers using what is called his "diagonal argument". | Georg (Ferdinand Ludwig Philipp) **Cantor** [GAY-ork **KAHN-tor**] |
| **3** | Give the simplified radical form for the cube root of 81. | $3\sqrt[3]{3}$ ["**3** times the **cube root** of **3**"] [do not prompt on partial answers] |

## Question #8: Mathematics – Algebra

*10 points per part*

| | This kind of mathematical thing is often defined using curly braces. | |
|---|---|---|
| **1** | Give this term for a list of elements in which neither repetition nor order matter. | **set**s [do not accept "data set(s)"] |
| **2** | If there are ten elements in the universal set and six elements in set $A$, how many elements are there in the complement of $A$? | **four** elements |
| **3** | The two laws named for this British mathematician are used to find the complements of the unions and intersections of sets. | Augustus **De Morgan** [prompt on **Morgan**] |

## Question #9: Science – Chemistry

*10 points per part*

| | Dacron was one of the first commercially successful examples of this class of molecules. | |
|---|---|---|
| 1 | Identify this polymer that is named in part for the organic groups that make it up. Those groups have a carbon atom single-bonded to one oxygen atom and double-bonded to another. | **polyester**s |
| 2 | Polyesters are often prepared by combining a carboxylic ["CAR-box-ILL"-ik] acid with a compound from this organic functional group. This group has a saturated carbon atom bonded to a hydroxyl ["hide-ROCKS-ill"] group. | **alcohol** group or **alcohol**s |
| 3 | Polyesters, like hydrocarbons in general, can be described as aromatic, or by this term if they do not have aromatic rings. | **aliphatic** [al-iff-AT-ik] compounds |

## Question #10: Science – Chemistry

*10 points per part*

| | This was the first person to have an element named for him while he was still alive; Yuri Oganessian [oh-guh-NESS-ee-un] was the second. | |
|---|---|---|
| 1 | Name this American scientist who played a central role in discovering several transuranic ["trans"-yur-AN-ik] elements. | Glenn T(heodore) **Seaborg** |
| 2 | After Edwin McMillan led a team that discovered neptunium [nep-TOO-nee-um], Seaborg used the beta decay of neptunium to create this element. | **plutonium** |
| 3 | Nucleosynthesis processes are classified based on the speed of neutron capture. The s-process is the slow process. What letter is used for faster neutron captures? It's not 'F'. | **r**-process [or **r**-capture] |

## Question #11: Social Studies – World History

*10 points per part*

| | King George II of Great Britain died during this series of conflicts. | |
|---|---|---|
| 1 | Name these conflicts among European powers. Their Indian theater was the Third Canatic War, and their American theater was the French and Indian War. | **Seven Year**s' War |
| 2 | During the Seven Years' War, Austria tried to regain control of this region from Prussia. This region is now mostly in Poland. | **Silesia** ["sigh"-LEE-zhuh] |
| 3 | This British major-general fought in all three Carnatic Wars and was the winner of the Battle of Plassey. | Robert **Clive** |

## Question #12: Social Studies – World History

*10 points per part*

| | At the same time that Egypt and Syria formed the United Arab Republic, these two countries formed the Arab Federation. | |
|---|---|---|
| 1 | Name these countries that were headed by members of the Hashemite [HASH-em-ait] family. | **Iraq** and **Jordan** [either order] |
| 2 | Because this territory was part of Jordan at the time, it was part of the Arab Federation. This territory was taken over by Israel in the Six-Day War and is now the larger part of the Palestinian territories. | **West Bank** [or ha-**gadah** ha-**ma'aravit** or ad-**diffah** i-**garbiyyah**] |
| 3 | The Arab Federation was headed by this last King of Iraq until he was killed in a revolution. | **Faisal II** [prompt on **Faisal**] |

## Question #13: Fine Arts – Jazz

*10 points per part*

| | This song was written by Paul Desmond, who said, "It was never supposed to be a hit — it was supposed to be a Joe Morello drum solo." However, it became a hit after Morello's drum solo was cut. | |
|---|---|---|
| 1 | Name this song from the album *Time Out*, which is written in an unusual quintuple meter. | "**Take Five**" |
| 2 | "Take Five" was a hit for the this pianist's quartet. | (David Warren) "Dave" **Brubeck** |
| 3 | Name the first song on *Time Out*. Inspired by street musicians, it is partly in 9/8 ["nine eight"] time. | "**Blue Rondo à la Turk**" [prompt on "**Blue Rondo**"] |

## Question #14: Fine Arts – Jazz

*10 points per part*

| | This musician claimed that his audience invented the term "bebop". | |
|---|---|---|
| 1 | Name this trumpeter known for his bent horn and large cheeks. | (John Birks) "Dizzy" **Gillespie** |
| 2 | Gillespie claimed to have composed this song, which is instrumental except for the several times when the title is said twice. Glenn Miller recorded a very similar song several years before Gillespie. | "**Salt Peanuts**" |
| 3 | Gillespie often collaborated with this Canadian piano player, who was nicknamed the "Maharaja of the keyboard". He was also known for his rendition of "C Jam Blues". | Oscar (Emmanuel) **Peterson** |

## Question #15: Literature – Mythology

*10 points*

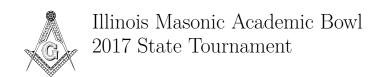| | |
|---|---|
| This god is served by the messenger Paynal, and his brothers include the gods of the southern stars, the Centzon Huitznaua [SENT-zohn weets-"NOW"-ah]. The dedicatee of the month of Panquetzaliztli [pahn-KAYTZ-uh-liz-tlee], he was depicted holding a "fire serpent". In one legend, the moon was formed after this god decapitated his sister, Coyolxauhqui [KOH-yohl-SHAO-kee]. This god and his brother Quetzalcoatl [KET-zahl-koh-AH-tul] were told to make the world orderly. This god was conceived when a ball of feathers fell on his mother Coatlicue [koh-AHT-lee-kway]. Name this Aztec god of war and the Sun. | **Huitzilopochtli** [**WEET-zee-loh-"POKED"-lee**] [prompt on answers containing **hummingbird**] |

## Question #16: Science – Physics

*10 points*

| | |
|---|---|
| The curve with this name shows the stopping power on charged particles as they move through matter with respect to path length, and has a peak also known by this name before falling to 0. The condition with this name leads to the constructive interference of radiation scattered by a crystal. The law with this name is equivalent to the Laue [LAO-uh] equations for determining when diffraction occurs from a crystal lattice. This name comes from the father-son team that shared a Nobel Prize in Physics for using X-rays to analyze crystal structure. Give this name used for the law stating that twice distance times sine theta equals an integer times wavelength. | **Bragg**('s) [accept more specific answers] |

## Question #17: Social Studies – U.S. Government

*10 points*

| One of the undersecretaries of this cabinet-level department oversees the National Institute of Standards and Technology, and another one oversees the Patent and Trademark Office. This department worked with the European Commission to create a Privacy Shield Framework to help companies meet EU data protection requirements. This department was joined with the Labor Department until 1913. Its mission is "to create the conditions for economic growth and opportunity". Name this department recently headed by Penny Pritzker. | United States Department of **Commerce** [or **Commerce** Department] |
|---|---|

## Question #18: Mathematics – Math Concepts

*10 points*

| One type of this shape can be generated by the equation $r^3 = 4x^2y^2$ ["*r* cubed equals 4 *x* squared *y* squared"] and is called a quadrifolium ["quad"-rih-FOH-lee-um]. The area enclosed by this curve equals one-half pi times the square of the size parameter if the other parameter is even, or half that if the other parameter is odd. If the non-size parameter is not an integer, then this shape overlaps itself. The number of enclosed curves making up this shape equals the non-size parameter if that parameter is odd, and it is twice that parameter if it is even. Name this shape generated by the equation $r$ equals the sine of $k$ theta, in which $k$ determines the number of petals. | **rose** [accept quadri**folium** before "quadrifolium"] |
|---|---|

## Question #19: Fine Arts – Art History

*10 points*

| This artist placed nine different moldings of different parts of a man's body — each its own color — above a picture of blue and yellow concentric circles with a red background; he called that work *Target with Plaster Casts*. This artist's painting *Map* shows the United States with the name of each state stenciled on it. Though it cannot be seen from afar, there is newsprint in his most popular piece, which depicts an object that this artist showed in many works, including one that is almost entirely white. Name this artist who used encaustic and plaster to depict U.S. flags. | Jasper **Johns** |
|---|---|

## Question #20: Literature – U.S. Literature

*10 points*

| In one of this man's castles, the suites had "sharp turns at every twenty or thirty yards" such that one could only see one suite at a time; that castle also contained arabesque figures and a giant ebony clock. This man met his fate shortly after midnight after running from the blue room to the velvet room, and he fell on his dagger upon seeing an uninvited guest. After five or six months of seclusion, this person hosted a masked ball for a thousand friends. Name this prince whose guests were exposed to the "red death" in an Edgar Allan Poe story. | Prince **Prospero** |
|---|---|

## Question #21: Science – Biology

*10 points per part*

| | This type of bond joins a carboxyl ["car-BOX-ill"] group and an amino group, and may be created by a dehydration synthesis reaction. | |
|---|---|---|
| **1** | Name these bonds between amino acids that are used to form proteins. | **peptide** bonds |
| **2** | These common enzymes, a subcategory of hydrolase ["HIDE-row-lace"] enzymes, break up proteins by the hydrolysis ["hide"-RAH-luh-siss] of peptide bonds. | **protease**s ["**PRO-tee-ace**"z] [or **peptidase** or **proteinase** or **proteolytic** enzyme] |
| **3** | Trypsin ["TRIP-sin"] and elastase [eh-"LAST-ace"] are proteases named for this amino acid because their active site always includes this amino acid. | **serine** [**SAIR-een**] proteases |

## Question #22: Science – Biology

*10 points per part*

| | This factor is named for a monkey in northern India and Pakistan. | |
|---|---|---|
| **1** | Name this blood type used to screen for hemolytic [hee-moh-LIT-ik] disease of newborns. | **rh**esus [REE-suss] factor or **rh**esus blood group system |
| **2** | If a person is described as Rh-positive, it means that they have the antigen named with this letter. | **D** antigen |
| **3** | Hemolytic disease of the newborn involves a high concentration of this substance in the blood. This substance causes skin to turn yellow during jaundice. | **bilirubin** |

## Question #23: Literature – U.S. Literature

*10 points per part*

| | In one poem, Christ is seen through flag-filled air, and crowns this person as King Jesus. | |
|---|---|---|
| 1 | Name the title character of that poem. His followers include walking lepers, vermin-eaten saints, and unwashed legions, and the speaker of the poem frequently asks "Are you washed with the blood of the lamb?". | General **William Booth** [accept either] |
| 2 | "General William Booth Enters into Heaven" is by this poet, an Illinois native who also wrote "The Congo." | (Nicholas) Vachel **Lindsay** |
| 3 | Booth was a real person who earned his title from founding this organization. George Bernard Shaw's Major Barbara also earned her title in this organization. | the **Salvation Army** |

## Question #24: Literature – U.S. Literature

*10 points per part*

| | This poem opens in a dive on 52nd Street, where "faces along the bar cling to their average day." | |
|---|---|---|
| 1 | Name this poem that states the public knows "what all schoolchildren learn / those to whom evil is done / do evil in return". | "**September 1, 1939**" |
| 2 | This English-American poet wrote "Musée de Beaux-Arts [myoo-zay day boh-zart] Arts" and "September 1, 1939". | W(ystan) H(ugh) **Auden** |
| 3 | Auden's "The Sea and the Mirror" is a commentary on this play, whose main antagonist is the son of the Algerian witch Sycorax ["SICK-or-axe"]. | The ***Tempest*** |

## Question #25: Social Studies – Economics

*10 points per part*

| | The misery index combines this rate with the unemployment rate. | |
|---|---|---|
| **1** | Name this increase in prices over time. | **inflation** [or **inflating**] |
| **2** | When comparing commodity prices over time, the real value takes inflation into account. What adjective is used when prices are tracked over time without accounting for inflation? | **nominal** prices |
| **3** | This economist's *Appreciation and Interest* supported using real interest rates instead of nominal ones, which are related by his namesake equation. In his separation theorem, corporations maximize present value. | Irving **Fisher** |

## Question #26: Social Studies – Economics

*10 points per part*

| | William Stanley Jevons wrote "We are always starting clear at each moment, judging the values of things with a view to" this economic concept. | |
|---|---|---|
| **1** | Give this term that refers to the ability of a good or service to satisfy a consumer. Jeremy Bentham developed a philosophy based on maximizing this concept. | **utility** [accept **utilitarian**ism] |
| **2** | On a graph where the axes represent different goods, this is the name of a curve along which utility is constant. | **indifference** curve |
| **3** | Leontief functions are useful for measuring utility when the indifference curve is 'L'-shaped, which occurs when two goods have this relationship. Increased demand for one of these goods leads to increased demand for the other. | **complement**ary goods or **complement**s |

## Question #27: Mathematics – Analytic Geometry

*10 points per part*

| | A shape is formed by connecting its vertices, which are at the points $(0, 2)$ ["0 comma 2"], the point $(2, 0)$, the point $(5, 0)$, the point $(5, 2)$, and then back to the original point at $(0, 2)$. | |
|---|---|---|
| **1** | Find the area of the shape. | **8** |
| **2** | Find the perimeter of the shape. | $\underline{\mathbf{10 + 2\sqrt{2}}}$ ["**10 plus 2** times the square **root** of **2**" or "**10 plus 2** times **radical 2**"] or $\mathbf{2\sqrt{2} + 10}$ |
| **3** | The shape given is a trapezoid because the top and bottom of it have this relationship to each other. | they are **parallel** line segments |

## Question #28: Mathematics – Analytic Geometry

*10 points per part*

| | The equation $x^2 + y^2 - z^2 = 0$ ["$x$ squared plus $y$ squared minus $z$ squared equals 0"] generates two of these shapes, meeting at their apexes. | |
|---|---|---|
| **1** | Name this type of quadric surface. | **cone**(s) |
| **2** | Find the volume inside the cone generated by the equation $x^2 + y^2 - z^2 = 0$ ["$x$ squared plus $y$ squared minus $z$ squared equals 0"] between $z = 0$ and $z = 1$. | $\mathbf{1/3\ \pi}$ or $\boldsymbol{\pi/3}$ |
| **3** | Using the same equation, find the positive value of $z$ if $x$ and $y$ each equal 1. | $\boldsymbol{\sqrt{2}}$ ["the square **root** of **2**" or "**radical 2**"] |

## Question #29: Social Studies – World History

*10 points*

| | |
|---|---|
| Abu Zakariya Yahya al-Wattasi of Fez defeated this person's Siege of Tangiers [tan-zheer], during which this person's brother Ferdinand the Holy Prince — who later died in captivity — was given to the Marinids. This person worked with his brother the Infante Pedro when Pedro became regent for Afonso V after their older brother Duarte [DWAR-tay] died. This person supported Gil Eanes [zhil ee-UH-nish] going past Cape Bojador [boh-zhuh-DOR], which is in what is now Western Sahara, and he also supported Alvise Cadamosto's [ahl-VEE-zih kah-thah-MOHSH-too'z] explorations of the Cape Verde Islands. Name this 15th-century Portuguese prince who sponsored many explorers. | Prince **Henry the Navigator** [or Infante **Henrique** of Portugal or the **Duke of Viseu**; prompt on **Henry**] |

## Question #30: Science – Biology

*10 points*

| | |
|---|---|
| Two of this molecule are combined at the beginning of the mevalonate [muh-VAL-un-"ate"] pathway, which produces terpenoids [TURP-uh-noydz]. Though this molecule is not used in the electron transport chain, it is produced by fatty-acid beta-oxidation. This molecule is also created by the pyruvate dehydrogenase ["pie"-ROO-vayt dee-"hide"-RAH-jun-"ace"] reaction. This molecule provides carbon atoms when it reacts with oxaloacetate ["OX-uh-low" ASS-uh-tayt] to form citrate ["SIT-rate"] during the Krebs cycle. Identify this molecule named for a functional group and a co-enzyme. | **acetyl coenzyme A** or **acetyl CoA** [do not prompt on partial answers] |

## Question #31: Literature – British Literature

*10 points*

| A queen purchases this character from a farmer for 1,000 pieces of gold after this character offers the farmer gold and coins. This former business partner of James Bates took a job on board a ship that succumbed to a storm in the East Indies, the *Antelope*. He is accused of treason for putting out a fire with urine, and he became embroiled in a war over how to crack an egg. This character encounters a group of continuously-aging immortals, the Struldbrugs. Name this doctor whose travels to Laputa and Lilliput are the subject of a Jonathan Swift novel. | (Dr.) **Lemuel Gulliver** [accept either underlined name] |
|---|---|

## Question #32: Mathematics – Math Concepts

*10 points*

| An abelian [uh-BEE-lee-un] group can be described by this adjective if it is cyclic and its order is a prime number. In general, a group is described by this word if all of its non-trivial proper subgroups are normal. A graph can be called either this adjective or strict if it does not have any loops or multiple edges. This word describes a root of a polynomial whose multiplicity [mul-tih-PLISS-ih-tee] is 1. This term describes curves and polygons that do not intersect themselves. Give this adjective for interest that accrues only on the principle, as contrasted with interest accruing on both the principal and previous interest, which is called compound interest. | **simple** |
|---|---|

## Extra Question #1: Fine Arts – Classical Music & Opera

*10 points*

| | |
|---|---|
| Ralph [rayff] Vaughan Williams' last concerto was written for this instrument, which premiered featuring Philip Catelinet. Some of the most respected 20th-century performers on this instrument were William Bell, Arnold Jacobs, and Harvey Phillips. This is the featured instrument in Michael Daugherty's *Reflections on the Mississippi.* A special kind of this instrument has features similar to the French horn and was developed for use in the opera *Das Rheingold.* This instrument is similar to, but pitched lower than, the euphonium [yoo-FOH-nee-um]. Name this large, low brass instrument. | **<u>tuba</u>** |

## Extra Question #2: Literature – British Literature

*10 points*

| | |
|---|---|
| Shortly after giving this speech, the speaker states "All things are ready, if our minds be so." Its speaker is "not covetous for gold", and argues "If it be a sin to covet honour, I am the most offending soul alive." The speaker of this speech claims that gentlemen should "think themselves accursed they were not here, and hold their manhoods cheap". This speech is addressed to "we few, we happy, we band of brothers" before the battle of Agincourt [ah-zheen-kor]. Name this speech given by Henry V in the Shakespeare play named for him. | St. **<u>Crispin</u>**'s Day speech [prompt on **<u>Henry V</u>**] |

## Extra Question #3: Social Studies – World History

*10 points*

| | |
|---|---|
| Though the capital of this empire probably moved a few times, the best evidence for its capital is in the El Ghaba Section of Kumbi. The final blow against this empire was probably dealt by Sundiata Keita in the 13th century, though it was weakened by the southern expansion of the Almoravids under Abu Bakr. The modern name for this empire originally referred to its warrior kings, and is also the name of a small modern-day country that is south of where this empire was. Name this empire that was wealthy due to its salt and gold trade, and that was located in what is now Mauritania and Mali. | **Ghana** Empire [or **Wagadu** or **Awkar**] |

## Extra Question #4: Science – Earth Science

*10 points*

| | |
|---|---|
| These locations are between the Hadley Cells and the Ferrel Cells, which is why they are the source of the westerlies and the trade winds. These areas of high pressure experience little precipitation and are sometimes called the calms or the subtropical highs. Though their location changes during the year, these regions are both about 30° and 35° north and south latitude. One theory for the name of these objects comes from celebrations that debts have been paid off. Identify these places whose name may derive from the practice of throwing animals overboard a ship running out of drinking water. | **horse latitude**s [accept **calm**s or **subtropical high**s before they are mentioned; accept **horse** after "latitude"] |

## Extra Question #5: Mathematics – Math Concepts

*10 points*

| | |
|---|---|
| The four exponentials conjecture says that of four numbers satisfying particular properties, at least one must be in this set. The first numbers shown to be in this set were the Liouville [lee-oo-veel] numbers. It is an immediate consequence of the Lindemann-Weierstrass ["VIE"-ur-shtrass] theorem that $e$ is this kind of number, and it is also easy to show that $\pi$ ["pi"] is this kind of number. This subset of the irrational numbers is defined by the fact that its elements are not solutions to any polynomial with integer coefficients, so although $\sqrt{2}$ ["the square root of 2"] is irrational, it is *not* this kind of number. Name this set contrasted with algebraic numbers. | **transcendental** numbers or **transcendental**s |

## Extra Question #6: Social Studies – U.S. History

*10 points per part*

| | Two members of this family from Virginia signed the Declaration of Independence. | |
|---|---|---|
| 1 | Name this family. The leading Confederate general during the Civil War was descended from it. | **Lee** family or **Lee**s |
| 2 | This was the nickname commonly used to refer to Robert E. Lee's father, Henry Lee III, who was a cavalry officer. | **Light-Horse Harry** Lee [prompt on partial answers] |
| 3 | During the Revolutionary War, Light-Horse Harry Lee captured Fort Watson and Fort Motte while working with this general nicknamed "The Swamp Fox". | Francis **Marion** |

## Extra Question #7: Social Studies – U.S. History

*10 points per part*

| | This person and his followers lived in the California desert during the 1960s until he was imprisoned for several murders, including that of the actress Sharon Tate. | |
|---|---|---|
| 1 | Name this person who carved an 'X' into his forehead just before his trial. He later turned that 'X' into a swastika. | Charles (Milles) **Manson** [or Charles (Milles) **Maddox**] |
| 2 | Manson predicted a race war, which he named for this song on the Beatles' *White Album.* | "**Helter Skelter**" |
| 3 | While Manson was in prison in 1975, his follower "Squeaky" Fromme attempted to assassinate this U.S. President, but her gun did not go off. | Gerald (Rudolph) **Ford** (Jr.) [or Leslie Lynch **King** Jr.] |

## Extra Question #8: Mathematics – Probability

*10 points per part*

| | This law states that as the number of trials increases, the sample mean approaches the theoretical mean. | |
|---|---|---|
| **1** | Name this law whose weak version describes the limit of a probability, while the strong version describes the probability of a limit. | (weak or strong) law of **large numbers** |
| **2** | This theorem states that as the number of trials increases, the sample distribution approaches a normal distribution. | **central limit** theorem |
| **3** | If a card is selected randomly from a deck and replaced 100 times, what is the expected number of times that the card will be a club? | **25** |

## Extra Question #9: Mathematics – Probability

*10 points per part*

| | In this situation, two people who are not cooperating have nothing to gain by switching strategies. | |
|---|---|---|
| **1** | Identify this situation named for a Nobel laureate in Economics who passed away in 2015. | **Nash equilibrium** |
| **2** | Nash equilibrium is a concept used in economics and this branch of mathematics. Many of the situations studied in this branch are classified as zero-sum. | **game** theory |
| **3** | Both participants in a game get 10 points if they both cooperate, and 6 points if each betrays the other. If one person cooperates and the other betrays, the betrayer gets 20 points and the cooperator gets 0 points. Find the expected number of points if each participant has a 50% chance of using each strategy. | **9** points |