



### Question #1: Science – Chemistry

10 points

<p>A mixture containing the sulfide of this ion is called white liquor, and is used at the beginning of the Kraft process to break down wood. To produce aluminium oxide in the Bayer process, this ion combines with <b>hydroxide</b> [“hide-ROCK-side”], then <b>aluminate</b> [al-OOM-in-“ate”], and then <b>carbonate</b> [“CAR-bun-ate”]. The <b>hypochlorite</b> [“hype-oh”-KLOOR-“ite”] of this ion, dissolved in water, forms bleach. This ion is combined with glutamic acid to make a food additive commonly used in Asian food, MSG. This is the <b>cation</b> [“CAT-ion”] in <b>halite</b> [“HAY-light”] and in baking soda. Name this ion that combines with <b>chloride</b> [KLOH-“ride”] to make table salt.</p>	<p><b>sodium</b> ion [or <b>Na<sup>1+</sup></b> or <b>Na<sup>+1</sup></b> or <b>Na<sup>+</sup></b>]</p>
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### Question #2: Miscellaneous – Agriculture

10 points

<p>The <b>colpodea</b> [“coal”-POH-dee-uh] subspecies of this organism is primarily found in Arctic regions. The Adelphi and Midnight varieties of this organism are better for southern climates than Touchdown and Bristol. This organism’s scientific name comes from the Latin for “meadow” and the Greek for “fodder”. Bentgrass, ryegrass, and this grass are the most popular for lawns in the United States. Name this grass whose colored flowers inspired Kentucky’s nickname.</p>	<p>Kentucky <b>bluegrass</b> [or <b>Poa pratensis</b>; accept <b>meadow grass</b> before “meadow”; prompt on <b>grass</b>]</p>
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**Question #3: Social Studies – U.S. Government**

10 points

This program was renamed in 1980 to honor a U.S. Senator from Rhode Island who served from 1961 to 1997. Because this program spent less money than expected in 2016, some Congressmen tried to reinstate it as a year-round program and allow it to spend more than \$6,000 per recipient per year. The institute that shares its name with this program conducts research on disabled, low-income, and first-generation college students. This program used to be known as the Basic Educational Opportunity Grant. Name this need-based program that gives money to students working on a bachelor's degree.

Pell Grant

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

10 points

In this novel, one character tells another “You’d drink out of a gutter if you was thirsty.” A former prizefighter in this novel uses a Vaseline-filled glove to keep his hand soft, but after he picks a fight to defend his flirtatious wife, that man’s hand is crushed. After a meeting at the Salinas river, one protagonist of this novel is shot in the back of the head to spare him from the lynch mob that wants to avenge the death of Curley’s wife. Name this novel about the farmhands George and Lennie, written by John Steinbeck.

*Of Mice and Men*



**Question #5: Science – Astronomy**

*10 points*

<p>A 2016 observation of one of these objects confirmed <b>Werner Heisenberg’s [VAIR-nur “HIGH”-sen-bairk’s]</b> predictions about magnetic fields changing light polarity, a phenomenon called vacuum <b>birefringence [“by”-ree-“FRINGE”-inss]</b>. The surfaces of these objects consist of dense iron aligned with a very strong magnetic field, and their interiors do not contain atoms. These objects are formed when a star collapse has too much mass to form a white dwarf but not enough mass to form a black hole. Magnetars are a type of these objects, as are the objects discovered in 1967 by Jocelyn Bell Burnell and Antony Hewish, pulsars. Name these very dense objects that are named for the subatomic particle that makes up most of them.</p>	<p><b>neutron stars</b> [prompt on <b>stars</b> or compact <b>stars</b>; prompt on <b>magnetars</b> or <b>pulsars</b> before they are mentioned]</p>
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**Question #6: Social Studies – World History**

*10 points*

<p>A rumor that this leader would arrive rallied his troops fighting under Man Singh at the Battle of <b>Haldighati [hal-dig-HAH-tee]</b>, causing a retreat of the Rajputs, who were led by <b>Maharana Pratap [mah-hah-RAH-nah PRAH-tahp]</b>. Earlier, this person massacred the inhabitants of <b>Chittorgarh [chih-TOR-gar]</b> Fort, strengthening his control of Mewar. Earlier than that, this person’s guardian Bairam Khan won an important victory when Hemu was hit in the eye by an arrow in 1556 at the Second Battle of Panipat. Name this son of Humayun, a strong supporter of the arts who expanded the Mughal Empire.</p>	<p>(Abu’l-Fath Jalal ud-din Muhammad) <b>Akbar</b> (I or the Great)</p>
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**Question #7: Mathematics – Geometry**

*10 points per part*

In a triangle, these segments divide a side of the triangle so that the lengths of the parts are proportional to the lengths of the other sides.		
<b>1</b>	Name these segments that divide angles in half.	angle <b>bisectors</b>
<b>2</b>	A triangle's angle bisectors intersect at this center of the circle.	<b>incenter</b> [accept center of the <b>inscribed circle</b> or center of the <b>incircle</b> ]
<b>3</b>	If the circle inscribed in a triangle has a radius of 3, and the perimeter of the triangle is 12, find the area of the triangle.	<b>18</b> square units

**Question #8: Mathematics – Geometry**

*10 points per part*

In a circle, this term refers to the distance from the center of the circle to the midpoint of a chord.		
<b>1</b>	Give this term that in a regular polygon refers to the distance from the center of the polygon to the midpoint of a side.	<b>apothem</b> [AP-uh-thum]
<b>2</b>	In a circle, this term refers to the segment going from the midpoint of a chord to the nearest point on the circle. Its length is therefore the radius minus the length of the apothem.	<b>sagitta</b>
<b>3</b>	If a circle has a radius of 6 and a chord in it has a length of 10, find the length of the apothem.	<b><math>\sqrt{11}</math></b> ["the square <b>root</b> of <b>11</b> " or " <b>radical 11</b> "] units



**Question #9: Literature – Mythology**

*10 points per part*

<p>Proteus [PROH-tee-uss] asked his father-in-law Iobates [“eye”-AH-buh-teez] to kill this hero.</p>		
1	Name this Corinthian. To avoid the Olympians’ wrath, Iobates sent him to slay the fire-breathing monster ravaging Lydia.	<u>Bellerophon</u>
2	Bellerophon was aided in his quest by this winged horse that emerged from the neck of the slain Medusa.	<u>Pegasus</u>
3	Polyeidos [pah-lee-AY-dohss] suggested Bellerophon spend a night in the temple of this goddess and offer her gifts. As a result, this goddess gave Bellerophon a golden bridle and told the hero where to find Pegasus.	<u>Athena</u> [accept <u>Minerva</u> ]

**Question #10: Literature – Mythology**

*10 points per part*

<p>The name of this primordial god translates as “the male who invites”, and he was told to speak first before procreating with his wife.</p>		
1	Name this god who ventured to the underworld after his wife died. Upon sealing the entrance to Yomi, he promised to create 1500 people each day.	<u>Izanagi</u> [ <u>ee-zah-nah-gee</u> ]
2	Izanagi and Izanami [ <u>ee-zah-nah-mee</u> ] are the primordial gods of this Japanese religion.	<u>Shintoism</u>
3	Izanami died after she gave birth to Kagu-Tsuchi [ <u>kah-goot soo-chee</u> ], the god of this. During Ragnarök, Surt will envelop the earth in this.	<u>fire</u> or <u>flames</u>



**Question #11: Fine Arts – Musical Theatre**

*10 points per part*

This musical includes the song “All That Jazz”, which in turn became the title of a movie about this show’s choreographer, Bob Fosse [FAW-see].		
<b>1</b>	Name this musical about Velma Kelly and Roxie Hart, two murderers.	<u><i>Chicago</i></u>
<b>2</b>	<i>Chicago</i> is one of many collaborations between this composer and lyricist Fred Ebb.	John <u>Kander</u>
<b>3</b>	The prisoners are overseen by Matron Morton, who goes by this nickname. In one song, she sings that if you’re good to her, then she’ll be good to you.	“ <u>Mama</u> ” Morton

**Question #12: Fine Arts – Musical Theatre**

*10 points per part*

This musical opens with the protagonist being thrown into a dungeon by the Spanish Inquisition.		
<b>1</b>	Name this musical set around a mock trial of the protagonist, who sings “The Impossible Dream”.	<u><i>Man of La Mancha</i></u>
<b>2</b>	The subject of the trial is this man. During the musical, he takes on the additional persona of his character Don Quixote.	Miguel de <u>Cervantes</u> (Saavedra)
<b>3</b>	This song in the musical is based on the nickname that the Innkeeper gives to Don Quixote. This song praises Quixote’s glorious deeds.	“ <u>Knight of the Woeful Countenance</u> ”



**Question #13: Science – Biology**

*10 points per part*

In humans, this organ includes the vestibular system — which provides balance — in its labyrinth.		
<b>1</b>	Name this organ whose inner section also includes the <b>cochlea</b> [“COKE”-lee-uh].	(inner) <b>ear</b> (s)
<b>2</b>	This organ, also called the spiral organ, is on the <b>basilar</b> [BASS-ih-lur] membrane inside the cochlea. Its hair cells help convert sounds into nerve signals.	organ of <b>Corti</b>
<b>3</b>	The inner ear contains two fluid-filled cavities for detecting acceleration and head tilts. The smaller one is called the <b>saccul</b> e [“SACK-you”-ul], and this is the name for the larger one.	<b>utricle</b> [“YOU-trickle”] or <b>utriculus</b> [“you-TRICK-you”-luss]

**Question #14: Science – Biology**

*10 points per part*

These DNA sequences are often used in paternity tests and to link diseases to <b>genotypes</b> [“GENE-oh-types”].		
<b>1</b>	Name these sequences with a known location on a chromosome that are used to identify the chromosome and to track nearby genes.	genetic <b>markers</b>
<b>2</b>	These sequences of two to four base pairs, repeated many times, are often used as genetic markers.	<b>microsatellites</b> [do not accept “minisatellite”]
<b>3</b>	Scientists often use markers in the DNA found in this organelle. Its DNA is inherited only from the mother. This organelle often called the powerhouse of the cell.	<b>mitochondria</b> [“might-oh-CON”-dree-uh] or <b>mitochondrion</b> [accept <b>mitochondrial</b> DNA]



**Question #15: Mathematics – Math Concepts**

10 points

Solutions to this kind of problem sometimes use a barrier function that approaches infinity near a boundary, or a penalty function that takes a negative value after the boundary is crossed. The simplex method is used to solve problems of this type that involve simple functions, which are called linear programming problems. Many games, including prisoner’s dilemma, are this type of problem. In calculus classes, these problems are often solved by finding points at which the first derivative is undefined or zero. Name these problems in which an objective function is supposed to be maximized or minimized.

**optimization** problems [accept word forms; prompt on **maximizing** or **minimizing** or word forms thereof; accept **linear programming** between “simplex” and “linear”]

**Question #16: Literature – World Literature**

10 points

One character in this play says “We may be your fortune”, then calls herself a two-months’ orphan and demonstrates that she can sing and dance. In this play, items being placed on pegs summons Madame **Pace** [PAH-chay]. Most of the minor characters in this play are rehearsing a performance of *Mixing it Up*. After a gunshot kills one of the title characters, another character complains “I’ve lost a whole day over these people!”. The Father, Step-Daughter, and four others seek a writer in what play by Luigi Pirandello?

*Six Characters In Search of an Author* [accept *Sei personaggi in cerca d’autore*]





**Question #17: Science – Physics**

10 points

Low resistance in one part of this device leads to the overheating and shorting of the other part. **Magnetorestriction** [“mag-NET-oh-restriction”] explains why this device makes a humming sound. William Stanley combined the Gaulard-Gibbs and ZBD designs for these devices and sold it to the Westinghouse Electric Company, which led to the War of Currents favoring alternating current. For these devices, the ratio of the primary and secondary potential differences equals the ratio of the number of loops in each coil. Name these devices that can “step up” or “step down” voltage.

electrical **transformers**

**Question #18: Fine Arts – Art History**

10 points

One painting by this artist shows a young woman with a red hat and her younger sister with flowers in her hat on the terrace of the **Maison Fournaise** [my-saw for-nyze] with a basket with balls of yarn. This painter showed a woman looking over the back of the bench she is on, with another woman looking over her, during an afternoon outdoor dance. Another painting by this artist shows a man seated backwards on a chair facing a table while a woman in a flowered hat plays with a dog on the table. That painting is set at the same place as *Two Sisters*. Name this painter of *Dance at Le moulin de la Galette* and *Luncheon of the Boating Party*.

**Pierre-Auguste Renoir**  
[pyair oh-goost ren-war]



**Question #19: Social Studies – U.S. History**

10 points

<p>This law was weakened by the <b>Gekas [GAY-kas]</b> Amendment, which lowered the time limit when it is applied. Some interim parts of this act were found to be in violation of the 10th Amendment in the <i>Printz v. United States</i> decision written by Antonin <b>Scalia [skuh-LEE-uh]</b>. This act was named for the White House Press Secretary at the beginning of the Reagan administration, and led the FBI to create the National Instant Criminal Background Check System. Name this bill opposed by the National Rifle Association that initially created a five-day waiting period for gun purchases.</p>	<p><b>Brady</b> Handgun Violence Prevention Act or <b>Brady</b> Bill [or <b>Brady</b> Law]</p>
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**Question #20: Literature – British Literature**

10 points

<p>In <i>A House on Mango Street</i>, <b>Meme [MAY-may]</b> breaks both arms doing an imitation of this character. Nikolai Rokoff engineered a duel in which this man refused to fire on Count Raoul de <b>Coude [code]</b>. This character's son took the name Korak, but was given the name Jack at birth. Kerchak killed this man's father, who was John Clayton II, Lord Greystoke. As a child, this person was adopted by the Mangani. Name this husband of Jane Porter who, in a series of books by Edgar Rice Burroughs, was raised by apes.</p>	<p><b>Tarzan</b> of the Apes [accept Lord/Viscount <b>Greystoke</b> or John <b>Clayton</b> before they are mentioned]</p>
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**Question #21: Social Studies – U.S. History**

*10 points per part*

This person took over the military of the California Republic during the Mexican-American War.		
<b>1</b>	Name this person who became the first Republican presidential candidate.	John C(harles) <u>Frémont</u>
<b>2</b>	Frémont’s first few western expeditions were guided by this frontiersman, who became the subject of several popular novels.	(Christopher) “Kit” <u>Carson</u>
<b>3</b>	When Frémont was court-martialed for mutiny and disobedience, this U.S. president commuted his sentence. This president was in power during the Mexican War.	James K(nox) <u>Polk</u>

**Question #22: Social Studies – U.S. History**

*10 points per part*

In 1774 the British Parliament passed the Quebec Act and this collection of laws that affected its North American colonies.		
<b>1</b>	Name these punitive acts that responded to the Boston Tea Party.	<u>Intolerable</u> Acts [or <u>Coercive</u> Acts]
<b>2</b>	The fourth Intolerable Act, based on an earlier law that had not been enforced, required this action. The Third Amendment to the Constitution was a response to it.	<u>quartering soldiers</u> [or <u>housing soldiers</u> , providing <u>food</u> to <u>soldiers</u> , or equivalents; prompt on partial answers]
<b>3</b>	The Intolerable Acts were supported by this British Prime Minister who held that position throughout the 1770s.	Lord Frederick <u>North</u> , 2nd Earl of Guilford



**Question #23: Science – Chemistry**

*10 points per part*

One example of these forces are London dispersion forces between instantaneously induced dipoles.		
<b>1</b>	Identify these intermolecular forces named for a Dutch scientist.	<b>van der Waals</b> [ <b>fan der vahls</b> ] forces or interactions
<b>2</b>	In the van der Waals equation, the letter ‘ <i>a</i> ’ corrects for forces, while the letter ‘ <i>b</i> ’ accounts for the fact that ideal gas molecules have a value of zero for this property, while real gas molecules have a nonzero value for it.	<b>volume</b> or <b>size</b>
<b>3</b>	Work by van der Waals allowed James Dewar and <b>Heike Kamerlingh Onnes</b> [ <b>HIKE-uh</b> <b>KAM-er-leenk AW-nuss</b> ] to perform this process on hydrogen and helium.	<b>liquefaction</b> or <b>liquefying</b> [accept answers containing the idea of turning them into a <b>liquid</b> ]

**Question #24: Science – Chemistry**

*10 points per part*

A two-letter abbreviation is commonly used to indicate that a reactant or product is in this type of solution.		
<b>1</b>	Give this term for a solution in which water is the solvent.	<b>aqueous</b> solution(s)
<b>2</b>	This word describes molecules that are attracted to water, and usually dissolve easily.	<b>hydrophilic</b> molecules [or <b>hydrophiles</b> or <b>hydrophilicity</b> ]
<b>3</b>	What is the common name for an aqueous suspension of magnesium <b>hydroxide</b> [ <b>hide-ROCK-side</b> ]?	<b>milk of magnesia</b>



**Question #25: Literature – British Literature**

10 points per part

These two characters attempt to trap their target with belts, but the man they were sent to spy on enters from a different direction with a dead body.		
1	Name these two characters who are sent to England to get Hamlet killed. Hamlet switches the letter with the instructions, and these characters end up dying instead.	<b>Rosencrantz</b> and <b>Guildenstern</b> [either order]
2	Hamlet gives this speech to Rosencrantz and Guildenstern. It ends “Man delights not me; no, nor Woman neither; though by your smiling you seem to say so.”	<b>What a piece of work is man!</b>
3	This author wrote an 1874 play entitled <i>Rosencrantz and Guildenstern, A Tragic Episode, in Three Tabloids</i> , which ends with Hamlet being exiled.	W(illiam) S(chwenck) <b>Gilbert</b> [do not accept answers mentioning “(Arthur) Sullivan”]

**Question #26: Literature – British Literature**

10 points per part

This character questions her choice to turn down Peter Walsh and marry Richard instead.		
1	Name this character. Doris Kilman despises her, but adores this character’s daughter Elizabeth.	Mrs. <b>Clarissa Dalloway</b> [accept either]
2	<i>Mrs Dalloway</i> is by this author, who wrote about the Ramsay family’s voyage to the title structure in <i>To the Lighthouse</i> .	(Adeline) Virginia <b>Woolf</b> [or <b>Stephen</b> ]
3	In <i>Mrs Dalloway</i> , the shell-shocked Septimus Warren Smith commits suicide in this way. Dr. Holmes called Septimus a coward for it, and drugged <b>Rezia</b> [REE-zhuh] so she did not have to see the result.	<b>jumping out a window</b> [or autodefenestration; accept equivalents; prompt on <b>jumping</b> ]



**Question #27: Mathematics – Pre-Calculus**

*10 points per part*

A function’s derivative is another function whose values are the slopes of lines with this relationship to the original function’s graph.		
<b>1</b>	Give this term for a line that touches a curve at one point, but does not cross the curve near that point.	<b><u>tangent</u></b> line
<b>2</b>	Find the value of $x$ on the graph of $y = x^2 + 6x + 5$ [“ $y$ equals $x$ squared plus 6 $x$ plus 5”] at which the tangent line has a slope of 0.	$x = \underline{-3}$ [do not accept or prompt on 3]
<b>3</b>	Find the slope of the line tangent to the graph of $y =$ the natural log of the quantity $2x$ , at the point where $x = 10$ .	<b><u>1/10</u></b> or <b><u>0.1</u></b>

**Question #28: Mathematics – Pre-Calculus**

*10 points per part*

If a sequence is described by this word, its formula is not given explicitly, though it might be possible to find an explicit formula.		
<b>1</b>	Give this term for a sequence in which each term, after the first or first few, is defined based on earlier terms.	<b><u>recursively</u></b> -defined sequence or <b><u>recurrence</u></b> relations [accept answers containing any underlined term or <b><u>recursion</u></b> ]
<b>2</b>	If the first term of a sequence is 6, and each term equals 3 times the previous term plus 1, then what is the second term of the sequence?	<b><u>19</u></b>
<b>3</b>	If the fifth term of a sequence is 42, and each term equals the previous term plus 6, find the value of the first term.	<b><u>18</u></b>



**Question #29: Social Studies – World History**

10 points

A medal celebrating this event showed an angel holding a sword and a cross on one side, and a portrait of Pope Gregory XIII [13] on the other. This event was a few days after the marriage of the King of Navarre and Margaret of Valois [val-wah], and was two days after a failed assassination attempt. It was approved by Charles IX [9] and was planned by his mother, Catherine de' Medici [MED-itch-ee]. One of the central actions in this event was the murder of Gaspard de Coligny [gas-par day koh-leen-yee]. Name this event on a feast day in 1572, during which thousands of Huguenots [h'YOO-guh-"knots"] were killed.

St. Bartholomew's Day massacre or Massacre de la Saint-Barthélemy  
[accept similar words in place of massacre]

**Question #30: Science – Biology**

10 points

This phylum contains a genus [JEE-nus] that has horns as well as the structures for which this phylum is named, the genus *Ceratium* [sur-AY-shee-um]. Several organisms in this phylum produce yessotoxins ["YES-oh-toxins"] that can accumulate in animals and then poison humans. Several of these organisms exhibit bio-luminescence, including *Noctiluca scintillans* ["knock-TICK-you"-luh sin-TILL-unz], also called the "sea tinkle". That characteristic led some biologists to call this phylum *Pyrrophyta* ["peer-oh-FIGHT-uh"]. Some of these protists are phytoplankton ["FIGHT-oh-"plank"-ton"] responsible for red tide. Name these organisms with two whip-like tails, one of which wraps around their body and the other of which projects out.

dinoflagellates  
["DIE-no"-fluh-JEL-uts]  
[accept Pyrrophyta before it is mentioned]



**Question #31: Literature – U.S. Literature**

10 points

<p>This author wrote a dystopian novel based on the Everhard Manuscript, in which favored unions side with the Oligarchy. He also wrote a novel in which Leach and Johnson fail in their mutiny aboard the <i>Ghost</i>; in that novel by this author, Maud Brewster and Humphrey van Weyden flee their ship, and there is a rivalry between the brothers Death and Wolf Larsen. This author of <i>The Iron Heel</i> and <i>The Sea-Wolf</i> wrote a novel in which Curly's death instills the "law of club and fang" into Buck. Name this author who wrote about sled dogs in Yukon in <i>The Call of the Wild</i>.</p>	<p>(John Griffith) "Jack" <u>London</u> [or John (Griffith) <u>Chaney</u>]</p>
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**Question #32: Mathematics – Math Concepts**

10 points

<p>This term describes a major category of statistical tests that assumes normally distributed data and that includes <math>t</math>-tests. This term also describes a way to express a surface in 3D so that its area can be calculated by integrating a cross product. This term can mean a setup in which an astroid curve can be written in terms of the third power of sine and cosine functions, and a hyperbola is easily written in terms of a tangent function and a secant function. Give this term for "equations" in which a graph is generated by expressing <math>x</math> and <math>y</math> in terms of a third variable, often <math>t</math>.</p>	<p><u>parametric</u> [accept <u>parameters</u>]</p>
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**Extra Question #1: Social Studies – U.S. History**

10 points

The first volume of this book ends with chapters called “The Crisis of 1878” and “The Compromise of 1880”, both of which involve the Hepburn Commission in the New York legislature and an effort to extradite several people from New York to Pennsylvania. This book called the Pittsburgh Plan an “unholy alliance”. Much of this book’s focus was on the rigging of railroad prices to gain an unfair advantage. This book started out as a series of articles in *McClure’s* magazine. This book described the Oil War of 1872 and was critical of John Rockefeller. Name this muckraking book by Ida Tarbell.

*The **History of the Standard Oil Company***  
[or *The **Rise of the Standard Oil Company***]

**Extra Question #2: Science – Health**

10 points

**Abaloparatide** [uh-BAL-oh-“PAIR-uh-tide”] is a promising drug for treating this disease, and may replace **Teriparatide** [“TARE-uh-pair-uh-tide”], a drug marketed with the name “Forteo”.  
Dual-energy X-ray **absorptiometry** [“absorb”-tee-AH-meh-tree], which is abbreviated DXA, is used to test for this disease. Like **Scheuermann’s** [SHOO-ur-mun’z] disease, this disease often results in **kyphosis** [ky-FOH-siss], or dowager’s hump, which is an overly curved spine. This disease is most common in women with low estrogen levels. Name this disease in which bones are less dense than they should be, and fracture easily.

**osteoporosis**



**Extra Question #3: Fine Arts – Composers of the Modern Era**

10 points

When **Olivier Messiaen** [aw-leev-yeh mess-yawn] taught this composer, Messiaen described him as the “lion flayed alive”. This composer was friends with Bruno Maderna, for whom he wrote *Rituel in memoriam*. This composer has a soprano sing sonnets written by **Stéphane Mallarmé** [steh-fahn mah-lar-meh] in his piece *Pli selon pli* [plee seh-law plee]. One of his pieces, based on the poetry of René Char, has a title meaning “The hammer without a master”, which in French is *Le marteau sans maître*. Name this serialist composer who died in January 2016, and who was the conductor and founder of Ensemble InterContemporain.

Pierre **Boulez** [boo-lez]

**Extra Question #4: Literature – World Literature**

10 points

This character was shown the way to an inheritance that was long sought by Caesar Borgia and carefully hidden by Caesar Spada. He ruined Heloise’s murderous plot by rescuing Valentine and revealing her true fate to Maximilian Morrel. After this character’s false arrest, Fernand Mondego married his fiancée, Mercédès. This character is taught by Abbé Faria while imprisoned in the **Château d’If** [shah-toh deef]. This person inherits a fortune after leaving prison, allowing him to seek vengeance against his enemies. Name this title character of a novel by Alexander **Dumas** [doo-mah].

**Edmond Dantès** [accept either; accept the **Count of Monte Cristo** or **Le Comte de Monte Cristo**, prompt on the **Count** or le **Comte** or **Sinbad** the Sailor or Lord **Wilmore** or Abbé **Busoni**]



**Extra Question #5: Mathematics – Math Concepts**

*10 points*

These numbers can be represented by  $2 \times 2$  [two by two] matrices in which the upper-left and lower-right entries are conjugates of each other, and the other numbers are opposite conjugates. Applying the Cayley-Dickson construction to the complex numbers gives these numbers, but in the process, it becomes apparent that with these numbers, multiplication is not commutative. A basic formula involving these numbers was carved into Brougham [“broom”] Bridge by the mathematician who described them, William Rowan Hamilton. Name this extension of the complex numbers that uses a real part as well as  $i$ ,  $j$ , and  $k$ .

**quaternions**  
[kwah-TUR-nee-unz]



**Extra Question #6: Mathematics – Trigonometry**

*10 points per part*

This method allows you to antidifferentiate expressions that don't have trigonometry in them to begin with, but do have expressions that can be interpreted as lengths of legs of right triangles.		
<b>1</b>	Name this method that can be used to integrate the square root of the quantity $9 - x^2$ ["9 minus $x$ squared"], $dx$ .	(integration by) <b>trigonometric substitution</b> [do not prompt on "substitution"]
<b>2</b>	To integrate that expression, which again is the square root of the quantity $9 - x^2$ , with respect to $x$ , what substitution should you make for $x$ ? Use $u$ as the variable.	$x = 3 \sin u$ [" $x$ equals <b>3</b> times the <b>sine</b> of $u$ "] [accept $x = 3 \cos u$ [" $x$ equals <b>3</b> times the <b>cosine</b> of $u$ "]]
<b>3</b>	Ignoring the constant of integration, what is the antiderivative of the cosine of $u$ ? It comes in handy when simplifying that integral.	<b><math>\sin u</math></b> (+ $C$ ) ["the <b>sine</b> of $u$ (plus a constant or plus $C$ )"]

**Extra Question #7: Mathematics – Trigonometry**

*10 points per part*

The trigonometric functions are examples of this class of functions.		
<b>1</b>	Name this type of function that satisfies the property $f(x)$ [" $f$ of $x$ "] always equals $f(x + p)$ [" $f$ of $x$ plus $p$ "] for some fixed number $p$ .	<b>periodic</b> function [accept <b>periodicity</b> ]
<b>2</b>	Periodic functions can be broken down into a sum of sine and cosine functions, forming a series named for this Frenchman.	(Jean-Baptiste) Joseph <b>Fourier</b> [fur-yay]
<b>3</b>	Find the amplitude of the function sine $x$ plus cosine $x$ .	$\sqrt{2}$ ["the square <b>root</b> of <b>2</b> "] or " <b>radical 2</b> "]



### Extra Question #8: Social Studies – World History

*10 points per part*

In 1868, the Japanese capital was moved to Edo, which was renamed Tokyo.		
<b>1</b>	Name the city that served as Japan’s capital for hundreds of years leading up to 1868.	<b><u>Kyoto</u></b>
<b>2</b>	This emperor was put in power when the capital moved, ending the Tokugawa Shogunate.	Emperor <b><u>Meiji</u></b> (the Great) [or <b><u>Meiji</u></b> -tenno or <b><u>Mutsuhito</u></b> ]
<b>3</b>	Saigo Takamori led this failed rebellion of samurai against the Meiji Emperor in 1877. This rebellion ended at the Battle of Shiroyama.	<b><u>Satsuma</u></b> Rebellion

### Extra Question #9: Social Studies – World History

*10 points per part*

Abdullah Öcalan, who is now in prison, is a leftist leader of these people.		
<b>1</b>	Name this ethnic group that lives mostly in what is now Turkey, Iran, Iraq, and Syria.	<b><u>Kurds</u></b> or <b><u>Kurdish</u></b> people
<b>2</b>	This Kurd started the <b>Ayyubid</b> [“ <b>EYE-you-bid</b> ”] dynasty in the 12th century. He was able to maintain control over Jerusalem during the Third Crusade.	<b><u>Saladin</u></b> [ <b><u>SAL-uh-din</u></b> ] or An-Nasir <b><u>Salah ad-Din</u></b> Yusuf ibn Ayyub
<b>3</b>	Before Saladin, Kurdish lands were controlled by this Turkish dynasty. <b>Tughril</b> [ <b><u>TUG-ril</u></b> ] started this dynasty, and it was led for a long time by Ahmad Sanjar.	<b><u>Seljuk</u></b> dynasty or <b><u>Seljuks</u></b> or <b><u>Seljuk</u></b> Turks