



1. This man became next in line to his country's throne a few years after the suicide of his cousin Rudolf in Mayerling. He had to promise not to pass succession on to his children in order to marry Sophie Chotek. This man was the presumptive heir to Franz Joseph until he was killed on the Latin Bridge in Sarajevo, precipitating the July Crisis. For 15 points, name this Austrian archduke whose assassination by Gavrilo Princip sparked World War I.

ANSWER: Archduke **Franz Ferdinand**

121-13-104-17101

BONUS: What South Korean company has found success with its Galaxy line of phones but received mixed reviews for its Galaxy Gear watch?

ANSWER: **Samsung**

015-13-104-1710-11

2. This theorem is a special case of an extended version proven by Cauchy, which replaces the identity function with a more general differentiable function. When applied to integration, this theorem can be used to prove the first fundamental theorem of calculus. Rolle's theorem is a special case of this theorem. For 15 points, name this theorem which states that for any two points on a differentiable curve, there exists a point between them whose derivative is equal to the slope of the secant line.

ANSWER: **mean value** theorem

121-13-104-17102

BONUS: What work's fourth book focuses on the love affair between Dido of Carthage and the title Trojan prince?

ANSWER: **Aeneid**

153-13-104-1710-11

3. This letter denotes the quotient of the minimum and maximum stresses in a fatigue test. At constant pressure, heat capacity of an ideal gas equals five-halves times a quantity symbolized by this letter. The correlation coefficient is represented by this letter. Species which reproduce quickly and provide little paternal nurturing are described by this letter, as opposed to K. The side chain of an amino acid is symbolized with this capital letter. For 15 points, name this letter which denotes the gas constant.

ANSWER: **r**

190-13-104-17103

BONUS: This is a 30-second calculation question. If you flip a fair coin four times, what is the probability that exactly three of the tosses turn up heads?

ANSWER: **1/4** [or **4/16**; or **25%**; or **0.25**]

190-13-104-1710-11

4. An annual prize named for this painter is awarded to the best artist under 50. He made a watercolor of the 1834 burning of the Houses of Parliament, which he then developed into two different paintings. In another painting by this artist, sailors prepare for an approaching typhoon by throwing slaves overboard. This "painter of light" depicted a train on the Great Western Railway barreling into the foreground of one of his landscapes. For 15 points, name this painter of *Rain, Steam, and Speed*.

ANSWER: John Mallord William **Turner**

190-13-104-17104

BONUS: What British economist wrote *On the Principles of Political Economy and Taxation*, in which he defined rent and laid out his theory of comparative advantage?

ANSWER: David **Ricardo**

014-13-104-1710-11

5. A speech in this book begins "My soul glorifies the Lord" and is known as the Magnificat. Another character in this book is struck dumb for doubting that his wife will have a child in old age. This book contains the Good Samaritan parable and the Prodigal Son and, along with Matthew, descends from the 'Q' Source. For 15 points, name this third Gospel, which is written by the author of the Book of Acts and is found after Matthew and Mark in the New Testament.

ANSWER: The Gospel of **Luke** [or Book of **Luke**; prompt on The **New Testament** until "Matthew" is read; prompt on The **Bible** until "Matthew" is read]

236-13-104-17105

BONUS: This is a 20-second calculation question. You invest 10 dollars at one percent interest, compounded continuously. Rounded to the nearest dollar, how much money will you have after one hundred years?

ANSWER: **\$27**

190-13-104-1710-11

6. In this organ, the Wnt signaling pathway directs differentiation of Lgr-5 expressing stem cells as they climb out of crypts lined with Paneth cells. Coeliac disease affects this organ. Brunner's glands secrete mucus in this organ, which receives bile from the pancreas through the Sphincter of Oddi in order to emulsify fats. The three main sections of this organ are called the ileum, the jejunum, and the ileum. For 15 points, name this organ which is connected to the stomach, which is where most absorption of nutrients takes place, along with its larger counterpart.

ANSWER: **small intestines**

190-13-104-17106

BONUS: What Danish physicist proposed a model of the atom with electrons traveling in defined orbits around the nucleus?

ANSWER: Niels **Bohr**

014-13-104-1710-11

7. A reduction in, or lack of, this substance is known as xerostomia. The polytene chromosomes of *Drosophila melanogaster* are found in this substance. This substance is secreted by the parotid gland. This substance contains an enzyme that catalyzes the decomposition of starch into maltose; that enzyme is amylase. For 15 points, identify this watery substance secreted by namesake glands and found in the mouths of many organisms.

ANSWER: **saliva**

066-13-104-17107

BONUS: What layer of the Earth lies below the boundary known as the Moho discontinuity?

ANSWER: **mantle**

052-13-104-1710-11

8. This appliance developed from experiments with radar during World War II. In 1947, Percy Spencer patented the prototype, which cost nearly \$100,000. The commercial versions were called Radaranges and were sold primarily to restaurants and vending machine companies at a cost of approximately \$3000 per unit. Today, they are made by Panasonic, Sharp, and KitchenAid. For 15 points, what is this popular kitchen accessory that can heat cold foods in a matter of seconds?

ANSWER: the **microwave** oven

045-13-104-17108

BONUS: This is a 30-second calculation question. Two adjacent angles in a parallelogram have measures “ $x + 20$ ” degrees and “ $4x - 40$ ” degrees. What is the measure of the larger angle?

ANSWER: **120** degrees

190-13-104-1710-11

9. This equation needs to be modified into the Goldman-Hodgkin-Katz equation when multiple ions are in a solution. This equation can be written so that a side is equal to the gas constant times temperature over the number of moles times Faraday's constant, all times the natural log of the reaction quotient. For 15 points, name this equation that can be used to find the voltage of an electrochemical cell or to find the concentration of an ion in a voltaic cell.

ANSWER: **Nernst** equation

023-13-104-17109

BONUS: The Ostwald process turns ammonia into what acid, mixed with hydrochloric acid in aqua regia?

ANSWER: **nitric** acid

233-13-104-1710-11

10. In a Chinese myth, flocks of magpies create one of these objects to unite the cowherd and weaver girl. Two four-eyed hounds guard another of these objects, called Chinvat, in Zoroastrian mythology. Monkeys in the *Ramayana* create one of these objects to help Rama rescue Sita. Another structure of this type is guarded by the owner of Gjallarhorn (gee-ALL-er-horn) and separates Midgard from Asgard. For 15 points, Heimdall guards Bifrost, the rainbow variety of what object?

ANSWER: **bridges**

020-13-104-17110

BONUS: What beautiful youth spurned Echo and died after falling in love with his own reflection?

ANSWER: **Narcissus**

014-13-104-1710-11

11. This chromosome contains the dystrophin gene, whose defects can cause Becker's and Duchenne muscular dystrophy. One of this chromosome is inactivated in the process of lyonization and then forms a Barr body. Its monosomy normally presents as a webbed neck, among other symptoms, in Turner syndrome, and extra copies of it in males results in Klinefelter's syndrome. For 15 points, identify this sex chromosome of which human females have two, unlike the Y chromosome.

ANSWER: **X** chromosome

066-13-104-17111

BONUS: Thomas Hunt Morgan worked with what type of insect in his experiments, specifically the species *Drosophila melanogaster*?

ANSWER: fruit **fly**

052-13-104-1710-11

12. The Val d'Aran is a valley in this mountain range, whose inhabitants speak a dialect of Occitan. A popular tourist site in this mountain range is the Ordesa Canyon. This mountain range borders both the Bay of Biscay and the Mediterranean Sea, and its western portion extends into Basque country. Andorra lies within this mountain range, which separates the Iberian Peninsula from the rest of Europe. For 15 points, name this mountain range on the border between Spain and France.

ANSWER: **Pyrenees**

140-13-104-17112

BONUS: This is a 20-second calculation question. The variance of a non-uniform data sample is ten times its standard deviation. What is the variance?

ANSWER: **100**

190-13-104-1710-11

13. A 1984 Reagan campaign ad claimed it was smart to "be as strong as" one of these animals, if there was one of them. One of these animals lives under the sign "Mr. Sanders" and mistakes his footprints for those of a wozzle. Boo Boo was the best friend of one of these creatures, who claimed to be "smarter than the average" one. A.A. Milne wrote about one who was friends with Piglet and Christopher Robin. For 15 points, name these animals which include Winnie-the-Pooh.

ANSWER: **bears**

121-13-104-17113

BONUS: What mountain range that runs along the Mediterranean coast of Northern Africa has its highest point at Toubkal (toob-KAHL)?

ANSWER: **Atlas** Mountains

015-13-104-1710-11

14. This country's fauna include a type of antelope that engages in "pronking". Its most populous region lies along the Witwatersrand ridge, and it also includes of the Drakensberg Mountains. This country's city of Durban is part of a province whose name is Portuguese for Christmas. Its grasslands, or veld, are home to springboks. The Vaal and Orange rivers named two republics here founded by Dutch colonists. For 15 points, name this African country home to Cape Town.

ANSWER: **South Africa**

232-13-104-17114

BONUS: In the 1950's, British authors like John Osborne and Kingsley Amis were described as what type of young men?

ANSWER: **angry**

052-13-104-1710-11

15. One generalization of this statement subtracts a constant times the number of moles from the volume. That modification introduces the constants a and b and is named for van der Waals. This statement assumes that particles have negligible volume and that there are no intermolecular forces between them; for this reason, it cannot be used at high pressures or low temperatures. It states that $P V = n R T$. For 15 points, identify this equation of state that combines Boyle's, Charles', and Avogadro's laws.

ANSWER: **ideal gas law**

226-13-104-17115

BONUS: What animated film features the fictional corporation Buy 'n' Large and is partially set on a spaceship where passengers have become obese due to inactivity?

ANSWER: **WALL-E**

052-13-104-1710-11

16. Plato stated that this action is an undesirable release from a "guard-post," and that perpetrators of this action should have unmarked graves. A French thinker compared differing rates for this action between Catholics and Protestants, and stated that soldiers performed it more often than civilians; that thinker divided this action into egoistic, altruistic, fatalistic, and anomic types. For 15 points, identify this action central to an Emile Durkheim work, the act of taking one's own life.

ANSWER: **suicide** [or equivalents]

189-13-104-17116

BONUS: This is a 20-second calculation question. An angle in standard position has a terminal side that passes through (-12, 9). What is the cotangent of this angle?

ANSWER: **-4/3**

037-13-104-1710-11

17. The affinity type of this procedure is often used to purify proteins, while the flash type applies pressure to perform this technique. These procedures rely on the different concentration ratios of each component, known as the partition coefficient. Absorbent materials are used in the thin-layer type of this procedure, in which the mobile phase flows through the stationary phase. For 15 points, name this technique in which a mixture is separated into different components.

ANSWER: **chromatography**

227-13-104-17117

BONUS: What is the term for repeating the initial sound of words, such as in the phrase "a purple poetic piece of prose"?

ANSWER: **alliteration**

052-13-104-1710-11

18. The Sinyetha Party and the Dobama Asiayone were two members of this country's Freedom Bloc. The National League for Democracy in this country challenged the domination of the State Law and Order Restoration Council under Saw Maung. U Thant was a United Nations Secretary General from this country, which was led by the dictator Ne Win. For 15 points, name this country in which Aung San Suu Kyi lived for many years under house arrest.

ANSWER: Union of **Burma** [or Union of **Myanmar**; or Pyidaungzu **Myanma** Naingngandaw]

030-13-104-17118

BONUS: What is the name for the voice register above bass but below tenor?

ANSWER: **baritone**

015-13-104-1710-11

19. This essay is prefaced by a brief poem beginning, "Cast the bantling on the rocks, suckle him with the she-wolf's teat." In response to a friend's objections that his impulses may come from below rather than above, the author states, "If I am the Devil's child, I will live then from the Devil." This essay concludes by praising "the triumph of principles" and stresses that "nothing can bring you peace but yourself." For 15 points, name this seminal essay by Ralph Waldo Emerson.

ANSWER: **"Self-Reliance"**

014-13-104-17119

BONUS: What type of curve is traced out by a point on a circle that is rolling on a line?

ANSWER: **cycloid** [prompt on "roulette"]

185-13-104-1710-11

20. The sum of this function's values for the angles of a non-right triangle equals the product of its values for those angles. The hyperbolic form of this function equals e to the two- x minus one over e to the two- x plus one. This function's antiderivative is the natural logarithm of the secant, and its derivative is the secant squared. The secant squared minus one equals the square of this function. For 15 points, name this trig function that equals opposite over adjacent in a right triangle.

ANSWER: **tangent** [accept the **tangent** of any variable, such as "**tangent** of x "]

185-13-104-17120

BONUS: What stuff is called "el pelo" in Spanish and "cheveux" in French?

ANSWER: **hair**

015-13-104-1710-11

21. After playing "Diminuendo and Crescendo in Blue" at the 1956 Newport Jazz Festival, this man returned to prominence. For a Carnegie Hall performance, this man wrote the jazz symphony *Black, Brown, and Beige*. This man's orchestra popularized such songs as "Mood Indigo." His signature tune was "Take the 'A' Train" and he composed "It Don't Mean a Thing (If It Ain't Got That Swing)." For 15 points, name this jazz musician nicknamed "Duke."

ANSWER: Edward Kennedy "Duke" **Ellington**

052-13-104-17121

BONUS: This is a 30-second calculation question. If angle theta is in quadrant II and sine theta is two over the square root of 29, what is sine of two theta?

ANSWER: **-20/29**

037-13-104-1710-11

22. The letter beta denotes a quantity known as the capacity of these substances, which can be represented on a titration curve by the areas with the lowest slopes. Norman Good listed and names twenty examples of these substances, whose properties are calculated using the Henderson-Hasselbalch equation. They consist of a weak acid or base and their conjugate. For 15 points, name these substances, which are used to resist changes in pH.

ANSWER: **buffer** solutions

140-13-104-17122

BONUS: Name the former Michigan State and Los Angeles Lakers player and member of the "dream team" who was rivals with Larry Bird.

ANSWER: Earvin "Magic" **Johnson**

120-13-104-1710-11

23. One equation used to find this value requires knowing the path length through a cell and multiplying that by the extinction coefficient. That equation for finding this value comes from the Beer-Lambert law. One piece of lab equipment can be used to create a spectrum of this logarithmic value versus wavelength. This value that can be found with the use of a spectrophotometer is equal to the log of one over the transmittance. For 15 points, name this concept in chemistry that leads to colors by causing certain wavelengths of light to not be reflected back.

ANSWER: **absorption** [or **absorbance**; accept word forms]

023-13-104-17123

BONUS: This is a calculation question. If you choose a number between 1 and 1000 inclusive, what is the probability that the number is divisible by 2 and 4 but not 8?

ANSWER: **1/8** [or **0.125**; or **12.5%**]

190-13-104-1710-11

24. In the membrane of this organelle, the translocon recognizes the stop-anchor sequence of a growing polypeptide. PDI catalyzes the formation of disulfide bonds in this organelle, where most chaperone proteins localize in order to promote protein folding. COPII-coated vesicles emerging from this organelle are moved to the Golgi in the second step of the secretory pathway. In eukaryotic cells, it's contiguous with the nucleus. For 15 points, name this organelle where ribosomes synthesize proteins, which comes in smooth and rough forms.

ANSWER: rough **endoplasmic reticulum** [or rough **ER**]

190-13-104-17124

BONUS: What data structure with "binary" and "red-black" forms consists of nodes linked to child nodes?

ANSWER: **trees**

080-13-104-1710-11

25. This city located on the southwest shore of Guanabara Bay is the site of Mount Corcovado. A cable car in this city can be used to reach Sugarloaf Mountain. A two and a half mile beach is located in this city's Copacabana neighborhood. Heitor da Silva Costa designed this city's colossal statue of Jesus with his arms outstretched. For 15 points, name this city that has the *Christ the Redeemer* statue and is the second-largest city in Brazil after Sao Paulo.

ANSWER: **Rio** de Janeiro

023-13-104-17125

00--20-1710-11

26. Nine of these pieces appear in the *Goldberg Variations*, each with an increasing interval size. More complex types of this technique include mensuration, retrograde, and inversion. "Frere Jacques" and "Row, Row, Row Your Boat" are the most famous pieces to use this technique, in which an imitation of a melody is played some time after it is first introduced. For 15 points, name this technique used in the most famous piece by Pachelbel.

ANSWER: **canon**

063-13-104-17126

00--20-1710-11



27. This thinker believed that sympathy works by turning "ideas" of another person's passion into what he called "impressions" in the mind. Summaries of this man's work ended the "dogmatic slumber" of Immanuel Kant. He allowed induction only in the case of a "missing shade of blue" in a book drawing on his earlier *Treatise of Human Nature*. For 15 points, name this Enlightenment empiricist skeptic who wrote an *Enquiry Concerning Human Understanding* in his native Scotland.

ANSWER: David **Hume**

104-13-104-17127

00--20-1710-11

28. After firing Tyrone Willingham, this school failed to entice its former wide receivers coach Urban Meyer. A student here named Declan Sullivan died after falling off a scissor lift in heavy winds. Its current quarterback is Tommy Rees, who was recruited by Charlie Weiss but now plays under Brian Kelly. This school, which was attended by Manti Te'o, is the setting for the film *Rudy*. For 15 points, name this Catholic school in South Bend, Indiana.

ANSWER: University of **Notre Dame**

015-13-104-17128