The abbreviation NOTA means "None of the above."

1. First things first. The term calculus is derived from a Greek word meaning what?

A. Change B. Pebble
C. Cut D. Limit E. NOTA

2. The origins of calculus go back thousands of years. The Greeks laid the foundations for limits by using the method shown below to determine the area of a circle. What is the name given to the method shown in the figure below?

A. Method of Inscription B. Polygonal Area Method
C. Method of Exhaustion D. Method of Approximating Areas E. NOTA

3. Speaking of ancient Greeks and limits, who is the Greek philosopher who developed a number of paradoxes dealing with infinitesimals intended to challenge ideas of space and time held in his day and eventually paved the way for the study of limits?

A. Zeno B. Thales
C. Pythagoras D. Eudoxus E. NOTA

4. The Ancient Egyptians also had precursors to integral calculus in finding the volumes of difficult figures. In which document, did Ancient Egyptians successfully determine the volume of a pyramidal frustum?

A. Berlin Papyrus B. Rhind Papyrus
C. Moscow Papyrus D. Reisner Papyrus E. NOTA

5. What ancient Greek mathematician was the first to determine the tangent to a curve other than a circle? As an added bonus, I will tell you that this mathematician was killed by Roman soldiers while drawing circles in the sand.

A. Pythagoras B. Eudoxus
C. Antiphon D. Euclid E. NOTA

6. Many texts claim that during the middle ages no advancements were made in the development of calculus. However, this is not true. The state of Kerala had a School of Astronomy and Mathematics which developed many of the ideas of common use in calculus today such as differentiation and integration term by term and the theorem that area under the curve is an integral. In which modern day country is Kerala located?

A. Iraq B. China
C. Japan D. India E. NOTA

7. Also during the middle ages, the Islamic mathematician Ibn al-Haytham was the first to derive the formula for the sum of the fourth powers, developing a method that is generalized to finding the sum of any integral powers. He proved his formula using a method whereby he proved that the first statement in his infinite series of statements was true and then was able to generalize this proof to the next in his infinite series and so on. What method of proof did he use?

A. Proof by contradiction B. Direct Proof
C. Two Column Proof D. Proof by Induction E. NOTA

8. The connection of algebra and geometry, and the creation of the field of analytic geometry, was a key element in the development of calculus. What mathematician is credited with the development of analytic geometry in his book Le Monde?

A. Rene Descartes B. Pierre de Fermat
C. Blaise Pascal D. John Wallis E. NOTA

9. This assistant to Tycho Brahe reconciled the ideas of rectilinear and curvilinear motion, developed a concept which allowed two dimensional figures to measure three dimensional volume and helped proliferate a new method of direct proof. These three contributions were critical to the development of calculus. Who is this mathematician?

A. Bonaventura Cavaleri B. Johannes Kepler
C. Evangilista Torricelli D. Michael Rolle E. NOTA

10. The man pictured below was one of the first to develop a method for finding the maximum or minimum of a function. Who is he?

A. Pierre de Fermat
B. Rene Descartes
C. Blaise Pascal
D. Carl Gauss
E. NOTA

11. This English mathematician, who is given partial credit for the development of infinitesimal calculus, introduced the symbol ∞ for infinity. He also used $\frac{1}{\infty}$ to denote infinitesimals which laid the groundwork for modern integral calculus. Who is he?

A. Michael Rolle B. Isaac Newton
C. John Wallis D. Isaac Barrow E. NOTA

12. Two mathematicians are generally credited with the independent development of calculus. What are their nationalities?

A. English and Italian B. English and French
C. French and German D. German and Italian E. NOTA

13. Sometimes called the method of indivisibles, the 2D version of this principle states that if two regions in a plane are included between two parallel lines in that plane and if every line parallel to these two lines intersects both regions in line segments of equal lengths, then the two regions have equal areas. What is the name of this principle?

A. Descartes' Principle B. Cavalieri's Principle
C. Rolle's Principle D. Roverval's Principle E. NOTA

14. Isaac Newton used the word "fluxion" to denote what common calculus term?

A. Derivative B. Integral
C. Limit D. Infinity E. NOTA

15. The notation $\int f(x)dx$ is known to represent an integral. Who was the first mathematician credited with using this notation to represent this concept?

A. Jacob Bernoulli B. Leonhard Euler
C. Augustin Cauchy D. Gottfried Leibnitz E. NOTA

16. John Wallis gave proof of the solution to the integral $\int_0^1 x^p dx$ by showing that for positive integers p, the fraction $\frac{0^p + 1^p + 2^p + \ldots + n^p}{n^p + n^p + n^p + \ldots + n^p}$ as n approaches infinity, tends to…

A. $\frac{1}{p}$ B. $\frac{p}{p+1}$ C. $\frac{p+1}{p}$ D. $\frac{1}{p+1}$ E. NOTA

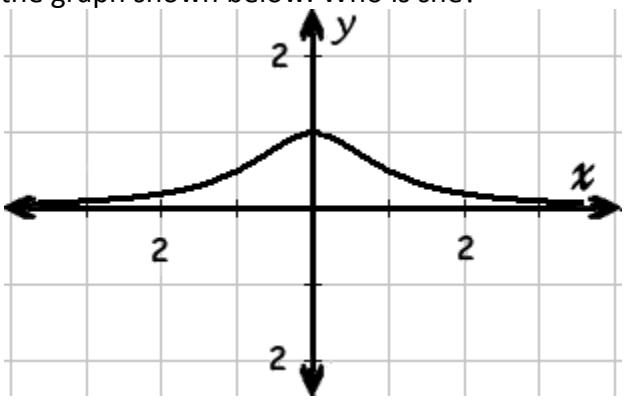
17. The first calculus textbook is credited to this mathematician, who is more popularly known for his rule which uses derivatives to determine a specific type of limit. Who is he?

A. Johann Bernoulli B. Christiaan Hugyens
C. Guillaume l'Hospital D. Gottfried Leibnitz E. NOTA

18. Fill in the blank: One of the first axioms in the textbook described above states: "Grant that a curved line may be considered as the assemblage of an infinite number of infinitely small ___"

A. Points B. Rectangles
C. Straight lines D. Vectors E. NOTA

19. At the age of 20, this female mathematician began working on the text *Analytical Institutions*, a book dealing with differential and integral calculus. She also lends her name to the graph shown below. Who is she?



A. Sophie Germain
B. Maria Agnesi
C. Lady Ada Lovelace
D. Sister Mary Gervase
E. NOTA

20. Bernard Bolzano worked closely with the concept of the limit in the development of calculus. He also proved an important theorem which bears his name. Which of the following situations could Bolzano's Theorem be used to prove?

A. If f(x) = sinx, then f(-x) = -sinx. Therefore, f(x) = sinx is an odd function.
B. If $f(x) = x^2 - 4$ and we know that f'(0) = 0, then f(x) has a relative extreme at x = 0.
C. $\int x dx = \frac{1}{2}x^2 + C$
D. If f(x) = 3x, then f(-1) = -3 and f(1) = 3. So, since f(x) is continuous, f(x) = 0 on the interval (-1,1) for some value of x.
E. NOTA

21. Which of the following is Leonhard Euler <u>NOT</u> credited with developing the notation for?

A. $\frac{dy}{dx}$ for the derivative of y with respect to x
B. Δy for finite differences
C. *e* for the base of the natural logarithm
D. Σ for summation
E. NOTA

22. Sophie Germain engrossed herself in mathematics even though her parents thought it was inappropriate for a lady. She even spent the time during the Reign of Terror teaching herself calculus. Germain was interested in the teachings of Lagrange and was able to obtain copies of his lecture notes and study from them. At the end of a term, Germain submitted a paper to Lagrange under a pseudonym; Lagrange was so impressed with the paper he wanted to meet the author and was surprised to learn that it was a woman. What was the pseudonym Germain used?

A. M. LeBlanc B. F. LeGrange
B. C. G. Moreau D. L. Dubois E. NOTA

23. George Berkeley, an Irish bishop an philosopher, is best known for his attack on the logical foundation Newton's calculus. A Scottish mathematician, in reply, published the first systematic treatise on Newton's methods. He is also known for giving his name to the series

$$f(x) = f(0) + f'(0)x + \frac{f''(0)x^2}{2!} + \frac{f'''(0)x^3}{3!} + \ldots$$ Who is he?

A. Jacob Bernoulli B. Brook Taylor
C. Colin Maclaurin D. Isaac Barrow E. NOTA

24. Augustin Cauchy is credited with developing a rigorous geometric basis for calculus. Which of the following statements about Cauchy's life is NOT true?

A. Joseph-Louis Lagrange was a visitor to the Cauchy home when Cauchy was a boy and took an interest in his mathematical education.
B. Cauchy was a devout Catholic.
C. Cauchy graduated from the École Polytechnique in 1807.
D. Cauchy worked well with other scientists in his field.
E. NOTA

25. Cauchy defined the integral of any continuous function on the interval [a,b] to be the limit of the sums of rectangular areas. Who generalized Cauchy's definition to include arbitrary functions?

A. Johann Bernoulli B. Georg Riemann
C. Isaac Barrow D. Leonhard Euler E. NOTA

26. This Russian mathematician was one of the most widely known Russian mathematicians of the late 19th Century. In her autobiography, she recalled being fascinated with calculus when her father temporarily used pages from a calculus text as wallpaper. A grant through the NSF and the Association for Women in mathematics, sponsor a day (bearing her name) each year to encourage women to pursue mathematics. Who is she?

A. Sonia Kovalevsky B. Valentina Borok
C. Elizaveta Litvinova D. Vera Maslennikova E. NOTA

27. Newton's calculus notations were different from those developed by Leibnitz. If Newton presented you with the function $f(x) = 3x^2$ and asked for $\dot{f}$, what would be the correct answer?

A. 6x B. $x^3 + C$ C. x = 0 D. ∞ E. NOTA

28. Srinivasa Ramanujan contributed to calculus in a number of ways, including working on Riemann series, elliptical integrals and functional equations of the zeta function. Which function below accurately represents the zeta function?

A. $\zeta(n) = \sum_{k=1}^{\infty} \frac{1}{k^n + 1}$ B. $\zeta(n) = \sum_{k=1}^{\infty} \frac{k}{k^n + 1}$

C. $\zeta(n) = \sum_{k=1}^{\infty} \frac{1}{k^n}$ D. $\zeta(n) = \sum_{k=1}^{\infty} \frac{1}{k^n - 1}$ E. NOTA

29. There are four main ways of representing a derivative in calculus. Who would be credited with writing out the Product Rule for the function $h(x) = f(x)g(x)$ as $h'(x) = f(x)g'(x) + f'(x)g(x)$

A. Leibnitz B. Newton C. Euler D. Lagrange E. NOTA

30. Newton is credited with saying "If I have seen further, it is by standing on the shoulders of giants". Which of the following mathematicians could NOT be one of the giants Newton was referring to, since he was born after Newton?

A. Blaise Pascal B. Rene Descartes
C. Leonhard Euler D. Pierre de Fermat E. NOTA