Important Instructions For This Test: Good luck, have fun, and as always: "NOTA" stands for "None of These Answers is correct."

1. In the Babylonian base-60 numeral system, the cuneiform symbol 𒌋 represents 10 and the symbol 𒁹 represents 1. Thus, for instance, 𒌋𒌋𒁹𒁹𒁹 is three 10s and nine 1s, and so represents 39. A space was left between symbols to represent a different place value. For instance, 𒌋 𒐜 represents $10 \cdot 60^1 + 5 \cdot 60^0 = 605$. However, since there was no symbol for zero, the space could indicate a *missing* place value. So 𒌋 𒐜 could represent 605, or $10 \cdot 60^2 + 5 \cdot 60^0 = 36005$, or even $10 \cdot 60^3 + 5 \cdot 60^1 = 2160300$. Which of the following is *not* a possible interpretation of the Babylonian numeral 𒋾 𒌋𒐜?

(A) 733 **(B)** 7213 **(C)** 43213 **(D)** 43980 **(E)** NOTA

2. In Egyptian hieroglyphic numerals, symbols for powers of 10 were placed next to each other. For instance 𓆼𓎆𓎆𓎆𓎆𓎆𓍢𓍢𓏺𓏺𓏺| represents $10000 + 5 \cdot 1000 + 2 \cdot 100 + 3 \cdot 10 + 1 = 15231$. The lack of zero was not an issue, since each symbol represented 10. Which of the following heiroglyphs represents the number 2025?

(A) 𓎆𓎆𓍢𓍢||||| **(B)** 𓎆𓎆𓍢𓏺𓏺𓏺𓏺 **(C)** 𓍢𓍢𓏺𓏺||||| **(D)** 𓎆𓎆𓏺𓏺||||| **(E)** NOTA

3. The Babylonians and Egyptians used a technique to solve what we would consider linear equations of the form $f(x) = n$: they guessed an answer a, plugged it in to get $f(a)$, scaled the result to match n, then scaled the initial guess a by the same amount to arrive at the correct solution. This is called the method of

(A) exhaustion. **(B)** duplation. **(C)** false position. **(D)** proportions. **(E)** NOTA

4. This ancient Greek philosopher devised paradoxes (the *Arrow*, the *Stadium*, *Archilles and the Tortoise*, and the *Dichotomy*) in order to argue that space, time, and motion are impossible. These paradoxes have influenced the conceptual notion of infinity in mathematics. Who devised these paradoxes?

(A) Aristotle **(B)** Archimedes **(C)** Pythagoras **(D)** Zeno **(E)** NOTA

5. A magnitude not expressible as the ratio of two integers, such as $\sqrt{2}$, is now called *irrational*. However, the ancient Greek philosophers called such a magnitude

(A) incommensurable.
(B) incomplete.
(C) evil.
(D) non-Pythagorean.
(E) NOTA

6. Three ancient problems the Greeks tried to solve, and that we now know are impossible to solve with only a straightedge and compass, are the problems of squaring the circle, trisecting the angle, and the Delian problem, which is also known as

(A) cubing the sphere.
(B) constructing the tetrahedron.
(C) doubling the cube.
(D) rectifying the ellipse.
(E) NOTA

7. The first mathematician to find a general method to solve a cubic equation did it with a geometric contruction (although the Greeks would have rejected this, since the method uses intersecting conic sections which cannot be constructed with a straightedge and compass alone). Who was this Islamic mathematician?

(A) Omar Khayyam **(C)** al-Tūsī **(E)** NOTA
(B) al-Khwarīzmī **(D)** al-Haytham

8. The fifth postulate in the first book of Euclid's *Elements* concerns proving that the base angles in an isosceles triangle are equal. Due to the diagram accompanying the proof, this postulate has become known as the

(A) two horns. **(C)** arrow's tip. **(E)** NOTA
(B) bride's chair. **(D)** bridge of assess.

9. The book *Liber Abaci* was first published in 1202. In it, the author presents a systematic description of calculating with Hindu-Arabic numerals by presenting many interesting problems, including one about breeding rabbits! Who is the author?

(A) Alcuin of York **(C)** Nichomachus **(E)** NOTA
(B) Regiomontanus **(D)** Fibonacci

10. In 1247, a Chinese mathematician, inventor, politician, and meteorologist wrote the book *Mathematical Treatise in Nine Sections*. In it, the author presents problems on military matters, surveying, indeterminate equations, and the first general solution to what is now called the "Chinese remainder theorem." Who is the author?

(A) Zu Chongzhi **(C)** Wang Xiotang **(E)** NOTA
(B) Qin Jiushao **(D)** Liu Hui

11. Long thought to be lost, the ancient Greek book *The Method of Mechanical Theorems*, or simply *The Method*, was rediscovered in 1906 in a Greek church. The work contains a description of the ingenious methods of discovery of the author's theorems. Who is the author?

(A) Archimedes **(B)** Euclid **(C)** Ptolmey **(D)** Apollonius **(E)** NOTA

12. When John Napier invented logarithms, he had the logarithm of x decreases as x increases. However, this was reversed, so that the logarithm increases as the input increases, upon the advice of a visiting mathematician. Indeed, this visiting mathematician suggested to Napier that the logarithm of 10 should be 1. Who is this mathematician?

(A) Gerolamo Cardano **(C)** John Dee **(E)** NOTA
(B) Henry Briggs **(D)** Johannes Kepler

13. Johannes Kepler was able to work out that the planets orbit the sun in ellipses because he had decades of meticulously accurate observational data of heavenly objects provided by his late employer, a Danish nobleman, mathematician, and astronomer. Who was this nobelman?

(A) Nicholaus Copernicus **(C)** Galileo Galilei **(E)** NOTA
(B) Henry Briggs **(D)** Tycho Brahe

14. Pierre de Fermat is regarded as humanity's foremost amateur mathematician, since mathematics was not his profession (he did math in his free time). What was his profession?

(A) priest **(B)** physician **(C)** accountant **(D)** farmer **(E)** NOTA

15. Although we call them derivatives, Isaac Newton called them

(A) differentials. **(B)** moments. **(C)** fluxions. **(D)** adequalities. **(E)** NOTA

16. Newton was frequently publicly challenged by other mathematicians to solve problems. One was the problem of the brachistochrone, which Newton solved in one night. He sent his solution to his challenger anonymously in 1697. His challenger knew immediately it was from Newton, exclaiming that he "recognizes a lion from his claw mark." Who was this challenger?

(A) Johann Bernoulli **(C)** Jean le Rond d'Alembert **(E)** NOTA
(B) Leonhard Euler **(D)** Pierre Laplace

17. Isaac Newton took over the position of Lucasian Chair of Mathematics at Cambridge in 1669 from his former teacher, who had worked on the problem of tangents to curves. Who was he?

(A) Isaac Barrow **(C)** Gottfried Leibniz **(E)** NOTA
(B) John Wallis **(D)** Humphrey Newton

18. Who, in the mid-17th century, was the first person to create a sustained vacuum and to discover the principle of the barometer?

(A) Isaac Newton **(C)** René Descartes **(E)** NOTA
(B) Evangelista Torricelli **(D)** Gilles de Roberval

19. Newton had quit mathematics and science almost totally by 1704. Hastening his leaving math behind, in 1696 he took a job with the British government which took up most of his time. He did so well, he was promoted in 1699 to what position?

(A) Chancellor of the Exchequer
(B) Warden of the Prison
(C) Master of the Mint
(D) Keeper of the Royal Grounds
(E) NOTA

20. Sophie Germain contributed to the leading research of the time, corresponding with Legendre and Gauss. She learned mathematics on her own as a teenager to keep herself entertained while confined indoors as what terrible event happened around her?

(A) The Fourth Crusade **(C)** World War I **(E)** NOTA
(B) The War of the Roses **(D)** The French Revolution

21. Put the following discoveries of Euler in chronological order of their first published appearance.

a) Euler's constant γ
b) Euler's polyhedron formula $V - E + F = 2$
c) Euler's totient function ϕ
d) Euler's formula $e^{ix} = \cos x + i \sin x$

(A) c, b, a, d **(B)** b, a, c, d **(C)** a, d, b, c **(D)** d, b, c, a **(E)** NOTA

22. It was not only Karl Gauss and János Bolyai who discovered the non-Euclidean geometry called "hyperbolic geometry." Which Russian mathematician also independently discovered it and published it a full two years before Bolyai?

(A) Pafnuty Chebyshev **(C)** Nikolaĭ Lobachevskiĭ **(E)** NOTA
(B) Andrei Kolmogorov **(D)** Andrey Markov

23. The discovery of a consistent non-Euclidean geometry was revolutionary, but so was the discovery of the first consistent non-commutative multiplication in 1843 by William Rowan Hamilton. What did he discover?

(A) matrices **(C)** hyperreals **(E)** NOTA
(B) quaternions **(D)** groups

24. The monumental work *Mécanique Céleste*, in which he extended Newton's results and proved new results about the solar system, earned him the nickname "the Newton of France." Who was he?

(A) Gaspard Monge **(C)** Joseph-Louis Lagrange **(E)** NOTA
(B) Adrien-Marie Legendre **(D)** Denis Poisson

25. Although first appearing in a work by Jean Leurechon in 1624, the pigeonhole principle was popularized in 1834 as this mathematician's "box principle." Who was this mathematician?

(A) Karl Gauss **(C)** Richard Dedekind **(E)** NOTA
(B) Bernhard Riemann **(D)** Peter Dirichlet

26. Which person, who was a student of Weierstrauss, became the first female to earn a doctorate in mathematics in Europe in 1874?

(A) Sofia Kovalevskaya **(C)** Emmy Noether **(E)** NOTA
(B) Mary Somerville **(D)** Florence Nightingale

27. This itinerant mathematician was the most prolific mathematician of the 20th century, publishing over 1500 papers in nearly all areas of mathematics, but especially number theory, graph theory, and probability. He would arrive at a colleague's doorstep and announce his readiness to prove theorems by saying "My brain is open." Who was he?

(A) Kurt Gödel **(C)** Paul Erdős **(E)** NOTA
(B) John Tate **(D)** Benoit Mandelbrot

28. This American mathematician, electrical engineer, computer scientist and cryptographer is known as the "father of information theory" and as the "father of the Information Age". He was the first to describe the Boolean gates that are essential to all digital electronic circuits, and was one of the founding fathers of artificial intelligence. Who is he?

(A) George Boole **(C)** Alan Turing **(E)** NOTA
(B) Claude Shannon **(D)** Norbert Weiner

29. In 1986, 1987, and 1988, this Australian-American became the youngest ever bronze, silver, and gold medalist in the history of the International Mathematics Olympiad, he earned the Fields medal in 2006, and he is widely considered to be one of the greatest living mathematicians in the world. Who is he?

(A) Noam Elkies **(C)** Timothy Gowers **(E)** NOTA
(B) Terence Tao **(D)** Grigori Perelman

30. In 1998, who became the first American female to make the United States Mathematical Olympiad team, and also won silver medals at the IMO in 1998 and 1999?

(A) Julia Robinson **(C)** Miriam Mirzakhani **(E)** NOTA
(B) Ana Caraiani **(D)** Melanie Wood