

Quiz 1

1. What is an example of an Afro-asiatic language?

- A. Hebrew.
 - B. Arabic.
 - C. Amhara.
 - D. All of the above.
 - E. None of the above.
-

2. What major language group dominates southern India?

- A. Turkic.
 - B. Afro-asiatic.
 - C. Dravidian.
 - D. All of the above.
 - E. None of the above.
-

3. Which river was a cradle for one the great ancient old-world civilizations?

- A. Amazon.
 - B. Yangzi.
 - C. Nile.
 - D. All of the above.
 - E. None of the above.
-

4. Where is the source of the Tigris and Euphrates rivers?

- A. China.
 - B. Turkey.
 - C. Iran.
 - D. All of the above.
 - E. None of the above.
-

5. Which world religion dominates central Asia?

- A. Hinduism.
- B. Buddhism.
- C. Christianity.
- D. All of the above.
- E. None of the above.

Quiz 2

1. In what way did the ancient Egyptian arithmetic exhibit strong links to modern positional numeration systems?

- A. Their numerals were a precursor to our decimal digits.
 - B. They used binary arithmetic for multiplication and division.
 - C. They used a positional numeration system, but with base 60.
 - D. None of the above.
-

2. In what way did the ancient Iraqi arithmetic exhibit strong links to modern positional numeration systems? (Same choices as above.)

- A. Their numerals were a precursor to our decimal digits.
 - B. They used binary arithmetic for multiplication and division.
 - C. They used a positional numeration system, but with base 60.
 - D. None of the above.
-

3. In what way did the ancient Chinese arithmetic exhibit strong links to modern positional numeration systems?

- A. Their numerals were a precursor to our decimal digits.
 - B. They used binary arithmetic for multiplication and division.
 - C. They used a positional numeration system, but with base 60.
 - D. None of the above.
-

4. How did the ancient Egyptians represent fractional quantities?

- A. With binary digits.
 - B. With decimal digits.
 - C. With sexagesimal digits.
 - D. None of the above.
-

5. How did the ancient Iraqis represent fractional quantities?

- A. With binary digits.
- B. With decimal digits.
- C. With sexagesimal digits.
- D. None of the above.

Quiz 3

1. What is part of the Obama-Biden proposals for early childhood education?

- A. Quadrupling funding for Head Start.
- B. Increase access for child care.
- C. Education for infants.

→D. All of the above.

E. None of the above.

2. What do Obama and Biden propose for NCLB?

→A. Increasing the funding.

B. Removing the accountability provisions.

C. Eliminating the assessment provisions.

D. All of the above.

E. None of the above.

3. What do Obama and Biden propose for charter schools?

A. Double funding.

B. Require states to close underperforming schools.

C. Encourage states to expand access to the best schools.

→D. All of the above.

E. None of the above.

4. What are specific proposals for math and science education in the Obama-Biden agenda?

A. Doubling funding for teacher retraining in math and science.

→B. Recruiting math and science graduates into teaching.

C. Improve standardized assessment for math and science students.

D. All of the above.

E. None of the above.

5. What is part of the Obama-Biden proposals for higher education?

A. Introduce a version of NCLB for colleges and universities.

B. Raise graduation requirements for math and science graduates.

→C. Streamlining the application for financial aid.

D. All of the above.

E. None of the above.

Quiz 4

1. What was a feature of Chinese mathematics 2000 years ago?

- A. Geometry was treated axiomatically.
 - B. The concept of proportionality was central.
 - C. All problems had a practical basis.
 - D. All of the above.
 - E. None of the above.
-

2. During the period of decline known as the “Dark Ages” in Europe, what other regions also were mathematically dormant?

- A. China.
 - B. India.
 - C. The Arab world.
 - D. All of the above.
 - E. None of the above.
-

3. Where in the Islamic empire did the Europeans go to translate classic mathematical texts?

- A. Iraq.
 - B. Egypt.
 - C. Spain.
 - D. All of the above.
 - E. None of the above.
-

4. What do we know about ancient Greek mathematicians?

- A. Almost all came from the province around Athens.
 - B. They worked almost exclusively in geometry.
 - C. They all spoke Greek.
 - D. All of the above.
 - E. None of the above.
-

5. What do we know about medieval Arabic mathematicians?

- A. Almost all came from the province around Baghdad.
- B. They worked almost exclusively in geometry.
- C. They all spoke Arabic.
- D. All of the above.
- E. None of the above.

Quiz 5

1. What was the state of mathematics around the world at the end of the 14th century?

A. Most cultures outside Europe were quite backward, and scholarly activity would revive only after European colonialism.

B. Most advanced cultures were tightly interlinked by trade, and hence mathematical ideas were shared easily.

→C. There were many advanced cultures, somewhat insulated, each with their own advances in mathematics.

D. None of the above.

2. What were features of European algebra in the 16th and 17th centuries?

A. A turn from the rhetorical to the symbolic.

B. A theory of polynomials and their roots.

C. New links between algebra and geometry.

→D. All of the above.

E. None of the above.

3. What “difficult questions” arose when scientists began using mathematics to study motion?

A. Impossibility of solving quintic equations.

B. Existence of the square roots of negative numbers.

→C. Infinite divisibility of a quantity.

D. All of the above.

E. None of the above.

4. What role does noneuclidean geometry play in “the real world”?

A. A theoretical framework for modern computer architecture.

→B. A fundamental tool in Einstein’s theory of gravitation.

C. Nothing — it is purely of abstract and esthetic interest.

5. What is the basis for the unity of modern mathematics?

A. Applications.

→B. Abstraction.

C. Formalism.

D. None of the above.

Quiz 6

1. Which civilization did *not* develop a positional numeration system?

- A. Greece.
 - B. Iraq.
 - C. India.
 - D. Maya.
 - E. None of the above.
-

2. What was a change brought about by the adoption of the decimal system?

- A. The widespread use of abaci and counting boards.
 - B. The rediscovery of Greek mathematics.
 - C. The weakening of the power of the Roman church.
 - D. All of the above.
 - E. None of the above.
-

3. Who or what brought arithmetic symbols to Europe?

- A. Arabic texts, in translation.
 - B. Chinese scholars, accompanying Mongol invaders.
 - C. Indian merchants, traveling the famed “silk road”.
 - D. None of the above.
-

4. What conceptual leap by Hindu mathematicians was “one of the most important mathematical events of all time”?

- A. The use of the infinitely large.
 - B. The use of the infinitely divisible.
 - C. The use of imaginary quantities.
 - D. None of the above.
-

5. What is Harriot’s Principle?

- A. The roots of a polynomial $p(x)$ are precisely the x -intercepts of the graph of $y = p(x)$.
- B. To solve a polynomial equation you should first transpose terms so that it has the form $p(x) = 0$.
- C. The number of roots (counted with multiplicity) of a polynomial equals the degree of that polynomial.
- D. None of the above.

Quiz 7

1. How might we represent the sexagesimal number 2, 25; 15?

A. $2\frac{25}{15}$

B. 225.15

C. 145.15

→D. 145.25

E. None of the above.

2. Who gave the world the metric system?

A. Hindu scholars of the 9th century.

B. Islamic scholars of the 12th century.

→C. French scholars of the 18th century.

D. None of the above.

3. What has been used to set the world standard for the meter?

A. The circumference of the earth.

B. The length of a certain platinum bar.

C. The wave length of certain radiation.

→D. All of the above.

E. None of the above.

4. When were negative numbers accepted as “first-class citizens”?

A. Over 3000 years ago in Iraq.

B. In most of the Islamic Empire by the 12th century.

C. England, at the beginning of the 19th century.

→D. Not until the latter half of the 19th century.

E. None of the above.

5. Who among the following made the greatest contribution to the understanding and widespread acceptance of negative numbers?

A. Brahmagupta.

B. Al-Khwarizmi.

C. Cardano.

D. Descartes.

E. Newton.

Quiz 8

1. What algebraic identity underlies the classical Chinese proof of the “pythagorean theorem”?

- A. $(a + b)^2 = a^2 + b^2 + 2ab$.
 - B. $(a + b)(a - b) = a^2 - b^2$.
 - C. $(a + b)^2 = a^2 + b^2$.
 - D. None of the above.
-

2. For what did Diophantos use his “secant-and-tangent” method?

- A. To find rational solutions of indeterminate quadratics.
 - B. To find rational solutions of determinate cubics.
 - C. To find all solutions of all determinate quadratics and cubics.
 - D. All of the above.
 - E. None of the above.
-

3. What was “chakravala” used to solve?

- A. Certain determinate quadratics.
 - B. Certain determinate cubics.
 - C. Certain indeterminate quadratics.
 - D. None of the above.
-

4. When were determinate cubic and quartic equations solved?

- A. Medieval India.
 - B. Renaissance Italy.
 - C. Revolutionary France.
 - D. Antebellum America.
 - E. None of the above.
-

5. Why did Galois introduce the concept of a group of permutations?

- A. To prove Fermat’s Last Theorem.
- B. To solve quintic equations using the “newfangled” complex numbers.
- C. To prove that quintic equations cannot be solved by radicals.
- D. None of the above.

Quiz 9

1. Why is it important to calculate π to millions of digits?
 - A. For accurate surveys of lakes and other geographical features.
 - B. For an accurate determination of the length of the meter.
 - C. To determine whether or not π is rational.
 - D. All of the above.
 - E. None of the above.

2. The text claims which of the following are essential for good algebraic notation?
 - A. It should suggest generalizations.
 - B. It should clarify ideas.
 - C. It should reveal patterns.
 - D. All of the above.
 - E. None of the above.

3. The text suggests that which of the following may have delayed the emergence of the use of letters for unknowns and parameters?
 - A. The influence of writers such as Chuquet, Bombelli, and Viète.
 - B. The slow adoption of the Hindu decimal system.
 - C. The increasing conservatism of the Catholic clergy.
 - D. All of the above.
 - E. None of the above.

4. What geometric principle underlies the method of double false position?
 - A. The slope between any pair of points on a line is constant.
 - B. The slope of perpendicular lines are negative reciprocals.
 - C. The area of a parallelogram is given by cross product.
 - D. None of the above.

5. What is the “fundamental insight” about linear equations that generalizes to many other problems?
 - A. Two points determine a line.
 - B. Parallel lines have the same slope.
 - C. Perpendicular lines have reciprocal slopes.
 - D. All of the above.
 - E. None of the above.

Quiz 10

1. If the problem is “a square and ten roots equal twenty-eight” what must you do to complete the square?
- A. Square half of ten, then add to twenty-eight.
 - B. Square ten, then add to twenty-eight.
 - C. Square half of twenty-eight, then add to ten.
 - D. Square twenty-eight, then add to ten.
 - E. None of the above.
-
2. What was the great advance in algebra during the Italian Renaissance?
- A. The solution of cubic and quartic equations.
 - B. The development of a fully symbolic algebra.
 - C. The algebraization of geometry through cartesian coordinates.
 - E. None of the above.
-
3. What new concept were mathematicians forced to confront after the discovery of Cardano’s formulas?
- A. Infinitesimals.
 - B. Complex numbers.
 - C. Symbolic algebra.
 - D. All of the above.
 - E. None of the above.
-
4. What is notable about Euclid’s proof of the pythagorean theorem?
- A. It shows how to decompose the square on the hypotenuse into two rectangles equal to the squares on the legs.
 - B. It avoids the contentious fifth postulate on parallels through a point.
 - C. It provides a beautiful application of the notion of similarity.
 - D. All of the above.
 - E. None of the above.
-
5. Who finally provide Fermat’s last theorem?
- A. Sophie Germain.
 - B. Andrew Wiles.
 - C. Ernst Kummer.
 - D. Nobody — it is still unproven.

Quiz 11

1. What is the subject of the “particularly important” Book V of Euclid’s *Elements*?

- A. Aristotelian logic.
 - B. Eudoxus’ theory of ratios.
 - C. Proving that the Platonic Solids are the only regular polyhedra.
 - D. All of the above.
 - E. None of the above.
-

2. What is the “touch of genius” which is the main goal of Book XIII of Euclid’s *Elements*? (Same choices as above.)

- A. Aristotelian logic.
 - B. Eudoxus’ theory of ratios.
 - C. Proving that the Platonic Solids are the only regular polyhedra.
 - D. All of the above.
 - E. None of the above.
-

3. The power of cartesian coordinates is the connection between algebraic expressions and shapes in the plane. Where was the first “glimmer of this idea”?

- A. Egyptian surveyors’ use of a rectangular grid.
 - B. Apollonius’ study of locus problems.
 - C. Nicole Oresme graphing the relationship between dependent and independent variables.
 - D. None of the above.
-

4. What is De Moivre’s formula?

- A. $\cos(x + iy) = \cos(x) \cos(y) - i \sin(x) \sin(y)$.
 - B. $\sin(x + iy) = \sin(x) \cos(y) + i \sin(x) \sin(y)$.
 - C. $(\cos(x) + i \sin(x))^n = \cos(nx) + i \sin(nx)$.
 - D. None of the above.
-

5. What is Euler’s formula?

- A. $e^{ix} = \cos(x) + i \sin(x)$.
- B. $e^{x+iy} = \cos(x) + i \sin(y)$.
- C. $e^{x+iy} = \cos(x) + \sin(iy)$.
- D. None of the above.

Quiz 12

1. What is De Moivre's formula related to?

- A. The addition formula for sine.
- B. The addition formula for cosine.
- C. Euler's exponential identity.

→D. All of the above.

E. None of the above.

2. What is the relationship of the sine to the chord?

→A. The sine is half the chord of twice the angle.

B. The chord is half the sine of twice the angle.

C. The sine is twice the chord of half the angle.

D. None of the above.

3. What does Euclid need the fifth postulate to prove?

A. Parallel lines are equidistant.

B. Angles in a triangle sum to 180° .

C. Pythagoras' theorem.

→D. All of the above.

E. None of the above.

4. What are characteristic features of lobachevskian geometry?

A. The sum of the angles in a triangle is less than 180° .

B. The ratio of a the circumference of a circle to its diameter is greater than π .

C. Similar triangles are congruent.

→D. All of the above.

E. None of the above.

5. What led to the development of projective geometry?

→A. Artists' need to portray depth on a flat surface.

B. Navigators' need for maps which do not distort distance.

C. The demand for a rigorous treatment of lobachevskian geometry.

D. All of the above.

E. None of the above.

Quiz 13

1. To what problem does probability trace its roots?
 - A. Fairly distributing the stakes of an unfinished game of chance.
 - B. Fairly distributing tax revenues according to an incomplete census.
 - C. Fairly distributing the estate of an intestate deceased.
 - D. None of the above.

2. What was the key to Pascal and Fermat's solution?
 - A. Finding the maximum likelihood of each event.
 - B. Finding the minimum likelihood of each event.
 - C. Understanding events of equal likelihood.
 - D. None of the above.

3. What is probability?
 - A. The exploration of an unknown sample of a known population.
 - B. The exploration of an unknown population from a known sample.
 - C. Both.
 - D. Neither.

4. What is statistics? (Same choices as above.)
 - A. The exploration of an unknown sample of a known population.
 - B. The exploration of an unknown population from a known sample.
 - C. Both.
 - D. Neither.

5. What was Legendre's contribution to the statisticians' standard tool set?
 - A. The Law of Large Numbers.
 - B. The Normal Curve.
 - C. The Method of Least Squares.
 - D. All of the above.
 - E. None of the above.

Quiz 14

1. What was the principal innovation of Babbage's "Analytical Engine"?

- A. It used binary arithmetic.
 - B. It was programmable.
 - C. It was easy to mass produce.
 - D. None of the above.
-

2. What was the key element of Boole's work?

- A. The algebra of truth values.
 - B. The logic of algebra.
 - C. The value of logic.
 - D. None of the above.
-

3. Which of the following did Cantor prove?

- A. There are more irrationals than rationals.
 - B. There are exactly as many rationals as counting numbers.
 - C. There are exactly as many points on a line as in the plane.
 - D. All of the above.
 - E. None of the above.
-

4. What worried Catholic theologians about Cantor's set theory?

- A. It might justify atheism.
 - B. It might justify pantheism.
 - C. It might justify animism.
 - D. All of the above.
 - E. None of the above.
-

5. What "won the day" for Cantor's theory?

- A. It reduced metaphysics to mathematics.
- B. It resolved all the philosophical questions about mathematics.
- C. It blurred the boundaries between religion, philosophy, and science.
- D. All of the above.
- E. None of the above.

Quiz 15

1. What does it mean to say that an approximation method exhibits quadratic convergence?

- A. To compute one step you solve a quadratic equation.
 - B. The limit satisfies a quadratic equation.
 - C. Each error is roughly the square of the previous one.
 - D. All of the above.
 - E. None of the above.
-

2. What is one of the important consequences of quadratic convergence?

- A. Convergence is monotone.
 - B. Accuracy roughly doubles at each step.
 - C. The computations are particularly easy in a place-value system.
 - D. All of the above.
 - E. None of the above.
-

3. What is $\binom{16}{8} + \binom{16}{9}$?

- A. $\binom{16}{10}$.
 - B. $\binom{17}{10}$.
 - C. $\binom{17}{9}$.
 - D. None of the above.
-

4. Who first discovered the binomial theorem?

- A. The ancient Iraqis.
 - B. The medieval Chinese.
 - C. Blaise Pascal.
 - D. Archimedes.
 - E. None of the above.
-

5. If we apply synthetic division with a polynomial $p(x)$ and a value r , what do we obtain?

- A. The remainder of $p(x) \div (x - r)$.
- B. The quotient of $p(x) \div (x - r)$.
- C. The value of $p(r)$.
- D. All of the above.
- E. None of the above.

Quiz 16

1. Which of the subjects of the *quadrivium* is traditionally associated with arithmetic?

- A. Logic.
 - B. Geometry.
 - C. Astronomy.
 - D. None of the above.
-

2. Which ratio defines the octave?

- A. 8 : 1
 - B. 8 : 5
 - C. 5 : 3
 - D. 3 : 2
 - E. 2 : 1
 - F. None of the above.
-

3. Which ratio defines the fifth?

- A. 8 : 1
 - B. 8 : 5
 - C. 5 : 3
 - D. 3 : 2
 - E. 2 : 1
 - F. None of the above.
-

4. What is the pythagorean comma?

- A. A proof of the irrationality of $\sqrt{2}$.
 - B. An ancient version of the Weber-Fechner Law.
 - C. The interval between 12 fifths and 7 octaves.
 - D. None of the above.
-

5. How did the conceptual separation of magnitude and number affect Greek mathematics?

- A. It blocked the general idea of algebra.
- B. It caused mischief with the notion of equality.
- C. It played havoc with the concept of volume.
- D. All of the above.
- E. None of the above.

Quiz 16 (bonus)

1. The system of equal semitones, or equal temperament, has “great simplicity and mathematical beauty” due to its

- A. irrational basic ratio, the twelfth root of 2.
 - B. immediate popularity and impact on music.
 - C. use of all integer ratios in music except the octave’s 2 : 1.
 - D. All of the above.
 - E. None of the above.
-

2. Kolmogorov said, “At any given moment there is only a fine layer between the trivial and the impossible.” He then went on to say

- A. “The true mathematician recognizes the difference.”
 - B. “Mathematical discoveries are made in this layer.”
 - C. “Mathematics advances when it digs below this layer.”
 - D. None of the above.
-

3. What scale is represented on a guitar fret board?

- A. One of equal temperament.
 - B. One based exclusively on true fifths.
 - C. One that interpolates equal semitones between true fifths.
 - D. None of the above.
-

4. What is the continued fraction expression for $1 + \sqrt{2}$?

- A. $2 + 1/(2 + 1/(2 + \dots))$
- B. $1 + 2/(1 + 2/(1 + \dots))$
- C. $2 + 2/(2 + 2/(2 + \dots))$
- D. $1 + 1/(1 + 1/(1 + \dots))$
- E. None of the above.

Quiz 17

1. Whom does Stillwell credit for being the first to sight complex arithmetic?
 - A. Euclid.
 - B. al-Khazin.
 - C. Galileo.
 - D. Bombelli.
 - E. None of the above.

2. What was this first sighting?
 - A. The fact that the product of sums of two squares is a sum of two squares.
 - B. The fact that the product of the sum and difference of two numbers is the difference of their squares.
 - C. The fact that a cubic can have a real solution even when its discriminant is negative.
 - D. None of the above.

3. How does Stillwell explain that the product of two negative numbers is positive?
 - A. By modeling positive numbers as assets and negative numbers as debts.
 - B. By exploiting the distributive property.
 - C. By a geometric construction.
 - D. None of the above.

4. What is the statement of the Fundamental Theorem of Algebra?
 - A. A root x_1 of a polynomial equation $p(x) = 0$ corresponds to a factor $x - x_1$ of $p(x)$.
 - B. A polynomial of degree n has exactly n roots in the complex plane.
 - C. Complex algebraic curves of degree m and n intersect in exactly mn points.
 - D. None of the above.

5. What is the statement of Bezout's Theorem?
 - A. A root x_1 of a polynomial equation $p(x) = 0$ corresponds to a factor $x - x_1$ of $p(x)$.
 - B. A polynomial of degree n has exactly n roots in the complex plane.
 - C. Complex algebraic curves of degree m and n intersect in exactly mn points.
 - D. None of the above.

Quiz 18

1. What was Bombelli's "brilliant move"?
 - A. To plot complex numbers as points in the plane.
 - B. To assume that $\sqrt{-1}$ obeys the usual laws of algebra.
 - C. To prove the Fundamental Theorem of Algebra.
 - D. None of the above.

2. What was Euler's "amazing" contribution to complex analysis?
 - A. To plot complex numbers as points in the plane.
 - B. To assume that $\sqrt{-1}$ obeys the usual laws of algebra.
 - C. To prove the Fundamental Theorem of Algebra.
 - D. None of the above.

3. If u and v are complex numbers what is the length of uv ?
 - A. The sum of the lengths of u and v .
 - B. The product of the lengths of u and v .
 - C. Neither of the above.

4. If u and v are complex numbers what is the angle of uv ?
 - A. The sum of the angles of u and v .
 - B. The product of the angles of u and v .
 - C. Neither of the above.

5. The proof of the Fundamental Theorem of Algebra was delayed by futile attempts to solve what?
 - A. Cubic equations.
 - B. Quartic equations.
 - C. Quintic equations.
 - D. All of the above.
 - E. None of the above.

Quiz 19

1. What is the algebraic formula which expresses the geometric method completing the cube?

A. $a^3 + b^3 = (a + b)^3 + 3ab(a + b)$.

B. $a^3 - b^3 = (a - b)^3 + 3(a - b)(a + b)$.

C. $a^3 + b^3 = (a - b)^3 + 3(a + b)(a - b)$.

→D. None of the above.

2. Why is notable about the *casus irreducibilis*?

→A. It is a case where real solutions seem to require complex expression.

B. It is a case where real solutions exist, but cannot be expressed by Cardano's formula.

C. It shows that Cardano's formula discriminates between the cases where real solutions do and do not exist.

D. None of the above.

3. What can we get from *anthyphairesis*?

A. Excellent rational approximations for irrationalities.

B. Periodic expressions for quadratic surds.

C. Solutions of Brahmagupta's equations.

→D. All of the above.

E. None of the above.

4. The solution set for Brahmagupta's equations form what modern algebraic structure?

A. A norm.

B. A conjugate.

→C. A group.

D. None of the above.

5. Which cubics did Bombelli prove always have a positive solution?

A. $x^3 + px = q$, where $p > 0$ and $q > 0$.

→B. $x^3 = px + q$, where $p > 0$ and $q > 0$.

C. $x^3 + q = px$, where $p > 0$ and $q > 0$.

D. All of the above.

E. None of the above.

Quiz 20

1. What is the complex number whose length is r and angle is θ ?

- A. $r + \theta i$.
 - B. $r \cos(\theta) i$.
 - C. $r \sin(\theta) i$.
 - D. $re^{\theta i}$.
 - E. None of the above.
-

2. What is de Moivre's formula?

- A. $(\cos(\theta) + \sin(\theta) i)^n = \cos^n(\theta) + \sin^n(\theta) i$.
 - B. $\cos(n\theta) + \sin(n\theta) i = \cos^n(\theta) + \sin^n(\theta) i$.
 - C. $(\cos(\theta) + \sin(\theta) i)^n = \cos(n\theta) + \sin(n\theta) i$.
 - D. None of the above.
-

3. What is $e^{\pi i}$?

- A. i .
 - B. 1 .
 - C. -1 .
 - D. None of the above.
-

4. In the complex plane, what is $\sqrt[3]{1}$?

- A. 1 .
 - B. $e^{2\pi i/3}$.
 - C. $e^{-2\pi i/3}$.
 - D. All of the above.
 - E. None of the above.
-

5. How many roots does the equation $x^5 + 3x^4 + 2x^3 + x^2 + 2 = 0$ have in the complex plane?

- A. 1 .
- B. 3 .
- C. 5 .
- D. Infinitely many.
- E. None of the above.

Quiz 21

1. Which theorem, together with the incidence axioms, implies all nine laws of algebra?

- A. Pappus' theorem.
 - B. Desargues' theorem.
 - C. Desargues' little theorem.
 - D. All of the above.
 - E. None of the above.
-

2. In *Yearning for the Impossible*, what does Stillwell claim is the first great advance in geometry after the time of Euclid?

- A. Coordinates.
 - B. Projective geometry.
 - C. The theory of conic sections.
 - D. None of the above.
-

3. What does Stillwell say about parallel lines?

- A. Their meeting is forced on the imagination by the eye.
 - B. They become more important when they are allowed to meet.
 - C. They lead to a paradox that makes geometry "bigger and better".
 - D. All of the above.
 - E. None of the above.
-

4. What sort of axioms define projective geometry?

- A. Incidence axioms.
 - B. Measurement axioms.
 - C. Completeness axioms.
 - D. All of the above.
 - E. None of the above.
-

5. Why did projective geometry appeal to 17th century mathematicians?

- A. It gave a deeper understanding of parallel lines.
- B. It led directly to the discovery of calculus.
- C. It helped explain the geometry of complex numbers.
- D. All of the above.
- E. None of the above.

Quiz 22

1. What was the goal of the “new geometric analysis” of the Italian Renaissance?
- A. To derive formulas for the tangent lines to higher-degree curves.
 - B. To remove the perceived flaws in Euclid’s theory of parallels.
 - C. To understand which geometric properties are invariant under change of perspective.
 - D. All of the above.
 - E. None of the above.
-
2. What are alternative homogeneous coordinates for the point represented in the projective plane by $(2, 4, 6)$?
- A. $(1, 2, 3)$.
 - B. $(0.2, 0.4, 0.6)$.
 - C. $(10, 20, 30)$.
 - D. All of the above.
 - E. None of the above.
-
3. What are the points at infinity for the curve $u^2 + v^2 = w^2$?
- A. $(i, -i, 0)$ and $(-i, i, 0)$.
 - B. $(i, -i, 1)$ and $(-i, i, 1)$.
 - C. $(0, 0, 0)$ (counted with multiplicity 2).
 - D. None of the above.
-
4. What is the homogeneous form of the equation $y = x^2$?
- A. $u = v^2$.
 - B. $uw = v^2$.
 - C. $u/v^2 = w$.
 - D. None of the above.
-
5. Which lines of sight represent points at infinity?
- A. Lines perpendicular to the canvas.
 - B. Lines parallel to the canvas.
 - C. Vertical lines in the canvas.
 - D. All of the above.
 - E. None of the above.

Quiz 23

1. Which of the following are invariant under change of perspective?

- A. Degree of a curve.
 - B. Tangency.
 - C. Points of intersection.
 - D. All of the above.
 - E. None of the above.
-

2. What are alternative homogeneous coordinates for the point represented in the projective plane by $(1, -1, 0)$?

- A. $(1, -1, 1)$.
 - B. $(0, -1, 1)$.
 - C. $(1, 1, 0)$.
 - D. All of the above.
 - E. None of the above.
-

3. What are the points at infinity for the curve $uv = w^2$?

- A. $(1, 0, 0)$ and $(0, 1, 0)$.
 - B. $(1, 1, 0)$ and $(1, -1, 0)$.
 - C. $(1, 1, 0)$ (counted with multiplicity 2).
 - D. None of the above.
-

4. What is the homogeneous form of the equation $x^2 + y^2 = 1$?

- A. $u^2 + v^2 = w^2$.
 - B. $u^2 + v^2 = 1$.
 - C. $uw + vw = 1$.
 - D. None of the above.
-

5. The projective and euclidean planes are both models of what type of geometry?

- A. Spherical geometry.
- B. Neutral geometry.
- C. Hyperbolic geometry.
- D. All of the above.
- E. None of the above.