NAME

Postulates

1 **Ruler Postulate** The points on a line can be matched one to one with the real numbers. The real number that corresponds to a point is the coordinate of the point. The distance between points A and B, written as AB, is the absolute value of the difference between the coordinates of A and B. (p. 17)

2 **Segment Addition Postulate** If B is between A and C, then $AB + BC = AC$. If $AB + BC = AC$, then B is between A and C. (p. 18)

3 **Protractor Postulate** Consider a point A on one side of $\overleftrightarrow{OB}$. The rays of the form $\overrightarrow{OA}$ can be matched one to one with the real numbers from 0 to 180. The measure of $\angle AOB$ is equal to the absolute value of the difference between the real numbers for $\overrightarrow{OA}$ and $\overrightarrow{OB}$. (p. 27)

4 **Angle Addition Postulate** If P is in the interior of $\angle RST$, then $m\angle RSP + m\angle PST = m\angle RST$. (p. 27)

5 Through any two points there exists exactly one line. (p. 73)

6 A line contains at least two points. (p. 73)

7 If two lines intersect, then their intersection is exactly one point. (p. 73)

8 Through any three noncollinear points there exists exactly one plane. (p. 73)

9 A plane contains at least three noncollinear points. (p. 73)

10 If two points lie in a plane, then the line containing them lies in the plane. (p. 73)

11 If two planes intersect, then their intersection is a line. (p. 73)

12 **Linear Pair Postulate** If two angles form a linear pair, then they are supplementary. (p. 111)

13 **Parallel Postulate** If there is a line and a point not on the line, then there is exactly one line through the point parallel to the given line. (p. 130)

14 **Perpendicular Postulate** If there is a line and a point not on the line, then there is exactly one line through the point perpendicular to the given line. (p. 130)

15 **Corresponding Angles Postulate** If two parallel lines are cut by a transversal, then the pairs of corresponding angles are congruent. (p. 143)

16 **Corresponding Angles Converse** If two lines are cut by a transversal so that corresponding angles are congruent, then the lines are parallel. (p. 150)

17 **Slopes of Parallel Lines** In a coordinate plane, two nonvertical lines are parallel if and only if they have the same slope. Any two vertical lines are parallel. (p. 166)

18 **Slopes of Perpendicular Lines** In a coordinate plane, two nonvertical lines are perpendicular if and only if the product of their slopes is -1. Vertical and horizontal lines are perpendicular. (p. 172)

19 **Side-Side-Side (SSS) Congruence Postulate** If three sides of one triangle are congruent to three sides of a second triangle, then the two triangles are congruent. (p. 212)

20 **Side-Angle-Side (SAS) Congruence Postulate** If two sides and the included angle of one triangle are congruent to two sides and the included angle of a second triangle, then the two triangles are congruent. (p. 213)

21 **Angle-Side-Angle (ASA) Congruence Postulate** If two angles and the included side of one triangle are congruent to two angles and the included side of a second triangle, then the two triangles are congruent. (p. 220)

22 **Area of a Square Postulate** The area of a square is the square of the length of its side, or $A = s^2$. (p. 372)

23 **Area Congruence Postulate** If two polygons are congruent, then they have the same area. (p. 372)

24 **Area Addition Postulate** The area of a region is the sum of the areas of its nonoverlapping parts. (p. 372)

25 **Angle-Angle (AA) Similarity Postulate** If two angles of one triangle are congruent to two angles of another triangle, then the two triangles are similar. (p. 481)

26 **Arc Addition Postulate** The measure of an arc formed by two adjacent arcs is the sum of the measures of the two arcs. (p. 604)

27 **Volume of a Cube** The volume of a cube is the cube of the length of its side, or $V = s^3$. (p. 743)

28 **Volume Congruence Postulate** If two polyhedra are congruent, then they have the same volume. (p. 743)

29 **Volume Addition Postulate** The volume of a solid is the sum of the volumes of all its nonoverlapping parts. (p. 743)

Theorems

2.1 Properties of Segment Congruence Segment congruence is reflexive, symmetric, and transitive.

Reflexive: For any segment AB, $\overline{AB} \cong \overline{AB}$.

Symmetric: If $\overline{AB} \cong \overline{CD}$, then $\overline{CD} \cong \overline{AB}$.

Transitive: If $\overline{AB} \cong \overline{CD}$ and $\overline{CD} \cong \overline{EF}$, then $\overline{AB} \cong \overline{EF}$. (p. 102)

2.2 Properties of Angle Congruence Angle congruence is reflexive, symmetric, and transitive.

Reflexive: For any angle A, $\angle A \cong \angle A$.

Symmetric: If $\angle A \cong \angle B$, then $\angle B \cong \angle A$.

Transitive: If $\angle A \cong \angle B$ and $\angle B \cong \angle C$, then $\angle A \cong \angle C$. (p. 109)

2.3 Right Angle Congruence Theorem All right angles are congruent. (p. 110)

2.4 Congruent Supplements Theorem If two angles are supplementary to the same angle (or to congruent angles) then they are congruent. (p. 111)

2.5 Congruent Complements Theorem If two angles are complementary to the same angle (or to congruent angles) then the two angles are congruent. (p. 111)

2.6 Vertical Angles Theorem Vertical angles are congruent. (p. 112)

3.1 If two lines intersect to form a linear pair of congruent angles, then the lines are perpendicular. (p. 137)

3.2 If two sides of two adjacent acute angles are perpendicular, then the angles are complementary. (p. 137)

3.3 If two lines are perpendicular, then they intersect to form four right angles. (p. 137)

3.4 Alternate Interior Angles If two parallel lines are cut by a transversal, then the pairs of alternate interior angles are congruent. (p. 143)

3.5 Consecutive Interior Angles If two parallel lines are cut by a transversal, then the pairs of consecutive interior angles are supplementary. (p. 143)

3.6 Alternate Exterior Angles If two parallel lines are cut by a transversal, then the pairs of alternate exterior angles are congruent. (p. 143)

3.7 Perpendicular Transversal If a transversal is perpendicular to one of two parallel lines, then it is perpendicular to the other. (p. 143)

3.8 Alternate Interior Angles Converse If two lines are cut by a transversal so that alternate interior angles are congruent, then the lines are parallel. (p. 150)

3.9 Consecutive Interior Angles Converse If two lines are cut by a transversal so that consecutive interior angles are supplementary, then the lines are parallel. (p. 150)

3.10 Alternate Exterior Angles Converse If two lines are cut by a transversal so that alternate exterior angles are congruent, then the lines are parallel. (p. 150)

3.11 If two lines are parallel to the same line, then they are parallel to each other. (p. 157)

3.12 In a plane, if two lines are perpendicular to the same line, then they are parallel to each other. (p. 157)

4.1 Triangle Sum Theorem The sum of the measures of the interior angles of a triangle is 180°. (p. 196)

Corollary The acute angles of a right triangle are complementary. (p. 197)

4.2 Exterior Angle Theorem The measure of an exterior angle of a triangle is equal to the sum of the measures of the two nonadjacent interior angles. (p. 197)

4.3 Third Angles Theorem If two angles of one triangle are congruent to two angles of another triangle, then the third angles are also congruent. (p. 203)

4.4 Reflexive Property of Congruent Triangles Every triangle is congruent to itself.

Symmetric Property of Congruent Triangles If $\triangle ABC \cong \triangle DEF$, then $\triangle DEF \cong \triangle ABC$.

Transitive Property of Congruent Triangles If $\triangle ABC \cong \triangle DEF$ and $\triangle DEF \cong \triangle JKL$, then $\triangle ABC \cong \triangle JKL$. (p. 205)

4.5 Angle-Angle-Side (AAS) Congruence Theorem If two angles and a nonincluded side of one triangle are congruent to two angles and the corresponding nonincluded side of a second triangle, then the two triangles are congruent. (p. 220)

4.6 Base Angles Theorem If two sides of a triangle are congruent, then the angles opposite them are congruent. (p. 236)

Corollary If a triangle is equilateral, then it is equiangular. (p. 237)

4.7 Converse of the Base Angles Theorem If two angles of a triangle are congruent, then the sides opposite them are congruent. (p. 236)

Corollary If a triangle is equiangular, then it is equilateral. (p. 237)

4.8 Hypotenuse-Leg (HL) Congruence Theorem If the hypotenuse and a leg of a right triangle are congruent to the hypotenuse and a leg of a second right triangle, then the two triangles are congruent. (p. 238)

5.1 Perpendicular Bisector Theorem If a point is on a perpendicular bisector of a segment, then it is equidistant from the endpoints of the segment. (p. 265)

5.2 Converse of the Perpendicular Bisector Theorem If a point is equidistant from the endpoints of a segment, then it is on the perpendicular bisector of the segment. (p. 265)

5.3 Angle Bisector Theorem If a point is on the bisector of an angle, then it is equidistant from the two sides of the angle. (p. 266)

5.4 Converse of the Angle Bisector Theorem If a point is in the interior of an angle and is equidistant from the sides of the angle, then it lies on the bisector of the angle. (p. 266)

5.5 Concurrency of Perpendicular Bisectors of a Triangle The perpendicular bisectors of a triangle intersect at a point that is equidistant from the vertices of the triangle. (p. 273)

5.6 Concurrency of Angle Bisectors of a Triangle The angle bisectors of a triangle intersect at a point that is equidistant from the sides of the triangle. (p. 274)

5.7 Concurrency of Medians of a Triangle The medians of a triangle intersect at a point that is two thirds of the distance from each vertex to the midpoint of the opposite side. (p. 279)

5.8 Concurrency of Altitudes of a Triangle The lines containing the altitudes of a triangle are concurrent. (p. 281)

5.9 Midsegment Theorem The segment connecting the midpoints of two sides of a triangle is parallel to the third side and is half as long. (p. 288)

5.10 If one side of a triangle is longer than another side, then the angle opposite the longer side is larger than the angle opposite the shorter side. (p. 295)

5.11 If one angle of a triangle is larger than another angle, then the side opposite the larger angle is longer than the side opposite the smaller angle. (p. 295)

5.12 Exterior Angle Inequality The measure of an exterior angle of a triangle is greater than the measure of either of the two nonadjacent interior angles. (p. 296)

5.13 Triangle Inequality The sum of the lengths of any two sides of a triangle is greater than the length of the third side. (p. 297)

5.14 Hinge Theorem If two sides of one triangle are congruent to two sides of another triangle, and the included angle of the first is larger than the included angle of the second, then the third side of the first is longer than the third side of the second. (p. 303)

5.15 Converse of the Hinge Theorem If two sides of one triangle are congruent to two sides of another triangle, and the third side of the first is longer than the third side of the second, then the included angle of the first is larger than the included angle of the second. (p. 303)

6.1 Interior Angles of a Quadrilateral The sum of the measures of the interior angles of a quadrilateral is 360°. (p. 324)

6.2 If a quadrilateral is a parallelogram, then its opposite sides are congruent. (p. 330)

6.3 If a quadrilateral is a parallelogram, then its opposite angles are congruent. (p. 330)

6.4 If a quadrilateral is a parallelogram, then its consecutive angles are supplementary. (p. 330)

6.5 If a quadrilateral is a parallelogram, then its diagonals bisect each other. (p. 330)

6.6 If both pairs of opposite sides of a quadrilateral are congruent, then the quadrilateral is a parallelogram. (p. 338)

6.7 If both pairs of opposite angles of a quadrilateral are congruent, then the quadrilateral is a parallelogram. (p. 338)

6.8 If an angle of a quadrilateral is supplementary to both of its consecutive angles, then the quadrilateral is a parallelogram. (p. 338)

6.9 If the diagonals of a quadrilateral bisect each other, then the quadrilateral is a parallelogram. (p. 338)

6.10 If one pair of opposite sides of a quadrilateral are congruent and parallel, then the quadrilateral is a parallelogram. **(p. 340)**

Rhombus Corollary A quadrilateral is a rhombus if and only if it has four congruent sides. **(p. 348)**

Rectangle Corollary A quadrilateral is a rectangle if and only if it has four right angles. **(p. 348)**

Square Corollary A quadrilateral is a square if and only if it is a rhombus and a rectangle. **(p. 348)**

6.11 A parallelogram is a rhombus if and only if its diagonals are perpendicular. **(p. 349)**

6.12 A parallelogram is a rhombus if and only if each diagonal bisects a pair of opposite angles. **(p. 349)**

6.13 A parallelogram is a rectangle if and only if its diagonals are congruent. **(p. 349)**

6.14 If a trapezoid is isosceles, then each pair of base angles is congruent. **(p. 356)**

6.15 If a trapezoid has a pair of congruent base angles, then it is an isosceles trapezoid. **(p. 356)**

6.16 A trapezoid is isosceles if and only if its diagonals are congruent. **(p. 356)**

6.17 **Midsegment Theorem for Trapezoids** The midsegment of a trapezoid is parallel to each base and its length is one half the sum of the lengths of the bases. **(p. 357)**

6.18 If a quadrilateral is a kite, then its diagonals are perpendicular. **(p. 358)**

6.19 If a quadrilateral is a kite, then exactly one pair of opposite angles are congruent. **(p. 358)**

6.20 **Area of a Rectangle** The area of a rectangle is the product of its base and height. $A = bh$ **(p. 372)**

6.21 **Area of a Parallelogram** The area of a parallelogram is the product of a base and its corresponding height. $A = bh$ **(p. 372)**

6.22 **Area of a Triangle** The area of a triangle is one half the product of a base and its corresponding height.

$A = \frac{1}{2}bh$ **(p. 372)**

6.23 **Area of a Trapezoid** The area of a trapezoid is one half the product of the height and the sum of the bases.

$A = \frac{1}{2}h(b_1 + b_2)$ **(p. 374)**

6.24 **Area of a Kite** The area of a kite is one half the product of the lengths of its diagonals. $A = \frac{1}{2}d_1d_2$ **(p. 374)**

6.25 **Area of a Rhombus** The area of a rhombus is equal to one half the product of the lengths of the diagonals. $A = \frac{1}{2}d_1d_2$ **(p. 374)**

7.1 **Reflection Theorem** A reflection is an isometry. **(p. 404)**

7.2 **Rotation Theorem** A rotation is an isometry. **(p. 412)**

7.3 If lines k and m intersect at point P, then a reflection in k followed by a reflection in m is a rotation about point P. The angle of rotation is $2x°$, where $x°$ is the measure of the acute or right angle formed by k and m. **(p. 414)**

7.4 **Translation Theorem** A translation is an isometry. **(p. 421)**

7.5 If lines k and m are parallel, then a reflection in line k followed by a reflection in line m is a translation. If P'' is the image of P, then the following is true:

(1) $\overleftrightarrow{PP''}$ is perpendicular to k and m. (2) $PP'' = 2d$, where d is the distance between k and m. **(p. 421)**

7.6 **Composition Theorem** The composition of two (or more) isometries is an isometry. **(p. 431)**

8.1 If two polygons are similar, then the ratio of their perimeters is equal to the ratios of their corresponding side lengths. **(p. 475)**

8.2 **Side-Side-Side (SSS) Similarity Theorem** If the lengths of the corresponding sides of two triangles are proportional, then the triangles are similar. **(p. 488)**

8.3 **Side-Angle-Side (SAS) Similarity Theorem** If an angle of one triangle is congruent to an angle of a second triangle and the lengths of the sides including these angles are proportional, then the triangles are similar. **(p. 488)**

8.4 **Triangle Proportionality Theorem** If a line parallel to one side of a triangle intersects the other two sides, then it divides the two sides proportionally. **(p. 498)**

8.5 **Converse of the Triangle Proportionality Theorem** If a line divides two sides of a triangle proportionally, then it is parallel to the third side. **(p. 498)**

8.6 If three parallel lines intersect two transversals, then they divide the transversals proportionally. **(p. 499)**

8.7 If a ray bisects an angle of a triangle, then it divides the opposite side into segments whose lengths are proportional to the lengths of the other two sides. **(p. 499)**

9.1 If an altitude is drawn to the hypotenuse of a right triangle, then the two triangles formed are similar to the original triangle and to each other. (p. 527)

9.2 In a right triangle, the altitude from the right angle to the hypotenuse divides the hypotenuse into two segments. The length of the altitude is the geometric mean of the lengths of the two segments. (p. 529)

9.3 In a right triangle, the altitude from the right angle to the hypotenuse divides the hypotenuse into two segments. Each leg of the right triangle is the geometric mean of the hypotenuse and the segment of the hypotenuse that is adjacent to the leg. (p. 529)

9.4 **Pythagorean Theorem** In a right triangle, the square of the length of the hypotenuse is equal to the sum of the squares of the lengths of the legs. (p. 535)

9.5 **Converse of the Pythagorean Theorem** If the square of the length of the longest side of a triangle is equal to the sum of the squares of the lengths of the other two sides, then the triangle is a right triangle. (p. 543)

9.6 If the square of the length of the longest side of a triangle is less than the sum of the squares of the lengths of the other two sides, then the triangle is acute. (p. 544)

9.7 If the square of the length of the longest side of a triangle is greater than the sum of the squares of the length of the other two sides, then the triangle is obtuse. (p. 544)

9.8 **45°-45°-90° Triangle Theorem** In a 45°-45°-90° triangle, the hypotenuse is $\sqrt{2}$ times as long as each leg. (p. 551)

9.9 **30°-60°-90° Triangle Theorem** In a 30°-60°-90° triangle, the hypotenuse is twice as long as the shorter leg, and the longer leg is $\sqrt{3}$ times as long as the shorter leg. (p. 551)

10.1 If a line is tangent to a circle, then it is perpendicular to the radius drawn to the point of tangency. (p. 597)

10.2 In a plane, if a line is perpendicular to a radius of a circle at its endpoint on the circle, then the line is tangent to the circle. (p. 597)

10.3 If two segments from the same exterior point are tangent to a circle, then they are congruent. (p. 598)

10.4 In the same circle, or in congruent circles, two minor arcs are congruent if and only if their corresponding chords are congruent. (p. 605)

10.5 If a diameter of a circle is perpendicular to a chord, then the diameter bisects the chord and its arc. (p. 605)

10.6 If one chord is a perpendicular bisector of another chord, then the first chord is a diameter. (p. 605)

10.7 In the same circle or in congruent circles, two chords are congruent if and only if they are equidistant from the center. (p. 606)

10.8 If an angle is inscribed in a circle, then its measure is half the measure of its intercepted arc. (p. 613)

10.9 If two inscribed angles of a circle intercept the same arc, then the angles are congruent. (p. 614)

10.10 If a right triangle is inscribed in a circle, then the hypotenuse is a diameter of the circle. Conversely, if one side of an inscribed triangle is a diameter of the circle, then the triangle is a right triangle and the angle opposite the diameter is the right angle. (p. 615)

10.11 A quadrilateral can be inscribed in a circle if and only if its opposite angles are supplementary. (p. 615)

10.12 If a tangent and a chord intersect at a point on a circle, then the measure of each angle formed is one half the measure of its intercepted arc. (p. 621)

10.13 If two chords intersect in the interior of a circle, then the measure of each angle is one half the sum of the measures of the arcs intercepted by the angle and its vertical angle. (p. 622)

10.14 If a tangent and a secant, two tangents, or two secants intersect in the exterior of a circle, then the measure of the angle formed is one half the difference of the measures of the intercepted arcs. (p. 622)

10.15 If two chords intersect in the interior of a circle, then the product of the lengths of the segments of one chord is equal to the product of the lengths of the segments of the other chord. (p. 629)

10.16 If two secant segments share the same endpoint outside a circle, then the product of the length of one secant segment and the length of its external segment equals the product of the length of the other secant segment and the length of its external segment. (p. 630)

10.17 If a secant segment and a tangent segment share an endpoint outside a circle, then the product of the length of the secant segment and the length of its external segment equals the square of the length of the tangent segment. (p. 630)

11.1 Polygon Interior Angles Theorem The sum of the measures of the interior angles of a convex n-gon is $(n-2) \cdot 180°$. (p. 662)

Corollary The measure of each interior angle of a regular n-gon is $\frac{1}{n} \cdot (n-2) \cdot 180°$, or $\frac{(n-2) \cdot 180°}{n}$. (p. 662)

11.2 Polygon Exterior Angles Theorem The sum of the measures of the exterior angles of a convex polygon, one angle at each vertex, is 360°. (p. 663)

Corollary The measure of each exterior angle of a regular n-gon is $\frac{1}{n} \cdot 360°$, or $\frac{360°}{n}$. (p. 663)

11.3 Area of an Equilateral Triangle The area of an equilateral triangle is one fourth the square of the length of the side times $\sqrt{3}$. $A = \frac{1}{4}\sqrt{3}s^2$ (p. 669)

11.4 Area of a Regular Polygon The area of a regular n-gon with side length s is half the product of the apothem a and the perimeter P, so $A = \frac{1}{2}aP$, or $A = \frac{1}{2}a \cdot ns$. (p. 670)

11.5 Areas of Similar Polygons If two polygons are similar with the lengths of corresponding sides in the ratio of $a:b$, then the ratio of their areas is $a^2:b^2$. (p. 677)

11.6 Circumference of a Circle The circumference C of a circle is $C = \pi d$ or $C = 2\pi r$, where d is the diameter of the circle and r is the radius of the circle. (p. 683)

Arc Length Corollary In a circle, the ratio of the length of a given arc to the circumference is equal to the ratio of the measure of the arc to 360°.

$\frac{\text{Arc length of } \widehat{AB}}{2\pi r} = \frac{m\widehat{AB}}{360°}$, or

Arc length of $\widehat{AB} = \frac{m\widehat{AB}}{360°} \cdot 2\pi r$ (p. 683)

11.7 Area of a Circle The area of a circle is π times the square of the radius, or $A = \pi r^2$. (p. 691)

11.8 Area of a Sector The ratio of the area A of a sector of a circle to the area of the circle is equal to the ratio of the measure of the intercepted arc to 360°.

$\frac{A}{\pi r^2} = \frac{m\widehat{AB}}{360°}$, or $A = \frac{m\widehat{AB}}{360°} \cdot \pi r^2$ (p. 692)

12.1 Euler's Theorem The number of faces (F), vertices (V), and edges (E) of a polyhedron are related by the formula $F + V = E + 2$. (p. 721)

12.2 Surface Area of a Right Prism The surface area S of a right prism can be found using the formula $S = 2B + Ph$, where B is the area of a base, P is the perimeter of a base, and h is the height. (p. 729)

12.3 Surface Area of a Right Cylinder The surface area S of a right cylinder is $S = 2B + Ch = 2\pi r^2 + 2\pi rh$, where B is the area of a base, C is the circumference of a base, r is the radius of a base, and h is the height. (p. 730)

12.4 Surface Area of a Regular Pyramid The surface area S of a regular pyramid is $S = B + \frac{1}{2}P\ell$, where B is the area of a base, P is the perimeter of the base, and ℓ is the slant height. (p. 736)

12.5 Surface Area of a Right Cone The surface area S of a right cone is $S = \pi r^2 + \pi r\ell$, where r is the radius of the base and ℓ is the slant height. (p. 737)

12.6 Cavalieri's Principle If two solids have the same height and the same cross-sectional area at every level, then they have the same volume. (p. 744)

12.7 Volume of a Prism The volume V of a prism is $V = Bh$, where B is the area of a base and h is the height. (p. 744)

12.8 Volume of a Cylinder The volume V of a cylinder is $V = Bh = \pi r^2 h$, where B is the area of a base, h is the height, and r is the radius of a base. (p. 744)

12.9 Volume of a Pyramid The volume V of a pyramid is $V = \frac{1}{3}Bh$, where B is the area of the base and h is the height. (p. 752)

12.10 Volume of a Cone The volume V of a cone is $V = \frac{1}{3}Bh = \frac{1}{3}\pi r^2 h$, where B is the area of the base, h is the height, and r is the radius of the base. (p. 752)

12.11 Surface Area of a Sphere The surface area S of a sphere with radius r is $S = 4\pi r^2$. (p. 759)

12.12 Volume of a Sphere The volume V of a sphere with radius r is $V = \frac{4}{3}\pi r^3$. (p. 761)

12.13 Similar Solids Theorem If two similar solids have a scale factor of $a:b$, then corresponding areas have a ratio of $a^2:b^2$, and corresponding volumes have a ratio of $a^3:b^3$. (p. 767)

2.4 Reasoning with Properties from Algebra

What you should learn

GOAL 1 Use properties from algebra.

GOAL 2 Use properties of length and measure to justify segment and angle relationships, such as the angles at the turns of a racetrack, as in Example 5 and Ex. 28.

Why you should learn it

▼ Using algebraic properties helps you when rewriting a formula, such as the formula for an athlete's target heart rate in Example 3.

REAL LIFE

GOAL 1 USING PROPERTIES FROM ALGEBRA

Many properties from algebra concern the equality of real numbers. Several of these are summarized in the following list.

ALGEBRAIC PROPERTIES OF EQUALITY

Let a, b, and c be real numbers.

ADDITION PROPERTY	If $a = b$, then $a + c = b + c$.
SUBTRACTION PROPERTY	If $a = b$, then $a - c = b - c$.
MULTIPLICATION PROPERTY	If $a = b$, then $ac = bc$.
DIVISION PROPERTY	If $a = b$ and $c \neq 0$, then $a \div c = b \div c$.
REFLEXIVE PROPERTY	For any real number a, $a = a$.
SYMMETRIC PROPERTY	If $a = b$, then $b = a$.
TRANSITIVE PROPERTY	If $a = b$ and $b = c$, then $a = c$.
SUBSTITUTION PROPERTY	If $a = b$, then a can be substituted for b in any equation or expression.

Properties of equality along with other properties from algebra, such as the *distributive property*,

$$a(b + c) = ab + ac$$

can be used to solve equations. For instance, you can use the subtraction property of equality to solve the equation $x + 3 = 7$. By subtracting 3 from each side of the equation, you obtain $x = 4$.

EXAMPLE 1 *Writing Reasons*

Solve $5x - 18 = 3x + 2$ and write a reason for each step.

~~Using Algebra~~

SOLUTION

$5x - 18 = 3x + 2$	**Given**
$2x - 18 = 2$	**Subtraction property of equality**
$2x = 20$	**Addition property of equality**
$x = 10$	**Division property of equality**

Note: You can abbreviate and write "Subtraction P.O.E."