Theorem List

Know how to state, prove, and use the following (unless otherwise indicated):

- ** : don't need to know (we didn't go over in class)
- * : don't need to prove

1. All right angles ≅
2. All straight angles ≅
3. **If a conditional statement is true, then its contrapositive is also true. (given p ⇒ q, ~q ⇒ ~p)
4. SSAC
5. SCAC
6. CSAC
7. CCAC
8. Addition property (segment + ≅ segments)
9. Addition property (angle + ≅ angles)
10. Addition property (≅ segments + ≅ segments)
11. Addition property (≅ angles + ≅ angles)
12. Subtraction property (≅ segments/angles - segment/angle)
13. Subtraction property (≅ segments/angles - ≅ segments/angles)
14. Multiplication property (like multiples of segments/angles)
15. Division property (like divisions of segments/angles)
16. Transitive property (2 segments/angles ≅ *same* segment/angle)
17. Transitive property (2 segments/angles ≅ ≅ segments/angles)
18. VAT
19. All radii of a circle ≅
20. If two sides of a triangle are ≅, the angles opposite the sides are ≅ (and inverse**)
21. If two angles of a triangle ≅, the sides opposite the angles ≅ (and inverse**)
22. Midpoint formula: $M = (\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2})$ (M = median; x_1, y_1 are coordinates of first point; x_2, y_2 are coordinates of second point)
23. If two angles supplementary and ≅, then they are right angles
24. If 2 points equidistant from the endpoints of a segment, then they determine the perpendicular bisector of that segment
25. If a point is on the perpendicular bisector of a segment, then it is equidistant from the endpoints of that segment
26. If two (non-vertical) lines are parallel, then their slopes are equal
27. If two (non-vertical) lines have the same slope, then they are parallel
28. If two lines are perpendicular (and neither is vertical), then each line's slope is the opposite reciprocal of the other's
29. If a line's slope is the opposite reciprocal of another line's slope, the two lines are perpendicular
30. Remote exterior angle inequality
31. Alternate interior angles ≅ ⇒ || lines
32. Alternate exterior angles ≅ ⇒ || lines
33. Corresponding angles ≅ ⇒ || lines
34. SSIS ⇒ || lines
35. SSES ⇒ || lines
36. If two coplanar lines are perpendicular to a third line, they are ||
37. || lines ⇒ ≅ alternate interior angles

38. || lines cut by transversal ⇒ any pair of angles formed are ≅ or supplementary
39. || lines ⇒ ≅ alternate exterior angles
40. || lines ⇒ ≅ corresponding angles
41. || lines ⇒ SSIS
42. || lines ⇒ SSES
43. In a plane, if a line is perpendicular to one of two parallel lines, it is perpendicular to the other.
44. **Transitive property (parallel lines)
45. **A line and a point not on the line determine a plane
46. **Two intersecting lines determine a plane
47. **Two parallel lines determine a plane
48. **If a plane is perpendicular to two distinct lines that lie in a plane and that pass through its foot, then it is perpendicular to the plane
49. **If a plane intersects two parallel planes, the lines of intersection are parallel
50. Triangle sum
51. Remote exterior angle sum
52. Midline theorem (midline of a triangle is ½ length of and parallel to side it doesn't intersect)
53. No-choice
54. AAS ≅
55. $S_i = 180^o * (n-2)$
56. $S_e = 360^o$
57. $d = (n * (n - 3)) / 2$
58. exterior angle of equiangular polygon $= 360^o / n$
59. MEP
60. MER
61. The ratio of the perimeters of two similar polygons = ratio of any pair of corresponding sides
62. AA
63. SSS ~
64. SAS ~
65. Side-splitter
66. If three or more || lines intersected by two transversals, the || lines divide the transversals proportionally
67. Angle bisector theorem
68. Altitude to hypotenuse
69. Pythagorean theorem
70. $a^2 + b^2 = c^2$ ⇒ right triangle (converse of Pythagorean theorem), with c as the longest side and the angle opposite to c being the right angle
71. distance = $\sqrt{(\Delta x)^2 + (\Delta y)^2}$
72. In a 30º-60º-90º triangle, the sides opposite these angles are x, $x\sqrt{3}$, and 2x, respectively
73. In a 45º-45º-90º triangle, the sides opposite these angles are x, x, and $x\sqrt{2}$, respectively
74. A radius perpendicular to a chord bisects that chord
75. A radius that bisects a chord is perpendicular to that chord
76. The perpendicular bisector of a chord passes through the center of a circle
77. If two chords equidistant from the center, then they are ≅
78. If two chords ≅, then they are equidistant from the center
79. (79-84) ≅ central angles ⇔ ≅ arcs ⇔ ≅ chords
85. Two-tangent theorem (2 tangents to same point are ≅)
86. Inscribed angle = ½ intercepted arc
87. Chord-chord angle = mean of intercepted arcs (½ sum of intercepted arcs)

88. Secant-secant, secant-tangent, tangent-tangent angle = ½ difference of intercepted arcs
89. If two inscribed or tangent-chord angles intercept the same arc, then they are ≅
90. If two inscribed or tangent-chord angles intercept ≅ arcs, then they are ≅
91. An angle inscribed in a semicircle is a right angle
92. **The sum of the measures of a tangent-tangent angle and its minor arc is 180^o
93. If a quadrilateral is inscribed in a circle, its opposite angles are supplementary
94. If a parallelogram is inscribed in a circle, it must be a rectangle
95. Chord-chord power theorem
96. Tangent-secant power theorem
97. Secant-secant power theorem
98. **The length of an arc is (AB being the arc, d being the diameter, and AB measured in degrees): $(\frac{mAB}{360})\pi d$
99. $Area_{square} = s^2$ (s = side length)
100. $Area_{parallelogram} = bh$ (b = base; h = height)
101. $Area_{triangle} = \frac{1}{2}bh$
102. $Area_{trapezoid} = \frac{1}{2}h(b_1 + b_2)$
103. **$Median_{trapezoid} = \frac{1}{2}(b_1 + b_2)$
104. **$Area_{trapezoid} = Mh$ (M = median; this is a combination of theorems 102 and 103)
105. $Area_{kite/rhombus} = \frac{1}{2}d_1d_2$ (d_1 and d_2 = diagonals)
106. $Area_{equilateral\ triangle} = \frac{s^2\sqrt{3}}{4}$
107. $Area_{regular\ polygon} = \frac{1}{2}ap$ (a = apothem; p = perimeter)
108. ** $Area_{sector} = (\frac{mAB}{360})\pi r^2$ (mAB is arc measure in degrees; r = radius)
109. **Similar figures theorem: If two figures are similar, then the ratio of their areas equals the square of the ratio of their corresponding segments: $\frac{A_1}{A_2} = (\frac{S_1}{S_2})^2$ (A_1, A_2 = areas; S_1, S_2 = two corresponding sides)
110. A median of a triangle divides the triangle into two triangles with equal areas.
111. **Hero's formula (skipped)
112. **Brahmagupta's formula (skipped)
113. $LSA_{cylinder} = 2\pi rh$
114. $LSA_{cone} = \pi rl$
115. $V_{rectangular\ box} = Bh$ (B = base area; h = height)
116. $V_{prism} = Bh$
117. $V_{cylinder} = \pi r^2 h$
118. **$V_{prism/cylinder} = Ch$ (C = cross-section (parallel to base) area; same as base)
119. *$V_{pyramid} = \frac{1}{3}Bh$
120. *$V_{cone} = \frac{1}{3}\pi r^2 h$
121. **In a pyramid or a cone, the ratio of the area of a cross section to the area of the base equals the square of the ratio of the figures' respective distances from the vertex.
122. *$V_{sphere} = \frac{4}{3}\pi r^2$

Postulates / Properties

Postulates are "obvious truths" — inferrable

- Two points determine a line/ray/segment
- A line/ray/segment determines two points
- Three points determine a plane
- A plane determines three points

- Two lines intersect at a point
- Two planes intersect at a line
- If a line is on a plane, then all points on the line must be on the plane
- If two things = each same thing, then they equal each other
- Any segment or angle is ≅ to itself (reflexive property)
- SSS ≅
- SAS ≅
- ASA ≅
- HL
- A line segment is the shortest distance between two points
- Parallel postulate
- If a line intersects a plane not containing it, then the intersection is exactly one point
- AAA ~
- Tangent is perpendicular to radius drawn to the point of contact
- If a line is perpendicular to a radius at its outer endpoint (on the circle), then it is tangent to the circle
- $C_{circle} = \pi d$
- $A_{circle} = \pi r^2$
- $A_{sphere} = 4\pi r^2$
- $V_{rectangular\ prism} = lwh$

Properties of Geometry

- Addition, subtraction, multiplication, division properties of algebra
- Addition, subtraction, multiplication, division properties of geometry
- Transitive property
- Substitution property
- Reflexive property
- Properties of quadrilaterals
    - Parallelograms
        - Rectangle
        - Rhombus
            - Square
    - Kites (½ properties of rhombi)
    - Trapezoids
        - Isosceles trapezoids

Definitions

View this Quizlet set (has most of the theorems as well).

Miscellaneous

- All definitions reversible; some theorems are
- Process of proving a theorem (including thought bubbles!)
- Probability
    - combinations and permutations
    - favorable choices vs. total
- Detour proofs

- Constructions
    - Perpendicular bisector
    - ≅ angles
    - ≅ segments
    - || lines
- Slope
- Indirect Proofs
- Transformations
- Geometric mean / mean proportional
- Indirect measurement
- Angle of incidence, reflection
- Right angle trigonometry
- Law of sines/cosines and derivations
- Walk-around problem
- Three cases (three proofs) of theorem 86 (inscribed angle = ½ intercepted arc)
- LSA vs. TSA
    - slant height and altitudes
    - great circle
    - “red rice experiments”
- Proportional analysis (unit conversions)