Fernando Trujano

1-1 Understanding Points, Lines and Planes

most basic figures
Undefined terms - cannot be defined by using other figures

Building blocks of Geometry

Point - Names location and has no size
Line - Straight path, no thiknes, extends forever
Plane - Flat surfeace " "
Collinear - Points that lie on the same land
Coplanar - Points that lie on the same plane
Segment - Part of a line consisting of 2 points and all between
endpoint - a point at one end of the segment
ray - Part of a line that starts at endpoint extends in one direction
Opposite rays - 2 rays that have a ~~comon~~ endpoint and form a line $\overleftrightarrow{CBA}$ $\overrightarrow{BA}$ $\overrightarrow{BC}$

$\overline{AB}$ C D R S

$\overline{MN}$ M N

Postulate - statement that is accepted as true without proof

2 Plane always intersect in a line

3 points must make a triangle to make a ~~triangle~~ plane

Find AB = distance or lenth

A (5) — B (12)

$12-5 = \boxed{7}$

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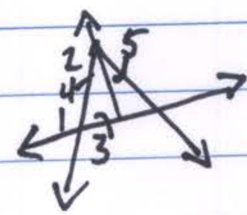
Pairs of Angles

Identifing Angle Pairs

Adjacent Angles - 2 angles in the same plane with a common vertex and a common side but no common interior points no gaps, no overlap

A **linear Pair.** of angles is a pair of Adjacent Angles whose noncommon sides are opposite rays.

Every Segment has one midpoint but infinite Segment bisector

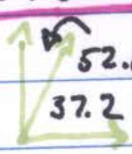


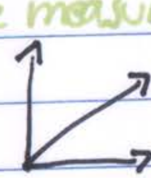
$\angle 1$ and $\angle 2$ not adjacent
$\angle 5$ and $\angle 4$ adjacent
$\angle 1$ and $\angle 3$ Adjacent and linear pair

Finding the measures of complements and supplements

$90-x$ **Complementary** - 2 angles whose measures have a sum of $90°$

$90-37.2=$





$180-x$ **Supplementary** - 2 angles whose measures have a sum of 180

$180° - (5x+49)$
$= 180° - 5x° - 49$
$131 - 5x$

Check

$130° - 5x° + 5x° + 49 = 131° + 49° = 180°$

Using Complements and Supplements to solve problems.

Ex: Twice an angle measures 9° more than the measure of its compliment.
Find the measure of its compliment

Let "x" be the unknown angle

$2x = 9 + (90 - x)$ Write equation

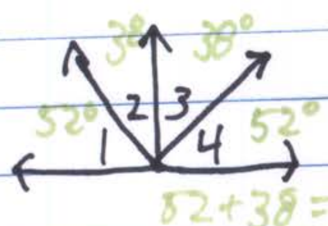
$3x = 99$ Solve

$x = 33$ You know that $x = 33$ to find the

$90 - 33 = 57°$ compliment

m compliment 57° Answer

Problem Solving Application



$\angle 2 = \angle 3$ $\angle 1$ and $\angle 2$ complimentary

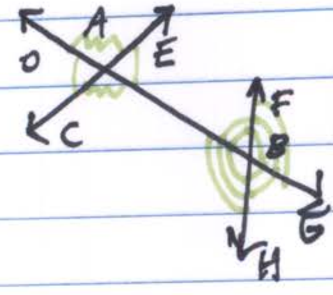
$\angle 3$ and $\angle 4$ complimentary

$m\angle 4 = 52°$

Find $\angle 1$ $\angle 2$ $\angle 3$

Identifyind Vertical Angles

Vertical Angle - 2 non adjacent angles formed by the 2 intersecting lines



$\angle CAD \leftrightarrow \angle EAG$

$\angle DBF \leftrightarrow \angle HBG$

$\angle CAG \leftrightarrow \angle DAE$

$\angle DBH \leftrightarrow \angle FBG$

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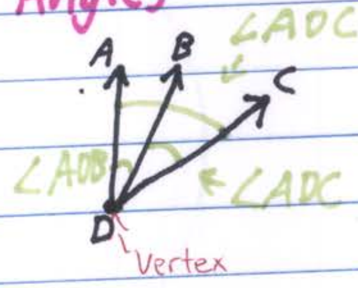
Measuring and Constructing Angles

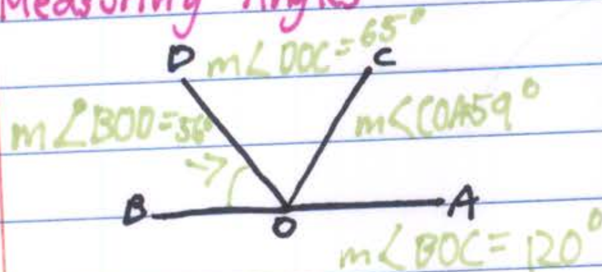
Naming Angles

An angle is formed by 2 rays. Common endpoint is called vertex.



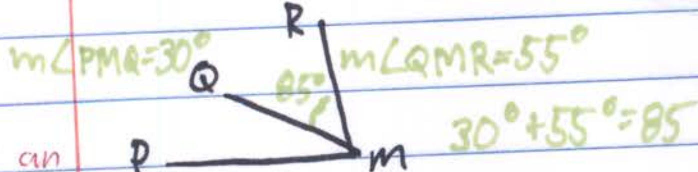
Acute — less than 90°
Right — 90°
Obtuse — more than 90° less than 180°
Straight

Measuring Angles



Use protractor to measure angles

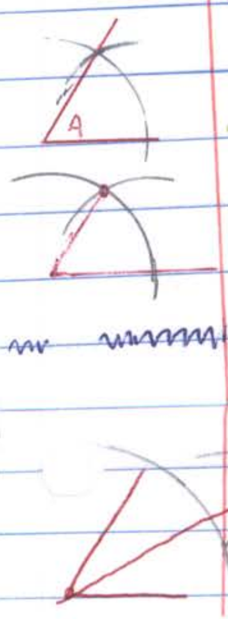
Using the Angle Addition Postulate



Angle Addition Postulate

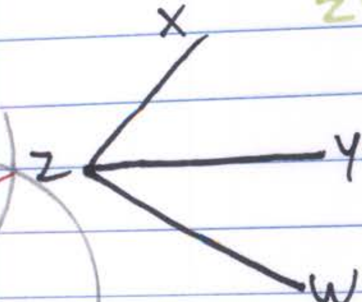
$m\angle PMQ + m\angle QMR = m\angle PMR$

Construct an Angle



Finding the measure of an angle

An **angle bisector** is a ray that divides an angle into 2 congruent angles.
^ Divides in half.



$\overrightarrow{ZY}$ bisects $\angle XZW$, $m\angle XZY = (7x+1)°$ and $m\angle YZW = (5x+11)°$ Find $m\angle X$...

WORK

$7x + 1 = 5x + 11$
$-5x - 1 \quad -5x - 1$

$\frac{2x}{2} = \frac{10}{2}$

$7(5) + 1 = 36°$

$36 + 36 = 72°$

$m\angle XZW = 72°$

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NOTES

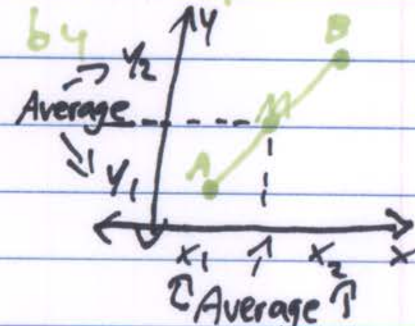
Midpoint and distance in the coordinate plane

Coordinate plane - plane that is divided into 4 regions by a horizontal line (x axis) and a vertical line (y axis). Location is given by an ordered pair (x, y)

MIDPOINT FORMULA

The midpoint M of $\overline{AB}$ with endpoints $A(x_1, y_1)$ and $B(x_2, y_2)$ is found by

$$M\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$



Finding the coordinates of an endpoint

M is the midpoint of $\overline{AB}$. A = (2, 2) M = (4, 3) find B

$(4,-3) = \left(\frac{2+x}{2}, \frac{2+y}{2}\right)$

Let the coordinates of B equal (x, y)

Use the Mid Point Formula

Find the x coordinate		Find the y coordinate
$4 = \frac{2+x}{2}$	Set the coordinates =	$-3 = \frac{2+y}{2}$
$2(4) = 2\left(\frac{2+x}{2}\right)$	mutiply both sides X2	$2(-3) = 2\left(\frac{2+y}{2}\right)$
$8 = 2+x$ -2	Simplify	$-6 = 2+y$ $-2 \quad -2$
$x = 6$		$y = -8$

The coordinates of B are (6, -8)

B = (6, -8)

Distance formula

In a coordinate plane the distance, d, between 2 points (x_1, y_1) and (x_2, y_2) is

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Determine is $\overline{AB} \cong \overline{CD}$

$A(0,3)$ $B(5,1)$ $C(-1,1)$ $D(-3,-4)$

$AB = \sqrt{(5-0)^2 + (1-3)^2}$
$= \sqrt{5^2 + (-2)^2}$
$= \sqrt{25+4}$
$= \sqrt{29}$

$CD = \sqrt{[-3-(-1)]^2 + (-4-1)^2}$
$\sqrt{(-2)^2 + (-5)^2}$
$= \sqrt{4+25}$
$= \sqrt{29}$

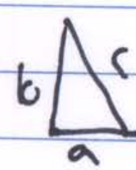
$AB = CD$, $\overline{AB} \cong \overline{CD}$

legs: 2 sides that form the right angle

hypotenuse: Side across from the right angle that stretches from 1 leg to the other.

Pythagorean Theorem

$$a^2 + b^2 = c^2$$



Finding Distances in the coordinate plane

Method 1

Use the distance formula. Substitute the values for the coordinates of A and B into the distance formula

Method 2

Use the Pythagorean theorem. Count the units for sides a and b

1-3
NOTES

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Using Formulas in Geometry

Perimeter P of a plane figure is the sum of the side lengths of the figure

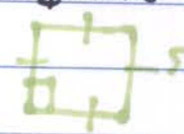
Area A of a plane figure is the # of nonoverlapping square units over a given size that exactly cover the figure

area = 2 units × 5 units
= 10 square units

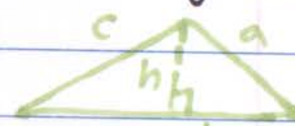
PERIMETER AND AREA

Rectangle

Square



Triangle



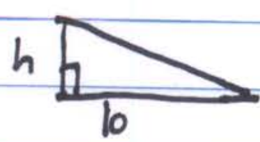
Rectangle: $P = 2l + 2w$ or $2(l + w)$; $A = lw$

Square: $P = 4s$; $A = s^2$

Triangle: $P = a + b + c$; $A = \frac{1}{2}bh$ or $\frac{bh}{2}$

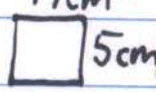
Base b - Any side of the triangle

Height h a segment from a vertex that forms a right angle with a line containing the base



Finding the perimeter and area

17cm



$P = 2l + 2w$

$p = 44cm = 2(17) + 2(5)$

$A = 85cm^2 = 34 + 10 = 44cm$

$A = lw$

$= (17)(5) = 85cm^2$

Triangle $a = 8$ $\quad P = a + b + c$

$b = (x+1)$ $\quad = 8 + (x+1) + 4x$

$c = 4x$ $\quad = 5x + 9$ $\quad p = 5x + 9$

$h = 6$ $\quad A = \frac{1}{2}bh$ $\quad A = 3x + 3$

$= \frac{1}{2}(x+1)(6)$ $3x + 3$

Diameter segment that passes through the center of the circle and whose endpoints are on the circle.

Radius A segment whose endpoints are at the center of the circle and a point on the circle.

Circumference The distance around the circle.

Circumference of a circle = $C = \pi d$ or $C = 2\pi r$

Area of a circle $A = \pi r^2$

$\pi \approx 3.14$ or $22/7$

Finding circumference and Area of a Circle

$C = 2\pi r$

$= 2\pi(3) = 6\pi$

≈ 18.8

$C \approx 18.8$

$A = \pi r^2$

$\pi(3)^2 = 9\pi$

≈ 28.3

$A \approx 28.3$

$6x^2 + 14x - 40$

$(2x+10)(3x+4)$

$2x+10=0 \quad 3x+4=0$

$-10 \; -10 \quad\quad -4 \; -4$

$2x=-10 \quad\quad \frac{3x}{3} = \frac{-4}{3}$

$x=-5$

$x = -\frac{4}{3}$

Distance formula

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$(-7, 2) \quad (11, -5)$

$$\sqrt{(11-7)^2 + (-5-2)^2}$$

$$\sqrt{324 + 49}$$

$$\sqrt{373}$$

$$d = 19.313\ldots$$

Midpoint formula $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$ $(-2, 4)$ $(4, 3)$ $(10, 2)$

$$\left(\frac{-2+10}{2} \quad \frac{4+2}{2}\right)$$

$m = (4, 3)$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$d = \sqrt{(10-4)^2 + (2-3)}$$

$36 + 1$

$\sqrt{37}$

$r = 6.1$

Study for Test!

$(x, 4)$ $\left(\frac{1}{2}, 2\right)$

A — m — B $(6, +1)$

$$m = \left(\frac{x+6}{2}, \frac{y+1}{2}\right) = \left(\frac{1}{2}, -2\right)$$

$$\frac{x+6}{2} = \frac{1}{2}$$

$\times 2$

$x = -5 \quad 2x + 12 = 2$

$-12 \; -12$

$2x \quad -10$

$x = -5$

$$\frac{y+1}{2} = \frac{-2}{1}$$

$\times 2$

$y + 1 = -4$

$-1 \quad -1$

$y = -5$

$y = -5$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$m = \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}$$

2, 7, 14, 21, 28, 32

When several examples form a pattern and you assume the pattern will continue, you are applying, inducting reasoning

A statement you beleive to be true based on inductive reasoning is called a conjection

Conjecture

The sum of 2 positive # = A positive #

The #= of lines formed by 4 points, no three if which are colinear is 6

Product of 2 odd # = odd #

To show that a conjecture is false, you have to find only one example in which the conjecture is not true.

Inductive reasoning

1. Look for a pattern.

A conditional statement is a statement that can be written in the form :

If p, then q

hypothesis — p, conclusion — q

$p \rightarrow q$

IF today is thanksgiving then its a thursday

Law of detachment and Law of syllogism

Law of detachment - If $p \to qu$ is a true statement and p is true then q is true

* Cannot draw any valid conclusion based on q

Law of syllogism.

if $p \to q$ and $q \to r$ are true statement then $p \to r$ is a true statement

q conclusion of 1st statement
q hypothesis 2nd statement

Biconditional statement and definition

$p \leftrightarrow q$
p iff q

When you convi ne a conditional statement and its converse you create a biconditional statement

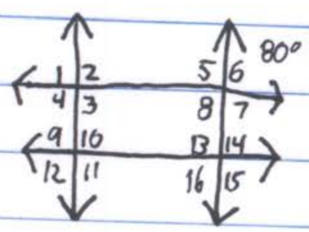
Conditional $p \to q$

Biconditional $p \leftrightarrow q$

For a biconditional statement to be true, both its conditional and its converce must be true. If eather is false, then the biconditional statement is false

Lines and Angles

Parallel lines are coplanar and do not intersect $\parallel$
Perpendicular lines intersect at a 90° angles $\perp$
Skew lines are not coplanar, are not parallel and do not intersect
Parallel Planes - planes that do not intersect
Transversal - line that intersects 2 coplanar lines at 2 different points.
Corresponding Angles - lie on the same side of the transversal t
Alternate interior Angles - non adjacent angles that lie on opposite sides of the transversal.
Same-side interior angles. or consecutive interior angles lie on the same side of the transversal



8=80°	2=80°	3=100°	10=80°	11=100°
5=100°	4=80°	14=80°	12= 80	13=100°
7=100°	1=100°	16=80°	9=100°	15=100°

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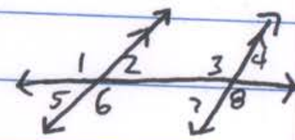
Angles Formed by Parallel Lines and Transversal

Corresponding Angles Postulate

If 2 paralel lines are cut by a transversal, then the pairs of Corresp onding Angles are equal.



∠1, ∠6

Alternate Interior Angles theorem

If 2 paralel lines are cut by a transversal, then the pairs of alternate interior ∡'s are congruent. (equal)

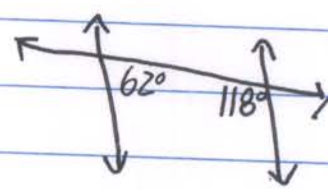
Alternate Exterior ∡'s Theorem.

If 2 paralel lines are cut by a transversal, then the 2 pairs of alternate exterior ∡'s are congruent. (equal)

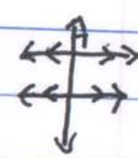
Same Side Interior ∡'s Theorem

If 2 paralel lines are cut by a transversal, then the 2 pairs of the Same Side Interior ∡'s are supplementary.

|| → cor ∡'s =
|| → SSI Sup
|| → SSE Sup



If a transversal perp to parallel lines all 8 ∡'s =

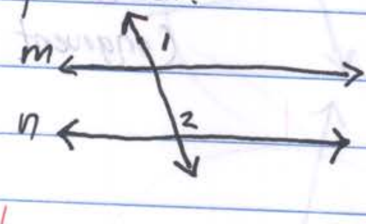


3-3

Proving lines Parallel

Converse of the corresponding Angles Postulate

If 2 coplanar lines are cut by a transversal so that a pair of corresponding angles are congruent, then the 2 lines are parallel.



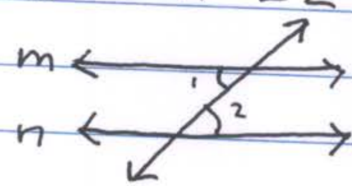
If $\angle 1 \cong \angle 2$, then $m \parallel n$

Parallel Postulate

Through a point P not on the line ℓ there is exactly one parallel to ℓ

Converse of the Alternate Interior Angles Theorm

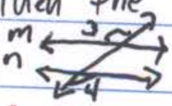
If 2 coplanar lines are cut by a transversal so that a pair of alternate interior angles are congruent, then the 2 lines are parallel. $\angle 1 = \angle 2$



$m \parallel n$

Converse of the Alternate Exterior Angles Theorm

If 2 coplanar lines are cut by a transversal so that a pair of alternate exterior Angles are congruent, then the 2 lines are parallel.



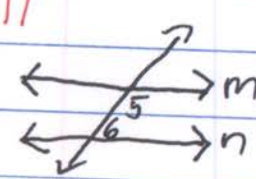
$\angle 3 \cong \angle 4$ $m \parallel n$

- cor ∡'s ≅ → ||
- AIA ≅ → ||
- AEA ≅ → ||
- SSI supp → ||
- SSE supp → ||

Converse of Same Side interior ∡'s theorm

" pair of same side interior ∡'s are sup, 2 — are ||

$\angle 5 + \angle 6 = 180$ $m \parallel n$



Lines in the Coordinate Plane

Point-slope form = $y - y_1 = m(x - x_1)$ m is the slope and (x_1, y_1) is a given point on the line.

Slope-intercept form = $y = mx + b$ m is slope and b is y-intercept.

Equation of a Vertical line (undefined) = $x = a$ a is x-intercept

" Horizontal line (0 slope) = $y = b$ b is y-intercept

Parallel Lines

$y = 5x + 8$

$y = 5x - 4$

Same slope diff y-intercept

Intersecting Lines

$y = 2x - 5$

$y = 4x + 3$

Diff slopes

Coinciding Lines

$y = 2x - 4$

$y = 2x - 4$

Same slope

Same y-intercept

Slope Formula $m = \frac{y_2 - y_1}{x_2 - x_1}$

Standard Form $Ax + By = C$

1. x and y must be on the same side
2. x must be positive
3. No fractions or decimal
4. Must be graphable

Factoring

1 $x^2+5x+6=0$

$(x+3)(x+2)$

2 $x^2-8x-80=$

Not Fact.

3 $3x^3-12x$

$3x(x^2-4)$

$3x(x+2)(x-2)$

4 $4x^2+4x-3$

$(2x-1)(2x+3)$

5 $8x^2+20x-48$

$4(2x^2+5x-12)$

$(2x-3)(x+4)$

6 a^3+a^2-2a

$a(a^2+a-2)$

$a(a+2)(a-1)$

7 $6x^2+11x-10$

$(3x-2)(2x+5)$

8 $4x^2+4x-3$

$(2x+3)(2x-1)$

9 $6x^2-5x-6$

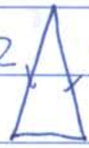
$(3x+2)(2x-3)$

4-2

1 Equilateral $\triangle$

60° Angles

All sides =

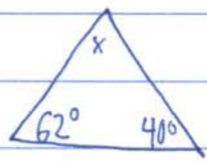


$3x+2=4x-7$

$2=x-7$

$x=9$

The sum of the measures of the $\measuredangle$'s of a $\triangle = 180^\circ$



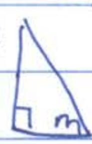
$62+40=102$

$180-102=78$

Corollary

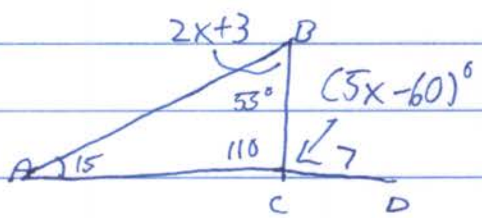
The acute $\measuredangle$'s of a right $\triangle$ are complementary

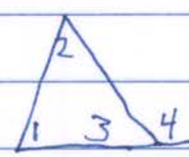
Equilateral $\rightarrow$ = sides $\rightarrow$ equalangular.



$m = 90-2x$

The measure of an exterior angle of a $\triangle$ is = to the sum of the measures to the remote interior $\measuredangle$'s





$\angle 1$ = remote $\measuredangle$'s

$\angle 2$ =

$\angle 1 + \angle 2 = \angle 4$

$5x-60=2x+3+15$

$5x-60=2x+18$

$-2x \quad -2x$

$3x-60=18$

$x=26$

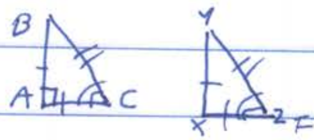
$2x+3=55$

$\angle ACD = 110$

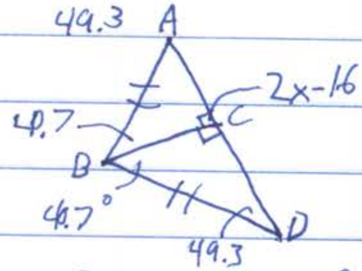
$\angle BCD = 70$

4-5

Corresponding ∡'s and Corr sides are in the same position in polygons with an = # of sides



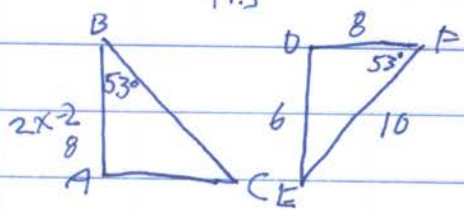
$\Delta BAC = YXF$



$\Delta ABC = DBC$

$2x-16=90$

$x=53$



$\Delta ABC = \Delta DEF$

$a^2+b^2=c^2$

$a=8$

$2x-2=8$

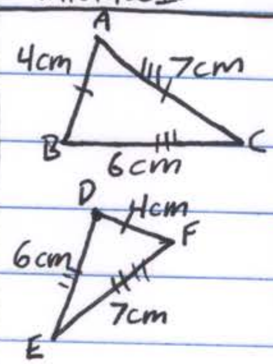
$x=5$

4-4

Triangle Congruence

Triangle rigidity gives you a shortcut to proving 2 Δ's congruent

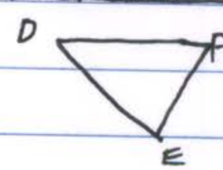
Side Side Side Congruence SSS

POSTULATE	HYPOTHESIS	CONCLUSION
If 3 sides of one Δ are congruent to 3 sides of another Δ then the Δ's are congruent		Δ ABC = Δ FDE

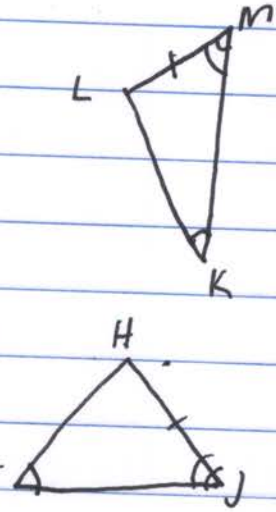
Side Angle-Side Congruence SAS

POSTULATE	HYPOTHESIS	CONCLUSION
If 2 sides in the included ∡ of 1 Δ are congruent to 2 sides and the included ∡		

Angle Side Angle ASA

POSTULATE	HYPOTHESIS	CONCLUSION
If 2 ∡'s and the included side of 1 Δ are conguent to 2 angles and the included		Δ ABC

Angle-Angle-Side AAS

THEOREM	HYPOTHESIS	CONCLUSION
If 2 ∠'s and a nonincluded side of 1 triangle are congruent to the corresponding angles and nonincluded side of another triangle, then the △'s are congruent		△GHJ ≅ △KLM

Hypothenus-Leg Congruenc HL

If the hypothenus and a leg of a right △ are congruent to the hypotenus and

A coordinate prooff is a style of a proof that uses coordinate geometry and algebra

① Use the origin as a vertex. keep them in Quadrant I

② Center the Fig @ the origin

③ Center side at origin

Prove diagonals bisect each other

Midpoint $AC = (2,5)$

Midpoint $BD = (2,5)$

$m = \left(\frac{x_2 + x_1}{2}, \frac{y_1 + y_2}{2} \right)$ $(2,5)$

$A(0,0)$ (x_1, y_1)

$C(4,10)$ (x_2, y_2)

$\frac{4}{2} = (2, 5)$ $\frac{10}{2}$

$B(4,0)$

$m = (2,5)$ $D(0,10)$

Since midpoint of AC and BD are the same, then the diagonals bisect each other.

Bisectors Mediom and Altitude of Δ

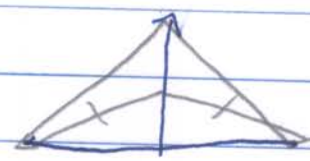
$\perp$ bisectors intercept at the circumcenter.

$\angle$ bisectors intercept at the incenter

Medians intercept at the centroid

Altitudes intercept at the orthocenter

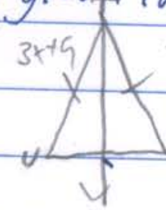
When a point is the same distance from 2 or more object the point is equidistant from the objects



A locus is a set of point that satisfies the given conditions.

Find TU = $3x+9$ $x=6.5$

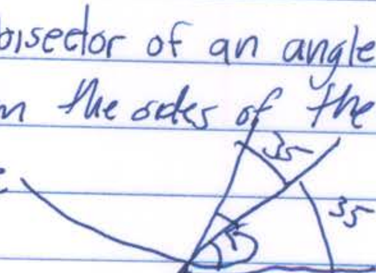
$7x-17=$



Angle bisector theorm.

If a point is on the bisector of an angle then it is ~~equilateral~~ equidistant from the sides of the angle

Converse of an $\angle$ bis converse



$x_1 \quad y_1$

$(6, -5)$

$(10, 1)$

$x_2 \quad y_2$

" $m = \frac{y_2 - y_1}{x_2 - x_1}$

$y - y_1 = m(x - x_1)$

① mP

② slope

③ opp rec

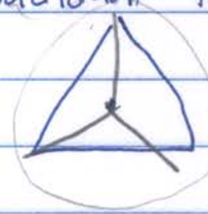
$m = \left(\frac{x_1 + x_2}{2}\right), \left(\frac{x_1 + y_2}{2}\right)$

$_mP = (8, -2)$

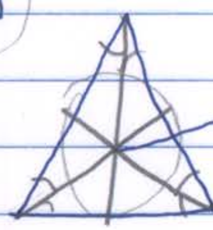
When 3 or more lines intersect @ one point the lines are said to be concurrent.
The point of concurrency is the point where they intersect in the construction

Circumcenter Theorem.

The circumcenter of a Δ is equadistant from the given vertices of Δ



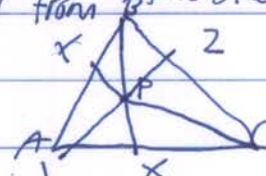
① Graph Δ
② Find eq of 2 $\perp$ b/s
③ Find intersection of $\perp$ b/s



The incenter is always inside the circle

The incenter of a Δ is equadistant from the sides of the Δ

$PX = PY = PZ$



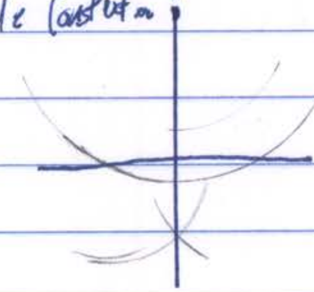
Find Average of X (10,7) (8,2)
Find Average of Y (6,6)

$$\frac{10+6+8}{3} = \frac{24}{8} = 8 \qquad (8,5)$$

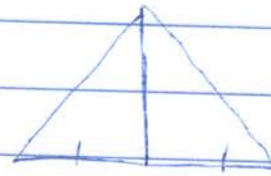
$$7+6+2 = \frac{15}{3} = 5$$

An altitude of a Δ is a perp seg from a vertex to the line containing to opposite side

Altitude Construction

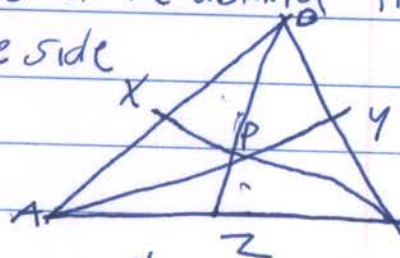


A median of a triangle is a segment whose endpoints are a vertex of a △ and the midpoint of the opposite side



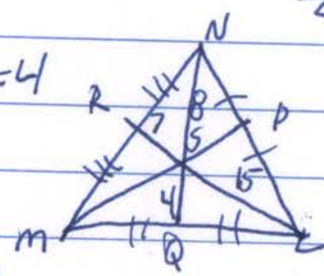
The centroid is always inside the Triangle. Is the center of gravity

The centroid of a △ is located 2/3 of the distance from each vertex to the MP of the opposite side



$AP = \frac{2}{3} AY$ $BP \frac{2}{3} BZ$

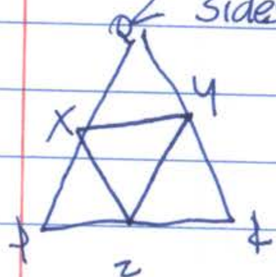
In △LMN RL=21 and SQ=4



OS x 2 = NS

Alt -> seg vertex ⊥ to opp side

A midseg of a △ is a seg that joins the MP of 2 sides of the △.



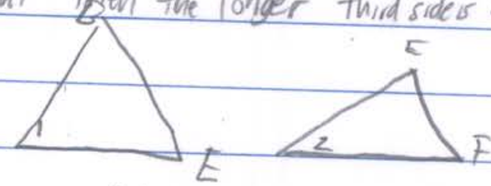
midsegments XY, YZ, XZ
midsegment △ △XYZ

5-6

Inequalities in 2 Δ's

Hinge Theorim

If two sides of one triangle are congruent to two sides of another Δ and the included angles are not congruent then the longer third side is across from the larger included ∢

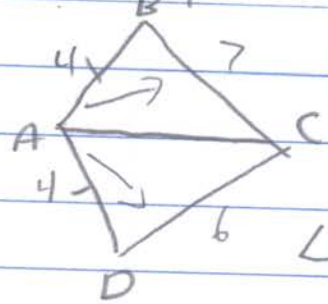


$\angle 1 > \angle 2$ BE > EF

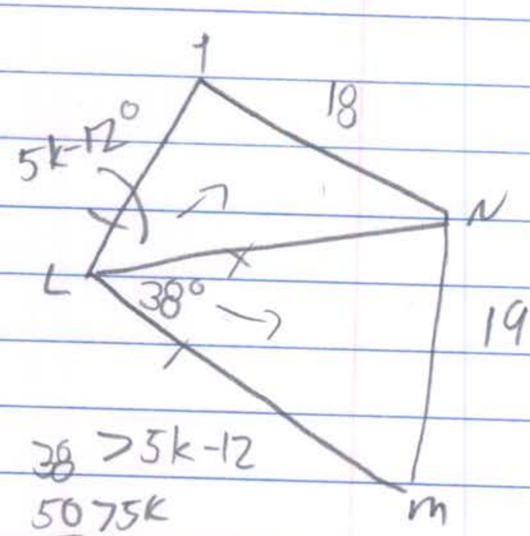
Converse of the Hinge Theorim

If 2 sides of one Δ are congruent to 2 sides of another triangle and the third sides are not congruent, then the larger included ∢ is across from the longer 3rd side

Compare ∠BAC and ∠DAC



$\angle BAC > \angle CAD$



$38 > 5k-12$

$50 > 5k$

$\frac{50}{5} > \frac{5k}{5}$

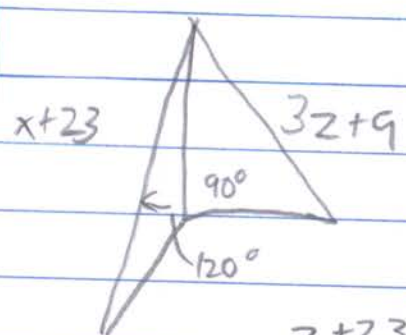
$10 > k$

$k < 10$

$5k-12 > 0$

$5k - 12$

$\frac{5}{5}k > \frac{5}{12}$



$z+23 > 3z+9$

$-z+9 \quad -z+9$

$\frac{14}{2} > \frac{2z}{2}$

$3z+9 > 0$

$3z > -9$

$z > -3$

$z > -3$

$z < 7$

$z < \cancel{16}$

$16 > 2z$

5-5

Writing an Indirect proof

Identify the conjecture to be proving

↓

Assume the negation of the proof is true

↓

Use direct reasoning to show the assumption leads to contradiction

↓

Conclude that since the assumption is false, the original must be true

Pythagorean Theorem $a^2+b^2=c^2$

$6^2+2^2=x^2 \quad 36+4= \quad 40=x^2 \quad x=\sqrt{40}$

$\sqrt{4\cdot 10}$

$4^2+x-2^2=x^2$

$2\sqrt{10}$

$16+\cancel{x^2}-4x+4=\cancel{x^2} \qquad (x-2)(x-2)$

$16-4x+4=$

x^2-4x+4

$4x=-20$

$\frac{4x}{4}=\frac{-20}{4}$

$x=5$

30×30: 00, 90, 900

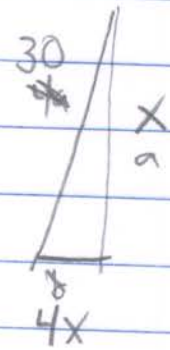
$x^2+3x^2=12^2$

$x^2+9x^2=144$

$10x^2=144$

$\sqrt{x^2}=\sqrt{14.4}$

$x=3.794$



$x^2+16x^2=30^2$

$\cancel{x^2}\ \frac{17x^2}{17}=\frac{900}{17}$

$\sqrt{x^2}=\sqrt{52.94}$

$x=7.276$

≈ 7 in

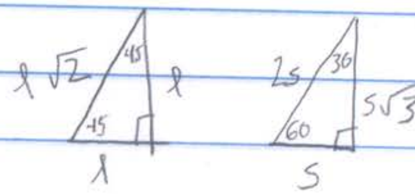
If $c^2>a^2+b^2$ then obtuse

If $c^2<a^2+b^2$ then acute

$d=\sqrt{(x_1-x_2)^2+(y_1+y_2)^2}$

Study Formulas For Quiz

Triangle △ $A = \frac{bh}{2}$



Trapezoid $A = \frac{(b_1 + b_2)h}{2}$

Rhombus / Kite ◇ $A = \frac{d_1 d_2}{2}$

Circle ○ $C = \pi d$ $\quad C = 2\pi r$

$A = \pi r^2$

Polygon ⬡ $A = \frac{1}{2} a P$

Eulers Formula $V - E + F = 2$

Pyramids and Cones

- Lateral Surface Area (LA) $LA = \frac{1}{2} P l$
- Surface Area (Total) $SA = \frac{1}{2} P l + B$
- Volume $V = \frac{1}{3} B h$

Prisms and Cylinders

- $LA = Ph$
- $SA = Ph + 2B$
- $V = Bh$

Sphere

- $V = \frac{4}{3} \pi r^3$
- $SA = 4 \pi r^2$

Fernando Trujano

6-1

Polygon

5 diagonals

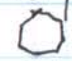
3 triangle
4 Quadrilateral
5 Pentagon
6 Hexagon
7 Heptagon
8 Octagon
9 Nonagon
10 Decagon
11 undecagon
12 Dodecagon

equilateral polygon - Polygon with = sides
equangular polygon - Polygon with = ∡
Regular Polygon - = sides = ∡

Concave - A diagonal occurs outside Figure

Convex - All diagonal occurs on inside polygon

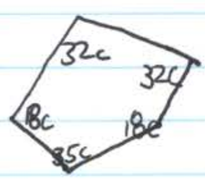
* A regular polygon is always convex



Sum of the interior angles = $(n-2)180$

\# of diagonals from 1 vertex $= n-3$ # Δ's

Measures of each interior angle



$= 540$ $32c + 32c + 18c + 18c + 35c = 540$

Find c and plug in

* For any convex polygon, the sum of the exterior angle = $360°$

Each exterior angle of a regular polygon $360/n$

Fernando Trujano

6.2

Properties of a paralelogram

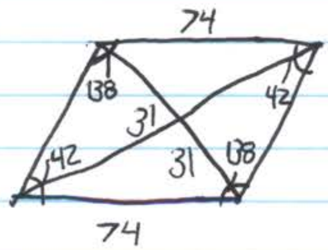
1 Paralelograms → opp sides ∥

2 ▱ → opp ∡ =

3 $\boxed{P}$ → cons ∡ supp

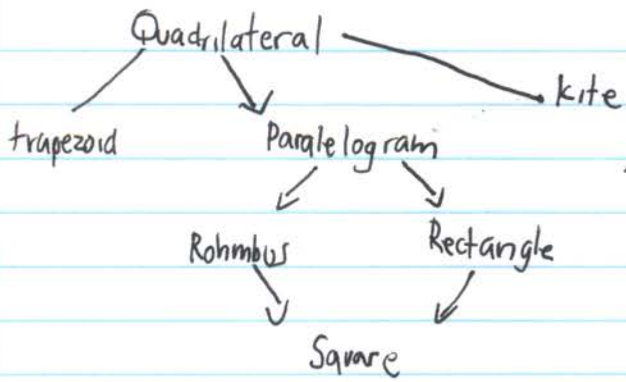
4 $\boxed{P}$ → diagonals bisect each other

5 $\boxed{P}$ → opp sides =



$6a+10=8a-4$
$-6a+4 \quad -6a+4$
$14=2a$
$a=7$

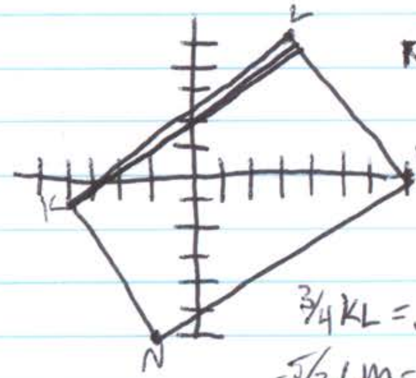
$18b-11+9b+2=180$
$27b-9=180$
$+9 \quad +9$
$27=b \; 189$



Conditions for paralelogran

▱ → opp sides ≅
▱ → opp side ∥
▱ → opp ∡'s =
▱ → con ∡'s sup
▱ → diag bisect eachother

if top an bottom are = + ∥ → ▱



Find slopes to prove paralelogram

SLOPE FORMULA

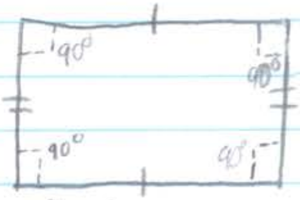
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$\frac{3}{4}$ KL = JM $\frac{3}{4}$

$-\frac{5}{3}$ LM = KJ $-\frac{5}{3}$

Ferraro b

Rectangles



Rectangle

All ∠ 90°

diag bisect eachother

con ∡'s =

opp sides = + ||

opp ∡'s =

diag congruent

Parallelogram

diag bisect each other

consecutive ∡ sup

opp sides = + ||

opp ∡'s =

Rhombus

diag bised each other

consecutive ∡'s sup

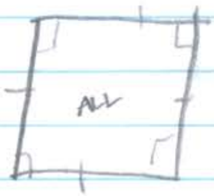
opp sides = + ||

opp ∡'s =

All sides =

diag bised corners

diag ⊥



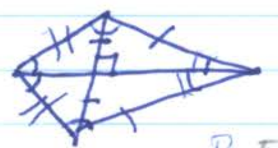
Square

distance formula = $\sqrt{(y_2-y_1)^2+(x_2-x_1)^2}$

midpoint formula $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$

Kites and Trapezoids

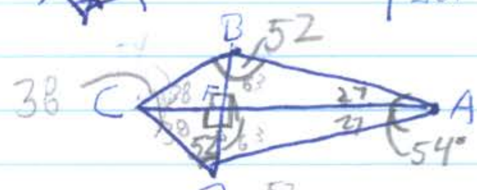
A kite is a parallelogram with exactly two pairs of congruent consecutive sides, not [illegible]



2 sets of con sides $\cong$

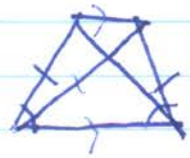
diagonals $\perp$

1 set opp $\angle$s $\cong$



$$\begin{array}{r} 52 \\ +90 \\ \hline 142 \end{array} \quad 38$$

A trapezoid is a quadrilateral with exactly one pair of parallel sides

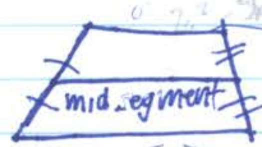


Bases $\parallel$

isoseles $\rightarrow$ base $\angle$'s $\cong$

isoseles $\triangle \rightarrow$ diag $\cong$

80



top + bot / 2 = midseg

143/2 = 71.5

Warm Up

$\frac{y_2-y_1}{x_2-x_1}$ $(1,5)$ $(3,9)$
x_1 y_1 x_2 y_2

$$\frac{9-5=4}{3-1\ \ =2}=\frac{2}{1}=2$$

$(-\cancel{8}6, 4)$ $(6,-2)$
x_1, y_1 x_2 y_2

$-2-4=-6$ $-3/2$
$6-4=2$

$4x+3x+8x=45$
$9x+$
$15x=45$
$x=3$
$(x-5)2=81$
$2x-10=81$
$+10$ $+10$

$2x=91$

Ratios

A ratio compares 2 #'s by division

The ratio of the side lenths of $\triangle$ is $4x \cdot 7x \cdot 5x$ is per 96cm. lenth of shortest side

$4x+7x+5x=96$

$x=6$ lenth of shortest side = 24 cm

$1:8:13 = 180$

$9x+13x=180$ $22=180$

solve: $\frac{7}{x} = \frac{56}{72}$ $\boxed{x=9}$ $7\times72\div9=$

$7\times72=56x$

$\frac{2y}{9} = \frac{8}{4y} =$ $\boxed{y=\pm3}$ $\cancel{x=12}$

$2y\times4y=72$

$\cancel{6y=72}$

$8y^2=72$

$y^2=9$

$y=\pm3$

$\frac{z-4}{5} = \frac{20}{z-4}$ $\boxed{z=14 \quad z=-6}$ $\cancel{z=54}$

$\cancel{2z-8=100}$ $(z-4)(z-4)=100$

$\cancel{2z=108}$ $z^2-4z-4z+16$

$\cancel{z=54}$

$z^2-8z+16=100$

$z^2-8z-84$

$(z-14)(z+6)$

$z=14$ $z=-6$

$\frac{\cancel{16}}{\cancel{20}} \quad \frac{\cancel{t}}{5}$

$\frac{4}{5} - \frac{18}{20} \quad \frac{t}{5}$

$(x+3)(x+3)=40$

$x^2+3x+3x+9=40$

$\cancel{x^2+6x+9=40}$ $\sqrt{x^2}=\sqrt{49}$

$\cancel{x^2+6x-31=0}$ $x=\pm7$

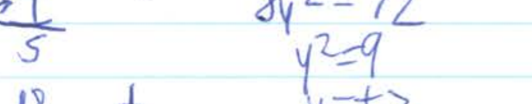
$\cancel{(x-\ )(x+\ )}$

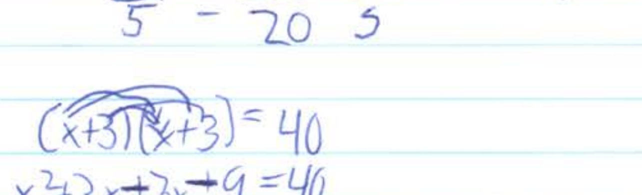
SIMILAR - Same shape - different size

$\sim$ = similar

① check all $\angle$'s =

② check sides proportional



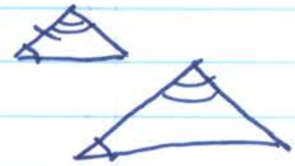


$\angle N \cong \angle Q$ $MN \sim TQ$

$\angle M = \angle T$ $MO \sim TR$

$\angle O = \angle R$ $NO \sim QR$

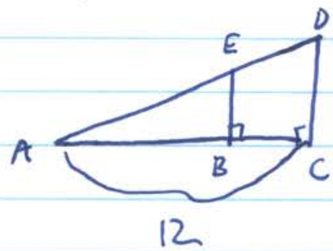
Triangle Similarity.



AA Similarity IF 2 ∡'s of one Δ are congruent to 2 angles of another Δ the Δ's are ~

SSS Similarity IF 3 sides of 1 Δ is proportional to the 3 corr sides of another Δ then the triangles are similar.

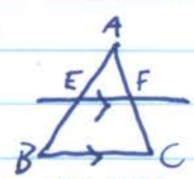
SAS Similarity IF 2 sides of 1 Δ are proportional to 2 sides of another Δ and their included ∡'s are ≅, then the triangles are ~



∠A=∠A Reflexive
∠ABE=∠ACD
similar by AA

ΔABE ~ ΔACD

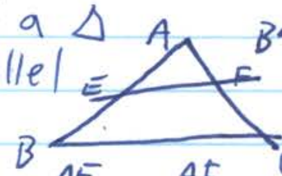
Δ Proportionality IF a line ∥ to a side of a Δ intersects the other 2 sides, then it devides those sides proportionally



$\frac{AE}{EB} = \frac{AF}{FC}$

EF ∥ BC

converse of If a line divides 2 sides of a Δ proportionally, then it is parallel to the third side.



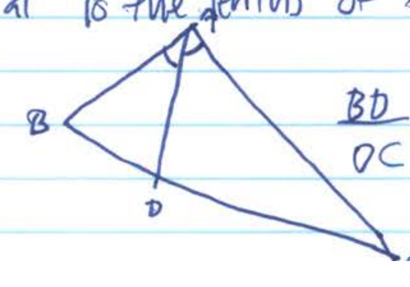
$\frac{AE}{EB} = \frac{AF}{FC}$

EF ∥ BC

2 transversal proportionality IF 3 or more ∥ lines intersect 2 transversals then they divide the transversals repeatedly.

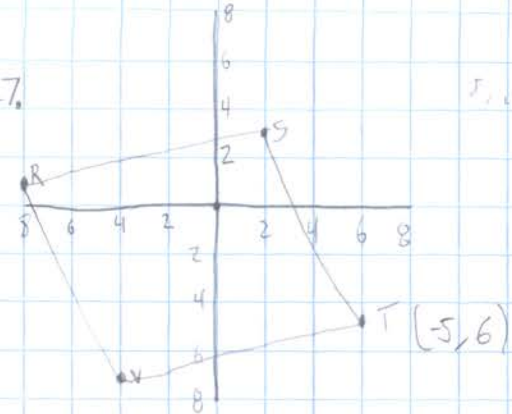
$\frac{AC}{CE} = \frac{BD}{DF}$

Δ∡'s bisector An ∡ bisector of a Δ divides the opp side into 2 seg-lenths are proportional to the lenths of the other 2 sides

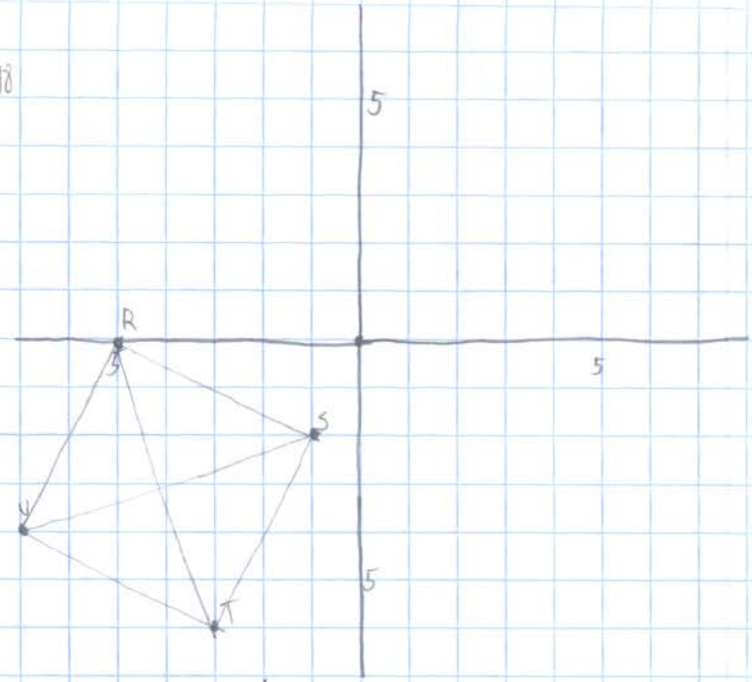


$\frac{BD}{DC} = \frac{AB}{AC}$

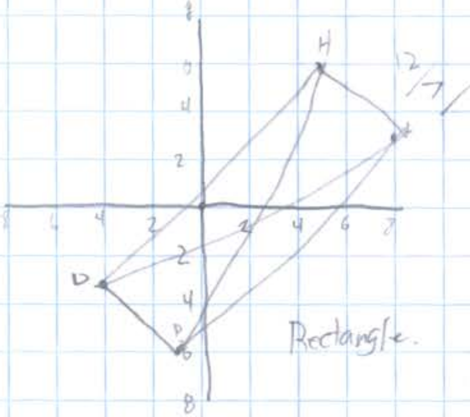
27.



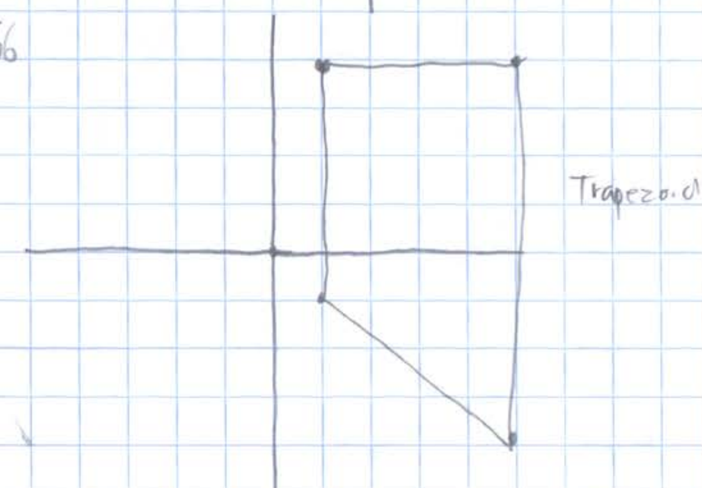
48



54



66



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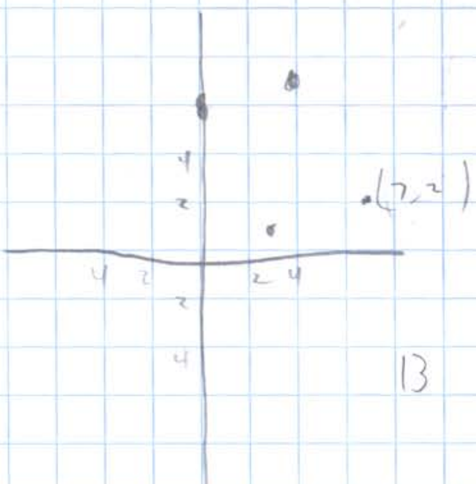
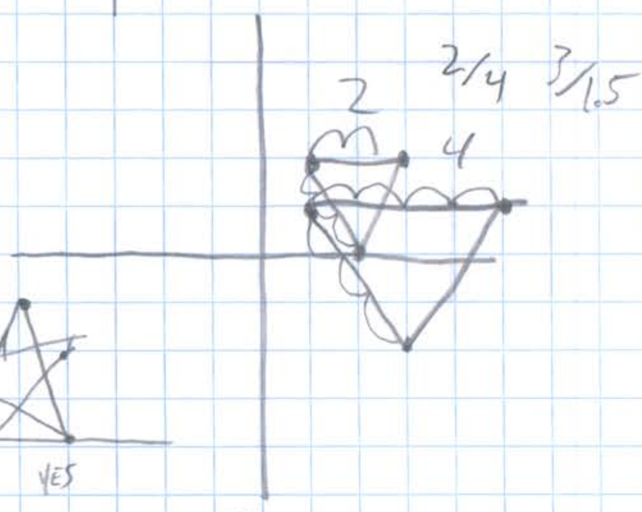
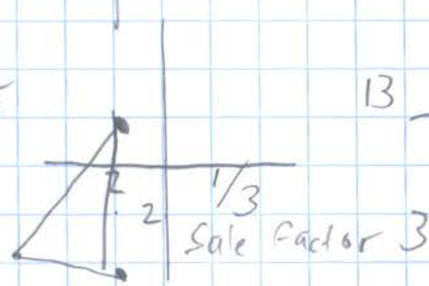


23

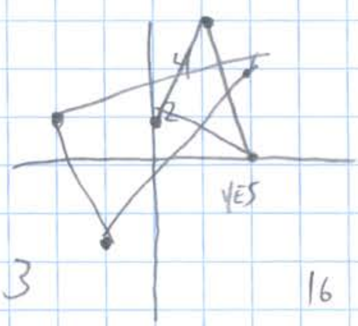


13

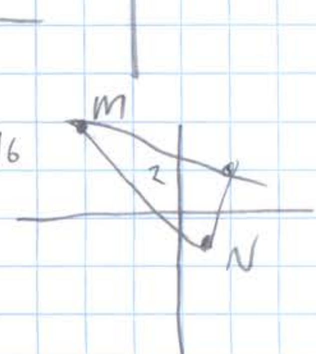
15



13



16



Dilation is a transformation that changes the size of a figure but not shape.

A scale factor - how much it is changed by

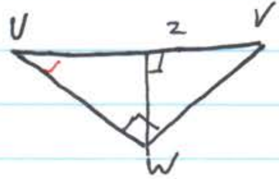
$\frac{1}{1}$ $\frac{3}{2}$ $\left(\frac{3}{2}, \frac{3}{2}\right)$ $\frac{3}{2}$ $\frac{3}{1}$ $\frac{9}{2}$ $\frac{3}{2}$ $\frac{2}{1}$ $\frac{6}{2}$ $\frac{1}{3}$

$(1.5, 1.5$ $\left(\frac{9}{2}, 3\right)$ $\left(3, \frac{9}{2}\right)$ $\left(\frac{3}{2}, 6\right)$

$0, \frac{16}{1}$ $\frac{1}{3}$

8.1

Similarity in rt △

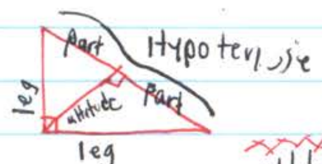


$\triangle WVU \sim \triangle ZWU \sim \triangle ZVW$

Geometric Mean $\frac{9}{x} = \frac{x}{b}$ Eg 4 and 25 $\frac{4}{x}\ \frac{x}{25}$

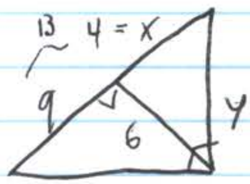
$x^2 = 100$

5 and 30 $\frac{5}{x}\ \frac{x}{30}$ $x^2 = 150$ $x = 5\sqrt{6}$ 2 and 8 $\frac{2}{x}\ \frac{x}{8}$ $16 = x^2$ $X = 4$ $x = 10$ $\frac{10}{x}\ \frac{x}{30}$ $300 = x^2$ $x = 10\sqrt{3}$



altitude^2 = part * part   leg^2 = hyp * p

Find x, y, z

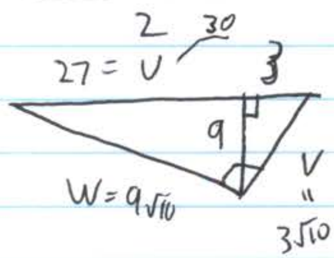


$6^2 = 9x$ $y^2 = 13 \times 4$ $z^2 = 13(9)$

$36 = 9x$ $y^2 = 312$ $z^2 = 117$

$x = 4$ $y = 2\sqrt{13}$ $z = 3\sqrt{13}$

Find u, v, w



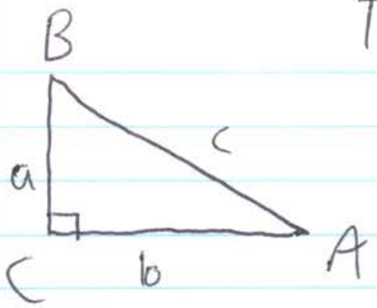
$81 = 3u$ $w^2 = 30 \times 27$ $v^2 = 30 \times 3$

$u = 27$ ✓ $w^2 = 810$ $v^2 = 90$

$w = 9\sqrt{10}$ ✓ $v = 3\sqrt{10}$ ✓

8-2

Trigonometric Ratios



A trigonometric ratio is a ratio of 2 sides of a right $\triangle$

$$\text{sine} = \frac{\text{opp leg}}{\text{hypotenuse}}$$

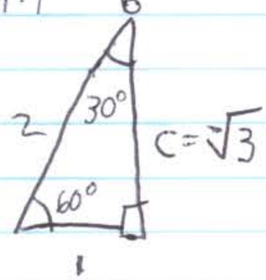
$$\sin A = \frac{a}{c}$$

$$\text{cosine} = \frac{\text{adjacent leg}}{\text{hybotenuse}}$$

$$\cos A = \frac{b}{c}$$

$$\text{tangent} = \frac{\text{opp leg}}{\text{adjacent leg}}$$

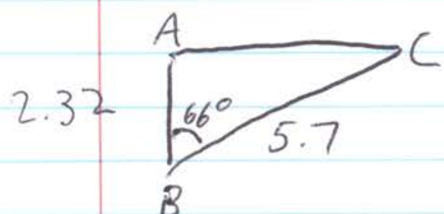
$$\tan A = \frac{a}{b}$$



$$1^2 + c^2 = 2^2$$
$$1 + c^2 = 4$$
$$c^2 = 3$$
$$c = \sqrt{3}$$

$$\tan b = \frac{1}{\sqrt{3}}$$

* This can be done by using the sin, tan, and cos button of a calculator



$$\cos B = \frac{\text{adj}}{\text{hyp}} = \frac{AB}{BC}$$

$$\cos 66^0 = \frac{AB}{5.7}$$

$AB = 5.7(\cos 66)$ * Calculator

$AB = 2.32$

8-3

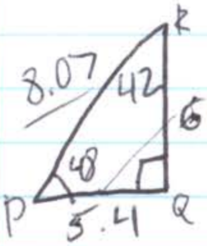
Inverse trigonometric Functions

if $\sin A = x$ then $\sin^{-1} x = m\angle A$

$\sin^{-1}(0.5) = 30°$ 2nd > Sin > number

$\cos^{-1}(0.25)$ $75.52°$

$\tan^{-1}(5.1) = 78.91$



$6^2 + 5.4^2 = c^2$

$c = 8.07$

$\tan P = \frac{adj}{opp} = \frac{6}{5.4}$

$\angle P = \tan^{-1}\left(\frac{6}{5.4}\right) = 48°$

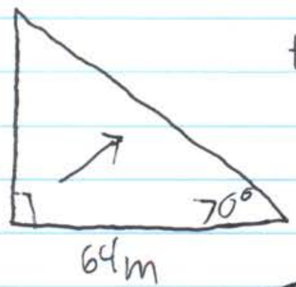
$$\begin{array}{r} 48 \\ +90 \\ \hline -180 \\ \hline 42 \end{array}$$

8-4

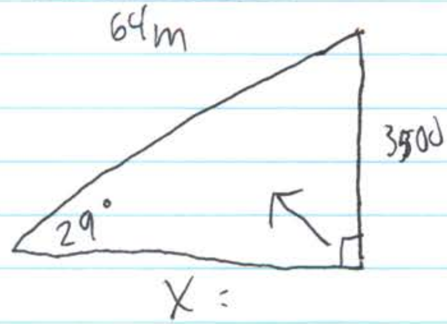
SOCATOA
SOHCAHTOA

Angle of Elevation

Angle of elevation is the ∡ formed by a horizontal line
depression ↓



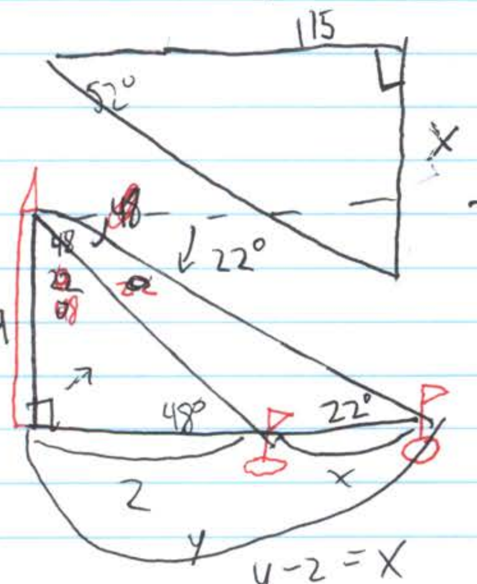
$\tan 70 = \frac{x}{67}$



$\tan 29 = \frac{3300}{x}$ $\quad x = \frac{3300}{\tan 29}$

$x = 6314$

X =



$\tan 52 = \frac{x}{115}$

$x = 147.19$

$\tan 48 = \frac{69}{z}$ $\quad z = \frac{69}{\tan 48}$

$z = 62$

$\tan 22 = \frac{69}{y}$ $\quad y = \frac{69}{\tan 22}$

$y = 170$

$y - z = x$

$170 - 62$

$x = 108$

Vectors

The speed and direction an object move can be represented by a vector
A vector is a quantity that has both lenth and direction.

A vector can be named by using the compound form $\langle x, y \rangle$

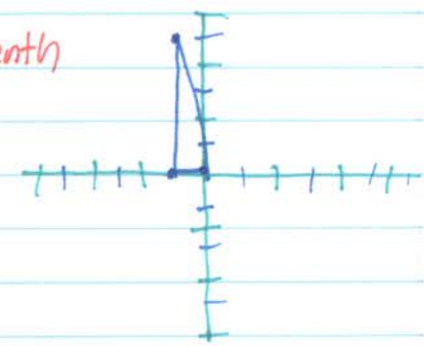
$= \langle x_2 - x_1, y_2 - y_1 \rangle$

$(-1, 1)$ $(6, 2)$
x_1 y_1 x_2 y_2

$6+1, 2-1$
$\langle 7, 1 \rangle$ horizontal $\rightarrow$ up

=

The magnitude of a vector is its lenth



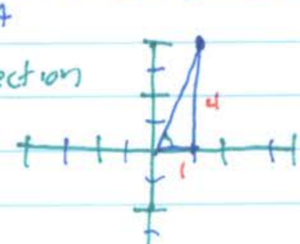
Draw and find magnitude $\langle -1, 5 \rangle$
distance formula $\langle \overset{x_1}{-1}, \overset{y_1}{5} \rangle$ $\langle \overset{x_2}{0}, \overset{y_2}{0} \rangle$

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
$d = \sqrt{(0+1)^2 + (0-5)^2}$
$d = 1 + 25$ OR $1^2 + 5^2 = x^2$
$d = \sqrt{26}$ $26 = x^2$ $x = \sqrt{26}$

Start - Initial

The direction of a vector is the $\measuredangle$ that it makes with horizontal line

Draw and find magnitude + direction
magnitude = $\sqrt{17}$
direction = 76



$1^2 + 4^2 = c^2$
$1 + 16 = c^2$
$17 = c^2$
$c = \sqrt{17}$

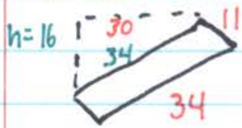
$\tan x = \frac{4}{1}$
$\tan^{-1}\left(\frac{4}{1}\right)$
$x = 76°$

Vectors are equal if they have same magnitude and direction

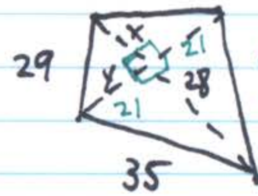
$A = \frac{d_1 d_2}{2}$

$\cancel{A = \frac{(28+x)(2y)}{2}}$ $\cancel{\frac{48y + 2yx}{2}}$

= Area parallelogram = $A = bh$



$A = 11 \times 16 = 176\, cm^2$



$\cancel{A = 24y + yx}$

$28^2 + y^2 = 35^2$

1225

$y = 21$

$21^2 + x^2 = 24^2$

$x = 20$

$\frac{48 \cdot 42}{2}$

$A = 1008\ in^2$

Find the height of a ▭

$b = 3 \qquad A = (6x^2 + 24x - 6)$

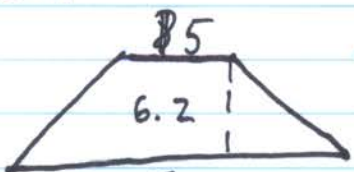
$A = bh$

$\frac{6x^2 + 24x - 6}{3} = \frac{3h}{3} \qquad h = 2x^2 + 8x - 2$

$2x^2 + 8x - 2 = h$

$A = \frac{bh}{2}$

$A = \frac{(b_1 + b_2)h}{2}$



$A = 40.3$

$A = \frac{(b_1 + b_2)h}{2}$

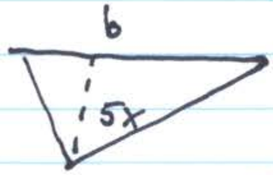
$A = \frac{(5+8)h6.2}{2}$

$A = 80.6/2$

$A = 40.3$

Find base of Δ

$A = 15x^2$

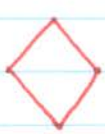


$A = \frac{bh}{2}$

$15x^2 = \frac{b(5x)}{2}$

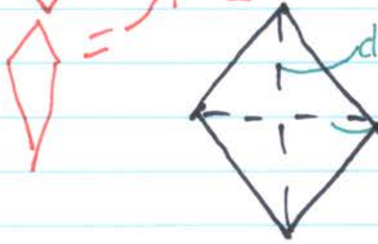
$\frac{30x^2}{5x} = \frac{b(5x)}{5x} \qquad b = 6x$

$6x = b$



$A = \frac{d_1 d_2}{2}$

=



$d_1 = 8x + 7$

$d_2 = 14x - 6$

F
O
I
L

$A = \frac{d_1 d_2}{2}$

$A = \frac{(8x+7)(14x-6)}{2}$

$A = 112x^2 - 48x + 98x - 42$

$A = \frac{112x^2 + 50x - 42}{2}$

$A = 56x^2 + 25x - 21$

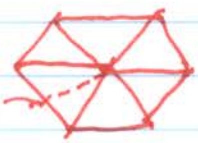
○ = $C = \pi d$ $C = 2\pi r$
$A = \pi r^2$

$A = \pi r^2$
$r = 3$
$A = \pi(3)^2$ 9π in^2

circumference $(65x+14)\pi$
$(65+14)\pi = 2\pi r$
$\frac{\div\pi}{\div 2}$ $\frac{\div\pi}{2}$

$r = 32.5x + 7$

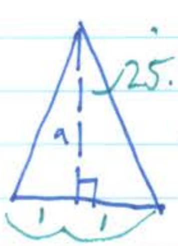
Pentagon



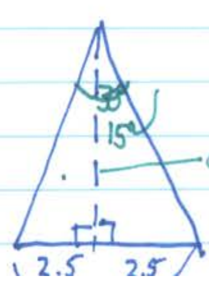
central ∠ = $\frac{360}{n}$

apothem

pentagon
⬠ = $A = \frac{1}{2}aP$



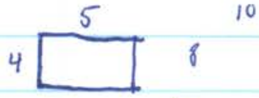
$25.71°$
$a = 2.77$



$\frac{360}{12}$
$30°$
$15°$
9.33
12sides
$\tan 15 = \frac{2.5}{x}$

Find area of dodecagon wid side lenth 5 cm

Dimentions



A 20 A=80
P 18 P=36

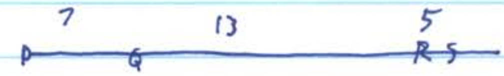
Change in Dimensions	Perimeter or Circumference	Area
$*a$ All dimensions multiplied by a	$*a$ Changes by Factor of A	a^2 Changes by a Factor of a^2

sample space all posible outcomes

Event outcomes

$P = \frac{\text{\# of outcomes in event}}{\text{\# of outcomes in sample space}}$

Geom Probability



$RS = \frac{RS}{PS} = \frac{5}{25} = \frac{1}{5}$

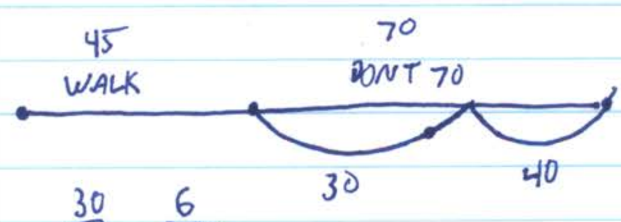
not in QR = $\frac{12}{25}$

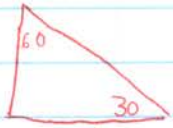
$\frac{45}{115} = \frac{9}{23}$

A pedestrian sign has this cycle WALK - 45 secs DONT - 70 secs

If u arrive at signal 40 times, predict how many times you will have to wait more than 40 seconds

Total 115





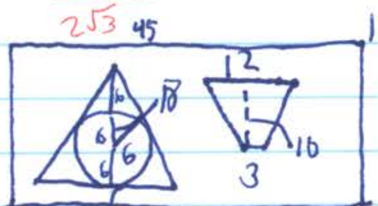
$\frac{30}{115}$ $\frac{6}{23}$

$2\sqrt{3}$ 45

10 times

900 - (187 + 75) $\frac{668}{900}$

$\square - \Delta +$ trapezoid



$15 \times 10 = \frac{150}{2}$

$\Delta = 162$ 187

trapezoid = 75

= 350

$\frac{113}{900}$ $\frac{550}{900}$ $\frac{11}{18}$

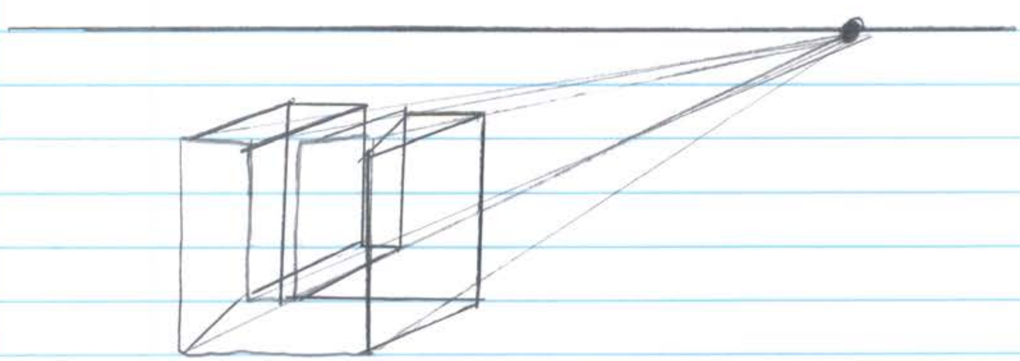
.61 .74

20

Face - Flat surface
Edges - intersection of 2 faces
Vertex - point of intersection of 3 or more faces

prism and pyramids - Any polygon as base
cone + cylinder only circles
Net - 3D figure unfolded
2D cross section - intersection of a 3D figure on a plane

Orthographic view - 6 views
Isometric - From a corner NO HORIZONTAL LINE



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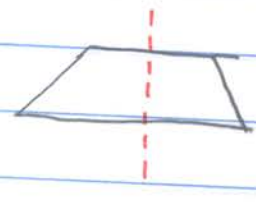
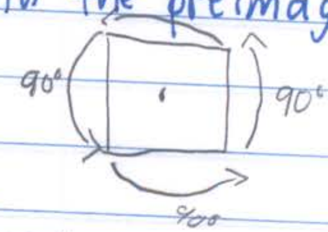
12-5 Symmetry

A figure has symmetry if there is a transformation of the figure such that the image coincides with the preimage.

Line of symmetry - divides figure into 2 congruent halves



Rotational Symmetry - image can be rotated about a point by an angle greater than 0° and less than 360° and the image coincides with the preimage



order - # of times figure will coincide with itself when rotating 360°

Symmetry about an axis -

order = 3

angle = 120°

Plane Symmetry - Take a shape and cut it with a plane

Fernando Trujano

12-6 Tessallations

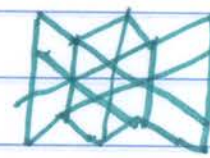
Translation symmetry - Pattern can be translated along a vector so that the image coincides with preimage.

Frieze Pattern - Translation symmetry along a line

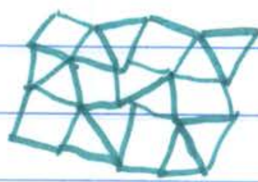
Glide Reflection - Pattern coincides with ~~its~~ image after a glide reflection

TESSALATION - Pattern of reapeating Figures that completely covers a plane with no gaps or overlaps. Measure of ∡ at each vertex is 360°

Regular tessalation - Formed by congruent regular polygons

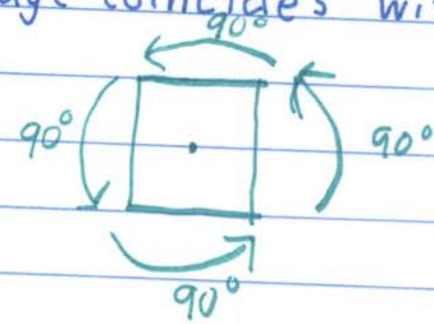


Semiregular tessalation - 2 or more different regular polygons



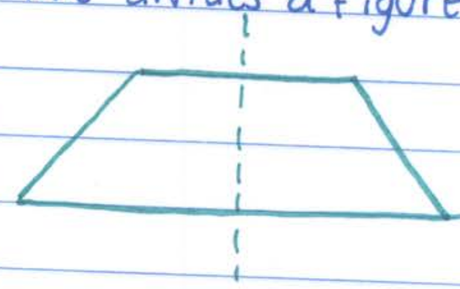
same # of polygons occuring in same order at every vertex

Rotational Symmetry - image can be rotated about a point, and the image coincides with the preimage.

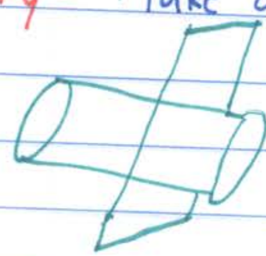


Line Symmetry - When a line divides a figure into 2 congruent halves.

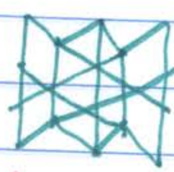
When you reflect a fig across a line



Plane Symmetry - Take a shape and cut it with a plane.

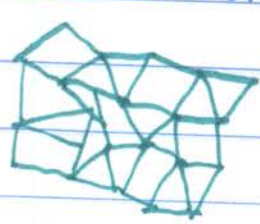


Regular tessalation - Tessalation formed by ① congruent regular polygons.

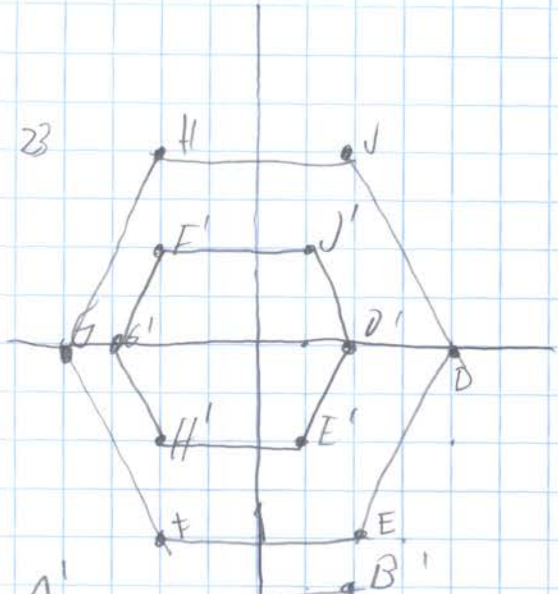


Equal Δ's

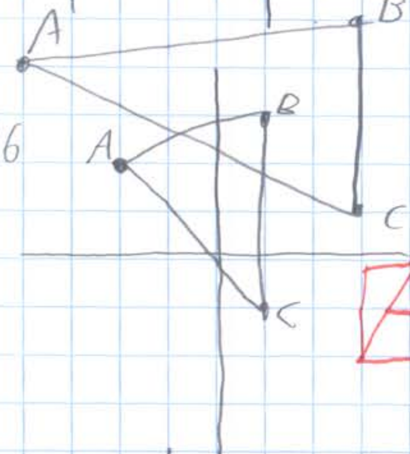
Semiregular Tessalation Tessalation formed by ② 2 or more different regular polygons.



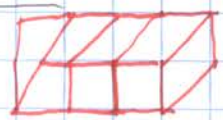
23

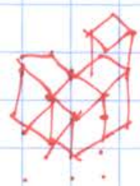


36

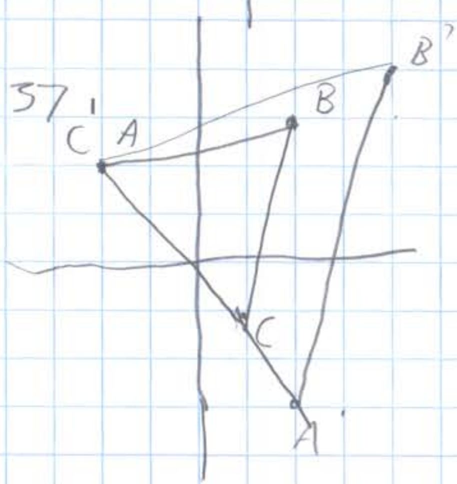


Scale factor
= 2



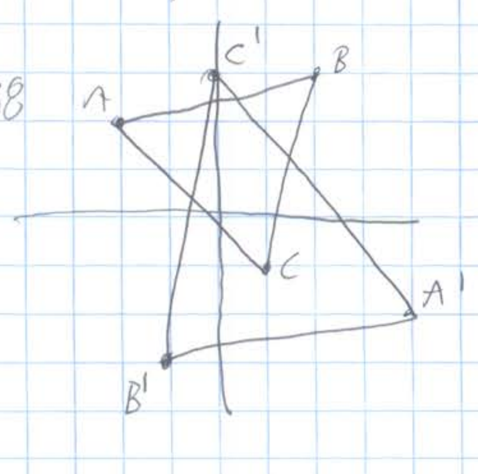


37



Scale factor
− 2

38



Scale factor
−3

Sec. 11.7

NAME Fernando Trujano DATE 5/15-5/18 PER
GEOMETRY HONORS 11.7 SUPPLEMENT ON CIRCLES

Find the radius and give the equation of the circle with center at the origin and containing the given point.

1. A) (0,-4) $r=4$

$(x-0)^2+(y-0)^2=16$

$x^2+y^2=16$

B) (3,5)

$\sqrt{34}$

$(x-0)^2+(y-0)^2=34$

$x^2+y^2=34$

C) $(2, -\sqrt{17})$

$r=5$

$x^2+y^2=25$

2. Write the equation of the circle with center (2,3) and containing the point (6,6).

distance formula $r=5$

$(x-2)^2+(y-3)^2=25$

3. Write the equation of the circle with center (-4,0) and containing the point (2,-1).

$r=6$

$(x+4)^2+y^2=36$

4. The endpoints of the diameter of a circle are (-6,2) and (6,-2). Find the center and radius and write the equation of the circle. midpoint formula

$c=(0,2)$

$r=6$

$x^2+(y-2)^2=36$

5. Write the equation of a circle having a diameter with endpoint s of (5,8) and (-1,-4).

$(x-2)^2+(y-2)^2=45$

$c=2,2$

6. Determine the center and radius of each circle:

a) $x^2+y^2=16$

center (0,0)

radius 4

b) $4x^2+4y^2=36$

center (-4,-4)

radius 6

c) $2x^2+2y^2-18=0$

center (-2,-2)

radius 3

d) $(x-3)^2+(y+7)^2=8$

center (3 -7)

radius $\sqrt{8}$

e) $(x+4)^2+(y-5)^2=36$

center (-4,5)

radius 6

f) $3x^2+3(y-1)^2=12$

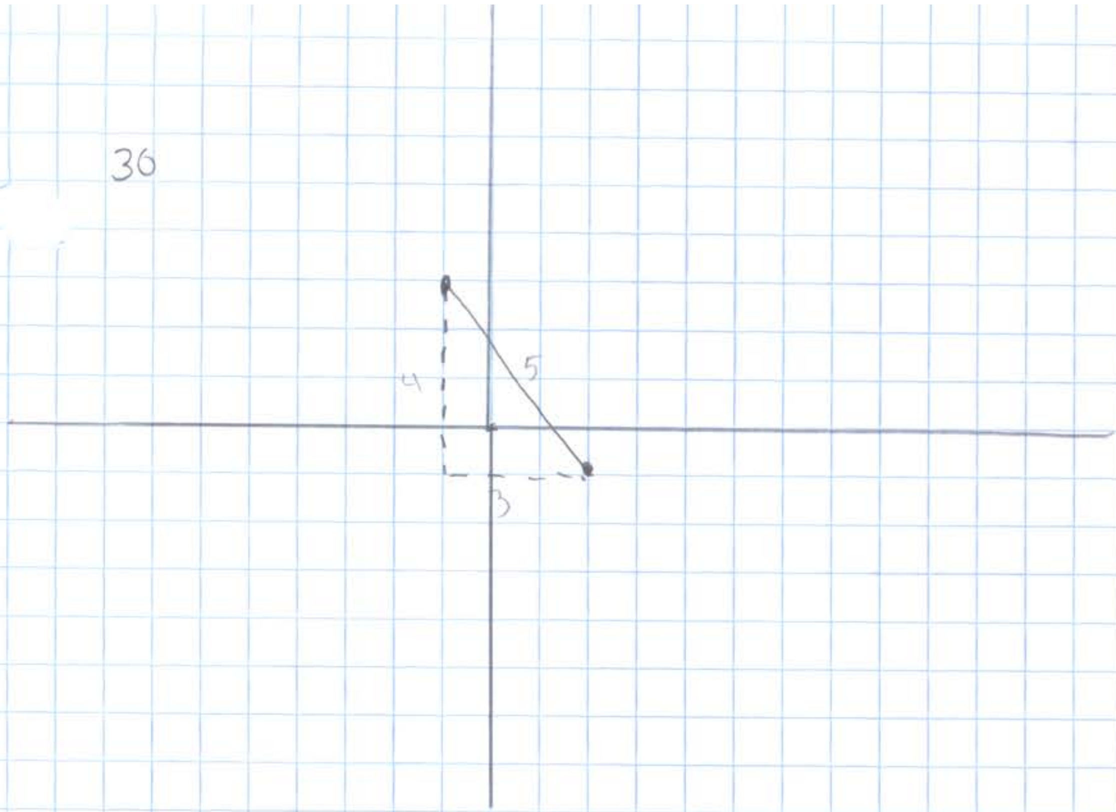
center (0,3)

radius 2

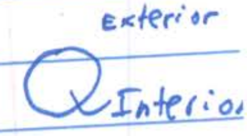
$\frac{3x^2+3y-3^2=12}{3}$

$x^2+(y-3)=4$

36



11.1 Lines that intersect circles



Interior of a ⊙ - set of points inside ⊙

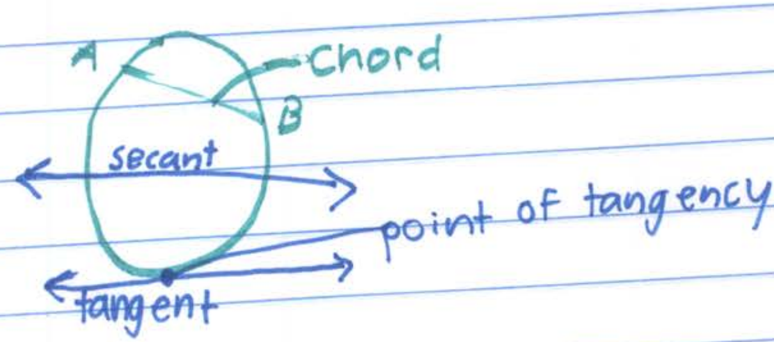
Exterior of a ⊙ set of all points outside ⊙

Chord - segment whose endpoints lie on a circle

Secant= line that intersects a circle at 2 points

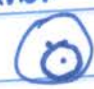
Tangent line in same plane as circle that intersecs at 1 point

point of tangency- point where tangent and circle intersect

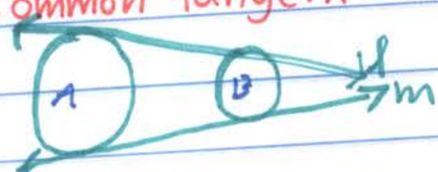


Congruent circles · have congruent radia

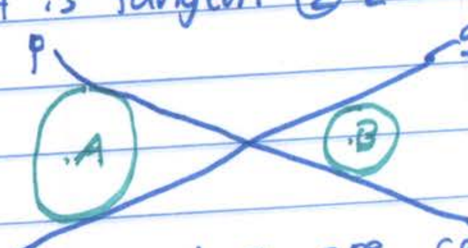
Coplanar circles · have the same center 

Tangent circles · 2 coplanar circles that intersect at exactly 1 point 

Common tangent - line that is tangent to 2 circles

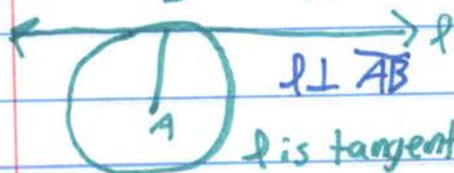


Lines l and m are common external tangents to ⊙A and ⊙B ~~internal~~



Lines p and q are common internal tangents to ⊙A and ⊙B

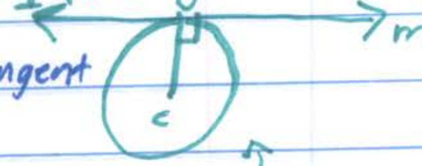
If a line is tangent to a circle, then it is perpendicular to the radios drawn to the point of tangency



$\ell \perp \overline{AB}$

ℓ is tangent to $\odot A$

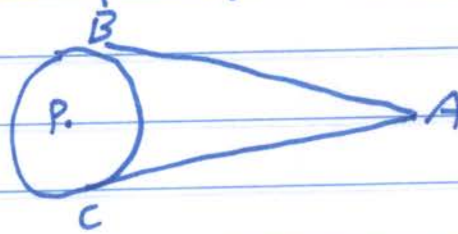
m is $\perp$ to CD at D



m is tangent to $\odot C$

If a line is perpendicular to a radious of a circle at a point on the Circle, then the line is tangent to circle

If 2 segments are tangent to a circle from the same external point, then the segments are congruent



$\overline{AB} \cong AC$

$\overline{AB}$ and $\overline{AC}$ are tangent to $\odot P$

HORIZON = TANGENT

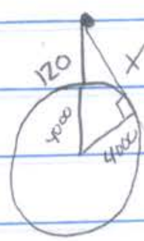
r = 3

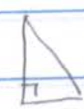
r = 1

(2, ~~4~~)

~~x = 2~~

y = -1





x = 987.11

$4 + 2a = 5a - 32$

$-2a$

36   3a

a = 12

28

11-2 Arcs and Chords

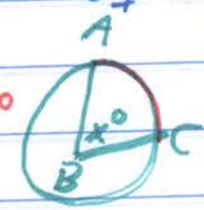
Central angle - angle whose vertex is the center of a circle.

Arc - unbroken part of circle consisting of 2 points called the endpoints and all points on ⊙ between them

Minor Arc - Arc whose points are on the interior of a central angle. 2 letters

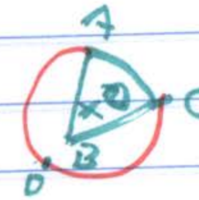
The measure of the minor arch is equal to the measure of its central angle

$m\widehat{AC} = m\angle ABC = x°$



Major arc - Arc whose points are on the exterior of central angle. 3 letters

The measure of a major arc = 360° minus the measure of its central angle



$m\widehat{ADC} = 360° - m\angle ABC$

$= 360° - x°$

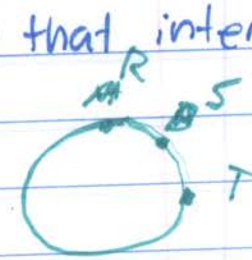
Semicircle - Endpoints of arc lie on a diameter.

The measure of a semicircle = 180°

$m\ \widehat{EFG} = 180°$

Adjacent arcs - Arcs of the same circle that intersects at exactly one point.

$\widehat{RS}$ and $\widehat{ST}$ are adjacent arcs



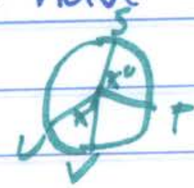
Arc Addition Postulate

The measure of an arc formed by 2 adjacent arcs is the sum of the measure of the 2 arcs

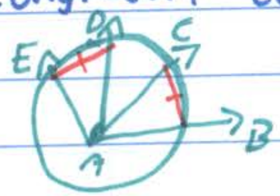
$m\widehat{ABC} = m\widehat{AB} + m\widehat{BC}$

Congruent Archs - 2 arcs that have the same measure.

$\widehat{ST} \cong \widehat{UV}$



① congruent central ∡'s have congruent chords



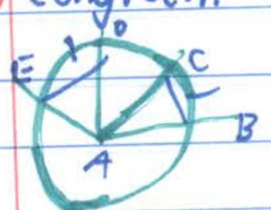
~~$\overline{ED} = \overline{BC}$~~ ~~$\angle DAE \cong$~~

$\angle EAD \cong \angle BAC$ $\overline{DE} \cong \overline{BC}$

② Congruent chords have congruen arcs

$\overline{ED} \cong \overline{BC}$ $\widehat{DE} = \widehat{BC}$

③ Congruent arcs have congruent central Angles

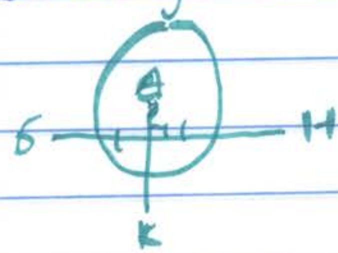


$\widehat{ED} \cong \widehat{BC}$ $\angle DAE \cong \angle BAC$

In a ⨀ if a radius (or diameter) is ⊥ to chord then it bisects cord and its arch

$\overline{CD} \perp EF$ CD bisecs EF and $\widehat{EF}$

In a ⊙ the ⊥ bisector of a chord is a radius (or diametr)

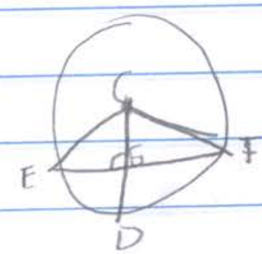


JK is a ⊥ bisector of GH

JK is a diameter of ⊙

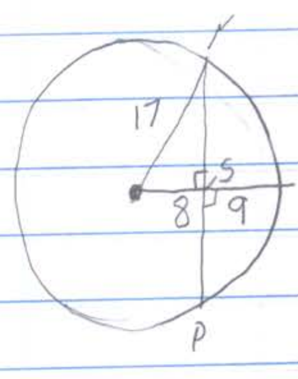
≅ chords → = ⊥'s → ≅ arcs → ≅ chords

9n-11



explain why EF = GF

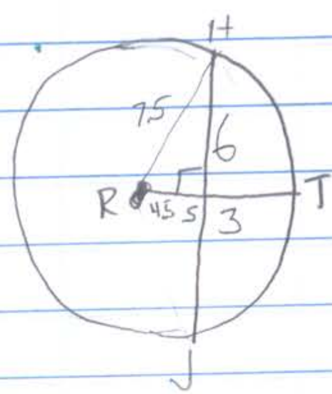
HL



$8^2+x^2=17^2$

289

NP = 30



RT = 7.5

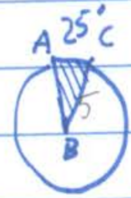
HJ = 12

ST = 3

Circle Area = πr^2

Circle Circumference = $2\pi r$

Sector



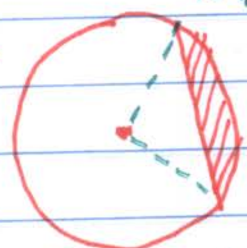
$$\frac{25}{360} = \frac{x}{25\pi}$$

Sector ABC = 1.74π ft^2

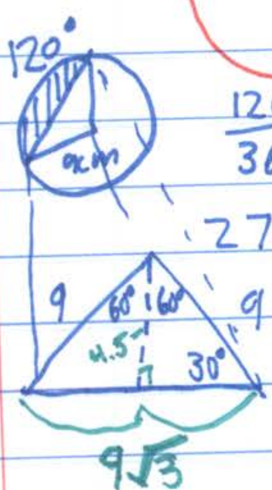
$$\frac{122}{360} = \frac{x}{324\pi}$$

109.8π 3449.468 3449 in^2

Segment



area of seg = sector − Δ



$$\frac{120}{360} = \frac{x}{81\pi}$$

$27\pi = x$

Special Right Δ = across from

$30 = x$

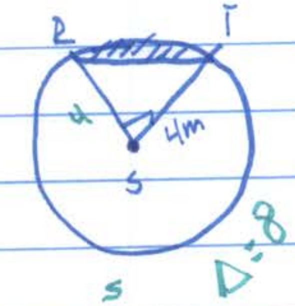
$60 = x\sqrt{3}$

$90 = 2x$

$$\frac{9\sqrt{3}(4.5)}{2}$$

39.07 = 49.75 cm^2

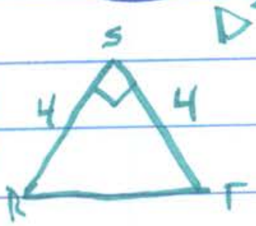
Fernando Trujano



$\frac{90}{360} = \frac{x}{16\pi}$

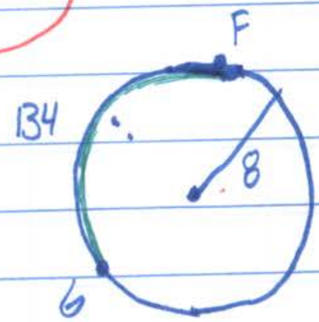
$x = 4\pi$

$4.566 m^2$



ARC leanth

$\frac{m^\circ}{360} = \frac{x}{\text{Circum}}$

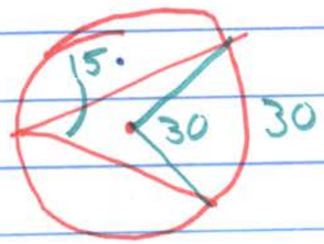


$\frac{134}{360} = \frac{x}{16\pi}$

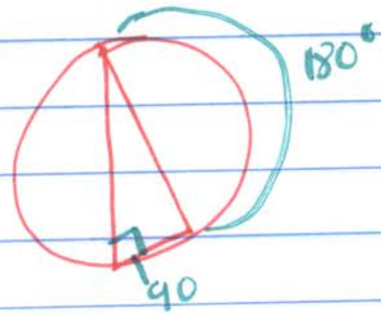
$5.95\pi = 18.71cm$

90° -> semicirch

Inscribed Angle



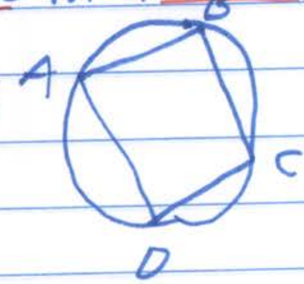
Inscribed angle is ½ the arc



If a quadrilateral is inscribed in a circle, a opposite angles are supplementary.

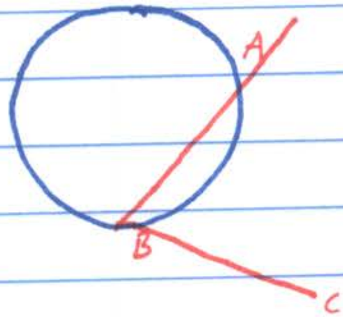
$B + D = 180°$

$A + C = 180°$



NOT IN QUIZ

11.5



Angle $ABC = \frac{1}{2}$ arc AB

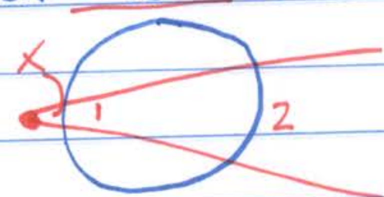
Vertex <u>on</u> circle

$\measuredangle = \frac{1}{2}$ arc

Vertex <u>in</u> circle

$\measuredangle_x = \frac{1}{2}(\overset{\frown}{1} + \overset{\frown}{2})$

Vertex <u>outside</u> circle

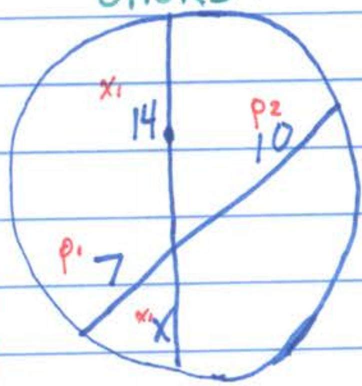


$\measuredangle x = \frac{1}{2}(\overset{\frown}{2} - \overset{\frown}{1})$

big arc   little arc

Segment Relationships in Circles
11-6

CHORD part*part = part*part



$7(10) = 14x$

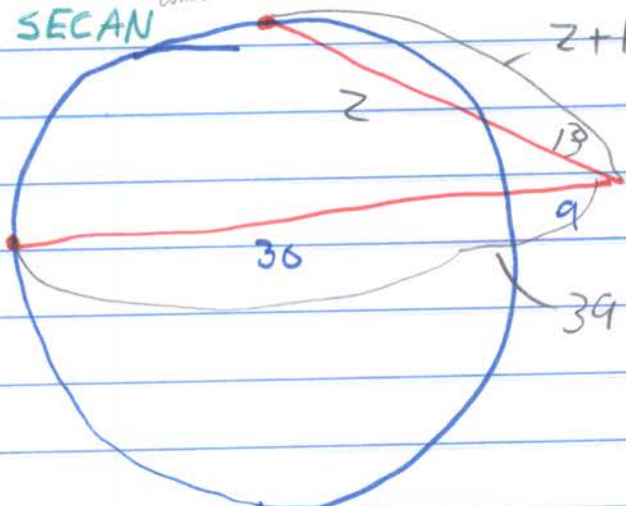
$70 = 14x$

$x = 5$

$p_1 \cdot p_2 = x_1 \cdot x_2$

$p_1 \times p_2 = x_1 * x_2$

SECAN whole*outer = whole * outer



$(z+13)(13) = (39)(9)$

$13z + 169 = 351$

$z = 14$

Whole • Outer = Whole • Outer

SECANT and TANGENT

SAME RULE AS SECAN

The equation of a circle with center (h,k) and radius R is

$$(x-h)^2 + (y-k)^2 = r^2$$

$$x^2 - 2xh + h^2 + y^2 - 2yk + k^2 = r^2$$