Geometry: Proofs and Postulates Worksheet

Practice Exercises (w/ Solutions)

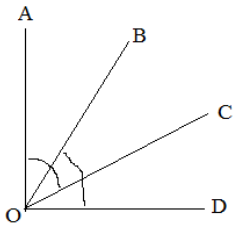
Statements	Reasons
1. $\overline{AD}$ and $\overline{BC}$ bisect each other	1. Given
2. $\overline{AM} \cong \overline{DM}$; $\overline{CM} \cong \overline{BM}$	2. Definition of bisector
3. $\angle AMC \cong \angle BMD$	3. Vertical angles are congruent
4. $\triangle AMC \cong \triangle DMB$	4. Side-Angle-Side (SAS) (2, 3, 2)
5. $\overline{AC} \cong \overline{BD}$	5. CPCTC (Corresponding Parts of Congruent Triangles are Congruent)

Topics include triangle characteristics, quadrilaterals, circles, midpoints, SAS, and more.

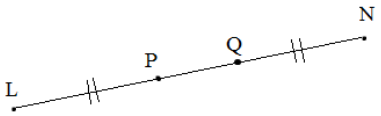
PRACTICE EXERCISES -→

Introduction to proofs: Identifying theorems and postulates

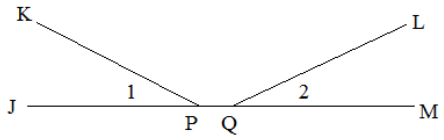
1) Why is $\angle AOB \cong \angle COD$?



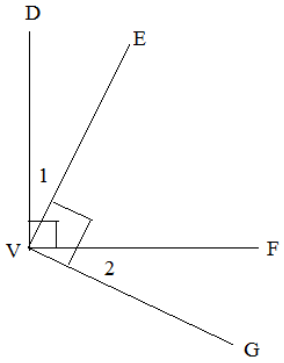
2) Why are $\overline{LQ}$ and $\overline{PN}$ congruent segments?



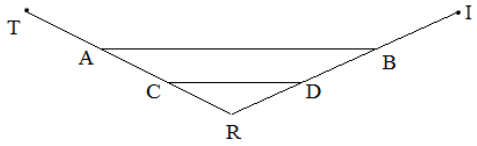
3) Angles 1 and 2 are congruent.
Why are $\angle KPM$ and $\angle LQJ$ congruent?



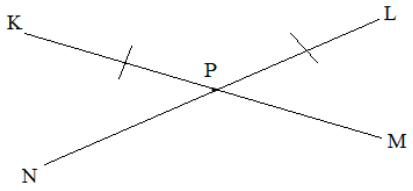
4) $DV \perp VF$ and $EV \perp VG$
Why is angle 1 congruent to angle 2?



5) If TR = RI, and AB and CD are trisectors,
why are CR and BD congruent segments?



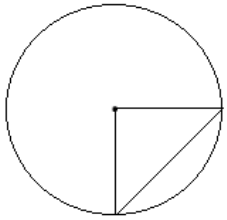
6) KM and LN bisect each other.
Is KM congruent to NL?



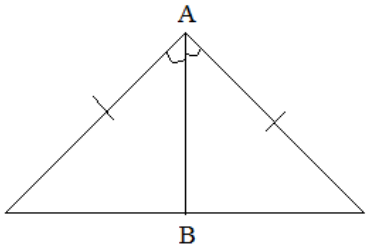
Introduction to proofs: Identifying geometry theorems and postulates

Explain using geometry concepts and theorems:

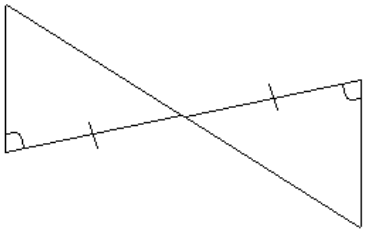
1) Why is the triangle isosceles?



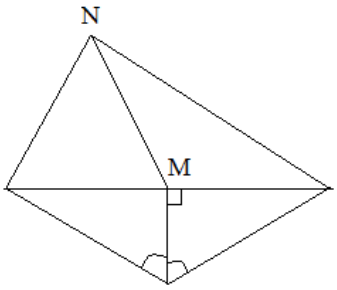
2) Why is $\overline{AB}$ an altitude?



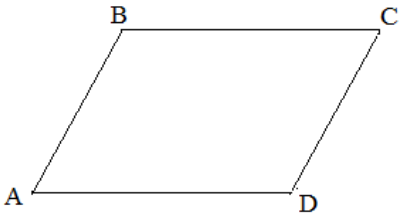
3) Why are the triangles congruent?



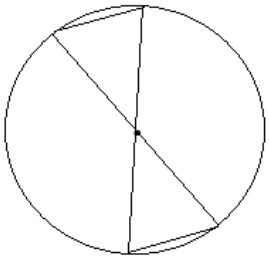
4) Why is $\overline{NM}$ a median?



5) If ABCD is a parallelogram, why are $\angle A$ and $\angle C$ congruent?



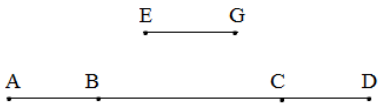
6) Why are the triangles congruent?



Geometry Proofs

A) Given: $\overline{AB} \cong \overline{EG}$
$\overline{CD} \cong \overline{EG}$

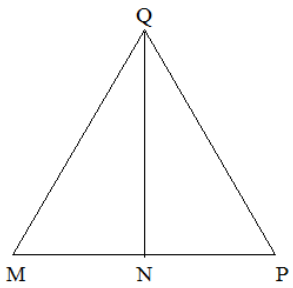
Prove: $\overline{AC} \cong \overline{BD}$



Statements	Reasons

B) Given: $\angle M$ is the complement to $\angle MQN$
$\angle P$ is the complement to $\angle PQN$
$\overline{NQ}$ bisects $\angle MQP$

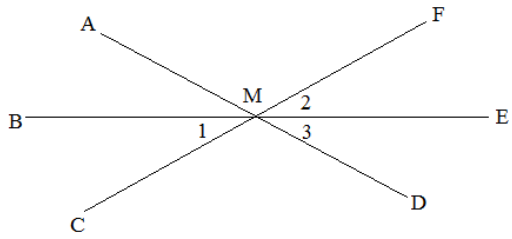
Prove: $\angle M \cong \angle P$



Statements	Reasons

C) Given: $\overline{BE}$ bisects $\angle FMD$

Prove: $\angle 1 \cong \angle 3$

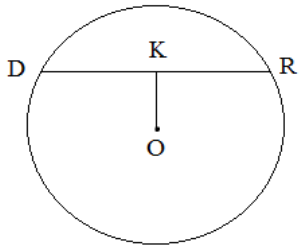


Statements	Reasons

Geometry Proofs

1) Given : $\odot O$; $\overline{DR} \perp \overline{OK}$

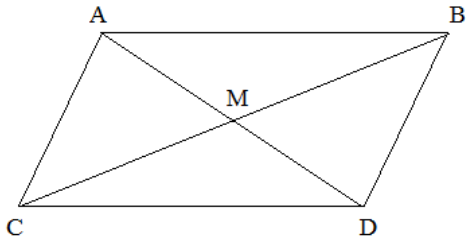
Prove: $\overline{DK} \cong \overline{KR}$



Statements	Reasons

2) Given: $\overline{AD}$ and $\overline{BC}$ bisect each other

Prove: $\overline{AC} \cong \overline{BD}$

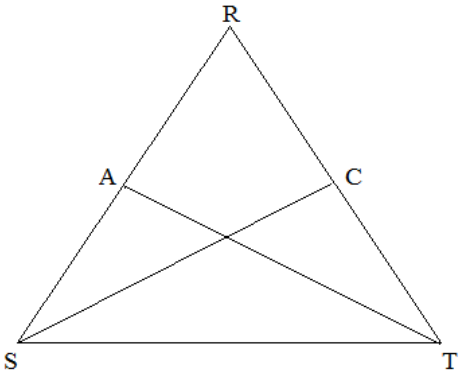


Statements	Reasons

3) Given: $\overline{RS} \cong \overline{RT}$

$\overline{AT}$ and $\overline{CS}$ are medians

Prove: $\overline{AT}$ and $\overline{CS}$ are congruent

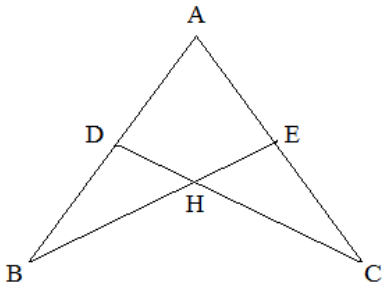


Statements	Reasons

Geometry Proofs

4) Given: $\overline{AC} \cong \overline{AB}$
D and E are midpoints

Prove: $\angle B \cong \angle C$



Statements	Reasons

5) Prove the diagonals of an isosceles trapezoid are congruent.

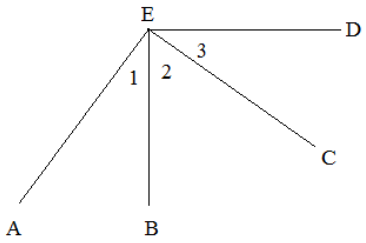
Statements	Reasons

Geometry Proofs

6) Given: $\overline{AE} \perp \overline{EC}$

$\overline{BE} \perp \overline{ED}$

Prove: $\angle 1 = \angle 3$



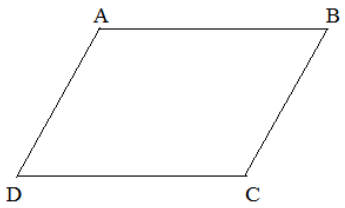
Statements	Reasons

7) Given: $\overline{AB} \parallel \overline{CD}$

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

Prove: $\overline{AD} \parallel \overline{BC}$

(Hint: Use an auxilary line segment)



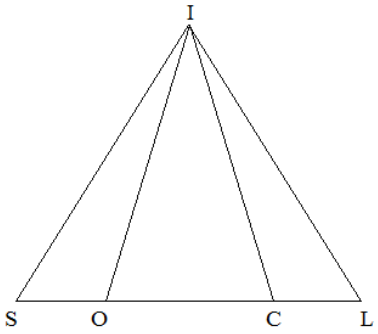
Statements	Reasons

Geometry Proofs

8) Given: △ OIC is an isosceles triangle (with base OC)

$\overline{SO} \cong \overline{CL}$

Prove: △ ISL is an isosceles triangle



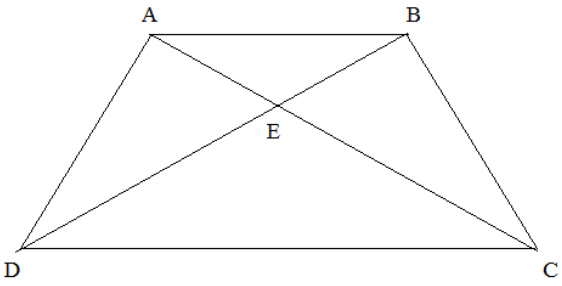
Statements	Reasons

9) Given: $\overline{AD} = \overline{BC}$

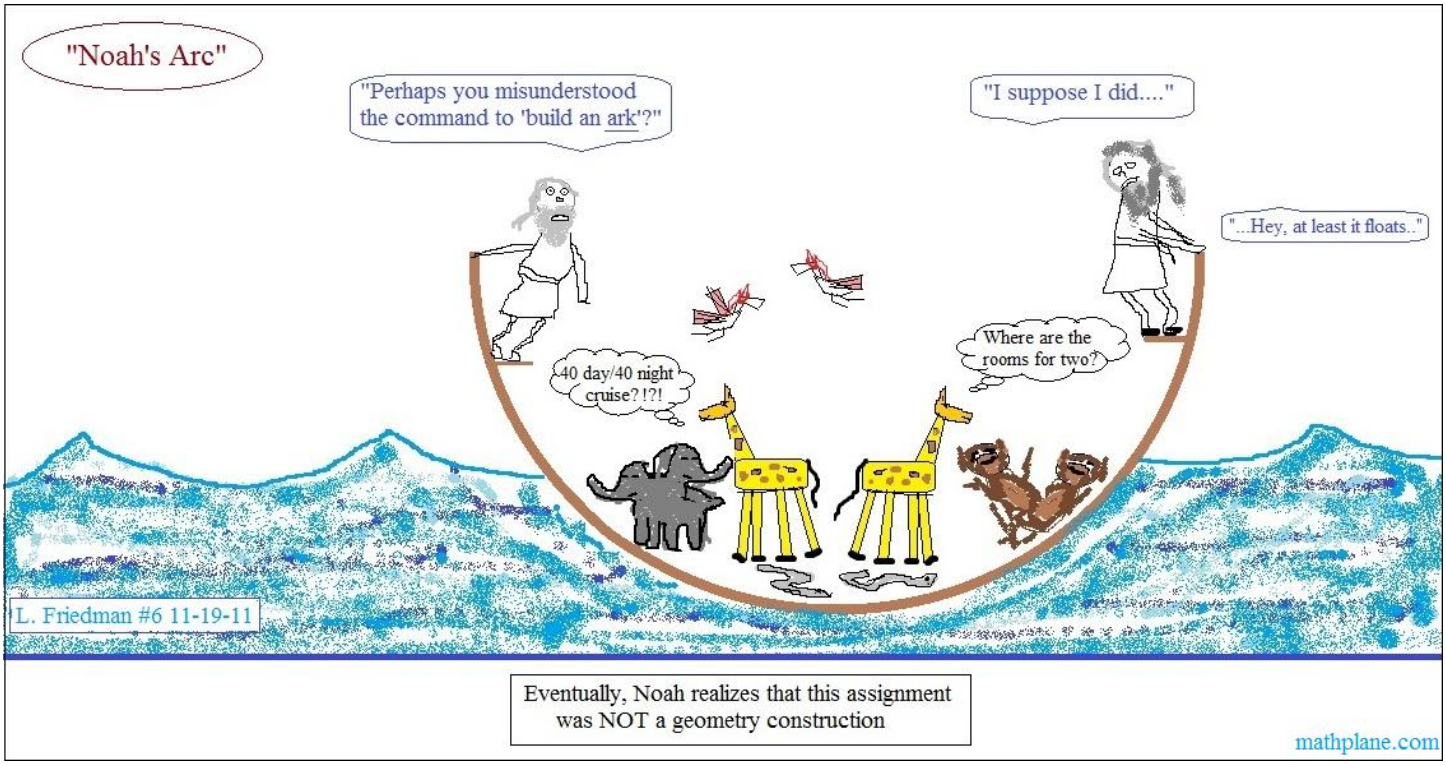
△ DEC is isosceles with base DC

△ ABE is isosceles with base AB

Prove: $\angle ADC \cong \angle BCD$



Statements	Reasons

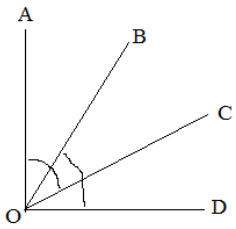

"Noah's Arc"
"Perhaps you misunderstood the command to 'build an ark'?"
"I suppose I did...."
"...Hey, at least it floats.."
Where are the rooms for two?
40 day/40 night cruise?!?!
L. Friedman #6 11-19-11
Eventually, Noah realizes that this assignment was NOT a geometry construction
mathplane.com

SOLUTIONS -→

Introduction to proofs: Identifying theorems and postulates

SOLUTIONS

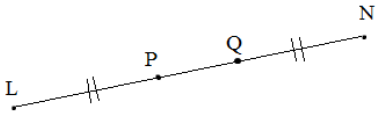
1) Why is $\angle AOB \cong \angle COD$?



Since AOC = BOD,
and BOC = BOC (reflexive property),
AOB = COD (subtraction property)

(If congruent angles are subtracted from congruent angles, then the differences are congruent)

2) Why are $\overline{LQ}$ and $\overline{PN}$ congruent segments?

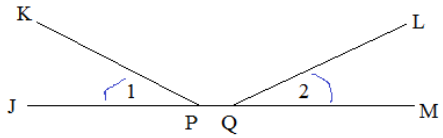


Since $\overline{LP} = \overline{QN}$,
and $\overline{PQ} = \overline{PQ}$ (reflexive property),

then $\overline{LQ}$ and $\overline{PN}$ are congruent (addition property)

(If congruent segments are added to equal segments, then the sums are the same!)

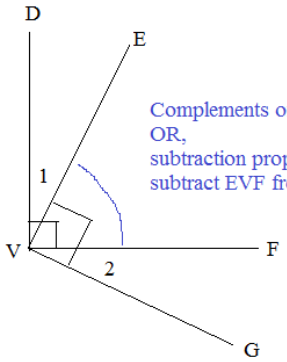
3) Angles 1 and 2 are congruent.
Why are $\angle KPM$ and $\angle LQJ$ congruent?



If angles are supplementary to congruent angles, then they are congruent..

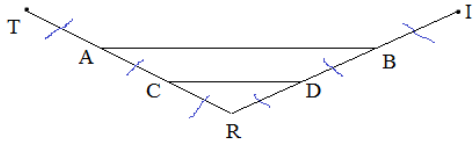
4) DV ⊥ VF and EV ⊥ VG

Why is angle 1 congruent to angle 2?



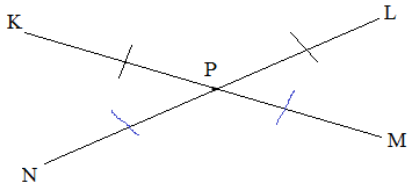
Complements of the same angle are congruent.
OR,
subtraction property (right angles are congruent... then, subtract EVF from each, leaving 1 and 2)

5) If TR = RI, and AB and CD are trisectors, why are CR and BD congruent segments?



Division Property (If equal segments are divided by the same amount, the divided amounts are congruent)

6) KM and LN bisect each other.
Is KM congruent to NL?



Yes... Since segments bisect each other, KP = PM and NP = PL.. Also, from diagram, KP = PL...
So, using substitution and addition properties, KM = NL

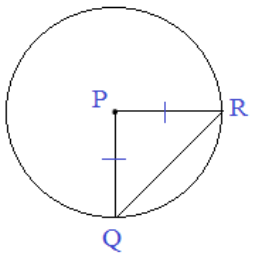
Or, use the multiplication property.. (Since KP = PL and both segments are doubled, the products are equal)

Introduction to proofs: Identifying geometry theorems and postulates

ANSWERS

Explain using geometry concepts and theorems:

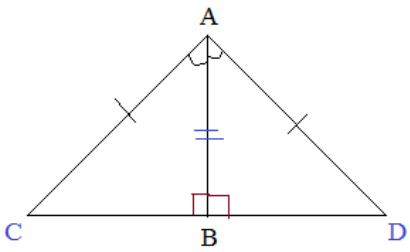
1) Why is the triangle isosceles?



$\overline{PR}$ and $\overline{PQ}$ are radii of the circle. Therefore, they have the same length.

A triangle with 2 sides of the same length is isosceles.

2) Why is $\overline{AB}$ an altitude?



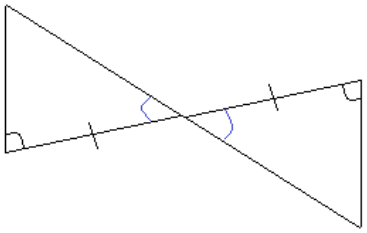
$\overline{AB} = \overline{AB}$ (reflexive)
therefore,
$\triangle CAB = \triangle DAB$
(side-angle-side)

If triangles are same, then
$\angle ABC = \angle ABD$
(CPCTC)

Since angles are same and must add up to 180, each is 90°

Therefore, $\overline{AB}$ is altitude.

3) Why are the triangles congruent?



Vertical angles are congruent
therefore,
triangles are congruent
(angle-side-angle)

4) Why is $\overline{NM}$ a median?

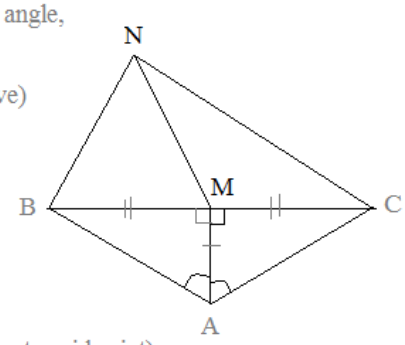
Since CMA is right angle,
AMB is right angle.

$\overline{AM} = \overline{AM}$ (reflexive)

$\triangle AMB = \triangle AMC$
(Angle-Side-Angle)

$\overline{BM} = \overline{CM}$
(CPCTC)

$\overline{NM}$ is a median
(segment from vertex to midpoint)



5) If ABCD is a parallelogram, why are $\angle A$ and $\angle C$ congruent?

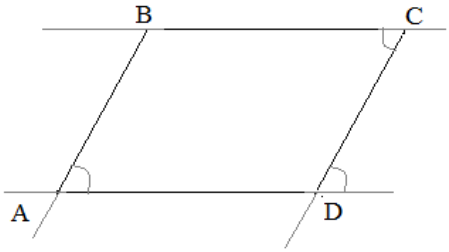
$\overline{BC} \parallel \overline{AD}$
(definition of a parallelogram)

$\angle C = \angle D$
(alternate interior angles)

$\overline{CD} \parallel \overline{AB}$
(def. of parallelogram)

$\angle A = \angle D$
(corresponding angles)

Since C = D and D = A, then A = C.

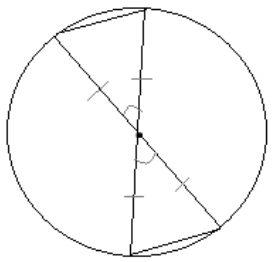


6) Why are the triangles congruent?

Since they are radii of the circle, the 4 marked sides are congruent.

Vertical angles

Triangles congruent by side-angle-side



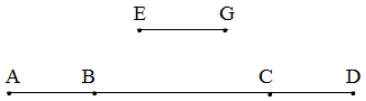
NOTE: CPCTC is "Corresponding Parts of Congruent Triangles are Congruent"

Geometry Proofs

SOLUTIONS

A) Given: $\overline{AB} \cong \overline{EG}$
$\overline{CD} \cong \overline{EG}$

Prove: $\overline{AC} \cong \overline{BD}$



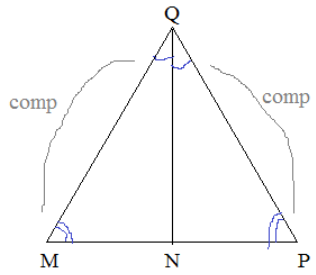
Statements	Reasons
1) AB = EG	1) Given
2) CD = EG	2) Given
3) AB = CD	3) Transitive Property (Segments that are congruent to the same segment are congruent)
4) BC = BC	4) Reflexive Property
5) AC = BD	5) Addition Property (If a segment is added to congruent segments, the sums are congruent)

OR,

Statements	Reasons
1) AB = EG	1) Given
2) CD = EG	2) Given
3) AB = CD	3) Transitive Property (Segments that are congruent to the same segment are congruent)
4) AC = BD	4) Addition Property (If segment (BC) is added to congruent segments, then the sums are congruent)

B) Given: $\angle M$ is the complement to $\angle MQN$
$\angle P$ is the complement to $\angle PQN$
$\overline{NQ}$ bisects $\angle MQP$

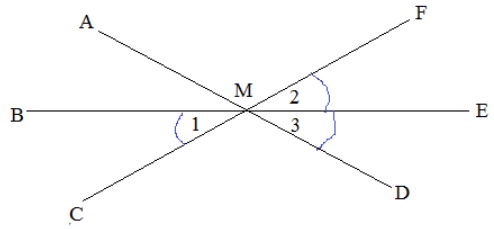
Prove: $\angle M \cong \angle P$



Statements	Reasons
1) $\overline{NQ}$ bisects $\angle MQP$	1) Given
2) $\angle MQN \cong \angle PQN$	2) Definition of (Angle) Bisector (If ray bisects an angle, the angle halves are congruent)
3) Angles M and MQN are complementary	3) Given
4) Angles P and PQN are complementary	4) Given
5) $\angle M = \angle P$	5) Substitution (If angles are complementary to congruent angles, then they are congruent) "Congruent Complements"

C) Given: $\overline{BE}$ bisects $\angle FMD$

Prove: $\angle 1 \cong \angle 3$



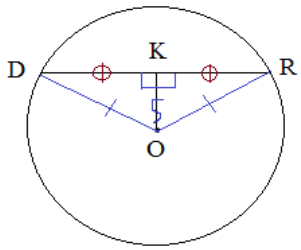
Statements	Reasons
1) $\overline{BE}$ bisects $\angle FMD$	1) Given
2) $\angle 2 = \angle 3$	2) Definition of Bisector (If segment bisects an angle, the angle halves are congruent)
3) $\angle 1 = \angle 2$	3) Vertical angles are congruent
4) $\angle 1 = \angle 3$	4) Transitive Property (Angles congruent to the same angle are congruent)

Geometry Proofs

SOLUTIONS

1) Given: $\odot O$; $\overline{DR} \perp \overline{OK}$

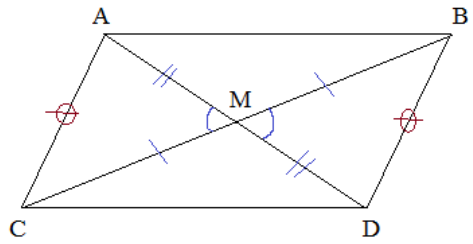
Prove: $\overline{DK} \cong \overline{KR}$



Statements	Reasons
1. Circle O	1. Given
2. $\overline{DR} \perp \overline{OK}$	2. Given
3. $\angle OKD$ and $\angle OKR$ are right angles	3. Definition of perpendicular
4. $\angle OKD \cong \angle OKR$	4. All right angles are congruent
5. Auxilary line segments $\overline{OR}$ and $\overline{OD}$	5. A segment joins 2 points
6. $\overline{OR} \cong \overline{OD}$	6. All radii are congruent
7. $\overline{OK} \cong \overline{OK}$	7. Reflexive property
8. $\triangle DOK = \triangle ROK$	8. Hypotenuse Leg Theorem (HL)
9. $\overline{DK} \cong \overline{KR}$	9. CPCTC (4, 6, 7)

2) Given: $\overline{AD}$ and $\overline{BC}$ bisect each other

Prove: $\overline{AC} \cong \overline{BD}$

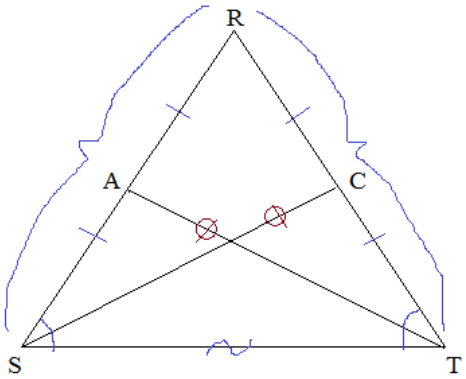


Statements	Reasons
1. $\overline{AD}$ and $\overline{BC}$ bisect each other	1. Given
2. $\overline{AM} \cong \overline{DM}$; $\overline{CM} \cong \overline{BM}$	2. Definition of bisector
3. $\angle AMC \cong \angle BMD$	3. Vertical angles are congruent
4. $\triangle AMC \cong \triangle DMB$	4. Side-Angle-Side (SAS) (2, 3, 2)
5. $\overline{AC} \cong \overline{BD}$	5. CPCTC (Corresponding Parts of Congruent Triangles are Congruent)

3) Given: $\overline{RS} \cong \overline{RT}$

$\overline{AT}$ and $\overline{CS}$ are medians

Prove: $\overline{AT}$ and $\overline{CS}$ are congruent



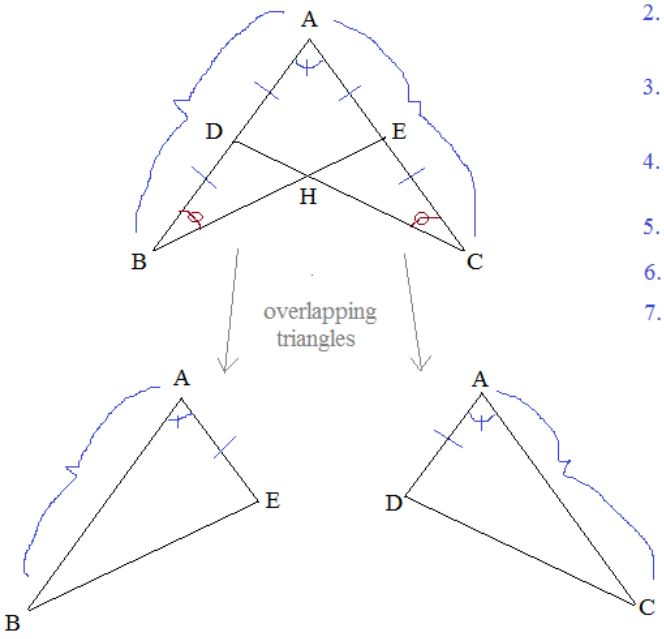
Statements	Reasons
1. $\overline{RS} \cong \overline{RT}$	1. Given
2. $\angle RST \cong \angle RTS$	2. Sides-Angles Theorem (Isosceles Triangle)
3. $\overline{AT}$ and $\overline{CS}$ are medians	3. Given
4. A and C are midpoints	4. Definition of median
5. $\overline{RA} \cong \overline{SA}$; $\overline{RC} \cong \overline{TC}$	5. Definition of midpoint
6. $\overline{SA} \cong \overline{CT}$	6. Division property (like division of congruent segments)
7. $\overline{ST} \cong \overline{ST}$	7. Reflexive property
8. $\triangle SAT \cong \triangle TCS$	8. Side-Angle-Side (SAS) (6, 2, 7)
9. $\overline{AT} \cong \overline{CS}$	9. CPCTC

Geometry Proofs

SOLUTIONS

4) Given: $\overline{AC} \cong \overline{AB}$
D and E are midpoints

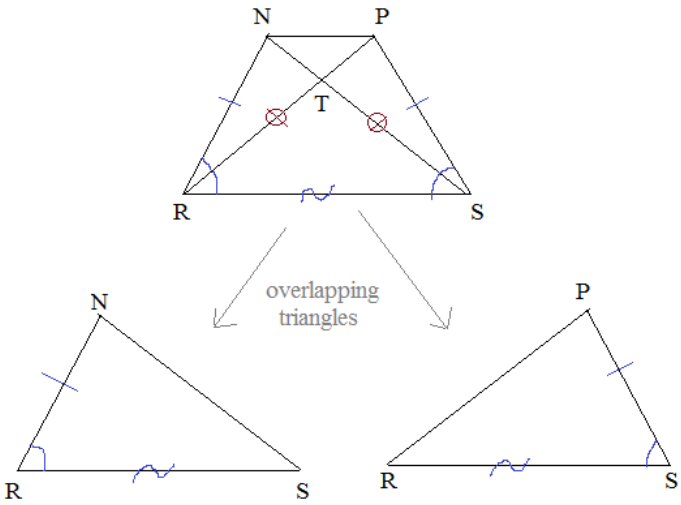
Prove: $\angle B \cong \angle C$



Statements	Reasons
1. $\overline{AC} \cong \overline{AB}$	1. Given
2. $\overline{AE} \cong \overline{EC}$ (AE is 1/2 of AC)	2. Definition of midpoint
3. $\overline{AD} \cong \overline{DB}$ (AD is 1/2 of AB)	3. Definition of midpoint
4. $\overline{AD} \cong \overline{AE}$	4. Division property ("like division" of congruent segments)
5. $\angle A \cong \angle A$	5. Reflexive property
6. $\triangle DAC \cong \triangle EAB$	6. Side-Angle-Side (SAS) (4, 5, 1)
7. $\angle B \cong \angle C$	7. CPCTC

5) Prove the diagonals of an isosceles trapezoid are congruent.

Definition of Isosceles Trapezoid: A trapezoid in which the base angles and non-parallel sides are congruent



Statements	Reasons
1. RNPS is isosceles trapezoid with base $\overline{RS}$	1. Given (diagram)
2. $\overline{NR} \cong \overline{PS}$	2. Definition of Isosceles Trapezoid
3. $\angle NRS \cong \angle PSR$	3. Definition of Isosceles Trapezoid
4. $\overline{RS} \cong \overline{RS}$	4. Reflexive property
5. $\triangle NRS \cong \triangle PSR$	5. Side-Angle-Side (SAS) (2, 3, 4)
6. (diagonals) $\overline{PR} \cong \overline{NS}$	6. CPCTC

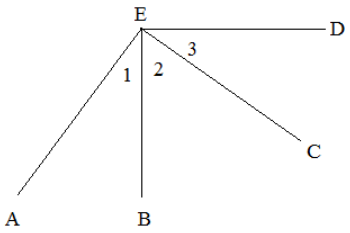
Geometry Proofs

SOLUTIONS

6) Given: $\overline{AE} \perp \overline{EC}$

$\overline{BE} \perp \overline{ED}$

Prove: $\angle 1 = \angle 3$



Proof 1: Using the Subtraction Property

Statements	Reasons
1) $\overline{AE} \perp \overline{EC}$	1) Given
2) $\overline{BE} \perp \overline{ED}$	2) Given
3) $\angle AEC$ is right angle	3) Definition of Perpendicular (Perpendicular lines form right angles)
4) $\angle BED$ is right angle	4) Definition of Perpendicular
5) $\angle AEC \cong \angle BED$	5) All right angles are congruent
6) $\angle 2 \cong \angle 2$	6) Reflexive property
7) $\angle 1 \cong \angle 3$	7) Subtraction property (If equal angles are subtracted from congruent angles, then the differences are congruent)

Proof 2: Using the Congruent Complements

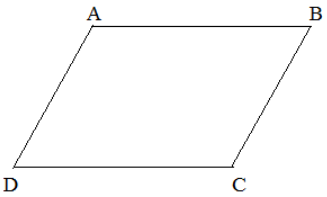
Statements	Reasons
1) $\overline{AE} \perp \overline{EC}$	1) Given
2) $\overline{BE} \perp \overline{ED}$	2) Given
3) $\angle AEC$ is right angle	3) Definition of Perpendicular (Perpendicular lines form right angles)
4) $\angle BED$ is right angle	4) Definition of Perpendicular
5) Angles 1 and 2 are complementary	5) Definition of complementary (Two angles that add up to 90 degrees i.e. form a right angle)
6) Angles 3 and 2 are complementary	6) Definition of Complementary
7) $\angle 1 \cong \angle 3$	7) Congruent Complements (Complements of the same angle are congruent)

7) Given: $\overline{AB} \parallel \overline{CD}$

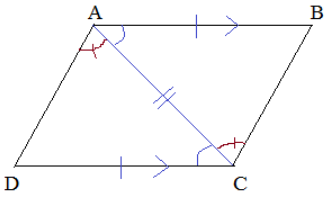
$\overline{AB} \cong \overline{CD}$

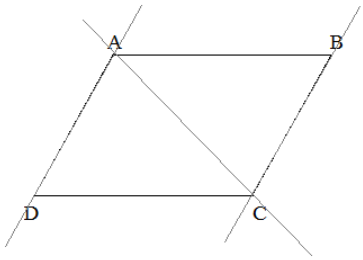
Prove: $\overline{AD} \parallel \overline{BC}$

(Hint: Use an auxilary line segment)



Statements	Reasons
1) $\overline{AB} = \overline{CD}$	1) Given
2) $\overline{AC}$ is a line segment	2) Auxilary line (2 points make a line)
3) $\overline{AB} \parallel \overline{CD}$	3) Given
4) $\angle BAC = \angle DCA$	4) If $\parallel$ lines cut by transversal, then alternate interior angles congruent
5) $\overline{AC} \cong \overline{AC}$	5) Reflexive Property
6) $\triangle BAC \cong \triangle DCA$	6) Side-Angle-Side (SAS) (1, 4, 5)
7) $\angle ACB = \angle CAD$	7) Corresponding Parts of Congruent Triangles are Congruent (CPCTC)
8) $\overline{AD} \parallel \overline{BC}$	8) If alternate interior angles are congruent, then lines are parallel



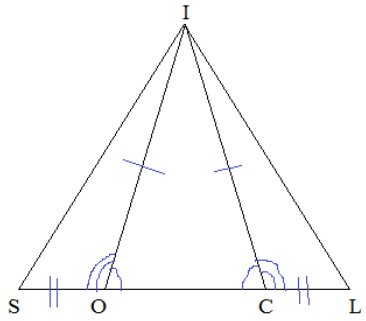


Geometry Proofs

8) Given: △ OIC is an isosceles triangle (with base OC)

$\overline{SO} \cong \overline{CL}$

Prove: △ ISL is an isosceles triangle



SOLUTIONS

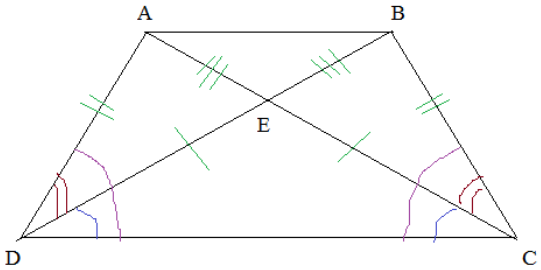
Statements	Reasons
1) OIC is an isosceles triangle with base $\overline{OC}$	1) Given
2) $\overline{IO} = \overline{IC}$	2) Definition of isosceles (2 congruent sides)
3) $\overline{SO} = \overline{CL}$	3) Given
4) $\angle IOC = \angle ICO$	4) If congruent sides (in triangle), then congruent angles.. (or, base angles of isosceles triangle are congruent)
5) $\angle IOS$ is supp. to $\angle IOC$ $\angle ICL$ is supp. to $\angle ICO$	5) If adjacent angles form a straight angle, then angles are supplementary
6) $\angle IOS = \angle ICL$	6) If 2 angles are supplementary to congruent angles, then the 2 angles are congruent
7) △ IOS = △ ICL	7) Side-Angle-Side (2, 6, 3)
8) $\angle S = \angle L$	8) CPCTC (corresponding parts of congruent triangles are congruent)
9) △ ISL is isosceles	9) If base angles of triangle are congruent, then triangle is isosceles

9) Given: $\overline{AD} = \overline{BC}$

△ DEC is isosceles with base DC

△ ABE is isosceles with base AB

Prove: $\angle ADC \cong \angle BCD$

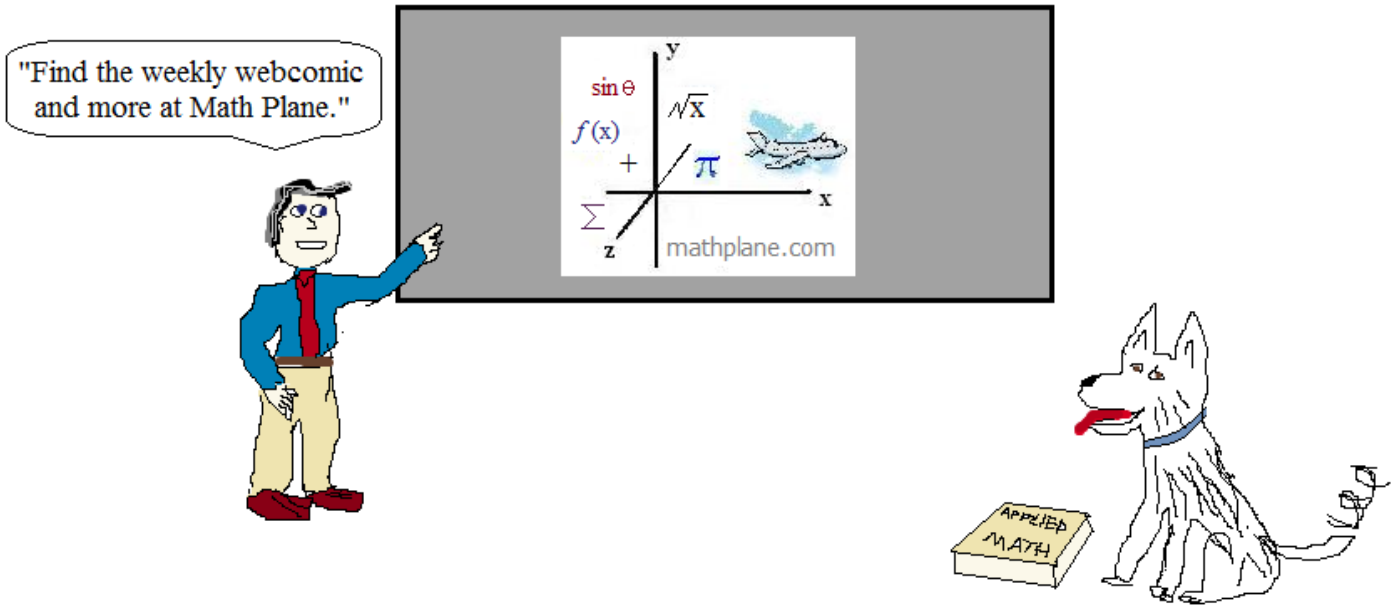


Statements	Reasons
1) $\overline{AD} = \overline{BC}$	1) Given
2) △DEC is isosceles	2) Given
3) $\angle EDC = \angle ECD$	3) Base angles of isoseces triangle are congruent
4) $\overline{DE} = \overline{EC}$	4) If congruent angles (in triangle), then congruent sides.. (or, use def. of isoseles triangle -- 2 congruent sides)
5) △ ABE is isosceles	5) Given
6) $\overline{AE} = \overline{BE}$	6) Definition of Isosceles (if isos., then at least 2 sides congruent)
7) △AED = △BEC	7) Side-Side-Side (6, 4, 1)
8) $\angle ADE = \angle BCE$	8) CPCTC (corresponding parts of congruent triangles are congruent)
9) $\angle ADC = \angle BCD$	9) Additional property (if 2 congruent angles are added to congruent angles, then the sums are congruent)

Thanks for visiting. (Hope it helped!)

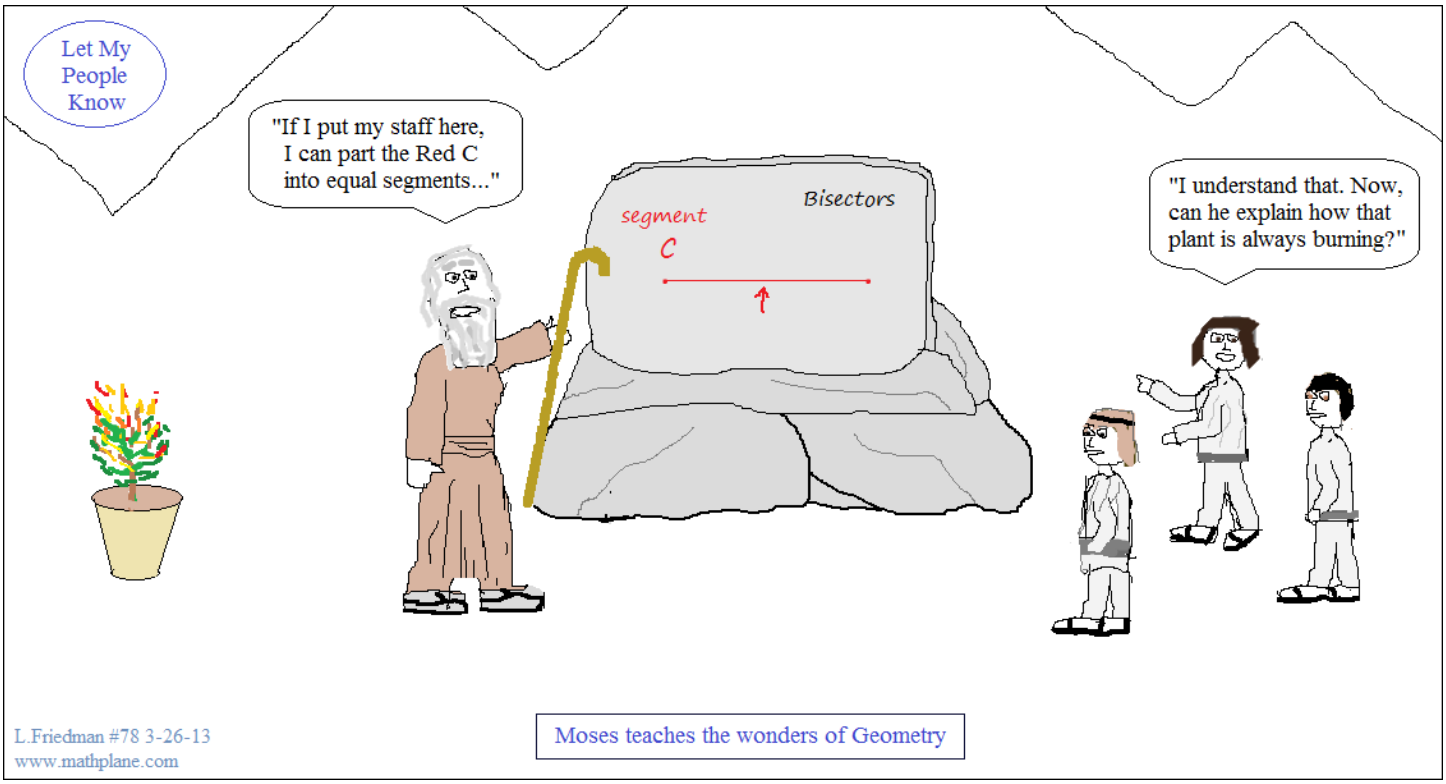
Find more proofs and geometry content at mathplane.com

If you have questions, suggestions, or requests, let us know.



Also, at Facebook, Google+, Pinterest, TES, and TeachersPayTeachers

And, Mathplane *Express* for mobile and tablets at Mathplane.ORG


Let My People Know
"If I put my staff here, I can part the Red C into equal segments..."
segment
C
Bisectors
"I understand that. Now, can he explain how that plant is always burning?"
L.Friedman #78 3-26-13
www.mathplane.com
Moses teaches the wonders of Geometry