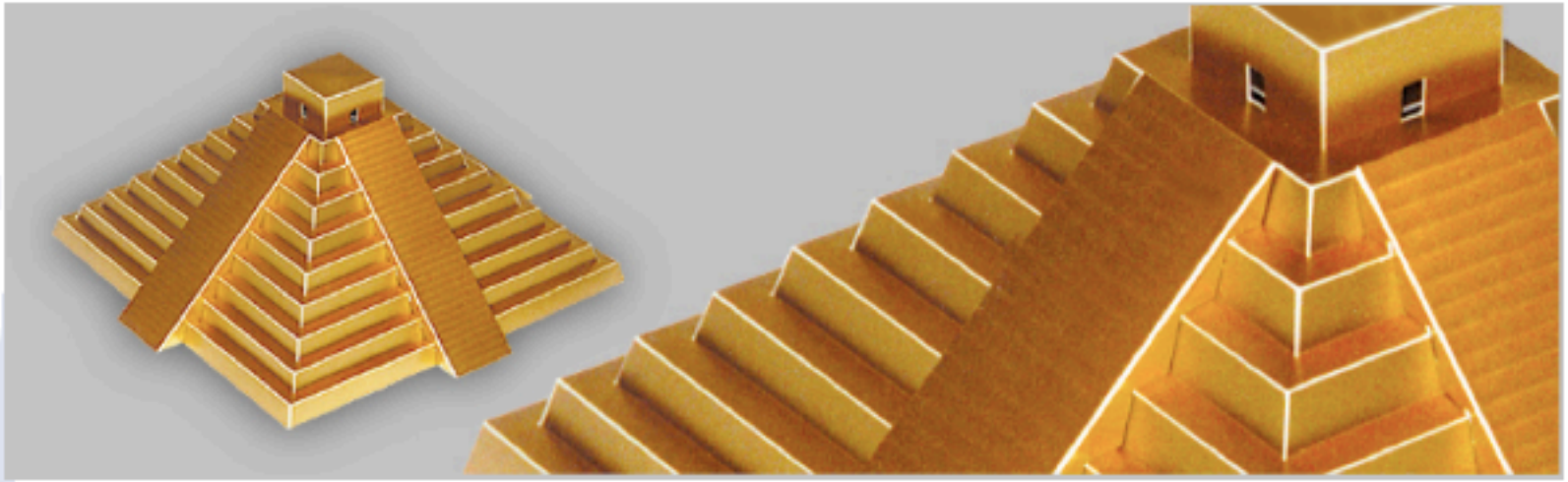
EL CASTILLO - ARCHITECTURAL 3-D MODEL BUILDING PROJECT



Instructor: Suzanne Delahanty – Cathedral City High School CAD Drafting, Design and Architecture Classes 2012

EL CASTILLO 3D MODEL UNIT

Instructor: Suzanne Delahanty **Grades: 9-12 CTE - Engineering and Design**
Career Explorations in Design CCHS 9-25-12

Content areas addressed throughout this unit: Visual arts, 3D design, architecture, mechanical drafting, reading and understanding scale, ancient history, construction, earth science, geometry, math and multiculturalism.

Unit Objectives:

- To understand and apply the proper procedure and model building skills needed to accurately build a scale 3D model of a iconic historic structure. (drafting skills, use of templates, glueing, cutting, scoring, etc)
- To understand and develop student's geometry, math and model making vocabulary and techniques, such as drafting, measuring, cutting, scoring, glueing, craftsmanship, research and presentation skills.
- Students will be introduced to a range of new drafting equipment: drafting pencil leads, t-squares, a drafting eraser, drafting brush & eraser shield, protractors, scales, rulers, model knifes, cutting boards, model glue etc..
- To apply basic drafting skills as applied to a model, such as: reading a technical drawing, mechanical drawing, measuring using a ruler and protractor, converting metric units to feet and inches, apply essential math skills such as adding & subtracting fractions, division, calculating basic ratios & averages, measuring angles, length and the depth of an object.
- To develop teamwork, work ethic, personal responsibility, peer evaluation skills, proper care of tools and work area cleanliness, organizational skills, note-taking, management skills, accountability and patience.
- To learn and apply proper use and safety of all tools, develop modeling skills and craftsmanship, and adapt strong equipment safety habits in the classroom at all times.

CTE Primary Standards Addressed For Engineering & Architectural Design Pathways - Grades 9-12th

1.1 Mathematics Standards 1.2; 12.0 ; 6.0; **4.0 Fine-Art Standards:** 1,1; 2.3**;** 2.2 **Writing Standards:** 1.3, **9.0 Leadership & Teamwork,** 5.0 **Problem Solving** and **Critical Thinking Skills**, 5.1-5.3.; 6.0 **Health & Safety** 6.1.6.2; 7.0 **Responsibility and Flexibility**; 10.0 **Technical Knowledge & Teamwork** 10.1-10.8, **Architectural & Structural Engineering** A1.0 - A1.2

Projects Materials:

Cardboard paper stock (recycled file folders), glue sticks, cutting boards, Exacto modeling knifes and extra blades, model template pieces, white glue, binder clips, drafting pencils, erasers, eraser shields, model paint (gold metallic-textured), paint brushes, t-squares, calculators, protractors, drafting brushes, glue dabbers, glue bottles & containers, scissors, metal edge rulers, plastic rulers, triangles, storage containers and storage envelopes.

Technology Requirement:

Web access for students to view related videos, complete the project's research component and to access the tutorial practice games & quizzes for measuring fractions, using a protractor and gauging polar angles#0

Handouts:

Scale plan and elevation views of El Castillo, measurement and angle worksheets, The “blown-up Inch”, the Polar angles reference sheet, notepaper & notebooks. Safety Quiz Handouts.

Powerpoints: One about Safety, the other about the proper sequence and step on making our models.

Time Required:

This introductory unit has 8-10 scaffolded lessons which will take approximately 4 weeks to complete.(1hr per day)

El Castillo - Unit – DAILY Sequence: (Approx 4 weeks)

1. Introduction & discussion to first part of the design challenge and how it relates & prepares them to future projects:

2. Students first research the model's history and cultural significance by performing a fact hunt on the web.

3. The class will discuss their findings and we will watch two short videos about the monument 's history and legends in one period of class. Recommended video: http://youtu.be/q0kOyGZxKh4

4. An introduction to modeling tools, proper use and safety is provided, with demonstrations for each group.

5. Students are quizzed on good safety habits and turn in their personal 3-ring binders for labeling & storage.

6. Students complete a "personal-inventory", listing their areas of strengths and areas they may need improvement in regards to working on a model project as a team member. Students will self-evaluate and write down their 3 best team attributes on suggested criteria such as math skills, artistic ability, communication skills, positive attitude, work ethic, team work skills, etc.

7. Students are broken into equal sized teams. (ESL students will be teamed with teams that are bilingual.)

8. Students share their personal strengths with their team members to help assist teams in best assigning various tasks to complete the model.

9. Team leaders and assistant leaders and workers are volunteered or are voted for by fellow team members.

10. Student Teams receive their model building kits, containing all equipment need to build their model. Team leaders help distribute work fairly to their team members, delegating such tasks as measuring, drawing, cutting, checking, organizing, labeling, cleaning, note-taking, etc.

11. Each item is labeled by team members by part #, team # and period.

12. The plan (top) and elevation (side) views of the model are distributed to all students. 13. Student are instructed that they will be shown how to use a protractor to properly measure three key angles of the stepped pyramid structure.(the side 45 degree angle, the angle of the nine major steps, and the angle of the base of the lower temple. Students may work in teams to assist each other in finding these answers.

13. Students are also introduced to the concept of "scale" and the scale of the drawings (1:100) and upcoming models are discussed. I introduce and demo the "calipers" tool to accurately estimate measurements.

14. I demonstrate and discuss proper protractor use and introduce new geometry vocabulary related to angles: (right angle, perpendicular, vertical, horizontal, obtuse, acute, vertex, degrees, etc.) Students are able to practice the use of their protractors, both on paper and by using a fun online protractor "find the angle" game that checks their answers as they play the game. Students will practice game for 1 full period. 15. Students will then complete two worksheets where they must correctly identify the angles shown. Students handouts are checked for understanding and graded, and they must continue on these practice sheets until they earn at least 80% accuracy.

15. This lesson introduces core vocabulary as well as allows students to refresh their understanding on protractors and measuring angles.

16. I will demonstrate and discuss proper protractor use and introduce new geometry vocabulary related to angles: (right angle, perpendicular, vertical, horizontal, obtuse, acute, vertex, degrees, etc.) Students are able to practice the use of their protractors, both on paper and by using a fun online protractor "find the angle" game that checks their answers as they play the game. Students will practice game for 1 full period.

17. Students will then complete two worksheets where they must correctly identify the angles shown. Students handouts are checked for understanding and graded, and they must continue on these practice sheets until they earn at least 80% accuracy.

18. I will demonstrate and discuss proper ruler use and fractional measurement using the ruler. The inch is discussed and fractions within an inch. Students are able to practice the use of their rulers, both on paper and

by using a fun online ruler "The ruler Game" game that checks their answers as they play the game. Students will practice game for 1 full period.

19. Students will then complete two worksheets where they must correctly identify the fractional measurements shown. Students handouts are checked for understanding and graded, and they must continue on these practice sheets until they earn at least 80% accuracy.

20. Demonstrate the specific methods, use and care of new or unique tools, techniques, etc. needed to assist students to prepare for this lesson. Review of safety issues, time-wasting and money-wasting concerns. (Potential issues, breakage, loss of materials, overuse, etc..)

21. Instructor & T'A.'s will periodically check on individual team progress and perform refresher demos of proper cutting habits with each team and make sure students are delegating tasks appropriately to all team members.

22. Students will watch a Powerpoint on the correct sequence and steps needed to construct our models. Questions and answers are provided afterward.

23. Students begin the model by receiving 14 template pieces to separate/cut out, and then glue down to cardboard stock. Demo on glueing and cutting and avoiding wasted material is given to each team.

24. Students then begin by cutting out the "perimeter/outside" edges of the 14 model pieces. (The vocabulary term "perimeter" is first explained to students).

25. Team then label all their parts with part numbers, team# & period. Students are instructed not to use scissors to cut the perimeter- They are instructed to use their Exacto knife with a metal straight-edge, and given individual team cutting demonstrations so they can practice on some scraps before cutting their pieces. Students must check for dull blades, and will come to me for a fresh blade if they need on. Students will be shown how to safely change an Exacto blade, and will demonstrate their ability to do this themselves at my desk where I keep all the Exacto cutting equipment.

26. I will check all the teams cut parts for accuracy, and make sure they redo any part(s) that are cut too small or inaccurately. Students will be shown how to use the "t-square" and ruler to locate and correct these errors as needed. Students will also learn to reuse any inaccurate parts for smaller pieces of their models to avoid wasting materials.

27. After checking for any issues and accuracy at each group, I will demonstrate and discuss the process of drawing and completing their "half-cutting" aka "scoring" lines. I will demonstrate how to properly practice scoring the board on some scrap material and how to test the scored pieces for strength.

28. After most of each team's parts are cut-out and scored, I will provide a demonstration on how to glue/assemble the models neatly and accurately. Students will practice on a sample piece and practice applying the glue correctly and sparingly so it does not show at all on the exterior of the model. The use of model pins and small triangles will be demonstrated and distributed before glueing begins, so students can see a demonstration of how to align and "square" all the steps at a "right-angle" while drying by inserting model pins carefully before the glue dries permanently.

29. At this time, some of the students in each team that like to sketch can develop rough draft designs of how they would like to display their team's models.

30. After the models are dry and glued properly, students will select a landscape design and will gather additional components (found objects such as rocks, sand,twigs, etc. are ideal) to create a display box for their team's model. Student will receive flat cardboard or a cardboard box base and create a landscape design by adding ground cover, lighting elements, backdrop-photos, additional texture, paint or other material applied to the exterior of their 3-D model to enhance the display. Students will compete to prepare their models for our school's window display box and for team contest entries.

Extension: Students with extra time to learn some basic CAD operations, may also receive some instruction so they may create a 2-D working drawing or a 3-D model of their pyramid structure.

Follow-up of Lesson: Display the students' models in the room, assigning each a number. Have the students critique and analyze each other's works and their own work. For each work, ask students to make three positive statements and if applicable, two constructive criticisms. Students will complete a 5 question online survey and vote on the following: Most sucessful model Overall, Most Creative Overall, Most Accurate Overall, Best Craftmanship Overall, & Least Successful Overall. Results will be t and may be viewedallied and displayedusing a bar graph at our next class. The online survey was created using Surveymonkey.com and may be viewed at:

Using only Google as a starting point, all students will look up each question pertaining to our mystery structure. The students answering the most questions first, will become the first team leaders for our upcoming group model project. They may also earn a special prize or "advantage".

The NEW 7th wonder of the World!!!

El Castillo- Treasure Hunt Assignment- Class Research Questions:

What is this structure called? (El Castillo)

What does the name "El Castillo" mean in Spanish?

How old is it?

What "god" was it a temple for?

Where is it located? (Present Country & city)

Who built this?

What type of building (type) is this called?

How big is it? Width, height, depth? How tall is each step?

Converting Metric into English Feet & inches, How big is it in metric???

What other name(s) does it go by?
What ancient city & civilization was this structure built for?

What form was the mystical creature known as

What optical illusions (using shadows), is this temple said to create during certain times of day?

What was later found hidden inside the temple, after the Mexican gov. did excavations in 1930:

How many steps on El Castillo are there in total?

Why is the number very significant?

What is the Haab?

What system do we use today instead of the Haab, and is it more or less accurate than the Haab?

The Legend of Quetzalcoatl: A Myth of Mexico

The legend of Quetzalcoatl is well known to Mexican children.
It is the origin of how the plumed serpent god, originally from the Toltec region of central Mexico, came to be known to the Maya.

It tells of a man who was revered as a great mystical leader much in the same ilk as Britain's King Arthur. Though there is some evidence to suggest that Quetzalcoatl was actually a living man that ruled the Toltecs. He first appeared to the people of Teotehuican near current day Mexico City, and taught the Toltecs all of their arts and science and became their ruler and led thir city to great prosperity and importance. He eventually fell in disgrace for violating his own laws and set himself on fire. He rose in flames to become the planet Venus and vowed to return one day to his people.

After this event, all priests in the Toltec cult were given the title of Quetzalcoatl. One such priest by the name of **Ce Acatl Topiltzin** rose to power and proclaimed himself as the second coming of Quetzalcoatl returning as promised, and in 968 AD became king of the Toltec people once again. He reigned for decades and built the Toltec capital of Tula. Eventually he was disposed of by his enemies and this time sailed east on a raft of snakes, vowing, like the first Quetzalcoatl, to return one day to rule his people. It is this snake reference that has caused the artwork depicting Quetzalcoatl as emerging, or being "reborn" as he emerges from the mouth of a serpent.

This raft of snakes carried Quetzalcoatl east and south across the gulf of Mexico to a Yucatan beach. By coincidence, the Mayan people were, at this time, expecting the return of their plumed serpent god Kukulkan. Kukulkan, in the same fashion as Quetzalcoatl, promised to return to rule his people after being forced to leave, and he was greeted as the returning Kukulkan by those that discovered him. **Topiltzin-Quetzalcoatl-Kukulkan** became the king of the Itza Maya and rebuilt the ancient capital of Chichen Itza. Massive stone sculptures reflecting his image as the plumed serpent god were built in his honor and can be seen in a large portion of their artwork.

His enemies eventually caught up with him again and he fled to **Uxmal** where he committed suicide and, according to legend, was buried under the **Temple of the Dwarf** where he remains to this day, though no burial plot has yet been discovered.

Students will view 2-3 very high quality videos about El Castillo: This Spanish lang. video is english subtitled but tells an outstanding story about the temple's myths, and displays the legendary Equinox at Chichen Itza:
http://www.youtube.com/watch?v=q0kOyGZxKh4&feature=BFa&list=LLH2WHmfrneNuSINWjLNH-og
and we will view this monument using Google Earth:
as well as viewing and discussing the amazing 3-Point Cloud model presented on http://archive.Cyark.org:

http://archive.cyark.org/3d-point-cloud-of-el-castillo-created-from-laser-scan-data-3dviewer

(Without Cyark.org's amazing work on preserving El Castillo's history through such technological feats as creating scaled measurements of this temple, much of this creative lesson plan would not have been possible.)

Using only Google as a starting point, All students will look up each question pertaining to our mystery structure. The students answering the most questions first, will become the first team leaders for our upcoming group model project. They may also earn a special prize or "advantage". (TBA)

El Castillo- Treasure Hunt Assignment:
Class Team Research Questions:(Shown below with Answers and helpful web links)

What is this structure called? (El Castillo)

How old is it? Built somewhere between the 9th and 12th centuries.

What "god" was it a temple for? temple to the god Kukulkan

Where is it located? (Present Country & city) Mexican state of Yucatán.

Who built this? Built by the pre-Columbian Maya civilization

What type of building (type) is this called? Mesoamerican step-pyramid (aka ziggerat)

What does the name "El Castillo" mean in Spanish? (Spanish for "castle")

How big is it? The structure is 24 m high, plus an additional 6 m for the temple. The square base measures 55.3 m across.

Converting Metric into English Feet & inches, How big is it? 90 feet tall

What other name(s) does it go by? also known as the **Temple of Kukulkan, or the "Pyramid of Quetzalcoatl" (the name for Kukulkan by the Toltecs)**

What ancient city & civilization was this structure built for? The ancient Mayans

What form was the mystical creature known as Kukulkan? A Feathered Serpent

What optical illusions (using shadows), is this temple said to create during certain times of day?
During the spring and autumn equinoxes, the late afternoon sun strikes off the northwest corner of the pyramid and casts a series of triangular shadows against the northwest balustrade, which some believe creates the illusion of a feathered serpent "crawling" down the pyramid.

What was later found hidden inside the temple, after the Mexican gov. did excavations in 1930:
They found another temple buried below the current one. Inside the temple chamber is a Chac Mool statue and a throne in the shape of jaguar, painted red with spots made of inlaid jade.

How many steps on El Castillo are there in total?
Each of the pyramid's four sides has 91 steps which, when added together and including the temple platform on top as the final 'step', produces a total of 365 steps.

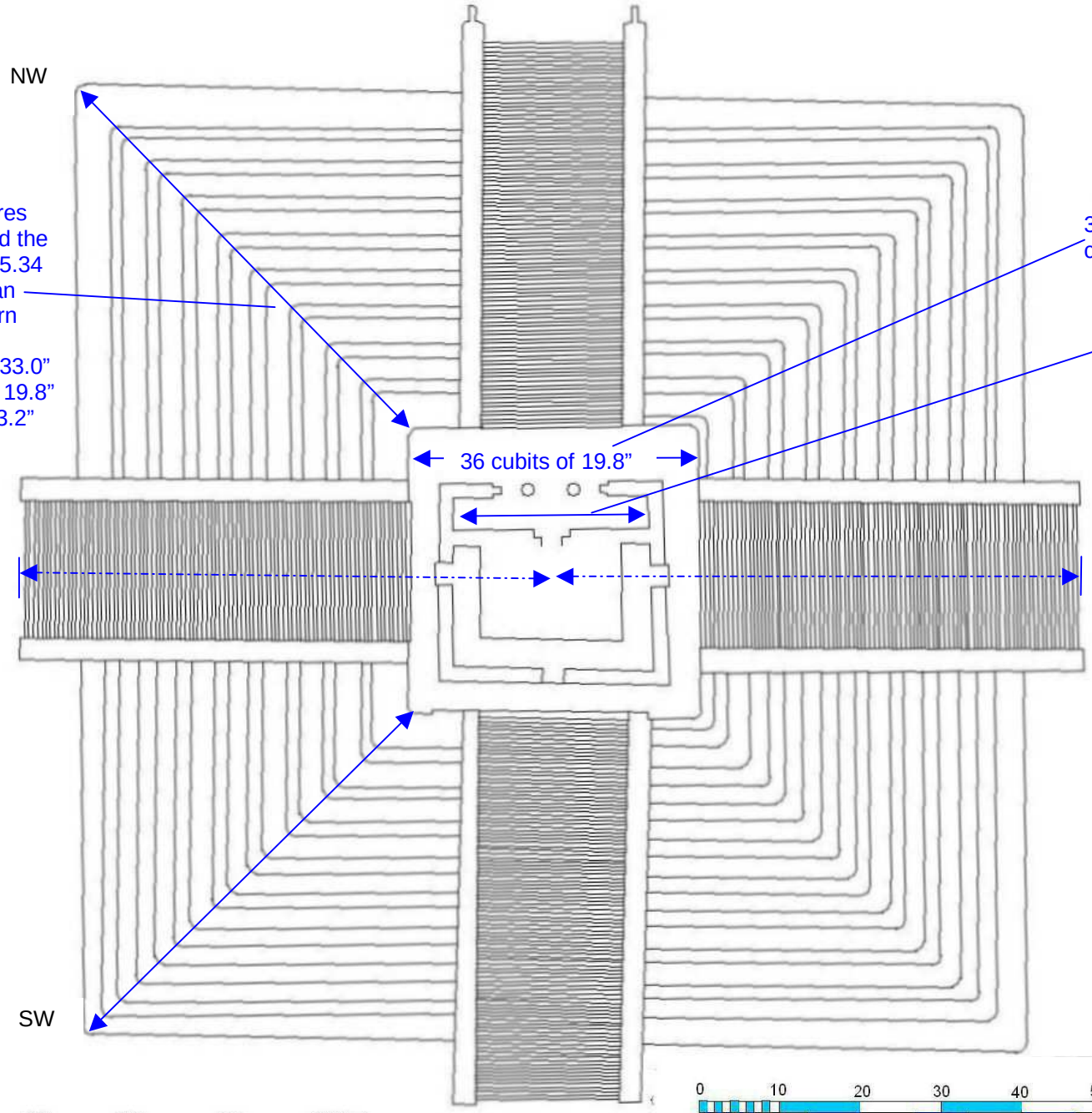
Why is the number (365) very significant? (This # is equal to the number of days of the *Haab'*)

What is the Haab?
The **Haab'** is part of the Maya calendric system. It was the Maya version of the 365-day calendar known to many of the pre-Columbian cultures of Mesoamerica.

What calendar system do we use use today, and is it more or less accurate than the Haab calendar and why?

There are at least two inscriptions with periods of 1508 Haab from Palenque, which equates to 1507 tropical years, or 550420 days. This gives the Maya approximation to the tropical year at being 365.2422 days, being more accurate than the Gregorian Year currently used across the world today.

El Castillo plan
Suggested
intended measurements
as scaled from drawing



The NW diagonal measures 36.68 Sumerian yards and the SW diagonal measures 35.34 Sumerian yards making an average of the two western diagonals of
36.00 Sumerian yards of 33.0”
60.00 Sumerian cubits of 19.8”
90.00 Sumerian feet of 13.2”
in plan view

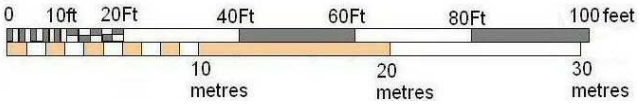
36 Sumerian cubits of 19.8”

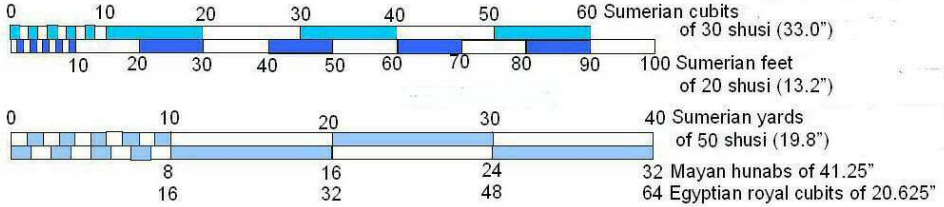
36 Sumerian feet of 13.2”

100 Sumerian feet of 13.2”

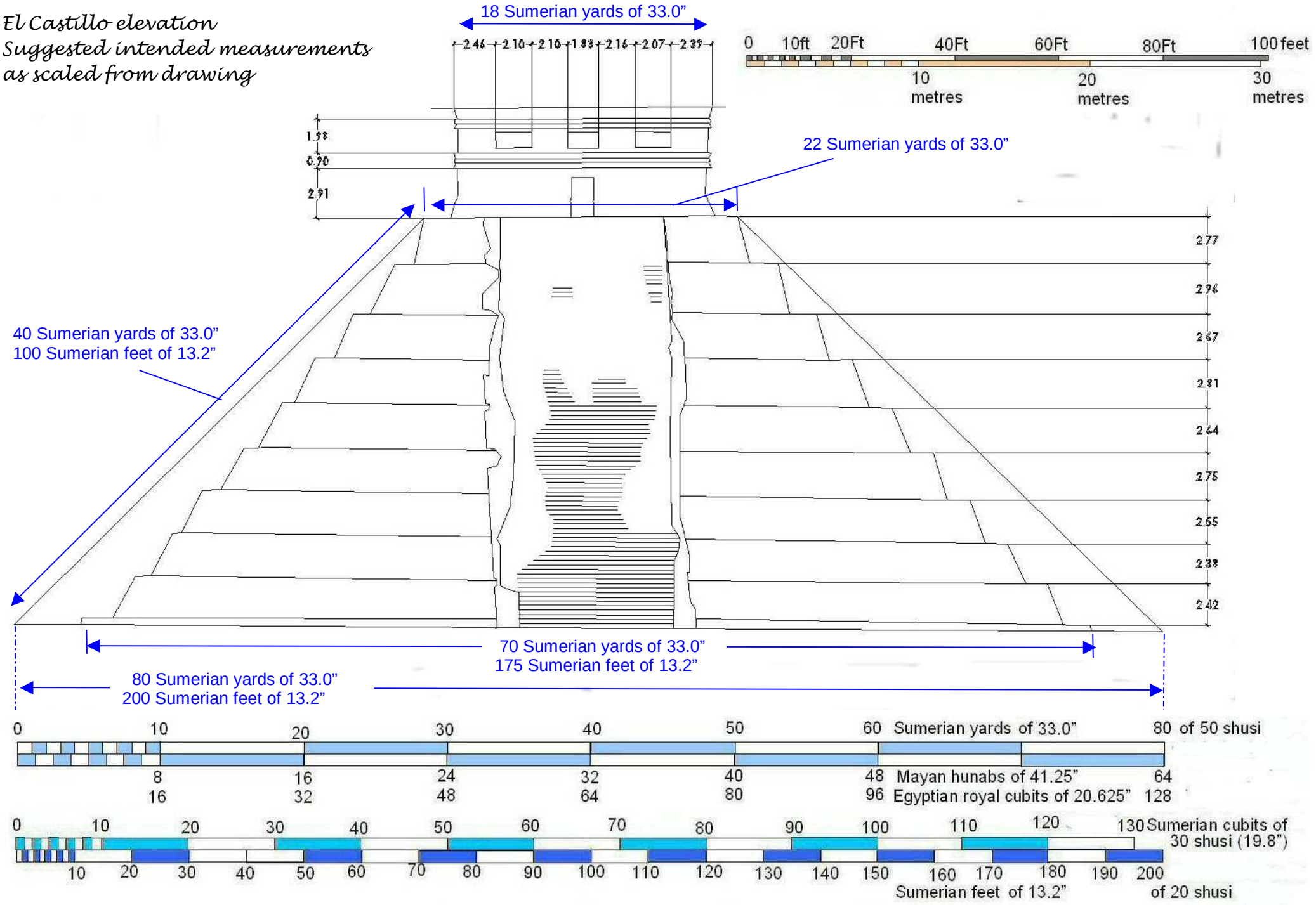
100 Sumerian feet of 13.2”

The half width of the pyramid is the same length as the sloping diagonal of the stairs on the preceding drawing, both 100 Sumerian feet





El Castillo elevation
Suggested intended measurements
as scaled from drawing



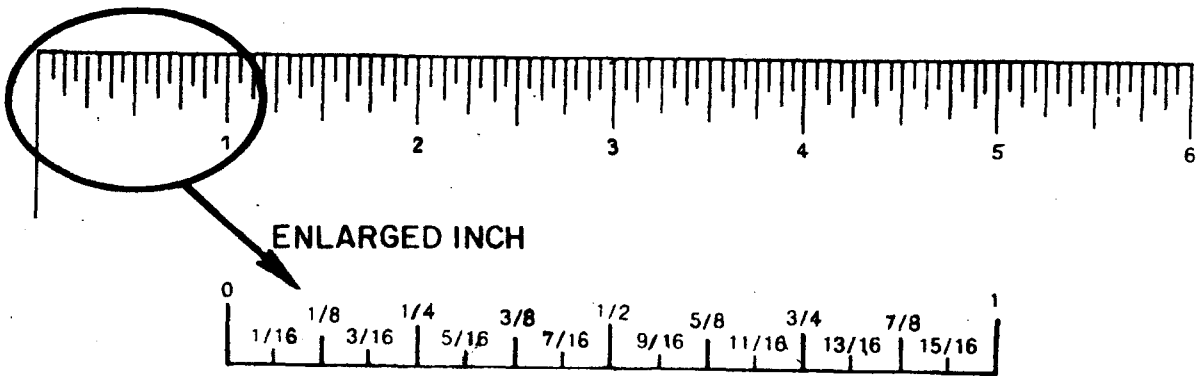
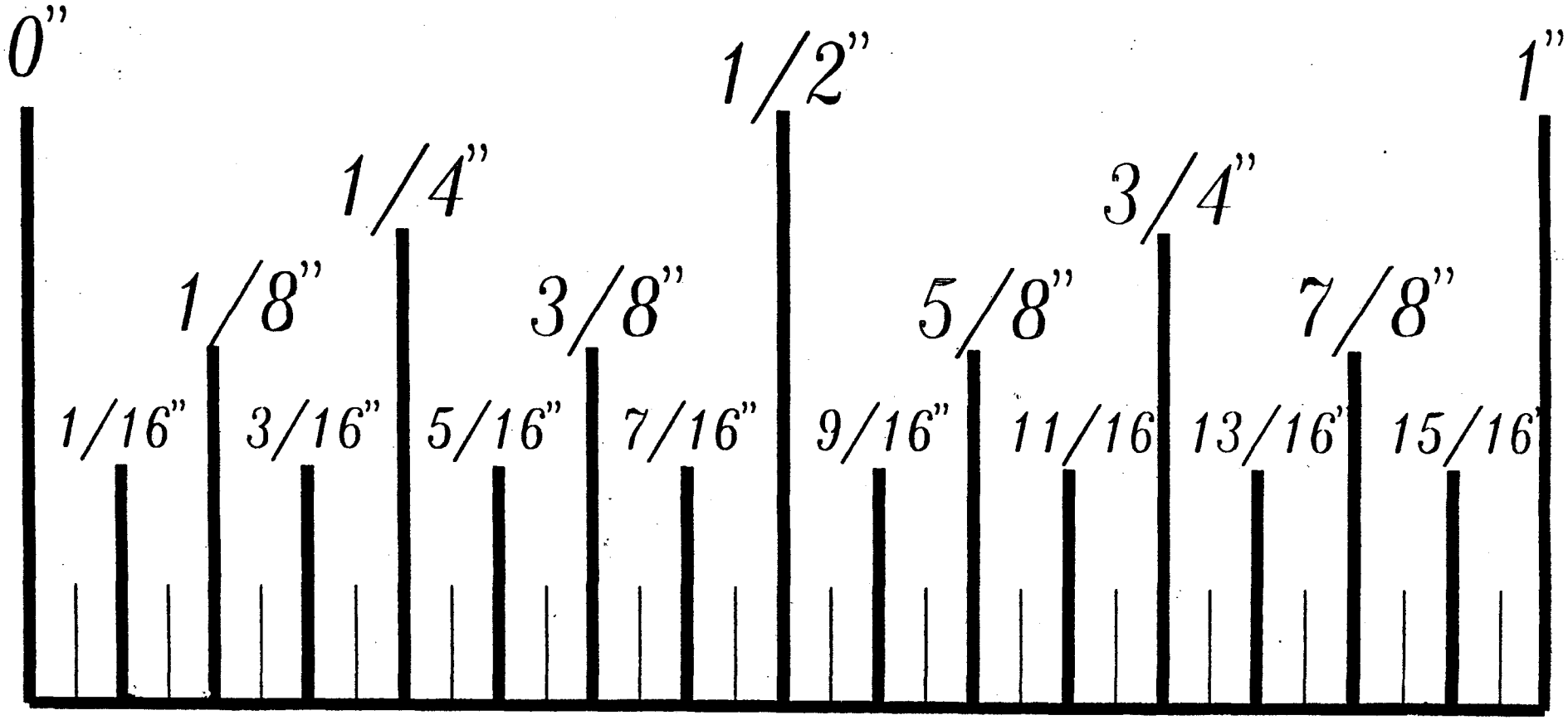


Fig. 3-16. The U.S. customary ruler is divided into 1/16, 1/8, 1/4, and 1/2 inch divisions.

SCALE HANDOUT



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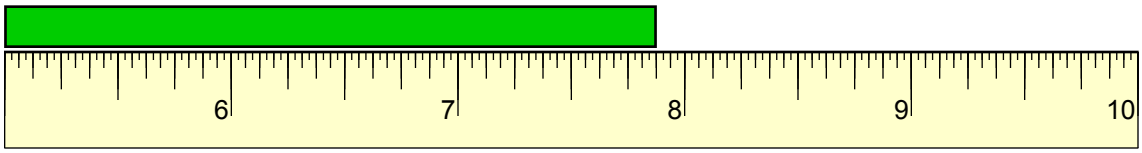
Reading a Tape Measure

How many Inches ?



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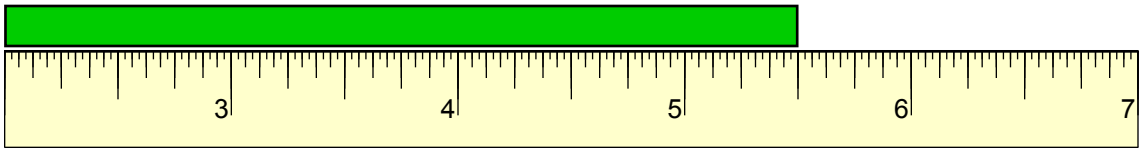

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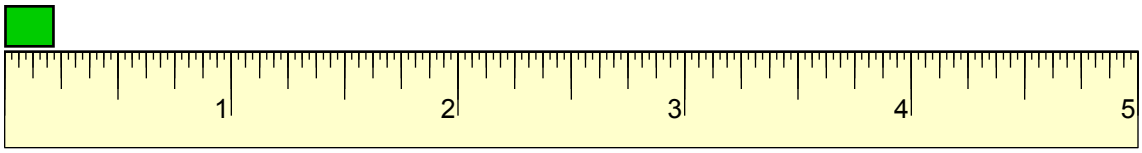

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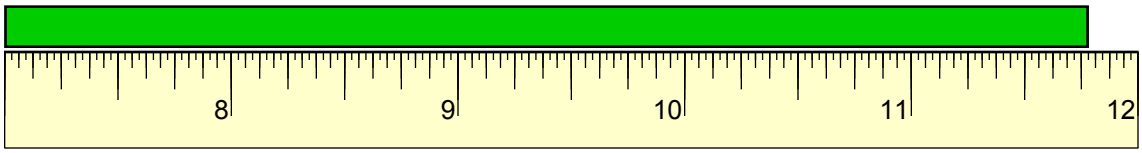

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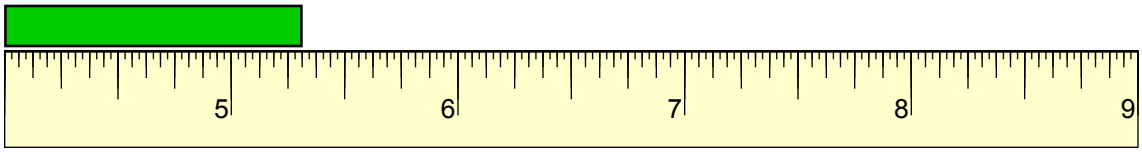

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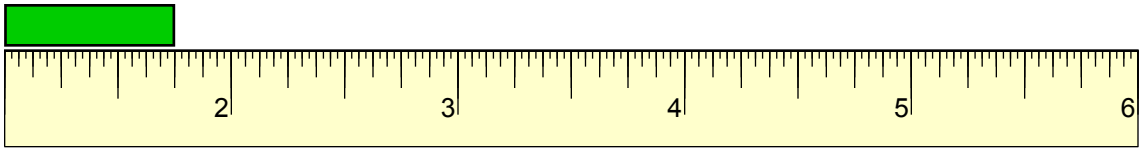

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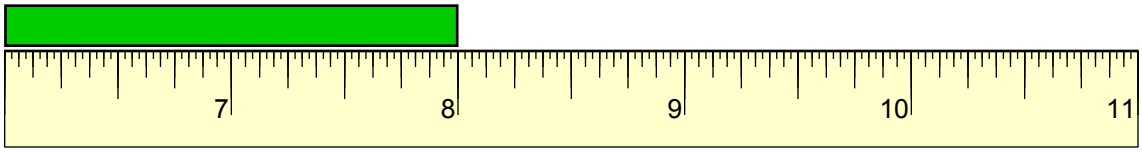

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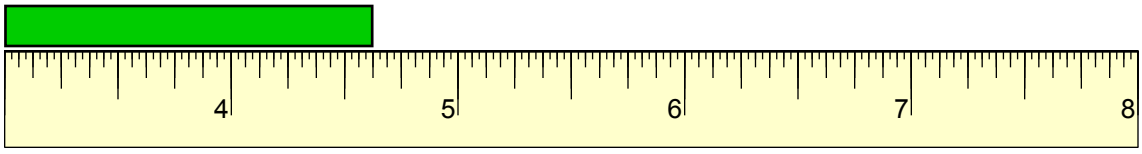

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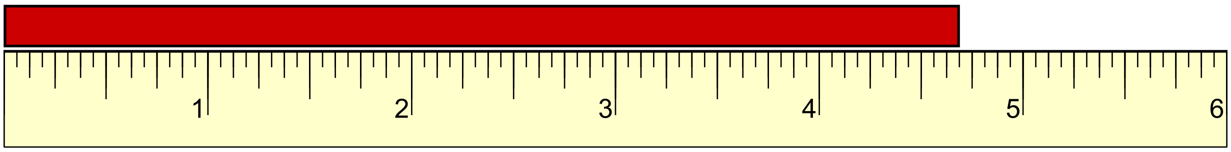
Measuring in Inches

How many Inches ?



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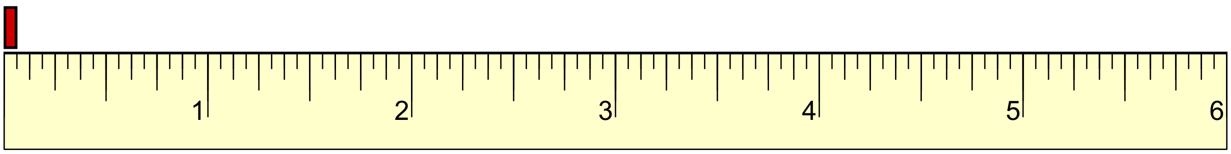

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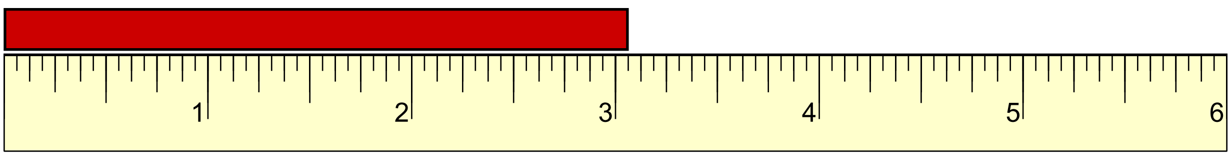

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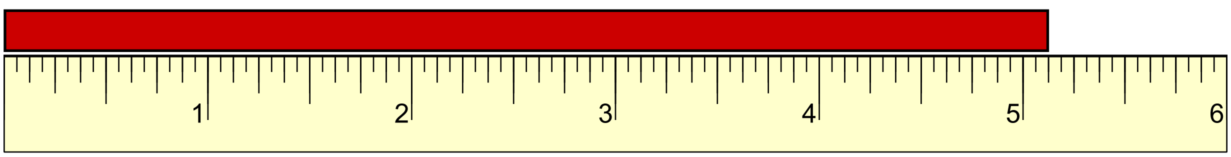

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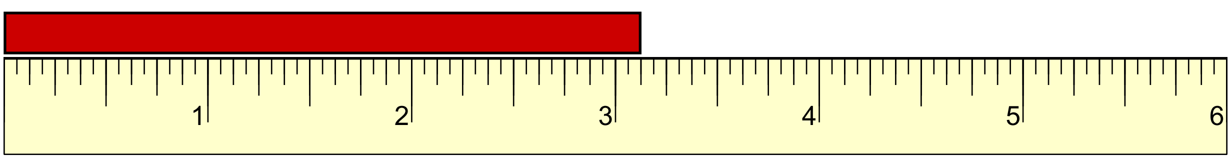

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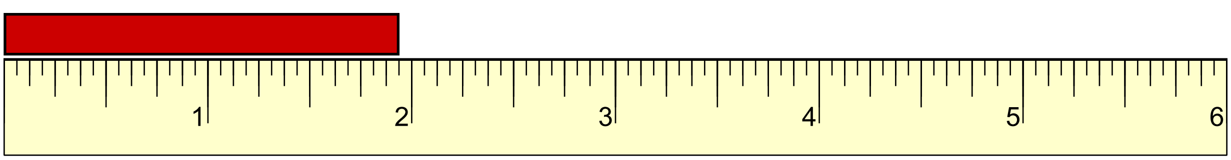

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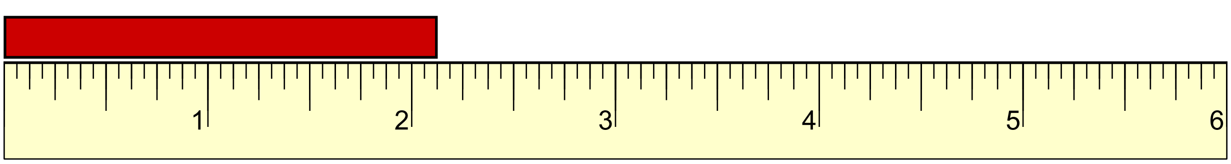

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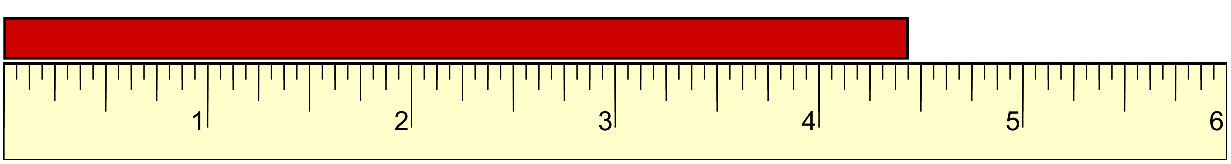

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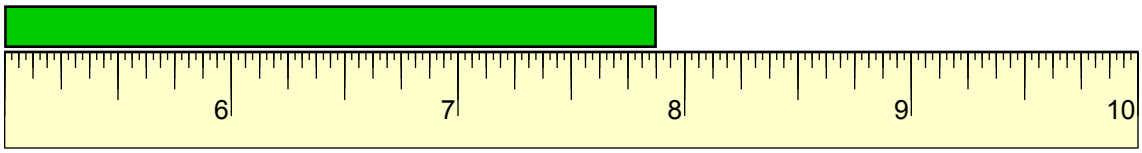
Reading a Tape Measure

How many Inches ?



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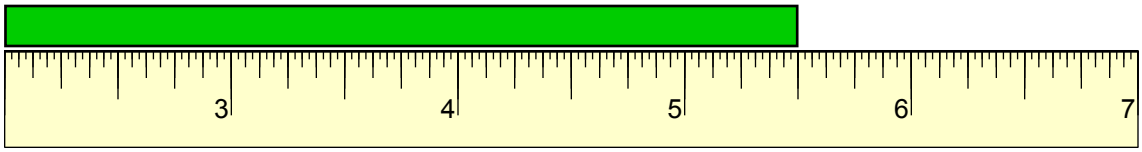
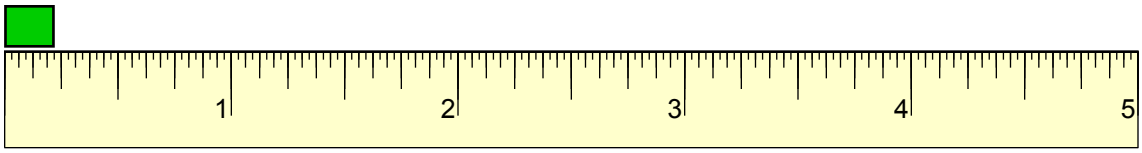
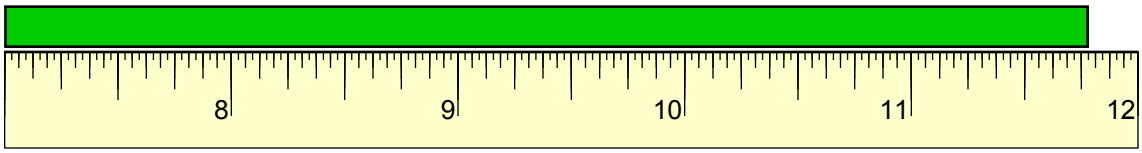


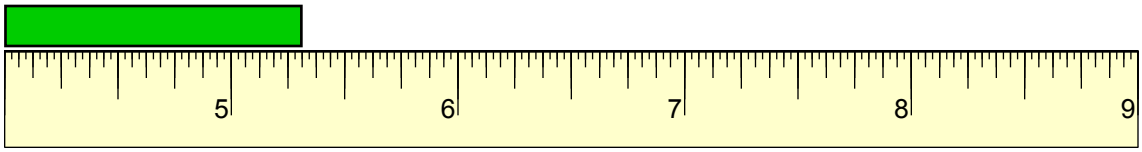
$5\frac{1}{2}$ in



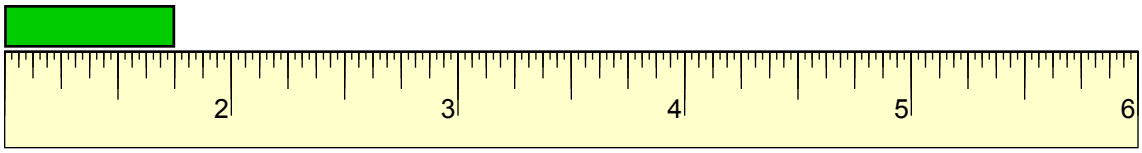
$\frac{7}{32}$ in



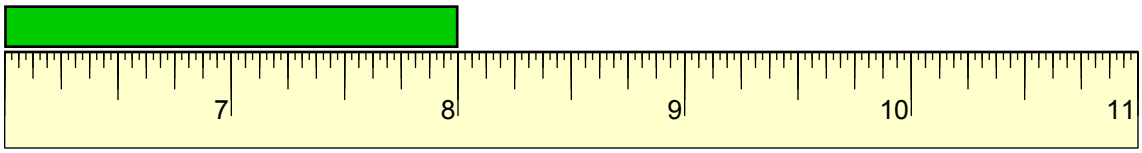
$11\frac{25}{32}$ in



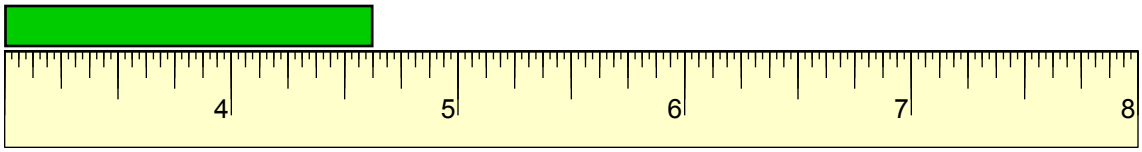
$5\frac{5}{16}$ in



$1\frac{3}{4}$ in



8 in



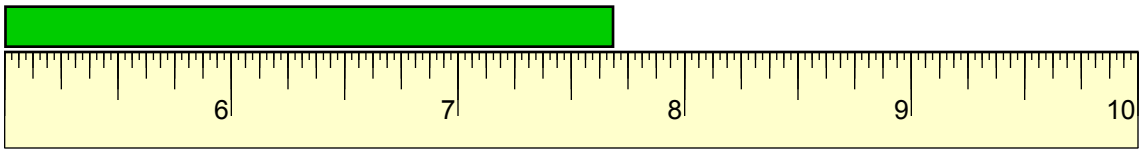
$4\frac{5}{8}$ in

Name : _____ Score : _____

Period : _____ Date : _____

Reading a Tape Measure

How many Inches ?



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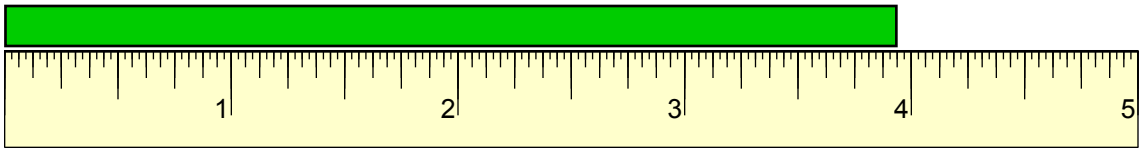

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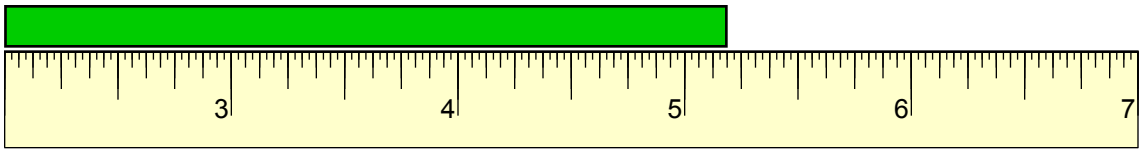

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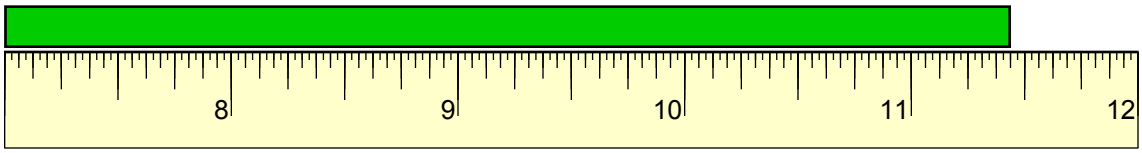

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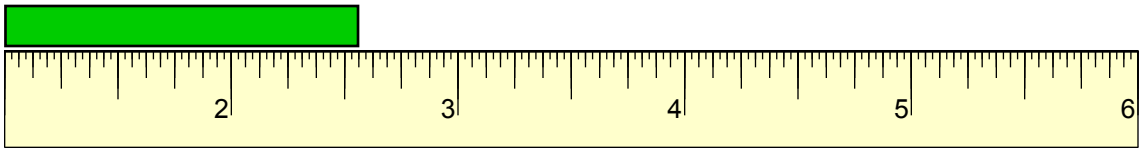

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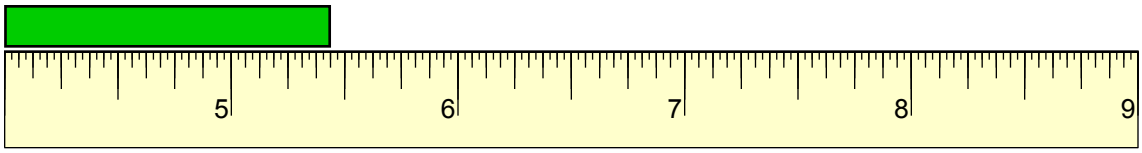

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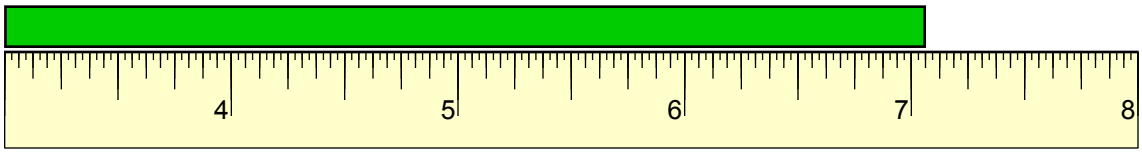

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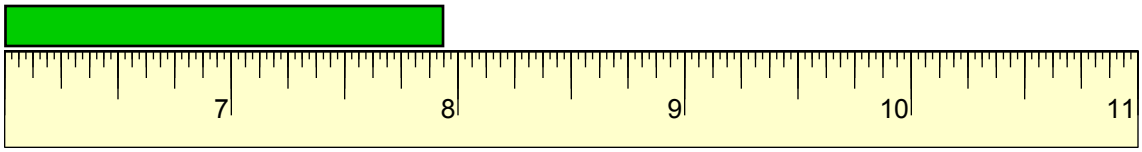

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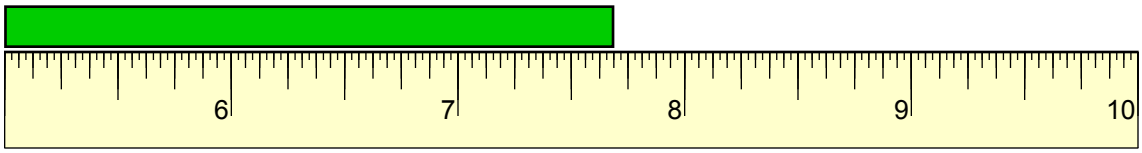
Name : _____ Score : _____

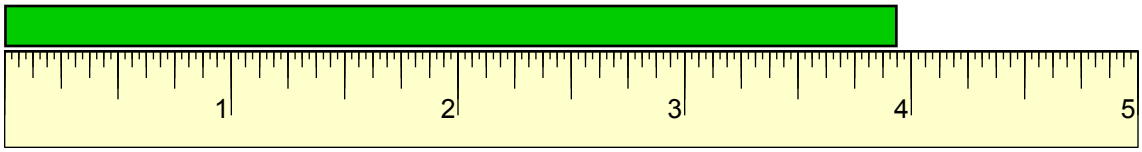
Teacher : _____ Date : _____

Reading a Tape Measure

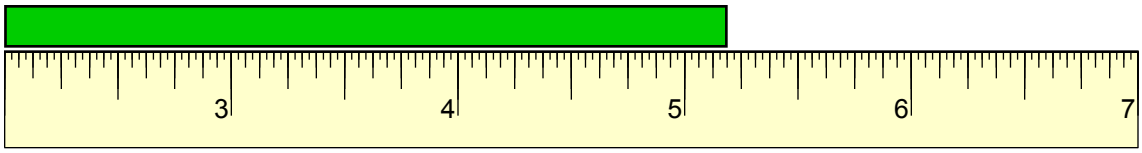
How many Inches ?



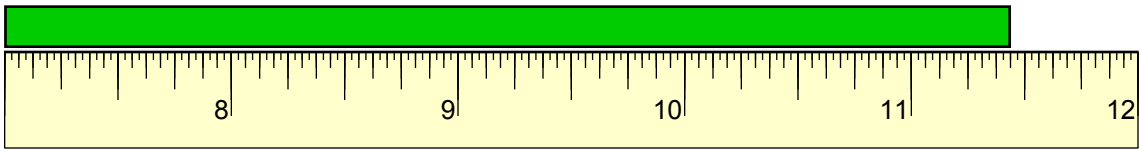
$7\frac{11}{16}$ in



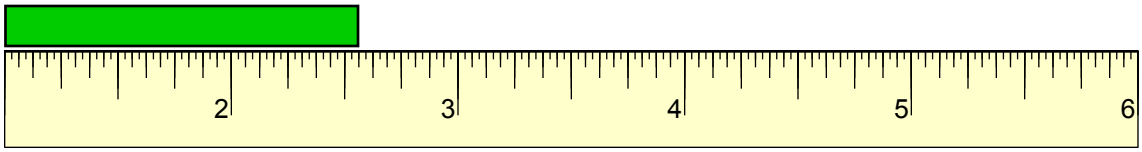
$3\frac{15}{16}$ in



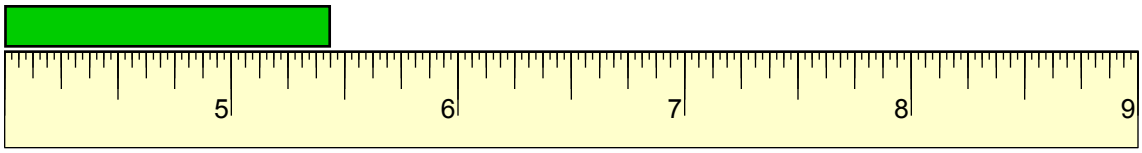
$5\frac{3}{16}$ in



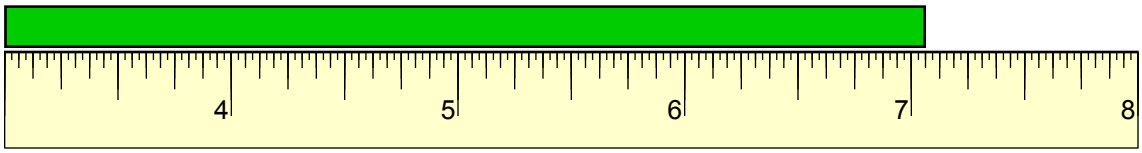
$11\frac{7}{16}$ in



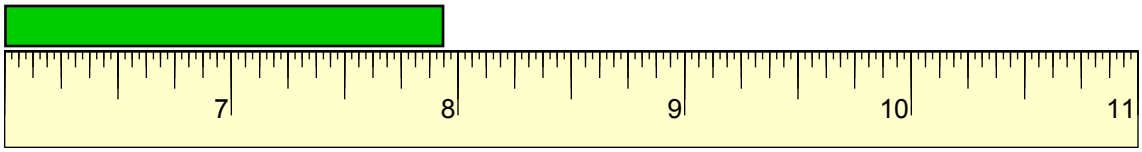
$2\frac{9}{16}$ in



$5\frac{7}{16}$ in



$7\frac{1}{16}$ in



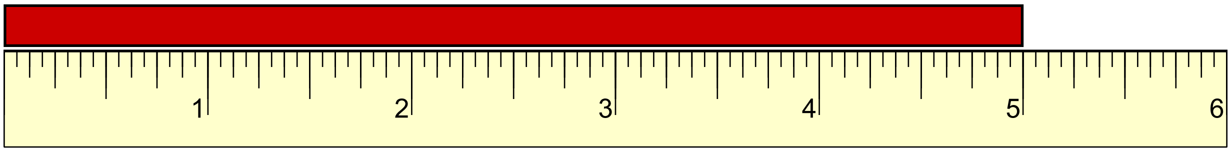
$7\frac{15}{16}$ in

Name : ______________________ Score : __________

Period : ______________________ Date : __________

Measuring in Inches

How many Inches ?



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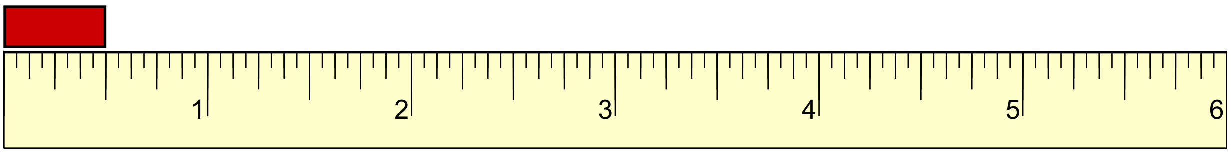

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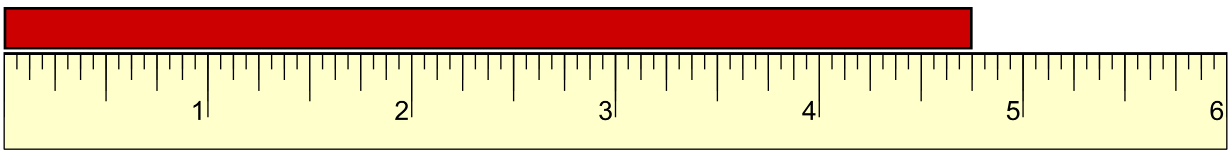

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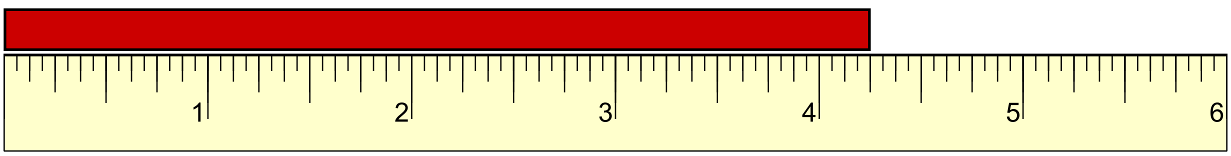

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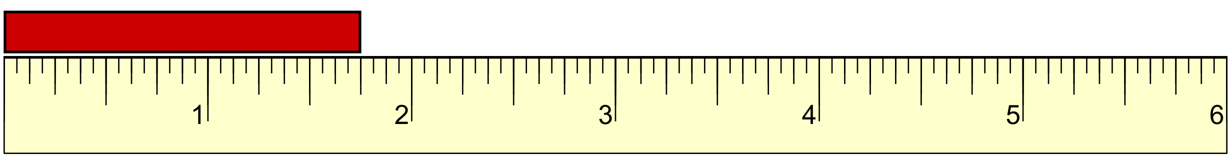

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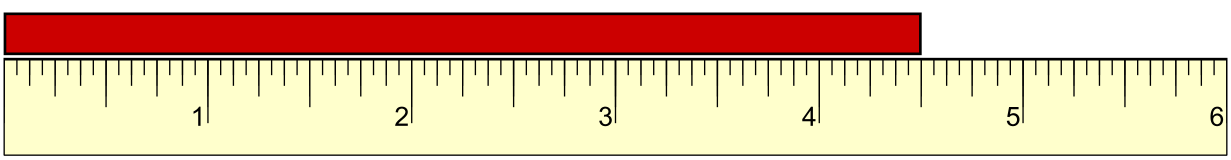

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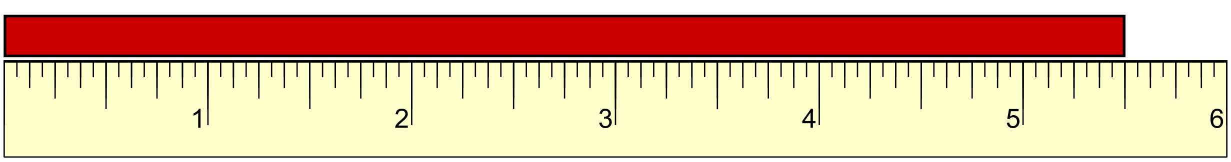

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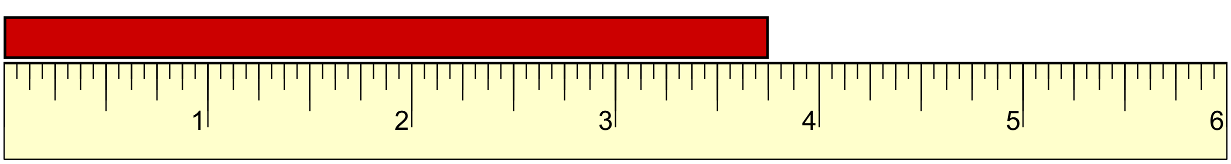

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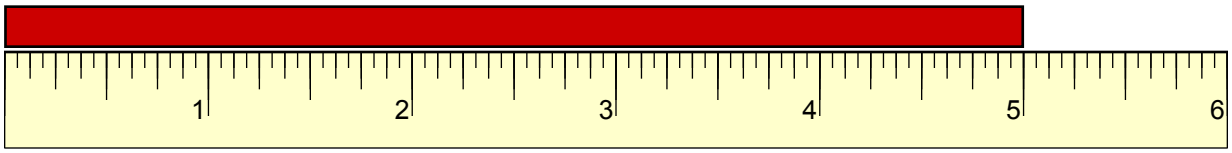
Name : _____ Score : _____

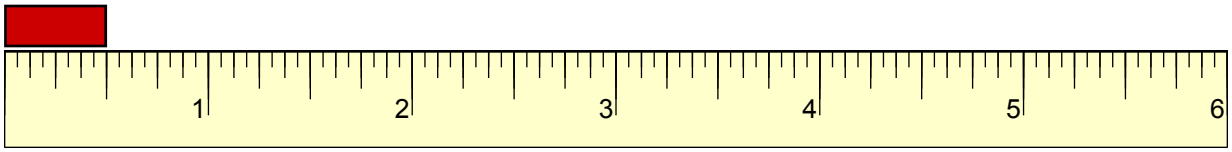
Teacher : _____ Date : _____

Measuring in Inches

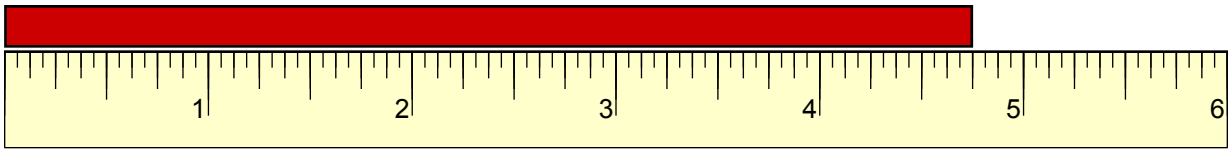
How many Inches ?



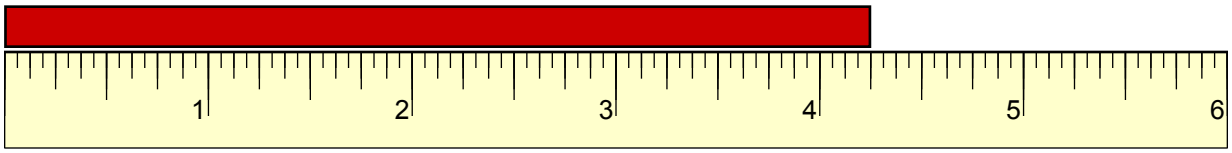
5 in



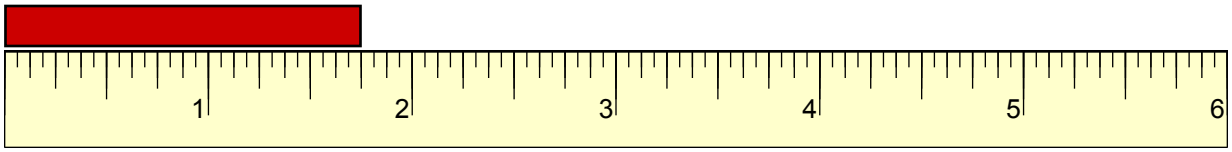
$\frac{1}{2}$ in



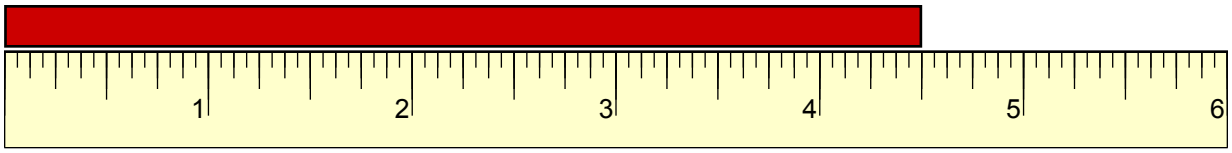
$4\frac{3}{4}$ in



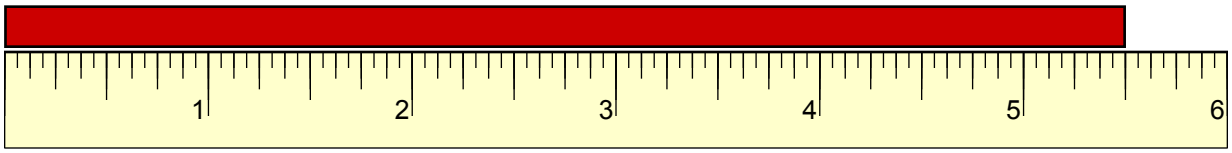
$4\frac{1}{4}$ in



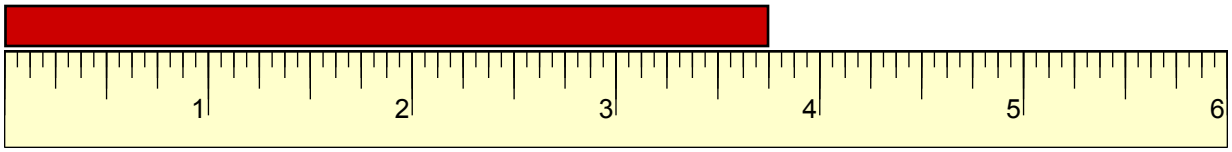
$1\frac{3}{4}$ in



$4\frac{1}{2}$ in



$5\frac{1}{2}$ in



$3\frac{3}{4}$ in

Name : _____ Score : _____

Period : _____ Date : _____

Measure It Out

Length to measure.

$2\frac{7}{16}$ in

$1\frac{5}{8}$ in

$\frac{3}{4}$ in

$2\frac{1}{8}$ in

$4\frac{11}{16}$ in

$1\frac{11}{16}$ in

$3\frac{5}{8}$ in

$4\frac{5}{8}$ in

$\frac{13}{16}$ in

$3\frac{9}{16}$ in

Name : _____ Score : _____

Teacher : _____ Date : _____

Measure It Out

Length to measure.

$2\frac{7}{16}$ in

$1\frac{5}{8}$ in

$\frac{3}{4}$ in

$2\frac{1}{8}$ in

$4\frac{11}{16}$ in

$1\frac{11}{16}$ in

$3\frac{5}{8}$ in

$4\frac{5}{8}$ in

$\frac{13}{16}$ in

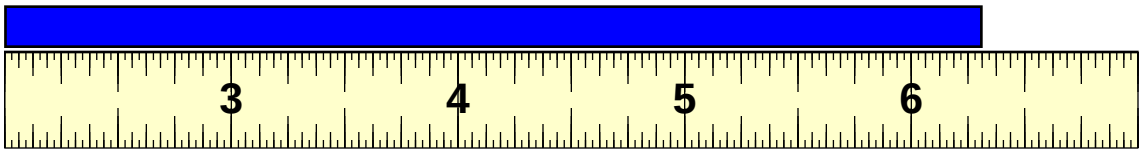
$3\frac{9}{16}$ in

Name : _____ Score : _____

Period : _____ Date : _____

Reading a Standard Ruler

How many Inches ?



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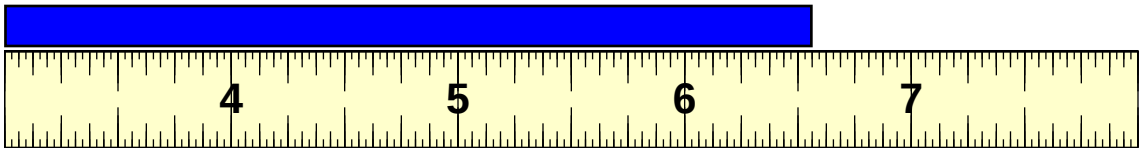

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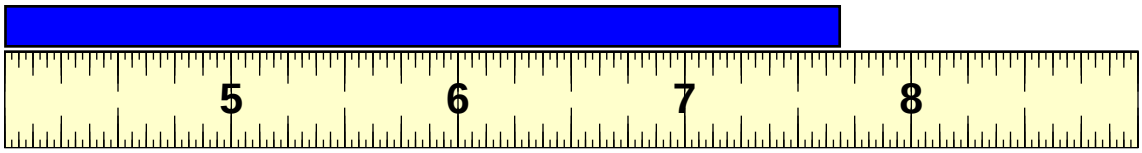

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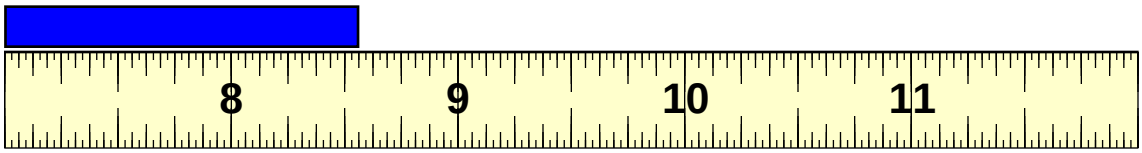

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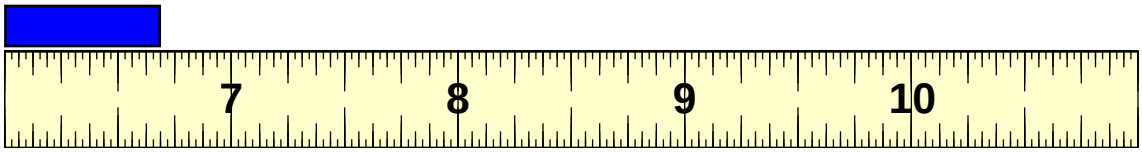

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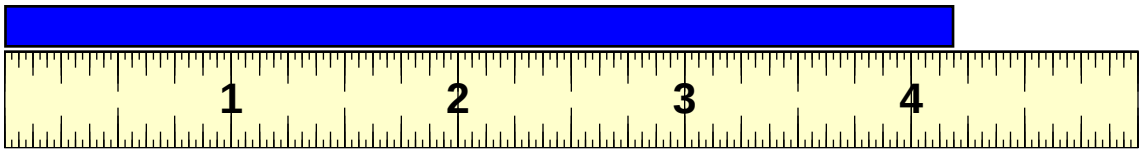

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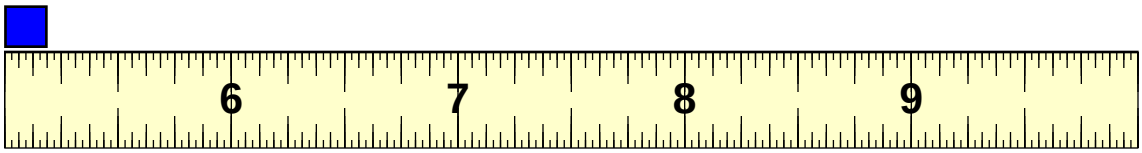

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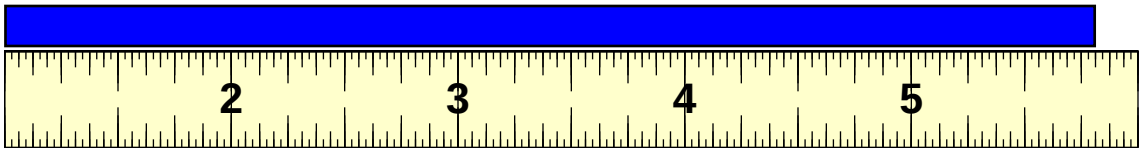

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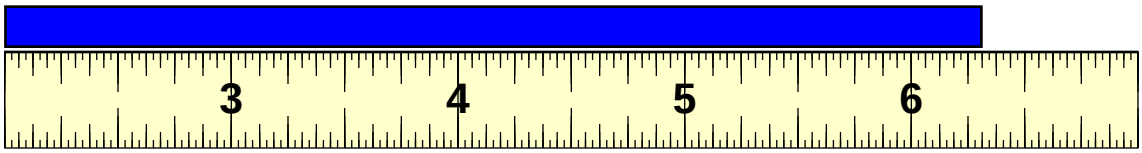
Name : _____ Score : _____

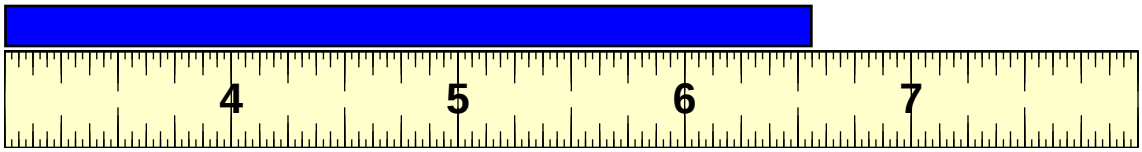
Teacher : _____ Date : _____

Reading a Standard Ruler

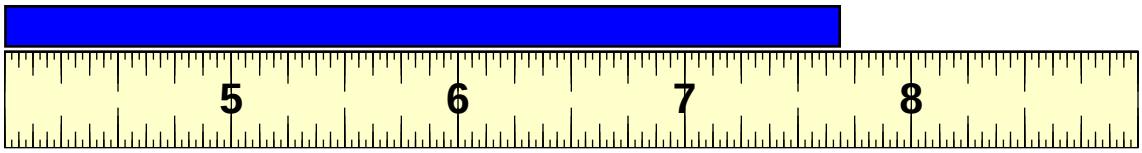
How many Inches ?



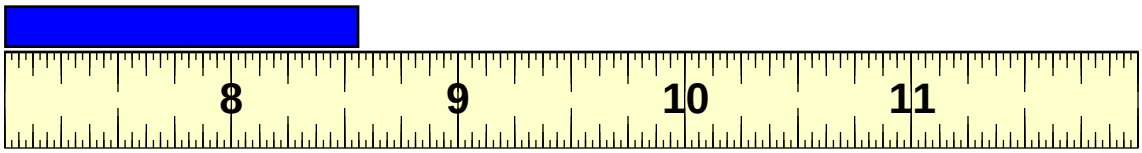
$6\frac{5}{16}$ in



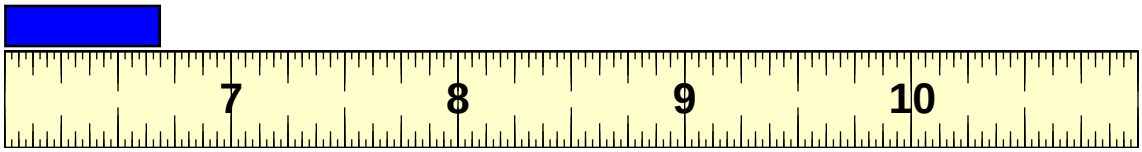
$6\frac{9}{16}$ in



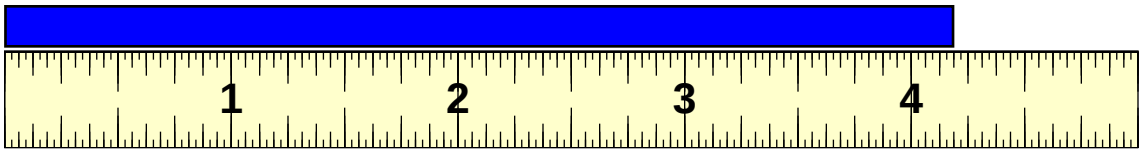
$7\frac{11}{16}$ in



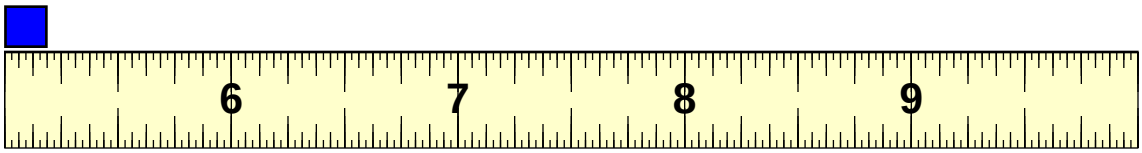
$8\frac{9}{16}$ in



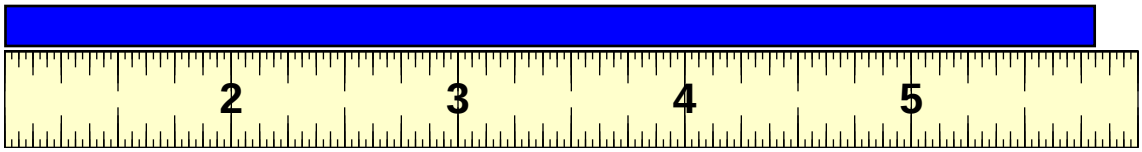
$6\frac{11}{16}$ in



$4\frac{3}{16}$ in



$5\frac{3}{16}$ in



$5\frac{13}{16}$ in

Standard measuring 16s inches

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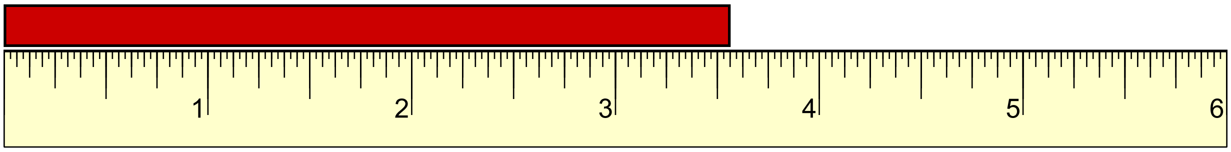
Name : ______________________________ Score : ____________

Period : _____________________________ Date : ____________

Measuring in Inches

How many Inches ?



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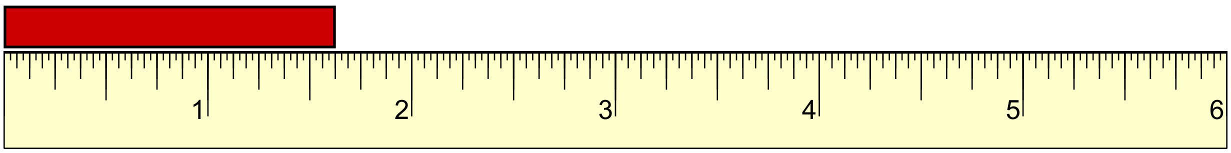

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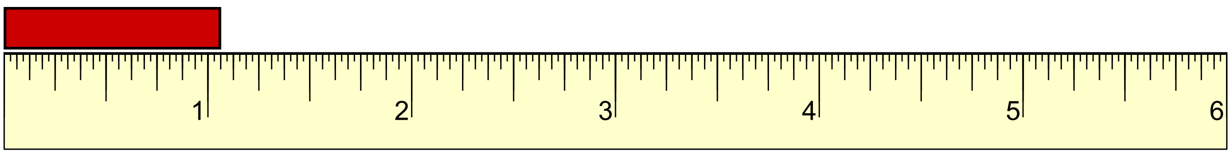

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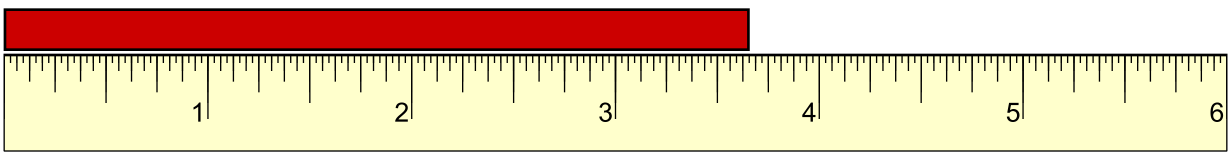

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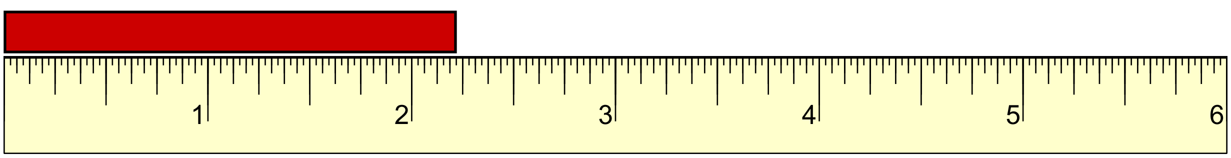

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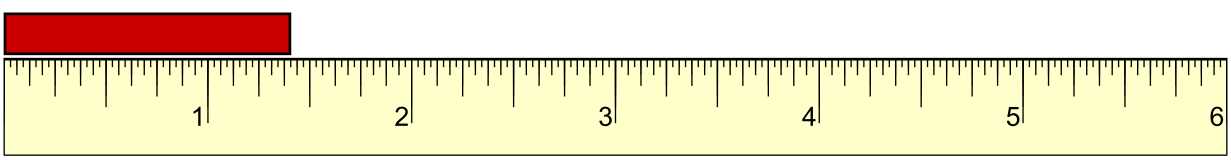

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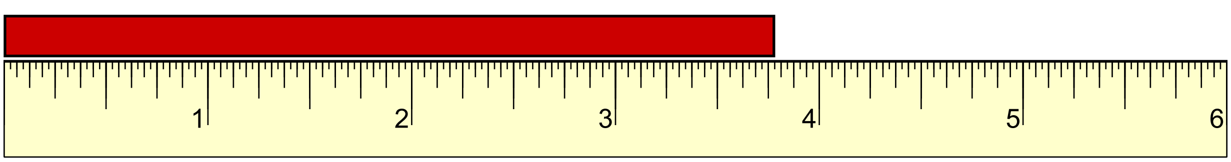

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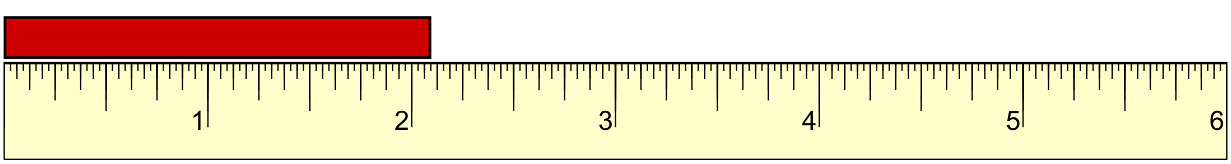

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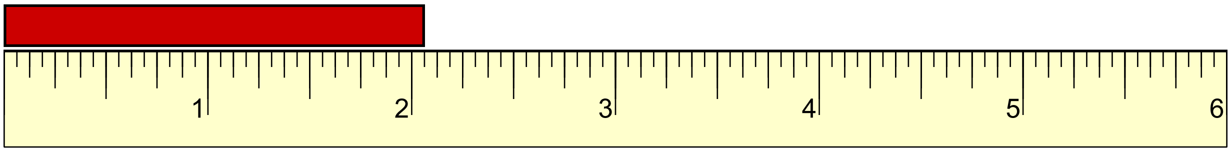
Name : ______________________________ Score : ____________

Period : ______________________________ Date : ____________

Measuring in Inches

How many Inches ?



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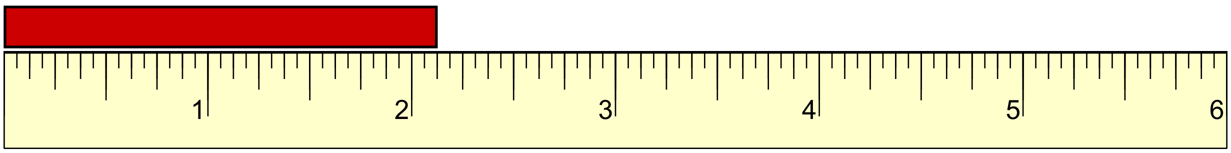

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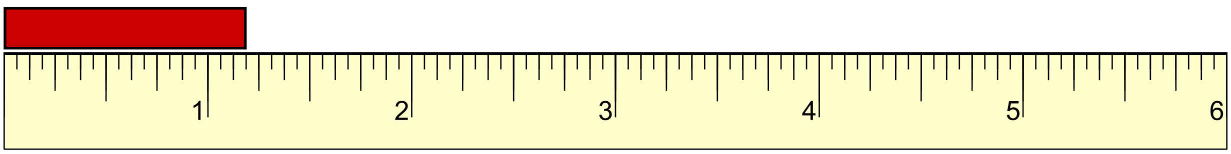

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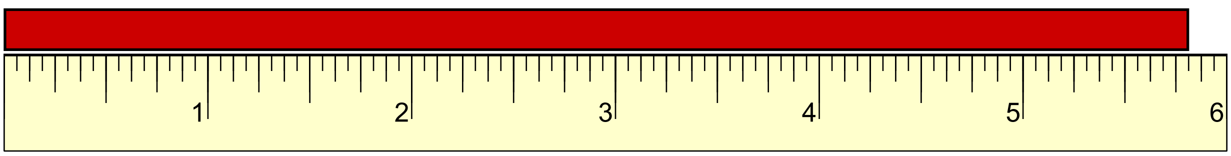

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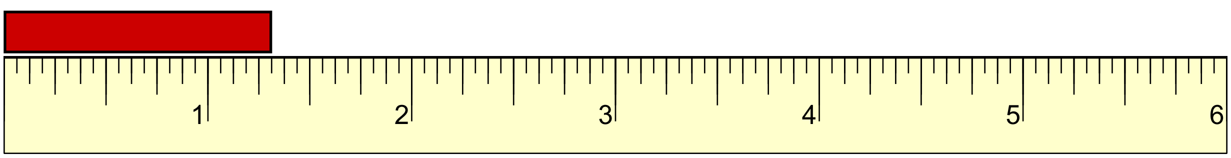

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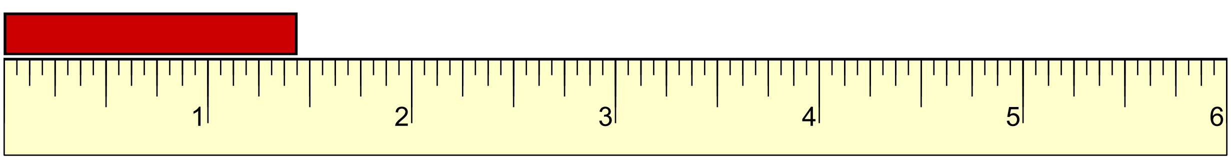

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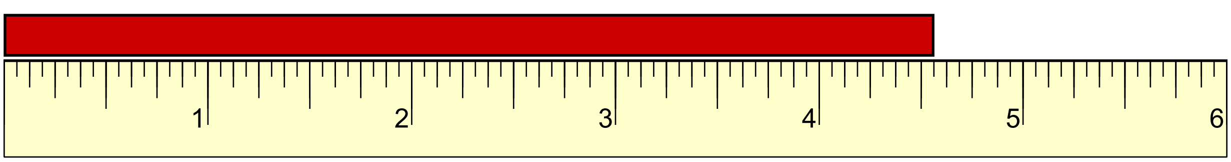

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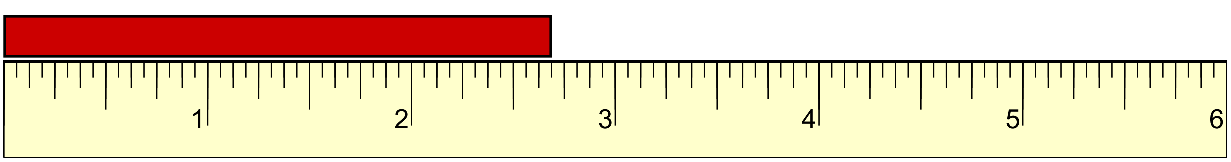

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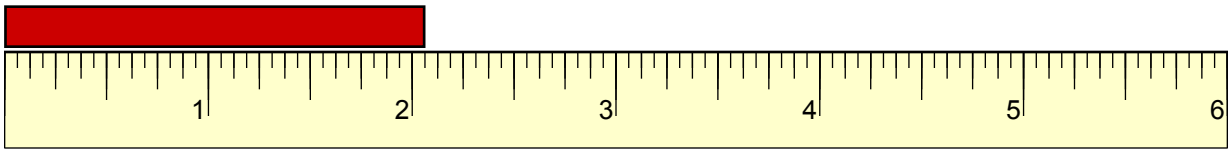
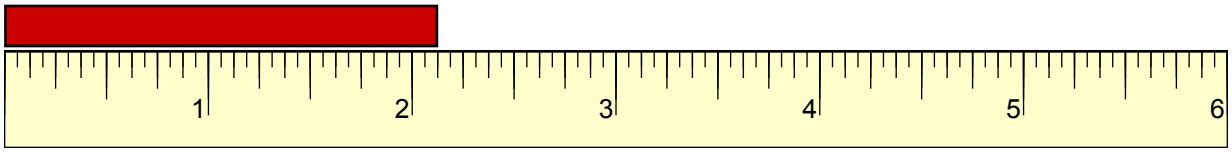
Teacher : _____ Date : _____

Measuring in Inches

How many Inches ?



$2\frac{1}{16}$ in



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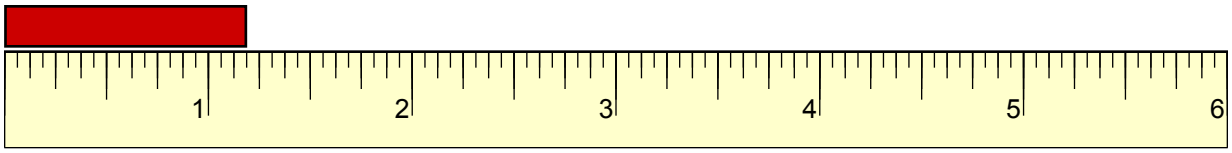
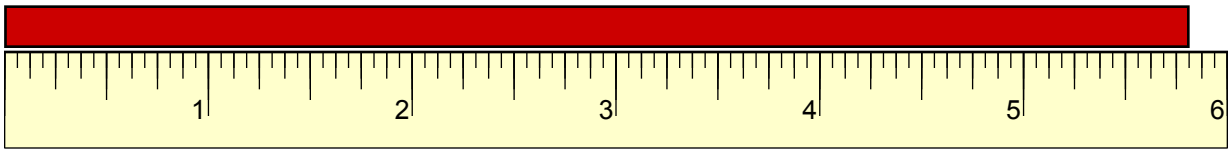
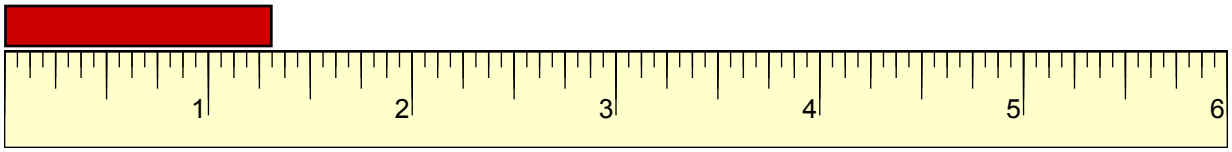


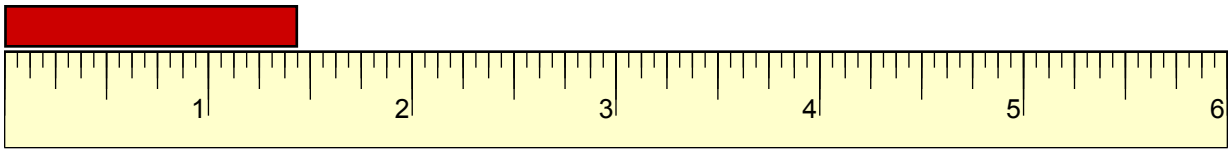
$1\frac{3}{16}$ in



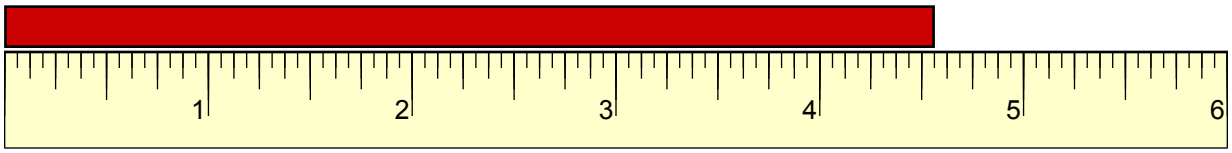
$5\frac{13}{16}$ in



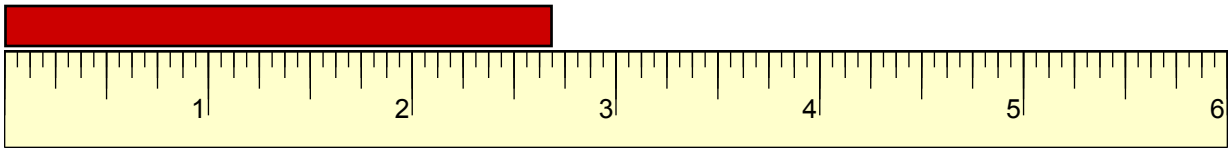
$1\frac{5}{16}$ in



$1\frac{7}{16}$ in



$4\frac{9}{16}$ in



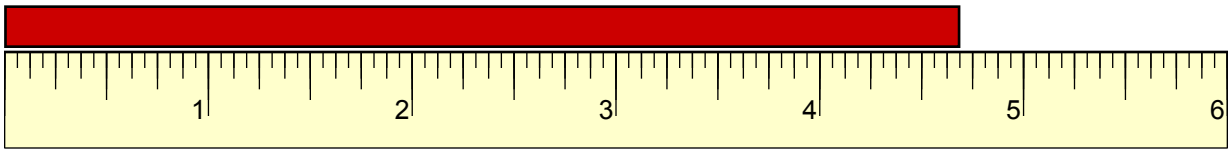
$2\frac{11}{16}$ in

Name : _____ Score : _____

Teacher : _____ Date : _____

Measuring in Inches

How many Inches ?



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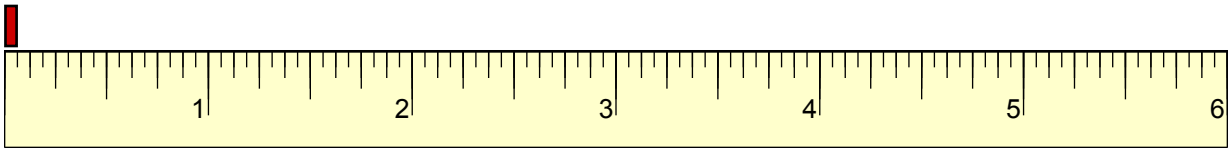
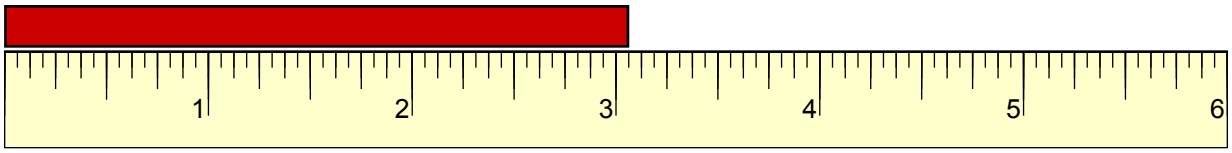
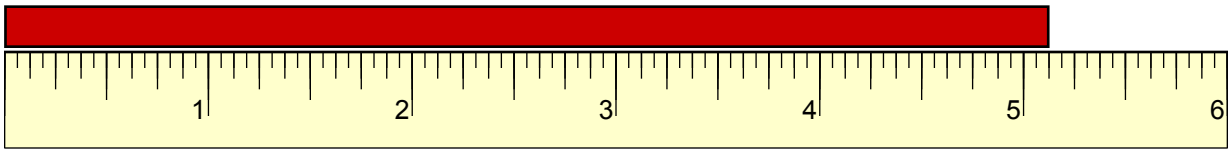


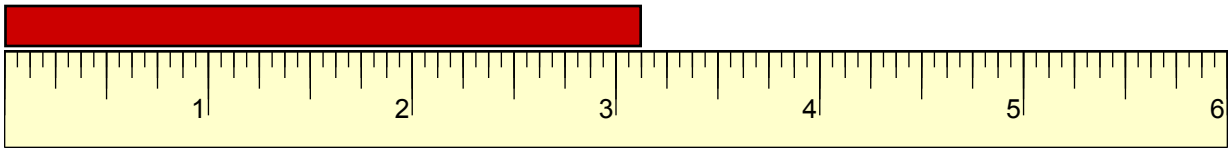
$\frac{1}{16}$ in



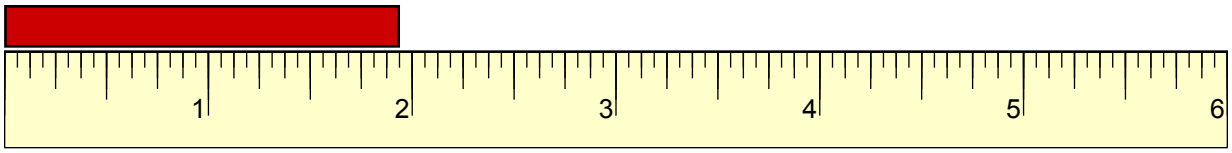
$3\frac{1}{16}$ in



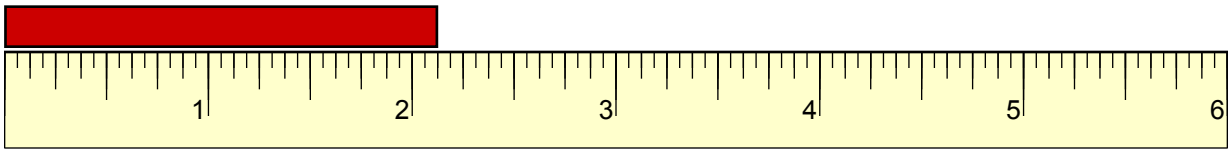
$5\frac{1}{8}$ in



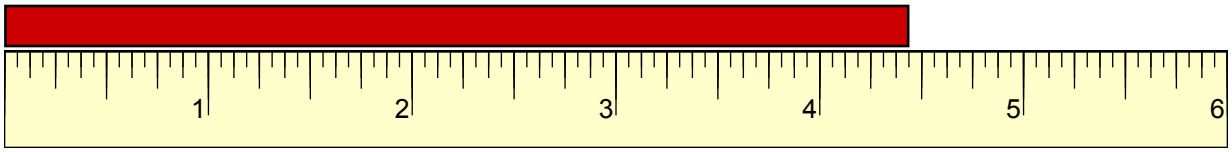
$3\frac{1}{8}$ in



$1\frac{15}{16}$ in



$2\frac{1}{8}$ in



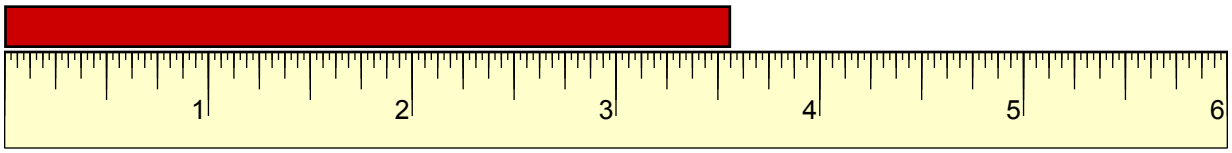
$4\frac{7}{16}$ in

Name : _____ Score : _____

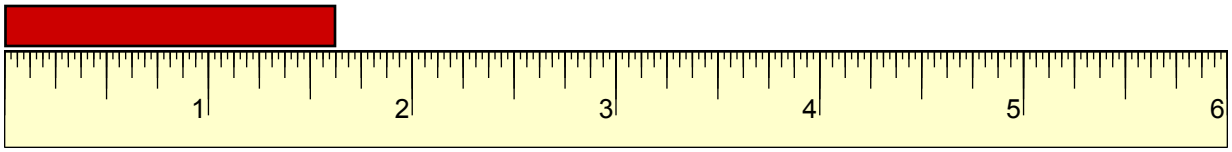
Teacher : _____ Date : _____

Measuring in Inches

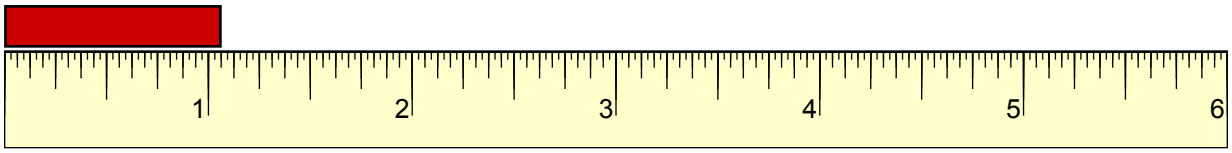
How many Inches ?



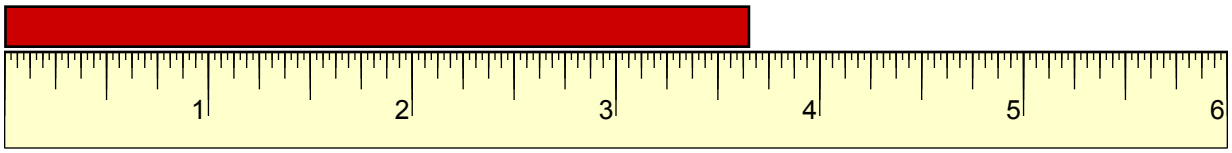
$3\frac{9}{16}$ in



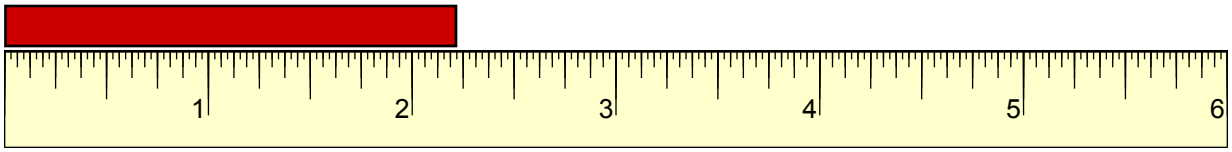
$1\frac{5}{8}$ in



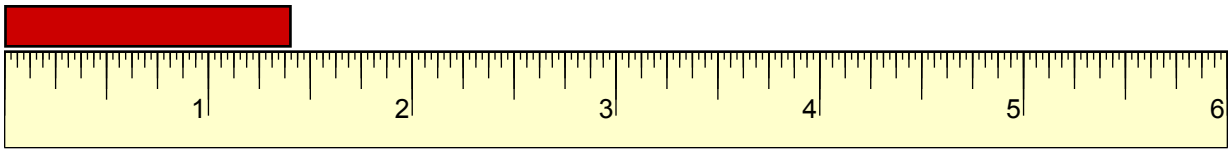
$1\frac{1}{16}$ in



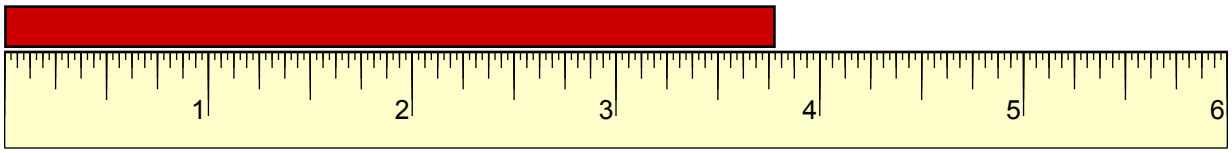
$3\frac{21}{32}$ in



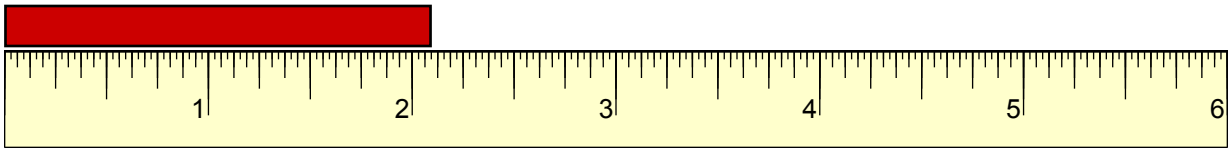
$2\frac{7}{32}$ in



$1\frac{13}{32}$ in



$3\frac{25}{32}$ in



$2\frac{3}{32}$ in

Name : _____ Score : _____

Period : _____ Date : _____

Adding Tape Measurement Fractions

1) $\frac{1}{16} + \frac{3}{4} =$

2) $\frac{3}{8} + \frac{1}{2} =$

3) $\frac{3}{8} + \frac{1}{2} =$

4) $\frac{3}{4} + \frac{1}{2} =$

5) $\frac{1}{4} + \frac{5}{8} =$

6) $\frac{5}{8} + \frac{1}{2} =$

7) $\frac{1}{16} + \frac{3}{8} =$

8) $\frac{1}{2} + \frac{1}{4} =$

9) $\frac{1}{2} + \frac{1}{4} =$

10) $\frac{1}{4} + \frac{5}{16} =$

Name : _____ Score : _____

Period : _____ Date : _____

Adding Fractional Inches

1) $4\frac{3}{4} + 6\frac{1}{4} =$

2) $4\frac{1}{2} + 6\frac{1}{2} =$

3) $8\frac{1}{4} + 6\frac{1}{4} =$

4) $2\frac{3}{4} + 10\frac{7}{16} =$

5) $6\frac{3}{8} + 9\frac{1}{4} =$

6) $11\frac{1}{2} + 10\frac{1}{4} =$

7) $5\frac{1}{2} + 7\frac{3}{8} =$

8) $2\frac{1}{8} + 7\frac{7}{16} =$

9) $2\frac{9}{16} + 2\frac{1}{4} =$

10) $6\frac{3}{8} + 7\frac{1}{2} =$

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Name : _____ Score : _____

Teacher : _____ Date : _____

Adding Fractional Inches

1) $4\frac{3}{4} + 6\frac{1}{4} = 4\frac{3}{4} + 6\frac{1}{4} = 10\frac{4}{4} = 11$

2) $4\frac{1}{2} + 6\frac{1}{2} = 4\frac{1}{2} + 6\frac{1}{2} = 10\frac{2}{2} = 11$

3) $8\frac{1}{4} + 6\frac{1}{4} = 8\frac{1}{4} + 6\frac{1}{4} = 14\frac{2}{4} = 14\frac{1}{2}$

4) $2\frac{3}{4} + 10\frac{7}{16} = 2\frac{12}{16} + 10\frac{7}{16} = 12\frac{19}{16} = 13\frac{3}{16}$

5) $6\frac{3}{8} + 9\frac{1}{4} = 6\frac{3}{8} + 9\frac{2}{8} = 15\frac{5}{8}$

6) $11\frac{1}{2} + 10\frac{1}{4} = 11\frac{2}{4} + 10\frac{1}{4} = 21\frac{3}{4}$

7) $5\frac{1}{2} + 7\frac{3}{8} = 5\frac{4}{8} + 7\frac{3}{8} = 12\frac{7}{8}$

8) $2\frac{1}{8} + 7\frac{7}{16} = 2\frac{2}{16} + 7\frac{7}{16} = 9\frac{9}{16}$

9) $2\frac{9}{16} + 2\frac{1}{4} = 2\frac{9}{16} + 2\frac{4}{16} = 4\frac{13}{16}$

10) $6\frac{3}{8} + 7\frac{1}{2} = 6\frac{3}{8} + 7\frac{4}{8} = 13\frac{7}{8}$

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Name : _____ Score : _____

Teacher : _____ Date : _____

Adding Tape Measurement Fractions

1) $\frac{1}{16} + \frac{3}{4} = \frac{1}{16} + \frac{12}{16} = \frac{13}{16}$

2) $\frac{3}{8} + \frac{1}{2} = \frac{3}{8} + \frac{4}{8} = \frac{7}{8}$

3) $\frac{3}{8} + \frac{1}{2} = \frac{3}{8} + \frac{4}{8} = \frac{7}{8}$

4) $\frac{3}{4} + \frac{1}{2} = \frac{3}{4} + \frac{2}{4} = \frac{5}{4} = 1\frac{1}{4}$

5) $\frac{1}{4} + \frac{5}{8} = \frac{2}{8} + \frac{5}{8} = \frac{7}{8}$

6) $\frac{5}{8} + \frac{1}{2} = \frac{5}{8} + \frac{4}{8} = \frac{9}{8} = 1\frac{1}{8}$

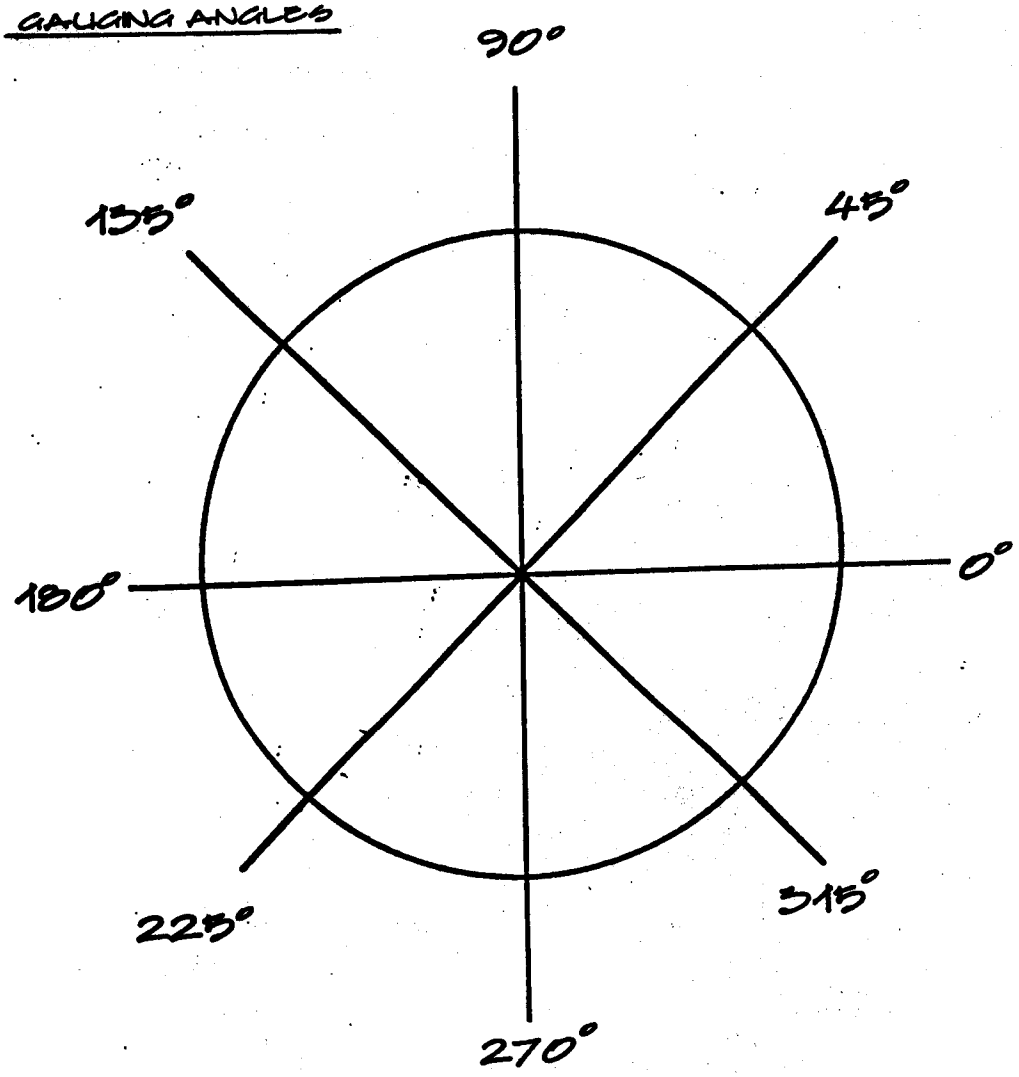
7) $\frac{1}{16} + \frac{3}{8} = \frac{1}{16} + \frac{6}{16} = \frac{7}{16}$

8) $\frac{1}{2} + \frac{1}{4} = \frac{2}{4} + \frac{1}{4} = \frac{3}{4}$

9) $\frac{1}{2} + \frac{1}{4} = \frac{2}{4} + \frac{1}{4} = \frac{3}{4}$

10) $\frac{1}{4} + \frac{5}{16} = \frac{4}{16} + \frac{5}{16} = \frac{9}{16}$

GAUGING ANGLES



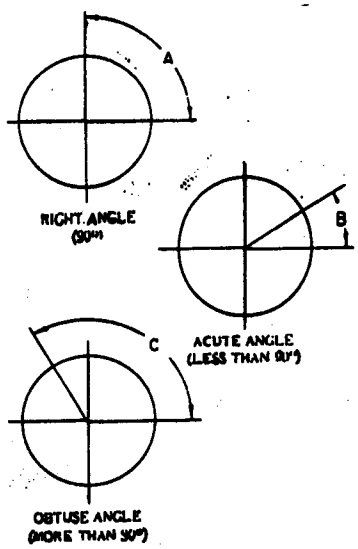
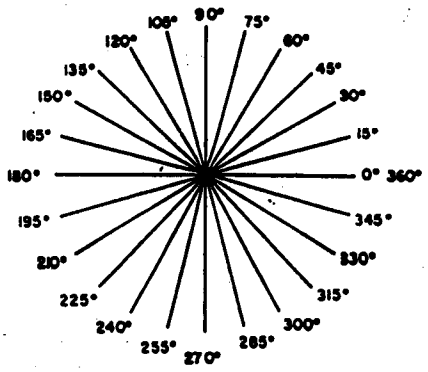


FIG. 3-17 Angles are measured in degrees, minutes, and seconds.



The common angles in circles can be measured in degrees. A complete circle has 360 degrees. How many degrees are in a half circle? Quarter circle?

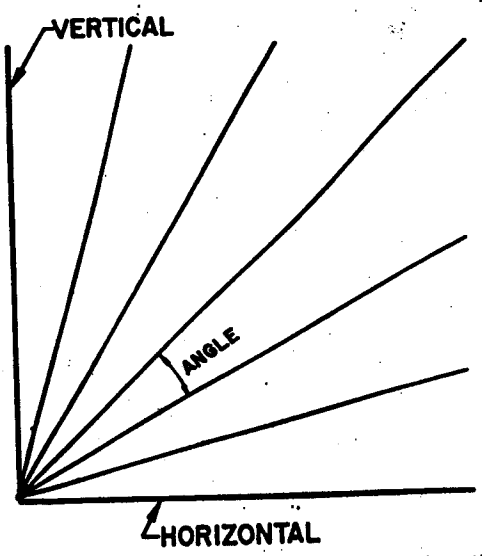


Fig. 4-13. Lines between the horizontal and vertical are called angular lines.

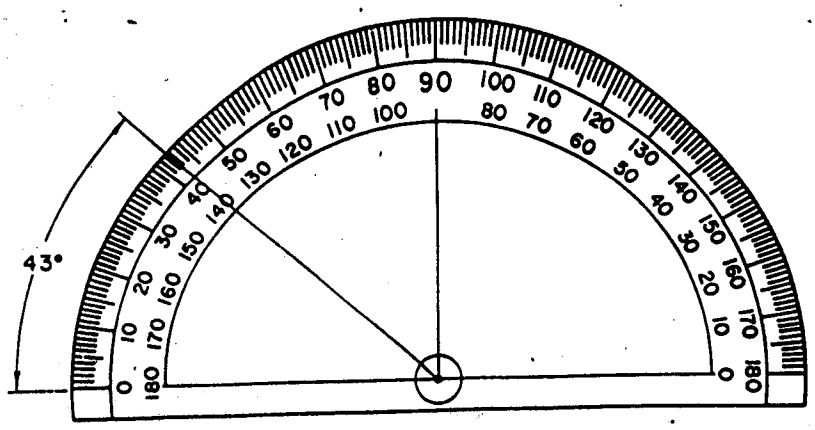
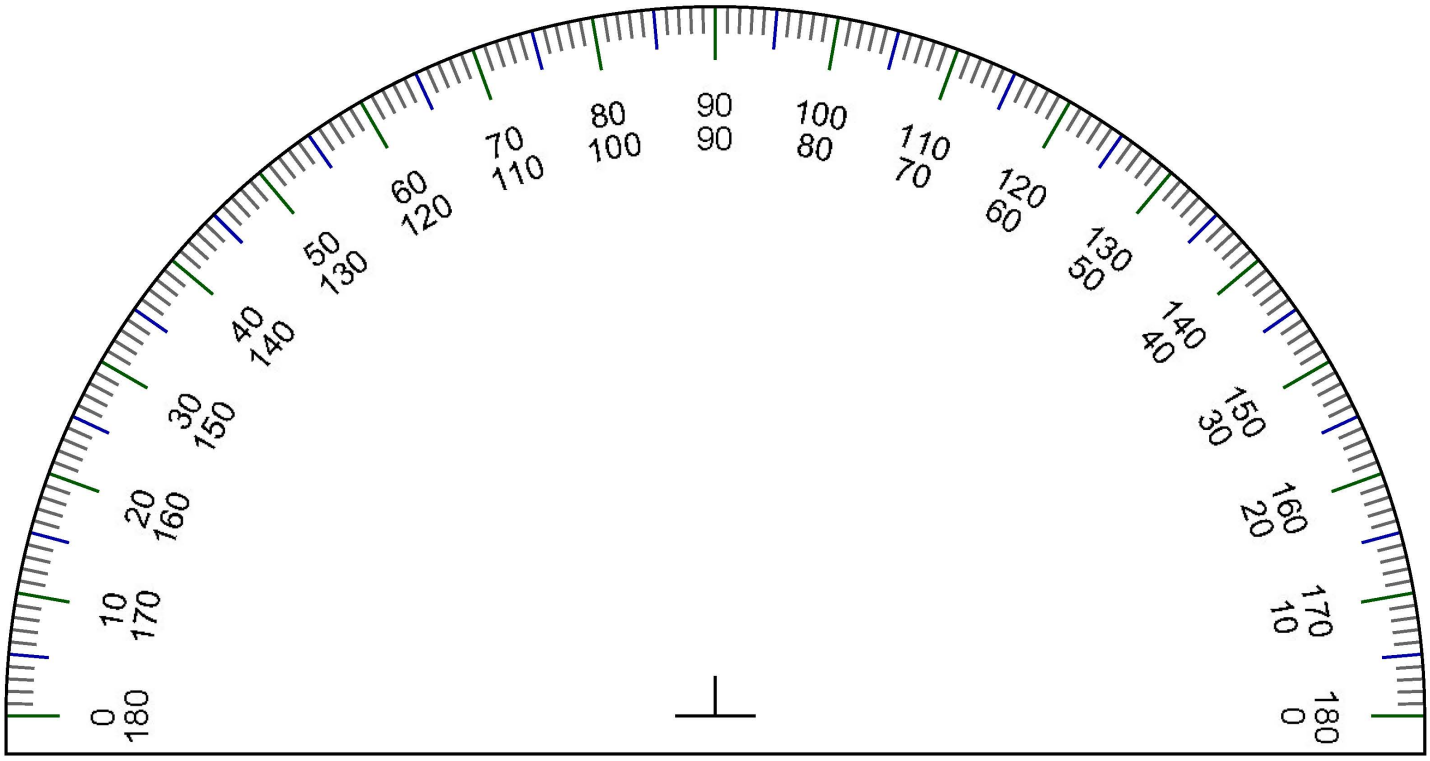


FIG. 3-19 A protractor is used to lay out, or measure angles.



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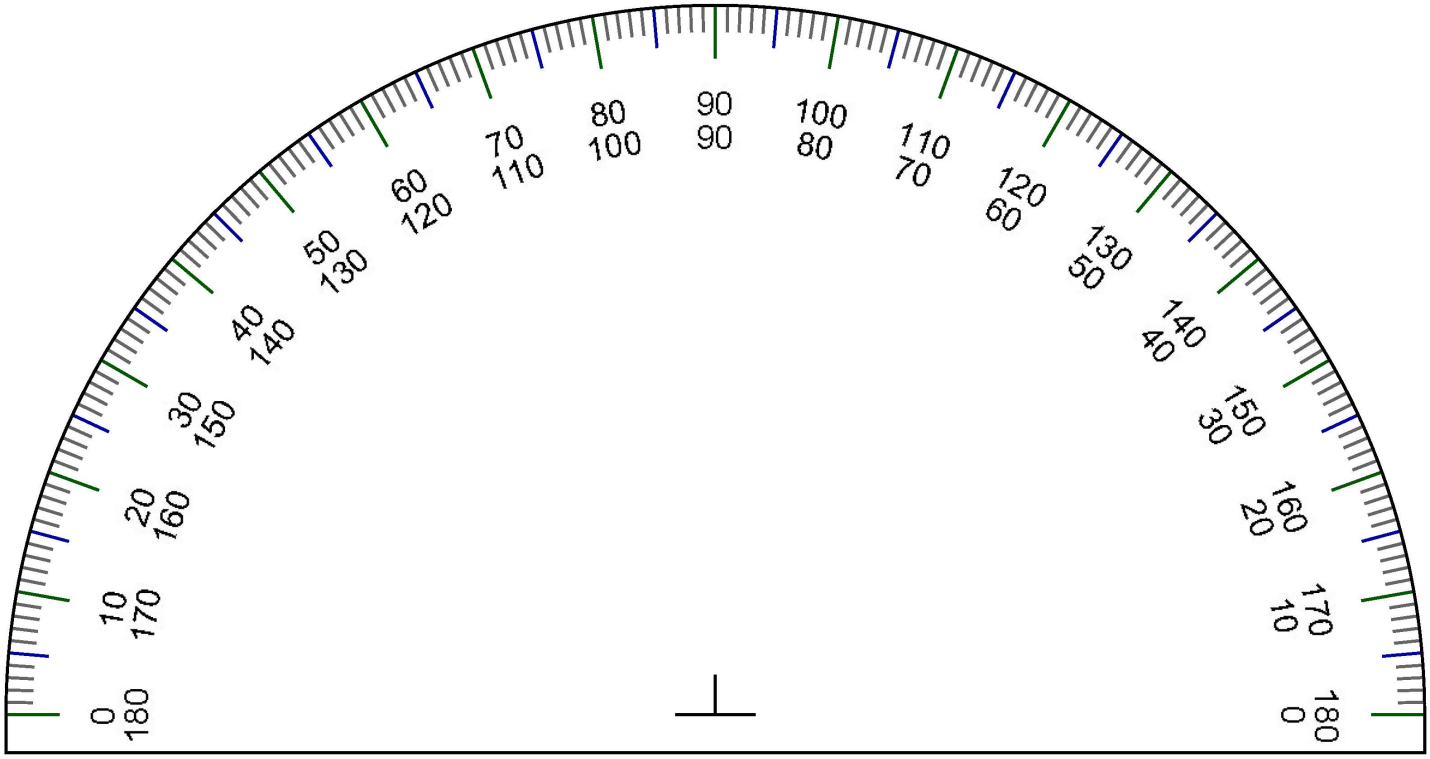

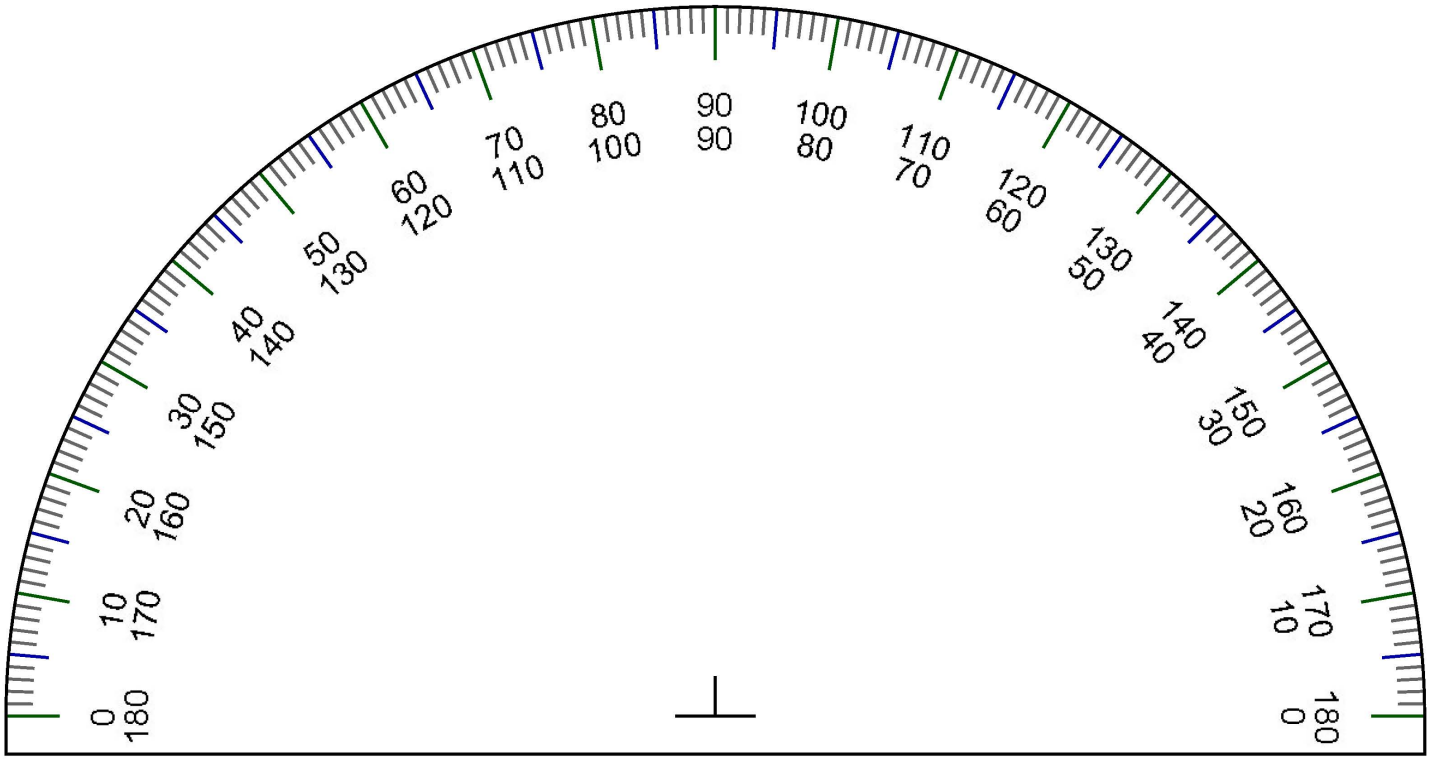

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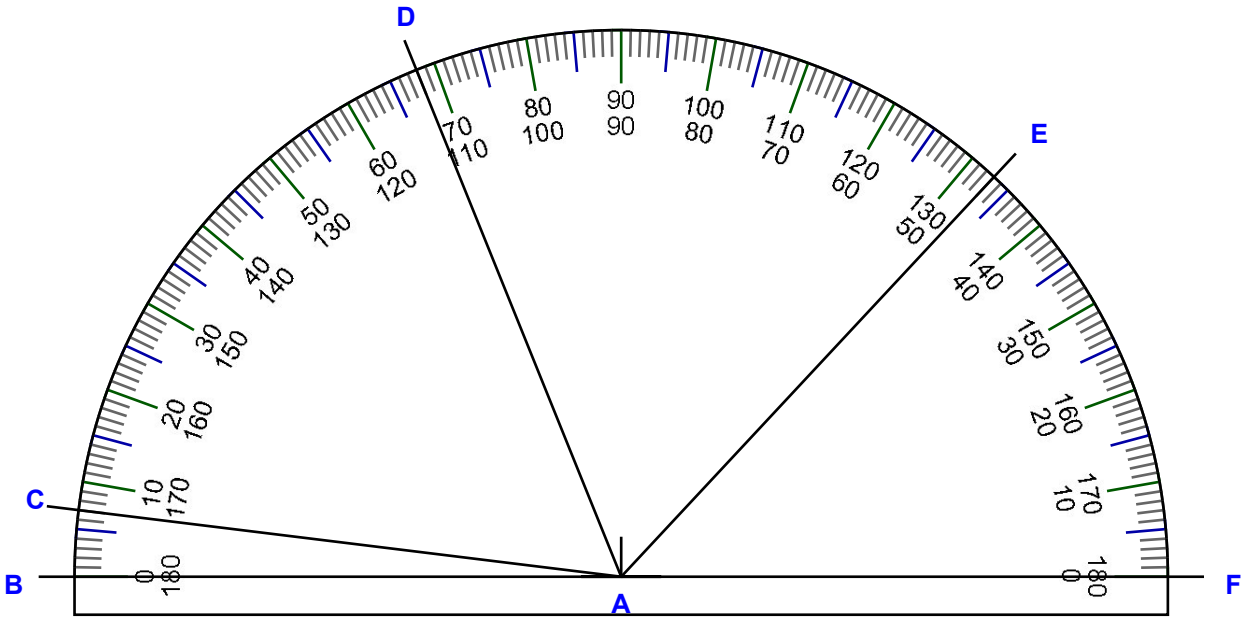
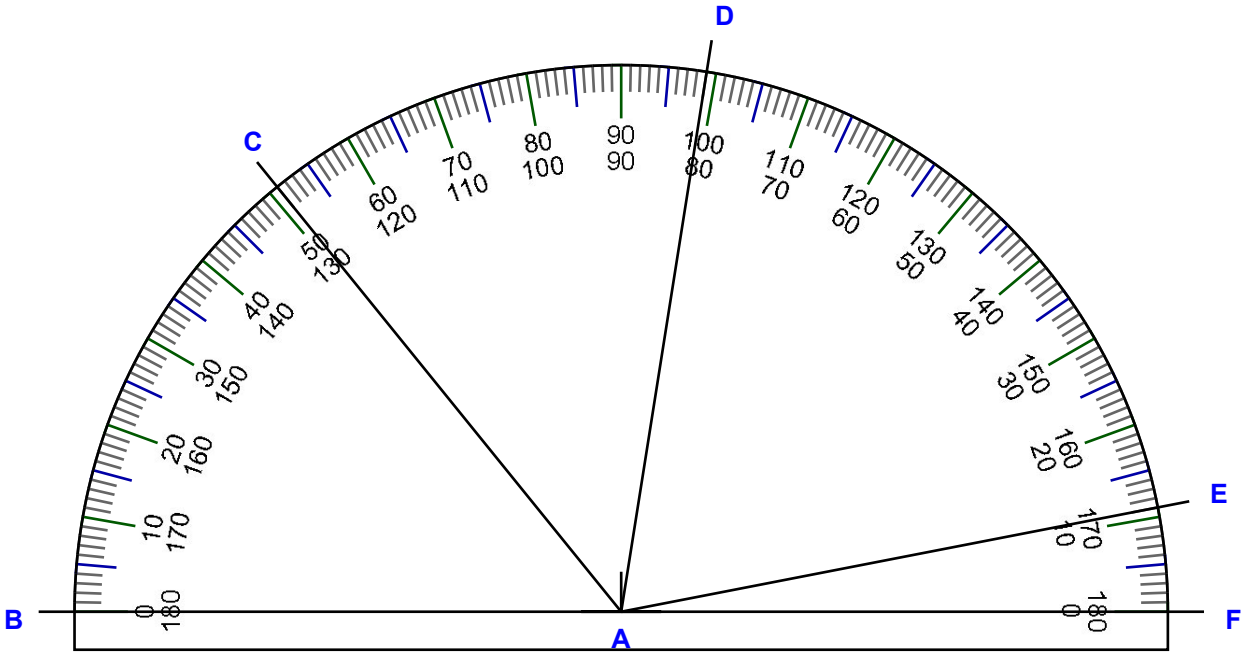
Period : _____ Date : _____

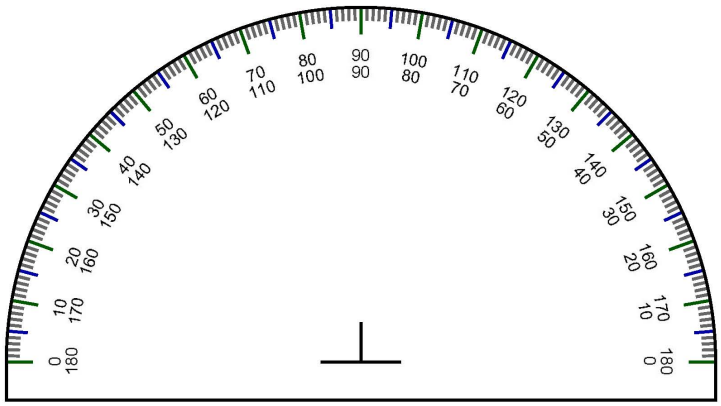
Find the measurment of each angle in degrees.

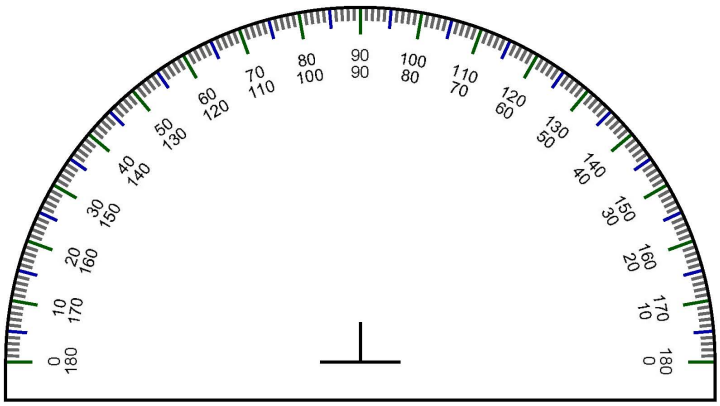


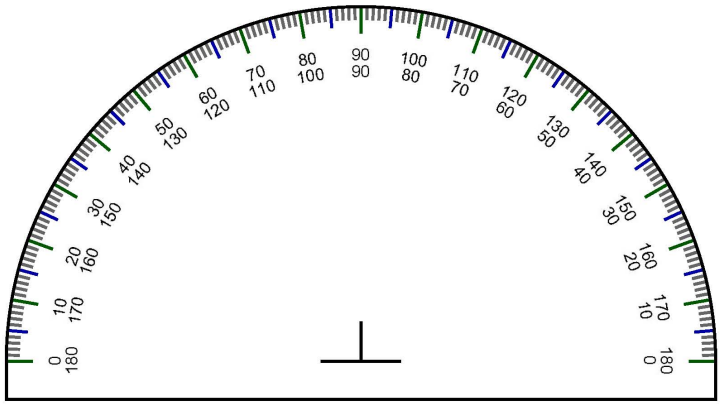
∠ CAB ____° ∠ DAB **68°** ∠ EAB **133°** ∠ CAF **173°** ∠ DAF **112°** ∠ EAF **47°**

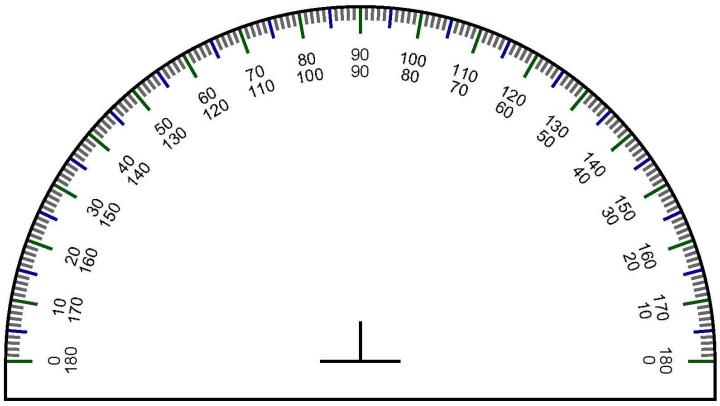


∠ CAB **51°** ∠ DAB **99°** ∠ EAB **169°** ∠ CAF **129°** ∠ DAF **81°** ∠ EAF **11°**









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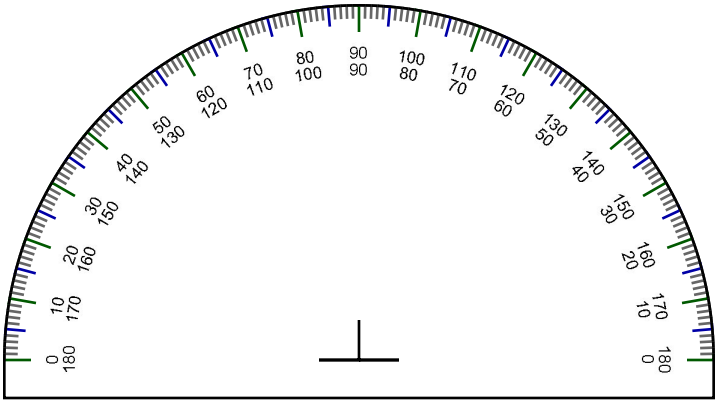
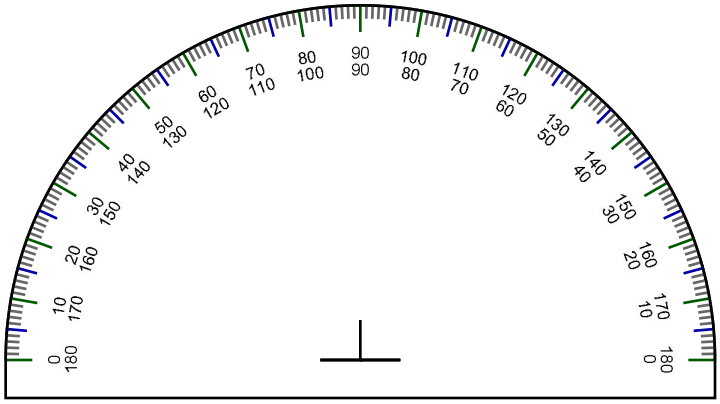
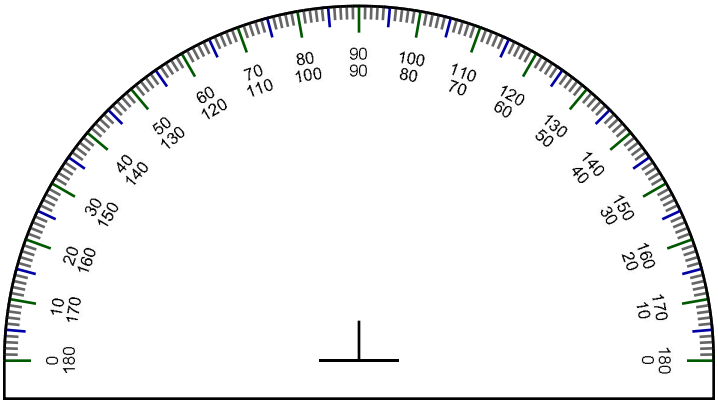
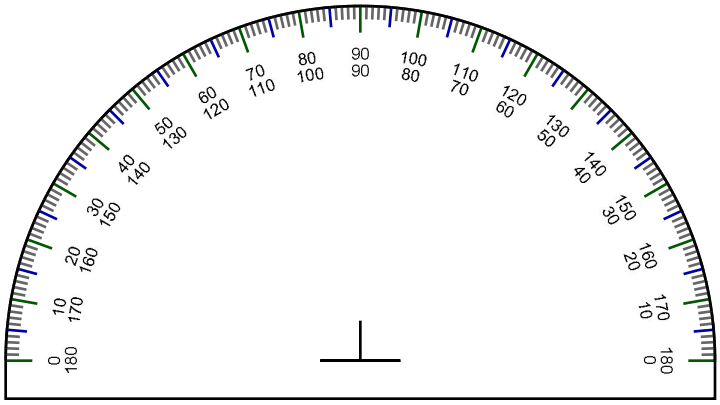
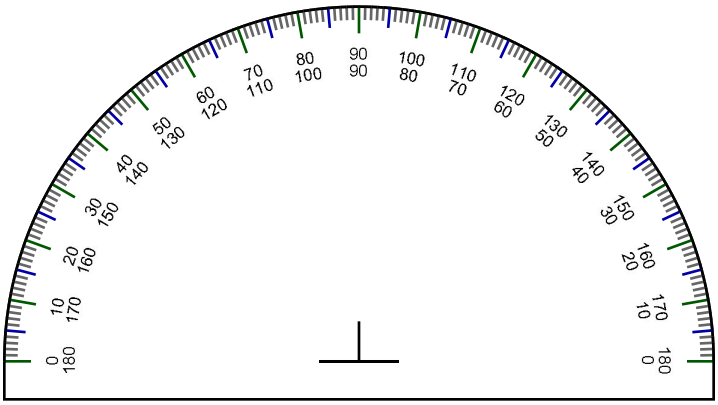
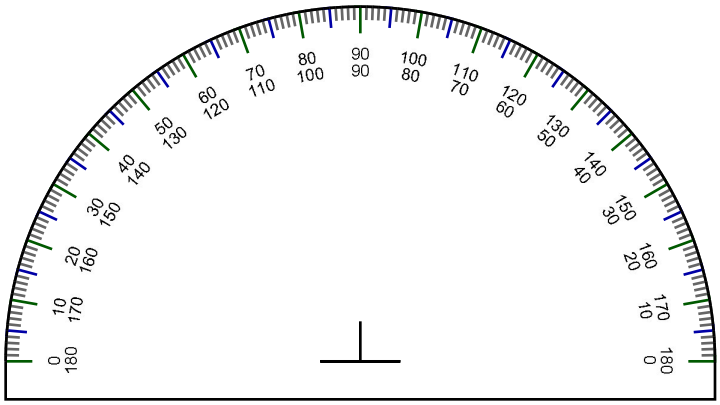

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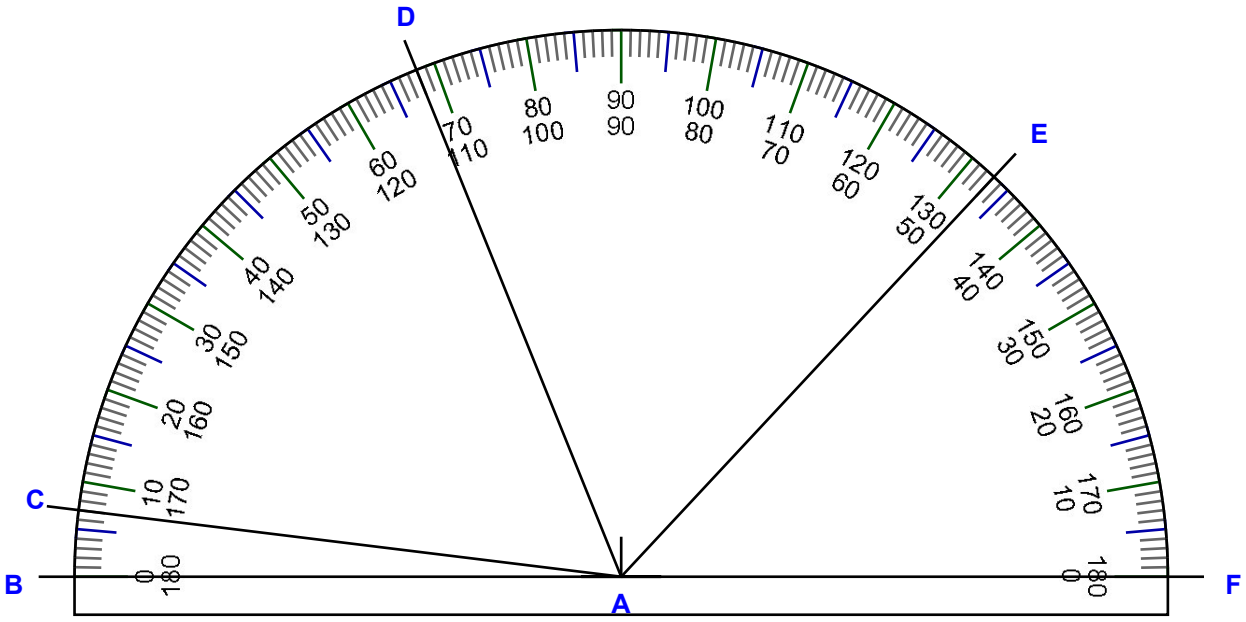
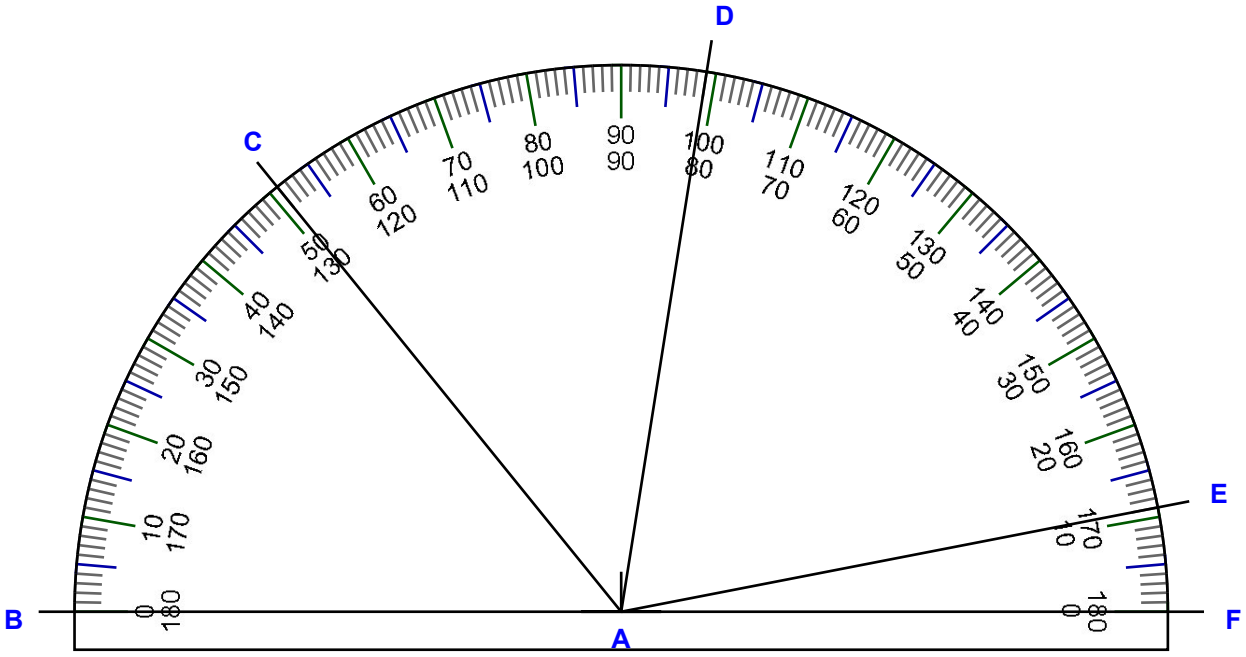
Name : _____ Score : _____

Period : _____ Date : _____

Find the measurment of each angle in degrees (A=vertex).



∠ CAB _____ ∠ DAB _____ ∠ EAB _____ ∠ CAF _____ ∠ DAF _____ ∠ EAF _____



∠ CAB _____ ∠ DAB _____ ∠ EAB _____ ∠ CAF _____ ∠ DAF _____ ∠ EAF _____

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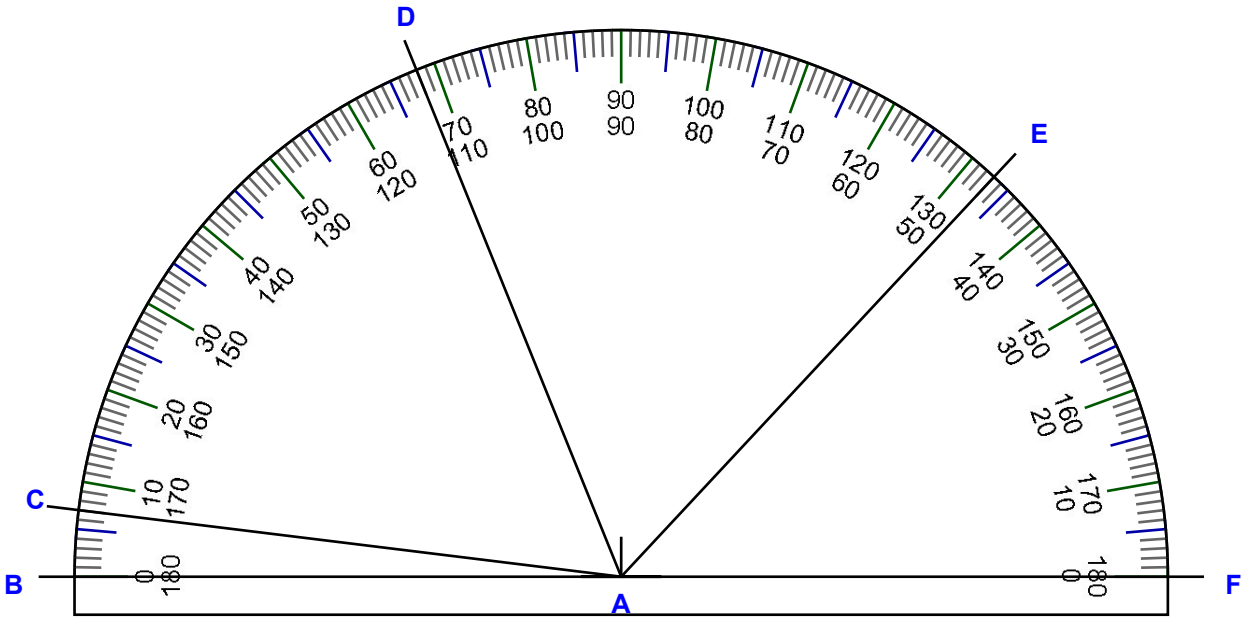
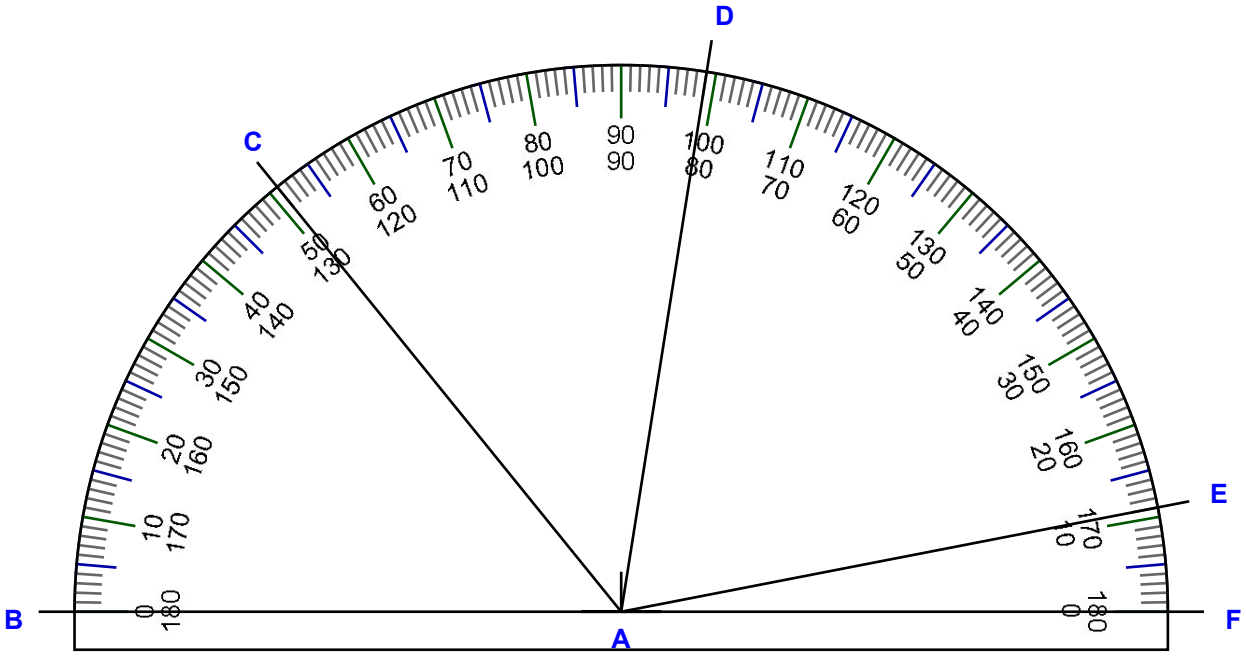


∠ CAB ____° ∠ DAB **68°** ∠ EAB **133°** ∠ CAF **173°** ∠ DAF **112°** ∠ EAF **47°**

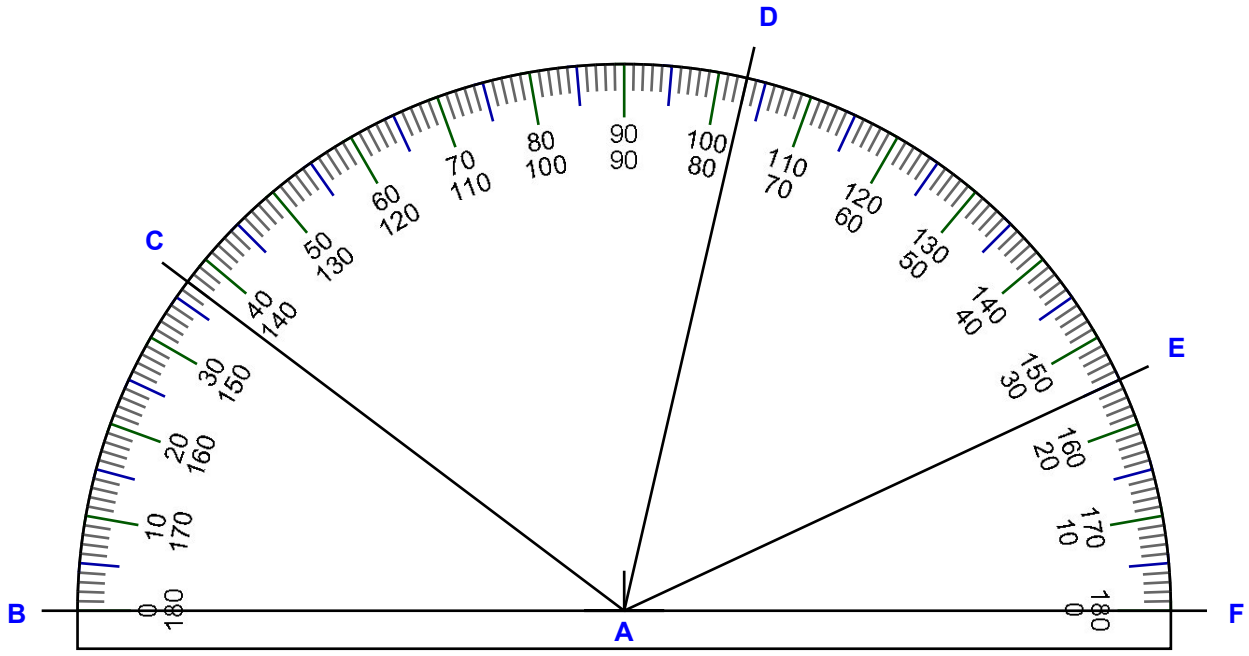


∠ CAB **51°** ∠ DAB **99°** ∠ EAB **169°** ∠ CAF **129°** ∠ DAF **81°** ∠ EAF **11°**

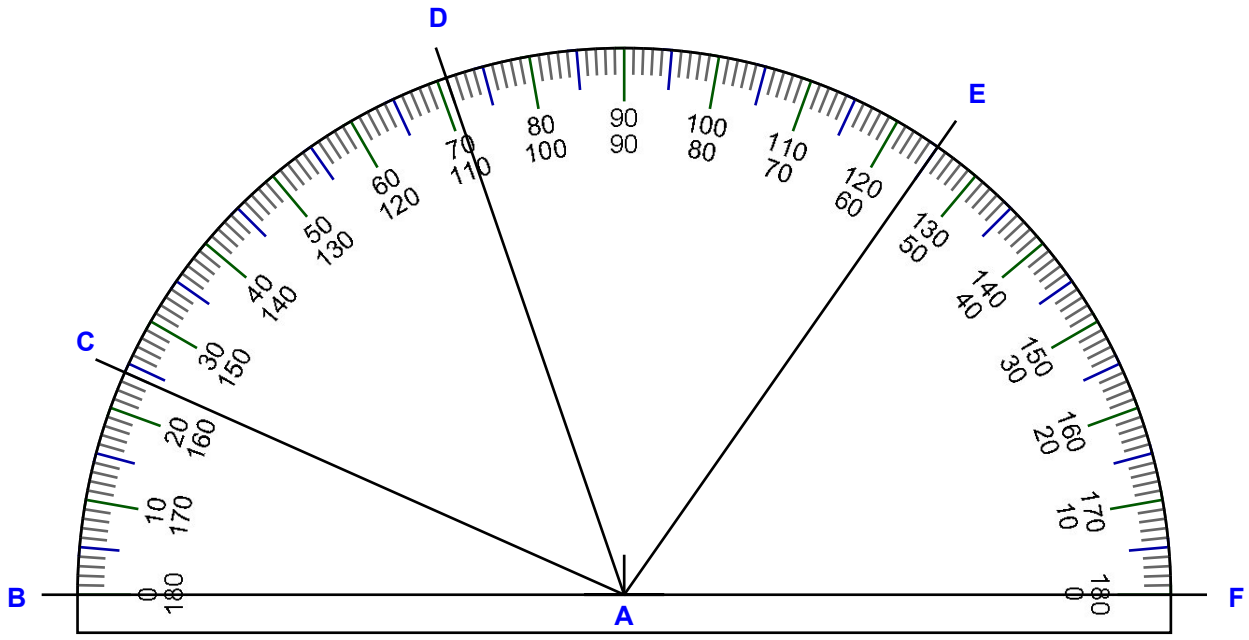
Name : _____ Score : _____

Period : _____ Date : _____

Find the measure of each angle in degrees.



∠ CAB **37°** ∠ DAB **103°** ∠ EAB **155°** ∠ CAF **143°** ∠ DAF **77°** ∠ EAF **25°**



∠ CAB **24°** ∠ DAB **71°** ∠ EAB **125°** ∠ CAF **156°** ∠ DAF **109°** ∠ EAF **55°**

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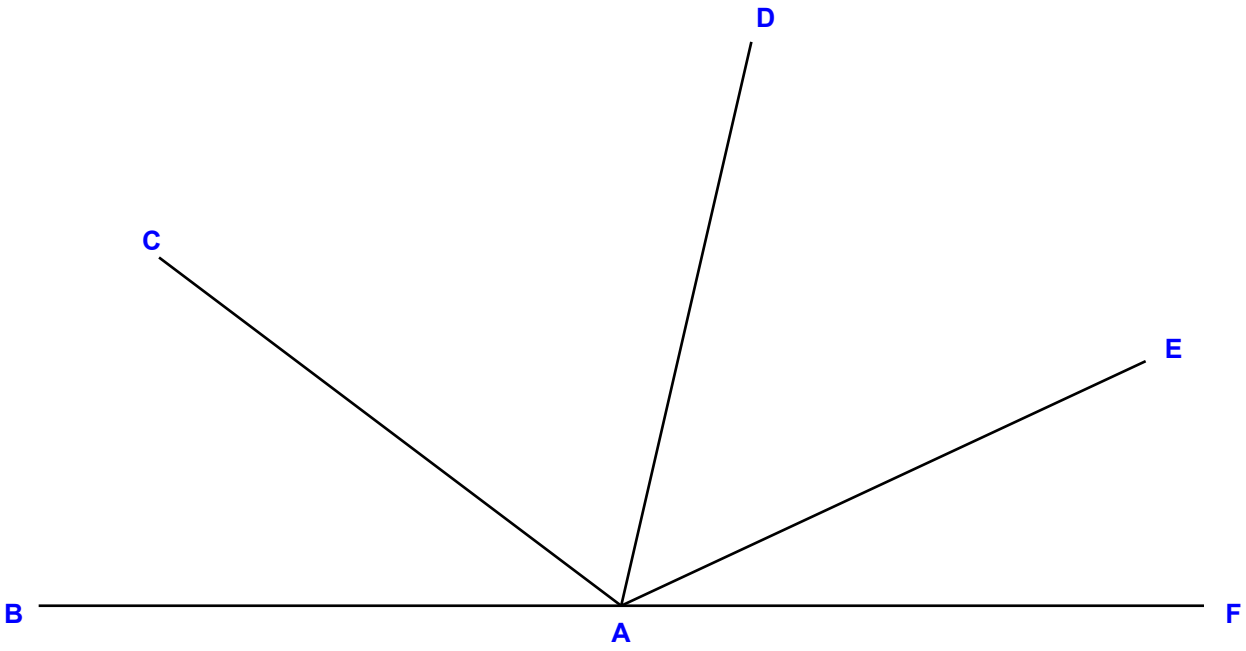
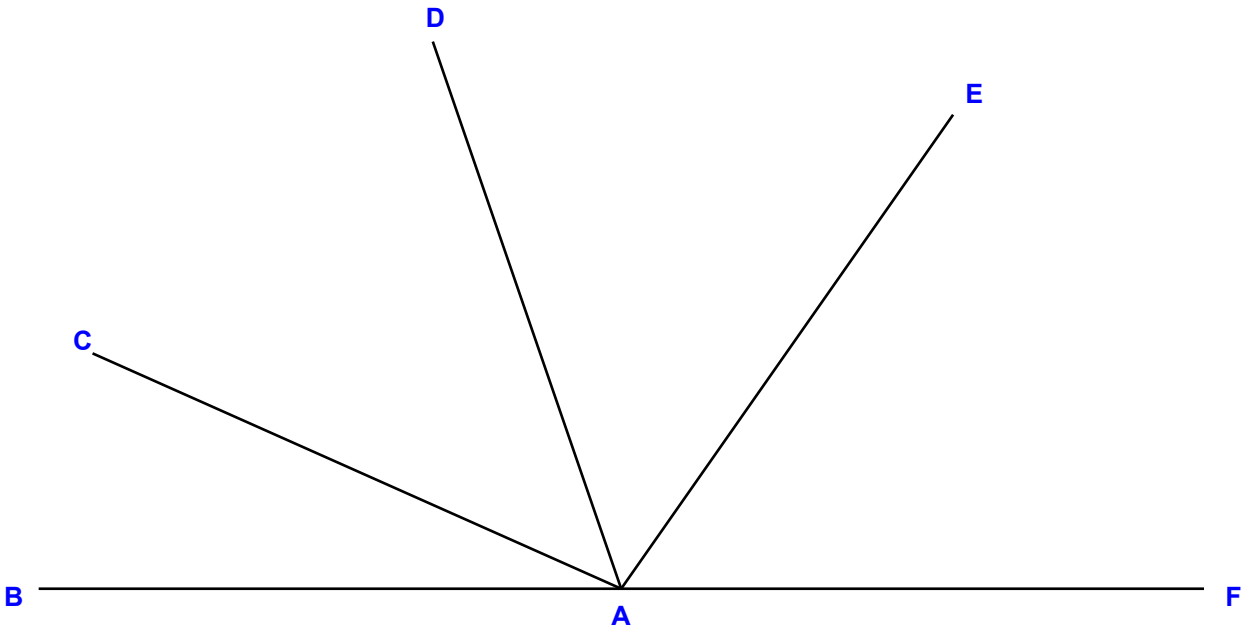
Name : _____ Score : _____

Period : _____ Date : _____

Using a protractor, find the angle in degrees. (A=vertex)



∠ CAB _____ ∠ DAB _____ ∠ EAB _____ ∠ CAF _____ ∠ DAF _____ ∠ EAF _____

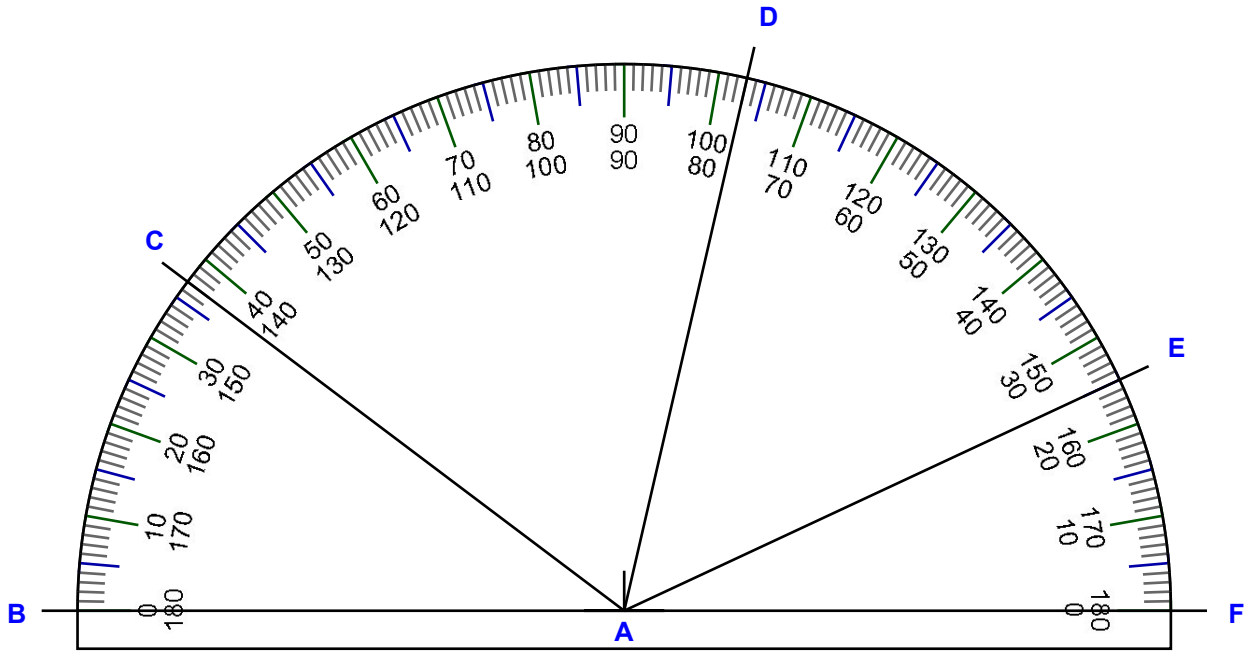


∠ CAB _____ ∠ DAB _____ ∠ EAB _____ ∠ CAF _____ ∠ DAF _____ ∠ EAF _____

Name : _____ Score : _____

Period : _____ Date : _____

Find the measure of each angle in degrees.



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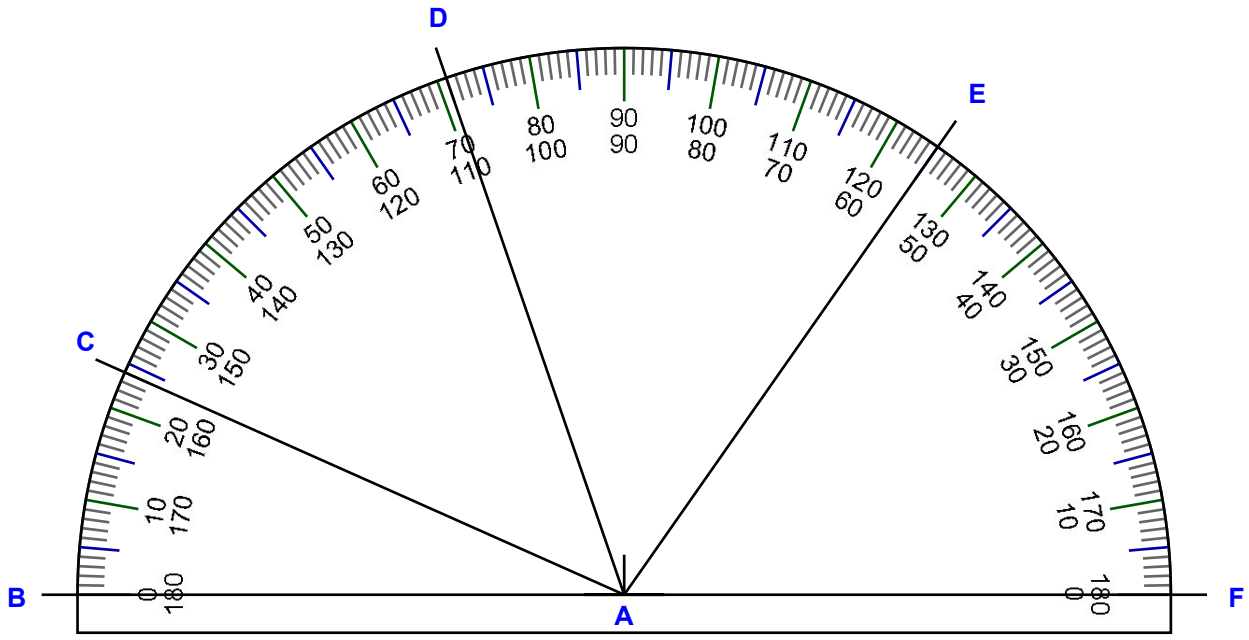

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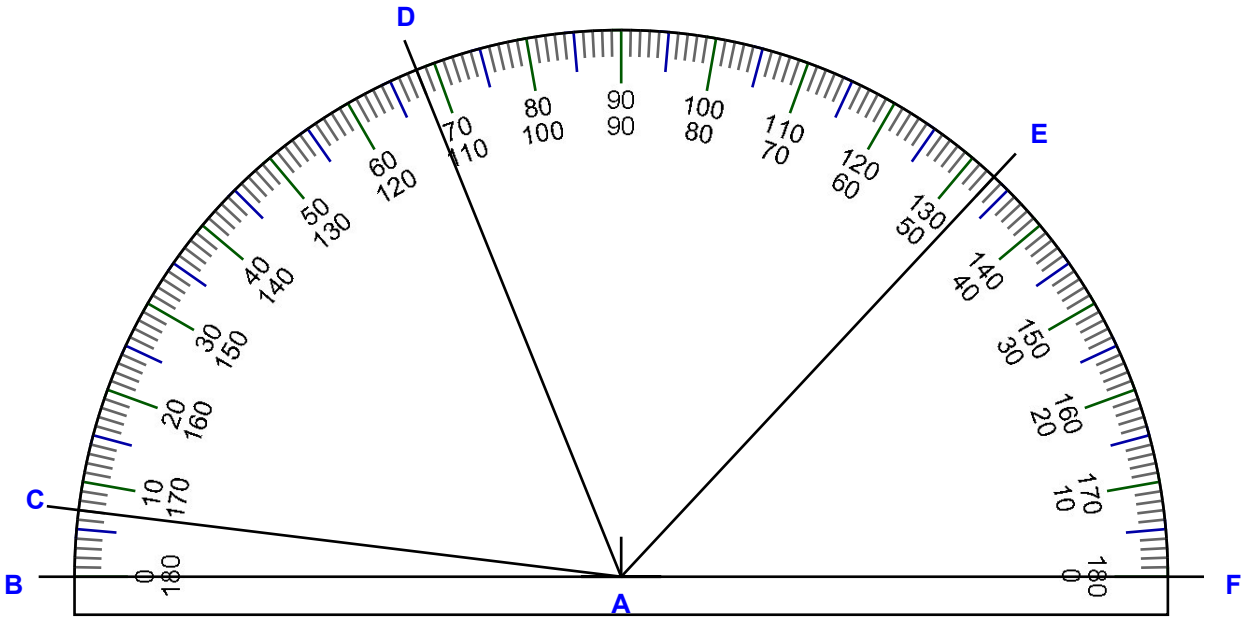

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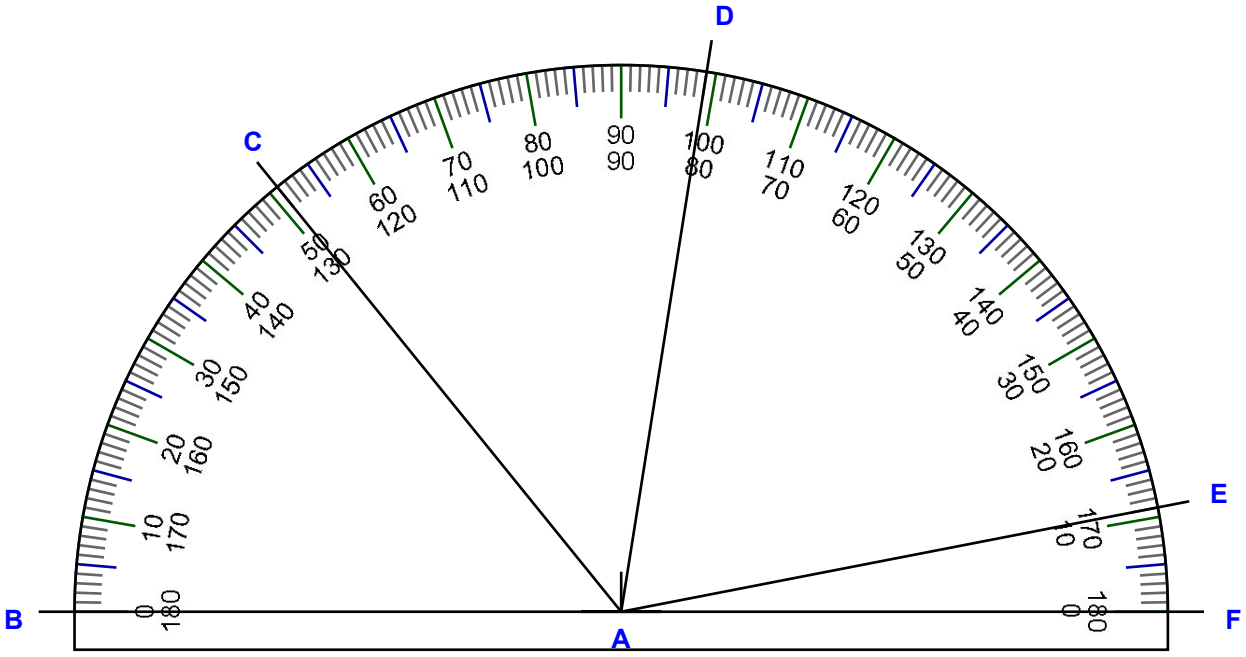

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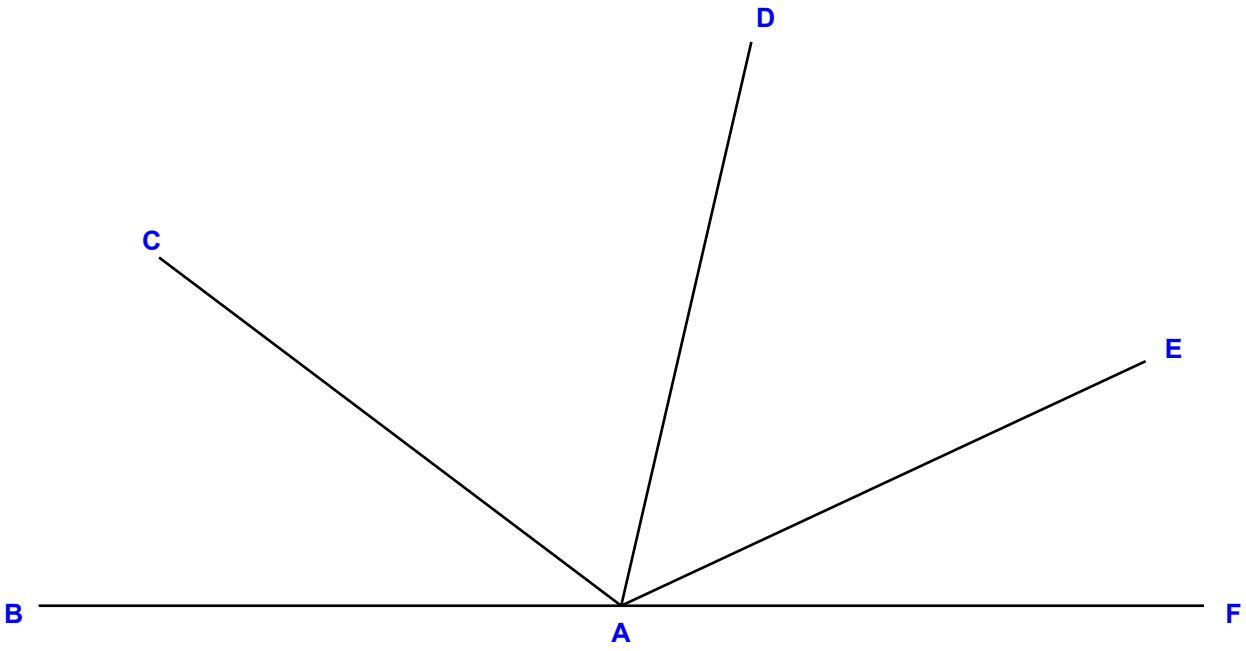
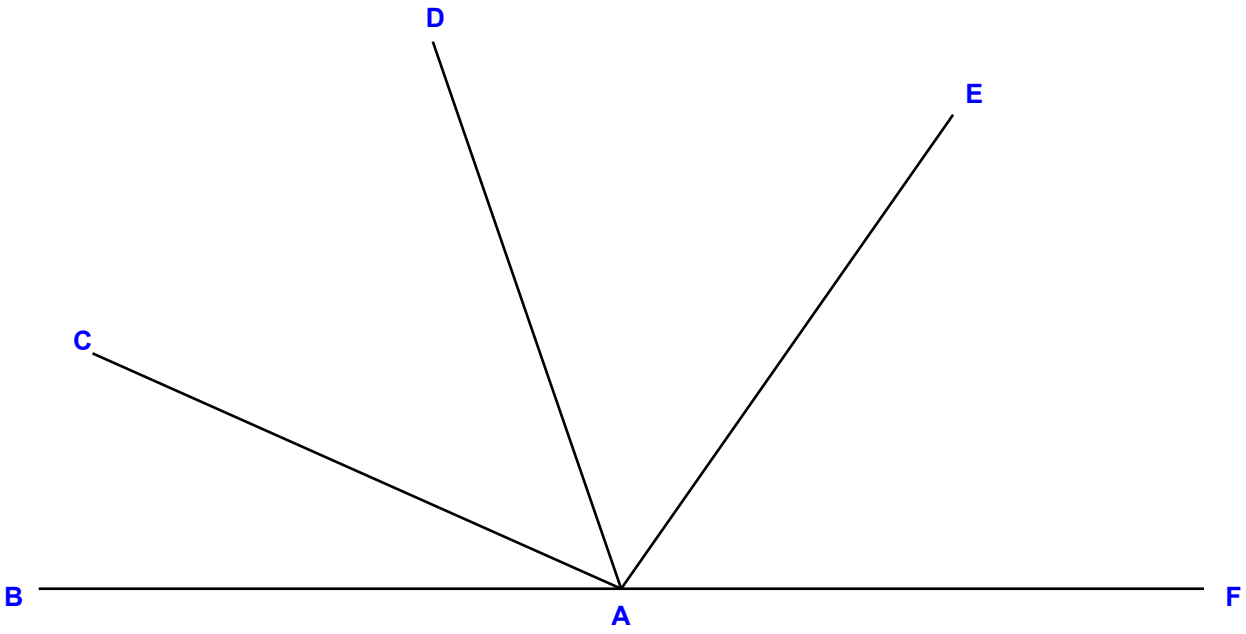


∠ CAB _____ ∠ DAB _____ ∠ EAB _____ ∠ CAF _____ ∠ DAF _____ ∠ EAF _____



∠ CAB _____ ∠ DAB _____ ∠ EAB _____ ∠ CAF _____ ∠ DAF _____ ∠ EAF _____

ACE Standards in Design Grading Rubric	**Advanced (Scores 88-100%)**	**Proficient (Scores 80-88%)**	**Basic (Scores 70-79%)**	**Unacceptable (Scores below 60%)**
Design Process &- Quality Control: Students understand the design process and how to solve analysis and design problems to produce a quality project. Team delegates these tasks effectively to appropriate team member(s).	The item is fabricated in a manner that meets industry standards for quality. Collected & interpreted data verify that it works as designed. Design is clearly producible, safe & feasible to market. Product would likely do well in the competitive marketplace.	The item is fabricated with only minor flaws when compared with basic industry standards. Project meets but does not exceed all design criteria according to rubrics/ collected data. Design is producible, safe or feasible, to market.	Project has three or more minor flaws when compared with industry standards. Project fails to meet one or two design criteria according to collected data. Product may not be producible, safe or feasible, to market.	Project has one or more major flaws that preclude it from meeting industry standards. Data collection is incomplete. Project does not function as designed.
Communications **Listening & Speaking Strategies & Applications:** Properly uses props, visual aids, graphs, and electronic media to enhance the appeal and accuracy of product or design presentations. Team delegates this task effectively to appropriate team member(s).	The team produces and presents computer-rendered and visually projected slides. The presentation is clear and comprehensive and involves all team members.	The team produces and presents good computer-rendered & visually projected slides or examples. Each member participates in an oral report that explains the project.	The team produces and presents examples or computer-rendered and visually projected slides of minimal quality. Only some members participate in an oral report that explains the project. The presentation may lack clarity, is visually & /or verbally unconvincing, or too difficult to understand the teams concepts and ideas.	The team fails to produce and present visually projected images, slides, drawings or models that communicate their design to others. Only one or few team members participate in an oral report that explains the project.
Leadership & Teamwork: Understand how to organize and structure work individually and in teams for effective performance and the attainment of goals. Team delegates this task effectively to appropriate team member(s).	The team is observed work ing cooperatively and effectively. All members participate and contribute. Effective use is made of the tools. Project is complete at or before the deadline.	The team is observed working effectively. Most members participate and contribute. Effective use is made of the tools. Project is completed no later than the deadline.	The team is observed working with a minimum of cooperation. Not all members participate and contribute. Minimal use is made of the tools. Project is completed later than the deadline.	The team is observed not working cooperatively. Many team members do not participate and contribute regularly or equally. Ineffective or no use is made of the tools. Project is completed late. Efficiency of the delegation of team work is completely lacking. Tools are used improperly.
Problem Solving & Critical Thinking: Apply appropriate problem-solving strategies and critical thinking skills to work-related issues and tasks, both individually & as a design team that apply directly to the design challenge or problem.	Students use logic and critical thinking skills to produce a very accurate drawing from the model. Scale , function & proportion are replicated accurately through analysis and observation. Creative solutions are used in a professional manner.	Students use logic and critical think ing skills to produce an accurate drawing from the model. Scale, function, proportion are replicated satisfactorily, with one or two errors. Solutions are somewhat creative.	Students use logic and critical thinking skills to produce a drawing from the model. Scale and proportion are presented or replicated, with more than two errors. Solutions show little thought or lack creativity.	Students do not produce a feasible drawing, prototype or model , or scale and proportion are not represented or replicated well. Little forethought or effort is apparent in end-product. Lacks any realistic application or viability in real world.

20. FRACTIONAL AND DECIMAL INCH AND MILLIMETER EQUIVALENTS

Decimal measurements may be set off directly on drawings with the aid of an engineers scale, Sec. 3.22.
Metric measurements may be set off directly on drawings with a metric scale.

4ths	8ths	16ths	32nds	64ths	To 4 Places	To 3 Places	To 2 Places	Millimeters
				1/64	.0156	.016	.02	.397
			1/32		.0312	.031	.03	.794
				3/64	.0469	.047	.05	1.191
		1/16			.0625	.062	.06	1.588
				5/64	.0781	.078	.08	1.984
			3/32		.0938	.094	.09	2.381
				7/64	.1094	.109	.11	2.778
	1/8				.1250	.125	.12	3.175
				9/64	.1406	.141	.14	3.572
			5/32		.1562	.156	.16	3.969
				11/64	.1719	.172	.17	4.366
		3/16			.1875	.188	.19	4.762
				13/64	.2031	.203	.20	5.159
			7/32		.2188	.219	.22	5.556
				15/64	.2344	.234	.23	5.953
1/4					.2500	.250	.25	6.350
				17/64	.2656	.266	.27	6.747
			9/32		.2812	.281	.28	7.144
				19/64	.2969	.297	.30	7.541
		5/16			.3125	.312	.31	7.938
				21/64	.3281	.328	.33	8.334
			11/32		.3438	.344	.34	8.731
				23/64	.3594	.359	.36	9.128
	3/8				.3750	.375	.38	9.525
				25/64	.3906	.391	.39	9.922
			13/32		.4062	.406	.41	10.319
				27/64	.4219	.422	.42	10.716
		7/16			.4375	.438	.44	11.112
				29/64	.4531	.453	.45	11.509
			15/32		.4688	.469	.47	11.906
				31/64	.4844	.484	.48	12.303
					.5000	.500	.50	12.700
				33/64	.5156	.516	.52	13.097
			17/32		.5312	.531	.53	13.494
				35/64	.5469	.547	.55	13.891
		9/16			.5625	.562	.56	14.288
				37/64	.5781	.578	.58	14.684
			19/32		.5938	.594	.59	15.081
				39/64	.6094	.609	.61	15.478
	5/8				.6250	.625	.62	15.875
				41/64	.6406	.641	.64	16.272
			21/32		.6562	.656	.66	16.669
				43/64	.6719	.672	.67	17.066
		11/16			.6875	.688	.69	17.462
				45/64	.7031	.703	.70	17.859
			23/32		.7188	.719	.72	18.256
				47/64	.7344	.734	.73	18.653
3/4					.7500	.750	.75	19.050
				49/64	.7656	.766	.77	19.447
			25/32		.7812	.781	.78	19.844
				51/64	.7969	.797	.80	20.241
		13/16			.8125	.812	.81	20.638
				53/64	.8281	.828	.83	21.034
			27/32		.8438	.844	.84	21.431
				55/64	.8594	.859	.86	21.828
	7/8				.8750	.875	.88	22.225
				57/64	.8906	.891	.89	22.622
			29/32		.9062	.906	.91	23.019
				59/64	.9219	.922	.92	23.416
		15/16			.9375	.938	.94	23.812
				61/64	.9531	.953	.95	24.209
			31/32		.9688	.969	.97	24.606
				63/64	.9844	.984	.98	25.003
					1.0000	1.000	1.00	25.400

DRAFTING 1- VOCABULARY

acute angle: An angle less than 90°.

arc: A segment of a circle.

axis: A reference line from which distances or angles are measured in a coordinate system; a center point or line in which parts of a structure may be referenced.

circumference: The boundary line of a circle.

concentric: Having a common center**.**

diagonal: A line or plane having a slanted or oblique direction.

diameter: A straight line segment passing through the center of a figure, especially of a circle or sphere.

eccentric: Objects **not** sharing a common center**.**

ellipse: A plane curve, especially: a. A conic section whose plane is not parallel to the axis, base, or generatrix of the intersected cone. An "eccentric" or irregular circular form.

horizontal: Parallel to or in the plane of the horizon. At right angles to a vertical line.

intersect: To cut across or through. To form an overlapping intersection with.

obtuse angle: An angle greater than 90° and less than 180°**.**

perpendicular: At right angles to the horizon or to level ground. vertical, upright.

parallel: Lying in the same plane and not intersecting.

radius: A line segment that joins the center of a circle with any point on its circumference.

tangent: Making contact at a single point or along a line; touching but not intersecting.

quadrant: A circular arc of 90°; one fourth of the circumference of a circle.

vertical: Being or situated at right angles to the horizon, an upright line or object.