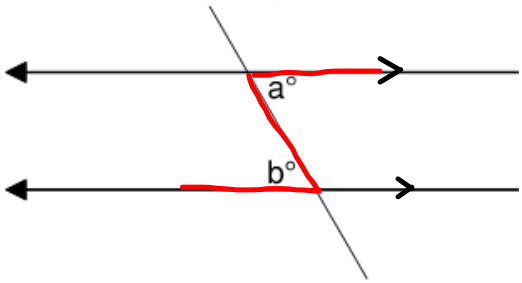
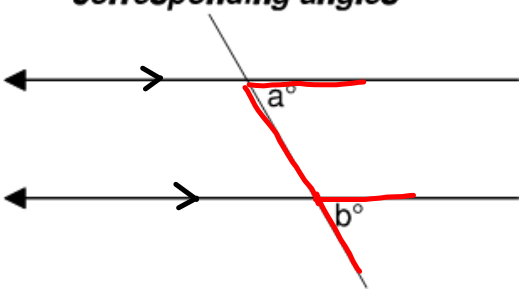
Chapter 7 - Angles and Parallel Lines

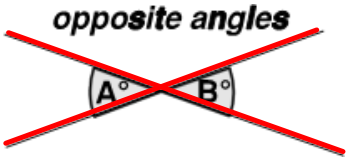
alternate angles



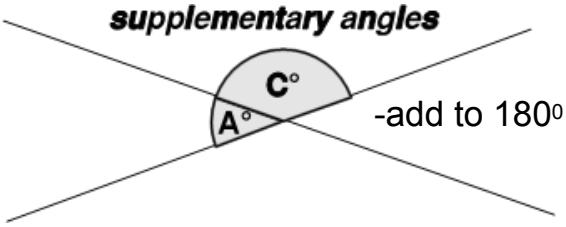
corresponding angles



opposite angles

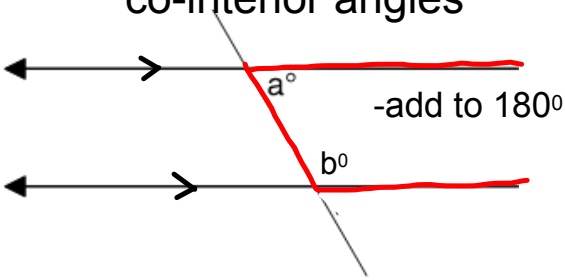


supplementary angles



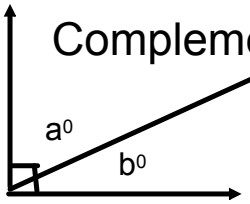
-add to 180^0

co-interior angles



-add to 180^0

Complementary



-add to 90^0

Let's talk angles...

Take a moment to look at the structures in your classroom that contain **angles**. Consider who would have been involved in creating the structures that have those angles, for example, architects, designers, surveyors, and carpenters. Angles are also useful to people who do not make structures. Aircraft pilots and boat pilots use angles for navigation. Astronomers use angles to locate objects in the sky.

So, what exactly is an angle? An angle is formed when two rays meet at a common endpoint called a vertex. Angles are measured with tools, such as a protractor, that are marked in degrees.

Visualize an angle that is used to express direction in navigation and mapping, such as east. In this case, the angle is measured relative to true north, which is 0° and may be expressed as a bearing. A **true bearing** describes the number of degrees, measured clockwise, between an imaginary line pointing towards true north (geographic north) and another imaginary line pointing towards an intended direction or along a pathway. East is represented in land navigation and mapping at a 90° angle from true north.

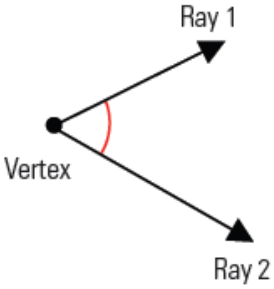
Angle measures can be estimated by using **referents**, which are common measurements like 90°, 45°, 30°, and 22.5°.

How can we draw angles? The tools used to measure angles can also be used to draw or replicate angles having specific measures. Tools have been designed to measure and create angles having only one or two specific measures, such as a set square used in technical drawings to draw right angles.

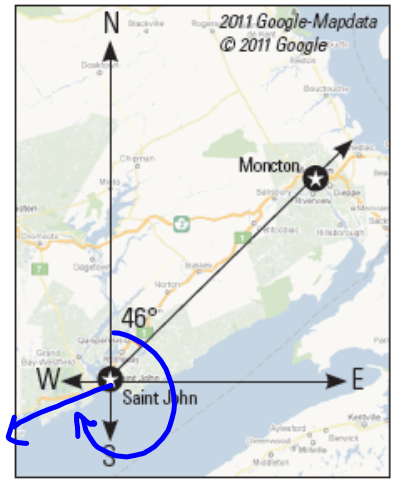
You have used a protractor and ruler to draw angles. You can also draw certain angles with a ruler and compass, and you can replicate any angle with these tools.

Key Terms...

angle: two rays that meet at a point called the vertex



true bearing: the angle measured clockwise between true north and an intended path or direction, expressed in degrees

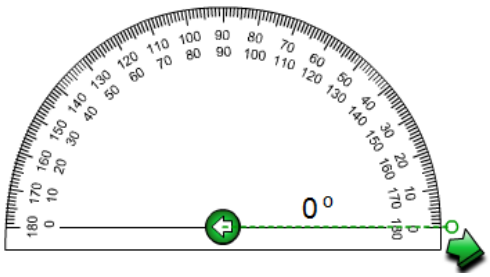


angle measure: a number representing the spread of the two rays of an angle, expressed in degrees

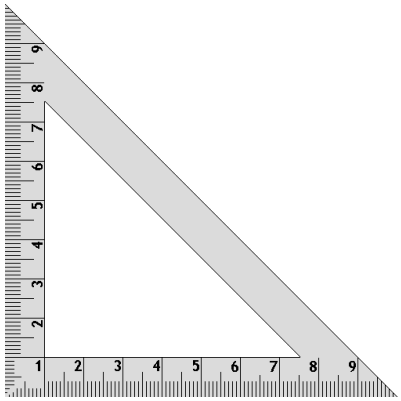
angle referent: a common standard of angle measure, for example, 0°, 45°, 90°, 180°, and 360°; they are used to estimate angles

Geometry Set... Bring tomorrow!

Protractor

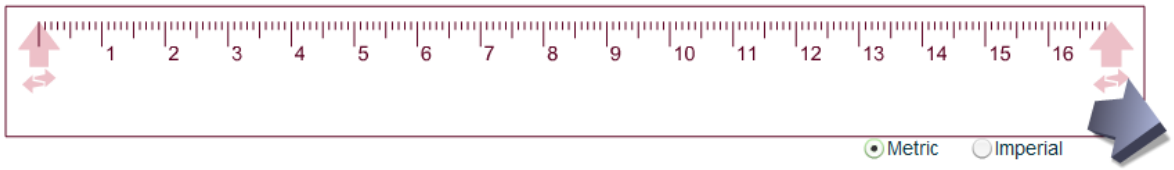


Right Triangle



Compass

Ruler



Some More Key Terms...

Acute angle - measure is between 0° and 90°

Right angle - measure is 90°; the two rays are perpendicular to each

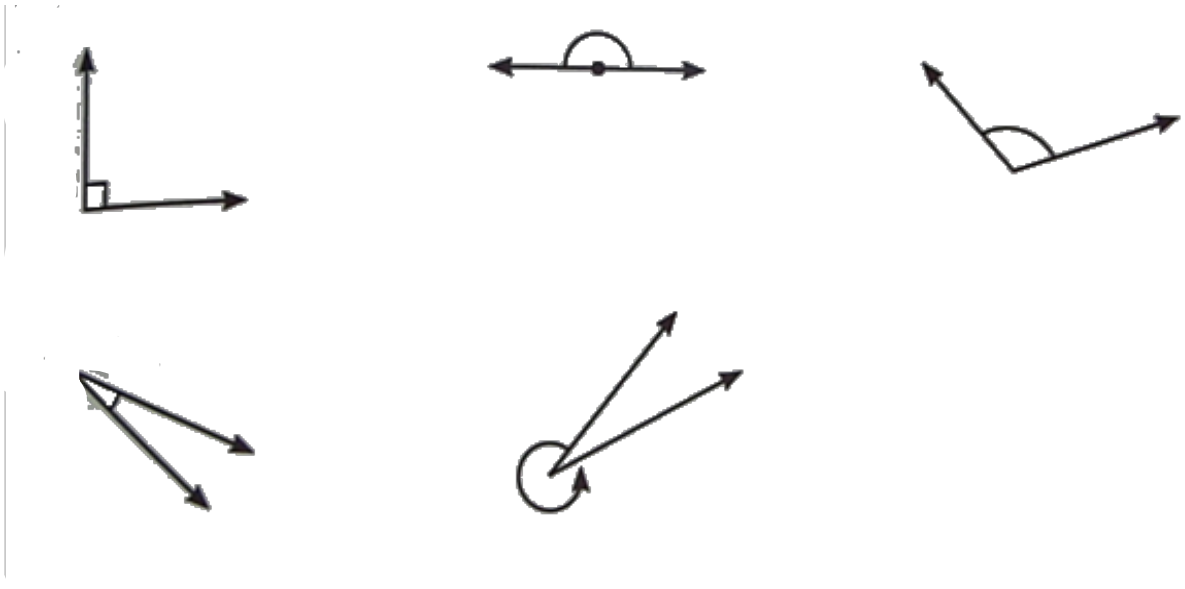
Obtuse angle - measure is between 90° and 180°

Straight angle - measure is 180°

Reflex angle - measure is between 180° and 360°

FIVE TYPES OF ANGLES	
Definition of angle	*Kind of angle*
greater than 0° but less than 90°	acute
90°	right
greater than 90° but less than 180°	obtuse
180° (two rays share a vertex and point in opposite directions)	straight
greater than 180° but less than 360°	reflex

EXERCISE: Identify each of the following angles using the correct terminology...



More Key Terms...

complementary angles:
two angles that have measures that add up to 90°

supplementary angles:
two angles that have measures that add up to 180°

Sort the following angles into pairs of **complementary** and **supplementary** angles.

Complementary
$\angle A + \angle D$
$\angle F + \angle C$

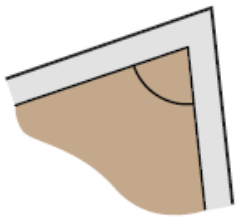
Supplementary
$\angle C + \angle E$
$\angle B + \angle H$

$\angle A = 42°$
$\angle B = 107°$
$\angle C = 59°$
$\angle D = 48°$
$\angle E = 121°$
$\angle F = 31°$
$\angle G = 19°$
$\angle H = 73°$

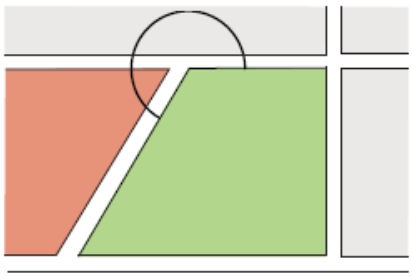
Estimating Angles using Referent Angles

Estimations are made in many trades that use angles. Imagine that you are working as a tradesperson in the situations below and make the following estimations (aim to be within 5°).

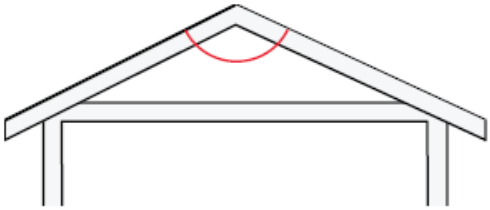
a) a landscaper estimating the angle of the corner of a garden bed



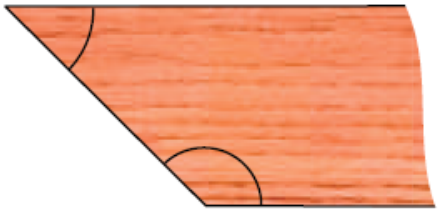
b) a surveyor estimating the angle of a property boundary line on a map



c) a roofer estimating the angle of the peak of a roof



d) a cabinet-maker estimating the angles of two corners of a shelf



SOLUTION

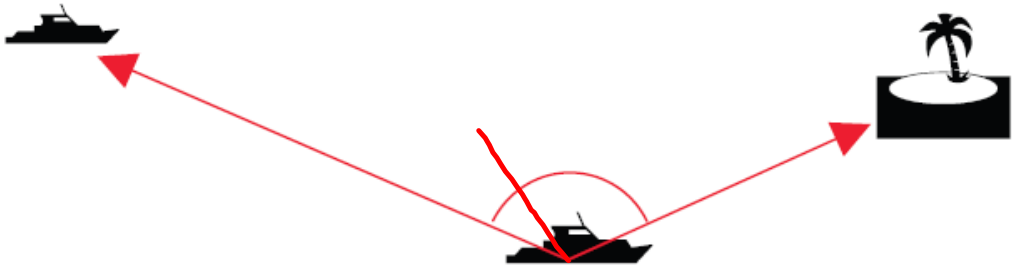
a) Students will be able to recognize a 90° angle without measuring, so they should be able to look at this angle and estimate it to be slightly less than 90°. They might also compare it to a real-life example of 90°, such as a corner. They will probably rotate the page on which the diagram appears, to position the angle so that one of the rays is horizontal, which will show clearly that the angle is an acute angle, less than 90°. A close estimate would be within 76° to 80°.

b) Students will be able to see instantly that this angle is more than 180°, but not quite big enough to add another 45°. So they may describe it as "a straight angle (180°) plus about a bit less than one-half of a right angle (45°)", and come up with a close estimate of 219° to 223°.

c) Students will see that this is greater than 90° but not quite wide enough to add another 45°. The will be able to suggest a close estimate of around 130°.

d) The acute angle is the top left corner can be seen to be a 45° angle by using a referent. The obtuse angle in the lower left corner can be seen to be a right angle plus a little more than a 45° angle so a close estimate will be about 145°.

Estimate the measure of this angle without using a measuring device.



7.1 - Measuring, Drawing and Estimating Angles

MATH *ON THE JOB*

Sue Rendell's job takes her from the digital world of graphic design and social media to granite cliffs inhabited by caribou, mink, and red fox. Sue and her partner Bob Hicks own and operate Gros Morne Adventures. Their guiding company takes customers on kayaking, hiking, snowshoeing, and ski touring trips through Gros Morne National Park. When guiding guests "we work with maps and a compass on some of our outings, which involves angles, bearings, and declination," says Sue.

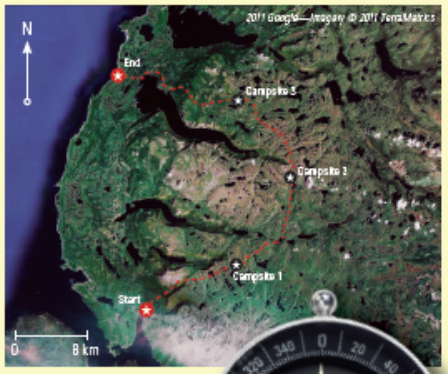
Sue was born in Gander, NL, but grew up in Goose Bay, Labrador. Her ancestors arrived in Newfoundland from England and Ireland in the late 1700s and mid 1800s.

Susan went to high school at St. Paul's High School in Gander, NL.

When not in the park, Sue markets her business through social media, photography, presentations, and print ads that she designs. This involves calculating dimension when she scales photos to include in advertisements. Her business also includes a café, so Sue must calculate food and labour costs and menu pricing. She also estimates staffing costs.

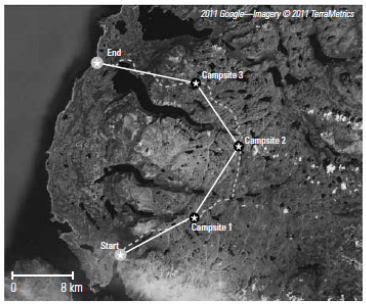
Sue guides hikes through Gros Morne National Park, NL, which is a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site. While they hike, her guests enjoy the park's mountains, fjords, waterfalls, and beaches.

Sue is planning to take guests on a challenging four-day hike along the Long Range Traverse route. Over the course of the hike, her guests will spend three nights at rough campsites along the route.



1. As a safety precaution, all hikers going into the backcountry need to know how to use a compass and map. Compasses are divided into 360°, as shown. Using the map provided, give the direction in degrees the hikers will need to take:
   a) From the start point to the first campsite.
   b) From the first campsite to the second campsite.
   c) From the second campsite to the third campsite.
   d) From the third campsite to the end point.
2. Using the scale provided, estimate the approximate length of the hike if hikers followed the route shown here.

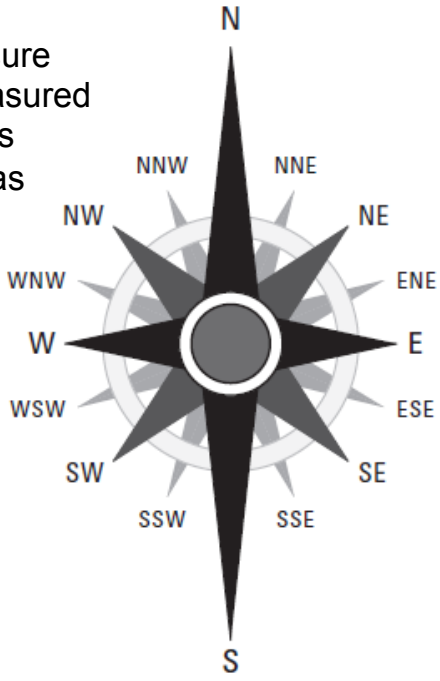
SOLUTION



1. Using Blackline Master 7.1 (p. 458), have students draw line segments to show what the directions the hikers will roughly follow between destinations and then use a protractor to calculate the number of degrees between north and the line the hikers will be travelling along. Suggest to students that they can more easily measure the degrees by extending the lines beyond the destination points to that they line up with the markings on their protractor.
   a) 65°
   b) 33°
   c) 325°
   d) 282°
2. As students are being asked to estimate the length of the hike, the answers here will vary. Students should measure the route with a ruler then convert the measured value using the scale provided. Answers should range between 40 and 50 km.

Working with True Bearing

In navigation and map-making, people often measure angles from the vertical, or north. The angle, measured in a clockwise direction from a line pointing north is referred to as the ***true bearing.*** Straight north has a bearing of 0°



NAVIGATIONAL BEARING	
Direction	*Bearing*
N	0°
NNE	22.5°
NE	45°
ENE	67.5°
E	90°
ESE	112.5°
SE	135°
SSE	157.50°
S	180°
SSW	202.5°
SW	225°
WSW	247.5°
W	270°
WNW	292.5°
NW	315°
NNW	337.5°

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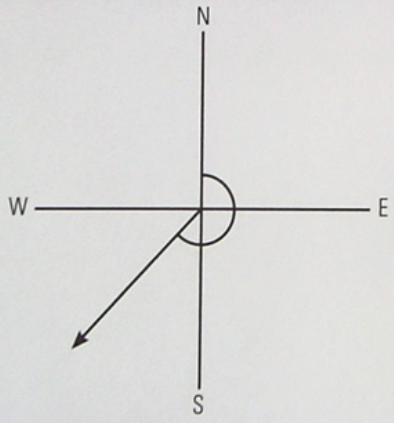
EXAMPLE...

A boat is heading directly southwest. What is its true bearing?

225° SW

SOLUTION



If the boat is heading southwest, measuring from the vertical will give you an obtuse angle of 225° (45° beyond a straight angle).

EXERCISE:

1) If a boat is travelling 25^{o} south of straight east, what is its true bearing?

(Solution - 115^{o})

2) What is the true bearing of a boat travelling south?

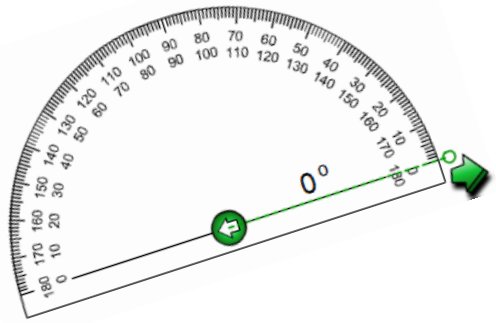
(Solution - 180^{o})

3) What is the true bearing of a boat travelling north-northwest?

(Solution - 337.5^{o})

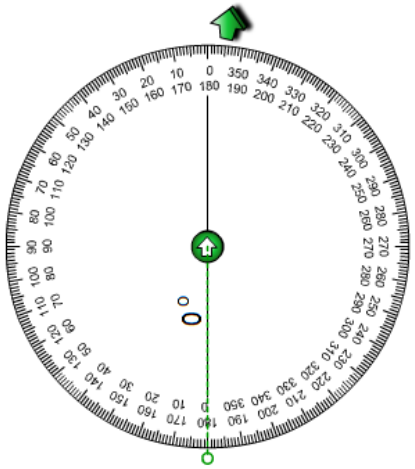
Examples...

a) Determine the true bearing bet... d B.



78°

b) Determine the true bearing between A and B.



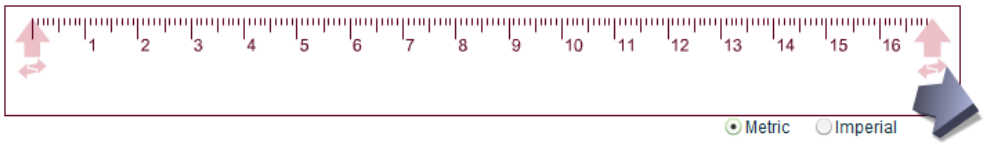
110°

Example 1

Use a ruler and compass to create the following angles.

a) Draw a 90° angle.

b) Replicate any existing angle.



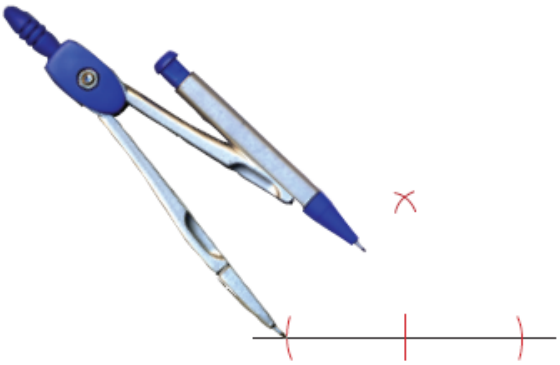
Angle Constructions... 1) Perpendicular Bisector

STEP 1:

Put the compass point at the mark you made. Open the compass slightly and make two more marks on each side of the first mark. Ensure they are the same distance from the first mark.

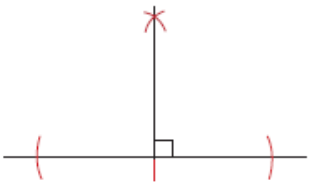
STEP 2:

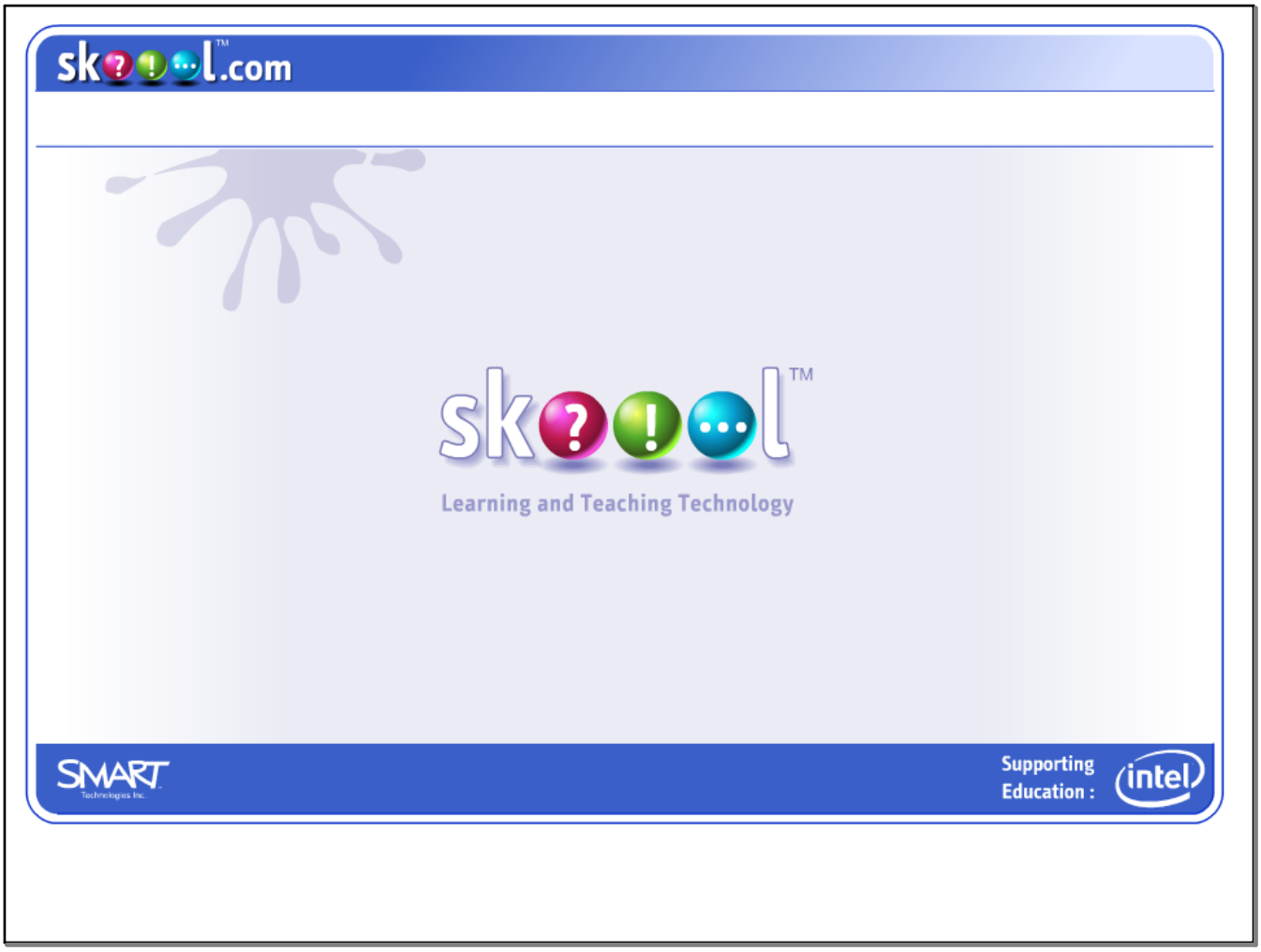
Widen the compass a bit more, and place the compass point at one of the new marks. Make a small arc, then do the same thing after placing the compass point at the other new mark. Ensure the two arcs intersect each other.



STEP 3:

Draw a line segment that goes between or through the point where the arcs intersect and the first mark you made. The two line segments are perpendicular to each other, and therefore form a 90° (right) angle.

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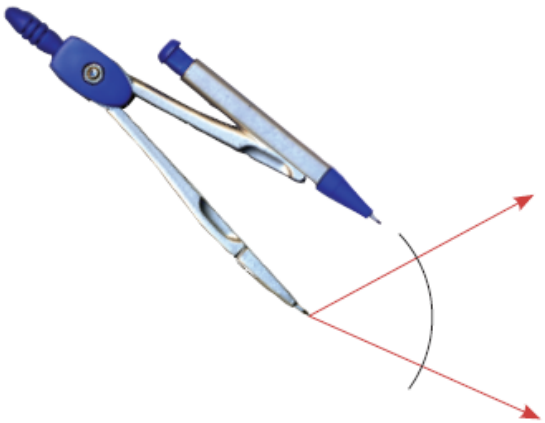
Angle Constructions... 2) Replicate an Angle

STEP 1:

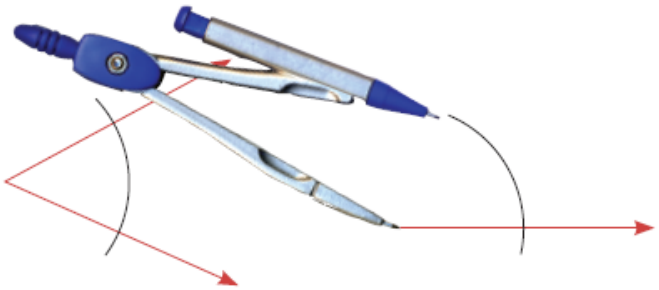
b) To replicate any existing angle, follow these steps.

Use a compass to lightly draw an arc centred at the vertex of the original angle.



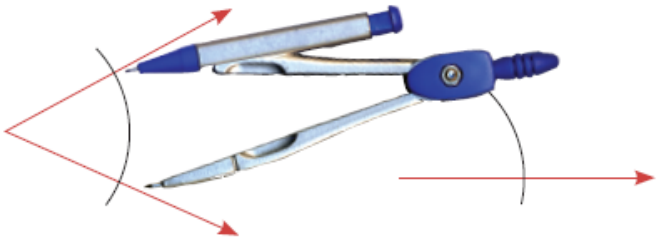
STEP 2:

Use a ruler to draw one side of the new angle, and draw an arc of the same radius and arc length as the one you just drew on the original angle.



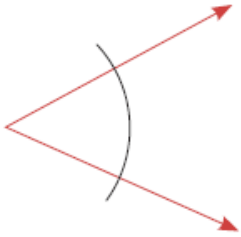
STEP 3:

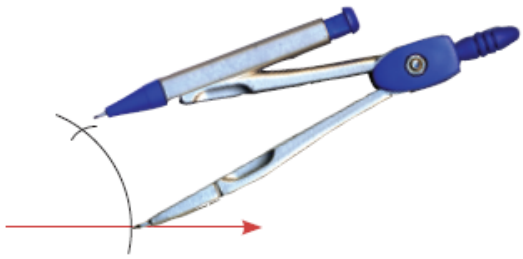
Bring the compass up to the original angle, and set it so that its point and the tip of the pencil touch the points where the original arc intersects the sides of the angle.



STEP 4:

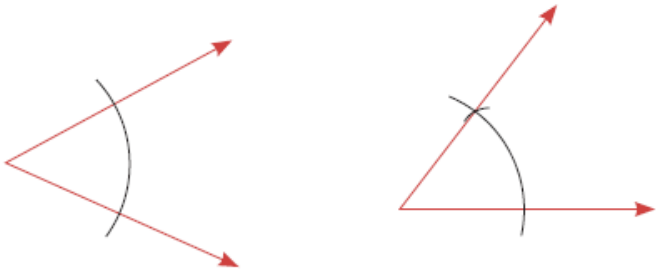
Place the compass point over to the point of intersection of the side of the new angle and the new arc. Draw a short arc through the new arc.



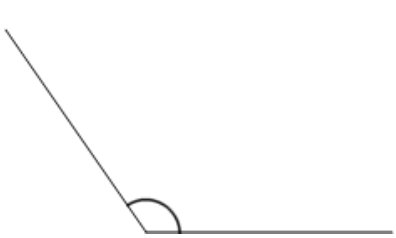


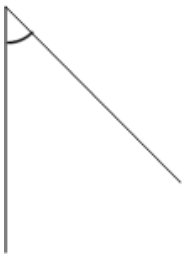
STEP 5:

Use the ruler to draw the other side of the angle, from the left end of the first side (the vertex) through the point of intersection of the two arcs. The result is a new angle with the same measure as the original.



Let's try a few...





HOMEWORK...

p. 284 #1 - 7 (omit #6)

7.1 - Build Your Skills Detailed Solutions.pdf

Attachments

7.1 - Build Your Skills Detailed Solutions.pdf