

## 6.4 Leap Year

### *A Practice Understanding Task*

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Carlos and Clarita are discussing their latest business venture with their friend Juanita. They have created a daily planner that is both educational and entertaining. The planner consists of a pad of 365 pages bound together, one page for each day of the year. The planner is entertaining since images along the bottom of the pages form a flip-book animation when thumbed through rapidly. The planner is educational since each page contains some interesting facts. Each month has a different theme, and the facts for the month have been written to fit the theme. For example, the theme for January is astronomy, the theme for February is mathematics, and the theme for March is ancient civilizations. Carlos and Clarita have learned a lot from researching the facts they have included, and they have enjoyed creating the flip-book animation.

The twins are excited to share the prototype of their planner with Juanita before sending it to printing. Juanita, however, has a major concern. "Next year is leap year," she explains, "you need 366 pages."

So now Carlos and Clarita have the dilemma of having to create an extra page to insert between February 28 and March 1. Here are the planner pages they have already designed.



## February 28

A circle is the set of all points in a plane that are equidistant from a fixed point called the center of the circle.

An angle is the union of two rays that share a common endpoint.

An angle of rotation is formed when a ray is rotated about its endpoint. The ray that marks the beginning of the rotation is referred to as the "initial ray" and the ray that marks the end of the rotation is referred to as the "terminal ray."

Angle of rotation can also refer to the number of degrees a figure has been rotated around a fixed point, with a counterclockwise rotation being considered a positive direction of rotation.



## March 1

Why are there 360° in a circle?

One theory is that ancient astronomers established that a year was approximately 360 days, so the sun would advance in its path relative to the earth approximately  $1/360$  of a turn, or one degree, each day. (The 5 extra days in a year were considered unlucky days.)

Another theory is that the Babylonians first divided a circle into parts by inscribing a hexagon consisting of 6 equilateral triangles inside a circle. The angles of the equilateral triangles located at the center of the circle were further divided into 60 equal parts, since the Babylonian number system was base-60 (instead of base-10 like our number system).

Another reason for 360° in a circle may be the fact that 360 has 24 divisors, so a circle can easily be divided into many smaller, equal-sized parts.



## Part 1

Since the theme for the facts for February is mathematics, Clarita suggests that they write formal definitions of the three rigid-motion transformations they have been using to create the images for the flip-book animation.

How would you complete each of the following definitions?

1. A translation of a set of points in a plane... It is a transformation that moves / slides every pt of a pre-image the same distance to preserve size & shape.  
\* All segments connecting the corresponding pts are  $\parallel$ .
2. A rotation of a set of points in a plane... It is a transformation in which a preimage is turned about a fixed pt called the center of rotation.  
\* The corresponding pts of the image & preimage are equidistant from the center of rotation.

3. A reflection of a set of points in a plane ... It is a transformation that used a line of reflection to create a mirror image of the pre-image.  
\* The line of reflection will be the  $\perp$  bisector of the segments connecting corresponding pts.


4. Translations, rotations and reflections are rigid motion transformations because ...

They preserve distance  
 $\Leftrightarrow$  angle measures.

Carlos and Clarita used these words and phrases in their definitions: perpendicular bisector, center of rotation, equidistant, angle of rotation, concentric circles, parallel, image, pre-image, preserves distance and angle measures.

Revise your definitions so they also use these words or phrases.

## **Part 2**

In addition to writing new facts for February 29, the twins also need to add another image in the middle of their flip-book animation. The animation sequence is of Dorothy's house from  of Oz as it is being carried over the rainbow by a tornado. The house in the February 28 drawing has been rotated to create the house in the March 1 drawing. Carlos believes that he can get from the February 28 drawing to the March 1 drawing by reflecting the February 28 drawing, and then reflecting it again.

Verify that the image Carlos inserted between the two images that appeared on February 28 and March 1 works as he intended. For example,

- What convinces you that the February 29 image is a reflection of the February 28 image about the given line of reflection?

- What convinces you that the **March 1** ~~February 29~~ image is a reflection of the **Feb. 29** ~~February 28~~ image about the given line of reflection?