

**Problem 1** (4 points). We are given an angle  $\theta = 15^\circ$  in standard position.

- (i) (2 points) Find an angle coterminal with  $\theta$  between  $720^\circ$  and  $1080^\circ$ .

Answer, in degrees:  $15 + 360 * 2 = 735^\circ$     Answer, in radians:  $735 \times \frac{2\pi}{360^\circ} = \frac{49}{12}\pi$

- (ii) (2 points) Find *all* angles coterminal with  $\theta$ .

Answer, in degrees:  $15^\circ + n \cdot 360^\circ$     Answer, in radians:  $15 \times \frac{2\pi}{360^\circ} + n \cdot 2\pi = \frac{1}{12}\pi + n \cdot 2\pi$ .

**Problem 2** (4 points). We are given an angle  $\phi = \frac{5\pi}{4}$  in standard position.

- (i) (2 points) Find an angle coterminal with  $\phi$  between  $-4\pi$  and  $-2\pi$ .

Answer, in degrees:  $-\frac{11}{4}\pi \times \frac{360^\circ}{2\pi} = -495^\circ$     Answer, in radians:  $\frac{5}{4}\pi - 2 \times 2\pi = -\frac{11}{4}\pi$ .

- (ii) (2 points) Find *all* angles coterminal with  $\phi$ .

Answer, in degrees:  $\frac{5}{4}\pi \times \frac{360^\circ}{2\pi} + n \cdot 360^\circ = 225^\circ + n \cdot 360^\circ$     Answer, in radians:  $\frac{5}{4}\pi + n \cdot 2\pi$ .

**Problem 3** (1 point). If the actual angle of an angle is  $198^\circ$ , then what is its reference angle?

Answer, in radians: The closest “ $x$ -axis” from  $198^\circ$  is  $180^\circ$ , so the reference angle is  $198^\circ - 180^\circ = 18^\circ$ . In radians, this is  $18^\circ \times \frac{2\pi}{360^\circ} = \frac{1}{10}\pi$ . Note that the angle is in the third quadrant.

**Problem 4** (1 point). If the reference angle of an angle in the fourth quadrant is  $\frac{\pi}{18}$ , then what is its actual angle?

Answer, in degrees: The closest “ $x$ -axis” from the fourth quadrant is  $2\pi$ , and so the acute angle is  $2\pi - \frac{\pi}{18} = \frac{35}{18}\pi$ . In degrees, this is  $\frac{35}{18}\pi \times \frac{360^\circ}{2\pi} = 350^\circ$ .