Trigonometry — Joysheet 2
MAT 145, Spring 2025 — D. Ivanšić

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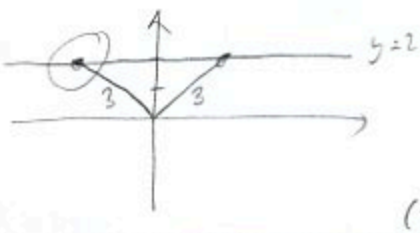
Covers: 6.3, 6.4 *Show all your work!*

1. (9pts) If $\sin\theta = \frac{2}{3}$ and θ is in the second quadrant, find the exact values of all the trigonometric functions of θ. Draw a picture.

$\sin\theta = \frac{2}{3} = \frac{y}{r}$



$x^2 + 2^2 = 3^2$

$x^2 + 4 = 9$

$x^2 = 5$

$x = \pm\sqrt{5}$

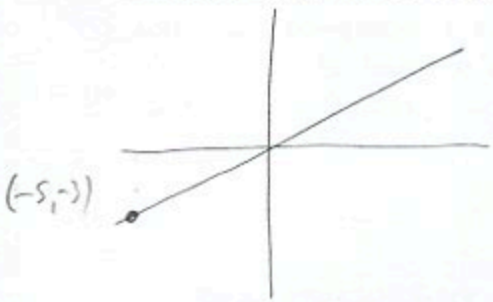
$x = -\sqrt{5}$ (2nd quad)

$\cos\theta = -\frac{\sqrt{5}}{3}$ $\quad \sec\theta = -\frac{3}{\sqrt{5}}$

$\sin\theta = \frac{2}{3}$ $\quad \csc\theta = \frac{3}{2}$

$\tan\theta = -\frac{2}{\sqrt{5}}$ $\quad \cot\theta = -\frac{\sqrt{5}}{2}$

2. (7pts) The terminal side of angle θ is in the third quadrant and lies on the line $3x - 5y = 0$. Find the exact values of $\cos\theta$ and $\cot\theta$. Draw a picture.



$3x - 5y = 0$

$5y = 3x$

$y = \frac{3}{5}x$

$x = -5$

$\Rightarrow y = \frac{3}{5}\cdot(-5) = -3$

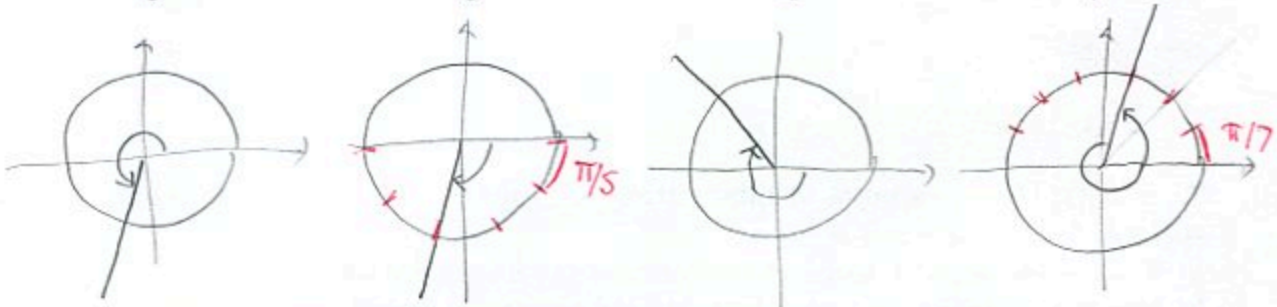
$r = \sqrt{(-5)^2 + (-3)^2} = \sqrt{25+9} = \sqrt{34}$

$\cos\theta = -\frac{5}{\sqrt{34}}$

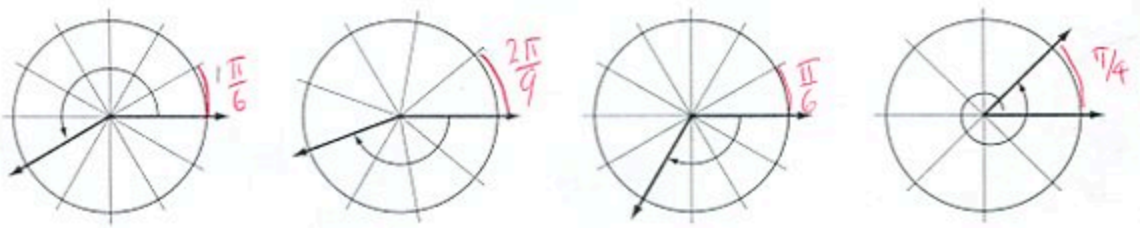
$\cot\theta = \frac{-5}{-3} = \frac{5}{3}$

3. (8pts) Sketch angles in standard position with indicated radian measure.

$\frac{4\pi}{3}$ $\quad -\frac{3\pi}{5}$ $\quad -\frac{5\pi}{4}$ $\quad \frac{17\pi}{7} = \left(2\frac{3}{7}\right)\pi$



4. (8pts) Indicate both the radian and degree measure under the following angles. (Use equally-spaced lines to help you determine what the angles are.)



$\frac{7\pi}{6} = 210^\circ$

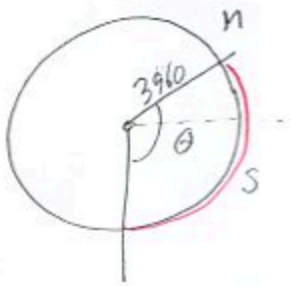
$-\frac{8\pi}{9}, -160^\circ$

$4\cdot\frac{2\pi}{9} = \frac{8\pi}{9}$

$-\frac{4\pi}{6} = -\frac{2\pi}{3} = -120^\circ$

$2\pi + \frac{1}{4}\pi = \left(2+\frac{1}{4}\right)\pi = \frac{9\pi}{4} = 405^\circ$

5. (8pts) What is the distance along Earth's surface from Murray, KY, latitude 36°36′34″N, to the South Pole, if the radius of Earth is 3960 miles?

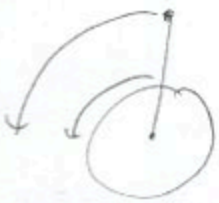


$s = r\theta = 3960 \cdot 2.209752$

$= 8750.616612$ miles

$\theta = 90^\circ + 36^\circ 36' 34'' = 90 + 36 + \frac{36}{60} + \frac{34}{3600} = 126.609444 = 126.6.. \cdot \frac{\pi}{180} = 2.209752$ rad

6. (8pts) A satellite is in geostationary orbit if it is always above a fixed point above the equator, which means it rotates around Earth at the same angular speed as Earth. This orbit is 26,200 miles from the Earth's center. What is the linear speed of a satellite in geostationary orbit?



1 rev = 2π rad

in 24 hrs

$\omega = \frac{2\pi}{24}$ rad/hr

$v = r\omega = 26200 \cdot \frac{2\pi}{24} = \frac{6550\pi}{3} = 6859.14396$ mph

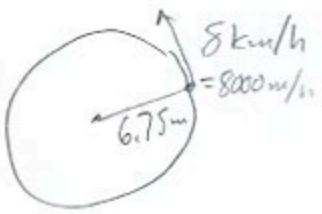
units: $\frac{\text{rad}}{\text{hr}} = \text{mph}$

7. (12pts) On a carousel, a rider sitting 6.75 meters from the center experiences linear speed of 8 kilometers per hour.

a) What is the angular speed of the carousel in radians per minute?

b) How many revolutions per minute does the carousel make?

a)



$v = r\omega$

$8000 = 6.75 \cdot \omega$

$\omega = \frac{8000}{6.75} = 1185.185185$ rad/hr $= 19.753086$ rad/min $\cdot \frac{1}{60}$

b) $\frac{19.75...}{2\pi} = 3.143801$ revs/min

(revolutions)