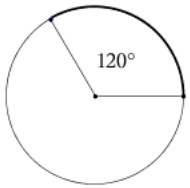
Problem 1

d=3 *inches*



You have a paint roller that has a diameter of 3 inches. You push the roller against the wall and it travels 120°

1) Number of revolutions

$\frac{120}{360} \blacktriangleright \frac{1}{3}$ number of revolutions $= \frac{1}{3}$

2) Measure of the angle in radians

$120 \cdot \frac{\pi}{180} \blacktriangleright \frac{2 \cdot \pi}{3}$ so $\theta = \frac{2 \cdot \pi}{3}$ radians

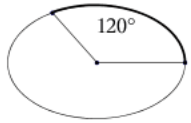
3) Length of of the arc

$s = \theta r$ so $s = \left(\frac{2 \cdot \pi}{3}\right)\left(\frac{3}{2}\right) = \pi$ inches

4) Amount of paint coverage linearly

π inches $\approx$3.142 inches

d=3 *inches*



$\theta = \frac{2 \cdot \pi}{3}$ radians $r = \frac{3}{2}$ inches

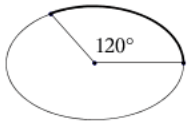
$s = \pi$ inches

5) if it took 10 seconds to roll the roller, then

5a) Find linear speed in inches/second

$$\text{linear speed} = \frac{s}{t} = \frac{\theta r}{t} = \frac{\left(\frac{2 \cdot \pi}{3}\right) \cdot \frac{3}{2} \text{ inches}}{10 \text{ seconds}} = \frac{\pi}{10} \frac{\text{in.}}{\text{sec.}}$$

d=3 *inches*



$\theta = \frac{2 \cdot \pi}{3}$ radians $r = \frac{3}{2}$ inches

$s = \pi$ inches

5) if it took 10 seconds to roll the roller, then

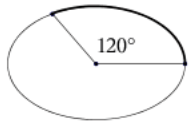
5b) Find linear speed in feet/second

$$\text{linear speed} = \frac{s}{t} = \frac{\theta r}{t} = \frac{\left(\frac{2 \cdot \pi}{3}\right) \cdot \frac{3}{2} \text{ inches}}{10 \text{ seconds}} = \frac{\pi}{10} \frac{\text{in.}}{\text{sec.}}$$

Now convert to $\frac{\text{ft.}}{\text{sec}}$

$$= \left(\frac{\pi}{10} \frac{\text{in.}}{\text{sec.}}\right)\left(\frac{1 \text{ ft.}}{12 \text{ in.}}\right) = \frac{\pi}{120} \frac{\text{ft.}}{\text{sec.}}$$

d=3 *inches*



$\theta = \frac{2 \cdot \pi}{3}$ radians $r = \frac{3}{2}$ inches

$s = \pi$ inches

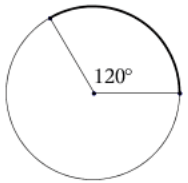
5) if it took 10 seconds to roll the roller, then

5c) Find linear speed in feet/minute

$$\text{linear speed} = \frac{s}{t} = \frac{\theta r}{t} = \frac{\pi}{120} \frac{\text{ft.}}{\text{sec.}}$$

Now convert to $\frac{\text{ft.}}{\text{min.}}$

$$= \left(\frac{\pi}{120} \frac{\text{ft.}}{\text{sec.}}\right)\left(\frac{60 \text{ sec.}}{1 \text{ min.}}\right) = \frac{60\pi}{120} \frac{\text{ft.}}{\text{min.}} = \frac{\pi}{2} \frac{\text{ft.}}{\text{min.}}$$



$\theta = \frac{2\cdot\pi}{3}$ radians $r = \frac{3}{2}$ inches $s = \pi$ inches

Linear speed $= \frac{\pi}{10}\frac{in.}{sec.}$

$= \frac{\pi}{120}\frac{ft.}{sec.}$

$= \frac{\pi}{2}\frac{ft.}{min.}$

6) if it took 10 seconds to roll the roller, then

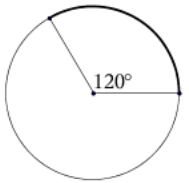
6a) Find angular speed in radians per second

angular speed $= \frac{\theta}{t}$

$= \frac{\frac{2\cdot\pi}{3}}{10}\frac{radians}{sec.}$

$= \frac{2\cdot\pi}{3}\cdot\frac{1}{10}\frac{radians}{sec.}$

$= \frac{\pi}{15}\frac{radians}{sec.}$



$\theta = \frac{2\cdot\pi}{3}$ radians $r = \frac{3}{2}$ inches $s = \pi$ inches

Linear speed $= \frac{\pi}{10}\frac{in.}{sec.}$

$= \frac{\pi}{120}\frac{ft.}{sec.} = \frac{\pi}{2}\frac{ft.}{min.}$

Angular speed $= \frac{\pi}{15}\frac{radians}{sec.}$

6) if it took 10 seconds to roll the roller, then

6a) Find angular speed in radians per minute

angular speed $= \frac{\theta}{t}$

$= \frac{\pi}{15}\frac{radians}{sec.}$

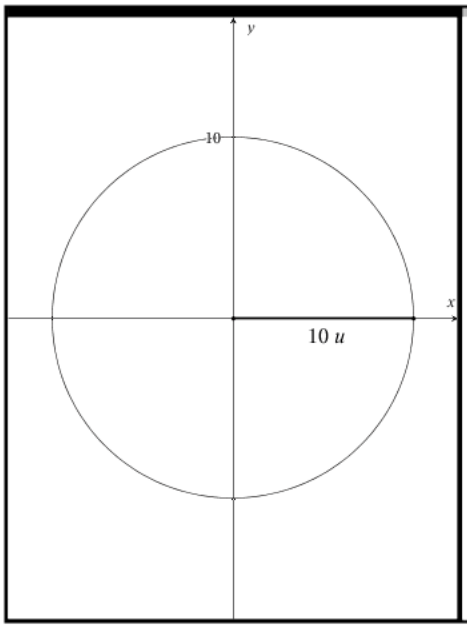
Now convert to $\frac{radians}{minute}$

$= \left(\frac{\pi}{15}\frac{radians}{sec.}\right)\left(\frac{60\ sec.}{1\ min.}\right)$

$= \frac{60\pi}{15}\frac{radians}{min}$

$= 4\cdot\pi\frac{radians}{min}$

Problem 2



7. You are pulling a cart and the cart's wheel is 20 inches in diameter and you notice that the wheel is making 1.8 revolutions per second

1.8 revolutions per second

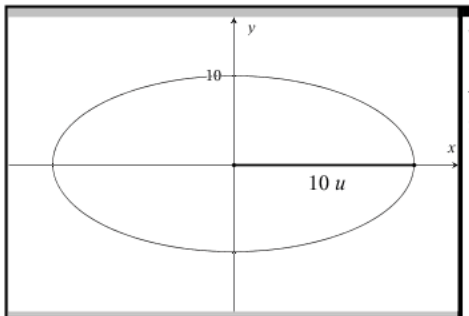
Angular speed $= \frac{1.8\ rev.}{sec.}\cdot\frac{360°}{rev}$

$= \frac{648°}{sec}$

7a) Angular speed $= \frac{1.8\ rev.}{sec.}\cdot\frac{2\pi}{rev}$

$= \frac{3.6\pi\ radians}{sec}$

Note Linear Speed =(Angular speed)(radius)



Angular speed $= \frac{1.8\ rev.}{sec.}\cdot\frac{2\pi}{rev}$

$= \frac{3.6\pi\ radians}{sec}$

$\theta = 3.6\cdot\pi\ radians$ $r = \frac{20}{2} = 10$ inches

7. You are pulling a cart and the cart's wheel is 20 inches in diameter and you notice that the wheel is making 1.8 revolutions per second

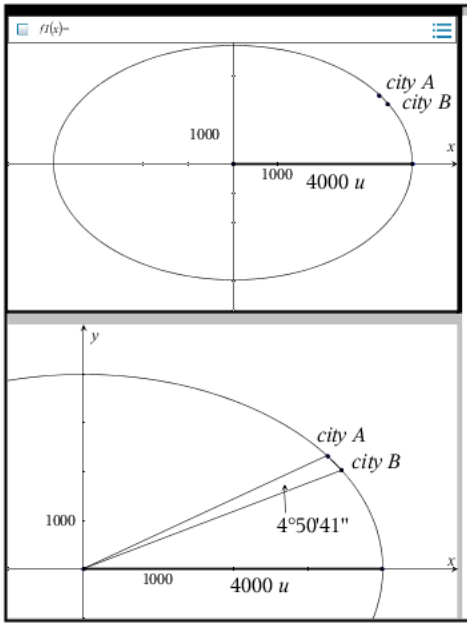
Linear Speed $= \frac{\theta r}{t} = \frac{3.6\cdot\pi\cdot 10\ in.}{1\ sec.}$

$= \frac{36\cdot\pi\ in.}{1\ sec}$

$\approx 113.097\frac{in.}{sec.}$

Note Linear Speed =(Angular speed)(radius)

Problem 3



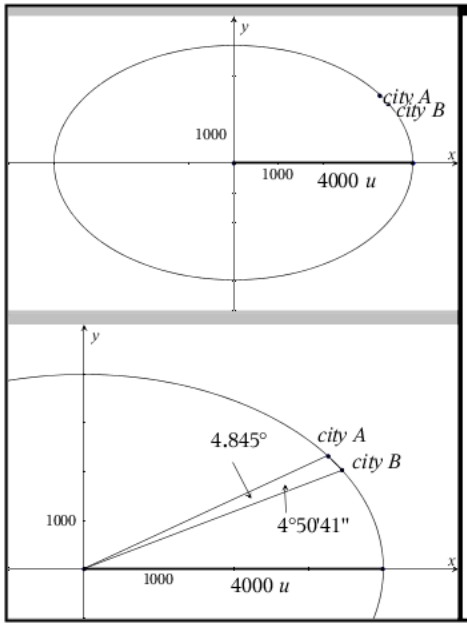
City A has a latitude of 35° 19' 46" N
City B has a latitude of 30° 29' 5" N
City A is due north of City B

8a) What is the difference in latitude measures in DMS?

35° 19' 46" N −30° 29' 5" N =

34° 79' 46" N −30° 29' 5" N =

=4° 50' 41"



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difference in latitude measures in DMS

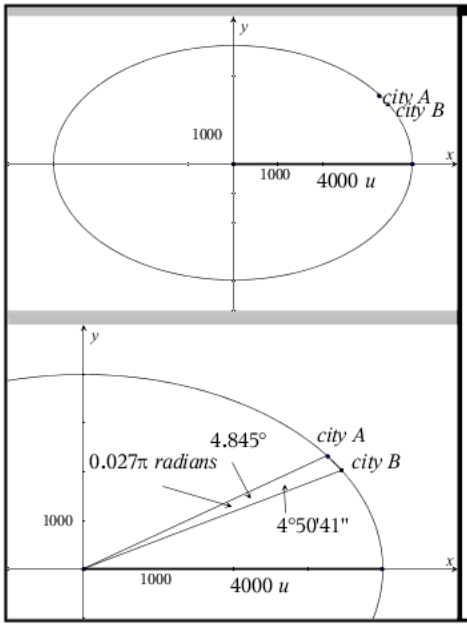
=4° 50' 41"

b. What is the difference in latitude measures in DD?

$4° + \frac{50}{60}° + \frac{41}{3600}°$

$= 4 + \frac{50}{60} + \frac{41}{3600} = \frac{17441}{3600}°$

$= 4.84472222222°$



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difference in latitude measures in DMS

=4° 50' 41"

difference in latitude measures in DD

$= 4.84472222222°$

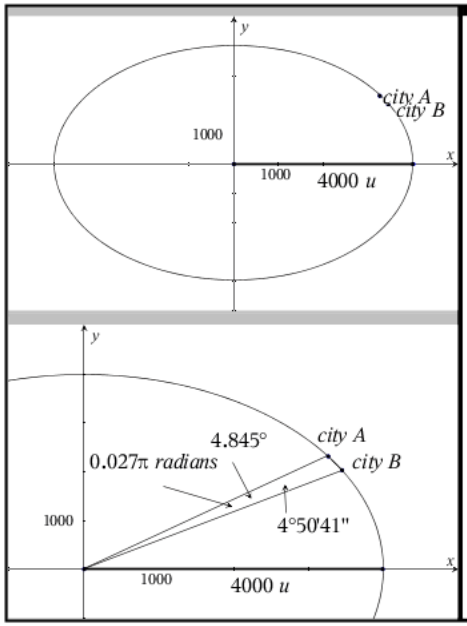
8c. What is radian measure of the latitude difference?

$4.84472222222° \cdot \frac{\pi}{180°}$ radians

$\frac{17441 \cdot \pi}{648000}$ radians

but for our purposes $\approx 0.027\,\pi$ radians will do

So $\theta \approx 0.027\,\pi$ radians



City A has a latitude of 35° 19' 46" N
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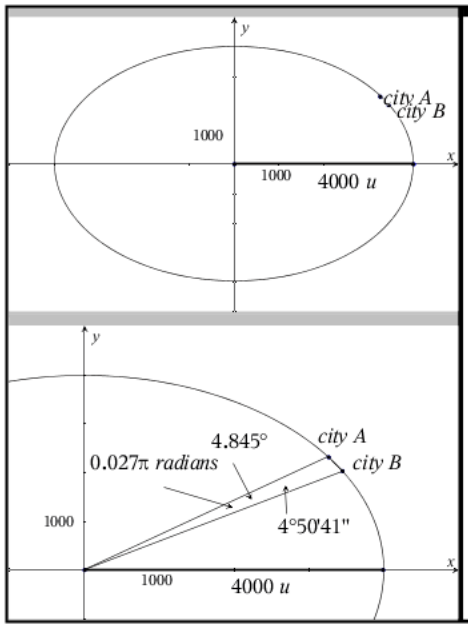
radius of earth approximately 4000 miles

$\theta = \frac{17441 \cdot \pi}{648000}$ radians $\quad \theta \approx 0.027\,\pi$ radians

8d. What is the EXACT distance between cities?

$s = \theta r = \frac{17441 \cdot \pi}{648000} \cdot 4000 = \frac{17441 \cdot \pi}{162}$ miles

$s = \theta r \approx (0.027\,\pi)(4000) \approx 108.\,\pi$ miles



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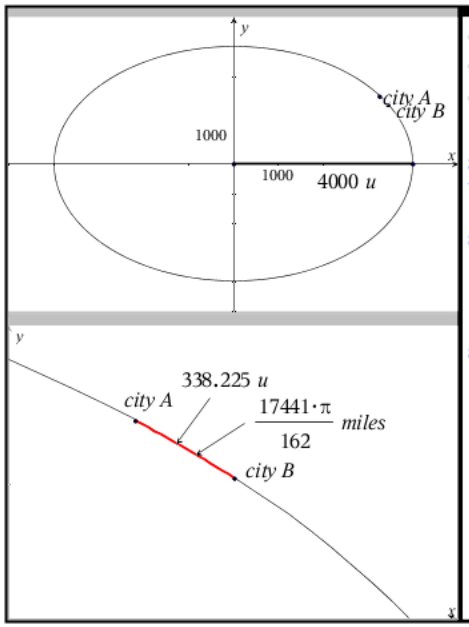
8e. What is the APPROXIMATE distance between cities?

$s = \theta r = \frac{17441 \cdot \pi}{648000} \cdot 4000 = \frac{17441 \cdot \pi}{162}$ miles

$\approx \frac{17441 \cdot \pi}{162.}$ ▸ 338.225 miles

$s = \theta r \approx (0.027\,\pi)(4000) \approx 108.\,\pi$ miles

≈ 339.292 miles



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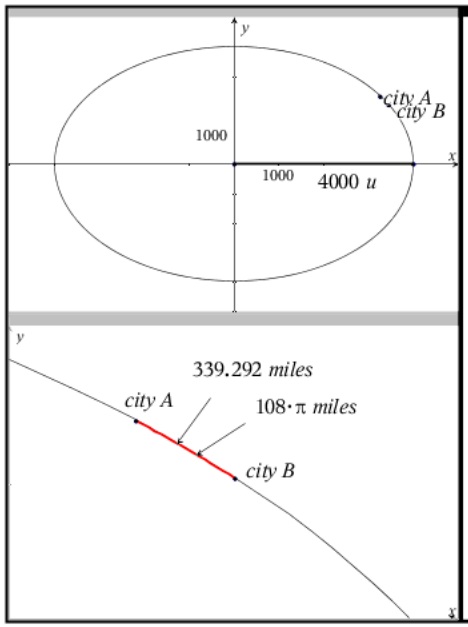
$\approx \frac{17441 \cdot \pi}{162.} = 338.225$ miles

$s = \theta r \approx (0.027\,\pi)(4000) \approx 108.\,\pi$ mile

≈ 339.292 miles



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