Math 120 B - Autumn 2018
Midterm Exam Number One
October 18th, 2018

Name: _____ Student ID no. : _____

Signature: _____ Section: _____

1	15	
2	15	
3	15	
4	15	
Total	60	

- This exam consists of FOUR problems on THREE double-sided pages.
- Show all work for full credit.
- You may use a TI-30X IIS calculator during this exam. Other calculators and electronic devices are not permitted.
- You do not need to simplify your answers.
- If you use a trial-and-error or guess-and-check method when a more rigorous method is available, you will not receive full credit.
- Draw a box around your final answer to each problem.
- **Do not write within 1 centimeter of the edge!** Your exam will be scanned for grading.
- If you run out of room, write on the back of the last page and indicate that you have done so. If you still need more room, ask your TA for an extra page to staple to your exam.
- You may use one hand-written double-sided 8.5″ by 11″ page of notes.
- You have 50 minutes to complete the exam.

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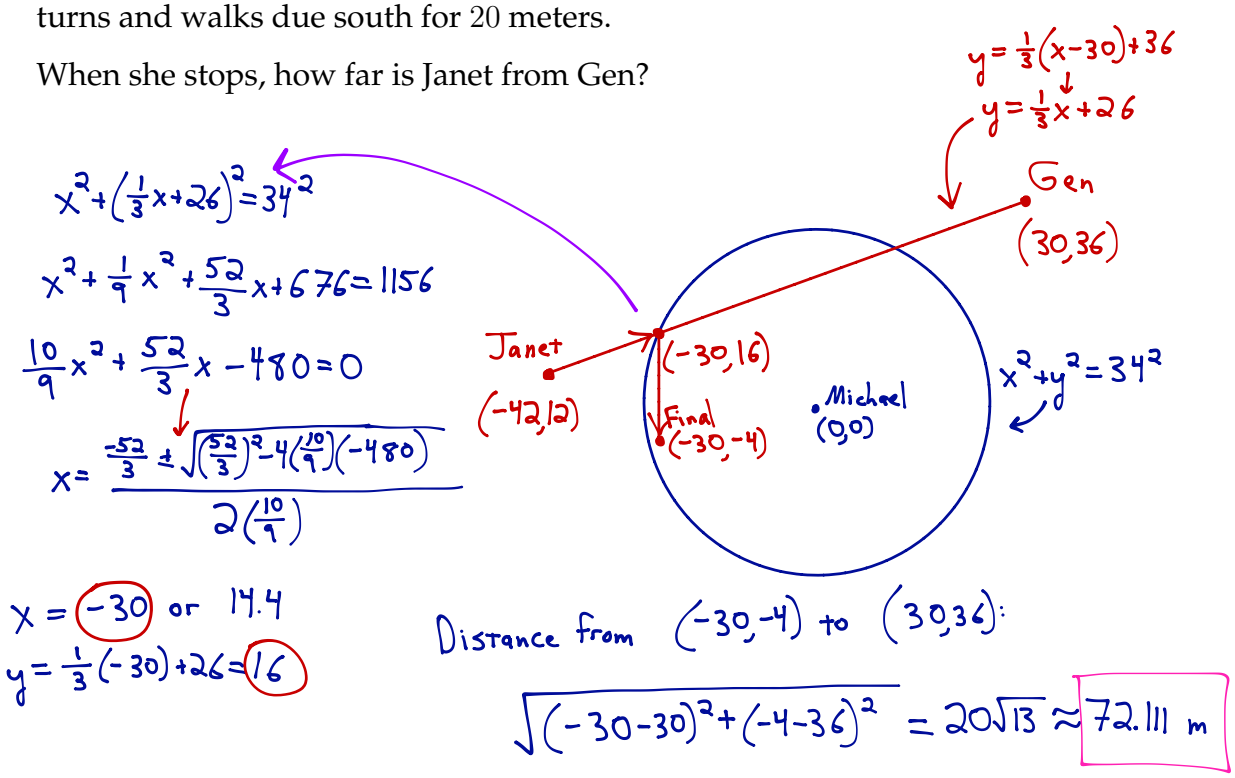
1. **[15 points]** Janet is standing 42 meters west and 12 meters north of Michael. Gen stands 30 meters east and 36 meters north of Michael.

   Janet begins walking towards Gen, but as soon as she's 34 meters away from Michael, she turns and walks due south for 20 meters.

   When she stops, how far is Janet from Gen?



$x^2+\left(\frac{1}{3}x+26\right)^2=34^2$

$x^2+\frac{1}{9}x^2+\frac{52}{3}x+676=1156$

$\frac{10}{9}x^2+\frac{52}{3}x-480=0$

$x=\dfrac{-\frac{52}{3}\pm\sqrt{\left(\frac{52}{3}\right)^2-4\left(\frac{10}{9}\right)(-480)}}{2\left(\frac{10}{9}\right)}$

$x=-30$ or 14.4

$y=\frac{1}{3}(-30)+26=16$

Distance from $(-30,-4)$ to $(30,36)$:

$\sqrt{(-30-30)^2+(-4-36)^2}=20\sqrt{13}\approx 72.111$ m

2. **[5 points per part]** Tunde is walking around the coordinate plane.

   He starts at the point $(-2, -3)$, and walks towards the point $(7, 5)$ in a straight line at a constant speed, reaching it after 8 seconds.

   (a) Write parametric equations for Tunde's location after t seconds.

$x_0 = -2 \quad y_0 = -3$

$x_1 = 7 \quad y_1 = 5$

$\Delta x = 9 \quad \Delta y = 8$

$\Delta t = 8$

$x = -2 + \frac{9}{8}t$

$y = -3 + \frac{8}{8}t$

$x = -2 + \frac{9}{8}t$

$y = -3 + t$

   (b) What are Tunde's coordinates 3 seconds after crossing the y-axis?

$x = -2 + \frac{9}{8}t = 0$

$\frac{9}{8}t = 2$

$t = \frac{16}{9}$

3 seconds later:

$t = \frac{16}{9} + 3 = \frac{43}{9}$

$x = -2 + \frac{9}{8}\cdot\frac{43}{9} = \frac{27}{8}$

$y = -3 + \frac{43}{9} = \frac{16}{9}$

$\left(\frac{27}{8}, \frac{16}{9}\right)$

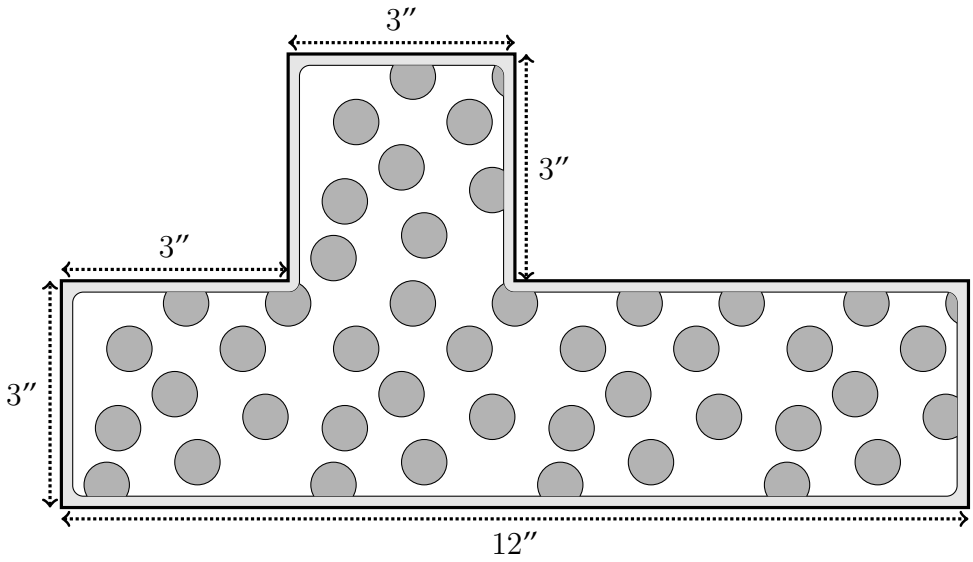
   (c) What is Tunde's speed?

Distance from $(-2,-3)$ to $(7,5) = \sqrt{9^2 + 8^2}$

$= \sqrt{145}$

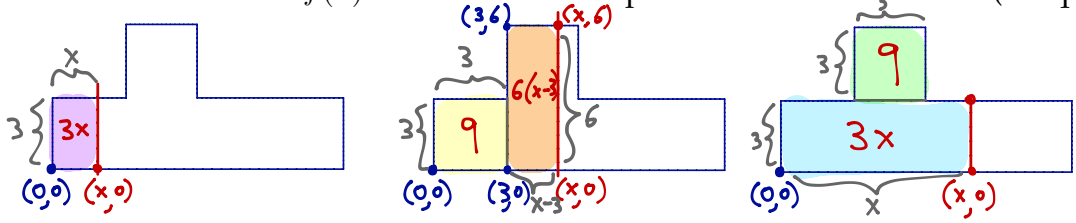
Speed $= \frac{\sqrt{145}}{8} \approx 1.505$ units/sec

3. Here at Pentomino's Pizza, we're proud of our peculiar polygonal pepperoni pizza.



(a) **[9 points]** Suppose we cut the pizza vertically, x inches from the left edge.

Write a function $f(x)$ for the area of the pizza to the **left** of the cut (in square inches).



$$f(x)=\begin{cases} 3x & \text{if } 0\le x\le 3 \\ 6x-9 & \text{if } 3\le x\le 6 \\ 3x+9 & \text{if } 6\le x\le 12 \end{cases}$$

(b) **[6 points]** Again, suppose we cut the pizza vertically, x inches from the left edge.

Write a function $g(x)$ for the area of the pizza to the **right** of the cut.

Area of whole pizza is 45, so $g(x)=45-f(x)$.

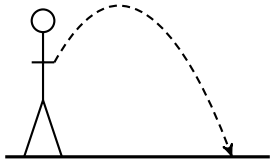
$$g(x)=\begin{cases} 45-3x & \text{if } 0\le x\le 3 \\ 54-6x & \text{if } 3\le x\le 6 \\ 36-3x & \text{if } 6\le x\le 12 \end{cases}$$

4. **[15 points]** Rowan throws a boomerang, but he's not great at it, because it flies in a parabolic arc. He throws the boomerang from an initial height of 6 feet above the ground.

   When it reaches its maximum height, the horizontal distance between Rowan and the boomerang is 8 feet.

   The boomerang lands on the ground 20 feet from Rowan.

   What is the maximum height of the boomerang?



$y = a(x-h)^2 + k$

$h = 8$

through $(0,6)$

through $(20,0)$

$6 = a(0-8)^2 + k \rightarrow 6 = 64a + k$

$0 = a(20-8)^2 + k \rightarrow -(0 = 144a + k)$

$6 = -80a$

$a = \frac{-3}{40} = -0.075$

$0 = 144(-0.075) + k$

$k = \boxed{10.8 \text{ ft}}$