

Math 120 B - Winter 2018  
Midterm Exam Number One  
January 25th, 2018

Name: \_\_\_\_\_

Student ID no. : \_\_\_\_\_

Signature: \_\_\_\_\_

Section: \_\_\_\_\_

1	12	
2	12	
3	12	
4	12	
5	12	
Total	60	

- This exam consists of FIVE 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, except on problem #5.
- 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.

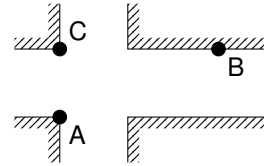
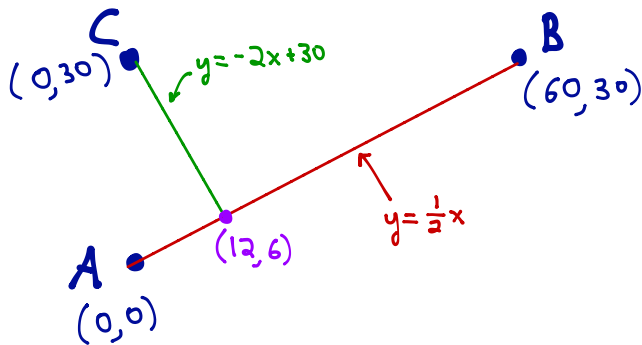
1. [12 points] Anthony and Carmela stand at the southwest and northwest corners (respectively) of an intersection, and Bobby stands 30 feet east of the northeast corner of the intersection. The streets are 30 feet wide.

Anthony walks in a straight line towards Bobby at a speed of 4 feet per second, paying no attention to traffic laws or common sense.

At the point when Anthony is closest to Carmela, Carmela yells at him for jaywalking.

Anthony immediately speeds up and walks the rest of the way towards Bobby at a speed of 8 feet per second.

How long does he spend walking, in total?



$$\begin{aligned} \frac{1}{2}x &= -2x + 30 \\ x &= 12 \\ y &= 6 \end{aligned}$$

$$\text{time} = \frac{\sqrt{12^2 + 6^2}}{4} + \frac{\sqrt{(60-12)^2 + (30-6)^2}}{8}$$

$$\approx 10.062 \text{ seconds}$$

2. [12 points] The populations of Mashon and Vercer grow linearly over time.

In the year 2000, there were 6 thousand people in Mashon. The population of Mashon grows by 5 thousand people every 10 years.

In the year 2004, the population of Vercer was half the population of Mashon. In the year 2018, the population of Vercer was 1 thousand less than the population of Mashon.

When will the populations of Mashon and Vercer be equal? Round your answer to the nearest year.

$x$ : # years after 2000  
 $y$ : population in thousands

$$\text{Mashon: } y = \frac{1}{2}x + 6$$

Mashon in 2004: 8 thousand people      Vercer in 2004: 4 thousand people  
Mashon in 2018: 15 thousand people      Vercer in 2018: 14 thousand people

Vercer: line through  $(4, 4)$  &  $(18, 14)$ :

$$y = \frac{5}{7}(x - 4) + 4$$

Populations equal:

$$\frac{1}{2}x + 6 = \frac{5}{7}(x - 4) + 4$$

$$x = \frac{68}{3} = 22.667, \text{ so around } \boxed{2023}$$

3. [6 points per part] Fungo is walking around the coordinate plane.

At time  $t = 0$ , Fungo begins walking from the point  $(7, 0)$  towards the point  $(-5, 9)$  at a constant speed, reaching it in 5 seconds.

(a) Write parametric equations for Fungo's coordinates after  $t$  seconds.

$$\begin{array}{l}
 x_0 = 7 \qquad y_0 = 0 \\
 x_1 = -5 \qquad y_1 = 9 \\
 \Delta x = -12 \qquad \Delta y = 9 \\
 \Delta t = 5
 \end{array}
 \qquad
 \begin{array}{l}
 x = 7 + \frac{-12}{5}t \\
 y = 0 + \frac{9}{5}t
 \end{array}
 \qquad
 \boxed{
 \begin{array}{l}
 x = 7 - 2.4t \\
 y = 1.8t
 \end{array}
 }$$

(b) A puddle is growing, centered at the origin. After  $t$  seconds its radius is  $2t$  units.

How much time will Fungo spend inside the puddle?

$$(7 - 2.4t)^2 + (1.8t)^2 = (2t)^2$$

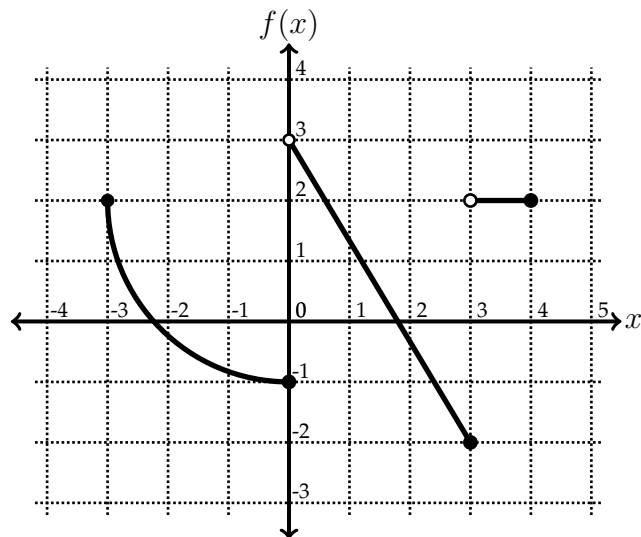
$$49 - 33.6t + 5.76t^2 + 3.24t^2 = 4t^2$$

$$5t^2 - 33.6t + 49 = 0$$

$$t = \frac{33.6 \pm \sqrt{33.6^2 - 4(5)(49)}}{10} = 2.1395 \text{ or } 4.5805$$

2.441 seconds in between

4. [12 points] Here's a graph of  $f(x)$ , consisting of a quarter-circle and two straight lines.



Write the multipart rule for  $f(x)$ .

$$f(x) = \begin{cases} 2 - \sqrt{9 - x^2} & \text{if } -3 \leq x \leq 0 \\ \frac{-5}{3}x + 3 & \text{if } 0 < x \leq 3 \\ 2 & \text{if } 3 < x \leq 4 \end{cases}$$

5. [12 points] Let  $g(x) = x^2 + x - 2$ . Simplify the following expression as much as possible:

$$\frac{g(x+h) - g(x-h)}{h}$$

$$= \frac{[(x+h)^2 + (x+h) - 2] - [(x-h)^2 + (x-h) - 2]}{h}$$

$$= \frac{\cancel{x^2} + 2xh + \cancel{h^2} + \cancel{x} + h - \cancel{2} - \cancel{x^2} + 2xh - \cancel{h^2} - \cancel{x} + h + \cancel{2}}{h} = \frac{4xh + 2h}{h} = 4x + 2$$