

Math 120 Fall 2007  
Exam 1 Solns

① Mongo:  $M(x) = m(x - x_1) + y_1$       $m = \frac{20000 - 18000}{1995 - 1980}$   
 $= \frac{400}{3} = 133.3$

$$M(x) = \frac{400}{3}(x - 1980) + 18000$$
$$= \frac{400}{3}x - 246000$$

Parn:  $P(x) = 200x - 331200$

We want  $P(x) = 3M(x)$  so

$$200x - 331200 = 400x - 738000$$

$$406800 = 200x$$

$$\boxed{x = 2034}$$

② (a)  $\frac{f(2x+h) - f(2x)}{h} = \frac{[(2x+h)^2 + 3(2x+h)] - [(2x)^2 + 3(2x)]}{h}$

$$= \frac{4x^2 + 4xh + h^2 + 6x + 3h - 4x^2 - 6x}{h}$$
$$= \frac{4xh + h^2 + 3h}{h}$$
$$= \frac{h(4x + h + 3)}{h} = \boxed{4x + h + 3}$$

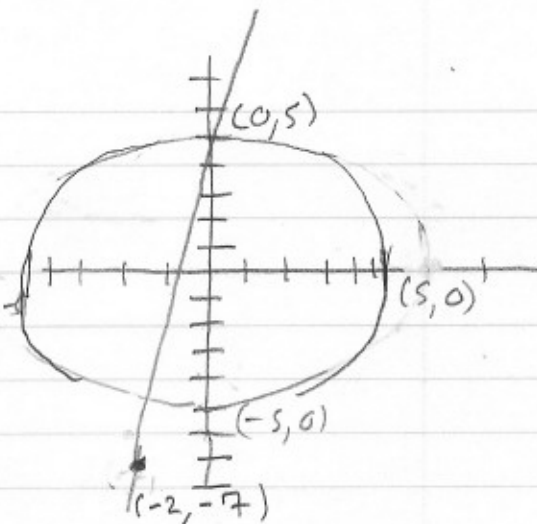
(b)  $h(g(x)) = h(3x+1)$   
 $= 7(3x+1) + b$  ?  
 $= 21x + 7 + b = 21x - 2$

so

$$7 + b = -2 \Rightarrow \boxed{b = -9}$$

③ CIRCLE:  $x^2 + y^2 = 25$

LINE:  $y = m(x - x_1) + y_1$   
 $m = \frac{5 - (-7)}{0 - (-2)} = \frac{12}{2} = 6$   
 $y = 6x + 5$



INTERSECTIONS:

$$x^2 + (6x + 5)^2 = 25$$

$$x^2 + 36x^2 + 60x + 25 = 25$$

$$37x^2 + 60x = 0$$

$$x(37x + 60) = 0$$

$$x = 0 \text{ or}$$

$$x = -\frac{60}{37}$$

$$x = -\frac{60}{37} = -1.621$$

$$y = 6\left(-\frac{60}{37}\right) + 5 = -\frac{175}{37} = -4.729$$

DISTANCE:  $\sqrt{(0 - (-1.621))^2 + (5 - (-4.729))^2}$   
 $= \sqrt{97.297} \approx 9.86393923832$

TIME:  $\text{TIME} = \frac{\text{DIST}}{\text{SPEED}} = \frac{9.86393923832}{6}$

$$\approx 1.64398987305$$

$$\boxed{1.64 \text{ HOURS}}$$

④ Let  $x =$  liters sold,  $P(x) =$  price per liter,  $T(x) =$  total sale

(a)  $P(x) = m(x - x_1) + y_1$       $m = \frac{7.5 - 6.75}{4 - 2} = -0.1875$

$$P(x) = -0.1875(x - 4) + 7.5 = \boxed{-0.1875x + 8.25}$$

$$T(x) = (\text{price}) \cdot (\text{liters sold}) = x(-0.1875x + 8.25)$$

$$T(x) = \boxed{-0.1875x^2 + 8.25x}$$

(b)  $T(x)$  is a downward parabola, so max = vertex.

Either complete the square or use the formula from the text

$$x = -\frac{b}{2a} = -\frac{8.25}{2(-0.1875)} = \boxed{22 \text{ liters}}$$

$$(5) (a) f(-1) = 3(-1) + 1 = \boxed{-2}$$

$$(b) \begin{array}{l} 3x+1=5, x < 2 \\ 3x=4 \\ x = \frac{4}{3} = 1.\bar{3} \end{array} \quad \text{or} \quad \begin{array}{l} x+10=5, x \geq 2 \\ x = -5 \end{array}$$

NOT IN DOMAIN

YES!

The only solution is  $x = \frac{4}{3} = 1.\bar{3}$

$$(c) f(2x+1) = \begin{cases} 3(2x+1)+1, & \text{if } 2x+1 < 2; \\ (2x+1)+10, & \text{if } 2x+1 \geq 2, \end{cases}$$

$$f(2x+1) = \begin{cases} 6x+4, & \text{if } 2x < 1 \\ 2x+11, & \text{if } 2x \geq 1 \end{cases}$$

$$f(2x+1) = \begin{cases} 6x+4, & \text{if } x < \frac{1}{2} \\ 2x+11, & \text{if } x \geq \frac{1}{2} \end{cases}$$

$$3f(2x+1) = \begin{cases} 3(6x+4), & \text{if } x < \frac{1}{2} \\ 3(2x+11), & \text{if } x \geq \frac{1}{2} \end{cases}$$

$$= \begin{cases} 18x+12, & \text{if } x < \frac{1}{2} \\ 6x+33, & \text{if } x \geq \frac{1}{2} \end{cases}$$