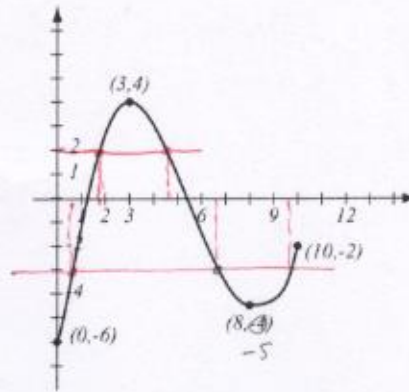


1. (8pts) Use the graph of the profits (in billions) of an airline to answer the questions below. Negative profits mean losses and  $x = 0$  corresponds to year 2003.

- Find the profits in 2006 and 2011.
- At what times was profit 2 billion?
- When was profit highest? What was the highest profit?
- At what times was the loss more than 3 billion?



a)  $x=3$   $y=4$  bil  
2006  
 $x=8$   $y=-5$  bil  
2011

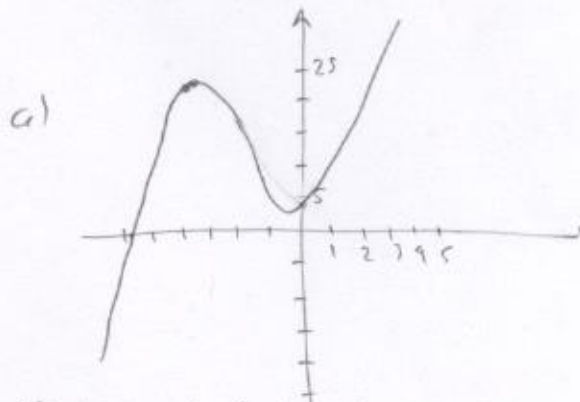
b)  $x=1.75$  (approx x 2005)  
 $x=4.5$  (2008)

c) Highest when  $x=3$  (2006)  
Highest profit: 4 bil

d)  $y \leq -3$  when  $x$  in  $[0, 0.75]$  2003-2004  
or  $[6.5, 9.5]$  2010-2013

2. (14pts) The equation  $y = x^3 + 7x^2 + 8x + 4$  is given.

- Use your calculator to accurately its graph. Draw the graph here, and indicate units on the axes.
- Find all the  $x$ - and  $y$ -intercepts (accuracy: 6 decimal points).
- Find the peaks and valleys of the graph (accuracy: 6 decimal points).



a)  $y$ -int:  $y=4$   
 $x$ -int:  $-5.724577$

c) Peak at  $(-4, 20)$   
valley at  $(-0.666666, 1.481482)$

Solve the inequalities. Write your solution in interval notation.

3. (5pts)  $-3 < 2x + 5 < 4$  | -5      4. (7pts)  $|x - 5| < 2$

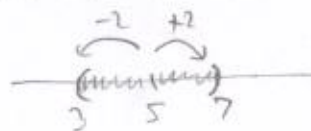
$-8 < 2x < -1$  |  $\div 2$

$-4 < x < -\frac{1}{2}$

~~$-4$~~        ~~$-\frac{1}{2}$~~

$(-4, -\frac{1}{2})$

dist. from  $x$  to 5  $< 2$



$(3, 7)$

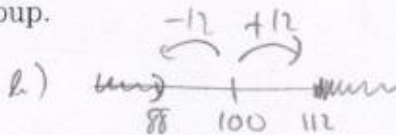
5. (8pts) The scores of a group of people who took an intelligence quotient test were more than 12 units away from 100.

a) If  $x$  is the IQ score, write an inequality involving absolute value that stands for the above statement.

b) Solve the inequality to get the scores of this group.

a) distance from  $x$  to 100  $> 12$

$$|x - 100| > 12$$



$$(-\infty, 88) \cup (112, \infty)$$

6. (10pts) Find the equation of the line (in form  $y = mx + b$ ) that is perpendicular to the line  $4x + 3y = 7$ , and passes through point  $(-1, -2)$ . Draw both lines.

$$4x + 3y = 7$$

$$3y = -4x + 7 \quad | \div 3$$

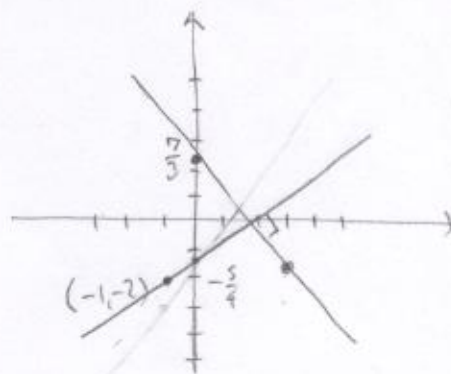
$$y = -\frac{4}{3}x + \frac{7}{3}$$

$$m = -\frac{1}{-\frac{4}{3}} = \frac{3}{4}$$

$$y - (-2) = \frac{3}{4}(x - (-1))$$

$$y + 2 = \frac{3}{4}x + \frac{3}{4} \quad | -2$$

$$y = \frac{3}{4}x - \frac{5}{4}$$



7. (12pts) The electricity bill for a household was \$57.72 when it used 352 kilowatt-hours (kWh) of electricity and it was \$79.17 when it used 547 kWh.

a) The bill for electric power  $y$  depends on the amount of power used  $x$  (in kWh) in a linear fashion. Write the equation that expresses this relationship.

b) How much will the household pay if it uses 0 kWh? What does this number mean?

c) How many kWh did the household use if it paid \$63.22?

a)  $(352, 57.72)$

$(547, 79.17)$

$$m = \frac{79.17 - 57.72}{547 - 352} = \frac{21.45}{195} = 0.11$$

$$y - 57.72 = 0.11(x - 352)$$

$$y = 0.11x - 38.72 + 57.72$$

$$y = 0.11x + 19$$

b) When  $x = 0$ ,  $y = 19$

\$19 is the monthly fee to have electric service

c)  $0.11x + 19 = 63.22$

$$0.11x = 44.22 \quad | \div 0.11$$

$$x = 402$$

8. (6pts) Find the domain of the function  $f(x) = \frac{\sqrt{1-x}}{x+4}$  in interval notation.

Must have:  $1-x \geq 0$       Can't have      exclude

$1 \geq x$        $x+4 \neq 0$       ~~At  $x = -4$~~

$x \leq 1$        $x \neq -4$        $-4$

$(-\infty, -4) \cup (-4, 1]$

9. (10pts) Let  $f(x) = x^2 - 7x + 4$ . Find the following and simplify where appropriate:

a)  $f(4) =$

$4^2 - 7 \cdot 4 + 4$   
 $= -8$

b)  $f(3x) =$

$(3x)^2 - 7 \cdot 3x + 4$   
 $= 9x^2 - 21x + 4$

c)  $f(x+2) =$

$= (x+2)^2 - 7(x+2) + 4$   
 $= x^2 + 4x + 4 - 7x - 14 + 4$   
 $= x^2 - 3x - 6$

10. (8pts) A wholesaler prices a certain type of coffee according to the rules below.

When buying	cost per pound is
between 0 and 100 pounds	\$ 1.39
more than 100 pounds	\$0.99 for the part over 100 pounds

Write the multi-part formula for the function  $C(x)$  which represents the cost of buying  $x$  pounds.

$$C(x) = \begin{cases} 1.39x & \text{if } 0 \leq x \leq 100 \\ 139 + 0.99(x-100) & \text{if } 100 < x \end{cases}$$



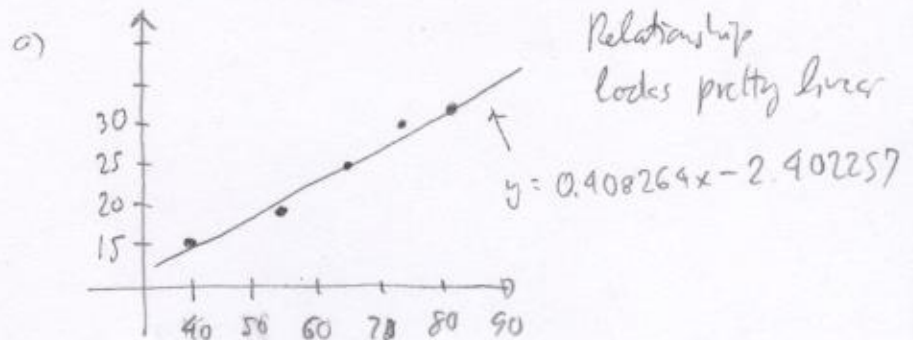
11. (12pts) The owners of a stadium would like to find the relationship between the forecast temperature for the day of the game and the number of people attending. The data for several days in the past is below.

a) Draw the scatterplot of the data (put temperature on the  $x$ -axis). Does the relationship look linear?

b) Use your calculator to find the "line of best fit" for the data. Draw the line on the graph.

c) How many people would the owners expect to attend if the forecast temperature is  $70^\circ$ ?

Temperature ( $^\circ\text{F}$ )	Attendance (thousands)
40	15
55	18
64	24
75	29
82	31



b)  $y = 0.408264x - 2.402257$

c) when  $x = 70$ ,  $y = 26.176223$

About 26,176 people

**Bonus.** (10pts) For the function  $f(x) = \frac{3}{x}$ , find the difference quotient  $\frac{f(x+h) - f(x)}{h}$  and simplify.

$$\begin{aligned} \frac{f(x+h) - f(x)}{h} &= \frac{\frac{3}{x+h} - \frac{3}{x}}{h} = \frac{\frac{3x - 3(x+h)}{(x+h)x}}{h} = \frac{3x - 3x - 3h}{(x+h)x} \cdot \frac{1}{h} = -\frac{3h}{(x+h)xh} \\ &= -\frac{3}{(x+h)x} \end{aligned}$$