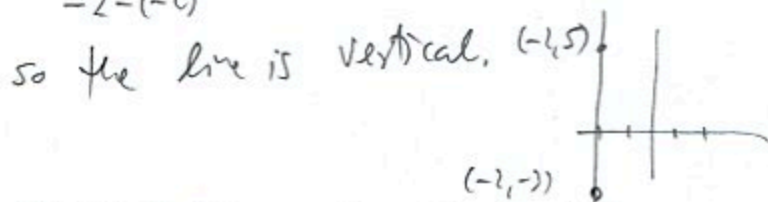**1.** (6pts) Find the equation of the line (in form $y = mx + b$) that passes through points $(-2, -3)$ and $(-2, 5)$.

$m = \dfrac{5 - (-3)}{-2 - (-2)} = \dfrac{8}{0}$ not defined,

Equation of line: $x = -2$

so the line is vertical.

$(-2, 5)$

$(-2, -3)$

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

Slope of line with $x$-int 4, $y$-int 3:

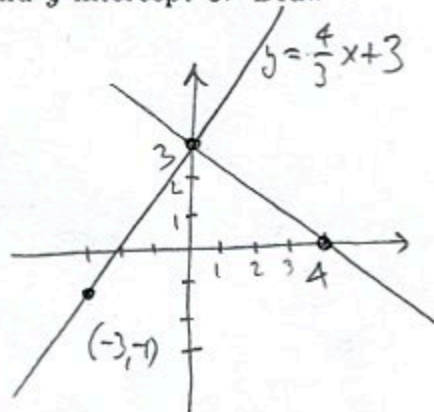passes thru $(4, 0), (0, 3)$

$m = \dfrac{3 - 0}{0 - 4} = -\dfrac{3}{4}$

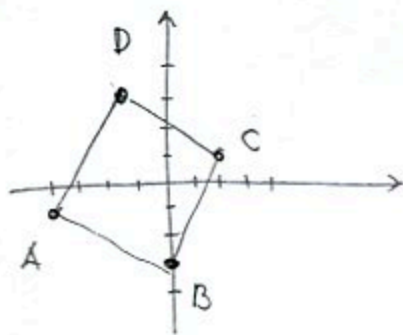Slope of perp. line is

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

Equation:

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

$y + 1 = \dfrac{4}{3}x + 4$, $\boxed{y = \dfrac{4}{3}x + 3}$

$y = -\dfrac{4}{3}x + 3$

$(-3, -1)$

**3.** (8pts) Draw the quadrangle with vertices $A = (-4, -1)$, $B = (0, -3)$, $C = (2, 1)$, $D = (-2, 3)$. Then use slopes to show that this quadrangle is a rectangle. Do not use the Pythagorean theorem.

Slopes of lines:

AB: $\dfrac{-3 - (-1)}{0 - (-4)} = -\dfrac{2}{4} = -\dfrac{1}{2}$

BC: $\dfrac{1 - (-3)}{2 - 0} = \dfrac{4}{2} = 2$

CD: $\dfrac{3 - 1}{-2 - 2} = \dfrac{2}{-4} = -\dfrac{1}{2}$

AD: $\dfrac{3 - (-1)}{-2 - (-4)} = \dfrac{4}{2} = 2$

Since slopes AB, CD are opposite reciprocal to slopes of BC and AD, lines AB and CD are perpendicular to lines AD and BC, so it is a rectangle

**4.** (4pts) The number of highway fatalities in the US has decreased from 43,510 in 2005 to 32,784 in 2010. Find the average rate of change in the number of highway fatalities from 2005 to 2010. What are the units for the average rate?

avg. rate of change $= \dfrac{32,784 - 43,510}{2010 - 2005} = -\dfrac{10726}{5} = -2145.2$ people per year

**5.** (12pts) Ann is the customer of an innovative cell-phone company that charges on actual monthly phone usage. In one month, when she used 122 minutes, she paid \$15.66. In another month, when she used 214 minutes, she paid \$20.72.

a) Assuming that monthly cost $C(x)$ is a linear function of minutes used $x$, write a formula for $C(x)$.

b) How much does Ann pay if she uses 0 minutes? What is the meaning of this number?

c) What is the meaning of the slope in this example?

a) The lines passes thru

$(122, 15.66)$ and $(214, 20.72)$

$m = \dfrac{20.72 - 15.66}{214 - 122} = \dfrac{5.06}{92} = 0.055$

$y - 15.66 = 0.055(x - 122)$

$y = 0.055x - 6.71 + 15.66$

$= 0.055x + 8.95$

$\boxed{C(x) = 0.055x + 8.95}$

b) $C(0) = 8.95$

This is a monthly fee that occurs even if no minutes are used

c) Slope $= 0.055$ is the cost per minute

($5.5¢$ per minute)

**6.** (20pts) A researcher is studying the number of intersections with traffic lights and the number of traffic accidents in small towns in order to model the relationship between lights and accidents. The table shows the data, where $I$ is the number of intersections, and $A$ is the number of accidents in a year. Solve the problems below with accuracy 6 decimal points.

a) Draw the scatterplot of the data. Does the relationship look linear?

b) Use two points in the scatterplot to get an equation of a line that models the relationship between $I$ and $A$. Draw the line on the graph.

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

d) Find the coefficient of correlation $r$. How strong is the linear relationship between $I$ and $A$?

e) What annual number of accidents does the researcher expect in a small town that has 30 intersections with traffic lights?

| I | A |
|---|---|
| 11 | 383 |
| 14 | 370 |
| 21 | 302 |
| 25 | 231 |
| 27 | 223 |
| 35 | 150 |

a) 
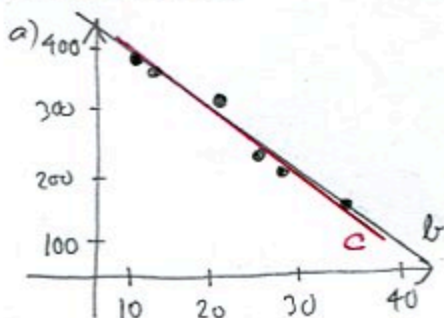
Looks linear.

b) Use pts $(11, 383)$ and $(35, 150)$

$m = \dfrac{150 - 383}{35 - 11} = \dfrac{-233}{24} = -9.708333$

$y - 383 = -9.708333(x - 11)$

$\boxed{y = -9.708333x + 489.791667}$

c) $\boxed{y = -10.270467x + 504.162023}$ (from calculator)

d) $r = -0.992117$, close to $-1$, so strong

e) $-10.270467 \cdot 30 + 489.791667 = 196.04801$

about $196$ accidents.