

8.5

$$A=0, \text{ so by (8.5)}$$

$$\chi^2 = \sum_{i=1}^N \frac{(y_i - Bx_i)^2}{\sigma_y^2}$$

Best fit occurs when  $\frac{\partial \chi^2}{\partial B} = 0$

$$\Rightarrow \frac{-2}{\sigma_y^2} \sum_{i=1}^N x_i (y_i - Bx_i) = 0$$

$$\Rightarrow B \sum_{i=1}^N x_i^2 = \sum_{i=1}^N x_i y_i \Rightarrow B = \frac{\sum_{i=1}^N x_i y_i}{\sum_{i=1}^N x_i^2}$$

Q.E.D.

8.7  $l = l_0 + \left(\frac{g}{k}\right)m$  let  $x=m$   $y=l$   $A=l_0$   $B=g/k$

$$\sum m^2 = 2.84 \times 10^6; \sum l = 56.2; \sum m = 4400; \sum ml = 33,460$$

$$N=8; \Delta = N \sum m^2 - (\sum m)^2 = 3.36 \times 10^6$$

by (8.10)

$$A = l_0 = \frac{\sum m^2 \sum l - \sum m \sum ml}{\Delta} = \frac{[(2.84 \times 10^6)(56.2)] - [4400](33,460)}{3.36 \times 10^6}$$

$$\Rightarrow \boxed{l_0 = 3.69 \text{ cm}}$$

by (8.11)

$$B = \left(\frac{g}{k}\right) = \frac{N \sum ml - \sum m \sum l}{\Delta} = \frac{[8(33,460)] - [4400](56.2)}{3.36 \times 10^6}$$

$$\frac{g}{k} = 6.07 \times 10^{-3} \text{ cm/g} \quad k = \frac{980 \text{ cm/s}^2}{6.07 \times 10^{-3} \text{ cm/g}} = 1.61 \times 10^5 \text{ g/s}^2 \times \frac{1 \text{ kg}}{1000 \text{ g}} \Rightarrow \boxed{R = 161 \text{ N/m}}$$

8.10

$$y = A + Bx$$

$$X_1 = 1 \quad X_2 = 2 \quad X_3 = 3$$

$$Y_1 = 2 \quad Y_2 = 3 \quad Y_3 = 2$$

$$W_1 = \frac{1}{(0.5)^2} = 4 \quad W_2 = 4 \quad W_3 = 1$$

A) Weighted:  $\sum wx^2 = 29$ ;  $\sum wy = 22$ ;  $\sum wx = 15$ ;  $\sum wxy = 38$

$$(8.9) \Delta = \sum w \sum wx^2 - (\sum wx)^2 = (9)(29) - 15^2 = 36$$

$$(8.8.37) A = \frac{\sum wx^2 \sum wy - \sum wx \sum wxy}{\Delta} = \frac{(29)(22) - (15)(38)}{36} = \boxed{1.89}$$

$$(8.8.38) B = \frac{\sum w \sum wxy - \sum wx \sum wy}{\Delta} = \frac{(9)(38) - (15)(22)}{36} = \boxed{0.33}$$

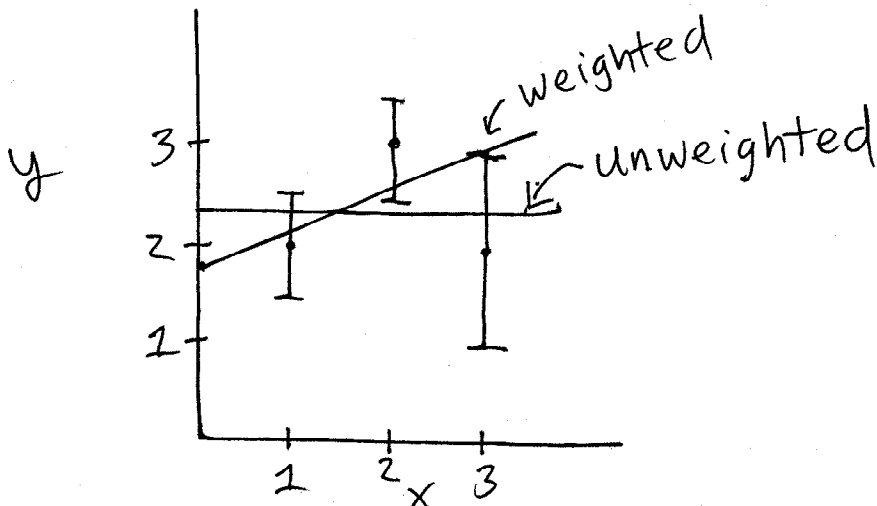
B) unweighted:  $\sum x^2 = 14$ ;  $\sum y = 7$ ;  $\sum x = 6$ ;  $\sum xy = 14$   
 $N = 3$

$$(8.12) \Delta = N \sum x^2 - (\sum x)^2 = 3(14) - 6^2 = 6$$

$$(8.10) A = \frac{\sum x^2 \sum y - \sum x \sum xy}{\Delta} = \frac{(14)(7) - (6)(14)}{6} = \boxed{2.33}$$

$$(8.11) B = \frac{N \sum xy - \sum x \sum y}{\Delta} = \frac{(3)(14) - (6)(7)}{6} = \boxed{0}$$

Graph



Weighted: Best fit through error bars  
unweighted: Best fit through points