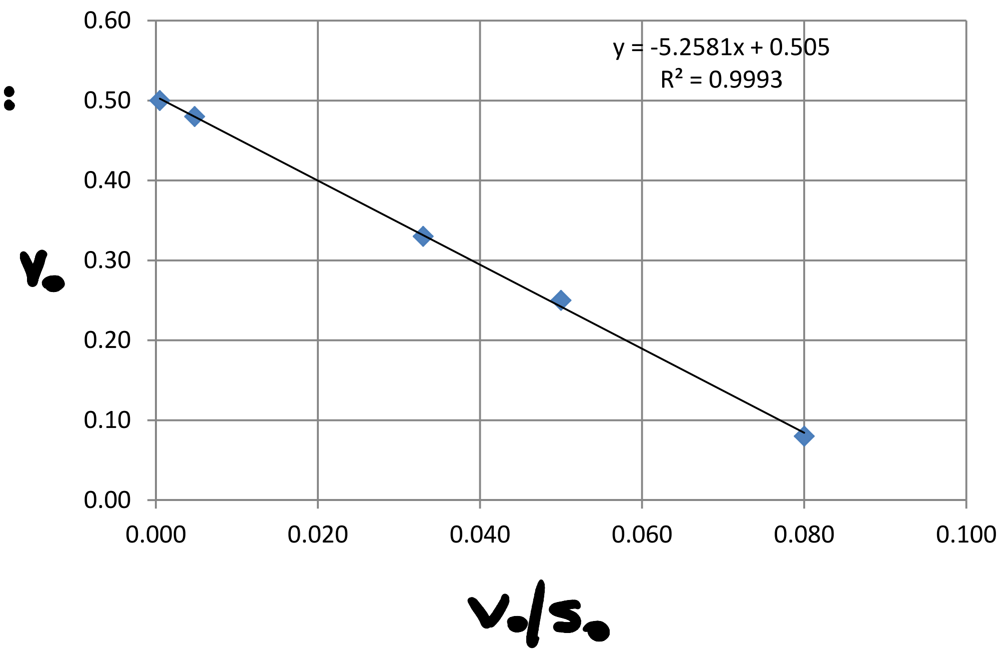
1B) i) PLOT DATA USING EADIE-HOFSTEE PLOT:

So (µmol/L)	Vo (µmol/Lmin)	Vo/So (1/min)
1	0.08	0.0800
5	0.25	0.0500
10	0.33	0.0330
100	0.48	0.0048
1000	0.50	0.0005



MAKE SURE YOU PLOT WITH V_o AS THE DEPENDENT VARIABLE AND V_o/S_o AS THE INDEPENDENT VARIABLE!

FROM PLOT $V_o = V_{MAX} - K_m \frac{V_o}{S_o}$

$V_{MAX} = 0.505$ µmol/Lmin

$K_m = 5.26$ µmol/L

ii) $$S_0 - S + K_m \ln(S_0/S) = V_{max}\, t$$

FIND S WHEN $S_0 = 20\ \mu mol/L$

$t = 60\ min$

UNITS OF TERMS ARE IN μmol, min, L

$$20 - S + 5.26 \ln(20/S) = (0.505)(60)$$

OR

$$\boxed{S = -10.3 + 5.26 \ln(20/S)}$$

SOLVE FOR S!

HOW DOES ONE SOLVE FOR S?

THREE METHODS EXIST...

METHOD 1

GUESS A VALUE FOR THE RIGHT SIDE OF EQUATION UNTIL THE ANSWER IS EQUAL TO WHAT YOU GUESSED

GUESS	S
5.00	-3.61
2.00	1.81
1.90	2.08
1.92	2.03
1.94	1.97
1.95	1.94

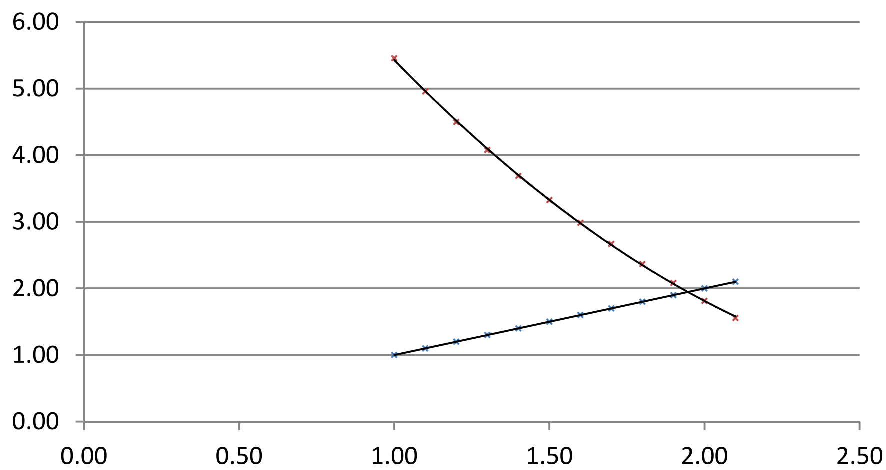
$S \cong 1.95\ \mu mol/L$

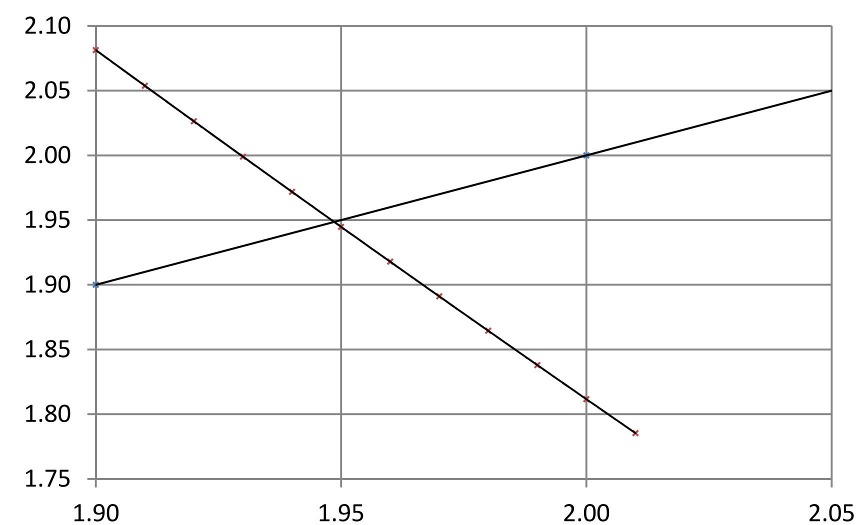
METHOD 2

GRAPHICAL. PLOT $y_1 = S$ AND

$$y_2 = -10.3 + 5.26 \ln(20/S)$$

POINT OF INTERSECTION IS WHERE $y_1 = y_2$





$S \cong 1.95\ \mu mol/L$

METHOD 3 - NEWTON'S METHOD OF FINDING ZEROS

THIS IS AN ITERATIVE METHOD USING:

$$y_{i+1} = y_i - \frac{f(y_i)}{f'(y_i)}$$

let $f(s) = s + 10.3 - 5.26\ln(20) + 5.26\ln(s)$

$f'(s) = 1 + 5.26/s$

GUESS $y_0 = 5$

$f(5) = 5 + 10.3 - 5.26\ln(20) + 5.26\ln(5)$

$= 8.008$

$f'(5) = 1 + 5.26/5 = 2.052$

$$y_1 = 5 - \frac{8.008}{2.052} = 1.097$$

$$f(y_1) = f(1.097) = 1.097 + 10.3 - 5.26\ln(20) + 5.26\ln(1.097)$$

$$= -3.871$$

$$f'(1.097) = 1 + 5.26/1.097 = 5.793$$

$$y_2 = 1.097 + \frac{3.871}{5.793} = 1.766$$

$$f(y_2) = f(1.766) = 1.766 + 10.3 - 5.26\ln(20) + 5.26\ln(1.766)$$

$$= -0.701$$

$$f'(1.766) = 1 + 5.26/1.766 = 3.979$$

$$y_3 = 1.766 + 0.701/3.979 = 1.942$$

$$f(y_3) = f(1.942) = 1.942 + 10.3 - 5.26\ln(20) + 5.26\ln(1.942)$$

$$= -0.025$$

$$f'(1.942) = 1 + 5.26/1.942 = 3.709$$

$$y_4 = 1.942 + 0.025/3.709 = 1.949$$

$$\underline{\text{ANS} = 1.949\ \mu\text{mol/L}}$$