(6.8)

THE PROBLEM STATEMENT PROVIDES:

$$\frac{dX}{dt} = \frac{\mu_{MAX} S}{K_S + S} X = \mu X$$

$$\frac{dS}{dt} = \frac{\mu_{MAX} S}{(K_S + S) Y_{X/S}} X = \frac{\mu X}{Y_{X/S}}$$

$$\frac{dP}{dt} = (\alpha \mu + \beta) X$$

IN A CHEMOSTAT (FROM NOTES):

$$S = \frac{K_S D}{\mu_{MAX} - D} \quad \text{(EQN A)} \qquad \mu = D$$

$$X = Y_{X/S}^{OBS} (S_{IN} - S)$$

IN THIS PROBLEM m_S (MAINTENANCE) = 0

SO $Y_{X/S}^{OBS} = Y_{X/S}$

$$X = Y_{X/S} (S_{IN} - S) \quad \text{(EQN B)}$$

SOLVE FOR DX & DP

$$DX = D\,Y_{X/S}\left(S_{IN} - S\right) \qquad DX = f_1(D)$$

$$DP = Q_p = \left(\alpha D + \beta\right) X \qquad DP = f_2(D)$$

WE WANT TO FIND VALUE OF D WHICH WILL GIVE US THE MAXIMUM DX & DP.

WRITE AN EXCEL SPREADSHEET IN WHICH WE VARY D (COLUMN 1). WE CAN CALCULATE S (EQN A, COLUMN 2) & X (EQN B, COLUMN 3). WE CAN THEN CALCULATE DX & DP (COLUMNS 4 & 5). PLOT DX VS. D AND DP VS. D,... FIND MAXIMA.

$\mu_{MAX} = 0.7\,h^{-1}$

$K_S = 20\,mg/L = 0.020\,g/L$

$Y_{X/S} = 0.5\,g/g$

$Y_{P/X} = 0.15\,g/g$

$\alpha = 0.1$

$\beta = 0.02\,h^{-1}$

$S_{IN} = 1\,g/L$