Evaporation Problem

In a triple-effect evaporator with forward feed, for concentrating 5 ton/hr of a 12% aqueous solution of sodium nitrate. The final mass concentration of the solution is 40%. The pressure of the heating steam is P_{abs}=4 atm at T=143 ^{o}C. Also the pressure at third effect is $P_{3,\,abs}$=0.2 atm. Calculate:

(a) Pressure in each effect;
(b) Required area of each effect;
(c) Vapor flow rate from each effect;
(d) Concentrated products output from each effect;
(e) Temperature of all streams

Assumptions and data:

(1) Consider equal surface area for effects
(2) The ratio of vapor produced in three effects are:
(effect 1/ effect 2/ effect 3=1.0/1.1/1.2)
(3) U_1=1700 W/m^2 K, U_2=990 W/m^2 K, U_3=580 W/m^2 K
(4) Boiling points of aqueous solutions of sodium nitrate:

Wt%	8.26	15.61	21.87	27.53	32.43	40.47	49.87	60.94	68.94
T_{bp} (^{o}C)	101	102	103	104	105	107	110	115	120