1) Given: 100 g of 20 wt% UN in water (F_W = 80g)

Assumption: Equilibrium batch contact.
Water and TBP are mutually insoluble.

$$K'_{UN} = \frac{Y_{UN}}{X_{UN}} = 5.5$$

Extraction factor: $E = KS/F_W = 5.5S/80 = 0.0688S$

(a) $$\frac{X^{(1)}}{X^{(F)}} = 0.10 = \frac{1}{1+E} = \frac{1}{1+0.0688S}$$

$$\boxed{S = 130.8\text{g of TBP}}$$

(b) $$\frac{X^{(2)}}{X^{(F)}} = 0.10 = \frac{1}{(1+E/2)^2} = \frac{1}{(1+0.0688S/2)^2}$$

$$\boxed{S = 62.9\text{g of TBP}}$$

(c) $$\frac{X^{(2)}}{X^{(F)}} = 0.10 = \frac{1}{(1+E+E^2)} = \frac{1}{(1+0.0688S+(0.0688S)^2}$$

$$\boxed{S = 36.9 \text{ of TBP}}$$

(d) $$\frac{X^{(\infty)}}{X^{(F)}} = 0.10 = \frac{1}{\exp(E)} = \frac{1}{\exp(0.0688S)}$$

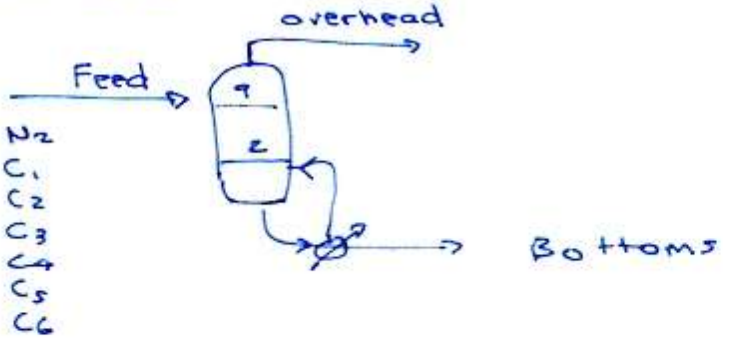
$$\boxed{S = 33.5\text{g of TBP}}$$

(e) $$\frac{X^{(\infty)}}{X^{(F)}} = 0.10 = 1-E = 1-0.0688S$$

$$\boxed{S = 13.1\text{ g of TBP}}$$

O.Y.

2) Given:



N-1 cascade and partial reboiler

element	N_V	N_E
N-1 cascade	$7(N-1)+2C(N-1)+2C+7$	$5(N-1)+2C(N-1)+2$
Partial Reboiler	$3C+10$	$2C+6$
total	$7N+2NC+3C+10$	$5N+2NC+3$

(Table 5.3)

a)
$$(N_V)_{unit} = \sum (N_V)_e - N_R(C+3) + N_A \qquad (5\text{-}68)$$
$$= (7N+2NC+3C+10) - 2(C+3)$$
$$= 7N+2NC+C+4$$

b)
$$(N_E)_{unit} = \sum (N_E)_e - N_R \qquad (5\text{-}69)$$
$$= 5N+2NC+3-2$$
$$= 5N+2NC+1$$

c)
$$N_D = N_V - N_E = 2N+C+3 \qquad (5.67)$$

d) Specification:

All feed condition	$C+2$
Number of stages	1
	$C+3$

2N additional specification:

All stage and reboiler pressure	N
Adiabatic stages	$N-1$
	$2N-1$

one specification left: bottom rate, distillate rate, or boilup rate or ratio.

R.Y.

Given: Packed tower for stripping.

Advantages: Air is available everywhere
Air is inexpensive.

Disadvantages: Air can form a flammable or explosive mixture with VOC.
with steam, the exit gas can be condensed and the VOC recovered as a liquid.

D.Y.