EngrD 2190 - Chemical Process Design & Analysis
Process Economic Analysis with Spreadsheets - 2025

There are two options for the reactor:

Type 1: High conversion, modest selectivity of *P* over *B*.
Type 2: Low conversion, good selectivity of *P* over *B*.

There are two options for the first separator:

Type 1: High recovery of *P*; low *P*:*A* ratio in liquid the liquid stream.
Type 2: Low recovery of *P*; moderate *P*:*A* ratio in liquid the liquid stream.

There are two options for the (optional) second separator:

Type 1: Excellent separation; high *A*:*B* ratio in the tops, low *A*:*B* ratio in the bottoms).
Type 2: Modest separation; good *A*:*B* ratio in the tops, moderate *A*:*B* ratio in the bottoms.

Your fiducial goal is to maximize the ROI for a configuration based on the last digit of your CU NetID.

CU NetID last digit	2	3	4	5	6	7	8	9
reactor type	1	1	1	1	2	2	2	2
separator I type	1	1	2	2	1	1	2	2
separator II type	1	2	1	2	1	2	1	2

Note: You may find that the highest ROI is achieved with no Separator II for your configuration. With no Separator II, the by-product *B* is eliminated in the purge only.

In general, a process unit with better specifications has a higher price and costs more to operate. There is economy of scale; the equipment price is proportional to (capacity)$^{0.6}$. Reactor and separator prices are given by the formula *price* = $k \times (F_T)^{0.6}$, where k is a constant conversion factor, F_T is the flow through the unit, in mol/day, and *price* is in $. For example, a reactor with double the capacity costs only 1.5 times as much. Operating costs for reactors and separators are given by the formula *operating cost* = $c \times F_T$; the units of *operating cost* are $/year.

	k	*c*
reactor, type 1 (conversion = 0.85, *P*:*B* = 3:1)	110,000	2,700
reactor, type 2 (conversion = 0.55, *P*:*B* = 12:1)	80,000	2,300
separator I, type 1 (99% *P* in tops, *P*:*A* = 1:50 in bottoms)	50,000	2,600
separator I, type 2 (99% *P* in tops, *P*:*A* = 1:5 in bottoms)	35,000	2,000
separator II, type 1 (*A*:*B* = 100:1 in tops, *A*:*B* = 1:50 in bottoms)	80,000	5,000
separator II, type 2 (*A*:*B* = 30:1 in tops, *A*:*B* = 1:10 in bottoms)	32,000	2,800

Reactant *A* costs $25/mol. Product *P* (99% *P*) sells for $90/mol. Disposal of waste contaminated with *B* costs $15/mol.

Equipment depreciation is calculated with a straight-line formula, with a lifetime of 10 years. The process operates 365 days/year.

Equipment purchase costs are paid at the beginning of the year. Operating costs are paid during the year. Revenue from *P* sales is received at the end of the year. You cannot spend money from sales revenue to purchase equipment and operate your process the first year.

Assignment: Start with $10,000,000. and maximize the ROI for your process. Complete the Process Design & Operation form with your Equipment Purchases and Operating Parameters and submit in lecture or deliver to the EngrD 2190 cabinet by **Monday October 20 at noon**. Send your spreadsheet as an attachment to tmd10@cornell.edu by **Monday October 20 at noon**.

IMPORTANT: The spreadsheet you deliver as an attachment **must** be named "EngrD 2190 Spreadsheet - <your name>." Files with other names, such as "my spreadsheet" will be discarded.