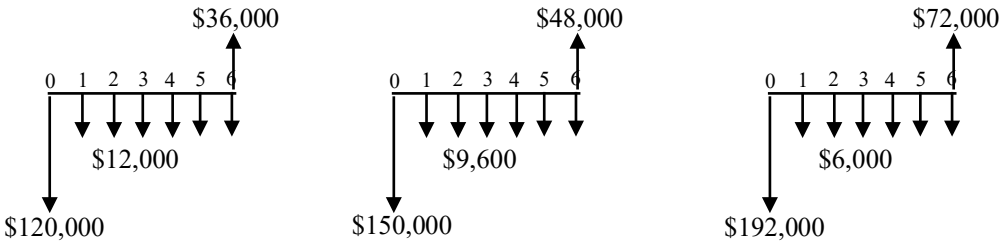
TIE2140 Engineering Economy
Solutions to Assignment #3

	Alternative A	Alternative B	Alternative C
Initial Cost	\$120,000	\$150,000	\$192,000
Useful Life	6 years	12 years	18 years
Annual O&M Cost	Year 1 to 6: \$12,000	Year 1 to 6: \$9,600 Year 7 to 12: \$14,400	Year 1 to 6: \$6,000 Year 7 to 12: \$12,000 Year 13 to 18: \$18,000
Market value at EoY 6	\$36,000	\$48,000	\$72,000
Market value at EoY 12	--	\$24,000	\$30,000
Market value at EoY 18	--	--	\$18,000

MARR = 6%.

(*a*) Study period = 6 years.
PW method.
Assume that Alternatives *B* and *C* are co-terminated at EoY 6.

Alternative *A* **Alternative *B*** **Alternative *C***



PW(6%) of *A* over 6 years
= – 120,000 – 12,000 [*P*/*A*, 6%, 6] + 36,000 [*P*/*F*, 6%, 6]
= – 120,000 – 12,000 (4.9173244) + 36,000 (0.7049605)
= **– \$ 153,629.31**

PW(6%) of *B* over 6 years
= – 150,000 – 9,600 [*P*/*A*, 6%, 6] + 48,000 [*P*/*F*, 6%, 6]
= – 150,000 – 9,600 (4.9173244) + 48,000 (0.7049605)
= **– \$ 163,368.21**

PW(6%) of *C* over 6 years
= – 192,000 – 6,000 [*P*/*A*, 6%, 6] + 72,000 [*P*/*F*, 6%, 6]
= – 192,000 – 6,000 (4.9173244) + 72,000 (0.7049605)
= **– \$ 170,746.79**

Answer: Choose Alternative *A* which has the highest *PW* over the study period of 6 years.

(*b*) Study period = 6 years.
Incremental *IRR* method
Assume that Alternatives *B* and *C* are co-terminated at EoY 6.
Project Type: Cost/Service projects

Initialization:
Projects sorted in increasing initial cost = [*A*, *B*, *C*]
Base project = "*A*".
Next project = "*B*"
List = [*C*]

Iteration 1:

	Cash flows for "*B* – *A*"	
Initial Cost	– 150,000 – (–120,000) =	– $30,000
Annual O&M Y1 to Y6	– 9,600 – (–12,000) =	$2,400
Market value at EoY 6	48,000 – 36,000 =	$12,000

To find *IRR*("*B* – *A*"), we solve:

$$-30{,}000 + 2{,}400\,[P/A,\ i\%,\ 6] + 12{,}000\,[P/F,\ i\%,\ 6] = 0$$

Using Excel: =RATE(6, 2400, -30000, 12000, 0, 0.1) = - 0.02695

IRR("*B* – *A*") = -2.695% < *MARR* = 6%.

$\Rightarrow$ Incremental investment from A to B is infeasible

Base project = "*A*".
Next project = "*C*"
List = [ ]

Iteration 2:

	Cash flows for "*C* – *A*"	
Initial Cost	– 192,000 – (–120,000) =	–$72,000
Annual Benefits	– 6,000 – (–12,000) =	$6,000
Market value at EoY 6	72,000 – 36,000 =	$36,000

To find *IRR*("*C* – *A*"), we solve:

$$-72{,}000 + 6{,}000\,[P/A,\ i\%,\ 6] + 36{,}000\,[P/F,\ i\%,\ 6] = 0$$

Using Excel: = RATE(6, 6000, -72000, 36000, 0, 0.1) = 0.00

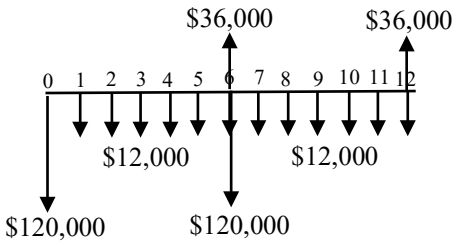
IRR("*C* – *A*") = 0% < *MARR* = 6%.

$\Rightarrow$ The incremental investment for A to C is infeasible

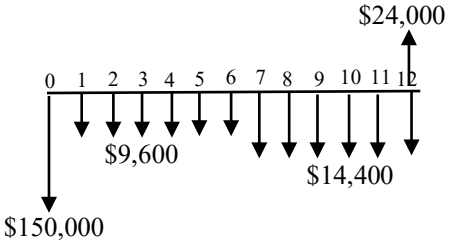
Answer: Choose Alternative *A* based on the incremental *IRR* analysis.

(*c*) Study period = 12 years.
PW method.
Assume that Alternative *A* is repeated once at EoY 6 and
Alternative *C* is co-terminated at EoY 12.

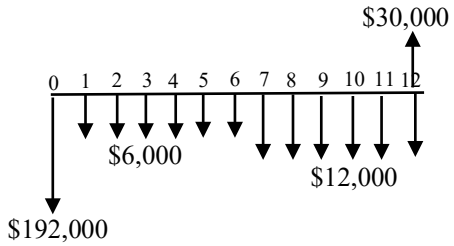
Alternative *A*



Alternative *B*



Alternative *C*



PW(6%) of *A* over 12 years
= *PW*(6%) of *A* over first 6 years (1 + [*P*/*F*, 6%, 6])
= – 153,629.31 (1 + 0.7049605) // from part (a)
= **– $ 261,931.92**

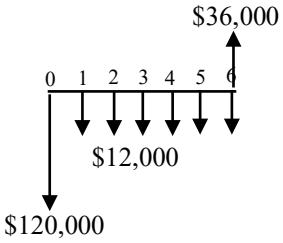
PW(6%) of *B* over 12 years
= – 150,000 – 9,600 [*P*/*A*, 6%, 6] – 14,400 [*P*/*A*, 6%, 6] [*P*/*F*, 6%, 6] + 24,000 [*P*/*F*, 6%, 12]
= – 150,000 – 9,600 (4.9173243) – 14,400 (4.9173243) (0.7049605) + 24,000 (0.4969694)
= **– $ 235,196.93**

PW(6%) of *C* over 12 years
= – 192,000 – 6,000 [*P*/*A*, 6%, 6] – 12,000 [*P*/*A*, 6%, 6] [*P*/*F*, 6%, 6] + 30,000 [*P*/*F*, 6%, 12]
= – 192,000 – 6,000 (4.9173243) – 12,000 (4.9173243) (0.7049605) + 30,000 (0.4969694)
= **– $ 248,193.10**

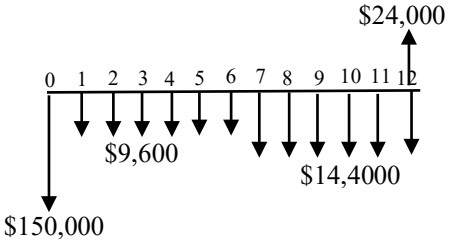
Answer: Choose Alternative *B* which has the highest *PW* over the study period of 12 years.

(*d*) Study Period = Infinity.
AW method.
Assume all 3 alternatives can be repeated indefinitely.

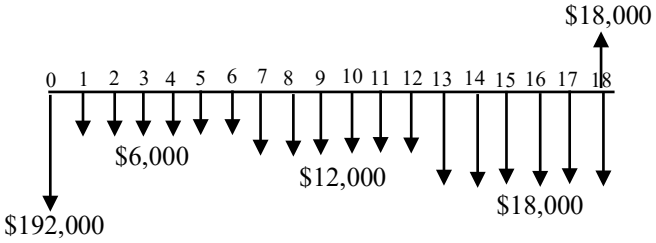
Alternative *A* (1 life cycle)



Alternative *B* (1 life cycle)



Alternative *C* (1 life cycle)



AW(6%) of *A* over 1 life cycle
= *PW*(6%) over 6 years [*A*/*P*, 6%, 6]
= – 153,629.31 (0.2033626)
= **– $ 31,242.46**

AW(6%) of *B* over 1 life cycle
= *PW*(6%) over 12 years [*A*/*P*, 6%, 12]
= –$235,196.93 (0.1192770)
= **– $ 28,053.59**

AW(6%) of *C* over 1 life cycle
= { –192,000 – 6,000 [*P*/*A*, 6%, 6] – 12,000 [*P*/*A*, 6%, 6] [*P*/*F*, 6%, 6]
– 18,000 [*P*/*A*, 6%, **5**] [*P*/*F*, 6%, 12] } [*A*/*P*, 6%, 18] # net CF at EoY 18 is zero

{ –192,000 – 6,000 (4.9173243) – 12,000 (4.9173243) (0.7049605)
– 18,000 (4.2123638) (0.4969694) } 0.0923565

= **– $ 27,779.34**

Answer: Choose System *C* which has the highest *AW* over the study period of infinity.