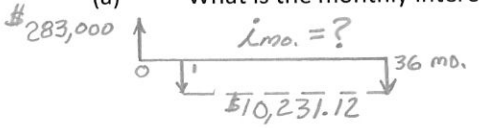
ENGINEERING ECONOMY
CIVL 314
Summer 2015

Name KEY

TEST 2

1. A small engineering company plans to borrow $283,000 to purchase new equipment. The cost of the equipment will be repaid with monthly payments of $10,231.12 over a 3 year (36 month) period, with payments beginning one month from now (i.e., the first payment will be exactly 1 month from the date of the loan). The compounding period is one month. [Show all work. For Part (a), *set up the solution showing factor notation. If equations are used, show the equation used also.]*

(a) What is the monthly interest rate? Include a cash flow diagram. (*8 points*)



$\$10,231.12 = \$283,000\left[\frac{A}{P}, i_{mo}, 36\right]$

$\left[\frac{A}{P}, i_{mo}, 36\right] = \frac{10,231.12}{283,000} = 0.03615$

$i_{mo} = 1.5\%$

(b) What is the nominal annual interest rate? (*8 points*)

$r = 12\,(1.5\%) = 18\%$

(c) What is the effective annual interest rate? (*8 points*)

$i = \left(1+\frac{r}{m}\right)^m - 1$

$= \left(1+\frac{0.18}{12}\right)^{12} - 1 = 0.19562$ OR 19.56%

Note: If you cannot solve Part (a), assume a value of, say, 1.25% per month if you think you need this value for either (b) or (c). In your solution, state clearly that you are assuming this value.

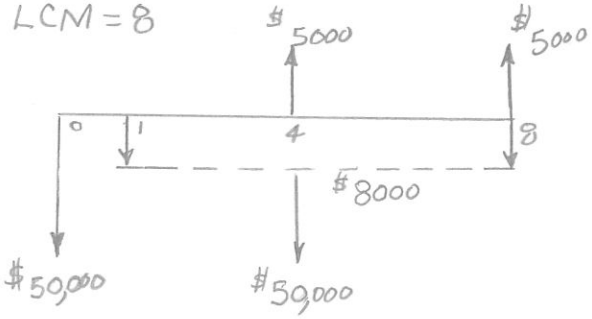
$r = (1.25)12 = 15\%$

$i = \left(1+\frac{0.15}{12}\right)^{12} - 1 = 0.1608$ OR $i = 16.08\%$

2. Machine "H" is being compared on a ***Present Worth*** basis with Machine "M." Machine "H" has a *four*-year life and Machine "M" has an *eight*-year life. Based on the following information, determine the present worth cost of Machine "H" that would be used to determine the best alternative between the two machines. (**Do not** determine the cost of Machine "M.") The interest rate is 8 %, compounded annually. Include a cash flow diagram. *{Set up the solution showing factor notation. If equations are used, show the equation used also. Clearly show the values substituted for the factors, whether obtained from a table or from an equation.}* (*24 points*)

	Machine "H"
First Cost	$-50,000
Annual Operating and Maintenance Cost	$-8,000
Salvage Value	$5,000
Life, years	4

LCM = 8



$PW_H = -\$50,000 - 50,000\left[\frac{P}{F}, 8\%, 4\right]$ (0.7350)

$+\$5000\left[\frac{P}{F}, 8\%, 4\right]$ (0.7350) $+\$5000\left[\frac{P}{F}, 8\%, 8\right]$ (0.5403)

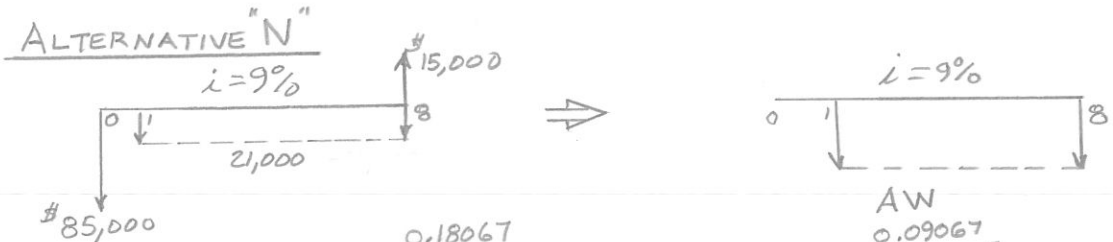
$-8000\left[\frac{P}{A}, 8\%, 8\right]$ (5.7466)

$PW_H = -\$126,346$

3. Alternative "N" is being compared with Alternative "O". Based on the following information, compare the two alternatives based on the capitalized cost (CC). The interest rate is 9 % per year, compounded annually. Include a cash flow diagram of each and indicate which alternative should be selected based on the analysis. *{Clearly show all work, including factor notation, equations, and values of factors.} (26 points)*

	Alternative "N"	Alternative "O"
First Cost	$-85,000	$-105,000
Annual Operating and Maintenance Cost	$-21,000	$-15,000
Salvage Value	$15,000	----------
Life, years	8	infinity

ALTERNATIVE "N"



$$AW_N = -\$85{,}000\left[\frac{A}{P}, 9\%, 8\right] - \$21{,}000 + 15{,}000\left[\frac{A}{F}, 9\%, 8\right]$$

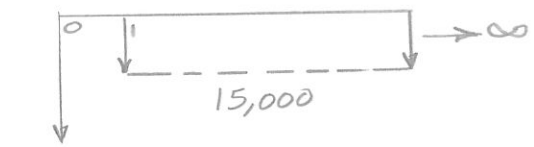
(0.18067 and 0.09067)

$$= -\$34{,}996.90$$

This value is for 8 years. However, the LCM is infinity, and an infinite number of 8-yr. cycles would have the same AW

$$CC_N = \frac{AW_N}{i} = \frac{-34{,}996.90}{0.09} = -\$388{,}854$$

ALTERNATIVE "O"



$$CC_O = -105{,}000 - \frac{15{,}000}{0.09}$$

$$= -\$271{,}667$$

ALTERNATIVE "O" COSTS LESS THAN ALTERNATIVE "N" AND SHOULD BE SELECTED BASED ON THE ANALYSIS

4. Three different projects are being considered for Quality Computer Accessories, Inc. Using the incremental rate of return method, determine the proper alternative to select if the MARR is 10% per year, compounded annually. The projects are mutually exclusive: at most, only one project can be selected and **none of the projects have to be selected**. Cash flow diagrams are not required. {*The solution must be shown in logical order and must be appropriately documented. Clearly label each comparison made and the alternative selected in each case. Note that a significant number of points will be deducted if the comparison made at any point in the solution is not correct. Show all work, including factor notation, equations, values of factors, etc.,*} *(26 points)*

	Project "X"	Project "Y"	Project "Z"
First Cost	$-166,000	$-129,000	$-185,000
Net annual cash flow	+ $28,000	+ $21,000	+ $31,000
Life, years	10	10	10

ORDER: DN, Y, X, Z

COMPARE Y TO DN

$0 \stackrel{?}{=} -PW_O + PW_I$

$0 = (-129{,}000 - 0) + (21{,}000 - 0)\left[\frac{P}{A}, \Delta i^*, 10\right]$

$\left[\frac{P}{A}, \Delta i^*, 10\right] = \frac{129{,}000}{21{,}000} = 6.1429$

$\left[\frac{P}{A}, 10\%, 10\right] = 6.1446$

$\left[\frac{P}{A}, \Delta i^*, 10\right] = 6.1429$

$\left[\frac{P}{A}, 11\%, 10\right] = 5.8892$

$\Delta i^* = \frac{6.1446 - 6.1429}{6.1446 - 5.8892}(11\% - 10\%) + 10\%$

$\Delta i^* = 10.007\%$

SELECT Y, ELIMINATE DN

COMPARE X TO Y

$0 = -PW_O + PW_I$

$0 = (-166{,}000 - (-129{,}000)) + (28{,}000 - 21{,}000)\left[\frac{P}{A}, \Delta i^*, 10\right]$

$\left[\frac{P}{A}, \Delta i^*, 10\right] = \frac{37{,}000}{7{,}000} = 5.2857$

$\left[\frac{P}{A}, 12\%, 10\right] = 5.6502$

$\left[\frac{P}{A}, \Delta i^*, 10\right] = 5.2857$

$\left[\frac{P}{A}, 15\%, 10\right] = 5.0188$

$\Delta i^* = \frac{5.6502 - 5.2857}{5.6502 - 5.0188}(15\% - 12\%) + 12\%$

$\Delta i^* = 13.7\%$

SELECT X, ELIMINATE Y

COMPARE Z TO X

$0 = -PW_O + PW_I$

$0 = (-185{,}000 - (-166{,}000)) + (31{,}000 - 28000)\left[\frac{P}{A}, \Delta i^*, 10\right]$

$\left[\frac{P}{A}, \Delta i^*, 10\right] = \frac{19{,}000}{3000} = 6.3333$

$\left[\frac{P}{A}, 9\%, 10\right] = 6.4177$

$\left[\frac{P}{A}, \Delta i^*, 10\right] = 6.3333$

$\left[\frac{P}{A}, 10\%, 10\right] = 6.1446$

$\Delta i^* = \frac{6.4177 - 6.3333}{6.4177 - 6.1446}(10\% - 9\%) + 9\%$

$\Delta i^* = 9.3\%$

SELECT X, ELIMINATE Z