Solution

DEPARTMENT OF CHEMISTRY & LIFE SCIENCE

QUIZ 3 – CH402 2023-2024
10 Minutes, 24 Points
28 February 2024

TEXT: Peters, Timmerhaus, & West
SCOPE: Present and future values

References Permitted: FE Reference Manual online.

INSTRUCTIONS

1. Do not mark this quiz until "begin work" is given. You will have 10 minutes.
2. Solve the problems in the space provided. Show all work to receive credit.
3. There are 7 problems on 3 pages in this quiz, not including the cover page.
4. Write your name on the top of each sheet.
5. Show work to receive partial credit.

(TOTAL WEIGHT: 24 POINTS)

DO NOT WRITE IN THIS SPACE

PROBLEM	VALUE	CUT
1	6	a
2	6	c
3	6	d
4	6	c
CUT		
BONUS	8	d b c c
GRADE	24	

The data below pertains to Problems 1 and 2 and shows the estimated before-tax annual cash flows for a project.

Year End	1	2	3	4
Cash Flow	$1,000	$1,000	$1,000	$1,000

1. (6 points) At 6% interest per year compounded annually, the *present* value of the project is most nearly

(A) $3,465
(B) $2,165
(C) $2,700
(D) $4,000

To P given A $\Rightarrow$ $(P/A, 6\%, 4) = 3.4651$

$1000 \cdot 3.4651 = \$3465$ ← ANS

2. (6 points) At 6% per year compounded annually, the *present* value of the project at the end of year 4 after 24% annual taxes is most nearly

A) $1,740
B) $3,040
C) $2,633
D) $1,333

$1000 \cdot (1 - .24) \cdot 3.4651 = \$2633$ ← ANS

3. (6 points) The present worth of the profits from a process is $1,606,000. Assuming a facility life of 18 years, what is the equivalent annual cash flow (A) from the process if the interest rate is 2% compounded annually?

A) $125,240
B) $150,300
C) $200,110
D) $107,120

to A given P $\Rightarrow \left(A/P, 2\%, 18\right) = .0667$

$1606000 \cdot .0667 = \$107,120$ —ANS

4. (6 points) A heat exchanger originally cost $21,000 and has a service life of three years with no scrap value. Assuming the cost of the original heat exchanger remains the same (no inflation), the capitalized costs of the heat exchanger at 6% annual interest is most nearly

A) $ 87,000
B) $137,000
C) $131,000
D) $ 59,000

$CC = C_V + P$ where $P = \dfrac{A}{i}$

to A given F $\Rightarrow \left(A/F, 6\%, 3\right) = .3141$

$21000 + \dfrac{21000 \cdot .3141}{.06} = \$130,935$ —ANS

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using formula

$21000 + \dfrac{21000}{\left(1 + .06\right)^3 - 1} = \$130,938$ —ANS

Bonus 1

(4 points) The annual maintenance costs for a facility are $0 for the first year and increase by $300 each year thereafter (assumed payable at the end of each year). Assuming a facility life of 15 years, what is the present worth of the maintenance costs over the lifetime of the facility if the interest rate is 8% compounded annually?

    A) $ 4,510
    B) $22,315
    C) $29,220
    D) $14,370

to P given G $\Rightarrow$ $(P/G, 8\%, 15) = 47.8857$

$300 \cdot 47.8857 = \$14,366$ ← ANS

Bonus 2

(2 points) The power scaling factor for acetic acid plants using the CH_3OH-CO catalytic process is 0.68. If the fixed capital investment for this type of plant producing 9,000 metric tons per year is $8,000,000, the price for a plant producing 18,000 metric tons per year is most nearly

    A) $12,120,000
    B) $12,800,000
    C) $16,000,000
    D) $13,700,000

exp. scaling method:

$8\,000\,000 \cdot \left(\dfrac{18\,000}{9\,000}\right)^{.68} \simeq \$12,817,000$ ← ANS "B"

TOR method: $\$16,000,000$ ← ANS "C"

Bonus 3

(2 points) The fixed capital investment in year 2000 for a chlorine plant producing 45,000 metric tons per year using electrolysis of NaCl was $33,000,000 and the selling price of chlorine was $30 per metric ton at that time. If the chemical engineering plant cost index was 394.1 in 2000 and 782.5 in 2024 and the selling price of chlorine is $69 per metric ton in 2024, the fixed capital investment for a plant producing 90,000 metric tons per year in 2024 is most nearly

    E) $ 66,000,000
    F) $127,000,000
    G) $131,000,000
    H) $ 99,000,000

$\dfrac{90\,000}{45\,000} \cdot 33\,000\,000 = \$66\,000\,000$

$66\,000\,000 \cdot \dfrac{782.5}{394.1} = \$131\,000\,000$ ← ANS