These problems address topics from the NCEES FE Civil CBT Exam Specifications at https://ncees.org/wp-content/uploads/FE-Civil-CBT-specs-1.pdf, see below.

YouTube Playlist

FE Civil Review 2022

Engineering Economics

NCEES Fundamentals of Engineering (FE)
CIVIL CBT Exam Specifications

Effective Beginning with the July 2020 Examinations

Knowledge	Number of Questions
3. Engineering Economics	**5–8**

A. Time value of money (e.g., equivalence, present worth, equivalent annual worth, future worth, rate of return)
B. Cost (e.g., fixed, variable, direct and indirect labor, incremental, average, sunk)
C. Analyses (e.g., break-even, benefit-cost, life cycle, sustainability, renewable energy)
D. Uncertainty (e.g., expected value and risk)

Notes
V0.1 draft 4/23/2022

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A. Time value of money

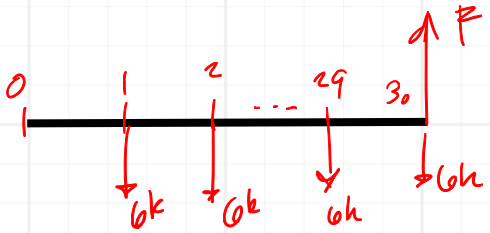
Question 1: A new engineer decides to invest $6000 each year into a retirement savings account. The engineer continues this practice for a 30-year period and earns on average 10% per year. The amount at the end of 30 years is most nearly:

A. $200,000

B. $990.000

C. $1,620,000

D. $3,140,000



$(F/A,\ 10\%,\ 30) = 164.4940$

$\therefore\ F = \$6000 \times 164.490 = \$986,940$

A. Time value of money

Question 2: A new engineer has a goal of investing enough money into a retirement to account to have the equivalent of $1,000,000 in today's dollars at retirement in 30 years. Assume a rate of return on the investment of 10% per year and average inflation of 2.0% per year, the amount that should be invested annually is most nearly:

A. $7,000

B. $9,000

C. $11,000

D. $13,000

1. figure out Future value of $1,000,000

$(F/P,\ 2\%,\ 30) = 1.8114$

$F = 1,000,000 \cdot 1.8114$

$= \$1,811,400$

2. figure out investments needed

$F\ (A/F,\ 10\%,\ 30) = 0.00061$

$A = 0.00061\ (\$1,811,400)$

$A = \$1,050$

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B. Cost

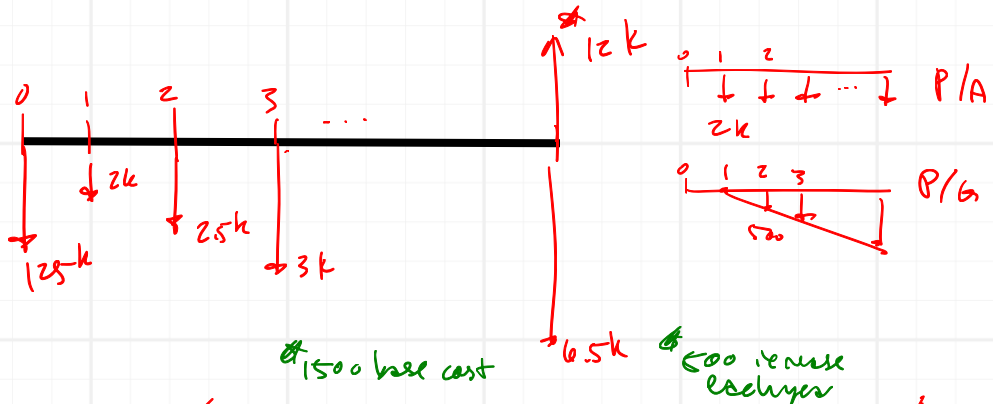
Question 3: A piece of equipment will have an initial cost of $125,000 to purchase. It is assumed that maintenance costs will begin at a base level of $2000 in the first year, increase to $2500 in year two, and continue to increase at $500 each year through year 10. The equipment will have a salvage value of $12,000 after 10 years. Using an interest rate of 8%, the present worth of the equipment cost is most nearly:

A. $128,000

B. $137,000

C. $142,000

D. $155,000



$$P = P_i + 2k\,(P/A, 8\%, 10) + 0.5k\,(P/G, 8\%, 10) + 12k\,(P/F, 8\%, 10)$$

$$= 125k + 2k\,(6.7101) + 0.5k\,(25.9768) - 12k\,(0.4632)$$

$$= 145.85k$$

B. Cost

Question 4: Interest on a loan is 8% per year compounded each month. The effective annualized interest rate is most nearly:

A. 8%

B. 8.1%

C. 8.3%

D. 8.7%

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

rate

term per year

$$i_e = \left(1 + \frac{8\%}{12}\right)^{12} - 1$$

$$i_e = 0.083$$

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B. Cost

Question 5: A piece of equipment with an initial cost of $120,000 is expected to have a salvage value of $15,000 after its 5-year service life is depreciated using the straight-line method. The equipment's book value at the end of year three is most nearly:

A. $52,000
B. $55,000
C. $57,000
D. $60,000

1. find Depreciation:

$$D_j = \frac{C - S_n}{n} = \frac{120k - 15k}{5 \text{ years}} = 21k/\text{year}$$

2. find book value:

$$B_u = \text{initial cost} - \Sigma D_j$$
$$= 120k - 3 \cdot 21k$$
$$= 57{,}000$$

B. Cost

Question 6: A piece of equipment with an initial cost of $120,000 is expected to have a salvage value of $15,000 after its 5-year service life is depreciated using the MACRS method. The depreciation charge for year three is most nearly:

A. $20,000
B. $21,000
C. $23,000
D. $24,000

MACRS → lookup factor

$$D_j = (\text{factor})\, C$$
$$D_3 = (19.20\%)\, 120k$$
$$D_3 = 23{,}040$$

why 6 factors?
- table assumes 1/2 year cycle to start and end
- converts to SL after year 4
- 5 year common for IRS for things like vehicles

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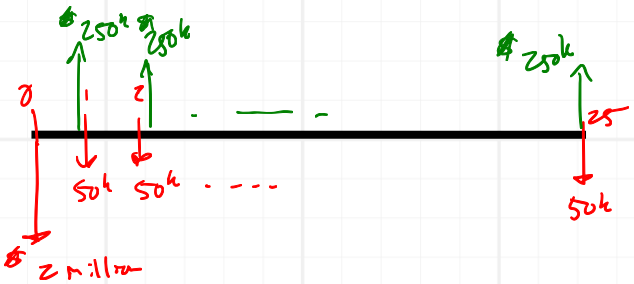
C. Analyses

Question 7: A solar project is expected to have an initial cost of $2 million, with an annual operations and maintenance cost of $50,000. Profits for the project have been estimated at $250,000 per year over a 25-year lifespan. Using an interest rate of 8% per year, the benefit to cost ratio for this project is most nearly:

A. 0.95
B. 1.00
C. 1.05
D. 1.10



$(P/A, 8\%, 25) = 10.6748$

benefits $= \$250k\,(P/A, 8\%, 25) = \$2,668,700$

costs $= \$2,000,000 + \$50,000\,(P/A, 8\%, 25) = \$2,533,740$

$\frac{b}{c} = 1.05$

C. Analyses

Question 8: Two alternatives are being considered for procuring a part. An interest rate of 8% will be used for each alternative. These alternatives are presented as follows:

Method A involves purchasing equipment at an initial cost of $100,000, with a 5-year equipment life, $5,000 equipment salvage value, and an operating cost of $15,000 per year. In addition, each part will cost ~~$15~~ 18 to make.
Method B involves purchasing parts from a supplier for ~~$30~~ 32 per part.

The number of parts required per year for the two methods to break even is most nearly:

A. 2800
B. 2950
C. 3100
D. 3250

Method A (find annual cost of equipment + parts)

let X be # of parts

$A_A = \$100,000\,(A/P, 8\%, 5) + \$15,000 - \$5,000\,(A/F, 8\%, 5) + 18X$

$(A/P, 8\%, 5) = 0.2505$

$(A/F, 8\%, 5) = 0.1705$

$A_A = \$39,197.5 + 15X$

Method B

$A_B = 32X$

set $A_A = A_B$

$\$39,197.5 + 18X = 32X$

$X = 2800$ parts

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D. Uncertainty

Question 9: Four levels of quality are being considered for equipment to produce a part. The initial cost and repair cost and probability of equipment failure in any given year is presented in the table below. If this equipment must be used for 10 years and an interest rate of 6% is used, the most economical option is most nearly:

Option	Initial Cost	Repair Cost	Probability of needing a major repair in any year
A	$50,000	$30,000	40%
B	$75,000	$35,000	25%
C	$85,000	$45,000	15%
D	$98,000	$50,000	5%

A. Option A

B. Option B

C. Option C

D. Option D

$EU = C_1 \cdot P_1 + C_2 \cdot P_2 \cdots$

A: $EU_A = \$50{,}000 \cdot 1 + \$30{,}000 \cdot 0.4 \left(P/A, 6\%, 10\right) = \$138{,}321$ (7.3601)

B: $EU_B = \$75{,}000 \cdot 1 + \$35{,}000 \cdot 0.25 \left(7.3601\right) = \$139{,}404$

C: $EU_C = \$85{,}000 \cdot 1 + \$45{,}000 \cdot 0.15 \left(7.3601\right) = \$134{,}681$

D: $EU_D = \$98{,}000 \cdot 1 + \$50{,}000 \cdot 0.05 \left(7.3601\right) = \$116{,}400$

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