

Civil Engineering FE CBT Exam

Knowledge: Engineering Economics with 8 Example Problems

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1 Fundamental Concepts of Time Value of Money

Engineering economics provides the formal analytical framework for evaluating competing civil engineering design alternatives based on financial viability. Because money possesses earning power over time through interest rates, cash amounts occurring at different points in time cannot be directly added or compared without converting them to an equivalent financial basis.

1.1 Cash Flow Conventions and Diagrams

A Cash Flow Diagram (CFD) maps cash inflows (receipts, savings, revenues, salvage values) and cash outflows (initial capital costs, maintenance, operating expenses) along a discrete time axis measured in compounding periods n .

- **Time Axis (n):** $n = 0$ represents “today” (present). Periods $n = 1, 2, \dots, N$ represent end-of-period milestones.
- **Cash Inflows (+):** Represented as upward-pointing arrows (benefits, revenue, salvage values).
- **Cash Outflows (-):** Represented as downward-pointing arrows (capital outlay, maintenance, taxes).
- **End-of-Period Convention:** Unless stated otherwise, place each cash flow at its period end. Compounding frequency is specified independently.

1.2 Primary Cash Flow Symbols and Nomenclature

To navigate the NCEES FE Reference Handbook, master the five standardized cash flow variables:

- **P (Present Worth / Value):** Single monetary amount occurring at time $n = 0$.
- **F (Future Worth / Value):** Single monetary amount occurring at future time $n = N$.
- **A (Annual Worth / Annuity):** Series of equal, uniform cash flows occurring at the end of each period from $n = 1$ through $n = N$.
- **G (Uniform Gradient):** Uniformly increasing or decreasing cash flow series where the transaction at period n equals $(n - 1)G$, starting at $n = 2$ with $1G$.
- **i (Interest Rate):** Effective interest or discount rate per compounding period (expressed as a decimal in formulas).
- **n (Number of Compounding Periods):** Total duration or life of the project in years or compounding intervals.

The fundamental governing equation of compound interest relates a present value P to a future value F after n periods at interest rate i :

$$F = P(1 + i)^n \quad (1)$$

Every interest factor in the *NCEES FE Reference Handbook* is mathematically derived from this single compound interest relationship.

1.3 NCEES Discount Factor Formulas

When an exact interest rate i is given that does not appear in the standard NCEES Interest Rate Tables (e.g., $i = 5.25\%$), candidates must calculate the discrete factor directly using the formulas below.

Factor Name	Converts	NCEES Symbol	Formula
Single Payment Compound Amount	$P \rightarrow F$	$(F/P, i\%, n)$	$(1 + i)^n$
Single Payment Present Worth	$F \rightarrow P$	$(P/F, i\%, n)$	$(1 + i)^{-n}$
Uniform Series Sinking Fund	$F \rightarrow A$	$(A/F, i\%, n)$	$\frac{i}{(1 + i)^n - 1}$
Capital Recovery	$P \rightarrow A$	$(A/P, i\%, n)$	$\frac{i(1 + i)^n}{(1 + i)^n - 1}$
Uniform Series Compound Amount	$A \rightarrow F$	$(F/A, i\%, n)$	$\frac{(1 + i)^n - 1}{i}$
Uniform Series Present Worth	$A \rightarrow P$	$(P/A, i\%, n)$	$\frac{(1 + i)^n - 1}{i(1 + i)^n}$
Uniform Gradient Present Worth	$G \rightarrow P$	$(P/G, i\%, n)$	$\frac{(1 + i)^n - i n - 1}{i^2(1 + i)^n}$
Uniform Gradient Uniform Series	$G \rightarrow A$	$(A/G, i\%, n)$	$\frac{1}{i} - \frac{n}{(1 + i)^n - 1}$

1.4 Non-Annual Compounding and Effective Interest Rates

When interest is nominal (r) and compounded m times per year (e.g., monthly $m = 12$, quarterly $m = 4$, daily $m = 365$), the **effective annual interest rate** (i_e) accounts for compounding intra-year interest:

$$i_e = \left(1 + \frac{r}{m}\right)^m - 1 \quad (2)$$

Use an effective rate per payment period; convert when payment and compounding periods differ.

Key Exam Strategy: Two Equivalent Methods for Non-Annual Compounding

1. **Method 1 (Period-Based):** Convert interest rate to $i = r/m$ and total periods to $n = m \times N$. Look up or calculate factors using $(i\%, n)$.
2. **Method 2 (Effective Rate Basis):** Compute $i_e = (1 + r/m)^m - 1$ and solve annually using $(i_e\%, N)$.

1.5 Shifted Uniform Series and Gradients

The standard P/A factor assumes the uniform series A begins at $n = 1$ and ends at $n = N$, yielding a present value P at time $n = 0$. If an annual series starts at year $n = k$ and ends at $n = N$, applying $(P/A, i\%, N - k + 1)$ yields an intermediate present worth at time $n = k - 1$. To discount this value back to $n = 0$:

$$P_0 = A \cdot (P/A, i\%, N - k + 1) \cdot (P/F, i\%, k - 1) \quad (3)$$

2 Cost Concepts & Cost Classification

In civil engineering project administration, cost modeling requires distinguishing between fixed, variable, direct, indirect, incremental, and sunk costs. Understanding cost structure is vital for bidding, estimating, and equipment replacement evaluations.

2.1 Cost Classifications in Engineering Practice

- **Fixed Costs:** Overhead and capital expenditures that remain constant regardless of production output or volume (e.g., equipment lease payments, building rent, baseline administrative salaries).
- **Variable Costs:** Costs that vary directly in proportion to the volume of output or construction activity (e.g., diesel fuel, raw concrete, rebar, hourly field labor).
- **Direct Labor / Direct Material:** Expenses directly traceable to a specific work breakdown structure (WBS) task or bid item (e.g., wages for equipment operators placing asphalt).
- **Indirect Labor / Overhead:** Expenses necessary to support construction operations but not directly assignable to a single physical bid item (e.g., jobsite trailer safety managers, quality assurance engineers, site security).
- **Average Cost:** Total cost divided by total quantity of output units (Q):

$$\text{Average Cost} = \frac{\text{Total Fixed Cost} + \text{Total Variable Cost}}{\text{Total Units Produced } (Q)} \quad (4)$$

- **Incremental (Marginal) Cost:** Additional cost incurred by producing one additional unit of output or extending project scope by one unit:

$$\text{Incremental Cost} = \frac{\Delta \text{Total Cost}}{\Delta Q} \quad (5)$$

- **Sunk Cost:** Money already expended due to past decisions that **cannot be recovered** regardless of future action. **CRITICAL EXAM RULE:** Sunk costs must be **COMPLETELY EXCLUDED** from engineering economic evaluations of future alternatives.

2.2 Cost Estimating and Cost Indexes

Converting historical project cost data to present-day estimates requires applying **Cost Indexes** (e.g., Engineering News-Record Construction Cost Index). A cost index reflects relative price levels of labor, materials, and equipment compared to a baseline year ($I_{\text{base}} = 100$).

$$\text{Cost in Year } B = \text{Cost in Year } A \times \left(\frac{\text{Index in Year } B}{\text{Index in Year } A} \right) \quad (6)$$

2.3 Capacity Power-Sizing / Equipment Scaling

When estimating major civil infrastructure or chemical treatment equipment costs across different plant capacities, the non-linear relationship is modeled using the **Power-Sizing Model**:

$$\text{Cost}_B = \text{Cost}_A \times \left(\frac{\text{Capacity}_B}{\text{Capacity}_A} \right)^x \quad (7)$$

Where x is the cost-capacity sizing exponent (typically $x \approx 0.6$ for industrial/process infrastructure, known as the "six-tenths rule").

Summary: Sunk Costs in Replacement Analysis

- When deciding whether to replace an existing asset ("defender") with a new asset ("challenger"):
- Original purchase price of defender = historical sunk expenditure; ignore it in the current decision.
 - Current book value = accounting value; it is not a relevant cash flow unless tax effects are specified.
 - Current market or trade-in value = relevant opportunity cost of keeping the defender.

3 Depreciation Methods & Asset Valuation

Depreciation is the systematic reduction in the financial book value of a physical capital asset over its useful life due to wear, tear, deterioration, or obsolescence. In engineering economy, depreciation is critical because it represents a non-cash business expense that reduces taxable income.

3.1 Straight-Line Depreciation Method

Straight-line depreciation distributes an equal amount of depreciation expense across each year j of an asset's useful life n .

$$D_j = \frac{C - S_n}{n} \quad (8)$$

Where D_j = annual depreciation charge, C = initial cost ($n = 0$), S_n = salvage value at n , n = useful life.

The **Book Value** (BV_j) at the end of year j is the initial cost minus cumulative depreciation:

$$BV_j = C - \sum_{k=1}^j D_k = C - j \cdot D_j \quad (9)$$

3.2 Modified Accelerated Cost Recovery System (MACRS)

MACRS is the primary tax depreciation system required by the U.S. Internal Revenue Service (IRS). MACRS accelerates depreciation charges into the early years of an asset's recovery period.

Key Rules for MACRS Depreciation on the FE Exam

1. **Salvage Value Ignored:** MACRS assumes $S_n = 0$. **Never subtract salvage value** when computing MACRS depreciation!
2. **Half-Year Table:** The factors below use the half-year convention and $n + 1$ recovery years. Applicable MACRS cases can instead require mid-quarter or mid-month conventions.
3. **Depreciation Formula:** $D_j = \text{Factor}_j \times C$, where Factor_j is read directly from the NCEES MACRS Percent Table.

3.3 Official NCEES MACRS Percentage Factors

Year (j)	Recovery Period Property Class			
	3-Year (%)	5-Year (%)	7-Year (%)	10-Year (%)
1	33.33	20.00	14.29	10.00
2	44.45	32.00	24.49	18.00
3	14.81	19.20	17.49	14.40
4	7.41	11.52	12.49	11.52
5		11.52	8.93	9.22
6		5.76	8.92	7.37
7			8.93	6.55
8			4.46	6.55
9				6.56
10				6.55
11				3.28

Cumulative MACRS Book Value at year j :

$$BV_j = C \left(1 - \sum_{k=1}^j \text{Factor}_k \right) \quad (10)$$

4 Economic Decision-Making & Alternative Evaluation

When selecting between mutually exclusive engineering designs, engineers must evaluate all candidate alternatives on an equivalent financial basis over an appropriate study period.

4.1 Present Worth (PW) Analysis

The **Present Worth** (PW) method converts all financial inflows and outflows across the project lifespan to time $n = 0$ using the Minimum Attractive Rate of Return ($MARR = i$).

$$PW(i) = -P_0 + \sum_{n=1}^N A_n(1+i)^{-n} + S_N(1+i)^{-N} \quad (11)$$

Decision Rule for Present Worth Analysis

- **Single Independent Project:** Accept if $PW(i) \geq 0$.
- **Mutually Exclusive Alternatives:** Select the alternative with the **maximum** (least negative or most positive) $PW(i)$.
- **Unequal Project Lifespans:** PW comparison **MUST** be conducted over an equal study period using the **Lowest Common Multiple (LCM)** of asset lives, or a fixed study horizon with assumed salvage trade-ins.

4.2 Equivalent Uniform Annual Worth (EAW/EUAW) Analysis

The **Equivalent Annual Worth** (EAW) converts all project costs, annual operations, and salvage values into an equivalent, uniform annual series A from $n = 1$ to $n = N$:

$$EAW(i) = -P_0(A/P, i\%, N) + A_{\text{net}} + S_N(A/F, i\%, N) \quad (12)$$

MAJOR EXAM ADVANTAGE: Unlike Present Worth analysis, EAW can be directly compared between mutually exclusive alternatives with **UNEQUAL USEFUL LIVES** without needing an LCM study period, provided the service is required indefinitely and assets repeat with identical costs.

4.3 Capitalized Cost Analysis (Perpetual Life)

Capitalized Cost (CC) represents the present worth P of an asset or public infrastructure project intended to provide service **indefinitely / perpetually** ($N \rightarrow \infty$), such as dams, bridges, aqueducts, or permanent right-of-way alignments.

The fundamental capitalized cost relationship derived as $N \rightarrow \infty$ is:

$$CC = P = \frac{A}{i} \quad (13)$$

Where CC = capitalized present worth (\$), A = perpetual uniform annual expenditure or revenue (\$/year), and i = discount rate / MARR per period.

For perpetual assets with periodic major overhaul costs occurring every k years at amount O :

$$CC_{\text{overhaul}} = \frac{O}{(1+i)^k - 1} = O(A/F, i\%, k) \cdot \frac{1}{i} \quad (14)$$

5 Specialized Economic Analyses & Uncertainty

5.1 Break-Even Analysis

Break-Even Analysis determines the threshold value of a design variable (such as annual production volume Q , operating hours, or usage rate) where two competing engineering alternatives yield equal financial results.

Setting total annual cost of Alternative A equal to Alternative B:

$$TC_A(Q_{BE}) = TC_B(Q_{BE}) \implies \text{Fixed}_A + \text{Var}_A \cdot Q_{BE} = \text{Fixed}_B + \text{Var}_B \cdot Q_{BE} \quad (15)$$

$$Q_{BE} = \frac{\text{Fixed}_B - \text{Fixed}_A}{\text{Var}_A - \text{Var}_B} \quad (16)$$

5.2 Benefit-Cost Ratio Analysis (B/C)

Public sector civil infrastructure projects (highways, flood control, water resource management) are evaluated using the **Benefit-Cost Ratio** (B/C). All benefits to the public (B), disbenefits to the public (D), and net costs to the government agency (C) must be expressed on an equivalent PW or EAW basis.

$$\text{Conventional } B/C = \frac{B - D}{C} = \frac{PW(\text{Benefits}) - PW(\text{Disbenefits})}{PW(\text{Capital Cost}) + PW(\text{O\&M})} \quad (17)$$

NCEES Benefit-Cost Decision Criteria

- **Acceptability:** A public project is economically justified if $B/C \geq 1.0$ (or $B - C \geq 0$).
- **Incremental B/C Analysis:** When evaluating mutually exclusive public alternatives, sort alternatives by increasing cost and compute incremental $\Delta B/\Delta C$. Select the higher-cost alternative only if $\Delta B/\Delta C \geq 1.0$.

5.3 Inflation-Adjusted Interest Rates

For real rate i_r and inflation f , the nominal rate is $d = i_r + f + i_r f$. Discount constant-dollar cash flows with $i_r = (1 + d)/(1 + f) - 1$.

$$d = i_r + f + i_r f \quad (18)$$

5.4 Uncertainty, Risk, and Expected Value (EV)

When future economic outcomes (e.g., traffic demand, flood severity) are probabilistic, decisions are evaluated using **Expected Value** (EV):

$$EV = \sum_{j=1}^K P(X_j) \cdot X_j = p_1 X_1 + p_2 X_2 + \cdots + p_K X_K \quad (19)$$

Where $\sum p_j = 1.0$ and X_j is the monetary payload of outcome j .

6 Example Problems and Solutions

Problem 1: Shifted Cash Flows and Non-Annual Compounding

A municipality plans to construct a regional stormwater detention basin. Land acquisition costs \$250,000 today ($n = 0$). Construction will occur in Year 3 at a cost of \$600,000. Maintenance costs will be \$20,000 annually starting at the end of Year 4 and continuing through Year 15. If the nominal interest rate is 8% per year compounded quarterly, what is the equivalent present worth (P_0) of the total project costs?

- A. -\$782,140 B. -\$840,456 C. -\$895,430 D. -\$954,820

Solution

Step 1: Determine effective annual interest rate (i_e). Given $r = 8\% = 0.08$, $m = 4$:

$$i_e = \left(1 + \frac{0.08}{4}\right)^4 - 1 = (1.02)^4 - 1 = 8.2432\%$$

Step 2: Land Acquisition Cost ($n = 0$). $P_1 = -\$250,000$.

Step 3: Discount Construction Cost ($n = 3$).

$$P_2 = -\$600,000 \cdot (1 + 0.082432)^{-3} = -\$600,000 \cdot 0.788493 = -\$473,096$$

Step 4: Discount Annual Maintenance Series ($n = 4$ to $n = 15$, 12 payments). First, find equivalent worth at $n = 3$:

$$P_{M,3} = -\$20,000(P/A, 8.2432\%, 12) = -\$20,000(7.4420) = -\$148,841$$

Now discount $P_{M,3}$ from Year 3 to Year 0:

$$P_3 = -\$148,841(1.082432)^{-3} = -\$117,360$$

Step 5: Sum total present worth (P_{total}).

$$P_{\text{total}} = -\$250,000 - \$473,096 - \$117,360 = -\$840,456 \quad (\text{Correct Answer: B})$$

Problem 2: Linear Gradient Series Evaluation

A heavy civil contractor purchases a fleet of earthmoving scrapers. Maintenance expenses are expected to be \$15,000 in Year 1, increasing by \$3,000 per year each year thereafter through Year 10. If the contractor's MARR is 10% per year compounded annually, what single uniform annual payment (A) over the 10-year period is equivalent to these maintenance costs?

- A. \$22,230 B. \$26,176.50 C. \$28,450 D. \$31,800

Solution

Step 1: Identify gradient series components. Base uniform cost $A_1 = \$15,000$, gradient $G = \$3,000$, $n = 10$ years.

Step 2: Calculate ($A/G, 10\%, 10$) factor.

$$(A/G, 10\%, 10) = \frac{1}{0.10} - \frac{10}{(1.10)^{10} - 1} = 10 - \frac{10}{1.59374} = 3.7255$$

Step 3: Calculate total equivalent annual worth (A_{total}).

$$A_{\text{total}} = \$15,000 + \$3,000(3.7255) = \$26,176.50 \quad (\text{Correct Answer: B})$$

Problem 3: Cost Index Escalation and Equipment Power-Sizing

In 2012, a municipal water treatment facility installed a 5.0 MGD (million gallons per day) clarification unit at a capital cost of \$1,800,000 when the ENR Construction Cost Index was 9,200. In 2026, the municipality plans to build a new 12.0 MGD clarification unit at a site where the ENR Index has risen to 13,800. If the capacity scaling exponent (x) for industrial clarification equipment is 0.68, what is the estimated capital cost of the new unit in 2026?

- A. \$3,410,000 B. \$4,896,744 C. \$5,230,000 D. \$6,150,000

Solution

Step 1: Adjust 2012 baseline cost for capacity scaling (5.0 MGD → 12.0 MGD).

$$\text{Cost}_{2012,12 \text{ MGD}} = \text{Cost}_{2012,5 \text{ MGD}} \times \left(\frac{12.0}{5.0} \right)^{0.68} = \$1,800,000 \times (2.4)^{0.68}$$

Keep full precision: $(2.4)^{0.68} = 1.813608925$.

$$C_{2012,12} = \$1,800,000(1.813608925) = \$3,264,496.06.$$

Step 2: Escalate scaled cost from 2012 to 2026 using Cost Indexes.

$$C_{2026,12} = \$3,264,496.06(13,800/9,200) = \$4,896,744.10 \text{ (Correct Answer: B).}$$

Problem 4: Sunk Cost and Opportunity Cost in Equipment Replacement

A contractor purchased an asphalt paver 3 years ago for \$180,000. Its current book value is \$108,000. The paver currently incurs annual maintenance costs of \$24,000 and can be sold today for \$45,000. A new high-efficiency paver costs \$220,000, has a 5-year life with zero salvage value, and reduces annual maintenance to \$6,000 per year. In evaluating whether to replace the existing paver today, what amount represents the opportunity cost of keeping the existing paver?

- A. \$45,000 B. \$63,000 C. \$108,000 D. \$135,000

Solution

Step 1: Identify sunk and accounting amounts. The \$180,000 original purchase price is a past expenditure and is sunk for the current replacement decision. The \$108,000 book value is an accounting measure, not a current economic cash flow unless tax effects are specified.

Step 2: Identify the opportunity cost. If the contractor keeps the existing paver, it gives up the \$45,000 that could be received by selling it today. Therefore, the current market value is the relevant opportunity cost:

$$\text{Opportunity Cost} = \text{Current Market Value} = \$45,000 \text{ (Correct Answer: A)}$$

The future maintenance costs of \$24,000 per year for the old paver and \$6,000 per year for the new paver are also relevant future cash flows when comparing the alternatives.

Problem 5: Straight-Line vs. MACRS Book Value Comparison

A civil engineering survey firm buys a specialized LiDAR mobile mapping system for \$150,000. The system has an estimated useful life of 5 years and an expected salvage value of \$30,000 at $n = 5$. What is the difference between the Book Value at the end of Year 3 (BV_3) calculated using Straight-Line depreciation versus MACRS 5-year recovery depreciation?

- A. \$18,400 B. \$24,800 C. \$34,800 D. \$42,000

Solution

Step 1: Calculate Straight-Line Book Value at $j = 3$ ($BV_{3,SL}$). Annual straight-line depreciation charge:

$$D_{SL} = \frac{C - S_5}{n} = \frac{\$150,000 - \$30,000}{5} = \frac{\$120,000}{5} = \$24,000/\text{year}$$

Book Value at Year 3:

$$BV_{3,SL} = C - 3(D_{SL}) = \$150,000 - 3(\$24,000) = \$150,000 - \$72,000 = \$78,000$$

Step 2: Calculate MACRS 5-Year Book Value at $j = 3$ ($BV_{3,MACRS}$). Retrieve MACRS 5-year percentage factors for Years 1, 2, and 3: Year 1 = 20.00%, Year 2 = 32.00%, Year 3 = 19.20%. Sum of cumulative MACRS factors through Year 3:

$$\sum_{k=1}^3 \text{Factor}_k = 20.00\% + 32.00\% + 19.20\% = 71.20\% = 0.712$$

MACRS completely ignores salvage value:

$$BV_{3,MACRS} = C(1 - 0.712) = \$150,000 \times 0.288 = \$43,200$$

Step 3: Calculate difference between $BV_{3,SL}$ and $BV_{3,MACRS}$.

$$\text{Difference} = \$78,000 - \$43,200 = \$34,800 \quad (\text{Correct Answer: C})$$

Problem 6: MACRS Year 2 Tax Depreciation Charge

A heavy civil contractor buys a mobile concrete batch plant for \$400,000. The IRS classifies this asset under the MACRS 7-year recovery period. What is the tax depreciation allowance (D_2) in Year 2?

- A. \$57,160 B. \$69,960 C. \$97,960 D. \$112,000

Solution

Step 1: Identify MACRS factor for Year 2 of a 7-year property class. From the NCEES MACRS table, for 7-year property: $\text{Factor}_1 = 14.29\%$, $\text{Factor}_2 = 24.49\%$.

Step 2: Compute Year 2 depreciation charge (D_2).

$$D_2 = \text{Factor}_2 \times C = 0.2449 \times \$400,000 = \$97,960 \quad (\text{Correct Answer: C})$$

Problem 7: Incremental Benefit-Cost Ratio Analysis (B/C)

A state DOT evaluates two highway bypass alignments (X and Y) over 30 years at $i = 6\%/yr$. Option X: Capital Cost \$10M, Annual Maint. \$200k, Annual User Savings \$1.2M. Option Y: Capital Cost \$16M, Annual Maint. \$350k, Annual User Savings \$2.1M. Using incremental B/C analysis ($\Delta B/\Delta C$), which option should be selected?

- A. Neither Option B. Option X only C. Option Y only D. Both preferred

Solution

Step 1: Compute Equivalent Annual Cost (EAC). Look up $(A/P, 6\%, 30) = 0.07265$. $EAC_X = \$10M(0.07265) + \$200k = \$926,500/yr$. $EAC_Y = \$16M(0.07265) + \$350k = \$1,512,400/yr$.

Step 2: Baseline B/C for Option X. $(B/C)_X = \$1,200,000/\$926,500 = 1.295 \geq 1.0$ (Feasible).

Step 3: Incremental Analysis ($\Delta Y - X$). $\Delta C = \$1,512,400 - \$926,500 = \$585,900/yr$. $\Delta B = \$2,100,000 - \$1,200,000 = \$900,000/yr$.

$$\frac{\Delta B}{\Delta C} = \frac{\$900,000}{\$585,900} = 1.536 \geq 1.0 \implies \text{Option Y is justified! (Correct Answer: C)}$$

Problem 8: Expected Value (EV) Decision Tree Analysis

Borings cost \$40,000. A cavern is present with probability 0.35 and causes a \$500,000 loss if undetected.

Conditional on a cavern being present, borings detect it with probability 0.80 and prevent that loss; otherwise no loss occurs. Find the expected net savings from borings.

- A. \$100,000 B. \$65,000 C. \$95,000 D. \$135,000

Solution

Step 1: Without borings. Expected cost = $0.35(\$500,000) = \$175,000$.

Step 2: With borings. Missed-cavern probability = $0.35(1 - 0.80) = 0.07$. Expected total cost = $\$40,000 + 0.07(\$500,000) = \$75,000$.

Step 3: Net expected savings. $\$175,000 - \$75,000 = \$100,000$ (Correct Answer: A).