1. Approximately how many years will it take to double an investment at a 6% effective annual rate?
   (A) 10 yr
   (B) 12 yr
   (C) 15 yr
   (D) 17 yr

2. An individual contributes $200 per month to a 401(k) retirement account. The account earns interest at a nominal annual interest rate of 8%, with interest being credited monthly. What is the value of the account after 35 years?
   (A) $368,000
   (B) $414,000
   (C) $447,000
   (D) $459,000

3. A graduating high school student decides to take a year off and work to save money for college. The student plans to invest all money earned in a savings account earning 6% interest, compounded quarterly. The student hopes to have $5000 by the time school starts in 12 months. How much money will the student have to save each month?
   (A) $396/mo
   (B) $405/mo
   (C) $407/mo
   (D) $411/mo

4. A gold mine is projected to produce $20,000 during its first year of operation, $19,000 the second year, $18,000 the third year, and so on. If the mine is expected to produce for a total of 10 years, and the effective annual interest rate is 6%, what is its present worth?
   (A) $118,000
   (B) $125,000
   (C) $150,000
   (D) $177,000

5. $5000 is put into an empty savings account with a nominal interest rate of 5%. No other contributions are made to the account. With monthly compounding, how much interest will have been earned after five years?
   (A) $1250
   (B) $1380
   (C) $1410
   (D) $1420

6. An engineer deposits $10,000 in a savings account on the day her child is born. She deposits an additional $1000 on every birthday after that. The account has a 5% nominal interest rate, compounded continuously. How much money will be in the account the day after the child's 21st birthday?
   (A) $36,200
   (B) $41,300
   (C) $64,800
   (D) $84,300

7. A machine costs $10,000 and can be depreciated over a period of four years, after which its salvage value will be $2000. What is the straight-line depreciation in year 3?
   (A) $2000
   (B) $2500
   (C) $4000
   (D) $6000

8. A groundwater treatment system is needed to remediate a solvent-contaminated aquifer. The system costs $2,500,000. It is expected to operate a total of 130,000 hours over a period of 10 years and then have a $250,000 salvage value. During its first year in service, it is operated for 6500 hours. What is its depreciation in the first year using the MACRS method?
   (A) $113,000
   (B) $125,000
   (C) $225,000
   (D) $250,000
9. A machine initially costing $25,000 will have a salvage value of $6000 after five years. Using MACRS depreciation, what will its book value be after the third year?
   (A) $5470
   (B) $7200
   (C) $10,000
   (D) $13,600

10. Given the following cash flow diagram and an 8% effective annual interest rate, what is the equivalent annual expense over the five-year period?

   \[\begin{array}{c|c|c|c|c}
   t=0 & t=1 & t=2 & t=3 & t=4 \\
   \$50 & \$100 & \$150 & \$150 & \$200 \\
   \$500 & & & & \\
   \end{array}\]
   \[\]

   (A) $209
   (B) $218
   (C) $251
   (D) $268

11. The construction of a volleyball court for the employees of a highly successful mid-sized publishing company in California is expected to cost $1200 and have annual maintenance costs of $300. At an effective annual interest rate of 5%, what is the project's capitalized cost?
   (A) $1500
   (B) $2700
   (C) $7200
   (D) $18,000

12. A warehouse building was purchased 10 years ago for $250,000. Since then, the effective annual interest rate has been 8%, inflation has been steady at 2.5%, and the building has had no deterioration or decrease in utility. What should the warehouse sell for today?
   (A) $427,000
   (B) $540,000
   (C) $678,000
   (D) $691,000

13. A delivery company is expanding its fleet by five vans at a total cost of $75,000. Operating and maintenance costs for the new vehicles are projected to be $20,000/year for the next eight years. After eight years, the vans will be sold for a total of $10,000. Annual revenues are expected to increase by $40,000 with the expanded fleet. What is the company's rate of return on the purchase?
   (A) 19.7%
   (B) 20.3%
   (C) 21.7%
   (D) 23.2%

14. A company is considering replacing its air conditioner. Management has narrowed the choices to two alternatives that offer comparable performance and considerable savings over their present system. The effective annual interest rate is 8%. What is the benefit-cost ratio of the better alternative?

   \[\begin{array}{c|c|c|c|c}
   & I & II \\
   initial cost & $7000 & $9000 \\
   annual savings & $1500 & $1900 \\
   salvage value & $500 & $1250 \\
   life & 15 yr & 15 yr \\
   \end{array}\]

   (A) 1.73
   (B) 1.76
   (C) 1.84
   (D) 1.88

15. A gourmet ice cream store has fixed expenses (rent, utilities, etc.) of $50,000/yr. Its two full-time employees each earn $25,000 per year. There is also a part-time employee who makes $14,000 plus $6000 in overtime if sales reach $120,000 in a year. The ice cream costs $4/L to produce and sells for $7/L. What is the minimum number of liters the store must sell to break even?
   (A) 38,000 L
   (B) 38,000 L
   (C) 40,000 L
   (D) 41,000 L
SOLUTIONS

1. Determine the number of years for the compound amount factor to equal 2.

\[ F = 2P = P(F/P, i\%, n) \]
\[ 2 = (F/P, 6\%, n) \]
\[ = (1 + i)^n \]
\[ = (1 + 0.06)^n \]
\[ \ln 2 = \ln 1.06^n \]
\[ = n(\ln 1.06) \]
\[ n = \frac{\ln 2}{\ln 1.06} \]
\[ = 11.9 \text{ yr (12 yr)} \]

Alternatively, use the 6% factor table. \( n \) is approximately 12 years.

Answer is B.

2. The effective rate per month is

\[ i = \frac{r}{m} = \frac{0.08}{12} = 0.00667 \]

Use the uniform series compound amount factor.

\[ F = A(F/A, i\%, n) \]

Because compounding is monthly, \( n \) is the number of months.

\[ n = (35 \text{ yr}) \left( \frac{12 \text{ mo}}{1 \text{ yr}} \right) \]
\[ = 420 \text{ mo} \]
\[ F = A \left( \frac{(1 + i)^n - 1}{i} \right) \]
\[ = (20000) \left( \frac{(1 + 0.00667)^{420} - 1}{0.00667} \right) \]
\[ = \$459,227 \ (\$459,000) \]

Answer is D.

3. The effective rate per quarter is

\[ i = \frac{r}{m} = \frac{0.06}{4} = 0.015 \]

There are four compounding periods during the year.

\[ n = 4 \]

Use the sinking fund factor.

\[ A = F(A/F, i\%, n) \]
\[ = (5000)(A/F, 1.5\%, 4) \]
\[ = (5000) \left( \frac{0.015}{(1 + 0.015)^4 - 1} \right) \]
\[ = \$1222 \]
\[ \frac{1222}{\frac{8}{\text{quarter}}} = \frac{8}{3 \text{ quarter}} \]
\[ = \$407/\text{mo} \]

Answer is C.

4. This cash flow is equivalent to a $20,000 annual series with a $-1000/year gradient. Use the factor tables.

\[ P = (20000)(P/A, 6\%, 10) - (1000)(P/G, 6\%, 10) \]
\[ = (20000)(7.3601) - (1000)(29.6023) \]
\[ = \$117,600 \ (\$118,000) \]

Answer is A.

5. The effective annual interest rate is

\[ i_e = \left( \frac{1 + \frac{r}{m}}{m} \right)^m - 1 \]
\[ = \left( \frac{1 + 0.05}{12} \right)^{12} - 1 \]
\[ = 0.05116 \]

The total future value is

\[ F = P(F/P, i\%, n) = P(1 + i)^n \]
\[ = (5000)(1 + 0.05116)^5 \]
\[ = \$6417 \]

The interest available is

\[ \text{interest} = F - P = \$6417 - \$5000 \]
\[ = \$1417 \ (\$1420) \]

(This problem can also be solved by calculating the effective interest rate per period and compounding for 60 months.)

Answer is D.
6. The uniform series compound amount factor does not include a contribution at \( t = 0 \). Therefore, calculate the future value as the sum of a single payment and an annual series.

\[
F = P(F/P, r\%, n) + A(F/A, r\%, n)
\]

\[
= P(e^{rn}) + A\left(\frac{e^{rn} - 1}{e^{r} - 1}\right)
\]

\[
= (\$10,000)e^{(0.05)(21)} + (\$1000)\left(\frac{e^{(0.05)(21)} - 1}{e^{0.05} - 1}\right)
\]

\[
= \$64,808 \quad (\$64,800)
\]

**Answer is C.**

7. With the straight-line method, depreciation is the same in each year.

\[
D_2 = D = \frac{C - S_n}{n}
\]

\[
= \frac{\$10,000 - \$2000}{4 \text{ yr}}
\]

\[
= \$2000/\text{yr} \quad (\$2000)
\]

**Answer is A.**

8. MACRS depreciation depends only on the original cost, not on the salvage cost or hours of operation.

\[
D_1 = C(\text{factor})
\]

\[
D_1 = (\$2,500,000)(0.10)
\]

\[
= \$250,000
\]

**Answer is D.**

9. Book value is the initial cost less the accumulated depreciation. Use the MACRS factors for a five-year recovery period.

\[
BV = C - \sum_{j=1}^{t} D_j
\]

\[
= C - \sum_{j=1}^{3} (C(\text{factor}_j))
\]

\[
= C\left(1 - \sum_{j=1}^{3} \text{factor}_j\right)
\]

\[
= (\$25,000)\left(1 - (0.20 + 0.32 + 0.192)\right)
\]

\[
= \$7200
\]

**Answer is B.**

10. First, find the present worth of all of the cash flows.

\[
P = 500 + (50)(P/A, 8\%, 5) + (50)(P/G, 8\%, 4)
\]

\[
+ (100)(P/F, 8\%, 5)
\]

\[
= 500 + (50)(3.9927) + (50)(4.6501)
\]

\[
+ (100)(0.6806)
\]

\[
= \$1000
\]

Next, find the effective uniform annual expense (cost).

\[
\text{EUAC} = (\$1000)(A/P, 8\%, 5)
\]

\[
= (\$1000)(0.2505)
\]

\[
= \$251
\]

**Answer is C.**

11. Find the capitalized cost of the annual maintenance and add the initial construction cost to it.

\[
P = C + \frac{A}{i} = \$1200 + \frac{\$300}{0.05}
\]

\[
= \$7200
\]

**Answer is C.**

12. Ideally, the current price should be the future worth (from 10 years ago) adjusted for inflation. Use the inflation-adjusted interest rate, \( d \), together with the single payment compound amount factor.

\[
d = i + f + if
\]

\[
= 0.08 + 0.025 + (0.08)(0.025)
\]

\[
= 0.107
\]

\[
F = P(F/P, d\%, n)
\]

\[
= (\$250,000)(1 + 0.107)^{10}
\]

\[
= \$699,902 \quad (\$691,000)
\]

**Answer is D.**
13. Rate of return is the effective annual interest rate that would make the investment's present worth zero.

\[ P = 0 = -($75,000) \]
\[ + ($40,000 - $20,000)(P/A, i\%, 8) \]
\[ + ($10,000)(P/F, i\%, 8) \]
\[ = ($20,000)
\frac{(1 + i)^8 - 1}{i(1 + i)^8}
\]
\[ + ($10,000)(1 + i)^{-8} \]

By trial and error, \( i = 0.217 \) (21.7%).

**Answer is C.**

14. Compute the present worth of the benefits and costs for each alternative. Salvage value should be counted as a decrease in cost, not as a benefit.

For alternative I,

\[ B = ($1500)(P/A, 8\%, 15) \]
\[ = ($1500)(8.5595) \]
\[ = $12,239 \]
\[ C = $7000 - ($500)(P/F, 8\%, 15) \]
\[ = $7000 - ($500)(0.3152) \]
\[ = $6842 \]
\[ \frac{B}{C} = \frac{$12,239}{$6842} = 1.88 \]

For alternative II,

\[ B = ($1900)(P/A, 8\%, 15) \]
\[ = ($1900)(8.5595) \]
\[ = $16,263 \]
\[ C = $9000 - ($1250)(P/F, 8\%, 15) \]
\[ = $9000 - ($1250)(0.3152) \]
\[ = $8606 \]
\[ \frac{B}{C} = \frac{$16,263}{$8606} = 1.89 \]

The alternatives cannot be compared to one another based simply on their ratios. Instead, perform an incremental analysis.

\[ \frac{B_{II} - B_I}{C_{II} - C_I} = \frac{$16,263 - $12,839}{$8606 - $6842} = 1.94 \]

Because the incremental analysis ratio is greater than one, alternative II is superior.

**Answer is A.**

15. Calculate the costs and revenues assuming sales of $120,000 are exceeded.

\[ \text{costs} = $50,000 + (2)($25,000) + $14,000 \]
\[ + $6000 + \left(4 \frac{8}{L}\right)Q \]
\[ \text{revenues} = \left(7 \frac{8}{L}\right)Q \]

At the break-even point, costs equal revenues.

\[ \text{revenues} = \text{costs} \]
\[ \left(7 \frac{8}{L}\right)Q = $120,000 + \left(4 \frac{8}{L}\right)Q \]
\[ Q = 40,000 L \]

Check the assumption that sales exceed $120,000.

\[ \left(7 \frac{8}{L}\right)(40,000 L) = $280,000 \] [ok]

**Answer is C.**