46.4 A commercial tenant entering into a 17 year lease has the option to make a down payment to lower the monthly rent. Assuming a 6% interest rate, which option has the best present value?

A. \$0 down, \$12,500/month

B. \$250K down, \$10,000/month

C. \$500K down, \$8,000/month

D. \$1M down, \$5,000/month

Find the present value for each option. The the $i = 6\%$ Factor Table to find P/A. The minimum present value is the best choice.

$$PV_1 = (12)\,(\$12,500)\,(P/A, 6\%, 17)$$

$$PV_1 = (12)\,(\$12,500)\,(10.4773) = \$1,571,595$$

$$PV_2 = \$250,000 + (12)\,(\$10,000)\,(P/A, 6\%, 17)$$

$$PV_2 = \$250,000 + (12)\,(\$10,000)\,(10.4773) = \$1,507,276$$

$$PV_3 = \$500,000 + (12)\,(\$8,000)\,(P/A, 6\%, 17)$$

$$PV_3 = \$500,000 + (12)\,(\$8,000)\,(10.4773) = \$1,505,821$$

$$PV_4 = \$1,000,000 + (12)\,(\$5,000)\,(P/A, 6\%, 17)$$

$$PV_4 = \$1,000,000 + (12)\,(\$5,000)\,(10.4773) = \$1,628,638$$

Answer C

46.5 A group of machines are maintained under a contract which costs $50,000 this year. The contract cost will inrease by $1000 per year over the next 10 years. What is the present value of the entire 10 years of maintenance using an effctive annual interest rate of 12%.

A. $303,000

B. $336,000

C. $352,000

D. $370,000

The present value can be represented as the sum of two cash flows: a recurring annual cost of $50,000 and a uniform gradient of $1,000. The gradient has a value of zero in the first year, such that the first year cost is $50,000, second year is $51,000, third year is $52,000, etc. There is no initial cost reflected in year 0 as it is customary in engineering economics to reflect costs that occur throughout the year at the end of the year.

Write an expression for the present value.

$$PV = A\left(P/A, 12\%, 10\right) + G\left(P/G, 12\%, 10\right)$$

Use the 12% Factor Table to look up the cash flow factors needed to translate the cash flows into present value. Solve for the present value.

$$PV = \left(\$50,000\right)\left(5.6502\right) + \left(\$1,000\right)\left(20.2541\right) = \$302,764$$

Answer A

46.6 A pump delivers 200 GPM of water at 130 feet of total dynamic head, operating from 7am-7pm Monday through Friday. The pump is 80% efficient and the motor is 93% efficient. What is the annual cost of operation at $0.13 per kWh?

A. $2670

B. $3490

C. $3750

D. $5030

The cost is a function of electrical power and time, and electrical power is a function of hydraulic horsepower (aka water horsepower i.e. whp) and efficiency. Start by calculating the water horsepower based on volume flow rate and feet of head provided by the pump:

$$whp = \frac{Q\Delta h}{3960} = \frac{\left(200\right)\left(130\right)}{3960} = 6.566hp$$