

**46.5** A group of machines are maintained under a contract which costs \$50,000 this year. The contract cost will increase by \$1000 per year over the next 10 years. What is the present value of the entire 10 years of maintenance using an effective 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.

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

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.

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

**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:

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