C. $145,000

D. $195,000

Draw a cash flow diagram or make a list of cash flows.

In year zero, there is an initial cost of $100,000 (negative).

In years 1 through 6, there is an annual revenue of $15,000.

In years 7-12, there is an annual revenue of $20,000.

Rather than handle the (6) additional $5,000 cash flows in years 7-12 as individual future cash flows, it is faster to assume and annual revenue of $20,000 for the entire 12 years, then compensate for overstating the revenue in years 1-6 by *subtracting* $5,000 per year over 6 years from the outset. This can be handled as an annualized cash flow over 6 years.

The present value can be determined with the following expression.

$$PV = -\$100,000 + (\$20,000)\,(P/A, 6\%, 12) - (\$5,000)\,(P/A, 6\%, 6)$$

Use the 6% Factor Table to look up the cash flow factors needed to translate the cash flows into present value. Solve for the present value.

$$PV = -\$100,000 + (\$20,000)\,(8.3838) - (\$5,000)\,(4.9173) = \$43,090$$

Answer A

45.22 A piece of equipment is purchased for $20K and will be sold 5 years later for $5K. The first year maintenance costs $2500, then increases by $500 per year. The effective interest rate is 8%. What is the present worth?

A. $-\$30K$

B. $-\$23K$

C. $-\$10K$

D. $-\$3K$

Draw a cash flow diagram or make a list of cash flows.

In Year 0, there is an initial payment of $20K (negative).

In Years 1-5, there is an annual maintenance cost of $2500 (negative) which escalates by an additional $500 per year. This can be treated as a uniform series of payments *plus* a uniform gradient.

In Year 5, there is a $5K future cash payment (positive) for the salvage value.

Write an expression for the present value. Use the $i = 8\%$ Factor Table to retreive the cash flow factors.

$$PV = -\$20,000 - \$2500\,(P/A, 8\%, 5) - \$500\,(P/G, 8\%, 5) + \$5000\,(P/F, 8\%, 5)$$

$$PV = -\$20,000 - \$2500\,(3.9927) - \$500\,(7.3724) + \$5000\,(0.6806) = -\$30,264$$

Answer A

45.23 What is the partial pressure of water in atmostpheric air at $120°F$ and 70% RH?

A. $0.3psi$

B. $0.8psi$

C. $1.2psi$

D. $1.7psi$

There are 3 alternative approaches to this problem.

Approach #1: Search for Properties of Saturated Water by temperature and find $120°F$ in the steam table. The saturation pressure at $120°F$ is:

$$p_{ws@120°F} = 1.7psia$$

Since the relative humidity is 70%, the partial pressure of water vapor in the air is only 70% of the saturation pressure. Recall that saturation pressure is the maximum possible pressure water vapor can have in air at a given temperature. Apply the definition of relative humidity to find the partial pressure of water.

$$\phi = \frac{p_w}{p_{ws}}$$

$$p_w = p_{sat}\phi = (1.7psia)(.7) = 1.19psia$$

Approach #2: This method involves looking up the dew point temperature on the Psychrometric Chart for High Temperature air. Recall that the dew point is the temperature at which the air would be saturated if it were sensibly cooled until reaching the saturation curve.

$$T_{dp} \approx 107°F$$

Return to the steam table and look up the saturation pressure at the dew point temperature. By definition, the partial pressure of water vapor in moist air is the saturation pressure at the dew point temperature.

$$p_w = p_{ws@T_{dp}} = 1.17psia$$

Approach #3: This method involves looking up the humidity ratio on the Psychrometric Chart for High Temperature air.

$$\omega \approx .055\frac{lb_{H2O}}{lb_{da}}$$

Since the humidity ratio is a ratio of the mass of water vapor to the mass of dry air, it is possible to work out the mole fraction of water vapor in the air. There are $0.055lb_{H2O}$ for every $1lb_{da}$. Find the corresponding number of moles for water and dry air using the molecular weights. Refer to the periodic table as needed. Rounding is permissible.

$$MW_{H20} = (2)(1) + (16) = 18\frac{lb}{mol}$$