

$$\begin{aligned}
PV &= (50,000 + 2000t)(-10e^{-0.10t}) \Big|_0^5 - \int_0^5 (-10e^{-0.10t})(2000dt) && \text{Using the parts} \\
&= (50,000 + 2000t)(-10e^{-0.10t}) \Big|_0^5 + 20,000 \int_0^5 e^{-0.10t} dt && \text{formula, } uv - \int vdu \\
&= (50,000 + 2000t)(-10e^{-0.10t}) \Big|_0^5 + (-200,000e^{-0.10t}) \Big|_0^5 \\
&= 60,000(-10e^{-0.5}) + 500,000 - 200,000(e^{-0.5}) + 200,000 \\
&= 700,000 - 800,000e^{-0.5} \\
&\approx 700,000 - 800,000(0.6065307) \\
&\approx 700,000 - 485,225 = 214,775
\end{aligned}$$

The present value of the new store's income stream is approximately \$214,775.

## 15.2 EXERCISES

### APPLICATIONS

- Annuity:** Estimate the amount of an annuity if \$1000 is deposited annually for 10 years at a rate of 8 percent compounded continuously.
- Annuity:** An amount of \$6000 is invested in an account each year for 8 years. Find the approximate balance at the end of the 8 years if the account pays interest at a rate of 7 percent compounded continuously.
- Annuity:** Christine has decided to invest \$2000 each year into an IRA account that pays interest at the rate of 9 percent compounded continuously. Find the amount in the account at the end of 15 years.
- Annuity:** Bob and Ann plan to deposit \$4000 per year into their retirement account. If the account pays interest at a rate of 8.4 percent compounded continuously, approximately how much will be in their account after 12 years?
- Annuity:** Bryan plans to deposit \$1200 each year into an annuity. If the account pays interest at a rate of 7.5 percent compounded continuously, find the approximate balance of his account after 10 years.
- Income stream:** Find the value of an income stream after 7 years if the rate of flow is estimated to be \$200,000 annually and the income is invested at a rate of 8 percent compounded continuously.
- Income stream:** The owner of a local convenience store estimates that the store will generate an annual income of \$340,000 for the next 4 years. If the rate of interest is 9 percent compounded continuously, find the value of the income stream.
- Income stream:** A real estate investment is expected to generate an income flow of \$12,000 annually for the next 6 years. Find the amount of the income stream if the interest rate is 7.8 percent compounded continuously.
- Income stream:** Find the value of an income stream after 5 years if  $R(t) = 3600e^{0.02t}$  is the rate of flow of revenue and the income is deposited at a rate of 7 percent compounded continuously.

10. **Income stream:** A certain investment has a continuous flow of money at a rate of  $R(t) = 7200e^{0.01t}$ . Find the value of this flow after 4 years if the interest rate is 8.2 percent compounded continuously.
11. **Income stream:** Find the value of an income stream if  $R(t) = 50 + 0.2t$  is the rate of flow of revenue reinvested at 6 percent compounded continuously for 8 years.
12. **Income stream:** Find the value of an income stream if  $R(t) = 80 + 1.2t$  is the rate of flow of revenue reinvested at 6.4 percent compounded continuously over the next 6 years.
13. **Income stream:** The profit from a number of soft drink machines is estimated to be at the rate of  $R(t) = 15 + 0.8t$  thousand dollars per year. If the profits are deposited into an account paying 6.5 percent compounded continuously, find the amount of the income stream after 7 years.
14. **Income stream:** It is estimated that a computer will save accounting fees at a small company at a rate of  $R(t) = 4 + 0.6t$  thousand dollars per year. If the savings are reinvested at 5 percent compounded continuously, find the amount of the income stream after 4 years.
15. **Income stream:** Find the present value of an income stream with  $R(t) = 60 - 0.4t$ ,  $r = 8$  percent, and  $T = 20$ .
16. **Income stream:** Find the present value of an income stream with  $R(t) = 150 - t$ ,  $r = 12$  percent, and  $T = 10$ .
17. **Income stream:** The rate of flow of an income stream is estimated by  $R(t) = 6000e^{0.015t}$  for the next 4 years. Find the present value of this flow if the interest rate is 6 percent compounded continuously.
18. **Income stream:** The rate of flow of an income stream for the next 6 years is estimated by  $R(t) = 10,000e^{-0.01t}$ . Find the present value of this flow if the interest rate is 8.5 percent compounded continuously.
19. **Income stream:** Sandy estimates that the profits from his ice cream store will be  $R(t) = 24 + 3.6t$  thousand dollars per year for the next 5 years. Find the present value of the store if the current interest rate is 10 percent compounded continuously.
20. **Income stream:** Elco Grain Company expects their profits to be  $R(t) = 30 + 12e^{0.02t}$  thousand dollars per year for the next 4 years. If the current interest rate is 8 percent compounded continuously, find the present value of the company.

**WRITING & THINKING**

21. In Figure 1, replace the column information with  $100e^{0.01(5)}$ ,  $100e^{0.01(4)}$ ,  $100e^{0.01(3)}$ ,  $100e^{0.01(2)}$ ,  $100e^{0.01(1)}$ ,  $100e^{0.01(0)}$ . This suggests that the future value of an annuity could be given by  $\int_0^N Pe^{rt} dt$ . Does this give the same result as the formula for the future value of an annuity shown in the lesson? Explain why or why not.