Business application:

Recall the accumulated present value of a
     continuous income stream

    R = yearly rate for c.i.s.   (or R(t) if it changes over time)
    T = years for investment
    k = interest rate

$$B = \int_0^T R e^{-kt}\, dt$$

    Question: what would the present value be if one did
         not just invest for T years, but perpetually?

So instead of T years, ∞ years

$$B = \int_0^\infty R e^{-kt}\, dt$$

This is the accumulated present value of a c.i.s.
    for all time into the future.

This is also known as the capital value.

Example: A rental property nets $1200/year paid into perpetuity.

Find the accumulated present value at 4% compounded continuously.

$$R = 1200 \qquad k = .04$$

$$B = \int_0^\infty 1200 e^{-.04t} \, dt$$

$$= \lim_{b \to \infty} \int_0^b 1200 e^{-.04t} \, dt$$

$$= \lim_{b \to \infty} \left. \frac{1200}{-.04} e^{-.04t} \right|_0^b$$

$$= \lim_{b \to \infty} \left. -30000 e^{-.04t} \right|_0^b$$

$$= \lim_{b \to \infty} \left(-30000 e^{-.04b} \right) - \left(-30000 e^0 \right)$$

$$= \bigcirc + 30,000$$

$$= \$ 30,000$$