7.2 Separable Differential Eq.

$$\frac{dy}{dx} = f(x, y)$$

1) Take the right hand side and use algebra to represent it as a product of functions one of x only and the other of y only.

$$\frac{dy}{dx} = g(x) \cdot h(y)$$

2) Multiply by dx and divide by $h(y)$

$$\frac{dy}{h(y)} = g(x)\, dx$$

3) Integrate both sides.

4) If possible solve for y in terms of x.

$$\frac{dy}{dx} = ky$$

$$\frac{dy}{dx} = y^2 x \qquad y(1) = 6$$

$$\frac{dy}{dx} = y^2 x$$

$$\frac{dy}{dx} = \frac{3x^2 y^3 - 6x^2}{y^2}$$

A tank contains 1000 L of brine with 15 kg of dissolved salt. Pure water enters the tank at a rate of 10 L/min. The solution is kept thoroughly mixed and drains from the tank at the same rate. How much salt is in the tank (a) after t minutes and (b) after 20 minutes?

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Plutonium-239   The half-life of the plutonium isotope is 24,360 years. If 10 g of plutonium is released into the atmosphere by a nuclear accident, how many years will it take for 80% of the isotope to decay?
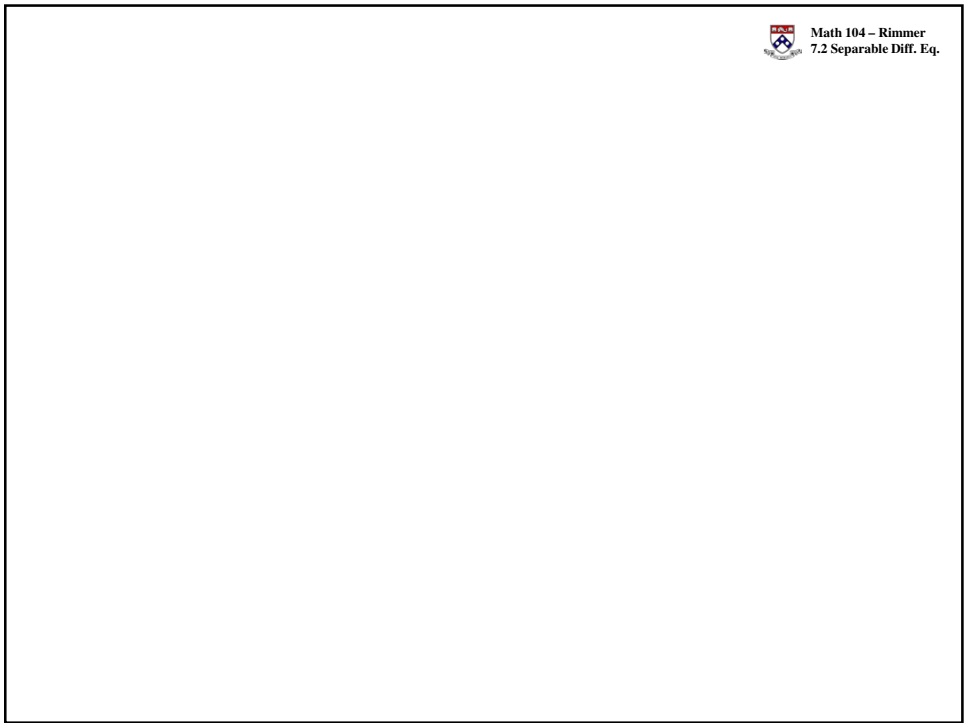
Cooling soup   Suppose that a cup of soup cooled from 90°C to 60°C after 10 min in a room whose temperature was 20°C. Use Newton's law of cooling to answer the following questions.
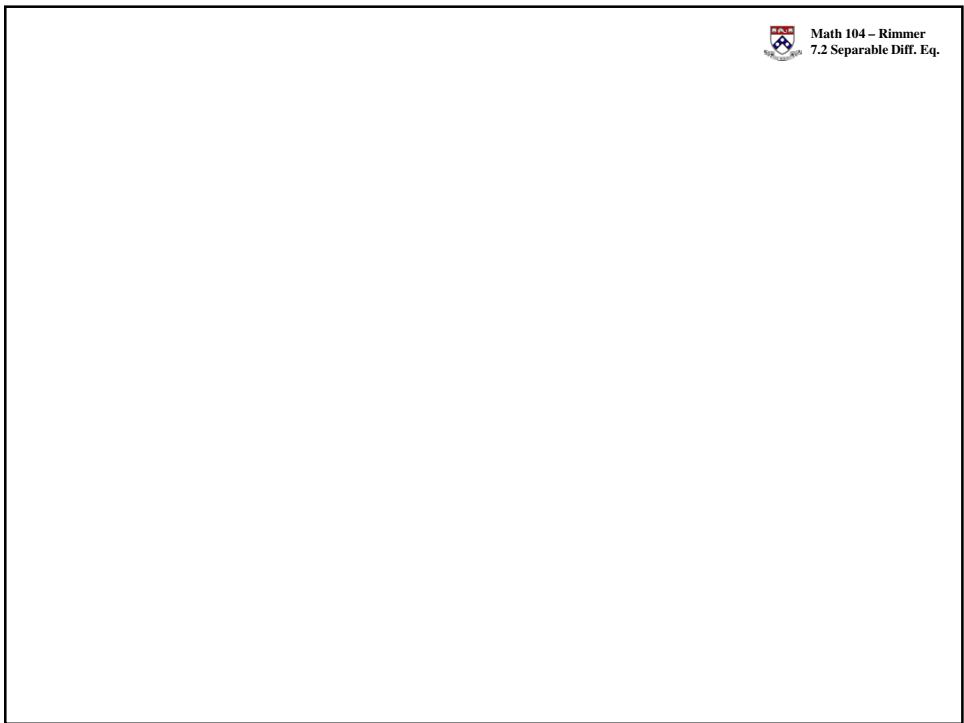
a. How much longer would it take the soup to cool to 35°C?

b. Instead of being left to stand in the room, the cup of 90°C soup is put in a freezer whose temperature is −15°C. How long will it take the soup to cool from 90°C to 35°C?

Newton's Law of Cooling   { the rate at which an object's temperature is changing at any given time is roughly proportional to the difference between its temperature and the temperature of the surrounding medium.

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