ORDINARY DIFFERENTIAL EQUATIONS

1. **Separable Equations**
   - A **separable equation** is a first-order differential equation, which has a form:

$$\boxed{P(x)dx + Q(y)dy = 0}$$

Solution:
Integrate both sides, we receive:

$$\int P(x)dx + \int Q(y)dy = C$$

2. **The differential Equation of the form**

$$\boxed{f_1(x).g_1(y)dx + f_2(x).g_2(y)dy = 0}$$

Solution:

$$\text{If } f_1(x), f_2(x), g_1(y), g_2(y) \neq 0, \text{then we divide both sides by } f_2(x).g_1(y). \text{ So:} \tag{1}$$

$$\frac{f_1(x)}{f_2(x)}dx + \frac{g_2(x)}{g_1(x)} = 0 \rightarrow \int \frac{f_1(x)}{f_2(x)}dx + \int \frac{g_2(y)}{g_1(y)}dy$$

3. **COOL PROBLEM**
   (Liên quan đến the rate of change cần chú ý)
   - The rate of change of the temperature T(t) is the derivative of $\frac{dT}{dt}$
   - Acording to the Newton's law of cooling:

$$\boxed{\frac{dT}{dt} = k(T - T_s)}$$

When k is a constant of propotionality.
Separating the variables we have:

$$\frac{dT}{T - T_s} = kdt \leftrightarrow \frac{dT}{T - T_s} = kdt \tag{2}$$

$$\rightarrow \int \frac{dT}{T - T_s} = k \int dt \rightarrow ln|T - T_s| = kt + lnC \tag{3}$$

$$\rightarrow T - T_s = e^{kt + lnC} = e^{kt}.e^{lnC} = Ce^{kt} \tag{4}$$

4. **The first-order linear differential equation**
   - The first-order **linear** differential equation is one that can be put into the form:

$$\boxed{\frac{dy}{dx} + P(x).y = Q(x)} \tag{5}$$

- To solve the linear difernetial equation, multply both side by the **integrate factor** $e^{P(x)dx}$ and integrate both sides:

$$\boxed{y = e^{-\int P(x)dx}.\int Q(x).e^{\int P(x)dx}dx + C} \tag{6}$$