1 Properties of Integral

1.
$$\int_a^b f(x)\mathrm{d}x = -\int_b^a f(x)\mathrm{d}x, \quad \int_a^a f(x)\mathrm{d}x = 0$$

2.
$$\int_a^b \text{CONSTANT } \mathrm{d}x = \text{CONSTANT} \cdot (b-a)$$

3.
$$\int_a^b [f(x) + g(x)]\mathrm{d}x = \int_a^b f(x)\mathrm{d}x + \int_a^b g(x)\mathrm{d}x, \quad \int_a^b cf(x)\mathrm{d}x = c\int_a^b f(x)\mathrm{d}x$$

4.
$$\int_a^b [c_1 f(x) + c_2 g(x)]\mathrm{d}x = c_1 \int_a^b f(x)\mathrm{d}x + c_2 \int_a^b g(x)\mathrm{d}x$$

5.
$$\boxed{\int_a^b f(x)\mathrm{d}x = \int_a^c f(x)\mathrm{d}x + \int_c^b f(x)\mathrm{d}x}$$

6.
- If $f(x) \geq 0$, then $\int_a^b f(x)\mathrm{d}x \geq 0$.
- If $f(x) \geq g(x)$, then $\int_a^b f(x)\mathrm{d}x \geq \int_a^b g(x)\mathrm{d}x$.
- If $m \leq f(x) \leq M$, then $m(b-a) \leq \int_a^b f(x)\mathrm{d}x \leq M(b-a)$

2 Fundamental Theorem of Calculus (FTC)

1. Differential Rule:
$$\text{If} \quad g(x) = \int_a^x f(t)\mathrm{d}t, \quad \text{then} \quad g'(x) = \frac{\mathrm{d}}{\mathrm{d}x}g(x) = f(x)$$

$$\boxed{\text{If} \quad g(x) = \int_{v(x)}^{u(x)} f(t)\mathrm{d}t, \quad \text{then} \quad g'(x) = \frac{\mathrm{d}}{\mathrm{d}x}g(x) = f[u(x)] \cdot u'(x) - f[v(x)] \cdot v'(x)}$$

2.
$$\int_a^b f(x)\mathrm{d}x = F(x)|_a^b = F(b) - F(a), \quad \text{where} \quad F'(x) = f(x)$$