1. $f(x) = x^3$; $[1,5]$; $n = 4$ subintervals

Left: $1^3(1) + 2^3(1) + 3^3(1) + 4^3(1) = \boxed{100}$

Right: $5^3(1) + 4^3(1) + 3^3(1) + 2^3(1) = \boxed{224}$

Mid: $\left(\frac{3}{2}\right)^3(1) + \left(\frac{5}{2}\right)^3(1) + \left(\frac{7}{2}\right)^3(1) + \left(\frac{9}{2}\right)^3(1)$

$= \boxed{153}$

$f(x) = -x^2 + 8x - 12$; $[2,6]$; $n = 4$ subintervals

Left: $\left[-(2^2)+8(2)-12\right](1) + \left[-(3^2)+8(3)-12\right](1)$

$+ \left[-(4^2)+8(4)-12\right](1) + \left[-(5^2)+8(5)-12\right](1)$

$= 0 + 3 + 4 + 3 = \boxed{10}$

Right: $\left[-(6^2)+8(6)-12\right](1) + \left[-(5^2)+8(5)-12\right](1)$

$+ \left[-(4^2)+8(4)-12\right](1) + \left[-(3^2)+8(3)-12\right](1)$

$= 0 + 3 + 4 + 3 = \boxed{10}$

$$\text{Mid} = \left[-\left(\frac{5}{2}\right)^2 + 8\left(\frac{5}{2}\right) - 12\right](1) + \left[-\left(\frac{7}{2}\right)^2 + 8\left(\frac{7}{2}\right) - 12\right](1)$$

$$+ \left[-\left(\frac{9}{2}\right)^2 + 8\left(\frac{9}{2}\right) - 12\right](1) + \left[-\left(\frac{11}{2}\right)^2 + 8\left(\frac{11}{2}\right) - 12\right](1)$$

$$= \frac{7}{4} + \frac{15}{4} + \frac{15}{4} + \frac{7}{4} = \boxed{11}$$

3. $f(x) = -\frac{1}{4}x^2 + 10$; $[-6,6]$; $n = 6$ subintervals

Left: $\left[-\frac{1}{4}(-6)^2+10\right](2) + \left[-\frac{1}{4}(-4)^2+10\right](2) + \left[-\frac{1}{4}(-2)^2+10\right](2)$

$+ \left[-\frac{1}{4}(0^2)+10\right](2) + \left[-\frac{1}{4}(2^2)+10\right](2) + \left[-\frac{1}{4}(4^2)+10\right](2)$

$= 2+12+18+20+18+12 = \boxed{82}$

Right: $\left[-\frac{1}{4}(6^2)+10\right](2) + \left[-\frac{1}{4}(4^2)+10\right](2) + \left[-\frac{1}{4}(2^2)+10\right](2)$

$+ \left[-\frac{1}{4}(0^2)+10\right](2) + \left[-\frac{1}{4}(-2)^2+10\right](2) + \left[-\frac{1}{4}(-4)^2+10\right](2)$

$= 2+12+18+20+18+12 = \boxed{82}$

$$\text{Mid}: \left[-\frac{1}{4}(5^2)+10\right](2) + \left[-\frac{1}{4}(3^2)+10\right](2) + \left[-\frac{1}{4}(1^2)+10\right](2)$$

$$+ \left[-\frac{1}{4}(-1)^2+10\right](2) + \left[-\frac{1}{4}(-3)^2+10\right](2) + \left[-\frac{1}{4}(-5)^2+10\right](2)$$

$$= \frac{15}{2} + \frac{31}{2} + \frac{39}{2} + \frac{39}{2} + \frac{31}{2} + \frac{15}{2}$$

$$= \frac{170}{2} = \boxed{85}$$

4. $f(x) = \ln(ex)$; $[1,5]$; $n = 2$ subintervals

Left: $[\ln(e)](2) + [\ln(3e)](2) = 2 + 2\ln 3 + 2$

$= \boxed{4 + 2\ln 3}$

Right: $[\ln 5e](2) + [\ln 3e](2) = 2 + 2\ln 5 + 2\ln 3 + 2$

$= 4 + \ln 25 + \ln 9 = \boxed{4 + \ln 225}$

Mid: $[\ln 2e](2) + [\ln 4e](2)$

$= 2\ln 2 + 2 + 2\ln 4 + 2 = \boxed{4 + \ln 64}$