

$$3) f(x) = \begin{cases} x & 0 \leq x < 1 \\ 2-x & 1 \leq x < 2 \\ 0 & \text{otherwise} \end{cases}$$

$$a) \int_1^2 2-x dx$$

$$\left(2x - \frac{1}{2}x^2 \right) \Big|_1^2$$

$$(2(2) - \frac{1}{2}(2)^2) - (2(1) - \frac{1}{2}(1)^2)$$

$$(4-2) - (2-\frac{1}{2})$$

$$2 - \frac{3}{2}$$

$$\boxed{\frac{1}{2}}$$

$$b) \int_{.5}^1 x dx + \int_1^2 2-x dx$$

$$\frac{1}{2}x^2 \Big|_{.5}^1 + \frac{1}{2}$$

$$\frac{1}{2} \left[(1)^2 - \left(\frac{1}{2}\right)^2 \right]$$

$$\frac{1}{2} \left[1 - \frac{1}{4} \right]$$

$$\boxed{\frac{3}{8}} + \boxed{\frac{1}{2}}$$

$$\frac{3}{8} + \frac{4}{8}$$

$$\boxed{\frac{7}{8}}$$

$$c) \int_1^2 2-x dx \quad \int_{.5}^1 x dx + \int_1^2 2-x dx$$

$$\frac{1}{2} \quad \frac{7}{8}$$

~~$$\frac{1}{2} \cdot \frac{7}{8}$$~~

$$\frac{1}{2} \cdot \frac{7}{8}$$

$$\boxed{\frac{4}{7}}$$

$$d) \int_0^1 x^2 dx + \int_1^2 2x-x^2 dx$$

$$\frac{1}{3}(x^3 \Big|_0^1 + (x^2 - \frac{1}{2}x^2) \Big|_1^2)$$

$$\frac{1}{3}((1)^3 - 0) + (2^2 - \frac{1}{2}(2)^2) - (1 - \frac{1}{2})$$

$$\boxed{\frac{1}{3}} + \left(4 - \frac{2}{2} \right) - \left(\frac{2}{2} \right)$$

$$\frac{12-4}{3} - \frac{2}{3}$$

$$\frac{4}{3} - \frac{2}{3} = \frac{2}{3}$$

$$\frac{1}{3} + \frac{2}{3} = \boxed{1}$$

$$e) \int_0^1 x^3 dx + \int_1^2 2x^2-x^3 dx$$

$$\frac{1}{4}(x^4 \Big|_0^1 + (\frac{2}{3}x^3 - \frac{1}{4}x^4) \Big|_1^2)$$

$$\frac{1}{4}((1)^4 - 0) + \left(\frac{2}{3}(2)^3 - \frac{1}{4}(2)^4 \right) - \left(\frac{2}{3} - \frac{1}{4} \right)$$

$$\boxed{\frac{1}{4}} + \left(\frac{16}{3} - 4 \right) - \left(\frac{8}{12} - \frac{3}{12} \right)$$

$$\frac{1}{4} + \left(\frac{64}{12} - \frac{48}{12} \right) - \left(\frac{5}{12} \right)$$

$$\frac{1}{4} + \frac{16}{12} - \frac{5}{12}$$

$$\frac{3}{12} + \frac{16}{12} - \frac{5}{12}$$

$$\boxed{\frac{14}{12}}$$

$$Var(x) = E(x^2) - (E(x))^2$$

$$\frac{14}{12} - (1)^2$$

$$\frac{2}{12} = \boxed{\frac{1}{6}} \quad \boxed{\sigma^2 = \frac{1}{6}}$$

$$f) \int_0^1 x dx + \int_1^2 2-x dx$$

$$\frac{1}{2}(x^2 \Big|_0^1 + (2x - \frac{1}{2}x^2) \Big|_1^2)$$

$$\frac{1}{2} + (2(2) - \frac{1}{2}(2)^2) - (2(1) - \frac{1}{2}(1)^2)$$

$$\frac{1}{2} + (2x - \frac{1}{2}x^2 - \frac{1}{2})$$

$$f(x) = -\frac{1}{2}x^2 + 2x$$