(a) $E(X) = \int_{-\infty}^{\infty} x f(x)\, dx$

$= \int_{1}^{2} x \cdot 2(x-1)\, dx$

$= \int_{1}^{2} (2x^2 - 2x)\, dx$

$= \left[\frac{2}{3}x^3 - x^2\right]_1^2$

$= \frac{2}{3} \cdot 8 - 4 - \left(\frac{2}{3} - 1\right) = 1\frac{2}{3}$

(b) $F(x) = \int_{-\infty}^{x} f(t)\, dt$.

So $F(x) = 0$ for $x < 1$.

For $1 \leq x \leq 2$:

$$F(x) = \int_1^x 2(t-1)\,dt = \left[t^2 - 2t\right]_1^x = x^2 - 2x - (1-2)$$
$$= x^2 - 2x + 1$$
$$(= (x-1)^2).$$

Or $\int_1^x 2(t-1)\,dt = \left[(t-1)^2\right]_1^x = (x-1)^2.$

For $x > 2$: $F(x) = 1.$

2a) $P(X=0) = \dfrac{\binom{7}{0}\binom{3}{2}}{\binom{10}{2}} = \dfrac{3}{45} = \dfrac{1}{15}$

$P(X=1) = \dfrac{\binom{7}{1}\cdot\binom{3}{1}}{\binom{10}{2}} = \dfrac{21}{45} = \dfrac{7}{15}$

$P(X=2) = \dfrac{\binom{7}{2}}{\binom{10}{2}} = \dfrac{21}{45} = \dfrac{7}{15}.$

$$E(X) = \sum_x x\, P(X=x) = 1 \cdot \frac{7}{15} + 2 \cdot \frac{7}{15} = \frac{21}{15} = \frac{7}{5}$$

b) $P(Y=y) = \binom{5}{y} \cdot \left(\frac{7}{10}\right)^y \cdot \left(\frac{3}{10}\right)^{5-y}$ for $y = 0, 1, 2, 3, 4, 5$.

Y has the binomial distribution (with parameters 5 and $\frac{7}{10}$).

or $Y \sim Bin\left(5, \frac{7}{10}\right)$

c) $P(W=w) = \left(\frac{7}{10}\right)^{w-1} \cdot \frac{3}{10}$ $\quad w = 1, 2, \dots$

W has the geometric distribution (with parameter $\frac{3}{10}$)

$W \sim Geom\left(\frac{3}{10}\right)$.