$$= \int_A \int_D p(x|y)\,dx\; p(y)\,dy \quad / \mathbb{P}(Y \in A)$$

$$= \int_A \mathbb{P}(X \in D \mid Y = y)\, p(y)\,dy \quad / \mathbb{P}(Y \in A)$$

~~$\mathbb{P}(X \in D \mid Y = y) =$~~

$$\mathbb{E}[\mathbb{1}(X \in D) \mid Y = y] = \int_D p_{X|Y}(x|y)\,dx$$

$$\mathbb{E}[\mathbb{1}(X \in D) \mid Y \in A] = \int_A p \int_D p_{X|Y}(x|y)\,dx\,dy.$$

$$= \mathbb{P}(X \in D \mid Y \in A)$$

$$\Rightarrow \mathbb{P}(X, Y) = \int_{-\infty}^{x} \mathbb{P}(Y \le y \mid X = u)\, p(u)\,du$$

$$\mathbb{P}(X \le x, Y \le y) = \int \mathbb{P}(Y \le y \mid X = x$$

Stahl E Question