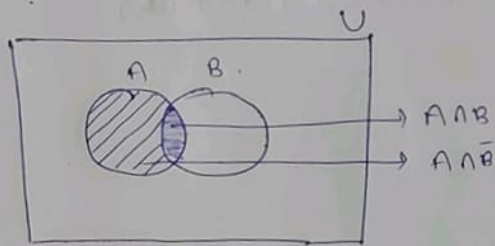(11)

(i) $P(A) = P(A \cap B) + P(A \cap \bar{B})$.

$A = A \cap S$, S is sample space.
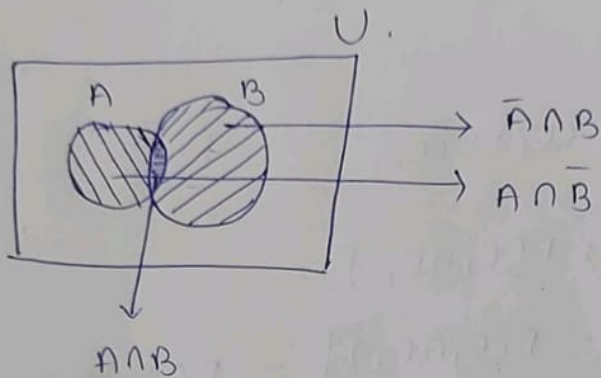
$\qquad = A \cap (B \cup \bar{B})$

$\qquad = (A \cap B) \cup (A \cap \bar{B})$.

Observe that $A \cap B$ and $A \cap \bar{B}$ are mutually exclusive.

$\therefore \quad P(A) = P\left[(A \cap B) \cup (A \cap \bar{B})\right]$

$\qquad\qquad = P(A \cap B) + P(A \cap \bar{B})$.

(ii) $P(A \cup B) = P(A \cap B) + P(A \cap \bar{B}) + P(\bar{A} \cap B)$.

$A \cap B$

Observe that,

$A \cup B = (A \cap B) \cup (\bar{A} \cap B) \cup (A \cap \bar{B})$.

Also, $A \cap B$, $\bar{A} \cap B$ and $A \cap \bar{B}$ are mutually exclusive.

$\therefore \quad P(A \cup B) = P(A \cap B) + P(A \cap \bar{B}) + P(\bar{A} \cap B)$.