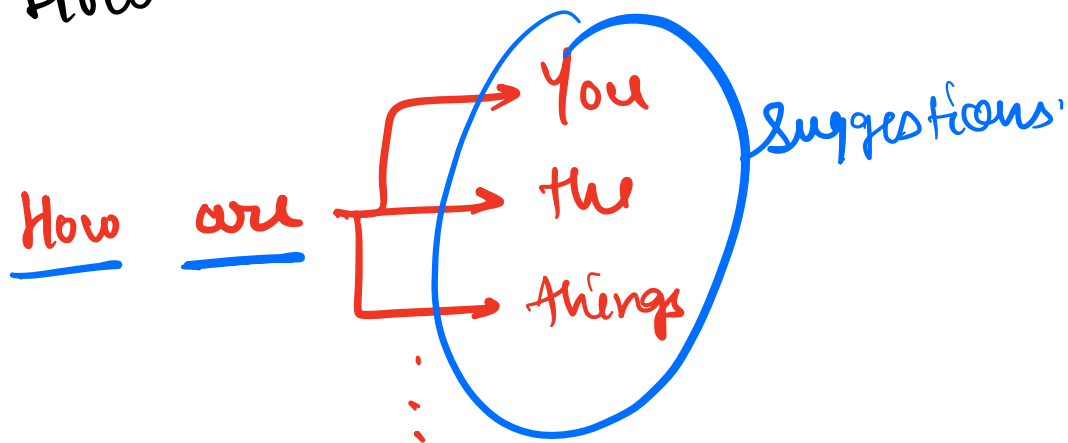


Agenda:-

- ✓ ① Conditional Prob
- ✓ ② Multiplication Rule
- ✓ ③ Marginal & Joint Prob
- ✓ ④ Tree diag approach.
- ✓ ⑤ Law of Total prob
- ★ ⑥ Baye's Thm.

① Conditional Prob

How are you / the / things



$X_1 \rightarrow$ first word (How)

$X_2 \rightarrow$ 2nd " (are)

$X_3 \rightarrow$ 3rd " (You)

$$P(X_3 = \text{"You"} \mid \underline{X_1} = \text{"How"} \text{ and } \underline{X_2} = \text{"are"})$$

eg2:- Sum of 2 dices

	D ₂					
	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

→ $6 \times 6 = 36$

$$Q1) \underline{P(D_1=2)} = \frac{6}{36} = \frac{1}{6}$$

$$(Q2) P(D_1 + D_2 \leq 5) = \frac{10}{36}$$

$$\underline{(Q.3)} \quad P(\underline{D_1 = 2} \cap \underline{D_1 + D_2 \leq 5})$$

$$= \frac{3}{36}$$

$$\underline{(Q.4)} \quad P(\underline{D_1 = 2} \mid \underline{D_1 + D_2 \leq 5})$$

↳ Conditional prob.

$$= \frac{3}{10} \checkmark$$

Conditional Prob:-

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

$$P(D_1 = 2 \mid (D_1 + D_2 \leq 5))$$

$$= \frac{P(D_1 = 2 \cap (D_1 + D_2 \leq 5))}{P(D_1 + D_2 \leq 5)}$$

$$= \frac{3/36}{10/36}$$

$$= \frac{3}{10}$$

$$= \boxed{\frac{3}{10}}$$

$$P(A|B) = \frac{P(A \cap B)}{P(B)} \quad \checkmark$$

$$\star \quad \boxed{P(\underline{A \cap B}) = P(A|B) * P(B)} \quad \checkmark$$

↳ Multiplication Rule *

$$\star \quad \textcircled{P(A \cap B) = P(B \cap A)}$$

* Joint Prob : $P(\underline{A \cap B})$

* Marginal Prob : $\underline{P(A), P(B)}$

Last lec → Sachin eg

Century \ Won	False	True	All
False	160	154	314
True	16	30	46
All	176	184	360

$$① P(\underline{won} = True) = \frac{184}{360}$$

w'
 c'

$$② P(w \cap c) = \frac{30}{360}$$

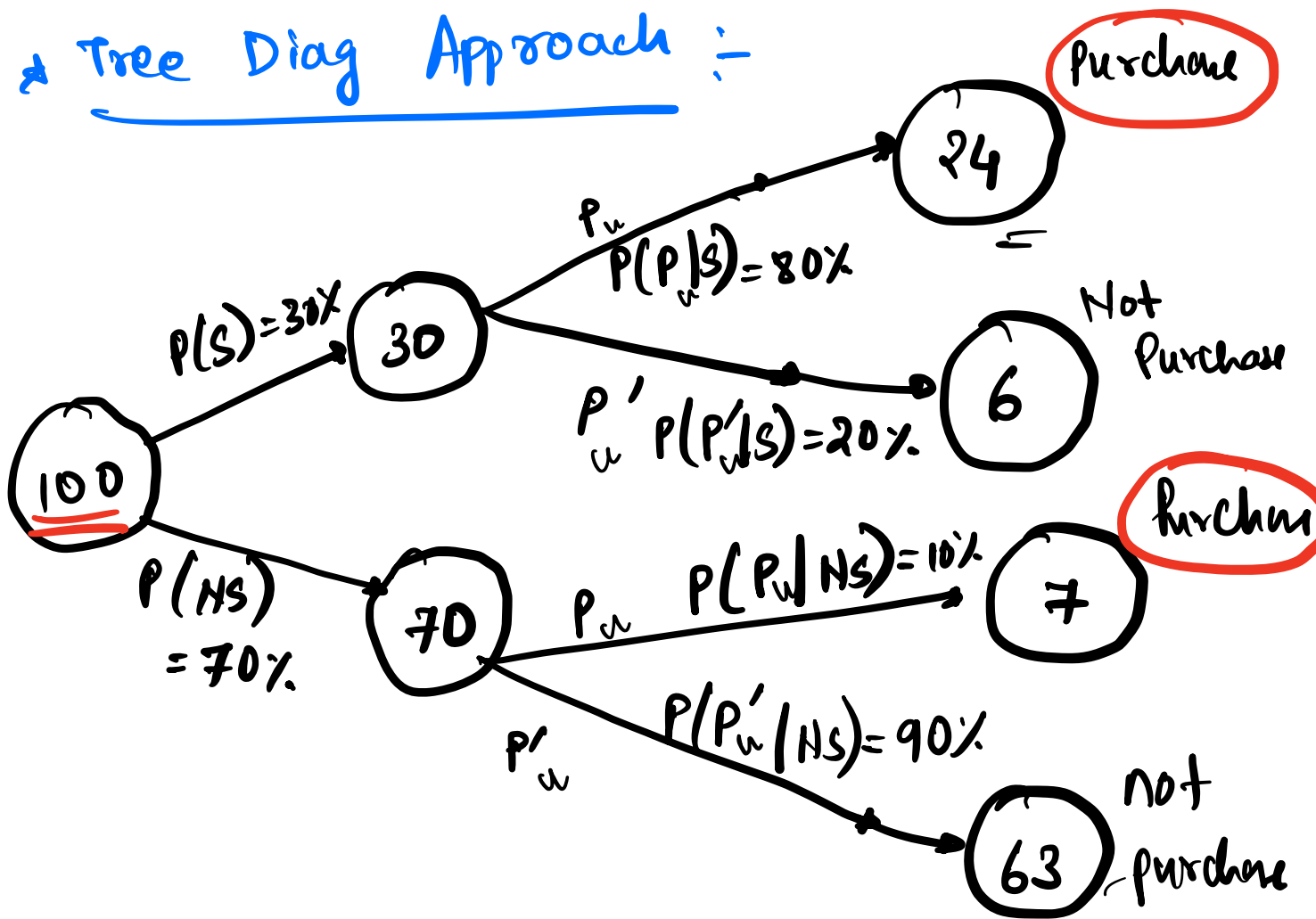
$$③ P(c) = \frac{46}{360}$$

$$④ P(\underline{w} | c) = \frac{30}{46} \quad \text{Logic}$$

$$= \frac{P(c \cap w)}{P(c)}$$

$$= \frac{\frac{36}{360}}{\frac{46}{360}} \rightarrow \left(\frac{36}{46} \right)$$

★ Tree Diag Approach :-

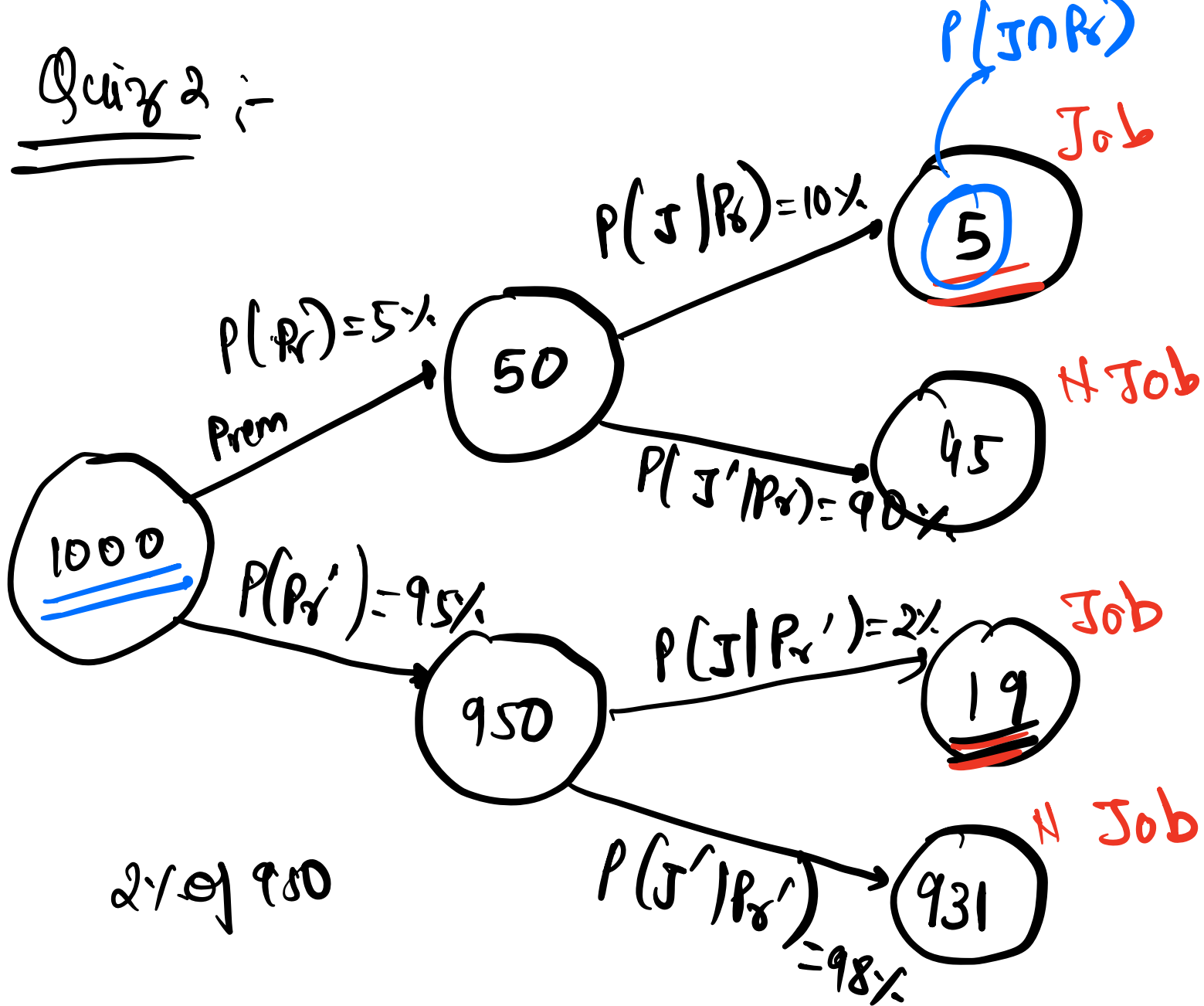


$$P(\underline{P_u}) = \frac{24 + 7}{100} = \frac{31}{100}$$

$$= \frac{31}{100} \times 100\%$$

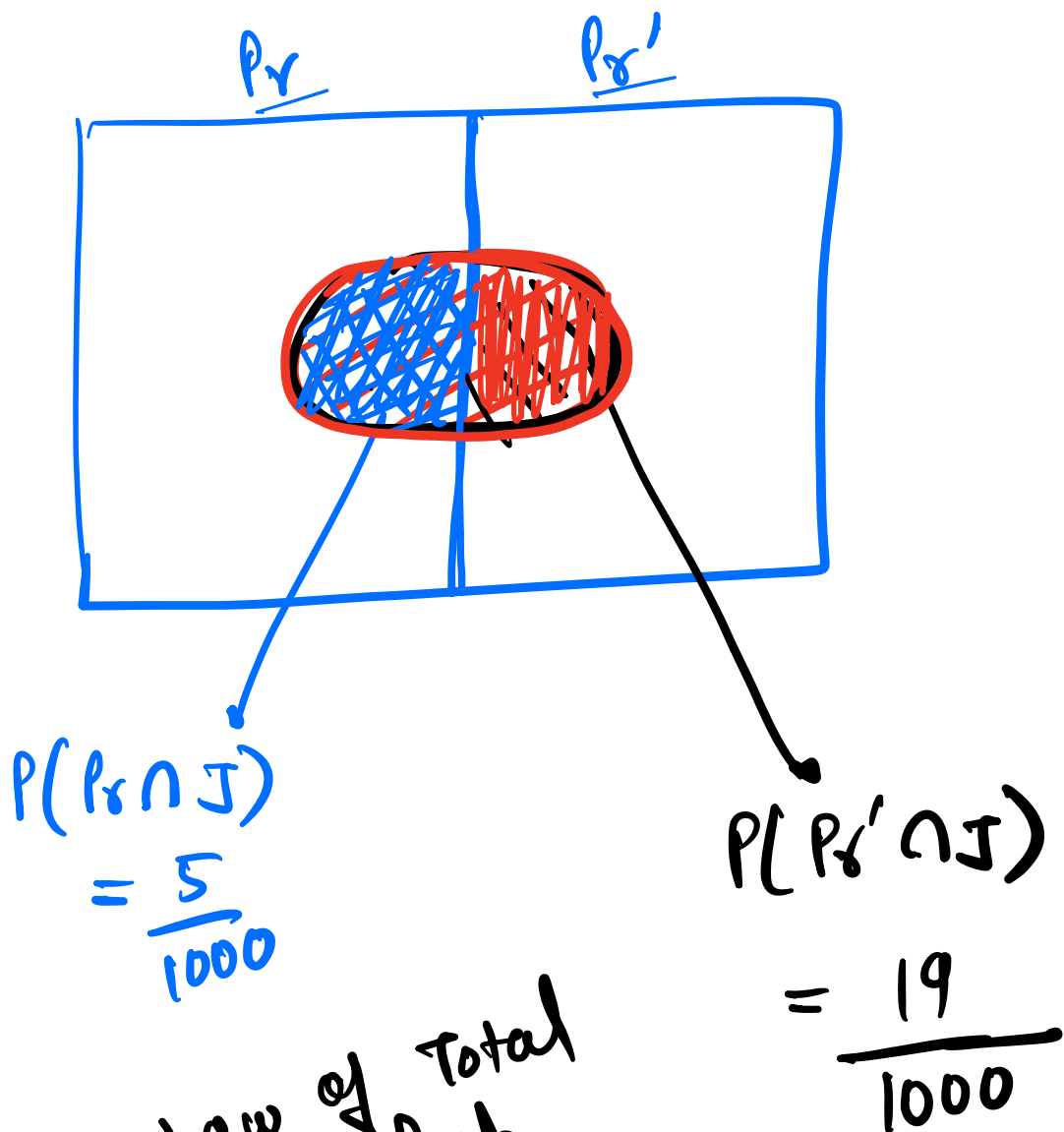
$$= \boxed{31\%}$$

Quiz 2 :-



$$P(J) = \frac{5 + 19}{1000} = \frac{24}{1000} \times 100\%$$

$$= \boxed{2.4\%}$$



Law of Total Prob

$$P(J) = P(J \cap P_r) + P(J \cap P_{r'})$$

$$= P(J|P_r) * P(P_r) + P(J|P_{r'}) * P(P_{r'})$$

$$= 10\% * 5\% + 2\% * 95\%$$

$$= \boxed{2.4\%}$$

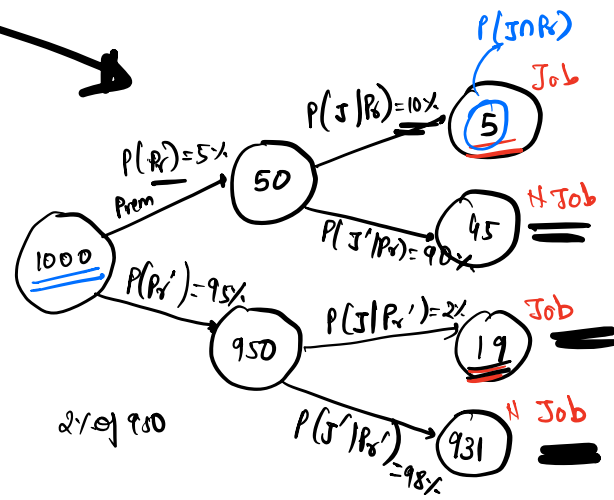
$$P(P_x) = 0.05$$

$$P(P_x \cap J) = \frac{5}{1000}$$

$$P(P_x \cap J') = \frac{45}{1000}$$

$$P(P_x' \cap J) = \frac{19}{1000}$$

$$P(P_x' \cap J') = \frac{931}{1000}$$



$$P(J|P_x) = \underline{\underline{10\%}}$$

$$P(J|P_x') = \underline{\underline{2\%}}$$

$$P(P_x) = \underline{\underline{5\%}}$$

$$P(P_x') = 95\%$$

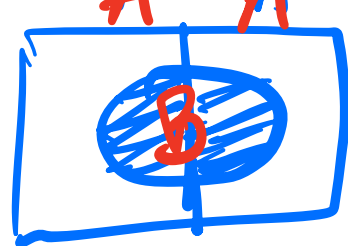
$$P(P_x|J) = \frac{P(J|P_x) * P(P_x)}{P(J)}$$

$$= \frac{10\% * 5\%}{P(J)}$$

$P_x \rightarrow A$
 $J \rightarrow B$

A A'

Summary :-



$$\textcircled{1} P(B) = P(B \cap A) + P(B \cap A')$$

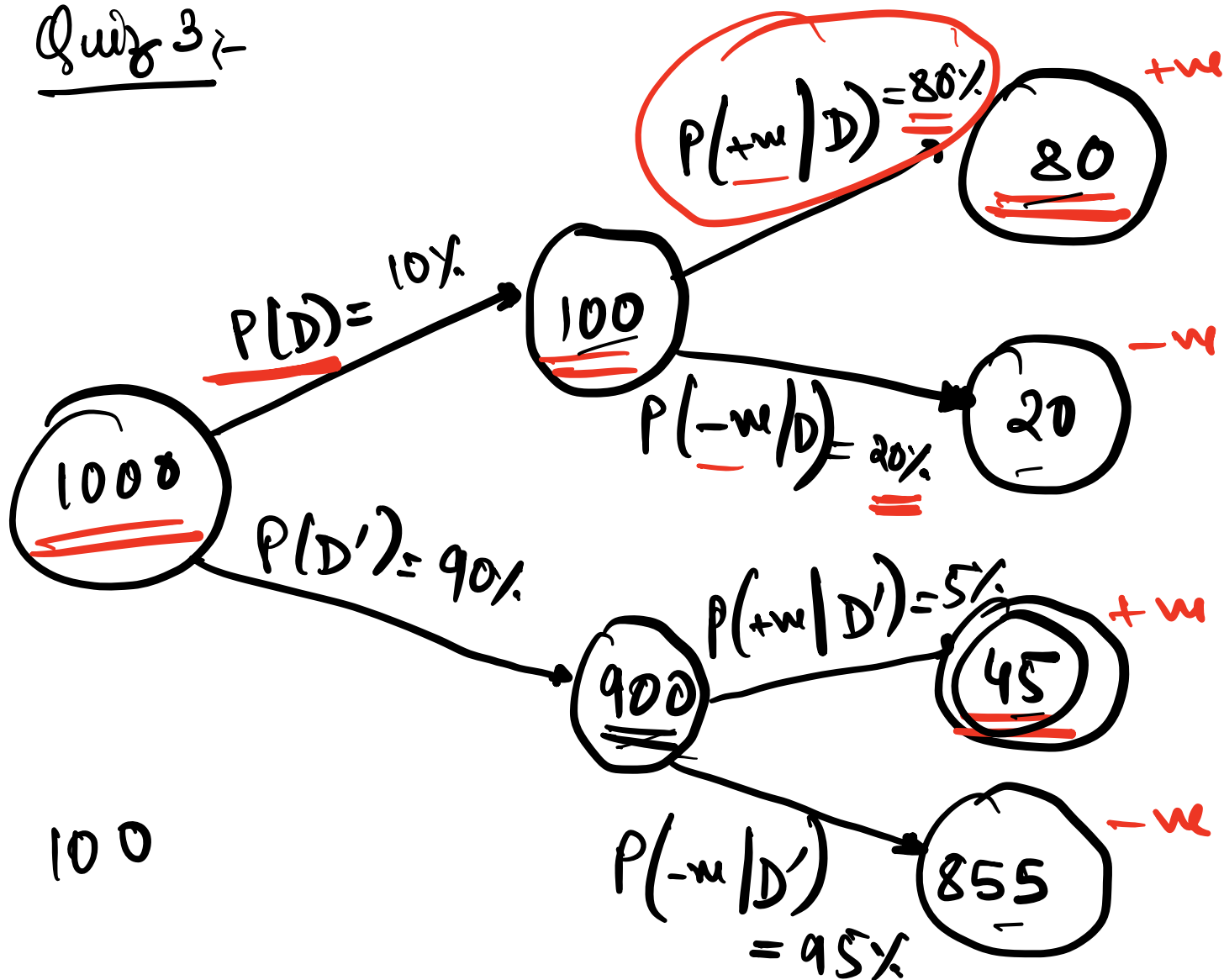
$$P(B) = P(B|A) * P(A) + P(B|A') * P(A')$$

→ Law of Total Prob

② Conditional Prob:

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

Quiz 3



$$P(+w) = \frac{80 + 45}{1000} \times 100\%$$

$$= \boxed{12.5\%}$$

$$P(+ve) = P(+ve \cap \underline{D}) + P(+ve \cap \underline{D}')$$

h.w: validate the above
ans using formula
logic.

$$\underline{\text{Quiz 4:}} \quad P(+ve | D)$$

$$= 80\%$$

$$= \underline{\underline{0.8}}$$

$$P(+ve | D) = \frac{P(+ve \cap D)}{P(D)}$$

$$= \frac{80}{1000}$$

$$= \frac{100}{1000}$$

$$= \frac{80}{100}$$

$$= 80\%$$

Quiz 5:

$$P(+ve \cap D') = 45/1000$$

$$= \boxed{0.045}$$

$$= \frac{45}{1000} \times 100 (\%)$$

$$= \underline{\underline{4.5 (\%)}}$$

① Baye's Thm

$$P(A|B) = \frac{P(B|A) * P(A)}{P(B)}$$

Simple derivation :-

$$P(A \cap B) = P(B \cap A) \rightarrow (1)$$

$$P(\underline{A|B}) = \frac{P(A \cap B)}{P(B)}$$

$$P(A \cap B) = P(A|B) * P(B) \rightarrow (2)$$

$$P(B|A) = \frac{P(B \cap A)}{P(A)}$$

$$P(B \cap A) = P(B|A) * P(A) \quad \text{--- ②}$$

from ①, 2, 3

$$P(A|B) * P(B) = P(B|A) * P(A)$$

Bayes's Thm

$$P(A|B) = P(B|A) * P(A)$$

$P(B)$

Posterior Prob

likelihood

Prior



Marginal Prob