QUESTION A certain disease is only suffered by men and can only be transmitted by direct inheritance from one's mother if she is a carrier. If a woman is a carrier the probability that she transmits the disease to any of her children (the boys being sufferers and the girls carrier), is 0.5, independently of all other children. A woman knows that her brother has the disease. If she already has two normal sons, what is the probability that her next child will be unaffected?

ANSWER Brother has disease $\Rightarrow$ Woman's mother carrier $\Rightarrow$ P(woman carrier)=P(woman not carrier)=$\frac{1}{2}$

P(two normal son's —carrier)=$\frac{1}{4}$, P(two normal son's —not carrier)=1.

P(two normal sons)= $\frac{1}{2} \times \frac{1}{4} + \frac{1}{2} \times 1 = \frac{5}{8}$.

P(woman carrier— two normal) $= \frac{\frac{1}{8}}{\frac{5}{8}} = \frac{1}{5}$, P(woman not carrier—two normal sons)= $\frac{4}{5}$

P(next child normal—carrier)= $\frac{1}{2}$, P(next child normal—not carrier)=1.

Hence P(next child normal)= $\frac{1}{2} \times \frac{1}{5} + 1 \times \frac{4}{5} = \frac{9}{10}$