4.   3R, 2W, 1B

a. $Pr(\text{Emma Winning}) = Pr(W) + Pr(RB) + Pr(RRW)$
$$+ Pr(RRRB)$$

$$= \frac{2}{6} + \left(\frac{3}{6} \times \frac{1}{5}\right) + \left(\frac{3}{6} \times \frac{2}{5} \times \frac{2}{4}\right)$$

$$+ \left(\frac{3}{6} \times \frac{2}{5} \times \frac{1}{4} \times \frac{1}{3}\right)$$

$$= \frac{2}{6} + \frac{3}{30} + \frac{3}{30} + \frac{1}{60}$$

$$= \frac{20+6+6+1}{60} = \frac{33}{60} = \frac{11}{20} /\!/$$

b. No. this is not a fair game.

$Pr(\text{Emma Winning}) \neq Pr(\text{Jack Winning})$

Emma has a slightly higher chance of winning

b. Pr (Emma winning | the first ball, picked was red)

$$= \frac{Pr(\text{Emma Wins} \mid \text{first ball is red})}{Pr(\text{1st ball is red})}$$

$$= \frac{\frac{11}{20} - \frac{2}{6}}{\frac{3}{6}} \qquad (\text{from part A})$$

$$= \frac{13/60}{3/6} = \frac{13}{3} \times \frac{6}{60} = \frac{13}{30} = 0.433$$

c. Pr (Emma losing by drawing black ball)

$$= Pr(B) + Pr(RRB) + Pr($$

$$= \frac{1}{6} + \left(\frac{3}{6} \times \frac{2}{5} \times \frac{1}{4} \right)$$

$$= \frac{1}{6} + \left(\frac{3}{60} \right) = \frac{13}{60} = 0.2166$$

d. Pr (Emma Winning by Jack drawing black ball)

$$= Pr(RB) + Pr(RRRB)$$

$$= \frac{3}{30} + \frac{1}{60} = \frac{7}{60} = 0.116$$

e. Pr (Emma losing by drawing a black ball, given that she lost)

$$= \frac{Pr(\text{Emma losing by drawing a black ball})}{Pr(\text{Emma lost})}$$

$$= \frac{0.2166}{(1 - 0.55)} = \frac{0.2166}{0.45} = 0.4813$$

f) Pr (Emma losing | Someone drew black ball)

$$= \frac{Pr(Emma\ losing\ by\ drawing\ a\ black\ ball)}{Pr(Emma\ drawing\ black + Pr(Jack\ drawing\ ball)\ black\ ball)}$$

$$\neq \frac{0.45}{(0.2166 + 0.116)} = \frac{0.2166}{0.2166 + 0.1166}$$

$$\neq = 0.6188$$

5.

a. Pr('HH' appearing before 'TT') = Pr(Lina Wins)

$$= \frac{1}{4}$$

b. Pr(Lina wins if she chooses HTT and Bepo choses TTH)

= Pr(HTT appearing before TTH)

~~$= \frac{1}{4}$~~

Considering the first 2 throws, the possible outcomes are HH, HT, TH and TT.

Out of these 4 outcomes, HH, HT and TH will eventually lead Lina to win as successive T's will result in HTT before TTH.

The only way Bepo wins is if the ~~the~~ first 2 throws are tails.

∴ Pr(Lina wins) = $\underline{\underline{3/4}}$

6.

L : Passing lighting test
S : Passing size test
I : Pass the info test
V : Photo is valid.

$$P(V) = P(S) \times P(S'|S) \times P(I|SL)$$

$$= 0.7 \times 0.8 \times 0.9$$

$$= 0.504$$

$P(V^c) = 0.496$ → Probability that a photo is invalid

∴ $Pr(L^c) = \dfrac{0.7 \times 0.2}{0.496} = \underline{\underline{0.2822}}$

$\left(Pr(L^c) = \dfrac{Pr(S) \times P(S'|S)}{Pr(V^c)} \right)$ → Sizing test passed and light test failed.