MARKS

6 5. In a large population of laboratory rats, 20% have long tails and 60% have brown coats; also, 25% have neither of these two traits.

(4, 2) (a) Find the proportion of the rats that have *both* these traits.

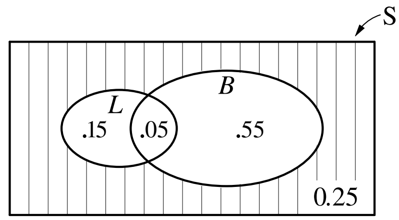
(b) Can the two traits 'long tail' and 'brown coat' reasonably be modelled as being *probabilistically independent*? Answer *Yes* or *No* and then justify your answer.

(a) A convenient way to approach this question is to show the information on a Venn diagram.

0.05 = 5%	(a)
Proportion	

Define event L: *a rat has a long tail*, $\Pr(L) = 0.20$,
and event B: *a rat has a brown coat*, $\Pr(B) = 0.60$.

We can show the probabilities given in the statement of the question as in the Venn diagram at the right, where we find the three central values knowing they add to 0.75 because the shaded area is 0.25.



We see that the proportion of rats that have *both* traits is is given by:

$$\Pr(L \cap B) = \text{common area} = 0.05 = 5\%.$$

(b) For **probabilistic independence**, we must have: $\Pr(L)\times\Pr(B) = \Pr(L \cap B)$.

No	(b)
Yes or *No*	

We have: $\Pr(L) = 0.2$, $\Pr(B) = 0.6$,
$\Pr(L \cap B) = 0.05$.

But: $\Pr(L)\times\Pr(B) = 0.2\times 0.6 = 0.12 \neq \Pr(L \cap B)$;

hence, the two traits can**not** reasonably be modelled as being probabilistically independent.