Tree diagrams

You can use a tree diagram to answer questions involving **conditional probability**.

A tree diagram shows all the possible outcomes from a series of events and their probabilities.

This is a tree diagram for Holly's journey to school.

You write the outcomes at the ends of the branches. You can use shorthand like this.

You write the probability for each event on the branch.

At each branch the probabilities add up to 1.
$\frac{2}{3} + \frac{1}{3} = 1$

The outcome of the first event can affect the probability of the second. Holly is less likely to be on time if she misses the bus.

Each branch is like a different parallel universe. In this universe, Holly misses the bus and gets to school on time.

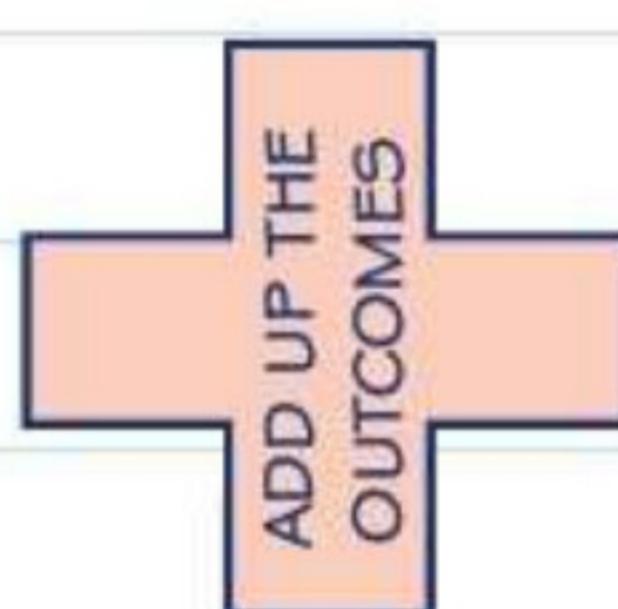|		Outcome	Probability
Catch bus $\frac{2}{3}$ — $\frac{1}{4}$ Late		CL	$\frac{2}{3} \times \frac{1}{4} = \frac{2}{12} = \frac{1}{6}$
— $\frac{3}{4}$ On time		CO	$\frac{2}{3} \times \frac{3}{4} = \frac{6}{12} = \frac{1}{2}$
Miss bus $\frac{1}{3}$ — $\frac{4}{5}$ Late		ML	$\frac{1}{3} \times \frac{4}{5} = \frac{4}{15}$
— $\frac{1}{5}$ On time		MO	$\frac{1}{3} \times \frac{1}{5} = \frac{1}{15}$

You multiply along the branches to find the probability of each outcome.
The probability that Holly misses the bus and is late for school is $\frac{4}{15}$

Golden rules

1 Look out for the words **replace** or **put back** in a probability question.

With replacement: probabilities stay the same.

Without replacement: first probability stays the same while the others change.

2 MULTIPLY ALONG THE BRANCHES ✕ ➕ ADD UP THE OUTCOMES

Worked example

Target grade **8**

There are 3 strawberry yoghurts and 4 pineapple yoghurts in a fridge. Noah picks two yoghurts at random. Work out the probability that both the yoghurts are the same flavour. **(4 marks)**
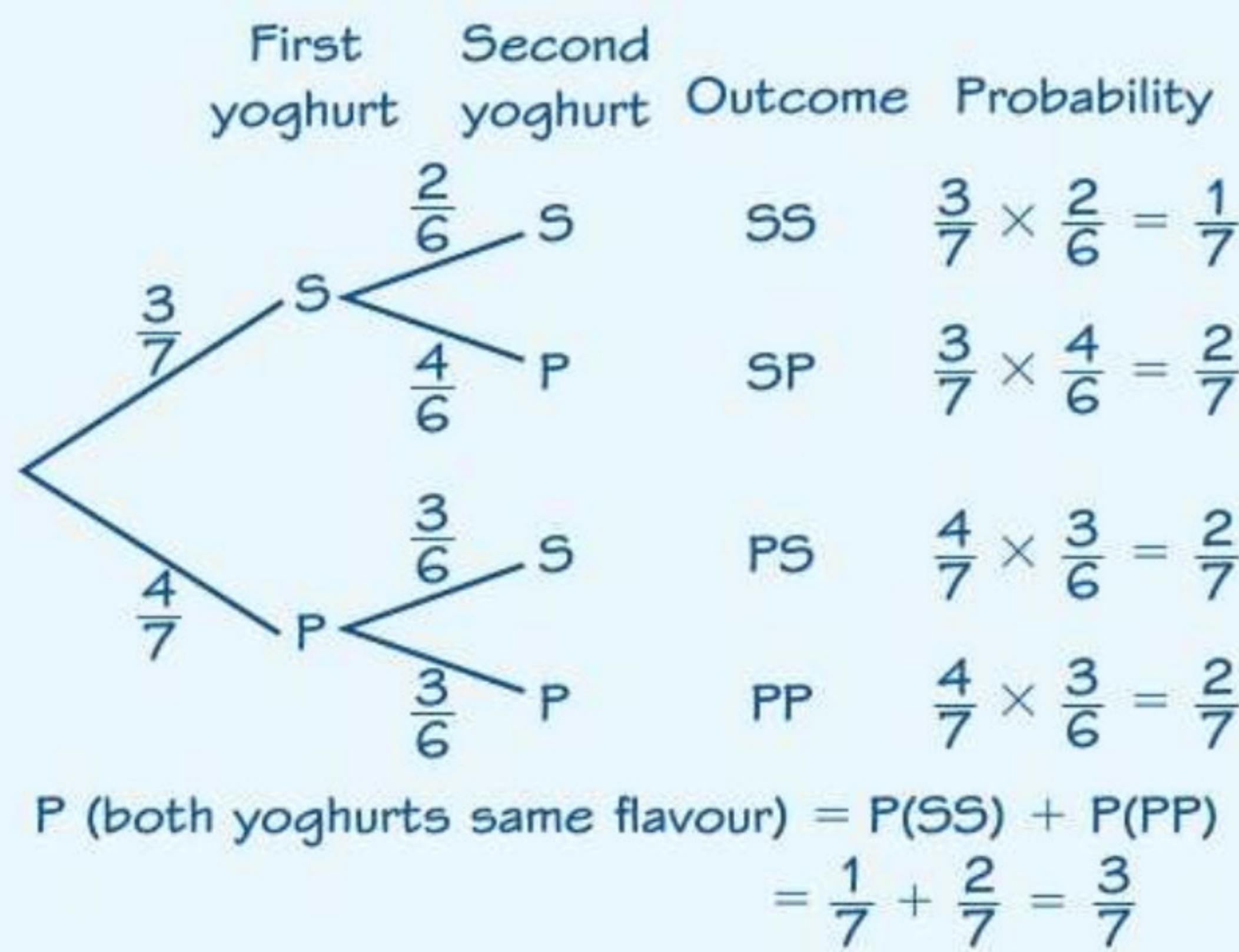
This is an example of selection **without replacement**. The two events are not independent. The probabilities for the second pick change depending on which flavour yoghurt was picked first. A tree diagram is the **safest** way to answer questions like this.

First yoghurt	Second yoghurt	Outcome	Probability
$\frac{3}{7}$ S	$\frac{2}{6}$ S	SS	$\frac{3}{7} \times \frac{2}{6} = \frac{1}{7}$
	$\frac{4}{6}$ P	SP	$\frac{3}{7} \times \frac{4}{6} = \frac{2}{7}$
$\frac{4}{7}$ P	$\frac{3}{6}$ S	PS	$\frac{4}{7} \times \frac{3}{6} = \frac{2}{7}$
	$\frac{3}{6}$ P	PP	$\frac{4}{7} \times \frac{3}{6} = \frac{2}{7}$

P (both yoghurts same flavour) = P(SS) + P(PP)
$= \frac{1}{7} + \frac{2}{7} = \frac{3}{7}$

Now try this

Worked solution video

Target grade **8**

The probability that a student at Jen's school has a dog is 0.3.
If a student has a dog, the probability that they have a cat is 0.12.
If a student does not have a dog, the probability that they have a cat is 0.25.
A student is chosen at random.
Work out the probability that they do not have a cat. **(4 marks)**