Activity description

In this activity the addition law for probabilities of mutually exclusive events and the multiplication law for probabilities of independent events are introduced, with reference to some simple examples.

Students are then asked to use these laws to tackle a number of probability problems.

Suitability and Time

Level 3 (Advanced); 1–2 hours

Resources

Student information sheet, worksheet
Optional: slideshow

Equipment

Calculators

Key mathematical language

Event, probability, mutually exclusive, independent, tree diagram, fair, biased, Venn diagram

Notes on the activity

The examples included in this resource concentrate on contexts where events are either mutually exclusive or independent.

In general, for two events A and B the probability that either A or B occurs is given by P(A or B) = P(A) + P(B) – P(A and B).

In certain situations, P(A or B) and P(A and B) can be calculated using P(A) and P(B). Two of these situations are as follows.

If A and B are mutually exclusive, P(A and B) = 0, so P(A or B) = P(A) + P(B), the addition law for probabilities of exclusive events.

If A and B are independent, P(A and B) = P(A) $\times$ P(B), the multiplication law for probabilities of independent events.

The information sheet gives a summary of the main points and some examples. The slideshow includes the same examples and can be used when this topic is introduced and/or for revision later.

During the activity

Students could discuss the ideas in the Information sheet in small groups, leading to a full class discussion of the key points.

As an alternative, if students are familiar with the ideas of independence and being mutually exclusive, the tree diagram in the example of the biased coin could be used to motivate a discussion of how the probabilities have been calculated, and how the ideas of independence and being mutually exclusive have been used.

Points for discussion

As well as performing the necessary calculations, students should be encouraged to think about how they have used the basic laws of probability in solving the problems.

This should include considering whether or not the assumption of mutual exclusivity or independence can be justified.

Extensions

The suggested extension requires students to work backwards from the probability of two combined events to the probability of a single event. In both parts of the question there are a number of ways of tackling the problem; some students may find a quick method of solving the second part of the problem. As with the main set of questions, students should be encouraged to think about how they have used the basic laws of probability.

Answers to questions

1 Mutually exclusive events

	Mutually exclusive?	
	Yes	**No**
Angela goes for her train to work: Event A: she catches the train Event B: she misses the train	✓	
Rory throws a dice: Event A: he gets an odd number Event B: he gets less than 4		✓
Rory throws a dice: Event A: he gets more than 3 Event B: he gets less than 3	✓	
Sue takes a card at random from a pack of 52: Event A: she gets a spade Event B: she gets a club	✓	
Sue takes a card at random from a pack of 52: Event A: she gets a spade Event B: she gets a queen		✓

2 Buttons

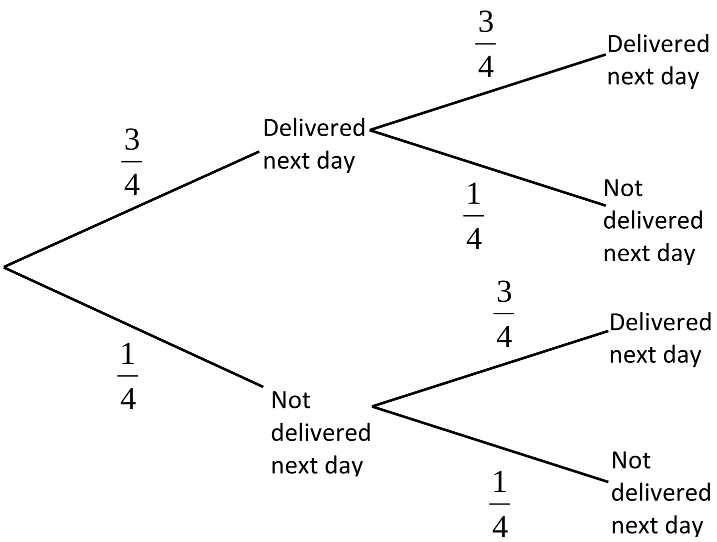
a $\frac{1}{9}$ **b** $\frac{3}{9} = \frac{1}{3}$ **c** $\frac{5}{9}$ **d** $\frac{4}{9}$ **e** $\frac{8}{9}$ **f** $\frac{6}{9} = \frac{2}{3}$

3 Independent events – tossing a coin

a $\frac{1}{2} \times \frac{1}{6} = \frac{1}{12}$ **b** $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$ **c** $\frac{1}{2} \times \frac{2}{6} = \frac{1}{6}$

4 Deliveries

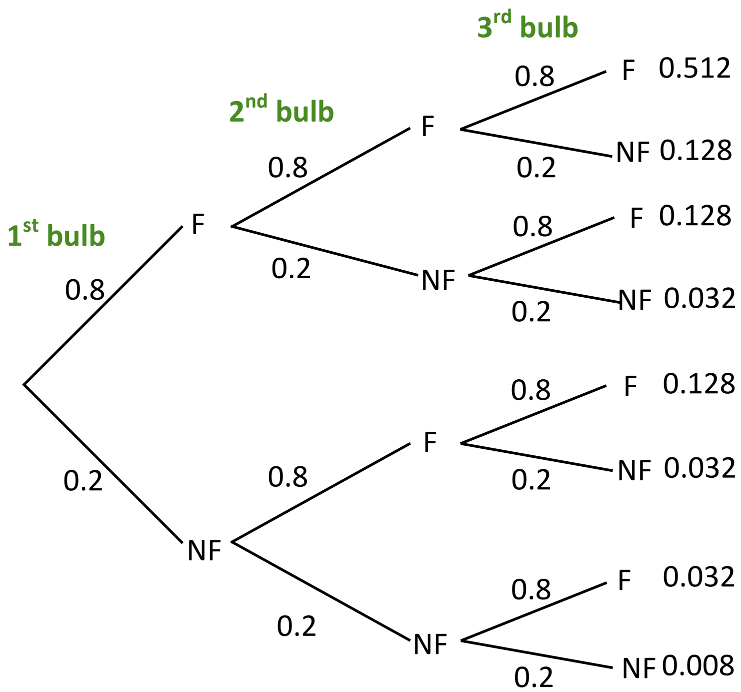
a



b i $\frac{9}{16}$ **ii** $\frac{1}{16}$

5 Potting bulbs

a



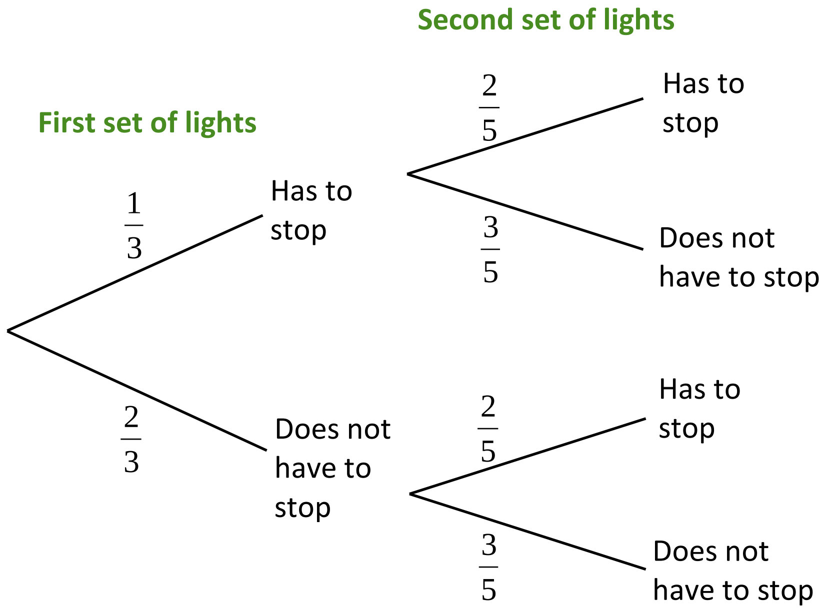
b i 0.512

ii 0.008

iii 0.896

6 Traffic lights

a



b i $\frac{2}{15}$ **ii** $\frac{2}{5}$ **c** 132

Answers to extension questions

P(Head on one toss) = $\frac{3}{5}$ or 0.6

P(at least one Head on three tosses) = $\frac{117}{125}$ or 0.936