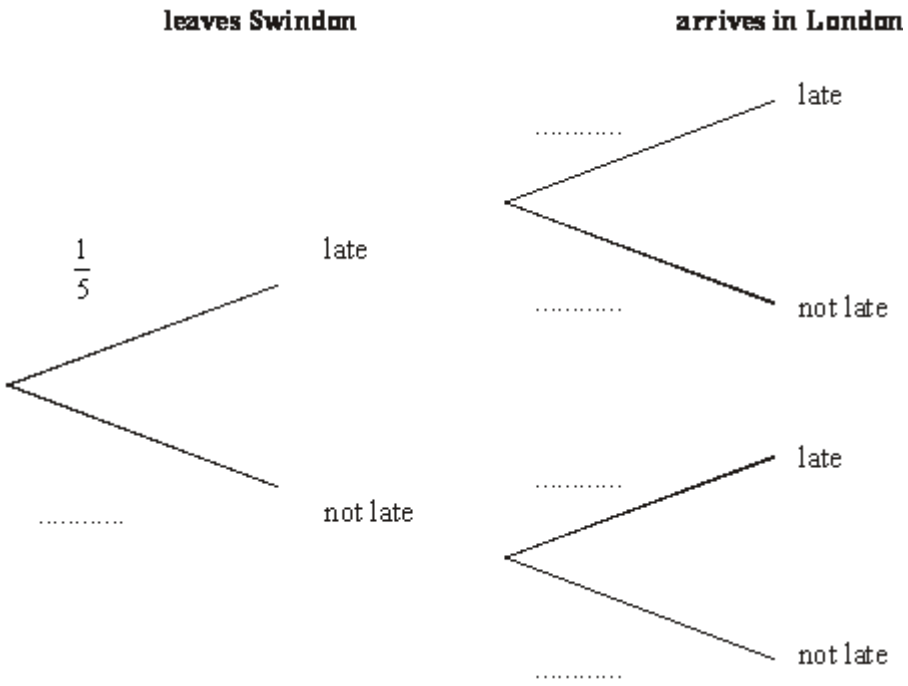
Q1. Nicola is going to travel from Swindon to London by train.

The probability that the train will be late leaving Swindon is $\frac{1}{5}$

If the train is late leaving Swindon, the probability that it will arrive late in London is $\frac{7}{10}$

If the train is **not** late leaving Swindon, the probability that it will arrive late in London is $\frac{1}{10}$

(a) Complete the probability tree diagram.



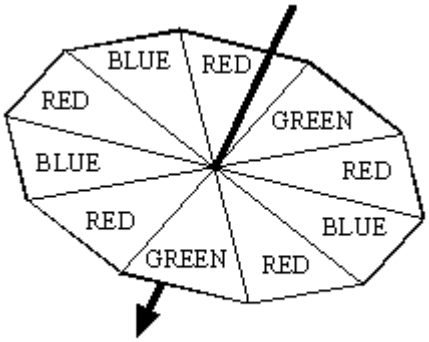
(2)

(b) Work out the probability that Nicola will arrive late in London.

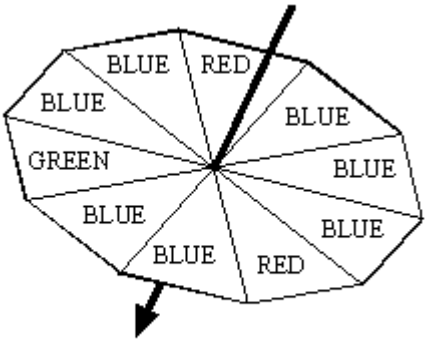
.....

(3)
(Total 5 marks)

Q2. William has two 10-sided spinners.
The spinners are equally likely to land on each of their sides.



A



B

Spinner **A** has 5 red sides, 3 blue sides and 2 green sides.
Spinner **B** has 2 red sides, 7 blue sides and 1 green side.

William spins spinner **A** once.
He then spins spinner **B** once.

Work out the probability that spinner **A** and spinner **B** do **not** land on the same colour.

.....

(Total 4 marks)

Q3. There are 4 bottles of orange juice,
3 bottles of apple juice,
2 bottles of tomato juice.

Viv takes a bottle at random and drinks the juice.
Then Caroline takes a bottle at random and drinks the juice.

Work out the probability that they both take a bottle of the same type of juice.

.....

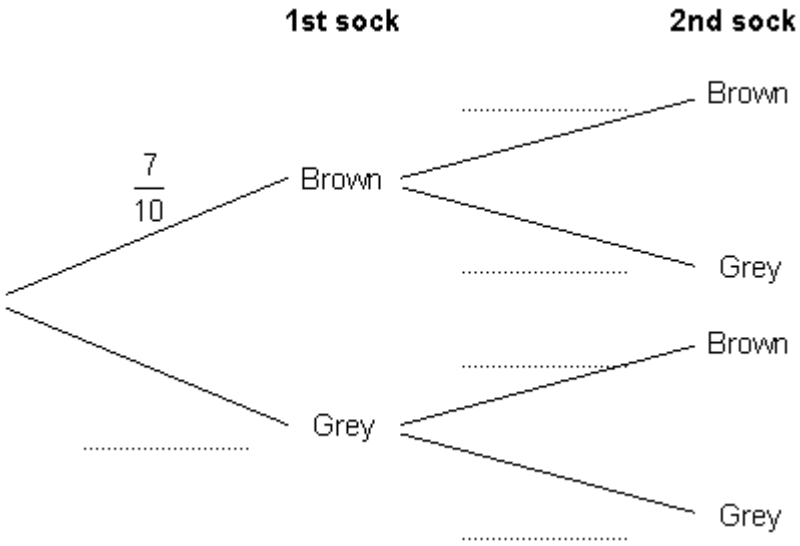
(Total 4 marks)

Q4. There are 10 socks in a drawer.

7 of the socks are brown.
3 of the socks are grey.

Bevan takes at random two socks from the drawer at the same time.

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that Bevan takes two socks of the same colour.

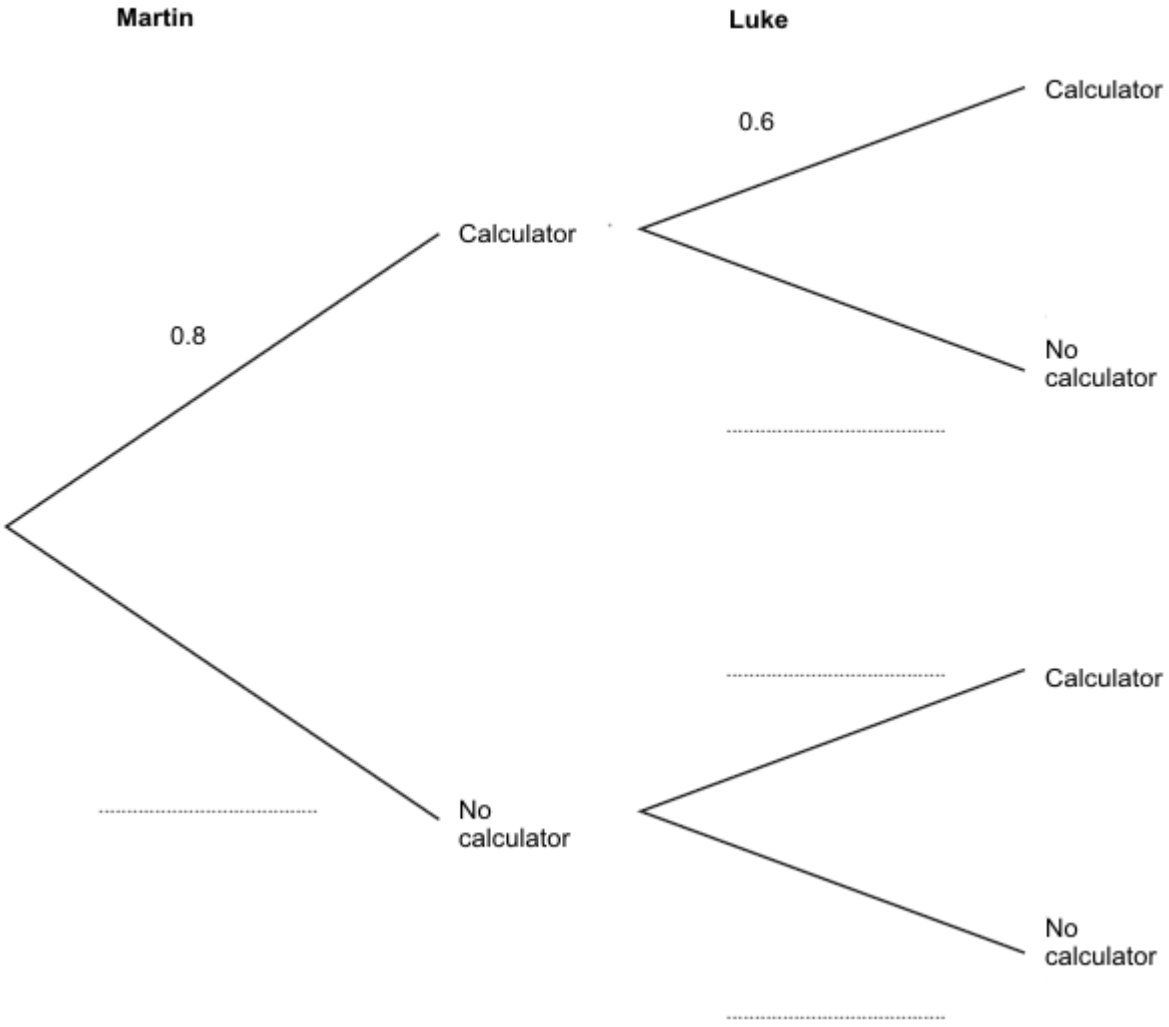
.....

(3)
(Total 5 marks)

Q5. Martin and Luke are students in the same maths class.

The probability that Martin will bring a calculator to a lesson is 0.8.
The probability that Luke will bring a calculator to a lesson is 0.6.

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that **both** Martin and Luke will **not** bring a calculator to a lesson.

.....

(2)
(Total 4 marks)

Q6. In a bag there are 5 red counters and 4 blue counters.

Suki takes at random two counters from the bag.

Work out the probability that the counters will each have a different colour.

.....

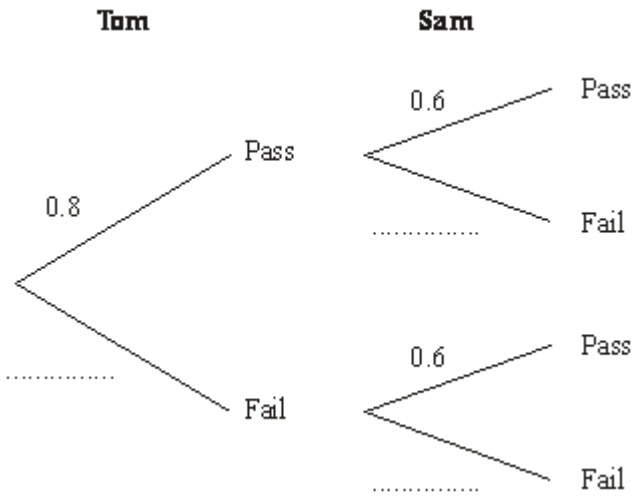
(Total 4 marks)

Q7. Tom and Sam each take a driving test.

The probability that Tom will pass the driving test is 0.8

The probability that Sam will pass the driving test is 0.6

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that both Tom and Sam will pass the driving test.

.....

(2)

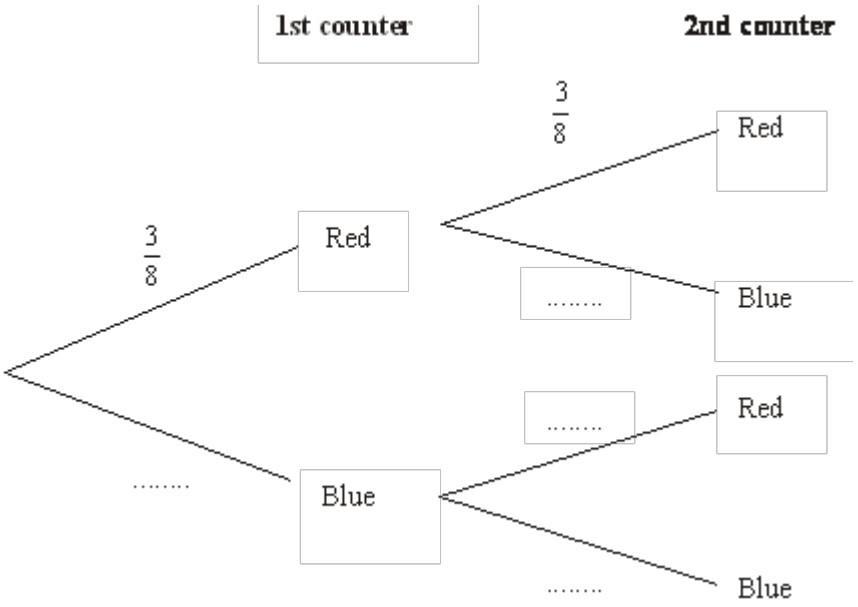
(c) Work out the probability that only one of them will pass the driving test.

.....

(3)
(Total 7 marks)

Q8. Matthew puts 3 red counters and 5 blue counters in a bag.
He takes at random a counter from the bag.
He writes down the colour of the counter.
He puts the counter in the bag again.
He then takes at random a second counter from the bag.

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that Matthew takes two red counters.

.....

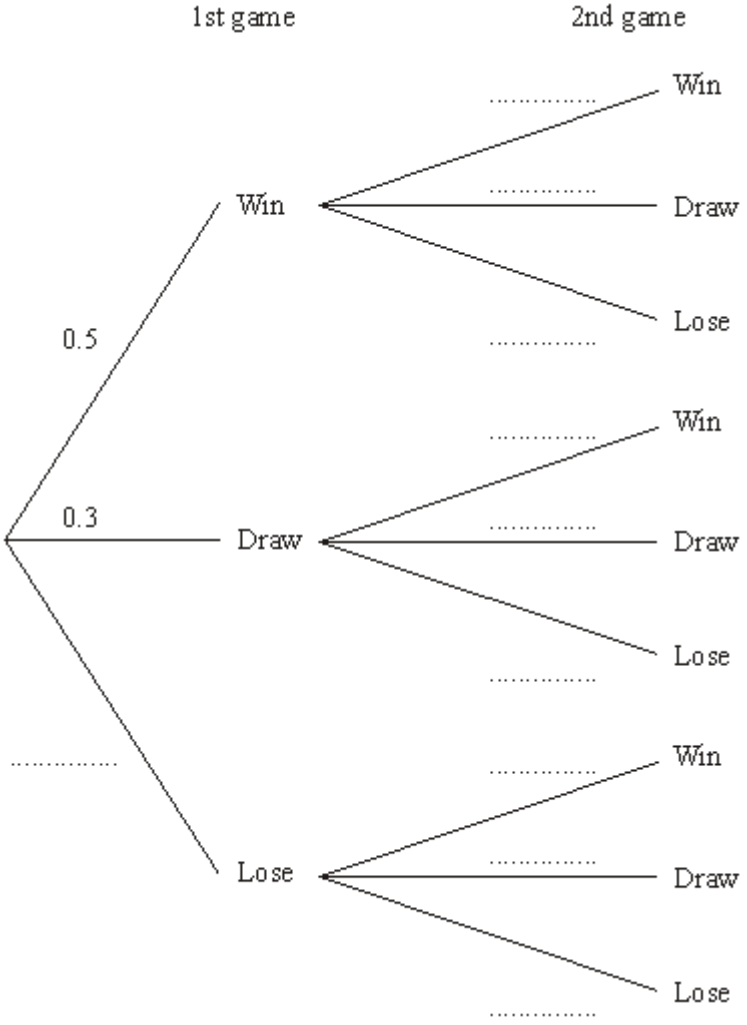
(2)
(Total 4 marks)

Q9. In a game of chess, a player can either win, draw or lose.

The probability that Vishi wins any game of chess is 0.5.
The probability that Vishi draws any game of chess is 0.3.

Vishi plays 2 games of chess.

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that Vishi will win both games.

.....

(2)
(Total 4 marks)

Q10. There are 10 students in a class.
6 of the students are boys and 4 of the students are girls.

Three students are picked at random from the class to form a team.

Work out the probability that the team consists of 1 girl and 2 boys.

.....

(Total 4 marks)

M1.

	Working	Answer	Mark	Additional Guidance
(a)		4/5 (7/10, 3/10) (1/10, 9/10)	2 3	**B2** cao (**B1** for 2 correct from 4/5, (7/10, 3/10), (1/10, 9/10)) **M1** for 1/5 × "7/10" or "4/5" × "1/10" oe selected **M1** for (1/5 × 7/10) + (4/5 × 1/10) oe **A1** for 11/50 oe
(b)	(1/5 × 7/10) + (4/5 × 1/10)	11/50		
				Total for Question: 5 marks

M2.

Working	Answer	Mark	Additional Guidance
$\left(\frac{5}{10}\times\frac{7}{10}\right)+\left(\frac{5}{10}\times\frac{1}{10}\right)$ $+\left(\frac{3}{10}\times\frac{2}{10}\right)+\left(\frac{3}{10}\times\frac{1}{10}\right)$ $+\left(\frac{2}{10}\times\frac{2}{10}\right)+\left(\frac{2}{10}\times\frac{7}{10}\right)$ $= \frac{35+5+6+3+4+14}{100}$ **OR** $1-\left[\left(\frac{5}{10}\times\frac{2}{10}\right)+\left(\frac{3}{10}\times\frac{7}{10}\right)\right]$ $+\left(\frac{2}{10}\times\frac{1}{10}\right)$	$\frac{67}{100}$	4	**M1** for a tree diagram with at most 2 errors or one of $\left(\frac{5}{10}\times\frac{7}{10}\right)$ or $\left(\frac{5}{10}\times\frac{1}{10}\right)$ etc **M1** for 5 out of 6 correct pairings of different colours or 2 out of 3 correct pairings of same colours or 8 out of 9 correct pairings of all colours **M1** (dep on **M2**) for adding 5 or 6 correct pairings of different colours or 1 – (2 or 3 correct pairings of same colours) **A1** for $\frac{67}{100}$ oe

$= 1 - \frac{10+21+2}{100} = 1 - \frac{33}{100}$			**SC** All correctly done but 2nd spinner all $\frac{x}{9}$ Award **M1** for a "correct tree" **M1** for adding 5 or 6 "correct pairings" of different colours or 1 – (2 or 3 "correct pairings" of same colours) **M0 A0** (answer = 67/90)
			Total for Question: 4 marks

M3.

Working	Answer	Mark	Additional Guidance
$\left(\frac{4}{9}\times\frac{3}{8}\right)+\left(\frac{3}{9}\times\frac{2}{8}\right)+\left(\frac{2}{9}\times\frac{1}{8}\right)$ $= \frac{12+6+2}{72}$	$\frac{20}{72}$ oe	4	**B1** for $\frac{3}{8}$ or $\frac{2}{8}$ or $\frac{1}{8}$ seen as 2nd probability **M1** for $\left(\frac{4}{9}\times\frac{3}{8}\right)$ or $\left(\frac{3}{9}\times\frac{2}{8}\right)$ or $\left(\frac{2}{9}\times\frac{1}{8}\right)$ **M1** for $\left(\frac{4}{9}\times\frac{3}{8}\right)+\left(\frac{3}{9}\times\frac{2}{8}\right)+\left(\frac{2}{9}\times\frac{1}{8}\right)$ **A1** for $\frac{20}{72}$ oe **Alternative scheme for replacement** **B0** for $\frac{4}{9}$ or $\frac{3}{9}$ or $\frac{2}{9}$ seen as 2nd probability **M1** for $\left(\frac{4}{9}\times\frac{4}{9}\right)$ or $\left(\frac{3}{9}\times\frac{3}{9}\right)$ or $\left(\frac{2}{9}\times\frac{2}{9}\right)$ **M1** for $\left(\frac{4}{9}\times\frac{4}{9}\right)+\left(\frac{3}{9}\times\frac{3}{9}\right)+\left(\frac{2}{9}\times\frac{2}{9}\right)$ **A0** for $\frac{29}{81}$ **Special cases** S.C. if **M0** scored, award **B2** for

			$\frac{29}{81}$ or $\frac{20}{81}$ or $\frac{29}{72}$ S.C. if **M0** scored award **B1** for $\frac{3}{9}$ or $\frac{2}{9}$ or $\frac{1}{9}$ **or** $\frac{3}{8}$ and $\frac{2}{8}$ and $\frac{4}{8}$ as second probability if **B2** not scored
			Total for Question: 4 marks

M4.

	Working	Answer	Mark	Additional Guidance
(a)		$\frac{3}{10}$ $\frac{6}{9}, \frac{3}{9}, \frac{7}{9}, \frac{2}{9}$	2	**B1** for $\frac{3}{10}$ correct for 1st sock **B1** for $\frac{6}{9}, \frac{3}{9}, \frac{7}{9}, \frac{2}{9}$ correct for 2nd sock
(b)	$\frac{7}{10}\times\frac{6}{9}+\frac{3}{10}\times\frac{2}{9}$	$\frac{48}{90}$	3	**M1** ft for $\frac{7}{10}\times'\frac{6}{9}'$ or $'\frac{3}{10}'\times'\frac{2}{9}'$ **M1** for $\frac{7}{10}\times'\frac{6}{9}'+'\frac{3}{10}'\times'\frac{2}{9}'$ **A1** for $\frac{48}{90}$ oe SC B2 for $\frac{58}{100}$ oe seen
				Total for Question: 5 marks

M5.

	Answer	Mark	Additional Guidance
(a)	0.2 0.4, 0.6, 0.4	2	**B1** for Martin correct **B1** for Luke correct
(b)	0.08	2	**M1** for "0.2" × "0.4" ft values from tree diagram if both < 1 **A1** cao
			Total for Question: 4 marks

M6.

Working	Answer	Mark	Additional Guidance
$\frac{5}{9}\times\frac{4}{8}+\frac{4}{9}\times\frac{5}{8}=\frac{20}{72}+\frac{20}{72}$ **OR** $1-\left[\frac{5}{9}\times\frac{4}{8}+\frac{4}{9}\times\frac{3}{8}\right]=1-\frac{32}{72}$	$\frac{40}{72}$	4	**M1** for tree diagram with at most 2 errors **or** one of $\frac{5}{9}\times\frac{4}{8}$ **or** $\frac{4}{9}\times\frac{5}{8}$ **or** $\frac{4}{9}\times\frac{3}{8}$ **or** $\frac{20}{72}$ **or** $\frac{12}{72}$ **or** $\frac{5}{18}$ **or** $\frac{3}{18}$ oe **M1** for any two of $\frac{5}{9}\times\frac{4}{8}, \frac{4}{9}\times\frac{5}{8}, \frac{4}{9}\times\frac{3}{8}$ **or** $\frac{20}{72}, \frac{20}{72}, \frac{12}{72}$ **or** $\frac{5}{18}, \frac{5}{18}, \frac{3}{18}$ oe **M1**for $\frac{5}{9}\times\frac{4}{8}+\frac{4}{9}\times\frac{5}{8}$ oe **or** $1-\left[\frac{5}{9}\times\frac{4}{8}+\frac{4}{9}\times\frac{3}{8}\right]$oe

	Total for Question: 4 marks

M7.

	Working	Answer	Mark	Additional Guidance
(a)		0.2 and 0.4, 0.4	2	**B1** for 0.2 oe on LH branch **B1** for 0.4 oe on both RH branches
(b)	0.8 × 0.6	0.48	2	**M1** for 0.8 × 0.6 oe **A1** for 0.48 oe
(c)	0.8 × 0.4 + 0.2 × 0.6	0.44	3	**M1** for 0.8 × '0.4' or '0.2' × 0.6 oe **M1** for 0.8 × '0.4' + '0.2' × 0.6 oe **A1** for 0.44 oe **OR** **M1** for '0.2' × '0.4' oe **M1** for 1 – ('0.8× 0.6' + '0.2' × '0.4') oe **A1** for 0.44 oe
				Total for Question: 7 marks

M8.

	Working	Answer	Mark	Additional Guidance
(a)		$\frac{5}{8}$	2	**B1** for $\frac{5}{8}$ correct for 1st counter **B1** for $\frac{5}{8}, \frac{3}{8}, \frac{5}{8}$ correct for 2nd counter

		$\frac{5}{8}, \frac{3}{8}, \frac{5}{8}$		
(b)	$\frac{3}{8} \times \frac{3}{8}$	$\frac{9}{64}$ oe	2	**M1** for $\frac{3}{8} \times \frac{3}{8}$ **A1** for $\frac{9}{64}$ oe
				Total for Question: 4 marks

M9.

	Working	Answer	Mark	Additional Guidance
(a)		Correct diagram	2	**B1** for 0.2 oe seen on bottom left branc **B1** for correct probabilities on other branches
(b)	prob(*WW*) = 0.5 × 0.5	0.25	2	**M1** for 0.5 × '0.5' **A1ft** for 0.25 oe
				Total for Question: 4 marks

M10.

Working	Answer	Mark	Additional Guidance

$\frac{4}{10} \times \frac{6}{9} \times \frac{5}{8} = \frac{120}{720}$ $\frac{120}{720} + \frac{6}{10} \times \frac{5}{9} \times \frac{4}{8} + \frac{6}{10} \times \frac{4}{9} \times \frac{5}{8}$	$\frac{360}{720}$	4	

Total for Question: 4 marks

E1. A considerable number of candidates were able to score full marks on this question.

Most candidates were able to score at least 1 mark in part (a). Common incorrect answers here include reversing the positions of 1/10 and 9/10 on the bottom right hand branches of the tree diagram, and giving both pairs of branches on the right hand side of the tree diagram as the same fractions (usually 7/10 and 3/10).

In part (c), the many candidates were able to write down 1/5 × 7/10 for one of the ways that Nicola could be late, but neglected to consider the other way (i.e. 4/5 × 1/10). Other common errors were based on a confusion in the required processes, e.g. (1/5 × 7/10) + (4/5 × 1/10); or in a misunderstanding of how to interpret a tree diagram, e.g. 7/10 × 1/10. Examiners reported a general weakness in the candidates' ability to deal with fractions.

E2. There were some excellent answers to this question in which a correctly drawn probability tree was constructed carrying the correct probabilities on each branch. The six required probability products were then identified leading to the final probability of 67/100. Over 20% of the candidates got this question fully correct with a further 6% only making one slip. The alternative methods being used in an attempt to arrive at the final answer did, however, seemed to be less successful. An abundance of fractions in the subsequent working very often left the student wondering how to combine them together into one single probability. There was some evidence of non-replacement seen thus making the question much more difficult than it need have been.

The fractions manipulation within the working is clearly an area of weakness as some found difficulty in combining fractions together. For example 5/10 × 7/10 ended up as 35/20, 12/100, and any other combination of the four numbers. Cancelling the fractions down before multiplying 5/10 × 7/10 = ½ × 7/10 = 7/20 was fine but then presented a problem when they had to add together fractions with different denominators. As a general rule it would be easier to achieve the final result if the fractions are not cancelled down. 60% of the candidates failed to score any marks on this question. Many had little idea what to do, though realising it involved the fractions 1/10; 2/10; 7/10 etc, then writing down some simple combination of these fractions, including multiplying 3 together, adding or taking away. Others had a separate tree diagram for each spinner, showing one or two throws but were then not sure what to do with their answers. Candidates using decimal notation also demonstrated correct tree diagrams but many had difficulty multiplying e.g. 0.2 × 0.2 correctly (the usual answer being 0.4).

E3. This was a fairly standard, but non-trivial, probability question. Many successful candidates drew correct probability tree diagrams and used them properly. 21% of candidates knew that they had to multiply the probabilities together as they worked along a set of branches starting with the root and a further 36% of candidates knew they had to be to add the resulting 3 fractions to get the right answer. However, there were a large number of errors due to inability to tackle the arithmetic of fractions correctly. These were of the following general types:

- carelessness, exemplified by one of $\frac{3}{9}\times\frac{2}{8}=\frac{5}{72}$ or $\frac{2}{9}\times\frac{1}{8}=\frac{3}{72}$
- confusion over multiplication, exemplified by all of $\frac{4}{9}\times\frac{3}{8}=\frac{7}{72}$, $\frac{3}{9}\times\frac{2}{8}=\frac{5}{72}$ and $\frac{2}{9}\times\frac{1}{8}=\frac{3}{72}$
- confusion over multiplication as exemplified by $\frac{3}{9}\times\frac{2}{8}=\frac{42}{72}$ or $\frac{3}{9}\times\frac{2}{8}=\frac{432}{72}$
- confusion over addition as exemplified by $\frac{6}{72}+\frac{2}{72}+\frac{12}{72}=\frac{20}{216}$

Many candidates made life harder for themselves by calculating the correct fractions for the cases OO, AA and TT, cancelling them and then making an error on the addition of the three fractions with different denominators.

Some candidates treated the problem as one of replacement and were rewarded as they had essentially the correct method.

Some candidates thought the total of bottles was 8 or 10 rather than 9 and ended up with a fraction over 56 or 90 and there were also some candidates who tried to drink 3 bottles or convert to decimals.

Other candidates gave fractions such as probability (2nd is O) = $\frac{2}{9}$ rather than $\frac{2}{8}$.

Some candidates drew out the whole equally likely sample space for the case with replacement and obtained the answer $\frac{29}{81}$

There were, of course many candidates who tried to draw a probability tree but could not get its structure correct (generally they did not have 3 branches from every node) and many others who could not get as far as that.

It was pleasing however to see that fully correct solutions were given in 30% of cases though 44% of candidates scored no marks.

##

This question proved to be a good discriminator. Nearly all candidates gained at least one mark for putting 3/10 on the first stage of the tree diagram in part (a). They then attempted to complete the diagram but a much smaller proportion of candidates realised the non replacement nature of this question and it was common to see the 7/10 and 3/10 repeated for the 2nd sock. There were many credit worthy attempts to part (b) of the question with a large proportion of candidates correctly discriminating when to use the multiplication and/or addition of probabilities. However, the multiplication and/or addition of fractions was often not carried out accurately, even though the use of a calculator was permissible. This is reflected in the award of marks. The majority of candidates gained at least one mark for their attempt at part (b).

##

The first part was generally correct, although it was not uncommon for candidates to put different probabilities on Luke's second branch. The most common wrong ones were 0.8 and 0.2 or 0.4 and 0.6 reversed.

In (b) a lot of candidates with a fully correct tree diagram could follow through correctly. However, it was common to see 0.2 × 0.4 = 0.8 even though candidates did have access to a calculator. The main error seen was adding 0.2 and 0.4 resulting in 0.6, this was seen very frequently.

E7. Part (a) was done well by the vast majority of the candidates. In part (b), many candidates knew that they needed to multiply the probabilities but a significant number of these were unable to do the calculation accurately, e.g. 0.8 × 0.6 = 4.8 or 0.42. Common incorrect methods were 0.8 + 0.6 = 1.4 and $\frac{0.8 + 0.6}{2} = 0.7$. In part (c), only the best candidates were able to score full marks for this question, but many were able to score 1 mark for either 0.8 × 0.4 or 0.2 × 0.6. Common errors here were similar to those in part (b), e.g. those involving poor arithmetic, e.g. 0.8 × 0.4 = 3.2, 0.24 or 2.4, or those involving confusion as to when to multiply the probabilities or when to add the probabilities, e.g. (0.8 + 0.4) × (0.2 + 0.6).

E8. Accurate completion of the probability tree diagram was good with most candidates scoring at least one mark. In part (b) however a great many candidates added the probabilities instead of multiplying. It is also of note that of the candidates who correctly quoted 3/8 × 3/8 a significant number failed to correctly work out this product; 9/16 being a common error.

E9. Very few candidates failed to score any marks at all in this question.

Part (a) was answered very well with most candidates completing the probability tree diagram correctly. Errors usually occurred on the right hand branches where some candidates put the values 0.5, 0.3 and 0.2 in the wrong order and some inserted the results of multiplying two probabilities together. A significant number of candidates were not aware that they needed to multiply the probabilities on the relevant branches in part (b) and many added 0.5 to 0.5 instead. Even when candidates did write down 0.5 × 0.5 this was sometimes evaluated incorrectly with answers of 0.5, 1 and even 2.5 seen quite frequently. Some candidates with incorrect answers lost the opportunity of gaining a method mark here because they did not show any working.