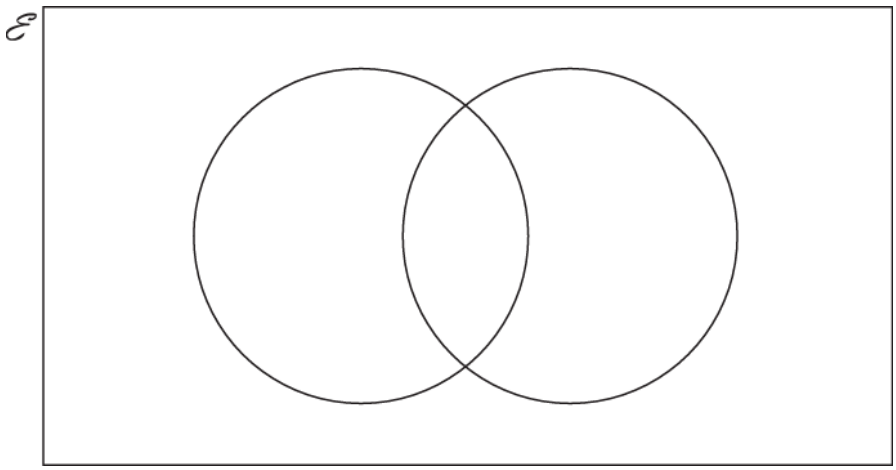
1(a). A skills test has two sections, literacy (L) and numeracy (N).

One day everyone who took the skills test passed at least one section.

88% passed the literacy section and 76% passed the numeracy section.

Represent this information on a Venn diagram.

Show clearly the **percentage** in each section of the diagram.



[3]

(b). One person is chosen at random from all the people who took the skills test that day.

What is the probability that this person

(i) passed the numeracy section, given that they passed the literacy section,

_____ **[2]**

(ii) passed the literacy section, given that they passed only one section?

_____ **[2]**

2. Lola collects 60 apples from the trees in her garden.
The masses of the apples are summarised in the table.

Mass (m grams)	Frequency
$80 < m \leqslant 100$	8
$100 < m \leqslant 110$	15
$110 < m \leqslant 120$	21
$120 < m \leqslant 130$	10
$130 < m \leqslant 150$	6

Lola takes two of these apples at random.

Find the probability that they both have a mass greater than 130 g.

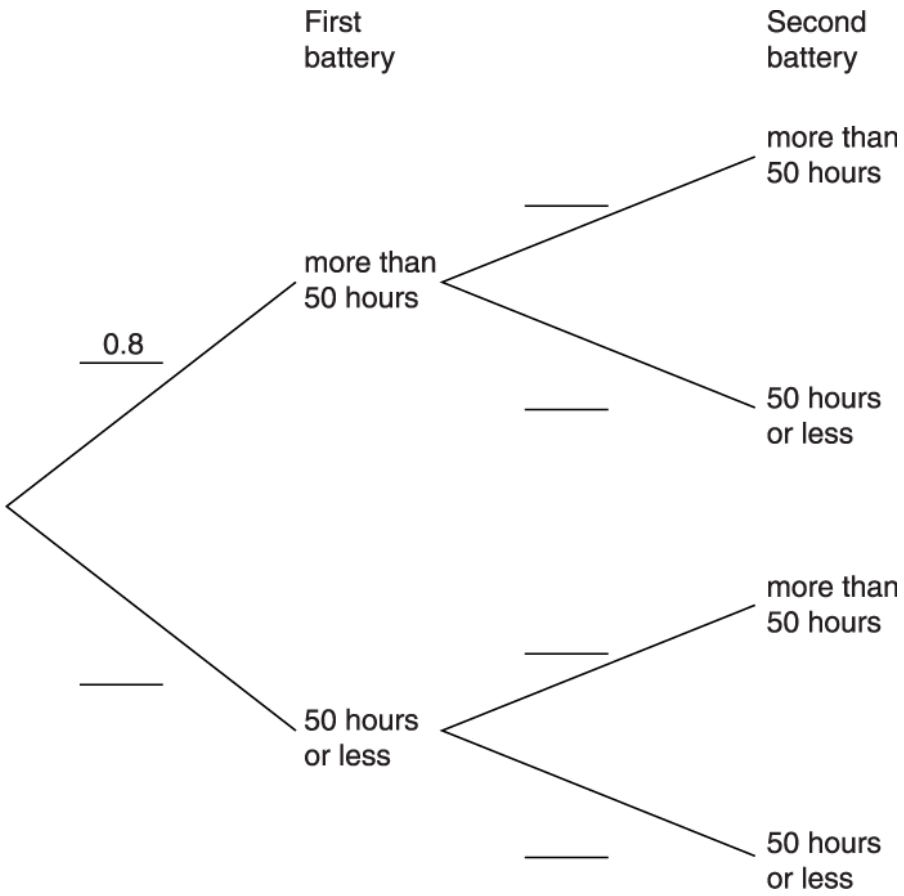
---

[3]

3(a). The probability that an *Everbright* battery works for more than 50 hours is 0.8.
A torch needs two working *Everbright* batteries to operate.

Two new *Everbright* batteries are put into the torch.

Complete the tree diagram for the life of these two batteries.



[2]

(b). Calculate the probability that the torch will **not** work for more than 50 hours.

[3]

4. Mrs Spencer goes to town by car, bus or taxi.

The probability she goes to town by car is 0.67.

The probability she goes to town by bus is 0.28.

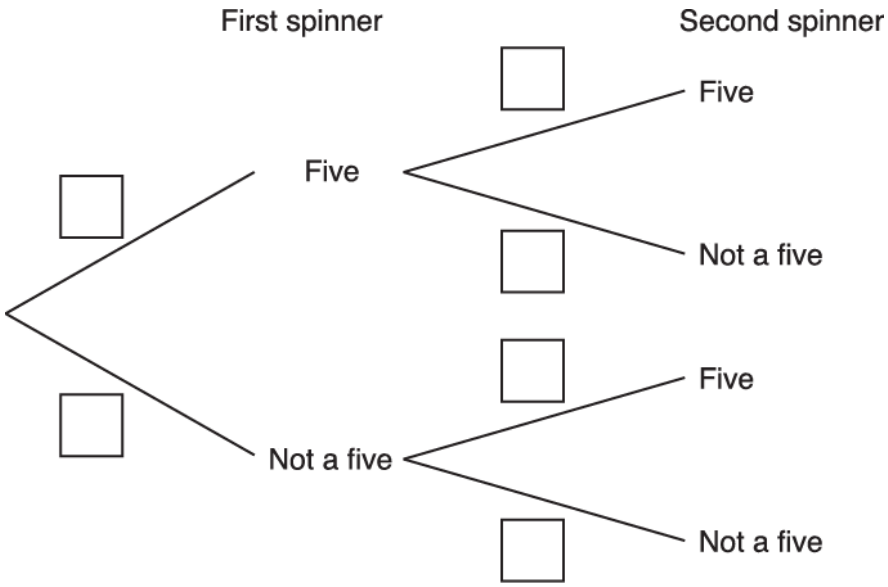
Calculate the probability that Mrs Spencer goes to town by taxi.

_____ **[2]**

5(a). Ahmed is playing a game with two unbiased five-sided spinners, each numbered 1 to 5.

He spins the two spinners.

Complete the tree diagram.



[3]

(b). Ahmed needs **exactly one** of the two spinners to show 5 to win the game.

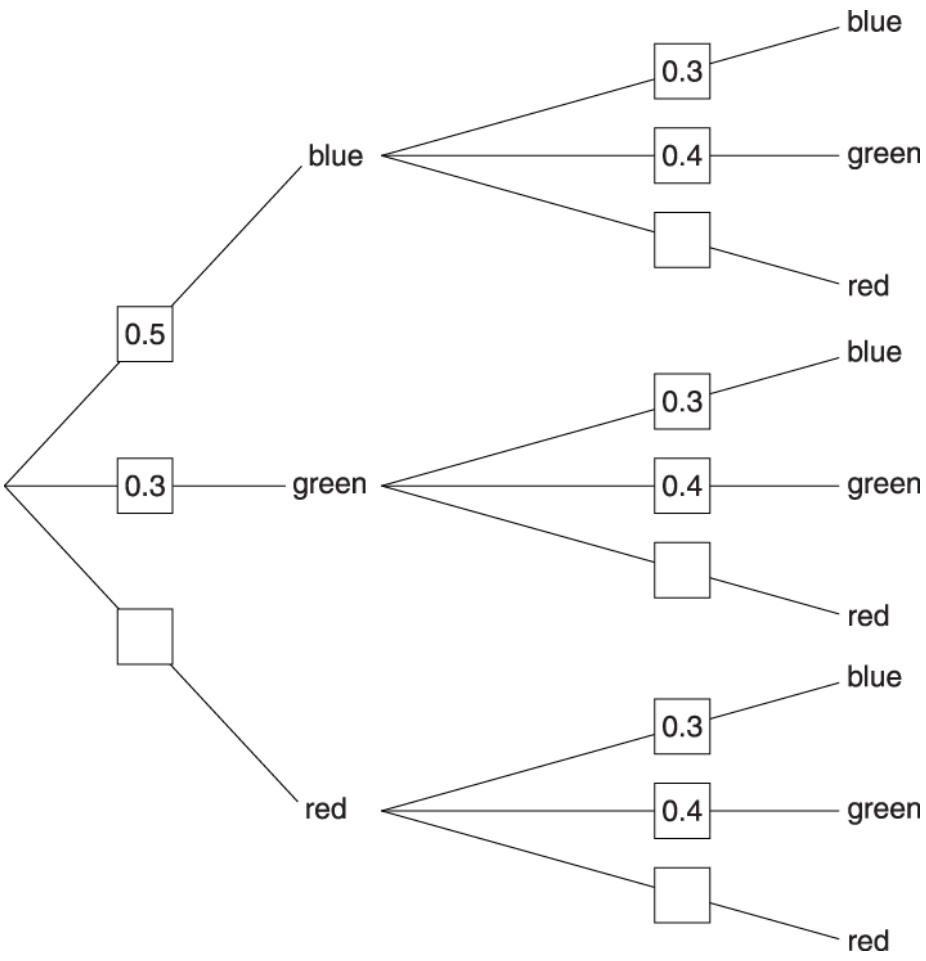
Calculate the probability that Ahmed wins the game.

_____ **[3]**

6(a). Jim and Fran each have a bag containing different numbers of blue, green and red counters only.
Jim chooses a counter at random from his bag and then Fran chooses a counter at random from her bag.
The probabilities of randomly choosing blue and green counters are shown in the tree diagram.

Complete the tree diagram.

Jim's choice Fran's choice



[2]

(b). Calculate the probability that one of the counters chosen is blue and the other is green.

_____ [3]

(c). Calculate the probability that the two counters chosen are **the same colour**.

_____ [3]

7. A box contains 8 milk chocolates, 6 dark chocolates and 2 white chocolates.
Varun takes a chocolate from the box at random and eats it.
He then takes another chocolate at random and eats it.

Find the probability that Varun eats at least one dark chocolate.

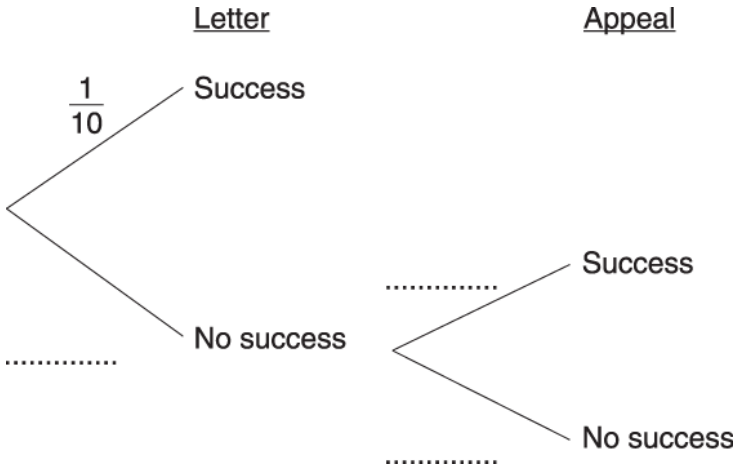
_____ **[4]**

8(a). Terry applies for funding to set up a community skatepark.
He writes a letter of application.

The probability of this being successful is $\frac{1}{10}$.

If his letter is unsuccessful, he can appeal. The probability of success at the appeal is $\frac{1}{3}$.

Complete the tree diagram.



[2]

(b). Work out the probability that he is successful in getting funding.

_____ [3]

9(a). A pottery factory makes teapots.

Each teapot has to go through two stages of quality testing.

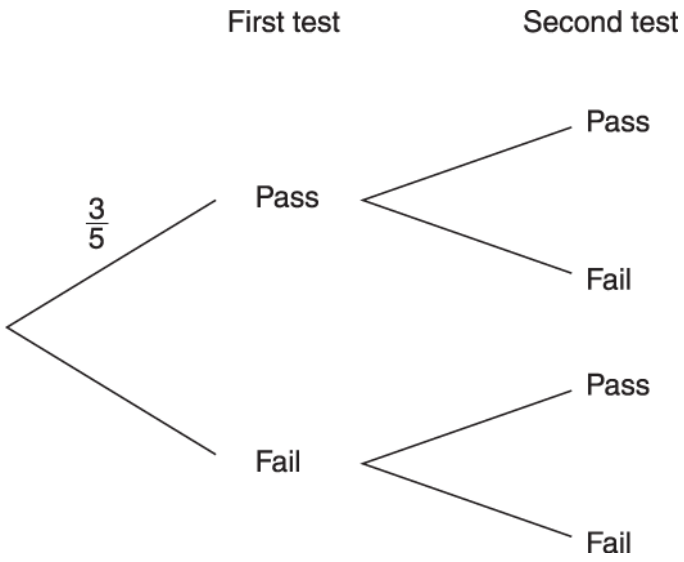
If it passes **both tests** it is called 'perfect' otherwise it is called 'faulty'.

The probability that any teapot will pass the first test is $\frac{3}{5}$.

If it passes the first test the probability that it passes the second test is $\frac{3}{4}$.

If it fails the first test the probability that it passes the second test is $\frac{1}{3}$.

Complete the tree diagram below.



[2]

(b). Work out the probability that a teapot will be called 'faulty'.

_____ [3]

10. Samuel has six types of coin in a bag.

The table shows the probability of each type of coin being picked.

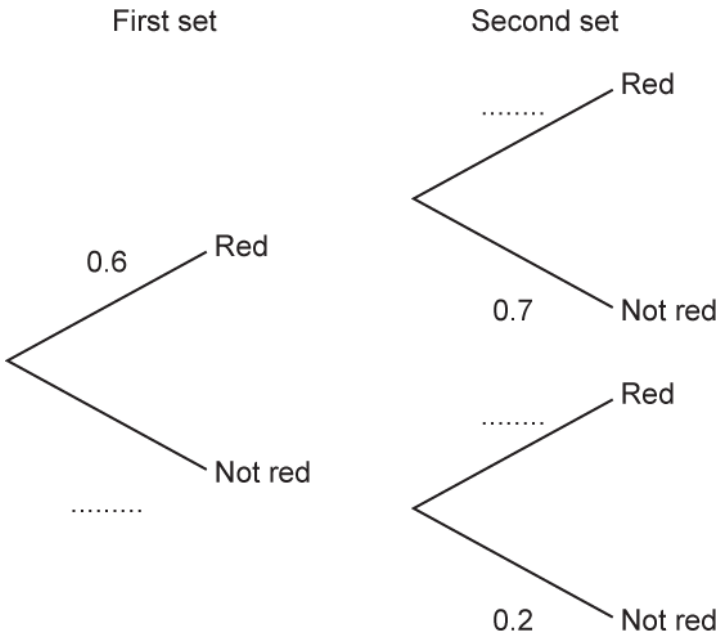
Coin	1p	2p	5p	10p	20p	50p
Probability	0.07	0.23	0.18	0.28	0.19	*x*

Work out *x*.

_____ [2]

11(a) Rashid drives his car along a road passing through two sets of traffic lights.

. The tree diagram shows the probabilities of the lights being **red** when he reaches them.



Complete the tree diagram. **[1]**

(b). Write down the probability that the first set is **not red**.

_____ **[1]**

(c). Given that the first set is **red**, write down the probability that the second set is **not red**.

_____ **[1]**

12. John has

- 8 different shirts
- 6 different hats
- 4 different scarves.

John thinks that if he picks **just two** of the three items of clothing there will be more than 192 combinations.

Is he correct?
Show your reasoning.

[3]

13. In a group of 120 adults, 85 watch football, 78 play a sport and 20 do neither.

Find the probability that an adult chosen at random from those who watch football does not play a sport.

_____ [5]

14(a) Diners choose one starter and one main from the options given in the table below.

. Vegetarian dishes are indicated with a (v).

Starter	Main
Cheese salad (v)	Steak and chips
Prawn cocktail	Fish and chips
Mozzarella sticks (v)	Tomato pizza (v)
	Pork chops
	Nut cutlet (v)

Work out the fraction of all the meal combinations which have at least one vegetarian option.

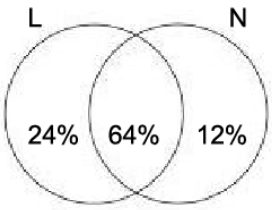
---------- [3]

(b). Diners also choose one of 6 dessert options.

How many different three-course meal combinations are available?

---------- [3]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Part marks and guidance	
1	a			3	**B1** for 24% in L and **B1** for 12% in N and **M1** for 100 – (*their* '12' + *their* '24') in overlap	Condone universal set missing
	b	i	$\frac{64}{88}$ **oe**	2	**M1** for 64 or 88	**FT** *their* Venn diagram
		ii	$\frac{24}{36}$ **oe**	2	**M1** for 24 or 36	**FT** *their* Venn diagram
			Total	7		
2			$\frac{1}{118}$ oe	3	**M2** for $\frac{6}{60} \times \frac{5}{59}$ oe OR **M1** for $\frac{6}{60}$ oe seen or $\frac{5}{59}$ seen	3 marks for $\frac{30}{3540}$ or equivalent, ISW incorrect cancellation Examiner's Comments It was common for candidates to gain 1 mark for finding the probability that the first apple had a mass greater than 130 g was $\frac{6}{60}$. It was rare to see the candidates attempting the product of two probabilities and even rarer to see candidates appreciate that there was no replacement. Only the very best candidates reached the correct solution. Some candidates attempted to draw a tree diagram, which sometimes led to a correct calculation, but in general most did not know how to access this unstructured probability question.

Question			Answer/Indicative content	Marks	Part marks and guidance
			Total	3	

Question			Answer/Indicative content	Marks	Part marks and guidance	
3	a		0.2 and 0.8 correctly placed throughout	2	**B1** for 0.2 correctly placed once **Examiner's Comments** This was usually fully correct.	
	b		0.36 oe	3	**M2** for 1 – (0.8 × 0.8) oe or for (0.8 × 0.2) + (0.2 × 0.8) + (0.2 × 0.2) oe soi Or **M1** for 0.8 × 0.2 or 0.2 × 0.8 or 0.2 × 0.2 oe soi **Examiner's Comments** All but the weakest candidates knew to multiply the individual probabilities. Good candidates scored full marks. Many others misunderstood the question. They overlooked that both batteries needed to work for the torch to work. Consequently, an answer of 0.04 appeared just as often as the correct one.	FT *their* tree for **M2** or **M1** May be on diagram
			Total	**5**		
4			0.05 oe	2	**M1** for 1 – (0.67 + 0.28) **Examiner's Comments** Very few failed to obtain the correct answer. The only error was giving 1 - 0.95 as 0.5 instead of 0.05.	
			Total	**2**		

Question			Answer/Indicative content	Marks	Part marks and guidance	
5	a		1/5 and 4/5 oe placed correctly throughout	3	**B1** for 1/5 oe placed correctly once **And B1** for 4/5 oe placed correctly once	
	b		$\frac{8}{25}$ or 0.32 or 32%	3	**M2** for $\frac{1}{5}\times\frac{4}{5}+\frac{4}{5}\times\frac{1}{5}$ oe Or **M1** for $\frac{1}{5}\times\frac{4}{5}$ oe **Or SC2** for answer of $\frac{9}{20}$ oe **Examiner's Comments** The vast majority of candidates completed the tree diagram successfully using either fractions or decimals. There were far fewer problems than in past years when combining probabilities. In general, candidates knew when to multiply and when to add. Many gave the correct answer, though some assumed that the acceptable result included the case in which both spinners showed '5'. There were also those who thought that only one combination was needed.	**FT** M2 or M1 for *their* probabilities
			Total	6		

Question			Answer/Indicative content	Marks	Part marks and guidance	
6	a		0.2 placed correctly 0.3 placed correctly three times	1 1	**Examiner's Comments** The tree diagram was invariably completed correctly.	
	b		0.29 oe	3	*In (a) and (b) -1 once for poor notation* **M2** for 0.5 × 0.4 + 0.3 × 0.3 oe Or **M1** for 0.5 × 0.4 or 0.3 × 0.3 oe **Examiner's Comments** Although there were a lot of correct answers, some only found the blue/green combination and overlooked that the green/blue combination also satisfied the question. The rules for combining probabilities are well known. However, there were those who added instead of multiplying and vice-versa.	Eg 0.29/1 etc With no extra Seen separately
	c		0.33 oe nfww	3	**M2** for 0.5 × 0.3 + 0.3 × 0.4 + *their0.2 × their0.3* oe Or **M1** for 0.5 × 0.3 or 0.3 × 0.4 or *their0.2 × their0.3* oe **Examiner's Comments** This was answered well. It was obvious to candidates that three products were required.	With no extra Seen separately
			Total	8		

Question			Answer/Indicative content	Marks	Part marks and guidance	
7			$\frac{5}{8}$ oe	4	**M3** for sum of at least four of required probabilities seen: DD, DM, MD, DW and WD Or for P(D) + P(MD) + P(WD) Or for 1 - P(no dark) OR **M2** for P(no dark) = $\frac{10}{16} \times \frac{9}{15}$ or $\frac{3}{8}$ Or for correct tree diagram showing probabilities on sufficient branches Or for at least two of the five required probabilities found OR **M1** for at least one correct combined probability seen Or for three correct probabilities for first chocolate seen: M = $\frac{8}{16}$, D = $\frac{6}{16}$ and W = $\frac{2}{16}$ Or for identifying the five required pairs of outcomes: DD, DM, MD, DW and WD OR **SC2** for answer $\frac{27}{28}$ or $\frac{39}{64}$ Or **SC1** for correct tree diagram assuming just 6 dark, 2 white chocolates or correct tree diagram	allow all method marks if correct multiplication seen, even if not evaluated or incorrectly evaluated P(MM) = $\frac{8}{16} \times \frac{7}{15} = \frac{7}{30}$ P(MD) = $\frac{8}{16} \times \frac{6}{15} = \frac{1}{5}$ P(MW) = $\frac{8}{16} \times \frac{2}{15} = \frac{1}{15}$ P(DM) = $\frac{6}{16} \times \frac{8}{15} = \frac{1}{5}$ P(DD) = $\frac{6}{16} \times \frac{5}{15} = \frac{1}{8}$ P(DW) = $\frac{6}{16} \times \frac{2}{15} = \frac{1}{20}$ P(WM) = $\frac{2}{16} \times \frac{8}{15} = \frac{1}{15}$ P(WD) = $\frac{2}{16} \times \frac{6}{15} = \frac{1}{20}$ P(WW) = $\frac{2}{16} \times \frac{1}{15} = \frac{1}{120}$ allow equivalent marks throughout for methods using dark/not dark

Question			Answer/Indicative content	Marks	Part marks and guidance	
					assuming replacement Examiner's Comments This was a challenging probability question that required a clear and accurate thought process or a good tree diagram. Most candidates could identify the three starting probabilities P(D), P(M) and P(W), but very few identified the easier option of starting with P(D) and P(not D). Tree diagrams, when drawn, were usually quite good with the first branches showing the correct probabilities, and often the second branches also showing correct probabilities. Some candidates failed to appreciate that there was no replacement, so used denominators of 16 throughout. Having drawn a tree diagram, work on identifying and calculating the required probabilities was often poor. All five required outcomes were seldom seen, usually at least P(DD) was omitted and sometimes it was not recognised that both P(MD) and P(DM), say, were required. When candidates attempted to calculate the probabilities, those that attempted to multiply often made calculation errors due to the large numbers being multiplied as few attempted simplifying by cancelling first.	
			Total	4		

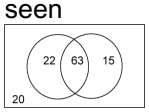
Question			Answer/Indicative content	Marks	Part marks and guidance	
8	a		$\frac{9}{10}$, $\frac{1}{3}$ and $\frac{2}{3}$ on the correct branches	2	M1 for either $\frac{9}{10}$, $\frac{1}{3}$ and $\frac{2}{3}$ on the correct branches	ignore any extra
	b		$\frac{2}{5}$ or $\frac{12}{30}$ oe isw	3	equivalents include decimals, fractions and percentages M2 for $\frac{1}{10}+\frac{9}{10}\times\frac{1}{3}$ FT their tree diagram or M1 for use of one correct branch ie $\frac{1}{10}$ or *their* $\frac{9}{10}\times\frac{1}{3}=\frac{9}{30}$ oe Examiner's Comments Most candidates correctly completed the tree diagram in (a) although some drew a pair of branches after 'success' in the letter column. The most common approach in (b) was to add 1/10 and 1/3 together. Again there was plenty of evidence to show that many were uncomfortable with multiplying and adding fractions. However very few candidates attempted to change the fractions to decimals.	Percentages must have % May be seen on diagram to count it has to be part of their answer eg $\frac{1}{10}$ [+…] for M1
			Total	5		

Question			Answer/Indicative content	Marks	Part marks and guidance	
9	a		$\frac{2}{5}$ on first branch and $\frac{3}{4}$ and $\frac{1}{4}$ on second test top branches and $\frac{1}{3}$ and $\frac{2}{3}$ on second test bottom branches	2	B1 for either $\frac{2}{5}$ on first branch or two of the four probabilities on the second test correct Examiner's Comments Most candidates completed this correctly, a few did repeat ¾ and ¼ (or ⅓ and ⅔) in both parts.	Accept % or decimals correct to at least 2 sf
	b		$\frac{11}{20}$oe or [0].55 or 55%	3	M2FT for 1 - $\frac{3}{5} \times \frac{3}{4}$ oe or M1FT for all three branches selected, or one branch correctly calculated isw incorrect simplification FT *their tree diagram* providing the probabilities are positive and < 1 Examiner's Comments Many did not know which branches to consider, and then they usually added all the fractions. The more successful ones wrote the products on the tree diagram and it was easier to keep the numbers as fractions rather than try to convert them into decimals. As three branches form the solution it was surprising that very few used the method 1 – P(pass+pass) which would have been much easier to work out.	e.g $\frac{3}{5} \times \frac{1}{4} + \frac{2}{5}$ or $\frac{3}{5} \times \frac{1}{4} + \frac{2}{5} \times \frac{1}{3} + \frac{2}{5} \times \frac{2}{3}$ scores M2 check their tree diagram
			Total	5		

Question			Answer/Indicative content	Marks	Part marks and guidance	
10			0.05 , 5% or $\frac{1}{20}$ **oe**	2	**M1** for 1 – (0.07 + 0.23 + 0.18 + 0.28 + 0.19) **oe** Examiner's Comments The common problem was still 1 – 0.95 = 0.5, despite candidates having a calculator available for them to use.	**isw** attempt to simplify accept $\frac{0.05}{1}$
			Total	2		

Question			Answer/Indicative content	Marks	Part marks and guidance		
11	a		[0].4, [0].3 and [0].8 oe in the correct places	1		Accept equivalent fractions or percentages with % sign in each part and **FT their tree diagram only if (a) scores 0 marks**	
	b		[0].4 or $\frac{2}{5}$ oe	1	FT *their* tree diagram	accept 40%: condone $\frac{4}{1}$, penalise wrong form once eg 4 : 10, 4 in 10	
					Examiner's Comments Most gave the correct answers in (a) and in (b).		
	c		[0].7 or $\frac{7}{10}$ oe	1		accept 70%	
					Examiner's Comments A conditional probability was required in this part, but many gave the probability of 'red' with 'not red' and worked out 0.6 × 0.7 to give 0.42 as the answer rather than 0.7.		
			Total	3			

Question			Answer/Indicative content	Marks	Part marks and guidance	
12			No and shows 104	3	**M2** for (8 × 6) + (8 × 4) + (6 × 4) oe Or **M1** for any correct product seen oe isw	M1 implied by 48 or 24 or 32 seen
					Examiner's Comments In part (b) there were fully correct answers, although many candidates thought there were only 48 or 24 or 32 possible combinations and did not realise that the total number of combinations was the sum of these products.	
			Total	3		

Question			Answer/Indicative content	Marks	Part marks and guidance		
13			$\frac{22}{85}$oe	5	isw conversion to other forms **M1** for (85 +78 +20) – 120 oe soi Or for 120 – 20 – 78 oe **B2FT** for correctly completed diagram with 85 – *x*, *x [their 63],* 78 – *x,* 20 correctly placed FT *their x* (can be algebraic or *x* is an integer $0 < x < 78$) Or **B1FT** for attempt at Venn diagram with 85 – *x* or 78 – *x* or 20 correctly placed FT *their x* (can be algebraic or *x* is an integer $0 < x < 78$) **B1** for $\frac{n}{85}$ or $\frac{22}{n}$	For 5 marks accept 0.2588.. or 0.259 or 25.88…% to 25.9% M1 implied by 63 or 22 seen  For B1, condone omission of rectangal for universal set	

Question			Answer/Indicative content	Marks	Part marks and guidance		
					(both proper fractions) seen		
					Examiner's Comments There was a mixed response to this question, with more able candidates often scoring all 5 marks. Most candidates gained some credit, but it was often only 1 or 2 marks out of the 5 available. Candidates who did not recognise that a Venn diagram would be a good method to use to obtain the values needed made little progress. Many obtained the value 22 as a starting point however. A common error when drawing the Venn diagram was to omit a key value or not to consider the universal set. A few candidates having shown appropriate working did not appreciate the conditional element to the probability and gave responses such as $\frac{22}{120}$.		
			Total	5			

Question			Answer/Indicative content	Marks	Part marks and guidance		
14	a		$\frac{12}{15}$ oe	3	M1 for 15 [options] or indicating 15 M1 for 12 or indicating 12	this could be the product rule, table, listing or implied by answer o $\frac{n}{15}$ o $\frac{12}{m}$ f r	
					Examiner's Comments In part (a) candidates needed to work out 15 options first which many did not do. Too many added so they thought that there were 8 options.		
	b		90	2FT	FT *their*(a) for 2 marks M1 for *their*(3 × 5) × 6	ie *their* total number of options × 6	
					Examiner's Comments However part (b) was answered better as many realised they multiplied the three numbers together.		
			Total	5			