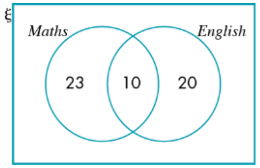
Guidance on the use of codes for this mark scheme	
M	Method mark
A	Accuracy mark
B	Mark awarded independent of method
cao	Correct answer only
oe	Or equivalent
ft	Follow through

Question	Working	Answer	Mark	AO	Notes	Grade
1 a		e.g. There is a 0% chance of rolling a seven on a one to six fair die. It is impossible.	B1	2	B1 for correct example	B
b		There is a 99% chance that …	B1		B1 for correct example	
c		There is a 75% chance that …	B1		B1 for correct example	
d		There is a 50% chance that I will throw a head on a fair heads/tails coin. It is certain that I will throw one or the other.	B1		B1 for correct example	
			4			
2		Example of a situation with equally likely outcomes with probability of $\frac{1}{3}$, with justification. E.g. I have three counters in a bag. One red, one green and one blue. Each has the same chance of being drawn from the bag at random. There are three mutually exclusive outcomes. Each has the probability of $\frac{1}{3}$ of being drawn.	B1 B1	2	B1 for correct example B1 for justification using example	B
			2			
3		8 out of 10 3 out of 10	B1 B1	2	B1 for words equivalent to 80% oe B1 for words equivalent to 0.3 oe	B
			2			
4		No The theoretical probability is predictive not exact. 10 is a limited number of experiments and will only sometimes produce five heads	B1 B1	2 3	B1 for No. B1 for good explanation	B
			1			

5		Examples of any situation with equally likely outcomes of: 0.5, $\frac{1}{5}$, 0.6, 25% with justification. E.g. The probability of throwing a head on a fair heads/tails coin is 0.5 (because there are two equally likely outcomes) A fair, five sided spinner has four green sections and one yellow section (all equally likely). The probability of landing on a yellow section is $\frac{1}{5}$. If the probability of passing a driving test first time is 0.6, then the probability of not passing is 0.4 In a standard pack of 52 playing cards, the probability of drawing a diamond is 25%, since 25% of the cards are diamonds.	B4 **4**	2	B1 for each correct example	B
6		The outcomes are not necessarily equally likely, e.g. the skill and the form of the teams, home or away is often very different, for example Chelsea playing Carlisle at home is most likely to be a home win, with an away win very unlikely.	B1 **1**	2 3	B1 for clear explanation	B
7		A valid example of two mutually exclusive events. e.g. Mutually exclusive events cannot happen at the same time, for example, the probability of passing a test and failing a test.	B1 **1**	2	B1 for correct example	B

8 a		False. Experiments have other outside factors which can affect results.	B1	2	B1 for each correct response with appropriate justification	B
b		True A large number of trials means that external factors have less impact on the trials as a whole.	B1			
c		False. It finds an approximation to true probability. As the number of trials increases relative frequency approaches get closer to the true probability.	B1 **3**			
9		The 10 000 computer spins is more likely because the greater number of trials, the closer the approximation to true probability, which is 0.5 for each outcome.	B1 **1**	2 3	B1 for correct reasoning Demonstrate an understanding that increasing the number of times an experiment is repeated generally leads to better estimates of probability	B
10		Two independent events with justification. For example: drawing a red counter from a bag of red and yellow counters; drawing a red card from a pack of playing cards. This is because neither event can influence the outcome of the other.	M1 A1 **2**	2	M1 for two independent events A1 for correct reasoning	M
11		An example of equally likely outcomes with an explanation. E.g. Rolling any one of 1, 2, 3, 4, 5 or 6 on a standard 1–6 unbiased die or throwing a head or a tail with a fair coin. In both cases, all outcomes have the same chance of occurring ($\frac{1}{6}$ for the first example and $\frac{1}{2}$ for the second).	M1 A1 **2**	2	M1 for two equally likely outcomes A1 for correct reasoning	M

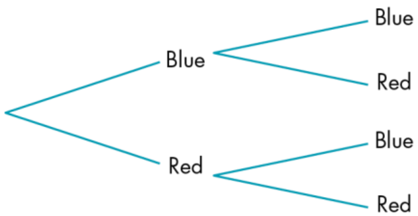
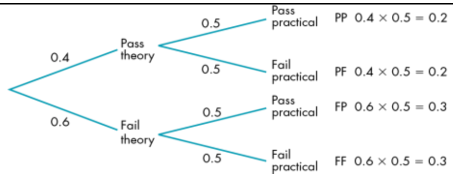
12		An example of an event for which the probability can only be calculated through an experiment with an explanation. E.g. An event where the likelihood of it occurring is not known, such as a sports tournament or a horse race.	M1 A1 2	2	M1 for appropriate example A1 for correct reasoning	
13	There are 7 parts in jar B so if there are 3 times as many parts in jar A there will be 21 parts split in the ratio 1 : 2. 21 ÷ 3 = 7 So the ratio of the combined jar is R : G : R : O = 7 : 14 : 3 : 4 Or R : G : O 10 : 14 : 4 So P(O) = $\frac{4}{28} = \frac{1}{7}$	P(O) = $\frac{1}{7}$	B1 M1 A1 **3**	3	B1 for accurate set up of ratios M1 for calculation of (their) probability as a fraction (ft) A1 cao	M
14	P(D) = 0.3 P(M) = $\frac{1}{5}$ = 0.2 P(B) = 45% = 0.45 P(K) = 1 – (0.3 + 0.2 + 0.45) = 1 – 0.95 = 0.05	P(Kevin winning) = 0.05 or 5%	B1 M1 A1 **3**	3	B1 for correct identification of probabilities as decimals oe M1 for calculation of probability of Kevin winning using 1– (P(D) + P(M)+P(B)) oe (ft) A1 cao	M
15	Prime numbers between 0 and 36 are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31 P(prime) = $\frac{11}{37}$ After 100 plays, expected value is 100 × $\frac{11}{37}$ = 29.729… So I expect to win 30 times	30 wins expected	B1 M1 M1 A1 **4**	3	B1 for correct identification of all prime numbers between 0 and 36 M1 for calculation of expected value M1 for appropriate rounding A1 cao	M

16		She should multiply the number of students (n) she has by the probability of being left-handed (0.14). The number of left-handed students will be $0.14n$.	B1 **1**	2	B1 for correct description of process	M
17	 P(E only) + P(E∩M) + P(M only) = 1 $P(E\cap M) = \frac{10}{53}$ $P(\text{E only}) = \frac{30}{53} - \frac{10}{53} = \frac{20}{53}$ Therefore P(M) = 1 – P(E only) $1 - \frac{20}{53} = \frac{33}{53}$	$P(\text{Maths}) = \frac{33}{53}$	B1 M1 M1 A1 **4**	3	B1 for accuracy and use of Venn oe M1 for use of all probabilities sum to 1 oe M1 for calculation of fraction oe A1 cao	M
18		The frequency is approximately the same for each region of the spinner, suggesting that the spinner is likely to be fair. There are no obvious anomalous results to indicate bias. So there is no strong evidence to suggest it is not fair.	B1 **1**	2	M1 for explanation	H
19	Joy wins: 0.65 × 52 = 33.8 which is approximately 34 wins Vicky won 10 times Joy + Vicky = 44 wins Max = 52-44 = 8 wins	Max can expect to win 8 times.	M1 A1 **2**	2 3	M1 for multiplication to find the number of Vicky's wins A1 cao	H

20 a		Anna, Ben Anna, Chloe Anna, Clara Anna, Ciaran Anna, Daniel Ben, Chloe Ben, Clara Ben, Ciaran Ben, Daniel Chloe, Clara Chloe, Ciaran Chloe, Daniel Clara, Ciaran Clara, Daniel Ciaran, Daniel	M1	3	M1 for being methodical	H
b i	P(Anna, Chloe)+ P(Anna, Clara) + P(Chloe, Clara)	$= \frac{3}{15} = \frac{1}{5}$	M1 A1		M1 for addition of fractions B1 for simplification.	
ii	P(Ben ,Ciaran) + P(Ben, Daniel) + P(Ciaran, Daniel)	$= \frac{3}{15} = \frac{1}{5}$	M1		M1 for addition of fractions	
iii	P(Chloe, Clara) + P(Chloe, Ciaran) + P(Clara, Ciaran)	$= \frac{3}{15} = \frac{1}{5}$	M1		M1 for addition of fractions	
iv	$1 - \frac{3}{15} = \frac{12}{15} = \frac{4}{5}$	$\frac{12}{15} = \frac{4}{5}$ Don’t need to find all the pairs with different initials because it is 1 minus all the pairs that have the same initials.	M1 A1		M1 for subtraction from one oe A1 for explanation with method	
c i		Mutually exclusive. Can’t select the same person twice.	B1		B1 for mutually exclusive with correct explanation oe	
ii		Mutually exclusive as two men cannot be a man and a women and vice versa.	B1		B1 for mutually exclusive with correct explanation oe	
iii		Mutually exclusive as no two men have the same initial.	B1		B1 for mutually exclusive with correct explanation oe	
iv		**Not** mutually exclusive as there are possible combinations where two women	B1		B1 for not mutually exclusive with correct explanation oe	

		have the same initial such as Chloe and Clara.				
d	P(Exhaustive outcomes) = 1 P(same sex) + P (not the same sex) = P(F, F) + P(M, M) + P(M ,F) = 1 OR P(two women) = P(A, Ch) + P(A, Cl)+P(Ch, Cl) = $\frac{3}{15}$ P(two men)= P(B, Ci) + P(C, D) + P(Ci, D) = $\frac{3}{15}$ P(Opposite sex) = P(A, B) + P(A, Ci)+ P(A, D) + P(B, Ch) + P(B, Cl) + P(Ch, Ci) + P(Ch, D) + P(Cl, Ci) + P(Cl, D) = $\frac{9}{15}$ $\frac{3}{15} + \frac{3}{15} + \frac{9}{15} = \frac{15}{15}$	Picking two people of the same sex or picking two people of the opposite sex. This is mutually exclusive **and** mutually exhaustive because the total probabilities add up to one.	M1 A1		M1 for mutually exclusive with correct explanation oe A1 for full demonstration of exhaustive outcomes to support argument oe	
			13			

21 a		Probability tree diagram to explain the key features of mutually exclusive and independent events on a tree diagram. Probabilities on each set of branches have to sum to 1 because they are mutually exhaustive and exclusive (an event happens or another event happens until all possible events accounted for). The probabilities at each stage may have the same denominator if they are independent (with replacement) or the denominator may change if they are dependent (without replacement). Final probabilities must sum to 1 because all possible outcomes have been considered.	M1 A1	2 3	M1 for clear explanation that includes mutually exclusive and independent events A1 for good use of the diagram to support the argument.	H
b		The probabilities on each branch have to sum to one because they are exhaustive and must describe **all** possible outcomes for that event.	M1 A1		M1 for clear explanation of exhaustive events A1 for good use of the diagram to support the argument	
c		Denominators of same event at different stages will be different if the question specified **without** replacement as there will be less counters to choose from, for example.	M1 A1		M1 for clear explanation of dependent events A1 for good use of the diagram to support the argument	
d		Check each set of branches sum to 1. Check if with or without replacement. Make sure know when to add (P(A) and P(B)) and when to multiply. Check the sum of the final probabilities after multiplication along the branches is 1.	B2 **8**		B1 for at least two checks that include final probabilities sum to 1 B1 for good use of the diagram to support the argument oe	
22	P(rain, not rain) + P(not rain, rain) = 0.25 × 0.52 + 0.75 × 0.48 = 0.49	0.49	M1 A1 **2**	3	M1 for multiplication of rain and complement. A1 cao	H

<table>
<tr><td>23 a</td><td><table><tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr><tr><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr><tr><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr><tr><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td></tr><tr><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table></td><td>P(1, 1) = $\frac{1}{36}$</td><td>M1
A1</td><td>3</td><td>M1 for good use of diagram such as two way table to support explanation
A1 cao</td><td>H</td></tr>
<tr><td>b</td><td></td><td>He can expect to win one in 36 so should expect to have 36 goes to win at least once.</td><td>B1</td><td></td><td>B1 for correct interpretation of 36 outcomes, of which only one wins</td><td></td></tr>
<tr><td>c</td><td>100 ÷ 36 = 2.7</td><td>If he has 100 goes, then he can expect 3 wins.</td><td>B1
4</td><td></td><td>B1 for division, rounding and correct interpretation in context</td><td></td></tr>
<tr><td>24</td><td></td><td>P(BB) = $\frac{2}{3} \times \frac{2}{3} = \frac{4}{9}$
P(RB) = 1 – (P(BB) + P(RR))
$= 1 - (\frac{4}{9} + \frac{1}{9})$
$= \frac{4}{9}$ as required.
</td><td>M1
A1
2</td><td>3</td><td>M1 for multiplication of $\frac{2}{3} \times \frac{2}{3}$ and subtraction from 1
A1 for use of technical notation and possible use of tree diagram to aid explanation</td><td>H</td></tr>
<tr><td>25 a</td><td></td><td></td><td>M1
B1</td><td>3</td><td>M1 for correct construction of probability tree diagram
B1 for probabilities and events identified clearly</td><td>H</td></tr>
<tr><td>b</td><td>P(PP) = 0.4 x 0.5 = 0.2</td><td></td><td>A1</td><td></td><td>A1 cao</td><td></td></tr>
</table>

		0.2	**3**			
26	P(6, 7, 8) = $\frac{12}{52} \times \frac{11}{51}$ = $\frac{11}{221}$ = 0.04977…	 0.050	M1 A1 **2**	2	M1 for multiplication showing without replacement for two draws A1 cao	H
27 a	P(late) = 0.08 P(not late) = 0.92 P(early) = 0.02 P(not early) = 0.98 P(rain) = 0.3 P(not rain) = 0.7 P(on time) = 1 – P(late) – P(early) = 1 - 0.08 – 0.02 = 0.9 P(on time, not raining) = 0.9 × 0.7 = 0.63	 0.63	B1	2	B1 for correct multiplication for different events oe	H
b	P(rain, rain, rain)= 0.3^3 = 0.027	 0.027	B1		B1 for correct multiplication for three same events oe	
c	P(not late five days in a row) = 0.92^5 = 0.6591	0.659	B1 **3**		B1 for correct multiplication for three same complement events oe	