projectmaths

Probability

16 **2** In a raffle, 30 tickets are sold and there is one prize to be won. What is the probability that someone buying 6 tickets wins the prize? **1** Solution

(A) $\frac{1}{30}$ (B) $\frac{1}{6}$ (C) $\frac{1}{5}$ (D) $\frac{1}{4}$

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16 **15 b** An eight-sided die is marked with numbers 1, 2, …, 8. A game is played by rolling the die until an 8 appears on the uppermost face. At this point the game ends. Solution

(i) Using a tree diagram, or otherwise, explain why the probability of the game ending before the fourth roll is $\frac{1}{8} + \frac{7}{8} \times \frac{1}{8} + \left(\frac{7}{8}\right)^2 \times \frac{1}{8}$. **2**

(ii) What is the smallest value of n for which the probability of the game ending before the nth roll is more than $\frac{3}{4}$? **3**

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15 **4** The probability that Mel's soccer team wins this weekend is $\frac{5}{7}$. The probability that Mel's rugby league team wins this weekend is $\frac{2}{3}$. What is the probability that neither team wins this weekend? **1** Solution

(A) $\frac{2}{21}$ (B) $\frac{10}{21}$ (C) $\frac{13}{21}$ (D) $\frac{19}{21}$

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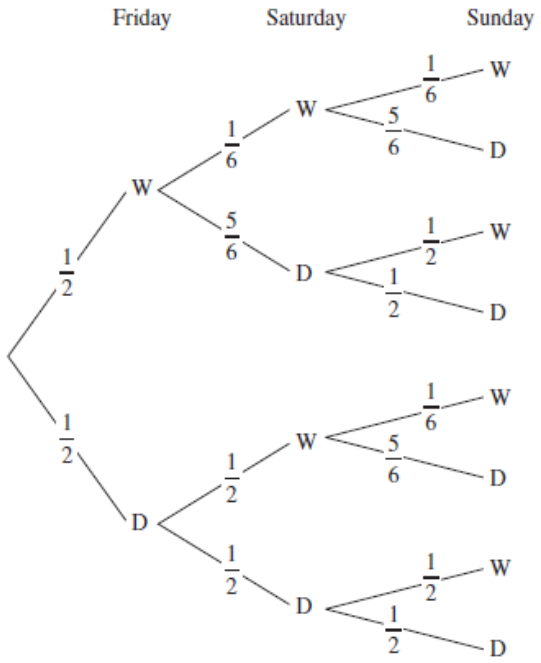
15 **14 b** Weather records for a town suggest that: **2** Solution

- if a particular day is wet (W), the probability of the next day being dry is $\frac{5}{6}$. **2**
- if a particular day is dry (D), the probability of the next day being dry is $\frac{1}{2}$.

In a specific week Thursday is dry. The tree diagram shows the possible outcomes for the next three days: Friday, Saturday and Sunday.



(i) Show that the probability of Saturday being dry is $\frac{2}{3}$. **1**

(ii) What is the probability of both Saturday and Sunday being wet? **2**

(iii) What is the probability of at least one of Saturday and Sunday being dry? **1**

14 **10** Three runners compete in a race. The probabilities that the three runners finish the race in under 10 seconds are $\frac{1}{4}$, $\frac{1}{6}$ and $\frac{2}{5}$ respectively. **1** Solution

What is the probability that at least one of the three runners will finish the race in under 10 seconds?

(A) $\frac{1}{60}$ (B) $\frac{37}{60}$ (C) $\frac{3}{8}$ (D) $\frac{5}{8}$

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14 **12 c** A packet of lollies contains 5 red lollies and 14 green lollies. Two lollies are selected at random without replacement. Solution

(i) Draw a tree diagram to show the possible outcomes. Include the probability on each branch. **2**

(ii) What is the probability that the two lollies are of different colours? **1**

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13 **5** A bag contains 4 red marbles and 6 blue marbles. Three marbles are selected at random without replacement. **1** Solution

What is the probability that at least one of the marbles selected is red?

(A) $\frac{1}{6}$ (B) $\frac{1}{2}$ (C) $\frac{5}{6}$ (D) $\frac{29}{30}$

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13 **15 d** Pat and Chandra are playing a game. They take turns throwing two dice. Solution

The game is won by the first player to throw a double six. Pat starts the game.

(i) Find the probability that Pat wins the game on the first throw. **1**

(ii) What is the probability that Pat wins the game on the first or on the second throw? **2**

(iii) Find the probability that Pat eventually wins the game. **2**

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12 **13 c** Two buckets each contain red marbles and white marbles. Bucket A contains 3 red and 2 white marbles. Bucket B contains 3 red and 4 white marbles. Chris randomly chooses one marble from each bucket. Solution

(i) What is the probability that both marbles are red? **1**

(ii) What is the probability that at least one of the marbles is white? **1**

(iii) What is the probability that both marbles are the same colour? **2**

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11 **1g** A batch of 800 items is examined. The probability that an item from this batch is defective is 0.02. How many items from this batch are defective? **1** Solution

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11 **5b** Kim has three red shirts and two yellow shirts. On each of the three days, Monday, Tuesday and Wednesday, she selects one shirt at random to wear. Kim wears each shirt that she selects only once. Solution

(i) What is the probability that Kim wears a red shirt on Monday? **1**

(ii) What is the probability that Kim wears a shirt of the same colour on all three days? **1**

(iii) What is the probability that Kim does not wear a shirt of the same colour on consecutive days? **2**

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10 **4c** There are twelve chocolates in a box. Four of the chocolates have mint centres, four have caramel centres and four have strawberry centres. Ali randomly selects two chocolates and eats them. Solution

(i) What is the probability that the two chocolates have mint centres? **1**

(ii) What is the probability that the two chocolates have same centres? **1**

(iii) What is the probability that the two chocolates have different centres? **1**

10 **8b** Two identical biased coins are tossed together, and the outcome is recorded. After a large number of trials it is observed that the probability that both coins land showing heads is 0.36. What is the probability that both coins land showing tails? **2** Solution

09 **5b** On each working day James parks his car in a parking station which has three levels. He parks his car on a randomly chosen level. He always forgets where he has parked so when he leaves work he chooses a level at random and searches for his car. If his car is not on that level, he chooses a different level and continues in this way until he finds his car. Solution

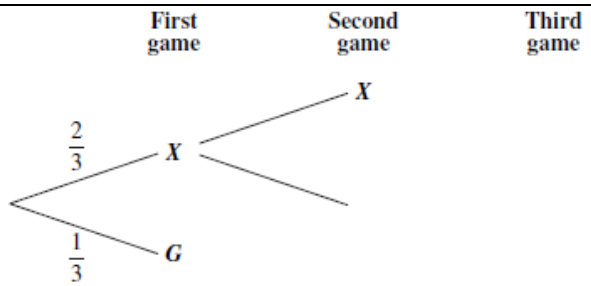
(i) What is the probability that his car is on the first level he searches? **1**

(ii) What is the probability that he must search all three levels before he finds his car? **1**

(iii) What is the probability that on every one of the five working days in a week, his car is not on the first level he searches? **1**

09 **9a** Each week Van and Marie take part in a raffle at their respective workplaces. The probability that Van wins a prize in his raffle is $\frac{1}{9}$. The probability that Marie wins a prize in her raffle is $\frac{1}{16}$. What is the probability that, during the next three weeks, at least one of them wins a prize? **2** Solution

08 **7c** Xena and Gabrielle compete in a series of games. The series finishes when one player has won two games. In any game, the probability that Xena wins is $\frac{2}{3}$ and the probability that Gabrielle wins is $\frac{1}{3}$. Solution



(i) Copy and complete the tree diagram. **1**

(ii) What is the probability that Gabrielle wins the series? **2**

(iii) What is the probability that three games are played in the series? **2**

08 **9a** It is estimated that 85% of students in Australia own a mobile phone. Solution

(i) Two students are selected at random. What is the probability that neither of them owns a mobile phone? **2**

(ii) Based on a recent survey, 20% of the students who own a mobile phone have used their mobile phone during class time. A student is selected at random. What is the probability that the student owns a mobile phone and has used it during classtime? **1**

07 **4b** Two ordinary dice are rolled. The score is the sum of the numbers on the top faces. Solution

(i) What is the probability that the score is 10? **2**

(ii) What is the probability that the score is not 10? **1**

07 **9b** A pack of 52 cards consists of four suits with 13 cards in each suit. Solution

(i) One card is drawn from the pack and kept on the table. A second card is drawn and placed beside it on the table. What is the probability that the second card is from a different suit to the first? **1**

(ii) The two cards are replaced and the pack shuffled. Four cards are chosen from the pack and placed side by side on the table. What is the probability that these four cards are all from different suits? **2**

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06 **4c** A chessboard has 32 black squares and 32 white squares. Tanya chooses three different squares at random. Solution

(i) What is the probability that Tanya chooses three white squares? **2**

(ii) What is the probability that the three squares Tanya chooses are the same colour? **1**

(iii) What is the probability that the three squares Tanya chooses are not the same colour? **1**

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05 **5d** A total of 300 tickets are sold in a raffle which has three prizes. There are 100 red, 100 green and 100 blue tickets. At the drawing of the raffle, winning tickets are NOT replaced before the next draw. Solution

(i) What is the probability that each of the three winning tickets is red? **2**

(ii) What is the probability that at least one of the winning tickets is not red? **1**

(iii) What is the probability that there is one winning ticket of each colour? **2**

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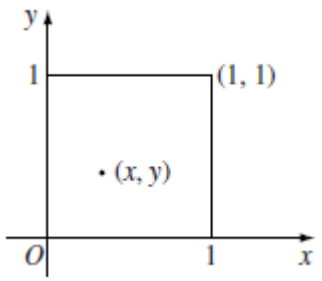
05 **10 b** Xuan and Yvette would like to meet at a cafe on Monday. They each agree to come to the cafe sometime between 12 noon and 1 pm, wait for 15 minutes, and then leave if they have not seen the other person. Their arrival times can be represented by the point (x, y) in the Cartesian plane, where x represents the fraction of an hour after 12 noon that Xuan arrives, and y represents the fraction of an hour after 12 noon that Yvette arrives. Solution



Thus $\left(\frac{1}{3}, \frac{2}{5}\right)$ represents Xuan arriving at 12:20 pm and Yvette arriving at 12:24 pm.

Note that the point (x, y) lies somewhere in the unit square $0 \le x \le 1$ and $0 \le y \le 1$ as shown in the diagram.

(i) Explain why Xuan and Yvette will meet if $x - y \le \frac{1}{4}$ or $y - x \le \frac{1}{4}$. **1**

(ii) The probability that they will meet is equal to the area of the part of the region given by the inequalities in part (i) that lies within the unit square $0 \le x \le 1$ and $0 \le y \le 1$.
Find the probability that they will meet. **2**

(iii) Xuan and Yvette agree to try to meet again on Tuesday. They agree to arrive between 12 noon and 1 pm, but on this occasion they agree to wait for t minutes before leaving. For what value of t do they have a 50% chance of meeting? **2**
