2 A sports event is taking place for 4 days, beginning on Sunday. The probability that it will rain on Sunday is 0.4. On any subsequent day, the probability that it will rain is 0.7 if it rained on the previous day and 0.2 if it did not rain on the previous day.

(a) Find the probability that it does **not** rain on any of the 4 days of the event. [1]

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(b) Find the probability that the first day on which it rains during the event is Tuesday. [2]

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(c) Find the probability that it rains on exactly one of the 4 days of the event. [3]

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2 The probability that a student at a large music college plays in the band is 0.6. For a student who plays in the band, the probability that she also sings in the choir is 0.3. For a student who does not play in the band, the probability that she sings in the choir is x. The probability that a randomly chosen student from the college does not sing in the choir is 0.58.

(a) Find the value of x. [3]

Two students from the college are chosen at random.

(b) Find the probability that both students play in the band and both sing in the choir. [2]

1 Each of the 180 students at a college plays exactly one of the piano, the guitar and the drums. The numbers of male and female students who play the piano, the guitar and the drums are given in the following table.

	Piano	Guitar	Drums
Male	25	44	11
Female	42	38	20

A student at the college is chosen at random.

(a) Find the probability that the student plays the guitar. [1]

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(b) Find the probability that the student is male given that the student plays the drums. [2]

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(c) Determine whether the events 'the student plays the guitar' and 'the student is female' are independent, justifying your answer. [2]

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2 Georgie has a red scarf, a blue scarf and a yellow scarf. Each day she wears exactly one of these scarves. The probabilities for the three colours are 0.2, 0.45 and 0.35 respectively. When she wears a red scarf, she always wears a hat. When she wears a blue scarf, she wears a hat with probability 0.4. When she wears a yellow scarf, she wears a hat with probability 0.3.

(a) Find the probability that on a randomly chosen day Georgie wears a hat. [2]

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(b) Find the probability that on a randomly chosen day Georgie wears a yellow scarf given that she does not wear a hat. [3]

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3 On each day that Alexa goes to work, the probabilities that she travels by bus, by train or by car are 0.4, 0.35 and 0.25 respectively. When she travels by bus, the probability that she arrives late is 0.55. When she travels by train, the probability that she arrives late is 0.7. When she travels by car, the probability that she arrives late is x.

On a randomly chosen day when Alexa goes to work, the probability that she does not arrive late is 0.48.

(a) Find the value of x. [3]

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(b) Find the probability that Alexa travels to work by train given that she arrives late. [3]

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4   To gain a place at a science college, students first have to pass a written test and then a practical test.

Each student is allowed a maximum of two attempts at the written test. A student is only allowed a second attempt if they fail the first attempt. No student is allowed more than one attempt at the practical test. If a student fails both attempts at the written test, then they cannot attempt the practical test.

The probability that a student will pass the written test at the first attempt is 0.8. If a student fails the first attempt at the written test, the probability that they will pass at the second attempt is 0.6. The probability that a student will pass the practical test is always 0.3.

(a)   Draw a tree diagram to represent this information, showing the probabilities on the branches.

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(b)   Find the probability that a randomly chosen student will succeed in gaining a place at the college.

[2]

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(c) Find the probability that a randomly chosen student passes the written test at the first attempt given that the student succeeds in gaining a place at the college. [2]

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5 On Mondays, Rani cooks her evening meal. She has a pizza, a burger or a curry with probabilities 0.35, 0.44, 0.21 respectively. When she cooks a pizza, Rani has some fruit with probability 0.3. When she cooks a burger, she has some fruit with probability 0.8. When she cooks a curry, she never has any fruit.

(a) Draw a fully labelled tree diagram to represent this information. [2]

(b) Find the probability that Rani has some fruit. [2]

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(c) Find the probability that Rani does not have a burger given that she does not have any fruit. [4]

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5 Jasmine throws two ordinary fair 6-sided dice at the same time and notes the numbers on the uppermost faces. The events A and B are defined as follows.

A: The sum of the two numbers is less than 6.

B: The difference between the two numbers is at most 2.

(a) Determine whether or not the events A and B are independent. [4]

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(b) Find $P(B \mid A')$. [3]

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5 A game is played with an ordinary fair 6-sided die. A player throws the die once. If the result is 2, 3, 4 or 5, that result is the player's score and the player does not throw the die again. If the result is 1 or 6, the player throws the die a second time and the player's score is the sum of the two numbers from the two throws.

(a) Draw a fully labelled tree diagram to represent this information. [2]

Events *A* and *B* are defined as follows.

A: the player's score is 5, 6, 7, 8 or 9

B: the player has two throws

(b) Show that $P(A) = \frac{1}{3}$. [3]

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(c) Determine whether or not events A and B are independent. [2]

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(d) Find $P(B \mid A')$. [3]

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6 Janice is playing a computer game. She has to complete level 1 and level 2 to finish the game. She is allowed at most two attempts at any level.

- For level 1, the probability that Janice completes it at the first attempt is 0.6. If she fails at her first attempt, the probability that she completes it at the second attempt is 0.3.

- If Janice completes level 1, she immediately moves on to level 2.

- For level 2, the probability that Janice completes it at the first attempt is 0.4. If she fails at her first attempt, the probability that she completes it at the second attempt is 0.2.

(a) Show that the probability that Janice moves on to level 2 is 0.72. [1]

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(b) Find the probability that Janice finishes the game. [3]

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(c) Find the probability that Janice fails exactly one attempt, given that she finishes the game. [4]

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6   Freddie has two bags of marbles.

Bag *X* contains 7 red marbles and 3 blue marbles.

Bag *Y* contains 4 red marbles and 1 blue marble.

Freddie chooses one of the bags at random. A marble is removed at random from that bag and not replaced. A new red marble is now added to each bag. A second marble is then removed at random from the same bag that the first marble had been removed from.

(a) Draw a tree diagram to represent this information, showing the probability on each of the branches.   [3]

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(b) Find the probability that both of the marbles removed from the bag are the same colour. [4]

(c) Find the probability that bag *Y* is chosen given that the marbles removed are **not** both the same colour. [2]