Probability

Worked solutions

KS3 Maths topic practice

This topic online

1 A bistro menu has 5 starters, 8 main courses and 4 desserts.

Callum chooses one starter, one main course and one dessert.

Work out the number of different three-course meals Callum can choose. (2 marks)

Multiply the number of choices at each stage

$5 \times 8 \times 4 = 160$ different meals

$\boxed{160}$

2 A bag contains 4 green counters, 7 yellow counters and 9 white counters.

A counter is taken from the bag at random.

Find the probability that the counter is **not** green. (2 marks)

Total number of counters $= 4 + 7 + 9 = 20$

Counters that are not green $= 7 + 9 = 16$

$P(\text{not green}) = \frac{16}{20} = \frac{4}{5}$

$\boxed{\frac{4}{5}}$

3 A spinner can land on red, blue or green only.

P(red) = 0.3 and P(blue) = 0.25.

a. Work out the probability that the spinner lands on red or blue.

b. Work out the probability that the spinner lands on green. (3 marks)

$P(\text{red or blue}) = 0.3 + 0.25 = 0.55$

The probabilities of red, blue and green must add up to 1

$P(\text{green}) = 1 - 0.55 = 0.45$

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4 Two fair spinners are each numbered 1, 2, 3 and 4.

Both spinners are spun and the two scores are added together.

+	1	2	3	4
1	2	3		
2	3			
3			6	
4				

a. Complete the sample space diagram.

b. Work out the probability that the total is 5

c. Work out the probability that the total is greater than 6

(4 marks)

a)

Add the row and the column

2 3 4 5

3 4 5 6

4 5 6 7

5 6 7 8

b)

4 x 4 = 16 outcomes

Totals of 5: 4 of them

$P(5) = \frac{4}{16}$

$\boxed{\frac{1}{4}}$

c)

Greater than 6: 7, 7, 8

3 outcomes

$\boxed{\frac{3}{16}}$

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5 Twelve cards are numbered 1 to 12. One card is taken at random.

Event A: the number is even.

Event B: the number is a multiple of 5

Event C: the number is an odd prime number.

a. Write down two of the events that are mutually exclusive. Give a reason for your answer.

b. Work out the probability that the number is even or an odd prime number.

c. Leah says, "P(A or B) = P(A) + P(B)". Explain why Leah is wrong.

(4 marks)

A: 2, 4, 6, 8, 10, 12

B: 5, 10

C: 3, 5, 7, 11

a)

No numbers in common

A and C

b)

$P(A \text{ or } C) = \frac{6}{12} + \frac{4}{12}$

$= \frac{10}{12}$

$\frac{5}{6}$

c)

10 is in A and in B

Adding counts 10 twice

A and B are not mutually exclusive

6 A four-sided spinner can land on 1, 2, 3 or 4.

The table shows some of the probabilities.

Number	1	2	3	4
Probability	0.2	0.35	0.15	

a. Work out the probability that the spinner lands on 4.

b. The spinner is spun 200 times. Work out an estimate for the number of times it lands on 4.

(4 marks)

The probabilities must add up to 1, and 0.2 + 0.35 + 0.15 = 0.7

P(4) = 1 - 0.7 = 0.3

Estimated number of 4s in 200 spins = 0.3 × 200 = 60

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7 Zainab and Theo play a game with two fair six-sided dice.

They roll both dice and multiply the two scores.

Zainab wins if the answer is even.

Theo wins if the answer is odd.

a. Show that the game is not fair.

b. They play the game 60 times. Work out the number of games Theo should expect to win.

c. Theo actually wins 18 of the 60 games. Kemi says, "The dice must be biased." Is Kemi right? Give a reason for your answer.

(4 marks)

a)

Odd only if both dice are odd

$3 \times 3 = 9$ odd answers

$6 \times 6 = 36$ outcomes

$P(\text{Theo}) = \frac{9}{36} = \frac{1}{4}$

$P(\text{Zainab}) = 1 - \frac{1}{4} = \frac{3}{4}$

$\frac{3}{4} \neq \frac{1}{4}$, so not fair

b)

$60 \times \frac{1}{4} = 15$

15 games

c)

Expected 15, actual 18

18 is close to 15

No, results vary a little

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8 80 adults went to a gym on Saturday.

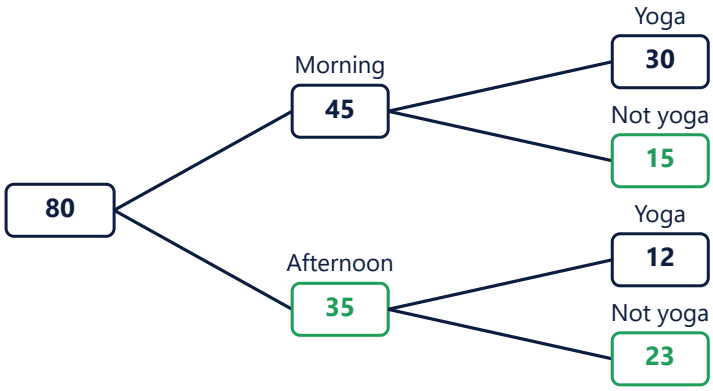
45 of the adults went to a morning class. The rest went to an afternoon class.

Of the adults at the morning class, 30 did yoga.

Of the adults at the afternoon class, 12 did yoga.

a. Complete the frequency tree.

b. One of the 80 adults is chosen at random. Find the probability that this adult went to the morning class and did yoga.



(4 marks)

Afternoon class = 80 - 45 = 35

Morning, not yoga = 45 - 30 = 15

Afternoon, not yoga = 35 - 12 = 23

$P(\text{morning and yoga}) = \frac{30}{80} = \frac{3}{8}$

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9 A running club has 120 members. Each member is an adult or a junior.

70 of the members are adults. The rest are juniors.

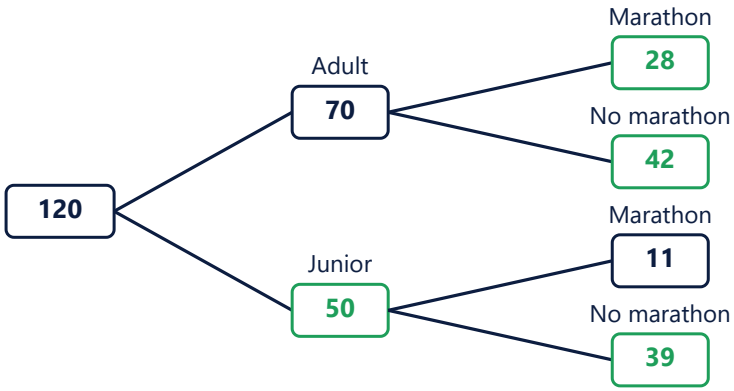
$\frac{2}{5}$ of the adults ran a marathon last year.

11 of the juniors ran a marathon last year.

a. Work out the number of juniors in the club.

b. Work out the number of adults who ran a marathon last year.

c. One of the members who ran a marathon last year is chosen at random. Work out the probability that this member is a junior.



(5 marks)

Juniors = 120 − 70 = 50

Adults who ran a marathon = $\frac{2}{5}$ of 70 = 28

Total members who ran a marathon = 28 + 11 = 39

P(junior) = $\frac{11}{39}$

10 The passcode for a tablet is a 4 digit number.

The first digit cannot be 0.

Digits may repeat.

a. Work out the number of different passcodes that are possible.

b. Ruby does not know the passcode. She types one 4 digit number at random, with a non-zero first digit. Write down the probability that Ruby types the correct passcode.

(3 marks)

(a) There are 9 choices for the first digit (1 to 9) and 10 choices for each of the other three digits

9 × 10 × 10 × 10 = 9000 passcodes

(b) Exactly one of the 9000 equally likely guesses is correct, so the probability is $\frac{1}{9000}$

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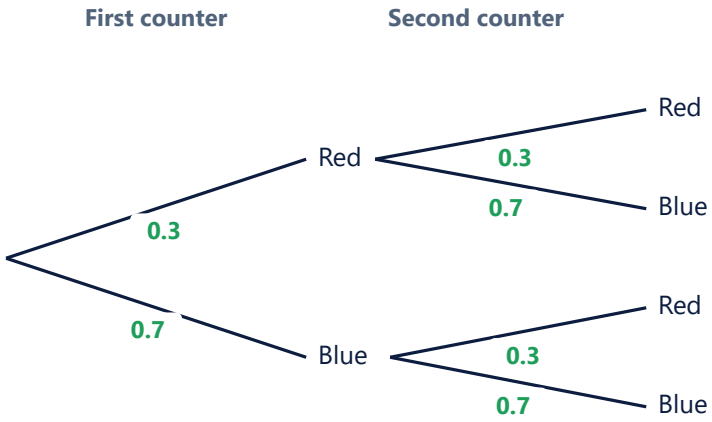
11 A bag contains 3 red counters and 7 blue counters.

Kira takes a counter at random, notes its colour and puts it back.

She then takes a second counter at random.

a. Complete the probability tree diagram for the two picks.

b. Work out the probability that both counters are blue.



(3 marks)

$P(\text{red}) = \frac{3}{10} = 0.3$ and $P(\text{blue}) = \frac{7}{10} = 0.7$

The counter is replaced, so the second pick has the same probabilities

$P(\text{both blue}) = 0.7 \times 0.7 = 0.49$

EXTENSION QUESTIONS

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12 80 Year 9 pupils were asked if they play chess. The two-way table shows some of the results.

	Chess	No chess	Total
Boys	12		48
Girls		24	
Total			80

a. Complete the two-way table.

b. One of the girls is chosen at random. Work out the probability that she plays chess.

c. Are the events "the pupil is a girl" and "the pupil plays chess" independent? You must show your working.

(5 marks)

a)

Boys, no chess: $48 - 12 = 36$

Girls total: $80 - 48 = 32$

Girls, chess: $32 - 24 = 8$

Chess total: $12 + 8 = 20$

No chess total: $36 + 24 = 60$

b)

Only look at the 32 girls

$$P(\text{chess} \mid \text{girl}) = \frac{8}{32}$$

$$\boxed{\frac{1}{4}}$$

c)

$$P(\text{chess}) = \frac{20}{80} = \frac{1}{4}$$

$$P(\text{chess} \mid \text{girl}) = \frac{1}{4}$$

The same, so knowing she is a girl changes nothing

$$\boxed{\text{Yes, independent}}$$

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13 There are 60 pupils in Year 9.

25 pupils play an instrument (I).

18 pupils sing in the choir (C).

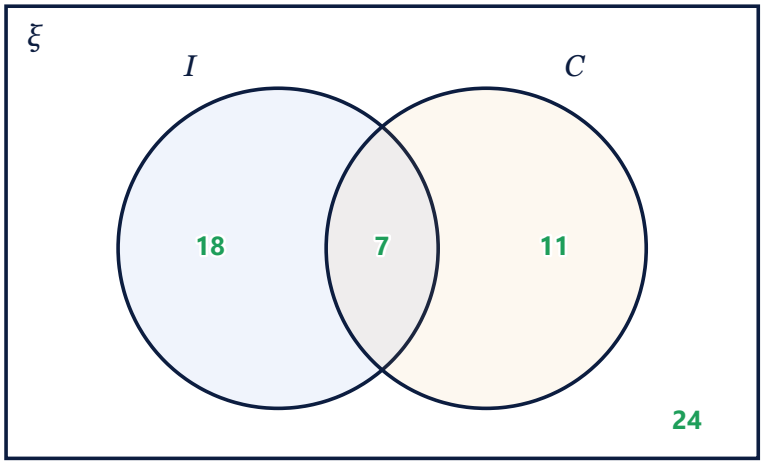
7 pupils play an instrument and sing in the choir.

a. Complete the Venn diagram.

b. One of the 60 pupils is chosen at random. Find P($I \cap C'$).

c. Find P(I').

d. A pupil who sings in the choir is chosen at random. Work out the probability that this pupil also plays an instrument.



(5 marks)

a)

I only: $25 - 7 = 18$

C only: $18 - 7 = 11$

Neither: $60 - 18 - 7 - 11 = 24$

b)

In I but not in C

$$P(I \cap C') = \frac{18}{60}$$

$$\boxed{\frac{3}{10}}$$

c)

Not in I

$11 + 24 = 35$

$$P(I') = \frac{35}{60}$$

$$\boxed{\frac{7}{12}}$$

d)

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Only look at the 18 in the choir

$P(I \mid C) = \frac{7}{18}$

$\boxed{\frac{7}{18}}$

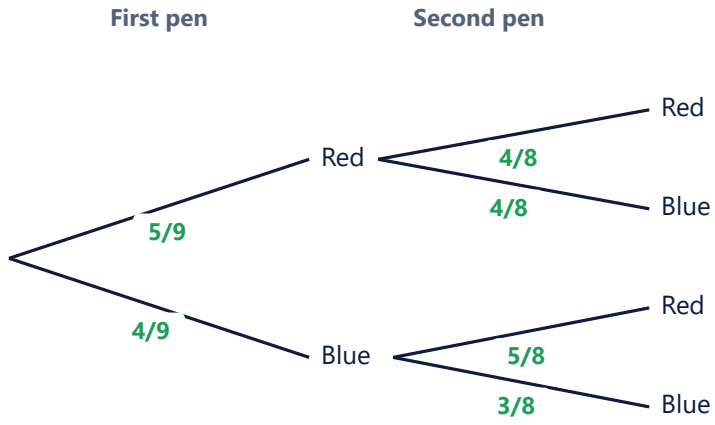
14 A box contains 5 red pens and 4 blue pens.

Milo takes a pen at random and does **not** replace it.

He then takes a second pen at random.

a. Complete the probability tree diagram.

b. Work out the probability that Milo takes at least one red pen.



(5 marks)

First pick

$P(\text{red}) = \frac{5}{9}$, $P(\text{blue}) = \frac{4}{9}$

The pen is not replaced, so 8 pens remain

after a red, $P(\text{red}) = \frac{4}{8}$ and $P(\text{blue}) = \frac{4}{8}$; after a blue, $P(\text{red}) = \frac{5}{8}$ and $P(\text{blue}) = \frac{3}{8}$

$P(\text{no red pens}) = P(\text{blue, blue}) = \frac{4}{9} \times \frac{3}{8} = \frac{12}{72} = \frac{1}{6}$

$P(\text{at least one red}) = 1 - \frac{1}{6} = \frac{5}{6}$

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