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EDEXCEL INTERNATIONAL GCSE MATHS: QUESTIONS BY TOPIC

Probability (P1)

International GCSE Mathematics A (4MA1) · Higher tier

95 questions · 425 marks · Mark schemes included

Past papers June 2018 - June 2025 · 4 sub-topics

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HOW TO USE THIS BOOKLET

Questions are grouped by sub-topic and run from the lowest to the highest mark tariff, then oldest paper first.

Click any row below to jump straight to that sub-topic or question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme; < QUESTION brings you back.

A gold bar in the left margin marks exactly where the question sits on the original page.

Diagrams, graphs, grids and tables are printed exactly as they appear in the original papers.

Each question is filed under its main topic; longer questions may also test skills from other topics.

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QUESTIONS

95 questions · 425 marks · 4 sub-topics

SUB-TOPIC P1a

BASIC PROBABILITY & EXPECTED OUTCOMES

Sub-topic P1a · 28 questions · 109 marks · lowest tariff first



Answer ALL TWENTY SIX questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1** The probability that a spinner will land on blue is 0.4

Rayyan is going to spin the spinner 280 times.

Work out an estimate for the number of times the spinner will land on blue.

.....
(Total for Question 1 is 2 marks)

- 2** Write 880 as a product of powers of its prime factors.
Show your working clearly.

.....
(Total for Question 2 is 3 marks)



- 2 Each time John plays a game, the probability that he wins the game is 0.65

John is going to play the game 300 times.

Work out an estimate for the number of games that John wins.

(Total for Question 2 is 2 marks)



- 5 Each time Evie plays a game against her computer, she will win or lose.

For each game, the probability that Evie will win is 0.74

Evie is going to play 300 games against her computer.

Work out an estimate for the number of games that Evie will lose.

(Total for Question 5 is 2 marks)

- 6 (a) Simplify $m^{10} \div m^3$

(1)

$$k^n \times k^4 = k^{12}$$

- (b) Write down the value of n

$$n = \dots\dots\dots$$

(1)

- (c) Simplify $(3x^6y^8)^2$

(2)

(Total for Question 6 is 4 marks)



- 6 There are some ice lollies in a freezer.

The flavour of each ice lolly is banana or strawberry or mint or chocolate.

Julius takes at random an ice lolly from the freezer.

The table shows the probabilities that the flavour of the ice lolly that Julius takes is banana or strawberry or chocolate.

Flavour	banana	strawberry	mint	chocolate
Probability	0.35	0.32		0.12

Work out the probability that the flavour of the ice lolly that Julius takes is either strawberry or mint.

(Total for Question 6 is 3 marks)

- 7 A football team played 55 games.
Each game was won, drawn or lost.

number of games won : number of games drawn : number of games lost = 6 : 3 : 2

Work out how many more games the team won than the team lost.

(Total for Question 7 is 3 marks)



- 2 A biased spinner can land on green or on yellow or on brown or on pink.

The table gives the probabilities that, when the spinner is spun, it will land on green or on yellow or on brown.

Colour	green	yellow	brown	pink
Probability	0.32	0.13	0.28	

Timucin spins the spinner 200 times.

Work out an estimate for the number of times the spinner lands on pink.

(Total for Question 2 is 3 marks)



14 Adriana is going to roll a biased dice and spin a biased coin.

The probability that the coin will land on Heads is 0.8

The probability that the dice will land on 6 and the coin will land on Heads is 0.24

Work out the probability that the dice will land on 6 and the coin will land on Tails.

(Total for Question 14 is 3 marks)



11 Khalid has a box of counters.

17 of the counters are red

28 of the counters are blue

the rest of the counters are orange

Khalid is going to take at random a counter from the box.

The probability that Khalid will take an orange counter is $\frac{4}{9}$

Work out the number of orange counters that are in the box.

(Total for Question 11 is 3 marks)

12 Expand and simplify $3x(2x+5)(7x-4)$

(Total for Question 12 is 3 marks)



- 16 There are 8 counters in a bag.
There is a number on each counter.



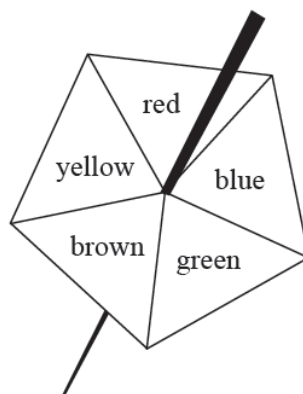
Fiona takes at random **three** of the counters.
She adds the numbers on the **three** counters to get her total.

Work out the probability that her total is an odd number.

(Total for Question 16 is 4 marks)



- 3 Here is a biased 5-sided spinner.



When the spinner is spun, it can land on red, blue, green, brown or yellow.

The table gives the probabilities that the spinner lands on red or on blue or on green.

Colour	red	blue	green	brown	yellow
Probability	0.15	0.26	0.33		

When the spinner is spun once, the probability that the spinner lands on brown is 0.06 more than the probability that the spinner lands on yellow.

Jenine spins the spinner 150 times.

Work out an estimate for the number of times the spinner lands on yellow.

(Total for Question 3 is 4 marks)



- 3 There are 90 counters in a bag.
Each counter in the bag is either red or blue so that

the number of red counters : the number of blue counters = 2 : 13

Li is going to put some more red counters in the bag so that

the probability of taking at random a red counter from the bag is $\frac{1}{3}$

Work out the number of red counters that Li is going to put in the bag.

(Total for Question 3 is 4 marks)



5 Becky has a biased 6-sided dice.

The table gives information about the probability that, when the dice is thrown, it will land on each number.

Number	1	2	3	4	5	6
Probability	$2x$	0.18	$2x$	$3x$	0.26	x

Becky is going to throw the dice 200 times.

Work out an estimate for the number of times that the dice will land on an even number.

(Total for Question 5 is 4 marks)



- 6 A bag contains only red beads, blue beads, green beads and yellow beads.

The table gives the probabilities that, when a bead is taken at random from the bag, the bead will be blue or the bead will be yellow.

Colour	red	blue	green	yellow
Probability		0.24		0.31

The probability that the bead will be green is twice the probability that the bead will be red.

Sofia takes at random a bead from the bag.

She writes down the colour of the bead and puts the bead back into the bag.

She does this 180 times.

Work out an estimate for the number of times she takes a red bead from the bag.

(Total for Question 6 is 4 marks)



- 2 Toy cars are made in a factory.
The toy cars are made for 15 hours each day.
5 toy cars are made every 12 seconds.

For the toy cars made each day, the probability of a toy car being faulty is 0.002

Work out an estimate of the number of faulty toy cars that are made each day.

(Total for Question 2 is 4 marks)



- 3 There are 54 fish in a tank.
Some of the fish are white and the rest of the fish are red.

Jeevan takes at random a fish from the tank.

The probability that he takes a white fish is $\frac{4}{9}$

- (a) Work out the number of white fish originally in the tank.

.....
(2)

Jeevan puts the fish he took out, back into the tank.
He puts some more white fish into the tank.

Jeevan takes at random a fish from the tank.

The probability that he takes a white fish is now $\frac{1}{2}$

- (b) Work out the number of white fish Jeevan put into the tank.

.....
(2)

(Total for Question 3 is 4 marks)



Answer ALL TWENTY THREE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1** A tin contains tea bags with a choice of four different flavours of tea.
The four flavours of tea are Assam or Darjeeling or Nilgiri or Rize.

Sara takes at random a tea bag from the tin.

The table shows each of the probabilities that the flavour of the tea Sara takes is Assam or Darjeeling or Rize.

Flavour of tea	Assam	Darjeeling	Nilgiri	Rize
Probability	0.38	0.24		0.16

- (a) Work out the probability that the flavour of the tea Sara takes is Nilgiri.

.....
(2)

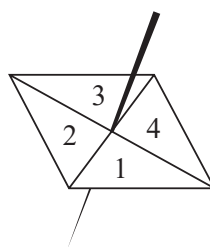
- (b) Work out the probability that the flavour of the tea Sara takes is either Darjeeling or Rize.

.....
(2)

(Total for Question 1 is 4 marks)



2 Here is a biased 4-sided spinner.



The table gives the probabilities that, when the spinner is spun once, it will land on 1 or it will land on 3

Number	1	2	3	4
Probability	0.26		0.18	

The probability that the spinner will land on 2 is equal to the probability that the spinner will land on 4

Ravina is going to spin the spinner a number of times.

Ravina works out that an estimate for the number of times the spinner will land on 3 is 45

Work out an estimate for the number of times the spinner will land on 4

(Total for Question 2 is 4 marks)

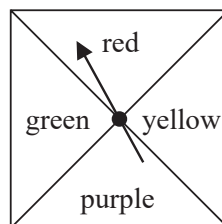


Answer ALL TWENTY FIVE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1** Here is a biased spinner.



When the spinner is spun once, the probabilities that it lands on red or on yellow or on green are given in the table.

Colour	red	yellow	purple	green
Probability	0.25	0.2		0.2

- (a) Work out the probability that the spinner lands on red or on yellow.

.....
(1)

Yang is going to spin the spinner 300 times.

- (b) Work out an estimate for the number of times the spinner will land on purple.

.....
(3)

(Total for Question 1 is 4 marks)



- 7 Some members of a library were asked to name the type of book that they each liked to read the best.

One of the members is chosen at random.

The table shows information about the probability of the type of book that this member answered.

Type of book	comedy	romance	mystery	thriller
Probability	0.24	0.40	$3x$	x

48 members answered comedy books.

Work out how many of the members answered mystery books.

.....
(Total for Question 7 is 4 marks)



- 6 In a bag, there are only red counters, blue counters, green counters and yellow counters.

The total number of counters in the bag is 80

In the bag

the number of red counters is $x + 7$

the number of blue counters is $x - 11$

the number of green counters is $3x$

Jude takes at random a counter from the bag.

The probability that he takes a red counter is $\frac{1}{4}$

Work out the probability that Jude takes a yellow counter.

(Total for Question 6 is 4 marks)



- 4 A biased spinner has three sections each of a different colour.

The table shows the probability that, when the spinner is spun once, it will land on blue or on orange or on white.

Colour	blue	orange	white
Probability	0.58	$2x$	x

- (a) Work out the value of x

$$x = \dots\dots\dots (2)$$

The spinner is spun 250 times.

- (b) Work out an estimate for the number of times the spinner will land on blue.

$$\dots\dots\dots (2)$$

(Total for Question 4 is 4 marks)

- 2 450 students were asked how they travelled to school on Monday.
Each student walked or travelled by bus or travelled by car or travelled by bicycle.
Each student used just one method of travel.

One of these students is chosen at random.

The table shows information about the probability of each method of travel.

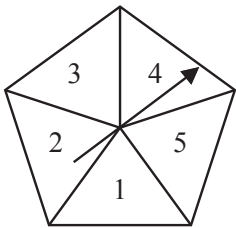
Method of travel	walk	bus	car	bicycle
Probability	0.20	x	$2x$	0.26

Work out how many of the 450 students travelled by car.

(Total for Question 2 is 4 marks)



2 Here is a biased spinner.



The table gives information about the probability that, when the spinner is spun once, it will land on each number.

Number	1	2	3	4	5
Probability	$2x$	0.27	0.04	x	0.12

Alexis is going to spin the spinner 400 times.

Work out an estimate for the number of times the spinner will land on an odd number.

(Total for Question 2 is 4 marks)



- 5 Cody has a biased 5-sided spinner, numbered 1, 2, 3, 4, 5

The table gives the probabilities that when the spinner is spun it will land on 2 or on 3 or on 5

Number	1	2	3	4	5
Probability		0.14	0.17		0.21

The probability that the spinner will land on 1 is the same as the probability that the spinner will land on 4

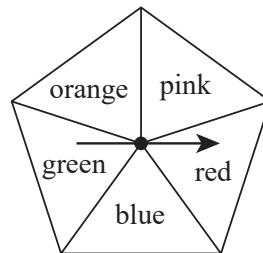
Cody is going to spin the spinner 400 times.

Work out an estimate for the number of times the spinner will land on 4

(Total for Question 5 is 4 marks)



- 6 Grace has a biased 5-sided spinner.



Grace is going to spin the arrow on the spinner once.

The table below gives the probabilities that the spinner will land on red or on blue or on green.

Colour	Red	Blue	Green	Orange	Pink
Probability	0.20	0.12	0.08		

The probability that the spinner will land on orange is 3 times the probability that the spinner will land on pink.

- (a) Work out the probability that the spinner will land on orange.

.....
(3)

Grace spins the arrow on the spinner 150 times.

- (b) Work out an estimate for the number of times the spinner lands on blue.

.....
(2)

(Total for Question 6 is 5 marks)



- 6 A bag contains only pink sweets, white sweets, green sweets and red sweets.

The table gives each of the probabilities that, when a sweet is taken at random from the bag, the sweet will be green or the sweet will be red.

Sweet	pink	white	green	red
Probability			0.2	0.35

The ratio

number of pink sweets : number of white sweets = 2 : 1

There are 28 red sweets in the bag.

Work out the number of white sweets in the bag.

(Total for Question 6 is 5 marks)



12 Moeen has a biased 6-sided dice.

The table gives information about the probability that, when the dice is thrown, it will land on each number.

Number	1	2	3	4	5	6
Probability	x	0.15	0.5	y	0.13	0.03

(a) Show that $x + y = 0.19$

(2)

Given that $3x - y = 0.09$

and $x + y = 0.19$

(b) work out the value of x and the value of y
Show clear algebraic working.

$x = \dots\dots\dots$

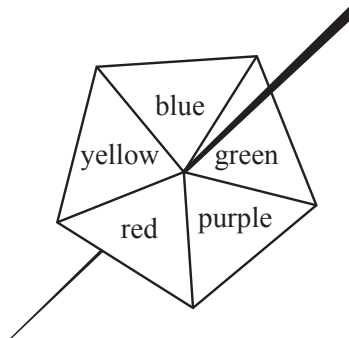
$y = \dots\dots\dots$

(3)

(Total for Question 12 is 5 marks)



- 4 Here is a biased 5-sided spinner.
When the spinner is spun, it can land on blue or on green or on purple or on red or on yellow.



The table gives information about the probability of the spinner landing on each colour.

Colour	blue	green	purple	red	yellow
Probability	0.12	0.20	0.38	$4x$	x

Sophie spins the spinner once.

- (a) Work out the probability that the spinner lands on blue or on green or on purple.

.....
(1)

Max spins the spinner 350 times.

- (b) Work out an estimate for the number of times the spinner lands on red.

.....
(4)

(Total for Question 4 is 5 marks)



Meghan has a jar containing 15 counters.

There are only blue counters, green counters and red counters in the jar.

Hector is going to take at random one of the counters from his bag of 12 counters.

He will look at the counter and put the counter back into the bag.

Hector is then going to take at random a second counter from his bag.

He will look at the counter and put the counter back into the bag.

Meghan is then going to take at random one of the counters from her jar of counters.

She will look at the counter and put the counter back into the jar.

The probability that the 3 counters each have a different colour is $\frac{7}{24}$

(c) Work out how many blue counters there are in the jar.

.....
(3)

(Total for Question 13 is 7 marks)



SUB-TOPIC P1b

SAMPLE SPACES, TWO-WAY TABLES & LISTING

Sub-topic P1b · 1 question · 4 marks · lowest tariff first



19 Jack plays a game with two fair spinners, **A** and **B**.

Spinner **A** can land on the number 2 or 3 or 5 or 7

Spinner **B** can land on the number 2 or 3 or 4 or 5 or 6

Jack spins both spinners.

He wins the game if one spinner lands on an odd number **and** the other spinner lands on an even number.

Jack plays the game twice.

Work out the probability that Jack wins the game both times.

(Total for Question 19 is 4 marks)



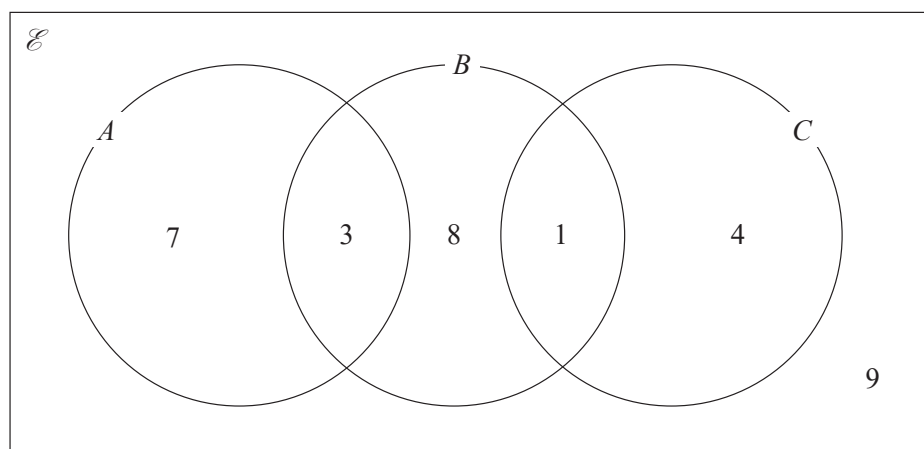
SUB-TOPIC P1c

VENN DIAGRAMS & SET NOTATION

Sub-topic P1c · 22 questions · 98 marks · lowest tariff first



15 The Venn diagram shows a universal set, $\mathcal{E}$, and sets A , B and C .



7, 3, 8, 1, 4 and 9 represent the **numbers** of elements.

Find

(i) $n(A \cup B)$

.....

(ii) $n(A' \cap C)$

.....

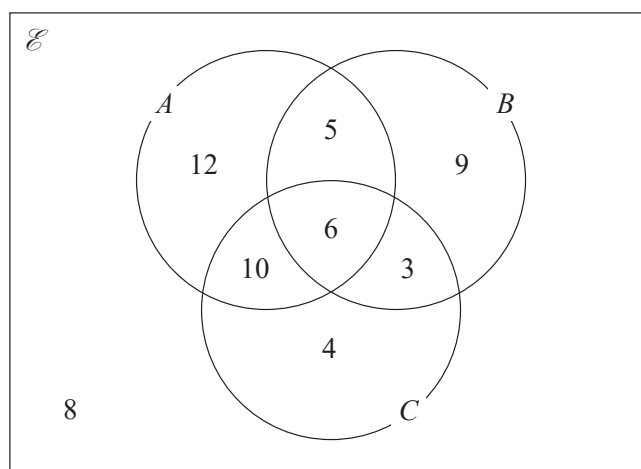
(iii) $n(A' \cup B')$

.....

(Total for Question 15 is 3 marks)



19 The Venn diagram shows a universal set, $\mathcal{E}$ and sets A , B and C .



12, 5, 9, 10, 6, 3, 4 and 8 represent the **numbers** of elements.

Find

(i) $n(A \cup B)$

.....
(1)

(ii) $n(A' \cap B')$

.....
(1)

(iii) $n([A \cap B] \cup C)$

.....
(1)

(Total for Question 19 is 3 marks)



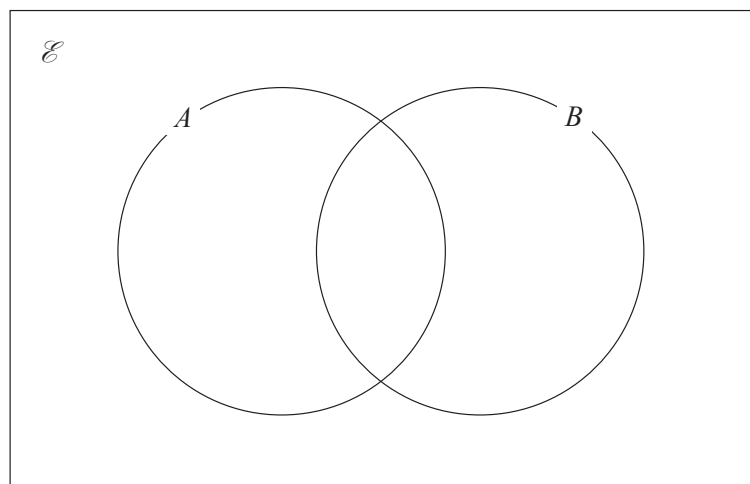
7 $\mathcal{E} = \{4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15\}$

$$A \cap B = \{5, 10, 15\}$$

$$B' = \{7, 8, 9, 11, 12, 13, 14\}$$

$$A' = \{4, 6, 7, 8, 14\}$$

Complete the Venn diagram for this information.



(Total for Question 7 is 3 marks)

8

$$a = 4.2 \times 10^{-24}$$

$$b = 3 \times 10^{145}$$

Work out the value of $a \times b$

Give your answer in standard form.

(Total for Question 8 is 2 marks)



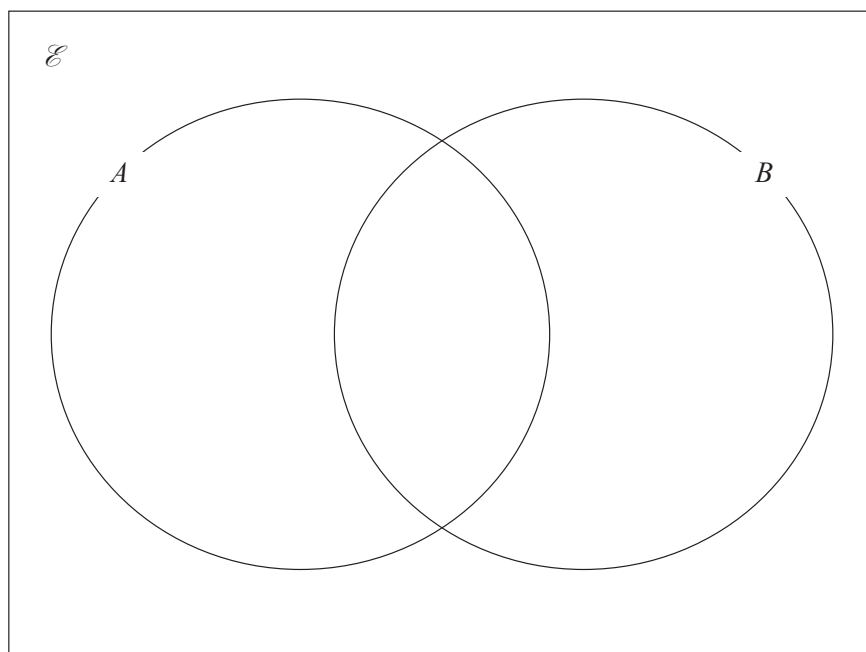
3 $\mathcal{E} = \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20\}$

$$A = \{\text{even numbers}\}$$

$$A \cap B = \{12, 16, 20\}$$

$$(A \cup B)' = \{17, 19\}$$

Complete the Venn diagram for the sets $\mathcal{E}$, A and B

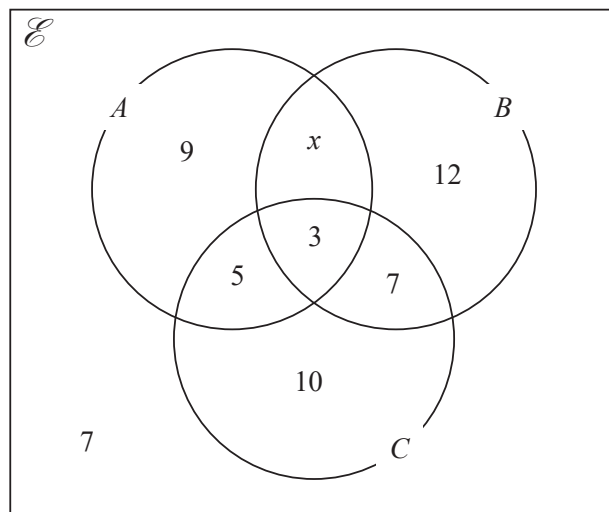


(Total for Question 3 is 3 marks)



16 The Venn diagram shows a universal set $\mathcal{E}$ and sets A , B and C

The numbers and the letter x represent **numbers** of elements.



Given that $n(A \cup B) = 42$

(a) find the value of x

$x = \dots\dots\dots$
(1)

(b) Find $n(A')$

$\dots\dots\dots$
(1)

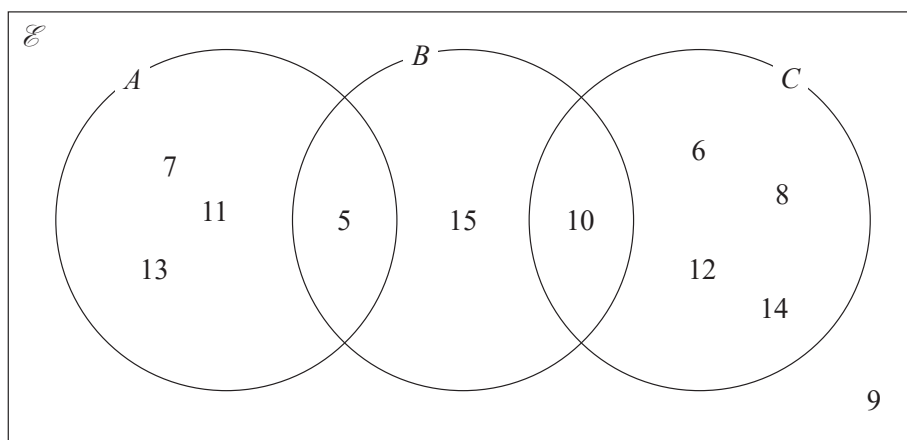
(c) Find $n(B' \cap C)$

$\dots\dots\dots$
(1)

(Total for Question 16 is 3 marks)



2 Here is a Venn diagram.



(a) Write down the numbers that are in the set

(i) A

(1)

(ii) $B \cup C$

(1)

Dominic writes down $9 \notin C$

(b) Explain why Dominic is correct.

(1)

(Total for Question 2 is 3 marks)

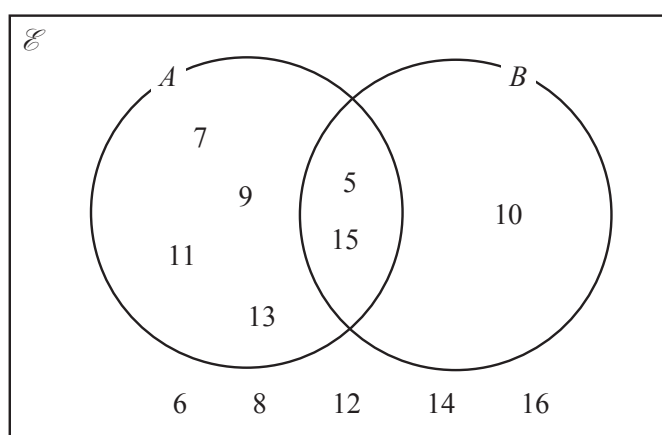


Answer ALL TWENTY FOUR questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 Here is a Venn diagram.



List the members of the set

(a) A

(1)

(b) $A \cap B$

(1)

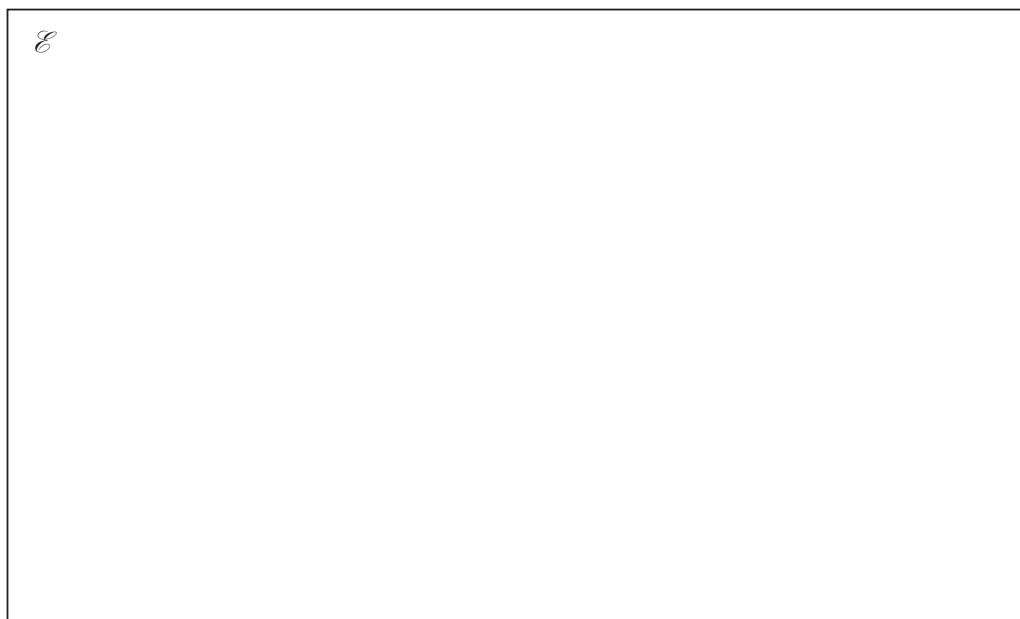
(c) $(A \cup B)'$

(1)

(Total for Question 1 is 3 marks)

- 4 $\mathcal{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$
 $A = \{\text{odd numbers}\}$
 $A \cap B = \{1, 3\}$
 $A \cup B = \{1, 2, 3, 4, 5, 6, 7, 9, 11, 12\}$

Draw a Venn diagram to show this information.



(Total for Question 4 is 4 marks)

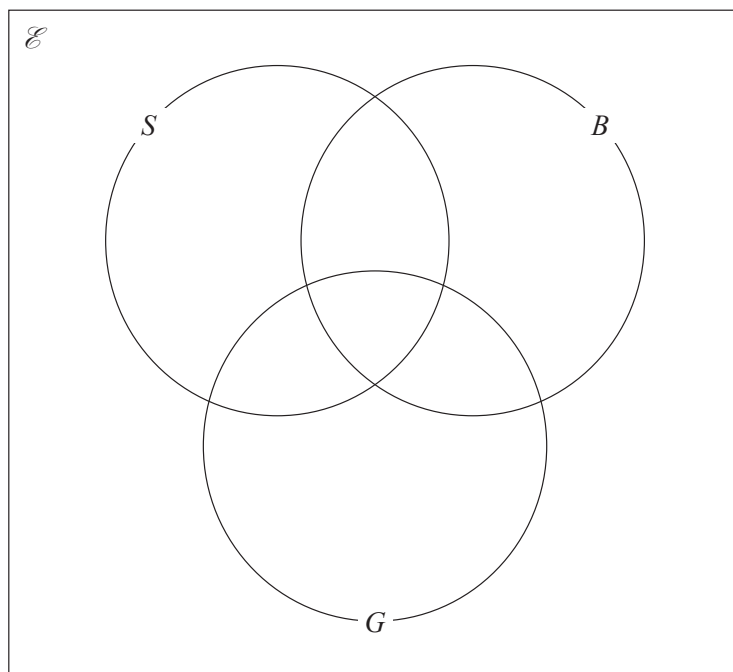


- 16 120 people who visited a sports centre were asked if they went swimming (S), played basketball (B) or used the gym (G).

Their answers showed that

- 28 people went swimming
- 16 people played basketball
- 27 people used the gym
- 3 people went swimming and played basketball
- 5 people played basketball and used the gym
- 7 people went swimming and used the gym
- 2 people went swimming, played basketball and used the gym

- (a) Using this information, complete the Venn diagram to show the number of people in each region of the Venn diagram.



(3)

One of the people who went swimming is chosen at random.

- (b) Find the probability that this person also played basketball.

(1)

(Total for Question 16 is 4 marks)

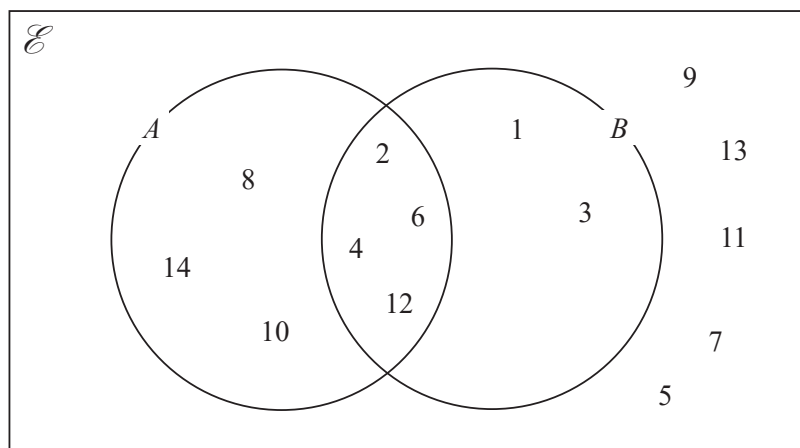


Answer ALL TWENTY FIVE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1 The numbers from 1 to 14 are shown in the Venn diagram.



- (a) List the members of the set $A \cap B$

.....
(1)

- (b) List the members of the set B'

.....
(1)

A number is picked at random from the numbers in the Venn diagram.

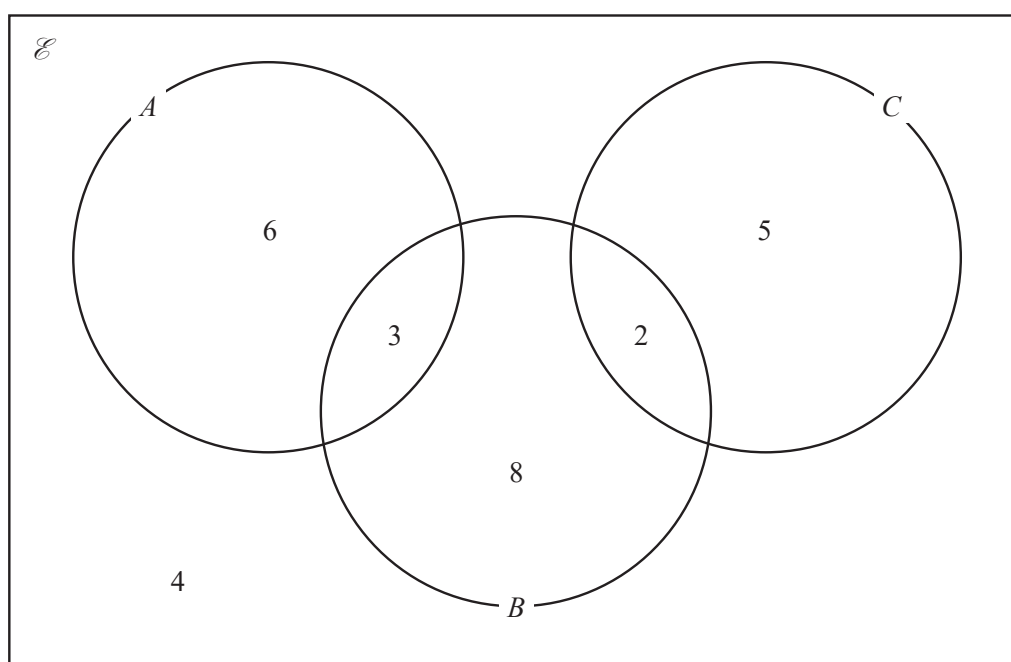
- (c) Find the probability that this number is in set A but is **not** in set B.

.....
(2)

(Total for Question 1 is 4 marks)



17 The Venn diagram shows a universal set $\mathcal{E}$ and three sets A , B and C .



6, 3, 8, 2, 5 and 4 represent the **numbers** of elements.

Find

(i) $n(A \cup B)$

.....
(1)

(ii) $n(A \cap C)$

.....
(1)

(iii) $n(B \cap C')$

.....
(1)

(iv) $n(A' \cup B' \cup C')$

.....
(1)

(Total for Question 17 is 4 marks)



20 A , B and C are three sets.

$$n(A \cap B \cap C) = 5$$

$$n(A \cap B \cap C') = 2$$

$$n(A \cap C) = 5$$

$$n(A) = 17$$

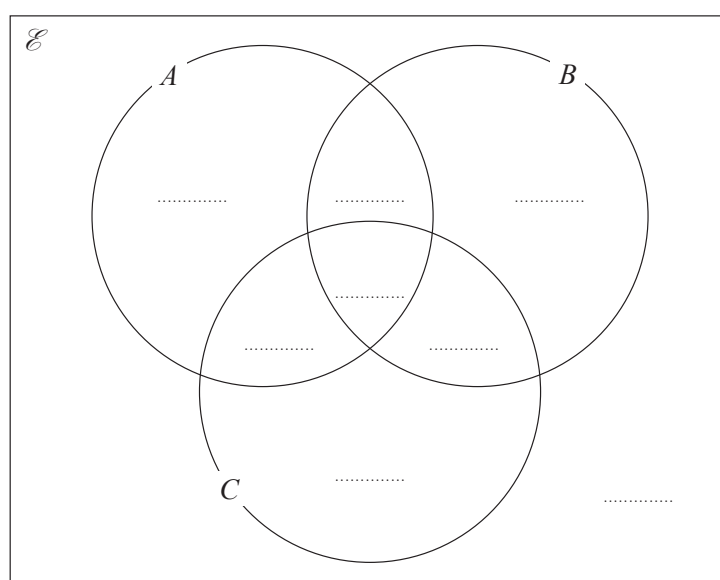
$$n([A \cup B \cup C]') = 3$$

$$n(A' \cap B \cap C') = 6$$

$$n(B \cap C) = 7$$

$$n(C) = 14$$

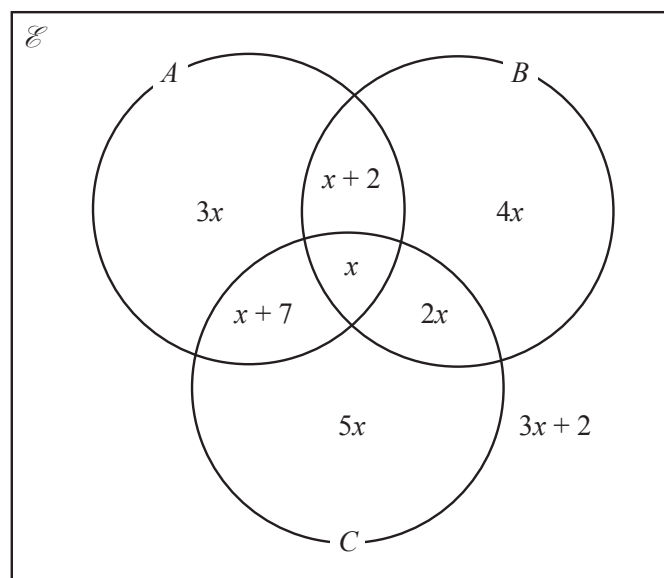
Complete the Venn diagram to show the number of elements in each region.



(Total for Question 20 is 4 marks)



- 21 The Venn diagram shows information about the numbers of items in set A , set B and set C , where x is an integer.



Given that $n(A \cup B)' = 26$

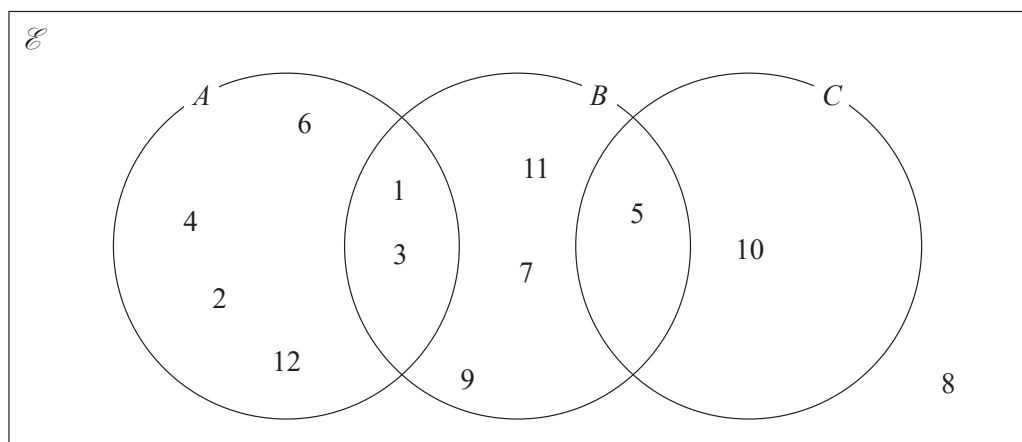
find $n(A' \cap C)$

$$n(A' \cap C) = \dots\dots\dots$$

(Total for Question 21 is 4 marks)



4 Here is a Venn diagram.



(a) Write down the numbers that are in the set

(i) A

(ii) $B \cup C$

(2)

Brian writes down the statement $A \cap C = \emptyset$

(b) Is Brian's statement correct?

You must give a reason for your answer.

(1)

One of the numbers in the Venn diagram is picked at random.

(c) Find the probability that this number is in set C'

(2)

(Total for Question 4 is 5 marks)



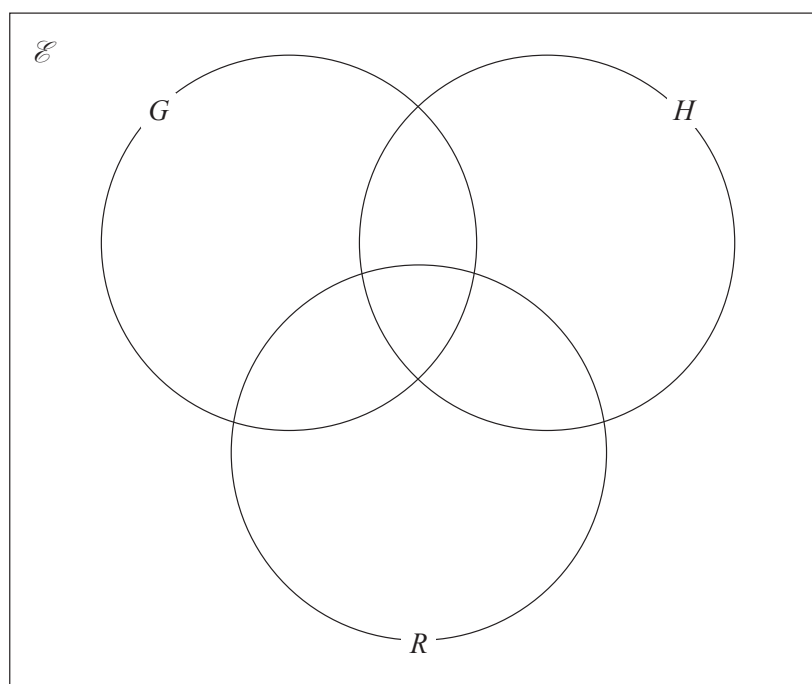
- 13 All the students in Year 11 at a school must study at least one of Geography (G), History (H) and Religious Studies (R).

In Year 11 there are 65 students.

Of these students

- 15 study Geography, History and Religious Studies
- 21 study Geography and History
- 16 study Geography and Religious Studies
- 30 study Geography
- 18 study only Religious Studies
- 37 study Religious Studies

- (a) Using this information, complete the Venn diagram to show the number of students in each region of the Venn diagram.



(3)

A student in Year 11 who studies both History and Religious Studies is chosen at random.

- (b) Work out the probability that this student does **not** study Geography.

(2)

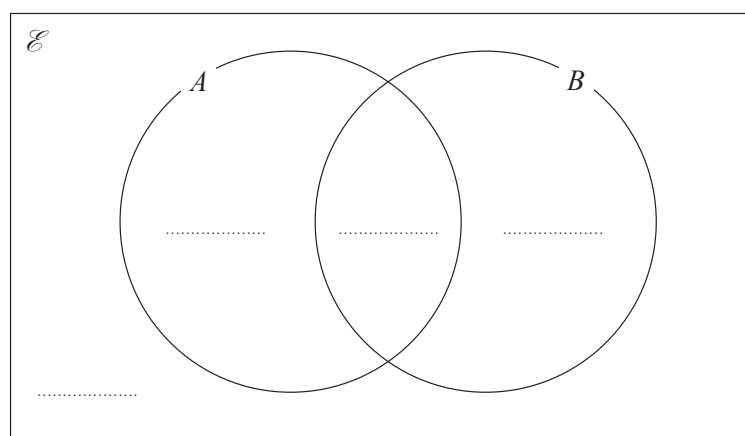
(Total for Question 13 is 5 marks)



16 Two events A and B are such that $n(A) = 62$ $n(B) = 30$ and $n(A \cup B) = 68$

Given that $n(\mathcal{E}) = 80$

(a) complete the Venn diagram to show the number of elements in each region.



(2)

An element is chosen at random from $\mathcal{E}$.

(b) Using the Venn diagram, find the probability that this element is in

(i) $A \cap B$

(1)

(ii) $A \cup B'$

(2)

(Total for Question 16 is 5 marks)



16 There are 32 students in a class.

In one term these 32 students each took a test in Maths (M), in English (E) and in French (F).

25 students passed the test in Maths.

20 students passed the test in English.

14 students passed the test in French.

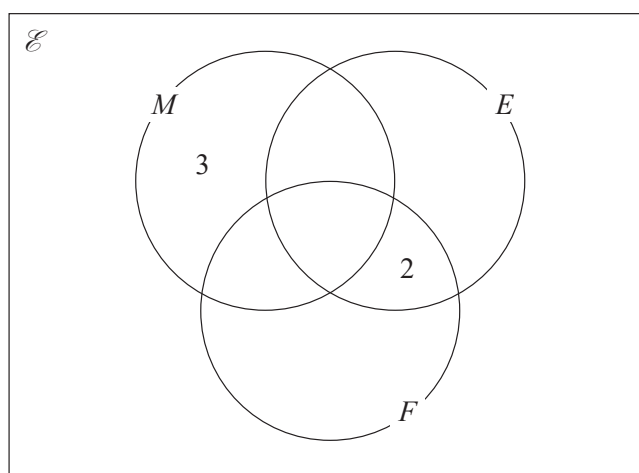
18 students passed the tests in Maths and English.

11 students passed the tests in Maths and French.

4 students failed all three tests.

x students passed all three tests.

The incomplete Venn diagram gives some more information about the results of the 32 students.

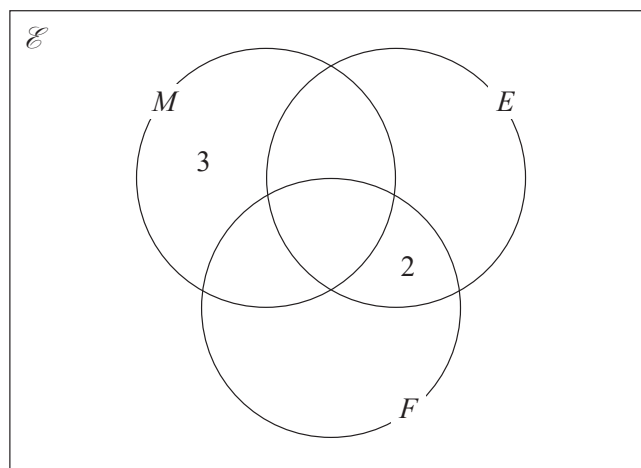


- (a) Use all the given information about the results of students who passed the test in Maths to find the value of x .

$x = \dots\dots\dots$
(2)



- (b) Use your value of x to complete the Venn diagram to show the number of students in each subset.



(2)

A student who passed the test in Maths is chosen at random.

- (c) Find the probability that this student failed the test in French.

(1)

(Total for Question 16 is 5 marks)



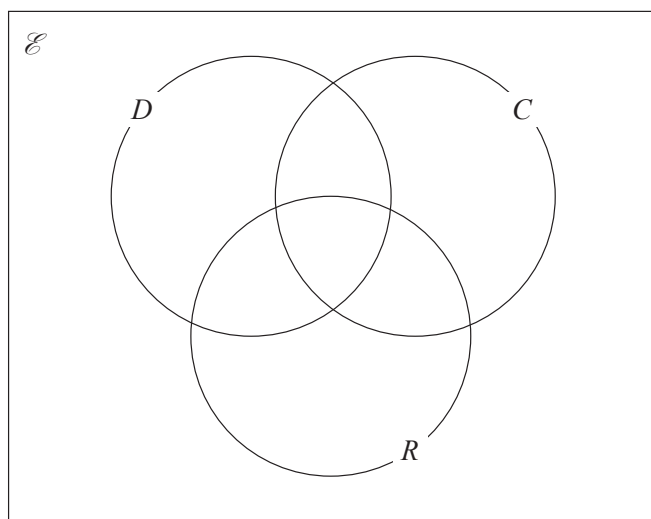
17 Some students in a school were asked the following question.

“Do you have a dog (D), a cat (C) or a rabbit (R)?”

Of these students

- 28 have a dog
- 18 have a cat
- 20 have a rabbit
- 8 have both a cat and a rabbit
- 9 have both a dog and a rabbit
- x have both a dog and a cat
- 6 have a dog, a cat and a rabbit
- 5 have not got a dog or a cat or a rabbit

- (a) Using this information, complete the Venn diagram to show the number of students in each appropriate subset.
Give the numbers in terms of x where necessary.



(3)

Given that a total of 50 students answered the question,

- (b) work out the value of x .

$x = \dots\dots\dots$

(2)



(c) Find $n(C' \cap D')$

.....
(1)

(Total for Question 17 is 6 marks)

18

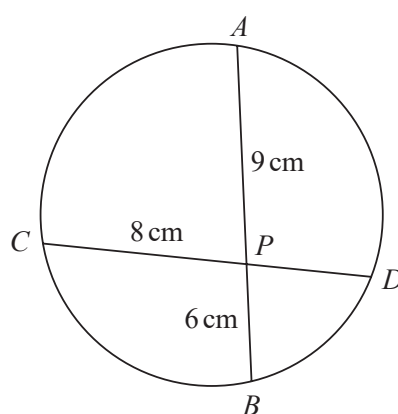


Diagram **NOT**
accurately drawn

APB and CPD are chords of a circle.

$AP = 9 \text{ cm}$ $PB = 6 \text{ cm}$ $CP = 8 \text{ cm}$

Calculate the length of PD .

..... cm

(Total for Question 18 is 2 marks)



16 Some students were asked the following question.

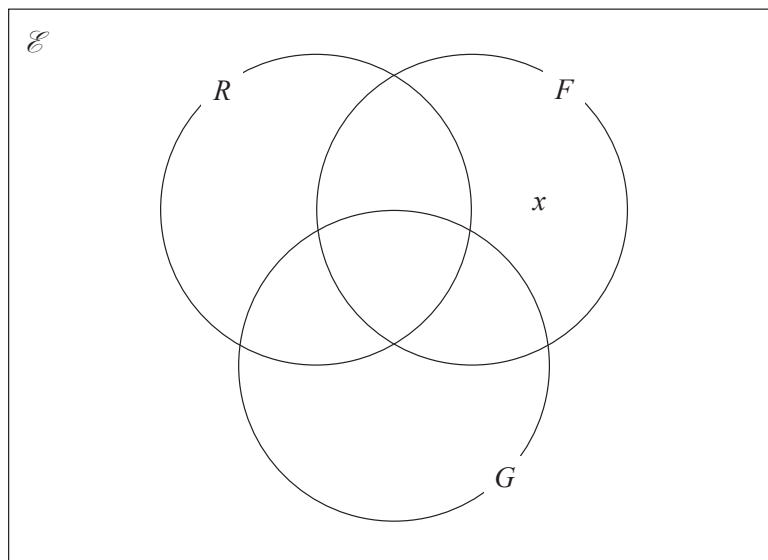
“Which of the subjects Russian (R), French (F) and German (G) do you study?”

Of these students

- 4 study all three of Russian, French and German
- 10 study Russian and French
- 13 study French and German
- 6 study Russian and German
- 24 study German
- 11 study none of the three subjects
- the number who study Russian only is twice the number who study French only.

Let x be the number of students who study French only.

- (a) Show all this information on the Venn diagram, giving the number of students in each appropriate subset, in terms of x where necessary.



(3)

Given that the number of students who were asked the question was 80

- (b) work out the number of these students that study Russian.

(3)

(Total for Question 16 is 6 marks)



20 120 gardeners were asked if they grow carrots (C) or potatoes (P) or tomatoes (T)

Of these gardeners

43 grow carrots

12 grow carrots and potatoes and tomatoes

18 grow carrots and potatoes

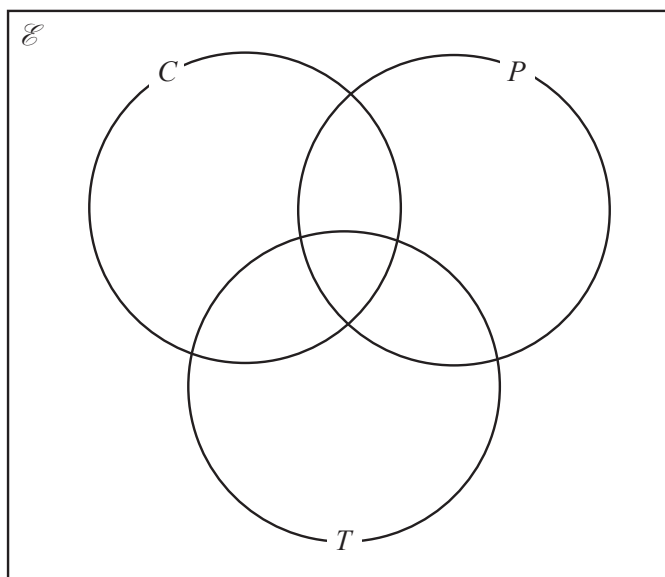
27 grow carrots and tomatoes

32 grow potatoes and tomatoes

29 do not grow carrots or potatoes or tomatoes

The number of these gardeners who grow only potatoes is equal to the number of these gardeners who grow only tomatoes.

(a) Complete the Venn diagram to show this information.



(3)

(b) Find $n(T' \cap C)$

(1)

One of the gardeners who grows carrots is chosen at random.

(c) Calculate the probability that this gardener also grows potatoes.

(2)

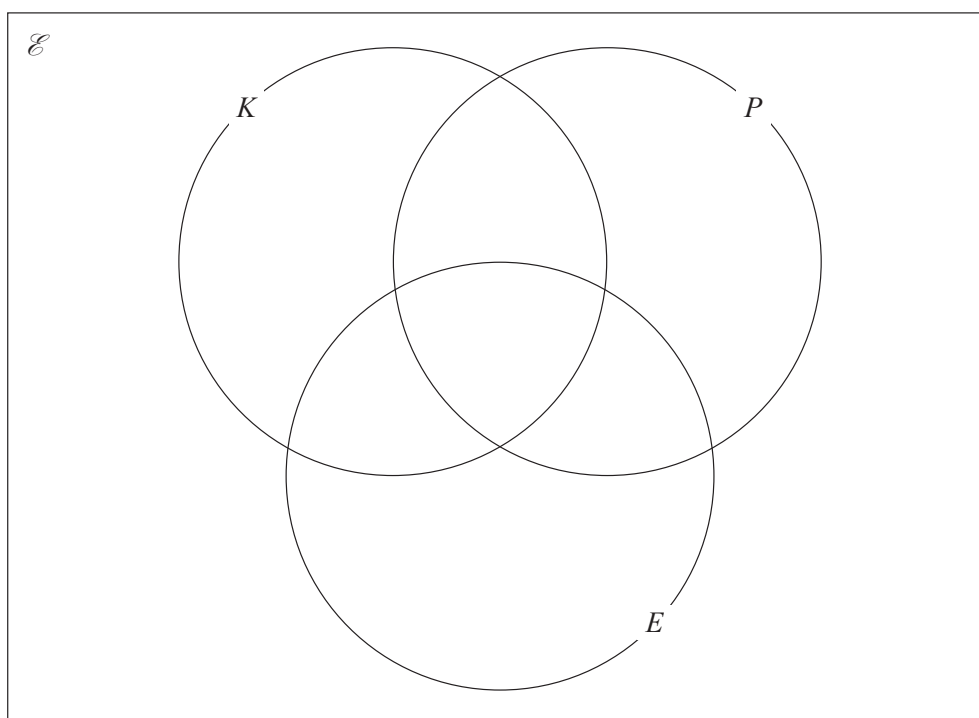
(Total for Question 20 is 6 marks)

- 16 60 art students were asked if they would like to attend workshops for knitting (K), for photography (P) or for embroidery (E)

Of these students

- 9 chose knitting, photography and embroidery
- 17 chose knitting and photography
- 16 chose photography and embroidery
- 20 chose knitting and embroidery
- 28 chose photography
- 39 chose embroidery
- 2 chose none of the workshops

- (a) Using this information, complete the Venn diagram to show the numbers of students in each subset.



(3)



One of the students is chosen at random.

Given that this student chose photography,

(b) find the probability that this student also chose knitting.

.....
(2)

(c) Find $n(P \cap K')$

.....
(1)

(d) Find $n([P \cup E] \cap K)$

.....
(1)

(Total for Question 16 is 7 marks)

17 Q is directly proportional to the square root of d

$$Q = 4.5 \text{ when } d = 324$$

Find a formula for Q in terms of d

.....
(Total for Question 17 is 3 marks)



16 100 farmers are asked if they have goats (G), sheep (S) or chickens (C) on their farms.

Of these farmers

31 have sheep

53 have chickens

6 have goats, sheep and chickens

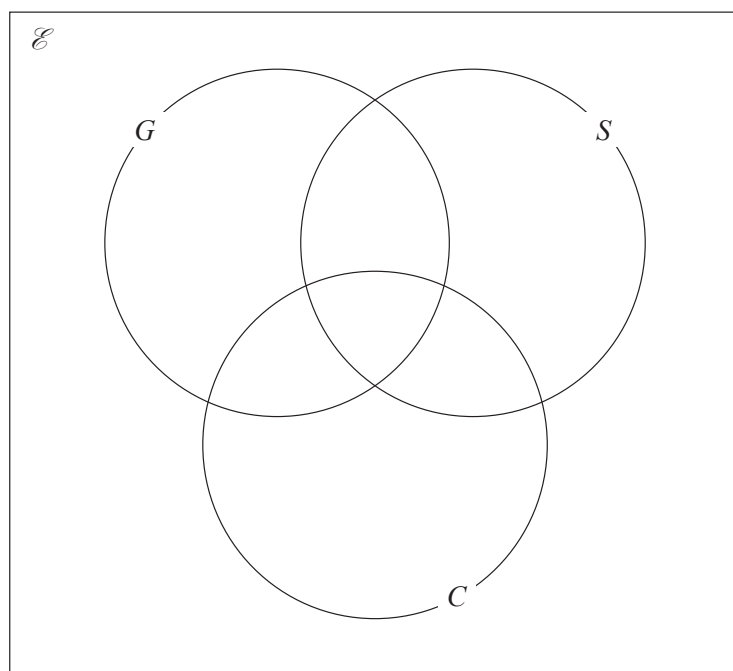
11 have sheep and goats

17 have sheep and chickens

18 have goats and chickens

20 do not have any goats, sheep or chickens

- (a) Using this information, complete the Venn diagram to show the number of farmers in each appropriate subset.



(3)



(b) Find

(i) $n(G)$

.....
(1)

(ii) $n([G \cup S]')$

.....
(1)

(iii) $n(G' \cap C)$

.....
(1)

One of the farmers who has chickens is chosen at random.

(c) Find the probability that this farmer also has goats.

.....
(2)

(Total for Question 16 is 8 marks)

17 M varies directly as the cube of h
 $M = 4$ when $h = 0.5$

Find the value of h when $M = 500$

.....
(Total for Question 17 is 4 marks)



SUB-TOPIC P1d

TREE DIAGRAMS, COMBINED & CONDITIONAL PROBABILITY

Sub-topic P1d · 44 questions · 214 marks · lowest tariff first



16 A box contains 15 counters.

There are 4 red counters, 5 green counters and the rest are yellow counters.

Niklas takes at random a counter from the box and writes down the colour of his counter.
He then puts the counter back into the box.

Sasha then takes at random a counter from the box and writes down the colour of her counter.

Work out the probability that the counters taken by Niklas and Sasha both have the same colour.

.....
(Total for Question 16 is 3 marks)



14 Ciara throws **four** fair six-sided dice.

The faces of each dice are labelled with the numbers 1, 2, 3, 4, 5, 6

Work out the probability that at least one of the dice lands on an even number.

(Total for Question 14 is 3 marks)



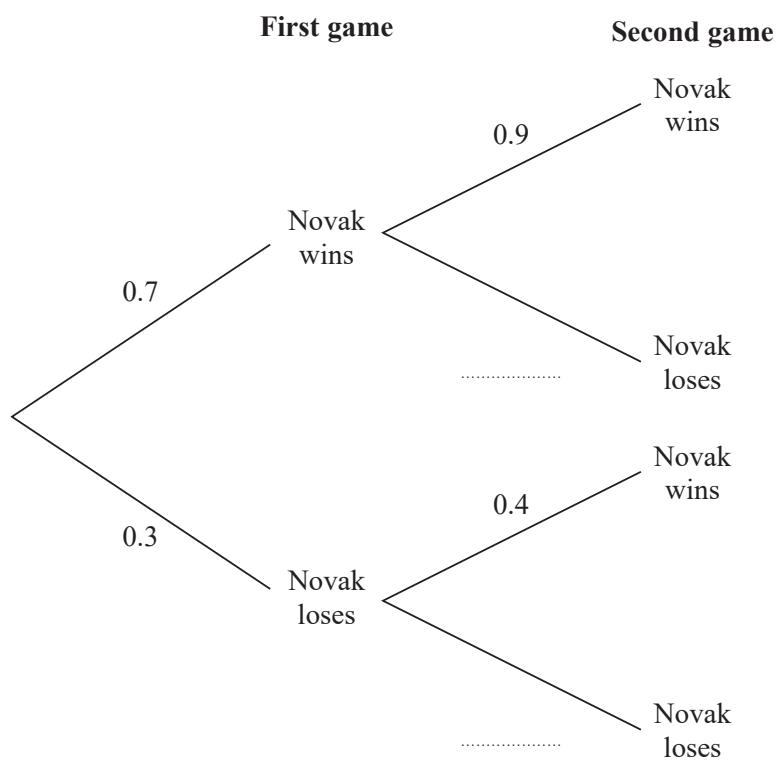
13 Novak is going to play two games of tennis.

The probability that he wins the first game is 0.7

If he wins the first game, the probability that he wins the second game is 0.9

If he loses the first game, the probability that he wins the second game is 0.4

(a) Complete the probability tree diagram.



(1)

(b) Work out the probability that Novak wins both games of tennis.

(2)

(Total for Question 13 is 3 marks)



20 There are 12 counters in a bag.

3 of the counters are red

9 of the counters are green

Ameya, Jack and Ella each take at random one counter from the bag.

Work out the probability that at least one red counter is still in the bag.

.....
(Total for Question 20 is 3 marks)



- 15 Osvaldo has a biased coin.
He spins the coin three times.

The probability that the coin lands on a head three times is $\frac{27}{64}$

Work out the probability that the coin will land on a tail three times.

(Total for Question 15 is 3 marks)



21 A box contains 20 counters.

9 of the counters are red

7 of the counters are yellow

4 of the counters are green

Alex takes at random three counters from the box.

Work out the probability that exactly two of the three counters are the same colour.

(Total for Question 21 is 3 marks)



- 19 Kannika has 9 counters.
There is a number on each counter.



Kannika puts the 9 counters in a bag.
She takes at random a counter from the bag and does not replace the counter.
She then takes at random a second counter from the bag.

Work out the probability that the sum of the numbers on the two counters
is less than 5

(Total for Question 19 is 3 marks)



18 There are 16 sweets in a bowl.

4 of the sweets are blackcurrant.

5 of the sweets are lemon.

7 of the sweets are orange.

Anna, Ravi and Sam each take at random one sweet from the bowl.

Work out the probability that the 5 lemon sweets are still in the bowl.

.....
(Total for Question 18 is 4 marks)



16 Steffi is going to play one game of tennis and one game of chess.

The probability that she will win the game of tennis is 0.6

The probability that she will win **both** games is 0.42

Work out the probability that she will **not** win either game.

(Total for Question 16 is 4 marks)



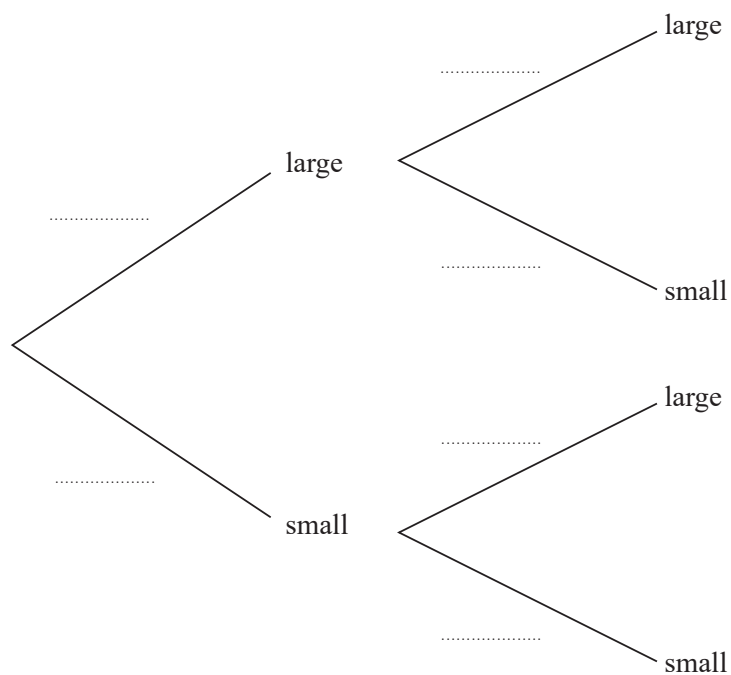
14 There are 20 glasses in a cupboard.

13 of the glasses are large

7 of the glasses are small

Roberto takes at random two glasses from the cupboard.

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that Roberto takes two small glasses.

(2)

(Total for Question 14 is 4 marks)

23 In a bag, there are only

3 blue beads
4 white beads
and x orange beads.

Jean is going to take at random two beads from the bag.

The probability that Jean will take two beads of the same colour is $\frac{3}{8}$

Find the total number of beads in the bag.

Show clear algebraic working.

(Total for Question 23 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS



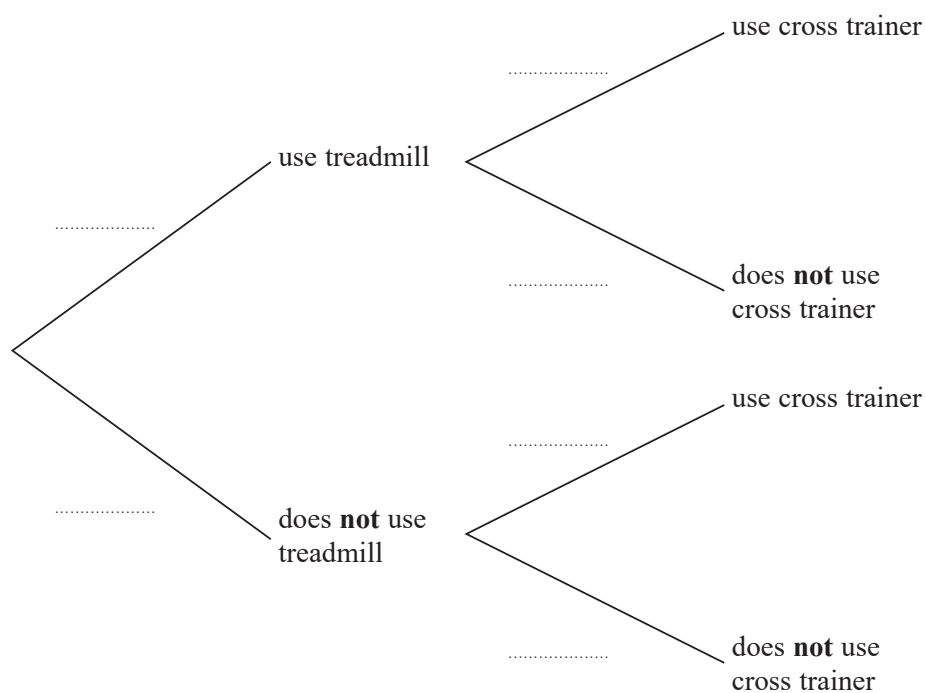
12 Rudolf goes to the gym.

The probability that he will use the treadmill is 0.8

When he uses the treadmill, the probability that he will use the cross trainer is 0.3

When he does **not** use the treadmill, the probability that he will use the cross trainer is 0.6

(a) Complete the probability tree diagram for this information.



(2)

(b) Work out the probability that Rudolf uses both the treadmill and the cross trainer.

(2)

(Total for Question 12 is 4 marks)



- 15 Abraham is going to play a computer game.
Abraham can win the game, draw the game or lose the game.

For any game that Abraham plays

the probability that he wins the game is 0.3
the probability that he draws the game is 0.5
the probability that he loses the game is 0.2

When Abraham wins a game, he scores +10 points.

When Abraham draws a game, he scores 0 points.

When Abraham loses a game, he scores −5 points.

Abraham plays 3 games and the points he scores in each of the 3 games are added together to get his total score.

Work out the probability that when he has played 3 games his total score is 0 points.

(Total for Question 15 is 4 marks)



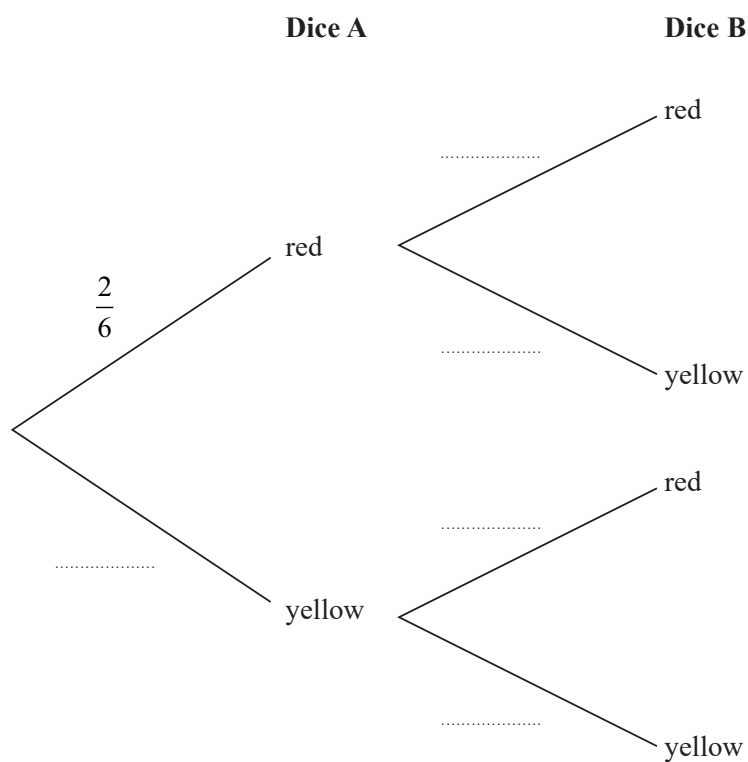
13 Narin has two fair 6-sided dice.

Dice **A** has 2 red faces and 4 yellow faces.

Dice **B** has 1 red face and 5 yellow faces.

Narin is going to throw each dice once.

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that both dice land on yellow.

(2)

(Total for Question 13 is 4 marks)

19 30 adults booked to stay in a hotel.

19 adults booked breakfast

15 adults booked dinner

4 adults did not book breakfast or dinner

Some adults booked breakfast **and** dinner.

Meihui chooses at random two of the 30 adults.

Work out the probability that these two adults each booked breakfast **and** dinner.

.....
(Total for Question 19 is 4 marks)



20 A bag contains only 10 cent coins and 20 cent coins.

Josip takes at random a coin from the bag, records its value and replaces it in the bag.
He then takes at random a second coin from the bag, records its value and replaces it in the bag.

Josip finds the mean value of the two coins.

The probability that the two coins have a mean value of 10 cents is $\frac{49}{121}$

Work out the probability that the two coins have a mean value of 15 cents.

(Total for Question 20 is 4 marks)



16 There are 20 sweets in a box.

15 of the sweets are red

5 of the sweets are yellow

Fred takes at random 3 sweets from the box.

Work out the probability that Fred takes at least one sweet of each colour from the box.

.....
(Total for Question 16 is 4 marks)

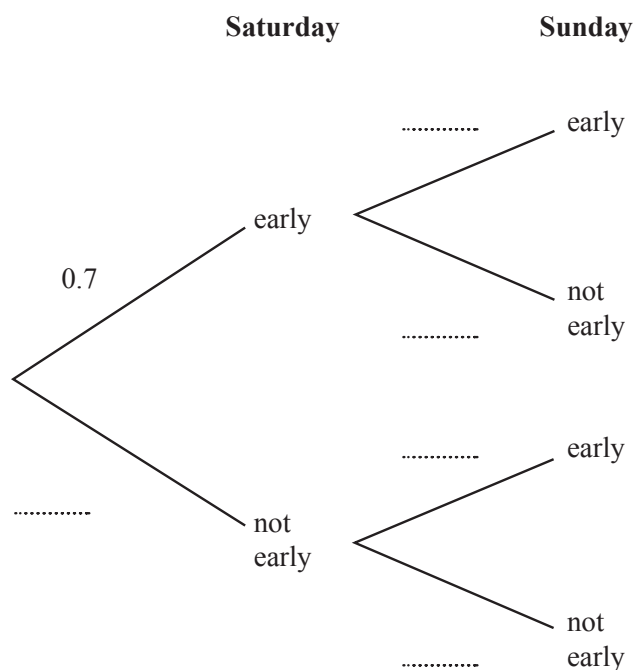


13 The probability that Thomas gets to work early on Saturday is 0.7

If Thomas gets to work early on Saturday, the probability that he will get to work early on Sunday is 0.9

If Thomas does **not** get to work early on Saturday, the probability that he will get to work early on Sunday is 0.6

(a) Use this information to complete the probability tree diagram.



(2)

(b) Work out the probability that Thomas gets to work early on both Saturday and Sunday.

(2)

(Total for Question 13 is 4 marks)



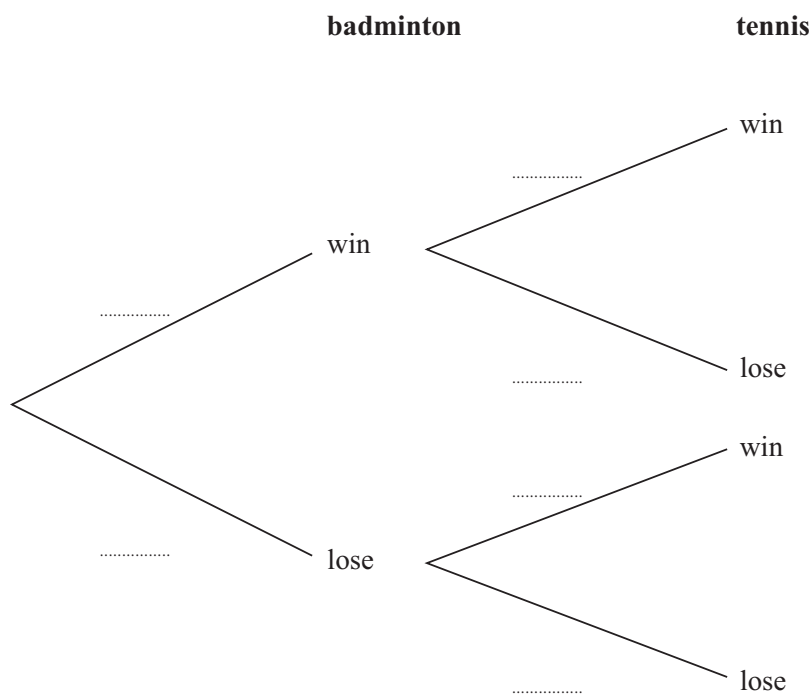
14 Ricardo is going to play one game of badminton and one game of tennis.

He can either win or lose each game.

The probability that he will win the game of badminton is 0.7

The probability that he will win the game of tennis is 0.4

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that Ricardo loses both games.

(2)

(Total for Question 14 is 4 marks)



13 Felix has 10 cards.

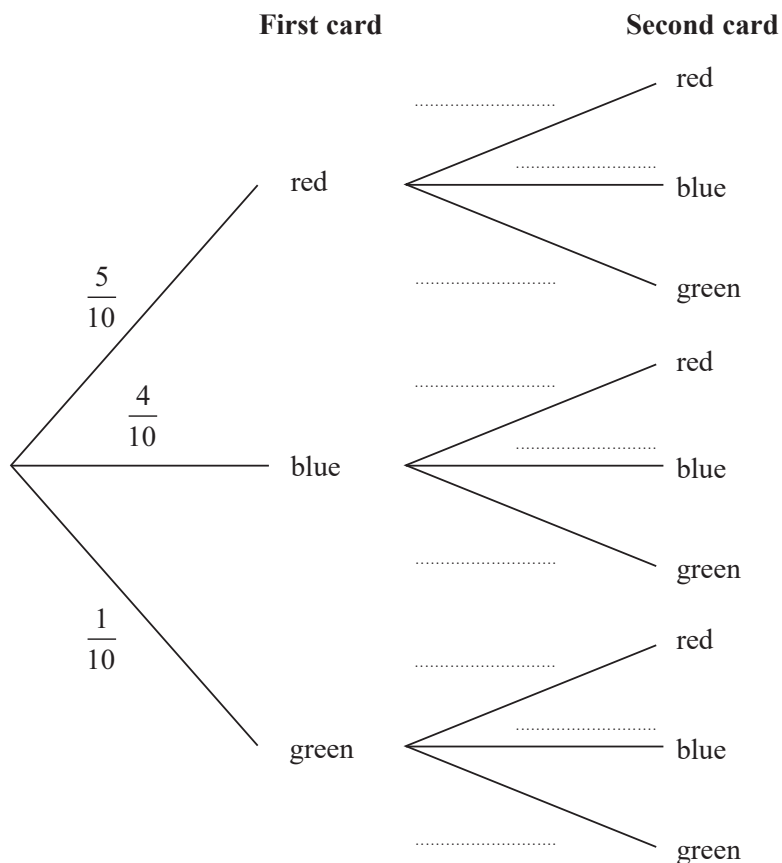
There are 5 red cards, 4 blue cards and 1 green card.

Felix takes at random one of the cards.

He does not replace the card.

Felix then takes at random a second card.

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that Felix takes at least one blue card and no green card.

(3)

(Total for Question 13 is 5 marks)



16 There are 12 beads in a bag.

7 of the beads are red.

3 of the beads are green.

2 of the beads are yellow.

Lucy takes at random a bead from the bag and keeps it.

Then Julian takes at random a bead from the bag.

(a) Work out the probability that they each take a yellow bead.

(2)

(b) Work out the probability that the beads they take are **not** the same colour.

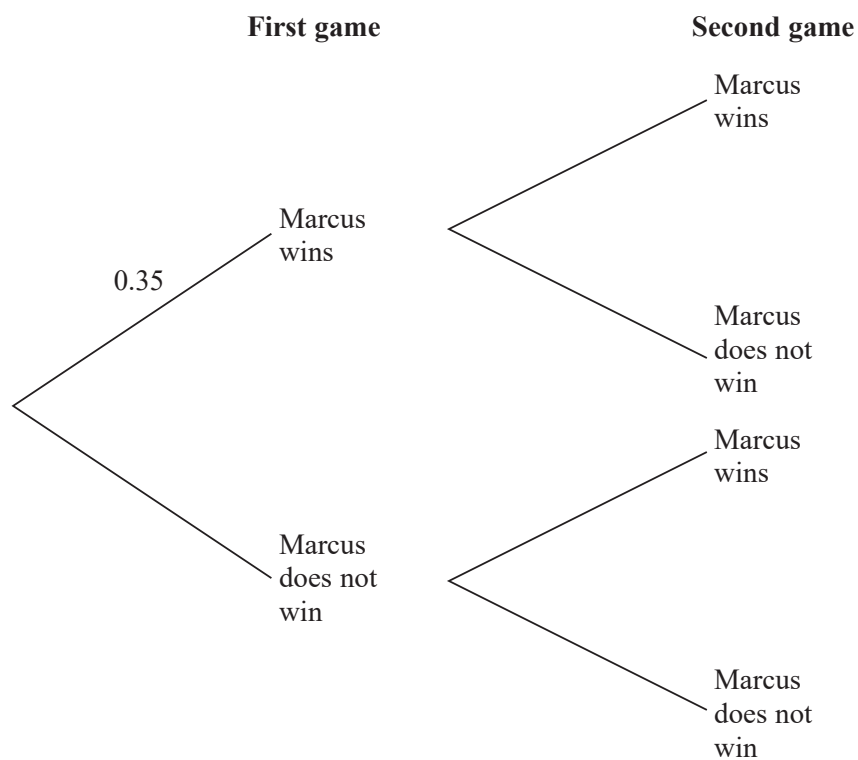
(3)

(Total for Question 16 is 5 marks)



- 14 Marcus plays two games of tennis.
For each game, the probability that Marcus wins is 0.35

(a) Complete the probability tree diagram.



(2)

- (b) Work out the probability that Marcus wins at least one of the two games of tennis.

(3)

(Total for Question 14 is 5 marks)



15 Barney has a biased coin.

When the coin is thrown once, the probability that the coin will land heads is 0.3

Barney throws the coin 4 times.

(a) Work out the probability that the coin will land heads exactly 3 times.

(3)

(b) Work out the probability that the coin will land heads at least once.

(2)

(Total for Question 15 is 5 marks)



23 Boris has a bag that only contains red sweets and green sweets.

Boris takes at random 2 sweets from the bag.

The probability that Boris takes exactly 1 red sweet from the bag is $\frac{12}{35}$

Originally there were 3 red sweets in the bag.

Work out how many green sweets there were originally in the bag.
Show your working clearly.

.....
(Total for Question 23 is 5 marks)



24 A box contains marbles.

4 of the marbles are red.

The rest of the marbles are yellow.

Antonia takes at random a marble from the box and does not replace it.

Sergio then takes at random a marble from the box.

The probability that Antonia and Sergio both take a yellow marble is 0.7

Work out how many marbles were originally in the box.

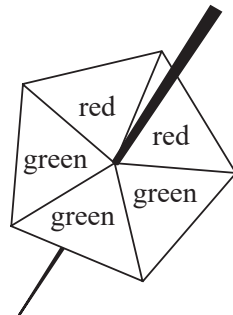
Show your working clearly.

(Total for Question 24 is 5 marks)

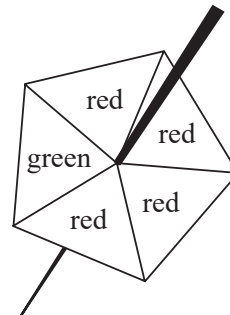
TOTAL FOR PAPER IS 100 MARKS



15 Harry has two fair 5-sided spinners.



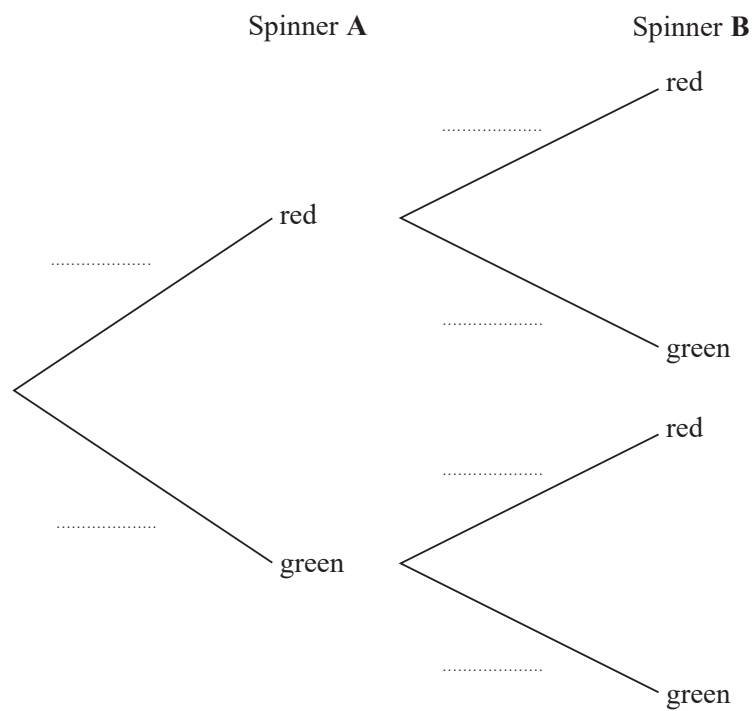
Spinner A



Spinner B

Harry is going to spin each spinner once.

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that at least one of the spinners will land on green.

.....
(3)

(Total for Question 15 is 5 marks)



20 A bag contains X counters.

There are only red counters and blue counters in the bag.

There are 4 more blue counters than red counters in the bag.

Finty takes at random 2 counters from the bag.

The probability that Finty takes 2 blue counters from the bag is $\frac{3}{8}$

Work out the value of X .

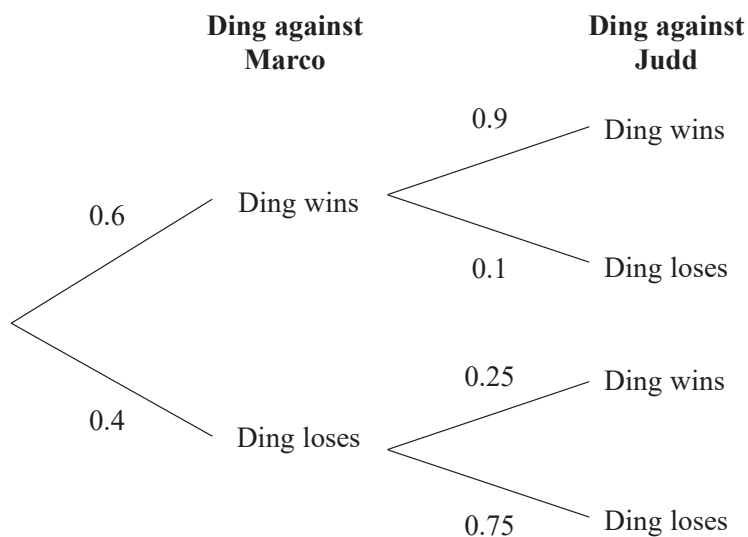
Show clear algebraic working.

(Total for Question 20 is 5 marks)



- 14 Ding is going to play one game of snooker against each of two of his friends, Marco and Judd.

The probability tree diagram gives information about the probabilities that Ding will win or lose each of these two games.



- (a) Work out the probability that Ding will win both games.

.....
(2)

- (b) Work out the probability that Ding will win exactly one of the games.

.....
(3)

(Total for Question 14 is 5 marks)



23 Pippa has a box containing N pens.

There are only black pens and red pens in the box.

The number of black pens in the box is 3 more than the number of red pens.

Pippa is going to take at random 2 pens from the box.

The probability that she will take a black pen **followed** by a red pen is $\frac{9}{35}$

Find the possible values of N .

Show clear algebraic working.



.....

(Total for Question 23 is 5 marks)

TOTAL FOR PAPER IS 100 MARKS



24 Elliot has x counters.

Each counter has one red face and one green face.

Elliot spreads all the counters out on a table and sees that the number of counters showing a red face is 5

Elliot then picks at random one of the counters and turns the counter over.
He then picks at random a second counter and turns the counter over.

The probability that there are still 5 counters showing a red face is $\frac{19}{32}$

Work out the value of x
Show clear algebraic working.

$x = \dots\dots\dots$

(Total for Question 24 is 5 marks)



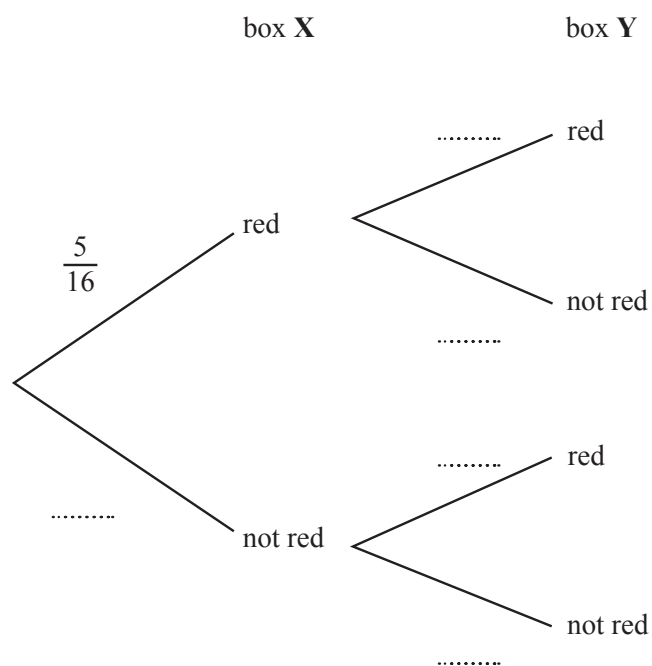
11 Sid has 2 boxes of crayons, box X and box Y

5 of the 16 crayons in box X are red.

7 of the 20 crayons in box Y are red.

Sid takes at random one crayon from box X and one crayon from box Y

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that Sid takes two crayons that are red or two crayons that are not red.

(3)

(Total for Question 11 is 5 marks)



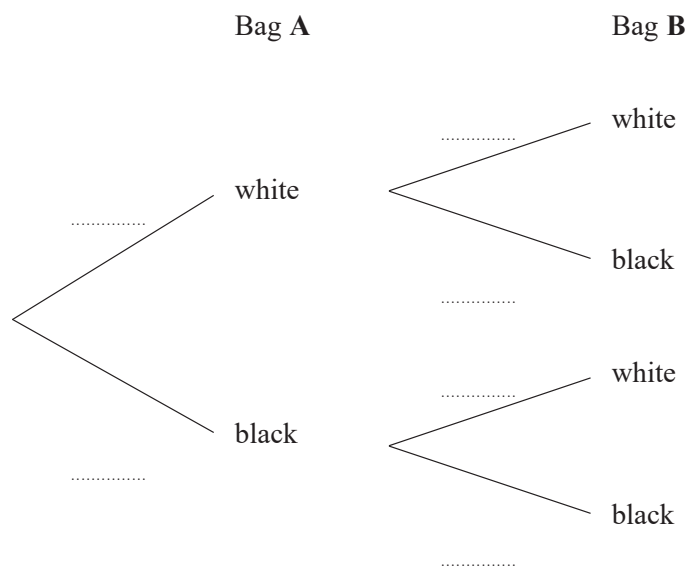
13 Harman has two bags of beads.

In bag **A**, there are 3 white beads and 7 black beads.

In bag **B**, there are 5 white beads and 4 black beads.

Harman takes at random a bead from bag **A** and a bead from bag **B**

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that Harman takes two beads of the same colour.

(3)

(Total for Question 13 is 5 marks)

21 There are 25 counters in a bag such that

6 counters are blue

x counters are orange, where $x > 9$

the rest of the counters are pink

Maalam takes at random two of the counters from the bag.

The probability that Maalam takes one orange counter and one pink counter is $\frac{22}{75}$

Calculate the probability that Maalam takes 2 pink counters from the bag.

Show clear algebraic working.

(Total for Question 21 is 5 marks)



- 20** A bowl contains n pieces of fruit.
Of these, 4 are oranges and the rest are apples.

Two pieces of fruit are going to be taken at random from the bowl.

The probability that the bowl will then contain $(n - 6)$ apples is $\frac{1}{3}$

Work out the value of n

Show your working clearly.

(Total for Question 20 is 6 marks)

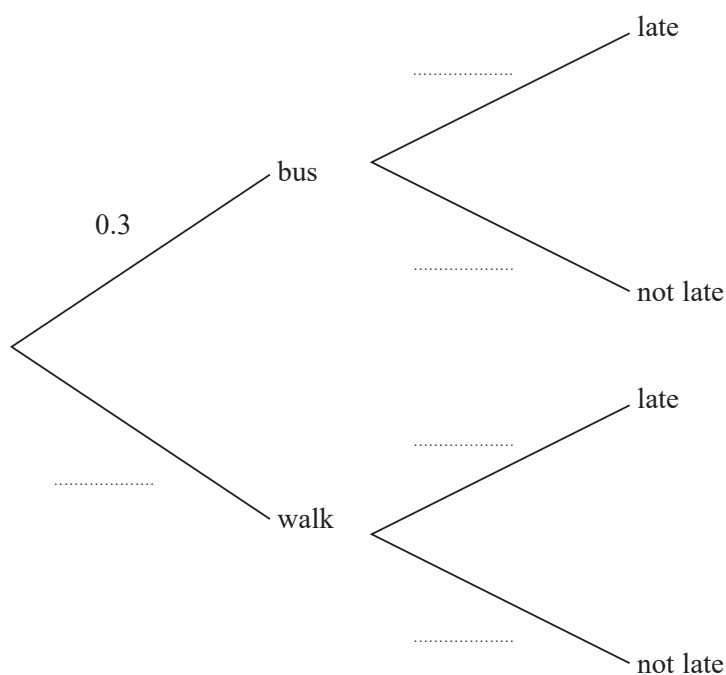


- 14 Each day that Barney goes to college, he either goes by bus or he walks.
The probability that Barney will go to college by bus on any day is 0.3

When Barney goes to college by bus, the probability that he will be late is 0.2

When Barney walks to college, the probability that he will be late is 0.1

- (a) Complete the probability tree diagram.



(2)

Barney will go to college on 200 days next year.

- (b) Work out an estimate for the number of days Barney will be late for college next year.

(4)

(Total for Question 14 is 6 marks)



- 21 A bag contains n beads.
6 of the beads are red and the rest are blue.

Ravi is going to take at random 2 beads from the bag.

The probability that the 2 beads will be of the same colour is $\frac{9}{17}$

Using algebra, and showing each stage of your working, calculate the value of n .



$$n = \dots\dots\dots$$

(Total for Question 21 is 6 marks)

Turn over for Question 22



- A team is made by picking at random one child from group C and one child from group D.

group C

girl

boy

group D

girl

boy

girl

boy

(b) Work out the probability that there are two boys in the team.



After the first team has been picked, a second team is picked.
One child is picked at random from the children left in group **C** and one child is picked at random from the children left in group **D**.

(c) Work out the probability that there are two boys in each of the two teams.

.....
(3)

(Total for Question 13 is 7 marks)

14 $\mathcal{E} = \{\text{positive integers less than } 20\}$

$$A = \{x : x < 12\}$$

$$B = \{x : 7 \leq x < 16\}$$

(a) List the members of $A \cap B$

.....
(2)

C is a set such that $C \subset A$ and $n(C) = 3$

Given that all members of C are even numbers,

(b) list the members of one possible set C .

.....
(1)

(Total for Question 14 is 3 marks)



15 Here are 9 cards. Each card has either a number on it or a letter on it.

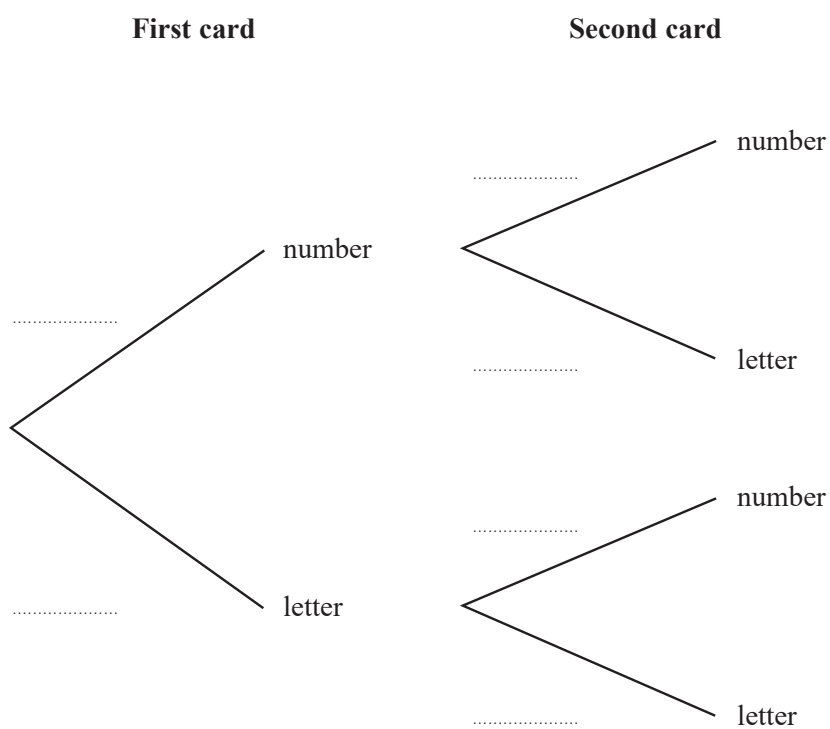


Tomas is playing a game.

Tomas takes at random one of the cards and keeps it.

Tomas then takes at random another card and keeps it.

(a) Complete the probability tree diagram.



(2)



(b) Work out the probability that each of the two cards has a number on it.

.....
(2)

(c) Work out the probability that there will be one card with a number on it and one card with a letter on it.

.....
(3)

(Total for Question 15 is 7 marks)



14 Sara has two bags, **A** and **B**

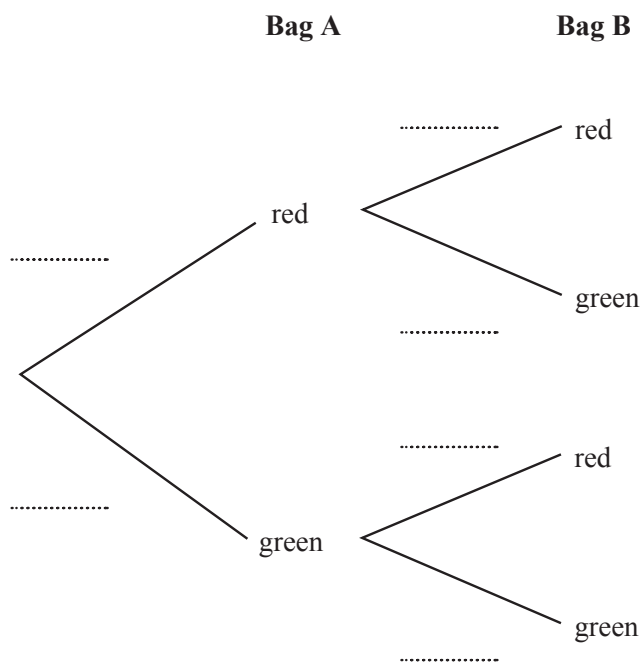
In bag **A**, there are only 5 red beads and 4 green beads.

In bag **B**, there are only 7 red beads and 3 green beads.

Sara takes at random a bead from bag **A**

She then takes at random a bead from bag **B**

(a) Use this information to complete the probability tree diagram.



(2)

(b) Work out the probability that Sara takes two red beads.

(2)



Sara puts the beads back into their original bags.

Sara also has a box of beads.

In the box, there are only red beads and green beads.

When a bead is taken at random from the box, the probability that it is

a green bead is $\frac{2}{11}$

Sara takes at random a bead from bag **A**

She then takes at random a bead from bag **B**

She then takes at random a bead from the box.

(c) Work out the probability that Sara takes more red beads than green beads.

.....
(3)

(Total for Question 14 is 7 marks)



15 There are two bags of counters, bag X and bag Y.

There are 20 counters in bag X.

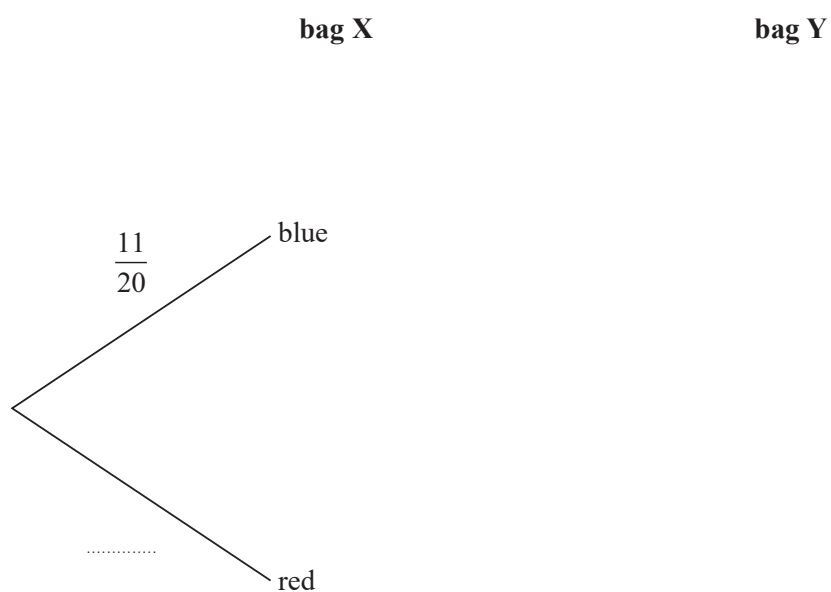
11 of the counters are blue and the rest are red.

There are 16 counters in bag Y.

9 of the counters are blue and the rest are red.

Arkady takes at random a counter from bag X and takes at random a counter from bag Y.

(a) Complete the probability tree diagram.



(3)



(b) Work out the probability that the two counters are both red.

.....
(2)

(c) Work out the probability that the two counters are both red or are both blue.

.....
(3)

(Total for Question 15 is 8 marks)



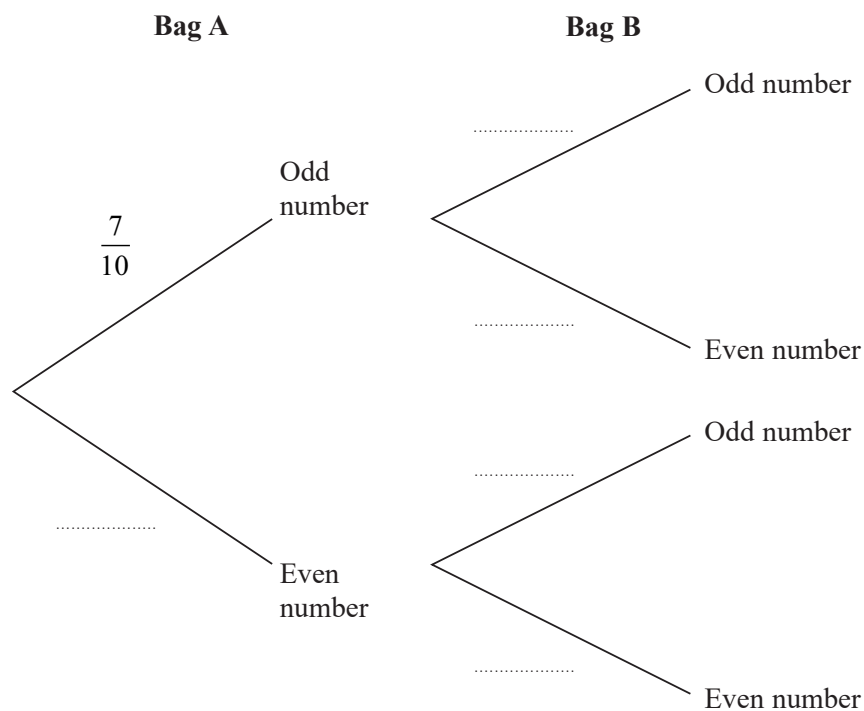
16 Cody has two bags of counters, bag A and bag B.

Each of the counters has either an odd number or an even number written on it.

There are 10 counters in bag **A** and 7 of these counters have an **odd** number written on them.
There are 12 counters in bag **B** and 7 of these counters have an **odd** number written on them.

Cody is going to take at random a counter from bag A and a counter from bag B.

(a) Complete the probability tree diagram.



(2)

- (b) Calculate the probability that the total of the numbers on the two counters will be an odd number.

.....
(3)

Harriet also has a bag of counters.

Each of her counters also has either an odd number or an even number written on it.

Harriet is going to take at random a counter from her bag of counters.

The probability that the number on each of Cody's two counters **and** the number on

Harriet's counter will all be even is $\frac{3}{100}$

- (c) Find the least number of counters that Harriet has in her bag.
Show your working clearly.

.....
(3)

(Total for Question 16 is 8 marks)



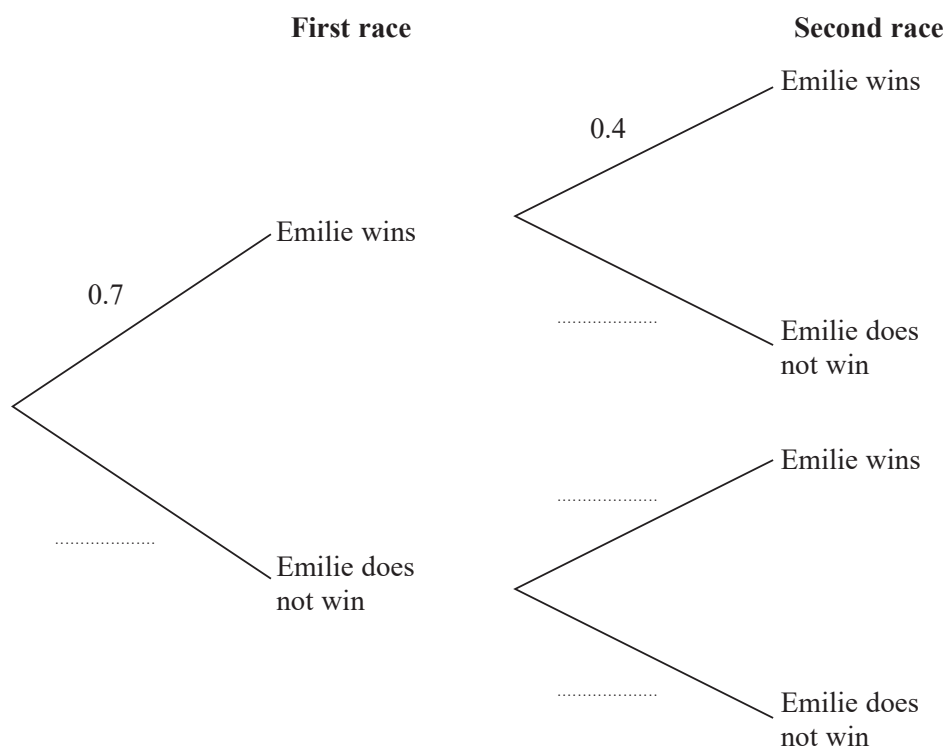
13 Emilie takes part in two races.

The probability that she wins the first race is 0.7

The probability that she wins the second race is 0.4

The outcomes of the two races are independent.

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that Emilie wins exactly one of the two races.

(3)

Emilie is going to take part in a third race.

If she wins both of the first two races, the probability that she will win the third race is 0.6

If she wins exactly one of the first two races, the probability that she will win the third race is 0.3

(c) Work out the probability that Emilie will win exactly two of the three races.

.....
(3)

(Total for Question 13 is 8 marks)



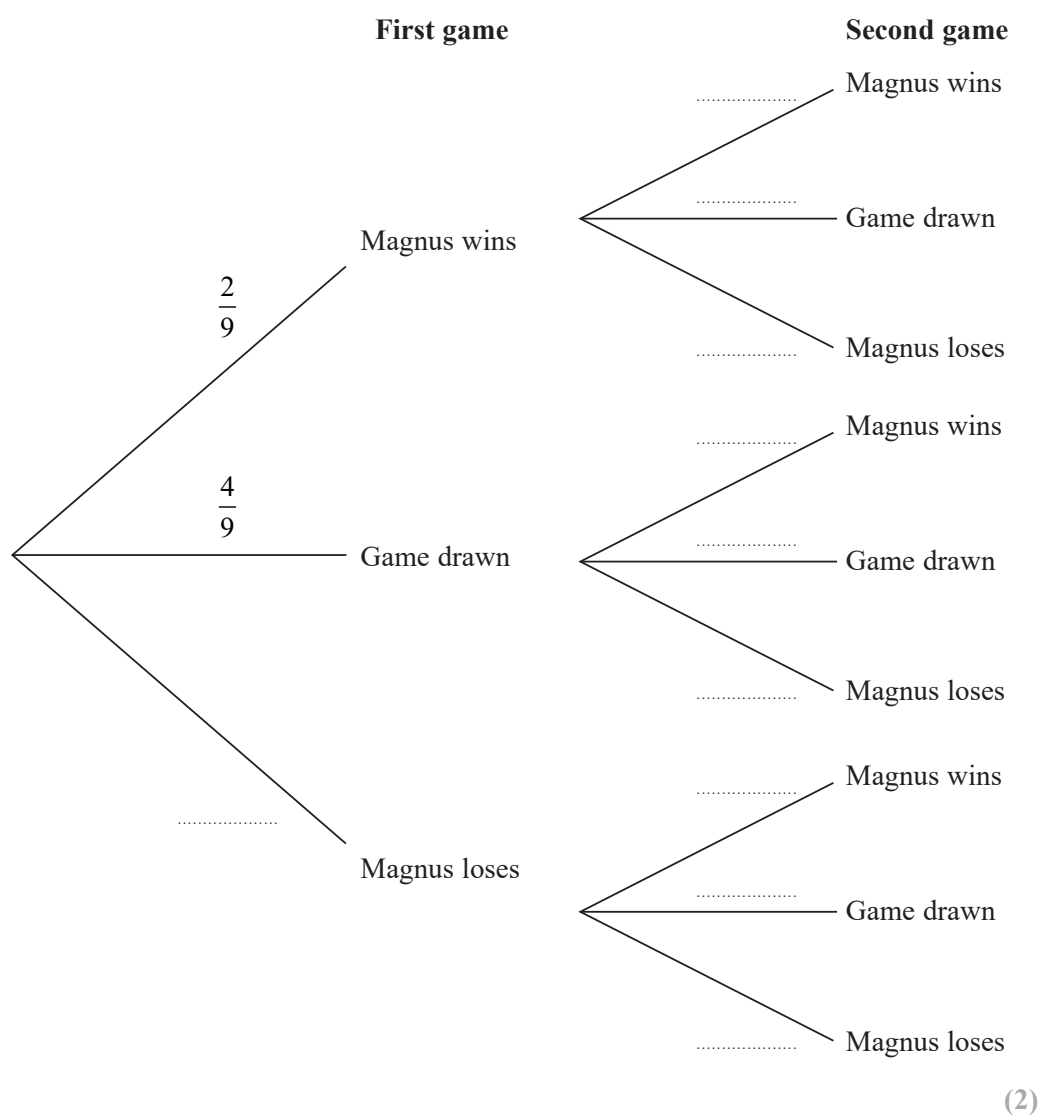
15 Magnus and Garry play 2 games of chess against each other.

The probability that Magnus beats Garry in any game is $\frac{2}{9}$

The probability that any game between Magnus and Garry is drawn is $\frac{4}{9}$

The result of any game is independent of the result of any other game.

(a) Complete the probability tree diagram.



For each game of chess,

the winner gets 2 points and the loser gets 0 points,
when the game is drawn, each player gets 1 point.

- (b) Work out the probability that, after 2 games, Magnus and Garry have the same number of points.

.....
(3)

Magnus and Garry now play a third game of chess.

- (c) Work out the probability that, after 3 games, Magnus and Garry have the same number of points.

.....
(3)

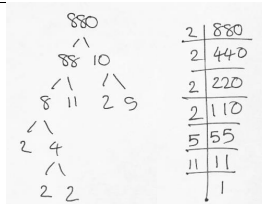
.....
(Total for Question 15 is 8 marks)

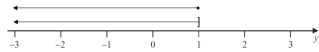


MARK SCHEMES

official mark schemes, in the same order as the questions



International GCSE Maths				
Apart from questions 2, 6, 15, 18 and 26, the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method.				
Q	Working	Answer	Mark	Notes
1	0.4×280 oe		2	M1
		112		A1 cao SC B1 for 168
				Total 2 marks
2	 Factor tree for 880: $880 \rightarrow 88 \times 10 \rightarrow 8 \times 11 \times 2 \times 5 \rightarrow 2 \times 2 \times 2 \times 11 \times 5$ Division table for 880: $\begin{array}{r} 2 \overline{) 880} \\ 2 \overline{) 440} \\ 2 \overline{) 220} \\ 2 \overline{) 110} \\ 5 \overline{) 55} \\ 11 \overline{) 11} \\ \downarrow \\ 1 \end{array}$		3	M1 for continual prime factorisation (at least two correct steps anywhere) or at least two stages of a factor tree, or table, correct. eg if first stage wrong, 800×80 then $800 = 80 \times 10$ and $80 = 40 \times 2$ would count as 2 correct steps.
				M1 dep M1 for a fully correct factor tree or a list (2,2,2,2,5,11) condone inclusion of 1's on branch ends. or $2 \times 2 \times 2 \times 2 \times 5 \times 11$
		$2^4 \times 5 \times 11$		A1 dep M2 for $2^4 \times 5 \times 11$ (with working seen)
				Total 3 marks

International GCSE Maths				
Apart from Questions 10, 14, 15, 22, 24 the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method.				
Q	Working	Answer	Mark	Notes
1 (a)		-2, -1, 0, 1, 2	2	B2 for -2, -1, 0, 1, 2 with no additions or repeats (B1 for 4 of -2, -1, 0, 1, 2 with no additions or repeats or for 6 values with no more than one incorrect value e.g. all of -2, -1, 0, 1, 2, 3 or for 5 values with one error)
(b)		Closed circle at $x = 1$ and a line with an arrow to the left	1	B1 for a closed circle at $x = 1$ and a line with an arrow of any length to the left Allow] for a closed circle Allow a line without an arrow if it reaches to at least -3
				Total 3 marks

2	0.65×300 oe			M1
		195		A1 (SCB1 for 105)
				Total 2 marks



5	eg $0.74 \times 300 (= 222)$ or $1 - 0.74 (= 0.26)$ seen or $\frac{78}{300}$		2	M1 for a method to work out an estimate for the number of games Evie will win or the probability that Evie will lose or an answer of $\frac{78}{300}$
	Correct answer scores full marks (unless from obvious incorrect working)	78		A1 cao
Total 2 marks				

6	(a)	m^7	1	B1
	(b)	8	1	B1 Allow k^8
	(c)	$9x^{12}y^{16}$	2	B2 B1 for a product in the form $ax^p y^q$ where 2 from a , p or q are correct eg $3x^{12}y^{16}$ (Allow $9x^{12}$ or $9y^{16}$ or $x^{12}y^{16}$ so as long as not added to any other terms)
Total 4 marks				

7	(a)	$4x^2 - 20x$	1	B1 $or -20x + 4x^2$
	(b)	$(y \pm 5)(y \pm 4)$ or $(5 \pm y)(4 \pm y)$ or $y(y - 4) - 5(y - 4)$ or $y(y - 5) - 4(y - 5)$	2	M1 for $(y \pm 5)(y \pm 4)$ or $(5 \pm y)(4 \pm y)$ or for $(y + a)(y + b)$ where $ab = 20$ or $a + b = -9$
	Correct answer scores full marks (unless from obvious incorrect working)	$(y - 5)(y - 4)$		A1 oe Allow any letter for y Accept $(5 - y)(4 - y)$
Total 3 marks				

Question		Working	Answer	Mark	Notes	
3	(a)		-5, 5, 5, -5	2	B2	All 4 correct values If not B2 then B1 for 2 or 3 correct values
	(b)		Fully correct curve	2	M1 A1	Plotting at least 6 points correctly from their table dep on B1 in part(a) Do not accept horizontal line at top of curve or straight line segments
Total 4 marks						
4	(a)	$40 \div 16 \times 12$ oe	30	2	M1 A1	$40 \times \frac{12}{16}$ oe
	(b)	$525 \div 100^2$	0.0525 oe	2	M1 A1	$\frac{525}{100^2}$ Accept 5.25×10^{-2}
Total 4 marks						
5			$(x + 4)(x - 9)$	2	M1 A1	For $(x + a)(x + b)$ where $ab = -36$ and a and b are integers Ignore extension to roots $x = -4$ & 9
						Total 2 marks
6		$P(\text{mint}) = 1 - (0.35 + 0.32 + 0.12) (= 0.21)$ $P(\text{strawberry or mint}) = 0.32 + 0.21$	0.53 oe	3	M1 M1 A1	Or a correct equation summing to 1 Dep Allow 0.53/1
						Total 3 marks
7		$55 \div (6 + 3 + 2) (= 5)$ $(6 \times "5") - (2 \times "5")$	20	3	M1 M1 A1	Or $\frac{4}{11} \times 55 (= 30)$ or $\frac{2}{11} \times 55 (= 10)$ Or M2 for Won = 30 and Lost = 10 (can be seen in a ratio 30 : 15 : 10)
						Total 3 marks

2	1 – (0.32 + 0.13 + 0.28) oe eg 1 – 0.73 (= 0.27) or 0.32 × 200 (= 64) or 0.13 × 200 (= 26) or 0.28 × 200 (= 56) or 0.73 × 200 (= 146)		3	M1 (0.27 may be seen in table) [could work with percentages eg 100 – 32 – 13 – 28 (=27)]
	[1 – “0.73”] × 200 oe eg “0.27” × 200 or 200 – “64” – “26” – “56” or 200 – “146”			M1 for a complete method or for an answer of $\frac{54}{200}$
	Correct answer scores full marks (unless from obvious incorrect working)	54		A1
				Total 3 marks

13	$\frac{60}{360} \times 2 \times \pi \times r$ oe or $\frac{1}{6} \times 2 \times \pi \times r$ oe		3	M1 for finding the length of the arc
	" $\frac{60}{360} \times 2 \times \pi \times r$ " + 2r oe or " $\frac{1}{6} \times 2 \times \pi \times r$ " + 2r oe			M1 dep on M1 for a complete expression from correct working for a method for the perimeter
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	$P = r \left(\frac{1}{3} \pi + 2 \right)$		A1 oe eg $P = r(0.33... \pi + 2)$ or $P = \left(\frac{1}{3} \pi + 2 \right) r$ or $P = \left(2 + \frac{120}{360} \pi \right) r$ or $P = \left(\frac{120}{360} \pi + 2 \right) r$
				Total 3 marks

14	$0.24 \div 0.8 (= 0.3)$ oe		3	M1
	"0.3" $\times (1 - 0.8)$ oe or "0.3" $\times 0.2$ oe or $1 - ("0.3" \times 0.8 + 0.7 \times 0.8 + 0.7 \times 0.2)$ oe or $1 - 0.94$ oe			M1 for a complete method
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	0.06		A1 oe eg $\frac{3}{50}$ or $\frac{6}{100}$ or 6%
				Total 3 marks

Question	Working	Answer	Mark	Notes
11	$(17 + 28) \div (9 - 4)$ or $45 \div 5$ or $1 - \frac{4}{9} (= \frac{5}{9})$ or $(17 + 28) = \frac{5}{9}$ oe or $\frac{p}{p + 28 + 17} = \frac{4}{9}$ oe or $\frac{p}{p + 45} = \frac{4}{9}$ or $\frac{m - 45}{m} = \frac{4}{9}$		3	M1 Allow 0.55(555...) or 55(.555...) % truncated or rounded
	$(17 + 28) \div 5 \times 4$ or $45 \div 5 \times 4$ or $(17 + 28) \div \frac{5}{9} (= 81)$ or $45 \div \frac{5}{9} (= 81)$ or $(17 + 28) \times \frac{9}{5} (= 81)$ or $45 \times \frac{9}{5} (= 81)$ or $(17 + 28) \div 5 \times 4$ or $45 \div 5 \times 4$ or $\frac{5}{9} = \frac{17 + 28}{n}$ oe or $n = 81$ or $9p = 4(p + 28 + 17)$ or $9p - 4p = 180$ oe or $5p = 180$ oe or $9(m - 45) = 4m$ or $9m - 4m = 405$ oe or $5m = 405$ oe or $m = 81$			M1 for the correct calculation for the total number of counters or for the correct calculation for the number of orange counters or for the correct equation for the total number of counters (removing the denominators) or for the correct equation for the number of orange counters (removing the denominators)
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	36		A1 cao
Total 3 marks				

Question	Working	Answer	Mark	Notes
16		$\frac{25}{56}$	4	M1 for $\frac{a}{8} \times \frac{b}{7} \times \frac{c}{6}$ where $a < 8, b < 7, c < 6$
	eg $P(o, o, o) = \frac{5}{8} \times \frac{4}{7} \times \frac{3}{6} \left(= \frac{60}{336} = \frac{5}{28} = 0.178(571...) \right)$ or $P(e, e, o) = \frac{3}{8} \times \frac{2}{7} \times \frac{5}{6} \left(= \frac{30}{336} = \frac{5}{56} = 0.0892(857...) \right)$			M1 for a complete method to find $P(o, o, o)$ or $P(o, e, e)$ or $P(e, o, e)$ or $P(e, e, o)$
				M1 for a complete method to find $P(o, o, o)$ and at least one of $P(o, e, e), P(e, o, e), P(e, e, o)$
				A1 oe $\frac{150}{336}, 0.446(428571...)$ SC B2 for $\frac{260}{512} \left(= \frac{65}{128} = 0.507(8125) \right)$, B1 for $\frac{170}{512} \left(= \frac{85}{256} = 0.332(03125) \right)$
				Total 4 marks

Question	Working	Answer	Mark	Notes
3	$1 - (0.15 + 0.26 + 0.33)$ or $1 - 0.74$ $(=0.26)$ $(P(\text{yellow}) =) \frac{0.26 - 0.06}{2}$ or 0.1 150×0.1	15	4	M1 can be implied by two values where $P(\text{brown}) + P(\text{yellow}) = 0.26$ (may be seen in table) M1 for a complete method to find $P(\text{yellow})$ M1 independent mark Award for $150 \times p$ where $0 < p < 1$ A1 NB: An answer of $\frac{15}{150}$ scores M3 A0

Question	Working	Answer	Mark	Notes	
1	$73 \div 200 (=0.365)$ or $73 \times 100 (= 7300)$ or $1 \text{ cm} = 2 \text{ m}$ oe $"0.365" \times 100$ or $"7300" \div 200$ $73 \div 2$			M1 M1 A1	M2 for $100 \div \frac{200}{73}$ oe Allow their incorrectly converted $73 \text{ m} \div 200$
2		36.5 $4n + 3$	3 2	B2oe	e.g. $7 + 4(n - 1)$ or $4n + (7 - 4)$ etc allow $T_n = 4n + 3$ or $x = 4n + 3$ etc If not B2 then award B1 for answer of $4n + k$ ($k \neq 3$) or $n = 4n + 3$
3	$90 \div (2 + 13) (= 6)$ or $\frac{12 + x}{90 + x} = \frac{1}{3}$ $"6" \times 2 (=12)$ or $"6" \times 13 (=78)$ or $3(12 + x) = 90 + x$ $("78" \div 2) - "12"$ or $2x = 54$ or $"78" \times 3/2 - "78" - "12"$ oe			M1 M1 M1 A1	M2 for $\frac{2}{15} \times 90 (=12)$ or $\frac{13}{15} \times 90 (= 78)$ dep on a correct method for "78" and "12"
		27	4		

5		$2x + 0.18 + 2x + 3x + 0.26 + x = 1$ or $1 - (0.18 + 0.26) (= 0.56)$		4	M1
		$x = (1 - 0.18 - 0.26) \div (2 + 2 + 3 + 1) (= 0.07)$			M1
		eg $(0.18 + 4 \times "0.07") \times 200$ or 0.46×200 or $36 + 42 + 14$ oe			M1 dep on M2 and probabilities between 0 and 1 or $\frac{92}{200}$, oe with 92 seen
			92		A1
					Total 4 marks

6		$12 \times 8 \times 5 (= 480)$		3	M1
		"480" $\times 0.7$			M1 Dep on M1
			336		A1
					Total 3 marks

6	$1 - (0.24 + 0.31) (= 0.45)$ Or $(0.24 + 0.31) \times 180 (= 99)$		4	M1 or for a correct equation for missing values eg $x + 0.24 + 2x + 0.31 = 1$ oe (can be implied by 2 probabilities that total 0.45 in table if not contradicted in working space)
	$'0.45' \div 3 (= 0.15)$ Or $'0.45' \times 180 (= 81)$ Or $180 - 99 (= 81)$			M1 (or 0.15 correctly placed in table as long as not contradicted)
	$'0.15' \times 180$ Or $'81' \div 3$			M1 or for an answer of $\frac{27}{180}$
		27		A1
				Total 4 marks

International GCSE Maths				
Apart from questions 7(a), 12, 17, 19 (where the mark scheme states otherwise) the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method				
Q	Working	Answer	Mark	Notes
1 (a)		2, 4, 6, 12	1	B1
(b)		5, 7, 8, 9, 10, 11, 13, 14	1	B1
(c)			2	M1 for $\frac{a}{14}$ with $a < 14$ or $\frac{3}{b}$ with $b > 3$ or for 3 and 14 used with incorrect notation e.g. 3 : 14
		$\frac{3}{14}$		A1 for $\frac{3}{14}$ or 0.214(...)
Total 4 marks				

2	$15 \times 60 \times 60 (= 54\,000)$ oe or $\frac{60}{12} \times 60 \times 15 (= 4500)$ oe or $5 \times \frac{60}{12} \times 60 (= 1500)$ oe		4	M1	M2 for $\frac{15 \times 60 \times 60 \times 5}{12}$ (= 22 500)
	$'54000' \div 12 \times 5 (= 22\,500)$ oe or $'4500' \times 5 (= 22\,500)$ oe or $'1500' \times 15 (= 22\,500)$ oe			M1	
	$'22\,500' \times 0.002$ oe			M1	dep on M2 for a complete method
		45		A1	
Total 4 marks					



3	(a)	$54 \div 9 \times 4$ oe or $\frac{4}{9} \times 54$ oe		2	M1 Allow $0.44(44\dots) \times 54$ or $\frac{24}{54}$
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	24		A1
	(b)	$\frac{"24" + n}{54 + n} = \frac{1}{2}$ or $\frac{30}{60}$ or $54 - "24" (= 30)$ and $"30" - "24"$ or $2 \times "30" - 54$		2	M1 ft if $"24" < 27$ or $\frac{6}{60}$
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	6		A1
Total 4 marks					

4		$2 \times 0.75 (= 1.5)$ oe or $2 \times 0.75 \times 2 (= 3)$ oe		5	M1 for area of rectangle
		$\pi \times (0.5 \div 2)^2 (= 0.1963)$ or $\frac{1}{2} \times \pi \times (0.5 \div 2)^2 (= 0.09817)$			M1 for area of circle or area of semicircle
		$"1.5" - "0.09817" (= 1.4018\dots)$ or $"3" - "0.1963" (= 2.8036\dots)$			M1
		$"1.4018" \times 2 \times 250 \div 4 (= 175.228\dots)$ or $"2.8036" \times 250 \div 4 (= 175.228\dots)$ or $"1.4018" \times 250 \div 4 (= 87.6\dots)$			M1or for 87 – 88
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	175		A1 Allow 175 – 176
Total 5 marks					



International GCSE Maths				
Apart from Questions 3b, 13, 17 and 18 (where the mark scheme states otherwise), the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method.				
Q		Working	Answer	Mark
1	(a)	$1 - (0.24 + 0.16 + 0.38)$ oe		2
			0.22	M1
	(b)	$0.24 + 0.16 (= 0.4)$ oe		2
			0.4	M1
				A1 oe
				Total 4 marks

2	$1 - (0.26 + 0.18) (= 0.56)$ oe or 0.28 oe or $x + x = 1 - (0.26 + 0.18)$ oe		4	M1 0.28 oe may be seen in the table
	$45 \div 0.18 (= 250)$ oe or $\frac{45}{18} (= 2.5)$ oe " $\frac{0.56}{2} \div 0.18 (= \frac{14}{9} = 1.55\dots)$ " oe or " $\frac{56}{2} \div 18 (= \frac{14}{9} = 1.55\dots)$ "			M1
	" $250 \times \frac{0.56}{2}$ " oe or $2.5 \times \frac{56}{2}$ oe or " 250×0.28 " oe or " $0.28 \div 0.18 \times 45$ oe or " $\frac{14}{9} \times 45$ oe or " $28 \div 18 \times 45$ oe or $\frac{45}{18} \times 28$ " oe			M1
		70		A1 ($\frac{70}{250}$ scores M3A0)
				Total 4 marks

International GCSE Maths				
Apart from question 6, 14, 21, 24 and 25, the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method				
Q	Working	Answer	Mark	Notes
1 (a)		0.45	1	B1 oe eg $\frac{9}{20}, \frac{45}{100}, 45\%$
(b)	eg $1 - (0.25 + 0.2 + 0.2) (= 0.35)$ or $1 - ("0.45" + 0.2) (= 0.35)$ or $300 \times (0.25 + 0.2 + 0.2)(=195)$		3	M1 allow use of their "0.45" from part (a), check the table
	eg $300 \times "0.35"$ or $300 - "195"$			M1 for a complete method
		105		A1 cao (award $\frac{105}{300}$ M2 only)
				Total 4 marks

2 (a)	eg $6 \times 2.4 + 5 \times 3.5$		2	M1
		31.9		A1 oe
(b)	($W =$) $5.9n$ or ($W =$) $5.9(n - 1) + 2.4$ or ($W =$) $2.4n + 3.5(n - 1)$		2	M1 for $2.4n + 3.5n$ or $5.9n$ seen
		$5.9n - 3.5$		A1 oe but must be in simplest form eg $-3.5 + 5.9n$
				Total 4 marks

7	$1 - (0.24 + 0.4) (= 0.36)$ oe or $3x + x = 1 - (0.24 + 0.4)$ oe		4	M1
	$48 \div 0.24 (= 200)$ or "0.36" $\div 4 (= 0.09)$ or "0.36" $\div 4 \times 3 (= 0.27)$			M1
	"0.27" $\times$ "200" or "200" $\times$ "0.36" $\div 4 \times 3$ ("200" $- 48 -$ "80") $\div 4 \times 3$			M1 for a complete method
		54		A1
				Total 4 marks

7 ALT	$1 - (0.24 + 0.4) (= 0.36)$ oe or $3x + x = 1 - (0.24 + 0.4)$ oe		4	M1
	$48 \div 24 (= 2)$ oe or $\left(\frac{"0.36"}{4} \times 3\right) \div 0.24 \left(= \frac{9}{8} = 1.125\right)$ oe or $\left(\frac{"36"}{4} \times 3\right) \div 24 \left(= \frac{9}{8} = 1.125\right)$ oe			M1
	"2" $\times$ $\left(\frac{"36"}{4} \times 3\right)$ oe or $\frac{9}{8}$ " $\times 48$ oe or ("27" $\div 24) \times 48$ oe			M1 for a complete method
	Correct answer scores full marks (unless from obvious incorrect working)	54		A1
				Total 4 marks

6	eg $\frac{x+7}{80} = \frac{1}{4}$ or $4(x+7) = 80$ or $x+7 = 20$		4	M1 for setting up a correct equation in terms of x only
	eg $x = 80 \times \frac{1}{4} - 7 (=13)$ or $4x + 28 = 80$ and $x = \frac{80-28}{4} (=13)$ or $x = 13$			M1 for a complete method to find the value of x or $x = 13$. Award of this mark implies M2.
	eg $80 - ("13" + 7 + "13" - 11 + 3 \times "13") (=19)$ or $\frac{"13" + 7 + "13" - 11 + 3 \times "13"}{80} (= \frac{61}{80})$			M1 for a method to find the number of yellow counters or $P(R \text{ or } B \text{ or } G)$
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{19}{80}$		A1 oe eg accept 0.2375 or 23.75% or 0.237 or 23.7% or 0.238 or 23.8% or 0.24 or 24%
				Total 4 marks



3	$1500 + (36 \times 450) (= 17\,700)$		4	M1
	"17 700" – 12 500 (= 5200) oe "17 700" or $\frac{17\,700}{12\,500} (=1.416)$ oe			M1
	$\frac{5200}{12500} (\times 100)$ oe or $0.416 (\times 100)$ or "17 700" $\div$ 12 500 $\times$ 100 or $141.6 (- 100)$			M1
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	41.6		A1 allow 42 from correct working
Total 4 marks				

4	(a)	$1 - 0.58 (= 0.42)$ or $100 - 58 (= 42)$ $0.58 + 2x + x = 1$ oe		2	M1
		<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	0.14		A1 oe eg 14% (must have % sign) or $\frac{7}{50}$ etc SCB1 for an answer of 14 if no other marks are awarded
	(b)	250×0.58 oe or $58 + 58 + (58 \div 2)$ oe		2	M1 or for $\frac{145}{250}$
		<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	145		A1 cao
Total 4 marks					



2	$1 - (0.20 + 0.26)$ oe or 0.54 oe or $x + 2x + 0.26 + 0.20 = 1$ oe or $x + 2x = 0.54$ oe or		4	M1 showing clear understanding that the total of probabilities is 1 If probabilities are given as percentages then % sign must be seen
	$\frac{0.54}{3} (= 0.18)$ or $\frac{2}{3} \times "0.54" (= 0.36)$ oe or " 0.54 " $\times 450 (= 243)$			M1 for a correct method to find x or $2x$
	$(2 \times) "$ 0.18" $\times 450$ oe or 81 or " 0.36 " $\times 450$ oe			M1 or for $\frac{81}{450}$ or $\frac{162}{450}$
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	162		A1
				Total 4 marks
2 ALT	$(0.2 \times 450) + (0.26 \times 450) (= 207)$ oe or $90 + 117 (= 207)$ or $0.46 \times 450 (= 207)$		4	M1
	$450 - "207" (= 243)$			M1
	$\frac{1}{3} \times "243"$ or 81 or $\frac{2}{3} \times "243"$			M1 or for $\frac{81}{450}$ or $\frac{162}{450}$
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	162		A1
				Total 4 marks

2	$1 - (0.27 + 0.04 + 0.12) (= 0.57)$ oe or $2x + 0.27 + 0.04 + x + 0.12 = 1$ oe or $0.27 \times 400 (= 108)$ and $0.04 \times 400 (= 16)$ and $0.12 \times 400 (= 48)$		4	M1 for showing a clear understanding that the total of probabilities is 1 or for finding estimates for the number of times the spinner will land on 2 and 3 and 5
	$(x =) \frac{400 - "108" - "16" - 48}{3} (= 76)$ oe or $\frac{400 - "108" - "16" - 48}{3} \times 2 (= 152)$ oe			M1 for a method to find the value of x or $2x$ or an estimate for the number of times the spinner will land on 4 or 1
	$(2 \times "0.19" + 0.04 + 0.12) \times 400$ or $2 \times "76" + "16" + "48"$			M1 for a complete method
	Correct answer scores full marks (unless from obvious incorrect working)	216		A1 for an answer of 216 answer of $\frac{216}{400}$ oe scores M3A0
Total 4 marks				



5	$1 - (0.14 + 0.17 + 0.21) (= 0.48)$ or $0.14 + 0.17 + 0.21 + x + x = 1$ oe or $0.14 \times 400 (= 56)$ or $0.17 \times 400 (= 68)$ or $0.21 \times 400 (= 84)$ or $(0.14 + 0.17 + 0.21) \times 400 (= 208)$ oe eg $0.52 \times 400 (= 208)$		4	M1	Correct use of probabilities total 1 or correct calculation for an estimate for number of times the spinner will land on 2 or on 3 or on 5
	$"0.48" \div 2 (= 0.24)$ [could be in table] or $400 - 56 - 68 - 84 (= 192)$ oe eg $400 - 208 (= 192)$ or $0.48 \times 400 (= 192)$			M1	A completely correct method to find the probability that the spinner will land on 4 or a completely correct method to find the number of times the spinner will land on 1 or on 4
	$"0.24" \times 400$ oe or $"192" \div 2$			M1	a correct calculation to find the estimate required or an answer leading from 96 seen eg $\frac{96}{400}$
	Correct answer scores full marks (unless from obvious incorrect working)	96		A1	cao SCB1 for 104 if no other marks have been awarded
Total 4 marks					

6	(a)	eg $1 - (0.2 + 0.12 + 0.08) (= 0.6)$ $1 - \left(\frac{20}{100} + \frac{12}{100} + \frac{8}{100}\right) \left(= \frac{60}{100}\right)$ oe or $100(\%) - (20(\%) + 12(\%) + 8(\%)) (= 60(\%))$ or $0.2 + 0.12 + 0.08 + 3x + x = 1$ oe		3	M1	For a correct calculation for the remaining probability or a correct equation for the remaining probability
		“0.6” $\div 4 (= 0.15)$ oe or “0.6” $\div 4 \times 3$ or “0.6” $\times 0.75$ oe (Sight of 0.15 in the table for Orange or Pink or 0.45 for Pink gains M2)			M1	For dividing the remaining probability by 4 or finding $\frac{3}{4}$ of the remaining probability NB “0.6” means 0.6 must come from correct working
		<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	0.45		A1	or $\frac{9}{20}$ oe or 45% (if working in % final answer must have % sign). Allow $\frac{0.45}{1}$ If no answer on answer line, check in the correct space in table above. Value on the answer line takes precedence over the table.
	(b)	0.12×150 oe eg $12 + 6$		2	M1	For a correct calculation to find the number of times the spinner lands on blue
		<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	18		A1	(an answer of $\frac{18}{150}$ scores M1A0 as this is a probability not a number of times)
					Total 5 marks	

6	$28 \div 0.35 (= 80)$ oe eg $(28 \div 7) \times 20 (= 80)$		5	M1 indep for calculating total number of sweets
	$1 - (0.2 + 0.35) (= 0.45)$ oe or $(0.2 + 0.35) \times "80" (= 44)$ or $28 + "16" (= 44)$			M1 or for a correct equation for missing values eg $x + 2x + 0.2 + 0.35 = 1$ oe (can be implied by 2 probabilities that total 0.45 in table if not contradicted in working space)
	$"0.45" \div 3 (= 0.15)$ oe or $"0.45" \times "80" (= 36)$ or $"80" - "44" (= 36)$			M1 (or 0.15 or 0.3 seen in table – either order)
	$"80" \times "0.15" \text{ or } "80" \times "0.3" (= 24)$ or $"36" \div 3$ or $"36" \div \frac{3}{2} (= 24)$			M1 A correct calculation for the number of white sweets or the number of pink sweets
		12		A1
6 alt	$1 - (0.2 + 0.35) (= 0.45)$ or $100(\%) - 20(\%) - 35(\%) = 45(\%)$		5	M1 or for a correct equation for missing values eg $x + 2x + 0.2 + 0.35 = 1$ oe
	$"0.45" \div 3 (= 0.15)$ $45(\%) \div 3 (= 15(\%))$			M1 (or 0.15 or 0.3 seen in table – either order)
	$\frac{n}{28} = \frac{0.15}{0.35}$ or $\left(\frac{n}{0.15} = \right) \frac{28}{0.35}$ or $\frac{n}{28} = \frac{0.15}{0.35}$ or $\left(\frac{n}{0.3} = \right) \frac{28}{0.35}$ or $35\% = 28$ so $5\% = 4$			M1 for using proportion with an expression for n white sweets or finding 5% oe to enable calculation to 15%
	$(n =) 28 \times \frac{0.15}{0.35}$ or $(n =) 0.15 \times \frac{28}{0.35}$ or $15\% = 3 \times 4$ or $28 \times \frac{0.15}{0.35}$ or $0.3 \times \frac{28}{0.35}$ or $30\% = 6 \times 4 (= 24)$			M1 a calculation using proportion that would lead to finding their n or $2n$
		12		A1
Total 5 marks				

12	(a)	eg $x + 0.15 + 0.5 + y + 0.13 + 0.03 = 1$ oe or $x + y = 1 - 0.15 - 0.5 - 0.13 - 0.03$ oe or $x + y + 0.81 = 1$ oe or $x + y = 1 - 0.81$ oe or $1 - 0.15 - 0.5 - 0.13 - 0.03 = 0.19$ oe or $1 - 0.81 = 0.19$ oe		2	M1 for setting up an equation in x and y using the sum of probabilities equals 1 or for showing that probabilities add up to 1
		Working required	Shown		A1 correctly rearranges to $x + y = 0.19$ (must be shown from a correct method) or a clear statement that $x + y = 0.19$
	(b)	$x + y = 0.19$ $3x - y = 0.09$ Adding $(x + 3x = 0.19 + 0.09$ or $4x = 0.28)$ or $3x - (0.19 - x) = 0.09$ or $x + 3x - 0.09 = 0.19$	$3x + 3y = 0.57$ $3x - y = 0.09$ Subtracting $(3y - -y = 0.57 - 0.09$ or $4y = 0.48)$ or $3(0.19 - y) - y = 0.09$ or $\left(\frac{0.09 + y}{3}\right) + y = 0.19$		3 M1 for a correct method to eliminate x or y : coefficients of x or y the same and correct operator to eliminate selected variable (condone any one arithmetic error in multiplication) or writing x or y in terms of the other variable and correctly substituting (condone missing brackets)
		$"0.07" + y = 0.19$ or $3 \times "0.07" - y = 0.09$ or $y = 0.19 - "0.07"$ or $y = 3 \times "0.07" - 0.09$	$3x + 3 \times "0.12" = 0.57$ or $3x - "0.12" = 0.09$ or $x = 0.19 - "0.12"$ or $x = \left(\frac{0.09 + "0.12"}{3}\right)$		M1 dep on first M1 for a correct method to find other variable by substitution of found variable into one equation or for repeating the above method to find the second variable.
		Working required	$x = 0.07$ and $y = 0.12$		A1 oe dep on M1
Total 5 marks					

4	(a)		0.7	1	B1 oe eg $\frac{7}{10}$ oe or 70% or $\frac{0.7}{1}$ If probabilities are given as percentages then % sign must be seen
	(b)	eg $1 - (0.12 + 0.2 + 0.38) (= 0.3)$ oe or $1 - "0.7" (= 0.3)$ oe or $0.12 + 0.20 + 0.38 + 4x + x = 1$ oe or $"0.7" \times 350 (= 245)$ oe or $0.12 \times 350 (= 42)$ or $0.38 \times 350 (= 133)$		4	M1 fit their "0.7" If probabilities are given as percentages then % sign must be seen
		eg $"0.3" \div 5 (= 0.06)$ or $"0.3" \div 5 \times 4 (= 0.24)$ or 0.24 or $(x =) 0.06$ or $(4x =) 0.24$ or $"0.3" \times 350 (= 105)$ oe or $350 - "245" (= 105)$ oe or $350 - "42" - 0.2 \times 350 - "133" (= 105)$ oe			M1
		eg $"0.06" \times 350 (= 21)$ oe or $"105" \div 5 (= 21)$ oe or $"0.06" \times 4 \times 350$ oe or $"0.24" \times 350$			M1 or for $\frac{21}{350}$ or $\frac{84}{350}$
		Correct answer scores full marks (unless from obvious incorrect working)	84		A1 cao
					Total 5 marks

13	(a)		$\frac{5}{12}$	2	B1 for first choice correct 0.41(666...) to 2 dp truncated or rounded
			$\frac{7}{12}, \frac{5}{12}$		B1 for second choice correct 0.58(333...) to 2 dp truncated or rounded 0.41(666...) to 2 dp truncated or rounded
	(b)	$2 \times \frac{5}{12} \times \frac{5}{12}$ oe		2	M1 ft from their tree diagram 0.58(333...) to 2 dp truncated or rounded
			$\frac{25}{144}$		A1 oe 0.17(361111...) to 2 dp truncated or rounded or 17.(361111)% to 2 sf truncated or rounded
	(c)	$\frac{7}{12} \times \frac{5}{12} \times \frac{x}{15}$ oe or $\frac{7}{12} \times \frac{5}{12} \times y$ or $2 \times \frac{7}{12} \times \frac{5}{12}$ oe		3	M1 for GRB or RGB or $2 \times GR$ or $2 \times RG$
		$2 \times \frac{7}{12} \times \frac{5}{12} \times \frac{x}{15} = \frac{7}{24}$ oe or $2 \times \frac{7}{12} \times \frac{5}{12} \times y = \frac{7}{24}$ oe or $\frac{7}{24} \div \left(\frac{7}{12} \times \frac{5}{12} \right) = \left(\frac{3}{5} \right)$ oe			M1 (ft their tree diagram) for a complete method 0.29(166...) to 2 dp truncated or rounded
			9		A1
					Total 7 marks

Question	Working	Answer	Mark	Notes
19	$\frac{1}{4} \times \frac{2}{5} \left(= \frac{2}{20} \right)$ or $\frac{3}{4} \times \frac{3}{5} \left(= \frac{9}{20} \right)$ or $\frac{1}{4} \times \frac{3}{5} \left(= \frac{3}{20} \right)$ or $\frac{3}{4} \times \frac{2}{5} \left(= \frac{6}{20} \right)$ $\frac{1}{4} \times \frac{2}{5} + \frac{3}{4} \times \frac{3}{5} \left(= \frac{11}{20} \right)$ or $1 - \left(\frac{1}{4} \times \frac{3}{5} + \frac{3}{4} \times \frac{2}{5} \right) \left(= \frac{11}{20} \right)$ $"\frac{11}{20}" \times "\frac{11}{20}"$ or $\left("\frac{2}{20}" + "\frac{9}{20}" \right)^2$	$\frac{121}{400}$ oe	4	M1 for any one correct probability M1 for a complete method M1 A1 for $\frac{121}{400}$ oe or 0.3025 or 30.25%

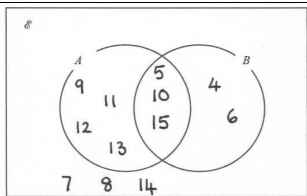


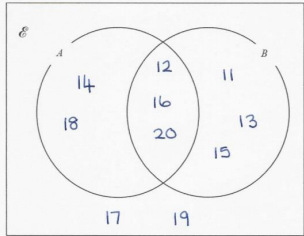
Question	Working	Answer	Mark	Notes
14	$2^7 = 4^{2x} \times 2^x$ or $128 = (2^2)^{2x} \times 2^x$	1.4	3	M1 Replacing 128 by 2^7 or 4 by 2^2
	$7 = 2(2x) + x$			M1
				A1 oe
				Total 3 marks
15	(i)	19	1	B1
	(ii)	5	1	B1
	(iii)	29	1	B1
				Total 3 marks

19	(i)		45	3	B1
	(ii)		12		B1
	(iii)		28		B1
					Total 3 marks

20		9.65, 9.75, 5.85, 5.95, 2.5, 3.5		3	B1 for any one of these stated or used, accept 9.749, 5.949, 3.49
		$\frac{9.75 - 5.85}{2.5}$			M1 for $\frac{UB_t - LB_w}{LB_y}$ where 9.7 < UB _t ≤ 9.75, 5.85 ≤ LB _w < 5.9, 2.5 ≤ LB _y < 3 This allows for the student who uses some sort of lower/upper value, but are slightly inaccurate eg using 9.74 for t
		Working required	1.56		A1 dep on previous marks (as working is requested)
					Total 3 marks

6	(a)	$5x \leq 2 + 7$ or $5x \leq 9$ or $\frac{5x}{5} - \frac{7}{5} \leq \frac{2}{5}$ oe		2	M1 allow any sign instead of $\leq$ or for an answer of 1.8 oe or x and 1.8 oe with the incorrect sign
			$x \leq 1.8$		A1 oe
	(b)(i)	$(y \pm 7)(y \pm 5)$		2	M1 for $(y \pm 7)(y \pm 5)$ or $(y + a)(y + b)$ where $ab = -35$ or $a + b = -2$
			$(y - 7)(y + 5)$		A1 isw if student goes on to solve the equation in this part
	(ii)		7, -5	1	B1ft answer must fit from their $(y + a)(y + b)$ in (b)(i). Award B0 for 7, -5 if no marks scored in (i)
					Total 5 marks

7			3	B3 all 4 parts of diagram correct (B2 for 2 or 3 parts correct) (B1 for 1 part correct) SCB1 if no marks scored, award B1 if 4,6 in the section $A \cap B'$ and 9, 11, 12, 13 in the section $A' \cap B$
				Total 3 marks

Question	Working	Answer	Mark	Notes
3			3	B3 Fully correct (B2 for 2 or 3 'regions' correct, B1 for one 'region' correct)
Total 3 marks				



15	(a)	$\sqrt{2} = 2^{\frac{1}{2}}$ or $8^3 = 2^9$ or $16^{\frac{3}{2}} = 2^6$		3	M1 for one of $\sqrt{2} = 2^{\frac{1}{2}}$ or $8^3 = 2^9$ or $16^{\frac{3}{2}} = 2^6$
					M1 for all of $\sqrt{2} = 2^{\frac{1}{2}}$ and $8^3 = 2^9$ and $16^{\frac{3}{2}} = 2^6$ OR $2^{\frac{1}{2}} \div 2^3$
		<i>Working required</i>	-2.5		A1 oe, dep on M1
	(b)	$0.04 \times 4.5 \times 10^{157}$ oe		3	M1
		$4 \times 10^{-2} \times 4.5 \times 10^{157} (= 18 \times 10^{155})$ or 0.18×10^{157} oe			M1
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	1.8×10^{156}		A1 SCB1 for $18 \times 10^{156} = 1.8 \times 10^{157}$ or $18 \times 10^{157} = 1.8 \times 10^{158}$
Total 6 marks					

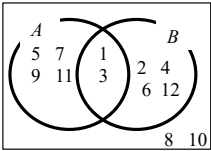
16	(a)		6	1	B1
	(b)		36	1	B1
	(c)		15	1	B1
					Total 3 marks

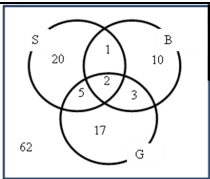
2	(a)(i)	5, 7, 11, 13	1	B1
	(ii)	5, 6, 8, 10, 12, 14, 15	1	B1
	(b)	Correct reason	1	B1 eg 9 is not a member of C or 9 is not in C or C only contains 6, 8, 10, 12, 14 or 9 is outside of C there must be no contradictory or incorrect statements
Total 3 marks				

3	(a)	eg $\frac{9.6}{6}$ (= 1.6 oe) or $\frac{6}{9.6}$ (= 0.625 oe) or $\frac{("GH")}{6} = \frac{4}{9.6}$ oe	2	M1 for a correct scale factor accept ratio notation eg 9.6 : 6 (can be seen near the diagram)
		Correct answer scores full marks (unless from obvious incorrect working)	2.5	A1 oe allow 2,5
	(b)	eg $5.7 \times "1.6"$ or $5.7 \div "0.625"$ or $5.7 \times \frac{4}{"2.5"}$ or $5.7 \div \frac{"2.5"}{4}$ or $\frac{("BC")}{9.6} = \frac{5.7}{6}$	2	M1 fit their scale factor from (a)
		Correct answer scores full marks (unless from obvious incorrect working)	9.12	A1 oe fit their scale factor from (a) allow 9,12
Total 4 marks				

International GCSE Maths					
Apart from questions 2b, 10, 13b, 19 where the mark scheme states otherwise the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method					
Q	Working	Answer	Mark	Notes	
1 (a)		5 7 9 11 13 15	1	B1 all numbers must be present with no repeats. Numbers can be in any order	
(b)		5 15	1	B1	
(c)		6 8 12 14 16	1	B1	
				Total 3 marks	
2 (a)		$6p(2q-3)$	2	B2 If not B2 then award B1 for any correct partial factorisation with 2 factors taken out ($2p$ or $3p$ or $6(2 \times 3)$) outside of the bracket $2p(6q-9)$ or $3p(4q-6)$ or $6(2pq-3p)$ or allow $6p$ and one error inside the bracket eg $6p(2q-a)$ or $6p(b-3)$ oe eg $6p(2q+3)$	
(b)	$y + (3y + 7) + (2y - 5) (= 6y + 2)$ oe or $56 - 7 + 5 (= 54)$		4	M1	M2 for $y + (3y + 7) + (2y - 5) = 56$ M3 for $(56 - 7 + 5) \div 6 (= 9)$
	$y + (3y + 7) + (2y - 5) = 56$ or “ $6y + 2 = 56$ oe eg $6y = 54$			M1	oe or $6y = 54$ oe M3 for $54 \div 6 (= 9)$
	$(y =) \frac{56-2}{6} (= 9)$ oe			M1 for a correct method to find the value of y or the correct value of y	
		13		A1 (or for 9 (gold), 34 (silver) and 13 (zinc) seen) dep on sight of ($y =$) 9 SCB2 for 16.6 (17 if rounded 16.6 seen) (if no other marks awarded) SCB1 for $5y + 2 = 56$ oe (if no other marks awarded)	
				Total 6 marks	

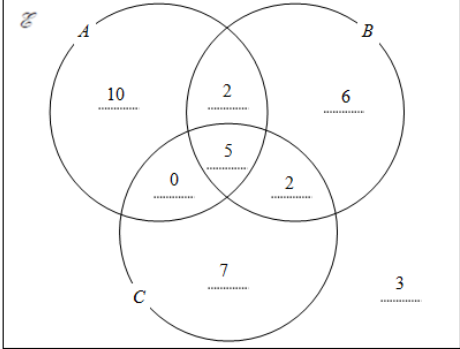


Question	Working	Answer	Mark	Notes
4		Fully correct Venn diagram	4	B4 fully correct Venn diagram with labels <i>A</i> and <i>B</i> (If not B4 then B3 for 3 correct regions, B2 for 2 correct regions B1 for 1 correct region)
5	$123 - 67 (=56)$ or $2x = 123 - 67$ or $2x + y = 67$ or $4x + y = 123$ or $x = \text{length of tile, } y = \text{width of tile}$ e.g. $"56" \div 2 (=28)$ $67 - 56 (=11)$ or $67 - 2 \times "28" (=11)$ or $123 - 4 \times "28" (=11)$ $(67 - 2 \times "11") \times (123 - 2 \times "11")$ (45×101) or $123 \times 67 - 12 \times "28" \times "11"$ $(8241 - 3696)$	4545	5	M1 M1 for method to find length or width M1 for method to find other dimension M1 dep on M2 A1

Question	Working	Answer	Mark	Notes
15 (a)	$0.3^3 \times 0.7$ $4 \times 0.3^3 \times 0.7$	0.0756	3	M1 oe M1 oe A1 $\frac{189}{2500}$ or 0.075 or 0.076
(b)	$1 - 0.7^4$ oe	0.7599	2	M1 Fully correct method A1 $0.759 - 0.7560$
16 (a)			3	M1 for 2 in the middle and one from 1 or 3 or 5 in the correct place in the Venn diagram M1 for any 4 correct entries A1 for a fully correct answer including 62 outside the circles inside the rectangle
(b)		$\frac{3}{28}$	1	B1ft

16	$\frac{100}{2}[2 \times 1 + (100 - 1) \times 4] (= 19\,900)$ oe or $1 + (41 - 1) \times 4 (= 161)$ oe or $1 + (100 - 1) \times 4 (= 397)$ oe		4	M1 for method to find the sum of the first 100 terms or for finding the 41 st term or for finding the 100 th term
	$\frac{40}{2}(2 \times 1 + (40 - 1) \times 4) (= 3160)$ oe or $\frac{41}{2}(2 \times 1 + (41 - 1) \times 4) (= 3321)$ oe or $100 - 41 + 1 (= 60)$ oe			M1 for method to find the sum of the first 40 terms or 41 terms or for finding the number of terms from the 41 st term to the 100 th term
	"19 900" – "3160" or $\frac{"60"}{2}["161" + "397"]$ or $\frac{"60"}{2}[2 \times "161" + ("60" - 1) \times 4]$ oe			M1 for finding the difference or for finding the sum from the 41 st term to the 100 th term
		16 740		A1
Total 4 marks				

17	(i)		19	1	B1
	(ii)		0	1	B1
	(iii)		11	1	B1
	(iv)		28	1	B1
Total 4 marks					

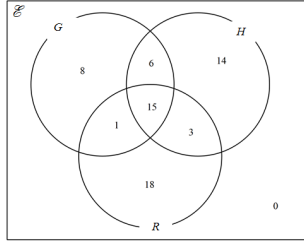
20		Fully correct Venn diagram	4	B4 for all 8 sections correct If not B4, then award B3 for 6 or 7 sections correct B2 for 4 or 5 sections correct B1 for 2 or 3 sections correct Allow the section where 0 should be to be blank if all other sections are populated with a number.
Total 4 marks				

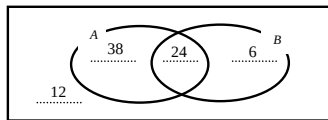
21	$5x + 3x + 2 = 26$ oe		4	M1 a correct equation for x
	$x = 3$ <i>Correct value of x scores M1A1 (unless from obvious incorrect working)</i>			A1
	$7 \times "3"$ oe eg " 15 " + " 6 " (where " 15 " is $5 \times "3"$ and " 6 " is $2 \times "3"$)			M1ft use of their positive value for x in $7x$ (ie use of correct regions from Venn diagram for the set required) [their value] is their value given for x which must be clearly assigned as x]
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	21		A1 cao
				Total 4 marks

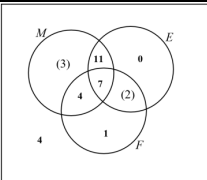


Question	Working	Answer	Mark	Notes
3 a		y^{14}	1	B1
b		$16m^{12}$	2	B2 if not B2 then B1 for am^{12} or $16m^b$ or 2^4m^{12} $b \neq 0$, $12 \neq 1$, 16
c	$5x + 15 = 3x - 4$ or $x + 3 = \frac{3x}{5} - \frac{4}{5}$ e.g. $5x - 3x = -4 - 15$	$-\frac{19}{2}$ oe	3	M1 for removing bracket in a correct equation or dividing all terms by 5 in a correct equation M1 ft from $ax + b = cx + d$ for correctly isolating terms in x on one side of equation and constant terms on the other side A1 dep on at least M1
d (i)		$(x - 4)(x + 6)$	2	M1 for $(x + a)(x + b)$ where either $ab = -24$ or $a + b = +2$ e.g. $(x - 6)(x + 4)$ A1
(ii)		4, -6	1	B1 cao or ft from any $(x + p)(x + q)$
4 a (i)		1, 2, 3, 4, 6, 12	1	B1 cao
(ii)		1, 3, 5, 7, 9, 10, 11	1	B1 cao
b		Yes with reason	1	B1 e.g. no numbers in both A and C or A and C do not intersect or A and C do not overlap or A and C are mutually exclusive
c		$\frac{10}{12}$ oe	2	M1 for $12 - 2 (=10)$ or $\frac{a}{12}$ with $a < 12$ or 10 and 12 used with incorrect notation E.g. $10 : 12$ A1 for $\frac{10}{12}$ oe or $0.83(3\dots)$ or $83(3\dots)\%$



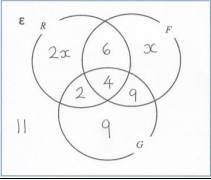
Question	Working	Answer	Mark	Notes
13 (a)		Correct Venn diagram	3	M2 for at least 4 correct entries If not M2 then M1 for 2 or 3 correct entries NB: For the award of the method marks do not accept a blank outside the circles as 0
(b)		$\frac{3}{18}$ oe	2	A1 Accept omission of 0 for the award of full marks M1 ft from Venn diagram for $\frac{a}{18}$ where a is an integer and $1 \leq a < 18$ or for $\frac{3}{b}$ where b is an integer and $b > 3$ A1 ft from Venn diagram

15	eg $(2m + 1)(2n + 1)$ or eg $(2m - 1)(2n + 3)$		4	M2 Product of 2 <u>different</u> odd numbers (in the form $2n + k$ where k is odd). Must have different letters/variables. (M1 for the product of same or different odd numbers where the variable is the same eg $(2n + 1)(2n - 1)$ or $(2n + 1)(2n + 3)$)	
	eg $4mn + 2m + 2n + 1$ or eg $4n^2 + 4n + 1$ or eg $4n^2 - 1$ or eg $4n^2 + 8n + 3$			M1 dep M1 Multiplying out the two brackets with odd numbers correctly.	
	eg $2(2mn + m + n) + 1$ therefore odd	Proved		A1 dep M3 Factorising <u>and</u> a conclusion or stating that the 3 leading terms are all even, hence result is odd.	
				Total 4 marks	
16	(a)		12, 38, 24, 6	2	B2 B2 for all 4 correct values, in correct regions. B1 for 2 or 3 correct values in correct regions
	(b) (i)		$\frac{24}{80}$ oe	1	B1ft 0.3 ft their 24
	(ii)	eg $62 + "12"$ or $80 - "6"$ oe		2	M1ft A complete method to find the number of elements in the required set.
			$\frac{74}{80}$ oe		A1 ft 0.925 Penalise incorrect probability notation once only
	Total 5 marks				

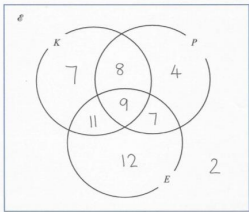
16	(a)	$(11 - x) + (x) + (18 - x) + 3 = 25$ oe or $(11 - x) + (x) + (18 - x) + 3 + 7 = 25 + 7$ oe or $x + y + z = 25 - 3$ and $x + z = 11$ and $x + y = 18$ oe where $y = M \cap E \cap F'$ and $z = M \cap F \cap E'$		2	M1 for setting up a correct equation
		Correct answer scores full marks (unless from obvious incorrect working)	7		A1 (allow 7 in the Venn diagram if no answer is given in (a))
	(b)			2	B2 ft for $18 - x$, x and $11 - x$ dep on M1 in part (a) and ($x < 12$) (NB 0, 1 and 4 are fixed) for 6 correct remaining values (B1 ft for 4 or 5 correct remaining values) Allow just E to be blank if other sections are populated with a number
	(c)	$\frac{3 + "11"}{25}$ or $\frac{3 + (18 - "7")}{25}$ or 0.56 oe	$\frac{14}{25}$	1	B1ft for $18 - x$, x and $11 - x$ oe
Total 5 marks					

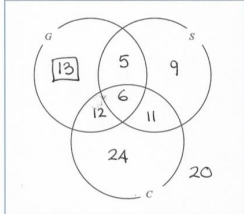
Question	Working	Answer	Mark	Notes
16 (a)		$\frac{3}{10}, \frac{7}{12}, \frac{5}{12}, \frac{7}{12}, \frac{5}{12}$	2	B2 B1 for $\frac{3}{10}$ oe B1 for all other correct probabilities 2d.p truncated or rounded (e.g 0.58 or 0.41 or 0.42)
(b)	$\frac{7}{10} \times \frac{5}{12}$ or $\frac{3}{10} \times \frac{7}{12}$ oe		3	M1ft
	$\frac{7}{10} \times \frac{5}{12} + \frac{3}{10} \times \frac{7}{12}$ oe			M1ft
		$\frac{56}{120}$ oe		A1 eg $\frac{7}{15}$ or 0.46....(2 dp truncated or rounded)
(c)	$\frac{3}{10} \times \frac{5}{12} \times x = \frac{3}{100}$ oe		3	M1ft A correct equation involving the unknown probability
	$x = \frac{3}{100} \div \frac{15}{120} (= \frac{6}{25})$ oe			M1ft Isolating or calculating the value of x
		25		A1 Dep on M1
Total 8 marks				
17 (a)			3	B3 All 8 values inserted correctly B2 for 4 to 7 correct values B1 for 2 or 3 correct values NB: Expressions involving x do not have to be simplified.
(b)	$[(25-x) + (x-6) + (16-x) + 3 + 6 + 2 + 9 + 5] = 50$		2	M1ft For sum of all their values = 50 oe
		10		A1
(c)		14	1	B1ft
Total 6 marks				



16	(a)			3	B3 For all sections completed correctly (B2 for 5 or 6 sections correct (excl x), B1 for 3 or 4 sections correct (excl x))
	(b)	$2x + 6 + x + 2 + 4 + 9 + 9 + 11 = 80$ $(80 - 6 - 2 - 4 - 9 - 9 - 11) \div 3$		3	M1ft ft their Venn diagram A correct equation to find x or subtracting all numerical values from 80 and dividing by 3 or other fully correct method to find x with all sections completed
		$x = 13$			A1 correct value for x
			38		B1 their $2x + 12$
Total 6 marks					

20 (a)		10 6 14 15 12 20 14 29	3	B3 for all numbers in correct regions (B2 for 5, 6 or 7 correct numbers B1 for 3 or 4 correct numbers)
(b)		16	1	B1 ft for their $a +$ their b Do not fit if there are no values for a and b
(c)			2	M1 for $\frac{n}{43}$ where $n < 43$ or $\frac{18}{m}$ where $m > 18$ or ft their $\frac{b+c}{p}$ where $p > b + c$ or ft their $\frac{q}{a+b+c+d}$ where $q < a + b + c + d$ Do not fit if there are no values for a, b, c and d
		$\frac{18}{43}$		A1 oe eg 0.41(860...) or 41(.860...) % truncated or rounded or ft their $\frac{b+c}{a+b+c+d}$ as a fraction or a decimal or a percentage
Total 6 marks				

16 (a)		Fully correct Venn diagram	3	B1 For 7 in just knitting B2 For all 7 others correct (B1 for 4, 5 or 6 others correct)
(b)	can either ft their Venn diagram or use values given in text	$\frac{17}{28}$	2	B2 ft oe 0.61 or 61% or 0.607... or 60.7% or better (B1ft for 17 as numerator or 28 as denominator in a fraction between 0 and 1) only ft where regions in Venn diagram have numbers indicated
(c)	can either ft their Venn diagram or use values given in text	11	1	B1ft only ft where regions in Venn diagram have numbers indicated
(d)	can either ft their Venn diagram or use values given in text	28	1	B1ft only ft where regions in Venn diagram have numbers indicated
Total 7 marks				

16 (a)		Fully correct Venn diagram	3	B1 For 13 correct in G only B2 For all 7 others correct (B1 for 4, 5 or 6 others correct (does not need to be complete for this))		
(b)(i)		36	1	B1ft	ft from a diagram where values are present in the required regions	If these 3 parts are given as probabilities, please mark incorrect the first time but award marks from there on if numerator is correct
(ii)		44	1	B1ft		
(iii)		35	1	B1ft		
(c)		$\frac{18}{53}$	2	B2ft	oe 0.33(96...) or 33(.96...) % ft their Venn diagram or (B1 for $\frac{18}{m}$ where $m > 18$ or $\frac{n}{53}$ where $n < 53$ or for 18 : 53 or other incorrect notation or B1ft their Venn diagram for $\frac{18}{m}$ where $m > 18$ or $\frac{n}{53}$ where $n < 53$)	
					Total 8 marks	

16	$\frac{4}{15} \times \frac{4}{15}$ or $\frac{5}{15} \times \frac{5}{15}$ or $\frac{6}{15} \times \frac{6}{15}$ oe (where $6 = 15 - 4 - 5$)		3	M1 oe for one correct product (allow decimals to 2 dp rounded or truncated) $(\frac{4}{15})^2 = (0.26(6...))^2 = 0.07(11...)$ $(\frac{5}{15})^2 = (0.33(3...))^2 = 0.11(1...)$ $(\frac{6}{15})^2 = (0.4)^2 = 0.16$
	$\frac{4}{15} \times \frac{4}{15} + \frac{5}{15} \times \frac{5}{15} + \frac{6}{15} \times \frac{6}{15}$ oe eg $\frac{16}{225} + \frac{1}{9} + \frac{4}{25}$ (where $6 = 15 - 4 - 5$)			M1 oe for the sum of all three correct products
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{77}{225}$		A1 oe 0.34(222...) or 34.(222...) % (if no marks awarded, SCB2 for $\frac{31}{105}$ oe from non-replacement, SCB1 for a fully correct method for non- replacement)
Total 3 marks				

14	$\text{eg } \left(\frac{1}{2}\right)^4 \left(= \frac{1}{16} \text{ or } 0.0625\right) \text{ or}$ $4\left(\frac{1}{2}\right)^4 \left(= \frac{4}{16} \text{ or } \frac{1}{4} \text{ or } 0.25\right) \text{ or}$ $6\left(\frac{1}{2}\right)^4 \left(= \frac{6}{16} \text{ or } \frac{3}{8} \text{ or } 0.375\right) \text{ oe}$		3	M1 for finding the probability of one correct combination eg calculation for oooo or eeee or $4 \times eooo$ or $4 \times eeeo$ or $6 \times eooo$
	$\text{eg } 1 - \left(\frac{1}{2}\right)^4 \text{ or } 4\left(\frac{1}{2}\right)^4 + 6\left(\frac{1}{2}\right)^4 + 4\left(\frac{1}{2}\right)^4 + \left(\frac{1}{2}\right)^4$ or $(e + oe + ooe + oooo)$ $\frac{1}{2} + \frac{1}{2} \times \frac{1}{2} + \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} + \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}$ $\left(= \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16}\right) \text{ oe}$			M1 for a complete method
		$\frac{15}{16}$		A1 oe eg 0.9375 (allow 0.937 or 0.938)
				Total 3 marks

13	(a)		0.1 and 0.6	1	B1	oe
	(b)	0.7×0.9 or $1 - (0.7 \times "0.1" + 0.3 \times 0.4 + 0.3 \times "0.6")$		2	M1	must be considering one correct product only or $1 -$ (all 3 correct products only) allow ft if using $1 - P(WL \text{ or } LW \text{ or } LL)$
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	0.63		A1	oe eg 63% or $\frac{63}{100}$ allow ft if using $1 - P(WL \text{ or } LW \text{ or } LL)$
					Total 3 marks	

20	(RRR:) $\frac{3}{12} \times \frac{2}{11} \times \frac{1}{10} (= \frac{1}{220})$ or $(0.25 \times 0.18... \times 0.1 = 0.0045...)$ (2R, 1G:) $\frac{3}{12} \times \frac{2}{11} \times \frac{9}{10} (= \frac{9}{220})$ or $(0.25 \times 0.18... \times 0.9 = 0.0409...)$ (2G, 1R:) $\frac{3}{12} \times \frac{9}{11} \times \frac{8}{10} (= \frac{36}{220} = \frac{9}{55})$ or $(0.25 \times 0.81... \times 0.8 = 0.163...)$ (GGG:) $\frac{9}{12} \times \frac{8}{11} \times \frac{7}{10} (= \frac{84}{220} = \frac{21}{55})$ $(0.25 \times 0.72... \times 0.7 = 0.381...)$		3	M1oe For an expression to find one of the stated probabilities
	$1 - \frac{1}{220}$ " (1 – "0.0045...") or "$\frac{84}{220}$" + $3 \times$ "$\frac{36}{220}$" + $3 \times$ "$\frac{9}{220}$" $(0.381... + 3 \times 0.163... + 3 \times 0.0409...)$			M1oe Dep M1 Complete method
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{219}{220}$		A1oe 0.9954...allow 0.99 (99%) or 0.995 (99.5%)
Total 3 marks				

14	(a)	20 20 22 23 25 26 26 27 28 29 29		3	M1 for ordering the numbers Allow one omission or error in the list
		22 and 28 identified for LQ and UQ eg 20 20 <u>22</u> 23 25 26 26 27 <u>28</u> 29 29			M1 for identifying 22 and 28 (22 and 28 implies the first M1)
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	6		A1
	(b)		<u>Akari</u> and reason using IQR	1	B1 ft from part (a) Akari as the IQR is lower/smaller oe (IQR must be part of the statement) Must have a value in (a) to compare the IQRs
					Total 4 marks

15		$\sqrt[3]{\frac{27}{64}} \left(= \frac{3}{4} = 0.75 \right)$		3	M1 for finding the probability of a head
		$\left(1 - \frac{3}{4} \right)^3$ or $\left(\frac{1}{4} \right)^3$ or 0.25^3			M1 for a complete method
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$\frac{1}{64}$		A1 oe Accept 0.015(625) or 1.55(625)% truncated or rounded
					Total 3 marks

21	$\text{eg } (P(RRY) = \frac{9}{20} \times \frac{8}{19} \times \frac{7}{18} \left(= \frac{504}{6840} = \frac{7}{95} \right) \text{ oe or } (P(RRG) = \frac{9}{20} \times \frac{8}{19} \times \frac{4}{18} \left(= \frac{288}{6840} = \frac{4}{95} \right) \text{ oe}$ $\text{or } (P(RRR) = \frac{9}{20} \times \frac{8}{19} \times \frac{7}{18} \left(= \frac{504}{6840} = \frac{7}{95} \right) \text{ oe or } (P(RRR') = \frac{9}{20} \times \frac{8}{19} \times \frac{11}{18} \left(= \frac{792}{6840} = \frac{11}{95} \right) \text{ oe}$ $\text{or } (P(YR) = \frac{7}{20} \times \frac{6}{19} \times \frac{9}{18} \left(= \frac{378}{6840} = \frac{21}{380} \right) \text{ oe or } (P(YYG) = \frac{7}{20} \times \frac{6}{19} \times \frac{4}{18} \left(= \frac{168}{6840} = \frac{7}{285} \right) \text{ oe}$ $\text{or } (P(YYY) = \frac{7}{20} \times \frac{6}{19} \times \frac{5}{18} \left(= \frac{210}{6840} = \frac{7}{228} \right) \text{ oe or } (P(YYY') = \frac{7}{20} \times \frac{6}{19} \times \frac{13}{18} \left(= \frac{546}{6840} = \frac{91}{1140} \right) \text{ oe}$ $\text{or } (P(GGR) = \frac{4}{20} \times \frac{3}{19} \times \frac{9}{18} \left(= \frac{108}{6840} = \frac{3}{190} \right) \text{ oe or } (P(GGY) = \frac{4}{20} \times \frac{3}{19} \times \frac{7}{18} \left(= \frac{84}{6840} = \frac{7}{570} \right) \text{ oe}$ $\text{or } (P(GGG) = \frac{4}{20} \times \frac{3}{19} \times \frac{2}{18} \left(= \frac{24}{6840} = \frac{1}{285} \right) \text{ oe or } (P(GGG') = \frac{4}{20} \times \frac{3}{19} \times \frac{16}{18} \left(= \frac{192}{6840} = \frac{8}{285} \right) \text{ oe}$ $\text{or } (P(RGY) = \frac{9}{20} \times \frac{7}{19} \times \frac{4}{18} \left(= \frac{252}{6840} = \frac{7}{190} \right) \text{ oe}$	3	M1 for finding one correct product, does not need to be labelled or for an answer of $\frac{17}{76}$ oe eg 0.22(3...) or 22(.3...)% or $\frac{65}{76}$ oe eg 0.85(5...) or 85(.5...)%
	$(P(RRR' \text{ or } YYY' \text{ or } GGG') = \left(3 \times \frac{9}{20} \times \frac{8}{19} \times \frac{11}{18} \right) + \left(3 \times \frac{7}{20} \times \frac{6}{19} \times \frac{13}{18} \right) + \left(3 \times \frac{4}{20} \times \frac{3}{19} \times \frac{16}{18} \right) \text{ oe}$ $\text{or } (P(RRY \text{ or } RRG \text{ or } YR \text{ or } YYG \text{ or } GGR \text{ or } GGY) =$ $\left(3 \times \frac{9}{20} \times \frac{8}{19} \times \frac{7}{18} \right) + \left(3 \times \frac{9}{20} \times \frac{8}{19} \times \frac{4}{18} \right) + \left(3 \times \frac{7}{20} \times \frac{6}{19} \times \frac{9}{18} \right) +$ $\left(3 \times \frac{7}{20} \times \frac{6}{19} \times \frac{4}{18} \right) + \left(3 \times \frac{4}{20} \times \frac{3}{19} \times \frac{9}{18} \right) + \left(3 \times \frac{4}{20} \times \frac{3}{19} \times \frac{7}{18} \right) \text{ oe}$ $\text{or } (1 - P(RRR \text{ or } YYY \text{ or } GGG \text{ or } RGY) =$ $1 - \left(\left(\frac{9}{20} \times \frac{8}{19} \times \frac{7}{18} \right) + \left(\frac{7}{20} \times \frac{6}{19} \times \frac{5}{18} \right) + \left(\frac{4}{20} \times \frac{3}{19} \times \frac{2}{18} \right) + \left(6 \times \frac{9}{20} \times \frac{7}{19} \times \frac{4}{18} \right) \right) \text{ oe}$		M1 for a complete calculation
	Correct answer scores full marks (unless from obvious incorrect working) SCB1 for an answer of $\frac{669}{1000}$ oe eg 0.66(9) or 66(.9)%	$\frac{51}{76}$	A1 oe eg 0.67(1...) or 67(.1...)%
			Total 3 marks



19	$\frac{2}{9} \times \frac{1}{8} \left(= \frac{2}{72} \right)$ oe or $\frac{1}{9} \times \frac{2}{8} \left(= \frac{2}{72} \right)$ oe or $\frac{2}{9} \times \frac{3}{8} \left(= \frac{6}{72} \right)$ oe or $\frac{3}{9} \times \frac{2}{8} \left(= \frac{6}{72} \right)$ oe or $\frac{2}{9} \times \frac{5}{8} \left(= \frac{10}{72} \right)$ oe or $\frac{5}{9} \times \frac{2}{8} \left(= \frac{10}{72} \right)$ oe or ${}^9C_2$ or $\frac{9!}{2!7!}$ or $\frac{9 \times 8}{2}$ or 36 or $1 + 2 + 6 (= 9)$		3	M1 for finding one correct product or for the correct number of total outcomes or for the correct number of outcomes when the sum < 5 NB if using decimals allow 2 decimal places truncated or rounded
	$3 \times \frac{2}{72} + 2 \times \frac{6}{72}$ oe or $\frac{2}{72} + \frac{6}{72} + \frac{10}{72}$ oe or ${}^9C_2$ or $\frac{9!}{2!7!}$ or $\frac{9 \times 8}{2}$ or 36 and $1 + 2 + 6 (= 9)$			M1 for a complete correct method or for the correct number of total outcomes and for the correct number of outcomes when the sum < 5
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{18}{72}$		A1 oe eg $\frac{9}{36}$ or 0.25 or 25% SCB1 for $\frac{21}{81}$ oe eg $\frac{7}{27}$ or 0.259(25...) or 25.9(25...) % truncated or rounded
	SEE NEXT PAGE FOR ALT METHOD			Total 3 marks



19 ALT	$\frac{2}{9} \times \frac{1}{8} \left(= \frac{2}{72} \right)$ oe or $\frac{1}{9} \times \frac{2}{8} \left(= \frac{2}{72} \right)$ or $\frac{1}{9} \times \frac{1}{8} \left(= \frac{1}{72} \right)$ oe or $\frac{2}{9} \times \frac{2}{8} \left(= \frac{4}{72} \right)$ or $\frac{3}{9} \times \frac{1}{8} \left(= \frac{3}{72} \right)$ oe or $\frac{1}{9} \times \frac{3}{8} \left(= \frac{3}{72} \right)$ oe or $\frac{2}{9} \times \frac{3}{8} \left(= \frac{6}{72} \right)$ oe or $\frac{3}{9} \times \frac{2}{8} \left(= \frac{6}{72} \right)$ oe or $\frac{1}{9} \times \frac{6}{8} \left(= \frac{6}{72} \right)$ oe or $\frac{6}{9} \times \frac{1}{8} \left(= \frac{6}{72} \right)$ oe or $\frac{3}{9} \times \frac{6}{8} \left(= \frac{18}{72} \right)$ oe or $\frac{6}{9} \times \frac{3}{8} \left(= \frac{18}{72} \right)$ oe or $\frac{1}{9} \times \frac{8}{8} \left(= \frac{8}{72} \right)$ oe or $\frac{8}{9} \times \frac{1}{8} \left(= \frac{8}{72} \right)$ or $\frac{2}{9} \times \frac{8}{8} \left(= \frac{16}{72} \right)$ oe or $\frac{8}{9} \times \frac{2}{8} \left(= \frac{16}{72} \right)$ oe		3	M1 for finding one correct product NB if using decimals allow 2 decimal places truncated or rounded
	$1 - \left(2 \times \frac{1}{72} + 7 \times \frac{2}{72} + 4 \times \frac{3}{72} + 2 \times \frac{4}{72} + 3 \times \frac{6}{72} \right)$ or $1 - \left(\frac{6}{72} + \frac{6}{72} + \frac{18}{72} + \frac{8}{72} + \frac{16}{72} \right)$ or $1 - \frac{54}{72}$ oe			M1 for a complete correct method
	Correct answer scores full marks (unless from obvious incorrect working) Do not allow $\frac{6}{9} \times \frac{3}{8} = \frac{18}{72}$ or $\frac{3}{9} \times \frac{6}{8} = \frac{18}{72}$ as this is an incorrect method (M1M0A0)	$\frac{18}{72}$		A1 oe eg $\frac{9}{36}$ or 0.25 or 25% SCB1 for $\frac{21}{81}$ oe eg $\frac{7}{27}$ or 0.259(25...) or 25.9(25...) % truncated or rounded
				Total 3 marks



18	$\frac{4}{16} \times \frac{3}{15} \times \frac{2}{14} \left(= \frac{24}{3360} = \frac{1}{140} \right)$ oe or $\frac{7}{16} \times \frac{6}{15} \times \frac{5}{14} \left(= \frac{210}{3360} = \frac{1}{16} \right)$ oe or $\frac{5}{16} \times \frac{4}{15} \times \frac{3}{14} \left(= \frac{60}{3360} = \frac{1}{56} \right)$ oe		4	M1 for finding <i>BBB</i> or <i>OOO</i> or <i>LLL</i>	M3 for $\frac{11}{16} \times \frac{10}{15} \times \frac{9}{14}$ oe
	$\frac{4}{16} \times \frac{7}{15} \times \frac{6}{14} \left(= \frac{168}{3360} = \frac{1}{20} \right)$ oe or $\frac{4}{16} \times \frac{3}{15} \times \frac{7}{14} \left(= \frac{84}{3360} = \frac{1}{40} \right)$ oe or $\frac{5}{16} \times \frac{4}{15} \times \frac{4}{14} \left(= \frac{80}{3360} = \frac{1}{42} \right)$ oe or $\frac{5}{16} \times \frac{4}{15} \times \frac{7}{14} \left(= \frac{140}{3360} = \frac{1}{24} \right)$ oe or $\frac{5}{16} \times \frac{4}{15} \times \frac{3}{14} \left(= \frac{60}{3360} = \frac{1}{56} \right)$ oe or $\frac{5}{16} \times \frac{7}{15} \times \frac{6}{14} \left(= \frac{210}{3360} = \frac{1}{16} \right)$ oe or $\frac{5}{16} \times \frac{7}{15} \times \frac{4}{14} \left(= \frac{140}{3360} = \frac{1}{24} \right)$ oe or $\frac{5}{16} \times \frac{4}{15} \times \frac{11}{14} \left(= \frac{220}{3360} = \frac{11}{168} \right)$ oe or $\frac{5}{16} \times \frac{11}{15} \times \frac{10}{14} \left(= \frac{550}{3360} = \frac{55}{336} \right)$ oe			M1 for finding the following in any order <i>BOO</i> or <i>BBO</i> or <i>LLB</i> or <i>LLO</i> or <i>LBB</i> or <i>LOO</i> or <i>LOB</i> or <i>LLX</i> or <i>LXX</i> ($X \neq L$)	
	$\frac{24}{3360} + 3 \times \frac{84}{3360} + \frac{210}{3360} + 3 \times \frac{168}{3360}$ oe or $1 - \left(\frac{60}{3360} + 3 \times \frac{80}{3360} + 3 \times \frac{140}{3360} + 3 \times \frac{60}{3360} + 3 \times \frac{210}{3360} + 6 \times \frac{140}{3360} \right)$ oe or $1 - \left(\frac{60}{3360} + 3 \times \frac{220}{3360} + 3 \times \frac{550}{3360} \right)$ oe			M1 for a complete method	
		$\frac{990}{3360}$		A1 for $\frac{990}{3360}$ oe e.g. $\frac{33}{112}$ or 0.29(464...)	
Total 4 marks					



16		$0.42 \div 0.6 (= 0.7)$ oe			M1 (indep)
		$1 - "0.7" (= 0.3)$ oe OR $1 - 0.6 (= 0.4)$ oe			M1 (indep)
		"0.3" $\times$ "0.4" oe			M1 for a complete method
		OR $1 - (0.42 + 0.6 \times "0.3" + "0.4" \times "0.7")$ oe			
			0.12	4	A1 oe
Total 4 marks					
17	a		9	1	B1
	b		$f(x) \geq 0$	1	B1 accept $y \geq 0$ or $f \geq 0$
	c	$(g(2) =) \frac{4}{2+3} \left(= \frac{4}{5} \right)$ oe			M1 or for sight of $fg(x)$ e.g. $\left(\frac{4}{x+3} - 4 \right)^2$
			10.24	2	A1 oe e.g. $\frac{256}{25}$
Total 4 marks					



14	(a)		2	B1 for $\frac{13}{20}$ and $\frac{7}{20}$ on the first branch (0.65 and 0.35)
		Correct probabilities on the tree diagram		B1 for $\frac{12}{19}$, $\frac{7}{19}$, $\frac{13}{19}$ and $\frac{6}{19}$ on the second branch (accept 2 dp or better 0.6315..., 0.3684..., 0.6842..., 0.3157...)
	(b)	$\frac{7}{20} \times \frac{6}{19}$ oe only	2	M1 ft from (a) as long as probabilities less than 1
		$\frac{21}{190}$		A1 for $\frac{21}{190}$ oe or 0.11... (at least 2 dp)
Total 4 marks				
15		C, B, E	3	B3 for all 3 correct (B2 for 2 correct) (B1 for 1 correct)
Total 3 marks				

23	e.g. $\frac{3}{x+7} \times \frac{2}{x+6} + \frac{4}{x+7} \times \frac{3}{x+6} + \frac{x}{x+7} \times \frac{x-1}{x+6} (= \frac{3}{8})$ or e.g. $\frac{3}{N} \times \frac{2}{N-1} + \frac{4}{N} \times \frac{3}{N-1} + \frac{N-7}{N} \times \frac{N-8}{N-1} (= \frac{3}{8})$ oe		4	M2 for all correct products and intention to add (M1 for one correct product)
	$5x^2 - 47x + 18 = 0$ oe ($x = 9$) or $5N^2 - 117N + 592 = 0$			M1 Correct quadratic equation
		16		A1 dep on M3
				Total 4 marks



14 (a)		$\frac{5}{12}, \frac{8}{15}, \frac{7}{15}, \frac{8}{15}, \frac{7}{15}$	2	B2 for all correct probabilities $\frac{5}{12}, \frac{8}{15}, \frac{7}{15}, \frac{8}{15}, \frac{7}{15}$ (B1 for $\frac{5}{12}$ or $\frac{8}{15}, \frac{7}{15}, \frac{8}{15}, \frac{7}{15}$) oe eg for $\frac{5}{12}$ accept 0.41(666...) or 0.42, for $\frac{8}{15}$ accept 0.53(333...) or 0.53, for $\frac{7}{15}$ accept 0.46(666...) or 0.47
(b)	$\frac{7}{12} \times \frac{8}{15}$		2	M1 ft their tree diagram
		$\frac{14}{45}$		A1 oe eg $\frac{56}{180}$ or 0.31(111...) or 31(.111...)%
Total 4 marks				

12	(a)		0.8 and 0.2 0.3 and 0.7 0.6 and 0.4	2	B2 for all 3 correct pairs of probabilities on the correct branches (B1 for 2 correct pairs of probabilities on the correct branches) Allow equivalent fractions
	(b)	"0.8" × "0.3"		2	M1ft (Both probabilities must be less than 1)
			0.24		A1ft oe
					Total 4 marks

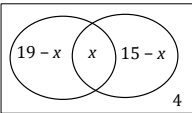
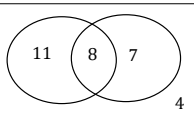


15	0.5^3 or $\frac{1}{8}$ or 0.125 oe		4	M1 for finding <i>DDD</i>
	0.3×0.2^2 or $\frac{3}{250}$ or 0.012 oe			M1 for finding <i>WLL</i> in any order
	$0.5^3 + 3 \times 0.3 \times 0.2^2$ or " $\frac{1}{8}$ " + " $\frac{9}{250}$ " or "0.125" + $3 \times$ "0.012" oe			M1 for a complete method
		0.161		A1 oe
				Total 4 marks

15 ALT	0.3^3 or 0.027 or 0.2^3 or 0.008 oe		4	M1 for finding <i>WWW</i> or <i>LLL</i>
	$0.3^2 \times 0.5$ or 0.045 or $0.3^2 \times 0.2$ or 0.018 or $0.5^2 \times 0.3$ or 0.075 or $0.5^2 \times 0.2$ or 0.05 or $0.2^2 \times 0.5$ or 0.02 or $0.3 \times 0.5 \times 0.2$ or 0.03 or $0.3^2 \times 0.7$ or 0.063 or $0.5^2 \times 0.5$ or 0.125 or $0.2^2 \times 0.5$ or 0.02 or $0.3 \times 0.5 \times 0.2$ or 0.03			M1 for finding <i>WWD</i> or <i>WWL</i> or <i>WDD</i> or <i>DDL</i> or <i>DLL</i> or <i>WDL</i> in any order or for finding <i>WWW'</i> or <i>DDD'</i> or <i>DLL</i> or <i>WDL</i> in any order
	$1 - (3 \times 0.3^2 \times 0.5 + 3 \times 0.3^2 \times 0.2 + 3 \times 0.5^2 \times 0.3 + 3 \times 0.5^2 \times 0.2 + 3 \times 0.2^2 \times 0.5 + 6 \times 0.3 \times 0.5 \times 0.2)$ or $1 - (3 \times 0.3^2 \times 0.7 + 3 \times 0.5^2 \times 0.5 + 3 \times 0.2^2 \times 0.5 + 6 \times 0.3 \times 0.5 \times 0.2)$			M1 for a complete method
		0.161		A1 oe
				Total 4 marks

13	(a)		$\frac{4}{6}$ $\frac{1}{6}, \frac{5}{6}, \frac{1}{6}, \frac{5}{6}$	2	B2oe B1 for $\frac{4}{6}$ (or $\frac{2}{3}$) on LH bottom branch B1 for all other branches correct (allow 0.66 or 0.67 or better, 0.16 or 0.17 or better, 0.83 or better)
	(b)	$\frac{4}{6} \times \frac{5}{6}$		2	M1ft ft their tree diagram if probabilities less than 1 (only considering this product or $1 - (RR + RY + YR)$)
		Correct answer scores full marks (unless from obvious incorrect working)	$\frac{5}{9}$		A1 oe eg $\frac{20}{36}$ or (0.55(55...)) or 55% or better or 56%
					Total 4 marks

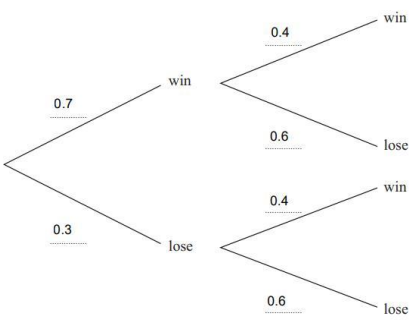


19	$(19 + 15 + 4) - 30$ or $38 - 30$ or $19 + 15 - 26$ or  or $19 - x + x + 15 - x + 4 = 30$ oe		4	M1 for a correct method to find the number of people booking breakfast and dinner	M1A1 for a fully correct Venn diagram  or for $\frac{8}{30}$
	8			A1 can be shown in a Venn diagram or a valid calculation	
	$\frac{8}{30} \times \frac{7}{29}$ or $\frac{8}{30} \times \frac{8}{30} = \frac{64}{900}$ or $\frac{16}{225}$ oe			M1 for the use of $\frac{k}{30} \times \frac{k-1}{29}$ where $k < 30$ or $\frac{"8"}{n} \times \frac{"8"-1}{n-1}$ where $n > 8$	
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{28}{435}$		A1 oe awrt 0.064 or awrt to 6.4%	
				Total 4 marks	

20	$\sqrt{\frac{49}{121}} \left(= \frac{7}{11} = 0.63(63\dots) \right)$		4	M1 Accept 0.63(63...) or 63(.6363...) % rounded or truncated
	$1 - \frac{7}{11} \left(= \frac{4}{11} = 0.36(36\dots) \right)$			M1 Accept 0.36(36...) or 36(.3636...) % rounded or truncated
	$2 \times \frac{7}{11} \times \frac{4}{11}$ or $1 - \left(\frac{49}{121} + \left(\frac{4}{11} \right)^2 \right)$ or $2 \times "0.63" \times "0.36"$ or $1 - (0.40(49\dots) + ("0.36")^2)$			M1 for a complete method
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	$\frac{56}{121}$		A1 oe Allow 0.46(280...) or 46(.280) %
				Total 4 marks

16	$\frac{15}{20} \times \frac{14}{19} \times \frac{5}{18} \left(= \frac{35}{228} \right)$ oe or $\frac{5}{20} \times \frac{4}{19} \times \frac{15}{18} \left(= \frac{5}{114} \right)$ oe or $\frac{15}{20} \times \frac{14}{19} \times \frac{13}{18} \left(= \frac{91}{228} \right)$ oe or $\frac{5}{20} \times \frac{4}{19} \times \frac{3}{18} \left(= \frac{1}{114} \right)$ oe		4	M1 for <i>RRY</i> or <i>YYR</i> in any order or <i>RRR</i> or <i>YYY</i> Allow equivalent decimals to 2 dp truncated or rounded Products must be correct (may not be evaluated)	M2 for <i>RY and YR</i> $\frac{15}{20} \times \frac{5}{19} \left(= \frac{15}{76} \right)$ oe and $\frac{5}{20} \times \frac{15}{19} \left(= \frac{15}{76} \right)$ oe
	$3 \times \frac{15}{20} \times \frac{14}{19} \times \frac{5}{18}$ oe or $3 \times \frac{5}{20} \times \frac{4}{19} \times \frac{15}{18}$ oe or $\frac{15}{20} \times \frac{14}{19} \times \frac{13}{18}$ oe and $\frac{5}{20} \times \frac{4}{19} \times \frac{3}{18}$ oe			M1 for ($3 \times$ <i>RRY</i>) or ($3 \times$ <i>YYR</i>) or <i>RRY and YR</i> (any order) or <i>RRR and YYY</i>	
	$3 \times \frac{15}{20} \times \frac{14}{19} \times \frac{5}{18} + 3 \times \frac{5}{20} \times \frac{4}{19} \times \frac{15}{18}$ oe or $\left(\frac{15}{20} \times \frac{14}{19} \times \frac{5}{18} \right) + \left(\frac{5}{20} \times \frac{4}{19} \times \frac{15}{18} \right) + \left(\frac{15}{20} \times \frac{5}{19} \right) + \left(\frac{5}{20} \times \frac{15}{19} \right)$ oe or $1 - \left(\frac{15}{20} \times \frac{14}{19} \times \frac{13}{18} + \frac{5}{20} \times \frac{4}{19} \times \frac{3}{18} \right)$ oe			M1 for a complete method using correct products	
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$\frac{45}{76}$		A1 oe 0.59(21..) to 2 dp truncated or rounded or 59.(21..) % to 2 sf truncated or rounded	
				Total 4 marks	

13	(a)	<pre>graph LR; A[] --- B[early 0.7]; A --- C[not early 0.3]; B --- D[early 0.9]; B --- E[not early 0.1]; C --- F[early 0.6]; C --- G[not early 0.4];</pre>	Correct probabilities	2	B2 for all 3 correct pairs of probabilities on the correct branches If not B2 then award B1 for one correct pair of probabilities on a correct branch Allow equivalent fractions 0.7 and 0.3 counts as a pair
	(b)	$0.7 \times "0.9"$ oe		2	M1ft (probabilities < 1) for a complete method involving one product
		Correct answer scores full marks (unless from obvious incorrect working)	0.63		A1 ft oe eg $\frac{63}{100}$ or 63%
					Total 4 marks

14	(a)		Correct probabilities	2	B2 for all 3 correct pairs of probabilities on the correct branches (B1 for 1 or 2 correct pairs of probabilities on the correct branches) Allow equivalent fractions or percentages
	(b)	"0.3" × "0.6"		2	M1ft (Both probabilities must be less than 1)
		Correct answer scores full marks (unless from obvious incorrect working)	0.18		A1ft oe eg $\frac{18}{100}$ or $\frac{9}{50}$ or $\frac{0.18}{1}$ or 18%
					Total 3 marks

Question	Working	Answer	Mark	Notes
13 (a)		$\frac{4}{9}, \frac{4}{9}, \frac{1}{9}, \frac{5}{9}, \frac{3}{9}, \frac{1}{9}, \frac{5}{9}, \frac{4}{9}, 0$	2	B2oe Award B1 for any 3 correct. Decimals must be correct (recurring shown), 0 can be $\frac{0}{9}$ or the branch crossed out or left blank
(b)			3	M1 Award M1 for one correct product (ft tree diagram)
	$\frac{5}{10} \times \frac{4}{9} + \frac{4}{10} \times \frac{5}{9} + \frac{4}{10} \times \frac{3}{9}$ or $\frac{5}{10} \times \frac{4}{9} + \frac{4}{10} \times \frac{8}{9}$ oe or $1 - \left(\frac{5}{10} \times \frac{4}{9} + \frac{5}{10} \times \frac{1}{9} + \frac{4}{10} \times \frac{1}{9} + \frac{1}{10} \right)$ oe			M1 A fully correct method (ft tree diagram)
		$\frac{52}{90}$		A1 oe decimals 0.577... or 57.7...% rounded or truncated to 2 or more sf
				Total 5 marks



Question	Working	Answer	Mark	Notes	
14 (a)		0.65 0.35, 0.65 0.35, 0.65	2	B2oe	for all correct If not B2 then award B1 for 0.65 in any of the 3 possible positions NB all values may be given as fractions
(b)	0.35×0.35 or 0.35×0.65 or 0.65×0.35 or 0.65×0.65 $0.35 \times 0.35 + 0.35 \times 0.65 + 0.65 \times 0.35$ or $1 - 0.65 \times 0.65$	0.5775	3	M1 M1 A1	ft from (a) ft from (a) oe e.g. $\frac{231}{400}$, 0.58 or 58% or better



23		RG and GR method	RR and GG method			
		$\frac{3}{t} \times \frac{t-3}{t-1}$ or $\frac{t-3}{t} \times \frac{3}{t-1}$	$\frac{3}{t} \times \frac{2}{t-1}$ or $\frac{t-3}{t} \times \frac{t-4}{t-1}$			M1 for one correct product
		$\frac{3}{t} \times \frac{t-3}{t-1} + \frac{t-3}{t} \times \frac{3}{t-1} = \frac{12}{35}$ or $2 \times \frac{3}{t} \times \frac{t-3}{t-1} = \frac{12}{35}$ oe	$\frac{3}{t} \times \frac{2}{t-1} + \frac{t-3}{t} \times \frac{t-4}{t-1} = \frac{23}{35}$			M1 dep on M1 for a correct equation
		e.g. $2t^2 - 37t + 105 (= 0)$ or allow $2t^2 - 37t = -105$				A1 (dep on M2) writing the correct quadratic expression in form $ax^2 + bx + c$ ($= 0$) allow $ax^2 + bx = c$
		e.g. $(2t - 7)(t - 15) = 0$ e.g. $t = \frac{-(-37) \pm \sqrt{(-37)^2 - 4 \times 2 \times 105}}{2 \times 2}$ e.g. $2 \left(\left(t - \frac{37}{4} \right)^2 - \left(\frac{37}{4} \right)^2 \right) = -105$				M1 (dep on A1) for a complete method to solve the 3-term quadratic equation (allow one sign error and some simplification – allow as far as $\frac{37 \pm \sqrt{1369 - 840}}{4}$) or Can be implied by answers of 15 (and $\frac{7}{2}$)
				12	5	A1 (dep on A1) cao
						Total 5 marks



23 Alt	RG and GR method	RR and GG method			
	$\frac{3}{x+3} \times \frac{x}{x+2}$ or $\frac{x}{x+3} \times \frac{3}{x+2}$	$\frac{3}{x+3} \times \frac{2}{x+2}$ or $\frac{x}{x+3} \times \frac{x-1}{x+2}$			M1 for one correct product
	$\frac{3}{x+3} \times \frac{x}{x+2} +$ $\frac{x}{x+3} \times \frac{3}{x+2} = \frac{12}{35}$ or $2 \times \frac{3}{x+3} \times \frac{x}{x+2} = \frac{12}{35}$ oe	$\frac{3}{x+3} \times \frac{2}{x+2} +$ $\frac{x}{x+3} \times \frac{x-1}{x+2} = \frac{23}{35}$			M1 dep on M1 for a correct equation
	e.g. $2x^2 - 25x + 12 (= 0)$ or allow $2x^2 - 25x = -12$				A1 (dep on M2) writing the correct quadratic expression in form $ax^2 + bx + c$ ($= 0$) allow $ax^2 + bx = c$
	e.g. $(2x - 1)(x - 12) = 0$ e.g. $x = \frac{-(-25) \pm \sqrt{(-25)^2 - 4 \times 2 \times 12}}{2 \times 2}$ e.g. $2 \left(\left(x - \frac{25}{4} \right)^2 - \left(\frac{25}{4} \right)^2 \right) = -12$				M1 (dep on A1) for a complete method to solve the 3-term quadratic equation (allow one sign error and some simplification - allow as far as $\frac{25 \pm \sqrt{625 - 96}}{4}$) or can be implied by answers of 12 (and $\frac{1}{2}$)
			12	5	A1 (dep on A1) cao



Question	Working	Answer	Mark	Notes
24	$\frac{x-4}{x} \times \frac{x-5}{x-1} = 0.7$ $3x^2 - 83x + 200 (= 0)$ oe $\frac{83 \pm \sqrt{83^2 - (4 \times 3 \times 200)}}{2 \times 3}$ or $(3x - 8)(x - 25) (=0)$ or $(x - 83/6)^2 + 200/3 - 83^2/36 (=0)$ Alt: $y = \text{yellow marbles}$ $\frac{y-1}{y+4} \times \frac{y-2}{y+3} = 0.7$ $3y^2 - 59y - 84 (= 0)$ oe $\frac{59 \pm \sqrt{59^2 - (4 \times 3 \times -84)}}{2 \times 3}$ or $(3y + 4)(y - 21)$ or $(y - 59/6)^2 - 84/3 - 59^2/36 (=0)$ $y = 21$ $21+4$	25	5	M2 If not M2 then M1 for either $\frac{x-4}{x}$ or $\frac{x-5}{x-1}$ A1 Rearrangement of their quadratic to the form $ax^2 + bx + c (= 0)$ M1 1 st step in solving the correct 3 term quadratic Accept 25 only (dep on M3 if using algebra) A1 If not M2 then M1 for either $\frac{y}{y+4}$ or $\frac{y-1}{y+3}$
	M2 Rearrangement of their quadratic to the form $ay^2 + by + c (= 0)$ A1 1 st step in solving the correct 3 term quadratic Accept 25 only (dep on M3 if using algebra) Give full marks if $\frac{21}{25} \times \frac{20}{24} = 0.7$ seen and 1 st M2 scored NB: SC B1 for completing 1 st step in solving incorrect 3 term quadratic			
Total 5 marks				
				Total for Paper: 100 marks



15	(a)		$\frac{2}{5}, \frac{3}{5}$ oe	2	B1 correct probabilities for spinner A
			$\frac{4}{5}, \frac{1}{5}, \frac{4}{5}, \frac{1}{5}$ oe		B1 correct probabilities for spinner B
	(b)	$\frac{2}{5} \times \frac{4}{5} \left(= \frac{8}{25} \right)$ or $\frac{2}{5} \times \frac{1}{5} \left(= \frac{2}{25} \right)$ or $\frac{3}{5} \times \frac{4}{5} \left(= \frac{12}{25} \right)$ or $\frac{3}{5} \times \frac{1}{5} \left(= \frac{3}{25} \right)$ oe		3	M1 ft from (a) provided $0 < \text{probability} < 1$
		$1 - \frac{8}{25}$ or $\frac{2}{25} + \frac{12}{25} + \frac{3}{25}$ or $\frac{2}{25} + \frac{3}{5}$ oe			M1 ft from (a) for a complete method
			$\frac{17}{25}$		A1 oe
Total 5 marks					

16	(a)(i)		122	1	B1
	(a)(ii)		reason	1	B1 (dep on a correct answer or a correct method seen for (i)) <u>Opposite angles</u> in a <u>cyclic quadrilateral</u> sum to 180°
	(b)	$360 - 2 \times 58$ or $2 \times '122'$		2	M1 ft from (a)
			244		A1
Total 4 marks					



20	$\frac{\left(\frac{X+4}{2}\right)}{X} (= \frac{X+4}{2X}) \text{ or } \frac{\left(\frac{X+4}{2}\right)^{-1}}{X-1} (= \frac{X+2}{2X-2})$	eg, where b = number of blue counters $\frac{b}{2b-4} \text{ or } \frac{b-1}{2b-5}$	eg, where r = number of red counters $\frac{r+4}{2r+4} \text{ or } \frac{r+3}{2r+3}$		M1 for making a correct start by finding the probability of the first counter being blue for their method
	eg $\frac{X+4}{2X} \times \frac{X+2}{2X-2}$	eg $\frac{b}{2b-4} \times \frac{b-1}{2b-5}$	eg $\frac{r+4}{2r+4} \times \frac{r+3}{2r+3}$		M1 oe correct calculation for 2 blue (using one variable)
	eg $8(X^2 + 6X + 8) = 3(4X^2 - 4X)$	eg $8b(b-1) = 3(2b-4)(2b-5)$	eg $8(r+4)(r+3) = 3(2r+4)(2r+3)$		M1 dep for a correct equation with no algebraic fractions eg could have $X^2 + 6X + 8 = \frac{3}{8}(4X^2 - 4X)$
	Eg $4X^2 - 60X - 64 (= 0)$ or $X^2 - 15X - 16 (= 0)$ oe	eg $4b^2 - 46b + 60 (= 0)$ or $2b^2 - 23b + 30 (= 0)$ oe	eg $4r^2 - 14r - 60 (= 0)$ or $2r^2 - 7r - 30 (= 0)$ oe		M1 for rearranging their equation to a correct 3 term quadratic
				16	5
					A1 cao dep on M4
					Total 5 marks

13	(a)	$\frac{8-4}{5-9} \left(= \frac{12}{-4} \right)$ oe or $\frac{-4-8}{9-5} \left(= \frac{-12}{4} \right)$ oe		2	M1 condone correct gradient embedded in an equation e.g. $y = -3x + c$ or expression e.g. $-3x$ or for an answer of 3
			-3		A1
	(b)		$\frac{1}{4}$	1	B1 accept 0.25 or $-\frac{1}{4}$ oe
					Total 3 marks

14	(a)	0.6×0.9		2	M1 oe
			0.54		A1 oe e.g. $\frac{27}{50}, \frac{54}{100}, 54\%$
	(b)	$0.6 \times 0.1 (= 0.06)$ or $0.4 \times 0.25 (= 0.1)$ or $0.4 \times 0.75 (= 0.3)$		3	M1 oe
		$0.6 \times 0.1 + 0.4 \times 0.25$ or $1 - (0.4 \times 0.75) = "0.54"$			M1 oe, ft their answer from (a)
			0.16		A1 oe e.g. $\frac{4}{25}, \frac{8}{50}, \frac{16}{100}, 16\%$
					Total 5 marks



23	$\text{eg } \frac{\left(\frac{N+3}{2}\right)}{N} \left(= \frac{N+3}{2N}\right)$	eg where b = number of black pens $\frac{b}{2b-3} \text{ or } \frac{b}{N} \text{ and } N = 2b-3 \text{ (or } b = \frac{N+3}{2})$	eg where r = number of red pens $\frac{r+3}{2r+3} \text{ or } \frac{r+3}{N} \text{ and } N = 2r+3 \text{ (or } r = \frac{N-3}{2})$	5	M1 for making a correct start by finding the probability of the first pen being black for their method. If in 2 variables, one must also be defined in terms of the other. (any letter may be used for the variable)
	$\text{eg } \frac{N+3}{2N} \times \frac{N-3}{2(N-1)} = \frac{9}{35}$	$\text{eg } \frac{b}{2b-3} \times \frac{b-3}{2b-4} = \frac{9}{35} \text{ or } \frac{b}{N} \times \frac{b-3}{N-1} = \frac{9}{35}$	$\text{eg } \frac{r+3}{2r+3} \times \frac{r}{2r+2} = \frac{9}{35} \text{ or } \frac{r+3}{N} \times \frac{r}{N-1} = \frac{9}{35} \text{ and } N = 2r+3$		M1 oe dep on previous M1 for a correct equation for black, red – must be in one variable or if 2 variables, one must be defined in terms of other.
	$\text{eg } 35(N+3)(N-3) = 9(2N(2N-2))$ or $35(N^2-9) = 9(4N^2-4N)$	$\text{eg } 35(b^2-3b) = 9(4b^2-14b+12)$	$\text{eg } 35(r^2+3r) = 9(4r^2+10r+6)$		M1 dep on previous marks for a correct equation in one variable with no algebraic fractions – brackets may or may not be expanded
	$\text{eg } N^2-36N+315 (= 0)$	$\text{eg } b^2-21b+108 (= 0)$	$\text{eg } r^2-15r+54 (= 0)$		M1 For correctly rearranging their equation to a 3 term quadratic
	Working must be seen			21, 15	A1 cao dep on M4
					Total 5 marks



24	$\frac{5}{x} \times \frac{(x-4)}{x}$ oe or $\frac{(x-5)}{x} \times \frac{6}{x}$ oe		5	M1 for a correct expression for P(R,G) or P(G,R)
	$\frac{5}{x} \times \frac{(x-4)}{x} + \frac{(x-5)}{x} \times \frac{6}{x}$ oe			M1 for a correct expression for P(R,G) + P(G,R)
	$19x^2 - 352x + 1600 (= 0)$ oe or $19x^2 - 352x = -1600$ oe			M1 for a correct equation in the form $ax^2 + bx + c (= 0)$ oe or $ax^2 + bx = -c$ oe
	$(x-8)(19x-200) (= 0)$ or $(x =) \frac{- -352 \pm \sqrt{(-352)^2 - (4 \times 19 \times 1600)}}{2 \times 19}$ or $19 \left[\left(x - \frac{176}{19} \right)^2 - \left(\frac{176}{19} \right)^2 \right] + 1600 (= 0)$			M1 for solving their 3-term quadratic equation using any correct method - if factorising, allow brackets which expanded give 2 out of 3 terms correct (if using formula or completing the square allow one sign error and some simplification – allow as far as $\frac{352 \pm \sqrt{123904 - 121600}}{38}$ oe or $19 \left(x - \frac{176}{19} \right)^2 - \frac{576}{19} (= 0)$ oe)
		8		A1 cao, dep on M2. Do not award if non-integer solution also given. 8 must come from correct working.
				Total 5 marks



Question	Working	Answer	Mark	Notes
11 (a)		$\frac{11}{16}$ $\frac{7}{20}, \frac{13}{20},$ $\frac{7}{20}, \frac{13}{20}$	2	B1 for $\frac{11}{16}$ oe (0.68(75)) on LH bottom branch (decimals to at least 2 dp truncated or rounded) for $\frac{7}{20}, \frac{13}{20}, \frac{7}{20}, \frac{13}{20}$ on RH branches B1 (0.35, 0.65, 0.35, 0.65)
(b)	$\frac{5}{16} \times \frac{7}{20}$ "or" $\frac{11}{16} \times \frac{13}{20}$ "or" $\frac{5}{16} \times \frac{13}{20}$ "or" $\frac{11}{16} \times \frac{7}{20}$		3	M1 fit their tree diagram (dep on $0 < p < 1$)
	$\frac{5}{16} \times \frac{7}{20} + \frac{11}{16} \times \frac{13}{20}$ "or" $1 - \frac{5}{16} \times \frac{13}{20} - \frac{11}{16} \times \frac{7}{20}$			M1 fit their tree diagram (dep on $0 < p < 1$)
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$\frac{89}{160}$		A1 oe 0.55(625) 55% or 56% SCB1 for $\frac{5}{16} \times \frac{7}{20} + \frac{11}{16} \times \frac{13}{20} \left(= \frac{5005}{102400} \right) \left(= \frac{1001}{20480} = 0.0488.... \right)$
				Total 5 marks

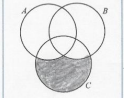


13	(a)		$\frac{3}{10}, \frac{7}{10}$ $\frac{5}{9}, \frac{4}{9}$ $\frac{5}{9}, \frac{4}{9}$	2	B2 for all 3 correct pairs of probabilities on the correct branches If not B2 then award B1 for 1 correct pair of probabilities on a correct branch Allow equivalent fractions/decimals (to 2 dp truncated or rounded ie 0.55(...) and/or 0.44(...))
	(b)	$\frac{3}{10} \times \frac{5}{9}$ oe or $\frac{7}{10} \times \frac{4}{9}$ oe or $\frac{3}{10} \times \frac{4}{9}$ oe or $\frac{7}{10} \times \frac{5}{9}$ oe or		3	M1ft (probabilities < 1) Allow equivalent fractions/decimals (to 2 dp truncated or rounded ie 0.55(...) and/or 0.44(...))
		$\frac{3}{10} \times \frac{5}{9} + \frac{7}{10} \times \frac{4}{9}$ oe or $1 - \left(\frac{3}{10} \times \frac{4}{9} + \frac{7}{10} \times \frac{5}{9} \right)$ oe			M1 ft Allow equivalent fractions/decimals (to 2 dp truncated or rounded ie 0.55(...) and/or 0.44(...))
		<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	$\frac{43}{90}$		A1ft oe 0.47(77..) to 2 dp truncated or rounded or 47.(77)% to 2 sf truncated or rounded
					Total 5 marks



21	eg $\frac{x}{25} \times \frac{25-(x+6)}{24}$ or $\frac{x}{25} \times \frac{19-x}{24}$ oe		5	M1 for a correct product for P(orange , pink)
	eg $2 \times \left(\frac{x}{25} \times \frac{19-x}{24} \right) = \frac{22}{75}$ oe			M1 for setting up a correct equation in x
	eg $2x^2 - 38x + 176 (=0)$ oe eg $x^2 - 19x + 88 (=0)$			M1 for dealing with the fractions to set up a correct quadratic equation
	$x = 11$ or pink = $25 - 6 - 11 (= 8)$			M1 (dep on M1) for $x = 11$ or pink = $25 - 6 - 11 (= 8)$
	Working required	$\frac{7}{75}$		A1 (dep on M2) oe eg 0.093... or 9.3...%
				Total 5 marks

Question	Working	Answer	Mark	Notes
20	$\frac{n-4}{n}$ or $\frac{n-5}{n-1}$ $\frac{n-4}{n} \times \frac{n-5}{n-1} = \frac{1}{3}$ Eg $3(n^2 - 9n + 20) = n(n-1)$ or $3n^2 - 27n + 60 = n^2 - n$ Eg $2n^2 - 26n + 60 = 0$ or $n^2 - 13n + 30 = 0$ Eg $(n-10)(n-3) = 0$ or $\frac{- -13 \pm \sqrt{(-13)^2 - 4 \times 1 \times 30}}{2 \times 1}$	10	6	M1 $\frac{n-4}{n}$ or $\frac{n-5}{n-1}$ M1 for the correct equation M1 for a correct quadratic equation with fractions removed M1 for a correct quadratic equation equal to 0 M1 dep on M2 ft for method to solve 3 term quadratic A1 for correct answer from correct working NB. Award M5A1 for an answer of 10 with justification e.g. $\frac{6}{10} \times \frac{5}{9} = \frac{1}{3}$ Award M0A0 for an answer of 10 with no working and no justification

13	(a)			1	B1 Professional judgment required, eg allow double shading if meaning clear.
	(b)		$(D \cup E) \cap F$	1	B1 oe eg $(D \cap F) \cup (E \cap F)$
Total 2 marks					

14	(a)		0.7, 0.2, 0.8, 0.1, 0.9	2	B2 oe, all correct
	(b)	$0.3 \times "0.2" (= 0.06)$ or $0.7 \times "0.1" (= 0.07)$ oe		4	(B1) 2 or 3 or 4 correct probabilities M1 ft from (a) dep on probabilities being between 0 and 1, OR $0.3 \times "0.8" (= 0.24)$ or $0.7 \times "0.9" (= 0.63)$ oe
		$0.3 \times "0.2" + 0.7 \times "0.1" (= 0.13)$ oe or $"0.06" \times 200 (= 12)$ or $"0.07" \times 200 (= 14)$			M1 ft from (a), OR $0.3 \times "0.8" + 0.7 \times "0.9" (= 0.87)$ oe or $"0.24" \times 200 (= 48)$ or $"0.63" \times 200 (= 126)$
		$"0.13" \times 200$ oe or $"12" + "14"$			M1 ft from (a), $200 - "0.87" \times 200$ oe or $(1 - "0.87") \times 200$ or $200 - "48" - "126"$
			26		A1 cao
Total 6 marks					

21	$\frac{6}{n} \times \frac{5}{n-1}$ or $\frac{n-6}{n} \times \frac{n-7}{n-1}$ oe or $\frac{6}{n} \times \frac{n-6}{n-1}$		6	M1 for red, red or blue, blue This may be seen as part of an equation allow eg $n-6-1$ in place of $n-7$ or for red, blue
	$\frac{6}{n} \times \frac{5}{n-1}$ and $\frac{n-6}{n} \times \frac{n-7}{n-1}$ oe or $2 \times \frac{6}{n} \times \frac{n-6}{n-1}$ oe			M1 for both products, with no other products This may be seen as part of an equation or for red, blue + blue, red
	$\frac{6}{n} \times \frac{5}{n-1} + \frac{n-6}{n} \times \frac{n-7}{n-1} = \frac{9}{17}$ oe or $2 \times \frac{6}{n} \times \frac{n-6}{n-1} = 1 - \frac{9}{17}$ oe			M1 Correct equation or correct equation using the complementary event.
	$2n^2 - 53n + 306 (= 0)$ oe			A1 Correct simplification of equation to a 3 term quadratic. eg $8n^2 - 212n + 1224 (= 0)$
	$(2n-17)(n-18) (= 0)$ or $\frac{-(-53) \pm \sqrt{(-53)^2 - 4 \times 2 \times 306}}{2 \times 2}$ or $\left(n - \frac{53}{4}\right)^2 - \left(\frac{53}{4}\right)^2 + 153 = 0$ oe			M1 For solving correct 3 term quadratic equation using any correct method. If factorising, allow brackets which expanded give 2 out of 3 terms correct (if using formula or completing the square allow one sign error and some simplification – allow as far as eg $\frac{53 \pm \sqrt{2809 - 2448}}{4}$ or eg $\left(n - \frac{53}{4}\right)^2 = \frac{361}{16}$ oe or for both correct solutions of the correct quadratic. $n = 18, n = 8.5$
		18		A1 cao dep M3 do not award if non-integer solution also given.
Total 6 marks				

13	(a)		$\frac{6}{14}, \frac{8}{14}$	2	B1 for $\frac{6}{14}\left(\frac{3}{7}\right), \frac{8}{14}\left(\frac{4}{7}\right)$ in correct positions. Allow decimals of 2dp or better (0.43, 0.57)
			$\frac{3}{10}, \frac{7}{10}, \frac{3}{10}, \frac{7}{10}$		B1oe for $\frac{3}{10}, \frac{7}{10}, \frac{3}{10}, \frac{7}{10}$ in correct positions.
	(b)	$\frac{8}{14} \times \frac{7}{10}$		2	M1 ft from (a)
			$\frac{2}{5}$ oe		A1
	(c)	$\frac{7}{13} \times \frac{6}{9} \left(= \frac{42}{117} = \frac{14}{39} = 0.35(897...) \right)$ or $\frac{8}{14} \times \frac{7}{13} \left(= \frac{56}{182} \text{ oe} \right)$ or $\frac{7}{10} \times \frac{6}{9} \left(= \frac{42}{90} \right)$		3	M1 ft from (a) $\left(\frac{7}{13} = 0.54 \text{ to 2dp} \right)$ $\frac{6}{9} = 0.67 \text{ to 2dp} \right)$
		" $\frac{42}{117}$ " " $\times$ " " $\frac{2}{5}$ " or $\left(\frac{8}{14} \times \frac{7}{13}\right) \times \left(\frac{7}{10} \times \frac{6}{9}\right)$			M1 ft from (b)
			$\frac{28}{195}$ oe		A1 for $\frac{28}{195}$ oe, e.g. 0.14(3589...) from accurate working
					Total 7 marks



15	(a)		$\frac{2}{9}, \frac{7}{9}$	2	B1 for correct probabilities for the first card Allow equivalent probabilities e.g 0.2
			$\frac{1}{8}, \frac{7}{8}, \frac{2}{8}, \frac{6}{8}$		B1 for correct probabilities for the second card Allow equivalent probabilities
	(b)	$\frac{2}{9} \times \frac{1}{8}$ or $1 - \frac{2}{9} \times \frac{7}{8} - \frac{7}{9} \times \frac{2}{8} - \frac{7}{9} \times \frac{6}{8}$		2	M1ft (All probabilities must be less than 1)
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$\frac{1}{36}$		A1ft oe probability must be less than 1 Allow equivalent decimal to at least 2 sf (truncated or rounded) for $\frac{1}{36}$ (= 0.027(77..))
	(c)	$\frac{2}{9} \times \frac{7}{8}$ or $\frac{7}{9} \times \frac{2}{8}$ oe or $\frac{2}{9} \times \frac{1}{8}$ and $\frac{7}{9} \times \frac{6}{8}$ oe or $\frac{1}{36}$ and $\frac{7}{9} \times \frac{6}{8}$ oe		3	M1ft (All probabilities must be less than 1)
		$\frac{2}{9} \times \frac{7}{8} + \frac{7}{9} \times \frac{2}{8}$ or $2 \times \frac{14}{72}$ oe or $1 - \frac{2}{9} \times \frac{1}{8} - \frac{7}{9} \times \frac{6}{8}$ oe or $1 - \frac{1}{36} - \frac{7}{9} \times \frac{6}{8}$ oe			M1ft



	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{7}{18}$		A1ft oe probability must be less than 1 Allow equivalent decimal to at least 2 sf (truncated or rounded) for $\frac{7}{18}$ (= 0.38(88..))
				Total 7 marks

14	(a)		$\frac{5}{9}$ and $\frac{4}{9}$ $\frac{7}{10}$ and $\frac{3}{10}$ $\frac{7}{10}$ and $\frac{3}{10}$	2	B2 for all 3 correct pairs of probabilities on the correct branches (B1 for 1 or 2 correct pairs of probabilities on the correct branches) Accept decimals or percentages rounded or truncated to at least 2sf. NB $\frac{5}{9} = 0.55(55\dots)$ and $\frac{4}{9} = 0.44(44\dots)$
	(b)	$\frac{5}{9} \times \frac{7}{10}$ or $1 - \left(\frac{5}{9} \times \frac{3}{10} + \frac{4}{9} \times \frac{7}{10} + \frac{4}{9} \times \frac{3}{10} \right)$		2	M1ft ft diagram, oe A1ft ft diagram, oe fraction, decimal or percentage. NB $\frac{7}{18} = \frac{35}{90} = 0.38(88\dots)$
		<i>Correct answer only scores full marks (unless from obviously incorrect working)</i>	$\frac{7}{18}$		Allow ft their tree diagram provided the relevant probabilities are less than 1 in each case For A1, allow decimals or percentages that round or truncate correctly to at least 2sf. ISW any attempt to convert to other form once correct probability seen



	(c) $(RRR \Rightarrow) \frac{5}{9} \times \frac{7}{10} \times \left(1 - \frac{2}{11}\right) \left(= \frac{315}{990} = \frac{7}{22}\right)$ or $(RRG \Rightarrow) \frac{5}{9} \times \frac{7}{10} \times \frac{2}{11} \left(= \frac{70}{990} = \frac{7}{99}\right)$ or $(RGR \Rightarrow) \frac{5}{9} \times \frac{3}{10} \times \left(1 - \frac{2}{11}\right) \left(= \frac{135}{990} = \frac{3}{22}\right)$ or $(GRR \Rightarrow) \frac{4}{9} \times \frac{7}{10} \times \left(1 - \frac{2}{11}\right) \left(= \frac{252}{990} = \frac{14}{55}\right)$ OR $(GGG \Rightarrow) \frac{4}{9} \times \frac{3}{10} \times \frac{2}{11} \left(= \frac{24}{990} = \frac{4}{165}\right)$ or $(GGR \Rightarrow) \frac{4}{9} \times \frac{3}{10} \times \left(1 - \frac{2}{11}\right) \left(= \frac{108}{990} = \frac{6}{55}\right)$ or $(GRG \Rightarrow) \frac{4}{9} \times \frac{7}{10} \times \frac{2}{11} \left(= \frac{56}{990} = \frac{28}{495}\right)$ or $(RGG \Rightarrow) \frac{5}{9} \times \frac{3}{10} \times \frac{2}{11} \left(= \frac{30}{990} = \frac{1}{33}\right)$ $\frac{7}{22} + \frac{7}{99} + \frac{3}{22} + \frac{14}{55}$ or $1 - \left(\frac{4}{165} + \frac{6}{55} + \frac{28}{495} + \frac{1}{33}\right)$ <i>Correct answer only scores full marks (unless from obviously incorrect working)</i>		3 M1ft ft diagram for a correct calculation to find the probability of one relevant outcome, eg <i>RRR</i> or <i>RRG</i> or <i>RGR</i> or <i>GRR</i> OR eg <i>GGG</i> or <i>GGR</i> or <i>GRG</i> or <i>RGG</i> May see <i>RRR</i> or <i>RRG</i> found using their answer to part (b): $(RRR \Rightarrow) \left[\frac{7}{18}\right] \times \left(1 - \frac{2}{11}\right)$ $(RRG \Rightarrow) \left[\frac{7}{18}\right] \times \frac{2}{11}$ where $\left[\frac{7}{18}\right]$ is their answer to part (b) and must be less than 1 M1ft ft diagram, for a method to find the probability required. Condone one error in one of the four relevant outcomes or omission of one outcome Note $P(RR) = P(RRR) + P(RRG)$, so may see $\frac{5}{9} \times \frac{7}{10} \left(= \frac{7}{18}\right)$ in place of $\frac{7}{22} + \frac{7}{99}$ for this mark (similar with $P(GG)$) A1ft ft diagram, correct probability or fraction, decimal or percentage NB $\frac{386}{495} = \frac{772}{990} = 0.77(979\dots)$	Allow ft their tree diagram provided the relevant probabilities are less than 1 in each case For A1, allow decimals or percentages that round or truncate correctly to at least 2sf. ISW any attempt to convert to other form once correct probability seen
			Total 7 marks	

15	(a)		$\frac{9}{20}$ on first red branch	3	B1
			Correct binary structure		B1
		$\frac{9}{16}, \frac{7}{16}, \frac{9}{16}, \frac{7}{16}$	Labels and correct probabilities on all second branches		B1
	(b)	$\frac{9}{20} \times \frac{7}{16}$	$\frac{63}{320}$ or 0.196(875)	2	M1
					A1 oe ft diagram Accept 0.20 or better
	(c)	$\frac{9}{20} \times \frac{7}{16} + \frac{11}{20} \times \frac{9}{16}$	$\frac{162}{320}$ or 0.506(25)	3	M1 for $\frac{11}{20} \times \frac{9}{16}$
					M1 for $\frac{9}{20} \times \frac{7}{16} + \frac{11}{20} \times \frac{9}{16}$
					A1 oe Accept 0.51 or better
Total 8 marks					

Question	Working	Answer	Mark	Notes
13 (a)		0.3		B1 oe first race branch correct
		0.6, 0.4, 0.6	2	B1 oe second race branches correct
(b)	$0.7 \times "0.6" (= 0.42)$ oe or $"0.3" \times "0.4" (= 0.12)$ oe or $0.7 \times 0.4 (= 0.28)$ oe or $"0.3" \times "0.6" (= 0.18)$ oe			M1 ft their tree diagram dep on probabilities being less than 1
	$"0.42" + "0.12"$ oe or $1 - "0.28" - "0.18"$ oe			M1 ft complete method to find probability that Emilie wins exactly one of the races
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	0.54	3	A1 oe, eg $\frac{27}{50}$ ft from their tree diagram on M marks only
(c)	$0.7 \times 0.4 \times (1 - 0.6) (= 0.112)$ oe or $"0.54" \times 0.3 (= 0.162)$ oe or $0.7 \times "0.6" \times 0.3 + "0.3" \times "0.4" \times 0.3 (= 0.162)$			M1 ft
	eg $"0.112" + "0.162"$			M1 ft For a fully correct method
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i> <i>NB: allow decimals, fractions or percentages with % as oe for probability</i>	0.274	3	A1 oe, eg $\frac{137}{500}$ ft from (a) and (b) on M marks only
Total 8 marks				

15 (a)		$\frac{3}{9}$ $\frac{2}{9}, \frac{4}{9}, \frac{3}{9}$	2	B1 for lower 1 st game branch probability B1ft for all values correct on 2 nd game branches
(b)	$\left(\frac{2}{9} \times \frac{3}{9}\right)$ or $\left(\frac{3}{9} \times \frac{2}{9}\right)$ or $\left(\frac{4}{9} \times \frac{4}{9}\right)$ oe or		3	M1ft from their tree diagram for one correct product from WL or L W or DD (allow probabilities to 2 dp truncated or rounded)
	$\left(\frac{2}{9} \times \frac{3}{9}\right) + \left(\frac{3}{9} \times \frac{2}{9}\right) + \left(\frac{4}{9} \times \frac{4}{9}\right)$ oe			M1ft for a fully correct method
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{28}{81}$		A1 Allow 0.345 ... (2 dp truncated or rounded) or 34.5% (2 sf truncated or rounded)
(c)	$\left(\frac{2}{9} \times \frac{4}{9} \times \frac{3}{9}\right)$ or $\left(\frac{4}{9} \times \frac{4}{9} \times \frac{4}{9}\right)$		3	M1ft from their tree diagram for any combination of WLD or DDD (allow probabilities to 2 dp truncated or rounded)
	$6 \times \left(\frac{2}{9} \times \frac{4}{9} \times \frac{3}{9}\right) + \left(\frac{4}{9} \times \frac{4}{9} \times \frac{4}{9}\right)$			M1ft for a fully correct method
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{208}{729}$		A1 Allow 0.285 ... (2 dp truncated or rounded) or 28.5% (2 sf truncated or rounded)
				Total 8 marks



15 ALT	(a)		$\frac{3}{9}$ $\frac{2}{9}, \frac{4}{9}, \frac{3}{9}$	2	B1 for lower 1 st game branch probability B1ft for all values correct on 2 nd game branches
	(b)	1 and $\left(\frac{2}{9} \times \frac{2}{9}\right)$ or $\left(\frac{4}{9} \times \frac{2}{9}\right)$ or $\left(\frac{4}{9} \times \frac{3}{9}\right)$ or $\left(\frac{3}{9} \times \frac{3}{9}\right)$ oe		3	M1ft from their tree diagram for 1 and one correct product from <i>WW, DW, DL</i> or <i>LL</i> (allow probabilities to 2 dp truncated or rounded)
		$1 - \left[\left(\frac{2}{9} \times \frac{2}{9}\right) + 2\left(\frac{4}{9} \times \frac{2}{9}\right) + 2\left(\frac{4}{9} \times \frac{3}{9}\right) + \left(\frac{3}{9} \times \frac{3}{9}\right) \right]$ oe			M1ft for a fully correct method
		Correct answer scores full marks (unless from obvious incorrect working)	$\frac{28}{81}$		A1 Allow 0.345 ... (2 dp truncated or rounded) or 34.5% (2 sf truncated or rounded)
	(c)	1 and $\left(\frac{2}{9} \times \frac{2}{9} \times \frac{2}{9}\right)$ or $\left(\frac{2}{9} \times \frac{2}{9} \times \frac{4}{9}\right)$ or $\left(\frac{2}{9} \times \frac{2}{9} \times \frac{3}{9}\right)$ or $\left(\frac{2}{9} \times \frac{4}{9} \times \frac{4}{9}\right)$ or $\left(\frac{2}{9} \times \frac{3}{9} \times \frac{3}{9}\right)$ or $\left(\frac{4}{9} \times \frac{4}{9} \times \frac{3}{9}\right)$ or $\left(\frac{4}{9} \times \frac{3}{9} \times \frac{3}{9}\right)$ or $\left(\frac{3}{9} \times \frac{3}{9} \times \frac{3}{9}\right)$ oe		3	M1ft from their tree diagram for 1 and one correct product from <i>WWW</i> or <i>WWD</i> or <i>WWL</i> or <i>WDD</i> or <i>WLL</i> or <i>DDL</i> or <i>DLL</i> or <i>LLL</i> (allow probabilities to 2 dp truncated or rounded)
		$1 - \left[\left(\frac{2}{9} \times \frac{2}{9} \times \frac{2}{9}\right) + 3\left(\frac{2}{9} \times \frac{2}{9} \times \frac{4}{9}\right) + 3\left(\frac{2}{9} \times \frac{2}{9} \times \frac{3}{9}\right) + 3\left(\frac{2}{9} \times \frac{4}{9} \times \frac{4}{9}\right) + 3\left(\frac{2}{9} \times \frac{3}{9} \times \frac{3}{9}\right) + 3\left(\frac{4}{9} \times \frac{4}{9} \times \frac{3}{9}\right) + 3\left(\frac{4}{9} \times \frac{3}{9} \times \frac{3}{9}\right) + \left(\frac{3}{9} \times \frac{3}{9} \times \frac{3}{9}\right) \right]$ oe			M1ft for a fully correct method
		Correct answer scores full marks (unless from obvious incorrect working)	$\frac{208}{729}$		A1 Allow 0.285 ... (2 dp truncated or rounded) or 28.5% (2 sf truncated or rounded)
					Total 8 marks

