Chapter 8

Probability

01. 0580_s24_qp_43 Q: 9

N	A	M	I	B	I	A

The diagram shows 7 cards.

(a) Amir picks a card at random.

Find the probability that the card shows

(i) the letter H

..... [1]

(ii) the letter B.

..... [1]

(b) Fumika picks one of the 7 cards at random.
She replaces it and picks a second card at random.

Find the probability that both cards show the letter I.

..... [2]

(c) Marcos picks two of the 7 cards at random, **without** replacement.

(i) Find the probability that one card shows the letter I and the other card shows the letter N.

..... [3]

(ii) Find the probability that the two cards show different letters.

..... [3]

(d) Nina picks one of the 7 cards at random without replacement.
She continues picking cards at random without replacement until she picks a card that shows the letter A.

The probability that this occurs when she picks the nth card is $\frac{4}{21}$.

Find the value of n.

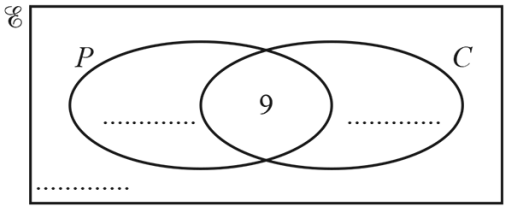
$n =$ ..... [2]

02. 0580_m23_qp_42 Q: 7

$\mathscr{E}$= {students in a class} P = {students who study Physics} C = {students who study Chemistry}

$n(\mathscr{E}) = 24$ $n(P) = 17$ $n(C) = 14$ $n(P \cap C) = 9$

(a) Complete the Venn diagram.



[2]

(b) **(i)** Find $n(P \cap C')$.

..... [1]

(ii) Find $n(P \cup C')$.

..... [1]

(c) Two students are picked from the class at random.

Find the probability that one student studies both subjects and one student studies Chemistry but not Physics.

..... [3]

(d) Two of the students who study Physics are picked at random.

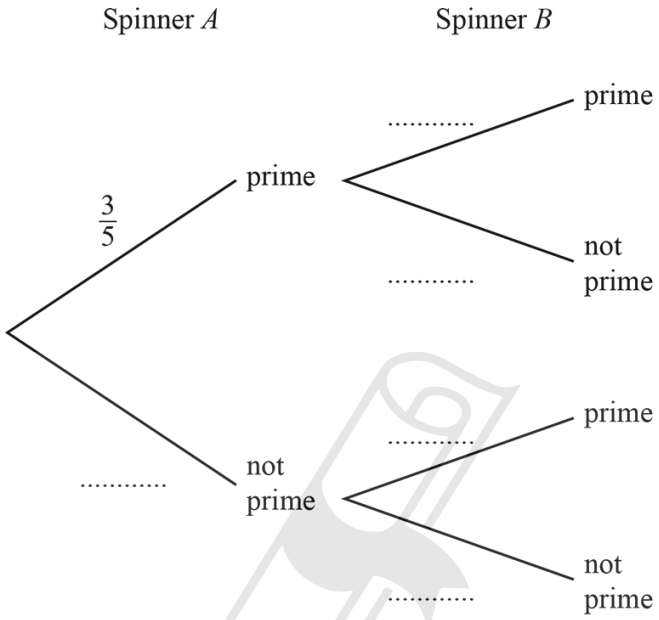
Find the probability that they both study Chemistry.

..... [2]

(a) Lucia has two fair spinners.
Spinner *A* is five-sided and is numbered 1, 2, 3, 4, 5.
Spinner *B* is nine-sided and is numbered 3, 3, 3, 4, 4, 4, 4, 5, 5.

Lucia spins the two spinners and records whether they land on a prime number.

(i) Complete the tree diagram.



[2]

(ii) Find the probability that

(a) the two numbers are both prime

..... [2]

(b) the two numbers are **not** both prime.

..... [1]

(b) Lucia spins Spinner A 120 times.

Find the expected number of times the spinner lands on a prime number.

..... [1]

(c) Lucia spins Spinner B twice.

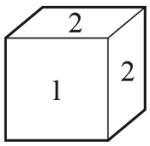
Find the probability that the two numbers it lands on add up to 9 or more.

..... [3]

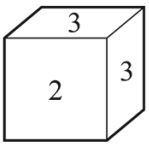
(d) Lucia keeps spinning Spinner B until it lands on a 4.

Find an expression, in terms of n, for the probability that this happens on the nth spin.

..... [2]



Dice A



Dice B

The diagram shows two fair dice.
Dice A is numbered 1, 2, 2, 2, 3, 6.
Dice B is numbered 2, 3, 3, 4, 4, 4.

(a) **(i)** Dice A is rolled once.

Write down the probability that it lands on the number 6.

..... [1]

(ii) Dice A is rolled 150 times.

Find the number of times it is expected to land on the number 6.

..... [1]

(b) Dice A and Dice B are each rolled once.

(i) Find the probability that the two numbers they land on have a total of 6.

..... [3]

(ii) Find the probability that when the two numbers they land on have a total of 6, both numbers are 3.

..... [2]

(c) Dice B is rolled n times.

The probability that on the nth roll it first lands on a number 3 is $\frac{32}{729}$.

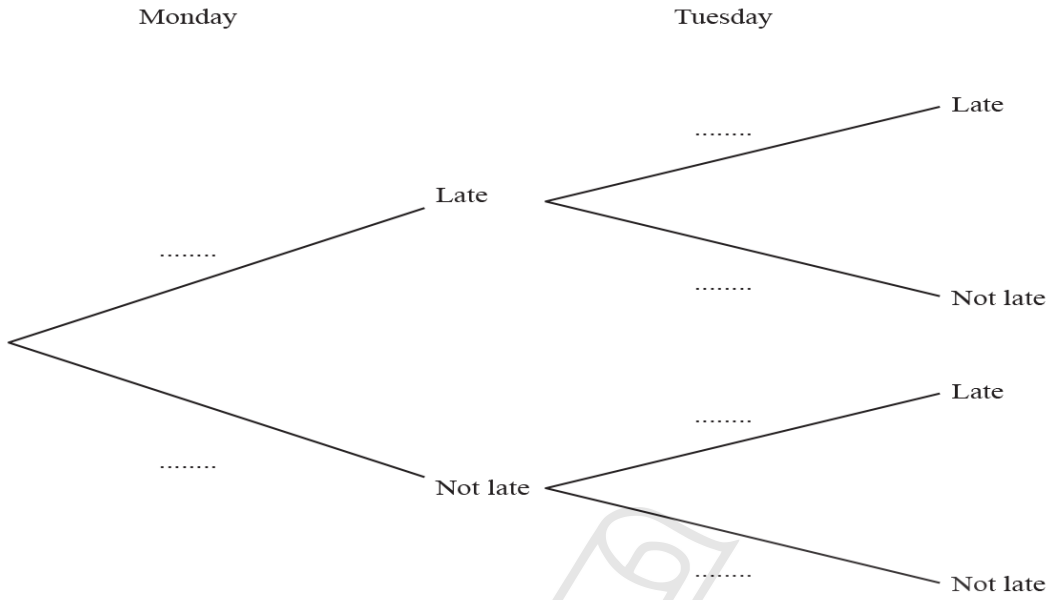
Find the value of n.

$n =$ ..... [2]

05. 0580_m22_qp_42 Q: 11

(a) The probability that Shalini is late for school on any day is $\frac{1}{6}$.

(i) Complete the tree diagram for Monday and Tuesday.

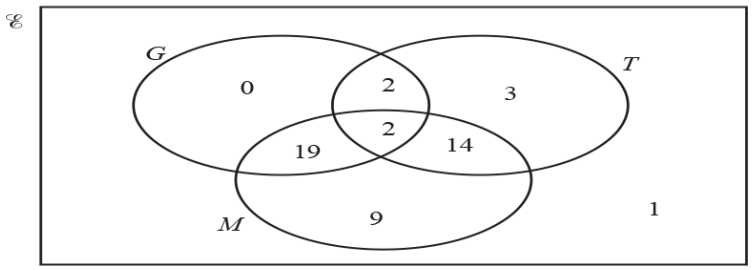


[2]

(ii) Calculate the probability that Shalini is late on Monday but is not late on Tuesday.

..... [2]

(b) The Venn diagram shows the number of students in a group of 50 students who wear glasses (G), who wear trainers (T) and who have a mobile phone (M).



(i) Use set notation to describe the region that contains only one student.

..... [1]

(ii) Find $\mathrm{n}\left(T' \cap (G \cup M)\right)$.

..... [1]

(iii) One student is picked at random from the 50 students.

Find the probability that this student wears trainers but does not wear glasses.

..... [1]

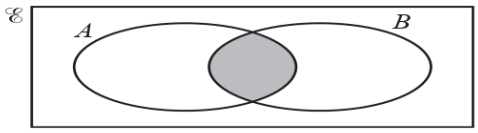
(iv) Two students are picked at random from those wearing trainers.

Find the probability that both students have mobile phones.

..... [3]

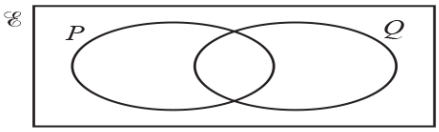
06. 0580_s22_qp_41 Q: 8

(a) **(i)** Use set notation to describe the shaded region in the Venn diagram.

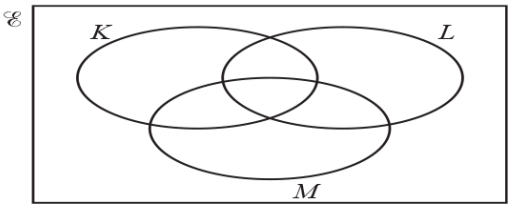


..... [1]

(ii) Shade the correct region in each Venn diagram.



$Q \cup P'$



$(K \cup L) \cap M'$

[2]

(b)

V	E	N	N	D	I	A	G	R	A	M

The diagram shows 11 cards.

(i) One of these cards is chosen at random.

Write down the probability that the letter on the card is **not** A.

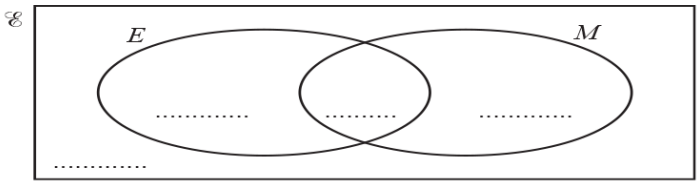
..... [1]

(ii) A card is chosen at random from these 11 cards and then replaced.
A second card is then chosen at random.

Find the probability that exactly one card has the letter N.

..... [3]

(c)



50 students are asked if they like English (E) and if they like mathematics (M).
3 say they do not like English and do not like mathematics.
33 say they like English.
42 say they like mathematics.

(i) Complete the Venn diagram. [2]

(ii) A student is chosen at random.

Find the probability that this student likes English and likes mathematics.

..... [1]

(iii) Two students are chosen at random.

Find the probability that they both like mathematics.

..... [2]

(iv) Two students who like English are chosen at random.

Find the probability that they both also like mathematics.

..... [2]

07. 0580_s22_qp_42 Q: 6

(a) At a festival, 380 people out of 500 people questioned say that they are camping.
There are 55 300 people at the festival.

Calculate an estimate of the total number of people camping at the festival.

..... [2]

(b) 12 friends travel to the festival.
5 travel by car, 4 travel by bus and 3 travel by train.
Two people are chosen at random from the 12 friends.

Calculate the probability that they travel by different types of transport.

..... [4]

(c) Arno buys a student ticket for $43.68 .
This is a saving of 16% on the full price of a ticket.

Calculate the full price of a ticket.

$ ..... [2]

(d) At a football match, there are 29 800 people, correct to the nearest 100.

(i) At the end of the football match, the people leave at a rate of 400 people per minute, correct to the nearest 50 people.

Calculate the lower bound for the number of minutes it takes for all the people to leave.

..... min [3]

(ii) At a cricket match there are 27 500 people, correct to the nearest 100.
Calculate the upper bound for the difference between the number of people at the football match and at the cricket match.

..... [2]

08. 0580_w22_qp_43 Q: 7

Regan is playing a game with these six number cards.

−3	−2	2	3	5	7

(a) She takes two cards at random, without replacement, and **multiplies** the two numbers to give a score.

Find the probability that

(i) the score is 35

..... [3]

(ii) the score is a positive number.

..... [3]

(b) Regan now takes three cards at random from the six cards, without replacement, and **adds** the three numbers to give a total.

Find the probability that her total is 5.

..... [4]

09. 0580_m21_qp_42 Q: 4

(a) A shop gives each of 1000 people a voucher.
28 people use their voucher.
The shop now gives each of 16 500 people a voucher.

Calculate how many of these 16 500 people are expected to use their voucher.

..... [1]

(b) In a class activity, all the 15 students wear hats.
7 students wear red hats, 6 students wear green hats and 2 students wear white hats.

(i) One of these students is picked at random.

Find the probability that this student wears a red hat.

..... [1]

(ii) Two of the 15 students are picked at random.

Show that the probability that these two students wear hats of the same colour is $\frac{37}{105}$.

[3]

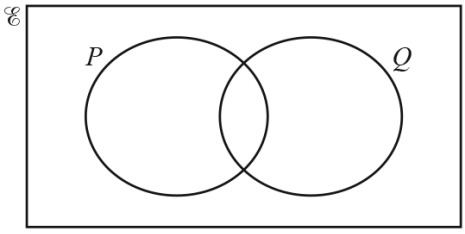
(iii) Three of the 15 students are picked at random.

Find the probability that at least two of these three students wear red hats.

..... [4]

10. 0580_s21_qp_41 Q: 6

(a) In the Venn diagram, shade the region $P' \cup Q$.

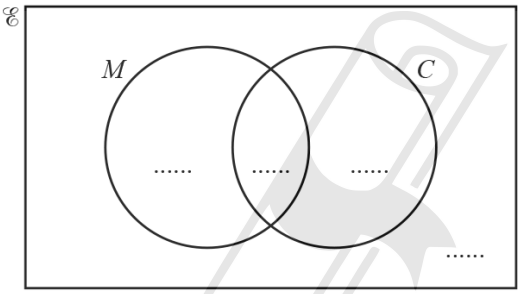


[1]

(b) There are 50 students in a group.

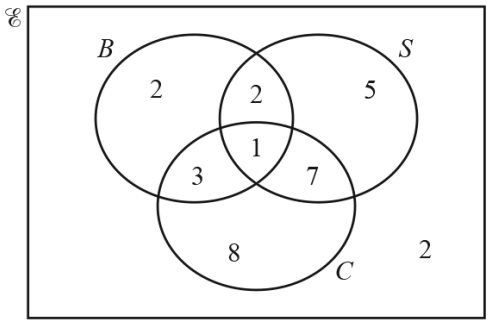
34 have a mobile phone (M).
39 have a computer (C).
5 have no mobile phone and no computer.

Complete the Venn diagram to show this information.



[2]

(c) The Venn diagram shows the number of students in a group of 30 who have brothers (B), sisters (S) or cousins (C).



(i) Write down the number of students who have brothers.

..... [1]

(ii) Write down the number of students who have cousins but do not have sisters.

..... [1]

(iii) Find $n(B \cup S \cup C)'$.

..... [1]

(iv) Use set notation to describe the set of students who have both cousins and sisters but do not have brothers.

..... [1]

(v) One student is picked at random from the 30 students.

Find the probability that this student has cousins.

..... [1]

(vi) Two students are picked at random from the students who have cousins.

Calculate the probability that both these students have brothers.

..... [3]

(vii) One student is picked at random from the 30 students.

Event A This student has sisters.
Event B This student has cousins but does not have brothers.

Explain why event A and event B are equally likely.

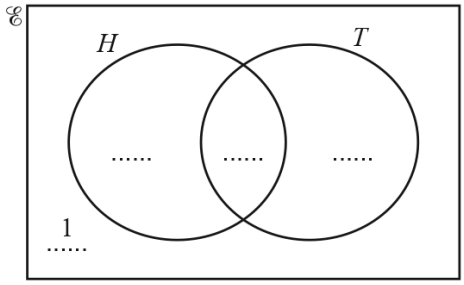
.....

..... [1]

11. 0580_s21_qp_43 Q: 6

In a class of 24 students, 18 students like homework (H), 15 students like tests (T) and 1 student does not like homework and does not like tests.

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



[2]

(b) Write down the number of students who like both homework and tests.

..... [1]

(c) Find $n(H' \cap T)$.

..... [1]

(d) A student is picked at random from the class.

Write down the probability that this student likes tests but does not like homework.

..... [1]

(e) Two students are picked at random from the class.

Find the probability that both students do not like homework and do not like tests.

..... [1]

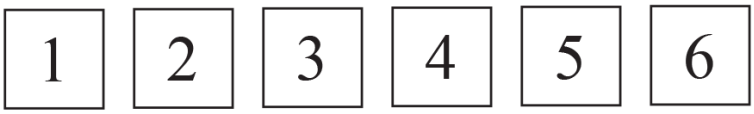
(f) Two of the students who like homework are picked at random.

Find the probability that both students also like tests.

..... [3]

12. 0580_m20_qp_42 Q: 6

Suleika has six cards numbered 1 to 6.



(a) She takes one card at random, records the number and replaces the card.

(i) Write down the probability that the number is 5 or 6.

..... [1]

(ii) Suleika does this 300 times.

Find how many times she expects the number 5 or 6.

..... [1]

(b) Suleika takes two cards at random, without replacement.

(i) Find the probability that the sum of the numbers on the two cards is 5.

..... [3]

(ii) Find the probability that at least one of the numbers on the cards is a square number.

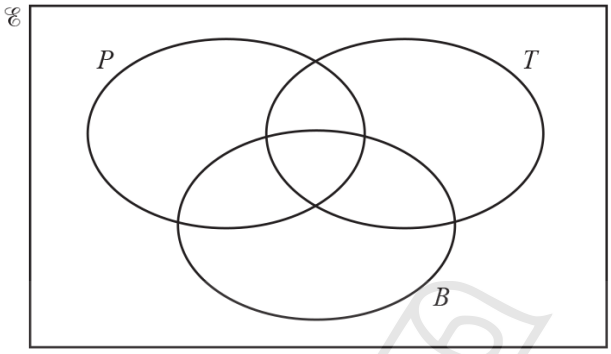
..... [3]

13. 0580_m20_qp_42 Q: 9

This year, 40 students have each travelled by one or more of plane (P), train (T) or boat (B).

7 have travelled only by plane.
11 have travelled only by train.
9 have travelled only by boat.

$n(P \cap T) = 8$
$n(B \cap T) = 3$
$n(B \cap P) = 6$



(a) Complete the Venn diagram. [3]

(b) Find $n\left((P \cup B)'\right)$.

..... [1]

(c) Use set notation to complete the statement.

$(P \cup T \cup B)' =$ ..... [1]

(d) Two students are chosen at random.

Calculate the probability that they both have travelled only by plane.

..... [2]

(e) Two students are chosen at random from those who have travelled by train.

Calculate the probability that they both have also travelled by plane.

..... [2]

14. 0580_s20_qp_42 Q: 7

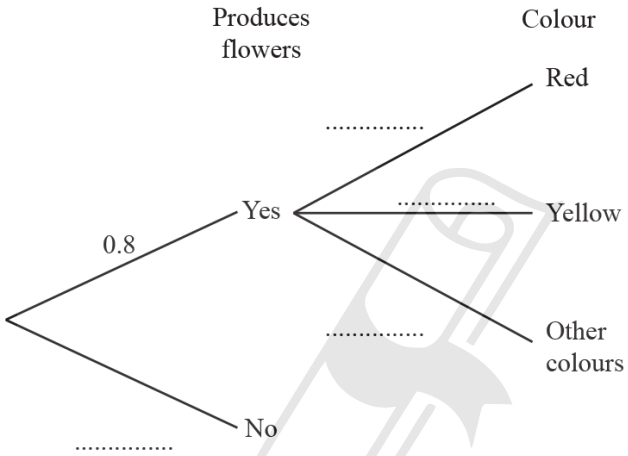
Tanya plants some seeds.
The probability that a seed will produce flowers is 0.8 .
When a seed produces flowers, the probability that the flowers are red is 0.6 and the probability that the flowers are yellow is 0.3 .

(a) Tanya has a seed that produces flowers.

Find the probability that the flowers are not red and not yellow.

..... [1]

(b) **(i)** Complete the tree diagram.



[2]

(ii) Find the probability that a seed chosen at random produces red flowers.

..... [2]

(iii) Tanya chooses a seed at random.

Find the probability that this seed does not produce red flowers and does not produce yellow flowers.

..... [3]

(c) Two of the seeds are chosen at random.

Find the probability that one produces flowers and one does not produce flowers.

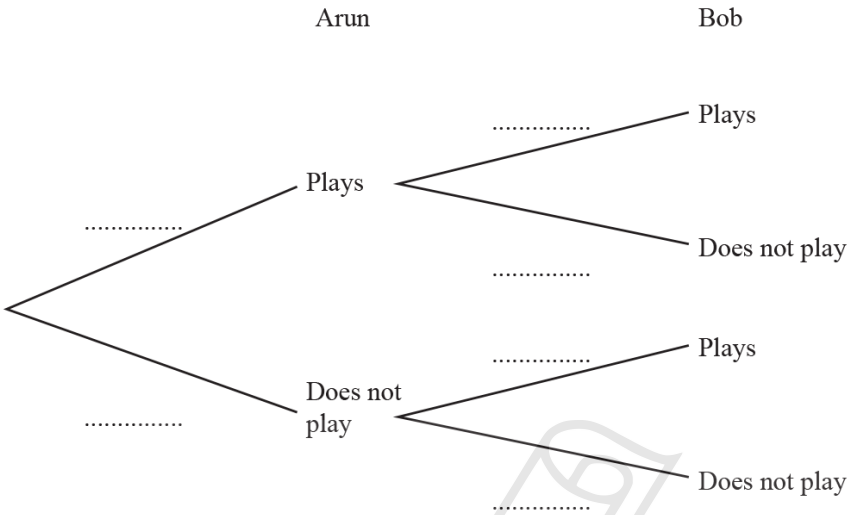
..... [3]

15. 0580_s20_qp_43 Q: 7

On any Saturday, the probability that Arun plays football is $\frac{3}{4}$.

On any Saturday, the probability that Bob plays football is $\frac{2}{5}$.

(a) (i) Complete the tree diagram.



[2]

(ii) Calculate the probability that, one Saturday, Arun and Bob both play football.

..... [2]

(iii) Calculate the probability that, one Saturday, either Arun plays football or Bob plays football, but not both.

..... [3]

(b) Calculate the probability that Bob plays football for 2 of the next 3 Saturdays.

..... [3]

(c) When Arun plays football, the probability that he scores the winning goal is $\frac{1}{7}$.

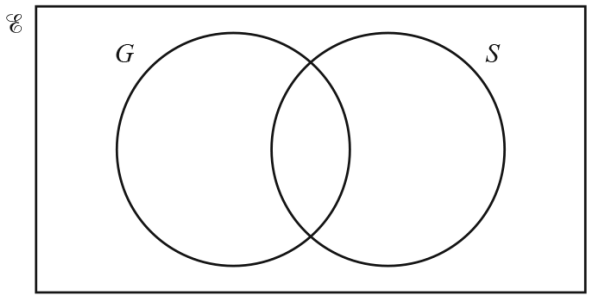
Calculate the probability that Arun scores the winning goal one Saturday.

..... [2]

16. 0580_w20_qp_41 Q: 9

(a) There are 32 students in a class.

5 do not study any languages.
15 study German (G).
18 study Spanish (S).



(i) Complete the Venn diagram to show this information. [2]

(ii) A student is chosen at random.

Find the probability that the student studies Spanish but not German.

..... [1]

(iii) A student who studies German is chosen at random.

Find the probability that this student also studies Spanish.

..... [1]

(b) A bag contains 54 red marbles and some blue marbles.
36% of the marbles in the bag are red.

Find the number of blue marbles in the bag.

..... [2]

(c) Another bag contains 15 red beads and 10 yellow beads.
Ariana picks a bead at random, records its colour and replaces it in the bag.
She then picks another bead at random.

(i) Find the probability that she picks two red beads.

..... [2]

(ii) Find the probability that she does not pick two red beads.

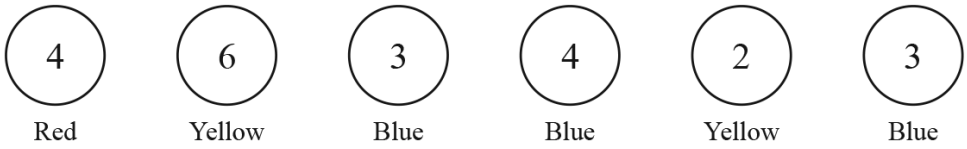
..... [1]

(d) A box contains 15 red pencils, 8 yellow pencils and 2 green pencils.
Two pencils are picked at random without replacement.

Find the probability that at least one pencil is red.

..... [3]

17. 0580_w20_qp_42 Q: 6



The diagram shows six discs.
Each disc has a colour and a number.

(a) One disc is picked at random.

Write down the probability that

(i) the disc has the number 4,

..... [1]

(ii) the disc is red and has the number 3,

..... [1]

(iii) the disc is blue and has the number 4.

..... [1]

(b) Two of the six discs are picked at random **without** replacement.

Find the probability that

(i) both discs have the number 3,

..... [2]

(ii) both discs have the same colour.

..... [3]

(c) Two of the six discs are picked at random **with** replacement.

Find the probability that both discs have the same colour.

..... [3]

18. 0580_w20_qp_43 Q: 4

P	O	S	S	I	B	I	L	I	T	Y

Morgan picks two of these letters, at random, **without** replacement.

(a) Find the probability that he picks

(i) the letter Y first,

..... [1]

(ii) the letter B then the letter Y,

..... [2]

(iii) two letters that are the same.

..... [3]

(b) Morgan now picks a third letter at random.

Find the probability that

(i) all three letters are the same,

..... [2]

(ii) exactly two of the three letters are the same,

..... [5]

(iii) all three letters are different.

..... [2]

19. 0580_m19_qp_42 Q: 3

Sushila, Ravi and Talika each have a bag of balls.
Each of the bags contains 10 red balls and 8 blue balls.

(a) Sushila takes one ball at random from her bag.

Find the probability that she takes a red ball.

..... [1]

(b) Ravi takes two balls at random from his bag, without replacement.

Find the probability that one ball is red and one ball is blue.

..... [3]

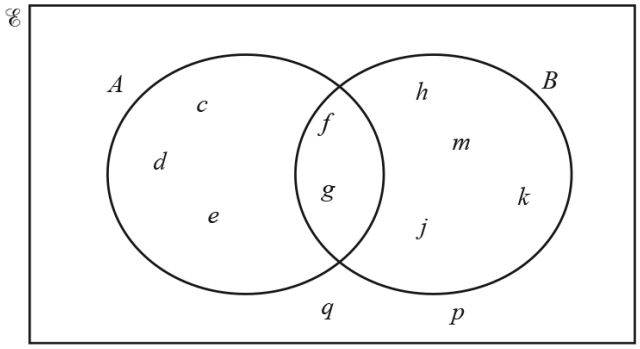
(c) Talika takes three balls at random from her bag, without replacement.

Calculate the probability that the three balls are the same colour.

..... [4]

20. 0580_m19_qp_42 Q: 9

(a) The Venn diagram shows two sets, A and B.



(i) Use set notation to complete the statements.

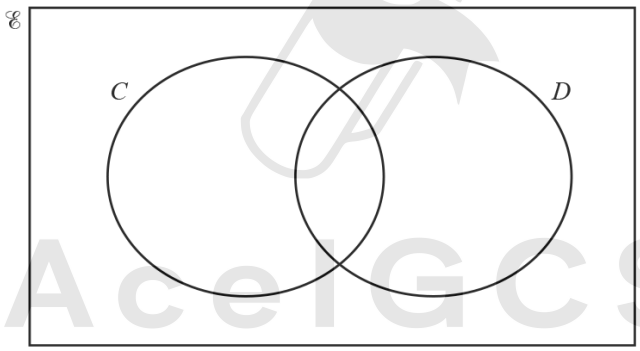
(a) d ..... A [1]

(b) $\{f, g\}$ = ... [1]

(ii) Complete the statement.

n (.....) = 6 [1]

(b) In the Venn diagram below, shade $C \cap D'$.

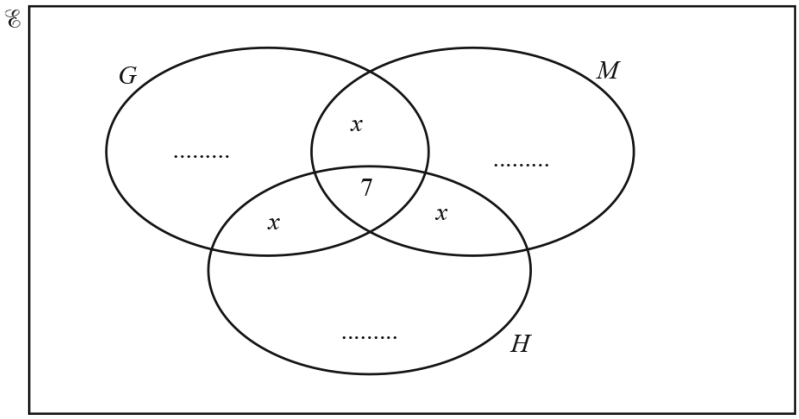


[1]

(c) 50 students study at least one of the subjects geography (G), mathematics (M) and history (H).

18 study only mathematics.
19 study two or three of these subjects.
23 study geography.

The Venn diagram below is to be used to show this information.



(i) Show that $x = 4$.

[2]

(ii) Complete the Venn diagram. [2]

(iii) Use set notation to complete this statement.

$(G \cup M \cup H)' =$ ..... [1]

(iv) Find $n(G \cap (M \cup H))$.

..... [1]

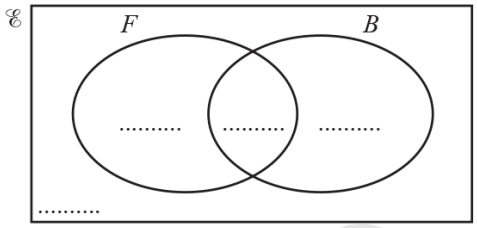
21. 0580_s19_qp_41 Q: 6

$\mathscr{E}$ = {students in a school}
F = {students who play football}
B = {students who play baseball}

There are 240 students in the school.

- 120 students play football
- 40 students play baseball
- 90 students play football but not baseball.

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



[2]

(b) Find $n(F' \cap B')$.

..... [1]

(c) A student in the school is chosen at random.

Find the probability that this student plays baseball but not football.

..... [1]

(d) Two students who play baseball are chosen at random.

Find the probability that they both also play football.

..... [3]

22. 0580_s19_qp_42 Q: 3

The probability that Andrei cycles to school is r.

(a) Write down, in terms of r, the probability that Andrei **does not** cycle to school.

..... [1]

(b) The probability that Benoit **does not** cycle to school is $1.3 - r$.
The probability that both Andrei and Benoit **do not** cycle to school is 0.4 .

(i) Complete the equation in terms of r.

(.....) × (.....) = 0.4 [1]

(ii) Show that this equation simplifies to $10r^2 - 23r + 9 = 0$.

[3]

(iii) Solve by factorisation $10r^2 - 23r + 9 = 0$.

r = ... or r = ... [3]

(iv) Find the probability that Benoit **does not** cycle to school.

..... [1]

23. 0580_s19_qp_43 Q: 8

(a) Angelo has a bag containing 3 white counters and x black counters.
He takes two counters at random from the bag, without replacement.

(i) Complete the following statement.

The probability that Angelo takes two black counters is

$$\frac{x}{x+3} \times \frac{\text{.....}}{\text{.....}}.$$

[2]

(ii) The probability that Angelo takes two black counters is $\frac{7}{15}$.

(a) Show that $4x^2 - 25x - 21 = 0$.

[4]

(b) Solve by factorisation.

$4x^2 - 25x - 21 = 0$

$x =$ ..... or $x =$ ..... [3]

(c) Write down the number of black counters in the bag.

..... [1]

(b) Esme has a bag with 5 green counters and 4 red counters.
She takes three counters at random from the bag without replacement.

Work out the probability that the three counters are all the same colour.

..... [4]

24. 0580_w19_qp_41 Q: 8

The diagram shows 5 cards.

(a) Donald chooses a card at random.

(i) Write down the probability that the number of dots on this card is an even number.

..... [1]

(ii) Write down the probability that the number of dots on this card is a prime number.

..... [1]

(b) Donald chooses two of the five cards at random, without replacement.
He works out the total number of dots on these two cards.

(i) Find the probability that the total number of dots is 5.

..... [3]

(ii) Find the probability that the total number of dots is an odd number.

..... [3]

25. 0580_w19_qp_43 Q: 8

(a) A bag contains 4 red marbles and 2 yellow marbles.
Behnaz picks two marbles at random without replacement.

Find the probability that

(i) the marbles are both red,

..... [2]

(ii) the marbles are not both red.

..... [1]

(b) Another bag contains 5 blue marbles and 2 green marbles.
Bryn picks one marble at random without replacement.
If this marble is not green, he picks another marble at random without replacement.
He continues until he picks a green marble.

Find the probability that he picks a green marble on his first, second or third attempt.

..... [4]

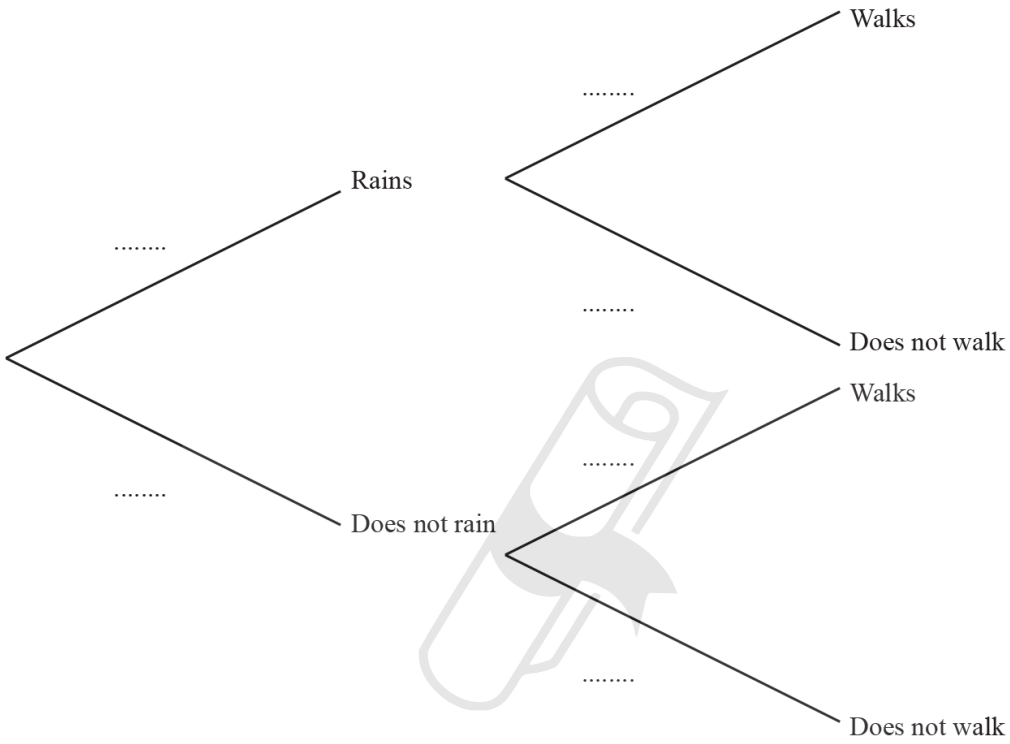
26. 0580_s18_qp_41 Q: 9

The probability that it will rain tomorrow is $\frac{5}{8}$.

If it rains, the probability that Rafael walks to school is $\frac{1}{6}$.

If it does not rain, the probability that Rafael walks to school is $\frac{7}{10}$.

(a) Complete the tree diagram.



[3]

(b) Calculate the probability that it will rain tomorrow and Rafael walks to school.

..... [2]

(c) Calculate the probability that Rafael does not walk to school.

..... [3]

27. 0580_s18_qp_41 Q: 10

(a) In 2017, the membership fee for a sports club was \$79.50 .
This was an increase of 6% on the fee in 2016.

Calculate the fee in 2016.

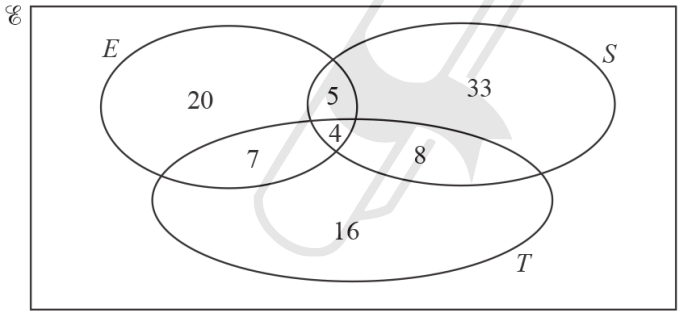
\$ ..... [3]

(b) On one day, the number of members using the exercise machines was 40, correct to the nearest 10.
Each member used a machine for 30 minutes, correct to the nearest 5 minutes.

Calculate the lower bound for the number of minutes the exercise machines were used on this day.

..... min [2]

(c) On another day, the number of members using the exercise machines (E), the swimming pool (S) and the tennis courts (T) is shown on the Venn diagram.



(i) Find the number of members using only the tennis courts.

..... [1]

(ii) Find the number of members using the swimming pool.

..... [1]

(iii) A member using the swimming pool is chosen at random.

Find the probability that this member also uses the tennis courts and the exercise machines.

..... [2]

(iv) Find $n(T \cap (E \cup S))$.

..... [1]

28. 0580_s18_qp_43 Q: 4

(a) The diagram shows two sets of cards.

Set A	1	1	2	2	2
Set B	0	1	1	1	2

(i) Jojo chooses two cards at random from Set A without replacement.

Find the probability that the two cards have the same number.

..... [3]

(ii) Jojo replaces the two cards.
Kylie then chooses one card at random from Set A and one card at random from Set B.

Find the probability that the two cards have the same number.

..... [3]

(iii) Who is the most likely to choose two cards that have the same number?
Show all your working.

..... [1]

(b)

Set C	4	4	5	5	5

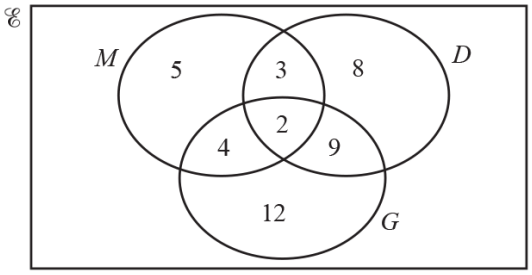
Lena chooses three cards at random from Set C without replacement.

Find the probability that the third card chosen is numbered 4.

..... [3]

29. 0580_w18_qp_41 Q: 6

(a)



The Venn diagram above shows information about the number of students who study Music (M), Drama (D) and Geography (G).

(i) How many students study Music?

..... [1]

(ii) How many students study exactly two subjects?

..... [1]

(iii) Two students are chosen at random from those who study Drama.

Calculate the probability that they both also study Music.

..... [3]

(iv) In the Venn diagram above, shade $M \cap D'$. [1]

(b) (i) $\mathscr{E} = \{x : x \text{ is an integer and } 1 \leqslant x \leqslant 10\}$

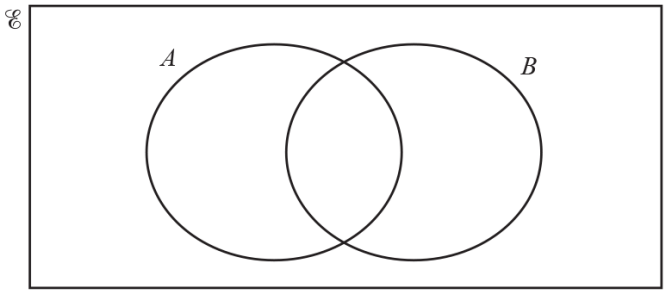
$A = \{x : x \text{ is even}\}$

$4 \in A \cap B$

$\mathrm{n}(A \cap B) = 1$

$(A \cup B)' = \{1, 7, 9\}$

Complete the Venn diagram below using this information.



[4]

(ii) Use your Venn diagram to complete the statement.

$B = \{.....\}$ [1]

30. 0580_w18_qp_42 Q: 12

A box contains 20 packets of potato chips.

6 packets contain barbecue flavoured chips.
10 packets contain salt flavoured chips.
4 packets contain chicken flavoured chips.

(a) Maria takes two packets at random **without replacement**.

(i) Show that the probability that she takes two packets of salt flavoured chips is $\frac{9}{38}$.

[2]

(ii) Find the probability that she takes two packets of different flavoured chips.

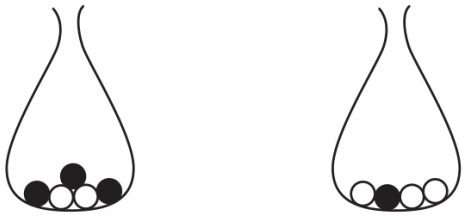
..... [4]

(b) Maria takes three packets at random, **without replacement**, from the 20 packets.

Find the probability that she takes **at least two** packets of chicken flavoured chips.

..... [3]

31. 0580_w18_qp_43 Q: 7



Bag *A* Bag *B*

Bag *A* contains 3 black balls and 2 white balls.
Bag *B* contains 1 black ball and 3 white balls.

(a) A ball is taken at random from each bag.

(i) Show that a black ball is more likely to be taken from bag *A* than from bag *B*.

[1]

(ii) Find the probability that the two balls have different colours.

..... [3]

(b) The balls are returned to their original bags.
Three balls are taken at random from bag A, without replacement.

Find the probability that

(i) they are all black,

..... [2]

(ii) they are all white.

..... [1]

(c) The balls are returned to their original bags.

A ball is taken at random from bag A and its colour is recorded.
This ball is then placed in bag B.
A ball is then taken at random from bag B.

Find the probability that the ball taken from bag B has a different colour to the ball taken from bag A.

..... [3]

32. 0580_m17_qp_42 Q: 4

Ravi spins a biased 5-sided spinner, numbered 1 to 5.
The probability of each number is shown in the table.

Number	1	2	3	4	5
Probability	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{1}{3}$	x	x

(a) Find the value of x.

$x =$ ..... [3]

(b) Ravi spins the spinner once.

Find the probability that the number is 2 or 3.

..... [2]

(c) Ravi spins the spinner twice.

Find the probability that

(i) the number is 2 both times,

..... [2]

(ii) the sum of the numbers is 3.

..... [3]

(d) Ravi spins the spinner 72 times.

Calculate how many times he expects the number 1.

..... [1]

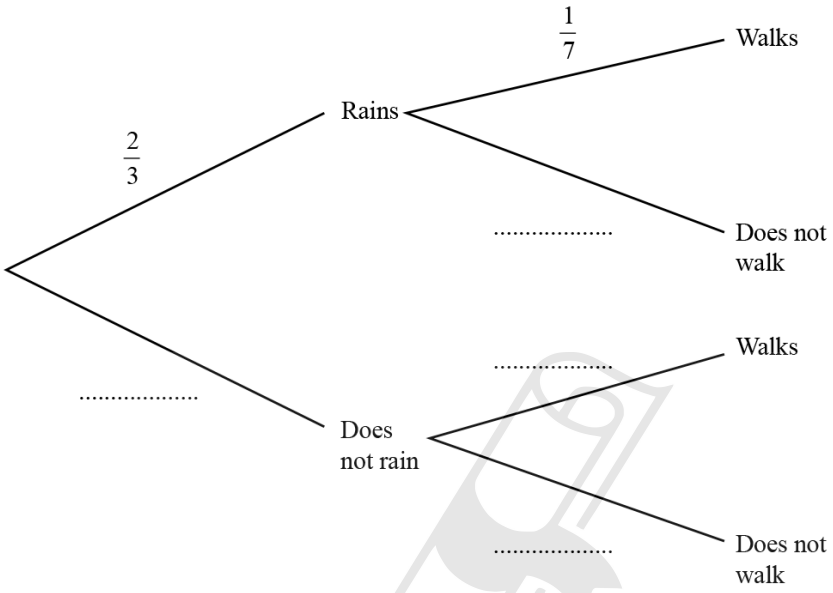
33. 0580_s17_qp_42 Q: 6

Each morning the probability that it rains is $\frac{2}{3}$.

If it rains, the probability that Asha walks to school is $\frac{1}{7}$.

If it does not rain, the probability that Asha walks to school is $\frac{4}{7}$.

(a) Complete the tree diagram.



[2]

(b) Find the probability that it rains and Asha walks to school.

..... [2]

(c) **(i)** Find the probability that Asha does not walk to school.

..... [3]

(ii) Find the expected number of days Asha does not walk to school in a term of 70 days.

..... [2]

(d) Find the probability that it rains on exactly one morning in a school week of 5 days.

..... [2]

34. 0580_w17_qp_41 Q: 9

(a) A bag contains red beads and green beads.
There are 80 beads altogether.
The probability that a bead chosen at random is green is 0.35 .

(i) Find the number of red beads in the bag.

..... [2]

(ii) Marcos chooses a bead at random and replaces it in the bag.
He does this 240 times.

Find the number of times he would expect to choose a green bead.

..... [1]

(b) A different bag contains 2 blue marbles, 3 yellow marbles and 4 white marbles.
Huma chooses a marble at random, notes the colour, then replaces it in the bag.
She does this three times.

Find the probability that

(i) all three marbles are yellow,

..... [2]

(ii) all three marbles are different colours.

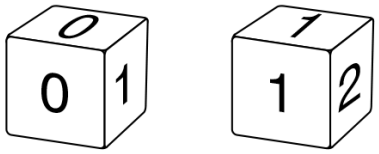
..... [3]

(c) Another bag contains 2 green counters and 3 pink counters.
Teresa chooses three counters at random **without** replacement.

Find the probability that she chooses more pink counters than green counters.

..... [4]

35. 0580_w17_qp_42 Q: 7



A *B*

The diagram shows two fair dice.
The numbers on dice *A* are 0, 0, 1, 1, 1, 3.
The numbers on dice *B* are 1, 1, 2, 2, 2, 3.
When a dice is rolled, the score is the number on the top face.

(a) Dice *A* is rolled once.

Find the probability that the score is not 3.

..... [1]

(b) Dice *A* is rolled twice.

Find the probability that the score is 0 both times.

..... [2]

(c) Dice *A* is rolled 60 times.

Calculate an estimate of the number of times the score is 0.

..... [1]

(d) Dice A and dice B are each rolled once.
The product of the scores is recorded.

(i) Complete the possibility diagram.

Dice B

3	0	0				
2	0	0				
2	0	0				
2	0	0				
1	0	0				
1	0	0	1	1	1	3
	0	0	1	1	1	3

Dice A

[2]

(ii) Find the probability that the product of the scores is

(a) 2,

..... [1]

(b) greater than 3.

..... [1]

(e) Eva keeps rolling dice B until 1 is scored.

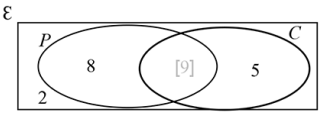
Find the probability that this happens on the 5th roll.

..... [2]

01. 0580_s24_ms_43 Q: 9

Question	Answer	Marks	Partial Marks
(a)(i)	0	**1**	
(a)(ii)	$\frac{1}{7}$ oe	**1**	
(b)	$\frac{4}{49}$ oe	**2**	**M1** for $\frac{2}{7}\times\frac{2}{7}$
(c)(i)	$\frac{2}{21}$ oe	**3**	**M2** for $\frac{2}{7}\times\frac{1}{6}+\frac{1}{7}\times\frac{2}{6}$ oe or **M1** for $\frac{2}{7}\times\frac{1}{6}$ or $\frac{1}{7}\times\frac{2}{6}$ oe seen If 0 scored SC1 for $\frac{4}{49}$
(c)(ii)	$\frac{19}{21}$ oe	**3**	**M2** for $1-\left(\frac{2}{7}\times\frac{1}{6}\right)-\left(\frac{2}{7}\times\frac{1}{6}\right)$ oe or **M1** for $\left(\frac{2}{7}\times\frac{1}{6}\right)+\left(\frac{2}{7}\times\frac{1}{6}\right)$ oe ALTERNATIVE **M2** for $\frac{1}{7}$ [× 1] × 3 + $\frac{2}{7}\times\frac{5}{6}\times 2$ or **M1** for $\frac{2}{7}\times\frac{5}{6}$ or $\frac{1}{7}$ [× 1] × 3 If 0 scored SC1 for $\frac{38}{49}$
(d)	3	**2**	**M1** for $\frac{5}{7}\times\frac{4}{6}\times\frac{2\text{or}3}{5}$

02. 0580_m23_ms_42 Q: 7

Question	Answer	Marks	Partial Marks
(a)	Completed Venn diagram.  	2	**B1** for two correct values
(b)(i)	8	1	**FT** *their* **(a)** *their* 8 dep < 24
(b)(ii)	19	1	**FT** *their* **(a)** 24 – *their* 5 dep on positive answer
(c)	$\frac{15}{92}$ oe	3	**M2** for $[2\times]\frac{9}{24}\times\frac{their\,5}{23}$ oe or **M1** for $\frac{9}{24}$ and $\frac{their\,5}{23}$ **or** $\frac{their\,5}{24}$ and $\frac{9}{23}$ If 0 scored **SC1** for answer $\frac{5}{32}$ oe
(d)	$\frac{9}{34}$ oe	2	**B1** for $\frac{9}{17}$ seen

03. 0580_w23_ms_41 Q: 4

Question	Answer	Marks	Partial Marks
(a)(i)	$\frac{2}{5}$ $\frac{5}{9}$, $\frac{4}{9}$ $\frac{5}{9}$, $\frac{4}{9}$	2	**B1** for $\frac{2}{5}$ and a pair of probabilities for spinner B that sum to 1
a(ii)(a)	$\frac{1}{3}$ oe	2	**FT dep** *their* tree diagram **M1** for $\frac{3}{5}\times$ *their* $\frac{5}{9}$
a(ii)(b)	$\frac{2}{3}$ oe	1	**FT** dep 1 – *their* $\frac{1}{3}$
(b)	72	1	

Question	Answer	Marks	Partial Marks
(c)	$\frac{20}{81}$ oe	3	**M2** for $\frac{2}{9}\times\frac{4}{9}$ $[\times 2]+\frac{2}{9}\times\frac{2}{9}$ oe or **M1** for $\frac{2}{9}\times\frac{4}{9}$ or $\frac{2}{9}\times\frac{2}{9}$ oe
(d)	$\left(\frac{5}{9}\right)^{n-1}[\times]\frac{4}{9}$ oe final answer	2	**M1** for $\left(\frac{5}{9}\right)^{n-1}$ seen

04. 0580_w23_ms_42 Q: 8

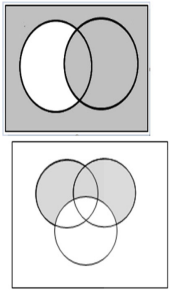
Question	Answer	Marks	Partial Marks
(a)(i)	$\frac{1}{6}$ oe	1	
(a)(ii)	25	1	**FT** *their* **(a)(i)** dep on $0 <$ **(a)** < 1
(b)(i)	$\frac{11}{36}$ oe	3	**M2** for $\frac{1}{6}\times\frac{2}{6}+\frac{3}{6}\times\frac{3}{6}$ oe or correct possibility diagram with 11 outcomes identified or **M1** for $\frac{1}{6}\times\frac{2}{6}$ or $\frac{3}{6}\times\frac{3}{6}$ oe or lists the 11 required outcomes or for possibility diagram but required outcomes not indicated
(b)(ii)	$\frac{2}{11}$ oe	2	**M1** for $\frac{2}{k}$ or $\frac{p}{their 11}$ seen oe leading to answer
(c)	6	2	**M1** for $\left(\frac{4}{6}\right)^k\times\frac{2}{6}=\frac{32}{729}$ written oe soi by one trial with $k > 1$ or $2^{n-1}=32$ or better or $3^n=729$ or better

05. 0580_m22_ms_42 Q: 11

Question	Answer	Marks	Partial Marks
(a)(i)	$\frac{1}{6}$ oe on all late branches $\frac{5}{6}$ oe on all not late branches	2	**B1** for one correct vertical pair $\frac{1}{6}$ oe and $\frac{5}{6}$ oe
(a)(ii)	$\frac{5}{36}$ oe	2	FT *their* tree **M1** for *their* $\frac{1}{6}\times$ *their* $\frac{5}{6}$
(b)(i)	$(G\cup T\cup M)'$ oe	1	
(b)(ii)	28	1	
(b)(iii)	$\frac{17}{50}$ oe	1	

Question	Answer	Marks	Partial Marks
(b)(iv)	$\frac{4}{7}$ oe	3	**M2** for $\frac{16}{21}\times\frac{15}{20}$ or **M1** for $\frac{n}{21}\times\frac{n-1}{20}$ or for $\frac{16}{21}$ and $\frac{15}{20}$ seen If 0 scored **SC1** for answer $\frac{256}{441}$ oe

06. 0580_s22_ms_41 Q: 8

Question	Answer	Marks	Partial Marks
(a)(i)	$A \cap B$	1	
(a)(ii)		2	**B1** for each
(b)(i)	$\frac{9}{11}$	1	
(b)(ii)	$\frac{36}{121}$ oe	3	**M2** for $2\times\frac{2}{11}\times\frac{9}{11}$ oe or **M1** for $\frac{2}{11}\times\frac{9}{11}$ oe If 0 scored **SC1** for $\frac{36}{110}$
(c)(i)	3, 5, 28, 14 correctly placed	2	**B1** for 28 in the intersection
(c)(ii)	$\frac{28}{50}$ oe	1	**FT** *their* 28 where *their* $28 < 50$
(c)(iii)	$\frac{123}{175}$ oe	2	**M1** for $\frac{42}{50}\times\frac{41}{49}$
(c)(iv)	$\frac{63}{88}$ oe	2	FT *their* 28 **M1** for $\frac{\textit{their}28}{33}\times\frac{\textit{their}28-1}{32}$

07. 0580_s22_ms_42 Q: 6

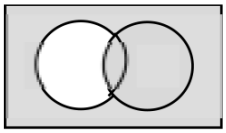
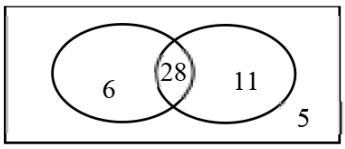
Question	Answer	Marks	Partial Marks
(a)	42 028	**2**	**M1** for $\frac{380}{500}$ oe soi isw
(b)	$\frac{47}{66}$ oe	**4**	0.712[1…] **M3** for $2\left(\frac{5}{12}\times\frac{4}{11}\right)+2\left(\frac{4}{12}\times\frac{3}{11}\right)+2\left(\frac{5}{12}\times\frac{3}{11}\right)$ oe or $1-\left(\frac{5}{12}\times\frac{4}{11}+\frac{4}{12}\times\frac{3}{11}+\frac{3}{12}\times\frac{2}{11}\right)$ oe or **M2** for sum of 3 or more correct product pairs and no incorrect pairs or for $\frac{5}{12}\times\frac{4}{11}+\frac{4}{12}\times\frac{3}{11}+\frac{3}{12}\times\frac{2}{11}$ and no other pairs or **M1** for $\frac{k}{12}\times\frac{j}{11}$ seen If 0 scored **SC1** for answer $\frac{94}{144}$ oe
(c)	52	**2**	**M1** for $x\times\frac{100-16}{100}=43.68$ oe or better
(d)(i)	70 or 70.16[5…] or 70.17 or 70.2	**3**	**M2** for $\frac{29750 \text{ to } 29800}{400+25}$ or $\frac{29750 \text{ to } 29800}{400+24}$ or $\frac{29800-50}{400 \text{ to } 425}$ or **B1** for 29 750 or 29 850 or 29 849 or 375 or 425 or 424 seen
(d)(ii)	2399 or 2400 nfww	**2**	**B1** for 27 450 or 27 550 or 27 549 or 29 850 or 29 849 seen

Question	Answer	Marks	Partial Marks
(a)(i)	$\frac{1}{15}$ oe	3	**M2** for $2\times\frac{1}{6}\times\frac{1}{5}$ oe or **M1** for $\frac{1}{6}\times\frac{1}{5}$ oe or list or indication of 2 correct pairs If 0 scored, **SC1** for answer $\frac{1}{18}$ oe
(a)(ii)	$\frac{7}{15}$ oe	3	**M2** for $\left(\frac{4}{6}\times\frac{3}{5}\right)+2\left(\frac{1}{6}\times\frac{1}{5}\right)$ oe or $14\left(\frac{1}{6}\times\frac{1}{5}\right)$ oe or $1-2\left(\frac{2}{6}\times\frac{4}{5}\right)$ or **M1** for $\left(\frac{4}{6}\times\frac{3}{5}\right)$ or $2\left(\frac{1}{6}\times\frac{1}{5}\right)$ oe or $2\left(\frac{2}{6}\times\frac{4}{5}\right)$ or correct identification of 14 pairs If 0 scored, **SC1** for answer $\frac{5}{9}$
(b)	$\frac{1}{10}$ oe nfww	4	**M3** for $6\left(\frac{1}{6}\times\frac{1}{5}\times\frac{1}{4}\right)+6\left(\frac{1}{6}\times\frac{1}{5}\times\frac{1}{4}\right)$ oe or **M2** for $6\left(\frac{1}{6}\times\frac{1}{5}\times\frac{1}{4}\right)$ oe or $2\left(\frac{1}{6}\times\frac{1}{5}\times\frac{1}{4}\right)$ oe or **M1** for $k\left(\frac{1}{6}\times\frac{1}{5}\times\frac{1}{4}\right)$ where k is an integer and $1 \leqslant k \leqslant 12$ but not $k=2$ or $k=6$ or identifies −2, 2 and 5 or −3, 3 and 5 as the 3 cards needed If 0 scored, **SC1** for answer $\frac{1}{18}$

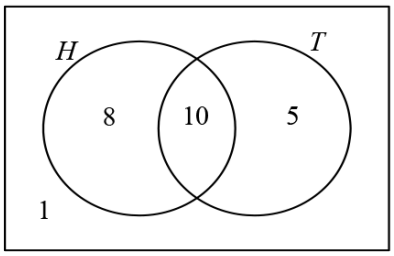
09. 0580_m21_ms_42 Q: 4

	Answer	Mark	Partial Marks
(a)	462	**1**	
(b)(i)	$\frac{7}{15}$ oe	**1**	
(b)(ii)	$\frac{7}{15}\times\frac{6}{14}+\frac{6}{15}\times\frac{5}{14}+\frac{2}{15}\times\frac{1}{14}$ $=\frac{37}{105}$	**3**	**M2** for addition of two of $\frac{7}{15}\times\frac{6}{14}+\frac{6}{15}\times\frac{5}{14}+\frac{2}{15}\times\frac{1}{14}$ or **M1** for one of the products seen
(b)(iii)	$\frac{29}{65}$ oe	**4**	**M3** for $\frac{7}{15}\times\frac{6}{14}\times\frac{5}{13}+3\times\frac{7}{15}\times\frac{6}{14}\times\frac{6}{13}+3\times\frac{7}{15}\times\frac{6}{14}\times\frac{2}{13}$ oe or $1-3\left(\frac{8}{15}\times\frac{7}{14}\times\frac{7}{13}\right)-\left(\frac{8}{15}\times\frac{7}{14}\times\frac{6}{13}\right)$ oe or **M2** for the sum of at least two of $\frac{7}{15}\times\frac{6}{14}\times\frac{5}{13}$, $N\times\frac{7}{15}\times\frac{6}{14}\times\frac{6}{13}$, $N\times\frac{7}{15}\times\frac{6}{14}\times\frac{2}{13}$ seen or for $\frac{7}{15}\times\frac{6}{14}\times\frac{13}{13}$ or $\frac{7}{15}\times\frac{6}{14}+N\times\frac{7}{15}\times\frac{6}{14}\times\frac{k}{13}$ seen or **M1** for $\frac{7}{15}\times\frac{6}{14}\times\frac{5}{13}$ or $N\times\frac{7}{15}\times\frac{6}{14}\times\frac{6}{13}$ or $N\times\frac{7}{15}\times\frac{6}{14}\times\frac{2}{13}$ seen If 0 scored **SC1** for $\frac{1519}{3375}$ oe

10. 0580_s21_ms_41 Q: 6

	Answer	Mark	Partial Marks
(a)		**1**	
(b)		**2**	**B1** for 2 or 3 correct elements or **M1** for $34-x$, x and $39-x$ correctly placed on diagram and $x = 28$
(c)(i)	8	**1**	
(c)(ii)	11	**1**	
(c)(iii)	2	**1**	
(c)(iv)	$C \cap S \cap B'$ oe	**1**	
(c)(v)	$\frac{19}{30}$ oe	**1**	
(c)(vi)	$\frac{2}{57}$ oe	**3**	**M2** for $\frac{4}{19} \times \frac{3}{18}$ or **M1** for $\frac{4}{19}$ seen
(c)(vii)	Equal numbers 15 or equal probability $\frac{15}{30}$ oe	**1**	

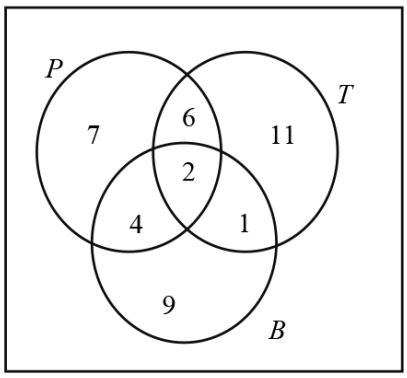
11. 0580_s21_ms_43 Q: 6

	Answer	Mark	Partial Marks
(a)		**2**	i.e. 8, 10 and 5 correctly placed **B1** for 10 correctly placed or **M1** for $18 - x$, x and $15 - x$ correctly placed on diagram and $x = 10$ seen
(b)	10	**1**	**FT** *their* Venn diagram
(c)	5	**1**	**FT** *their* Venn diagram
(d)	$\frac{5}{24}$ oe	**1**	**FT** *their* 5 on the Venn diagram
(e)	0	**1**	
(f)	$\frac{5}{17}$ oe	**3**	**M2** for $\frac{their10}{18} \times \frac{their9}{17}$ or **B1FT** for $\frac{their10}{18}$ or $\frac{their9}{17}$ seen After 0 scored, **SC1** for answer $\frac{25}{81}$ oe

12. 0580_m20_ms_42 Q: 6

	Answer	Mark	Partial Marks
(a)(i)	$\frac{1}{3}$ oe	**1**	
(a)(ii)	100	**1**	**FT** *their* **(a)(i)** × 300 to at least 3 sf or rounded to the nearest integer
(b)(i)	$\frac{2}{15}$ oe	**3**	**M2** for $4\times\frac{1}{6}\times\frac{1}{5}$ oe or **M1** for $k\left(\frac{1}{6}\times\frac{1}{5}\right)$ oe or list or indication of 4 correct pairs
(b)(ii)	$\frac{3}{5}$ oe	**3**	**M2** for $1-\frac{4}{6}\times\frac{3}{5}$ or $2\left(\frac{2}{6}\times\frac{4}{5}\right)+\frac{2}{6}\times\frac{1}{5}$ oe or $\frac{2}{6}+\left(\frac{4}{6}\times\frac{2}{5}\right)$ oe or **M1** for $\frac{4}{6}\times\frac{3}{5}$ oe seen or $\frac{2}{6}\times\frac{4}{5}[\times 2]$ oe seen or $\frac{2}{6}\times\frac{1}{5}$ oe seen or correct identification of 18 pairs or space diagram oe

13. 0580_m20_ms_42 Q: 9

	Answer	Mark	Partial Marks
(a)		3	**B2** for 5 correct entries including '2' correctly placed at the intersection of the 3 sets or **M1** for $k+8-k+3-k+6-k=40-(7+9+11)$ oe or for k, $8-k$, $3-k$, $6-k$, seen correctly placed on diagram with 7, 11 and 9 correctly placed
(b)	11	1	
(c)	Ø or { }	1	
(d)	$\frac{7}{260}$ oe	2	**M1** for $\frac{7}{40}\times\frac{6}{39}$ oe
(e)	$\frac{14}{95}$ oe	2	**FT** *their* Venn diagram **M1** for $\frac{8}{20}\times\frac{7}{19}$

14. 0580_s20_ms_42 Q: 7

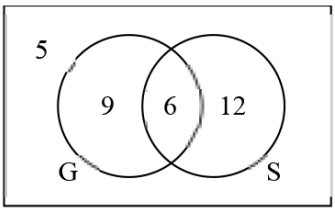
	Answer	Mark	Partial Marks
(a)	0.1	1	
(b)(i)	0.2 oe 0.6, 0.3, 0.1 oe	2	**B1** for 0.2 **B1** for 0.6, 0.3, 0.1
(b)(ii)	0.48 oe	2	**FT** *their* 0.6 from tree diagram **M1** for $0.8\times$ *their* 0.6

	Answer	Mark	Partial Marks
(b)(iii)	0.28 oe	3	**M2** for $0.2+0.8\times0.1$ oe or **M1** for 0.2 or 0.8×0.1 or $0.8\times(0.6+0.3)$
(c)	0.32 oe	3	**M2** for $0.8\times0.2+0.2\times0.8$ oe **M1** for one of these products

15. 0580_s20_ms_43 Q: 7

	Answer	Mark	Partial Marks
(a)(i)	$\frac{3}{4}, \frac{1}{4}$ $\frac{2}{5}, \frac{3}{5}$ $\frac{2}{5}, \frac{3}{5}$	**2**	**B1** for one correct pair
(a)(ii)	$\frac{3}{10}$ oe	**2**	**FT** *their* tree diagram **M1** for $\frac{3}{4}\times\frac{2}{5}$
(a)(iii)	$\frac{11}{20}$ oe	**3**	**M2** for $\frac{3}{4}\times\frac{3}{5}+\frac{1}{4}\times\frac{2}{5}$ or **M1** for $\frac{3}{4}\times\frac{3}{5}$ or $\frac{1}{4}\times\frac{2}{5}$
(b)	$\frac{36}{125}$ oe	**3**	**M2** for $\left(\frac{2}{5}\right)^2\times\frac{3}{5}\times 3$ oe or **M1** for $\left(\frac{2}{5}\right)^2\times\frac{3}{5}$
(c)	$\frac{3}{28}$ oe	**2**	**M1** for $\frac{3}{4}\times\frac{1}{7}$

16. 0580_w20_ms_41 Q: 9

	Answer	Mark	Partial Marks
(a)(i)		2	**B1** for two correct values Or **B1** 5 outside and total in G = 15 and total in S = 18
(a)(ii)	$\frac{3}{8}$ oe	1	**FT** $\frac{\textit{their } 12}{32}$
(a)(iii)	$\frac{2}{5}$ oe	1	**FT** $\frac{\textit{their } 6}{15}$
(b)	96	2	**M1** for $\frac{36}{64}=\frac{54}{x}$ oe or $36=\frac{54}{(54+b)}\times 100$ oe If 0 scored **SC**1 for answer 150
(c)(i)	$\frac{9}{25}$ oe	2	**M1** for $\frac{15}{25}\times\frac{15}{25}$ oe
(c)(ii)	$\frac{16}{25}$ oe	1	**FT** 1 – *their* **(c)(i)**
(d)	$\frac{17}{20}$ oe	3	**M2** for $1-\frac{10}{25}\times\frac{9}{24}$ oe or for $\frac{15}{25}\times\frac{14}{24}+\frac{15}{25}\times\frac{8}{24}+\frac{15}{25}\times\frac{2}{24}+\frac{8}{25}\times\frac{15}{24}+\frac{2}{25}\times\frac{15}{24}$ oe or **M1** for one correct relevant product

17. 0580_w20_ms_42 Q: 6

	Answer	Mark	Partial Marks
(a)(i)	$\frac{1}{3}$ oe	**1**	
(a)(ii)	0	**1**	
(a)(iii)	$\frac{1}{6}$ oe	**1**	
(b)(i)	$\frac{1}{15}$ oe	**2**	**M1** for $\frac{2}{6}\times\frac{1}{5}$ or equivalent method
(b)(ii)	$\frac{4}{15}$ oe	**3**	**M2** for $\frac{2}{6}\times\frac{1}{5}+\frac{3}{6}\times\frac{2}{5}$ or equivalent method or **M1** for $\frac{2}{6}\times\frac{1}{5}$ oe seen or $\frac{3}{6}\times\frac{2}{5}$ oe seen
(c)	$\frac{7}{18}$ oe	**3**	**M2** for $\left(\frac{1}{6}\right)^2+\left(\frac{2}{6}\right)^2+\left(\frac{3}{6}\right)^2$ oe or **M1** for one correct product seen or sample space with 14 correct pairs identified

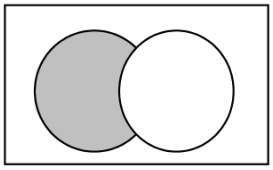
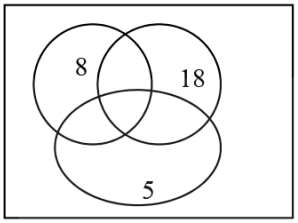
18. 0580_w20_ms_43 Q: 4

	Answer	Mark	Partial Marks
(a)(i)	$\frac{1}{11}$ oe	**1**	
(a)(ii)	$\frac{1}{110}$ oe	**2**	**M1** for $\frac{1}{11}\times\frac{1}{10}$ oe
(a)(iii)	$\frac{4}{55}$ oe	**3**	**M2** for $\left(\frac{2}{11}\times\frac{1}{10}\right)+\left(\frac{3}{11}\times\frac{2}{10}\right)$ oe **or M1** for $\left(\frac{2}{11}\times\frac{1}{10}\right)$ or $\left(\frac{3}{11}\times\frac{2}{10}\right)$ seen oe
(b)(i)	$\frac{1}{165}$ oe	**2**	**M1** for $\frac{3}{11}\times\frac{2}{10}\times\frac{1}{9}$ oe
(b)(ii)	$\frac{1}{5}$ oe	**5**	**M4** for $3\left(\frac{2}{11}\times\frac{1}{10}\times\left[\frac{9}{9}\right]\right)+3\left(\frac{3}{11}\times\frac{2}{10}\times\frac{8}{9}\right)$ oe or **M3** for $3\left(\frac{3}{11}\times\frac{2}{10}\times\frac{8}{9}\right)$ or **M2** for $3\left(\frac{2}{11}\times\frac{1}{10}\times\left[\frac{9}{9}\right]\right)$ or $\frac{3}{11}\times\frac{2}{10}\times\frac{8}{9}$ oe or **M1** for $\frac{2}{11}\times\frac{1}{10}\times\left[\frac{k}{9}\right]$ where k is 3, 6 or 9
(b)(iii)	$\frac{131}{165}$ oe	**2**	**M1** for 1 – (*their* **(b)(i)** + *their* **(b)(ii)**) oe

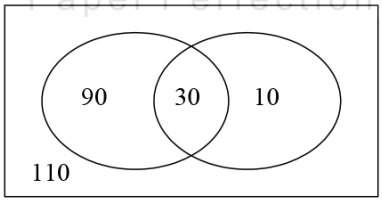
19. 0580_m19_ms_42 Q: 3

	Answer	Mark	Partial Marks
(a)	$\frac{5}{9}$ oe	1	
(b)	$\frac{80}{153}$ oe	3	**M2** for $2\times\frac{10}{18}\times\frac{8}{17}$ oe or **M1** for $\frac{10}{18}\times\frac{8}{17}$ oe If 0 scored, **SC1** for $\frac{160}{324}$ oe
(c)	$\frac{11}{51}$ oe	4	**M3** for $\frac{10}{18}\times\frac{9}{17}\times\frac{8}{16}+\frac{8}{18}\times\frac{7}{17}\times\frac{6}{16}$ oe or **M2** for $\frac{10}{18}\times\frac{9}{17}\times\frac{8}{16}$ oe or $\frac{8}{18}\times\frac{7}{17}\times\frac{6}{16}$ oe or **M1** for $\frac{10}{18},\frac{9}{17},\frac{8}{16}$ or $\frac{8}{18},\frac{7}{17},\frac{6}{16}$ If 0 scored, **SC1** for $\frac{1512}{5832}$ oe

20. 0580_m19_ms_42 Q: 9

	Answer	Mark	Partial Marks
(a)(i)(a)	$\in$	1	
(a)(i)(b)	$A \cap B$	1	
(a)(ii)	B or A'	1	
(b)		1	
(c)(i)	$3x + 7 = 19$ oe	M1	must see 19 and 7
	$3x = 19 - 7$ or better leading to $x = 4$	A1	with no errors seen
(c)(ii)		2	B1 for 2 correct
(c)(iii)	$\varnothing$ or { }	1	
(c)(iv)	15	1	

21. 0580_s19_ms_41 Q: 6

	Answer	Mark	Partial Marks
(a)		2	B1 for any one correct
(b)	110	1	FT *their* 110 in Venn diagram
(c)	$\frac{10}{240}$ oe	1	FT $\frac{their 10}{240}$

	Answer	Mark	Partial Marks
(d)	$\frac{870}{1560}$ oe	3	**M2** for $\frac{their30}{40}\times\frac{their30-1}{39}$ or **M1** for $\frac{p}{q}\times\frac{p-1}{q-1}$ $p<q$ or for $\frac{their30}{40}$ soi

22. 0580_s19_ms_42 Q: 3

	Answer	Mark	Partial Marks
(a)	$1-r$	1	
(b)(i)	$(1-r)(1.3-r)$ [= 0.4]	1	**FT** *their*(**a**) dep on **(a)** being an expression in r
(b)(ii)	$1.3-1.3r-r+r^2$ or better nfww	M1	**FT** *their* **(b)(i)**
	$0.9-2.3r+r^2$[= 0] OR $13-13r-10r+10r^2=4$ oe	M1	**Strict FT** *their* expansion to a quadratic then equating to 0.4 and then collecting to 3 terms on 'one side' OR **Strict FT** *their* expansion to a quadratic = 0.4 all multiplied by 10
	$10r^2-23r+9=0$	A1	no errors or omissions seen

	Answer	Mark	Partial Marks
(b)(iii)	$(5r-9)(2r-1)$ [= 0]	B2	or **B2** for e.g. $5r(2r-1)-9(2r-1)$ **and then** $5r-9=0$ **and** $2r-1=0$ or **B1** for $5r(2r-1)-9(2r-1)$ [= 0] or $2r(5r-9)-1(5r-9)$ [= 0] or $(5r+a)(2r+b)$ [= 0] where a, b are integers and $ab=+9$ or $2a+5b=-23$ If 0 scored, **SC1** for $5r-9$ **and** $2r-1$ seen but not in factorised form
	[r =] $\frac{9}{5}$ oe [r =] $\frac{1}{2}$ oe	B1	
(b)(iv)	0.8 or $\frac{4}{5}$ oe	1	

23. 0580_s19_ms_43 Q: 8

	Answer	Mark	Partial Marks
(a)(i)	$\frac{x-1}{x+2}$	**2**	**B1** for either numerator or denominator correct
(a)(ii)(a)	$\frac{x}{x+3}\times\frac{x-1}{x+2}=\frac{7}{15}$	**B1**	**FT** *their* **(a)(i)** = $\frac{7}{15}$
	$15x(x-1) = 7(x+3)(x+2)$	**M1**	Removes all algebraic fractions **FT** *their* equation if in comparable form
	$15x^2 - 15x = 7x^2 + 21x + 14x + 42$	**M1**	Correctly expands all brackets **FT** *their* equation if in comparable form
	$[8x^2 - 50x - 42 = 0]$ $4x^2 - 25x - 21 = 0$	**A1**	With no errors or omissions seen and one further stage seen after final M1
(a)(ii)(b)	$(4x + 3)(x - 7)$ [= 0]	**M2**	**M1** for $4x(x - 7) + 3(x - 7)$ or $x(4x + 3) - 7(4x + 3)$ or for $(4x + a)(x + b)$ where either $ab = -21$ or $4b + a = -25$ If 0 scored, **SC1** for $4x + 3$ **and** $x - 7$ seen but not in factorised form
	7 and $-\frac{3}{4}$	**B1**	
(a)(ii)(c)	7	**1**	**FT** *their* positive solution

	Answer	Mark	Partial Marks
(b)	$\frac{1}{6}$ oe	**4**	**M3** for $\frac{5}{9}\times\frac{4}{8}\times\frac{3}{7}+\frac{4}{9}\times\frac{3}{8}\times\frac{2}{7}$ or **M2** for $\frac{5}{9}\times\frac{4}{8}\times\frac{3}{7}$ or $\frac{4}{9}\times\frac{3}{8}\times\frac{2}{7}$ or **M1** for $\frac{5}{9},\frac{4}{8},\frac{3}{7}$ seen or $\frac{4}{9},\frac{3}{8},\frac{2}{7}$ seen If 0 scored, **SC1** for $\frac{5^3+4^3}{729}$ oe

24. 0580_w19_ms_41 Q: 8

	Answer	Mark	Partial Marks
(a)(i)	$\frac{4}{5}$ oe	1	
(a)(ii)	$\frac{4}{5}$ oe	1	
(b)(i)	$\frac{6}{20}$ oe nfww	3	**M2** for $\frac{1}{5}\times\frac{3}{4}+\frac{3}{5}\times\frac{1}{4}$ oe or $2\times\frac{1}{5}\times\frac{3}{4}$ oe or **M1** for $\frac{1}{5}\times\frac{3}{4}$ alone or $\frac{3}{5}\times\frac{1}{4}$ alone or for answer $\frac{3}{20}$ nfww After 0 scored, **SC1** for answer $\frac{6}{25}$
(b)(ii)	$\frac{8}{20}$ oe nfww	3	**M2** for $1-\frac{4}{5}\times\frac{3}{4}$ or $\frac{1}{5}\times1+\frac{4}{5}\times\frac{1}{4}$ oe or $2\times\frac{1}{5}\times1$ or $2\times\frac{1}{5}\times\frac{3}{4}+2\times\frac{1}{5}\times\frac{1}{4}$ or *their* (b)(i) + $2\times\frac{1}{5}\times\frac{1}{4}$ or **M1** for answer $\frac{2\text{ or }4\text{ or }5\text{ or }6\text{ or }7}{20}$ oe nfww After 0 scored, **SC1** for answer $\frac{8}{25}$

25. 0580_w19_ms_43 Q: 8

	Answer	Mark	Partial Marks
(a)(i)	$\frac{2}{5}$ oe	2	**M1** for $\frac{4}{6}\times\frac{3}{5}$
(a)(ii)	$\frac{3}{5}$ oe	1	**FT** $1 - \textit{their}\ \frac{12}{30}$ oe
(b)	$\frac{5}{7}$ oe nfww	4	**M3** for $\frac{2}{7}+\frac{5}{7}\times\frac{2}{6}+\frac{5}{7}\times\frac{4}{6}\times\frac{2}{5}$ oe or for $1-\frac{5}{7}\times\frac{4}{6}\times\frac{3}{5}$ oe or **M1** for each of $\frac{5}{7}\times\frac{2}{6}$ and $\frac{5}{7}\times\frac{4}{6}\times\frac{2}{5}$ oe or completed tree diagram with appropriate probabilities shown

26. 0580_s18_ms_41 Q: 9

	Answer	Mark	Partial Marks
(a)	$\frac{5}{8}$ $\frac{3}{8}$ $\frac{1}{6}$ $\frac{5}{6}$ $\frac{7}{10}$ $\frac{3}{10}$	3	**B1** for each pair

	Answer	Mark	Partial Marks
(b)	$\frac{5}{48}$ oe	2	**M1FT** for $\textit{their}\ \frac{5}{8}\times\textit{their}\ \frac{1}{6}$
(c)	$\frac{304}{480}$ oe	3	**M2** for $\textit{their}\frac{5}{8}\times\textit{their}\frac{5}{6}+\textit{their}\frac{3}{8}\times\textit{their}\frac{3}{10}$ oe or **M1** for $\textit{their}\frac{5}{8}\times\textit{their}\frac{5}{6}$ or $\textit{their}\frac{3}{8}\times\textit{their}\frac{3}{10}$

27. 0580_s18_ms_41 Q: 10

	Answer	Mark	Partial Marks
(a)	75	**3**	**M2** for $79.5 \div 1.06$ oe or **M1** for 79.5 associated with 106 [%]
(b)	962.5 cao	**2**	**B1** for 35 or 27.5 seen
(c)(i)	16	**1**	
(c)(ii)	50	**1**	
(c)(iii)	$\frac{4}{50}$ oe	**2**	**FT** *their* **(c)(ii)** for 1 or 2 marks **B1** for $\frac{4}{k}$, $k > 4$ or $\frac{k}{their 50}$, $k < 50$
(c)(iv)	19	**1**	

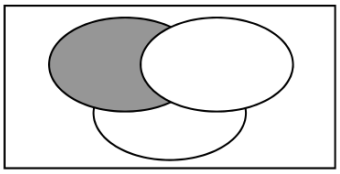
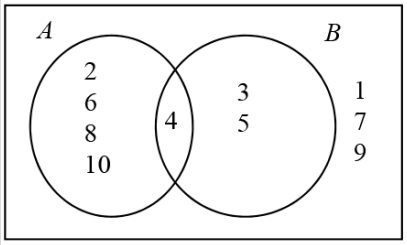
28. 0580_s18_ms_43 Q: 4

	Answer	Mark	Partial Marks
(a)(i)	$\frac{8}{20}$ oe	**3**	**M2** for $\frac{2}{5}\times\frac{1}{4}+\frac{3}{5}\times\frac{2}{4}$ or **M1** for one of these products OR **M1** for probability tree identifying all 20 outcomes with the correct 8 identified OR **M1** for completed possibility space / 2-way table identifying the 8 possible outcomes out of 20, oe **SC1** for $\frac{13}{25}$ with replacement

	Answer	Mark	Partial Marks
(a)(ii)	$\frac{9}{25}$ oe	3	**M2** for $\frac{2}{5}\times\frac{3}{5}+\frac{3}{5}\times\frac{1}{5}$ oe or **M1** for one of these products OR **M1** for probability tree identifying all 25 outcomes with the correct 9 identified OR **M1** for completed possibility space / 2-way table identifying the 9 possible outcomes out of 25, oe
(a)(iii)	Jojo and e.g. $\frac{40}{100}>\frac{36}{100}$	1	**1FT** *their* **(i)** and **(ii)** dep on being in range 0 to 1
(b)	$\frac{24}{60}$ oe	3	**M2** for $\frac{2}{5}\times\frac{3}{4}\times\frac{1}{3}+\frac{3}{5}\times\frac{2}{4}\times\frac{1}{3}+\frac{3}{5}\times\frac{2}{4}\times\frac{2}{3}$ oe or **M1** for any one correct product OR **M1** for 4, 5, 4 and 5, 4, 4 and 5, 5, 4 clearly identified on a tree or in a list

29. 0580_w18_ms_41 Q: 6

	Answer	Mark	Partial Marks
(a)(i)	14	1	
(a)(ii)	16	1	
(a)(iii)	$\frac{20}{462}$ oe	3	**M2** for $\frac{5}{22}\times\frac{4}{21}$ or **M1** for $\frac{5}{22}$ seen

	Answer	Mark	Partial Marks
(a)(iv)	Correct shading 	**1**	
(b)(i)	Fully correct Venn diagram 	**4**	**B1** for each correct region
(b)(ii)	3 4 5	**1**	**FT** *their* **(b)(i)**

30. 0580_w18_ms_42 Q: 12

	Answer	Mark	Partial Marks
(a)(i)	$\frac{10}{20} \times \frac{9}{19}$ oe	**M2**	**B1** for $\frac{9}{19}$ oe seen
(a)(ii)	$\frac{62}{95}$ oe	**4**	**M3** for $\frac{6}{20} \times \frac{14}{19} + \frac{10}{20} \times \frac{10}{19} + \frac{4}{20} \times \frac{16}{19}$ oe or $1 - \frac{6}{20} \times \frac{5}{19} - \frac{10}{20} \times \frac{9}{19} - \frac{4}{20} \times \frac{3}{19}$ oe or **M2** for the sum of two products of different flavours isw or **M1** for one correct product of different flavours isw
(b)	$\frac{5}{57}$ oe	**3**	**M2** for $N \times \left(\frac{4}{20} \times \frac{3}{19} \times \frac{16}{18}\right) + \frac{4}{20} \times \frac{3}{19} \times \frac{2}{18}$ oe or for $3\left(\frac{4}{20} \times \frac{3}{19} \times \frac{16}{18}\right)$ oe or $1 - \{N \times \left(\frac{4}{20} \times \frac{16}{19} \times \frac{15}{18}\right) + \frac{16}{20} \times \frac{15}{19} \times \frac{14}{18}\}$ oe or **M1** for $\frac{4}{20} \times \frac{3}{19} \times \frac{k}{18}$ oe seen

31. 0580_w18_ms_43 Q: 7

	Answer	Mark	Partial Marks
(a)(i)	$\frac{3}{5} > \frac{1}{4}$ oe or $\frac{12k}{20k}$ and $\frac{5k}{20k}$ or 0.6 and 0.25 or 60% and 25%	**1**	
(a)(ii)	$\frac{11}{20}$ oe	**3**	**M2** for $\frac{3}{5}\times\frac{3}{4} + \frac{2}{5}\times\frac{1}{4}$ oe or $1 - \frac{3}{5}\times\frac{1}{4} - \frac{2}{5}\times\frac{3}{4}$ oe or **M1** for $\frac{3}{5}\times\frac{3}{4}$ or $\frac{2}{5}\times\frac{1}{4}$ oe (but not as part of a larger product)
(b)(i)	$\frac{6}{60}$ oe	**2**	**M1** for $\frac{3}{5}\times\frac{2}{4}\times\frac{1}{3}$ oe If 0 scored, **SC1** for answer $\frac{27}{125}$ oe
(b)(ii)	0	**1**	Accept $\frac{0}{60}$

	Answer	Mark	Partial Marks
(c)	$\frac{11}{25}$ oe	**3**	**M2** for $\frac{3}{5}\times\frac{3}{5} + \frac{2}{5}\times\frac{1}{5}$ oe or $1 - \frac{3}{5}\times\frac{2}{5} - \frac{2}{5}\times\frac{4}{5}$ oe or **M1** for $\frac{3}{5}\times\frac{3}{5}$ or $\frac{2}{5}\times\frac{1}{5}$ or for a correct tree showing all 25 outcomes with the 11 correct outcomes identified

32. 0580_m17_ms_42 Q: 4

	ANSWER	MARK	PARTIAL MARKS
(a)	$\frac{1}{8}$ oe	**3**	**M2** for $\frac{1}{2}\left(1-\frac{1}{6}-\frac{1}{4}-\frac{1}{3}\right)$ oe or **M1** for $\frac{1}{6}+\frac{1}{4}+\frac{1}{3}$ seen oe or idea that all sum to 1
(b)	$\frac{7}{12}$ oe	**2**	**M1** for $\frac{1}{3}+\frac{1}{4}$ oe
(c) (i)	$\frac{1}{16}$ oe	**2**	**M1** for $\frac{1}{4}\times\frac{1}{4}$ oe
(ii)	$\frac{2}{24}$ oe	**3**	**M2** for $2\times\frac{1}{6}\times\frac{1}{4}$ oe or **M1** for $\frac{1}{6}\times\frac{1}{4}$ oe
(d)	12	**1**	

33. 0580_s17_ms_42 Q: 6

	ANSWER	MARK	PARTIAL MARKS
(a)	$\frac{1}{3}, \frac{6}{7}$ correctly placed	**1**	
	$\frac{4}{7}, \frac{3}{7}$ correctly placed	**1**	

	ANSWER	MARK	PARTIAL MARKS
(b)	$\frac{2}{21}$ oe	**2**	**M1** for $\frac{2}{3}\times\frac{1}{7}$
(c)(i)	$\frac{15}{21}$ oe	**3**	**M2** for $\frac{2}{3}\times\frac{6}{7}+\frac{1}{3}\times\frac{3}{7}$ oe or **M1** for $\frac{2}{3}\times\frac{6}{7}$ oe or $\frac{1}{3}\times\frac{3}{7}$ oe seen
(c)(ii)	50	**2FT**	**FT** (70 × *their* **(c)(i)**) rounded up or down to integer **M1** for 70 × *their* **(c)(i)**
(d)	$\frac{10}{243}$ oe	**2**	**M1** for $\frac{2}{3}\times\frac{1}{3}\times\frac{1}{3}\times\frac{1}{3}\times\frac{1}{3}[\times k]$ oe nfww where k is positive integer less than 5

34. 0580_w17_ms_41 Q: 9

	ANSWER	MARK	PARTIAL MARKS
(a)(i)	52	**2**	**M1** for $(1 - 0.35) \times 80$ oe
(a)(ii)	84	**1**	
(b)(i)	$\frac{27}{729}$ oe	**2**	**M1** for $\frac{3}{9} \times \frac{3}{9} \times \frac{3}{9}$
(b)(ii)	$\frac{144}{729}$ oe	**3**	**M2** for $\frac{2}{9} \times \frac{3}{9} \times \frac{4}{9} \times 6$ oe or **M1** for $\frac{2}{9} \times \frac{3}{9} \times \frac{4}{9}$ oe isw
(c)	$\frac{42}{60}$ oe	**4**	**M3** for $\frac{3}{5} \times \frac{2}{4} \times \frac{1}{3} + \frac{3}{5} \times \frac{2}{4} \times \frac{2}{3} \times 3$ oe or **M2** for $\frac{3}{5} \times \frac{2}{4} \times \frac{2}{3} \times 3$ oe or for $\frac{3}{5} \times \frac{2}{4} \times \frac{1}{3} + \left(\frac{3}{5} \times \frac{2}{4} \times \frac{2}{3}\right)$ [×2] or **M1** for $\frac{3}{5} \times \frac{2}{4} \times \frac{1}{3}$ or $\frac{3}{5} \times \frac{2}{4} \times \frac{2}{3}$ oe isw or for PPG, PGP, GPP and PPP selected soi

35. 0580_w17_ms_42 Q: 7

	ANSWER	MARK	PARTIAL MARKS
(a)	$\frac{5}{6}$	**1**	
(b)	$\frac{4}{36}$ oe	**2**	**M1** for $\frac{2}{6} \times \frac{2}{6}$
(c)	20	**1**	

	ANSWER	MARK	PARTIAL MARKS
(d)(i)	Diagram completed correctly x x 3 3 3 9 x x 2 2 2 6 x x 2 2 2 6 x x 2 2 2 6 x x 1 1 1 3	**2**	**B1** for 3 correct columns or for 4 correct rows
(d)(ii)(a)	$\frac{9}{36}$ oe	**1FT**	**FT** *their* **(d)(i)**
(d)(ii)(b)	$\frac{4}{36}$ oe	**1FT**	**FT** *their* **(d)(i)**
(e)	$\frac{512}{7776}$ oe	**2**	**M1** for $\left(\frac{4}{6}\right)^k \times \frac{2}{6}$ oe $k = 3$, 4 or 5 only