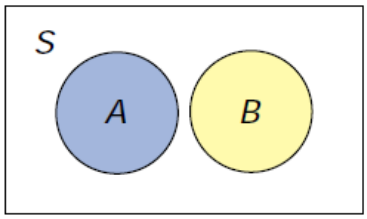
MUTUALLY EXCLUSIVE EVENTS

When events A and B are mutually exclusive, the probability that A or B will occur is given by the **addition rule for mutually exclusive events**:

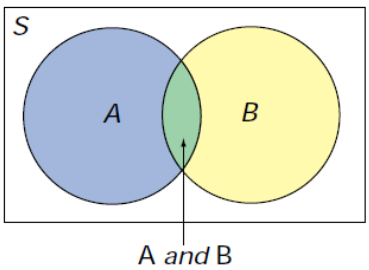
$$P(A \text{ or } B) = P(A) + P(B)$$

A Venn diagram shows mutually exclusive events as non-overlapping, or disjoint. Thus, you can apply the additive counting principle (see Chapter 4) to prove this rule.



When events A and B are non-mutually exclusive, the probability that A or B will occur is given by the **addition rule for non-mutually exclusive events**:

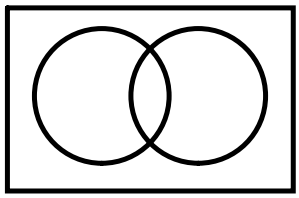
$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$



EXAMPLE: Three cards are selected from a standard deck of cards.

What is the probability that ...

A) they are face cards or clubs?



B) they are face cards and clubs?

C) they are face cards or aces?

EXAMPLE: The results of a survey of 60 people on the modes of transportation they tend to use are as follows:

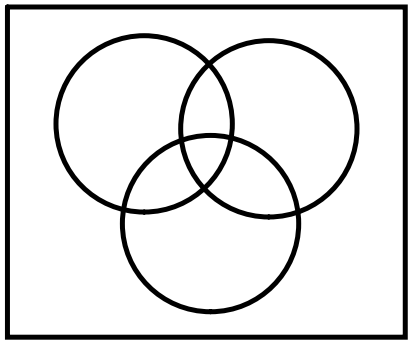
35 people use the TTC, 24 use their bicycle, 30 use their car,

13 people use the TTC and a car, 12 use the TTC and their bicycle,

11 use a car and their bicycle, and 4 use all 3 modes of transportation.

What is the probability that a randomly chosen person prefers...

A) to cycle



B) to cycle, given that they like to use TTC

C) to cycle if they also use the TTC and a car

D) to cycle if they also use the TTC or a car

E) to use the TTC or a car, but not cycle

F) to use a car, but not the TTC

Practise

A

1. Classify each pair of events as mutually exclusive or non-mutually exclusive.

	Event A	Event B
a)	Randomly drawing a grey sock from a drawer	Randomly drawing a wool sock from a drawer
b)	Randomly selecting a student with brown eyes	Randomly selecting a student on the honour roll
c)	Having an even number of students in your class	Having an odd number of students in your class
d)	Rolling a six with a die	Rolling a prime number with a die
e)	Your birthday falling on a Saturday next year	Your birthday falling on a weekend next year
f)	Getting an A on the next test	Passing the next test
g)	Calm weather at noon tomorrow	Stormy weather at noon tomorrow
h)	Sunny weather next week	Rainy weather next week

2. Nine members of a baseball team are randomly assigned field positions. There are three outfielders, four infielders, a pitcher, and a catcher. Troy is happy to play any position except catcher or outfielder. Determine the probability that Troy will be assigned to play
   a) catcher
   b) outfielder
   c) a position he does not like

11. The eight members of the debating club pose for a yearbook photograph. If they line up randomly, what is the probability that
   a) either Hania will be first in the row or Aaron will be last?
   b) Hania will be first and Aaron will not be last?

Apply, Solve, Communicate

B

4. As a promotion, a resort has a draw for free family day-passes. The resort considers July, August, March, and December to be "vacation months."

a) If the free passes are randomly dated, what is the probability that a day-pass will be dated within

i) a vacation month?

ii) June, July, or August

b) Draw a Venn diagram of the events in part a).

7. **Application** In an animal-behaviour study, hamsters were tested with a number of intelligence tasks, as shown in the table below.

Number of Tests	Number of Hamsters
0	10
1	6
2	4
3	3
4 or more	5

If a hamster is randomly chosen from this study group, what is the likelihood that the hamster has participated in

a) exactly three tests?

b) fewer than two tests?

c) either one or two tests?

d) no tests or more than three tests?

C

13. A grade 12 student is selected at random to sit on a university liaison committee. Of the 120 students enrolled in the grade 12 university-preparation mathematics courses,

- 28 are enrolled in data management only
- 40 are enrolled in calculus only
- 15 are enrolled in geometry only
- 16 are enrolled in both data management and calculus
- 12 are enrolled in both calculus and geometry
- 6 are enrolled in both geometry and data management
- 3 are enrolled in all three of data management, calculus, and geometry

a) Draw a Venn diagram to illustrate this situation.

b) Determine the probability that the student selected will be enrolled in either data management or calculus.

c) Determine the probability that the student selected will be enrolled in only one of the three courses.

16. **Inquiry/Problem Solving** The table below lists the degrees granted by Canadian universities from 1994 to 1998 in various fields of study.

a) If a Canadian university graduate from 1998 is chosen at random, what is the probability that the student is

i) a male?

ii) a graduate in mathematics and physical sciences?

iii) a male graduating in mathematics and physical sciences?

iv) not a male graduating in mathematics and physical sciences?

v) a male *or* a graduate in mathematics and physical sciences?

b) If a male graduate from 1996 is selected at random, what is the probability that he is graduating in mathematics and physical sciences?

c) If a mathematics and physical sciences graduate is selected at random from the period 1994 to 1996, what is the probability that the graduate is a male?

d) Do you think that being a male and graduating in mathematics and physical sciences are independent events? Give reasons for your hypothesis.

	1994	1995	1996	1997	1998
Canada	178 074	178 066	178 116	173 937	172 076
Male	76 470	76 022	75 106	73 041	71 949
Female	101 604	102 044	103 010	100 896	100 127
Social sciences	69 583	68 685	67 862	66 665	67 019
Male	30 700	29 741	29 029	28 421	27 993
Female	38 883	38 944	38 833	38 244	39 026
Education	30 369	30 643	29 792	27 807	25 956
Male	9093	9400	8693	8036	7565
Female	21 276	21 243	21 099	19 771	18 391
Humanities	23 071	22 511	22 357	21 373	20 816
Male	8427	8428	8277	8034	7589
Female	14 644	14 083	14 080	13 339	13 227
Health professions and occupations	12 183	12 473	12 895	13 073	12 658
Male	3475	3461	3517	3460	3514
Female	8708	9012	9378	9613	9144
Engineering and applied sciences	12 597	12 863	13 068	12 768	12 830
Male	10 285	10 284	10 446	10 125	10 121
Female	2312	2579	2622	2643	2709
Agriculture and biological sciences	10 087	10 501	11 400	11 775	12 209
Male	4309	4399	4756	4780	4779
Female	5778	6102	6644	6995	7430
Mathematics and physical sciences	9551	9879	9786	9738	9992
Male	6697	6941	6726	6749	6876
Female	2854	2938	3060	2989	3116
Fine and applied arts	5308	5240	5201	5206	5256
Male	1773	1740	1780	1706	1735
Female	3535	3500	3421	3500	3521
Arts and sciences	5325	5271	5755	5532	5340
Male	1711	1628	1882	1730	1777
Female	3614	3643	3873	3802	3563