

30. [Probability]

Skill 30.1 Describing the degree of likelihood of an event.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

Q. There are 27 marbles in a bag and 18 of them are green. How many marbles do you have to select to make sure you have a green marble?

A. *Chances of selecting a green marble = 18*
Chances of selecting a different color marble = 27 - 18 = 9
⇒ **10** It is possible to select all 9 other colored marbles before you choose a green marble.

a) There are 6 red, 2 purple and 4 white rulers in a drawer. What is the largest number of rulers you could select from the drawer without taking a white ruler?

red = 6, purple = 2, white = 4

6 red + 2 purple =

b) There are 8 chocolate, 10 milk and 5 cream biscuits in a box. How many biscuits do you have to pick to make sure you have a chocolate biscuit?

..... =

c) Linda has 8 nickels and 12 dimes in her bag. How many coins does she need to take out from her bag to make sure she has 3 dimes?

..... =

d) There are 7 orange, 9 red and 6 white jellybeans in a jar. How many jellybeans do you have to select without looking in order to pick a white jellybean?

..... =

e) There are twenty different pairs of socks in the drawer. How many socks need to be picked up without looking in order to have a pair of matching socks?

..... =

f) Of the 300 songs on an iPod, 185 are pop songs. How many songs do you need to play on a random setting to be sure you will hear a pop song?

..... =

g) Of the 18 movies on Tom's computer, 6 are comedies. How many movies does Tom have to watch on a random setting to be sure he watches a comedy?

..... =

h) How many people do you need to gather to be sure that at least two of them were born on the same day of the week?

..... =

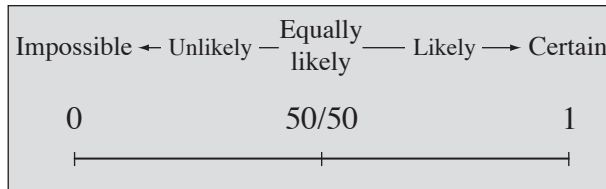
Skill 30.2 Recognizing the likelihood of an event.

MMBlue 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

Hints: Probability ranges from 0 to 1.

The closer the probability is to 1, the more likely the event is to happen.

The closer the probability is to 0, the more unlikely the event is to happen.



Q. ‘Mary’s new baby will be a boy.’
Which expression best represents the probability of this event?

- A) very unlikely
- B) a 50/50 chance
- C) very likely
- D) certain

A. Consider the possibilities.

The new baby can either be a boy or a girl so there is a 50/50 chance

⇒ The answer is **B**.

a) ‘Einstein will be the oldest living person.’
Which expression best represents the probability of this event?

- A) impossible
- B) very unlikely
- C) very likely
- D) certain

A

b) ‘It will rain in the Sahara desert tomorrow.’
Which expression best represents the probability of this event?

- A) impossible
- B) very unlikely
- C) very likely
- D) certain

c) ‘The football team will win the next game.’
Which expression best represents the probability of this event?

- A) very unlikely
- B) a 50/50 chance
- C) very likely
- D) certain

d) ‘The whole class will get 100% in the next Math test.’
Which expression best represents the probability of this event?

- A) very likely
- B) a 50/50 chance
- C) very unlikely
- D) impossible

e) ‘There will be no school holidays next year.’
Which expression best represents the probability of this event?

- A) very unlikely
- B) a 50/50 chance
- C) very likely
- D) certain

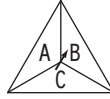
f) ‘Wednesday comes before Thursday.’
Which expression best represents the probability of this event?

- A) very unlikely
- B) a 50/50 chance
- C) very likely
- D) certain

Skill 30.3 Finding the possible outcomes (sample spaces) of an event by completing tables.

- Complete the table to reveal all the possible outcomes (PO) (sample space).
- Count the number of possible outcomes (PO) (sample space).

Q. How many different outcomes are possible when a die is thrown and this spinner is spun? [Complete the table.]



		Die					
		1	2	3	4	5	6
Spinner	A	A,1	A,2				
	B	B,1					
	C	C,1					

A. $PO = 18$

Possible outcomes		Die					
		1	2	3	4	5	6
Spinner	A	A,1	A,2	A,3	A,4	A,5	A,6
	B	B,1	B,2	B,3	B,4	B,5	B,6
	C	C,1	C,2	C,3	C,4	C,5	C,6

Each space represents 1 outcome

a) A zoo has both male and female primates. There are gorillas and chimpanzees. Find the size of the sample space.

[Complete the table.]

Outcomes (sample space)		
male	gorilla	1
male	chimpanzee	2
female	gorilla	3
female	chimpanzee	4

Each row represents 1 outcome

b) How many different outcomes are possible choosing a primary color (red, blue and green) and tossing a coin?

[Complete the table.]

Possible outcomes		Primary color		
		R	G	B
Coin	H	H,R		
	T			

c) How many different outcomes are possible when rolling a die and flipping a coin? [Complete the table.]

Possible outcomes		Die					
		1	2	3	4	5	6
Coin	H	H,1	H,2				
	T	T,1					

d) How many different outcomes are possible when spinning a spinner labeled 1, 2, 3, 4, 5 and flipping a coin?

[Complete the table.]

Possible outcomes		Spinner				
		1	2	3	4	5
Coin	H	H,1				
	T					

e) A car comes in silver, red or purple as a convertible or hardtop. Find the size of the sample space. [Complete the table.]

Outcomes (sample space)	
silver	convertible
silver	
red	

f) A vendor sells vanilla and chocolate ice cream. Customers can have a waffle or sugar cone and either hot fudge or caramel topping. How many different outcomes are possible when ordering an ice cream in a cone with a single topping?

Outcomes (sample space)		
vanilla	waffle	hot fudge
vanilla		caramel
vanilla		

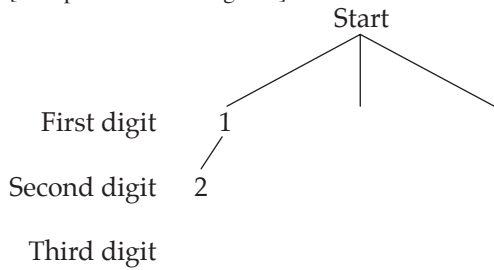
Skill 30.4 Finding the possible outcomes (sample spaces) of an event by completing tree diagrams (1).

MMBlue 1 1 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

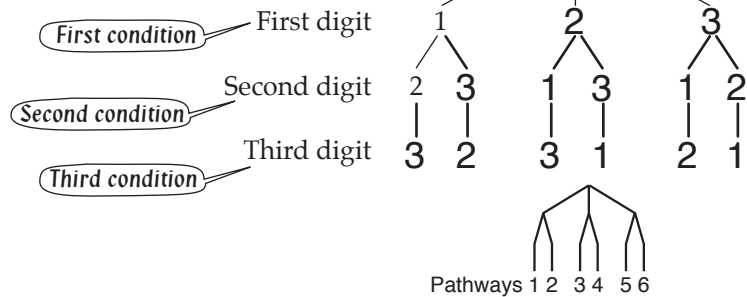
- From the start use the first condition to list all the possible outcomes (PO) on the first set of branches.
- From each of the first outcomes create enough branches to list all the possible outcomes of the second condition.
- Continue in this way until the tree diagram is completed.
- Count the number of pathways from the start to the end of each branch line.
The number of pathways equals the total number of possible outcomes (sample space).

Q. How many different 3-digit numbers can be made using the digits 1, 2 and 3 if the digits can be used only once?

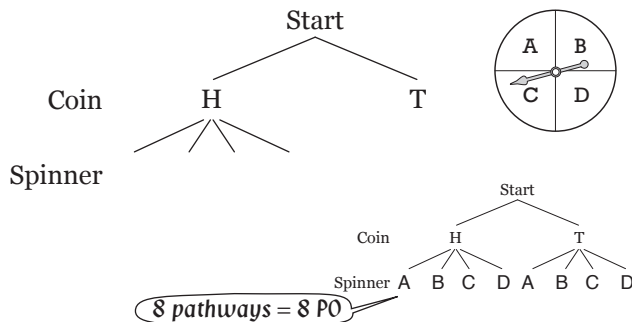
[Complete the tree diagram.]



A. Possible outcomes (PO)
= 123, 132, 213, 231, 312, 321
= 6



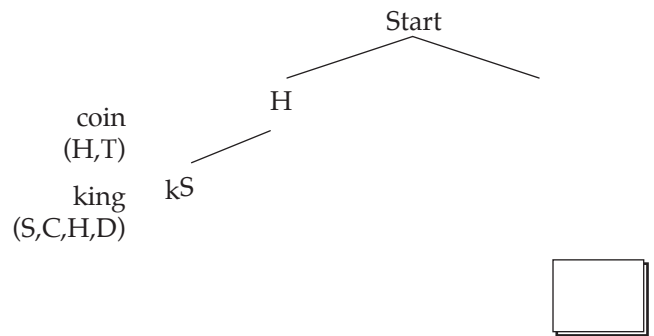
a) How many different outcomes are possible when flipping a coin and spinning this spinner? [Complete the tree diagram.]



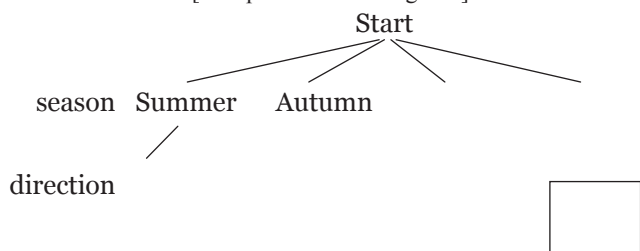
PO = HA, HB, HC, HD, TA, TB, TC, TD =

b) How many different outcomes are possible when flipping a coin and cutting a king from any of the 4 suits in a pack of cards?

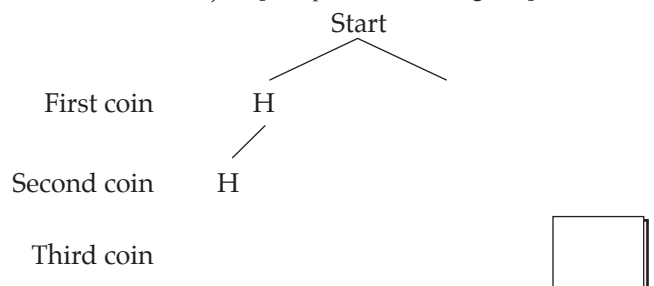
[Complete the tree diagram.]



c) How many different outcomes are possible when choosing a season of the year and one of the 4 point compass directions? [Complete the tree diagram.]



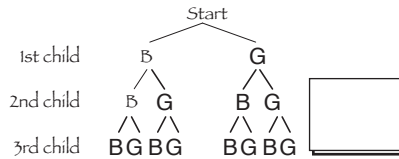
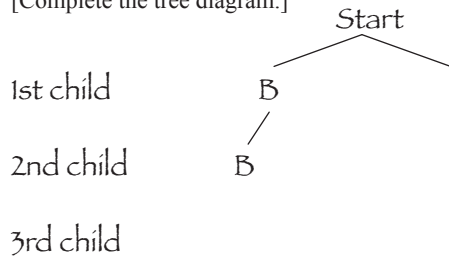
d) How many different outcomes are possible when flipping 3 coins (assuming order matters)? [Complete the tree diagram.]



Skill 30.4 Finding the possible outcomes (sample spaces) of an event by completing tree diagrams (2).

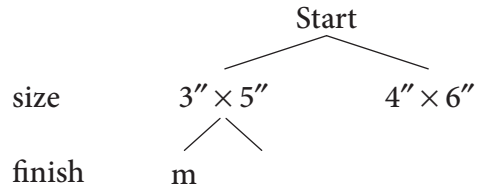
e) How many different gender combinations are possible if a couple have 3 children and order matters?

[Complete the tree diagram.]



f) Photos can be printed in various sizes (3" × 5" or 4" × 6") and finishes (matte or gloss) with single or double prints an option. How many choices are possible?

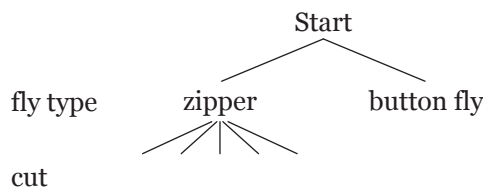
[Complete the tree diagram.]



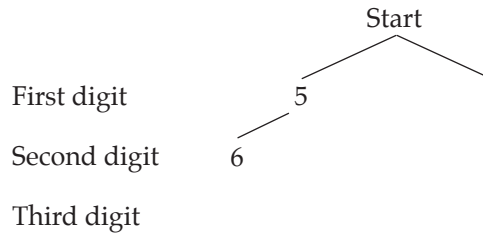
number

g) Jeans come with 2 fly types (zipper or button fly) and 5 cuts (boot cut, stove pipe, straight leg, skinny and flared). How many choices of jeans are possible?

[Complete the tree diagram.]



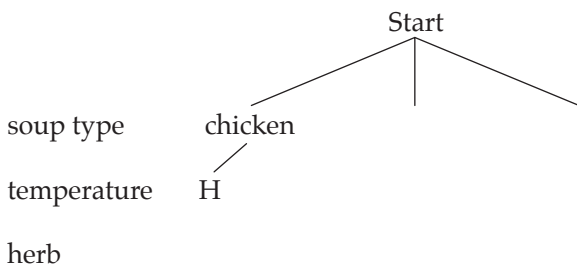
h) How many different 3-digit numbers less than 700 can be made using the digits 5, 6, 7 and 8 if the digits can be used only once? [Complete the tree diagram.]



Third digit

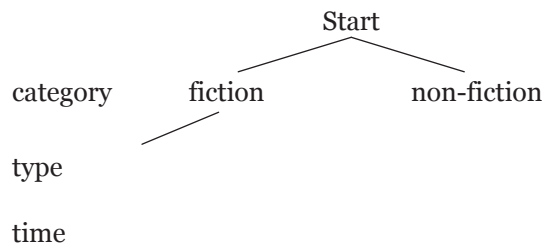
i) There are 3 kinds of soup on the menu: chicken, vegetable and pumpkin. They may be served hot or cold and always with a condiment of parsley or basil. How many choices are possible?

[Complete the tree diagram.]



j) On a library visit Tara must decide whether to loan a fiction or non-fiction item in one of the available formats (book, movie, tape, large print) for 2 weeks or 4 weeks. How many different options does Tara have?

[Complete the tree diagram.]





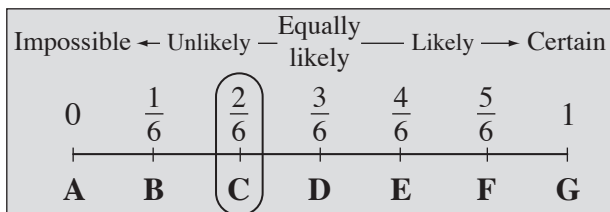
Skill 30.5 Calculating the probability of a simple event (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Find the number of favorable outcomes for the event.
- Find the total number of possible outcomes.
- Divide the number of favorable outcomes by the number of possible outcomes:

$$\Pr(\text{event}) = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}} = \frac{\text{FO}}{\text{PO}}$$

Example: Experiment throwing a standard die  OR 
 Event throwing a number greater than 4
 Possible outcomes (PO) 6 (throwing a 1, 2, 3, 4, 5 or a 6)
 Favorable outcomes (FO) 2 (throwing a 5 or a 6)
 Probability (Pr) 2 out of 6 = $\frac{2}{6}$ (FO out of PO)

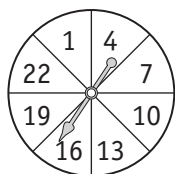


Hints: Probability ranges from 0 to 1.

The closer the probability is to 1, the more likely the event is to happen.

The closer the probability is to 0, the more unlikely the event is to happen.

Q. When a spinner is spun, what is the probability of spinning a number greater than 10?



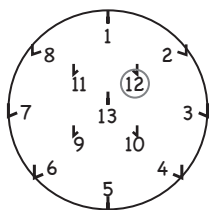
A. FO = 4 (13, 16, 19, 22)
 PO = 8 (1, 4, 7, 10, 13, 16, 19, 22)

$$\Pr(\text{number} > 10) = \frac{\text{FO}}{\text{PO}}$$

$$= \frac{4}{8}$$

$$= \frac{1}{2} = 0.5$$

a) A hookey ring is thrown. What is the probability of hooking an even number?

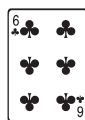


FO = 6 (2, 4, 6, 8, 10, 12)

PO = 13 (1 to 13)

$$\Pr(\text{even number}) = \frac{\text{FO}}{\text{PO}} = \boxed{}$$

b) A 52 card deck of playing cards is shuffled, and one card is dealt from the top of the deck. What is the probability that it will be a black card?



FO = _____

PO = _____

$$\Pr(\text{black card}) = \frac{\text{FO}}{\text{PO}} = \boxed{}$$

Skill 30.5 Calculating the probability of a simple event (2).

- c) When a die is rolled, what is the probability of rolling an even number?

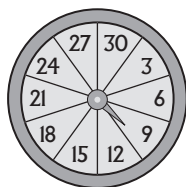


$FO =$

$PO =$

$Pr(\text{even number}) = \frac{FO}{PO} =$ =

- e) A spinner is divided into 10 equal parts. When it is spun once, what is the probability of spinning an odd number?



$FO =$

$PO =$

$Pr(\text{odd number}) = \frac{FO}{PO} =$ =

- g) A 52 card deck of playing cards is shuffled, and one card is dealt from the top of the deck. What is the probability that it will be a King?

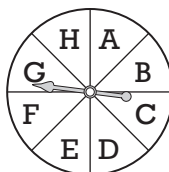


$FO =$

$PO =$

$Pr(\text{king}) = \frac{FO}{PO} =$ =

- d) When a spinner is spun, what is the probability of spinning a G?

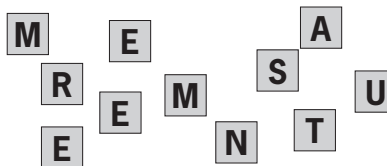


$FO =$

$PO =$

$Pr(\text{spinning a G}) = \frac{FO}{PO} =$ =

- f) If a letter tile is chosen at random, find the probability of choosing letter M.



$FO =$

$PO =$

$Pr(\text{letter M}) = \frac{FO}{PO} =$ =

- h) A day is randomly selected from the month of November. What is the probability that it will be a federal holiday?

November						
SUN	MON	TUE	WED	THU	FRI	SAT
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

× federal holiday

$FO =$

$PO =$

$Pr(\text{holiday}) = \frac{FO}{PO} =$ =

Skill 30.5 Calculating the probability of a simple event (3).

- i) A bag contains 20 keys, one of which opens the door to the prize car. One key is randomly selected from the bag. What is the probability of selecting the winning key?

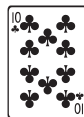


$FO =$

$PO =$

$Pr(\text{winning key}) = \frac{FO}{PO} =$ =

- j) A 52 card deck of playing cards is shuffled, and one card is dealt from the top of the deck. What is the probability that it will be a club?



$FO =$

$PO =$

$Pr(\text{club}) =$ = =

- k) A 52 card deck of playing cards is shuffled, and one card is dealt from the top of the deck. What is the probability that it will be a red card?

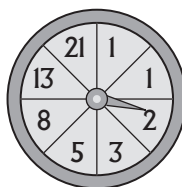


$FO =$

$PO =$

$Pr(\text{red card}) =$ = =

- l) A spinner is divided into 8 equal parts. When it is spun once, what is the probability of spinning an even number?

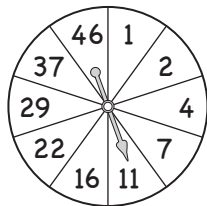


$FO =$

$PO =$

$Pr(\text{even number}) =$ = =

- m) When the spinner is spun once, what is the probability of spinning a prime number?

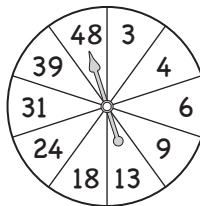


$FO =$

$PO =$

$Pr(\text{prime number}) =$ = =

- n) When the spinner is spun once, what is the probability of spinning a composite number?



$FO =$

$PO =$

$Pr(\text{composite number}) =$ = =

Skill 30.5 Calculating the probability of a simple event (4).

o) There are 8 pennies, 10 nickels, 6 dimes and 12 quarters in a piggy bank. If a coin is selected at random, what is the probability that a dime will be drawn?

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p) Ten balls numbered 1 to 10 are mixed together, and then one ball is drawn. Find the probability that a number less than 5 is drawn.

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q) There are 7 tomato soup cans, 3 chicken soup cans, 5 vegetable soup cans and 3 pumpkin soup cans in the cupboard. If a can is chosen at random, what is the probability that it is a chicken soup can?

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r) Mia has a bag that contains 7 blue, 5 white, 12 green and 6 yellow marbles. If Mia is randomly selecting a marble, what is the probability that she chooses a green marble?

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Q. Which event is most unlikely to happen?

- A) choosing a spade from a deck of 52 playing cards
- B) rolling a '4' on a standard die
- C) selecting a white marble from a bag of 8 black and 2 white marbles

A. Consider each alternative:

- a) 13 spades in 52 cards = $\frac{13}{52} = \frac{1}{4}$ Simplify: ÷ 13
- b) 1 four on a 6 sided die = $\frac{1}{6}$ Least likely
- c) 2 white marbles out of 10 = $\frac{2}{10} = \frac{1}{5}$ Simplify: ÷ 2

⇒ The answer is **B**.

s) Which event is most unlikely to happen?

- A) rolling a '6' on a standard die
- B) drawing a diamond from a deck of 52 playing cards
- C) predicting 'boy' for an unborn baby

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t) Which event is most likely to happen?

- A) choosing 'false' as the answer
- B) selecting the winner in a 10 horse race
- C) scoring the only touchdown in a game of football

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Skill 30.5 Calculating the probability of a simple event (5).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

u) Which event is most likely to happen?

- A) winning the jackpot in a lottery
- B) rolling an odd number on a die
- C) selecting a consonant from the word GEOMETRY

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v) Which event is most likely to happen?

- A) turning 'heads' on a tossed coin
- B) serving an ace ten times in a row
- C) rolling a number greater than 1 on a standard die

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w) Which event is most unlikely to happen?

- A) marking a 'cross' playing tic-tac-toe
- B) selecting an even number from the numbers 1 to 8
- C) throwing a 13 on a hookey board marked 1 to 13

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x) Which event does **not** have a 50% chance of success?

- A) drawing a red card from a deck of 52 playing cards
- B) throwing a bullseye on a dartboard
- C) marking a 'nought' in tic-tac-toe

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y) Which event is most likely to happen?

- A) selecting 'red' from the 7 colors of the rainbow
- B) moving a pawn at the start of a chess game
- C) randomly hitting a key on a keyboard and it being the 'tab' key

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z) Which event is most likely to happen?

- A) choosing a prime number from the numbers 2 to 7
- B) winning a car in a raffle
- C) selecting a vowel from the word PROBABILITY

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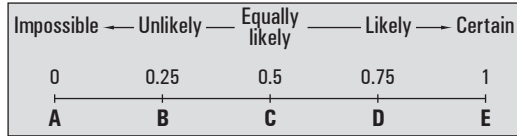
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Skill 30.6 Calculating the probability of a simple event using probability scales.

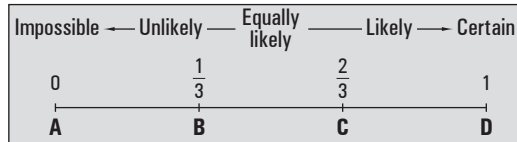
- Divide the number of favorable outcomes (FO) by the number of possible outcomes (PO).
(see skill 30.5, page 306)

Q. ‘A coin is tossed and tails comes up.’
Which letter A to E best represents the probability of the event?



A. $FO = 1$ (tails)
 $PO = 2$ (heads or tails) possible outcomes
 $Pr(\text{event}) = \frac{FO}{PO}$
 $= \frac{1}{2} = 0.5$
 The answer is **C**.

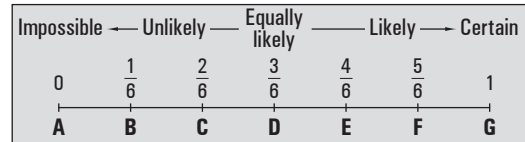
a) ‘A blue tile will be drawn from a box containing 8 black tiles and 4 blue tiles.’
Which letter A to D best represents the probability of the event?



$FO = 4$ $PO = 12$

$\frac{FO}{PO} = \frac{4}{12}$ simplify: ÷ 4 \Rightarrow

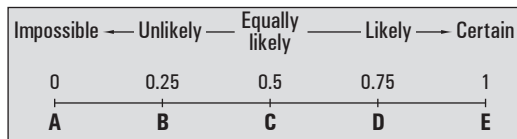
b) ‘A die is rolled and a 6 comes up.’
Which letter A to G best represents the probability of the event?



$FO =$ $PO =$

$\frac{FO}{PO} =$ \Rightarrow

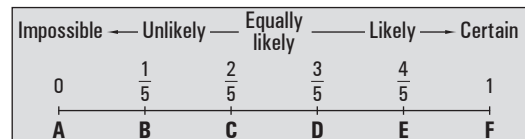
c) ‘A caramel candy will be drawn from a box with 12 caramel and 4 milk candies.’
Which letter A to E best represents the probability of the event?



$FO =$ $PO =$

$=$ \Rightarrow

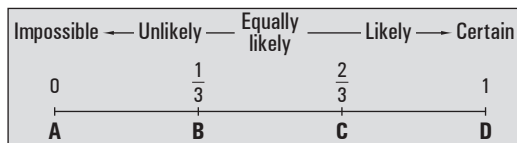
d) ‘A 5-sided pencil is rolled and the logo, printed on 1 side, comes up.’
Which letter A to F best represents the probability of the event?



$FO =$ $PO =$

$=$ \Rightarrow

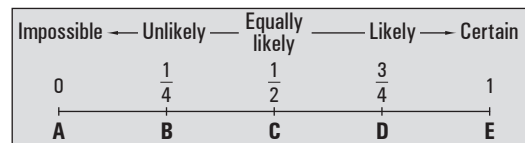
e) ‘A red marble will be drawn from a bag containing 3 red and 6 blue marbles.’
Which letter A to D best represents the probability of the event?



$FO =$ $PO =$

$=$ \Rightarrow

f) ‘A club is drawn from a deck of 52 playing cards.’
Which letter A to E best represents the probability of the event?



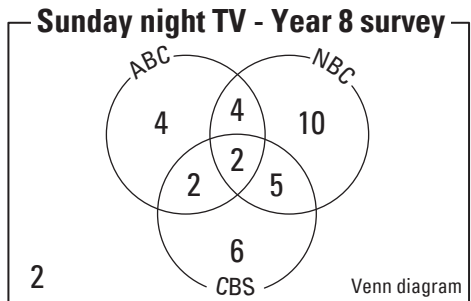
$FO =$ $PO =$

$=$ \Rightarrow

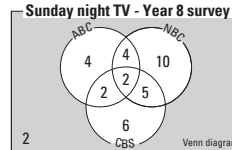
Skill 30.7 Interpreting Venn diagrams.

- Count the total number of possible outcomes.
- Shade the areas inside the Venn diagram that fit the description for favorable outcomes.
- Use the formula for the probability of an event.

Q. What is the probability that a student selected at random from the Year 8 class did not watch any Sunday night TV?

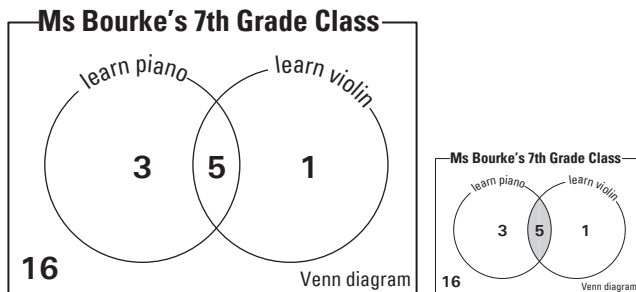


A. $FO = 2$ possible outcomes
 $PO = 4 + 4 + 2 + 2 + 10 + 5 + 6 + 2$
 $= 35$
 $Pr(event) = \frac{FO}{PO} = \frac{2}{35}$



Students who do not watch TV are shown in the shaded area. Students who do watch TV are shown in the white area.

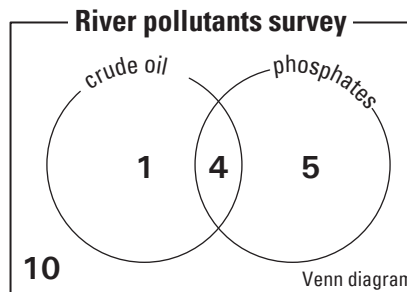
a) What is the probability that a student chosen at random from Ms Bourke's class learns both piano and violin?



$FO = 5$ $PO = 16 + 3 + 5 + 1 = 25$

$Pr(event) = \frac{FO}{PO} = \frac{5}{25} = \frac{1}{5}$

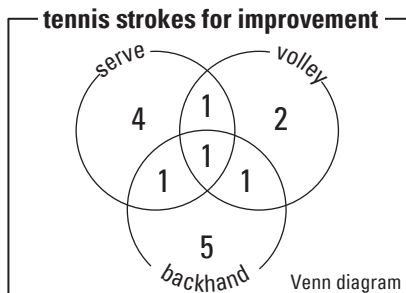
b) What is the probability that a surveyed river, visited at random, contained only phosphate pollutants?



$FO =$ $PO =$

$Pr(event) = \frac{FO}{PO} = \frac{5}{10} = \frac{1}{2}$

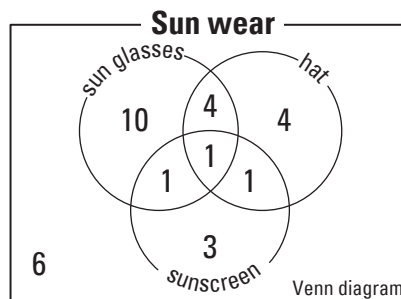
c) What is the probability that a tennis player chosen at random named the serve as the stroke that needs improvement?



$FO =$ $PO =$

$Pr(event) = \frac{FO}{PO} = \frac{4}{14} = \frac{2}{7}$

d) What is the probability that a person chosen at random did not wear sunscreen?



$FO =$ $PO =$

$Pr(event) = \frac{FO}{PO} = \frac{6}{16} = \frac{3}{8}$

Skill 30.8 Calculating the probability of complementary events.

- Identify and calculate the probability of the event. $\Pr(\text{event}) = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}} = \frac{\text{FO}}{\text{PO}}$
- Identify the complementary events.
- To calculate the probability of the complementary event, subtract the probability of the event from 1: $\Pr(\text{complementary event}) = 1 - \Pr(\text{event})$

Hints: The complement of the event “the plane will be on time” is “the plane will not be on time”.
Winning - not winning, voting “yes” - voting “no” are examples of complementary events.

Q. A box contains 10 blue, 2 green and 6 white ribbons. If a ribbon is selected at random, find the probability that it is not a green ribbon.

A. *Event = green*
Complementary event = not a green

$$\Pr(\text{green}) = \frac{2}{18}$$

$$\Pr(\text{not green}) = 1 - \frac{2}{18}$$

$$= \frac{18}{18} - \frac{2}{18} = \frac{16}{18} = \frac{8}{9}$$

a) The probability of an earthquake of 7.5 magnitude occurring in San Francisco in any year is 2%. What is the probability of there being no earthquake in San Francisco next year? [Give the answer as a percent.]

$$\Pr(\text{earthquake}) = 2\%$$

$$\Pr(\text{no earthquake}) = 100\% - 2\% = \boxed{}$$

b) The cookie jar contains 12 cookies of which 4 are burnt. What is the probability of Leah choosing a cookie that is not burnt?

$$\Pr(\text{burnt}) =$$

$$\Pr(\text{not burnt}) = \boxed{}$$

c) A bag contains gold and silver discs. The probability of choosing a gold disc is $\frac{2}{5}$. What is the probability of not choosing a gold disc?

$$\Pr(\text{gold}) =$$

$$\Pr(\text{not gold}) = \boxed{}$$

d) Ten balls numbered 1 to 10 are mixed together, and then one ball is drawn. Find the probability that the number drawn is not a perfect square (i.e. 1, 4 or 9).

$$\Pr(\text{perfect square}) =$$

$$\Pr(\text{not perfect square}) = \boxed{}$$

e) A ballot box contains 20 independent, 12 conservative and 18 labor votes. If one vote is picked at random, what is the probability that it is not labor?

$$ \boxed{}$$

f) In the USA, 53% of students are in elementary school and 24% are in post-secondary education. What is the probability that a student selected at random is not in either area of education? [Give the answer as a percent.]

$$ \boxed{}$$

Skill 30.9 Calculating the probability of mutually exclusive events.

- Find the probability of each event.

$$\Pr(\text{event}) = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}} = \frac{\text{FO}}{\text{PO}}$$

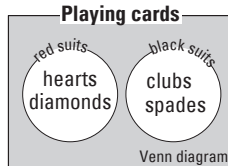
- Add the probabilities of each event in order to find the probability of both events occurring.

$$\Pr(A \text{ and } B) = \Pr(A) + \Pr(B)$$

- Simplify the fraction where necessary.

Hint: Mutually exclusive events cannot occur at the same time.

Example: A card selected from a pack of playing cards can either be red or black, not both.



- Q.** A bag contains 3 dimes, 1 nickel and 8 quarters. If a coin is selected at random, find the probability that it is a dime or a quarter.

A. $\Pr(D) = \frac{3}{12}$
 $\Pr(Q) = \frac{8}{12}$
 $\Pr(D \text{ or } Q) = \Pr(D) + \Pr(Q)$
 $= \frac{3}{12} + \frac{8}{12}$
 $= \frac{11}{12}$

- a)** What is the probability of drawing a red card or a club from a pack of cards?

$$\Pr(\text{red}) = \frac{26}{52} \quad \Pr(\text{club}) = \frac{13}{52}$$

$$\Pr(\text{red or club}) = \Pr(\text{red}) + \Pr(\text{club})$$

$$= \frac{26}{52} + \frac{13}{52} = \frac{39}{52} = \frac{3}{4}$$

- b)** When a die is rolled, what is the probability of rolling a 5 or a 6?



$$\Pr(5) = \quad \Pr(6) =$$

$$\Pr(5 \text{ or } 6) = \Pr(5) + \Pr(6)$$

$$= \quad =$$

- c)** In the lucky dip box there are 5 lolly bags, 4 marble bags and 3 sand bags. If a bag is selected at random, find the probability that it is a lolly or a marble bag.

$$\Pr(\text{lolly bag}) = \quad \Pr(\text{marble bag}) =$$

$$= \quad =$$

- d)** When a die is rolled, what is the probability of rolling an odd number or an even number?

$$= \quad =$$

Skill 30.10 Finding the possible outcomes of an event by applying the counting principle.

- Multiply the number of possibilities in event 1 by the number of possibilities in event 2.
Hint: The counting principle can be extended to 3 or more events.

Q. Maria chose one chemistry class, one math class, one history class and one English class. According to the schedule she has 2 different chemistry classes, 4 different math classes, 3 different history classes, and 3 different English classes to choose from. If no scheduling conflicts exist, how many different four-course selections can Maria make?

A. *Number of 4-course selections*
 $= 2 \times 4 \times 3 \times 3$
 $= 72$

a) How many different 3-digit numbers can be made from the digits 4, 5, 6, 7 and 8, if a digit can appear just once?

$N = 5 \times 4 \times 3 = \boxed{60}$

5 digits in 1st position, 4 digits in 2nd position, 3 digits in 3rd position

b) In how many ways can a family of five stand in a line for a photograph?

$N = \dots = \boxed{}$

c) A dime and a six-sided die are tossed. How many results are possible?

$N = \dots = \boxed{}$

d) How many 4-digit numbers can be formed with the digits 1, 2, 3 and 4 if no digit can be used more than once?

$N = \dots = \boxed{}$

e) Two dimes and one five-sided die are tossed. How many results are possible?

$N = \dots = \boxed{}$

f) In how many ways can six books be arranged on a shelf?

$N = \dots = \boxed{}$

g) How many possible outfits can be created with 3 different dresses, 5 different vests and 2 different pairs of shoes?

$N = \dots = \boxed{}$

h) Using one of each kind of ingredient, how many hamburger combinations can be made with 3 different kinds of bread, 6 different fillings and 2 different sauces?

$N = \dots = \boxed{}$

i) In how many ways can a coach select two emergencies from a total of five players?

$N = \dots = \boxed{}$

j) In how many ways can any 4 of the vowels be arranged assuming they are not repeated?

$N = \dots = \boxed{}$