



Grade 7 (Pre-algebra) End-of-the-Year Test

This test is quite long, because it contains lots of questions on all of the major topics covered in the *Math Mammoth Grade 7 Complete Curriculum*. Its main purpose is to be a diagnostic test—to find out what the student knows and does not know about these topics.

You can use this test to evaluate a student's readiness for an Algebra 1 course. In that case, it is sufficient to administer the *first four sections* (Integers through Ratios, Proportions, and Percent), because the topics covered in those are prerequisites for algebra or directly related to algebra. The sections on geometry, statistics, and probability are not essential for a student to be able to continue to Algebra 1. The Pythagorean Theorem is covered in high school algebra and geometry courses, so that is why it is not essential to master, either.

Since the test is so long, I recommend that you break it into several parts and administer them on consecutive days, or perhaps on morning/evening/morning/evening. Use your judgement.

A calculator is *not* allowed for the first three sections of the test: Integers, Rational Numbers, and Algebra.

A *basic* calculator *is* allowed for the last five sections of the test: Ratios, Proportions, and Percent; Geometry, The Pythagorean Theorem, Probability, and Statistics.

The test is evaluating the student's ability in the following content areas:

- operations with integers
- multiplication and division of decimals and fractions, including with negative decimals and fractions
- converting fractions to decimals and vice versa
- simplifying expressions
- solving linear equations
- writing simple equations and inequalities for word problems
- graphs of linear equations
- slope of a line
- proportional relationships and unit rates
- basic percent problems, including percentage of change
- working with scale drawings
- drawing triangles
- the area and circumference of a circle
- basic angle relationships
- cross-sections formed when a plane cuts a solid
- solving problems involving area, surface area, and volume
- using the Pythagorean Theorem
- simple probability
- listing all possible outcomes for a compound event
- experimental probability, including designing a simulation
- biased vs. unbiased sampling methods
- making predictions based on samples
- comparing two populations and determining whether the difference in their medians is significant

If you are using this test to evaluate a student’s readiness for Algebra 1, I recommend that the student score a minimum of 80% on the first four sections (Integers through Ratios, Proportions, and Percent). The subtotal for those is 118 points. A score of 94 points is 80%.

I also recommend that the teacher or parent revise with the student any content areas in which the student may be weak. Students scoring between 70% and 80% in the first four sections may also continue to Algebra 1, depending on the types of errors (careless errors or not remembering something, versus a lack of understanding). Use your judgement.

You can use the last four sections to evaluate the student’s mastery of topics in Math Mammoth Grade 7 Curriculum. However, mastery of those sections is not essential for a student’s success in an Algebra 1 course.

My suggestion for points per item is as follows.

Question	Max. points	Student score
Integers		
1	2 points	
2	2 points	
3	3 points	
4	6 points	
5	2 points	
6	3 points	
<i>subtotal</i>		/ 18
Rational Numbers		
7	8 points	
8	3 points	
9	3 points	
10	2 points	
11	4 points	
<i>subtotal</i>		/ 20
Algebra		
12	6 points	
13	3 points	
14	12 points	
15	2 points	
16a	1 point	
16b	2 points	
17	3 points	
18	4 points	

Question	Max. points	Student score
19a	2 points	
19b	1 point	
20	8 points	
21	2 points	
22a	2 points	
22b	1 point	
<i>subtotal</i>		/ 49
Ratios, Proportions, and Percent		
23	4 points	
24a	1 point	
24b	2 points	
24c	1 point	
24d	1 point	
25a	1 point	
25b	2 points	
26	2 points	
27	2 points	
28a	2 points	
28b	2 points	
29	2 points	
30	2 points	
31	2 points	
32	Proportion: 1 point Solution: 2 points	
33	2 points	
<i>subtotal</i>		/ 31
SUBTOTAL FOR THE FIRST FOUR SECTIONS:		/118

Question	Max. points	Student score
Geometry		
34a	2 points	
34b	2 points	
35	3 points	
36	2 points	
37	2 points	
38	2 points	
39a	1 points	
39b	3 points	
40a	2 points	
40b	2 points	
41	2 points	
42	3 points	
43a	2 points	
43b	2 points	
44a	2 points	
44b	2 points	
45a	2 points	
45b	1 point	
46a	1 point	
46b	2 points	
<i>subtotal</i>		/ 40
The Pythagorean Theorem		
47	2 points	
48	2 points	
49	2 points	
50	3 points	
<i>subtotal</i>		/9

Question	Max. points	Student score
Probability		
51	3 points	
52a	2 points	
52b	1 point	
52c	1 point	
52d	1 point	
53	3 points	
54	3 points	
<i>subtotal</i>		/14
Statistics		
55	2 points	
56a	1 point	
56b	2 points	
56c	2 points	
57	2 points	
58a	1 point	
58b	1 point	
58c	1 point	
58d	3 points	
<i>subtotal</i>		/15
SUBTOTAL FOR THE LAST FOUR SECTIONS:		/78
TOTAL		/196

Math Mammoth End-of-the-Year Test - Grade 7

Integers

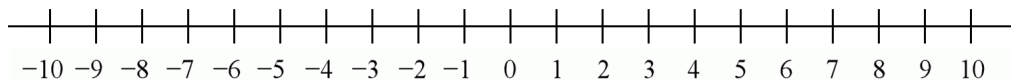
A calculator is not allowed for the problems in this section.

1. Give a real-life situation for the sum $-15 + 10$.

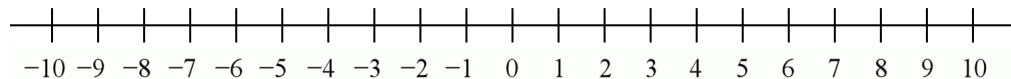
2. Give a real-life situation for the product $4 \cdot (-2)$.

3. Represent the following operations on the number line.

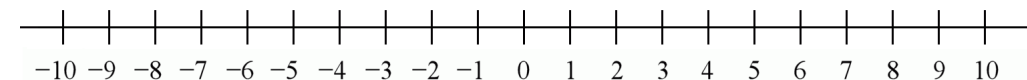
a. $-1 - 4$



b. $-2 + 7$



c. $-2 + (-7)$



4. Solve.

a. $-13 + (-45) + 60 = \underline{\hspace{2cm}}$

b. $-8 - (-7) = \underline{\hspace{2cm}}$

c. $2 - (-17) + 6 = \underline{\hspace{2cm}}$

d. $-3 \cdot (-8) = \underline{\hspace{2cm}}$

e. $48 \div (-4) = \underline{\hspace{2cm}}$

f. $(-2) \cdot 3 \cdot (-2) = \underline{\hspace{2cm}}$

5. The expression $|20 - 31|$ gives us the distance between the numbers 20 and 31.
Write a similar expression for the distance between -5 and -15 and simplify it.

6. Divide. Give your answer as a fraction or mixed number in lowest terms.

a. $1 \div (-8)$

b. $-4 \div 16$

c. $-21 \div (-5)$

Rational Numbers

A calculator is not allowed for the problems in this section.

7. Multiply and divide. For problems with fractions, give your answer as a mixed number in lowest terms.

a. $-\frac{2}{7} \cdot \left(-3\frac{5}{8}\right)$	b. $27.5 \div 0.6$
c. $-0.7 \cdot 1.1 \cdot (-0.001)$	d. $(-0.12)^2$
e. $\frac{\frac{3}{4}}{\frac{5}{12}}$	f. $\frac{5\frac{1}{2}}{-\frac{7}{8}}$
g. $-\frac{1}{6} \cdot 1.2$	h. $-\frac{2}{5} \div (-0.1)$

8. Write the decimals as fractions.

a. 0.1748	b. -0.00483	c. 2.043928
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9. Write the fractions as decimals.

a. $-\frac{28}{10\,000}$	b. $\frac{2493}{100}$	c. $7\frac{1338}{100\,000}$
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10. Convert to decimals. If you find a repeating pattern, give the repeating part. If you don't, round your answer to five decimals.

a. $\frac{7}{13}$	b. $1\frac{9}{11}$
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11. Give a real-life context for each multiplication or division. Then solve.

a. $1.2 \cdot 25$
b. $(3/5) \div 4$

Algebra

A calculator is not allowed for the problems in this section.

12. Simplify the expressions.

a. $7s + 2 + 8s - 12$	b. $x \cdot 5 \cdot x \cdot x \cdot x$	c. $3(a + b - 2)$
d. $0.02x + x$	e. $\frac{1}{3}(6w - 12)$	f. $-1.3a + 0.5 - 2.6a$

13. Factor the expressions (write them as multiplications).

a. $7x + 14$ =	b. $15 - 5y$ =	c. $21a + 24b - 9$ =
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14. Solve the equations.

a. $2x - 7 = -6$	b. $2 - 9 = -z + 4$
c. $120 = \frac{c}{-10}$	d. $2(x + \frac{1}{2}) = -15$
e. $\frac{2}{3}x = 266$	f. $x + 1\frac{1}{2} = \frac{3}{8}$

15. Chris can run at a constant speed of 12 km/h. How long will it take him to run from his home to the park, a distance of 0.8 km?

Remember to check that your answer is reasonable.

16. a. Which equation matches the situation?

A pair of binoculars is discounted by $\frac{1}{5}$ of their original price (p), and now they cost \$48.

$$\frac{p}{5} = 48$$

$$\frac{4p}{5} = 48$$

$$\frac{5p}{4} = 48$$

$$p - \frac{1}{5} = 48$$

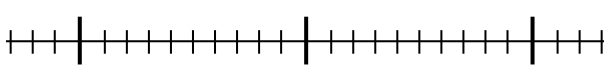
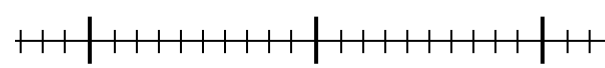
$$p - \frac{4}{5} = 48$$

$$5p - 4 = 48$$

- b. Solve the equation to find the original price of the binoculars.

17. The perimeter of a rectangle is 254 cm. Its length is 55 cm. Represent the width of the rectangle with a variable and write an equation to solve for the width. Then solve your equation.

18. Solve the inequalities and plot their solution sets on a number line. Write appropriate multiples of ten under the bolded tick marks (for example, 30, 40, and 50).

<p>a. $3x - 7 < 83$</p>  <p>A number line with 100 tick marks. The line is divided into four equal segments by three bolded tick marks. Each segment contains 25 tick marks. The bolded tick marks are located at the 25th, 50th, and 75th positions from the left.</p>	<p>b. $2x - 16.3 \geq 10.5$</p>  <p>A number line with 100 tick marks. The line is divided into four equal segments by three bolded tick marks. Each segment contains 25 tick marks. The bolded tick marks are located at the 25th, 50th, and 75th positions from the left.</p>
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19. You need to buy canning jars. They cost \$15 a box, and you only have \$150 to spend. You also have a coupon for a \$25 discount on your total. How many boxes can you buy at most?

a. Write an inequality for the problem and solve it.

b. Describe the solution of the inequality in words.

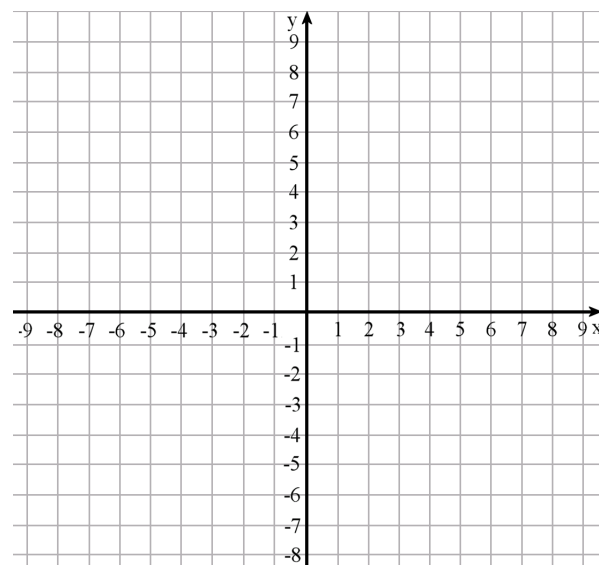
20. *Solve.

<p>a. $9y - 2 + y = 5y + 10$</p>	<p>b. $2(x + 7) = 3(x - 6)$</p>
<p>c. $\frac{y + 6}{-2} = -10$</p>	<p>d. $\frac{w}{2} - 3 = 0.8$</p>

21. *Draw a line that has a slope of $\frac{1}{2}$ and that goes through the point $(0, 4)$.

22. **a.** *Draw the line $y = -2x + 1$.

b. *What is its slope?



Ratios, Proportions, and Percent

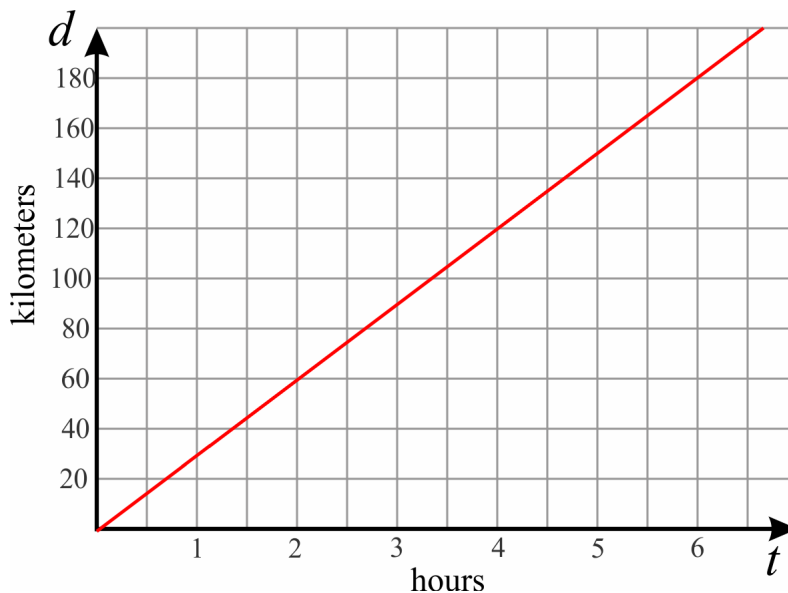
You may use a basic calculator for all the problems in this section.

23. (1) Write a unit rate as a complex fraction. (2) Then simplify it. Be sure to include the units.

a. Lily paid \$6 for $\frac{3}{8}$ of a taxi fare she shared with a friend.
How much was the total taxi fare?

b. John picked $2\frac{1}{2}$ pails of strawberries in $\frac{3}{4}$ of an hour.
How many pails of berries can he pick per hour?

24. The graph below shows the distance covered by a Moped advancing at a constant speed.



- What is the speed of the Moped?
- Plot on the line the point that corresponds to the time $t = 4$ hours.
What does that point signify in this context?
- Write an equation relating the quantities d and t .
- Plot the point that corresponds to the unit rate in this situation.

25. Sedan A is able to drive 900 km on 45 litres of petrol (highway driving).
Sedan B can drive 995 km on 65 litres of petrol (highway driving).
- Which sedan gets better fuel economy?
 - Calculate the difference in costs if you drive a distance of 500 kilometres with each sedan, if petrol costs \$1.40 per litre.
26. Sally deposits \$2 500 at 8% interest for 3 years.
How much can she withdraw at the end of that period?
27. A ticket to a fair initially costs \$10. The price is increased by 15%. Then, the price is decreased by 25% (from the already increased price). What is the final price of the ticket?
28. In December, Sarah's website had 72 000 visitors. In December of the previous year it had 51 500 visitors.
- Find the percentage of increase to the nearest tenth of a percent in the number of visitors her website had for that year.
 - If the number of visitors continues to grow at the same rate, about how many visitors (to the nearest thousand) will her site have in December of the following year?
29. Alex measured the rainfall on his property to be 10.5 cm in June, which he calculated to be a 35% increase compared to the previous month. How much had it rained in May?

30. A square with sides of 15 cm is enlarged in a ratio of 3 : 4. What is the area of the resulting square?

31. How long is a distance of 8 km if measured on a map with a scale of 1 : 50 000?

32. Write a proportion for the following problem and solve it.

600 ml of oil weighs 554 g.

How much would 5 litres of oil weigh?

$$\text{—————} = \text{—————}$$

33. A farmer sells potatoes in sacks of various weights. The table shows the price per weight.

Weight	5 kg	10 kg	15 kg	20 kg	30 kg	50 kg
Price	\$4	\$7.50	\$9	\$12	\$15	\$25

a. Are these two quantities in proportion?

Explain how you can tell that.

b. If so, write an equation relating the two and state the constant of proportionality.

Geometry

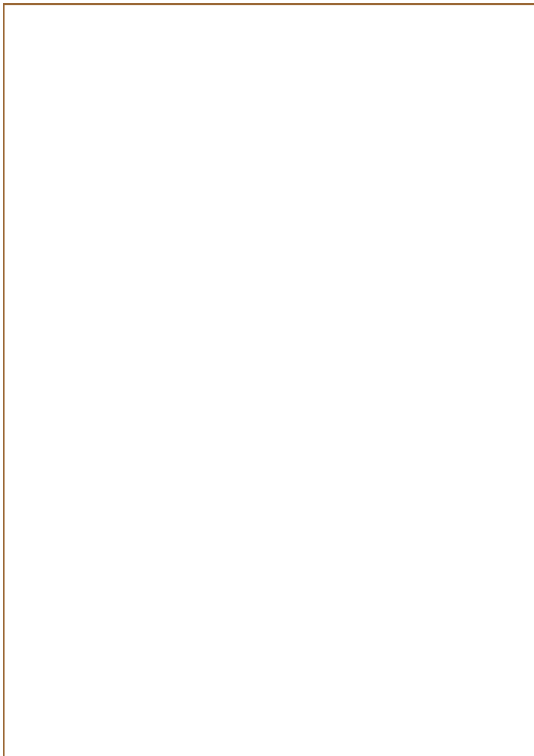
You may use a basic calculator for all the problems in this section.

34. The rectangle you see below is Jayden's room, drawn here at a scale of 1 : 45.

a. Calculate the area of Jayden's room in reality, in square metres.

Hint: measure the dimensions of the rectangle in centimetres.

b. Reproduce the drawing at a scale of 1 : 60.



Scale 1 : 45

35. A room measures 4 cm by 3 cm in a house plan with a scale of 1 cm : 1 m.
Calculate the actual dimensions of the room.

36. Calculate the area of a circle with a diameter of 16 cm.

37. Calculate the circumference of a circle with a radius of 9 centimetres

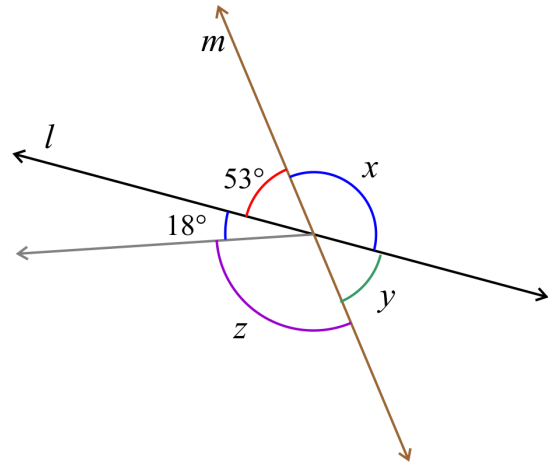
38. Draw a triangle with sides 8 cm, 11 cm, and 14.5 cm using a compass and a ruler.

39. A triangle has angles that measure 36° , 90° , and 54° , and a side of 8 cm.

a. Does the information given determine a unique triangle?

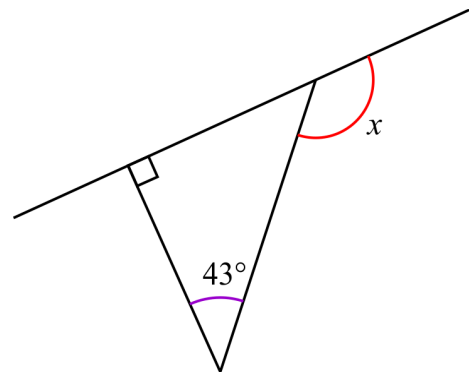
b. If so, draw the triangle. If not, draw several different triangles that fit the description.

40. a. Write an equation for the measure of angle x , and solve it.

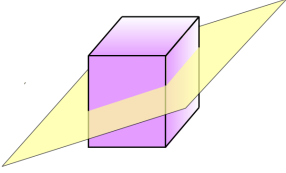
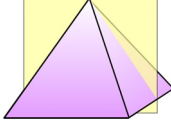
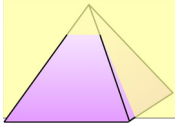


b. Write an equation for the measure of angle z , and solve it.

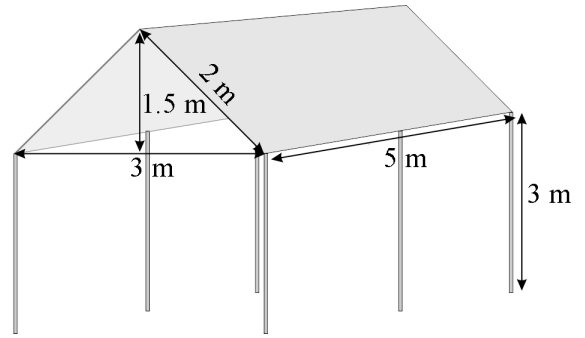
41. Calculate the measure of the unknown angle x .



42. Describe the cross sections formed by the intersection of the plane and the solid.

<p>a. </p> <p>The cross section is _____.</p>	<p>b. </p> <p>The cross section is _____.</p>	<p>c. </p> <p>The cross section is _____.</p>
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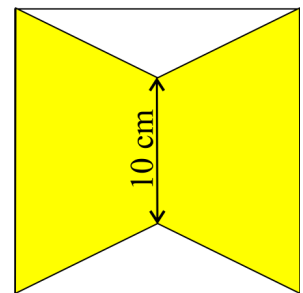
43. **a.** Calculate the volume enclosed by the roof (the top part).



- b.** Calculate the total volume enclosed by the canopy.

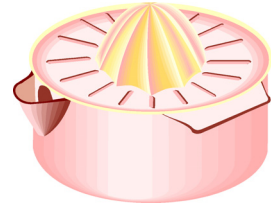
44. Two identical trapeziums are placed inside a 15 cm by 15 cm square.

- a.** Calculate their area.



- b.** What percentage of the square do the trapeziums cover?

45. **a.** *Find the volume of the cylindrical part of the juicer, if its bottom diameter is 12 cm and its height is 4.5 cm.



- b.** *Convert the volume to millilitres and to litres, considering that $1 \text{ ml} = 1 \text{ cm}^3$.

46. **a.** *How many cubic centimetres are in one cubic metre?

- b.** *The edges of a cube measure 3.25 m. Calculate the volume of the cube in cubic metres.

The Pythagorean Theorem

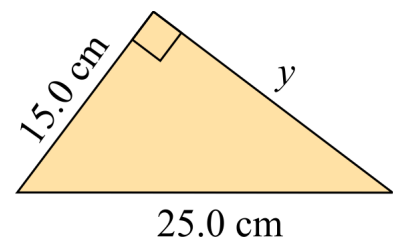
You may use a basic calculator for all the problems in this section.

47. *a. What is the area of a square, if its side measures $\sqrt{5}$ m?

*b. How long is the side of a square with an area of 45 cm^2 ?

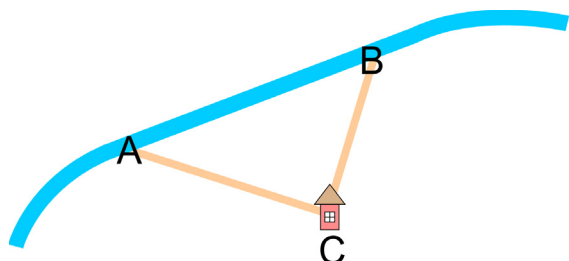
48. *Determine whether the lengths 57 cm, 95 cm, and 76 cm form a right triangle. Show your work.

49. *Solve for the unknown side of the triangle to the nearest tenth of a centimetre.



50. *You and your friends are at a river at point A. You suddenly remember you need something from home, which is at point C. So you decide to go home (distance AC) and then walk along the road (distance CB) to meet your friends, who will walk along the riverside from A to B.

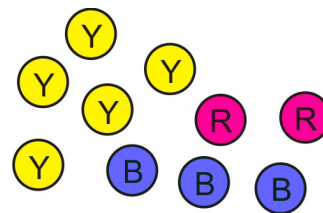
If ABC is a right triangle, $AC = 120$ m, and $CB = 110$ m, how much longer distance (in meters) will you walk than your friends?



Probability

You may use a basic calculator for all the problems in this section.

51. You randomly pick one marble from these marbles.
Find the probabilities:



- a. $P(\text{not red})$
- b. $P(\text{blue or red})$
- c. $P(\text{green})$

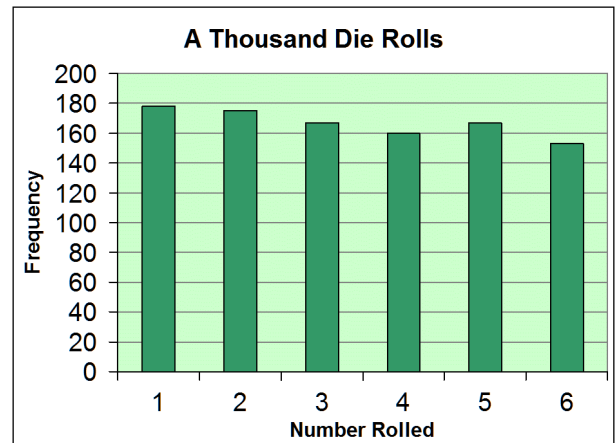
52. A cafeteria offers a main dish with chicken or beef. The customer then chooses a portion of rice, pasta, or potatoes, and a side dish of green salad, green beans, steamed cabbage, or coleslaw.
- a. Draw a tree diagram or make a list of all the possible meal combinations.

A customer chooses the parts of the meal randomly. Find the probabilities:

- b. $P(\text{beef, rice, coleslaw})$
- c. $P(\text{no coleslaw nor steamed cabbage})$
- d. $P(\text{chicken, green salad})$

53. John and Jim rolled a dice 1 000 times. The bar graph shows their results. Based on the results, which of the following conclusions, if any, are valid?

- (a) This dice is unfair.
- (b) On this dice, you will always get more 1s than 6s.
- (c) Next time you roll, you will not get a 4.



54. Let's assume that when a child is born, the probability that it is a boy is $\frac{1}{2}$ and also $\frac{1}{2}$ for a girl. One year, there were 10 births in a small community, and nine of them were girls. Explain how you could use coin tosses to simulate the situation, and to find the (approximate) probability that out of 10 births, exactly nine are girls. (You do not have to actually perform the simulation—just explain how it would be done.)

Statistics

You may use a basic calculator for all the problems in this section.

55. To determine how many students in her college use a particular Internet search engine, Cindy chose some students randomly from her class, and asked them whether they used that search engine.

Is Cindy's sampling method biased or unbiased?

Explain why.

56. Four people are running for mayor in a town of about 20 000 people. Three polls were conducted, each time asking 150 people who they would vote for. The table shows the results.

	Clark	Taylor	Thomas	Wright	Totals
Poll 1	58	19	61	12	150
Poll 2	68	17	56	9	150
Poll 3	65	22	53	10	150

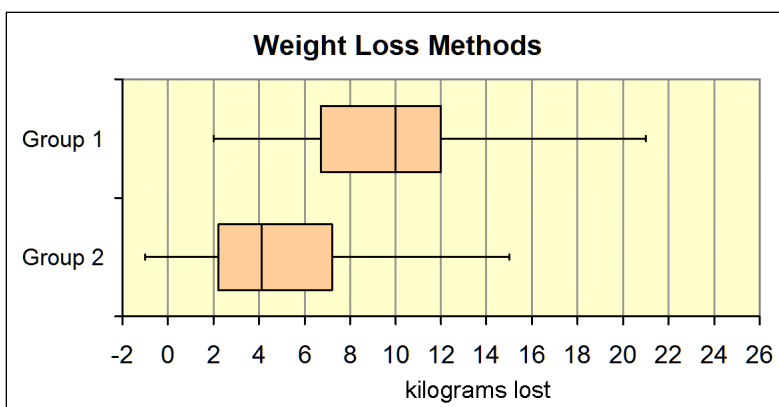
- a. Based on the polls, predict the winner of the election.
- b. Assuming there will be 8 500 voters in the actual election, estimate to the nearest hundred votes how many votes Thomas will get.
- c. Gauge how much off your estimate might be.

57. Gabriel randomly surveyed some households in a small community to determine how many of them support building a new highway near the community. Here are the results:

Opinion	Number
Support the highway	45
Do not support it	57
No opinion	18

If the community contains a total of 2 120 households, predict how many of them would support building the highway.

58. Researchers compared two different methods for losing weight by assigning 50 overweight people to use each method. The side-by-side boxplots show how many kilograms people in each Group lost.



- Just looking at the two distributions, which group, if any, appears to have lost more weight?
- Which group, if any, appears to have a greater variability in the amount of weight lost?
- In Group 2, there is one person whose weight loss was -1 kilogram. What does that mean?
- Is one of the weight loss methods significantly better than the other?
If so, which one?
Justify your reasoning.