COMPASS® Math

Workbook

Math Exercises, Tutorials and Multiple Choice Strategies

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Getting Started

CONGRATULATIONS! By deciding to take the COMPASS® you have taken the first step toward a great future! Of course, there is no point in taking this important examination unless you intend to do your best to earn the highest grade that you possibly can. That means getting yourself organized and discovering the best approaches, methods and strategies to master the material. Yes, that will require real effort and dedication on your part, but if you are willing to focus your energy and devote the study time necessary, before you know it you will be passing the COMPASS® with a great score!

We know that taking on a new endeavor can be scary, and it is easy to feel unsure of where to begin. That's where we come in. This workbook is designed to help you improve your test-taking skills, show you a few tricks of the trade and increase both your competency and confidence.

The COMPASS® Exam Math Content

Numerical Skills

Scientific Notation
Exponents and Radicals
Square Root
Fractions, Decimals and Percent
Means, Median and Modes

Algebra

Solve real world problems with ratio and proportion
Solve one and two variable equations
Identify and solve quadratic equations given values or graphs
Solve quadratic using different methods
Translate real world problems into quadratic equations and solve

Advanced Algebra

Trigonometry
Logarithms
Sequences

Simple Geometry

Slope of a line
Identify linear equations from a graph
Calculate perimeter, circumference and volume
Solve problems using the Pythagorean theorem
Determine geometric transformations
Solve real world problems using the properties of geometric shapes

The COMPASS® Study Plan

Now that you have made the decision to take the COMPASS®, it is time to get started. Before you do another thing, you will need to figure out a plan of attack. The best study tip is to start early! The longer the time period you devote to regular study practice, the more likely you will be to retain the material and be able to access it quickly. If you thought that 1x20 is the same as 2x10, guess what? It

really is not, when it comes to study time. Reviewing material for just an hour per day over the course of 20 days is far better than studying for two hours a day for only 10 days. The more often you revisit a particular piece of information, the better you will know it. Not only will your grasp and understanding be better, but your ability to reach into your brain and quickly and efficiently pull out the tidbit you need, will be greatly enhanced as well.

The great Chinese scholar and philosopher Confucius believed that true knowledge could be defined as knowing both what you know and what you do not know. The first step in preparing for the COMPASS® is to assess your strengths and weaknesses. You may already have an idea of what you know and what you do not know, but evaluating yourself for each of the math areas will clarify the details.

Making a Study Schedule

To make your study time the most productive, you will need to develop a study plan. The purpose of the plan is to organize all the bits of pieces of information in such a way that you will not feel overwhelmed. Rome was not built in a day, and learning everything you will need to know to pass the COMPASS® is going to take time, too. Arranging the material you need to learn into manageable chunks is the best way to go. Each study session should make you feel as though you have accomplished your goal, and your goal is simply to learn what you planned to learn during that particular session. Try to organize the content in such a way that each study session builds on previous ones. That way, you will retain the information, be better able to access it, and review the previous bits and pieces at the same time.

Basic Math

THE BASIC MATH SECTION COVERS:

- Fractions, Decimals and Percent
- Scientific Notation
- Exponents and Radicals

Fraction Tips, Tricks and Shortcuts

When you are writing an exam, time is precious, and anything you can do to answer faster is a real advantage. Here are some ideas, shortcuts, tips and tricks that can speed up answering fractions problems.

Remember that a fraction is just a number which names a portion of something. For instance, instead of having a whole pie, a fraction says you have a part of a pie--such as a half of one or a fourth of one.

Two digits make up a fraction. The digit on top is known as the numerator. The digit on the bottom is known as the denominator. To remember which is which, just remember that “denominator” and “down” both start with a “d.” And the “downstairs” number is the denominator. So for instance, in ½, the numerator is the 1 and the denominator (or “downstairs”) number is the 2.

- It’s easy to add two fractions if they

have the same denominator. Just add the digits on top, and leave the bottom one the same: 1/10 + 6/10 = 7/10.

- It's the same with subtracting fractions with the same denominator: 7/10 - 6/10 = 1/10.

- Adding and subtracting fractions with different denominators is more complicated. First, you have to get the problem so that they do have the same denominators. The easiest way to do this is to multiply the denominators: For 2/5 + 1/2 multiply 5 by 2. Now you have a denominator of 10. But now, you have to change the top numbers too. Since you multiplied the 5 in 2/5 by 2, you also multiply the 2 by 2, to get 4. So the first number is now 4/10. Since you multiplied the second number times 5, you also multiply its top number by 5, to get a final fraction of 5/10. Now you can add 5 and 4 together to get a final sum of 9/10.

- Sometimes you'll be asked to reduce a fraction to its simplest form. This means getting it to where the only common factor of the numerator and denominator is 1. Think of it this way: Numerators and denominators are brothers that must be treated the same. If you do something to one, you must do it to the other, or it's just not fair. For instance, if you divide your numerator by 2, then you should also divide the denominator by the same. Let's take an example: The fraction 2/10 . This is not reduced to its simplest terms because there is a number that will divide evenly into both: the number 2. We want to make it so that the only number that will divide evenly into both is 1. What can we divide into 2 to get 1? The number 2, of course! Now to be "fair," we have to do the same thing to the denominator: Divide 2 into 10 and you get 5. So our new, re-

duced fraction is 1/5.

- In some ways, multiplying fractions is the easiest of all: Just multiply the two top numbers and then multiply the two bottom numbers. For instance, with this problem:
  2/5 X 2/3 you multiply 2 by 2 and get a top number of 4; then multiply 5 by 3 and get a bottom number of 15. Your answer is 4/15.

- Dividing fractions is more involved, but still not too hard. You once again multiply, but only AFTER you have turned the second fraction upside-down. To divide ⅞ by ½, turn the ½ into 2/1, then multiply the top numbers and multiply the bottom numbers: ⅞ X 2/1 gives us 14 on top and 8 on the bottom.

Converting Fractions to Decimals

There are a couple of ways to become good at converting fractions to decimals. The fastest way is to memorize some basic fraction facts. Here are fractions that you should know:

1/100 is “one hundredth,” expressed as a decimal, it’s .01.

1/50 is “two hundredths,” expressed as a decimal, it’s .02.

1/25 is “one twenty-fifths” or “four hundredths,” expressed as a decimal, it’s .04.

1/20 is “one twentieth” or “”five hundredths,” expressed as a decimal, it’s .05.

1/10 is “one tenth,” expressed as a decimal, it’s .1.

1/8 is “one eighth,” or “one hundred twenty-five thousandths,” expressed as a decimal, it’s .125.

1/5 is “one fifth,” or “two tenths,” expressed as a decimal, it’s .2.

1/4 is “one fourth” or “twenty-five hundredths,” expressed as a decimal, it’s .25.

1/3 is “one third” or “thirty-three hundredths,” expressed as a decimal, it’s .33.

1/2 is “one half” or “five tenths,” expressed as a decimal, it’s .5.

3/4 is “three fourths,” or “seventy-five hundredths,” expressed as a decimal, it’s .75.

Of course, if you’re no good at memorization, another good technique for converting a fraction to a decimal is to manipulate it so that the fraction’s denominator is 10, 100, 1000, or some other power of 10. Here’s an example: We’ll start with 3/4. What is the first number in the 4 “times table” that you can multiply and get a multiple of 10? Can you multiply 4 by something to get 10? No. Can you multiply it by something to get 100? Yes! 4 X 25 is 100. So let’s take that 25 and multiply it by the numerator in our fraction ¾. The numerator is 3, and 3 X 25 is 75. We’ll move the decimal in 75 all the way to the left, and we find that ¾ is .75.

We’ll do another one: 1/5. Again, we want to find a power of 10 that 5 goes into evenly. Will 5 go into 10? Yes! It goes 2 times. So we’ll take that 2 and multiply it by our numerator, 1, and we get 2. We move the decimal in 2 all the way to the left and find that 1/5 is equal to .2.

Answer Sheet

	A	B	C	D	E		A	B	C	D	E
1	○	○	○	○	○	26	○	○	○	○	○
2	○	○	○	○	○	27	○	○	○	○	○
3	○	○	○	○	○	28	○	○	○	○	○
4	○	○	○	○	○	29	○	○	○	○	○
5	○	○	○	○	○	30	○	○	○	○	○
6	○	○	○	○	○	31	○	○	○	○	○
7	○	○	○	○	○	32	○	○	○	○	○
8	○	○	○	○	○	33	○	○	○	○	○
9	○	○	○	○	○	34	○	○	○	○	○
10	○	○	○	○	○	35	○	○	○	○	○
11	○	○	○	○	○	36	○	○	○	○	○
12	○	○	○	○	○	37	○	○	○	○	○
13	○	○	○	○	○	38	○	○	○	○	○
14	○	○	○	○	○	39	○	○	○	○	○
15	○	○	○	○	○	40	○	○	○	○	○
16	○	○	○	○	○	41	○	○	○	○	○
17	○	○	○	○	○	42	○	○	○	○	○
18	○	○	○	○	○	43	○	○	○	○	○
19	○	○	○	○	○	44	○	○	○	○	○
20	○	○	○	○	○	45	○	○	○	○	○
21	○	○	○	○	○	46	○	○	○	○	○
22	○	○	○	○	○	47	○	○	○	○	○
23	○	○	○	○	○	48	○	○	○	○	○
24	○	○	○	○	○	49	○	○	○	○	○
25	○	○	○	○	○	50	○	○	○	○	○

Basic Math Practice

1. 2/3 + 5/12 =

a. 9/17`
b. 3/11
c. 7/12
d. 1 1/12

2. 3/5 + 7/10 =

a. 1 1/10
b. 7/10
c. 1 3/10
d. 1 1/12

3. 4/5 – 2/3 =

a. 2/2
b. 2/13
c. 1
d. 2/15

4. 13/16 – 1/4 =

a. 1
b. 12/12
c. 9/16
d. 7/16

Answer Key

1. D
A common denominator is needed,which both 3 and 12 will divide into. So, 8 + 5/12 = 13/12 = 1 1/12

2. C
A common denominator is needed for 5 and 10.
6 + 7/10 = 13/10 = 1 3/10

3. D
A common denominator is needed for 5 and 3.
12 - 10/15 = 2/15

4. C
A common denominator is needed for 16 and 4.
13 - 4/16 = 9/16

Word Problems

WORD PROBLEMS ARE INCLUDED IN THE NUMERICAL SKILLS SECTION OF THE MATHEMATICS TEST.

How to Solve Word Problems

Most students find math word problems difficult. Tackling word problems is much easier if you have a systematic approach which we outline below.

Here is the biggest tip for studying word problems.

Practice regularly and systematically. Sounds simple and easy right? Yes it is, and yes it really does work.

Word problems are a way of thinking and require you to translate a real world problem into mathematical terms.

Some math instructors go so far as to say that learning how to think mathematically is the main reason for teaching word problems.

So what do we mean by Practice regularly and systematically? Studying word problems and math in general requires a logical and mathematical frame of mind. The only way that you can get this is by practicing regularly, which means everyday.

It is critical that you practice word problems

everyday for the 5 days before the exam as a bare minimum.

If you practice and miss a day, you have lost the mathematical frame of mind and the benefit of your previous practice is pretty much gone. Anyone who has done any number of math tests will agree – you have to practice everyday.

Everything is important. The other critical point about word problems is that all the information given in the problem has some purpose. There is no unnecessary information! Word problems are typically around 50 words in 1 to 3 sentences. If the sometimes complicated relationships are to be explained in that short an explanation, every word has to count. Make sure that you use every piece of information.

Here are 9 simple steps to solve word problems.

Step 1 – Read through the problem at least three times. The first reading should be a quick scan, and the next two readings should be done slowly to answer these important questions:

What does the problem ask? (Usually located towards the end of the problem)

What does the problem imply? (This is usually a point you were asked to remember).

Mark all information, and underline all important words or phrases.

Step 2 – Try to make a pictorial representation of the problem such as a circle and an arrow to show travel.

This makes the problem a bit more real and sensible to you.

A favorite word problem is something like, 1 train leaves Station A traveling at 100 km/hr and another train leaves Station B traveling at 60 km/hr. …

Draw a line, the two stations, and the two trains at either end. This will solidify the situation in your mind.

Step 3 – Use the information you have to make a table with a blank portion to show information you do not know.

Step 4 – Assign a single letter to represent each unknown datum in your table. You can write down the unknown that each letter represents so that you do not make the error of assigning answers for the wrong unknown, because a word problem may have multiple unknowns and you will need to create equations for each unknown.

Step 5 – Translate the English terms in the word problem into a mathematical algebraic equation. Remember that the main problem with word problems is that they are not expressed in regular math equations. Your ability to correctly identify the variables and translate the word problem into an equation determines your ability to solve the problem.

Step 6 – Check the equation to see if it looks like regular equations that you are used to seeing and whether it looks sensible. Does the equation appear to represent the information in the question? Take note that you may need to rewrite some formulas needed to solve the word problem equation. For example, word distance problems may need you rewriting the distance formula, which is Distance = Time x Rate. If the word problem requires that you solve for time you will need to use Distance/Rate and Distance/Time to solve for Rate. If you understand the distance word problem you should be able to identify the variable you need to solve for.

Step 7 – Use algebra rules to solve the derived equation.

Take note that the laws of equation demands that what is done on this side of the equation has to also be done on the other side. You have to solve the equation so that the unknown ends alone on one side. Where there are multiple unknowns you will need to use elimination or substitution methods to resolve all the equations.

Step 8 – Check your final answers to see if they make sense with the information given in the problem. For example if the word problem involves a discount, the final price should be less or if a product was taxed then the final answer has to cost more.

Step 9 – Cross check your answers by placing the answer or answers in the first equation to replace the unknown or unknowns. If your answer is correct then both side of the equation must equate or equal. If your answer is not correct then you may have derived a wrong equation or solved the equation wrongly. Repeat the necessary steps to correct.

Types of Word Problems

Word problems can be classified into 12 types. Below are examples of each type with a complete solution. Some types of word problems can be solved quickly using multiple choice strategies and some cannot. Always look for ways to estimate the answer and then eliminate choices.

1. Age

A girl is 10 years older than her brother. By next year, she will be twice the age of her brother. What are their ages now?

a. 25, 15
b. 19, 9
c. 21, 11
d. 29, 19

Solution: B

We will assume that the girl's age is "a" and her brother's age is "b." This means that based on the information in the first sentence,
a = 10 + b

Next year, she will be twice her brother's age, which gives, a + 1 = 2(b + 1)

We need to solve for one unknown factor and then use the answer to solve for the other. To do this we substitute the value of "a" from the first equation into the second equation. This gives

10+b + 1 = 2b + 2
11 + b = 2b + 2
11 – 2 = 2b – b
b= 9

9 = b this means that her brother is 9 years old. Solving for the girl's age in the first equation gives a = 10 + 9. a = 19 the girl is aged 19. So, the girl is aged 19 and the boy is 9

Answer Sheet

	A	B	C	D	E		A	B	C	D	E
1	○	○	○	○	○	21	○	○	○	○	○
2	○	○	○	○	○	22	○	○	○	○	○
3	○	○	○	○	○	23	○	○	○	○	○
4	○	○	○	○	○	24	○	○	○	○	○
5	○	○	○	○	○	25	○	○	○	○	○
6	○	○	○	○	○						
7	○	○	○	○	○						
8	○	○	○	○	○						
9	○	○	○	○	○						
10	○	○	○	○	○						
11	○	○	○	○	○						
12	○	○	○	○	○						
13	○	○	○	○	○						
14	○	○	○	○	○						
15	○	○	○	○	○						
16	○	○	○	○	○						
17	○	○	○	○	○						
18	○	○	○	○	○						
19	○	○	○	○	○						
20	○	○	○	○	○						

Word Problem Practice

1. Translate the following into an equation: Five greater than 3 times a number.

a. 3X + 5
b. 5X + 3
c. (5 + 3)X
d. 5(3 + X)

2. Translate the following into an equation: three plus a number times 7 equals 42.

a. 7(3 + X) = 42
b. 3(X + 7) = 42
c. 3X + 7 = 42
d. (3 + 7)X = 42

3. Translate the following into an equation: 2 + a number divided by 7.

a. (2 + X)/7
b. (7 + X)/2
c. (2 + 7)/X
d. 2/(7 + X)

4. Translate the following into an equation: six times a number plus five.

a. 6X + 5
b. 6(X+5)
c. 5X + 6
d. (6 * 5) + 5

5. A box contains 7 black pencils and 28 blue ones. What is the ratio between the black and blue pens?

a. 1:4
b. 2:7
c. 1:8
d. 1:9

6. The manager of a weaving factory estimates that if 10 machines run at 100% efficiency for 8 hours, they will produce 1450 meters of cloth. Due to some technical problems, 4 machines run of 95% efficiency and the remaining 6 at 90% efficiency. How many meters of cloth can these machines will produce in 8 hours?

a. 1334 meters
b. 1310 meters
c. 1300 meters
d. 1285 meters

7. In a local election at polling station A, 945 voters cast their vote out of 1270 registered voters. At polling station B, 860 cast their vote out of 1050 registered voters and at station C, 1210 cast their vote out of 1440 registered voters. What is the total turnout from all three polling stations?

a. 70%
b. 74%
c. 76%
d. 80%

Answer Key

Part 1 - Equation Translation

1. A
Five greater than 3 times a number.
5 + 3 times a number.
3X + 5

2. A
Three plus a number times 7 equals 42.
Let X be the number.
(3 + X) times 7 = 42
7(3 + X) = 42

3. A
2 + a number divided by 7.
(2 + X) divided by 7.
(2 + X)/7

4. B
Six times a number plus five is the same as saying six times (a number plus five). Or,
6 * (a number plus five). Let X be the number so,
6(X + 5).

5. A
The ratio between black and blue pens is 7 to 28 or 7:28. Bring to the lowest terms by dividing both sides by 7 gives 1:4.

6. A
At 100% efficiency 1 machine produces 1450/10 = 145 m of cloth.

At 95% efficiency, 4 machines produce 4 * 145 * 95/100 =

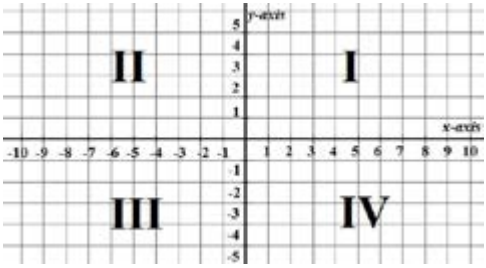
Basic Geometry

THE BASIC GEOMETRY SECTION INCLUDES:

- slope of a line
- Identify linear equations from a graph
- Calculate perimeter, circumference and volume
- Solve problems using the Pythagorean theorem
- Determine geometric transformations
- Solve real world problems using the properties of geometric shapes

Cartesian Plane, Coordinate Grid and Plane

To locate points and draw lines and curves, we use the coordinate plane. It also called Cartesian coordinate plane. It is a two-dimensional surface with a coordinate grid in it, which helps us to count the units. For the counting of those units, we use x-axis (horizontal scale) and y-axis (vertical scale).



The whole system is called a coordinate system which is divided into 4 parts, called quadrants. The quadrant where all numbers are positive is the 1st quadrant (I), and if we go counterclockwise, we mark all 4 quadrants.

The location of a dot in the coordinate system is represented by coordinates. Coordinates are represented as a pair of numbers, where the 1st number is located on the x-axis and the 2nd number is located on the y-axis. So, if a dot A has coordinates a and b, then we write:

A=(a,b) or A(a,b)

The point where x-axis and y-axis intersect is called an origin. The origin is the point from which we measure the distance along the x and y axes.

In the Cartesian coordinate system we can calculate the distance between 2 given points. If we have dots with coordinates:
A=(a,b)
B=(c,d)

Then the distance d between A and B can be calculated by the following formula:

$$d = \sqrt{(c-a)^2 + (d-b)^2}$$

Cartesian coordinate system is used for the drawing of 2-dimentional shapes, and is also commonly used for functions.

Example:

Draw the function y = (1 - x)/2

To draw a linear function, we need at least 2 points.
If we put that x=0 then value for y would be:

$$y=\frac{1-x}{2}=\frac{1-0}{2}=\frac{1}{2}$$

We found the 1st point, let's name it A, with following coordinates:

A = (0,1/2)

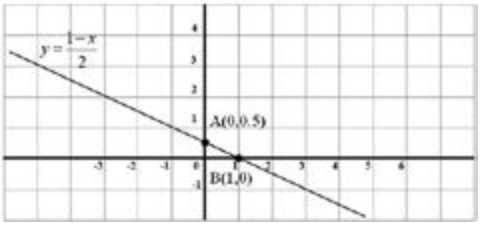
To find the 2nd point, we can put that x=1. In this case, the value for y would be:

$$y=\frac{1-x}{2}=\frac{1-1}{2}=\frac{0}{2}=0$$

If we denote the 2nd point with B, then the coordinates for this point are:

B=(1,0)

Since we have 2 points necessary for the function, we find them in the coordinate system and we connect them with a line that represents the function,



Perimeter Area and Volume

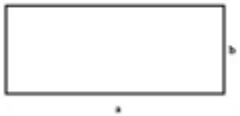
Perimeter and Area (2-dimentional shapes)

Perimeter of a shape determines the length around that shape, while the area includes the space inside the shape.

Rectangle:

$P = 2a + 2b$

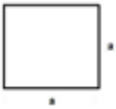
$A = ab$



Square

$P = 4a$

$A = a^2$



Parallelogram

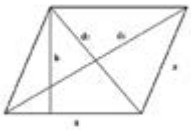
$P = 2a + 2b$

$A = ah_a = bh_b$

Rhombus

$P = 4a$

$A = ah = \frac{d_1 d_2}{2}$



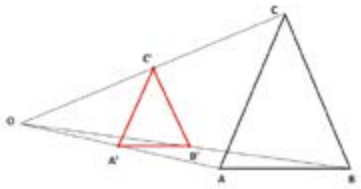
Geometric Transformations

If we want to move a geometric shape, or change its direction or size, we would use one of the following geometric transformations:

1) Dilation
2) Translation
3) Rotation
4) Reflection

Dilation

Dilation is transformation where 2D shape is either enlarged or contracted, where the direction of the shape is kept. If we have a triangle ABC that we want to reduce to a new triangle half of its size, we would make an arbitrary point of dilation O and connect it with points A, B and C. We find the centers of lines OA, OB and OC and mark them as A', B' and C', respectively. We cut the lines in half because we want the new triangle to be half the size of the original one. These new points make the triangle A'B'C' which is the one we are looking for.



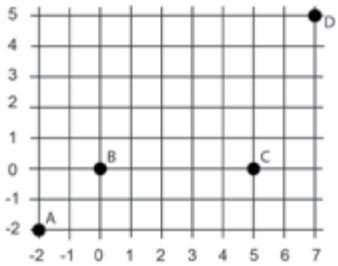
Translation

Translation is a transformation we use for moving the 2D shapes, without changing their size or direction. It can be moved using a grid or a coordinate system. If we have a square ABCD in a grid we want to move 6 units to the left and 5 units down, we move each point of the square and

Answer Sheet

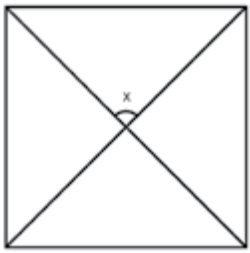
1.	A	B	C	D	21.	A	B	C	D
2.	A	B	C	D	22.	A	B	C	D
3.	A	B	C	D	23.	A	B	C	D
4.	A	B	C	D	24.	A	B	C	D
5.	A	B	C	D	25.	A	B	C	D
6.	A	B	C	D	26.	A	B	C	D
7.	A	B	C	D	27.	A	B	C	D
8.	A	B	C	D	28.	A	B	C	D
9.	A	B	C	D	29.	A	B	C	D
10.	A	B	C	D	30.	A	B	C	D
11.	A	B	C	D	31.	A	B	C	D
12.	A	B	C	D	32.	A	B	C	D
13.	A	B	C	D	33.	A	B	C	D
14.	A	B	C	D	34.	A	B	C	D
15.	A	B	C	D	35.	A	B	C	D
16.	A	B	C	D	36.	A	B	C	D
17.	A	B	C	D	37.	A	B	C	D
18.	A	B	C	D	38.	A	B	C	D
19.	A	B	C	D	39.	A	B	C	D
20.	A	B	C	D	40.	A	B	C	D

Geometry Practice Questions



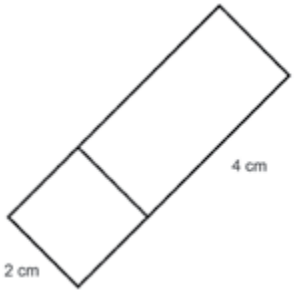
1. Which of the above points represents the origin?

a. A
b. B
c. C
d. D



2. What is measurement of the indicated angle?

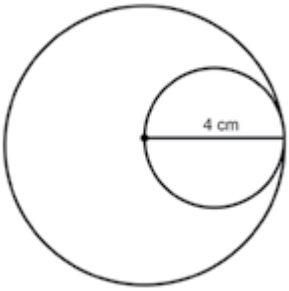
a. 45°
b. 90°
c. 60°
d. 30°



Note: figure not drawn to scale.

3. Assuming the figure with side 2 cm. is square, what is the perimeter of the above shape?

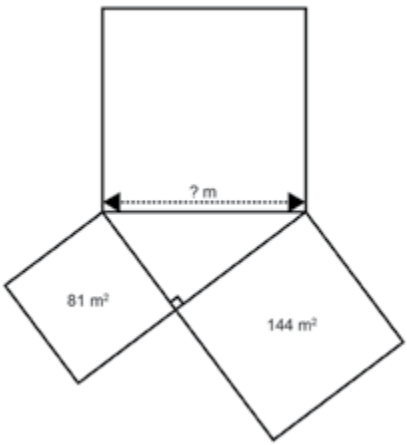
a. 12 cm
b. 16 cm
c. 6 cm
d. 20 cm



Note: Figure not drawn to scale

4. Assuming the diameter of the small circle is the radius of the larger circle, what is (area of large circle) - (area of small circle) in the figure above?

a. 8 π cm^2
b. 10 π cm^2
c. 12 π cm^2
d. 16 π cm^2



Note: Figure not drawn to scale

5. Assuming the shapes around the center right triangle are square, what is the length of each side of the indicated square above?

a. 10
b. 15
c. 20
d. 5

Answer Key

1. A
Point A represents the origin.

2. A
The diagonals of a square intersect at right angles, so each angle measures 90°. Half of that angle will be 45^{0}

3. B
We see that there is a square with side 2 cm and a rectangle adjacent to it, with one side 2 cm (common side with the square) and the other side 4 cm. The perimeter of a shape is found by summing up all sides surrounding the shape, not adding the ones inside the shape. Three 2 cm sides from the square, and two 4 cm sides and one 2 cm side from the rectangle contribute the perimeter.

So, the perimeter of the shape is: 2 + 2 + 2 + 4 + 2 + 4 = 16 cm.

4. C
We are given a large circle and a small circle inside it; with the diameter equal to the radius of the large one. The diameter of the small circle is 4 cm. This means that its radius is 2 cm. Since the diameter of the small circle is the radius of the large circle, the radius of the large circle is 4 cm. The area of a circle is calculated by: πr^2 where r is the radius.

Area of the small circle: $\pi(2)^2 = 4\pi$

Area of the large circle: $\pi(4)^2 = 16\pi$

The difference area is found by:

Area of the large circle - Area of the small circle = $16\pi - 4\pi = 12\pi$

5. B
We see that there are three squares forming a right triangle in the middle. Two of the squares have the

areas 81 m^2 and 144 m^2. If we denote their sides a and b respectively:

$a^2 = 81$ and $b^2 = 144$. The length, which is asked, is the hypotenuse; a and b are the opposite and adjacent sides of the right angle. By using the Pythagorean Theorem, we can find the value of the asked side:

Pythagorean Theorem:

$(\text{Hypotenuse})^2 = (\text{Opposite Side})^2 + (\text{Adjacent Side})^2$

$h^2 = a^2 + b^2$

$a^2 = 81$ and $b^2 = 144$ are given. So;

$h^2 = 81 + 144$

$h^2 = 225$

$h = 15$ m

Basic Algebra

THE BASIC ALGEBRA SECTION COVERS THE FOLLOWING:

- Ratio and proportion
- Linear equations with 1 and 2 variables
- Quadratics
- Real-world quadratic questions
- Identify quadratic equations from graphs
- Identify linear equations from graphs
- Polynomials
- Solve Geometric problems with Algebra

Solving One-Variable Linear Equations

Linear equations with variable x is an equation with the following form:

$$ax = b$$

where a and b are real numbers. If a=0 and b is different from 0, then the equation has no solution.

Let's solve one simple example of a linear equation with one variable:

$$4x - 2 = 2x + 6$$

When given this type of equation, move variables to one side, and real numbers to the other. Always remember: if you are changing sides, you are changing signs. Move all variables to the left, and real numbers to the right:

$4x - 2 = 2x + 6$
$4x - 2x = 6 + 2$
$2x = 8$
$x = 8/2$
$x = 4$

When 2x goes to the left it becomes -2x, and -2 goes to the right and becomes +2. After calculations, we find that x is 4, which is a solution of our linear equation.

Let's solve a little more complex linear equation:

$2x - 6/4 + 4 = x$
$2x - 6 + 16 = 4x$
$2x - 4x = -16 + 6$
$-2x = -10$
$x = -10/-2$
$x = 5$

We multiply whole equation by 4, to lose the fractional line. Now we have a simple linear equation. If we change sides, we change the signs.

Solving Two-Variable Linear Equations

If we have 2 or more linear equations with 2 or more variables, then we have a system of linear equations. The idea here is to express one variable using the other in one equation, and then use it in the second equation, so we get a linear equation with one variable. Here is an example:
$x - y = 3$
$2x + y = 9$
From the first equation, we express y using x.

Answer Sheet

	A	B	C	D	E		A	B	C	D	E
1	○	○	○	○	○	26	○	○	○	○	○
2	○	○	○	○	○	27	○	○	○	○	○
3	○	○	○	○	○	28	○	○	○	○	○
4	○	○	○	○	○	29	○	○	○	○	○
5	○	○	○	○	○	30	○	○	○	○	○
6	○	○	○	○	○	31	○	○	○	○	○
7	○	○	○	○	○	32	○	○	○	○	○
8	○	○	○	○	○	33	○	○	○	○	○
9	○	○	○	○	○	34	○	○	○	○	○
10	○	○	○	○	○	35	○	○	○	○	○
11	○	○	○	○	○	36	○	○	○	○	○
12	○	○	○	○	○	37	○	○	○	○	○
13	○	○	○	○	○	38	○	○	○	○	○
14	○	○	○	○	○	39	○	○	○	○	○
15	○	○	○	○	○	40	○	○	○	○	○
16	○	○	○	○	○	41	○	○	○	○	○
17	○	○	○	○	○	42	○	○	○	○	○
18	○	○	○	○	○	43	○	○	○	○	○
19	○	○	○	○	○	44	○	○	○	○	○
20	○	○	○	○	○	45	○	○	○	○	○
21	○	○	○	○	○						
22	○	○	○	○	○						
23	○	○	○	○	○						
24	○	○	○	○	○						
25	○	○	○	○	○						

Basic Algebra Practice

1. Solve the linear equation: $-x - 7 = -3x - 9$

a. -1
b. 0
c. 1
d. 2

2. Solve the system: $4x - y = 5 \quad x + 2y = 8$

a. (3,2)
b. (3,3)
c. (2,3)
d. (2,2)

3. Simplify the following expression:

$3x^3 + 2x^2 + 5x - 7 + 4x^2 - 5x + 2 - 3x^3$

a. $6x^2 - 9$
b. $6x^2 - 5$
c. $6x^2 - 10x - 5$
d. $6x^2 + 10x - 9$

4. Find 2 numbers that sum to 21 and the sum of the squares is 261.

a. 14 and 7
b. 15 and 6
c. 16 and 5
d. 17 and 4

Answer Key

1. A
We should collect similar terms on the same side. Here, we can collect x terms on left side, and the constants on the right side:

$- x - 7 = - 3x - 9$ …. Let us add 3x to both sides:

$- x - 7 + 3x = - 3x - 9 + 3x$

$2x - 7 = - 9$ … Now, we can add + 7 to both sides:

$2x - 7 + 7 = - 9 + 7$

$2x = - 2$ … Dividing both sides by 2 gives us the value of x:

$x = -2/2$

$x = -1$

2. C
First, we need to write two equations separately:
$4x - y = 5$ (I)

$x + 2y = 8$ (II) … Here, we can use two ways to solve the system. One is substitution method, the other one is linear elimination method:

1. Substitution Method

Equation (I) gives us that $y = 4x - 5$. We insert this value of y into equation (II):

$x + 2(4x - 5) = 8$

$x + 8x - 10 = 8$

$9x - 10 = 8$

$9x = 18$

$x = 2$

Bu knowing $x = 2$, we can find the value of y by inserting $x = 2$ into either of the equations. Let us choose equation (I):

$4(2) - y = 5$

$8 - y = 5$

$8 - 5 = y$

$y = 3 \rightarrow$ solution is (2, 3)

2. Linear Elimination Method:

2•/ $4x - y = 5$ … by multiplying equation (I) by 2, we see that -2y will form; and y terms

$x + 2y = 8$ … will be eliminated when summed with +2y in equation (II):

2•/ $4x - y = 5$

$+ \quad x + 2y = 8$

$8x - 2y = 10$

$+ \quad x + 2y = 8$ … Summing side by side:

$8x + x - 2y + 2y = 10 + 8$ … -2y and +2y eliminate each other:

$9x = 18$

$x = 2$

By knowing $x = 2$, we can find the value of y by inserting $x = 2$ into either of the equations. Let us choose equation (I):

$4(2) - y = 5$

$8 - y = 5$

$8 - 5 = y$

$y = 3 \rightarrow$ solution is (2, 3)

3. B

$3x^3 + 2x^2 + 5x - 7 + 4x^2 - 5x + 2 - 3x^3$ … write similar terms together:

$= 3x^3 - 3x^3 + 2x^2 + 4x^2 + 5x - 5x - 7 + 2$ … operate within the same terms. $3x^3$ and $- 3x^3$, 5x and -5x cancel:

$= 6x^2 - 5$

4. B

There are two statements made. This means that we can write two equations according to these statements:

The sum of two numbers are 21: $x + y = 21$

The sum of the squares is 261: $x^2 + y^2 = 261$

We are asked to find x and y.

Since we have the sums of the numbers and the sums of their squares; we can use the square formula of x + y, that is:

$(x + y)^2 = x^2 + 2xy + y^2$ … Here, we can insert the known values $x + y$ and $x^2 + y^2$:

$(21)^2 = 261 + 2xy$ … Arranging to find xy:

$441 = 261 + 2xy$

$441 - 261 = 2xy$

$180 = 2xy$

$xy = 180/2$

$xy = 90$

We need to find two numbers which multiply to 90. Checking the answer choices, we see that in (b), 15 and 6 are given. $15 \cdot 6 = 90$. Also their squares sum up to 261 ($15^2 + 6^2 = 225 + 36 = 261$). So these two numbers satisfy the equation.

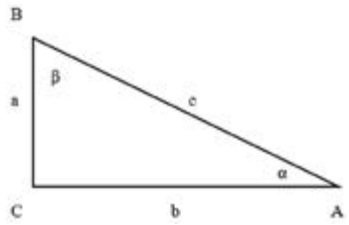
Advanced Algebra

THE ADVANCED ALGEBRA SECTION COVERS THE FOLLOWING:

Trigonometry
Sequences
Logarithms

Trigonometry - A Quick Tutorial

If we are observing a right triangle, where a and b are its legs and c is its hypotenuse, we can use trigonometric functions to make a relationship between angles and sides of the right triangle.



If the right angle of the right triangle ABC is at the point C, then the sine (sin) and the cosine (cos) of the angles α (at the point A) and β (at the point B) can be found like this:

$\sin\alpha = a/c \quad \sin\beta = b/c$
$\cos\alpha = b/c \quad \cos\beta = a/c$

Notice that sinα and cosβ are the equal, and same goes for sinβ and cosα. So, to find sine of the angle, we divide the side that is

opposite of that angle and the hypotenuse. To find cosine of the angle, we divide the side that makes that angle (adjacent side) by the hypotenuse.

There are 2 more important trigonometric functions, tangent and cotangent:

$$tg\alpha = \sin\alpha/\cos\alpha = a/b$$
$$ctg\alpha = \cos\alpha/\sin\alpha = b/a$$

For the functions sine and cosine, there is a table with values for some of the angles, which is to be memorized as it is very useful for solving various trigonometric problems.

	0^0	30^0	45^0	60^0	90^0
$\sin\alpha$	0	1/2	$\sqrt{2}/2$	$\sqrt{3}/2$	1
$\cos\alpha$	1	$\sqrt{3}/2$	$\sqrt{2}/2$	1/2	0

Let's see an example:

If a is 9 cm and c is 18 cm, find α.
We can use the sine for this problem:

$$\sin\alpha = a/c = 9/18 = 1/2$$

We can see from the table that if sinα is 1/2, then angle α is 30^0.

Besides degrees we can write angles using π, where π represents 180^0. For example, angle π/2 means a right angle of 90^0.

Logarithms - A Quick Tutorial

Logarithm is a function that has the form

$$\log_y x = a$$

It actually solves this equation: which number do we put as a degree on the variable y to get the variable x, that is:

$$y^a = x$$

y is called the base and a is the exponent.
For example, let's solve logarithm $\log_5 25 = a$.

$$5^a = 25$$
$$5^a = 52$$
$$a = 2$$

Here, we represent 25 using 5 and the second degree. a and 2 are both on the number 5, so they must be the same.

We can see from the way the logarithm works, that:

$$\log_a 1 = 0 \text{ and } \log_a a = 1$$

From $\log_a 1 = 0$ we have that $a^0 = 1$, which is true for any real number a.

From $\log_a a = 1$ we have that $a^1 = a$, which is true for any real number a.

If in the logarithm the base is 10, then instead of $\log_{10}$ we write l_g.

When we are solving some logarithm, any part can be

Answer Sheet

1.	A	B	C	D	21.	A	B	C	D
2.	A	B	C	D	22.	A	B	C	D
3.	A	B	C	D	23.	A	B	C	D
4.	A	B	C	D	24.	A	B	C	D
5.	A	B	C	D	25.	A	B	C	D
6.	A	B	C	D	26.	A	B	C	D
7.	A	B	C	D	27.	A	B	C	D
8.	A	B	C	D	28.	A	B	C	D
9.	A	B	C	D	29.	A	B	C	D
10.	A	B	C	D	30.	A	B	C	D
11.	A	B	C	D	31.	A	B	C	D
12.	A	B	C	D	32.	A	B	C	D
13.	A	B	C	D	33.	A	B	C	D
14.	A	B	C	D	34.	A	B	C	D
15.	A	B	C	D	35.	A	B	C	D
16.	A	B	C	D	36.	A	B	C	D
17.	A	B	C	D	37.	A	B	C	D
18.	A	B	C	D	38.	A	B	C	D
19.	A	B	C	D	39.	A	B	C	D
20.	A	B	C	D	40.	A	B	C	D

Advanced Algebra Practice

1. If sides a and b of a right triangle are 8 and 6, respectively, find cosine of α.

a. 1/5
b. 5/3
c. 3/5
d. 2/5

2. Find tangent of α of a right triangle, if a is 3 and b is 5.

a. 1/4
b. 5/3
c. C. 4/3
d. d. 3/4

3. If α = 30º, find sin30º + cos60º.

a. 1/2
b. 2/3
c. 1
d. 3/2

4. Calculate (sin230º - sin0º) / (cos90º - cos60º).

a. -1/2
b. 2/3
c. 0
d. 1/2

Answer Key

Trigonometry

1. C
$a = 8$
$b = 6$
$a^2 + b^2 = c^2$
$8^2 + 6^2 = c^2$
$64 + 36 = c^2$
$c^2 = 100$
$c = 10$
$\cos\alpha = b/c = 6/10 = 3/5$

2. D
$a = 3$
$c = 5$
$a^2 + b^2 = c^2$
$3^2 + b^2 = 5^2$
$b^2 = 25 - 9$
$b^2 = 16$
$b = 4$
$\text{tg}\alpha = a/b = 3/4$

3. C
$\alpha = 30^o$
$\sin 30^o + \cos 60^o = 1/2 + 1/2 = 1$

4. A
$(\sin 230^o - \sin 0^o) / (\cos 90^o - \cos 60^o)$
$= ((1/2)2 - 0) / (0 - 1/2)$
$= (1/4) / (-1/2) = -1/2$

Basic Math Multiple Choice

Math is the one subject where you need to make sure that you understand the processes before you ever tackle it. Generally, the time allowed for the math portion is so short there's not much room for error. You have to be fast and accurate. It's imperative that before the test day arrives, you've learned all the main formulas that will be used, and then to create your own problems (and solve them).

On the actual test day, use the "Plug-Check-Check" strategy. Here's how it goes.

Read the problem, but not the answers. You'll want to work the problem first and come up with your own answers. If you do the work right, you will find your answer among the options given.

If you need help with the problem, plug actual numbers into the variables given. You'll find it easier to work with numbers than it is to work with letters. For instance, if the question asks, "If Y - 4 is 2 more than Z, then Y+5 is how much more than Z?" Try selecting a value for Y. Let's take 6. Your question now becomes, "If 6-4 is 2 more than Z, then 6 plus 5 is how much more than Z?" Now your answer is easier to work with.

Check the answer choices to see if your answer matches one of those.

If no answer matches your answer, re-check your math, but this time, use a different method. In math, it's common for there to be more

How to Study for a Math Test

EVERY SUBJECT HAS ITS OWN PARTICULAR STUDY METHOD. Math is mostly numerical, rather than verbal, and requires logical thinking; it has its own way to be studied. Before touching on significant points of studying a math test, lets look at some of the fundamentals of “learning.”

Learning is not an instant experience; it is a procedure. Learning is a process not an event. Rome wasn’t built in a day, and learning anything (or everything) isn’t going to happen in a day either. You cannot expect to learn everything in one day, at night, before the test. It is important and necessary to learn day-by-day. Good time management plays a considerable role in learning. When you manage your time, and begin test preparation well in advance, you will notice the subjects are easier than you thought, or feared, and you will take the test without the stress of a sleepless body and an anxious mind.

Memorizing is a temporary step of learning if information is not comprehended and applied afterwards. Memorize just the basics and understand the meaning; then apply, analyze, synthesize and evaluate.

These are the hierarchical layout of cognitive learning: Of course, there are some basic properties that you need to memorize in the beginning, since you cannot prove the facts every time you solve a math test. For example; the inner angles of a triangle sum up to 180°. If you do not know this, you may not

How to Prepare for a Test

MOST STUDENTS HIDE THEIR HEADS AND PROCRASTINATE WHEN FACED WITH PREPARING FOR AN EXAM, HOPING THAT SOMEHOW THEY WILL BE SPARED THE AGONY, ESPECIALLY IF IT IS A BIG ONE THAT THEIR FUTURES RELY ON. Avoiding a test is what many students do best and unfortunately, they suffer the consequences because of their lack of preparation.

Test preparation requires strategy and dedication. It is the perfect training ground for a professional life. Besides having several reliable strategies, successful students also has a clear goal and know how to accomplish it. These tried and true concepts have worked well and will make your test preparation easier.

The Study Approach

Take responsibility for your own test preparation.

It is a common - but big - mistake to link your studying to someone else's. Study partners are great, but only if they are reliable. It is your job to be prepared for the test, even if a study partner fails you. Do not allow others to distract you from your goals.

Prioritize the time available to study

When do you learn best, early in the day or at night? Does your mind absorb and retain information most efficiently in small blocks of time, or do you require long stretches to get

the most done? It is important to figure out the best blocks of time available to you when you can be the most productive. Try to consolidate activities to allow for longer periods of study time.

Find a quiet place where you will not be disturbed

Do not try to squeeze in quality study time in any old location. Find a peaceful place with a minimum of distractions, such as the library, a park or even the laundry room. Good lighting is essential and you need to have comfortable seating and a desk surface large enough to hold your materials. It is probably not a great idea to study in your bedroom. You might be distracted by clothes on the floor, a book you have been planning to read, the telephone or something else. Besides, in the middle of studying, that bed will start to look very comfortable. Whatever you do, avoid using the bed as a place to study since you might fall asleep to avoiding studying!

The exception is flashcards. By far the most productive study time is sitting down and studying and studying only. However, with flashcards you can carry them with you and make use of odd moments, like standing in line or waiting for the bus. This isn't as productive, but it really helps and is definitely worth doing.

Determine what you need to study

Gather together your books, your notes, your laptop and any other materials needed to focus on your study for this exam. Ensure you have everything you need so you don't waste time. Remember paper, pencils and erasers, sticky notes, bottled water and a snack. Keep your phone with you if you need it to find essential information, but keep it turned off so others can't distract you.

How to Take a Test

EVERYONE KNOWS THAT TAKING AN EXAM IS STRESSFUL, BUT IT DOES NOT HAVE TO BE THAT BAD! There are a few simple things that you can do to increase your score on any type of test. Take a look at these tips and consider how you can incorporate them into your study time.

OK - so you are in the test room - Here is what to do!

Reading the Instructions

This is the most basic point, but one that, surprisingly, many students ignore and it costs big time! Since reading the instructions is one of the most common, and 100% preventable mistakes, we have a whole section just on reading instructions.

Pay close attention to the sample questions. Almost all standardized tests offer sample questions, paired with their correct solutions. Go through these to make sure that you understand what they mean and how they arrived at the correct answer. Do not be afraid to ask the test supervisor for help with a sample that confuses you, or instructions that you are unsure of.

Tips for Reading the Question

We could write pages and pages of tips just on reading the test questions. Here are a few that will help you the most.

- **Think first.** Before you look at the

CONGRATULATIONS! You have made it this far because you have applied yourself diligently to practicing for the exam and no doubt improved your potential score considerably! Passing your up-coming exam is a huge step in a journey that might be challenging at times but will be many times more rewarding and fulfilling. That is why being prepared is so important.

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