CHAPTER 13 - MATH

Notes:

Approximately 10% (8 to 10) questions will be "math"-related on both the Uniform and Colorado portions of the license exam.

The main focus of the Uniform “math” questions are on "real-life" math situations with which a broker would normally be concerned. Examples include commissions, sales prices, interest, and property taxes. You will notice that the Math Questions here specifically focus on these types of questions.

The Math Questions in this chapter are specifically written to reflect the true focus of questions on the State exam. One major difference, however, is that all questions on the State exam are multiple-choice. This "crutch" has been eliminated for the problems in this chapter to give the student practice in properly solving the problems.

Approximately two-thirds of the math problems on the Uniform license exam are “straight” math. If you can use a simple four-function (add, subtract, multiply, and divide) calculator, then you will be able to solve any of the calculations on this particular form of math question. The difficult part is deriving the correct information to “plug into” your calculations from the word problem. The following is the classic example:

"*What are the quarterly real estate taxes for the property at 1313 Mockingbird Lane, if the Mill Levy is 80.89, the appraised value of the house is $150,000, and the assessed value is $27,500. The Equalization factor in this county is 1.25."*

a) $2,780.60
b) $695.15
c) $556.12
d) $3,791.72

In order to solve any math word problems such as those found on the license exam, you must *translate the words into figures*. Also keep in mind that there are often “red herrings” - facts that are irrelevant to the calculation, and are simply placed in the problem to distract the examinee.

For example, the “red herring” above is the sentence: "the appraised value of the house is $150,000. . ." The *appraised value*, *selling price*, *asking price*, etc., are irrelevant to **property taxes**, because they are merely reflections of the sales market. (*See* Chapter 10.) Therefore, the $150,000 figure in that problem is irrelevant and should be ignored. Property taxes are *solely based on the* ***assessed value***, which in Colorado is determined by the County Assessor's office for each individual property. You will notice that the

assessed value ($27,500) bears no relationship to the appraised value ($150,000).

Other important *property tax* concepts for math questions:

A **mill levy** is also referred to as a **tax rate**. So another way of stating this portion of the problem would be "the tax rate is $80.89 per thousand dollars of assessed value."

An **equalization factor** can be loosely defined as a method by which the State Board of Equalization can be "fairer" to property-value poor counties. In this case, whatever the taxes are for this particular property will be *multiplied by* 1.25 or 125%, presumably because it is in a "richer" county. In a "poorer" county, the residents might be given a break with an equalization factor of, say, 75%.

The calculation, therefore, would properly be expressed as:
27,500 / 1000 = 27.50
27.50 x 80.89 = 2,224.48
2,224.48 x 1.25 = $2,780.60

If you think the answer is simply *a) $2,780.60* and need look no farther, you're wrong. You forgot to *read the entire question* again to determine what it was *really* asking for. Read the question again. It was asking for *quarterly* taxes, not annual, so you must still divide by four. The answer is really $695.15, or answer *b)*.

But don't stop there. Each *wrong* answer is there for a reason, also. You must look at every choice before committing to one. For instance, answer *c)* would be the answer if the examinee erroneously left out the equalization factor. Answer *d)* would be the figure if one uses the $150,000 *appraised value* instead of the correct $27,500 *assessed value*.

These are prime examples of "wrong answers." The authors of the exam do not randomly choose the incorrect answers on any questions. They calculate these other choices based on errors that the examinee is most likely to make. Most of these choices are used - especially in math problems - because they are the result of *inattention*. So thoughtful consideration of all facts in a problem – paying special attention to eliminating the "red herrings" – is absolutely essential.

Another "red herring" choice common in math problems is based on *miscalculation*. One of the wrong answers in the above problem could have been $69.52, or $6,951.50, because examinees are often inclined to calculate in their heads (therefore mis-multiplying by a factor of 10) or miss a digit when entering the figures on the calculator. The moral to this story is: "Never calculate in your head" *and* "Always double-check your answers."

Solving for the Unknown

The remaining third of math problems involve "solving for an unknown." In these problems, it is necessary to first perform some basic math, in order to determine the three figures necessary for the eventual calculation of the correct answer. Next, you can "plug in" the resultant three figures into *one, all-purpose formula*, which can be used to derive the remaining (unknown) figure, commonly described as ***X***. This will be the answer to your problem. An example of this type of problem:

> *"Jefferson was having trouble selling his house at the asking price of $175,000, so he had to discount it to $135,000. What percentage of discount did Jefferson make?"*

The figures we are given are $135,000, $175,000, and 100, because our answer will be a *per cent* (from the Latin, "*per 100".*) But we must do some *math* first, because although Jefferson discounted it to $135,000, it does not tell us *how much* he discounted it - which we need to compare the amount of discount to the original price. The amount he discounted it was, of course, $40,000 ($175,000 - $135,000). That is the "math" you had to do before you got the last figure you need to plug into the formula. Now you can compare the discount of $40,000 to the original price of $175,000.

$$\frac{X}{100} = \frac{40{,}000}{175{,}000}$$

This could otherwise be expressed as: "If $175,000 was the original full amount (*100 percent*), what would be the $40,000 discount (in terms of percent)?"

To answer, simply *cross-multiply* 40,000 x 100 and divide it by 175,000.
40,000 x 100 = 4,000,000 / 175,000 = 22.86

Any answer like 23% or 22.9% also would be correct.

Another variation on solving for an unknown, might read like this:

> *"When executing a listing, owner Scarlet told Broker Rhett that all she wanted out of the sale of the Plantation Tara was $500,000), after deducting all expenses. If the only expense was Rhett's 7% commission, what is the minimum amount at which Rhett must list the Plantation, so as not to violate Scarlet's instructions."*

First rephrase the question, discarding the cute names and getting right down to the basic figures: "*After* deducting a 7% commission, the sale left the owner with $500,000."

Then translate this to figures. *One hundred percent* compares with the figure we want. But the figure you have ($500,000) is one-hundred percent *after* you take out *seven* percent.

100 - 7 = 93. $\frac{93}{100} = \frac{500{,}000}{x}$

100 x 500,000 = 50,000,000 / 93 = $537,634.41
(Note that if you simply multiply 535,000 by 7% [535,000 x .07 = 37,450] and subtract that from that sales price [535,000 – 37450 = 497,550] then you will be violating the conditions of the sale, because you *won't have enough*. So, it is as simple as saying that "$500,000 is 93% of what we want the final figure to be… What is that final figure?" Plug the figures into our simple "formula" and you will get the correct answer every time.

You should always check your solution: 537,634.41 x .07 = 37,634.41. Subtract 37,634.41 from 537,634.41, and you are left with the required $500,000 figure.)

After practice, you may find that there are quicker ways to do this. This method, however, will allow you to simply solve any problem requiring you to "solve for an unknown" without having to memorize a bunch of different formulas. Above all – *don't take shortcuts* – because you may leave out a step and get the incorrect answer. Remember that the wrong answers specifically anticipate the common shortcuts and miscalculations.

MATH CONCEPTS – FOR THE UNIFORM LICENSE EXAM

1. First you do your *math*, then you do your *algebra*
   problem: $10 per month interest on a $1000 loan, what is the interest rate?
   math: $10 x 12 months = $120 per year
   algebra: $\frac{120}{1000} = \frac{X}{100}$ = 120 x 100 = 12000 / 1000(x) = 12%

2. Convert fractions: 7% = $\frac{7}{100}$ = .07, not .7

3. On the *Uniform* license exam math questions, a *year* has 360 days and every month has 30 days. This is to simplify some math calculations, as it involves round numbers and does not require the examinee to know how many days are in each month, whether it is a leap-year, etc. (*Note, however*: The *Colorado* portion of the license exam will include "closings" questions that will certainly expect you to know the number of days in each month, whether it is a leap-year, etc. This will be thoroughly discussed in the Closings course to follow.)

4. Conversions (*memorize this list*):
a. 1 quarter = 3 months = 1/4 year, etc.
b. 1 foot = 12 inches = 1/3 yard, etc.
e. Board foot = 144 cubic in.
f. Acre = 43,560 sq. feet

c. 1 year = 12 months = *360 days*
d. 1 month = *30 days*
g. Mile = 5,280 feet (1760 yds.)

5. Remember to calculate, then subtract (rarely add) the costs, before figuring percentage profit, expenses.
6. Know what's been *left out* of the calculation, before choosing an answer. For example, “a payment of $100 per month plus interest” means you must figure interest, *then* add. A question with $100 per month “including interest” or “principal and interest” means the interest payment has already been figured in.

7. The license exam questions may ask about the second, third, fourth, or last month, so you will have to subtract only the principal (i.e. - $100), then figure the balance.

8. Interest on a loan is almost *always* paid *in arrears*, so a loan payment due/paid on August 1 includes interest for *the previous month*, July. So, for example, if closing is on July 15, then *seller* will pay the “due July 1st” payment on his or her existing loan (which pays for the *June* interest) *and* at closing Seller owes Buyer 15 days (i.e. - yearly taxes divided by 360 days times 15 days) as a credit to Buyer.

This concept is probably the single most important concept – and the questions most commonly missed – in the Closings course, and in many license exam questions. Memorize it.

9. Always go back and *check your answer.* It is simple to verify that you got the correct answer, just by plugging it back into the question. If, by working the problem backwards, you get a figure that is different from the one given, you calculated incorrectly. Figure out where you went wrong. (This should be easy because you will always show your work, won’t you?)

10. Last, but not least: If you are stuck & can't remember where everything fits in the above “solving for the unknown” formula, work backwards and plug the four answers given into what you know. This is time-consuming and not advisable on every math questions on the timed license exam. However, for the rare, tricky question you can eliminate impossible answers easily this way. i.e.: A question that asks for a 10% loss on an $86,000 property is not going to be $85,140 (1% less), and obviously not $94,600 (10% more).