Diagnostic Math Test

- Absolutely crucial to identify weak areas in mathematics and repair it ASAP.
- Answer key is provided on the last page: score yourself by assigning 1pt. for each correct answer.
- If your score is lower than 15, bring the completed Math Test to the instructor ***immediately***.
- If your score is above 15 but lower than 23, immediately seek help from a **college algebra tutor** in CASA. Bring completed Math Test with you to show where you need help.
- Score between 23 and 27 indicates that you might have problems and need to review algebra and trigonometry.
- If you score 28 -30, just pay attention…

1. **Scientific Notation**: Review the linked page about Scientific Notation. Make sure you can enter numbers into your calculator in Scientific Notation, and that you can interpret numbers that the calculator reports to you in Scientific notation. Please note:
   1. The "e notation" is used in calculators and when programming computers, but it **should not be used on paper or in scientific reports**. Use notation similar to this in reports: 6.02×10^{23}
   2. Be careful about square roots and division. On some calculators, division will require parentheses in the denominator.

   Express the following in scientific notation:

   1. 38,000 =
   2. 34,598,000 =
   3. 0.0702 =
   4. 0.281 =
   5. 0.002 =

2. **Significant Figures**: Review the linked page about Significant Figures. Understand that when a value is given to you, it is only as accurate as the significant digits it contains. In general, you should report results with only as many digits as are needed to accurately represent your value. Technically, a non-decimal number with zeroes at the end has fewer significant figures than digits (e.g. 120 has 2 significant figures because the 0 doesn't count). But, if you are presented with a value in that form, take it in context. Do not reduce your calculation to one significant figure just because one of the data points happens to have a value of 200. If the other data points have 2 significant figures, assume that for this point as well. Please note:
   - **During a calculation**, you should not round your values. Use the value that the calculator or computer gives you. The "Ans" button in the calculator is your friend. You should also learn how to save temporary values, so that you can use them again in a few minutes. In Excel, let the computer do the calculating. Don't do calculations by hand, just to type them into Excel.

   How many significant figures are in the following numbers?

   6. 80
   7. 85.0
   8. 0.1492
   9. 0.000587

3. **Order of Operations**: Review the linked page about the Order of Operations. The biggest out-of-order problem we encounter is accidentally splitting the denominator of a fraction. For example, if you want to do the following calculation:

$$\frac{1.2+3.4}{5.6\times10^7}$$

There a few acceptable ways of typing this:

- (Preferred): `(1.2+3.4)/5.6E7`
- (Optional): `(1.2+3.4)/(5.6*10^7)`
- (Excel): `=(1.2+3.4)/5.6e7`

Notice that the `E` symbol is being used for the "EE" or "Exp" button on the calculator. This is the symbol that usually comes up on the screen. In Microsoft Excel, you would use just the letter "e". Note that Excel requires you to start a formula with an equals sign. The most important thing about this is to make sure that the 10⁷ doesn't "pop out" of the fraction.

$$1.2+3.4/5.6*10\text{\textasciicircum}7 \quad \text{means} \quad 1.2 + \frac{3.4}{5.6} \cdot 10^7$$

There are two different things that went wrong, and each should be carefully avoided. Also, be careful about things like $(1/2x)$. It's hard to tell whether the writer means $1/(2x)$ or if they mean $(1/2)x$. Generally, in text it's the first choice, but in a calculator or in Excel, it's the second. Evaluate the following using your calculator:

10. $\frac{453\cdot1234}{13+94}$

11. $\frac{12^3-4}{3^2-5} + 75$

12. $6.67 \times 10^{-11} + \frac{700\times6.59\times10^{12}}{6.02\times10^{23}}$

13. $0.9251^{2/3}$

14. $12 + \sqrt{33}$

15. $(6 \times 10^3)^{1/2}$

4. **Algebraic Manipulations**: Review the linked page if necessary. Very occasionally, we must factor or solve a quadratic equation. Expand the following (i.e. carry out the multiplication and write an expression without parentheses):

16. $(x + 3)(x - 3)$
17. $(x^2 + 3x - 7)(x - 8)$

In the following, factorize and write an expression that is a product of two factors (i.e. make them look like the questions above):

18. $x^2 + 2x - 3$
19. $\alpha^2 - \beta^2$

5. **Proportions:** Much of the math we deal with is the math of proportionality, possibly with powers involved. Do remember that you can move a multiplicative factor into the numerator (i.e. $\frac{2}{3}x = \frac{2x}{3}$) and that dividing is the same as multiplying by the reciprocal (i.e. $\frac{2}{3} \div 4 = \frac{2}{3} \cdot \frac{1}{4} = \frac{2}{3 \cdot 4}$).
Solve for x in each of the following:

    20. $kx = mg$
    21. $\frac{q_1 q_2}{x^2} = kx$
    22. $\frac{\alpha}{\beta} = \frac{5x}{\delta}$

6. **Solving Linear Equations**: This is the second most common type of manipulation. In each case, solve for the indicated variable:

    23. Solve for x: $2x - 7 = 11$
    24. Solve for y: $ay + bx = c$
    25. Solve for z: $3 = 12 - 7z$
    26. Solve for k: $3c = 2b - 7k$

7. **Solving Quadratic Equations:** Very occasionally, we will have to solve a quadratic equation. We won't do it much, but it is an important skill for dealing with projectile motion. In case you forget, the standard form of a quadratic equation is: $Ax^2 + Bx + C = 0$
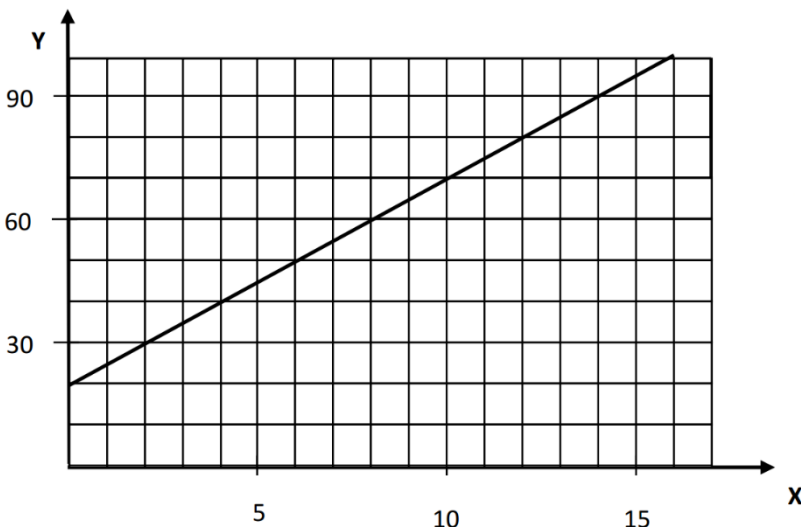and if you have a quadratic equation in standard form, the solutions are:

$$x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$$

Solve for the variable in each of these:

    27. $2x^2 - 8x + 8 = 0$
    28. $a^2 + 3a - 2 = 0$

8. Interpreting Graphs: We will frequently use graphs to summarize or interpret data sets. Find the requested data about this dimensionless graph:

Figure 1: Sample graph for questions 29-31.

29. Slope of the above graph:

30. y-intercept of the above graph:

31. Write the equation of the graph in standard form ($y = mx + b$, but filling in the known values):

Answer Key:

1. 3.8×10^4
2. 3.4598×10^7
3. 7.02×10^{-2}
4. 2.81×10^{-1}
5. 2×10^{-3}
6. 1
7. 3
8. 4
9. 3
10. 5224
11. 506
12. 7.73×10^{-9}
13. 0.9494
14. 18 (unless the integers are exact, then ~17.74...)
15. 80 (unless you don't believe it's really one sig fig, then ~77.46)
16. $x^2 - 9$
17. $x^3 - 5x^2 - 31x + 56$
18. $(x + 3)(x - 1)$
19. $(\alpha + \beta)(\alpha - \beta)$
20. mg/k
21. $\left(\frac{q_1 q_2}{k}\right)^{1/3} = \sqrt[3]{\frac{q_1 q_2}{k}}$
22. $\frac{\alpha \delta}{5\beta}$
23. $x = 9$
24. $y = (c - bx)/a$
25. $z = 9 / 7$
26. $k = (2b - 3c)/7$
27. $x = 2$ (There is no second solution.)
28. $a = -3.562$ or $a = 0.562$
29. 5
30. 20
31. $y = 5x + 20$