Prerequisites for MATH 130

This represents only **some** of the basic material with which you should be very familiar. We will **not** be reviewing all of these details, but will use them regularly. You may wish to consult Appendix B of your text, the summary of Algebra, Geometry, Trigonometry and Graphs of Elementary Functions inserts at the front and back of your text, and Chapter 1 of your text.

1. Exponents and radicals rules, including:

a) $x^m x^n = x^{m+n}$ **b)** $(x^m)^n = x^{mn}$ **c)** $\sqrt[n]{x} = x^{1/n}$

d) $\dfrac{1}{x^n} = x^{-n}$ **e)** $\sqrt[n]{x^m} = x^{m/n}$ **f)** $\left(\dfrac{x}{y}\right)^n = \dfrac{x^n}{y^n}$

2. The quadratic formula: If $ax^2 + bx + c = 0$ then

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

3. Set and interval notation (for each part below we list set notation followed by interval notation; note the different types of brackets):

a) Open interval: $\{x : a < x < b\}$ or (a, b).
b) Closed interval: $\{x : a \leq x \leq b\}$ or $[a, b]$.
c) Half-open interval: $\{x : a \leq x < b\}$ or $[a, b)$.
d) Various rays: $\{x : x < a\}$ or $(-\infty, a)$; $\{x : x \geq a\}$ or $[a, \infty)$.
e) All reals: $\{x : -\infty < x < \infty\}$ or $(-\infty, \infty)$ or $\mathbb{R}$.

4. Absolute value: If $a > 0$, then:

a) $|x| = a$ means $x = \pm a$.
b) $|x| < a$ means $-a < x < a$ or x is an element of $(-a, a)$.
c) $|x| \leq a$ means $-a \leq x \leq a$ or x is an element of $[-a, a]$.
d) $|x| > a$ means $x < -a$ or $x > a$ or x is an element of $(-\infty, -a) \cup (a, \infty)$.
e) $|x| \geq a$ means $x \leq -a$ or $x \geq a$ or x is an element of $(-\infty, -a] \cup [a, \infty)$.
f) Recall that $\sqrt{x^2} = |x|$ not just x. (Try a negative value for x to see why.)

5. **a)** The expression $|x - a|$ represents the *distance* between x and a. So for example, $|x - 2| = 3$ says that the distance between x and 2 is 3. (So x is either 5 or -1.) You can also use the definitions above (4a) to solve this:

$$|x - 2| = 3 \Longrightarrow \begin{cases} x - 2 = 3, & \text{or } x = 5 \\ x - 2 = -3, & \text{or } x = -1 \end{cases}$$

Note that this means that $|x|$ is the distance from x to the origin on the real number line.

b) With an inequality such as $|x - 2| < 3$, again use the basic definitions. So by (4b), $|x - 2| < 3$ means $-3 < (x - 2) < 3$ or $-1 < x < 5$.

6. From above we can see that the absolute value function is a piecewise function as follows:

$$|x| = \begin{cases} x, & \text{if } x \geq 0 \\ -x, & \text{if } x < 0 \end{cases}$$

with domain $(-\infty, \infty)$ and range $[0, \infty)$. You should know how to graph this function.

7. The distance formula for the distance between two points (x_1, y_1) and (x_2, y_2) is $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$. This can be derived directly from the Pythagorean theorem if you draw the two points and a right triangle determined by them.

8. Equations of lines:

a) Slope-intercept form: $y = mx + b$, where m is the slope and b is the y-intercept.

b) Point-slope form: $y - y_0 = m(x - x_0)$, where (x_0, y_0) is a point on the line. This is particularly useful for calculus.

c) Know how to obtain the equation of a line from two points (x_1, y_1) and (x_2, y_2).

9. Functions, how to graph them and how to determine their domain and range.

10. Composition of functions: $f \circ g(x) = f(g(x))$. For example, if $f(x) = x^2 - 6$ and $g(x) = 1 + 2x^3$, then

$$f \circ g(x) = f(g(x)) = f(1 + 2x^3) = (1 + 2x^3)^2 - 6 = 1 + 4x^3 + 4x^6 - 6 = 4x^3 + 4x^6 - 5.$$

11. Basic geometry formulas:

a) Triangles, Area: $A = \frac{1}{2}bh$.

b) Rectangles, Area: $A = lw$, Perimeter: $P = 2l + 2w$.

c) Circles, Area: $A = \pi r^2$, Circumference: $C = 2\pi r$.

d) Spheres, Volume: $V = \frac{4}{3}\pi r^3$, Surface Area: $SA = 4\pi r^2$.

e) Cylinder, Volume: $V = \pi r^2 h$, Surface Area: $SA = 2\pi r^2 + 2\pi rh$.

f) Cone, Volume: $V = \frac{1}{3}\pi r^2 h$.

g) Rectangular box, Volume: $V = lwh$, Surface Area: $SA = 2lw + 2lh + 2wh$.

12. We will always measure angles in *radians*. The conversion factors are:

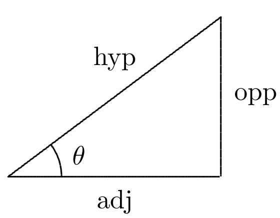
a) π radians $= 180°$.

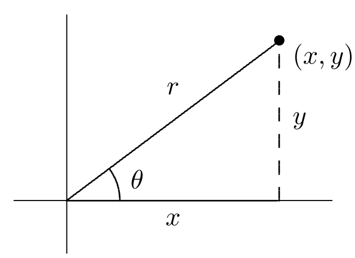
b) So $1° = \frac{\pi}{180}$ rad

c) and 1 rad $= \frac{180}{\pi}°$.

13. Recall for a right triangle, we can define the basic trig functions in terms of the sides of the triangle. (See diagram below.)

a) $\sin\theta = \dfrac{\text{opp}}{\text{hyp}}$ **b)** $\cos\theta = \dfrac{\text{adj}}{\text{hyp}}$ **c)** $\tan\theta = \dfrac{\text{opp}}{\text{adj}}$ **d)** $\sec\theta = \dfrac{\text{hyp}}{\text{adj}}$





14. For more general angles, we have the following. (See diagram above.)

a) $\sin\theta = \dfrac{y}{r}$ **b)** $\cos\theta = \dfrac{x}{r}$ **c)** $\tan\theta = \dfrac{y}{x}$ **d)** $\sec\theta = \dfrac{r}{x}$

15. You should know the values of the trig functions at these basic angles and multiples of these angles with**out** using your calculator. See the front summary insert page of your book for a beautiful unit circle reviewing these.

θ	0	$\pi/6$	$\pi/4$	$\pi/3$	$\pi/2$
$\sin\theta$	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1
$\cos\theta$	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0
$\tan\theta$	0	$\frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	undefined