MATH 121 Formulas

Properties of Exponents

1. $a^n a^m = a^{n+m}$
2. $\dfrac{a^n}{a^m} = a^{n-m}$
3. $\left(a^n b^m\right)^r = a^{nr} b^{mr}$
4. $\left(\dfrac{a^n}{b^m}\right)^r = \dfrac{a^{nr}}{b^{mr}}$
5. $b^{-r} = \dfrac{1}{b^r}$

Properties of Radicals

1. $\left(\sqrt[n]{b}\right)^m = \sqrt[n]{b^m} = b^{\frac{m}{n}}$
2. $\sqrt[n]{b}\sqrt[n]{b} = \sqrt[n]{ab}$
3. $\sqrt[m]{\sqrt[n]{b}} = \sqrt[mn]{b}$
4. $\dfrac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\dfrac{a}{b}}, \quad b \neq 0$

Special Product Formulas

1. $(a+b)^2 = a^2 + 2ab + b^2$
2. $(a-b)^2 = a^2 - 2ab + b^2$
3. $(a-b)(a+b) = a^2 - b^2$

Sum or Difference of Cubes

4. $a^3 - b^3 = (a-b)(a^2 + ab + b^2)$
5. $a^3 + b^3 = (a+b)(a^2 - ab + b^2)$

Quadratic Formula

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

Vertex of Parabola

$$\left(\frac{-b}{2a}, f\left(\frac{-b}{2a}\right)\right)$$

$$f(x) = a(x-h)^2 + k$$

Vertex at (h,k)

Circle

$$(x-h)^2 + (y-k)^2 = r^2$$

$$center = (h,k)$$

$$radius = r$$

Distance Formula

$$d = \sqrt{\left(x_2 - x_1\right)^2 + \left(y_2 - y_1\right)^2}$$

$$M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

Equations for Graphing Lines

$$m = \frac{y_2 - y_1}{x_2 - x_1}, \quad y = mx + b$$

$$y - y_1 = m\left(x - x_1\right)$$

Absolute Value Inequalities

$$|E| \le k \quad iff \quad -k \le E \le k$$

$$|E| \ge k \quad iff \quad E \le -k \quad or \quad E \ge k$$

Properties of Logarithms

1. $y = \log_b x \quad iff \quad b^y = x$
2. $\log_b b = 1$
3. $\log_b b^p = p$
4. $\log_b 1 = 0$
5. $b^{\log_b p} = p$
6. $\log_b m^p = p \log_b m$
7. $\log_b (mn) = \log_b m + \log_b n$
8. $\log_b \left(\dfrac{m}{n}\right) = \log_b m - \log_b n$
9. $\log(a) = \log_{10}(a)$
10. $\ln(a) = \log_e(a)$

Change of Base Formula

$$\log_b x = \frac{\log_{10} x}{\log_{10} b} = \frac{\ln x}{\ln b}$$

Exponential Growth Model:

$P(t) = P_0 e^{kt}$

Doubling Time: $T = \dfrac{\ln 2}{k}$

Exponential Decay Model:

$P(t) = P_0 e^{-kt}$

Half Life: $T = \dfrac{\ln 2}{k}$

Interest Formulas

Compound

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

Continuous

$$A = Pe^{rt}$$

Remainder Theorem: For any polynomial $P(x)$, the remainder obtained when dividing $P(x)$ by $x - r$ is $P(r)$.

Rational Root Theorem: Let $P(x) = a_n x^n + a_{n-1} x^{n-1} + \ldots + a_1 x + a_0$, where all coefficients are integers and n is a positive integer. If $\dfrac{c}{d}$ is a root of $P(x)$ then c is a factor of a_0 and d is a factor a_n.

***Note:** Students are not allowed to use this formula sheet during any tests or final exams.*