Math Review

Exponents – **Basic Definitions**

For *any* real number **base** x, we define powers of x: $x^0=1$, $x^1=x$, $x^2=x \cdot x$, $x^3=x \cdot x \cdot x$, etc. (The exception is 0^0 , which is considered indeterminate.) Powers are also called **exponents.**

Example: $5^0 = 1$, $(-11.2)^1 = -11.2$, $(8.6)^2 = 8.6 \cdot 8.6 = 73.96$, $10^3 = 10 \cdot 10 \cdot 10 = 1000$

Also, we can define fractional exponents in terms of roots, such as $x^{1/2}=\sqrt{x}$, the square root of x.

Similarly, $x^{1/3} = \sqrt[3]{x}$, the cube root of x, $x^{2/3} = \sqrt[3]{(x)^2}$, etc. In general, we have $x^{m/n} = \sqrt[n]{(x)^m}$

Example:
$$64^{1/2} = \sqrt{64} = 8$$
, $64^{1/3} = \sqrt[3]{64} = 4$, $64^{3/2} = \sqrt{(64)^3} = 512$, $64^{2/3} = \sqrt[3]{(64)^2} = 4^2 = 16$

Finally, we define *negative* exponents: $x^{-r} = \frac{1}{x^r}$. Thus, $x^{-1} = \frac{1}{x}$, $x^{-2} = \frac{1}{x^{2r}}$, $x^{-1/2} = \frac{1}{\sqrt{x}}$, etc.

Example:
$$10^{-1} = \frac{1}{10} = 0.1$$
, $7^{-2} = \frac{1}{7^2} = \frac{1}{49}$, $36^{-1/2} = \frac{1}{\sqrt{36}} = \frac{1}{6}$, $9^{-5/2} = \frac{1}{\sqrt{9^5}} = \frac{1}{243}$

Properties of Exponents

1. $x^{a} \cdot x^{b} = x^{a+b}$	$2. \frac{x^a}{x^b} = x^{a-b}$	3. $(x^a)^b = x^{ab}$	
Simplify:	Simplify:	Simplify:	
1. $x^2 \cdot x^3 =$	4. $\frac{x^5}{x^3} =$	7. $(x^3)^2 =$	
2. $x^{1/2} \cdot x^{1/3} =$	5. $\frac{x^3}{x^5} =$	8. $(x^{-1/2})^7 =$	
3. $x^3 \cdot x^{-1/2} =$	6. $\frac{x^3}{x^{\frac{1}{2}}} =$	9. $(x^{2/3})^{5/7}=$	

Functions and their graphs:

Input X
$$\longrightarrow f$$
 Output Y
 $f' Y = f(x)$
Independent Variable Dependent Variable

- 1. *Linear: y* = *mx* + *b*
- 2. Polynomial: $y = ax^n + bx^{n-1} + \dots + cx$
- 3. Power: $y = ax^n$
- 4. Exponential: $y = ab^{x}$

Match a function:

- 1. Linear
- 2. Polynomial
- 3. Exponential
- 4. Power

A. $Y = 2x^{2} + 3x - 8$ B. $Y = 4^{x}$ C. Y = 2x + 3D. $Y = x^{-2}$ E. Y = 3x - 1.5F. $Y = x^{2}$









Significant Figures

- A significant figure is a reliably known digit
- All non-zero digits are significant
- Zeroes that only locate the decimal point are NOT significant
- Scientific notion removes the possibility of misinterpretation

Express in scientific notation keeping 3 sig.figs:

38,034 = 34,798,000 = 0.0702 = 0.285 = 0.002 = 300,000,876,000 =

Prefixes

- Basic Unit has no prefix (g, s, m, L)
- Prefixes are conversion factors to a basic unit
- Prefixes correspond to powers of 10
- Each prefix has a specific name
- Each prefix has a specific abbreviation

10 ⁻¹²	pico	Р	pF	pico-Farada
10 ⁻⁹	nano	n	nm	nano-Meter
10 ⁻⁶	micro	μ	μC	micro-Coulomb
10 ⁻³	milli	m	mA	milli-Amper
10 ³	kilo	k	kg	kilo-gram
10 ⁶	mega	Μ	MV	mega-Volt
10 ⁹	giga	G	GHz	giga-Hertz

Conversions

- When units are not consistent, you may need to convert to appropriate ones
- Need to know a conversion factor!
- Units can be treated like algebraic quantities that can "cancel" each other
- Example:

$$15.0 in \times \frac{2.54 \, cm}{1 \, in} = 38.1 \, cm$$

300 MHz to Hz

520 nm to m

0.876 mg to g

834 km to cm

4.h to min

0. 20 s to hours

563 μm to cm

72 km/h to m/s