Topic 1: Algebra	*Sequences and Series*
A sequence is a set of terms which follow a rule (pattern)	$u_1, u_2, u_3, \dots, u_{n-1}, u_n$
Arithmetic Progression: Terms differ by a common difference, $\boldsymbol{d}$	$u_1 + u_2 + u_3 + \cdots + u_{n-1} + u_n$

$\boldsymbol{d = u_n - u_{n-1}}$	$c - b = b - a$	$u_1 = a$	$u_2 = a + d$	$u_3 = a + 2d$	$u_n = a + (n-1)d$

Sum of arithmetic progression	$S_n = \frac{n}{2}(u_1 + u_n)$	$S_n = \frac{n}{2}(2a + (n-1) + d)$

Geometric Progression: Terms differ by a common ratio, r	$u_1 \times u_2 \times u_3 \times \dots \times u_{n-1} \times u_n$

$\boldsymbol{r = \frac{u_{n+1}}{u_n}}$	$\frac{b}{a} = \frac{a}{c}$	$u_1 = a$	$u_2 = ar$	$u_3 = ar^2$	$u_n = ar^{n-1}$

Sum of geometric progression	$S_n = \frac{u_1(1 - r^n)}{1 - r}$	Sum of infinite geometric progression	$S_n = \frac{u_1}{1 - r}$

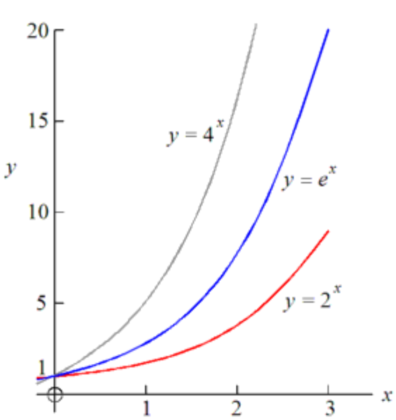
Topic 1: Algebra	*Exponents and Logarithms*
Exponent (Index) Laws:	Logarithm Laws: $b = a^x \Leftrightarrow x = \log_a b$

$\boldsymbol{a^n \times a^m = a^{n+m}}$	$a^n \div a^m = \frac{a^n}{a^m} = a^{n-m}$	$\log_a x + \log_a x = \log_a xy$	$\log_a x + \log_a x = \log_a \frac{x}{y}$

$\boldsymbol{a^{\frac{m}{n}} = \sqrt[n]{a^m}}$ **or** $\boldsymbol{(\sqrt[n]{a})^m}$	$a^1 = a$	$a^0 = 1$	$\log_a x^n = n\log_a x$	$\log_a 1 = 0$	$\log_a a = 1$

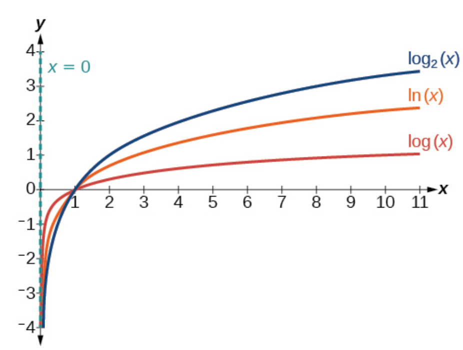
$\boldsymbol{(a^x)^y = a^{xy}}$	$(ab)^x = a^x b^x$	$a^x = a^y$ $x = y$	$a^{-x} = \frac{1}{a^x}$	$\log_a a^r = r$	$a^{\log_a x} = x$	$\log_a x = \log_a y$ $x = y$	$\log_e x = \ln x$
				$\log_a(0) = undefined$			$\log(-x) = 0$

Graphs of exponential functions and $\boldsymbol{e^x}$	
No stationary points	
Always positive	
Always increasing	
y-axis is HA	
No VA	
One-to-one	



Change of Base Formula	$\log_a b = \frac{1}{\log_b a}$
$x = \frac{\log_c b}{\log_c a} = \frac{\ln b}{\ln a}$	

Graphs of logarithms



Topic 1: Algebra	*Induction*	
1. Test	Let $n = 1$	Ensure $LHS = RHS$
2. Assume	Assume true for $n = k$	Substitute k for n in statement
3. Prove	Let $n = k + 1$	Substitute part of $n = k + 1$ with $n = k$
4. Explain	Since statement is true for $n = k$, then it is also true for $n = k + 1$ The proposition is true for $n = 1$ and	

Topic 1: Algebra		*Complex Numbers*			
There are two types of complex numbers		$i^2 = -1$	$i^3 = -i$	$i^4 = 1$	$i^5 = i$
polar form	mod-arg form	Modulus (r): The distance from the origin		$r = \lvert z\rvert = \sqrt{a^2 + b^2}$	
$\boldsymbol{z = a + bi}$	$z = r(cos\theta + isin\theta) = r(cis\theta)$	Argument (θ): the angle is subtended from the real axis		$\theta = \tan^{-1}\frac{b}{a}$	

Topic 1: Algebra		*Permutations and Combinations*	
$\times$: AND	$+$: OR	$-$: EXCLUDING	
Permutations (pick): To pick $\boldsymbol{r}$ objects out of $\boldsymbol{n}$ distinct objects is:	${}^nP_r = \frac{n!}{(n-r)!}$	Combinations (choose): To choose r objects out of n distinct objects (order not important) is:	${}^nC_r = \frac{n!}{r!\,(n-r)!} = \binom{n}{r}$

Topic 1: Algebra		*Sum and Product of Roots*		
Formula of Quadratic: $\boldsymbol{x^2 - (\alpha + \beta)x + \alpha\beta}$ or $\boldsymbol{x^2 - S_N x + P_N}$				
For a quadratic equation:	$S_N = \alpha + \beta = -\frac{b}{a}$	For a polynomial:	$S_N = \alpha + \beta = -\frac{a_{n-1}}{a_n} = -\frac{second}{first}$	
	$P_N = \alpha\beta = \frac{c}{a}$		$P_N = \alpha\beta = \frac{(-1)^n a_n}{a_n} = \frac{last}{first}$	Odd number: Negative Even number: Positive