

# OSSD - Calculus and Vector

MCV4U

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**Unit 1: Rate of change.** In the first unit, we will discuss the concept of Rate of Change, Continuity and Limits. Also, the the introduction to the Derivatives will be discussed.

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# 1 Continuity and Limits

## 1.1 Continuity and Limits

**Definition 1.1** (Limits Law). Assume we have function  $f(x)$  and  $g(x)$ , which

$$\lim_{x \rightarrow a} f(x) \text{ and } \lim_{x \rightarrow a} g(x) \text{ both exist}$$

We also have constant  $c$  We get these properties:

(i)

$$\lim_{x \rightarrow a} c = c$$

(ii)

$$\lim_{x \rightarrow a} x = a$$

(iii)

$$\lim_{x \rightarrow a} [f(x) + g(x)] = \lim_{x \rightarrow a} f(x) + \lim_{x \rightarrow a} g(x)$$

(iv)

$$\lim_{x \rightarrow a} [f(x) - g(x)] = \lim_{x \rightarrow a} f(x) - \lim_{x \rightarrow a} g(x)$$

(v)

$$\lim_{x \rightarrow a} [f(x) * g(x)] = \lim_{x \rightarrow a} f(x) * \lim_{x \rightarrow a} g(x)$$

(vi)

$$\lim_{x \rightarrow a} \frac{f(x)}{g(x)} = \frac{\lim_{x \rightarrow a} f(x)}{\lim_{x \rightarrow a} g(x)}$$

(vii)

$$\lim_{x \rightarrow a} [f(x)]^n = (\lim_{x \rightarrow a} f(x))^n$$

(viii)

$$\lim_{x \rightarrow a} \sqrt[n]{f(x)} = \sqrt[n]{(\lim_{x \rightarrow a} f(x))}$$

Somes cases you should be careful

**Example 1.2.** Evaluate and simplify

$$\lim_{x \rightarrow a} \sqrt{x}$$

Recall: if a limit exist

(i)

$$\lim_{x \rightarrow a^-} f(x) \text{ exists}$$

(ii)

$$\lim_{x \rightarrow a^+} f(x) \text{ exists}$$

(iii)

$$\lim_{x \rightarrow a^-} f(x) = \lim_{x \rightarrow a^+} f(x)$$

In this case,

$$\lim_{x \rightarrow 0^-} \sqrt{x} \text{ does not exist}$$

because

$$D : x \in \mathcal{R} | x \geq 0$$

**Example 1.3.** Evaluate and simplify:

$$\lim_{x \rightarrow 1} x^2 - 5x$$

*Remark.* Please be carefull with the bracket, don't mix with

$$\lim_{x \rightarrow 1} (x^2 - 5x)$$

The solution should be:

$$\begin{aligned} &= (\lim_{x \rightarrow 1} x)^2 - 5x \\ &= (1)^2 - 5x \\ &= 1 - 5x \end{aligned}$$

## 2 Reference Sheet

### 2.1 Assume Knowledge

#### 2.1.1 Log Laws

$$\log_b A + \log_b B = \log_b (A \times B)$$

$$\log_b \left( \frac{M}{N} \right) = \log_b M - \log_b N$$

$$\log_b M^k = k \log_b M$$

$$\log_b b^k = k$$

$$b^{\log_b k} = k$$

#### 2.1.2 Trig Laws

$$\tan \theta = \frac{\sin \theta}{\cos \theta}$$

$$\cot \theta = \frac{\cos \theta}{\sin \theta}$$

$$\csc \theta = \frac{1}{\sin \theta}$$

$$\sec \theta = \frac{1}{\cos \theta}$$

$$\sin^2 \theta + \cos^2 \theta = 1$$

$$1 + \cot^2 \theta = \csc^2 \theta$$

$$\tan^2 \theta + 1 = \sec^2 \theta$$

$$\sin(A \pm B) = \sin A \cos B \pm \sin B \cos A$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\tan(\alpha \pm \beta) = \frac{\tan \alpha \pm \tan \beta}{1 \mp \tan \alpha \tan \beta}$$

sin Law:

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

Cosine Law:

$$a^2 = b^2 + c^2 - 2bc \cos A$$

Unit Circle:

