

2.10 Derivatives of tan x, cot x, sec x, and csc x

Name: _____ Class: _____ Date: _____ Total: 9 marks

KEY WORDS trigonometric functions 三角函数 • derivative 导数

Objective

Build the skills to answer exam questions on the derivatives of tangent, cotangent, secant, and cosecant.

You must be able to:

- state and use the derivatives of the four remaining trigonometric functions 三角函数

1 Worked examples

Study these first. Each one shows the method for a question type used later.

More trig derivatives

$$\frac{d}{dx}[\tan x] = \sec^2 x, \quad \frac{d}{dx}[\cot x] = -\csc^2 x,$$

$$\frac{d}{dx}[\sec x] = \sec x \tan x, \quad \frac{d}{dx}[\csc x] = -\csc x \cot x.$$

2 Practice

2.1 State $\frac{d}{dx}[\tan x]$. [1]

2.2 State $\frac{d}{dx}[\sec x]$. [1]

2.3 State $\frac{d}{dx}[\cot x]$ and $\frac{d}{dx}[\csc x]$. [2]

3 Exam-style questions

3.1 $\frac{d}{dx}[\tan x]$ equals [1]

- A $\sec^2 x$
- B $-\csc^2 x$
- C $\sec x \tan x$
- D $-\sin x$

3.2 $\frac{d}{dx}[\sec x]$ equals [1]

- A $\sec^2 x$
- B $\sec x \tan x$
- C $-\csc x \cot x$
- D $\tan x$

3.3 Differentiate each.

(a) $\tan x$. [1]

(b) $\cot x$. [1]

(c) $\csc x$. [1]

Solutions

2.1 $\sec^2 x$.

2.2 $\sec x \tan x$.

2.3 $\frac{d}{dx}[\cot x] = -\csc^2 x$; $\frac{d}{dx}[\csc x] = -\csc x \cot x$.

3.1 A.

3.2 B.

3.3 (a) $\sec^2 x$. (b) $-\csc^2 x$. (c) $-\csc x \cot x$.