2.10 Derivatives of Tangent, Cotangent, Secant, and Cosecant

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

KEY WORDS trigonometric functions • derivative

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**

1 Key knowledge and 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

Each answer shows the steps, then the **result**.

2.1

- $\sec^2 x$

2.2

- $\sec x \tan x$

2.3

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

3.1 A

- $\sec^2 x$.

3.2 B

- $\sec x \tan x$.

3.3

(a)

- $\sec^2 x$

(b)

- $-\csc^2 x$

(c)

- $-\csc x \cot x$