

# 2.10 Derivatives of Tangent, Cotangent, Secant, and Cosecant

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 9 marks

## 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]

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### 3 Exam-style questions

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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]

### 4 Go further

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- work through the **2.10 Finding the Derivatives of Tangent, Cotangent, Secant, and/or Cosecant Functions** lesson on the **Learn** page;
- read the **Differentiation: Definition and Fundamental Properties** section of the AP Calculus BC handout on the **Know** page.

## Solutions

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**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)  $-\csc x \cot x$ .