

## 3.2 Implicit Differentiation

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

Total: 9 marks

### Objective

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Build the skills to answer exam questions on **implicit differentiation**.

You must be able to:

- differentiate an **implicit relation** 隐式关系 by attaching  $\frac{dy}{dx}$  to every  $y$
- solve for  $\frac{dy}{dx}$

### 1 Worked examples

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

#### ■ Implicit differentiation

Differentiate both sides with respect to  $x$ , writing  $y'$  each time you differentiate  $y$  (the chain rule), then solve for  $y'$ .

#### ■ Example

$$x^2 + y^2 = 25 \Rightarrow 2x + 2y y' = 0 \Rightarrow y' = -\frac{x}{y}.$$

### 2 Practice

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2.1 State what to attach when differentiating  $y$ . [1]

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2.2 Differentiate  $x^2 + y^2 = 25$  implicitly. [2]

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2.3 State the final step. [1]

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### 3 Exam-style questions

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3.1 In implicit differentiation, differentiating  $y^2$  gives [1]

- A  $2y$
  - B  $2y y'$
  - C  $y'$
  - D  $2x$
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3.2 After differentiating, you [1]

- A stop
  - B solve for  $\frac{dy}{dx}$
  - C set  $y = 0$
  - D integrate
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3.3  $x^2 + y^2 = 25$ .

(a) Differentiate both sides. [1]

(b) Isolate the  $y'$  term. [1]

(c) Solve for  $y'$ . [1]

### 4 Go further

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- work through the **3.2 Implicit Differentiation** lesson on the **Learn** page;
- read the **Differentiation: Composite, Implicit, and Inverse Functions** section of the AP Calculus AB handout on the **Know** page.

## Solutions

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**2.1** the factor  $\frac{dy}{dx}$  (i.e.  $y'$ ).

**2.2**  $2x + 2y y' = 0$ , so  $y' = -\frac{x}{y}$ .

**2.3** solve the equation for  $\frac{dy}{dx}$ .

**3.1 B.**

**3.2 B.**

**3.3** (a)  $2x + 2y y' = 0$ . (b)  $2y y' = -2x$ . (c)  $y' = -\frac{x}{y}$ .