AP CALCULUS BC • EXERCISE SHEET

4.5 Solving Related Rates Problems

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

Objective

Build the skills to answer exam questions on **solving related rates problems**.

You must be able to:

- carry out the full related-rates procedure and solve for the unknown rate

1 Worked examples

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

■ Solving related rates

1. write the relation;
2. differentiate with respect to t;
3. substitute the known values and rates;
4. solve for the unknown rate.

■ Example

A circle's radius grows at $\frac{dr}{dt} = 2$ cm/s. At $r = 3$: $\frac{dA}{dt} = 2\pi r \frac{dr}{dt} = 2\pi(3)(2) = 12\pi$ cm^2/s.

2 Practice

2.1 List the steps of a related-rates solution. [1]

2.2 A circle's r grows at 2 cm/s. At $r = 3$, find $\frac{dA}{dt}$ (with $A = \pi r^2$). [2]

2.3 State the units of $\frac{dA}{dt}$ here. [1]

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3 Exam-style questions

3.1 After differentiating, the next step is to [1]

- **A** stop
- **B** substitute known values and solve
- **C** integrate
- **D** graph

3.2 If $\frac{dr}{dt} = 2$ and $r = 3$, then $\frac{dA}{dt} = 2\pi r \frac{dr}{dt}$ equals [1]

- **A** 6π
- **B** 12π
- **C** 4π
- **D** 9π

3.3 $A = \pi r^2$, $\frac{dr}{dt} = 2$, $r = 3$.

(a) Write $\frac{dA}{dt} = 2\pi r \frac{dr}{dt}$. [1]

(b) Substitute. [1]

(c) State $\frac{dA}{dt}$. [1]

4 Go further

- work through the **4.5 Solving Related Rates Problems** lesson on the **Learn** page;
- read the **Contextual Applications of Differentiation** section of the AP Calculus BC handout on the **Know** page.

Solutions

2.1 write the relation; differentiate with respect to t; substitute; solve for the unknown rate.

2.2 $\dfrac{dA}{dt} = 2\pi(3)(2) = 12\pi$ cm^2/s.

2.3 cm^2/s.

3.1 B.

3.2 B.

3.3 (a) $\dfrac{dA}{dt} = 2\pi r \dfrac{dr}{dt}$. (b) $2\pi(3)(2)$. (c) 12π cm^2/s.