

4.5 Solving Related Rates Problems

Name: _____ Class: _____ Date: _____

Total: 9 marks

KEY WORDS related rates

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 Key knowledge and 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 $r = 3$: $\frac{dA}{dt} = 2\pi r \frac{dr}{dt} = 2\pi(3)(2) = 12\pi$ cm²/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]

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]

Solutions

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

2.1

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

2.2

- $\frac{dA}{dt} = 2\pi(3)(2) = 12\pi \text{ cm}^2/\text{s}$

2.3

- cm^2/s

3.1 B

- substitute known values and solve.

3.2 B

- 12π .

3.3

(a)

- $\frac{dA}{dt} = 2\pi r \frac{dr}{dt}$

(b)

- $2\pi(3)(2)$

(c)

- $12\pi \text{ cm}^2/\text{s}$