

2.12 Logarithmic Function Manipulation

Name: _____ Class: _____ Date: _____

Total: 9 marks

KEY WORDS laws of logarithms

• logarithmic function

• change-of-base

• logarithm

• base

Objective

Build the skills to answer exam questions on **logarithmic function manipulation**.**You must be able to:**

- apply the **laws of logarithms** (product, quotient, power)
- use the **change-of-base** formula

1 Key knowledge and worked examples

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

■ Laws of logarithms

$$\log_b(xy) = \log_b x + \log_b y, \quad \log_b\left(\frac{x}{y}\right) = \log_b x - \log_b y, \quad \log_b(x^n) = n \log_b x.$$

■ Change of base

$$\log_b(x) = \frac{\ln x}{\ln b}.$$

■ Example

$$\log_2(8x) = \log_2 8 + \log_2 x = 3 + \log_2 x.$$

2 Practice

2.1 Expand $\log(xy)$.

[1]

2.2 Write $\log(x^3)$ using the power rule. [1]

2.3 Combine $\log 6 + \log 2$ into a single logarithm. [2]

3 Exam-style questions

3.1 $\log_b(xy)$ equals [1]

- ☐ **A** $\log_b x \cdot \log_b y$
B $\log_b x + \log_b y$
C $\log_b x - \log_b y$
D $\log_b(x + y)$

3.2 $\log_b(x^n)$ equals [1]

- ☐ **A** $n + \log_b x$
B $n \log_b x$
C $(\log_b x)^n$
D $\log_b(nx)$

3.3 Expand $\log_2(8x)$.

(a) Apply the product rule. [1]

(b) Evaluate $\log_2 8$. [1]

(c) Write the final expression. [1]

Solutions

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

2.1

- $\log x + \log y$

2.2

- $3 \log x$

2.3

- $\log(6 \cdot 2) = \log 12$

3.1 B

- $\log_b x + \log_b y.$

3.2 B

- $n \log_b x.$

3.3

(a)

- $\log_2 8 + \log_2 x$

(b)

- 3

(c)

- $3 + \log_2 x$