

2.4 Exponential Function Manipulation

Name: _____ Class: _____ Date: _____

Total: 9 marks

KEY WORDS laws of exponents • exponential function

Objective

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

- apply the **laws of exponents** (product, quotient, power)
- rewrite $a \cdot b^{x+c}$ as a constant times b^x

1 Key knowledge and worked examples

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

■ Laws of exponents

$$b^{m+n} = b^m \cdot b^n; b^{m-n} = \frac{b^m}{b^n}; (b^m)^n = b^{mn}.$$

■ Rewriting a shift as a scaling $a \cdot b^{x+c} = (a \cdot b^c) \cdot b^x$ – a horizontal shift of an exponential is the same as a vertical scaling.**■ Example**

$$5 \cdot 2^{x+2} = 5 \cdot 2^2 \cdot 2^x = 20 \cdot 2^x.$$

2 Practice

2.1 Simplify $b^3 \cdot b^4$. [1]

2.2 Simplify $(b^2)^5$. [1]

2.3 Rewrite 2^{x+3} as a constant times 2^x . [2]

3 Exam-style questions

3.1 $b^m \cdot b^n$ equals [1]

- ☐ **A** b^{mn}
B b^{m+n}
C b^{m-n}
D $b^m + b^n$

3.2 $(b^m)^n$ equals [1]

- ☐ **A** b^{m+n}
B b^{mn}
C $b^m \cdot n$
D b^{m-n}

3.3 Rewrite $5 \cdot 2^{x+2}$ as a constant times 2^x .

- (a) Split the exponent. [1]
(b) Evaluate 2^2 . [1]
(c) Write the result as a constant times 2^x . [1]

Solutions

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

2.1

- b^7

2.2

- b^{10}

2.3

- $2^{x+3} = 2^3 \cdot 2^x = 8 \cdot 2^x$

3.1 B

- b^{m+n} .

3.2 B

- b^{mn} .

3.3

(a)

- $5 \cdot 2^{x+2} = 5 \cdot 2^2 \cdot 2^x$

(b)

- $2^2 = 4$

(c)

- $20 \cdot 2^x$