Numbers and shapes

VOCABULARY PRACTICE

ADVANCED | C1

Name: _____ **Date:** _____

1 Match each advanced mathematical concept with its meaning.

1 cardinality	____	a property unchanged under a specified transformation
2 scalar quantity	____	b estimate expressed on a power-of-ten scale
3 vector quantity	____	c study of properties preserved under continuous deformation
4 tessellation	____	d quantity described by magnitude and direction
5 topology	____	e repeated covering of a surface without gaps or overlaps
6 fractal dimension	____	f value close to, rather than exactly equal to, a target
7 geometric invariant	____	g measure of the number of elements in a set
8 asymptotic behaviour	____	h quantity described by magnitude alone
9 order of magnitude	____	i measure capturing how a fractal fills space
10 numerical approximation	____	j way a function behaves as its input approaches a limit

2 Complete the advanced mathematics collocations.

approximation | behaviour | dimension | invariant | magnitude | quantity | scale | tessellation

1 a scalar _____

2 order of _____

3 numerical _____

4 asymptotic _____

5 fractal _____

6 a geometric _____

7 a logarithmic _____

8 construct a regular _____

3 Choose the concept that best captures the distinction.

1 Velocity includes direction: *vector / scalar quantity*.

2 Temperature has magnitude only: *scalar / vector quantity*.

3 A pattern covers a plane without gaps: *tessellation / topology*.

4 A coffee cup and ring are equivalent under deformation: *topology / cardinality*.

5 The estimate is accurate but not exact: *numerical approximation / invariant*.

6 The long-run trend of a function concerns *asymptotic behaviour / fractal dimension*.

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4 Complete the advanced mathematics review with terms from the box.

asymptotic behaviour | cardinality | fractal dimension | geometric invariant | numerical approximation | order of magnitude | scalar quantity | tessellation | topology | vector quantity

The number of elements in a set is its **1** _____. Mass is a **2** _____, whereas force is a **3** _____. A plane covered by repeating tiles demonstrates **4** _____. The study of continuous deformation belongs to **5** _____, where a preserved property may act as a **6** _____. Irregular self-similar forms can be described by **7** _____. When an exact calculation is impractical, a **8** _____ may suffice. The scale of a value can be summarised by its **9** _____, while long-run function trends reveal **10** _____.

5 Read the text and answer the questions concisely.

Modelling imperfect shapes

Classical geometry describes ideal lines, circles and solids, but many natural structures are irregular. Coastlines, branching trees and cloud boundaries may show detail across several scales. Fractal models capture aspects of this complexity through repeated patterns and non-integer dimensions. The measured length of a coastline can depend on the size of the measuring unit: smaller units follow more detail and usually produce a longer result. The model is useful, but it remains an approximation rather than a complete copy of nature.

1 What does classical geometry describe? _____

2 Which natural structures are mentioned? _____

3 How do fractal models represent complexity? _____

4 Why can coastline length vary? _____

5 What happens with smaller measuring units? _____

6 What limitation of the model is stated? _____

6 Paraphrase using the expression in capitals.

1 The value differs by roughly a factor of one thousand. **MAGNITUDE** _

2 The property remains unchanged after rotation. **INVARIANT** _

3 The calculation gives a close but inexact value. **APPROXIMATION** _

4 The pattern fills the surface without gaps. **TESSELLATION** _

OVER TO YOU

Write a **160-190 word** discussion of how mathematical models simplify shape or quantity. Address assumptions, scale, precision and limitations.

[ ] Use at least ten target terms or collocations. [ ] Distinguish model from reality. [ ] Evaluate precision cautiously.

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ANSWER KEY

1 Advanced mathematical concepts

1 **g** 2 **h** 3 **d** 4 **e** 5 **c** 6 **i** 7 **a** 8 **j** 9 **b** 10 **f**

2 Advanced mathematics collocations

1 **quantity** 2 **magnitude** 3 **approximation** 4 **behaviour** 5 **dimension** 6 **invariant** 7 **scale** 8 **tessellation**

3 Conceptual distinctions

1 **vector quantity** 2 **scalar quantity** 3 **tessellation**
4 **topology** 5 **numerical approximation** 6 **asymptotic behaviour**

4 Advanced mathematics review

1 **cardinality** 2 **scalar quantity** 3 **vector quantity** 4 **tessellation** 5 **topology**
6 **geometric invariant** 7 **fractal dimension** 8 **numerical approximation** 9 **order of magnitude** 10 **asymptotic behaviour**

5 Reading - suggested answers

1 Ideal lines, circles and solids. 2 Coastlines, trees and clouds. 3 Through repeated patterns and non-integer dimensions.
4 It depends on measuring-unit size. 5 More detail is followed and the result grows. 6 It is only an approximation.

6 Paraphrasing - possible answers

1 They differ by three orders of **magnitude**. 2 It is a geometric **invariant**. 3 It is a numerical **approximation**. 4 The pattern forms a **tessellation**.

Over to you: Answers will vary. Check mathematical precision, assumptions, scale and limitations.