Logarithmic scales: 10 practice questions

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Name: _____ Date: _____

Attempt all questions and show your working. Suggested time: 15 to 20 minutes.

Section A: Consolidating (Questions 1-4)

Question 1

Write each number as a power of 10.

(a) 1000

(b) 0.001

(c) 1,000,000

(d) 0.1

Question 2

On a logarithmic scale, each mark is 10 times the mark before it. Four of the marks, in order, are labelled 1, 10, 100, 1000.

(a) What are the labels on the next two marks after 1000?

(b) What are the labels on the two marks just before 1?

Question 3

Without a calculator, find:

(a) $\log_{10} 100$

(b) $\log_{10} 10{,}000$

(c) $\log_{10} 0.01$

Question 4

On the pH scale, each decrease of 1 means the solution is 10 times more acidic.

How many times more acidic is a drink with pH 3 than a drink with pH 5?

Section B: Standard (Questions 5-10)

Question 5

The Richter scale is a logarithmic scale: each increase of 1 in magnitude means the ground shaking (amplitude) is 10 times larger.

(a) How many times larger is the amplitude of a magnitude 7 earthquake than a magnitude 5 earthquake?

(b) An earthquake has an amplitude 1000 times larger than a magnitude 3.2 earthquake. What is its magnitude?

(c) Explain why a magnitude 6 earthquake is not "twice as strong" as a magnitude 3 earthquake.

Question 6

Sound level is measured in decibels (dB). Each increase of 10 dB means the sound intensity is multiplied by 10.

(a) A normal conversation is 60 dB and a lawn mower is 90 dB. How many times more intense is the lawn mower?

(b) A rock concert is 110 dB. How many times more intense is it than the conversation?

(c) A sound is 100 times less intense than a 70 dB vacuum cleaner. What is its sound level?

Question 7

Write each measurement in scientific notation, and state the power of 10 it lies between (for example, between 10^2 and 10^3).

(a) The width of a human hair: 0.00008 m

(b) The height of Uluru above the surrounding plain: 348 m

(c) The distance from Earth to the Sun: 150 000 000 km

Question 8

On a horizontal axis with a logarithmic scale, the marks for 10 and 100 are 3 cm apart.

(a) How far apart are the marks for 100 and 10 000?

(b) How far to the right of the mark for 100 is the mark for 1000?

(c) How far, and in which direction, is the mark for 0.1 from the mark for 10?

Question 9

Tom wants to draw a column graph of the populations of a country town (2000 people), a regional city (90 000 people), a capital city (5 000 000 people) and a whole country (26 000 000 people).

Explain why a logarithmic scale on the vertical axis would be more useful than an ordinary scale.

Question 10

Use $\log_{10} 2 \approx 0.301$ to find, without a calculator:

(a) $\log_{10} 20$

(b) $\log_{10} 200$

(c) $\log_{10} 0.2$

Hint: write each number as $2 \times$ a power of 10.

Logarithmic scales: answers

Question 1

Answer: (a) 10^3 (b) 10^{-3} (c) 10^6 (d) 10^{-1}

Question 2

Answer: (a) 10,000 and 100,000 (b) 0.1 and 0.01 (in order: 0.01, 0.1, then 1)

Question 3

Answer: (a) 2 (b) 4 (c) -2

Question 4

Answer: 100 times (10^2)

Question 5

Answer: (a) 100 times (b) 6.2 (c) An increase of 3 in magnitude means $10^3 = 1000$ times the amplitude, not 2 times, because the scale goes up by multiplying by 10 for each step.

Question 6

Answer: (a) 1000 times (b) 100,000 times (10^5) (c) 50 dB

Question 7

Answer: (a) 8×10^{-5} m, between 10^{-5} and 10^{-4} (b) 3.48×10^2 m, between 10^2 and 10^3 (c) 1.5×10^8 km, between 10^8 and 10^9

Question 8

Answer: (a) 6 cm (b) 3 cm (c) 6 cm to the left

Question 9

Answer: The values range over several powers of 10. On an ordinary scale the town (and the regional city) would be too small to see next to 26 million; a log scale spaces each power of 10 evenly, so every value can be shown and compared clearly.

Question 10

Answer: (a) 1.301 (b) 2.301 (c) -0.699 (0.301 - 1)