SCIENCE FOUNDATIONS

Dilution calculations

Difficulty level: Advanced

Science Foundations

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Overview of the concept

This is how a nurse mixes a weaker medicine from a strong stock bottle, or how you water down concentrated juice so it tastes right. A cleaner dilutes bleach before mopping, because the strong stock would damage the floor. A lab tech prepares a standard solution at exactly the right strength for a test to mean anything. Knowing dilution tells you how much water to add to get the strength you need without wasting the stock or making it too weak to work.



Rule

Dilution calculations: dilution changes the volume and the concentration, but the number of moles of solute stays the same, so $C_1 \times V_1 = C_2 \times V_2$.

Use the same units on both sides.

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Worked examples

EXAMPLE 1

Q Dilute 2.0 mol/L stock to 0.50 mol/L in a final volume of 4.0 L. What stock volume is needed?

SOLUTION

Write the equation with the knowns:

$2.0 \times V_1 = 0.50 \times 4.0$.

Work out the right side:

$0.50 \times 4.0 = 2.0$

Divide by 2.0 to find V_1:

$V_1 = 2.0 \div 2.0 = 1.0$ L

The result is 1.0 L of stock.

EXAMPLE 2

Q What is the final molarity when 1.0 L of 4.0 mol/L stock is diluted to 8.0 L?

SOLUTION

Write the equation:

$4.0 \times 1.0 = M_2 \times 8.0$.

Work out the left side:

$4.0 \times 1.0 = 4.0$

Divide by 8.0 to find M_2:

$M_2 = 4.0 \div 8.0 = 0.50$ mol/L

The result is 0.50 mol/L.

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Practice questions

1 Dilution equation?

A $M_1V_1 = M_2V_2$

B $M_1 + V_1 = M_2 + V_2$

C $\frac{M_1}{V_1} = \frac{M_2}{V_2}$

D $M_1V_2 = M_2V_1$

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2 3.0 mol/L stock to 1.0 mol/L in 6.0 L: stock volume?

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1.5 L of 2.0 mol/L diluted to 5.0 L: final molarity?

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What stays the same in a dilution?

A Moles of solute

B Volume of solution

C Molarity

D Mass of water

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A solution is diluted to twice its volume. What happens to its molarity?

A It halves

B It doubles

C It stays the same

D It drops to zero

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What final volume results when 2.0 L of 3.0 mol/L stock is diluted to 1.5 mol/L?

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7 How much water must be added to 1.0 L of 4.0 mol/L stock to make 2.0 mol/L?

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8 Does dilution change the volume?

A. Yes, it increases

B. No, it stays the same

C. Yes, it decreases

D. Yes, it doubles

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9 A nurse needs 500 mL of 0.20 mol/L saline from 1.0 mol/L stock. What volume of stock, in mL, is needed?

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Which is larger: stock or diluted molarity?

A Stock

B Diluted

C They are equal

D It changes each time

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ANSWER KEY

1. $M_1V_1 = M_2V_2$

2. 2.0 L

3. 0.60 mol/L

4. Moles of solute

5. It halves

6. 4.0 L

7. 1.0 L

8. Yes, it increases

9. 100 mL

10. Stock

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