F_WORKSHEET # 009 | Australian Curriculum Year 8 Mathematics | FWM8T1U1

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Indices, Scientific Notation, Rational Numbers, and Surds

8

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Focus: A set of questions and solutions for Year 8 students on Indices and Scientific Notation, tailored to the Australian Curriculum under the strand 'Number and Algebra':

1. Basic Index Laws:

a) Simplify $3^2 \times 3^3$ **.**

b) Simplify $\frac{5^7}{5^4}$ **.**

2. Negative and Zero Indices:

a) Evaluate 2^{-3}.

b) What is the value of 7^0?

3. Fractional Indices:

a) Simplify $8^{\frac{1}{3}}$.

b) Evaluate $16^{\frac{1}{2}}$ **.**

4. Scientific Notation:

a) Convert 0.000056 **into scientific notation.**

b) Express $345{,}000$ **in scientific notation.**

5. Operations with Scientific Notation:

a) Multiply 2.5×10^3 **by** 3×10^2 **.**

b) Divide 6×10^8 **by** 2×10^4 **.**

6. Application of Indices and Scientific Notation:

a) The distance from Earth to the Sun is approximately $1.5 \times 10^8\, km$ **. If light travels at** $3 \times 10^8\, m/s$ **, how many seconds does it take for light to travel this distance?** $(1\, km = 1000\, m)$

b) If the mass of an electron is approximately $9.1 \times 10^{-31}\, kg$, how many electrons would be needed to have a mass of $1\, kg$?

7. Rational Numbers and surds.

a) What is the result of $-2 + 7$?

b) Put the following set of numbers in ascending order: $\{\, 5, -2, 1, -3{,}7 \,\}$

c) Solve the following multiplication: $-3 \times (-2)$.

d. Perform the division: $\frac{-20}{-3}$.

e) Calculate the following expression involving rational numbers: $\frac{-7}{2} + \frac{1}{4}$.

f) Simplify: $\sqrt{192}$ as much as possible without using a calculator.

Solutions

1a.

Using the law: $a^m \times a^n = a^{m+n}$:

$$\begin{aligned} &\rightarrow 3^2 \times 3^3 \\ &= 3^{2+3} \\ &= 3^5 . \end{aligned}$$

b.

Using the law: $\frac{a^m}{a^n} = a^{m-n}$:

$$\begin{aligned} &\rightarrow \frac{5^7}{5^4} \\ &= 5^{7-4} \\ &= 5^3 . \end{aligned}$$

2a.

$$\begin{aligned} &\rightarrow 2^{-3} \\ &= \frac{1}{2^3} \qquad x^{-n} = \frac{1}{x^n} \\ &= \frac{1}{8} . \end{aligned}$$

b.

Any non-zero number raised to the power of 0, is 1 ,

$$\begin{aligned} &\rightarrow 7^0 \qquad x^0 = 1 \\ &= 1 . \end{aligned}$$

3a.

$8^{\frac{1}{3}}$ means the cube root of 8 :

$$\begin{aligned} &\rightarrow 8^{1/3} \\ &= \sqrt[3]{8} \\ &= 2 . \end{aligned}$$

b.

$16^{\frac{1}{2}}$ means the square root of 16 :

$$\begin{aligned} &16^{1/2} \\ &= \sqrt{16} \\ &= 4 . \end{aligned}$$

4a.

Move the decimal point 5 places to the right
to get a number between 1 and 10 :

$$\begin{aligned} & 0.000056 \\ & = 5.6 \times 10^{-5} . \end{aligned}$$

b.

Move the decimal point 5 places to the left:

$$\begin{aligned} & 345{,}000 \\ & = 3.45 \times 10^{5} . \end{aligned}$$

5a.

Multiply the numbers and add the exponents:

$$\begin{aligned} (2.5 \times 3) \times (10^{3} \times 10^{2}) &= 7.5 \times 10^{3+2} \\ &= 7.5 \times 10^{5} . \end{aligned}$$

b.

Divide the numbers and subtract the exponents:

$$\begin{aligned} \frac{6 \times 10^{8}}{2 \times 10^{4}} &= \frac{6}{2} \times 10^{8-4} \\ &= 3 \times 10^{4} . \end{aligned}$$

6a.

First, convert km to metres:

$$\begin{aligned} & \rightarrow 1.5 \times 10^{8}\, km \\ & = 1.5 \times 10^{8}\, \cancel{km} \times 1{,}000\, m / \cancel{km} \\ & = 1.5 \times 10^{8} \times 1 \times 10^{3}\, m \\ & = (1.5 \times 1) \times (10^{8} \times 10^{3})\, m \\ & = 1.5 \times 10^{8+3}\, m \\ & = 1.5 \times 10^{11}\, m . \end{aligned}$$

Then, calculate time:

$$\begin{aligned} \text{Time} &= \frac{\text{Distance}}{\text{Speed}} \\ &= \frac{1.5 \times 10^{11}\, \cancel{m}}{3 \times 10^{8}\, \cancel{m}/s} \\ &= (1.5 \div 3) \times 10^{11-8}\, s \\ &= 0.5 \times 10^{11-8}\, s \\ &= 0.5 \times 10^{3}\, s \\ &= 500 \text{ seconds} . \end{aligned}$$

b.

$$\text{Number of electrons} = \frac{\text{Total mass}}{\text{Mass of one electron}}$$
$$= \frac{1\ \cancel{kg}}{9.1 \times 10^{-31}\ \cancel{kg}}$$
$$= (1 \div 9.1) \times 10^{+31}$$
$$\approx 0.1099 \times 10^{31}$$
$$\approx 0.11 \times 10^{31}$$
$$\approx 1.1 \times 10^{30}\ .$$

7a.

$2\ .\ (7 - 2)$

b.

$-3, -2, 1, 5\ , 7\ .$

c.

-3 times -2 gives a positive result because multiplying two negatives results in a positive:

($-\times-=+$) If signs are:
opposite → change to $-$
same → change to $+$

$$-3 \times (-2) = 3 \times 2$$
$$= 6\ .$$

d.

Dividing two negative numbers gives a positive result:

$$\frac{-20}{-5} = \frac{20}{5}$$
$$= 4\ .$$

e.

First, find a common denominator (4 in this case):

$$\frac{-7 \times 2}{2 \times 2} = \frac{-10}{4}$$

$$\rightarrow \frac{-14}{2} + \frac{1}{4}$$
$$= \frac{-14}{4} + \frac{1}{4}$$
$$= \frac{-14 + 1}{4}$$
$$= \frac{-13}{4}\ .$$

Additional Notes for Teachers:

Learning Outcomes:
Students should master the manipulation of indices, understanding laws of indices, and be proficient in converting between standard and scientific notation.

Teaching Strategies:
Use real-world examples like distances in space or the size of particles to make indices and scientific notation relevant. Interactive tools or games that involve powers and roots can enhance learning.

Assessment:
Evaluate through exercises requiring simplification of expressions with indices, conversion between standard and scientific notation, and solving problems involving these concepts.

Resources:
Calculators with scientific notation capabilities for real-time practice. Online simulations or software for visualising the scale of numbers in scientific notation.

This set of questions aligns with the Australian Curriculum for Year 8, focusing on deepening students' understanding of indices and their application in scientific notation.

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