02-07-25 MTH 111

1.2 Integers

1.2 Exercise Set, page 69 (51): 1, 2, 6, 18, 25, 32, 39, 40, 48

1.4 Decimals

1.4 Exercise Set, page 112 (94): 1, 2, 4, 5, 9, 10, 18, 19, 25, 31, 33, 42, 44

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1.5 Exercise Set, page 142 (124): 1, 3, 6, 8, 11, 18, 20, 22, 26, 28, 30, 32, 34, 36, 38, 41

I will provide supplementary material about identifying significant digits.

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Exam 1, 02/14/25

1.1, 1.2, 1.4,1.5, significant digits

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### Definition

The significant figures of a given number are those significant or important digits, which convey the meaning according to its accuracy. For example, 6.658 has four significant digits. These substantial figures provide precision to the numbers. They are also termed as significant digits.

### Rules for Significant Figures

- All non-zero digits are significant. 198745 contains six significant digits.
- All zeros that occur between any two non zero digits are significant. For example, 108.0097 contains seven significant digits.
- All zeros that are on the right of a decimal point and also to the left of a non-zero digit is never significant. For example, 0.00798 contained three significant digits.
- All zeros that are on the right of a decimal point are significant, only if, a non-zero digit does not follow them. For example, 20.00 contains four significant digits.
- All the zeros that are on the right of the last non-zero digit, after the decimal point, are significant. For example, 0.0079800 contains five significant digits.
- All the zeros that are on the right of the last non-zero digit are significant if they come from a measurement. For example, 1090 m contains four significant digits.

Co-pilot, what's the relation between accuracy and precision?

I'm still confused. What about accuracy and precision and writing down the digits of a numerical calculation?

Ok, let's break it down. In numerical calculations, accuracy refers to how close your recorded number is to the true value. Precision is about how many digits you include in your number, which shows how detailed your measurement is.

So, if your number is 3.14 but the true value is 3.14159, you're accurate to two decimal places. If you write down 3.1415926, you're very precise because you've included more digits, but you might be less accurate if the true value has fewer significant digits. The goal is to balance both for the most reliable results.

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How do I find the number of significant digits in a number?

Determining significant digits is all about counting the important figures in a number. Here's a quick rundown of the rules:

1. **Non-zero digits** are always significant. For example, in 123.45, all digits are significant.
2. **Any zeros between significant digits** are also significant. For instance, 1002 has four significant digits.
3. **Leading zeros** (zeros to the left of the first non-zero digit) are not significant. For example, 0.0025 has two significant digits (the 2 and the 5).
4. **Trailing zeros** in a decimal number are significant. For example, 2.300 has four significant digits.

So, to find the number of significant digits, you just count all the significant figures in the number, following these rules. How about we try an example together? Give me a number, and I'll show you how to count the significant digits.

# Multiply

$876.05 \times 3.1$

$$\begin{array}{r} 876,05 \\ \times \quad 3,1 \\ \hline 87605 \\ 262815\phantom{0} \\ \hline 2715,755 \end{array}$$

$\approx (900)(3)$

$2700$

$\approx$

$8 \times 4 = 32$

1.5

Memorize

## Exponential Notation (Power)

$a^m$ ← exponent, $a$ ↑ base

$a^m$ means multiply $m$ factors of $a$

$a^m = \underbrace{a \cdot a \cdot a \cdot \ldots \cdot a}_{m \text{ factors}}$

"a raised to the mth power" means multiply a by itself m times, where m is an integer

$(2)(2)(2)(2)(2)(2)(2) = 2^7$

2^7=128

2 ^ 7 =

128

$\left(\frac{5}{6}\right)^2 = \frac{5^2}{6^2} = \frac{25}{36}$

5 ÷ 6 ^ 2 =

0.13888888888888888888888888
8888889

5/36=0.1389 wrong set up

( 5 ÷ 6 ) ^ 2 =

0.69444444444444444444444444

25/36=0.6944

$$(2\cdot 2\cdot 2)(2\cdot 2\cdot 2\cdot 2)$$
$$= 2\cdot 2\cdot 2\cdot 2\cdot 2\cdot 2\cdot 2 = 2^7$$
$$= (2^3)(2^4) = 2^7 = 2^{3+4}$$

$$\boxed{(a^m)(a^n) = a^{m+n}}$$ memorize

$$\frac{2^5}{2^2} = \frac{\cancel{2}\cdot\cancel{2}\cdot 2\cdot 2\cdot 2}{\cancel{2}\cdot\cancel{2}} = 2^3 = 2^{5-2}$$

$$\boxed{\frac{a^m}{a^n} = a^{m-n}}$$ memorize

$$\frac{2^3}{2^3} = \frac{8}{8} = 1$$

By rule $\frac{2^3}{2^3} = 2^{3-3} = 2^0$

To keep our beautiful rule
we define $2^0 = 1$

$$\boxed{a^0 = 1}$$ memorize

$$\frac{2^2}{2^5} = \frac{\cancel{2}\cdot\cancel{2}\ ^{1}}{\cancel{2}\cdot\cancel{2}\cdot 2\cdot 2\cdot 2}$$
$$= \frac{1}{2\cdot 2\cdot 2} = \frac{1}{2^3} = \frac{1}{8}$$

by rule $\frac{2^2}{2^5} = 2^{2-5} = 2^{-3}$

To keep our rule
define $2^{-3} = \frac{1}{2^3}$

$$\boxed{a^{-m} = \frac{1}{a^m}}$$ memorize

$$\frac{2^3}{2^2} = \frac{\cancel{2}\cdot\cancel{2}\cdot 2}{\cancel{2}\cdot\cancel{2}\ _{1}} = 2$$

by rule $2^3$ $\;^{3-2}$ $\;^{1}$

by rule $\frac{2^3}{2^2} = 2^{3-2} = 2^1$

define $2^1 = 2$

rule $\boxed{a^1 = a}$ memorize

by rule $3^{\frac{1}{2}} \cdot 3^{\frac{1}{2}} = 3^{\frac{1}{2}+\frac{1}{2}} = 3^1 = 3$

$\sqrt{3} \cdot \sqrt{3} = 3$

define $3^{\frac{1}{2}} = \sqrt{3}$

$\boxed{a^{\frac{1}{2}} = \sqrt{a}}$ memorize

$\boxed{\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}}$

Power of a quotient =
Quotient of the powers

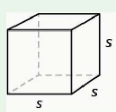
$\left(\frac{2}{3}\right)^4 = \frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3}$

$= \frac{2 \cdot 2 \cdot 2 \cdot 2}{3 \cdot 3 \cdot 3 \cdot 3} = \frac{2^4}{3^4}$

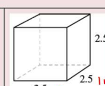
Memorize

**Volume and Surface Area of a Cube**

For any cube with sides of length $s$,




Volume: $V = s^3$
Surface Area: $S = 6s^2$

| | |
|---|---|
| Step 1. **Read** the problem. Draw the figure and label it with the given information. |  |

| a) | |
|---|---|
| Step 2. **Identify** what you are looking for. | the volume of the cube |
| Step 3. **Name.** Choose a variable to represent it. | let $V$ = volume |
| Step 4. **Translate.** Write the appropriate formula. | $V = s^3$ |
| Step 5. **Solve.** Substitute and solve. | $V = (2.5)^3$ $V = 15.625$ $V = (2.5\text{ in})^3 = (2.5)^3\text{ in}^3$ |
| Step 6. **Check:** Check your work. | $V = 15.625\text{ in}^3$ |
| Step 7. **Answer** the question. | The volume is 15.625 cubic inches. |

| b) | |
|---|---|
| Step 2. **Identify** what you are looking for. | the surface area of the cube |
| Step 3. **Name.** Choose a variable to represent it. | let $S$ = surface area |
| Step 4. **Translate.** Write the appropriate formula. | $S = 6s^2 = 6(2.5\text{ in})^2$ |
| Step 5. **Solve.** Substitute and solve. | $S = 6 \cdot (2.5)^2$ $S = 37.5$ $= 6 \cdot (2.5)^2\text{ in}^2$ $= 37.5\text{ in}^2$ |
| Step 6. **Check:** The check is left to you. | |
| Step 7. **Answer** the question. | The surface area is 37.5 square inches. |

| | |
|---|---|
| Step 5. **Solve.** Substitute and solve. | $S = 6 \cdot (2.5)^2$<br>$S = 37.5$<br>$= 6 \cdot (2.5)\ in^2$<br>$\boxed{= 37.5\ in^2}$ |
| Step 6. **Check:** The check is left to you. | |
| Step 7. **Answer** the question. | The surface area is 37.5 square inches. |

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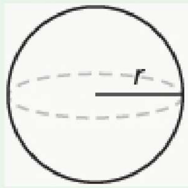
## Volume and Surface Area of a Sphere

For a sphere with radius $r$:




Volume: $V = \frac{4}{3}\pi r^3$

Surface Area: $S = 4\pi r^2$

memorize

## Scientific Notation

A number is expressed in scientific notation when it is of the form

$a \times 10^n$ where $1 \leq a < 10$ and $n$ is an integer

$\underbrace{365}_{\leftarrow 2\ \text{places}} = 3.65 \times 10^2$

$0.\underbrace{07}_{\rightarrow 2\ \text{places}}4 = 7.4 \times 10^{-2}$

Memorize the process

### HOW TO: Convert from decimal notation to scientific notation

1. Move the decimal point so that the first factor is greater than or equal to 1 but less than 10.
2. Count the number of decimal places, *n*, that the decimal point was moved.
3. Write the number as a product with a power of 10.
   If the original number is:

Memorize the process

**HOW TO: Convert scientific notation to decimal form.**

To convert scientific notation to decimal form:

1. Determine the exponent, $n$, on the factor 10.
2. Move the decimal $n$ places, adding zeros if needed.
    - If the exponent is positive, move the decimal point $n$ places to the right.
    - If the exponent is negative, move the decimal point $|n|$ places to the left.
3. Check.

$$8.0713 \times 10^3 \approx (8)(1000) = 8000$$

$$8071.3 \approx 8000$$

$$(300)(0.08) =$$

1. convert to scientific notation
2. do the calculation with rules of exponents
3. convert back to decimal form

$$(3 \times 10^2)(8 \times 10^{-2})$$

$$= (3)(8)(10^2 \times 10^{-2})$$

$$= (24)(10^{2-2})$$

$$= 24 \times 10^0$$

$$= \boxed{2.4 \times 10^1}$$

$$= 24$$

300*0.08=24.0

$$\frac{0.54}{3.9} = \frac{5.4 \times 10^{-1}}{3.9 \times 10^0}$$

$$= \left(\frac{5.4}{3.9}\right)(10^{-1}) \approx 1.3846 \times 10^{-1}$$

order of

$$= \left(\frac{5.4}{3.9}\right)\left(10^{-1}\right) \approx 1.3846 \times 10^{-1}$$

$$= \boxed{0.13846} \approx \boxed{1 \times 10^{-1}}$$ order of magnitude

5.4/3.9=1.3846

agree

Use scientific notation and rounding to single digits to estimate the calculation.

$$\frac{0.54}{3.9} = \frac{5.4 \times 10^{-1}}{3.9 \times 10^{0}} \approx \frac{5 \times 10^{-1}}{4 \times 10^{0}} \approx \boxed{1 \times 10^{-1}}$$

approximate

Use scientific notation and rounding to a single digit, to estimate the calculation.

Then use your calculator and convert answer to scientific notation rounded to a single digit.
Compare orders of magnitude

(38.56*807.1*0.2)/(571*0.04)=272.5199

$$\approx 300 = \boxed{3 \times 10^{2}}$$

order of magnitude

$$\frac{(38.56)(807.1)(0.2)}{(571)(0.04)}$$

$$\approx \frac{(4 \times 10^{1})(8 \times 10^{2})(2 \times 10^{-1})}{(6 \times 10^{2})(4 \times 10^{-2})}$$

$$= \frac{(\cancel{4})(8)(\cancel{2})}{(\cancel{6})(\cancel{4})} \times \frac{10^{1+2-1}}{10^{2-2}}$$

3

$$= \frac{8}{3} \times \frac{10^{2}}{10^{0}}$$

$$= \frac{8}{3} \times 10^{2}$$

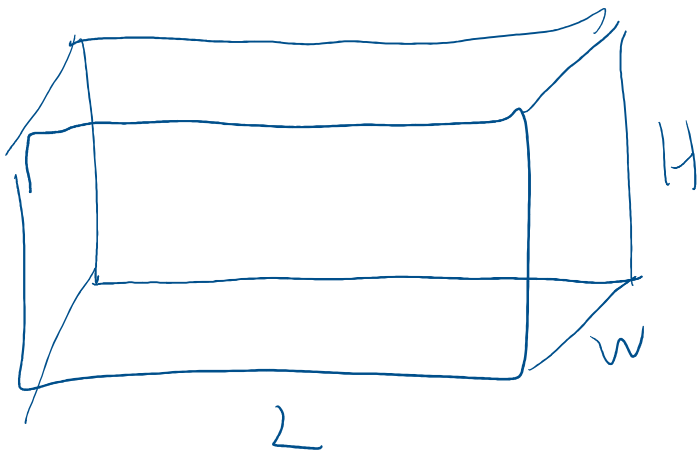
agree

$= \frac{8}{3} \times 10$

$\approx \frac{9}{3} \times 10^2$

$= \boxed{3 \times 10^2}$

2 order of magnitude




$\text{Volume} = (L)(W)(H)$

$\text{surface area} = 2(LH) + 2(LW) + 2(HW)$

$= 2(LH + LW + HW)$

cube $L = W = H = s$

memorize

$\text{Volume } s \cdot s \cdot s = s^3$

$\text{surface area} = 2(s^2 + s^2 + s^2)$

$= 2(3)(s^2)$

$= \boxed{6s^2}$