Name: Key Period: ___ Date: _____

Homework – Significant Figures and Scientific Notation

Determine the number of significant figures for each of the following.

1.	5.432	4	6.	40.319	5	11.	146	3	16.	3.285	4
2.	0.189	3	7.	429.3	4	12.	2873.0	5	17.	99.9	3
3.	0.0023	2	8.	144	3	13.	2500	2	18.	2500.0	5
4.	1.04	3	9.	35.08	4	14.	8365.6	5	19.	48.57193	7
5.	7.500	4	10.	7,500	2	15.	0.920	3	20.	~~0.002~~300	4

Rules 4 + 5

Using significant figures, calculate the following addition and subtraction problems.

placement

1. 12 cm + 0.031 cm + 7.969 cm = 20.cm or 20 cm
2. 0.085 cm + 0.062 cm + 0.14 cm = 0.29 cm
3. 3.419 g + 3.912 g + 7.0518 g + 0.00013 g = 14.383g
4. 8.7 g + 15.43 g + 19 g = 43 g
5. 143.0 ml + 289.25 ml + 107.85 ml = 540.1 ml
6. 41.025 cm – 23.28 cm = 17.75cm
7. 289 g – 43.7 g = 245g
8. 145.63 ml – 28.9 ml = 116.7ml
9. 62.47 g – 39.9 g = 22.6 g
10. 40.08 ml – 29.0941 ml = 10.99 ml

145.63
- 28.9

40.08
- 29.0941
10.9859

Using significant figures, calculate the following multiplication and division problems.

counting

1. 2.89 cm x 4.01 cm = 11.6 cm^2
2. 17.3 cm x 6.2 cm = 110 cm^2
3. 3.08 m x 1.2 m = 3.7 m^2
4. 5.00 mm x 7.3216 mm = 36.6 mm^2
5. 20.8 dm x 123.1 dm = 2560 dm^2
6. 8.071 cm^2 ÷ 4.216 cm = 1.914 cm
7. 24,789.4 km^2 ÷ 43.5 km = 570. km
8. 109.3758 m^2 ÷ 5.813 m = 18.82 m
9. 6.058 mm^2 ÷ 0.85 mm = 7.1 mm
10. 4.23 m^2 ÷ 18.491 m = 0.229 m

107 → 110
not significant

109.3758 ÷ 5.813 =

$m^2 \div m$ $\frac{m^2}{m}$ $\frac{m \cdot m}{m}$

18.8116 → 18.82

_____ . _____ $\times 10^{n}$ ⑥ 62,500, 6.25×10^{4}

single digit (1-9)

Convert the following standard notations to scientific notation.

1.	28.000.000	2.8×10^{7}	6.	62,500	6.25×10^{4}
2.	305,000	3.05×10^{5}	7.	0.002403	2.403×10^{-3}
3.	0.000024863	2.4863×10^{-5}	8.	8,809,000	8.809×10^{6}
4.	345.23	3.4523×10^{2}	9.	0.251	2.51×10^{-1}
5.	0,00025	2.5×10^{-4}	10.	3,010,000	3.01×10^{6}

Convert the following scientific notations to standard notation.

1.	8.54×10^{12}	8540,000,000,000	6.	3.86×10^{9}	3,860,000,000
2.	2.101×10^{-5}	0.00002101	7.	2.511×10^{-7}	0.0000002511
3.	3.051×10^{7}	30510000	8.	4.820×10^{6}	4,820,000
4.	5.94×10^{-4}	0.000594	9.	2.88×10^{5}	288,000
5.	8.27×10^{3}	8270	10.	4.05×10^{-2}	0.0405

Calculate the following addition and subtraction problems.(Remember Sig. Figs.)

1. $(1.20 \times 10^{2}) + (3.600 \times 10^{3}) + (4.5000 \times 10^{4}) =$ 4.8720×10^{4}
2. $(7 \times 10^{1}) + (6.5 \times 10^{-1}) + (4.9 \times 10^{-2}) =$ 7×10^{1}
3. $(5.3 \times 10^{19}) + (1.32 \times 10^{18}) =$ 5.4×10^{19}
4. $(1.2 \times 10^{1}) + (3.1 \times 10^{-2}) + (7.969 \times 10^{2}) =$ 8.09×10^{2}
5. $(8.5 \times 10^{3}) + (6.2 \times 10^{4}) + (3.412 \times 10^{2}) =$ 7.1×10^{4}
6. $(8.523 \times 10^{2}) - (6.27 \times 10^{1}) =$ 7.896×10^{2}
7. $(3.25 \times 10^{-2}) - (4.679 \times 10^{-5}) =$ 3.25×10^{-2}
8. $(6.452 \times 10^{6}) - (5.352 \times 10^{5}) =$ 5.917×10^{6}
9. $(6.2 \times 10^{-2}) - (6.18 \times 10^{-3}) =$ 5.6×10^{-2}
10. $(2.89 \times 10^{7}) - (4.37 \times 10^{2}) =$ 2.89×10^{7}

Calculate the following multiplication and division problems.(Remember Sig. Figs.)

1. $(6 \times 10^{5}) \times (4 \times 10^{-3}) =$ 2×10^{3}
2. $(3.2 \times 10^{3}) \times (3.332 \times 10^{-5}) =$ 1.1×10^{-1}
3. $(5.432 \times 10^{4}) \times (3.67953 \times 10^{6}) =$ 1.999×10^{11}
4. $(9.8670 \times 10^{-3}) \times (2.1 \times 10^{-4}) =$ 2.1×10^{-6}
5. $(7.26 \times 10^{7}) \times (5.0030 \times 10^{5}) =$ 3.63×10^{13}
6. $(7.7 \times 10^{6}) / (1.1 \times 10^{2}) =$ 7.0×10^{4}
7. $(8.53 \times 10^{5}) / (5.0 \times 10^{3}) =$ 1.7×10^{2}
8. $(9.32 \times 10^{-3}) / (3.1 \times 10^{-5}) =$ 3.0×10^{2}
9. $\dfrac{(2.1 \times 10^{-2})(4.56 \times 10^{5})}{(6.4 \times 10^{-7})} =$ 1.5×10^{10}
10. $\dfrac{(8.4 \times 10^{-5})(1.4 \times 10^{3})}{(4.367 \times 10^{-2})} =$ 2.7×10^{0}

make students add + sign

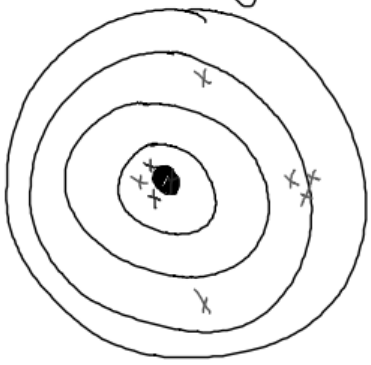
9/22 Evaluating Measurements

Accuracy: how close are your measurements to the accepted value.
(known value, reference value, theoretical value)

This is calculated by **Percent Error**

$$\%\text{ Error} = \left| \frac{\text{measured} - \text{accepted}}{\text{accepted}} \right| \times 100$$

Precision: obtaining the same result everytime. Repeatability



Blue: most accurate + quite precise
Red: lowest for both accuracy + precision
Purple: most precise + low accuracy

precision is measured by **Range**

accepted value is 3.55 cm.

1. 3.52 cm, 2.99 cm, 3.67 cm ← Accurate / Not Precise
2. 2.98 cm, 2.97 cm, 2.96 cm ← Not Accurate / Precise

$$\%\text{ Error} = \left| \frac{2.97\text{cm} - 3.55\text{cm}}{3.55\text{cm}} \right| \times 100 = \boxed{16.3\%\text{ error}}$$

$D = \frac{m}{V}$

The student measured the mass of copper to be 4.22 g and the volume to be 0.88 mL. What is the % error if the actual density is $\boxed{6.39\text{ g/mL}}$?

$$D = \frac{4.22\text{g}}{0.88\text{mL}} = 4.8\text{ g/mL}$$

$$\%\text{ error} = \left| \frac{4.8\text{ g/mL} - 6.39\text{ g/mL}}{6.39\text{ g/mL}} \right| \times 100 = \frac{23.8}{24}\%\text{ error}$$

°C → K

0°C = 273K

−273°C = 0K

9/22 Evaluating Measurements

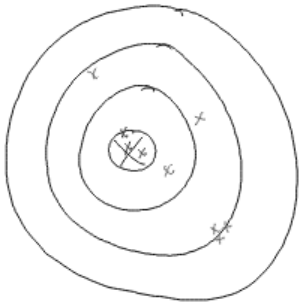
Accuracy: Closeness to the expected result (accepted value, theoretical value, known value)

Accuracy is measured by % error

$$\text{Percent Error} = \left| \frac{\text{measured} - \text{accepted}}{\text{accepted}} \right| \times 100$$

Precision: repeatability (consistency) between measurements

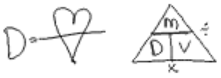
Precision is measured by comparing ranges



blue: most accurate, good precision

red: fairly accurate, poor precision

purple: least accurate, best precision



A student measured the mass of an object to be 4.33g and the volume to be 0.88 ml. ① What is the density?

② What is the percent error if the accepted density is 5.7 g/ml?

$$D = \frac{4.33\text{ g}}{0.88\text{ ml}} = 4.9\text{ g/ml} \qquad \%\text{ Error} = \left| \frac{4.9 - 5.7}{5.7} \right| \times 100 =$$

What is the volume of an object whose density is (13.8 g/ml) (3 sf) with a mass of 25.43g? 14% error

What is the percent error if the known volume is 2.00 ml?

$$V = \frac{m}{D} = \frac{25.43\text{ g}}{13.8\text{ g/ml}} = 1.84\text{ ml} \qquad \left| \frac{1.84 - 2.00}{2.00} \right| \times 100 = 8.00\%\text{ error}$$

Two students measured the length of a steel rod, the known value is 3.50cm. Determine accuracy/precision.

① 3.59cm, 2.74cm, 3.62cm ave = 3.32cm Most accurate

② 2.98cm, 2.99cm, 2.97cm ave = 2.98cm Most precise

°C to K

0°C = 273K $\underbrace{-273°C = 0K}_{\text{absolute zero}}$ cold!

°C + 273 = K K − 273 = °C

52°C = ? K 52 + 273 = 325K -20.°C = 253K 61 K = -212 °C

9/22 Evaluating Measurements

Accuracy: how close a measurement is to the true value

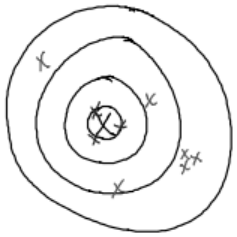
(true value = known, accepted, reference, theoretical)

accuracy is evaluated with Percent Error

$$\left|\frac{(\text{measured} - \text{accepted})}{\text{accepted}}\right| \times 100 = \%\text{ error}$$

Precision: closeness of a set of measurements, compared to each other Repeatability/consistency

precision is measured by range.



blue: most accurate, good precision

red: somewhat accurate, least precision

purple: least accurate, best precision

① What is the density if a student measured the mass as 4.33g and 0.88ml? What is the percent error if the known density is 5.9 g/ml?

$D = \frac{m}{v}$

$$D = \frac{4.33\text{g}}{0.88\text{ ml}} = 4.9\text{ g/ml} \qquad \left|\frac{4.9-5.9}{5.9}\right| \times 100 = 17\%\text{ error}$$

Two students measured a 3.75 cm steel rod. Evaluate their results for accuracy and precision.

① 3.79, 2.80, 3.85 cm — range = 2.80–3.85, ave. = 3.48 cm ← most accurate

② 2.99, 2.97, 2.98 cm — ave. = 2.98 cm, Range = 2.97–2.99 ← most precise

Temperature: Celcius + Kelvin

0°C = 273 K (Standard Temperature) $\qquad$ −273°C = 0 K (absolute zero)

52°C = 325 K $\qquad$ −20.°C = 253 K $\qquad$ 40. °C = 313K