SPH3U
UNIVERSITY PHYSICS

REVIEW: MATH SKILLS

☞ Calculations Using Measurements
(P.651; 653)

Rounding

If measurements are approximate, the calculations based on them must also be approximate. Scientists agree that calculated answers should be rounded so they do not give a misleading idea of how precise the original measurements were. Use these rules when making calculations and rounding answers to calculations.

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Rounding

RULES FOR ROUNDING

1. *When the first digit to be dropped is 4 or less, the last digit retained should **not** be changed.*

    For example: 3.141 326   rounded to 4 digits is   3.141

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Rounding

RULES FOR ROUNDING

2. When the first digit to be dropped is greater than 5, or if it is a 5 followed by at least one digit other than zero, the last digit retained is increased by 1 unit.

For example: 2.221 372   rounded to five digits is   2.2214
                     4.168 501   rounded to four digits is   4.169

Rounding

RULES FOR ROUNDING

3. When the first digit discarded is five or a five followed by only zeros, the last digit retained is increased by 1 if it is odd, but not changed if it is even.

For example: 2.35   rounded to two digits is   2.4
                     2.45   rounded to two digits is   2.4
                     -6.35   rounded to two digits is   -6.4

NOTE!
This is sometimes called the **even-odd rule**.

Adding & Subtracting

RULES FOR ADDING & SUBTRACTING
When adding and/or subtracting, the answer has the same number of decimal places as the measurement with the fewest decimal places.

For example: 6.6 cm + 18.74 cm + 0.766 cm
                  =   26.106 cm
                  =   26.1 cm

NOTE!
The answer must be rounded to 26.1 cm because the first measurement (6.6 cm) limits the precision to a tenth of a centimetre.

Multiplying & Dividing

RULES FOR MULTIPLYING & DIVIDING

When multiplying and/or dividing, the answer has the same number of significant digits as the measurement with the fewest number of significant digits.

For example: *77.8 km/h x 0.8967 h*

     =   69.76326 km

     =   69.8 km

NOTE!

The certainty of the answer is limited to three significant digits, so the answer is rounded up to 69.8 km. The same applies to scientific notation. For example,

$$(5.5 \times 10^4) \div (5.675 \times 10^{-2}) = 9.7 \times 10^5$$

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Multistep Calculations

RULES FOR MULTISTEP CALCULATIONS

For multistep calculations, round-off errors occur if you use the rounded-off answer from an earlier calculation in a subsequent calculation. Thus, leave all digits in your calculator until you have finished all your calculations and then round the final answer.

For example: *5.21 x 0.45 ÷ 0.00600*

     =   2.3445 ÷ 0.00600   *or*   *=   2.3 ÷ 0.00600*

     =   390.75   *=   383.333333*

     =   390 ✔   *=   380* ✘

NOTE!

The certainty of the answer is limited to two significant digits, so the answer is rounded accordingly. In the second example though, rounding occurred during the calculation which introduced a round-off error.

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Calculations – Summary

ADDING & SUBTRACTING

❖   fewest decimal places

MULTIPLYING & DIVIDING

❖   fewest number of significant digits

MULTISTEP CALCULATIONS

❖   leave all digits in the calculator until finished and then round

NOTE!

If a combination of addition, subtraction, multiplication and division are involved, follow the rules for multiplying and dividing.

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Calculations Using Measurements

PRACTICE

1. Perform the following operations. Round your answers accordingly.

(a)	67.8 + 968 + 3.87	1039.67	= 1040
(b)	463.66 + 29.2 + 0.17	493.03	= 493.0
(c)	68.7 - 23.95	44.75	= 44.8
(d)	(2.6)(42.2)	109.72	= 110
(e)	(65)(0.041)(325)	866.125	= 870
(f)	(0.0060)(26)(55.1)	8.5956	= 8.6
(g)	650 ÷ 4.0	162.5	= 160
(h)	3.5^2	12.25	= 12
(i)	$(1.62 \times 10^{-3})(7.3 \times 10^{-1})$	0.0011826	= 0.0012
(j)	$(5.019 \times 10^{-4}) \div (3.1 \times 10^{-7})$	1619.0322...	= 1600

Calculations Using Measurements

PRACTICE

2. Solve each of the following. Round your answers accordingly.

(a) Find the perimeter of a rectangular carpet that has a width and length of 3.56 m and 4.5 m.

(a) 16.1 m

Calculations Using Measurements

PRACTICE

2. Solve each of the following. Round your answers accordingly.

(b) Find the area of a rectangle whose sides are 4.5 m and 7.5 m.

(b) 34 m^2

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Calculations Using Measurements

PRACTICE

2. Solve each of the following. Round your answers accordingly.

(c) A triangle has a base of 5.75 cm and a height of 12.45 cm. Calculate the area of the triangle. (Recall A = ½bh)

(c) 35.8 cm²

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Calculations Using Measurements

PRACTICE

2. Solve each of the following. Round your answers accordingly.

(d) On the planet Zot distances are measured in zaps and zings. If 3.9 zings equal 7.5 zaps, how many zings are equal to 93.5 zaps?

(d) 49 zings

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Calculations Using Measurements

PRACTICE

2. Solve each of the following. Round your answers accordingly.

(e) The Earth has a mass of 5.98×10^{24} kg while Jupiter has a mass of 1.90×10^{27} kg. How many times larger is the mass of Jupiter than the mass of the Earth?

(e) 318 times

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