SI Units and Conversion Factors

Length

SI unit: meter (m)

1 meter	= 1.0936 yards
1 centimeter	= 0.39370 inch
1 inch	= 2.54 centimeters (exactly)
1 kilometer	= 0.62137 mile
1 mile	= 5280 feet
	= 1.6093 kilometers
1 angstrom	= 10^{-10} meter
	= 100 picometers

Mass

SI unit: kilogram (kg)

1 kilogram	= 1000 grams
	= 2.2046 pounds
1 pound	= 453.59 grams
	= 0.45359 kilogram
	= 16 ounces
1 ton	= 2000 pounds
	= 907.185 kilograms
1 metric ton	= 1000 kilograms
	= 2204.6 pounds
1 atomic mass unit	= 1.66056×10^{-27} kilograms

Volume

SI unit: cubic meter (m^3)

1 liter	= 10^{-3} m^3
	= 1 dm^3
	= 1.0567 quarts
1 gallon	= 4 quarts
	= 8 pints
	= 3.7854 liters
1 quart	= 32 fluid ounces
	= 0.94633 liter

Temperature

SI unit: kelvin (K)

0 K	= −273.15°C
	= −459.67°F
K	= °C + 273.15
°C	= $\frac{5}{9}$(°F − 32)
°F	= $\frac{9}{5}$(°C) + 32

Energy

SI unit: joule (J)

1 joule	= 1 kg · m^2/s^2
	= 0.23901 calorie
	= 9.4781×10^{-4} btu (British thermal unit)
1 calorie	= 4.184 joules
	= 3.965×10^{-3} btu
1 btu	= 1055.06 joules
	= 252.2 calories

Pressure

SI unit: pascal (Pa)

1 pascal	= 1 N/m^2
	= 1 kg/m · s^2
1 atmosphere	= 101.325 kilopascals
	= 760 torr (mmHg)
	= 14.70 pounds per square inch
1 bar	= 10^5 pascals

SI UNIT PREFIXES

Multiplication Factor	Prefix	Symbol	Pronunciation (USA) (1)	Term (USA)	Term (Other Countries)
1 000 000 000 000 000 000 = 10^{18}	exa	E	as in Texas	one quintillion (2)	one trillion
1 000 000 000 000 000 = 10^{15}	peta	P	as in petal	one quadrillion (2)	one thousand billion
1 000 000 000 000 = 10^{12}	tera	T	as in terrace	one trillion (2)	one billion
1 000 000 000 = 10^{9}	giga	G	jig' a (a as in about)	one billion (2)	one milliard
1 000 000 = 10^{6}	mega	M	as in megaphone	one million	
1 000 = 10^{3}	kilo	k	as in kilowatt	one thousand	
100 = 10^{2}	hecto	h (3)	heck'toe	one hundred	
10 = 10	deka	da (3)	deck' a (a as in about)	ten	
0.1 = 10^{-1}	deci	d (3)	as in decimal	one tenth	
0.01 = 10^{-2}	centi	c (3)	as in sentiment	one hundredth	
0.001 = 10^{-3}	milli	m	as in military	one thousandth	
0.000 001 = 10^{-6}	micro	μ (4)	as in microphone	one millionth	
0.000 000 001 = 10^{-9}	nano	n	nan' oh (nan as in Nancy)	one billionth (2)	one milliardth
0.000 000 000 001 = 10^{-12}	pico	p	peek' oh	one trillionth (2)	one billionth
0.000 000 000 000 001 = 10^{-15}	femto	f	fem' toe (fem as in feminine)	one quadrillionth (2)	one thousand billionth
0.000 000 000 000 000 001 = 10^{-18}	atto	a	as in anatomy	one quintillionth (2)	one trillionth

(1) The first syllable of every prefix is accented to assure that the prefix will retain its identity.

(2) These terms should be avoided in technical writing because the denominations above one million and below one millionth are different in most other countries, as indicated in the last column. Instead, use the prefixes or ten raised to an integral power.

(3) While hecto, deka, deci, and centi are SI prefixes, their use should generally be avoided except for the SI unit-multiples for area and volume and nontechnical use of centimeter, as for body and clothing measurement.

(4) Although Recommendation 1.4 prescribes upright type, the sloping form is sometimes used in the USA for the Greek letter μ (pronounced "mew") because of the scarcity of the upright style.

Dimensional Analysis Practice Problems

1) 0.56kg = ? mg

$$0.56\ \text{kg} \times \frac{\text{g}}{\text{kg}} \times \frac{\text{mg}}{\text{g}} = \underline{\quad\quad} \text{ mg}$$

2) 1.2ng = ? g

$$1.2\ \text{ng} \times \frac{\text{g}}{\text{ng}} = \underline{\quad\quad} \text{ g}$$

3) 2.0 in = ? mm (1in = 2.54 cm)

$$2.0\ \text{in} \times \frac{\text{cm}}{\text{in}} \times \frac{\text{m}}{\text{cm}} \times \frac{\text{mm}}{\text{m}} = \underline{\quad\quad} \text{ mm}$$

4) 500ft = ? m

$$500\ \text{ft} \times \frac{\text{in}}{\text{ft}} \times \frac{\text{cm}}{\text{in}} \times \frac{\text{m}}{\text{cm}} = \underline{\quad\quad} \text{ m}$$

5) 10μL = ? cc (1mL = 1cm^3 = 1 cc)

$$10\mu\text{L} \times \frac{\text{L}}{\mu\text{L}} \times \frac{\text{mL}}{\text{L}} \times \frac{\text{cc}}{\text{mL}} = \underline{\quad\quad} \text{ cc}$$

6) 3 wk = ? min

3 wk x _____ x _____ x _____ = _____ min

7) 50mL = ? cups (1L = 4.226cups)

50mL x _____ x _____ = _____ cups

8) 5.33km = ? dm

5.33 km x _____ x _____ = _____ dm

9) 123.0 ng = ? Mg

123.0ng x _____ x _____ = _____ Mg

10) 3yds = ? in (1 yd = 3ft)

3 yds x _____ x _____ = _____ in

Worksheet: Dimensional Analysis

1. The distance from the thumb to the little finger on Erbie Terbium's hand is 9 inches. Convert this to centimeters.

2. According to the Guinness Book of Records the heaviest baby ever born weighed 29 lbs 4 oz. (29.25 lbs). What was the baby's mass in kG? (Historical Note: The birth occurred in Effingham IL in 1939 and due to respiratory problems the baby died two hours later. The heaviest babies to survive weighed 22.5 lbs and were born in 1955 and 1982.)

3. Your cross country skis are 210 cM long. What is their length in inches?

4. A condor has a wing span of 3.05 M. What is the wing span in feet?

5. In Europe gasoline is sold by the liter. Assume that it takes 14 gallons of gasoline to fill the tank of a compact car. How many liters of gasoline will it take?

6. You have just received a French cookbook from the exchange student. You want to make 3 quarts of punch for a party. Will a recipe of 2.5 L be enough?

7. Some owls maintain territories of up to 3 acres. How many owls could live in a large wooded area of 20 hectares? (1 hectare=1 sq. dekameter=100 m^2= 2.47 acres)

8. Ruth Palladium (RuPd) bought 10 acres of land and built a house on 2 acres. RuPd wanted to raise sheep on the remaining 8 acres. If it takes 1/8 (0.125) hectare to raise one sheep, how many sheep can be raised on the 8 acres.

9. One 1.6 oz. of package of cinnamon and spice instant oatmeal contains 34 G of carbohydrates. If you had instant oatmeal 6 days a week, how many ounces of carbohydrate would you consume in a week? (16 oz =1 lb = 454 G =256 Drams = 7000 Grains)

10. Many candybars have 9 G of fat per bar. If during a "chocolate attack" you ate one pack of candy (0.6 dekabars), how many ounces of fat would you have eaten? There are approximately 9 Calories per gram of fat, how many Calories is this?

11. If the RDA for vitamin C is 60 mG per day and there are 70 mG of vitamin C per 100 G of orange, how many 3 oz. oranges would you have to eat each week to meet this requirement?

12. If Gasp cigarettes have 5 mG tar and 0.4 mG nicotine per cigarette and there are 20 cigarettes per pack, how many packs of cigarettes would have to be smoked to coat your lungs with 8 oz (1/4 lb.) of tar? How many packs would you have to smoke to coat your lungs with one gram of nicotine?

13. You are riding home from a party and the driver has been drinking. The car is traveling at 60 mi per hour. Suddenly a child steps into the road ahead. Because the driver has been drinking his reaction time has been slowed by 1 second. How far toward the impending accident will the car travel before the driver begins to stop? (Note: This is equal to the extra distance it will take to stop the car because the driver has been drinking.)

Guidelines

1. Express answers for volumes of less than 1 mL to the hundredths. (0.73 mL, not 0.728 mL). When relating this to insulin dosages, NEVER round volumes when referring to an insulin calculation. (46 units of U-100 insulin = 0.46 mL, not 0.5 mL).
2. Express answers for volumes of greater than 1 mL to the tenths. (5.4 mL, not 5.41 mL or 5.412 mL).
3. When calculating body weights, express answers to the tenths unless specifically requested to calculate pounds and ounces. (3.2 lbs, not 3 lbs; 3.8 lbs, not 4 lbs).
4. A zero should ALWAYS appear before a decimal. (0.75, not .75).
5. A zero should NEVER appear after a decimal. (2, not 2.0; 2.2, not 2.20).
6. Drops should be expressed as a whole number. (32 gtts, not 31.6 gtts)
7. Wait until the last step of the calculation to round.

Sample Problems (to supplement the DA text)

1. The order reads to infuse 3 liters over 24 hours. At what rate (mL/hr) will you set the IMED pump?
2. The 50 mL bag of medication is to infuse over 30 minutes. At what secondary rate (mL/hr) will you set the pump?
3. Convert 97.8°F to °C. Convert 39.2°C to °F.
4. A 250 mL bag of IV fluid is started at 1845 on Monday and programmed to infuse at 20 mL/hr. At what time should the infusion be completed? *(***Remember that if minutes become >60, subtract 60 and add to hours; if hours become >24, subtract 24 and indicate new day)*
5. Using a 1mL,U-100 insulin syringe, how many mL will you be instilling when you administer 43 units of U-100 insulin?
6. You are to administer 8 mcg/kg/min. Your medication is 40 mg/100mL. Your patient weighs 64 lbs. At what rate (ml/hr) will you set the pump?
7. A 500mL bag containing 10,000 units of med is infusing at 40mL/hr. How many units are infusing per hour?
8. The order is to administer 15 mL orally. When discharging your patient, you know that this is equivalent to: ___tsp *or* ___tbsp *or* ___oz
9. Using gravity drip tubing with a drip factor of 15 gtt/mL, you need to administer 120 mL/hr. What flow rate (gtt/min) will you need? What will the 15-second rate be?

10. The order reads to infuse 40 mEq/L of IV fluid. The medication is available in 20 mEq/10 mL vials. How many mL of med will you add to a 250 mL bag of IV fluid?

11. 100 mL of a medication is to be administered in 30 minutes using a set calibrated at 10 gtts/ mL. Calculate the flow rate.

12. A medication of 500 mL is to be administered in 3 hours using macrodrip tubing of 20 gtt/mL. Calculate the flow rate.

13. You are supposed to infuse 800 mL NS over 5 hours. After 2 hours you notice that 500 mL have already infused. The set being used is calibrated at 15 gtt/mL. Recalculate the new flow rate to complete the infusion on time.

14. An IV of 700 mL D51/2 NS is to infuse at a rate of 125 mL/hr.
    a. How long will it take to complete the infusion? (express your answer in hours and minutes)

    b. If the infusion started at 8:45 pm on Sunday, August 20 when would the infusion be complete?

15. Your drug is provided as 150mg / 250 mL. At what rate would you program the IMED to infuse it at 0.5mg/ min?

16. At what rate would you program your IMED to infuse a medication at 4mcg/ min if your bag contains 50 mg/100 mL?

17. You are infusing a medication at 50 mL/hr. The strength of the medication is 250 mg/ 100 mL. What dose is infusing per minute?

18. An IV of 500 mL containing 600 mg of medication is ordered to infuse at the reate of 20 mL/hr. What dosage is infusing per hour?

19. Calculate the flow rate for insuing 125 mL/hr when a microdrip set is used.

20) Your order reads: D5 ¼ NS + 20 mEq of Potassium Chloride Liter. Pharmacy sends you a vial of KCl 10 mEq / 5 mL. How many mL of Potassium Chloride will you add to a 1000 cc bag of D5 ¼ NS?

20a) Using the same order and the same concentration of KCl, how many mL of Potassium Chloride will you add to a 250 bag of D5 ¼ NS?