

Name: Key
 Blk: _____ Date: _____

Chemistry 11 METRIC CONVERSIONS

As was already stated: In chemistry it is of utmost importance that you know how to problem solve using the UNIT CONVERSIONS METHOD!!

For Chemistry 11 you must commit the following **SI BASE UNITS** to memory:

QUANTITY	Written Unit	Unit Symbol
Length	metre	m
Mass	gram	g
Time	second	s
Volume	Litre	L
Amount of substance	mole	mol

The metric system is devised in such a way that there are **MULTIPLES** of the **BASE UNITS**

Written Prefix	Prefix Symbol	Exponential Equivalent
Mega	M	1×10^6
Kilo	k	1×10^3
Deci	d	1×10^{-1}
Centi	c	1×10^{-2}
Milli	m	1×10^{-3}
Micro	μ	1×10^{-6}

Ex 1. Re-write the following expressions using:

- i. Prefix and UNIT symbols
- ii. An EXPONENTIAL EQUIVALENT and Unit symbol

- a. 5 kilograms $\rightarrow 5 \text{ kg} \rightarrow 5 \times 10^3 \text{ g}$
- b. 2.5 centimetres $\rightarrow 2.5 \text{ cm} \rightarrow 2.5 \times 10^{-2} \text{ m}$
- c. 5.1 decigrams $\rightarrow 5.1 \text{ dg} \rightarrow 5.1 \times 10^{-1} \text{ g}$
- d. 0.25 megalitres $\rightarrow 0.25 \text{ ML} \rightarrow 0.25 \times 10^6 \text{ L}$

Ex 2. Re-write the following expressions using

1. a WRITTEN PREFIX and UNIT
2. an EXPONENTIAL EQUIVALENT and UNIT symbol

- a. 2 ms $\rightarrow 2 \text{ milliseconds} \rightarrow 2 \times 10^{-3} \text{ s}$

- b. 2.5 mm \rightarrow 2.5 millimetres \rightarrow 2.5×10^{-3} m
 c. 6.5 dL \rightarrow 6.5 decilitres \rightarrow 6.5×10^1 L
 d. 1.9 kmol \rightarrow 1.9 kilomoles \rightarrow 1.9×10^3 mol

Ex 3. Re-Write the following expressions using:

i. A WRITTEN PREFIX and UNIT

ii. A PREFIX and UNIT symbol

- a. 2.7×10^{-2} m \rightarrow 2.7 centimetres \rightarrow 2.7 cm
 b. 4.5×10^{-3} mol \rightarrow 4.5 millimoles \rightarrow 4.5 mmol
 c. 0.50×10^{-6} L \rightarrow 0.50 microlitres \rightarrow 0.5 μ L
 d. 7.25×10^3 g \rightarrow 7.25 kilograms \rightarrow 7.25 kg

Create METRIC CONVERSION FACTORS using Exponential Equivalents and the SI BASE UNITS

Ex 4. Write a conversion factor relating

- a. kg and g \rightarrow $1 \text{ kg} = 1 \times 10^3 \text{ g}$
 b. Mm and m \rightarrow $1 \text{ Mm} = 1 \times 10^6 \text{ m}$
 c. cL and L \rightarrow $1 \text{ cL} = 1 \times 10^{-2} \text{ L}$
 e. mmol and mol \rightarrow $1 \text{ mmol} = 1 \times 10^{-3} \text{ mol}$
 f. cs and s \rightarrow $1 \text{ cs} = 1 \times 10^{-2} \text{ s}$

Ex 5. Express 8 kg in milligrams

C = # mg

A = 8 kg

B = $1 \text{ kg} = 1 \times 10^3 \text{ g}$; $1 \text{ mg} = 1 \times 10^{-3} \text{ g}$

PUT IT ALL TOGETHER:

$$\# \text{ mg} = 8 \text{ kg} \times \frac{1 \times 10^3 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mg}}{1 \times 10^{-3} \text{ g}} = \boxed{8 \times 10^6 \text{ mg}}$$

Ex 6. Express 5 Mg/mL in kilograms/litre

C = # kg/L

A = 5 Mg/mL

B = $1 \text{ Mg} = 1 \times 10^6 \text{ g}$; $1 \text{ kg} = 1 \times 10^3 \text{ g}$; $1 \text{ mL} = 1 \times 10^{-3} \text{ L}$

PUT IT ALL TOGETHER:

$$\frac{\# \text{ kg}}{\text{L}} = \frac{5 \text{ Mg}}{\text{mL}} \times \frac{1 \times 10^6 \text{ g}}{1 \text{ Mg}} \times \frac{1 \text{ kg}}{1 \times 10^3 \text{ g}} \times \frac{1 \text{ mL}}{1 \times 10^{-3} \text{ L}} = \boxed{5 \times 10^6 \text{ kg/L}}$$

Seatwork/Homework: Exercises 16 - 18

KEY TO EX: 16-18

16. (a) # of milligrams = $0.25 \text{ Mg} \times \frac{1 \times 10^6 \text{ g}}{1 \text{ Mg}} \times \frac{1 \text{ mg}}{1 \times 10^{-3} \text{ g}} = 2.5 \times 10^8 \text{ mg}$

(b) # of centiseconds = $10 \text{ } \mu\text{s} \times \frac{10^{-6} \text{ s}}{1 \text{ } \mu\text{s}} \times \frac{1 \text{ cs}}{10^{-2} \text{ s}} = 1 \times 10^{-3} \text{ cs}$

(c) # of millimetres = $5.8 \text{ cm} \times \frac{10^{-2} \text{ m}}{1 \text{ cm}} \times \frac{1 \text{ mm}}{10^{-3} \text{ m}} = 158 \text{ mm} \quad 1.58 \times 10^2 \text{ mm}$

(d) # of kilograms = $250 \text{ mg} \times \frac{10^{-3} \text{ g}}{1 \text{ mg}} \times \frac{1 \text{ kg}}{10^3 \text{ g}} = 2.5 \times 10^{-4} \text{ kg}$

(e) # of decilitres = $0.5 \text{ kL} \times \frac{10^3 \text{ L}}{1 \text{ kL}} \times \frac{1 \text{ dL}}{10^{-1} \text{ L}} = 5 \times 10^3 \text{ dL}$

17. (a) # of milliseconds = $3 \text{ s} \times \frac{1 \text{ ms}}{1 \times 10^{-3} \text{ s}} = 3 \times 10^3 \text{ ms}$

(b) # of litres = $50.0 \text{ mL} \times \frac{10^{-3} \text{ L}}{1 \text{ mL}} = 5.00 \times 10^{-2} \text{ L}$

(c) # of microlitres = $2 \text{ L} \times \frac{1 \text{ } \mu\text{L}}{10^{-6} \text{ L}} = 2 \times 10^6 \text{ } \mu\text{L}$

(d) # of grams = $25 \text{ kg} \times \frac{10^3 \text{ g}}{1 \text{ kg}} = 2.5 \times 10^4 \text{ g}$

(e) # of metres = $3 \text{ Mm} \times \frac{10^6 \text{ m}}{1 \text{ Mm}} = 3 \times 10^6 \text{ m}$

(f) # of decilitres = $2 \text{ L} \times \frac{1 \text{ dL}}{10^{-1} \text{ L}} = 2 \times 10^1 \text{ dL}$

* (g) # of milliseconds = $7 \text{ } \mu\text{s} \times \frac{1 \times 10^{-6} \text{ s}}{1 \text{ } \mu\text{s}} \times \frac{1 \text{ ms}}{1 \times 10^{-3} \text{ s}} = 7 \times 10^{-3} \text{ ms}$

(h) # of milligrams = $51 \text{ kg} \times \frac{10^3 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mg}}{10^{-3} \text{ g}} = 5.1 \times 10^7 \text{ mg}$

(i) # of kilolitres = $3125 \text{ } \mu\text{L} \times \frac{10^{-6} \text{ L}}{1 \text{ } \mu\text{L}} \times \frac{1 \text{ kL}}{10^3 \text{ L}} = 3.125 \times 10^{-6} \text{ kL}$

(j) # of centigrams = $1.7 \text{ } \mu\text{g} \times \frac{10^{-6} \text{ g}}{1 \text{ } \mu\text{g}} \times \frac{1 \text{ cg}}{10^{-2} \text{ g}} = 1.7 \times 10^{-4} \text{ cg}$

(k) # of seconds = $1 \text{ yr} \times \frac{365 \text{ d}}{1 \text{ y}} \times \frac{24 \text{ h}}{1 \text{ d}} \times \frac{60 \text{ min}}{1 \text{ h}} \times \frac{60 \text{ s}}{1 \text{ min}} = 3.15 \times 10^7 \text{ s}$

* (l) # of $\frac{\text{grams}}{\text{litre}} = \frac{1 \text{ mg}}{\text{dL}} \times \frac{10^{-3} \text{ g}}{1 \text{ mg}} \times \frac{1 \text{ dL}}{10^{-1} \text{ L}} = 1 \times 10^{-2} \frac{\text{g}}{\text{L}}$

* (m) # of $\frac{\text{kilometres}}{\text{second}} = \frac{1 \text{ cm}}{\text{ } \mu\text{s}} \times \frac{10^{-2} \text{ m}}{1 \text{ cm}} \times \frac{1 \text{ km}}{10^3 \text{ m}} \times \frac{1 \text{ } \mu\text{s}}{10^{-6} \text{ s}} = 1 \times 10^1 \frac{\text{km}}{\text{s}}$

(n) # of $\frac{\text{decigrams}}{\text{litre}} = \frac{1 \text{ cg}}{\text{mL}} \times \frac{10^{-2} \text{ g}}{1 \text{ cg}} \times \frac{1 \text{ dg}}{10^{-1} \text{ g}} \times \frac{1 \text{ mL}}{10^{-3} \text{ L}} = 1 \times 10^2 \frac{\text{dg}}{\text{L}}$

(o) # of $\frac{\text{mg}}{\text{s}} = \frac{5 \text{ cg}}{\text{ds}} \times \frac{10^{-2} \text{ g}}{\text{cg}} \times \frac{1 \text{ mg}}{10^{-3} \text{ g}} \times \frac{\text{ds}}{10^{-1} \text{ s}} = 5 \times 10^2 \frac{\text{mg}}{\text{s}}$

$3.1536 \times 10^7 \text{ s}$

18. (a) # of metres = $8.3 \text{ min} \times \frac{60 \text{ s}}{1 \text{ min}} \times \frac{3.00 \times 10^8 \text{ m}}{1 \text{ s}} = 1.5 \times 10^{11} \text{ m}$
- (b) # of seconds = $3.8 \times 10^5 \text{ km} \times \frac{10^3 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ s}}{3.00 \times 10^8 \text{ m}} = 1.3 \text{ s}$
- (c) # of minutes = $7.83 \times 10^7 \text{ km} \times \frac{10^3 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ s}}{3.00 \times 10^8 \text{ m}} \times \frac{1 \text{ min}}{60 \text{ s}} = 4.35 \text{ min}$
19. # of $\frac{\text{kg}}{\text{m}^3} = \frac{9.0 \text{ lb}}{\text{in}^3} \times \frac{1 \text{ kg}}{2.2 \text{ lb}} \times \left(\frac{39 \text{ in}}{1 \text{ m}} \right)^3 = 2.4 \times 10^5 \frac{\text{kg}}{\text{m}^3}$
20. (a) # of dollars = $90.0 \text{ kg} \times \frac{\$9.80}{10 \text{ kg}} = \$88.2$
- (b) # of dollars = $6.00 \text{ t} \times \frac{10^3 \text{ kg}}{1 \text{ t}} \times \frac{\$9.80}{10 \text{ kg}} = \$5880$
21. (a) # of centimetres = $20.0 \text{ inch} \times \frac{2.54 \text{ cm}}{1 \text{ inch}} = 50.8 \text{ cm}$
- (b) # of metres = $36 \text{ inch} \times \frac{2.54 \text{ cm}}{1 \text{ inch}} \times \frac{10^{-2} \text{ m}}{1 \text{ cm}} = 0.914 \text{ m}$
22. # of centigrams = $90 \mu\text{g} \times \frac{10^{-6} \text{ g}}{1 \mu\text{g}} \times \frac{1 \text{ cg}}{10^{-2} \text{ g}} = 9 \times 10^{-3} \text{ cg}$
23. (a) # of hours = $450 \text{ km} \times \frac{1 \text{ h}}{105 \text{ km}} = 4.3 \text{ h}$
- (b) # of seconds = $2.0 \times 10^2 \text{ m} \times \frac{1 \text{ km}}{10^3 \text{ m}} \times \frac{1 \text{ h}}{105 \text{ km}} \times \frac{60 \text{ min}}{1 \text{ h}} \times \frac{60 \text{ s}}{1 \text{ min}} = 6.9 \text{ s}$
- (c) # of kilometres = $10.0 \text{ min} \times \frac{1 \text{ h}}{60 \text{ min}} \times \frac{105 \text{ km}}{1 \text{ h}} = 17.5 \text{ km}$
- (d) # of centimetres = $1.00 \text{ ms} \times \frac{10^{-3} \text{ s}}{1 \text{ ms}} \times \frac{1 \text{ min}}{60 \text{ s}} \times \frac{1 \text{ h}}{60 \text{ min}} \times \frac{105 \text{ km}}{1 \text{ h}} \times \frac{10^3 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ cm}}{10^{-2} \text{ m}} = 2.92 \text{ cm}$
24. (a) # of kilograms = $7.00 \text{ L} \times \frac{5.50 \text{ kg}}{1 \text{ L}} = 38.5 \text{ kg}$
- (b) # of litres = $22 \text{ kg} \times \frac{1 \text{ L}}{5.50 \text{ kg}} = 4.0 \text{ L}$