Name:_____

Blk:_____Date:_____

Chemistry 11

Metric Conversions

Although you might already think that you know how to perform metric conversions, in chemistry you will be using the UNITARY CONVERSION method to do so!

The following are the most important **SI BASE UNITS** that we will use in CHEMISTRY 11

QUANTITY	Written base unit	Base Unit Symbol
length	meters	m
* mass *	gram	g
Time	seconds	s
Volume	Liters	L
Amount of substance	mole	mol

The METRIC SYSTEM is devised in such a way that there are MULTIPLES or (Exponential Equivalents) of the base units.

Written Prefix	Prefix symbol	Exponential Equivalent
* * Kilo *	K	$1 \cdot 10^{3}$
deci	d	$1 \cdot 10^{-1}$
centi	c	$1 \cdot 10^{-2}$
* * milli *	m	$1 \cdot 10^{-3}$
micro	μ	$1 \cdot 10^{-6}$

Please note: You have access to the EXPONENTIAL EQUIVALENTS (called MAGNITUDE) in your CHEMISTRY 11 DATA BOOKLETS!!!!

Ex 1. Re-write the following expressions using:

➔ *Prefix* and Unit Symbol → An *EXPONENTIAL EQUIVALENT* and Unit Symbol

a. 5 *kilo*grams → 5 *k*g → 5 x 10^{3} g

b. 2.5 centimetres → 2.5 cm → $2.5 \cdot 10^{-2}$ m

c. 5.1 decigrams → 5.1 dg → $5.1 \cdot 10^{-1}$ g

Example 2. Re-write the following using:

➔ a *Written Prefix* and Unit Symbol → An *EXPONENTIAL EQUIVALENT* and Unit Symbol

a. 2 *m*s → 2 *milli*seconds → 2 x 10^{-3} s

b. 2.5 mm → 2.5 millimeters → $2.5 \cdot 10^{-3}$ m

c. 6.5 dL → 6.5 decilitres → $6.5 \cdot 10^{-1}$ L

d. 1.9kmol → 1.9 kilomols → $1.9 \cdot 10^{3}$ mol

Example 3. Re-write the following using:

→ a *Written Prefix* and Unit Symbol → A *Prefix* and Unit Symbol

a. 2.7×10^{-2} m → 2.7 *centi*metres → 2.5 cm

b. 4.5×10^{-3} mol → 4.5 millimoles → 4.5 mmol

c. 5.0×10^{-6} L → 5.0 microlitres → 5.0 µL

d. 7.25×10^{1} g → 7.25 dekagram → 7.25 dag

THE RULE FOR CREATING METRIC CONVERSIONS only include the **PREFIX** and **EXPONENTIAL EQUIVALENT**

1 PREFIX **Base Unit** = 1 EE **Base Unit**

Write a metric conversion for the following:

mL → 1 mL = 1x 10^{-3} L

Kg → 1 Kg = $1 \cdot 10^{3}$ g

mm → 1 mm = $1 \cdot 10^{-3}$ m

µs → 1 µs = $1 \cdot 10^{-6}$ s

Example 4. Use the Unitary Conversion method to express 8 kg in milligrams: (A x B = C)

A= 8 kg

B= 1 Kg = $1 \cdot 10^{3}$ g ; 1 mg = $1 \cdot 10^{-3}$ g

Put it all together: $\frac{8\text{ kg}}{1} \cdot \frac{1 \cdot 10^{3}\text{ g}}{1\text{ kg}} \cdot \frac{1\text{ mg}}{1 \cdot 10^{-3}\text{ g}} = 8 \cdot 10^{6}\text{ mg} = 8\,000\,000\text{ mg}$

Example 5. Use the Unitary conversion method to express 5 Mg/mL in kilograms/L: (A x B = C)

A= $\frac{5\text{ Mg}}{\text{mL}}$ 1 Mg = $1 \cdot 10^{6}$ g 1 kg = $1 \cdot 10^{3}$ g

B=

Put it all together: 1 EXP 6 1 mL = $1 \cdot 10^{-3}$ L

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

Practice Questions: 16- 18

Exponential Equivalent

The Metric Prefixes

Prefix:	Symbol:	Magnitude:	Meaning (multiply by):
Yotta-	Y	1×10^{24}	1 000 000 000 000 000 000 000 000
Zetta-	Z	1×10^{21}	1 000 000 000 000 000 000 000
Exa-	E	1×10^{18}	1 000 000 000 000 000 000
Peta-	P	1×10^{15}	1 000 000 000 000 000
Tera-	T	1×10^{12}	1 000 000 000 000
Giga-	G	1×10^{9}	1 000 000 000
Mega-	M	1×10^{6}	1 000 000
kilo-	k	1×10^{3}	1000
hecto-	h	1×10^{2}	100
deka-	da	1×10^{1}	10
-	-	-	-
deci-	d	1×10^{-1}	0.1
centi-	c	1×10^{-2}	0.01
milli-	m	1×10^{-3}	0.001
micro-	μ	1×10^{-6}	0.000 001
nano-	n	1×10^{-9}	0.000 000 001
pico-	p	1×10^{-12}	0.000 000 000 001
femto-	f	1×10^{-15}	0.000 000 000 000 001
atto-	a	1×10^{-18}	0.000 000 000 000 000 001
zepto-	z	1×10^{-21}	0.000 000 000 000 000 000 001
yocto-	y	1×10^{-24}	0.000 000 000 000 000 000 000 001

18. (a) # of metres = $8.3 \text{ min} \times \frac{60 \text{ s}}{1 \text{ min}} \times \frac{3.00 \times 10^8 \text{ m}}{1 \text{ s}} = \mathbf{1.5 \times 10^{11} \text{ m}}$

(b) # of seconds = $3.8 \times 10^5 \text{ km} \times \frac{10^3 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ s}}{3.00 \times 10^8 \text{ m}} = \mathbf{1.3 \text{ s}}$

(c) # of minutes = $7.83 \times 10^7 \text{ km} \times \frac{10^3 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ s}}{3.00 \times 10^8 \text{ m}} \times \frac{1 \text{ min}}{60 \text{ s}} = \mathbf{4.35 \text{ min}}$

19. # of $\frac{\text{kg}}{\text{m}^3} = \frac{9.0 \text{ lb}}{\text{in}^3} \times \frac{1 \text{ kg}}{2.2 \text{ lb}} \times \left(\frac{39 \text{ in}}{1 \text{ m}}\right)^3 = \mathbf{2.4 \times 10^5 \frac{kg}{m^3}}$

20. (a) # of dollars = $90.0 \text{ kg} \times \frac{\$9.80}{10 \text{ kg}} = \mathbf{\$88.2}$

(b) # of dollars = $6.00 \text{ t} \times \frac{10^3 \text{ kg}}{1 \text{ t}} \times \frac{\$9.80}{10 \text{ kg}} = \mathbf{\$5880}$

21. (a) # of centimetres = $20.0 \text{ inch} \times \frac{2.54 \text{ cm}}{1 \text{ inch}} = \mathbf{50.8 \text{ cm}}$

(b) # of metres = $36 \text{ inch} \times \frac{2.54 \text{ cm}}{1 \text{ inch}} \times \frac{10^{-2} \text{ m}}{1 \text{ cm}} = \mathbf{0.914 \text{ m}}$

22. # of centigrams = $90 \mu\text{g} \times \frac{10^{-6} \text{ g}}{1 \mu\text{g}} \times \frac{1 \text{ cg}}{10^{-2} \text{ g}} = \mathbf{9 \times 10^{-3} \text{ cg}}$

23. (a) # of hours = $450 \text{ km} \times \frac{1 \text{ h}}{105 \text{ km}} = \mathbf{4.3 \text{ h}}$

(b) # of seconds = $2.0 \times 10^2 \text{ m} \times \frac{1 \text{ km}}{10^3 \text{ m}} \times \frac{1 \text{ h}}{105 \text{ km}} \times \frac{60 \text{ min}}{1 \text{ h}} \times \frac{60 \text{ s}}{1 \text{ min}} = \mathbf{6.9 \text{ s}}$

(c) # of kilometres = $10.0 \text{ min} \times \frac{1 \text{ h}}{60 \text{ min}} \times \frac{105 \text{ km}}{1 \text{ h}} = \mathbf{17.5 \text{ km}}$

(d) # of centimetres = $1.00 \text{ ms} \times \frac{10^{-3} \text{ s}}{1 \text{ ms}} \times \frac{1 \text{ min}}{60 \text{ s}} \times \frac{1 \text{ h}}{60 \text{ min}} \times \frac{105 \text{ km}}{1 \text{ h}} \times \frac{10^3 \text{ m}}{1 \text{ km}}$

24. (a) # of kilograms = $7.00 \text{ L} \times \frac{5.50 \text{ kg}}{1 \text{ L}} = \mathbf{38.5 \text{ kg}}$

(b) # of litres = $22 \text{ kg} \times \frac{1 \text{ L}}{5.50 \text{ kg}} = \mathbf{4.0 \text{ L}}$

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17 a) 3 s into milliseconds $1\,ms = 1\cdot10^{-3}\,s$

$3\,s \cdot \frac{1\,ms}{1\cdot10^{-3}\,s} = 3{,}000\,ms$ or $3\cdot10^{3}\,ms$

c) 2 L into microlitres $1\,\mu L = 1\cdot10^{-6}\,L$

$2\,L \cdot \frac{1\,\mu L}{1\cdot10^{-6}\,L} = 2\cdot10^{6}\,\mu L$ or $2\,000\,000\,\mu L$

e) $3\,Mm$ into metres $1\,Mm = 1\cdot10^{6}\,m$

$3\,Mm \cdot \frac{1\cdot10^{6}\,m}{1\,Mm} = 3\cdot10^{6}\,m$

g) $7\,\mu s$ into milliseconds ~~$1\,\mu s = 1\cdot10^{-6}\,s$~~ $1\,ms = 1\cdot10^{-3}\,s$

$7\,\mu s \cdot \frac{1\cdot10^{-6}\,s}{1\,\mu s} \cdot \frac{1\,ms}{1\cdot10^{-3}\,s} = 7\cdot10^{-3}\,ms$

$0.007\,ms$

i) + j)

i) $3125\,\mu L \cdot \frac{1\cdot10^{-6}\,L}{1\,\mu L} \cdot \frac{1\,kL}{1\cdot10^{3}\,L} = 3.125\cdot10^{-6}\,kL$

j) $1.7\,mg \cdot \frac{1\cdot10^{-6}\,g}{1\,\mu g} \cdot \frac{1\,cg}{1\cdot10^{-2}\,g} = 1.7\cdot10^{-4}\,cg$

17 l)

$\frac{1\,mg}{dL} \cdot \frac{1\cdot10^{-3}\,g}{1\,mg} \cdot \frac{1\,dL}{1\cdot10^{-1}\,L} = 0.01\,g/L$

m)

$$\frac{1\ cm}{us} \cdot \frac{1 \cdot 10^{-2}\ m}{1\ cm} \cdot \frac{1\ km}{1 \cdot 10^{3}\ m} \cdot \frac{1\ us}{1 \cdot 10^{-6}\ s} = \boxed{10\ km/s}$$

n)

$$\frac{1\ cg}{ml} \cdot \frac{1 \cdot 10^{-2}\ g}{1\ cg} \cdot \frac{1\ dg}{1 \cdot 10^{-1}\ g} \cdot \frac{1\ mL}{1 \cdot 10^{-3}\ L} = \boxed{100\ dg/L}$$

o)

$$\frac{5\ cg}{ds} \cdot \frac{1 \cdot 10^{-2}\ g}{1\ cg} \cdot \frac{1\ mg}{1 \cdot 10^{-3}\ g} \cdot \frac{1\ ds}{1 \cdot 10^{-1}\ s} = \boxed{500\ mg/s}$$

$1 \cdot 10^{3}\ g$

$\updownarrow$

$\boxed{1\ tonne = 1000\ kg}$