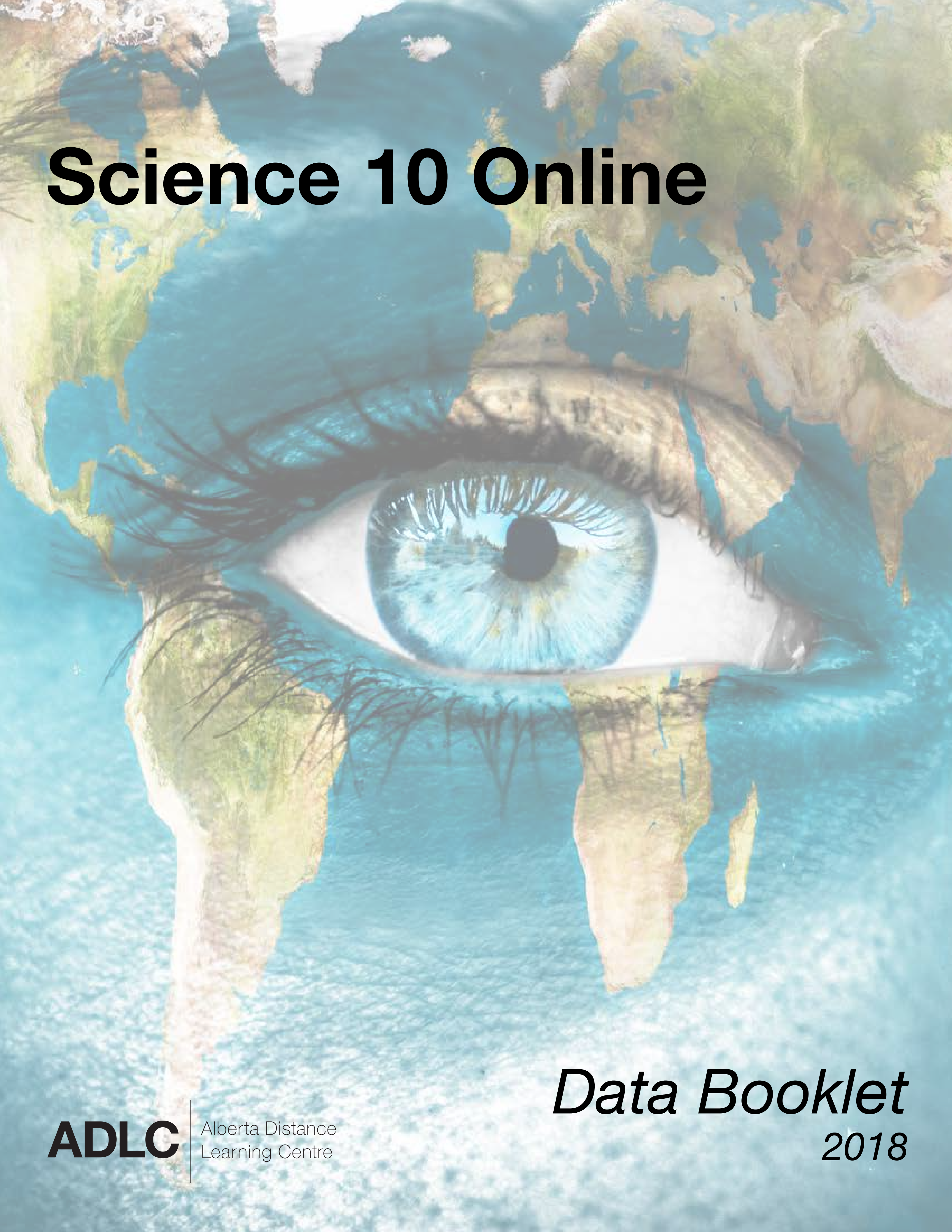
Science 10 Online



Data Booklet

2018

ADLC | Alberta Distance Learning Centre

Science 10 Data Booklet

Conversion chart:

1000 nm = 1 µm
1000 µm = 1 mm
10 mm = 1 cm
100 cm = 1 m
1000 m = 1 km

1000 mg = 1 g
1000 g = 1 kg

1000 mL = 1 L
1000 L = 1 kL

Biology Unit:

Cube = lws or $6l^2$
Sphere = $4\pi r^2$
Cylinder = $2\pi rl + 2\pi r^2$
Rectangular prism = $2(lw + hl + hw)$

Cube = lwh
Sphere = $\frac{4}{3}\pi r^3$
Cylinder = $\pi r^2 l$
Rectangular prism = lwh

l =length
w = width
h = height
s = number of sides
π = pi = 3.14
r = radius

*These variables can be in any unit as long as all the measurements you are using in your formula are the same unit.

$\text{triangle} = \frac{bh}{2}$

$\text{rectangle} = bh$

b = base
h = height
*These variables can be in any unit as long as all the measurements you are using in your formula are the same unit.

$\text{magnification} = \text{power of ocular lens} \times \text{power of objective lens}$

Periodic Chart of the Elements and Ions

Note: The legend at the right denotes the physical state of the elements at 101.325 kPa and 298.15 K (25°C).

Legend for the Elements

Solid	Liquid	Gas	Seldom forms ions

Table of Polyatomic Ions

Polyatomic ions

acetate	CH_3COO^-	chlorate	ClO_3^-	iodate	IO_3^-	permanganate	MnO_4^-	sulfite	SO_3^{2-}
ammonium	NH_4^+	chlorite	ClO_2^-	nitrate	NO_3^-	phosphate	PO_4^{3-}	hydrogen sulfide	HS^-
benzoate	$C_6H_5COO^-$	hypochlorite	ClO^-	nitrite	NO_2^-	hydrogen phosphate	HPO_4^{2-}	hydrogen sulfate	HSO_4^-
borate	BO_3^{3-}	chromate	CrO_4^{2-}	methanoate	$CHOO^-$	dihydrogen phosphate	$H_2PO_4^-$	hydrogen sulfite	HSO_3^-
carbonate	CO_3^{2-}	dichromate	$Cr_2O_7^{2-}$	oxalate	$OOCCOO^{2-}$	silicate	SiO_3^{2-}	thiocyanate	SCN^-
hydrogen carbonate	HCO_3^-	cyanide	CN^-	hydrogen oxalate	$HOOCCOO^-$	sulfate	SO_4^{2-}	thiosulfate	$S_2O_3^{2-}$
perchlorate	ClO_4^-	hydroxide	OH^-						

1	2	3	4	5	6	7	8	9
1 H hydrogen 1.01 H^+ hydrogen								
3 Li lithium 6.94 Li^+ lithium	4 Be beryllium 9.01 Be^{2+} beryllium							
11 Na sodium 22.99 Na^+ sodium	12 Mg magnesium 24.31 Mg^{2+} magnesium							
19 K potassium 39.10 K^+ potassium	20 Ca calcium 40.08 Ca^{2+} calcium	21 Sc scandium 44.96 Sc^{3+} scandium	22 Ti titanium 47.87 Ti^{4+} titanium(IV) Ti^{3+} titanium(III)	23 V vanadium 50.94 V^{5+} vanadium(V) V^{4+} vanadium(IV)	24 Cr chromium 52.00 Cr^{3+} chromium(III) Cr^{2+} chromium(II)	25 Mn manganese 54.94 Mn^{2+} manganese(II) Mn^{4+} manganese(IV)	26 Fe iron 55.85 Fe^{3+} iron(III) Fe^{2+} iron(II)	27 Co cobalt 58.93 Co^{2+} cobalt(II) Co^{3+} cobalt(III)
37 Rb rubidium 85.47 Rb^+ rubidium	38 Sr strontium 87.62 Sr^{2+} strontium	39 Y yttrium 88.91 Y^{3+} yttrium	40 Zr zirconium 91.22 Zr^{4+} zirconium	41 Nb niobium 92.91 Nb^{5+} niobium(V) Nb^{3+} niobium(III)	42 Mo molybdenum 95.94 Mo^{6+} molybdenum	43 Tc technetium (98) Tc^{7+} technetium	44 Ru ruthenium 101.07 Ru^{3+} ruthenium(III)	45 Rh rhodium 102.91 Rh^{3+} rhodium
55 Cs cesium 132.91 Cs^+ cesium	56 Ba barium 137.33 Ba^{2+} barium	57 La lanthanum 138.91 La^{3+} lanthanum	72 Hf hafnium 178.49 Hf^{4+} hafnium	73 Ta tantalum 180.95 Ta^{5+} tantalum	74 W tungsten 183.84 W^{6+} tungsten	75 Re rhenium 186.21 Re^{7+} rhenium	76 Os osmium 190.23 Os^{4+} osmium	77 Ir iridium 192.22 Ir^{4+} iridium
87 Fr francium (223) Fr^+ francium	88 Ra radium (226) Ra^{2+} radium	89 Ac actinium (227) Ac^{3+} actinium	104 Rf rutherfordium (261)	105 Db dubnium (262)	106 Sg seaborgium (266)	107 Bh bohrium (264)	108 Hs hassium (277)	109 Mt meitnerium (268)

Lanthanide and Actinide Series Begins

58 Ce cerium 140.12 Ce^{3+} cerium	59 Pr praseodymium 140.91 Pr^{3+} praseodymium	60 Nd neodymium 144.24 Nd^{3+} neodymium	61 Pm promethium (145) Pm^{3+} promethium	62 Sm samarium 150.36 Sm^{3+} samarium(III) Sm^{2+} samarium(II)
90 Th thorium 232.04 Th^{4+} thorium	91 Pa protactinium 231.04 Pa^{5+} protactinium(V) Pa^{4+} protactinium(IV)	92 U uranium 238.03 U^{6+} uranium(VI) U^{4+} uranium(IV)	93 Np neptunium (237) Np^{5+} neptunium	94 Pu plutonium (244) Pu^{4+} plutonium(IV) Pu^{6+} plutonium(VI)

Key

Atomic number	91
Symbol of the element	Pa
Name of the element	protactinium
Atomic mass	231.04
Ion charge	Pa^{5+}
Stock name (IUPAC)	protactinium(V)
	Pa^{4+} protactinium(IV)

Based on $^{12}_{6}C$

Most stable or common ion is listed above dotted line. Atomic mass in parentheses indicates mass of the most stable isotope.

10	11	12	13	14	15	16	17	18
							1 H hydrogen 1.01 H^- hydride	2 He helium 4.00 He helium
			5 B boron 10.81 B boron	6 C carbon 12.01 C carbon	7 N nitrogen 14.01 N^{3-} nitride	8 O oxygen 16.00 O^{2-} oxide	9 F fluorine 19.00 F^- fluoride	10 Ne neon 20.18 Ne neon
			13 Al aluminium 26.98 Al^{3+} aluminium	14 Si silicon 28.09 Si silicon	15 P phosphorus 30.97 P^{3-} phosphide	16 S sulfur 32.07 S^{2-} sulfide	17 Cl chlorine 35.45 Cl^- chloride	18 Ar argon 39.95 Ar argon
28 Ni nickel 58.69 Ni^{2+} nickel(II) Ni^{3+} nickel(III)	29 Cu copper 63.55 Cu^{2+} copper(II) Cu^+ copper(I)	30 Zn zinc 65.41 Zn^{2+} zinc	31 Ga gallium 69.72 Ga^{3+} gallium	32 Ge germanium 72.64 Ge^{4+} germanium	33 As arsenic 74.92 As^{3-} arsenide	34 Se selenium 78.96 Se^{2-} selenide	35 Br bromine 79.90 Br^- bromide	36 Kr krypton 83.80 Kr krypton
46 Pd palladium 106.42 Pd^{2+} palladium(II) Pd^{3+} palladium(III)	47 Ag silver 107.87 Ag^+ silver	48 Cd cadmium 112.41 Cd^{2+} cadmium	49 In indium 114.82 In^{3+} indium	50 Sn tin 118.71 Sn^{4+} tin(IV) Sn^{2+} tin(II)	51 Sb antimony 121.76 Sb^{3+} antimony(III) Sb^{5+} antimony(V)	52 Te tellurium 127.60 Te^{2-} telluride	53 I iodine 126.90 I^- iodide	54 Xe xenon 131.29 Xe xenon
78 Pt platinum 195.08 Pt^{4+} platinum(IV) Pt^{2+} platinum(II)	79 Au gold 196.97 Au^{3+} gold(III) Au^+ gold(I)	80 Hg mercury 200.59 Hg^{2+} mercury(II) Hg^+ mercury(I)	81 Tl thallium 204.38 Tl^+ thallium(I) Tl^{3+} thallium(III)	82 Pb lead 207.2* Pb^{2+} lead(II) Pb^{4+} lead(IV)	83 Bi bismuth 208.98 Bi^{3+} bismuth(III) Bi^{5+} bismuth(V)	84 Po polonium (209) Po^{2+} polonium(II) Po^{4+} polonium(IV)	85 At astatine (210) At^- astatide	86 Rn radon (222) Rn radon
110 Ds darmstadtium (271)	111 Rg roentgenium (272)							

Polyatomic Elements

Elements			
astatine	At_2	iodine	I_2
bromine	Br_2	nitrogen	N_2
chlorine	Cl_2	oxygen	O_2
fluorine	F_2	phosphorus	P_4
hydrogen	H_2	sulfur	S_8

* The isotopic mix of naturally occurring lead is more variable than that of other elements, preventing precision to greater than tenths of a gram per mole.

63 Eu europium 151.96 Eu^{3+} europium(III) Eu^{2+} europium(II)	64 Gd gadolinium 157.25 Gd^{3+} gadolinium	65 Tb terbium 158.93 Tb^{3+} terbium	66 Dy dysprosium 162.50 Dy^{3+} dysprosium	67 Ho holmium 164.93 Ho^{3+} holmium	68 Er erbium 167.26 Er^{3+} erbium	69 Tm thulium 168.93 Tm^{3+} thulium	70 Yb ytterbium 173.04 Yb^{3+} ytterbium(III) Yb^{2+} ytterbium(II)	71 Lu lutetium 174.97 Lu^{3+} lutetium
95 Am americium (243) Am^{3+} americium(III) Am^{4+} americium(IV)	96 Cm curium (247) Cm^{3+} curium	97 Bk berkelium (247) Bk^{3+} berkelium(III) Bk^{4+} berkelium(IV)	98 Cf californium (251) Cf^{3+} californium	99 Es einsteinium (252) Es^{3+} einsteinium	100 Fm fermium (257) Fm^{3+} fermium	101 Md mendelevium (258) Md^{2+} mendelevium(II) Md^{3+} mendelevium(III)	102 No nobelium (259) No^{2+} nobelium(II) No^{3+} nobelium(III)	103 Lr lawrencium (262) Lr^{3+} lawrencium

Chemistry Unit

$$n = \frac{m}{M}$$

n = number of moles (mol)
m = mass (g)
M = molar mass (g/mol)

Solubility of Selected Ionic Compounds in Aqueous Solutions at 25°C

Ion	Group 1 ions NH_4^+ NO_3^- ClO_3^- ClO_4^- CH_3COO^-	F^-	Cl^- Br^- I^-	SO_4^{2-}	CO_3^{2-} PO_4^{3-} SO_3^{2-}	IO_3^- $OOCCOO^{2-}$	OH^-
Solubility greater than or equal to 0.1 mol/L (very soluble) (aq)	most	most	most	most	Group 1 ions NH_4^+	Group 1 ions NH_4^+ $Co(IO_3)_2$ $Fe_2(OOCCOO)_3$	Group 1 ions NH_4^+
Solubility less than 0.1 mol/L (slightly soluble) (s)	$RbClO_4$ $CsClO_4$ $AgCH_3COO$	Li^+ Mg^{2+} Ca^{2+} Sr^{2+} Ba^{2+} Fe^{2+} Pb^{2+}	Cu^+ Ag^+ Pb^{2+} Tl^+	Ca^{2+} Sr^{2+} Ba^{2+} Ag^+ Pb^{2+} Ra^{2+}	most	most	most

Note: This solubility table is only a guideline that was established using the K_{sp} values. A concentration of 0.1 mol/L corresponds to approximately 10 g/L to 30 g/L, depending on molar mass.

Naming Acids:

Solutions of compounds named	Acid name
hydrogen ___ide	hydro____ic acid
hydrogen___ate	____ic acid
hydrogen___ite	____ous acid

Physics Unit

$v = \frac{\Delta d}{\Delta t}$

$\vec{v} = \frac{\Delta \vec{d}}{\Delta t}$

$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$

$\vec{F} = m\vec{a}$

$W = F\Delta d$

$E_p = mgh$

$E_k = \frac{1}{2}mv^2$

$percent\ efficiency = \left(\frac{output}{input}\right) x\ 100\%$

$slope = \frac{rise}{run} = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$

v = average speed (m/s)
$\vec{v}$ = average speed (m/s)
d = distance (m)
$\vec{d}$ = displacement (m)
t = time elapsed (s)
$\vec{a}$ = acceleration (m/s^2)
$\vec{F}$ = force ($kg \cdot m/s^2$ or N)
F = magnitude of a force (N)
m = mass (kg)
W = work ($N \cdot m$ or J)
Δ = change in
E_p = gravitational potential energy (J)
g = magnitude of acceleration due to gravity (9.81 m/s^2)
E_k = kinetic energy (J)

Environmental Unit

$Q = mc\Delta t = mc(t_f - t_i)$

Q = the quantity of thermal energy **in joules** (J)
m = the mass of the substance (g)
c = the specific heat capacity of the substance (J/g•˚C)
Δ = change in
t = temperature (˚C)

Specific heat capacity of water: 4.19 J/g•˚C

$H_{fus} = \frac{Q}{n}$

$H_{vap} = \frac{Q}{n}$

H_{vap} = heat of vaporization (kJ/mol)
Q = the quantity of thermal energy **in kilojoules** (kJ)
n = the number of mols (mol)

H_{fus} = Heat of fusion (kJ/mol)

H_{fus} for water = 6.01 kJ/mol
H_{vap} for water = 40.66 kJ/mol

Guidelines for Significant Digits, Manipulation of Data and Rounding for Science Diploma Examinations

Significant Digits (measured values)

1. For all non-logarithmic values, regardless of decimal position, any of the digits 1 to 9 is a significant digit; 0 may be significant. For example:

   123   0.123   0.00230 2.30×10^3 2.03
   all have 3 significant digits

2. Leading zeros are not significant. For example:

   0.12 and 0.012 each have two significant digits

3. The Learner Assessment Branch considers all trailing zeros to be significant. For example:

   200 has three significant digits
   0.123 00 and 20.000 each have five significant digits

4. For logarithmic values such as pH, any digit to the left of the decimal is **not** significant. For example:

   a pH of 1.23 has two significant digits
   a pH of 7 has no significant digits

Manipulation of Data

1. When adding or subtracting measured quantities, the calculated answer should be rounded to the same degree of precision as that of the least precise number used in the computation **if this is the only operation**. For example in the following addition:

   12.3 (least precise)
   0.12
   12.34
   24.76

   The answer should be rounded to 24.8.

2. When multiplying or dividing measured quantities, the calculated answer should be rounded to the same number of significant digits as are contained in the quantity with the fewest number of significant digits **if this is the only operation**. For example:

   (1.23)(54.321) = 66.81483

   The answer should be rounded to 66.8.

3. When a series of calculations is performed, each interim value should not be rounded before carrying out the next calculation. The final answer should then be rounded to the same number of significant digits as are contained in the quantity in the **original data** with the fewest number of significant digits. For example:

   In determining the value of (1.23)(4.321) / (3.45 – 3.21), three calculations are required:

   a. 3.45 – 3.21 = 0.24
   b. (1.23)(4.321) = 5.31483
   c. 5.31483 / 0.24 = 22.145125
   [Not 5.31 / 0.24 = 22.125]

   The value should be rounded to 22.1.

   Note: In the example given, steps *a* and *b* yield interim values. These values should not be used in determining the number of significant digits.

4. When calculations involve exact numbers (counted and defined values) the calculated answer should be rounded based upon the precision of the measured value(s). For example:

   12 eggs x 52.3 g/egg = 627.6 g
   or
   5 mol x 32.06 g/mol = 160.30 g
   or
   (1 mol)(–1 095.8 kJ/mol) + (2 mol)(40.8 kJ/mol) = –1 014.2 kJ

Rounding

1. When the first digit to be dropped is less than or equal to 4, the last digit retained should not be changed. For example:

   1.2345 rounded to three digits is 1.23

2. When the first digit to be dropped is greater than or equal to 5, the last digit retained should be increased by one. For example:

   12.25 rounded to three digits is 12.3