

# PSC315118 - PHYSICAL SCIENCES

## EXTERNAL EXAM INFORMATION SHEET

### CONSTANTS

Acceleration due to gravity:  $g = 9.81 \text{ m s}^{-2}$  down

Charge on an electron:  $e = -1.60 \times 10^{-19} \text{ C}$

### EQUATIONS OF MOTION (for constant acceleration)

$$v_{\text{av}} = \frac{s}{t}$$

$$v = u + at$$

$$v^2 = u^2 + 2as$$

$$s = ut + \frac{1}{2}at^2$$

MOMENTUM, ENERGY & POWER	PHYSICAL QUANTITY SYMBOLS (SI UNITS)
$p = mv$ $F_{\text{net}} = \frac{\Delta p}{\Delta t} = \frac{m(v-u)}{\Delta t}$ $F_{\text{net}} = ma$ $F_g = mg$ $E_k = \frac{1}{2}mv^2$ $E_p = mgh$ $P_{\text{av}} = \frac{W}{t} = \frac{\Delta E}{t}$ $W = Fs$ $W = \Delta E$	$s$ = displacement (m) $u$ = initial velocity ( $\text{m s}^{-1}$ ) $v$ = final velocity ( $\text{m s}^{-1}$ ) $a$ = acceleration ( $\text{m s}^{-2}$ ) $t$ = time (s) $p$ = momentum ( $\text{kg m s}^{-1}$ ) $\Delta p$ = change in momentum ( $\text{kg m s}^{-1}$ ) $m$ = mass (kg) $F$ = force (N) $E_k$ = kinetic energy (J) $E_p$ = potential energy (J) $\Delta E$ = change in energy (J) $g$ = acceleration due to gravity ( $\text{m s}^{-2}$ ) $h$ = vertical height (m) $P_{\text{av}}$ = average power (W) $W$ = work done (J)  $q$ = charge (C) $I$ = current (A) $V$ = potential difference (V) $R$ = resistance ( $\Omega$ )
<b>ELECTRICITY</b> $I = \frac{q}{t}$ $V = \frac{W}{q} = \frac{\Delta E}{q}$ $V = IR$ $P = VI = I^2R = \frac{V^2}{R}$ $R_T = R_1 + R_2 + R_3$ resistors in series  $R_T = \frac{R_1 R_2}{R_1 + R_2}$ resistors in parallel  <b>OR</b> $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$	

## PREFIXES

T	-	tera	$10^{12}$
G	-	giga	$10^9$
M	-	mega	$10^6$
k	-	kilo	$10^3$
c	-	centi	$10^{-2}$
m	-	milli	$10^{-3}$
$\mu$	-	micro	$10^{-6}$
n	-	nano	$10^{-9}$

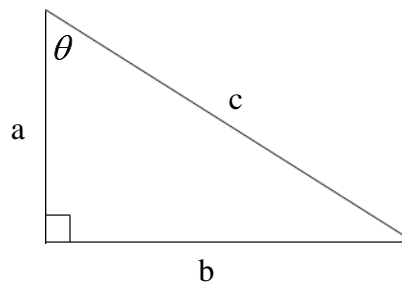
## VECTORS AT RIGHT ANGLES

$$\tan \theta = \frac{\text{opposite}}{\text{adjacent}} = \frac{b}{a}$$

$$\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}} = \frac{b}{c}$$

$$\cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}} = \frac{a}{c}$$

$$c^2 = a^2 + b^2$$



## IONISING RADIATION

### PHYSICAL QUANTITY SYMBOL (SI unit)

A = Activity (Bq)

	$\alpha$ (alpha)	$\beta$ (beta negative)	$\gamma$ (gamma)	Neutron	Proton
<b>Particle</b>	helium nucleus	Electron	electromagnetic waves	neutron	proton
	${}^4_2\text{He}$	${}^0_{-1}\text{e}$	${}^0_0\gamma$	${}^1_0\text{n}$	${}^1_1\text{H}$

## ORGANIC CHEMISTRY

Alkanes:  $C_nH_{2n+2}$

Alkenes:  $C_nH_{2n}$

Alkynes:  $C_nH_{2n-2}$

Cyclic Alkanes:  $C_nH_{2n}$

Cyclic Alkenes:  $C_nH_{2n-2}$

## ORGANIC STEM NAMES

Carbon Atoms in Chain	1	2	3	4	5	6	7	8	9	10
Stem Name	meth-	eth-	prop-	but-	pent-	hex-	hept-	oct-	non-	dec-

## SIDE CHAINS AND FUNCTIONAL GROUPS

methyl	$-CH_3$	bromo	$-Br$
ethyl	$-C_2H_5$	chloro	$-Cl$
propyl	$-C_3H_7$	fluoro	$-F$
		iodo	$-I$

## PREFIXES

Atoms in molecule	1	2	3	4	5	6	7	8	9	10
Prefix	mono-	di-	tri-	tetra-	penta-	hexa-	hepta-	octa-	nona-	deca-

## GENERAL CHARACTERISTICS OF DIFFERENT STRUCTURES

Structure	Melting /boiling point	Electrical conductivity			Further physical properties	Particles present	Charges carriers
		Solid	Molten	Aqueous			
<b>Metallic</b>	high	conducts	conducts	not applicable	dense, malleable, ductile, lustrous	+ ions & electrons	electrons
<b>Ionic</b>	high	non-conducting	conducts	conducts if soluble	hard, brittle	+ & - ions	ions
<b>Covalent molecular</b>	low	non-conducting	non-conducting	non-conducting if soluble	soft solids, liquids or gases	molecules	none
<b>Covalent network</b>	very high	non-conducting	non-conducting	not applicable	hard, brittle	macro-molecule	none

## COMMON POSITIVE IONS (CATIONS)

1+	2+	3+	4+
ammonium $\text{NH}_4^+$	barium $\text{Ba}^{2+}$	aluminium $\text{Al}^{3+}$	lead(IV) $\text{Pb}^{4+}$
hydrogen $\text{H}^+$	calcium $\text{Ca}^{2+}$	chromium(III) $\text{Cr}^{3+}$	tin(IV) $\text{Sn}^{4+}$
lithium $\text{Li}^+$	copper(II) $\text{Cu}^{2+}$	iron(III) $\text{Fe}^{3+}$	
potassium $\text{K}^+$	iron(II) $\text{Fe}^{2+}$		
silver $\text{Ag}^+$	lead(II) $\text{Pb}^{2+}$		
sodium $\text{Na}^+$	magnesium $\text{Mg}^{2+}$		
	mercury(II) $\text{Hg}^{2+}$		
	nickel(II) $\text{Ni}^{2+}$		
	strontium $\text{Sr}^{2+}$		
	tin(II) $\text{Sn}^{2+}$		
	zinc $\text{Zn}^{2+}$		

## COMMON NEGATIVE IONS (ANIONS)

1-	2-	3-
bromide: $\text{Br}^-$	carbonate: $\text{CO}_3^{2-}$	nitride $\text{N}^{3-}$
chloride: $\text{Cl}^-$	chromate: $\text{CrO}_4^{2-}$	phosphate $\text{PO}_4^{3-}$
ethanoate (acetate): $\text{CH}_3\text{COO}^-$	dichromate: $\text{Cr}_2\text{O}_7^{2-}$	phosphide $\text{P}^{3-}$
fluoride: $\text{F}^-$	oxalate: $\text{C}_2\text{O}_4^{2-}$	
hydrogen carbonate: $\text{HCO}_3^-$	oxide: $\text{O}^{2-}$	
hydrogen sulfate: $\text{HSO}_4^-$	sulfate: $\text{SO}_4^{2-}$	
hydrogen sulfite: $\text{HSO}_3^-$	sulfide: $\text{S}^{2-}$	
hydroxide: $\text{OH}^-$	sulfite: $\text{SO}_3^{2-}$	
iodide: $\text{I}^-$	thiosulfate $\text{S}_2\text{O}_3^{2-}$	
nitrate: $\text{NO}_3^-$		
nitrite: $\text{NO}_2^-$		
permanganate $\text{MnO}_4^-$		

## IMPORTANT REACTIONS OF ACIDS

- acid + base [hydroxide/ metal oxide]  $\rightarrow$  salt + water
- acid + reactive metal  $\rightarrow$  salt + hydrogen
- acid + carbonate/ hydrogen carbonate  $\rightarrow$  salt + water + carbon dioxide

## SOLUBILITY TABLE FOR SOME IONIC COMPOUNDS

Negative ions (anions)	Solubility of compounds
ethanoates (acetates) ( $\text{CH}_3\text{COO}^-$ )	All soluble
nitrates ( $\text{NO}_3^-$ )	All soluble
chlorides ( $\text{Cl}^-$ )	All soluble except $\text{AgCl}$ , $\text{PbCl}_2$
bromides ( $\text{Br}^-$ )	All soluble except $\text{AgBr}$ , $\text{PbBr}_2$
iodides ( $\text{I}^-$ )	All soluble except $\text{AgI}$ , $\text{PbI}_2$
sulfates ( $\text{SO}_4^{2-}$ )	All soluble except $\text{BaSO}_4$ , $\text{CaSO}_4$ , $\text{SrSO}_4$ , $\text{PbSO}_4$ , $\text{Ag}_2\text{SO}_4$
hydroxides ( $\text{OH}^-$ )	Insoluble except $\text{LiOH}$ , $\text{NaOH}$ , $\text{KOH}$ , $\text{RbOH}$ , $\text{NH}_4\text{OH}$ , $\text{Sr}(\text{OH})_2$ , $\text{Ba}(\text{OH})_2$
sulfides ( $\text{S}^{2-}$ )	Insoluble except $\text{Li}_2\text{S}$ , $\text{Na}_2\text{S}$ , $\text{K}_2\text{S}$ , $\text{Rb}_2\text{S}$ , $(\text{NH}_4)_2\text{S}$ , $\text{MgS}$ , $\text{CaS}$ , $\text{SrS}$ , $\text{BaS}$
carbonates ( $\text{CO}_3^{2-}$ )	Insoluble except $\text{Li}_2\text{CO}_3$ , $\text{Na}_2\text{CO}_3$ , $\text{K}_2\text{CO}_3$ , $\text{Rb}_2\text{CO}_3$ , $(\text{NH}_4)_2\text{CO}_3$
phosphates ( $\text{PO}_4^{3-}$ )	Insoluble except $\text{Li}_3\text{PO}_4$ , $\text{Na}_3\text{PO}_4$ , $\text{K}_3\text{PO}_4$ , $\text{Rb}_3\text{PO}_4$ , $(\text{NH}_4)_3\text{PO}_4$
sulfites ( $\text{SO}_3^{2-}$ )	Insoluble except $\text{Li}_2\text{SO}_3$ , $\text{Na}_2\text{SO}_3$ , $\text{K}_2\text{SO}_3$ , $\text{Rb}_2\text{SO}_3$ , $(\text{NH}_4)_2\text{SO}_3$

## QUANTITATIVE CHEMISTRY

Avogadro's Number:  $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$

$$N = n \times N_A$$

$$c = \frac{n}{V}$$

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

$N$  = number of particles, etc

$n$  = amount of substance (mol)

$m$  = mass (g)

$M$  = molar mass ( $\text{g mol}^{-1}$ )

$c$  = concentration ( $\text{mol L}^{-1}$ )

$V$  = volume (L)

TABLE OF RELATIVE ATOMIC MASSES (BASED ON  $^{12}\text{C} = 12.00$ )

Name	Symbol	Atomic Number	Relative Atomic Mass	Name	Symbol	Atomic Number	Relative Atomic Mass
actinium	Ac	89	-	mercury	Hg	80	200.6
aluminium	Al	13	26.98	molybdenum	Mo	42	95.94
americium	Am	95	-	neodymium	Nd	60	144.2
antimony	Sb	51	121.8	neon	Ne	10	20.18
argon	Ar	18	39.95	neptunium	Np	93	-
arsenic	As	33	74.92	nickel	Ni	28	58.71
astatine	At	85	-	niobium	Nb	41	92.91
barium	Ba	56	137.3	nitrogen	N	7	14.01
berkelium	Bk	97	-	nobelium	No	102	-
beryllium	Be	4	9.012	osmium	Os	76	190.2
bismuth	Bi	83	209.0	oxygen	O	8	16.00
boron	B	5	10.81	palladium	Pd	46	106.4
bromine	Br	35	79.90	phosphorus	P	15	30.97
cadmium	Cd	48	112.4	platinum	Pt	78	195.1
caesium	Cs	55	132.9	plutonium	Pu	94	-
calcium	Ca	20	40.08	polonium	Po	84	-
californium	Cf	98	-	potassium	K	19	39.10
carbon	C	6	12.01	praseodymium	Pr	59	140.9
cerium	Ce	58	140.1	promethium	Pm	61	-
chlorine	Cl	17	35.45	protactinium	Pa	91	-
chromium	Cr	24	52.00	radium	Ra	88	-
cobalt	Co	27	58.93	radon	Rn	86	-
copper	Cu	29	63.54	rhenium	Re	75	186.2
curium	Cm	96	-	rhodium	Rh	45	102.9
dysprosium	Dy	66	162.5	rubidium	Rb	37	85.47
einsteinium	Es	99	-	ruthenium	Ru	44	101.1
erbium	Er	68	167.3	samarium	Sm	62	150.4
europium	Eu	63	152.0	scandium	Sc	21	44.96
fermium	Fm	100	-	selenium	Se	34	78.96
fluorine	F	9	19.00	silicon	Si	14	28.09
francium	Fr	87	-	silver	Ag	47	107.9
gadolinium	Gd	64	157.3	sodium	Na	11	22.99
gallium	Ga	31	69.72	strontium	Sr	38	87.62
germanium	Ge	32	72.59	sulfur	S	16	32.06
gold	Au	79	197.0	tantalum	Ta	73	180.9
hafnium	Hf	72	178.5	technetium	Tc	43	-
helium	He	2	4.002	tellurium	Te	52	127.6
holmium	Ho	67	164.9	terbium	Tb	65	158.9
hydrogen	H	1	1.008	thallium	Tl	81	204.4
indium	In	49	114.8	thorium	Th	90	232.0
iodine	I	53	126.9	thulium	Tm	69	168.9
iridium	Ir	77	192.2	tin	Sn	50	118.7
iron	Fe	26	55.85	titanium	Ti	22	47.90
krypton	Kr	36	83.80	tungsten	W	74	183.9
lanthanum	La	57	138.9	uranium	U	92	238.0
lawrencium	Lr	103	-	vanadium	V	23	50.94
lead	Pb	82	207.2	xenon	Xe	54	131.3
lithium	Li	3	6.941	ytterbium	Yb	70	173.0
lutetium	Lu	71	175.0	yttrium	Y	39	88.91
magnesium	Mg	12	24.31	zinc	Zn	30	65.37
manganese	Mn	25	54.94	zirconium	Zr	40	91.22
mendelevium	Md	101	-				

# PERIODIC TABLE OF ELEMENTS

Atomic number	→	5	B	←	Symbol
Name	→	Boron			
Relative atomic mass	→	10.81			

Atomic radii decreases →

Atomic radii increases ↓

I	II											III	IV	V	VI	VII	VIII
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 <b>H</b> Hydrogen 1.008																	2 <b>He</b> Helium 4.002
3 <b>Li</b> Lithium 6.941	4 <b>Be</b> Beryllium 9.012											5 <b>B</b> Boron 10.81	6 <b>C</b> Carbon 12.01	7 <b>N</b> Nitrogen 14.01	8 <b>O</b> Oxygen 16.00	9 <b>F</b> Fluorine 19.00	10 <b>Ne</b> Neon 20.18
11 <b>Na</b> Sodium 22.99	12 <b>Mg</b> Magnesium 24.31											13 <b>Al</b> Aluminium 26.98	14 <b>Si</b> Silicon 28.09	15 <b>P</b> Phosphorus 30.97	16 <b>S</b> Sulfur 32.06	17 <b>Cl</b> Chlorine 35.45	18 <b>Ar</b> Argon 39.95
19 <b>K</b> Potassium 39.10	20 <b>Ca</b> Calcium 40.08	21 <b>Sc</b> Scandium 44.96	22 <b>Ti</b> Titanium 47.90	23 <b>V</b> Vanadium 50.94	24 <b>Cr</b> Chromium 52.00	25 <b>Mn</b> Manganese 54.94	26 <b>Fe</b> Iron 55.85	27 <b>Co</b> Cobalt 58.93	28 <b>Ni</b> Nickel 58.71	29 <b>Cu</b> Copper 63.54	30 <b>Zn</b> Zinc 65.37	31 <b>Ga</b> Gallium 69.72	32 <b>Ge</b> Germanium 72.59	33 <b>As</b> Arsenic 74.92	34 <b>Se</b> Selenium 78.96	35 <b>Br</b> Bromine 79.90	36 <b>Kr</b> Krypton 83.80
37 <b>Rb</b> Rubidium 85.47	38 <b>Sr</b> Strontium 87.62	39 <b>Y</b> Yttrium 88.91	40 <b>Zr</b> Zirconium 91.22	41 <b>Nb</b> Niobium 92.91	42 <b>Mo</b> Molybdenum 95.94	43 <b>Tc</b> Technetium	44 <b>Ru</b> Ruthenium 101.1	45 <b>Rh</b> Rhodium 102.9	46 <b>Pd</b> Palladium 106.4	47 <b>Ag</b> Silver 107.9	48 <b>Cd</b> Cadmium 112.4	49 <b>In</b> Indium 114.8	50 <b>Sn</b> Tin 118.7	51 <b>Sb</b> Antimony 121.8	52 <b>Te</b> Tellurium 127.6	53 <b>I</b> Iodine 126.9	54 <b>Xe</b> Xenon 131.3
55 <b>Cs</b> Caesium 132.9	56 <b>Ba</b> Barium 137.3	57 <b>La</b> Lanthanum 138.9	72 <b>Hf</b> Hafnium 178.5	73 <b>Ta</b> Tantalum 180.9	74 <b>W</b> Tungsten 183.9	75 <b>Re</b> Rhenium 186.2	76 <b>Os</b> Osmium 190.2	77 <b>Ir</b> Iridium 192.2	78 <b>Pt</b> Platinum 195.1	79 <b>Au</b> Gold 197.0	80 <b>Hg</b> Mercury 200.6	81 <b>Tl</b> Thallium 204.4	82 <b>Pb</b> Lead 207.2	83 <b>Bi</b> Bismuth 209.0	84 <b>Po</b> Polonium	85 <b>At</b> Astatine	86 <b>Rn</b> Radon
87 <b>Fr</b> Francium	88 <b>Ra</b> Radium	89 <b>Ac</b> Actinium	104 <b>Rf</b> Rutherfordium	105 <b>Db</b> Dubnium	106 <b>Sg</b> Seaborgium	107 <b>Bh</b> Bohrium	108 <b>Hs</b> Hassium	109 <b>Mt</b> Meitnerium	110 <b>Ds</b> Darmstadtium	111 <b>Rg</b> Roentgenium	112 <b>Cn</b> Copernicium	113 <b>Nh</b> Nihonium	114 <b>Fl</b> Flerovium	115 <b>Mc</b> Moscovium	116 <b>Lv</b> Livermorium	117 <b>Ts</b> Tennessine	118 <b>Og</b> Oganesson

58–71 Lanthanide Series	58 <b>Ce</b> Cerium 140.1	59 <b>Pr</b> Praseodymium 140.9	60 <b>Nd</b> Neodymium 144.2	61 <b>Pm</b> Promethium	62 <b>Sm</b> Samarium 150.4	63 <b>Eu</b> Europium 152.0	64 <b>Gd</b> Gadolinium 157.3	65 <b>Tb</b> Terbium 158.9	66 <b>Dy</b> Dysprosium 162.5	67 <b>Ho</b> Holmium 164.9	68 <b>Er</b> Erbium 167.3	69 <b>Tm</b> Thulium 168.9	70 <b>Yb</b> Ytterbium 173.0	71 <b>Lu</b> Lutetium 175.0
90–103 Actinide Series	90 <b>Th</b> Thorium 232.0	91 <b>Pa</b> Protactinium	92 <b>U</b> Uranium 238.0	93 <b>Np</b> Neptunium	94 <b>Pu</b> Plutonium	95 <b>Am</b> Americium	96 <b>Cm</b> Curium	97 <b>Bk</b> Berkelium	98 <b>Cf</b> Californium	99 <b>Es</b> Einsteinium	100 <b>Fm</b> Fermium	101 <b>Md</b> Mendelevium	102 <b>No</b> Nobelium	103 <b>Lr</b> Lawrencium