3.1 Physical Chemistry

includes:
- atomic structure
- amount of substance
- structure and bonding
- energetics
- kinetics
- equilibria
- redox

(the following are A2 only)
- thermodynamics
- rate equations
- Kp
- electrode potentials
- acids and bases

3.1.1 Atomic Structure

Section:	Completed?
fundamental particles	yes
mass number, isotopes	no
electron configuration	yes

Fundamental Particles

plum pudding model	a sphere of positive charge with balls of negative charge embedded within: essentially looks like a plum pudding
electron shell model	small, dense positive charged nucleus with protons and neutrons; electrons orbit in shells
Rutherford's gold foil experiment	(Geiger-Marsdon experiment)
	shot alpha particles through thin gold foil
	- vast majority pass through
	- few deflected by large angles
	- ~1/10000 deflected back to side it came from
Rutherford's conclusions	
	- nucleus is small, positive, dense, massive (heavy)
	- most of the atom is empty space
relative mass	proton/neutron = 1; electron = 1/1840
relative charge	proton = +1; neutron = 0; electron = -1

Electron Configuration (1.1)

four atomic orbitals	s, p, d, f
	s orbitals are spherical
	p orbitals are dumbell shaped
	(go practice some of these questions on paper)
spin	electrons in same orbital have opposite spin
first ionisation energy	*energy required to remove 1mol of electrons from 1mol of gaseous atoms*
	always refer to "1 mole"
	lower ionisation energy = easier to form ion
general equation (ionisation energy)	$X_{(g)}$ --> $X^{+}_{(g)}$ + e^{-}
	state symbols are important!!
factors affecting ionisation energy:	
> nuclear charge	more protons = more positively charged = stronger e^{-} attraction = higher ionisation energy
> distance from nucleus	e^{-} closer to nucleus = stronger attraction = higher ionisation energy
> shielding	higher num orbitals between nucleus and outer e^{-} = weaker attraction = lower ionisation energy
trends in ionisation energy	
down a group:	decreases
	> each element down a group has an extra e^{-} shell

Electron Configuration (1.1) (cont)

	- extra inner shells shield outer e^- from attraction to nucleus
	- extra shells also mean outer e^- are further from nucleus
across a period	generally increases
	> proton num increasing
	- which means there's a stronger nuclear attraction
	> little extra shielding or nuclear distance
	- as all elements across period have same number of shells
(across a period cont)	focusing on period three elements
dip between group 2 and 3	ie between Mg and Al
	Mg is $1s^2\ 2s^2\ 2p^6\ 3s^2$
	Al is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$
	Al outer e^- is in 3p orbital
	- 3p has a slightly higher energy level so is slightly further from nucleus
	- shielded by 3s orbital
	so ionisation energy drops slightly
	provides evidence for electron subshell theory
dip between group 5 and 6	ie P and S
	P is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$
	S is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$

Electron Configuration (1.1) (cont)

e^- from S is being removed from orbital with two e^-

repulsion between e^- in same orbital means e^- are easier to remove

(P has single occupied orbital so no added repulsion)

equations and associated calculations

Mass num, Isotopes (1.1)

mass num (A) =	num protons + num neutrons
atomic num (Z) =	num protons
isotope	atom with same number of protons but a different number of neutrons
mass spectrometry	
stage 1: ionisation	
	the sample can be ionised by either *electrospray* or *electron impact*
electrospray	Sample (X) is dissolved in violent solvent; injected through a hypodermic needle to produce a fine mist; tip of needle is attached to positive terminal of high voltage power supply; ionised by gaining a proton; solvent evaporates; XH+ ions attracted to negative plate - accelerated
electron impact	sample (X) is vaporised; high energy electron fired from electron gun - knocks off one outer shell electron from each particle; 1+ ions attracted to negative plate - accelerated
stage 2: acceleration	

Mass num, Isotopes (1.1) (cont)

positive ions accelerated using electric field so all ions have the same kinetic energy (Ek)
Ek = ½mv^2 (Ek = ½ * mass * velocity^2)
lighter ion = higher velocity
stage 3: flight tube (drift region)
lighter ions move faster than heavier ones (Ek is the same)
lighter ions reach the detector first
s = vt (distance = velocity * time)
stage 4: detection
positive ion hits negatively charged plate
ion gains an electron
why use mass spec?

moles, Avagadro const

Avogadro constant	number of particles in a mole

empirical and molecular formula

empirical formula	simplest whole number ratio of atoms of each element in a compound
molecular formula	actual number of atoms of each element in a compound

3.1.2 Amount of Substance

Section:	Completed?
Mr, Ar	yes
moles, Avogadro const	no
ideal gas equation	no
empirical and molecular formula	no
equations and associated calculations	no

Ar, Mr (1.2)

relative atomic mass (Ar)	mean mass of an atom of an element divided by ⅟₁₂ mean mass of atom of C^{12} isotope
relative molecular mass (Mr)	mean mass of molecule of a compound divided by ⅟₁₂ of mean mass of an atom of C^{12}
	known as relative formula mass for ionic compounds

ideal gas equation

equation:	pV = nRT

3.1.3 bonding

Section:	Completed?
ionic	no
covalent, dative covalent	no
metallic	no
physical properties	no
shapes of molecules and ions	no
bond polarity	no
forces between molecules (imf)	no