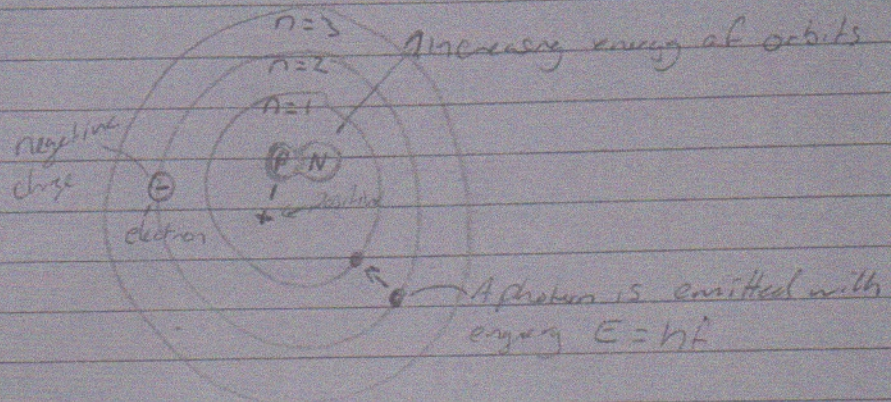


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Question 1

a) Bohr model



b) Bohr's postulates

- 1 - An electron can revolve around the nucleus at in certain fixed orbits of definite energy without emission of any radiant energy. stationary orbits
- 2 - An electron can make a transition from a stationary orbit of higher energy to that of a lower energy and in doing so emits a single photon with a characteristic wavelength.
- 3 - Only orbits for which the angular momentum of the orb is an integer multiple of $h/2\pi$ where h - Planck's constant.

c) with hydrogen have a single electron there are infinite number of energy levels within the hydrogen atom

d) relatively easy to identify via Spectroscopy can be used as an identifier

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Question 2

a) Hydrogen, alkali metals, alkali earth metals, transition metal
poor metals, nonmetals, noble gases, ~~rare~~ rare earth metals.

b) Mass Number - Total number of protons and neutrons in
an atom

atomic number - the number of protons found in the
nucleus of every atom of that element.

c) Nitrogen = 5 Oxygen = 6 Fluorine = 7
neon = 8

d)

1

2

4

7
=

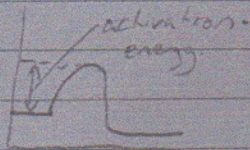
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Question 3

a) Stability = the ability of an explosive to be stored without deterioration (breakdown) of the material

b) $p = e^{\frac{-E}{kT}}$ - the formula to explain the specific velocity of molecules relating to temperature

c) activation energy is the amount of energy required by the System (explosive material) to begin reacting



d)

e)

Question 3

f) rate of reaction with will double for every increase of 10°C above ambient conditions. moving from 20°C to 50°C , an increase of 30°C suggests the rate of reaction will double 3 times. dropping life of round to approx 1 year in these conditions.

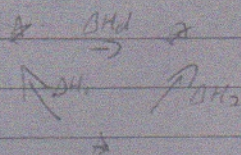
g) Significant off gassing from the round on our pressure of container resulting in blown cases. decreased stability therefore increased sensitivity resulting in fire/deflagration. Cyprus incident. 2011

(3)

(5)

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Question 4

a) Hess law - The overall enthalpy change that accompanies a reaction is independent of the route taken, provided the initial and final states are the same



Question 8

a) nitrocellulose does not refer to a single type of molecular compound but is a generic term for a family
Correct name = Cellulose Nitrate.

b) Cellulose (^{fibre} cotton ~~fibre~~) treated with Sulphuric acid and potassium nitrate, creates Cellulose mononitrate

Cotton is prepared and separated to produce pure cellulose.

nitrated with Sulphuric acid and nitric acid to produce pure nitrocellulose.

perached, once washed, to remove components that would accelerate material breakdown. - boiled in water dried out before being mixed with ether or alcohol and pressed into ~~flat~~ pellets/grains.

c) The Sulphuric acids acts as ^{by protonating} ~~catalyst~~ producing nitronium's, these bind to certain sites ~~on~~ the Cellulose material to nitrate it

d) porching is the boiling of nitrocellulose in water in order to remove impurities that would otherwise ~~the~~ cause premature breakdown/destability of the material.

e) ~~the~~ nitrogen content of nitrocellulose ranges from 10.5 - 13.5% Nitrogen, lower content ~~and~~ can be described as having content at around 10.5% nitrogen.

Question 6

f) Single base - high content nitrocellulose mixed with plasticiser such as Carbanite.

These are typically used in small arms ammunition.

double base - This adds nitroglycerin as a reaction of the nitrocellulose producing a more powerful reaction. Used in Pistol ammunition where

X higher pressures are required than that of Single based.

triple base - This adds nitroguanidine to the nitrocellulose/nitroglycerin mix in order to reduce the temperature and heat of the reaction. This is used in large bore systems such as tank guns and artillery.

g) high erosion to barrel throat and breech face due to temperature of reaction. Significant muzzle flash as a result.

h) - well understood and characterised production method coupled with cost implications and good overall performance.

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Question 7

a) Sensitivity - the degree to which an explosive can be initiated by impact, heat or friction.

b) typically mining/blasting works, cratering charges
Cheap in comparison to other options and safe as can be transported in 2 parts and mixed on site during use.

c) ammonium nitrate → Oxidiser

Sodium nitrate → Oxidiser - also neutral VOD
and reduces critical Diameter

Water → Flow/suspension agent

Oil → Fuel/suspension agent.

aluminium → Fuel/sensitiser

Sorbitan Sesquioleate → Emulsifier

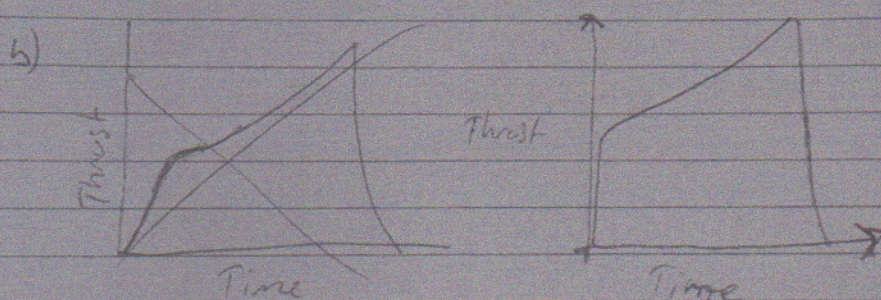
glass micro balloons → Sensitiser - creates heat pockets during detonation

d) typically droplets of explosive suspended in a 2nd liquid
Typically, the fuel (oil) emulsifier acts to keep separation of the 2 structures on a molecular level but still allows flow.

e) by creating hot spots during detonations, they collapse under pressure to create a void of super heated, compressed gas in ~~the~~ throughout the mixture

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Question 8

a) grain geometry, rocket body geometry - internal surfaces
chemical additives stabilisers such as to slow or cool the burn.

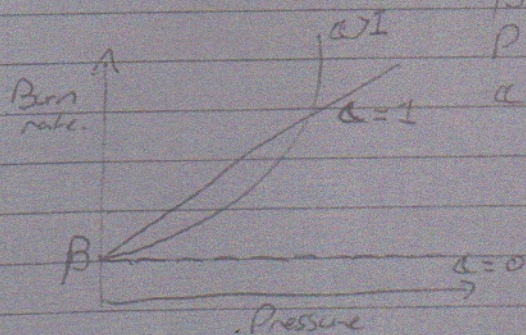


c) $r = \beta P^a$ where r = burn rate (mm s^{-1})

β = burn rate coefficient

P = Pressure (P_0)

a = Pressure index



d) $\log P$

$\log K$

On ~~graph~~ graphs

$$y = 0.9704x + 0.444$$

How?

1.397

1.851

1.698

2.143

1.875

2.313

2

2.436

2.096

2.528

2.176

2.606

2.243

2.671

2.301

2.727