|  |  |  |
| --- | --- | --- |
| Equations | | |
|  |  | |
|  |  | |
|  |  | |
|  |  | |
|  |  | |
| From N5: |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Key Number | Meaning | Key Number | Meaning |
| 6.6310-34 Js | Plank’s Constant | 9.11****10-31 kg | Mass of an electron |
| +1.6010-19 C | Charge Proton | 1.675****10-27 kg | Mass of a neutron |
| -1.6010-19 C | Charge Electron | 1.673****10-27 kg | Mass of a proton |
| 3.0 × 108 ms-1 | Speed of light | 9.0 × 1016 m2s-2 | Speed of light squared |

|  |  |
| --- | --- |
| Key Words | Meaning |
| Electric field | Electric fields are regions in which a charge experiences a force. They exist around charged particles and plates. The direction and strength of the field be visualised by the drawing of field lines. |
| Potential Difference | Potential difference is the work done in moving a unit charge between two points.  1J is the work done moving a charge of 1C through a p.d of 1V. |
| Electronvolt | From the formula, *E=QV*, if we accelerate an electron, which is electrically charged by a potential difference of one-volt, it will gain an energy of 1.6 × 10−19J or 1 ‘electronvolt’, eV. |
| Standard Model | The standard model is the collection of the fundamental particles that make up everything. There are serval particles included in it. |
| Fermion | Fermions are matter particles, they consist of quarks and leptons. |
| Quark | There are 6 types (Up, Down, Charm, Strange, Top, Bottom). Each quark has a fraction of the magnitude charge of an electron. |
| Lepton | There are 6 types. The Electron, Muon, Tau each have a charge of -1. The Electron Neutrino, Muon Neutrino, Tau Neutrino each have a charge of 0 |
| Hadron | The word comes from Greek meaning heavy. These are particles made up of Quarks. |
| Baryon | Made up of 3 Quarks, e.g., the proton and the neutron. |
| Meson | Made of a Quark and Anti-Quark pair. Very short lifespan. |
| Boson | The Force mediating Particles, consists of Photons, W and Z bosons and gluons. |
| Particle accelerator | Collisions of particles inside particle accelerators is evidence for the existence of quarks. |
| Anti-particle | Will have the same magnitude of charge as the corresponding particle, however the sign will be opposite. E.g., and up quark has a charge of 2/3e and an anti-up quark has a charge of -2/3e. |
| Annihilation | This occurs when a particle comes into contact with its corresponding antiparticle. This produces energy which is evidence for antimatter. |
| Beta decay | To follow the conservation of energy a third particle must be released during the decay. This particle is the neutrino, and beta decay is used as evidence for the existence of the neutrino. |
| Photoelectric Effect | Photons incident on a metal can cause the metal to eject an electron. The photons must be of sufficient energy. This phenomenon is called photoemission and is evidence for the particle model of light. *The production of a photoelectron from the surface of a metal when electromagnetic radiation, of sufficiently high frequency is incident on it.* |
| Threshold Frequency | The minimum frequency to allow photoemission to occur. |
| Work Function | The minimum energy to allow photoemission to occur. |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Diagrams |  | | | | | | | | |
| Field Patterns[[1]](#endnote-1) | | | | | **[[2]](#endnote-2)** | | | | **[[3]](#endnote-3)** |
| Why is electric field lines away from (+) and toward (-)? - Physics Stack  Exchange | | | | |  | | | | The Electric Field Revisited | Boundless Physics |
| Secret Sign of the Physicist | **Grip Rule** | | | | | | | **Slap rule, thumb= particle motion** | |
| A picture containing floor, person, wooden, wood  Description automatically generated | A person's hand with painted nails  Description automatically generated with low confidence | | | | | | | palm = directn force on –ve particle  backhand = directn force on +ve particle | |
| How does a 3D diagram fit on a page, well things can come out and go in to the page. | | | | | | | | | |
| Arrow coming towards you (out of the page)  Arrow going away from you (into the page) | | | | | | | | | |
| Waves/Particles | | **Fusion[[4]](#endnote-4)** | | | | | | | |
| |  |  | | --- | --- | | Particle | Wave | | Spectra | Diffrection | | Refraction | Refraction | | Reflection | Reflection | | Photoelectric effect | Interference\* |   \*test for a wave | | small nuclei join to form nucleus of larger mass numberNuclear Fusion | | | | | | | |
| Fission[[5]](#endnote-5) | | | **Atomic Equations[[6]](#endnote-6)** | | | | | | |
| large nucleus split to form nuclei of smaller mass number | | | | | | | Atoms and Elements | | |
| An electron is accelerated from rest through a potential difference of 200 V. Calculate:(a) Ek of the electron; (b) the final speed of the electron. | | | | | | | | | |
| *EK* = *Ew* by the electric field  *EK* = *QV*  *EK* = 1.60 × 10−19 × 200  *EK* = 3.20 × 10−17 J  *EK*= ½*mv*2  3.20 × 10−17 = 0.5 × 9.11 × 10−31 × *v*2  *v*2 = 7.025 × 1013  *v* = 8.38 × 106 m s−1 | | | | | |  | | | |
| Nuclear reaction | | |  | | | | | | |
| A nuclear fission reaction is shown opposite.  This releases energy .  Why is energy released during fusion and fission reactions?  The mass of the products is less than the mass of the reactants. The difference in mass is converted to energy according to E=mc2 | | | | |  |  | | --- | --- | | Mass Before | *Mass after* | | 3.90088×10-25 kg | 1.6249×10-25 kg | | 1.6749×10-27 kg | 2.2556×10-25 kg | | Total 3.917629×10-25 kg | 3.3498×10-27 kg | |  | 3.32×10-30 kg | |  | Total 3.914031×10-25 kg | | | | | | |
| Mass difference | | | Energy equivalence | | | | | | |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | Mass Before | *Mass after* | | | mass change = mass before – mass after  mass change = 3.917629×10-25 kg - 3.914031×10-25 kg  mass change = 3.598×10-28 kg  The same method works for fusion reactions | | 3.90088×10-25 kg | 1.6249×10-25 kg | | | | 1.6749×10-27 kg | 2.2556×10-25 kg | | | | Total 3.917629×10-25 kg | 3.3498×10-27 kg | | | |  | 3.32×10-30 kg | | | | Usually the mass of the beta particles are ignored as they play a minimal effect on the mass difference. | Total 3.914031×10-25 kg | | | | Nuclear fusion reactors require charged particles at a very high temperature (plasma) which have to be contained by magnetic fields. | | | | | |  | | **Photo Electric effect[[7]](#endnote-7)** | | | | The photoelectric effect is evidence for the particle model of light.  Photons of sufficient energy (high frequency) can eject electrons from the surface of materials (photoemission).  The threshold frequency, *f0* is the minimum frequency of a photon required for photoemission.  The work function, *W* or *hf0* of a material is the minimum energy of a photon required to cause photoemission. | | schoolphysics ::Welcome:: | | | |  | | | | | | |  |  | | --- | --- | | **Evidence** | **Conclusion** | | **UV discharges the zinc plate of an electro-scope which is negatively charged.** | **Discharge is the result of ejecting electrons and not a result of ionising the air.** | | **Visible radiation, however bright, doesn’t produce the same effect.** | **It is NOT simply a case of the energy supplied but whether each “bundle” has radiation of the appropriate frequency.** |   I/μA  f/Hz  0  *fo* | | | | | |  | | |  | | | How they can ask photoelectric questions  Incident photon = E= hf = hc/λ  Work function = W= hf0 = hc/λ  *I=Nhf*  I N hf  irradiance = No. of photons Energy per photon  (Wm-2) per second per (J)  square metre (s-1m-2)  Extra Ek = Ek = ½mv2 = qV0= stopping energy | | | | The energy supplied by light or other electromagnetic radiation takes the form of photons of energy, ***hf***. When a photon goes into the metal it is wholly absorbed by a single electron.  If ***hf < W*** no electron emission  If ***hf = W=hf0*** then the photon is just able to release an electron from its surface without it having any EK (f0 or THRESHOLD FREQUENCY). (hf = W = hf0)  If ***hf > W*** then excess energy is given to the freed electron as EK.  ***hf = W + EK*** | | | | | | | | | | | | | | |

1. https://physics.stackexchange.com/questions/288172/why-is-electric-field-lines-away-from-and-toward [↑](#endnote-ref-1)
2. https://commons.wikimedia.org/wiki/File:Field\_lines\_parallel\_plates.svg [↑](#endnote-ref-2)
3. https://courses.lumenlearning.com/boundless-physics/chapter/the-electric-field-revisited/ [↑](#endnote-ref-3)
4. http://hyperphysics.phy-astr.gsu.edu/hbase/NucEne/fusion.html [↑](#endnote-ref-4)
5. https://en.wikipedia.org/wiki/Discovery\_of\_nuclear\_fission [↑](#endnote-ref-5)
6. http://hyperphysics.phy-astr.gsu.edu/hbase/Chemical/atom.html [↑](#endnote-ref-6)
7. http://schoolphysics.org/age16-19/quantum%20physics/text/Photoelectric\_effect/index.html [↑](#endnote-ref-7)