**Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Teacher\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**✓ I am confident that I understand this and I can apply this to problems**

**? I have some understanding but I need to revise this some more**

**🗶 I don’t know this or I need help because I don’t understand it**

|  |  |  |
| --- | --- | --- |
| **Orders of Magnitude** | Covered  (✓) | How well can you do this? |
| To be able to discuss the range of orders of magnitude of length from the very small (sub-nuclear) to the very large (distance to furthest known celestial objects). |  | 🗶 ? ✓ |
|  | | |
| **The Standard Model** | Covered  (✓) | How well can you do this? |
| To be able to discuss the evidence for the sub-nuclear particles and the existence of antimatter. |  | 🗶 ? ✓ |
|  | | |
| State that Fermions, the matter particles, consist of Quarks (6 types) and the 6 Leptons (Electron, Muon and Tau, together with their neutrinos). |  | 🗶 ? ✓ |
|  | | |
| State that Hadrons are composite particles made of Quarks |  | 🗶 ? ✓ |
|  | | |
| State that Baryons are made of three Quarks and Mesons are made of two Quarks. |  | 🗶 ? ✓ |
|  | | |
| To be able to describe beta decay as the first evidence for the neutrino |  | 🗶 ? ✓ |
|  | | |
| State that the force mediating particles are bosons (Photons, W and Z Bosons and Gluons) |  | 🗶 ? ✓ |
|  |  |  |
| Describe how a PET scanner works |  | 🗶 ? ✓ |
| **Electric Fields** | Covered  (✓) | How well can you do this? |
| State that, in an electric field, an electric charge experiences a force |  | 🗶 ? ✓ |
|  | | |
| State that an electric field applied to a conductor causes the free electric charges in it to move |  | 🗶 ? ✓ |
| **Movement of Charge** | Covered  (✓) | How well can you do this? |
| State that work, W, is done when a charge, Q, is moved in an electric field. |  | 🗶 ? ✓ |
|  | | |
| State that the potential difference (V) between two points is a measure of the work done in moving one coulomb of charge between the two points |  | 🗶 ? ✓ |
|  | | |
| State that if one joule of work is done moving one coulomb of charge between two points, the potential difference between the points is one volt. |  | 🗶 ? ✓ |
|  | | |
| State the relationship V = W/Q. |  | 🗶 ? ✓ |
|  | | |
| Carry out calculations involving the relationship V = W/Q |  | 🗶 ? ✓ |
|  | | |
| Calculate the speed of a charged particle accelerated in an electric field using the relationship QV = ½ mv2. |  | 🗶 ? ✓ |
|  | | |
| **Charged Particles in a Magnetic Field** | Covered  (✓) | How well can you do this? |
| State that a moving charge produces a magnetic field |  | 🗶 ? ✓ |
|  | | |
| Describe the force acting on a charged particle in a magnetic field. |  | 🗶 ? ✓ |
|  | | |
| **Particle Accelerators** | Covered  (✓) | How well can you do this? |
| State the three types of particle accelerator |  | 🗶 ? ✓ |
|  | | |
| Describe the basic operation of particle accelerators in terms of acceleration, deflection and collision of charged particles |  | 🗶 ? ✓ |
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| **Fission and Fusion** | Covered  (✓) | How well can you do this? |
| Explain what is meant by alpha, beta and gamma decay of radionuclides |  | 🗶 ? ✓ |
|  | | |
| Identify the processes occurring in nuclear reactions written in symbolic form |  | 🗶 ? ✓ |
| State that in fission a nucleus of large mass number splits into two nuclei of smaller mass numbers, usually along with several neutrons |  | 🗶 ? ✓ |
|  | | |
| State that fission may be spontaneous or induced by neutron bombardment |  | 🗶 ? ✓ |
|  | | |
| State that in fusion two nuclei combine to form a nucleus of larger mass number |  | 🗶 ? ✓ |
|  | | |
| Explain, using *E = mc*2*,* how the products of fission and fusion acquire large amounts of kinetic energy |  | 🗶 ? ✓ |
|  |  |  |
| Carry out calculations using *E = mc*2for fission and fusion reactions. |  | 🗶 ? ✓ |
|  | | |
| Describe the principles of the operation of a nuclear fission reactor in terms of fuel rods, moderator, control rods, coolant and containment vessel |  | 🗶 ? ✓ |
|  | | |
| Describe the coolant and containment issues in nuclear fusion reactors. |  | 🗶 ? ✓ |
|  | | |
| **The Photoelectric Effect and Wave Particle Duality** | Covered  (✓) | How well can you do this? |
| State that photoelectric emission from a surface occurs only if the frequency of the incident radiation is greater than some threshold frequency, *fo*, which depends on the nature of the surface |  | 🗶 ? ✓ |
|  | | |
| State that a beam of radiation can be regarded as a stream of individual energy bundles called photons, each having an energy  *E = hf,* where *h* is Planck’s constant and *f* is the frequency of the radiation. |  | 🗶 ? ✓ |
|  | | |
| Carry out calculations involving the relationship *E = hf* |  | 🗶 ? ✓ |
|  | | |
| State that photoelectrons are ejected with a maximum kinetic energy, *Ek*, which is given by the difference between the energy of the incident photon *hf* and the work function *hfo* of the surface:  *Ek = hf – hfo.* |  | 🗶 ? ✓ |
|  | | |
| State that for frequencies smaller than the threshold value, an increase in the irradiance of the radiation at the surface will not cause photoelectric emission. |  | 🗶 ? ✓ |
|  | | |
| State that for frequencies greater than the threshold value, the photoelectric current produced by monochromatic radiation is directly proportional to the irradiance of the radiation at the surface. |  | 🗶 ? ✓ |
|  | | |
| Explain that if *N* photons per second are incident per unit area on a surface, the irradiance at the surface *I = Nhf.* |  | 🗶 ? ✓ |
|  |  |  |
| **Conditions for Constructive and Destructive Interference** | Covered  (✓) | How well can you do this? |
| Use correctly in context the terms: ‘in phase’, ‘out of phase’ and ‘coherent’, when applied to waves |  | 🗶 ? ✓ |
|  | | |
| Explain the meaning of: ‘constructive interference’ and ‘destructive interference’ in terms of superposition of waves. |  | 🗶 ? ✓ |
|  | | |
| State that interference is the test for a wave |  | 🗶 ? ✓ |
|  |  |  |
| **Interference of Waves using two Coherent Sources** | Covered  (✓) | How well can you do this? |
| State the conditions for maxima and minima in an interference pattern formed by two coherent sources in the form:  Path difference = nl for maxima and  Path difference = (n + ½) l for minima, where *n* is an integer |  | 🗶 ? ✓ |
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| Carry out calculations using the above relationships |  | 🗶 ? ✓ |

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| **Gratings** | Covered  (✓) | How well can you do this? |
| Describe the effect of a grating on a monochromatic light beam |  | 🗶 ? ✓ |
|  | | |
| Carry out calculations using the grating equation ;  *dsin*θ *= nλ* |  |  |
|  | | |
| Describe the principles of a method for measuring the wavelength of a monochromatic light source, using a grating |  | 🗶 ? ✓ |
|  | | |
| State approximate values for the wavelengths of red, green and blue light. |  | 🗶 ? ✓ |
|  | | |
| Describe and compare the white light spectra produced by a grating and a prism |  | 🗶 ? ✓ |
|  | | |
| **Refraction** | Covered  (✓) | How well can you do this? |
| State that the ratio sinθ1 /sinθ2 is a constant when light passes obliquely from medium 1 to medium 2 |  | 🗶 ? ✓ |
|  | | |
| State the absolute refractive index, n, of a medium is the ratio  sinθ1 /sinθ2, where θ1 is in a vacuum (or air as an approximation) and θ2 is in the medium |  | 🗶 ? ✓ |
|  | | |
| Describe the principles of a method for measuring the absolute refractive index of glass for monochromatic light |  | 🗶 ? ✓ |
|  | | |
| Carry out calculations using the relationship for refractive index |  | 🗶 ? ✓ |
|  | | |
| State that the refractive index depends on the frequency of the incident light. |  | 🗶 ? ✓ |

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| State that the frequency of a wave is unaltered by a change in medium |  | 🗶 ? ✓ |
|  | | |
| State the relationships for refraction of a wave from medium 1 to medium 2 |  | 🗶 ? ✓ |
|  | | |
| Carry out calculations using the above relationships |  | 🗶 ? ✓ |
|  | | |
| **Critical Angle and Total Internal Reflection** | Covered  (✓) | How well can you do this? |
| Explain what is meant by total internal reflection |  | 🗶 ? ✓ |
|  | | |
| Explain what is meant by critical angle θc |  | 🗶 ? ✓ |
|  | | |
| Describe the principles of a method for measuring a critical angle |  | 🗶 ? ✓ |
|  | | |
| Derive the relationship sinθc = 1/n, where θc is the critical angle for a medium of absolute refractive index, n. |  | 🗶 ? ✓ |
|  | | |
| Carry out calculations using the above relationship |  | 🗶 ? ✓ |
|  | | |
| **Irradiance and the Inverse Square Law** | Covered  (✓) | How well can you do this? |
| State that the irradiance I at a surface on which radiation is incident is the power per unit area. |  | 🗶 ? ✓ |
|  | | |
| Describe the principles of a method for showing that the irradiance is inversely proportional to the square of the distance from a point source. |  | 🗶 ? ✓ |
|  | | |
| Carry out calculations involving the relationship *I = k/d*2 |  | 🗶 ? ✓ |
|  | | |
| Explain why a beam of laser light having a power even as low  as 0.1 mW may cause eye damage |  | 🗶 ? ✓ |
|  | | |
| **Spectra** | Covered  (✓) | How well can you do this? |
| State that electrons in a free atom occupy discrete energy levels |  | 🗶 ? ✓ |
|  | | |
| Draw a diagram which represents qualitatively the energy levels of a hydrogen atom |  | 🗶 ? ✓ |
|  | | |
| Use the following terms correctly in context: ground state, excited state, ionisation level |  | 🗶 ? ✓ |
|  | | |
| State that an emission line in a spectrum occurs when an electron makes a transition between an excited energy level W2 and a lower level W1, where *W2 - W1 = hf* |  | 🗶 ? ✓ |
|  | | |
| State that an absorption line in a spectrum occurs when an electron in energy level W1 absorbs radiation of energy hf and is excited to energy level W2, where *W2 = W1 + hf.* |  | 🗶 ? ✓ |
|  | | |
| Explain the occurrence of absorption lines in the spectrum of sunlight. |  | 🗶 ? ✓ |