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| OCR Physics A  Module 4C : Quantum physics | Module RAG sheet |

Use this sheet to track and review your learning and revision.

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| **4.5** | **Quantum physics** | RAG1 | RAG2 | RAG3 |
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| **4.5.1** | **Photons** |  |  |  |
| (a) | the particulate nature (photon model) of electromagnetic radiation |  |  |  |
| (b) | photon as a quantum of energy of electromagnetic radiation |  |  |  |
| (c) | energy of a photon; *E = hf* and *E = hc/* λ |  |  |  |
| (d) | the electronvolt (eV) as a unit of energy |  |  |  |
| (e)(i) | using LEDs and the equation *eV = hc / λ* to estimate the value of Planck constant *h*  No knowledge of semiconductor theory is required. |  |  |  |
| (e)(ii) | Determine the Planck constant using different coloured LEDs. |  |  |  |
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| **4.5.2** | **The photoelectric effect** |  |  |  |
| (a)(i) | photoelectric effect, including a simple experiment to demonstrate this effect  Learners should understand that photoelectric effect provides evidence for particulate nature of electromagnetic radiation. Internet research on the development of quantum physics. |  |  |  |
| (a)(ii) | demonstration of the photoelectric effect using, e.g. gold-leaf electroscope and zinc plate |  |  |  |
| (b) | a one-to-one interaction between a photon and a surface electron |  |  |  |
| (c) | Einstein’s photoelectric equation *hf = φ + Ek* |  |  |  |
| (d) | work function; threshold frequency |  |  |  |
| (e) | the idea that the maximum kinetic energy of the photoelectrons is independent of the intensity of the incident radiation |  |  |  |
| (f) | the idea that rate of emission of photoelectrons above the threshold frequency is directly proportional to the intensity of the incident radiation. |  |  |  |
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| **4.5.3** | **Wave–particle duality** |  |  |  |
| (a) | electron diffraction, including experimental evidence of this effect  Learners should understand that electron diffraction provides evidence for wave-like behaviour of particles. |  |  |  |
| (b) | diffraction of electrons travelling through a thin slice of polycrystalline graphite by the atoms of graphite and the spacing between the atoms |  |  |  |
| (c) | the de Broglie equation *p = h / λ* |  |  |  |