Understanding Assessment and Improving Delivery in IAL Physics

Exemplar material

Linkage questions

YPH11/19IF02 - to be confirmed

WPH11 1906 Q16c

Example A

*(c) Explain why the sample of wire used in this experiment should be long and thin.

(6)

as uncertainty of metre rule is ± 1mm hence if length of wire is long percentage uncertainty will be small as it equals $\frac{\text{absolute uncertainty}}{\text{length}} \times 100$ hence it will be more accurate. Also it means extention will be long so easier to measure longer result. If it is thin it means less force is required to produce decent extenstion hence it enables experiment to be done with basic lab equipment.

Example B

*(c) Explain why the sample of wire used in this experiment should be long and thin.

(6)

If the wire is longer, the extensions produced ~~to~~ will be bigger so it is easier to measure the extension in ~~th~~ a longer wire. The wire has to be thin ~~as~~ otherwise it will take a huge load to break the wire ~~and~~. If its ~~so~~ thin, it will have less cross sectional area which means smaller forces can produce larger strains on the wire.

Example C

*(c) Explain why the sample of wire used in this experiment **should be long** and thin.

(6)

A longer thinner wire means that it will have a greater extension at a smaller load which means it will be easier to measure the extension using a ruler. The bigger the extension the easier to measure it (more realible). A thinner + longer wire will have a higher extension because the cross sectional area will be less and the original length will be more. Cross sectional area is inversly proportional to extension.

original length is directly proportional to extension.

$$\frac{F\,x}{A \cdot \text{Young Moduls}} = \Delta x$$

$$\frac{1}{A} = \Delta x \qquad x = \Delta x$$

(Total for Question 16 = 13 marks)

Example D

*(c) Explain why the sample of wire used in this experiment should be long and thin.

(6)

- The wire should be long because by extending the wire as much as possible, the percentage error of measurement will be smaller, i.e. $\frac{0.010}{2.4} \times 100\% = 0.417\%$. The extension will also be larger as well, so it is easier to measure it and reduces percentage error.

- The wire being thin causes the extension to be higher, as mass of wire is reduced, $E = \frac{1}{2}Fe$, less weight is required for wire to extend the same amount, causing percentage error of extension (strain) to decrease.

(Total for Question 16 = 13 marks)

Example E

*(c) Explain why the sample of wire used in this experiment should be long and thin.

(6)

- For a thin wire, it is easy to see the extension as $\Delta x \propto \frac{1}{A}$. So the ~~g~~ smaller the diameter, smaller will be the area and so the extension will be greater for the same applied force.

- For a long wire, longer the wire, easier it will be to see the extension as $\Delta x \propto x$, ~~for a const~~ where area, force and the Young Modulus is constant.

- Therefore a long and thin wire will produce greater Δx for same force, so the Δx is easier to observe.

(Total for Question 16 = 13 marks)

WPH12 1906 Q14

Example A

*14 In 1921, Albert Einstein was awarded the Nobel Prize for Physics "for his discovery of the law of the photoelectric effect".

To explain this effect, Einstein proposed that electromagnetic radiation should be modelled as a particle rather than as a wave.

Explain why, when considering the photoelectric effect, treating electromagnetic radiation as a particle is a more successful model than treating electromagnetic radiation as a wave.

(6)

The photoelectric effect supports the particle model for electromagnetic radiation, suggesting that light acts as a particle when interacting with matter. This was shown in many ways. One support is that photons have a threshold frequency, which is the minimum frequency required by a photon to emit an electron from the surface of a metal. This would not be true for waves, as energy supply in waves is continous, so ~~after a~~ any frequency of waves would be able to emit an electron. Also, in reality electrons are emitted instantaneously if the energy of the photon is suitable, whereas if it were waves, the energy supply is continous, so if any frequency of waves were allowed to shine for a suitable duration of time, an electron would be emitted. Furthermore, increasing intensity of the source does not increase max kinetic energy of electrons, it only increases the rate of emmission of electrons. Whereas for waves, increasing intensity would increase max. kinetic energy of electron. Lastly, one photon is only able to emit one electron, whereas this is not true for waves.

Example B

14 In 1921, Albert Einstein was awarded the Nobel Prize for Physics "for his discovery of the law of the photoelectric effect".

To explain this effect, Einstein proposed that electromagnetic radiation should be modelled as a particle rather than as a wave.

Explain why, when considering the photoelectric effect, treating electromagnetic radiation as a particle is a more successful model than treating electromagnetic radiation as a wave.

(6)

If light acted as a wave an electron would ~~not~~ take time to emit as energy is being built up. An electron could've been emitted at any frequency as eventually enough energy would build up to emit it. The emitted electron in this case would have no kinetic energy. However in the photoelectric effect an electron~~s~~ is emitted instantly as electromagnetic radiation is shone on it. That is because electromagnetic radiation contains packets of energy called photons. The electrons in the photoelectric effect are emitted ~~at~~ ~~e~~ only if the energy of the photon is greater than the minimum energy required to emit an electron. That is known as the work function (Ø). Energy of a photon depends on its frequency ($E = hf$). The equation for the photo electric effect ($E = Ø + KE_{max}$) shows that electrons are emitted with a maximum kinetic energy.

(Total for Question 14 = 6 marks)

Example C

14 In 1921, Albert Einstein was awarded the Nobel Prize for Physics "for his discovery of the law of the photoelectric effect".

To explain this effect, Einstein proposed that electromagnetic radiation should be modelled as a particle rather than as a wave.

Explain why, when considering the photoelectric effect, treating electromagnetic radiation as a particle is a more successful model than treating electromagnetic radiation as a wave.
(6)

photoelectric effect can only occur when a light photon having a fequency above threshold frequency hits an electrone transfering energy to the electrone and the electrone immediately is emitted and if a light ray of below the threshold frequency is shown then there will be no photoelectric effect meaning according to electromagnetic radiation as a particle is been proved right while according to Albert Einstein ~~Sho~~ electromagnetic radiation as a wave is true there is nothing like threshold frequency maximum wave length that affects photo electric emission energy ~~it~~ is transfered to the electrons and slowly build up until it is sufficient to remove an electrone which is not reliable a ray of light ~~be~~ haveing a frequeny below threshold frequency is shown on a metal and left for 10 years of even more no photoelectric emission will occur ~~to~~ because electrons are not able to store energy hence making electromagnetic radiation as a particle model ~~to~~ to be more sucessful.

(Total for Question 14 = 6 marks)

Example D

(1) instate
(1) KE α F
(1) Brightness ↑
(4) 1 photon 1 electron
(1) f_0 and ϕ

*14 In 1921, Albert Einstein was awarded the Nobel Prize for Physics "for his discovery of the law of the photoelectric effect".

To explain this effect, Einstein proposed that electromagnetic radiation should be modelled as a particle rather than as a wave.

Explain why, when considering the photoelectric effect, treating electromagnetic radiation as a particle is a more successful model than treating electromagnetic radiation as a wave.

(6)

Photo electric effect is basically removing an electron from the metal surface by shining in light (Electro magnetic waves) particle model is more succesful since in our observations during this experiment we will see that Electrons are removed instateonusly when shone with EM waves. No Energy is Accumulated. This means one photon emits one electron. This further makes us believe that Energy is Not Accumulated. Particle model believes in minimum Threshold Frequency and ϕ, below the f_0 no photoelectric emmission will take place. but in waves model emission can take place at any frequency. The kinetic energy of the electron depends upon the frequency ie $hf = hf_0 + KE_{max}$ if frequency is high then kinetic energy will be high however their is a limit to this in particle model since electrons have distinct energy levels, which require specific frequencies. but in wave model there is No limit in the kinetic energy. And also if the Brightness Increases, more electrons will be emitted by the metal surface provided that the waves frequency is higher than the f_0. more Bright means more photons hence more electrons emmitted per unit time

(Total for Question 14 = 6 marks)

Example E

14 In 1921, Albert Einstein was awarded the Nobel Prize for Physics "for his discovery of the law of the photoelectric effect".

To explain this effect, Einstein proposed that electromagnetic radiation should be modelled as a particle rather than as a wave.

Explain why, when considering the photoelectric effect, treating electromagnetic radiation as a particle is a more successful model than treating electromagnetic radiation as a wave.

(6)

The photoelectric effect is when a photon has a larger discrete amount of energy, hf, than the work function ~~to be~~ and is thus able to emitt an electron from the surface of a metal. Rather than a continuous wave, one photon transfers energy and is absorbed by one electron. The ability of a photon to emitt an electron is dependent on its frequency which ~~w~~ should be above that of, f_0, the threshhold frequency. For waves, the energy that is transferred to the electron can only come from its intensity which proves to be wrong. ~~at~~ A photon ~~is~~ is a ~~discret~~ package containing a discrete amount of energy. These packages are like particles, each one is ~~ind~~ an individual and is not a continuous wave.