

**PROBLEM 1 – 6 points**

[2 points] (a) Do we have any evidence that light acts like a wave? If so, provide two examples of experiments, or situations, which can only be explained in terms of light acting as a wave.

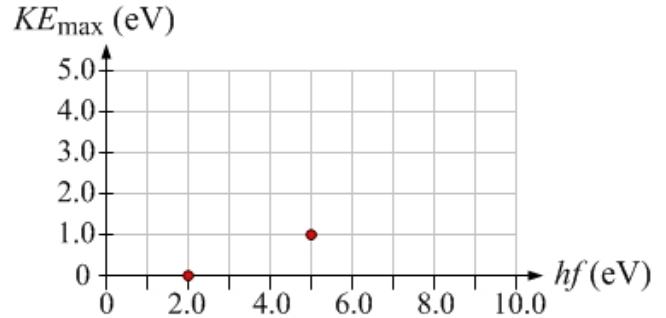
[2 points] (b) Do we have any evidence that light acts like it is made of particles? If so, provide two examples of experiments, or situations, which can only be explained in terms of light acting as particles.

[2 points] (c) Do we have any evidence that things we generally think of as particles (such as electrons, protons, or neutrons) can exhibit wave properties? If so, provide one example.

**PROBLEM 2 – 15 points**

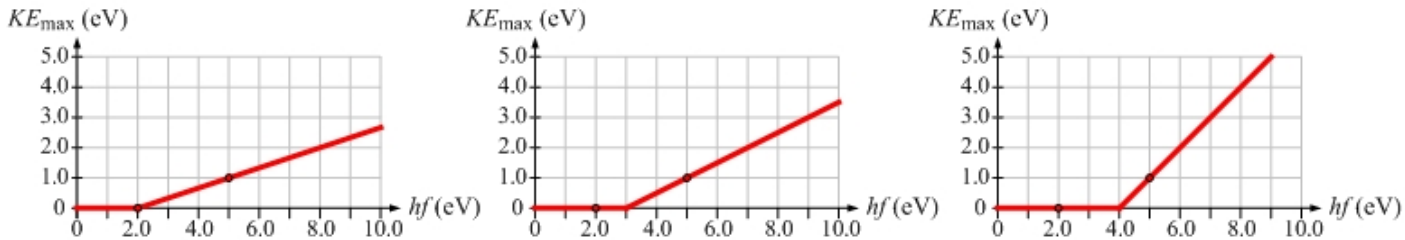
The graph shows two values of the maximum kinetic energy of electrons emitted when light of a certain intensity shines on a particular metal plate, as a function of the energy of the photons in the light. When the photon energy is 2.0 eV, no electrons are emitted (so  $KE_{\max} = 0$ ). When the photon energy is 5.0 eV, the maximum kinetic energy of emitted electrons is 1.0 eV.

[3 points] (a) Calculate the work function (in eV) of this particular metal.



[2 points] (b) Circle the graph below that correctly shows the relationship between the maximum energy of emitted electrons and the energy of the photons in the incident light.

[2 points] (c) Justify your answer to part (b).

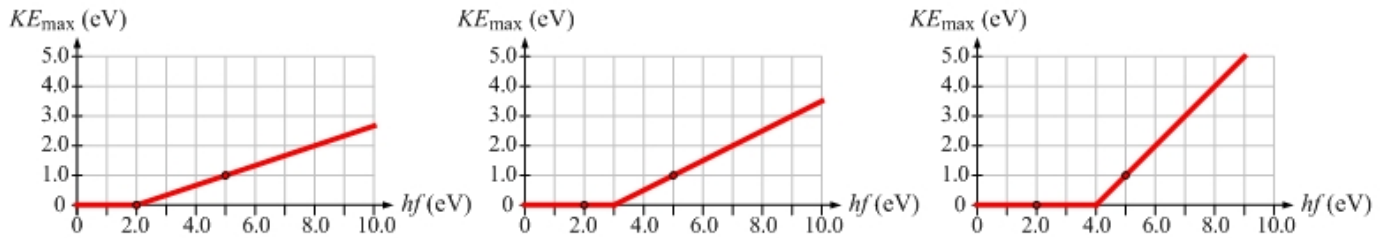


[2 points] (d) With the photon energy held constant at 5.0 eV, the intensity of light shining on the metal is now doubled. The maximum kinetic energy of emitted electrons is now...

- [ ] more than 1.0 eV      [ ] still 1.0 eV      [ ] less than 1.0 eV

## PROBLEM 2 (continued)

For your reference, we show the three graphs from part (b) again.



We now replace the original plate by a different metal plate with a larger work function, and again plot a graph of the maximum kinetic energy of emitted electrons as a function of the energy of the incident photons (using the original intensity of light).

[2 points] (e) The slope of the new graph, compared to the slope of the correct graph in (b), is ...

smaller                       equal                       larger

[2 points] (f) For the new metal plate, the value of the maximum kinetic energy of emitted electrons when the incident photons have an energy of 5.0 eV is ...

more than 1.0 eV                       still 1.0 eV  
 less than 1.0 eV, and possibly no electrons are emitted at all

[2 points] (g) Are we going to observe electrons emitted from the new metal plate when the photons have an energy of 2.0 eV?

Definitely not                       Yes, for certain                       Possibly – we can't be sure