The Photoelectric Effect – Graphing

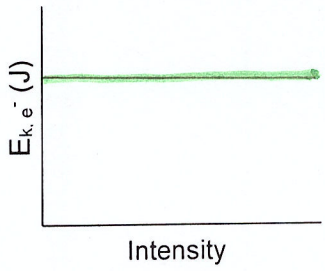
- Recall some of the major observations of the photoelectric effect

Manipulated Variable LIGHT	Responding Variable ELECTRONS
frequency of incident light ➢ If frequency of light increases	kinetic energy of ejected electrons ➢ Kinetic energy of ejected electrons increases
intensity/brightness of incident light ➢ If intensity of light increases	number of eject electrons (ie. current) ➢ Number of electrons emitted (ie. current) will increase

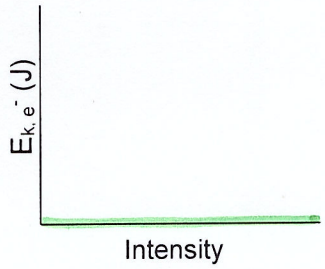
- These same observations can be represented graphical

EXAMPLES

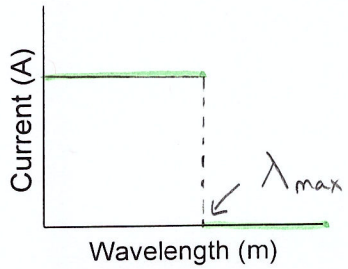
Kinetic Energy of Electrons vs. Intensity of Incident Light
(frequency of light is greater than threshold frequency)



Kinetic Energy of Electrons vs. Intensity of Incident Light
(frequency of light is less than threshold frequency)

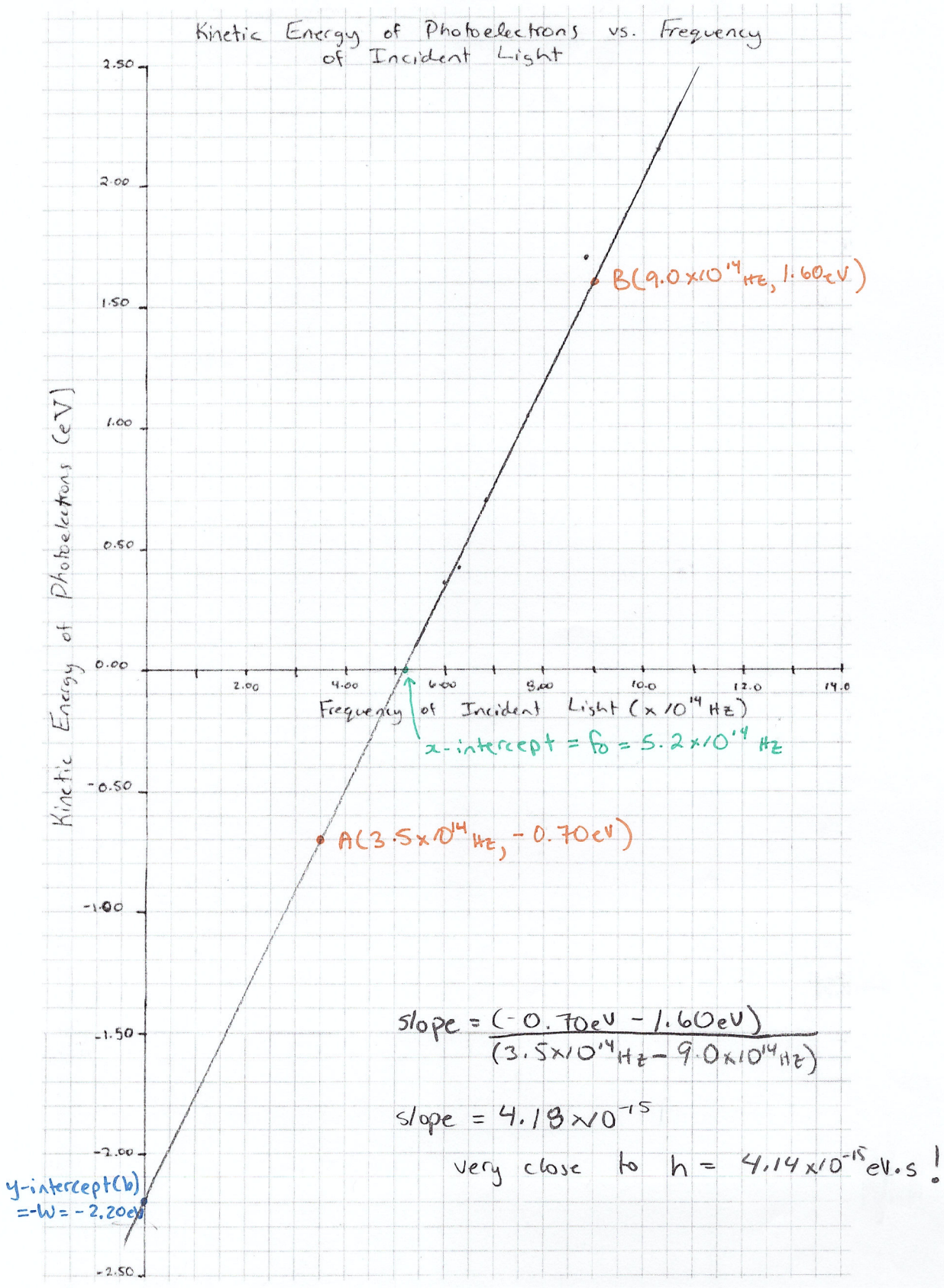


Current vs. Wavelength of Incident Light



- However, some graphs for the photoelectric effect require more analysis and calculations than just simply making general conclusions based on trends

EXAMPLE: In a photoelectric experiment, the maximum kinetic energy of the emitted electrons was measured based on the frequency of the lighting hitting a metal surface. The data was collected and complied into a graph as shown below.



$y = mx + b$

1. Using linear regression, analyze the meaning of the graph.
   a. What is the significance/meaning of the slope?
   b. What is the significance/meaning of the y-intercept?
   c. What is the significance/meaning of the x-intercept?

$x = f$

$y = E_K$

$E_i = E_{out}$

$E_{incident} = W + E_{K,e^-}$

$E_{K,e^-} = E_{incident} - W$ but $E = hf$

$E_{K,e^-} = hf - W$

$\therefore \quad y = mx + b$

$E_{K,e^-} = (h)f + (-W)$

a.) slope $= h$

b.) $b = -W$

c.) x-intercept $\simeq 5.2 \times 10^{14}$ Hz which represents the threshold frequency (f_0) b/c electrons have no speed yet (i.e. $E_{K,max} = 0.0\,eV$)

2. Use your graph to determine the work function of the metal surface.

$-W = b = -2.20\,eV$

$\therefore \boxed{W = 2.20\,eV}$

Now try pg.261 #7-12, 15, 21, 31, 32 (excellence)