Photoelectric effect worksheet 4

15. The energy needed to free an electron from potassium is 5.67×10^{-18} J.

a. What is the work function of potassium?

= ______x 10___ ____

b. What is the threshold frequency of potassium?

= ______x 10___ ____

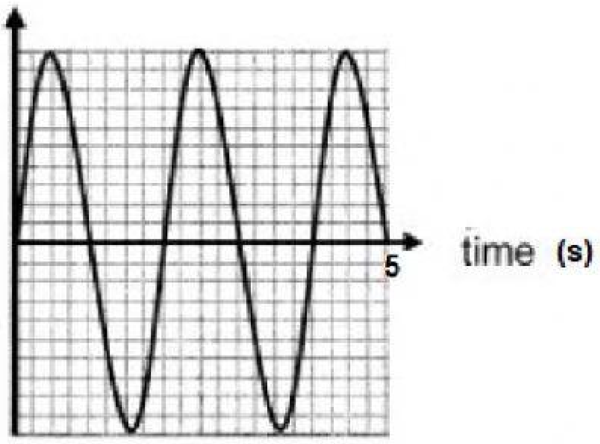
c. Will an electron be emitted when light of wavelength 200 nm falls on it? If so what will its kinetic energy be when it leaves the surface of the metal?

= ______x 10___ ____

Yes No

16. Use this question as an example

The following shows the waveform of a light wave.



Calculate the energy of this light wave

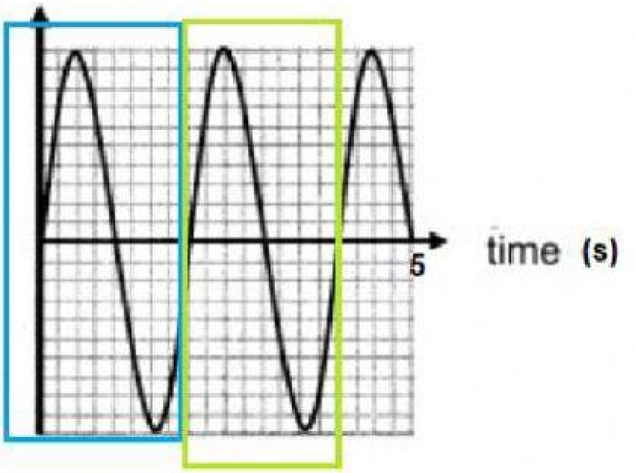
In this case the frequency needs to be calculated first using the gr 10 period formula

Notice also that there are 2,5 waves that form in 5 seconds.

Thus time to form one wave = $\frac{5\ s}{2{,}5\ waves}$

= 2s per 1 wave

Thus T (how long it takes to make one wave) = 2s



f $= \frac{1}{T}$

$= \frac{1}{2}$

= 0,5 Hz (how many waves made per second)

E = h.f

= 6,6,3x10^{-34} (0,5)

= 3,32 x 10^{-34} J

Since light thus behaves like a wave in certain situations and like a wave under certain circumstances, it is known as **wave-particle duality**. Higher frequency radiation tends to behave more like particles and lower frequency like waves. Some people imagine a wave of particles to help them visualise it.

Homework:

Pg 379 Q2.4; 2.5

Pg 380 Q12

Pg 381 Q14; Q15

Pg 382 Q15 and 4.2

Pg 383 Q14

Pg 384 Q14

Pg 385 Q14

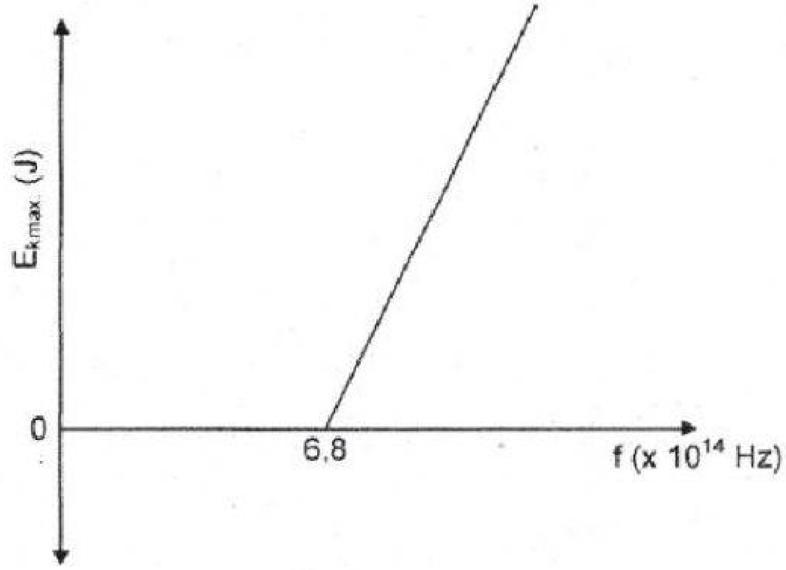
Pg 389 Q11

2 questions given below (that are not in your phys book)

The following 2 questions are not in your booklet

QUESTION 10 (Start on a new page.)

The graph below is obtained for an experiment on the photoelectric effect using different frequencies of light and a given metal plate.



The threshold frequency for the metal is $6,8 \times 10^{14}$ Hz.

10.1 Define the term *threshold frequency*. (2)

In the experiment, the brightness of the light incident on the metal surface is increased.

10.2 State how this change will influence the speed of the photoelectrons emitted.

Choose from INCREASES, DECREASES or REMAINS UNCHANGED. (1)

10.3 Show by means of a calculation whether the photoelectric effect will be OBSERVED or NOT OBSERVED, if monochromatic light with a wavelength of 6×10^{-7} m is used in this experiment. (5)

One of the radiations used in this experiment has a frequency of $7,8 \times 10^{14}$ Hz.

10.4 Calculate the maximum speed of an ejected photoelectron. (5)

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November 2015

QUESTION 11 (Start on a new page.)

In an experiment to demonstrate the photoelectric effect, light of different wavelengths was shone onto a metal surface of a photoelectric cell. The maximum kinetic energy of the emitted electrons was determined for the various wavelengths and recorded in the table below.

INVERSE OF WAVELENGTH $\frac{1}{\lambda}$ **(× 10^{6} m^{-1})**	**MAXIMUM KINETIC ENERGY** $E_{k(max)}$ **(× 10^{-19} J)**
5,00	6,60
3,30	3,30
2,50	1,70
2,00	0,70

11.1 What is meant by the term *photoelectric effect?* (2)

11.2 Draw a graph of $E_{k(max)}$ (y-axis) versus $\frac{1}{\lambda}$ (x-axis) ON THE ATTACHED ANSWER SHEET. (3)

11.3 USE THE GRAPH to determine:

11.3.1 The threshold frequency of the metal in the photoelectric cell (4)

11.3.2 Planck's constant (4)
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