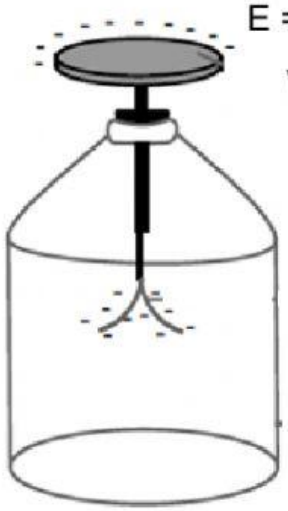
# Photoelectric effect worksheet 3

Quick practise:

- ✓ Leave no spaces between values and units
- ✓ If no photoelectrons are emitted, answer any subsequent questions with n/a
- ✓ Type meters per second as m.s-1

1.



E = 240 J

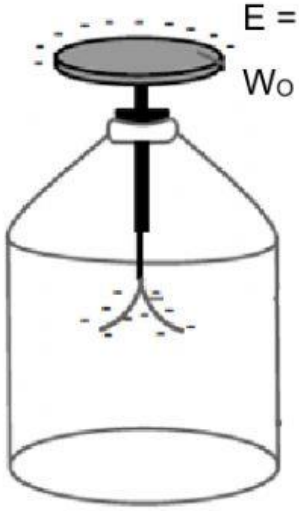
$W_O$ = 300 J

Determine

a) Whether electrons will be emitted yes no

b) If yes, the energy of the emitted photoelectrons Ek =

2.



E = 420 J

$W_O$ = 350 J

Determine

a) Whether electrons will be emitted yes no

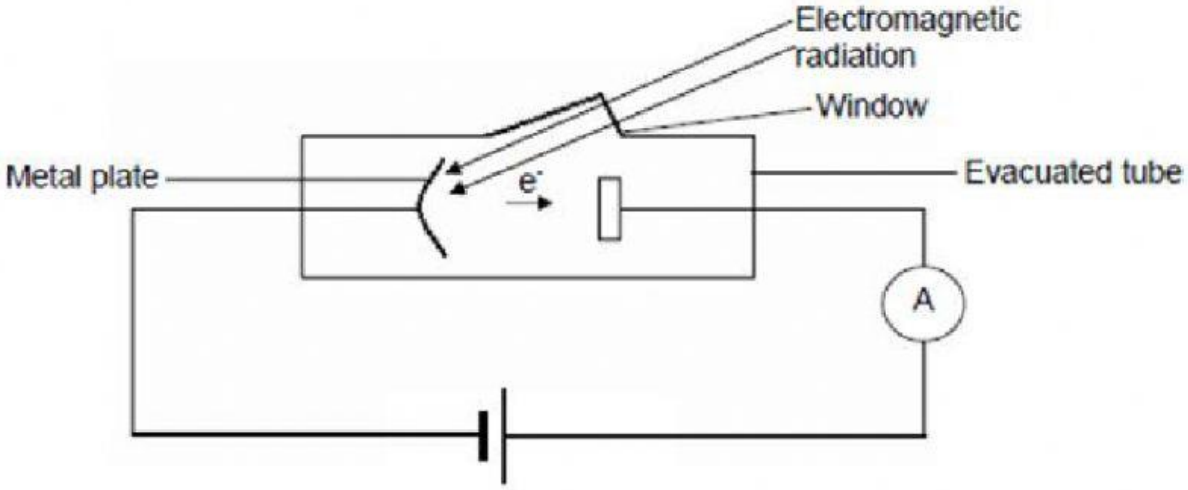
b) If yes, the energy of the emitted photoelectrons Ek =

c) Calculate the speed of the emitted photoelectrons v = _____ x 10 _____m.s-1

# Brightness and frequency of the light and the relationship with current in a photocell

*A photocell in a solar panel is a practical application of the photoelectric effect.*

The diagram below shows a metal plate that emits electrons when a certain frequency of electromagnetic radiation is incident on it. The plate is connected to a source of potential difference and an ammeter as shown in the circuit below.



## Brightness of the light and the current

The only real difference here compared to other theory questions is that current is the number of electrons/photoelectrons that flow past a point per second. Thus you must ensure to say that in your explanation.

Increasing the brightness of the light causes the following (*key phrases to use in an explanation*)

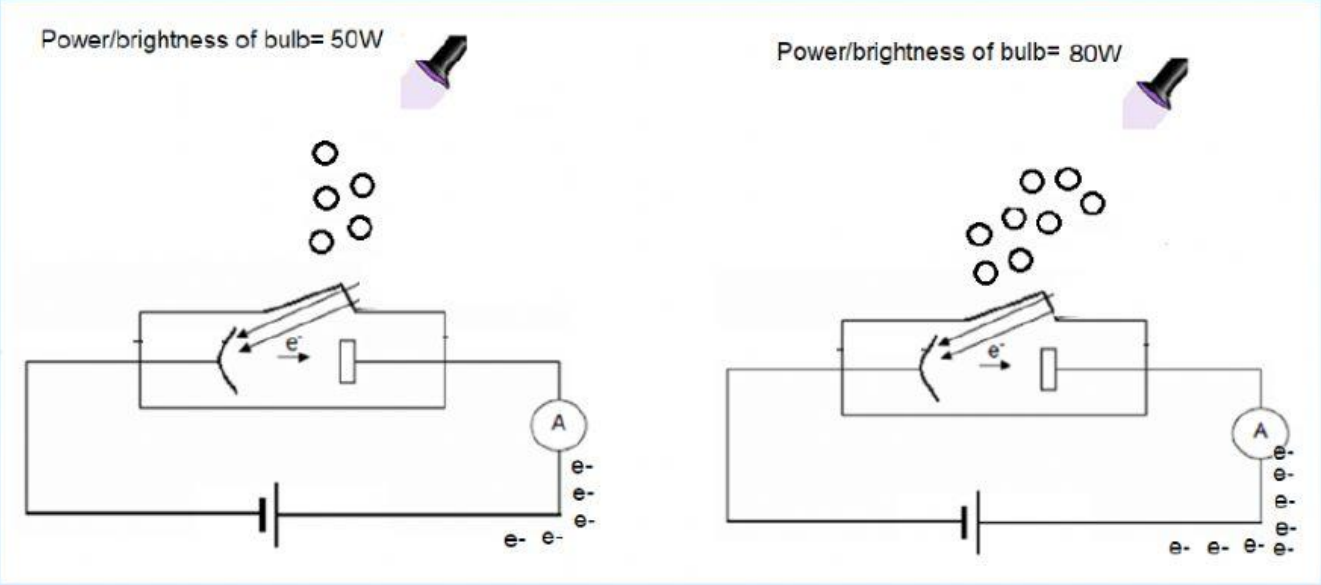
-more photons to be emitted per second

-thus more photons hit the metal plate per second

-and more photoelectrons will be emitted per second

(But only if the energy of the light is greater than the work function of the metal

-thus the current will increase in the photocell



# Frequency of the light and current

Increasing the frequency causes

-the energy of the photons to increase. (f is directly proportional to energy.)

-The number of photoelectrons is **not** affected.

Thus the photons travelling towards the metal have more energy and are moving faster. This causes the photoelectrons emitted to gain more energy ($Ek_{max}$) and also to move faster and have higher speed when emitted. {However there are still the same number of electrons emitted **per second**, they are just moving faster). Since there is the same number of emitted photoelectrons, but they move faster, there just ends up being larger spaces between each emitted photoelectron.}

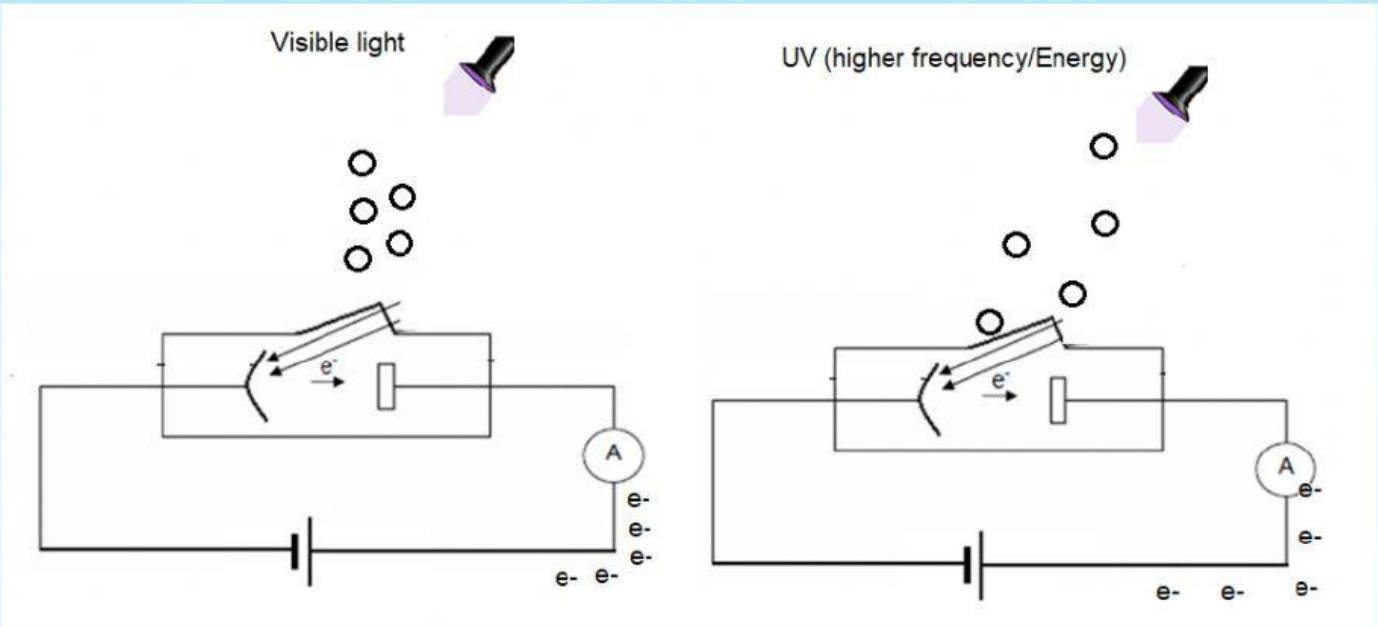
Key phrases to use are

-photons with more energy are released

-but the same number of photons are released per second

-thus the same number of photoelectrons are released per second, but they just have more Ek (they move faster)

-thus the current in the photocell remains constant.



Exercise 1:

Question 1 to 7 must be answered in your phys book

1. What is the photoelectric effect?
2. Why does wave theory fail to explain it?
3. What is a photon?
4. What happens to the energy of a photon when it collides with the surface of the metal?
5. What is the threshold frequency of a substance?
6. What is the work function of a substance?
7. Write an equation to show how the work function and threshold frequency are related?
8. Calculate the energy of a photon of light if it has a frequency of $7{,}5 \times 10^{15}$ Hz.

= _____x 10___ ____

unit

Answer (to 2 decimal places)

Exponent, written as a regular number

9. What is the energy of a photon with a wavelength of $4.6 \times 10^{-6}$ m

= _____x 10___ ____

10. Rank red, green and yellow light from greatest to smallest according to: (type red,green,yellow with no spaces in the correct order separated by a comma)
    a. wavelength
    b. frequency
    c. energy

Which of these three is most likely to emit an electron from a metal surface?

Red Green Yellow

12. The threshold frequency of a particular metal is $4.3 \times 10^{15}$ Hz.

a. Calculate the work function of the metal.

= _____x 10___ ____

b. Would a photon with $2 \times 10^{-18}$ J of energy emit an electron from the metal?

Yes no

13.

The threshold frequency of a particular metal is the frequency of green light. What would happen to the current in a photo electric cell if:

a. dim yellow light no current there will be current current increases current decreases current remains the same

b. bright yellow light no current there will be current current increases current decreases current remains the same

c. dim blue light no current there will be current current increases current decreases current remains the same

d. bright blue light no current there will be current current increases current decreases current remains the same

were shone onto the metal cathode.

14. **Copper has a work function of $6,2 \times 10^{-19}$ J. If copper is irradiated with a wavelenght of 800nm will electrons be emitted?**
**Calculate the energy of the light first.**

E = _____x 10___ ____

Yes No