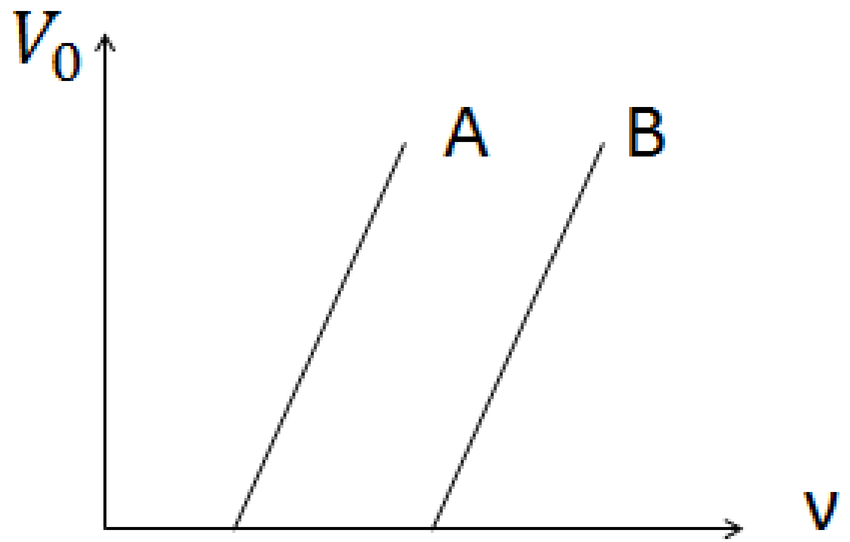
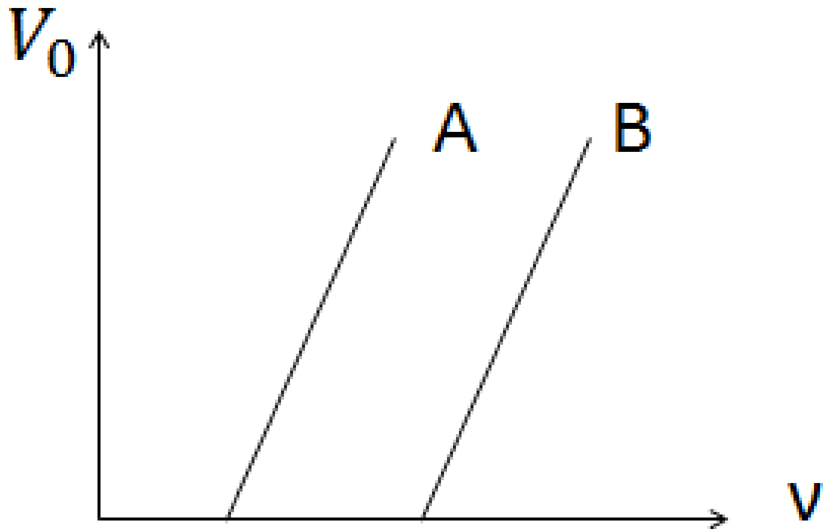
Einstein's Photoelectric Equation

Use of Einstein's Photoelectric Equation

The following figure shows the graphs between stopping potential V_0 and frequency ν of incident radiation for two different photo-sensitive surfaces A and B.

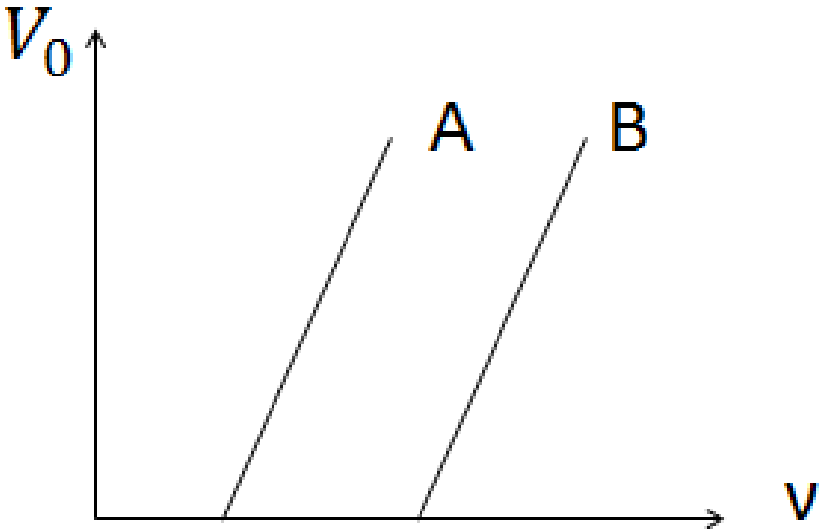


a) **Which surface, out of A and B, has greater value of work function?**



Solution: The straight line for A is at nearer to the origin than for B which suggest that the light of smaller frequency can emit photoelectrons from the surface of metal A, consequently the work-function of A is lesser than B.

b) What Information can be obtained from the value of intercept on the potential axis?



Solution: When the straight lines of A and B are stretched backward then they intercept at the potential axis at the two different points. Out of which the intercept of B is greater than A which denotes the greater value of work function for B than A.

c) **Which metal would emit electrons of smaller kinetic energy if the wavelength of incident radiation remains the same?**

Answer: Using the Einstein's equation

$$E_k = h(\nu - \nu_0)$$

If the maximum velocity of the emitted electron be v_{max} then the kinetic energy of the emitted electron be

$$\frac{1}{2}m{v_{max}}^2 = h(\nu - \nu_0)$$

From the above equation we can say that the value of maximum kinetic energy will be maximum for the metal for which the value of threshold frequency will be lower.

Hence the answer is metal A.

d) **How will the stopping potential change, if the distance between the light source and metal surface is doubled? Justify your answer in each case**.

Answer: We know the energy of emitted photoelectron is $E = eV_0$ and the value of E for the photoelectron having maximum velocity v_{max} is $\frac{1}{2}mv_{max}{}^2$.

So, $\frac{1}{2}mv_{max}{}^2 = eV_0$

The above equation shows that the value of stopping potential does not depends upon the distance form the source.

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