



eduresourceza.com

CONSOLIDATION EXERCISE

SECTION A: TYPICAL EXAM QUESTIONS

Question 1 – 12 minutes

The photoelectric threshold frequency of copper is $9,4 \times 10^{14} \text{ Hz}$.

1.1 What is the work function of copper? (3)

1.2 With what maximum kinetic energy will electrons be ejected when light of frequency

$2,2 \times 10^{15} \text{ Hz}$ is shone onto the copper. (5)

1.3 What would the velocity of the electrons as they are ejected from the metal be? (4)

Question 2 – 11 minutes

2. The threshold frequency of a certain metal is $4,47 \times 10^{15}$ Hz.

2.1. Calculate the work function of the metal. (3)

2.2. If light of wavelength 234 nm shines on the metal, find the maximum kinetic energy of the photoelectrons. (8)

Question 3 – 7 minutes

The hydrogen alpha line in the solar spectrum has a wavelength of 656,285 nm. Remember that all stars are simply similar in nature to our sun and they should contain the same elements. The hydrogen alpha spectral line, that is detected on earth, in the light from a nearby star has a wavelength of 656,315 nm. What can we conclude about the motion of this star? Briefly explain your answer. (5)

SECTION B: SOLUTIONS AND HINTS**Question 1:**

$$1.1 W = hf \checkmark = 6,6 \times 10^{-34} \times 9,4 \times 10^{14} \checkmark \\ = 6,2 \times 10^{-19} \text{ J} \checkmark \quad (3)$$

$$1.2 \quad hf = W + E_K \quad \checkmark \\ 6,6 \times 10^{-34} \checkmark \times 2,2 \times 10^{15} \checkmark = 6,2 \times 10^{-19} + E_K \checkmark \\ E_K = 8,32 \times 10^{-19} \text{ J} \checkmark \quad (5)$$

$$1.3 \quad E_K = \frac{1}{2} mv^2 \checkmark \\ 8,32 \times 10^{-19} \checkmark = \frac{1}{2} (9,1 \times 10^{-31}) v^2 \checkmark \quad (m \text{ is the mass of an electron}) \\ v = 1,9 \times 10^6 \text{ m} \cdot \text{s}^{-1} \checkmark \quad (4)$$

Question 2:

$$2.1 W = hf \checkmark = 6,6 \times 10^{-34} \times 1,1 \times 10^{15} \checkmark \\ = 7,3 \times 10^{-19} \text{ J} \checkmark \quad (3)$$

$$2.2 v = \lambda f \checkmark \\ 3 \times 10^8 \checkmark = (234 \times 10^{-9}) f \checkmark \\ f = 1,3 \times 10^{15} \text{ Hz} \checkmark$$

$$hf = W + E_K \quad \checkmark \\ 6,6 \times 10^{-34} \times 1,3 \times 10^{15} \checkmark = 7,3 \times 10^{-19} + E_K \checkmark \\ E_K = 1,3 \times 10^{-19} \text{ J} \checkmark \quad (8)$$

Question 3:

The longer wavelength of the star in comparison to the sun suggests red shift. $\checkmark$ This is the Doppler effect $\checkmark$ in relation to light. As the star moves away from the earth, $\checkmark$ the waves spread apart $\checkmark$ so we detect a longer wavelength. $\checkmark$ (5)

SECTION E: SOLUTIONS TO SESSION 19 HOMEWORK**Question 1:**

- 1.1 Different metals have different ionisation energies/Different metals attract electrons with different forces. ✓ (1)

1.2

$$hf = W_0 + \frac{1}{2}mv^2 \quad \checkmark \text{ and } c = f\lambda \quad \checkmark$$

$$hc/\lambda = W_0 + \frac{1}{2}mv^2$$

$$\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{2,3 \times 10^{-7}} \checkmark = W_0 + \frac{1}{2}(9,11 \times 10^{-31})(4,78 \times 10^5)^2 \checkmark$$

$$W_0 = 7,58 \times 10^{-19} \text{ J} \quad \checkmark \quad \text{Metal X is silver} \quad \checkmark \quad (6)$$

- 1.3 (Establish) particle nature of light ✓ (1)

Question 2:

- 2.1
- Blue light has a shorter wavelength (or higher frequency) than the other colours.
 - Blue light is therefore scattered more easily than the other colours.
 - The air molecules absorb the blue photons better and then the sky appears to be blue ✓ (3)

2.2.1 $E = hf = h \frac{c}{\lambda} = 6,63 \times 10^{-34} \frac{3 \times 10^8}{360 \times 10^{-9}} = 5,525 \times 10^{-19} \text{ J} \quad \checkmark \quad (3)$

2.2.2 $E = W + \frac{1}{2}mv^2 \quad \checkmark$

$$5,525 \times 10^{-19} = 3,204 \times 10^{-19} + \frac{1}{2}(9,1 \times 10^{-31})v^2 \quad \checkmark$$

$$v^2 = 5,101 \times 10^{11}$$

$$v = 7,14 \times 10^5 \text{ m} \cdot \text{s}^{-1} \quad \checkmark \quad (4)$$