

Λύσεις κριτηρίου 31

**ΘΕΜΑ Α** Α1. (δ) Α2. (γ) Α3. (β) Α4. (β) Α5. α. Λ β. Σ γ. Λ δ. Σ ε. Λ

**ΘΕΜΑ Β**

**B1. (i)**

$$\Delta x = 2\lambda_D = \frac{2h}{p}$$

$$\Delta p \Delta x \geq \frac{h}{2\pi} \Rightarrow \Delta p_{\min} \Delta x = \frac{h}{2\pi} \Rightarrow m\Delta v_{\min} \frac{2h}{p} = \frac{h}{2\pi} \Rightarrow \Delta v_{\min} = \frac{p}{4\pi m} = \frac{v}{4\pi}$$

**B2. (ii)**

$$K_1 = E_{\psi} - \varphi = hf_1 - hf_0 = h \frac{c}{\lambda_1} - h \frac{c}{\lambda_0} \Rightarrow K_1 = h \frac{c}{\lambda_0} - h \frac{c}{\lambda_0} \Rightarrow K_1 = h \frac{c}{\lambda_0} - h \frac{c}{2\lambda_0} \Rightarrow K_1 = h \frac{c}{2\lambda_0}$$

$$K_2 = hf_2 - \varphi = hf_2 - hf_0 = h \frac{c}{\lambda_2} - h \frac{c}{\lambda_0} \Rightarrow K_2 = h \frac{c}{\lambda_0} - h \frac{c}{\lambda_0} \Rightarrow K_2 = 3h \frac{c}{\lambda_0} \Rightarrow K_2 = 3K_1$$

**B3. (iii)**

$$\lambda' - \lambda = \frac{h}{mc} (1 - \sigma \nu \varphi) \Rightarrow \lambda' - \lambda = \lambda_c (1 - \sigma \nu 60^\circ) \Rightarrow \lambda' - \lambda = 0,5\lambda_c$$

$$K_c = E_{\psi} - E_{\psi'} = hf - hf' = h \frac{c}{\lambda} - h \frac{c}{\lambda'} \Rightarrow K_c = hc \frac{\lambda - \lambda'}{\lambda \lambda'} = hc \frac{\lambda_c}{\lambda \lambda'} \Rightarrow K_c = \frac{hc \lambda_c}{2\lambda \lambda'}$$

**ΘΕΜΑ Γ**

**Γ1.**

$$I = \frac{E_{\text{ολ}}}{S \cdot \Delta t} = \frac{Nhf}{S \cdot \Delta t} \Rightarrow f = \frac{IS \cdot \Delta t}{hN} \Rightarrow f = 2 \cdot 10^{15} \text{ Hz}$$

$$c = \lambda f \Rightarrow \lambda = 1,5 \cdot 10^{-7} \text{ m}$$

$$p = \frac{h}{\lambda} = 4,4 \cdot 10^{-27} \text{ kg} \cdot \text{m} / \text{s}$$

**Γ2.**

$$K_{\text{τελ}} - K_{\text{αρχ}} = W_{\text{F}_{\text{ηλ}}} = eV \Rightarrow K_{\text{αρχ}} = 7\text{eV} - 2\text{eV} = 5\text{eV}$$

$$K_{\text{αρχ}} = \frac{1}{2} m v_{\text{αρχ}}^2 \Rightarrow v_{\text{αρχ}} = \sqrt{\frac{2 \cdot 5 \cdot 1,6 \cdot 10^{-19} \text{ J}}{9 \cdot 10^{-31} \text{ kg}}} = \frac{4}{3} \cdot 10^6 \text{ m} / \text{s}$$

**Γ3.**

$$\lambda_D = \frac{h}{p} = \frac{h}{m v_{\text{αρχ}}} = 5,5 \cdot 10^{-10} \text{ m}$$

**Γ4.**

$$K_{\text{αρχ}} = E_{\varphi} - \varphi \Rightarrow \varphi = hf - K_{\text{αρχ}} = 6,6 \cdot 10^{-34} \cdot 2 \cdot 10^{15} - 5 \cdot 1,6 \cdot 10^{-19} \Rightarrow$$

$$\varphi = 5,2 \cdot 10^{-19} \text{ J} \quad \text{ή} \quad \varphi = 3,25 \text{ eV}$$

$$\Gamma 5. \quad i = \frac{q}{\Delta t} = \frac{0,33 \text{ Ne}}{\Delta t} = \frac{0,33 \cdot 10^{16} \cdot 1,6 \cdot 10^{-19}}{3,3} \text{ A} \Rightarrow i = 1,6 \cdot 10^{-4} \text{ A} \quad \text{ή} \quad i = 0,16 \text{ mA}$$

**ΘΕΜΑ Δ**

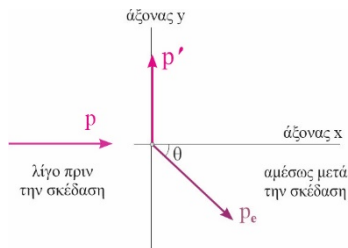
$$\Delta 1. \quad E = hf \Rightarrow f = 5 \cdot 10^{20} \text{ Hz}, \quad c = \lambda f \Rightarrow \lambda = 0,6 \cdot 10^{-12} \text{ m}$$

$$\lambda' - \lambda = \frac{h}{mc} (1 - \cos \varphi) \Rightarrow \lambda' = \lambda + \lambda_c (1 - \cos 90^\circ) \Rightarrow \lambda' = 3 \cdot 10^{-12} \text{ m}$$

**Δ2.**

$$\pi\% = \frac{K_{\text{ε}}}{E_{\varphi}} \% = \frac{E_{\varphi} - E_{\varphi'}}{E_{\varphi}} \% = \frac{hf - hf'}{hf} \% \Rightarrow \pi\% = \frac{h \frac{c}{\lambda} - h \frac{c}{\lambda'}}{h \frac{c}{\lambda}} = \frac{\lambda - \lambda'}{\lambda} \Rightarrow \pi\% = 80\%$$

**Δ3.**  $\Delta\Delta\text{O: } p_{\text{αρχ}} = p_{\text{τελ}} \Rightarrow p = p_e + p \Rightarrow$

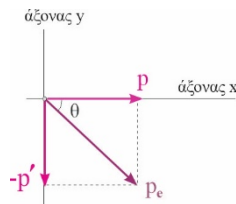


$p_e = p + (-p)$

$p_e = \sqrt{p^2 + p'^2} = \sqrt{\left(\frac{h}{\lambda}\right)^2 + \left(\frac{h}{\lambda'}\right)^2} \Rightarrow$

$p_e = h \sqrt{\left(\frac{1}{0,6 \cdot 10^{-12}}\right)^2 + \left(\frac{1}{3 \cdot 10^{-12}}\right)^2} \Rightarrow$

$p_e = 2,2 \cdot 10^{-22} \sqrt{26} \text{ kg} \cdot \text{m} / \text{s}$



$\epsilon\varphi\theta = \frac{p}{p} = \frac{\frac{h}{\lambda'}}{\frac{h}{\lambda}} = \frac{\lambda}{\lambda'} = 0,2$

**Δ4.**  $\lambda_{D,\min} = \frac{h}{p_{e,\max}} \quad (1)$

για σκέδαση  $180^\circ$

$p_e = p + (-p) \Rightarrow p_{e,\max} = p + p$

$\lambda_{\max}' - \lambda = \lambda_c (1 - \cos 180^\circ) \Rightarrow \lambda_{\max}' = \lambda + 2\lambda_c = 5,4 \cdot 10^{-12} \text{ m}$

$\Rightarrow \frac{h}{\lambda_{D,\min}} = \frac{h}{\lambda} + \frac{h}{\lambda'} \Rightarrow \lambda_{D,\min} = \frac{\lambda\lambda'}{\lambda + \lambda'} = 0,54 \cdot 10^{-12} \text{ m}$

Από (1) και (2)