OVN DUGGA LV6.

(1). In a double slit experiment, the second bright fringe is located at a distance of 3.0 cm from the central bright spot. The slits are 2.0 mm apart and the screen is 2.0 m from the slits. What is the wavelength of the light in m?

a. 1.5×10^{-5}
b. 6.0×10^{-5}
c. 1.5×10^{-2}
d. 3.5×10^{-6}
e. 1.6×10^{-6}

(2). Suppose two flat glass plates 30 cm long are in contact along one end and separated by a human hair at the other end. If the diameter of the hair is 50 μm, find the separation of the interference fringes in mm when the plates are illuminated by green light, $\lambda = 546$ nm.

a. 1.59
b. 1.61
c. 1.69
d. 1.64
e. 1.66

(3). A single slit of width 1.00 mm is illuminated with light of 600×10^{-6} m wavelength. At what angle θ in degrees does the first dark fringe appear?

a. 36.9
b. 0.564
c. 6.87
d. 42.4
e. 5.05×10^{-4}

(4) A diffraction grating has 5000 lines/cm. What angle θ is associated with the first fringe of a 640 nm source?

a. 2.65×10^{-5} rad
b. 1.866×10^{-2} rad
c. 22.43°
d. 18.7°
e. 15.21°

(5) An energy of 13.6 eV is needed to ionize an electron from the ground state of a hydrogen atom. What wavelength in nm is needed if a photon accomplishes this task? ($h = 6.626\times10^{-34}$ J·s; $c = 3.00\times10^{8}$ m/s)

a. 60
b. 80
c. 70
d. 90
e. 40

(6). What is the maximum velocity in km/s of a photoelectron emitted from a surface whose work function is 5.0 eV when the surface is illuminated by radiation of 200 nm wavelength?
($h = 6.626\times10^{-34}$ J·s; $c = 3.00\times10^{8}$ m/s; $e = 1.60\times10^{-19}$C)

a. 460
b. 650
c. 420
d. 550
e. 1480

(7). The light intensity incident on a metallic surface with a work function of 3 eV produces photoelectrons with a maximum kinetic energy of 2 eV. The frequency of the light is doubled. The maximum kinetic energy in eV is

a. 3.
b. 2.
c. $\sqrt{2}$.
d. 4.
e. 7.

When the principle quantum number is 2, the energy of the state of the hydrogen atom in eV is (8)

a. −1.67.
b. −3.40.
c. 2.30.
d. 1.65.
e. 1.36.

(9). How many possible orbital states are there for the $n = 3$ level of hydrogen?

a. 4
b. 9
c. 12
d. 16
e. 25

(10). The permitted values of m_ℓ for $n = 3$ are

a. −1, 0, 1.
b. 2, 1, 0.
c. 2, 1, 0, −1, −2.
d. 0.
e. 3, 2, 1, 0, −1, −2, −3.

(11). The energy in eV needed to remove an electron from the first excited state of a Li^{2+} ion ($Z = 3$) is

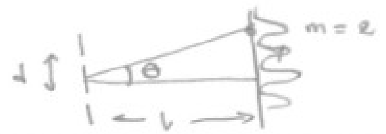
a. 54.4.
b. 30.6.
c. 91.8.
d. 122.4.
e. 10.2.

(12). When the ℓ quantum number remains constant but the principal quantum number may have any value n, the maximum number of electrons in the subshell is

a. equal to $2(2\ell+1)$.
b. equal to n.
c. equal to n^2.
d. equal to $n(2\ell+1)$.
e. equal to $2n(2\ell+1)$.

Övningsdugga 6 okt 2010.

(1)



$d \cdot \sin\theta = m\lambda \Rightarrow \lambda = \frac{d \cdot \sin\theta}{m} = \frac{d \cdot y}{m l} =$

$\sin\theta \approx \tan\theta = \frac{y}{l}$ $\quad = \frac{2 \cdot 10^{-3} \cdot 3 \cdot 10^{-2}}{2 \cdot 2{,}0} = \underline{\underline{1{,}5 \cdot 10^{-5}\ m}}$

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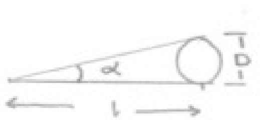
(2)



$\tan\alpha = \frac{D}{l} = \frac{\lambda/2}{x} \Rightarrow x = \frac{\lambda/2 \cdot l}{D} = \frac{546 \cdot 10^{-9} \cdot 0{,}30}{2 \cdot 50 \cdot 10^{-6}} =$

$= \underline{\underline{1{,}64 \cdot 10^{-3}\ m}}$

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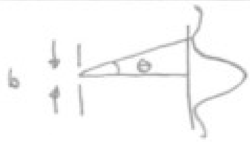
(3)



1:a min : $b \cdot \sin\theta = \lambda$

$\Rightarrow \sin\theta = \frac{600 \cdot 10^{-6}}{1 \cdot 10^{-3}} \Rightarrow \underline{\underline{\theta = 36{,}9^\circ}}$

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(4) $d \cdot \sin\theta = m\lambda$ $\quad d = \frac{1}{5000 \cdot 100}$ meter

$m = 1$

$\Rightarrow \sin\theta = 640 \cdot 10^{-9} \cdot 5000 \cdot 100 \Rightarrow \underline{\underline{\theta = 18{,}7^\circ}}$

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(5) $E_{foton} = hf = \frac{hc}{\lambda}\ (J)$; eV : $\frac{hc}{\lambda e} = 13{,}6 = E \Rightarrow \lambda = \frac{hc}{eE} = \frac{6{,}63 \cdot 10^{-34} \cdot 3 \cdot 10^{8}}{1{,}6 \cdot 10^{-19} \cdot 13{,}6}$

$= 9{,}1 \cdot 10^{-8}\ m = \underline{\underline{91\ nm}}$

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(6) $\frac{hc}{\lambda} - \phi = \frac{1}{2} m v_{max}^2 \Rightarrow v_{max} = \sqrt{\frac{2\left(\frac{hc}{\lambda} - \phi\right)}{m}} = \left[\frac{2\left(\frac{6{,}63 \cdot 10^{-34} \cdot 3 \cdot 10^{8}}{200 \cdot 10^{-9}} - 5 \cdot 1{,}6 \cdot 10^{-19}\right)}{9{,}11 \cdot 10^{-31}}\right]^{1/2}$

$\phi = 5 \cdot 1{,}6 \cdot 10^{-19}\ J$ $\quad = 6{,}53 \cdot 10^{5}\ m/s = \underline{653\ km/s}$

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(7) $\left.\begin{array}{l} E_{foton} - \phi = E_{max} \\ 2E_{foton} - \phi = E'_{max} \end{array}\right\} \Rightarrow \left.\begin{array}{l} -2E_{foton} + 2\phi - E_{max} \\ 2E_{foton} - \phi = E'_{max} \end{array}\right\}$ Addera ekv

$\Rightarrow E'_{max} = \phi + 2E_{max}$

$= 3 + 2 \cdot 2 = \underline{7\ eV}$

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(8) $E_n = -13{,}6 \frac{1}{n^2}\ eV$ $\quad n = 2 \Rightarrow E_2 = -13{,}6 \frac{1}{2^2} = \underline{\underline{-3{,}4\ eV}}$

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(9) utan spinn $\quad m_l$

$n = 3$ → $l = 2$ $\quad +2, +1, 0, -1, -2$

→ $l = 1$ $\quad +1, 0, -1$

→ $l = 0$ $\quad 0$

} sammanlagt $\underline{\underline{9}}$ tillstånd

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(10)

$n = 3$ se ovan $\quad$ svar : $\underline{\underline{c}}$

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(11) väteliknande system $\quad E_n = Z^2 \cdot (-13{,}6) \frac{1}{n^2}$

här $Z = 3$ $\Rightarrow E_{jon} = 9 \cdot 13{,}6\ eV = \underline{\underline{122{,}4\ eV}}$

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(12) givet l och $n \geq l + 1$

antal komb. av $m_l = 2l + 1$

dessutom 2 varianter av spinnet för varje m_l

∴ $\underline{2(2l+1)}$