Name: ______________________ Class: ________________ Date: ________ ID: A

1cs10q5

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question.

____ 1. What is the wavelength of a monochromatic light beam, where the photon energy is 3.00 eV? ($h = 6.63 \times 10^{-34}$ J·s, $c = 3.00 \times 10^8$ m/s, 1 nm = 10^{-9} m, and 1 eV = 1.6×10^{-19} J)

a. 311 nm
(b.) 414 nm
c. 622 nm
d. 1 243 nm
e. 1 735 nm

$E = hf = hc/\lambda \Rightarrow \lambda = \frac{hc}{E} = \frac{1240 \text{ eV}\cdot\text{nm}}{3\text{eV}} = 413.33 \text{ nm}$

[hint: hc = 1240 nm·eV]

____ 2. Light of wavelength 450 nm is incident on a target metal that has a work function of 1.80 eV. What stopping potential is required for this combination in a phototube? ($h = 6.63 \times 10^{-34}$ J·s, $c = 3.00 \times 10^8$ m/s, 1 eV = 1.60×10^{-19} J and 1 nm = 10^{-9} m)

a. 0.57 V
(b.) 0.96 V
c. 2.76 V
d. 4.56 V
e. 5.83 V

$hf - \phi = \frac{hc}{\lambda} - \phi = \frac{1240 \text{ nm}\cdot\text{eV}}{450\text{nm}} - 1.80\text{eV} = 0.955\text{eV}$

$eV_s = hf - \phi = 0.955\text{eV} \Rightarrow V_s = 0.955 \text{ V}$

____ 3. Light of wavelength 480 nm is incident on a metallic surface with a resultant photoelectric stopping potential of 0.55 V. What is the work function of the metal? ($h = 6.63 \times 10^{-34}$ J·s, $c = 3.00 \times 10^8$ m/s, 1 eV = 1.60×10^{-19} J, and 1 nm = 10^{-9} m)

(a.) 2.04 eV
b. 3.19 eV
c. 2.59 eV
d. 0.55 eV
e. 0.27 eV

$\phi = \frac{hc}{\lambda} - eV_s = \frac{1240 \text{ nm}\cdot\text{eV}}{480\text{nm}} - 0.55\text{eV} = 2.033\text{eV}$

____ 4. The de Broglie wavelength of a 0.060 kg golf ball is 4.28×10^{-34} m. What is its speed? ($h = 6.63 \times 10^{-34}$ J·s)

a. 15 m/s
(b) 26 m/s
c. 31 m/s
d. 48 m/s
e. 84 m/s

$V = \frac{h}{m\lambda} = \frac{6.63}{0.06 \cdot 4.28} \text{ m/s} = 25.8 \text{ m/s}$

____ 5. An electron microscope operates with electrons of kinetic energy 50.0 keV. What is the wavelength of these electrons? Assume this speed is not relativistic. ($h = 6.63 \times 10^{-34}$ J·s, $c = 3.00 \times 10^8$ m/s, 1 eV = 1.60×10^{-19} J, and $m_e = 9.11 \times 10^{-31}$ kg)

a. 9.28×10^{-10} m
b. 7.14×10^{-11} m
(c) 5.49×10^{-12} m
d. 2.75×10^{-13} m
e. 3.26×10^{-13} m

$E = \frac{p^2}{2m} = \frac{h^2}{2\lambda^2 m} \Rightarrow \lambda = \frac{h}{\sqrt{2mE}} = 5.49 \times 10^{-12} \text{ m}$

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____ 6. When an electron moves from the $n = 1$ to the $n = 2$ orbit:
a. both the radius and the angular momentum double.
b. both the radius and the angular momentum increase by a factor of 4.
c. the radius doubles and the angular momentum increases by a factor of 4.
(d.) radius increases by a factor of 4 and the angular momentum doubles.
e. radius increases by a factor of 4 and the angular momentum is conserved.

____ 7. A photon is emitted from a hydrogen atom that undergoes a transition from $n = 3$ to $n = 2$. Calculate the energy and wavelength of the photon. (The ionization energy of hydrogen is 13.6 eV, and $h = 6.63 \times 10^{-34}$ J·s, $c = 3.00 \times 10^8$ m/s, 1 eV = 1.60×10^{-19} J, and 1 nm = 10^{-9} m)
(a.) 1.89 eV, 658 nm
b. 2.21 eV, 563 nm
c. 1.89 eV, 460 nm
d. 3.19 eV, 658 nm
e. 2.21 eV, 460 nm

$E = -13.6\left(\frac{1}{9} - \frac{1}{4}\right) eV = 1.89 eV$

$\lambda = \frac{hc}{E} = \frac{1240}{1.89} nm = 656 nm$

____ 8. A ruby laser can deliver an 8.57 J pulse in approximately 50 nanoseconds. The wavelength of the light is 694.4 nm. At least how many atoms within the ruby rod had to be excited to allow this high-energy laser pulse? ($h = 6.63 \times 10^{-34}$ J·s, $c = 3.00 \times 10^8$ m/s, 1 eV = 1.6×10^{-19} J, and 1 nm = 10^{-9} m)
a. 4×10^{18}
b. 8×10^{18}
(c.) 3×10^{19}
d. 6×10^{20}
e. 9×10^{20}

$Nhf = 8.57 J$

$N = \frac{8.57 J \cdot \lambda}{hc} = \frac{8.57 \cdot 694.4 \times 10^{-9}}{6.63 \times 10^{-34} \cdot 3 \times 10^8} = 2.99 \times 10^{19}$