Problems from 27.1 - Photon Theory

$c = f\lambda$

1. What is the frequency of a 3.00 m long radio wave? (1.00x10⁸ Hz)
2. What is the frequency of a 400. nm light wave? (7.50x10¹⁴ Hz)
3. What is the frequency of a 12.0 cm microwave? (2.50x10⁹ Hz)
4. What is the wavelength of a 91.1 MHz FM radio wave? (3.29 m)
5. What is the wavelength of a 60.0 Hz radio wave? (5.00x10⁶ m)

$\lambda = \dfrac{hc}{E}$ Elementary charge $\big|$ e $\big|$ $1.60 \times 10^{-19}\,C$

6. What is the wavelength of a 2.13 eV photon? (583 nm)
7. What is the energy in eV of a 400. nm light wave? (3.10 eV)
8. What is the energy in eV of a 700. nm light wave? (1.77 eV)
9. What is the wavelength of a 1.20 MeV photon? (1.03x10⁻¹² m)
10. What is the energy of a 0.00130 nm photon in eV? (9.54x10⁵ eV)

$E_{max} = hf - \Phi$

11. 415 nm light ejects photo-electrons from a metal with a work function of 2.06 eV. What is the stopping potential of the photo-electrons? (0.930 V)
12. 213 nm light ejects photo-electrons from a metal with a work function of 3.10 eV. What is the kinetic energy of the photo-electrons in eV? (2.73 eV)
13. 117. nm light ejects photo-electrons that have a stopping potential of 3.56 V from a metal. What is the work function of the metal in electron volts? (7.05 eV)
14. Light ejects photo-electrons that have a stopping potential of 1.17 V from a metal with a work function of 2.36 eV. What is the wavelength of the light? (352 nm)
15. 315 nm light ejects photo-electrons from a metal that have a stopping potential of 2.65 V. What is the work function of the metal in electron volts? (1.29 eV)

Electron rest mass	m_e	$9.110 \times 10^{-31}\,kg = 0.000549\,u = 0.511\,MeV\,c^{-2}$
Proton rest mass	m_p	$1.673 \times 10^{-27}\,kg = 1.007276\,u = 938\,MeV\,c^{-2}$
Neutron rest mass	m_n	$1.675 \times 10^{-27}\,kg = 1.008665\,u = 940\,MeV\,c^{-2}$

$\lambda = \dfrac{hc}{E}$

16. A photon creates a proton/anti proton pair each with 180. MeV of kinetic energy. What is the maximum wavelength the photon could have? (5.55x10⁻¹⁶ m)
17. A photon with a wavelength of 7.21x10⁻¹³ m creates an electron/positron pair each with what maximum kinetic energy? (0.349 MeV)
18. A photon creates an electron/positron pair each with 3.20 MeV of energy. What is its wavelength? (1.67x10⁻¹³ m)
19. A 5.85x10⁻¹⁶ m photon creates a neutron/anti neutron pair each with what kinetic energy? (121 MeV)
20. A 3.20x10⁻¹⁵ m photon creates a charged matter/anti matter pair each having a kinetic energy of 53.9 MeV. What is the rest mass of the particles created in MeV? (140. MeV)

$p = mv$ $p = \dfrac{h}{\lambda}$ ←This is not in the data packet

21. What is the velocity of a **proton** with a de Broglie wavelength of 450. nm? (0.880 m/s)
22. What is the mass of a particle that has a de Broglie wavelength of 926 nm, and a velocity of 0.265 m/s? (2.70x10⁻²⁷ kg)
23. What is the de Broglie wavelength of an **electron** with a velocity of 1750 m/s? (416 nm)
24. What is the velocity of **proton** with a de Broglie wavelength of 1.00 x 10⁻¹⁰ m? (3.96x10³ m/s)
25. A particle going 1200. m/s has a de Broglie wavelength of 137 nm. What is the mass of the particle? (4.03x10⁻³⁰ kg)