On the following problems show all your work. Partial credit will be given, if earned. Write your answers in the blanks provided. Note: \( c = 2.998 \times 10^8 \text{ m/s} \) and \( 1 \text{ eV} = 1.602 \times 10^{-19} \text{ J} \).

(16 pts) 1. When light of wavelength 600 nm falls on a certain metal surface, the maximum kinetic energy of the emitted photoelectrons is 1.40 eV. What is the maximum kinetic energy of the photoelectrons when the wavelength of the light is changed to 500 nm?

Ans. __________________
(16 pts) 2. A photon of wavelength 0.1800 nm strikes a free electron that is initially at rest and the photon is scattered at an angle of 180° from its original direction.

a) What is the energy of the photon (in eV) after it has scattered from the electron?

Ans. __________________

b) What is the energy of the electron (in eV) after it has had the collision with the photon?

Ans. __________________
(16 pts) 3. Light of wavelength 70.0 nm ionizes a hydrogen atom that initially was in the $n = 2$ energy level. What is the kinetic energy of the ejected electron?

   Ans. ________________

(14 pts) 4.

a) How many different $5f$ states does a hydrogen atom have? ($f$ means $l = 3$)

   Ans. ________________

b) For an electron in a $5f$ state of hydrogen, what is the minimum possible angle between the orbital angular momentum vector $\vec{L}$ and the $z$-axis? (Express your answer in degrees.)

   Ans. ________________
(16 pts) 5. What is the kinetic energy in eV of an electron that has de Broglie wavelength 120 nm?

Ans. ______________

b) What is the momentum (in kg·m/s) of a photon that has energy 6.00 eV?

Ans. ______________
(22 pts) 6. The nucleus $^{11}_4 \text{Be}$ undergoes $\beta^-$ decay with a half-life of 13.8 s. The atomic mass of $^{11}_4 \text{Be}$ is 11.021660 u.

a) How many neutrons are in the daughter nucleus that is produced by this decay?

Ans. ________________

b) What is the total kinetic energy of the decay products, the energy released in the decay? Express your result in MeV. Refer to the copy of Table 30.2 that is on the formula sheet.

Ans. ________________

c) What is the activity, in decays/s, of a sample containing 5.0 grams of $^{11}_4 \text{Be}$?

Ans. ________________