This shows **some** of the possible questions you encountered on the online test. Point values here are arbitrary.

1. (5) A laser emits a beam of monochromatic photons of frequency 432 THz (terahertz). How many photons n need to be emitted so that their total energy is equal to 1.0 J. Enter the answer in units of exa-photons (exa=E=10^{18}).

2. (5) Find the wavelength of light in nanometers whose photons will eject electrons with maximum kinetic energy of 3.20 eV from sodium metal, which has a binding energy of 2.28 eV.

3. (5) An electron is accelerated from rest through a potential difference of 2500 volts. After finding how fast it is going and hence its momentum, determine its de Broglie wavelength, in pm (picometers). Info: electron mass = 9.109×10^{-31} kg.

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4. (5) At what speed in m/μs (meters/microsecond or megameters/second) will a proton have a de Broglie wavelength of 5.25 fm (1 fm = femtometer = 10^{-15} m), which is similar to the size of an atomic nucleus? Info: proton mass = 1.6726×10^{-27} kg.

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5. (5) An excited state of an atom is found to exist only during the brief time of 8.20 ps (picoseconds). Using the approximate form of Heisenberg's uncertainty principle (without the factor of 4π), estimate the uncertainty in the energy of that excited state, in meV (milli-electron-volts).