1. Different compounds are used in sunscreens to protect skin from sun damage. Two examples are:
   a) PABA or paraamino benzoic acid…see figure
   b) Zinc oxide (ZnO)…a white insoluble powder

   How do these work?

2. A laser produces light that is coherent, monochromatic and collimated. An incandescent light source can also be collimated using a parabolic mirror. If the absorbance of a solution of PABA (see above) dissolved in ethanol is measured using either a laser beam or a collimated incandescent light beam, the absorbance values will be very different. What is the reason for the difference? Explain in detail.

3. The speed of a photon decreases when it interacts with matter, i.e. enters a liquid, solid or gaseous medium. Given a photon with a wavelength of 500 nm in vacuum, what is its wavelength and frequency when traveling through a medium with a refractive index of 1.33?

4. A photon can only be absorbed by a molecule when the photon resonates with an electron in a molecular orbital. Estimate the interaction time during which a photon might be absorbed by said electron given the following information:
   The refractive index of the medium is 1.33.
   The molecular orbital is 1 nm in length.
   The photon has a wavelength of 500 nm in vacuum.