

---

## Photochemistry I – Problems

---

### Series A

1. An organic compound has a molecular weight  $M = 260.4 \text{ g} \cdot \text{mol}^{-1}$ . At a wavelength  $\lambda_{\text{max}}$  corresponding to a maximum of its absorption spectrum, the compound in solution is characterized by a decadic molar extinction coefficient  $\varepsilon = 10^5 \text{ mol}^{-1} \cdot \text{l} \cdot \text{cm}^{-1}$ .
  - a) What is the value of the effective cross section of its molecules for the absorption of light at the wavelength  $\lambda_{\text{max}}$  ?
  - b) What would be the maximum value of the extinction coefficient that would be expected for this compound ?
  
2. A compact monomolecular layer of the compound described in exercise 1 here above is adsorbed at a liquid | liquid interface. The refractive index of the monolayer and that of both liquids is  $n = 1.3$ .
  - a) What is the value of the absorbance  $A$  of the monolayer at the wavelength  $\lambda_{\text{max}}$  ?
  - b) What would be the value of the Fresnel reflectance  $R_S$  at normal incidence of a similar dense monolayer deposited on a glass substrate in air ?
  
3. A UV-curable lacquer contains an initiator diluted in an opaque polymer base. The absolute diffuse reflectance  $R_\infty$  of optically thick lacquer films ( $d \sim 1 \text{ mm}$ ), containing various concentrations  $c$  of the initiator, is measured at a single wavelength. Results are provided by the table here below.

Knowing the molecular weight of the initiator  $M = 339 \text{ g} \cdot \text{mol}^{-1}$ , the phenomenological scattering coefficient of the polymer base  $S = 6.2 \cdot 10^2 \text{ cm}^{-1}$ , and the density of the lacquer film  $\rho = 1.42 \cdot 10^3 \text{ kg} \cdot \text{m}^{-3}$ , determine the decadic molar extinction coefficients  $\varepsilon$  of the polymer and the initiator at the probe wavelength.

$c$ [weight %]	0	0.05	0.10	0.15	0.20
$R_\infty$ [-]	0.81	0.66	0.55	0.49	0.44