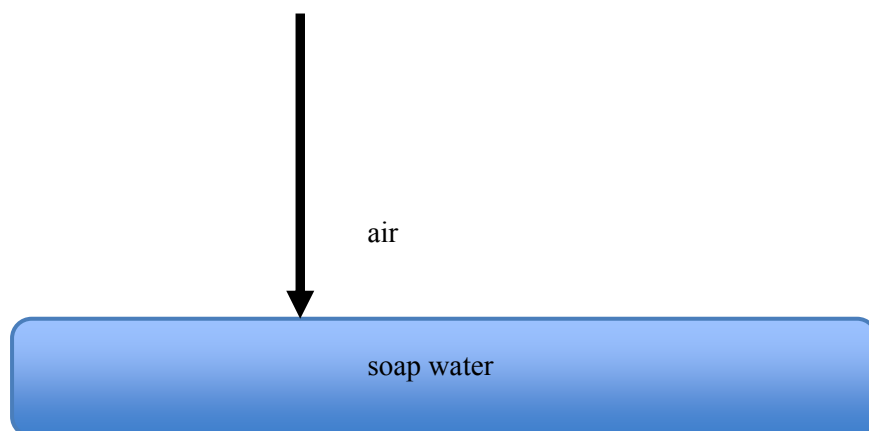


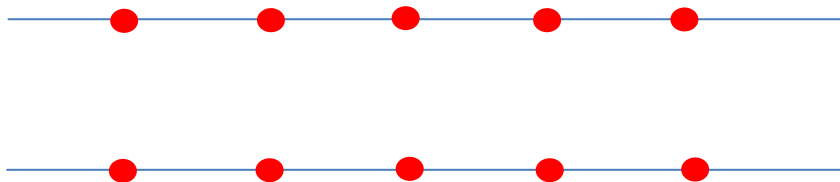
**Extension Worksheet – Option G, Worksheet 3, HL only**

- 1 The accelerating voltage in an X-ray tube is 28 kV. Calculate the minimum wavelength of X-rays produced. [2]
- 2 State the effect on the minimum wavelength of X-rays produced in an X-ray tube when the accelerating voltage is increased. [1]
- 3 State the effect, if any, on the minimum wavelength of X-rays produced in an X-ray tube when the target is replaced by another target made of a different metal but the accelerating voltage stays the same. [2]
- 4 State the effect, if any, on the position of the characteristic lines in the X-ray spectrum when the accelerating voltage is increased. [2]
- 5 A thin soap film is suspended in air and is illuminated with white light.
  - a State and explain the condition for destructive interference for light incident (normally) on the film. [2]
  - b State and explain what will happen if the film thickness is much smaller than the wavelength of light. [3]
  - c A thin soap film of thickness  $0.190\ \mu\text{m}$  and refractive index 1.45 is suspended in air. The film is illuminated with white light.



- Calculate the wavelength of light (in air) for which complete destructive interference takes place, assuming normal incidence. [3]
- 6 Strong reflection is observed for X-rays incident on a crystal making an angle of  $5.0^\circ$  to the crystal face. Calculate the next angle at which strong reflection will be observed. [2]

- 7 Use the diagram below to derive the Bragg scattering formula  $2d \sin \theta = n\lambda$  for the angles at which strong reflection off a crystal face takes place.

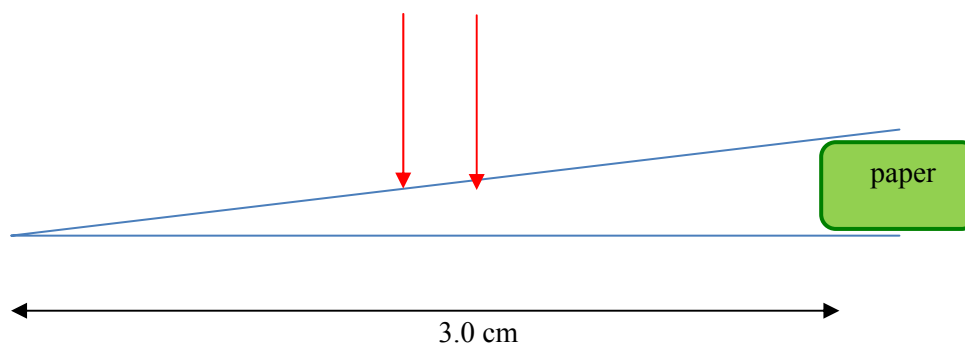


[2]

- 8 X-rays of wavelength  $\lambda = 2.2 \times 10^{-10}$  m are incident on a crystal face making an angle of  $22^\circ$  to the crystal face. Calculate the spacing between the crystal atoms.

[2]

- 9 A thin piece of paper is placed in between two glass plates.



When the plates are illuminated with light of wavelength  $\lambda = 5.6 \times 10^{-7}$  m, bright and dark fringes are observed. The number of dark fringes from where the plates touch to where the paper is placed is 25. Estimate the thickness of the paper.

[3]