Course: BSO 203 Instructor: S. Raychaudhuri

SESSION 2002-2003, SEMESTER I

QUIZ I

1. In a laboratory setup, a 100 watt electric bulb is placed behind a sodium vapour lamp, also of 100 watts and the combination is observed through a spectroscope. What will you see?

(1)

Answer: Sodium has a line spectrum consisting of two closely spaced yellow lines at 5992 and 5996 Angstroms respectively, which look like a single line in a low-resolution spectrometer. Thus the sodium vapour will emit 100 Watts of light in that frequency alone, whereas the bulb will emit 100 Watts distributed over an (approximate) blackbody spectrum. Thus we will see one (or two closely-spaced) bright yellow lines superposed on a continuous background. Any absorption effects will be maked by the bright line(s).

2. Write the dimension of Planck's constant in terms of length, mass and time. Does this match with any other physical quantity known to you?

(2)

Answer: Dimensions of Planck's constant = energy × time = ML^2T^{-1}. This is identical with the dimension of *angular momentum*.

3. A 60-watt device emits monochromatic light of wavelength 6000 Angstroms. Calculate the number of photons emitted per second.

(2)

Answer: Energy of each photon is given by

$$E = h\nu = \frac{hc}{\lambda} = 3.313 \times 10^{-19} \quad \text{J}$$

taking $h = 6.626 \times 10^{34}$ Js and $c = 3 \times 10^8$ ms^{-1}.

Amount of energy emitted per second = 60 watts × 1 second = 60 J.

Number of photons follows on dividing; it is 1.8×10^{20}.

(If you took Planck's constant to be 6.26×10^{34} J, you would have got $E = 3.13 \times 10^{-19}$ J and the number = 1.9×10^{20}.)