Unit 6J
Spectral Composition
Practice Problems TEACHER

PHYSICS IN MOTION
gpb.org/physics-motion

Work each of the following problems. SHOW ALL WORK.

1. **Hydrogen produces the following atomic emission spectral lines: 410.1 nm, 434.0 nm, 486.1 nm, 656.2 nm. For each of these wavelengths, determine the corresponding frequency**

a. **410.1 nm**

$$c = \lambda f$$
$$(3 \times 10^{8}\ m/s) = (410.1 \times 10^{-9}\ m)f$$
$$f = 7.32 \times 10^{14}\ Hz$$

b. **434.0 nm**

$$c = \lambda f$$
$$(3 \times 10^{8}\ m/s) = (434.0 \times 10^{-9}\ m)f$$
$$f = 6.91 \times 10^{14}\ Hz$$

c. **486.1 nm**

$$c = \lambda f$$
$$(3 \times 10^{8}\ m/s) = (486.1 \times 10^{-9}\ m)f$$
$$f = 6.17 \times 10^{14}\ Hz$$

d. **656.2 nm**

$$c = \lambda f$$
$$(3 \times 10^{8}\ m/s) = (656.2 \times 10^{-9}\ m)f$$
$$f = 4.57 \times 10^{14}\ Hz$$

2. **Based on what you know about the Doppler effect, if the atomic emission spectrum of a star has the spectral lines 414 nm, 438 nm, 491 nm, and 663 nm, in which direction is the star moving relative to the telescope?**

These wavelengths are longer than those emitted by a stationary hydrogen sample which means their corresponding frequencies are lower than those emitted by a stationary hydrogen sample. Therefore, this star is moving away from the telescope because the observed frequency is lower than the emitted frequency.

3. **Neon has many atomic emission spectral lines in the orange and red areas of the visible spectrum. What does this indicate about the difference between energy levels in a neon atom?**

The large number of spectral lines indicates there are many transformations between energy levels in a neon atom. The fact that these lines are on the red and orange end of the spectrum indicates the transformations are of low energy, as this end of the spectrum represents lower energy changes.

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