**Name** _____

# Quiz 8: Misc.

$$e = 1.6 \times 10^{-19}\,\mathrm{C} \qquad h = 6.63 \times 10^{-34}\,\mathrm{J \cdot s} \qquad 1\,\mathrm{nm} = 10^{-9}\,\mathrm{m} \qquad E = hf = \frac{hc}{\lambda} \qquad E = q\Delta V$$

**1.** A light-emitting diode (LED) emits blue photons of wavelength 480 nm. What would be the minimum voltage you would expect to apply to the LED before it emits light? (Hint: we assume all of the potential energy of one electron, $e\Delta V$, is converted into light.)

The electron's potential energy is $e\Delta V$, the photon's energy is $hf = hc/\lambda$. Thus,

$$\Delta V = \frac{hc}{e\lambda} \approx 2.58\,\mathrm{V} \tag{1}$$

**2.** An atom has energy levels of (only) $E_1 = 1.2$, $E_2 = 2.4$, and $E_3 = 4.8\,\mathrm{eV}$ (where $1\,\mathrm{eV} = 1.6 \times 10^{-19}\,\mathrm{J}$). What are the possible **energies** of photons that could be emitted by this atom?

Photons with energies corresponding to the energy *differences* in these levels are possible. The possible differences, and therefore possible photon energies, are

$$\Delta E_{12} = E_2 - E_1 = 1.2\,\mathrm{eV} \tag{2}$$
$$\Delta E_{23} = E_3 - E_2 = 2.4\,\mathrm{eV} \tag{3}$$
$$\Delta E_{13} = E_3 - E_1 = 3.6\,\mathrm{eV} \tag{4}$$

**3.** Myopia, also called near- or short-sightedness, is a refractive defect of the eye in which collimated light produces image focus in front of the retina when accommodation is relaxed, rather than directly on the retina. What sort of lens(es) could be used to correct this condition?

- ■ convex (curves away on top)
- □ it depends on the degree of myopia
- □ concave (curves toward on top)

From the wikipedia: "With myopia, the eyeball is too long, or the cornea is too steep, so images are focused in the vitreous inside the eye rather than on the retina at the back of the eye." Thus, we want to push the focal point back farther to the retina - we want to diverge the rays just a little bit to push the focal length back farther. For this we want a diverging lens, and a convex lens does nicely. See. `http://en.wikipedia.org/wiki/Myopia` for more information.

**4.** An object is placed to the left of a converging lens. Which of the following statements are true and which are false?

1. The image is always to the right of the lens
2. The image can be upright or inverted
3. The image is always smaller or the same size as the object

- □ 1 and 2 are true, 3 is true
- □ 2 and 3 are false, 1 is true
- ■ 1 and 3 are false, 2 is true
- □ 2 and 3 are true, 1 is false

**Name** _____

The image can be virtual if $p < f$, placing the image to the left of the lens. The image can be enlarged in this situation, which makes both 1 and 3 false. The image can be upright or inverted, depending on whether $p$ is inside or outside the focal point.