In class quiz - nature of light
Nature of light - review

- Light travels at very high but finite speed.
- Light is electromagnetic wave characterized by wavelength (or frequency).
- An opaque object, treated or approximated as a blackbody, emits a continuum, the shape of which only depends on its surface temperature and is described by Planck’s function. Therefore a continuum spectrum is used to find the temperature and then the radiation flux of a star.
- A gas cloud (or atmosphere) generates emission or absorption lines, which may be observed to determine the chemical composition, temperature, density, and line-of-sight velocity of the gas cloud.
1. An electric spark, such as lightening, generates electromagnetic radiation over a wide range of wavelengths. How much longer does a pulse of radio energy take to travel between two detectors 100m apart than a pulse of ultraviolet radiation from the same spark?

   a. Much longer
   b. Much shorter
   c. Just a little longer
   d. Same time
2. the average distance of Pluto from the Sun is 40 AU. How long does it take for light to travel across the solar system from one side of Pluto’s orbit to the other?
3. True or False: Visible light is electromagnetic radiation. Infrared radiation is thermal radiation by heat and is not electromagnetic radiation.
4. Astronomers observe a nebula at the following wavelengths: (a) 0.85 nm, (b) 500 nm, (c) 1200 nm. In what wavelength ranges (visible, radio, UV, infrared, X-ray etc.) are the observations made?
5. Mars is a red planet, and Neptune appears blue. According to Wien’s displacement law, we know that Mars has a lower surface temperature than Neptune.
6. An example of an object that emits no radiation at all is:
   a. A very dark object
   b. A transparent object
   c. An object made of ice
   d. An object at the temperature of 0 K
7. The surface temperature of Sirius is 10,000K. According to Wien’s law, its emission peaks at 290nm in ultraviolet wavelength. Therefore, Sirius appears dark in visible light which is in the wavelength range of 400nm to 700nm.
8. The luminosity of the Sun is $4 \times 10^{26}$ W, and the solar constant is 1400 W/m$^2$.

a. If the Sun were placed at 2 AU away from the Earth, its luminosity would drop to $1 \times 10^{26}$ W.

b. If the Sun were placed at 2 AU away from the Earth, the solar constant would drop to 350 W m$^{-2}$.

c. If the Sun’s diameter were reduced by one half, its luminosity would remain the same.

d. If the Sun’s temperature were reduced by one half, the solar constant would drop to 350 W m$^{-2}$. 
9. If the surface temperature of the Sun were doubled, describe what would be the observational consequence.
10. True or false: about a few thousand absorption lines, the Fraunhofer lines, are discovered in spectroscopic observation of the Sun’s atmosphere. The observations therefore indicate that there are a few thousand different atoms in the Sun’s atmosphere.
11. A low-density sodium gas is heated and is observed to emit a yellow line at 596.3nm. Now we place a very hot (hotter than the gas) glowing solid iron bar behind the sodium gas and make spectroscopic observations:

a. Iron lines in emission will be observed.

b. an absorption line at 596.3nm will be observed superimposed on a smooth continuum.

c. We still observe an emission line at 596.3nm, and some absorption iron lines at other wavelengths.

d. We will observe an emission line at 596.3nm and some emission iron lines at other wavelengths.
Cool filament material against the hot sun disk is absorptive.

The same filament appears in emission when observed at the limb.
12. Spectroscopic observations show that a star’s atmosphere produces H-alpha absorption line at 656.3 nm. Imaging observations show that this star once moved in the plane of sky by 15 arcminute within a minute. What wavelength was the H-alpha absorption line shifted to when such motion was observed?
13. Astronomers make spectroscopic observations of a star, and find that the star’s corona produces an emission line and the line profile is asymmetric which can split into two components, one not shifted and centered at 3.177 Angstrom, and the other shifted to 3.178 Angstrom. What conclusion can we draw about the motion of plasmas in the star’s corona?