Use the following drawings (A-D) of molecules to answer the Questions 1-3. Each of the drawings shows a molecule at two different times: once before and once after a photon of light has either been emitted or absorbed.

Before

A

After

Before

B

After

After

Before

C

After

Before

D

1. Which drawing corresponds to the emission of a photon with the least energy?
   1. A
   2. B
   3. C
   4. D
   5. There’s not enough information to tell.
2. Which drawing corresponds to the absorption of a photon with the shortest wavelength?
   1. A
   2. B
   3. C
   4. D
   5. There’s not enough information to tell.
3. Which drawing corresponds to the absorption of a photon of a visible light?
   1. A
   2. B
   3. C
   4. D
   5. None of the above.
4. Which telescope is best suited for studying the light emitted by vibrating molecules?
   1. the radio telescope at Green Bank
   2. the Chandra X-ray Observatory
   3. the twin visible- and infrared-detecting Keck Telescopes
   4. the GALEX ultraviolet telescope
   5. More than one of the above.
5. Which one of the following telescopes would you use if you wanted to detect the greatest amount of radiation by charged particles spiraling around the magnetic field of a black hole?
   1. the infrared Spitzer Space Telescope
   2. the Very Large Array radio telescope
   3. the Chandra X-ray Observatory
   4. the GALEX ultraviolet telescope
6. Which telescope is best suited for studying the light emitted by rotating molecules?
   1. the radio telescope at Green Bank
   2. the Chandra X-ray Observatory
   3. the twin visible- and infrared-detecting Keck Telescopes
   4. the GALEX ultraviolet telescope
   5. More than one of the above.
7. Is it possible to observe synchrotron radiation coming from a pulsar at X-ray wavelengths?
   1. No, synchrotron radiation is not emitted at X-ray wavelengths.
   2. No, synchrotron radiation is not emitted from pulsars.
   3. No, pulsar synchrotron radiation is mostly emitted at radio wavelengths.
   4. Yes, because pulsars emit far more synchrotron radiation at X-ray wavelengths than any other type of light.
   5. Yes, because the thermal spectrum of a pulsar does not emit strongly over all X-ray wavelengths, but synchrotron radiation does emit over all X-ray wavelengths.
8. Which of the following drawings (A-C) shows the process that produces a photon that is most likely to be detected by the Very Large Array radio telescope?



* 1. A
  2. B
  3. C
  4. more than one of the above
  5. none of the above

1. An object that produces synchrotron radiation is emitting light at which of the following wavelengths?
   1. radio
   2. X-rays
   3. visible
   4. a and b
   5. all of the above
2. Which of the following describes the most likely change a molecule experiences after it absorbed an infrared photon?
   1. The molecule rotates faster
   2. The molecule rotates slower
   3. The molecule vibrates faster
   4. The molecule vibrates slower
3. What process produces the spectrum of light shown below?



* 1. Electrons in an atom jump from a high energy levels to a low energy levels.
  2. Rotating molecules convert some of their rotational energy into photons.
  3. Vibrating molecules convert some of their vibrational energy into photons.
  4. Electrons are accelerated around a magnetic field.
  5. Photons collide with energetic electrons and gain some of the electrons’ energy.

1. Which of the following drawings (A-C) corresponds to the process by which a photon of visible light is absorbed?



* 1. A
  2. B
  3. C
  4. more than one of the above
  5. none of the above