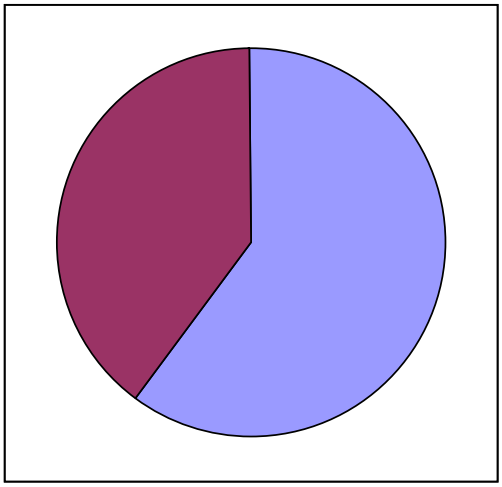
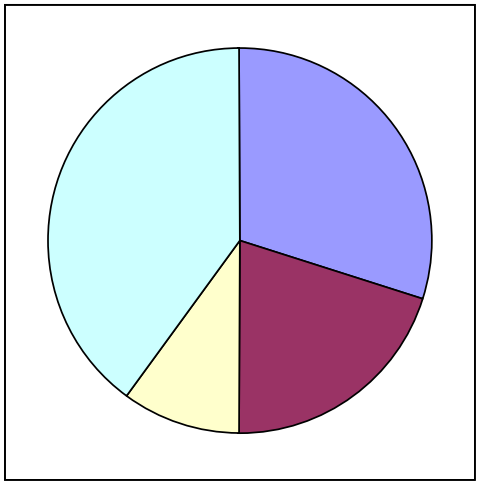
Solar Storm Energy and Pie Graphs

The pie charts below show approximately how various forms of energy are involved in a solar flare. Flares occur when stored magnetic energy is suddenly released. The chart on the left shows how much of this magnetic energy is available for creating a flare (purple) and how much is lost (blue). The chart on the right shows how much of the available magnetic flare energy goes into four different phenomena: Light green represents forms of radiation such as visible light and x-rays. Blue represents (kinetic) energy in ejected clouds of gas called Coronal Mass Ejections. Purple represents flare energy that goes into heating local gases to millions of degrees Centigrade, and white is the portion of the flare energy that is lost to working against gravity.



Graph of stored magnetic energy



Graph of solar flare energy forms

Problem 1 - About what percentages of each of the four forms of energy are represented in the right-hand chart?

Problem 2 - About what percentage of the original, stored magnetic energy is available for flares?

Problem 3 - About what fraction of the original magnetic energy ends up as solar flare radiation, assuming all forms of energy can be interchanged with each other?

Problem 4 - About what fraction of the original magnetic energy ends up in CME ejection?

Problem 5 - A typical large flare has enough total energy to meet the world-wide power demands of human civilization for 10,000 years. How many years would be equivalent to A) causing the flare to shine and B) ejecting a CME?

Answer Key

Problem 1 – What percentages of each of the four forms of energy are represented in the right-hand chart?

Answer: **Radiation = 40%, CME = 30%, Gas heating = 20 % and Gravity = 10%**

Problem 2 - What percentage of the original, stored magnetic energy is available for flares?

Answer: The size of the purple sector is **40%**

Problem 3 – What fraction of the original magnetic energy ends up as solar flare radiation?

Answer: 40% of the original magnetic energy is available for a flare, and 40% of the flare energy ends up as radiation, so the fraction of the original magnetic energy involved is 0.40 x 0.40 = **0.16**

Problem 4 – What fraction of the original magnetic energy ends up in CME ejection?

Answer: 40% of the original magnetic energy is available for a flare, and 30% of the flare energy ends up as CME (kinetic) energy, so the fraction of the original magnetic energy involved is 0.40 x 0.30 **= 0.12**

Problem 5 – A typical large flare has enough total energy to meet the power demands of human civilization for 10,000 years. How many years would be equivalent to A) causing the flare to shine and B) ejecting a CME?

Answer: A) 40% of the flare energy ends up as radiation so this is equivalent to 0.40 x 10,000 years = *4,000 years* of human energy consumption.

B) 30% of the flare energy is available for CME kinetic energy, so this equals an equivalent of 0.30 x 10,000 years **= 3,000 years** of human energy consumption.