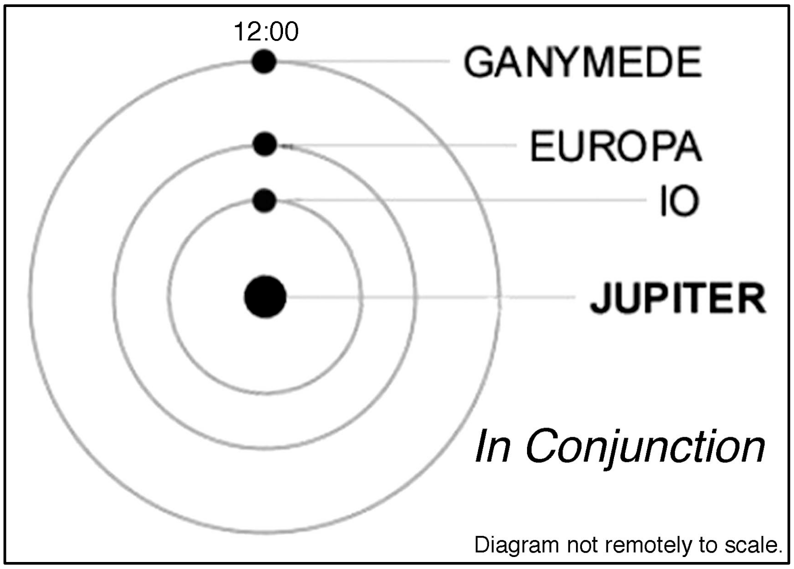
EXTRA CREDIT 2



7a. The orbital period of Io (one of Jupiter's moons) is approximately 1.75 earth-days.* Europa's period is twice as long as Io's. Ganymede's is twice as long as Europa's. If all three moons are in conjunction at 12:00 as shown above, how long will it take for them to be in conjunction again at 12:00? ... and again... and again..

Answer:

Just think about it.

Every 7 days.

Ganymede only hits 12:00 every 7 days, so that is the minimum time.
And both Io and Europa are also there at the same time.
So... every 7 days all three are in conjunction at 12:00.

This is math, but it doesn't require much calculation.

Extra Credit. Now lets up the ante. [This is pretty hard.] Callisto is another of Jupiter's moons. It has an orbital period of 16.66 days. If all 4 moons are in conjunction (at 12:00), how long until all 4 are in conjunction again (at 12:00)?

* All of the orbital periods in this problem and the next are approximations.

Answer:
We know from 7a (above) that the 3-moon system is in conjunction at 12:00 every 7 days. So what we need to figure out is the conjunction of this 7-day periodic system with the 16.66 day period of Callisto. Here is one way to set this up.

$\left(\frac{7days}{rev}\right)x = \left(\frac{16.66days}{rev}\right)y$	...where x and y are integral numbers of revolutions. They need to both be integers so that they will be in conjunction at 12:00. Any non-integer and the planet will not be at 12:00. You might need to draw this out to understand it. Now simplify by dividing out like-terms... "*rev*" and "*days*"
7x = 16.66y	Looking easier.
$\frac{x}{y} = \frac{16.66}{7} = 2.38$	Rearrange.
$x = 2.38y$	Now it looks really easy.... but it's not quite right... Let me take it back one step.
$\frac{x}{y} = \frac{2.38}{1}$	Let's try this again. Ah-ha! How can we make these variables integers? How about....
$\frac{100x}{y} = 238$	...we multiply both sides by 100! Now we're making donuts.
$\frac{x}{y} = \frac{238}{100}$	These are integers. They will work. But are they reduced to the lowest possible form?
$\frac{x}{y} = \frac{119}{50}$	No. We can reduce this fraction to its lowest integral terms. And this is your answer. The *x* and the *y* are the number of respective revolutions necessary which will make the period of the great conjunction equal.
$\left(\frac{7days}{rev}\right)119rev = \left(\frac{16.66days}{rev}\right)50rev$	Plug your values into the original equation. ...*revs* all cancel out and you are left with *days*.
(7days)(119) = (16.66days)(50) = ***833 days***	Every 833 days the system will fall into conjunction at 12:00. ...like clockwork.

This is not a hard problem in terms of number crunching. But it is pretty hard in terms of the math.

This is math.

Number crunching is just calculation. It is so mindless that even a cell phone can do it.

The math is understanding relationships and how quantities interact.