In the first problem you have to assemble your own cosmic calendar according to the dates given in Table 1 of the Laboratory handout. Since the calendars you can find online might be a bit different, you have to calculate the cosmic calendar dates on your own.

Let's do two examples. To do the problem, one must know the number of days that have passed at the end of each month, so first let's calculate that. In the table below I list the number of days in each month and the total number of days that have passed in the year at the **end** of those months.

Month	Number of days in Month	Total number of days
January	31	31
February	28	59
March	31	90
April	30	120
May	31	151
June	30	181
July	31	212
August	31	243
September	30	273
October	31	304
November	30	334
December	31	365

First example

Table 1 in your problem set gives that Galaxies formed 10 billion years ago. Since we are taking the age of the universe to be 12 billion years, it means that Galaxies formed when the universe was

$$t = 12 \text{ billion years} - 10 \text{ billion years} = 2 \text{ billion years} \tag{1}$$

old. Since the total age of the universe is 12 billion years, it means that Galaxies formed at when the universe was

$$P = \frac{2 \text{ billion years}}{12 \text{ billion years}} = \frac{1}{6} \tag{2}$$

-th of its current age. Projecting this to a full year, which has 365 days, Galaxies formed on the

$$\mathrm{D}_{\mathrm{year}} = \frac{1}{6} \times 365 \text{ day} = 60.833 \text{ day} \tag{3}$$

of the year. Looking at the table in this guideline, we can see that at the end of February 59 days have passed, and at the end of March, 90 days have passed. This means that our event projects into the month of March. Now, let's subtract the nearest lower round number. This would be the "59" days that mark the end of February. This will tell us, that Galaxies formed on day

$$\mathrm{D}_{\mathrm{month}} = 60.833 \text{ day} - 59 \text{ day} = 1.833 \text{ day} \tag{4}$$

in March. Since this number is between 1 and 2, it means that we are **in** the second day of March. So our date is: **March 2nd**. Now, since we can, let's calculate an exact time. Let's subtract off the round number, which will leave us that we are in the 0.833 part of the day. Since there are 24 hours in a day, that means we are at hour

$$H = 0.833 \times 24 \text{ hour} = 20 \text{ hour} . \tag{5}$$

In our cosmic calendar, Galaxies formed on March 2$^{\text{nd}}$, at 20:00.

Let's do a second example. Table 1 in your problem set gives that the trilobite mass extinction happened 200 million years ago, or 0.2 billion years ago (there are a 1000 million years in a billion year). Since we are taking the age of the universe to be 12 billion years, it means that the trilobite mass extinction happened when the universe was

$$t = 12 \text{ billion years} - 0.2 \text{ billion years} = 11.8 \text{ billion years} \tag{6}$$

old. Since the total age of the universe is 12 billion years, it means that the trilobite mass extinction happened when the universe was

$$P = \frac{11.8 \text{ billion years}}{12 \text{ billion years}} = 0.9833 \tag{7}$$

-th of its current age. Projecting this to a full year, which has 365 days, Galaxies formed on the

$$\text{D}_{\text{year}} = \frac{59}{60} \times 365 \text{ day} = 358.9166 \text{ day} \tag{8}$$

of the year. Looking at the table in this guideline, we can see that at the end of November 334 days have passed, and at the end of December, 365 days have passed. This means that our event projects into the month of December. Now, let's subtract the nearest lower round number. This would be the "334" days that mark the end of November. This will tell us, that the trilobite mass extinction happened on day

$$\text{D}_{\text{month}} = 358.9166 \text{ day} - 334 \text{ day} = 24.9166 \text{ day} \tag{9}$$

in December. Since this number is between 24 and 25, it means that we are **in** the 25$^{\text{th}}$ day of December. So our date is: **December 25$^{\text{th}}$**. Now, since we can, let's calculate an exact time. Let's subtract off the round number, which will leave us that we are in the 0.9166 part of the day. Since there are 24 hours in a day, that means we are at hour

$$H = 0.9166 \times 24 \text{ hour} = 22 \text{ hour} . \tag{10}$$

In our cosmic calendar, the trilobite mass extinction happened on Christmas day, at 22:00.

In the case of a not round hour, be sure to calculate minutes as well with the same procedure, knowing that there are 60 minutes in an hour.