Imagine that you have received six pictures of six different children who live near six of the closest stars to the Sun. Each picture shows a child on his or her 12th birthday. The pictures were each broadcast directly to you (using a satellite) on the day of the child's birthday. Note the abbreviation "ly" is used below to represent a light-year.

- Benjamin lives on a planet orbiting Ross 154, which is 9.5 ly from the Sun.
- Natalie lives on a planet orbiting Barnard's Star, which is 6.0 ly from the Sun.
- Dale lives on a planet orbiting Sirius, which is 8.6 ly from the Sun.
- Sydney lives on a planet orbiting Alpha Centauri, which is 4.3 ly from the Sun.
- Joyce lives on a planet orbiting Epsilon Eridani, which is 10.8 ly from the Sun.
- Crystal lives on a planet orbiting Procyon, which is 11.4 ly from the Sun.

1) Describe in detail what a light-year is. Is it an interval of time, a measure of length, or an indication of speed? It can only be one of these quantities.

2) Which child lives closest to the Sun? How far away does he or she live?

3) What was the greatest amount of time that it took for any one of the pictures to travel from the child to you?

4) If each child was 12 years old when he or she sent his or her picture to you, how old was each of the children when you received their picture?

Benjamin _____ Natalie _____ Dale _____
Sydney _____ Joyce _____ Crystal _____

5) Complete the blanks in the sentences of the following paragraph by circling the correct response in the parentheses ().

The light from the child that is farthest from Earth will take the ____ (greatest/least) amount of time to get to us. The child will be getting older this entire time, and therefore will be the ____ (oldest/youngest) of all the children at the time when we receive their picture.

6) Imagine that the six pictures of the children all arrived at exactly the same time. For this to happen, could the children have all sent their pictures at the same time? If not, which child sent his or her picture first and which child sent his or her picture last?

7) The telescope image at the right was taken of the Andromeda Galaxy, which is located about 2.5 million ly away from us. Is this an image showing how the Andromeda Galaxy looks right now, how it looked in the past, or how it will look in the future? Explain your reasoning.

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8) Imagine that you are observing the light from a distant star that was located in a galaxy 100 million ly away from you. By analysis of the starlight received, you are able to tell that the image we see is of a 10-million-year-old star. You are also able to predict that the star will have a total lifetime of 50 million years, at which point it will end in a catastrophic supernova.

   a) How old does the star appear to be to us here on Earth?

   b) How long will it be before we receive the light from the supernova event?

   c) Has the supernova already occurred? If so, when did it occur?

9) Imagine that you take images of two main sequence stars that have the same mass. From your observations, both stars *appear* to be the same age. Consider the following possible interpretations that could be made from your observations.

   a) Both stars are the same age and the same distance from you.
   b) Both stars are the same age but at different distances from you.
   c) The stars are actually different ages but at the same distance from you.
   d) The star that is closer to you is actually the older of the two stars.
   e) The star that is farther from you is actually the older of the two stars.

   How many of the five choices (a–e) are possible? Which ones? Explain your reasoning.