**Astronomy Assessment and TPS Questions:**

**Lookback Times and Distances**

The drawing below (not to scale) shows Star A, Star B, and Earth all in a line. Star B is 50,000 light-years from Star A, while Earth is 80,000 light-years from Star A. Use this information to answer the next two questions.

**A**

**B**

**Earth**

80,000 light-years

50,000 light-years

1. When Star A appears 90,000 years old to an observer orbiting Star B, how old would Star A appear to an observer on Earth?
2. 30,000 years old
3. 40,000 years old
4. 50,000 years old
5. 60,000 years old
6. When an observer on Earth can first see Star A, how old would Star A appear to an observer orbiting Star B?
7. 30,000 years old
8. 50,000 years old
9. 80,000 years old
10. 130,000 years old
11. You are floating a boat across a river that is 20 feet wide. As you release the boat, it starts to rain and the level of the river rises. The river is 30 feet wide when you retrieve your boat on the other side. How far did the boat have to travel to reach the other side?
    1. 20 feet
    2. less than 20 feet
    3. more than 20 feet
12. You are floating a boat across a river that is 20 feet wide. As you release the boat, it starts to rain and the level of the river rises. The river is 30 feet wide when you retrieve your boat on the other side. If the boat travels at a speed of 1 foot per minute, how long did it take the boat to cross the river?
    1. 20 minutes
    2. less than 20 minutes
    3. more than 20 minutes
13. When you look at a universe that is not expanding, the time it takes for the light to travel from one location to another is \_\_\_\_\_\_\_\_ how far away the distance between them is in light years.
    1. more than
    2. less than
    3. the same as
14. In an expanding universe, if a star is formed 2 billion light years away from Earth, how long will it be before we receive the light?
    1. More than 2 billion years
    2. Less than 2 billion years
    3. Exactly 2 billion years
15. Galaxy J and Galaxy K are 8 billion light years apart. If a star goes supernova in Galaxy J today, how long will the light take to travel to Galaxy K in an expanding universe?
    1. 8 billion light years
    2. more than 8 billion light years
    3. less than 8 billion light years
16. Galaxy Omicron is observed and has a strong redshift. It is determined that Omicron is 12 billion light-years away from the Milky Way Galaxy. When Galaxy Omicron emitted the light that we are observing now, how far away from the Milky Way was it?
    1. 12 billion light-years away
    2. more than 12 billion light-years away
    3. less than 12 billion light-years away
17. The universe is expanding. Galaxy H is 5 billion light-years away from Galaxy O. A supernova explosion occurs in Galaxy H. How long will it be until the light from the supernova reaches Galaxy O?
    1. more than 5 billion years
    2. less than 5 billion years
    3. 5 billion years
    4. Because supernovae are so bright, the light will reach Galaxy O instantly.
18. In an expanding universe, we receive light from the supernova of Star B that took 4.5 billion years to reach Earth. How far away from Earth was Star B when the supernova occurred?
    1. More than 4.5 billion light years
    2. Less than 4.5 billion light years
    3. Exactly 4.5 billion light years
19. In an expanding universe, we observe a supernova from a star that is currently 20,000 light years away. How far away was the star when the supernova occurred?
    1. More than 20,000 light years away
    2. Less than 20,000 light years away
    3. Exactly 20,000 light years away
20. We discover a group of galaxies 3 billion light years away. Just as we discover the galaxies, Star Z, located in the group of galaxies, ended in a supernova. How long will it take for the light from the supernova to reach Earth if the universe is constantly expanding?
    1. Exactly 3 billion years
    2. More than 3 billion years
    3. Less than 3 billion years
21. A photon of light took 12 billion years to travel from Galaxy A to Galaxy B. If the universe is expanding, how far apart might Galaxies A and B have been when the light originally left Galaxy A?
    1. 9 billion light years
    2. 12 billion light years
    3. 15 billion light years
22. The star Sirius is in the Milky Way Galaxy and is 9 light years away from us. In an expanding universe, how long does it take for light from Sirius to reach us?
    1. 9 years
    2. less than 9 years
    3. more than 9 years
    4. The light from Sirius reaches us instantly because the star is so close.
23. You travel at the speed of light from Galaxy Q to Galaxy Y. When you begin your journey the two galaxies are 9 billion light years apart. If the universe is constantly expanding and it takes you X billion years to reach Galaxy Y, which of the following is true?
    1. X is greater than 9
    2. X is less than 9
    3. X is equal to 9
24. You travel at the speed of light from Galaxy N to Galaxy P. When you begin your journey the two galaxies are 11 billion light years apart. If the universe is constantly expanding and it takes you X billion years to reach Galaxy P, how much further apart are Galaxies N and P at the end of your journey than they were at the beginning of your journey?
    1. X - 11 billion light years
    2. 11 - X billion light years
    3. X + 11 billion light years
    4. More than X - 11 billion light years