

Topic 4.3 Assessment

Check Your Understanding Answers

Understanding Key Ideas

1. Star temperature is related to its surface colour and to some extent by its brightness. Red stars have a cool surface (3000°C) while bluish stars are hot (above $20\,000^{\circ}\text{C}$).
2. High-mass stars, which are more than 10 solar masses, undergo a supernova explosion, which produces and ejects into space heavy elements.
3. nebula, star, red giant, white dwarf. A star forms from the gravitational collapse of a nebula. After its hydrogen nuclear fuel runs out, its core begins to fuse helium. This heats the star and causes it to expand into a red giant. The surface of the red giant is much cooler than the original yellow star in the diagram, even though the core of the red giant is hotter. After the nuclear fuel is spent, the core of the red giant begins to cool while its outer layers drift into space as a planetary nebula. This leaves behind a still white hot, but cooling, core. This core becomes a white dwarf, and can be about the size of Earth.
4. A star the size of our Sun cannot become a supernova, since it does not have enough mass to result in the sudden collapse of its core and trigger an explosion.
5. For example, our own Sun is currently a main sequence yellow star. Its position on the H-R diagram would change over time as it evolves into a red giant (top right), then gradually becomes white hot (moves left on the diagram from the red giant position), and then, as it become dimmer as the core shrinks, moves vertically down in the white star zone, ending up bottom left as a white dwarf.
6. Light travels about $300\,000\,000\text{ m/s}$. More precisely, it travels exactly $299\,792\,458\text{ m/s}$ in a vacuum. Since a nanosecond is one billionth of a second, light travels 0.3 m/ns .
7. A black hole is a tiny patch of space that has no volume, but it does have mass. Black holes are thought to be common in the universe because the conditions for producing them are very common. For example, there are known to be many stars that have more than 20 times the mass of our Sun, and these are thought to end up as black holes. Also, it is believed that all, or at least most, galaxies have a supermassive black hole at their centre, and there are known to be billions of galaxies in the universe.

Connecting Ideas

8. a) Mb)G
- c) O and B types are likely to become supernovae because they both have masses above 10 solar masses. White stars are borderline and the heaviest of them, with a mass above about 8 solar masses, would go supernova as well. These stars last the shortest of all stars, from about 1 million years to about half a billion years.
- d) Our Sun is about 5 billion years old. The only other stars that formed at the same time and that are still on the main sequence would be G, K, and M.

Making New Connections

9. a) Colliding galaxies mostly pass right through each other without individual stars colliding because the stars are very far apart from each other.
- b) As galaxies collide, gravitational interactions cause nebulas to collapse, initiating new star formation.
- c) As the Milky Way galaxy and the Andromeda galaxy collide and pass through each other, the Sun is likely to survive without colliding with other objects.