Chapter 17-18

A star's life is a struggle between ________ wanting to crush it, and ________ wanting to expand it.

a) nuclear forces, hot gases
b) gravity, nuclear fusion
c) gravity, convection
d) gravity, radiation
e) gas pressure, radiation

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b) not massive enough to become a star.
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b) they can have starspots like the Sun's sunspots.
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When does a star leave the main sequence?

a) after a few million years
b) after a few billion years
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What happens to nuclear fusion when the hydrogen in a star's core runs low?

a) it stops
b) it shifts from the core to a shell around the core
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In a red giant star, three helium atoms (^4He) can fuse together to

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b) prolong the star's life.
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After the Sun becomes a red giant star and makes carbon in its core, why will it not make heavier elements?

a) It will have run out of fuel.
b) It will be near the end of its life.
c) It will not be hot enough for further reactions to occur.
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b) planetary nebula.
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How does the life of a high mass star differ from the Sun's life?

a) It forms much faster.
b) It lives a shorter time on the main sequence.
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Can elements heavier than iron produce energy through fusion?

a) Yes, though the amount of energy produced is less than in fusion of lighter elements.
b) No. Elements heavier than iron use energy in order to fuse.
c) We don't know, as the conditions necessary to fuse iron have not been observed.

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What remnant does a supernova leave?

a) white dwarf
b) neutron star
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Why are supernovas important to *galactic ecology*?

a) They recycle material from stars that have died.
b) They create new elements and blow them out into space so that new generations of stars can be made from them.
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The binary star Algol has a 3.7 solar mass main sequence star and a 0.8 solar mass red giant. How could that be?

a) In this system, the lower mass star must have evolved faster than the higher mass one.
b) The red giant might be made of some different elements, so it evolved faster.
c) The lower mass star *used to be* a more massive main sequence star, but when it became a giant some of its mass was transferred to the other star.

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Suppose the universe contained only low-mass stars. Would elements heavier than carbon exist?

a) Yes, all stars create heavier elements than carbon when they become a supernova.
b) Yes, but there would be far fewer heavier elements because high-mass stars form elements like iron far more prolifically than low-mass stars.
c) No, the core temperatures of low-mass stars are too low to fuse other nuclei to carbon, so it would be the heaviest element.
d) No, heavy elements created at the cores of low-mass stars would be locked away for billions of years.
e) No, fission reactions would break down all elements heavier than carbon.

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What would stars be like if hydrogen, rather than iron, had the lowest mass per nuclear particle?

a) Stars would rapidly burn all their hydrogen and have very short lifetimes.
b) Nuclear fusion would be impossible so stars would slowly cool and dim after their initial formation.
c) Nuclear fission would be impossible and elements heavier than iron would not exist.
d) Stars would continue burning heavier and heavier elements and the universe would have far more lead and uranium.
e) Stars would be much less dense, and therefore larger, but otherwise the same.

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True or False? When helium fusion begins in the core of a low-mass star, the extra energy generated causes the star's luminosity to rise.

a) True, stars that undergo helium fusion are more luminous than main-sequence stars.
b) True, this is called a helium flash.
c) False, when helium fusion begins, the star's core expands, lowering the luminosity generated by hydrogen shell burning.
d) False, main-sequence low-mass stars do not have sufficiently high core temperatures to allow for helium fusion.

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True or False? If you could look inside the Sun today, you'd find that its core contains a much higher proportion of helium and a lower proportion of hydrogen than it did when the Sun was first born.

a) True, the Sun is about halfway through its hydrogen-burning life, so it has turned about half its core hydrogen into helium.
b) False, the proportion of helium only increases near the end of the Sun's life.
c) False, the proportion of helium in the Sun will always be the same as when it first formed.
d) False, the lighter helium will rise to the surface and the proportion of hydrogen in the core will remain the same.

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c) a white dwarf.
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A white dwarf

a) is the core of the star from which it formed, and contains most of the mass.
b) is about the size of Earth.
c) is supported by electron degeneracy.
d) is so dense that one teaspoonful would weigh about as much as an elephant.
e) all of the above

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What keeps a white dwarf from collapsing further?

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If a white dwarf in a binary has a companion close enough that some material begins to spill onto it, it can

a) cool off.
b) be hidden from view behind the material.
c) have new nuclear reactions and experience a nova.
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What happens if a white dwarf has a nearby binary companion that tries to expand as it evolves?

a) Hydrogen may be pulled into an accretion disk around the white dwarf, then onto it.
b) The hydrogen may begin to fuse and create a nova, as bright as 100,000 Suns.
c) The white dwarf may then collapse into a black hole.
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If the mass transferred to a white dwarf exceeds the 1.4 solar mass limit, what happens?

a) Carbon can begin to fuse rapidly on the white dwarf's surface.
b) The star can emit 100 *billion* times as much light as the Sun for several days.
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A supernova may leave behind as a remnant

a) nothing the star is destroyed
b) a neutron star.
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Chapter 17-18

A neutron star

a) contains most of the mass of the star from which it formed.
b) is about the size of a small town.
c) can sometimes be a pulsar.
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If the beam from a spinning neutron star hit Earth,

a) we would all die.
b) we would not notice it.
c) we would call it a pulsar.
d) we would call it a quasar.
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Chapter 17-18

Pulsars were first discovered by

a) a student named Jocelyn Bell.
b) a student named John Bell
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If a pulsar in a binary has a companion close enough that some material begins to spill onto it,

a) gas may be pulled into an accretion disk around the pulsar, then onto it.
b) the temperature of the gas may spike dramatically and emit X rays.
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If significantly <u>more</u> mass than a neutron star was concentrated in the same spot,

a) it would collapse even smaller than a neutron star.
b) it would keep collapsing and nothing could stop it.
c) gravity would get stronger and stronger as it collapsed further.
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Gravity in a black hole is so strong that

a) nothing that passes the *event horizon* can ever escape.
b) it will never emit any light.
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If the Sun were suddenly squeezed small enough to become a black hole,

a) Earth would get sucked in.
b) Earth would continue in orbit pretty much as before.
c) Earth would get very cold.
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The size (Schwarzchild radius) of a black hole depends on its

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What happens near a black hole?

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b) Time is distorted.
c) Time and space are both distorted.
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Black holes can't be seen. Can they be detected?

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When the *Compton Gamma Ray Observatory* was launched in 1991, it showed that gamma ray bursts were coming uniformly from all over the sky. What does this tell us about the source of the gamma ray bursts?

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b) They weren't in our solar system.
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What would happen to Earth's orbit if our Sun suddenly became a black hole?

a) Earth would be sucked into the center of the black hole.
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True or False?: The radii of white dwarfs in close binary systems gradually increase as they accrete matter.

a) True, their radii will slightly increase due to the extra material.
b) True, their radii will continue to increase up to the white dwarf mass limit.
c) False, the radius of a white dwarf star is constant.
d) False, the matter will be ejected in novae and their radii will remain unchanged.
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True or False?: Before pulsars were discovered, no one knew for sure whether neutron stars existed.

a) True, pulsars were the first evidence for the existence of objects more compact than a white dwarf.
b) True, neutron stars had been observed before at optical wavelengths but it was only after they were found to pulsate at radio wavelengths that astronomers realized their nature.
c) False, the existence of neutron stars was predicted by theory and it was widely accepted that they were common in the universe.
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True or False?: If a black hole ten times more massive than our Sun were lurking just beyond Pluto's orbit, we'd have no way of knowing it was there.

a) True. Black holes do not emit light so they cannot be detected.
b) True. Such a low mass black hole would have no influence on the solar system.
c) False. Such a black hole would measurably affect the orbits of the planets.
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True or False?: We can detect black holes with X-ray telescopes because matter falling into a black hole emits X-rays after it smashes into the event horizon.

a) True, the energy of matter smashing into the event horizon is very high and creates strong X-ray emission.
b) False, after matter smashes into the event horizon, its radiation cannot escape.
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