Asteroids, Comets, and Dwarf Planets: Their Nature, Orbits, and Impacts
12.1 Asteroids and Meteorites

- What are asteroids like?
- Why is there an asteroid belt?
- How are meteorites related to asteroids?
How big is the largest asteroid?

a) about 100 km in diameter
b) about 300 km in diameter
c) about 1000 km in diameter
d) about 3000 km in diameter
e) about 10,000 km in diameter
How big is the largest asteroid?

a) about 100 km in diameter
b) about 300 km in diameter

**c) about 1000 km in diameter**

d) about 3000 km in diameter
e) about 10,000 km in diameter
What is the average distance between asteroids in the asteroid belt?

a) about 100 km
b) about 1000 km
c) about 10,000 km
d) about 100,000 km
e) about 1,000,000 km
Chapter 12

What is the average distance between asteroids in the asteroid belt?

a) about 100 km
b) about 1000 km
c) about 10,000 km
d) about 100,000 km
e) about 1,000,000 km
Why didn't the material in the asteroid belt form a planet?

a) There was not enough material there to gravitationally accrete into a planet.
b) The asteroids were too far apart to run into each other frequently enough to form a planet.
c) A planet formed early in the solar system and was broken apart by a giant impact.
d) Orbital resonances with Jupiter disrupted the orbits of the asteroids and prevented them from forming a planet.
e) Tidal forces from Jupiter prevented the asteroids from accreting into a planet.
Why didn't the material in the asteroid belt form a planet?

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d) **Orbital resonances with Jupiter disrupted the orbits of the asteroids and prevented them from forming a planet.**

e) Tidal forces from Jupiter prevented the asteroids from accreting into a planet.
What are the *Trojan asteroids*?

a) They are particularly large asteroids in the main asteroid belt.

b) They are asteroids in the 1:1 resonance with Jupiter in Jupiter's orbit.

c) They are asteroids whose orbits cross the orbits or Earth and Mars.

d) They are asteroids in any resonance with Jupiter.

e) They are hollow asteroids.
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d) They are asteroids in any resonance with Jupiter.

e) They are hollow asteroids.
Why are most meteorites found in Antarctica?

a) Meteorites are dark and easy to spot against the ice in Antarctica.
b) Meteorites melt coming through the atmosphere and usually only survive if quickly refrozen by the cold temperatures of Antarctica.
c) Because of the slower rotational speed of Earth near the poles, meteorites are more likely to survive atmospheric entry near the poles.
d) The orbits of meteoroids and the tilt Earth's axis make them more likely to impact near the poles.
e) Penguins confuse meteorites with their eggs and rescue them, making them easy to collect from Antarctica.
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What are the most common type of meteorite?

a) carbon-rich primitive meteorites
b) stony primitive meteorites
c) metal-rich processed meteorites
d) rocky processed meteorites
e) meteorites from the Moon and Mars
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12.2 Comets

- What are comets like?
- Where do comets come from?
What is the orientation of a comet's plasma tail?

a) The plasma tail extends from the nucleus in the opposite direction of the comet's motion.
b) The plasma tail extends from the nucleus in the opposite direction of the Sun.
c) The plasma tail extends from the nucleus both away from the Sun and away from the orbital motion of the comet.
d) The plasma tail extends from the nucleus toward the Sun.
e) The plasma tail "wags" between various different orientations behind the direction of the comet's motion.
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e) The plasma tail "wags" between various different orientations behind the direction of the comet's motion.
What produces meteor showers?

a) Meteor showers are caused by the passage of Earth through the debris left by a comet in its orbit.

b) Meteor showers are caused by the passage of Earth through the dust tail of a comet.

c) Meteor showers are caused by the passage of Earth through a debris cloud from an asteroid collision.

d) Meteor showers are produced by a large meteoroid breaking up as it enters the atmosphere.
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Comet nuclei are often described as

a) "icy asteroids."
b) "icy impactors."
c) "dirty snowballs."
d) "giant snowballs."
e) "dirty ice cubes."
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12.3 Pluto: Lone Dog No More

- How big can a comet be?
- What are the largest objects of the Kuiper belt like?
Where do the Kuiper belt comets come from?

a) They formed in the asteroid belt and were scattered out by Jupiter.
b) They formed in the Kuiper belt.
c) They formed among the jovian planets and were scattered out by Jupiter.
d) They formed among the jovian planets and were pushed out by the solar wind.
e) They formed around another star and were captured by the Sun when it passed near that star.
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e) They formed around another star and were captured by the Sun when it passed near that star.
How is Pluto different than the other objects in the Kuiper belt?

a) Its orbit is unlike the orbits of other Kuiper belt objects.
b) It has moons, unlike other Kuiper belt objects.
c) It is larger than all the other Kuiper belt objects.
d) It is the only Kuiper belt object in resonance with Neptune.

e) none of the above
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d) It is the only Kuiper belt object in resonance with Neptune.
e) none of the above
How many moons have been discovered around Pluto?

a) 1
b) 2
c) 3
d) 4
e) 5
How many moons have been discovered around Pluto?

a) 1
b) 2
c) 3
d) 4
e) 5
What is a *dwarf planet*?

a) A dwarf planet is any object orbiting the Sun that is not one of the 9 planets.
b) A dwarf planet is any object orbiting the Sun that is not one of the 8 planets.
c) A dwarf planet is any object orbiting the Sun that is large enough to be round but not one of the 8 planets.
d) A dwarf planet is any object orbiting the Sun that is large enough to be round but not one of the 4 jovian planets.
e) A dwarf planet is any object orbiting the Sun that is not one of the 4 jovian planets.
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d) A dwarf planet is any object orbiting the Sun that is large enough to be round but not one of the 4 jovian planets.

e) A dwarf planet is any object orbiting the Sun that is not one of the 4 jovian planets.
What is the largest dwarf planet discovered to date?

a) Pluto
b) Triton
c) Ceres
d) Eris
e) Sedna
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a) Pluto  
b) Triton  
c) Ceres  
d) Eris  
e) Sedna
12.4 Cosmic Collisions: Small Bodies Versus the Planets

• Have we ever witnessed a major impact?
• Did an impact kill the dinosaurs?
• Is the impact threat a real danger or media hype?
• How do the jovian planets affect impact rates and life on Earth?
What is comet SL9?

a) It is the largest comet in the Oort cloud.
b) It is the comet that was studied by the Deep Impact spacecraft, which sent an impactor into its nucleus.
c) It is a comet that was seen crashing into Jupiter.
d) It is the comet that hit Earth 65 million years ago leading to a mass extinction.
What is comet SL9?

a) It is the largest comet in the Oort cloud.
b) It is the comet that was studied by the Deep Impact spacecraft, which sent an impactor into its nucleus.
c) It is a comet that was seen crashing into Jupiter.
d) It is the comet that hit Earth 65 million years ago leading to a mass extinction.
Which of the following is not evidence for a large impact on Earth 65 million years ago?

a) enhanced levels of elements common in meteorites in 65 million year old sediment layers
b) soot in sediment layers indicating global fires
c) traces of a crater scar underground
d) solidified rock droplets in the sediment layers
e) globally distributed meteorites with a radiometric age of 65 million years
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- b) soot in sediment layers indicating global fires
- c) traces of a crater scar underground
- d) solidified rock droplets in the sediment layers
- e) globally distributed meteorites with a radiometric age of 65 million years
How large was the object that caused the Tunguska event?

a) about 40 meters across
b) about 100 meters across
c) about 400 meters across
d) about 1 km across
e) about 4 km across
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a) about 40 meters across
b) about 100 meters across
c) about 400 meters across
d) about 1 km across
e) about 4 km across
How often does an impactor large enough to cause a tsunami and widespread devastation strike Earth?

a) about once in 1000 years
b) about once in a million years
c) about once in a hundred million years
d) about once in a billion years
How often does an impactor large enough to cause a tsunami and widespread devastation strike Earth?

a) about once in 1000 years
b) about once in a million years
c) about once in a hundred million years
d) about once in a billion years
How would the impact history on Earth have been different if Jupiter did not exist?

a) There would be no significant difference.
b) There would be more impacts from comets and asteroids.
c) There would be fewer impacts from comets and asteroids.
d) There would be more impacts from comets and fewer from asteroids.
e) There would be more impacts from asteroids and fewer from comets.
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