

## ASTR 220 Homework #3

Spring 2005

Due Tuesday, March 1, 2005, at the beginning of lecture.

Please neatly write or type your homework.

Be aware of potential plagiarism: make sure to put the answer into your own words. Feel free to discuss the questions with your classmates, but write up the answers yourself - do not copy.

Make sure to show your work for any calculations - answers that appear like magic will receive no credit.

1. Visit this page on the class website: <http://www.astro.umd.edu/~avondale/ASTR220/HW3/> . Surfaces A through J are images of terrestrial planets and moons.
  - (a) Arrange the surfaces in order *from oldest to youngest*. **DO NOT** try to identify which planets and moons are pictured, because it is very difficult to do.
  - (b) Describe how you decided which surfaces were older and younger.
  - (c) Estimate how many times older the *two* oldest surfaces are than the *two* youngest surfaces (you may average the two oldest surfaces and the two youngest surfaces). Describe how you arrived at this estimate.
2. *ECP*: Ch. 7, Surprising Discoveries, #28.
3. *ECP*: Ch. 9, Surprising Discoveries, #21.
4. *NCC*: Scientists try to present clear-cut results, such as: “The foobar period started 150 million years ago and ended 75 million years ago, according to rock layers X and Y in a rock formation in Timbuktu.” Explain three geologic or biologic processes that can blur the results from the study of geologic layers.
5. *NCC*: Explain what a “blind test” is and why it might be used.
6. *NCC*: Explain why the two typical types of volcanoes described in *NCC* could not have caused a “cosmic winter”.
7. *NCC*: Briefly explain the “zircon fingerprint” and how it confirmed Chicxulub is the K-T crater.
8. *NCC*: Briefly explain the Signor-Lipps effect. How significant do you think it is in interpreting the K-T extinction data?
9. In class, we have discussed a wide variety of impacts: the comet impact with Jupiter, the Tunguska “impact” in 1908, the man-made impact that will be created by the Deep Impact spacecraft in July 2005, and several very large impacts that we suspect occurred when the solar system was very young.

The table below lists the estimated masses and velocities of some of these impacts. (A \* means that we guess the velocity at impact was the orbital velocity of the planet.)

Impact	Mass (kg)	Velocity (m/s)	Target
Tunguska	$6 \times 10^7$	$3 \times 10^4^*$	Earth
Shoemaker-Levy 9	$3.6 \times 10^{14} kg$ (largest fragment)	$6 \times 10^4$	Jupiter
formation of Moon	“size of Mars” approx. $6.4 \times 10^{23}$	$3 \times 10^4^*$	Earth
tilting Uranus	“size of Uranus” approx. $8.7 \times 10^{25}$	$6.8 \times 10^3^*$	Uranus
Deep Impact	370	$1 \times 10^4$	Comet Tempel 1
K-T impact	$1 \times 10^{15}$	$1.1 \times 10^4$	Earth

- Which impact had the largest amount of kinetic energy? What was that energy? (You don't need to calculate all the kinetic energies: make an educated guess about which ones are likely to have the most and work them out. You need only show your work for the most.)
- Which impact had the smallest amount of kinetic energy? What was that energy?
- Compare the energies from the previous two parts to Table 4.1 in *ECP*. Comment on the comparisons: do they change your impression of how much or how little energy was released?
- We discussed in class about how large of an impact would be needed to shatter the planet that was hit: we said that the energy of the impact would have to be equal to or greater than the total gravitational potential energy of the planet. Calculate the minimum amount of energy needed to destroy the Earth.
- If you assume that an object hit the Earth with the exact amount of energy you calculated in the previous part *and* that the object hit the Earth at  $3 \times 10^4 m/s$ , what would the mass of the object be?
- What object in the table above is closest to that mass?