Earthquakes – Chapter Questions

1. Memorize and understand this seven-part explanation of what causes an earthquake. Explain what is meant by elastic rebound.

    1. Stress (pressure) is continually applied to rocks or pre-existing faults.
       This stress most likely comes from plate tectonics and is at a plate boundary.
    2. Stress builds where strong rocks or locked faults withstand it.
       (Friction is the internal force that locks a fault, making its two sides stick together.)
    3. Rocks and faults deform elastically (strain) in response to the building stress.
    4. Stress finally builds higher than rock strength or fault's friction and rock breaks or fault slips.
    5. Stress is released in the form of energy waves that move outward in all directions.
    6. The rocks or faults elastically rebound and strain energy is released.
    7. After the rocks or faults have settled back into place, the stress begins building again.

2. Faults that are experiencing no active creep may be considered "safe." Rebut or defend this statement.
3. **How are faults, foci, and epicenters related?
4. **Distinguish between surface waves and body waves.
5. **Understand the major differences between P and S waves (demonstrate them with slinky or rope).

	P wave	**S wave**
Speed	7 km/s	3.5 km/s
Arrival time	First!	Second
Motion type	Compressional (push-pull)	Transverse (side to side)
Materials wave can travel through?	All	Solids only

6. Which type of seismic wave causes the greatest destruction to buildings? Why?
7. **Distinguish between the Mercalli Intensity, Richter, and Moment-Magnitude scale. What does each measure?
8. Describe the principle of a seismograph.
9. An earthquake measuring 7 on the Richter scale has an amplitude how many times taller than a size 6 earthquake? How many times more energy released? An 8 compared to a 6? What's the difference between energy and amplitude?
10. Approximately how many earthquakes occur for the following magnitudes each year?

magnitude <4.0	**magnitude 4-6**	**magnitude > 6.0**

11. On a seismogram, identify the arrival of the P and S waves. Measure the time interval between their arrival.
12. Determine the approximate distance between an earthquake and a seismic station if the first S wave arrives 3 minutes after the first P wave.
13. What more information do you need to determine exact location of the earthquake?
14. **List factors that increase the amount of destruction caused by earthquakes.
15. **What is a tsunami? How is one generated?
16. Where are earthquakes concentrated globally?
17. What kind of property and home design would you look to buy in earthquake country to minimize damage?

18. **Interference** is the meeting of two waves arriving from opposite directions. When the two waves meet, they add to each other. If they meet crest to crest, or trough to trough (in phase), they increase the wave height. For earthquakes that increase means more shaking. When the two waves meet crest to trough (out of phase), they decrease the wave height. That increase means less shaking. Interference happens during an earthquake when the seismic waves bounce off a hard object underground, like the edge of a basin, or the side of a granite intrusion. Areas between the epicenter and the reflection surface will experience two waves from opposite directions – the original earthquake waves and the reflected waves. The pattern that interference makes on the surface is similar to a chessboard – in black squares waves meet out of phase and shaking is reduced; in white squares waves meet in phase and shaking is increased. In the center of black squares people may not feel any shaking at all. In the center of white squares, shaking may be so intense that structures fail. Evidence that interference has occurred can be seen when you view this checkerboard pattern of destruction in an area, like a housing development, where all structures and ground material are similar. Be sure you understand this process: its causes, effects, and what evidence is found after an earthquake to indicate it occurred.
19. **Resonance** is the matching of the period (or frequency) of an earthquake wave with the natural vibrational period (or frequency) of an object, like a building. All buildings vibrate at a period (number of seconds per vibration) that depends mainly on the height of the building. If the period of an earthquake is the same as the natural period of the object, shaking increases more and more with each wave's arrival, until the object falls apart. You can see examples of resonance when you push a child on a swing (if your pushing period matches the child's swinging period, the child will swing higher and higher) or when an opera singer makes a glass shatter. After an earthquake, you would see evidence of resonance if you noticed that all buildings of a particular height experienced more damage than other buildings, shorter or taller than it. Be sure you understand this process: its causes, effects, and what evidence is found after an earthquake to indicate it occurred.