Worksheet Waves and Energy Transfer Theory ANSWERS

1. Some examples of mechanical waves are: water waves, sound waves, and the waves that travel along a spring.
2. To move, mechanical waves require a transmitting medium.
3. Examples of electromagnetic waves are: TV, radio, light, and X – rays.
4. Although electromagnetic waves can travel through a vacuum, they can also travel through a transmitting medium.
5. All electromagnetic waves travel at the same speed, $3 * 10^{8}$ m/s.
6. Mechanical waves that are visible, e.g., water waves, are used to study invisible electromagnetic waves because the general properties of both types of waves are the similar.
7. A third general type of wave is the matter wave, shown under certain conditions by electrons.
8. The two general divisions of mechanical waves are: transverse and longitudinal.
9. Stretch a spring between two people and then have one of them shake their end up and down to make transverse waves in it. Squish together and then release some coils to start a longitudinal wave travelling along a spring.
10. Piano and guitar strings transmit transverse waves. Fluids, liquids, gases and plasmas usually transmit only longitudinal waves.
11. Floating particles are moved in an oval or circular fashion by waves passing underneath them.
12. Energy moving through deep ocean water travels in longitudinal waves.
13. Some people mistakenly think that waves push floating objects ahead of them.
14. Water at the ocean's surface, just like the particles floating there, moves in a circular or oval fashion.
15. a) A third general type of mechanical wave is the surface wave.
    b) A surface wave is the combination of transverse and longitudinal waves, hence the oval motion of surface water.
16. A wave pulse is a single crest or trough moving through a medium. A regular sequence of them is a wave train or a travelling wave. If the energy source vibrates with simple harmonic motion, it will send a continuous travelling wave moving through the medium.
17. Student diagram.
18. Many waves can pass through one spot at the same time.
19. Only the properties of the transmitting medium determine the speed of waves passing through it.
20. The temperature of air, the depth of water and the density of a spring control the speed of waves passing through them.
21. A wave's amplitude indicates the amount of energy it transfers.
22. If a large amplitude wave and a small amplitude wave are moving through the same medium, they will travel at the same speed.
23. Recall that only the properties of a medium determine the speed of waves travelling through it.
24. Frequency and wavelength are inversely related. A high frequency wave will have a short wavelength while a low frequency wave will have a long wavelength.
25. Waves squished together (with short wavelengths) indicate high frequency.
26. Omit
27. Omit
28. Omit
29. Omit
30. The unequal speeds occur because the media in which the two waves travel have different properties.

31. If the two media are similar:

a) the behavior of the incident and transmitted waves is similar.
b) the amplitude of the transmitted wave will be only slightly less than that of the incident wave.
c) the amplitude of the reflected wave will be much less than that of the incident wave because not much energy reflects back.
d) the incident and transmitted waves will have similar speeds because the properties of the two media are similar.
e) the energy of the incident and transmitted waves will be similar.

32. If the two media are similar, most of the incident wave's energy will move into the new medium.
33. a) A crest returns from a boundary with a more dense material as a crest.
    b) Not much energy moves into the new medium.
    c) As a result, most of the incident wave reflects.
34. Student diagram. Refer to Figure 14-10, p 295.
35. A crest returns from a boundary with a less dense material as a trough.
36. Student diagram. Refer to Figure 14-9, p 295.
37. Superposition causes waves of unexpectedly large or small height.
38. There is constructive and destructive interference.
39. When waves meet in phase, wave height increases.
40. When waves meet out of phase, wave height decreases.
41. Energy pulses pass through each other unaffected.
42. Two nodes, points of no vibration, occur on either side of an antinode, a zone of maximum vibration.
43. In a standing wave, the locations of the nodes and antinodes are constant.
44. A ray is an arrow showing the path energy takes through a medium. It is drawn at 90^0 to the crests of waves moving through the medium.
45. As we use the term here, rays are only visual aids and do not exist.
46. Waves can show rectilinear propagation, reflection, refraction and diffraction. Diffraction from adjacent apertures results in an interference pattern. See Figures 14-20a and b, p 301.
47. Student diagrams.
48. Waves of small wavelength generate minimal diffraction. Or, as the size of the aperture increases, the degree of diffraction decreases.