Waves Review - key

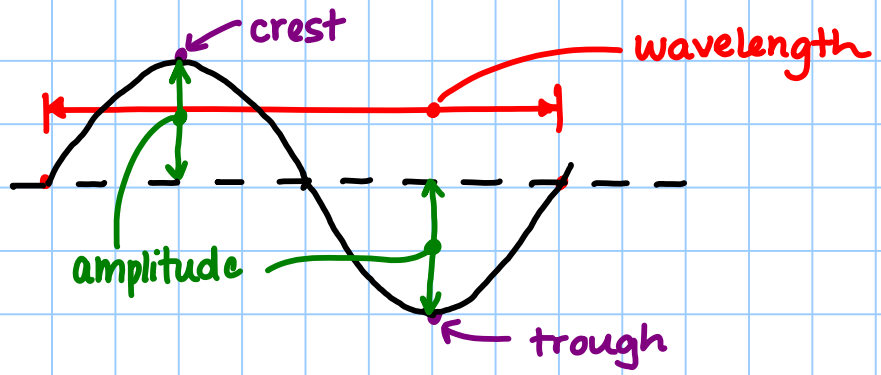
Note Title 6/13/2016

1. equal (Law of Reflection)

2. normal line

3. transverse waves : direction of particle motion is perpendicular to direction of wave motion

   longitudinal waves : direction of particle motion is parallel to direction of wave motion

4. 

5. f will increase, λ will decrease, pitch will be higher

6. f will decrease, λ will increase, pitch will be lower

7. Blue shift and red shift relate to the apparent change in frequency of light (from stars) as they move away from or closer to us (on Earth).

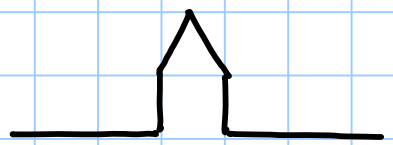
   blue shift → star is moving towards us (f increases and wavelength decreases)

   red shift → star is moving away from us (f decreases and wavelength increases)

8. 

   use superposition

   both pulses are upright so you add amplitudes together



9. destructive interference

10. constructive interference (same thing happens when 2 troughs meet)

11. $v = \frac{d}{t} = \frac{15}{10} =$ 1.5 m/s

12. $\lambda = 2.0\ m$
$f = 5.0\ Hz$
$v = \lambda f = (2.0)(5.0) =$ 10 m/s

13. $T = \frac{1}{f} = \frac{1}{5.0} =$ 0.20 s

14. $f = 6.28 \times 10^{14}$ Hz

$\lambda = ?$

$V = \lambda f$

$\frac{V}{f} = \frac{\lambda f}{f}$

$\lambda = \frac{V}{f} = \frac{3.0 \times 10^{8}}{6.28 \times 10^{14}} = 4.78 \times 10^{-7}$ m

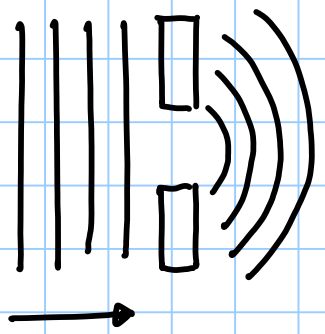
15. $V = \frac{d}{t} = \frac{20}{30} = 0.\overline{6}$ m/s

just a coincidence that these are the same

$f = \frac{1}{T} = \frac{1}{1.5} = 0.\overline{6}$ Hz

$\lambda = \frac{V}{f} = \frac{0.\overline{6}}{0.\overline{6}} = 1$ m

16.



diffraction

17. $\theta_i = 48°$
$n_i = 1.0003$ (air)
$\theta_r = ?$
$n_r = 1.7$ (plastic)

$n_i \sin\theta_i = n_r \sin\theta_r$
$(1.0003)(\sin 48) = (1.7)\sin\theta_r$
$\frac{0.7434}{1.7} = \frac{1.7\sin\theta_r}{1.7}$
$0.4373 = \sin\theta_r$

$\theta_r = \sin^{-1}(0.4373) = 26°$

18. $\theta_i = 12°$
$n_i = ?$ (glass)
$\theta_r = 22°$
$n_r = 1.0003$ (air)

$n_i \sin\theta_i = n_r \sin\theta_r$
$n_i(\sin 12°) = (1.0003)(\sin 22°)$
$\frac{n_i(0.2079)}{0.2079} = \frac{0.3747}{0.2079}$
$n_i = 1.8$

19. $\theta_i = \theta_c = ?$
$n_i = 1.54$ (quartz)

$\theta_r = 90°$
$n_r = 1.0003$ (air)

$$n_i \sin\theta_c = n_r \sin\theta_r$$

$$(1.54)\sin\theta_c = (1.0003)(\sin 90^\circ)$$

$$\frac{1.54\sin\theta_c}{1.54} = \frac{1.0003}{1.54}$$

$$\sin\theta_c = 0.6495$$

$$\theta_c = \sin^{-1}(0.6495) = 40.5^\circ = 41^\circ$$

Optics Review - Key

1. a) higher density → higher n
   b) higher density → lower speed

2. a) $v = 3.0 \times 10^8$ m/s (in a vacuum)
   b) $v = \frac{c}{n} = \frac{3.0 \times 10^8}{1.0003} = 2.999 \times 10^8$ m/s (in air)
   c) $v = \frac{3.0 \times 10^8}{1.33} = 2.26 \times 10^8$ m/s (in water)

3. $V = \frac{c}{n} \Rightarrow n = \frac{c}{V} = \frac{3.0 \times 10^8}{1.88 \times 10^8} = 1.60$

4. All angles should be measured from the normal line

5. away

6. + f → concave mirrors and convex lenses
   − f → convex mirrors and concave lenses

7. if image is virtual → di is negative
   hi is positive

8. if image is real → di is positive
   hi is negative

9. upright (virtual !) lens type ?

$m = +3$

$d_o = +2.0$ cm

$$m = \frac{-d_i}{d_o} \qquad 3.0 = \frac{-d_i}{2.0} \qquad d_i = -6.0 \text{ cm}$$

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$= \frac{1}{2.0} + \frac{1}{-6.0}$$

$$\left(\frac{1}{f}\right)^{-1} = \left(0.\overline{3}\right)^{-1}$$

$f = 3.0$ cm

Since f is positive, it's a convex lens.

10. inverted image (real!)

$m = -\frac{1}{2}$

$f = 4.0\ cm$

$d_i = ?$

$d_o = ?$

$m = \frac{-d_i}{d_o}$ $\qquad -\frac{1}{2} = -\frac{d_i}{d_o}$ $\qquad d_o = 2d_i$

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$\frac{1}{4.0} = \frac{1}{2d_i} + \frac{1}{d_i}\left(\frac{2}{2}\right)$$

$$\frac{1}{4.0} = \frac{1}{2d_i} + \frac{2}{2d_i}$$

$$\frac{1}{4.0} = \frac{3}{2d_i}$$

$$\frac{2d_i}{2} = \frac{12}{2}$$

$d_i = 6\ cm$

$d_o = 12\ cm$