P27.2 $\lambda = \frac{v}{f} = \frac{354 \text{ m/s}}{2\,000 \text{ s}^{-1}} = 0.177 \text{ m}$

(a) $d\sin\theta = m\lambda$ so $(0.300 \text{ m})\sin\theta = 1(0.177 \text{ m})$ and $\theta = \boxed{36.2°}$

(b) $d\sin\theta = m\lambda$ so $d\sin 36.2° = 1(0.030\,0 \text{ m})$ and $d = \boxed{5.08 \text{ cm}}$

(c) $(1.00\times10^{-6} \text{ m})\sin 36.2° = (1)\lambda$ so $\lambda = 590 \text{ nm}$

$$f = \frac{c}{\lambda} = \frac{3.00\times10^{8} \text{ m/s}}{5.90\times10^{-7} \text{ m}} = \boxed{508 \text{ THz}}$$

P27.15 (a) The light reflected from the top of the oil film undergoes phase reversal. Since $1.45 > 1.33$, the light reflected from the bottom undergoes no reversal. For constructive interference of reflected light, we then have

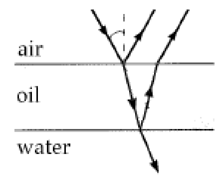

FIG. P27.15

$$2nt = \left(m + \frac{1}{2}\right)\lambda$$

or $\lambda_m = \frac{2nt}{m+(1/2)} = \frac{2(1.45)(280 \text{ nm})}{m+(1/2)}$.

Substituting for m gives: $m = 0$, $\lambda_0 = 1\,620 \text{ nm}$ (infrared)

$m = 1$, $\lambda_1 = 541 \text{ nm}$ (green)

$m = 2$, $\lambda_2 = 325 \text{ nm}$ (ultraviolet).

Both infrared and ultraviolet light are invisible to the human eye, so the dominant color in reflected light is $\boxed{\text{green}}$.

(b) The dominant wavelengths in the transmitted light are those that produce destructive interference in the reflected light. The condition for destructive interference upon reflection is

$$2nt = m\lambda$$

or $\lambda_m = \frac{2nt}{m} = \frac{812 \text{ nm}}{m}$.

Substituting for m gives: $m = 1$, $\lambda_1 = 812 \text{ nm}$ (near infrared)

$m = 2$, $\lambda_2 = 406 \text{ nm}$ (violet)

$m = 3$, $\lambda_3 = 271 \text{ nm}$ (ultraviolet).

Of these, the only wavelength visible to the human eye (and hence the dominate wavelength observed in the transmitted light) is 406 nm. Thus, the dominant color in the transmitted light is $\boxed{\text{violet}}$.

P27.21 $\frac{y}{L} \approx \sin\theta = \frac{m\lambda}{a}$ $\Delta y = 3.00\times10^{-3} \text{ nm}$

$\Delta m = 3 - 1 = 2$ and $a = \frac{\Delta m\lambda L}{\Delta y}$

$$a = \frac{2(690\times10^{-9} \text{ m})(0.500 \text{ m})}{(3.00\times10^{-3} \text{ m})} = \boxed{2.30\times10^{-4} \text{ m}}$$

P27.46 The central bright fringe is wider than the side bright fringes, so the light must have been diffracted by a $\boxed{\text{single slit}}$. For precision, we measure to the third minimum from the center

$$y = 4.0\text{ cm}$$

$$\tan\theta = \frac{y}{L} = \frac{0.04\text{ m}}{2.6\text{ m}} = 0.015\ 4$$

$$\theta = 0.881° = 0.015\ 4\text{ rad}$$

$$a\sin\theta = m\lambda$$

$$a = \frac{m\lambda}{\sin\theta} = \frac{3\left(632.8\times10^{-9}\text{ m}\right)}{\sin 0.881°} = \frac{3\left(632.8\times10^{-9}\text{ m}\right)}{0.015\ 4} = \boxed{1.23\times10^{-4}\text{ m}}$$

P27.47 For destructive interference, the path length must differ by $m\lambda$. We may treat this problem as a double slit experiment if we remember the light undergoes a $\frac{\pi}{2}$-phase shift at the mirror. The second slit is the mirror image of the source, 1.00 cm below the mirror plane. Modifying the equation for Young's experiment, $\frac{dy}{L} = m\lambda$ we have

$$y_{\text{dark}} = \frac{m\lambda L}{d} = \frac{1\left(5.00\times10^{-7}\text{ m}\right)(100\text{ m})}{\left(2.00\times10^{-2}\text{ m}\right)} = \boxed{2.50\text{ mm}}.$$