The results from the small angle approximation (sin $\theta \approx$ than $\theta = y/L$) are used in many interference and diffraction exercises: $y_n \approx \frac{nL\lambda}{d}$, $\Delta y = \frac{L\lambda}{d}$, $y_m = \frac{mL\lambda}{w}$, and $\Delta y = \frac{L\lambda}{w}$.

1. (b), because $\sin\theta_n = \frac{n\lambda}{d} \propto \frac{1}{d}$.

2. (b). Destructive interference occurs when $\Delta L = \frac{(2m+1)\lambda}{2}$, $m = 0, 1, 2, \ldots$.

3. (b). Since $\sin\theta_n = \frac{n\lambda}{d} \propto \lambda$, blue is closer to the central maximum.

4. The path-length difference will change because of the airplane. This change in path-length difference results in a change in the condition of interference, i.e., constructive is no longer constructive, etc. Therefore, the pictures flutter.

5. Since $\Delta y = \frac{L\lambda}{d} \propto \lambda$, $\boxed{\text{the spacing between the maxima would increase}}$ if wavelength increases.

6. $\boxed{\text{No}}$, this is not a violation of the conservation of energy. $\boxed{\text{There are minima}}$, and the energy is simply redistributed (energy is moved from the minima to the maxima). The total energy is still conserved.

$\boxed{8}$. 0.75 m = 0.50 m + 0.25 m = 1.5(0.50 m) = 1.5λ. So the waves will interfere $\boxed{\text{destructively}}$.

1.0 m = 0.50 m + 0.50 m = 2(0.50 m) = 2λ. So the waves will interfere $\boxed{\text{constructively}}$.

9. This angle is the angle for the first maximum. From $d \sin\theta = n\lambda$

$$\sin\theta = \frac{n\lambda}{d} = \frac{(1)(480 \times 10^{-9}\text{ m})}{0.075 \times 10^{-3}\text{ m}} = 6.4 \times 10^{-3}. \text{ So } \theta = \sin(6.4 \times 10^{-3}) = \boxed{0.37^\circ}$$

11. $d\sin\theta = n\lambda$, ☞ $\lambda = \frac{d\sin\theta}{n} = \frac{(0.350 \times 10^{-3}\text{ m})\sin 0.160^\circ}{2} = 4.89 \times 10^{-7}\text{ m} = \boxed{489\text{ nm}}$.

20. (a), because only the reflection at the n_o—n_1 interface has 180° phase shift.

21. (a), because both reflections have 180° phase shifts.

22. (b). If the thinnest part (thickness equal to zero) is bright, there is constructive interference. So neither beam should have 180° phase shift, or both beams should have 180° phase shift. Had the index of refraction of kerosene been greater than that of water, the beam reflected at the air-kerosene would have an 180° phase shift, but the beam reflected at the kerosene-water would not have the phase shift.

23. The wavelengths that are not visible in the reflected light are $\boxed{\text{all wavelengths except bluish purple}}$.

24. $\boxed{\text{No}}$, because there are regions where waves interfere constructively. The total energy is still conserved.

25. It is always dark because of $\boxed{\text{destructive interference due to the 180° phase shift}}$. If there had not been the 180° phase shift, zero thickness would have corresponded to constructive interference.

$\boxed{26}$. (a) The answer is $\boxed{\text{(3) two}}$. Both waves experience 180° phase shift.

(b) $t_{min} = \frac{\lambda}{4n_1}$, ☞ $\lambda = 4n_1 t_{min} = 4(1.4)(1.0 \times 10^{-7}\text{ m}) = 5.6 \times 10^{-7}\text{ m} = \boxed{560\text{ nm}}$.

36. (b).

37. (a). As the number of lines per unit length increases, the spacing between adjacent slits, d, decreases, so the spacing between bright fringes increases. This is because $d\sin\theta = n\lambda$ or $\sin\theta \propto 1/d$.

38. (a), because the width depends on $\frac{2L\lambda}{w}$.

39. $w\sin\theta = m\lambda$. If $w = \lambda$, then $\sin\theta = m$. The maximum value for $\sin\theta$ is 1.

So the answer for $m = 2$ is $\boxed{\text{no}}$, it cannot be seen.

For the $m = 1$ dark fringe, the answer is $\boxed{\text{yes (barely, seen at } \theta = 90^\circ)}$.

40. If the slit length is comparable to the width, $\boxed{\text{a second diffraction pattern perpendicular to the first}}$ will also be observed.

41. According to $d \sin\theta = n\lambda$, the advantage is a $\boxed{\text{wider diffraction pattern, as } d \text{ is smaller}}$.

$\boxed{42}$. (a) The width of the central maximum is $2\Delta y = 2y_1 = \dfrac{2L\lambda}{w} = \dfrac{2(1.0\text{ m})(480 \times 10^{-9}\text{ m})}{0.20 \times 10^{-3}\text{ m}} = \boxed{4.8\text{ mm}}$.

(b) The width of the side maxima is half the width of the central maximum. $\Delta y_3 = \Delta y_4 = \dfrac{L\,\lambda}{w} = \boxed{2.4\text{ mm}}$.

48. $\lambda = \dfrac{c}{f} = \dfrac{3.00 \times 10^{8}\text{ m/s}}{5.0 \times 10^{17}\text{ Hz}} = 6.0 \times 10^{-10}$ m.

$2d \sin\theta = n\lambda$, ☞ $d = \dfrac{n\lambda}{2\sin\theta} = \dfrac{(1)(6.0 \times 10^{-10}\text{ m})}{2\sin 25^\circ} = \boxed{7.1 \times 10^{-10}\text{ m}}$.

57. (d).
58. (a).
59. (c). Longitudinal waves cannot be polarized.
60. This can be checked by looking through the lens of one pair while rotating the lens of the other pair in front of the first pair. If the intensity changes as the lenses are rotated, both pairs are polarized. If the intensity does not change, either both are not polarized or one of the two pairs is not polarized.

$\boxed{61}$. When the axes are perpendicular, it darkens, and when the axes are parallel it lightens.

(a) $\boxed{\text{Twice}}$. (b) $\boxed{\text{Four times}}$.

(c) $\boxed{\text{None}}$. (d) $\boxed{\text{Six times}}$.

62. In selective absorption, $\boxed{\text{one of the two electric field components is absorbed}}$.

63. $\boxed{\text{The numbers appear and disappear as the sunglasses are rotated}}$, because the light from the numbers on a calculator is polarized.

68. In air, $\tan\theta_p = n$, ☞ $\theta_p = \tan^{-1} n$. So $\theta_1 = \theta_p = \tan^{-1} n = \tan^{-1} 1.62 = 58.3^\circ$.

$n_1 \sin\theta_1 = n_2 \sin\theta_2$, ☞ $\sin\theta_2 = \dfrac{n_1 \sin\theta_1}{n_2} = \dfrac{(1)\sin 58.3^\circ}{1.62} = 0.525$. So $\theta_2 = \boxed{31.7^\circ}$.

71. Since $n_1 = 1$ (air), $\tan\theta_p = \dfrac{n_2}{n_1} = n_2$. So $\theta_p = \tan^{-1} n_2 = \tan^{-1} 1.55 = \boxed{57.2^\circ}$.

Since the glass is vertical, this is the Sun's altitude angle.

$\boxed{72}$. (a) The answer is $\boxed{\text{(2) less than}}$. Since $\theta_p = \tan^{-1}\dfrac{n_2}{n_1}$ with $n_1 = 1$ (air) and $n_2 = 1.60$ or $n_1 = 1.33$ (water) and

$n_2 = 1.60$, $\dfrac{n_2}{n_1}$ is smaller for water. So θ_p in water is less than θ_p in air.

(b) In air, $\theta_p = \tan^{-1}\dfrac{n_2}{n_1} = \tan^{-1}\dfrac{1.60}{1.00} = \boxed{58.0^\circ}$. In water, $\theta_p = \tan^{-1}\dfrac{n_2}{n_1} = \tan^{-1}\dfrac{1.60}{1.33} = \boxed{50.3^\circ} <$ 58.0°.