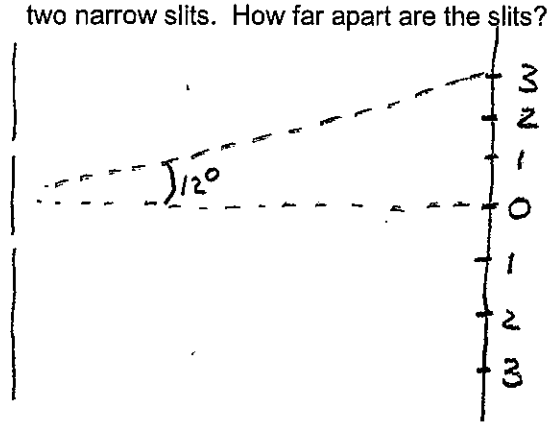
Unit 16: Interference of light
Pre-Quiz / 25

Name: KEY
Per _____ Date _____

Directions: Show all your work! Circle answers. 5 points each.

1. The third-order fringe of 450 nm light is observed at an angle of 12 degrees when the light falls on two narrow slits. How far apart are the slits?

$d = ?$
$m = 3$
$\lambda = 450\text{nm}$
$\theta = 12^\circ$



$d \sin\theta = m\lambda$

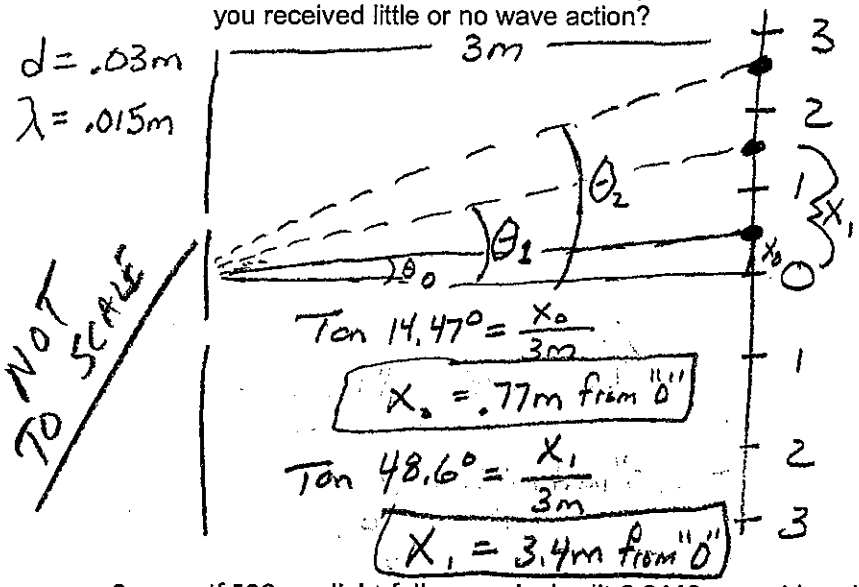
$d = \frac{m\lambda}{\sin\theta}$

$d = \frac{3 \cdot 450 \times 10^{-9}\,m}{\sin 12^\circ}$

$d = 6.49 \times 10^{-6}\,m$ or $6.49\ \mu m$

2. In a water tank experiment, water waves are generated with their crests 1.5 cm apart and parallel. They pass through two openings 3.0 cm apart in a long wooden board. If the end of the tank is 3.0 m beyond the boards, where would you stand, relative to the "straight-through" direction, so that you received little or no wave action?

$d = .03\text{m}$
$\lambda = .015\text{m}$



$\tan 14.47^\circ = \frac{x_0}{3m}$

$x_0 = .77\text{m}$ from "0"

$\tan 48.6^\circ = \frac{x_1}{3m}$

$x_1 = 3.4\text{m}$ from "0"

STAND WHERE DESTRUCTIVE INTERFERENCE OCCURS

$d \sin\theta = (m + \frac{1}{2})\lambda$

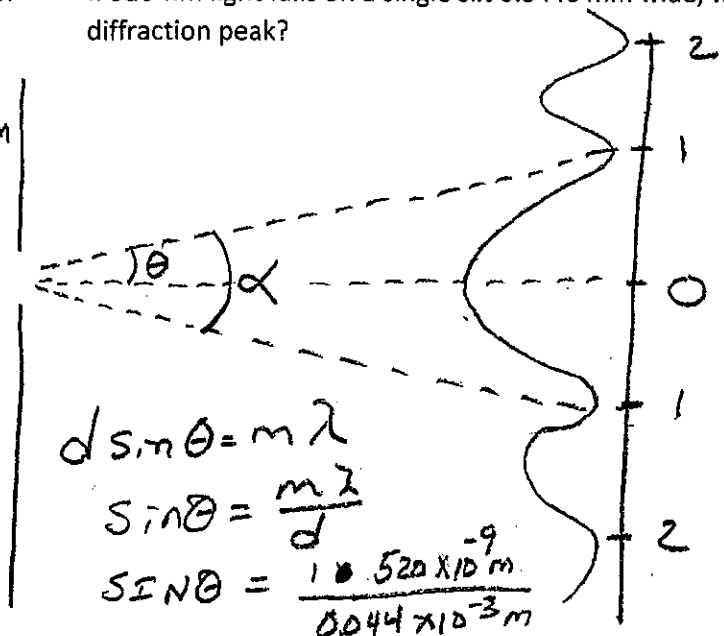
Solve Angles for $m = 0, 1, 2$.

$\sin\theta = \frac{(m+\frac{1}{2})\lambda}{d}$

$\theta_0 = 14.47^\circ$
$\theta_1 = 48.6^\circ$
$\theta_2 = X$ Greater than 90°

3. If 520-nm light falls on a single slit 0.0440 mm wide, what is the angular width of the central diffraction peak?

$\lambda = 520\text{nm}$
$d = 0.044\text{mm}$



$d \sin\theta = m\lambda$

$\sin\theta = \frac{m\lambda}{d}$

$\sin\theta = \frac{1 \cdot 520 \times 10^{-9}\,m}{0.044 \times 10^{-3}\,m}$

$\theta = 0.68^\circ$

Find α! TO DO THAT, Find θ THEN DOUBLE IT!

$\theta = 0.68^\circ$

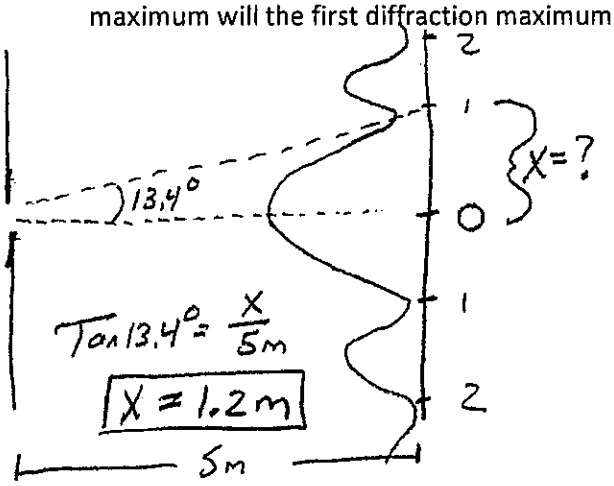
$\alpha = 0.68^\circ \times 2 = \boxed{1.35^\circ}$

4. Light of wavelength 580-nm falls on a slit that is 2.5×10^{-3} mm wide. How far from the central maximum will the first diffraction maximum fringe be if the screen is 5.0 m away?

$\lambda = 580\,nm$

$d = 2.5 \times 10^{-3}\,mm$

$X = ?$



$\tan 13.4^\circ = \frac{X}{5m}$

$\boxed{X = 1.2m}$

$d \sin\theta = m\lambda$

$\sin\theta = \frac{m\lambda}{d}$

$\sin\theta = \frac{1 \cdot 580 \times 10^{-9}\,m}{2.5 \times 10^{-6}\,m}$

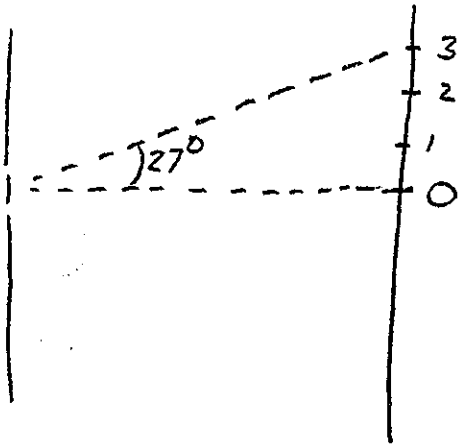
$\theta = 13.4^\circ$

5. How many lines per centimeter does a grating have if the third-order occurs at a 27 degree angle for 570-nm light? ONE DOUBLE SLIT PRODUCES ONE LINE. FIND "d"!

$m = 3$

$\lambda = 570\,nm$

$\theta = 27^\circ$



$d \sin\theta = m\lambda$

$d = \frac{m\lambda}{\sin\theta} = \frac{3 \cdot 570 \times 10^{-9}\,m}{\sin 27^\circ}$

$d = \frac{3.77 \times 10^{-6}\,m}{1\ Line}$

$\therefore \frac{1\ Line}{3.77 \times 10^{-6}\,m} = 2.65 \times 10^{5}\,\frac{Line}{m} \times \frac{1\,m}{100\,cm}$

$\boxed{= 2.65 \times 10^{3}\,Line/cm}$

Bonus: You have fifty coins totaling $1.00. You drop one down an open drain while tossing the coins in your hand. What is the chance that you have lost a quarter? (do your research, the same question will be on the quiz, ∴ no answer will be given at this time. 5 points.