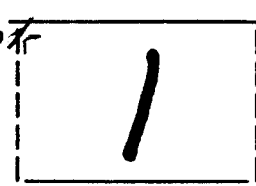


$N = 275$ students
 $\bar{x} = 13.7$



THIRD MIDTERM

Name (Print) Bertolina Name (Signed) _____

Discussion Instructor (Circle One): Bertolina Krantz Lakner

Discussion Section #: _____ McDonald Pollard Sun

REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!

Use the conversion constants and data given on the front page.

- (a) What is the critical angle for total internal reflection of a diamond immersed in water (use light of $\lambda = 589$ nm).

$\theta_c = \sin^{-1}\left(\frac{1.33}{2.419}\right) = 33.4^\circ$

\rightarrow # taken from data sheet

- (b) If the microwaves in your oven have a frequency of 800 MHz, calculate their wavelength.

$\lambda = \frac{c}{f} = \frac{3.00 \times 10^8}{800 \times 10^6} = 0.375 \text{ m}$

- (c) A diffraction grating with 26,500 lines/inch used as in class is used with yellow light of wavelength 589 nm in a perpendicular incidence. What is the largest possible order that can be observed in the interference pattern?

$m = \frac{d \sin \theta}{\lambda}$ $\lambda = 589 \times 10^{-9} \text{ m}$ $M = 1.63$ but must be an integer
 $\sin \theta = \sin 90^\circ = 1$ so $M = 1$
 $d = \left(\frac{1 \text{ inch}}{26,500 \text{ lines}}\right) \left(\frac{1 \text{ ft}}{12 \text{ in}}\right) \left(\frac{1 \text{ m}}{3.28 \text{ ft}}\right) = 9.587 \times 10^{-7} \text{ m}$

- (d) Sun light is incident on a solar reflector with an intensity of 655 W/m². Calculate the peak value of the electric field in this light beam.

$S = \frac{1}{2} \frac{E_{\text{max}} \times B_{\text{max}}}{\mu_0}$ $B = \frac{E}{c}$ so $S = \frac{1}{2} \frac{E_{\text{max}}^2}{\mu_0 c} = 655 \frac{\text{W}}{\text{m}^2}$
 $E = \sqrt{(655) \times (2) \times (4\pi \times 10^{-7}) \times (3 \times 10^8)} = 703 \frac{\text{V}}{\text{m}}$

- (e) Calculate the force on 1.00 m² of the solar collector in (d) if 20% of the light is reflected and 80% absorbed. (Intensity is same as (d).)

Pressure = $\left(\frac{0.8 + 2(0.2)}{c}\right) S$ $F = PA = \left[\frac{1.2(655)}{3 \times 10^8}\right] [1.00 \text{ m}^2]$
 $= 2.62 \times 10^{-6} \text{ N}$

Common errors

- c) having m be equal to a non integer or negative value
- d) wrong units
- e) not multiplying 20% by 2