Quiz 25 Name: Inigo Montoya Score: 20 / 20

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As always, *show all your work* and *circle your final answer*. All numeric values are good to 3 significant figures.

$$c = \lambda f \qquad v_n = \frac{c}{n} \qquad \lambda_n = \frac{\lambda}{n}$$

$$d\sin\theta = m\lambda \qquad m\lambda_n = 2t \text{ or } (m+\tfrac{1}{2})\lambda_n = 2t$$

$$a\sin\theta = m\lambda \qquad a\sin\theta = 1.22\lambda$$

1. [3 pts.] Which of the following would help a telescope to resolve finer details of objects? (In other words, what would make the diffraction angle the smallest?)

A. A smaller diameter mirror collecting light.	**B.** A larger diameter mirror collecting light.	**C.** A smaller focal length mirror collecting light.	**D.** A larger focal length mirror collecting light.

2. [3 pts.] You are working with a laser beam and a single slit, creating a diffraction pattern on a distant screen. If you make the width of the single slit smaller, the spacing between the dark spots of the diffraction pattern will

A. get closer together.	**B.** get farther apart.	**C.** stay exactly the same.	**D.** More information is needed to predict this result.

3. [3 pts.] You are working with a laser beam and a diffraction grating, creating a diffraction pattern on a distant screen. If you make the spacing between the grating's slits smaller, the spacing between the bright spots of the diffraction pattern will

A. get closer together.	**B.** get farther apart.	**C.** stay exactly the same.	**D.** More information is needed to predict this result.

4. [3 pts.] An unknown film floating on water (n=1.33) appears dark at its edges where the film's thickness is approaching zero. As you know, this is due to thin film interference, but the thickness of the film is almost zero; so there must be a single phase shift in one of the two reflections. You conclude that the index of refraction of the unknown film must be

A. greater than 1.33	**B.** less than 1.33	**C.** equal to 1.33	**D.** None of these can be predicted for sure.

5. [8 pts.] When red light with a wavelength of 630 nm illuminates a diffraction grating it produces a diffraction pattern on a screen. The grating has 6000 lines per cm. How many orders of constructive interference appear?

$d\sin\theta = m\lambda$ → $d = \frac{1}{6000}\text{ cm}$

Find how many "m" fit in 90°:

$$m = \frac{d\sin\theta}{\lambda} = \frac{\left(\frac{1}{6000}\times 10^{-2}\text{ m}\right)(\sin 90^\circ \to 1)}{630\times 10^{-9}\text{ m}}$$

$m = 2.645\ldots$ but can only be an integer, so

$m = 2$