

Physics 122-01

Test 3

April 26, 2004

Name: _____

Start all problems with a fundamental principle or with an equation from the equation sheet. Be sure to show your work **clearly** and **draw a box around your answer**. If any question is unclear, please ask immediately.

1. (20 pts.) White light is incident normally on a thin film of oil (index of refraction 1.40) that is floating on water (index of refraction 1.33). Light of wavelength 680 nm (measured in air) is particularly bright in the reflected light. (That is, it undergoes constructive interference.)

a. (10 pts.) What is the minimum thickness of the film of oil?

b. (10 pts.) Are there any wavelengths of visible light (400 - 700 nm) that are *not* present in the reflected light (i.e. that undergo destructive interference)?

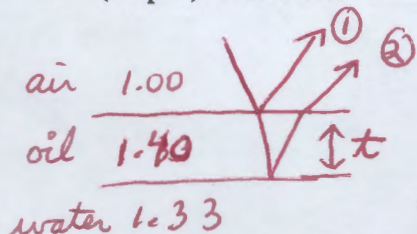
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SOLUTIONS

Start all problems with a fundamental principle or with an equation from the equation sheet. Be sure to show your work **clearly** and **draw a box around your answer**. If any question is unclear, please ask immediately.

1. (20 pts.) White light is incident normally on a thin film of oil (index of refraction 1.40) that is floating on water (index of refraction 1.33). Light of wavelength 680 nm (measured in air) is particularly bright in the reflected light. (That is, it undergoes constructive interference.)

a. (10 pts.) What is the minimum thickness of the film of oil?



Wave ① is inverted. Wave ② is not.

Constructive: $2nt = (m + \frac{1}{2})\lambda$

minimum thickness $\Rightarrow m = 0$

$$t = \frac{\frac{1}{2}\lambda}{2n} = \frac{1}{4} \frac{(680)}{1.40} = \boxed{121.4 \text{ nm}}$$

Look for destructive: $2nt = m\lambda \Rightarrow \lambda = \frac{2nt}{m}$

$$\lambda = \frac{2(1.40)(121.4)}{m}$$

Tabulate

m	λ
1	340
2	170
3	113

These are all ultraviolet — No visible light.

b. (10 pts.) Are there any wavelengths of visible light (400 - 700 nm) that are *not* present in the reflected light (i.e. that undergo destructive interference)?