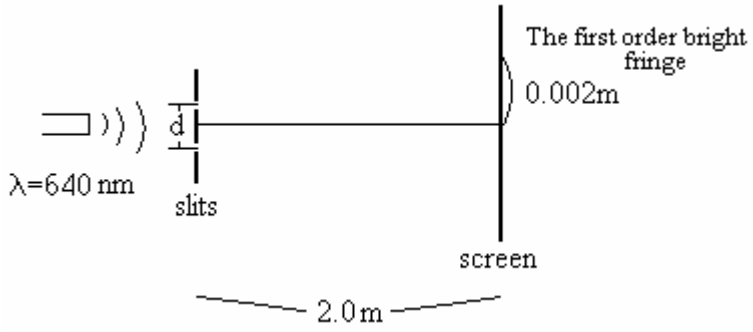
Practice Problems for the Final (Fall 2010)

1. From the figure, find the distance between slits. [Conceptual notes: Can you find the angle from the center to the fringe? What is the meaning of the order?]

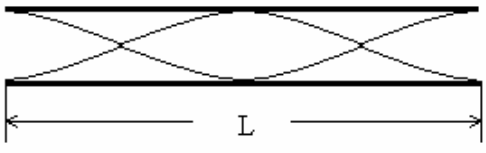


2. You find a dark fringe with a double-slit. The conditions are: the order → 3, the distance of the slits → 4.8×10^{-4} m, and wavelength of the laser → 630×10^{-9} m. Find the angle from center to the fringe. [Conceptual notes: What is the difference between bright and dark fringe in terms of the equations?]

3. One calculates the wavelength of light source with a single slit experiment. The variables she obtains are: Order → 1, the slit width → 4.0×10^{-6} m, and the angle → 9.9° (from the center of slit to the fringe). Find the wavelength of the light source. Is the fringe bright or dark? [Conceptual notes: What is the difference of the physical results between single and double slits?]

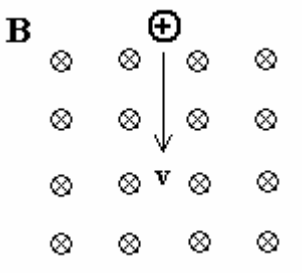
4. Find the speed of sound in steel, which has the Young's modulus, 2.0×10^{11} N/m^2, and density, 8.0×10^3 kg/m^3. [Conceptual notes: Can you calculate any other speeds of sound?]

5. Here is a tube open at both ends. A sound makes the standing waves inside the tube. If the wave length is 1.20 m, what is the length of the tube? [Conceptual notes: Is this the fundamental or second harmonics? Can you draw any one of them?]



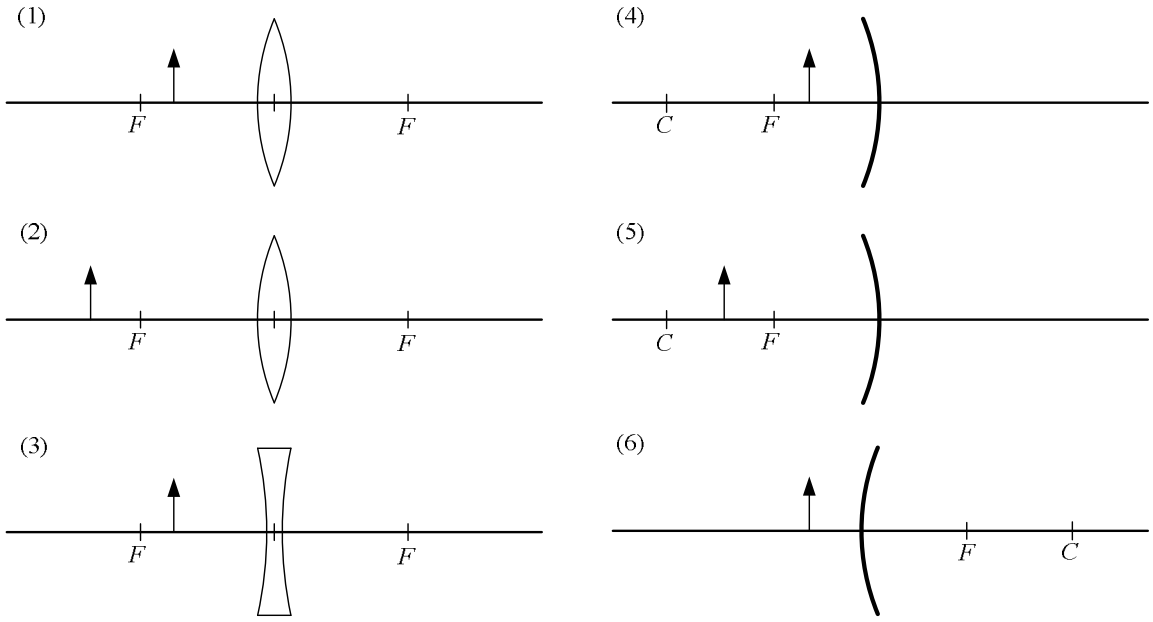
6. A circuit consumes 30 (W). If current flow of the circuit is 1.2 (A), what is the resistance? [Conceptual notes: Can this situation be applied to an AC power supply?]

7. A positive charge, 2.5 μC, is moving at a constant velocity, 5.0×10^6 m/s. It is about to go into a magnetic field, 1.8 T. Find the magnitude and direction of the force in the magnetic field. [What is the name of the force? How do you find the direction? What if the charge is negative?]



8. The peak magnetic field in free space is 2.0×10^{-6} T. What is the *rms* of the magnetic field? [Conceptual notes: Can you also calculate average or peak intensity from this condition?]

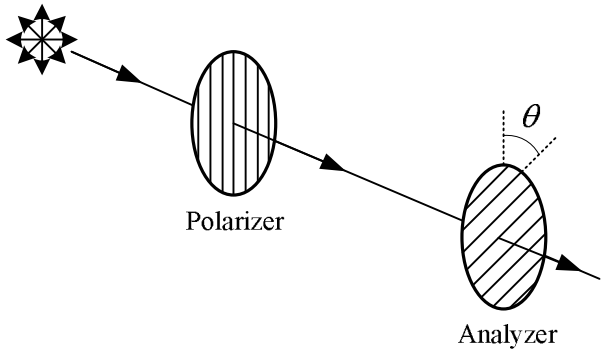
9. Draw ray diagrams for each case, and write the properties of images. [Conceptual notes: Can you associate each case with your daily life experiences?]



10. A ray of light coming from air is reflected on the surface of oil (n = 1.21). You look at the reflection from other side. At certain angle, the surface of oil looks glare (polarized into one that is parallel with the surface). What is the incident angle of the light ray? [Conceptual notes: What is the keyword? What is the name of the law?]

11. A violet light (λ = 410 nm in vacuum) falls on a grating whose separation width of slits is 1.00×10^{-6} m. Find the angle that locates the first order maxima. [Conceptual notes: Write applications of gratings.]

12. Unpolarized light of intensity passes through two sheets of polarizing material whose transmission axes make an angle $\theta = 60^{o}$ with each other as shown in the figure. What is the intensity of the transmitted beam? [Conceptual notes: What is a main purpose of the polarizer? What is a difference between polarizer and analyzer?]

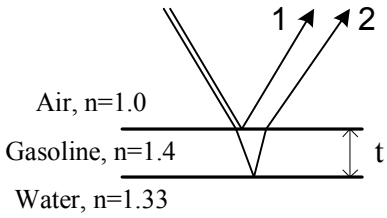


13. The thin-film interference is shown in the figure, and the thickness of the thin-film is t. [Conceptual notes: How do you select either constructive or destructive interference?]

    i. What is the net phase change and the path length difference between the light rays reflected on the surface of gasoline and the surface of water? Choose the answer from the following table. Then, write your reasoning.

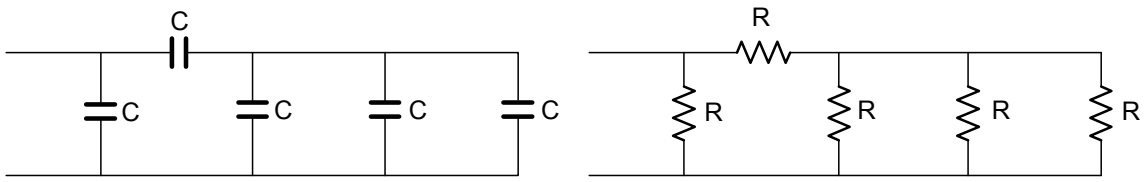
	Net phase change	Path length diff.
(A)	$2t$	$\lambda_{film}/2$
(B)	$\lambda_{film}/2$	$2t$
(C)	0	$2t$
(D)	$2t$	0
(E)	t	$\lambda_{film}/2$
(F)	$\lambda_{film}/2$	t

(Reason)

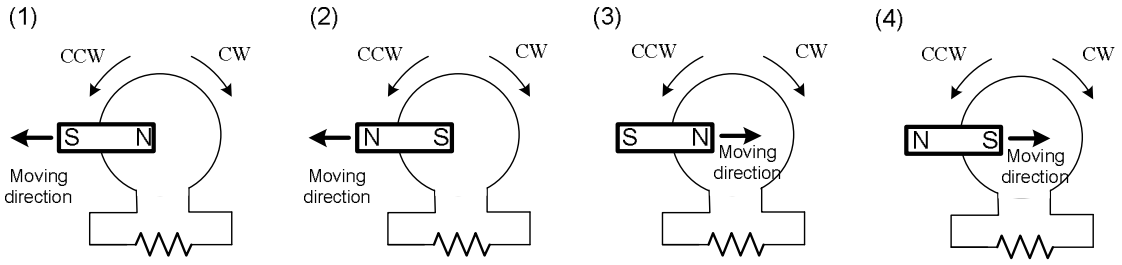


    ii. To gain a blue color (469 nm in vacuum) by the interference, what is the minimum non-zero thickness of the thin film?

14. Find the following equivalent capacitance and the equivalent resistance, assuming that all the capacitance and resistance of the circuits are 1.0 F and 1.0 Ω. [Conceptual notes: What is the difference of the following two systems in terms of how to find the equivalent resistance?]



15. Find the direction of induced current. [Conceptual notes: Can you imagine these situations three-dimensionally?]



Answer keys

1. 6.43×10^{-4} m
2. 0.26°
3. 690 nm; dark
4. 5000 m/s
5. 1.2 m
6. 20.8 Ω
7. 22.5 N, right
8. 1.41×10^{-6} T
9. (1) [virtual upright magnified], (2) [real inverted magnified], (3) [virtual upright reduced], (4) [virtual upright magnified], (5) [real inverted reduced], (6) [virtual upright reduced]
10. 50.4^{o}
11. 24.2^{o}
12. One eighth or 12.5 % of the original intensity
13. i. (B); ii. 8.38×10^{-8} m
14. C_{eq} = 7/4 or 1.75 F; R_{eq} = 4/7 or 0.57 Ω
15. (1) CW; (2) CCW; (3) CCW; (4) CW