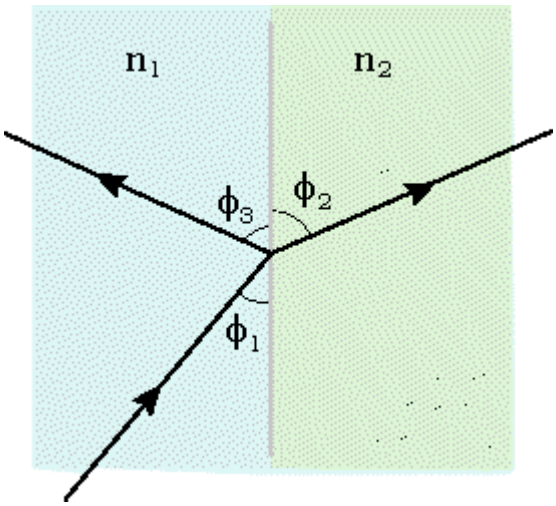
Light in one medium (n_1 = 1.2) encounters a boundary to a second medium (with n_2 = 1. 8) where part of the light is transmitted into the second media and part is reflected back into the first media. The incident angle is ϕ_1 = 16° measured WITH RESPECT TO THE BOUNDRY (as shown in the picture).



1) What is the reflected angle ϕ_3 measured WITH RESPECT TO THE BOUNDRY as shown?

a) 0°
b) 11°
c) 16°
d) 50°
e) 42°

2) What is the refracted angle ϕ_2 measured WITH RESPECT TO THE BOUNDRY as shown?

a) 0°
b) 11°
c) 16°
d) 50°
e) 42°

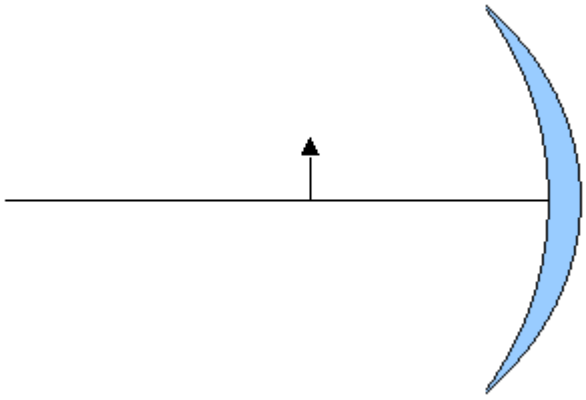
3) How does the speed of light in the two materials compare?

a) the speed is greater in medium 1
b) the speed is greater in medium 2
c) the speed is the same

4) What is the critical angle between the two media?

a) 0°
b) 11°
c) 16°
d) 50°
e) 42°

An object is placed 10.0 cm in front of a concave mirror. The mirror produces an inverted magnified image that is 2.5 times bigger than the object.



5) Where is the image located?

a) 0 cm
b) 4 cm
c) 7.14 cm
d) 10 cm
e) 25 cm

6) Describe the image:

a) real
b) virtual
c) it could be either

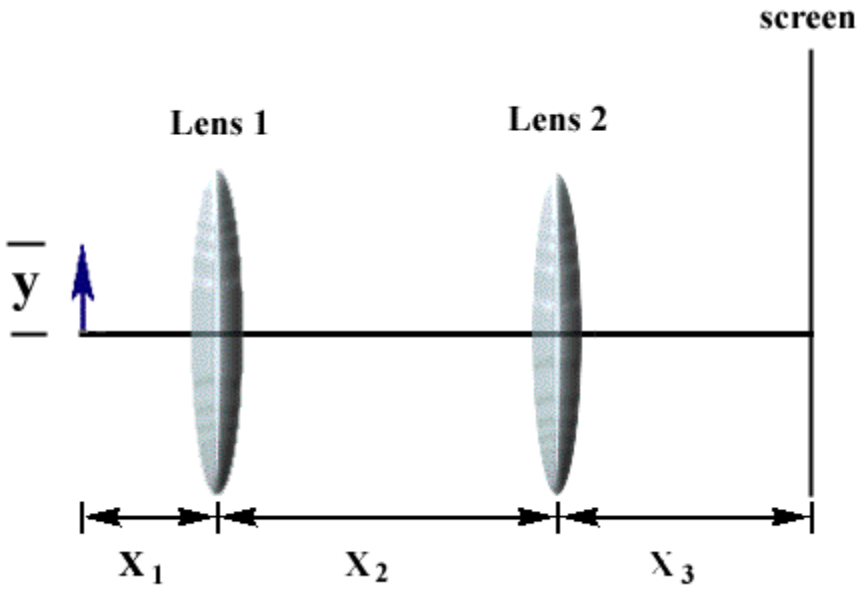
7) If the object is now moved very far from the mirror, where will the new image be formed?

a) 0 cm
b) 4 cm
c) 7.14 cm
d) 10 cm
e) 25 cm

8) Describe the new image:

a) real and inverted
b) virtual and inverted
c) real and upright
d) virtual and upright
e) none of the above

An object is 20 cm in front of converging lens 1 that has a focal length of 6 cm.



9) Where is the image of the object through ONLY THE FIRST LENS located?

a) 6.59 cm
b) 7.21 cm
c) 8.57 cm
d) 9.33 cm
e) 10.32 cm

10) Lens 2 is located 28 cm to the right of lens 1. If the final imaged is focused on a screen 22 cm to the right of lens 2, what is the focal length of lens 2?

a) 6.59 cm
b) 7.21 cm
c) 8.57 cm
d) 9.33 cm
e) 10.32 cm

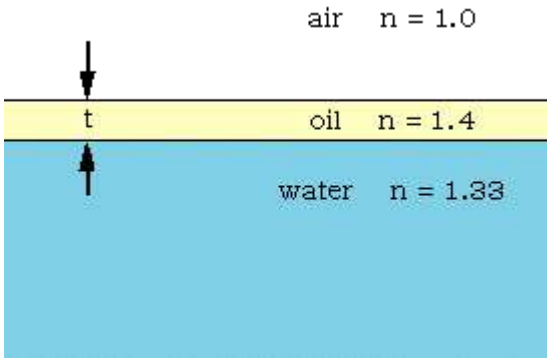
11) Describe the final image:

a) real and inverted
b) virtual and inverted
c) real and upright
d) virtual and upright
e) none of the above

12) Is it possible to make the final image show up on the screen if a single diverging lens was used?

a) Yes.
b) No.
c) It depends on the focal length of the diverging lens.

Light with wavelengths from 400 nm to 700 nm is involved in thin film interference with oil on water.



13) At what minimum non-zero thickness will there be constructive interference for blue light? (400nm)

a) 71.4 nm
b) 142.9 nm
c) 250 nm
d) 350 nm
e) 500 nm

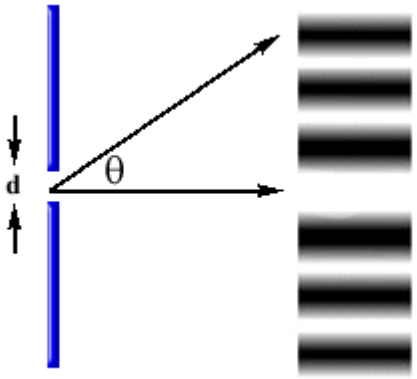
14) At what minimum non-zero thickness will there be destructive interference for red light? (700nm)

a) 71.4 nm
b) 142.9 nm
c) 250 nm
d) 350 nm
e) 500 nm

15) If the oil was on glass (n = 1.5) instead of water, how would the two previous answers change?

a) Both would increase.
b) Both would decrease.
c) Both would remain the same.
d) #13 would increase, #14 would decrease
e) #13 would decrease, #14 would increase

Light with wavelength 582 nm goes through a single slit of width 0.016 mm and displays a diffraction pattern on a screen 2.2 m away.



16) What is the width of the central bright fringe?

a) 0.16 m
b) 0.32 m
c) 0.48 m
d) 0.64 m
e) 0.80 m

17) What is the angle to the 3rd dark fringe?

a) 0°
b) 2°
c) 4°
d) 6°
e) 8°

18) If the apparatus was placed under water, what would happen to the pattern?

a) the fringes would spread out
b) the fringes would get closer together
c) nothing

19) If the slit width was increased, what would happen to the pattern?

a) the fringes would spread out
b) the fringes would get closer together
c) nothing

Two unrelated radioactivity problems are asked below.

20) Uranium $^{238}_{92}U$ decays into Thorium $^{234}_{90}Th$ via what type of decay?

a) α
b) β+
c) β-
d) δ
e) γ

21) The half life of Carbon-14 is around 6000 years old. How old is a fossil with only 1/8 of the Carbon-14 it had when it died?

a) 750 years old
b) 6,000 years old
c) 12,000 years old
d) 18,000 years old
e) 48,000 years old

It is known that an electron in an atom is in the 3p orbital.

22) What are the possibilities for the quantum number m_ℓ?

a) -3, -2, -1, 0, +1, +2, or +3
b) -1, 0, or +1
c) 0, 1, 2, or 3
d) 0, 1, or 2
e) 0 or 1

23) What is the principle quantum number n?

a) 4
b) 3
c) 2
d) 1
e) 0

In a photoelectric effect experiment, visible light (400nm to 750nm) shines on a metal with a work function of 2.8eV.

24) What is the maximum KE of ejected electrons?

a) 0.30 eV
b) 1.30 eV
c) 2.30 eV
d) 3.30 eV
e) 4.30 eV

25) What is the cutoff frequency for this metal?

a) 4.77×10^{14} Hz
b) 5.77×10^{14} Hz
c) 6.77×10^{14} Hz
d) 7.77×10^{14} Hz
e) 8.77×10^{14} Hz

26) Which of the following metals' work functions would emit no electrons when visible light shines on it?

a) 0 eV
b) 1.0 eV
c) 2.0 eV
d) 3.0 eV
e) 4.0 eV

An electron in an excited hydrogen atom makes two transitions. First the electron drops from the n=5 to the n=2 state, then the electron drops from the n=2 to the n=1 state.

27) Compare the energy and wavelength of the photon emitted in each transition.

a) in the 1st transition the energy of the photon and the wavelength of the photon are both greater
b) in the 1st transition the energy of the photon is greater and the wavelength of the photon is less
c) in the 1st transition the energy of the photon is less and the wavelength of the photon is greater
d) in the 1st transition the energy of the photon and the wavelength of the photon are both less
e) none of the above

28) Calculate the frequency of the photon emitted in the first transition.

a) 2.91×10^{14} Hz
b) 3.91×10^{14} Hz
c) 4.91×10^{14} Hz
d) 5.91×10^{14} Hz
e) 6.91×10^{14} Hz

29) Calculate the momentum of the photon emitted in the second transition.

a) 1.44×10^{-27} kg-m/s
b) 2.44×10^{-27} kg-m/s
c) 3.44×10^{-27} kg-m/s
d) 4.44×10^{-27} kg-m/s
e) 5.44×10^{-27} kg-m/s

Three space ships are seen flying past your classroom on a space station. When moving, Ship 1 is measured to be only 65% of its length compared to when it is at rest at the space station. Ship 2 is moving away from the space station at 0.5c and Ship 3 is moving toward the space station (in the opposite direction as Ship 2) at 0.9c.

30) How fast is Ship 1 moving relative to the space station?

a) 0c
b) 0.34c
c) 0.59c
d) 0.76c
e) 1.00c

31) After 3 hours pass on your watch, how much time do you measure to have passed on Ship 2's clocks?

a) 1.50 hours
b) 2.60 hours
c) 3.00 hours
d) 3.50 hours
e) 6.00 hours

32) How fast does Ship 2 measure Ship 3 to be moving?

a) 0.40c
b) 0.72c
c) 0.97c
d) 1.00c
e) 1.40c

33) You send a radio signal (at the speed of light) to Ship 3. How fast does Ship 3 measure it approaching?

a) 0.1c
b) 0.9c
c) 1.0c

Online Physics 122 Formulas

$$F = ma \qquad F = \frac{kq_1q_2}{r^2} \qquad E = \frac{F}{q_o} \qquad E = \frac{kq}{r^2}$$

$$U = \frac{kq_1q_2}{r} \qquad V = \frac{U}{q_o} \qquad V = \frac{kq}{r} \qquad E = \frac{V}{d}$$

$$C = \varepsilon_o \frac{A}{d} \qquad C = \frac{Q}{V} \qquad U = \frac{1}{2}QV \qquad I = \frac{Q}{t}$$

$$C_p = C_1 + C_2 \qquad \frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} \qquad R_s = R_1 + R_2 \qquad \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$R = \rho \frac{L}{A} \qquad V = IR \qquad P = IV \qquad Q = Q_o e^{\frac{-t}{RC}}$$

$$Q = Q_o\left(1 - e^{\frac{-t}{RC}}\right) \qquad F = qvB\sin\theta \qquad F = ILB\sin\theta \qquad B = \frac{\mu_o I}{2\pi r}$$

$$B = \mu_o nI \qquad r = \frac{mv}{qB} \qquad \Phi_B = BA\cos\phi \qquad emf = vBL$$

$$emf = -N\frac{\Delta\Phi_B}{\Delta t} \qquad U = \frac{1}{2}LI^2 \qquad \frac{V_s}{V_p} = \frac{N_s}{N_p} \qquad V_{rms} = I_{rms}Z$$

$$Z = \sqrt{R^2 + \left(X_L - X_C\right)^2} \qquad X_c = \frac{1}{2\pi fC} \qquad X_L = 2\pi fL$$

$$\overline{P} = V_{rms}I_{rms}\cos\phi \qquad \tan\phi = \frac{X_L - X_C}{R} \qquad f_o = \frac{1}{2\pi\sqrt{LC}} \qquad c = \lambda f$$

$$c = \frac{1}{\sqrt{\varepsilon_o\mu_o}} \qquad U = \frac{1}{2}\varepsilon_o E^2 + \frac{1}{2\mu_o}B^2 \qquad E = cB$$

$$I = I_o\cos^2\theta$$

$$k = 8.99\times10^9\, Nm^2/C^2$$
$$\varepsilon_o = 8.85\times10^{-12}\, C^2/m^2N$$
$$q_e = 1.60\times10^{-19}\, C$$
$$\mu_o = 4\pi\times10^{-7}\, Tm/A$$
$$c = 3\times10^8\, m/s$$

Online Physics 122 Formulas

$$\frac{1}{d_o}+\frac{1}{d_i}=\frac{1}{f} \qquad m=\frac{h_i}{h_o}=-\frac{d_i}{d_o} \qquad f=\frac{1}{2}R \qquad \theta_i=\theta_r$$

$$n=\frac{c}{v} \qquad n_1\sin\theta_1=n_2\sin\theta_2 \qquad \sin\theta_c=\frac{n_2}{n_1} \qquad \tan\theta_B=\frac{n_2}{n_1}$$

$$P=\frac{1}{f} \qquad d\sin\theta=\left(m+\frac{1}{2}\right)\lambda \qquad d\sin\theta=m\lambda \qquad W\sin\theta=m\lambda$$

$$\theta_{\min}=1.22\frac{\lambda}{D} \qquad 2t=\left(m+\frac{1}{2}\right)\lambda' \qquad 2t=m\lambda' \qquad \lambda'=\frac{\lambda}{n}$$

$$hf=KE_{\max}+W_o \qquad \lambda'-\lambda=\frac{h}{mc}(1-\cos\theta) \qquad p=\frac{h}{\lambda} \qquad E=hf$$

$$E^2=p^2c^2+m^2c^4 \qquad E_n=\frac{-13.6eV}{n^2} \qquad \Delta p\Delta y\geq\frac{h}{4\pi} \qquad \Delta E\Delta t\geq\frac{h}{4\pi}$$

$$\Delta t=\frac{\Delta t_o}{\sqrt{1-\frac{v^2}{c^2}}} \qquad L=L_o\sqrt{1-\frac{v^2}{c^2}} \qquad p=\frac{mv}{\sqrt{1-\frac{v^2}{c^2}}} \qquad E=\frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$v_{AB}=\frac{v_{AC}+v_{CB}}{1+\frac{v_{AC}v_{CB}}{c^2}}$$

$$c=3\times10^8\,m/s$$
$$h=6.626\times10^{-34}\,J\cdot s$$
$$m_e=9.11\times10^{-31}kg$$
$$m_p=1.67\times10^{-27}kg$$

ON-LINE PHYSICS 122
EXAM #2
MR. POTTER

Name: _____ Date: _____

1) Bubble in the ID number section of the scantron form with FIVE ZEROS and then the LAST FIVE DIGITS of your SOCIAL SECURITY NUMBER. (For example 0000054321.)

2) This Exam is 90 min long - 33 multiple-choice questions. Choose the one BEST answer for each question. You are not penalized for guessing. Watch your time! (Answer all questions.)

3) You may use only a pencil and calculator. (Formula sheet is provided.)

4) Use the test as scratch paper (or the paper provided by the testing center). Hand EVERYTHING back in or you will receive a 0 on the exam!

5) Scoring: all 5 answer choice questions are 6 pts. each, all 3 answer choice questions are 3 pts. each, all 2 answer choice questions are 2 pts. each. Total possible points = 180 pts.

6) This is test form ____. Be sure to FILL THIS IN on your scantron form. All forms are "equivalent" tests (only numbers have been changed.)

7) Also, write your name, the class, the date, and my name on the scantron form.

Good Luck!

DID YOU BUBBLE IN AN ID NUMBER AND TEST FORM ON THE SCANTRON?

(see front page for instructions)