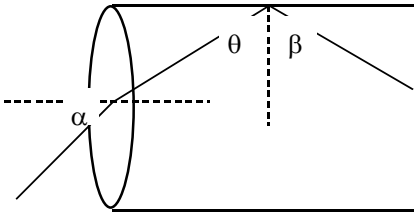
Light in air (n = 1.0) enters a fiber optic cable (of material with n = 1.28) where it goes through total internal reflection as it travels down the cable.

1) What is the minimum angle θ that it must strike the walls of the cable to undergo total internal reflection?



a) 40.1 degrees
b) 44.9 degrees
c) 48.2 degrees
d) 51.4 degrees
e) 53.0 degrees

2) To be at this critical angle calculated above, what is the angle α that it must enter the cable?

a) 40.1 degrees
b) 44.9 degrees
c) 48.2 degrees
d) 51.4 degrees
e) 53.0 degrees

3) Compare the two angles θ and β in the above diagram?

a) $\theta = \beta$
b) $\theta > \beta$
c) $\theta < \beta$
d) It depends on index of refraction of the cable.
e) It depends on the initial angle entering the cable.

An object is placed 10.0 cm in front of a mirror. The mirror produces an upright magnified image that is 3 times bigger than the object.

4) What type of mirror is it?

a) A concave mirror with focal length less than 10 cm.
b) A concave mirror with focal length greater than 10 cm.
c) A convex mirror with focal length less than 10 cm.
d) A convex mirror with focal length greater than 10 cm.
e) This could happen with either a concave or a convex mirror.

5) How far from the mirror is the image? (Give the magnitude of this distance.)

a) 3.33 cm
b) 6.67 cm
c) 10 cm
d) 15 cm
e) 30 cm

An object is 18 cm in front of a converging lens that has a focal length of 12 cm.

6) Which statement best describes the image of the object?

a) Real and Upright
b) Real and Inverted
c) Virtual and Upright
d) Virtual and Inverted
e) No image is formed in this situation.

7) What is the magnitude of the distance the image is located from the lens?

a) 7.2 cm
b) 13.5 cm
c) 17.3 cm
d) 28.7 cm
e) 36.0 cm

8) The object is moved a few centimeters closer to the lens. What happens to the image?

a) It moves away from the lens and gets bigger.
b) It moves toward the lens and gets bigger.
c) It moves away from the lens and gets smaller.
d) It moves toward the lens and gets smaller.
e) Nothing.

9) The lens (made of glass with n = 1.52) is placed underwater (n = 1.33). What happens to the magnitude of the focal length of the lens?

a) It increases.
b) It decreases.
c) Nothing.
d) The lens becomes a diverging lens with a smaller focal length.
e) The lens becomes a diverging lens with a larger focal length.

Light with wavelengths from 400 nm to 700 nm is involved in a two slit interference experiment with a slit spacing of 0.0045 mm

10) At what angle will the second order maximum be located for blue light (400 nm)?

a) 10 degrees
b) 20 degrees
c) 30 degrees
d) 40 degrees
e) 50 degrees

11) How many full order spectra (from 400nm to 700nm) can be seen above the central bright fringe?

a) 2
b) 4
c) 6
d) 8
e) 10

12) How would the previous answer change if the slit spacing was doubled?

a) Increase.
b) Decrease.
c) Remain the same.
d) It depends on the distance the screen is from the slits.
e) No spectra would appear.

Photons of energy 12.75 eV are produced from electron transitions in the Hydrogen atom.

13) What energy levels does this transition involve?

a) n = 2 to n = 1
b) n = 1 to n = 5
c) n = 7 to n = 2
d) n = 2 to n = 3
e) n = 4 to n = 1

14) What is the frequency and momentum of this photon?

a) 3.08×10^{15} Hz, 6.80×10^{-27} kg-m/s
b) 4.06×10^{15} Hz, 5.28×10^{-27} kg-m/s
c) 5.17×10^{15} Hz, 4.19×10^{-27} kg-m/s
d) 6.48×10^{15} Hz, 3.31×10^{-27} kg-m/s
e) 7.02×10^{15} Hz, 2.01×10^{-27} kg-m/s

15) What best describes this light?

a) ultraviolet
b) blue
c) green
d) red
e) infrared

16) If the initial and final state were both one level higher, how would the energy and momentum of the photon compare with the original?

a) It would have a greater energy and greater momentum.
b) It would have a smaller energy and greater momentum.
c) It would have a greater energy and smaller momentum.
d) It would have a smaller energy and smaller momentum.
e) Such a transition is impossible!

17) What is the wavelength of light emitted when an electron in a Hydrogen atom drops from the fourth excited state (n = 6) to the first excited state (n = 2)?

a) 397 nm
b) 410 nm
c) 434 nm
d) 486 nm
e) 656 nm

Photons with a frequency of 2.5×10^{14} Hz collide off an electron in a Compton Effect experiment.

18) What is the change in wavelength of the photons if the photon rebounds at a right angle (at an angle of 90 degrees)?

a) 1.43×10^{-12} m
b) 2.43×10^{-12} m
c) 3.43×10^{-12} m
d) 4.43×10^{-12} m
e) 5.43×10^{-12} m

19) If the electron ends up moving with a velocity of 765 m/s, what is its Debroglie wavelength?

a) 551 nm
b) 651 nm
c) 751 nm
d) 851 nm
e) 951 nm

20) If the deflection occurs at an angle greater than 90 degrees, making the speed of the electron greater, what will happen to the above two answers?

a) The change in wavelength will be less and the Debroglie wavelength will be less.
b) The change in wavelength will be greater and the Debroglie wavelength will be less.
c) The change in wavelength will be less and the Debroglie wavelength will be greater.
d) The change in wavelength will be greater and the Debroglie wavelength will be greater.
e) It depends on what the angle is!

Two unrelated radioactivity problems are asked below.

21) Thorium $^{234}_{90}Th$ decays into Protactinium $^{234}_{91}Pa$ via what type of decay?

a) α
b) $\beta+$
c) $\beta-$
d) δ
e) γ

22) The half life of Carbon-14 is around 6000 years old. How old is a fossil with only ¼ of the Carbon-14 it had when it died?

a) 1,500 years old
b) 3,000 years old
c) 6,000 years old
d) 12,000 years old
e) 24,000 years old

On the earth, you are watching a spaceship move directly away from the earth at 0.8c relative to the earth.

23) While moving at 0.8c away from earth it sends a smaller ship back towards the earth at 0.9c (relative to the spaceship). How fast do you (an observer on earth) measure the smaller ship to be moving?

a) 0c
b) 0.1c
c) 0.36c
d) 0.72c
e) 1.7c

24) The proper length of the original spaceship is 100 m (this is the length people on the spaceship measure the length of the spaceship to be). How long do you measure the spaceship to be when it is moving at 0.8c?

a) 60 m
b) 80 m
c) 100 m
d) 125 m
e) 167 m

25) After a while, you notice 15 minutes have passed on the clocks of the earth. How much time do you observe to have elapsed on the clocks of the spaceship?

a) 9 min
b) 12 min
c) 15 min
d) 19 min
e) 25 min

It is known that an electron in an atom is in the 2s orbital.

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

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

27) 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 1.3eV.

28) What is the maximum KE of ejected electrons?

a) 1.30 eV
b) 1.45 eV
c) 1.65 eV
d) 1.80 eV
e) 3.10 eV

29) What is the cutoff frequency for this metal?

a) 1.15×10^{14} Hz
b) 2.15×10^{14} Hz
c) 3.15×10^{14} Hz
d) 4.15×10^{14} Hz
e) 5.15×10^{14} Hz

30) What is the difference in maximum KE of electrons ejected by 400nm light versus 750nm light?

a) 1.30 eV
b) 1.45 eV
c) 1.65 eV
d) 1.80 eV
e) 3.10 eV

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 - 30 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)