1) When an object is placed outside the center of curvature of a concave mirror, the image is _____ .

    a) upright and virtual
    b) inverted and smaller
    c) larger and real

2) When an object is placed inside the focal point of a diverging lens, the image is _____ .

    a) upright and virtual
    b) inverted and smaller
    c) larger and real

3) When light reflects off a surface the angle of reflection is _____ the angle of incidence.

    a) greater than
    b) less than
    c) equal to

4) The speed of light in glass is _____ the speed of light in air.

    a) greater than
    b) less than
    c) equal to

5) In the same single slit diffraction experiment, the separation of the dark fringes when blue light is used is _____ compared to the separation of the dark fringes when red light is used.

    a) the same distance
    b) closer together
    c) farther apart

6) The _____ of light explains the colorful pattern when there is a thin film of oil on water.

    a) polarization
    b) diffraction
    c) interference

7) In the photoelectric effect, the _____ of the light determines the kinetic energy of the ejected electrons.

    a) intensity
    b) frequency
    c) speed

8) Which experiment cannot be explained by the wave properties of light?

    a) two slit interference
    b) the Compton effect
    c) x-ray diffraction

9) The only visible lines in the hydrogen spectra involve transitions that end at the _____ energy level.

    a) $n = 1$
    b) $n = 2$
    c) $n = 3$

10) How many electrons can fit in the p subshell?

    a) 2
    b) 6
    c) 10

11) As a space ship approaches the speed of light_____.

    a) its clocks are measured to speed up
    b) its length is measured to increase
    c) its mass is meassured to increase

12) One of the two postulates of the special theory of relativity is that _____.

    a) nothing can travel faster than the speed of light
    b) all observers, in all reference frames, measure the speed of light to be the same value
    c) the speed of light depends on the medium the light travels in

An object is placed 20.0 cm in front of a concave mirror. The mirror produces an inverted image that is 5.0 cm in front of the mirror.
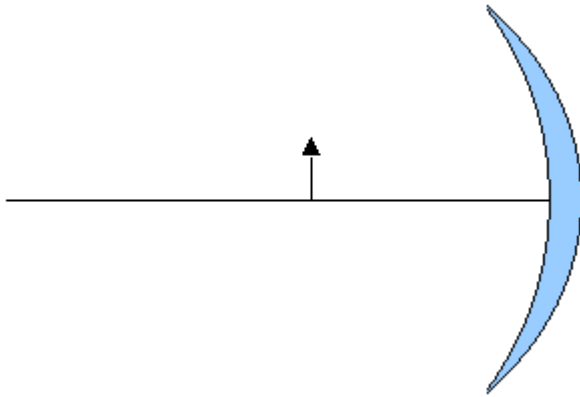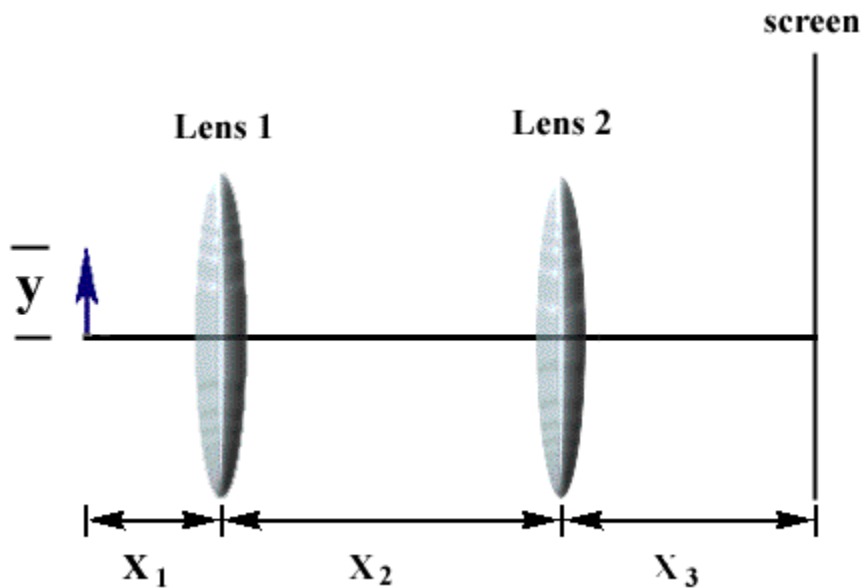
13) What is the focal length of the mirror?

   a) 4 cm
   b) 5 cm
   c) 8 cm
   d) 10 cm
   e) 20 cm

14) What is the magnification of the image?

   a) -1/4
   b) +1/4
   c) 0
   d) -4
   e) +4

An object is 18 cm in front of converging lens 1 that has a focal length of 30 cm.

screen

Lens 1   Lens 2

$\bar{y}$

X_1 X_2 X_3

15) Where is the image of the object through ONLY THE FIRST LENS located (relative to the first lens)?

    a) 15 cm to the left of lens 1
    b) 36 cm to the right of lens 1
    c) 36 cm to the left of lens 1
    d) 45 cm to the right of lens 1
    e) 45 cm to the left of lens 1

16) 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) 5.5 cm
    b) 7.2 cm
    c) 9.5 cm
    d) 12.3 cm
    e) 16.9 cm

Light with wavelengths from 400 nm to 750 nm is involved in a two slit interference experiment with a slit spacing of 0.0025 mm. (1 nm = 1x10⁻⁹ m and 1 mm = 1x10⁻³ m)

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

   a) 19 degrees
   b) 29 degrees
   c) 39 degrees
   d) 49 degrees
   e) 59 degrees

18) How many full order spectra (from 400nm to 750nm) can be seen above the central bright fringe?

   a) 1
   b) 3
   c) 5
   d) 7
   e) 9

Light with wavelength 575 nm goes through a single slit of width 0.036 mm and displays a diffraction pattern on a screen 4.2 m away.
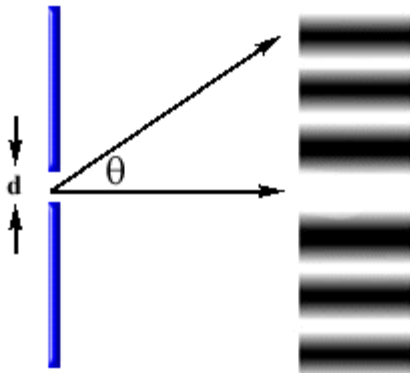
19) What is the width of the central bright fringe?

   a) 5.5 cm
   b) 7.4 cm
   c) 9.4 cm
   d) 11.4 cm
   e) 13.4 cm

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

   a) 1°
   b) 3°
   c) 5°
   d) 7°
   e) 9°

Photons scatter off an electron in a Compton Effect experiment.

21) At what deflection angle relative to its initial path does a photon have the greatest change in wavelength?
(where 0 degrees is continuing straight and 180 degrees is deflecting directly back)

       a) 0 degrees
       b) 45 degrees
       c) 90 degrees
       d) 135 degrees
       e) 180 degrees

A certain metal in the photoelectric effect experiment has a work function of 4.2 eV.
For a given experiment, the maximum kinetic energy of the ejected electrons is 1.8 eV.

22) What is the wavelength of the incident photons?

       a) 207 nm
       b) 307 nm
       c) 407 nm
       d) 507 nm
       e) 607 nm

23) What is the DeBroglie wavelength of the ejected electrons?

       a) 0.51 nm
       b) 0.61 nm
       c) 0.71 nm
       d) 0.81 nm
       e) 0.91 nm

24) What is the maximum wavelength of photons that would eject electrons from this metal?

       a) 295 nm
       b) 395 nm
       c) 495 nm
       d) 595 nm
       e) 695 nm

An electron in an excited hydrogen atom makes two transitions. First the electron drops from the n=7 to the n=4 state, then the electron drops from the n=4 to the n=1 state.

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

     a) 1.4×10^{14} Hz
     b) 2.4×10^{14} Hz
     c) 3.4×10^{14} Hz
     d) 4.4×10^{14} Hz
     e) 5.4×10^{14} Hz

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

     a) 3.8×10^{-27} kg-m/s
     b) 4.8×10^{-27} kg-m/s
     c) 5.8×10^{-27} kg-m/s
     d) 6.8×10^{-27} kg-m/s
     e) 7.8×10^{-27} kg-m/s

27) Which of the following quantum states could the electron have been in at some point during these transitions?

     a) $n = 1, \ell = 1, m_\ell = 0, m_s = +\frac{1}{2}$
     b) $n = 4, \ell = -1, m_\ell = 0, m_s = -\frac{1}{2}$
     c) $n = 4, \ell = 0, m_\ell = 1, m_s = +\frac{1}{2}$
     d) $n = 7, \ell = 3, m_\ell = -1, m_s = +\frac{1}{2}$
     e) $n = 7, \ell = 1, m_\ell = -3, m_s = -\frac{1}{2}$

On the earth, you are watching a spaceship move directly away from the earth at 0.6c relative to the earth.

28) While moving at 0.6c 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) 0.19c
   c) 0.3c
   d) 0.65c
   e) 1.5c

29) 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 0.6c?

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

30) After a while, you notice 15 minutes have passed on the clocks of the earth (your clocks). 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

Online Physics 122 Formulas

$F = ma$ $\qquad$ $F = \dfrac{kq_1 q_2}{r^2}$ $\qquad$ $E = \dfrac{F}{q_o}$ $\qquad$ $E = \dfrac{kq}{r^2}$

$U = \dfrac{kq_1 q_2}{r}$ $\qquad$ $V = \dfrac{U}{q_o}$ $\qquad$ $V = \dfrac{kq}{r}$ $\qquad$ $E = \dfrac{V}{d}$

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

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

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

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

$B = \mu_o n I$ $\qquad$ $r = \dfrac{mv}{qB}$ $\qquad$ $\Phi_B = BA\cos\phi$ $\qquad$ $emf = vBL$

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

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

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

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

$I = I_o \cos^2 \theta$

$k = 8.99 \times 10^9 \, Nm^2 / C^2$

$\varepsilon_o = 8.85 \times 10^{-12} \, C^2 / m^2 N$

$q_e = 1.60 \times 10^{-19} \, C$

$\mu_o = 4\pi \times 10^{-7} \, Tm/A$

$c = 3 \times 10^8 \, m/s$

Online Physics 122 Formulas

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

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

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

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

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

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

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

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

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

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 = 144 pts.

6) This is test form _A_. 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)