An object is placed 20 cm in front of a convex mirror that has a radius of curvature of magnitude 16 cm (note this is not the focal length).

1) Describe the image formed:

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

2) What is the magnitude of the image distance?

   a) 3.7 cm
   b) 4.7 cm
   c) 5.7 cm
   d) 6.7 cm
   e) 7.7 cm

An object is placed in front of a converging lens outside the focal length of 28 cm. The lens produces an image that is 4 cm high and 45 cm from the lens.

3) Describe the image:

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

4) What is the height of the object?

   a) 2.2 cm
   b) 3.3 cm
   c) 4.4 cm
   d) 5.5 cm
   e) 6.6 cm

5) What is the magnitude of the object distance?

   a) 74 cm
   b) 84 cm
   c) 94 cm
   d) 104 cm
   e) 114 cm

6) What would happen to the absolute value of the magnification of this object if the lens were placed under water? (Assume the index of refraction of the lens is greater than the index of refraction of water.)

   a) it would increase
   b) it would decrease
   c) it would remain the same

Light with wavelength of 500 nm is involved in a single slit diffraction experiment with a slit width of 0.03 mm. A screen that is placed 2 m away from the slit displays the diffraction pattern.

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

a) 2.7 cm
b) 3.7 cm
c) 4.7 cm
d) 5.7 cm
e) 6.7 cm

8) At what angle above the central bright fringe is the 3rd dark fringe located?

a) 1.9 degrees
b) 2.9 degrees
c) 3.9 degrees
d) 4.9 degrees
e) 5.9 degrees

9) How many dark fringes can be seen on the screen?

a) 40
b) 80
c) 120
d) 160
e) 200

10) What would happen to the pattern if the slit width were decreased?

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

Radar with a wavelength of 1.35 cm is incident on a thin protective coating covering a stealth fighter. The index of refraction of the thin coating is 1.84.

11) What is the wavelength of the radar waves in the thin coating?

a) 0.73 cm
b) 1.12 cm
c) 1.35 cm
d) 1.86 cm
e) 2.48 cm

12) At what minimum thickness is the reflected radar a minimum (destructive interference)?

a) 0.07 cm
b) 0.15 cm
c) 0.18 cm
d) 0.29 cm
e) 0.41 cm

13) How does the minimum thickness for constructive interference compare to the above answer?

a) it is greater
b) it is less
c) it is the same

Photons scatter off an electron in a Compton Effect experiment.

14) 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

15) In the Compton Effect experiment, the photon exhibits which properties?

a) wave-like properties
b) particle-like properties
c) electron-like properties

A certain metal in the photoelectric effect experiment has a work function of 2.7 eV. For a given experiment, the maximum kinetic energy of the ejected electrons is 1.8 eV.

16) What is the wavelength of the incident photons?

a) 276 nm
b) 376 nm
c) 476 nm
d) 576 nm
e) 676 nm

17) 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

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

a) 359 nm
b) 459 nm
c) 559 nm
d) 659 nm
e) 759 nm

19) If the work function were increased, how would the above answer change?

a) it would increase
b) it would decrease
c) it would stay the same

An electron in an excited hydrogen atom makes two transitions. First the electron drops from the n=5 to the n=3 state, then the electron drops from the n=3 to the n=1 state.

20) 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

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

a) 1.34×10^{14} Hz
b) 2.34×10^{14} Hz
c) 3.34×10^{14} Hz
d) 4.34×10^{14} Hz
e) 5.34×10^{14} Hz

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

a) 3.46×10^{-27} kg-m/s
b) 4.46×10^{-27} kg-m/s
c) 5.46×10^{-27} kg-m/s
d) 6.46×10^{-27} kg-m/s
e) 7.46×10^{-27} kg-m/s

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

a) $n = 1, \ell = 1, m_\ell = 0, m_s = +½$
b) $n = 3, \ell = -1, m_\ell = 0, m_s = -½$
c) $n = 3, \ell = 0, m_\ell = 1, m_s = +½$
d) $n = 5, \ell = 3, m_\ell = -1, m_s = +½$
e) $n = 5, \ell = 1, m_\ell = -3, m_s = -½$

Three space ships are seen flying past your classroom on a space station. When moving, Ship 1 is measured to be only 78% of its length compared to when it is at rest at the space station. Ship 2 is moving away from the space station at 0.6c and Ship 3 is moving toward the space station (in the opposite direction as Ship 2) at 0.8c.

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

a) 0c
b) 0.23c
c) 0.43c
d) 0.63c
e) 0.83c

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

a) 1.80 hours
b) 2.40 hours
c) 3.00 hours
d) 3.75 hours
e) 5.00 hours

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

a) 0.20c
b) 0.38c
c) 0.95c
d) 1.00c
e) 1.40c

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

a) 0.2c
b) 0.8c
c) 1.0c

Finally, three additional physics 122 problems are below:

28) All transitions of electrons in the Hydrogen atom that produce visible light involve which energy level?

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

29) In radioactive decay, an alpha particle is _____, a beta particle is _____, and a gamma particle is _____.

a) an electron, electromagnetic radiation, a helium nucleus
b) electromagnetic radiation, a helium nucleus, an electron
c) a helium nucleus, an electron, electromagnetic radiation

30) What is the meaning of a materials half-life?

a) the amount of material remaining when half of it has decayed away
b) the energy released from the nucleus in radioactive decay
c) the time it takes for half of a sample to decay away

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

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

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

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

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

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

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

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

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

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

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 = 156 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)