An object 4 cm tall is placed 12 cm from a diverging lens with a focal length of –15 cm.

1) Which best describes 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) How far from the lens is the image? (Give only the magnitude of this distance.)

(a) 6.67 cm
(b) 7.67 cm
(c) 8.67 cm
(d) 9.67 cm
(e) 10.67 cm

3) How tall is the image? (Give only the magnitude of this distance.)

(a) 2.22 cm
(b) 3.13 cm
(c) 3.53 cm
(d) 4.67 cm
(e) 5.21 cm

A converging lens with a focal length of 10 cm is now placed 20 cm to the right of the original lens. The image formed in the original diverging lens now acts as the object for this new converging lens and a new image is formed.

4) What best describes this final image?

(a) Real and enlarged.
(b) Real and reduced.
(c) Virtual and enlarged.
(d) Virtual and reduced.
(e) None of the above.

5) How far is the final image from the converging lens? (Give only the magnitude of this distance.)

(a) 5.4 cm
(b) 10.3 cm
(c) 16.0 cm
(d) 20.1 cm
(e) 25.0 cm

An object placed in front of a concave mirror, with radius of curvature of 30 cm, forms an image 25 cm behind the lens with a height of 8 cm.

6) What is the distance the object is from the mirror?

(a) 5.4 cm
(b) 6.4 cm
(c) 7.4 cm
(d) 8.4 cm
(e) 9.4 cm

7) What is the height of the object?

(a) 1 cm
(b) 2 cm
(c) 3 cm
(d) 4 cm
(e) 5 cm

Radio waves (f = 107.1 MHz, with λ = 2.8 m) diffract through an opening with width of 3.8 m.

8) At what angle above the central maximum will no signal reach (where should you not place your radio)?

(a) 27°
(b) 37°
(c) 47°
(d) 57°
(e) 67°

9) If you tune into a lower frequency station (f = 100.3 MHz, with λ = 3.0 m) what will happen to this angle?

(a) it will increase
(b) it will decrease
(c) it will stay the same

White light (wavelengths ranging from 400 nm to 750 nm) shines through two slits and an interference pattern is displayed on a screen 1.5 m away.

10) If the blue light (wavelength 400 nm) forms its first order maximum at an angle of 13.8° above the bright central maximum, what is the distance between the slits?

(a) 1.68 µm
(b) 2.45 µm
(c) 3.86 µm
(d) 4.41 µm
(e) 5.22 µm

11) How wide is the first order spectrum on the screen (that is, how far away is the first order bright fringe from the 400 nm light and the first order bright fringe from the 750 nm light)?

(a) 17 cm
(b) 23 cm
(c) 38 cm
(d) 45 cm
(e) 51 cm

12) Is the angle the first order red fringe is located at greater than, less than, or equal to the first order blue fringe?

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

13) If the entire apparatus was placed in water, what would happen?

(a) The entire pattern would spread out.
(b) The entire pattern would get closer together.
(c) Nothing.

In the photoelectric effect, the minimum frequency for electrons to be emitted from a surface is 4.5×10^{14} Hz.

14) What is the momentum of these photons?

(a) 2.24×10^{-28} kg-m/s
(b) 3.94×10^{-28} kg-m/s
(c) 5.54×10^{-28} kg-m/s
(d) 8.14×10^{-28} kg-m/s
(e) 9.94×10^{-28} kg-m/s

15) What is the work function of this metal? $(1 \text{ eV} = 1.6 \times 10^{-19} \text{ J})$

(a) 1.86 eV
(b) 2.34 eV
(c) 3.12 eV
(d) 3.71 eV
(e) 4.28 eV

16) Now light with wavelength 420 nm was directed unto the metal. What is the KE of the emitted electrons?

(a) 0.79 eV
(b) 1.09 eV
(c) 1.64 eV
(d) 2.11 eV
(e) 2.67 eV

17) If photons with greater momentum were used, what would happen to the DeBroglie wavelength of the emitted electrons?

(a) It would increase.
(b) It would decrease.
(c) It would stay the same.

18) If light with higher intensity were used, what would happen to the KE of the emitted electrons?

(a) It would increase.
(b) It would decrease.
(c) It would stay the same.

An electron in a Hydrogen atom transitions from its n = 4 energy level to its n = 1 energy level.

19) What best describes this transition?

(a) a photon was absorbed by the electron
(b) a photo was emitted by the electron

20) True or False? The photon emitted is in the frequency range of visible light.

(a) True
(b) False

21) What energy photon was involved in this transition?

(a) 9.11 eV
(b) 10.4 eV
(c) 11.9 eV
(d) 12.8 eV
(e) 13.6 eV

22) What is the wavelength of the photon involved?

(a) 97 nm
(b) 223 nm
(c) 412 nm
(d) 675 nm
(e) 703 nm

23) When in the n = 1 state, which of the following sets of quantum numbers could describe the electron? The quantum numbers are in the form: (n, l, m_l, m_s).

(a) $(1, 1, -1, +\frac{1}{2})$
(b) $(1, 0, -1, +\frac{1}{2})$
(c) $(1, 1, 0, +\frac{1}{2})$
(d) $(1, 0, 0, -\frac{1}{2})$
(e) $(1, 1, 1, -\frac{1}{2})$

24) With the electron in the n = 4 state, how much energy is needed to ionize the atom (remove the electron completely)?

(a) 0.54 eV
(b) 0.85 eV
(c) 1.5 eV
(d) 3.4 eV
(e) 13.6 eV

There are 64 grams of a radioactive element: $^{218}_{84}$Po.

25) How much is left after 3 half-lives?

(a) 61 g
(b) 32 g
(c) 21 g
(d) 8 g
(e) none

26) If the sample goes through alpha decay, what is the other product?

(a) $^{214}_{84}$Pb

(b) $^{218}_{80}$Pb

(c) $^{214}_{82}$Pb

(d) $^{216}_{82}$Pb

(e) $^{218}_{84}$Pb

27) If the original sample goes through beta decay instead, what is the other product?

(a) $^{214}_{85}$At

(b) $^{218}_{82}$At

(c) $^{216}_{84}$At

(d) $^{217}_{82}$At

(e) $^{218}_{85}$At

28) In either decay, what is true about the nucleon number during the process?

(a) The total nucleon number increases during the decay.
(b) The total nucleon number decreases during the decay.
(c) The total nucleon number stays the same during the decay.

Out in a space station a spaceship's mass and length are measured and you synchronize your clock with their clock. Then the spaceship begins to travel away from you at 0.8c while you stay on the space station.

29) What happens to the ship's mass as measured by you?

(a) It increases.
(b) It decreases.
(c) It stays the same.

30) What happens to the ship's length as measured by you?

(a) It increases.
(b) It decreases.
(c) It stays the same.

31) What happens to the ship's clocks as measured by you?

(a) It slows down.
(b) It speeds up.
(c) It stays the same.

32) What happens to the ship's length as measured by people on the ship?

(a) It increases.
(b) It decreases.
(c) It stays the same.

33) Now you send a second ship to catch the first one. It moves at 0.95c away from you. At what speed does the spaceship measure it approaching?

(a) 0.234c
(b) 0.478c
(c) 0.625c
(d) 0.782c
(e) 0.881c

Online Physics 122 Formulas

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

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

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

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

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

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

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

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

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

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

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

$$I = I_o \cos\theta$$

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

Online Physics 122 Formulas

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$$

$$m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$$

$$f = \frac{1}{2}R$$

$$\theta_i = \theta_r$$

$$n = \frac{c}{v}$$

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

$$\sin\theta_c = \frac{n_2}{n_1}$$

$$\tan\theta_B = \frac{n_2}{n_1}$$

$$P = \frac{1}{f}$$

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

$$d\sin\theta = m\lambda$$

$$W\sin\theta = m\lambda$$

$$\theta_{min} = 1.22\frac{\lambda}{D}$$

$$2t = \left(m + \frac{1}{2}\right)\lambda'$$

$$2t = m\lambda'$$

$$\lambda' = \frac{\lambda}{n}$$

$$hf = KE_{max} + W_o$$

$$\lambda' - \lambda = \frac{h}{mc}(1 - \cos\theta)$$

$$p = \frac{h}{\lambda}$$

$$E = hf$$

$$E^2 = p^2c^2 + m^2c^4$$

$$E_n = \frac{-13.6eV}{n^2}$$

$$\Delta p \Delta y \geq \frac{h}{4\pi}$$

$$\Delta E \Delta t \geq \frac{h}{4\pi}$$

$$\Delta t = \frac{\Delta t_o}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$L = L_o\sqrt{1 - \frac{v^2}{c^2}}$$

$$p = \frac{mv}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$E = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

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

$$c = 3\times10^8\, m/s$$

$$h = 6.626\times10^{-34}\, J \cdot s$$

$$m_e = 9.11\times10^{-31}\, kg$$

$$m_p = 1.67\times10^{-27}\, kg$$