Name: Key

2018-2019 Physics Semester 2 Review Problems

Study chapters 6, 7, 11- 16

Exam includes: Multiple choice, short answer, and problems. Equation sheet will be provided. All answers require units and proper significant figures. Know metric conversions.

Ch. 6 1. Find the momentum of a 200 kg horse trotting at 4 m/s.

$p = mv \quad p = (200kg)(4m/s) = 800\ kg \cdot m/s$

2. What is the impulse given to a 0.1 kg baseball moving towards (right) the bat at 25 m/s which bounces off the bat at 30 m/s?

$F\Delta t = \Delta p \quad F\Delta t = (0.1kg)(+30m/s) - (0.1kg)(25m/s) = -5.5\ kg \cdot m/s$

$5.5\ kg \cdot m/s$ Left

b) If the impulse is delivered over 0.05 seconds, what force does the ball experience?

$F = \frac{5.5\ kg \cdot m/s}{0.05s} = -110N$

3. Each ball in a croquet set has a mass of 0.500 kg. The red ball, traveling at 10.2 m/s, strikes the green ball, which is at rest. Find the final speed of the green ball in each of the following situations:

$mv + mv = mv + mv$

a. The red ball stops moving after it strikes the green ball.

$(0.500kg)(10.2m/s) + (0.500kg)(0m/s) = (0.500kg)(0m/s) + (0.500kg)v_f$

$v_f = 10.2m/s$

b. The red ball continues moving after the collision at 3.20 m/s in the same direction.

$(0.500kg)(10.2m/s) + (0.500kg)(0m/s) = (0.500kg)(3.20m/s) + (0.500kg)v_f$

$v_f = 7.00m/s$

c. The red ball continues moving after the collision at 0.500 m/s in the same direction.

$(0.500kg)(10.2m/s) + (0.500kg)(0m/s) = (0.500kg)(0.500m/s) + (0.500kg)v_f$

$v_f = 9.70_{m/s}$

d. The green ball and red ball move in the same direction after the collision, the red ball has a speed of 1.40 m/s.

$(0.500kg)(10.2m/s) + (0.500kg)(0m/s) = (0.500kg)(1.40m/s) + (0.500kg)v_f$

$v_f = 8.80m/s$

4. An empty train car (1 .0kg) moving east as 21 m/s collides with a loaded train car initial at rest that has twice the mass of the empty car. The two cars stick together.

a. what type of collision is this? inelastic

b. Find the velocity of the two cars after the collision.

$m_1v_1 + m_2v_2 = (m_1+m_2)v$

$(1.0kg)(21m/s) + (2.0kg)(0m/s) = (1.0+2.0kg)v_f \quad v_f = 7.0m/s$

c. Find the final speed if the loaded car moving at 17 m/s has hit the empty car initially at rest.

$(1.0kg)(0m/s) + (2.0kg)(17m/s) = (1.0+2.0kg)\,v_f \quad v_f = 11m/s$

5. Two billiard balls, each with a mass of 0.35 kg, strike each other head-on. One ball initially moving left at 4.1 m/s and ends up moving right at 3.5 m/s. The second ball is initially moving to the right at 3.5 m/s. Find the final velocity of the second ball. (elastic)

$mv + mv = mv + mv$

$(0.35kg)(-4.1m/s) + (0.35kg)(3.5m/s) = (0.35kg)(3.5m/s) + (0.35kg)v_f$

$v_f = 4.1m/s$ left

Ch.7

6. The sun has a mass of 2.0×10^{30} kg and a radius of 7.0×10^5 km. How large is the gravitational force on a 62.5 kg mass at the sun's surface?

$F_g = \frac{GM_1M_2}{r^2} \qquad F_g = \frac{(6.673\times10^{-11}\,N\cdot m^2/kg^2)(2.0\times10^{30}kg)(62.5kg)}{(7.0\times10^8m)^2} = 1.2\times10^{13}N$

7. The radius of curvature of the track of a roller coaster is 23 m and the roller car has a tangential speed of 17 m/s, and mass of 1900 kg. What is the magnitude of the centripetal force applied to the car?

$F_c = \frac{mv_t^2}{r} \qquad F_c = \frac{(1900kg)(17m/s)^2}{23m} = 24{,}000N$

8. Find the torque produced by a 8.2 N force applied at an angle of 59° to a door 0.32 m from the hinge.

$\tau = Fd\sin\theta \qquad \tau = 8.2N(0.32m)\sin 59°$

$\tau = 2.2\ N\cdot m$

9. If the torque required to loosen a nut that hold a wheel on a car has a magnitude of 82 N·m, what force must be exerted at the end of a 0.42 m lug wrench to loosen the nut when the angle is 54°? (4pts)

$\tau = Fd\sin\theta \qquad 84\ N\cdot m = F(0.42m)\sin 54°$

$F = 240N$

10. A cylindrical space station with a 115 m radius rotates around its longitudinal axis at an tangential speed of 33.6 m/s. Calculate the centripetal acceleration on a person at the following locations:

$a_c = \frac{V_t^2}{r}$

a. at the center of the station.

$a_c = \frac{(33.6 m/s)^2}{0m} = 0 m/s^2$

b. halfway to the rim of the station.

$a_c = \frac{(33.6 m/s)^2}{(115m/2)_2} = 19.6 m/s^2$

c. at the rim of the station.

$a_c = \frac{(33.6 m/s)^2}{115m} = 9.82 m/s^2$

Ch. 11

11. A 76 N crate is attached to a spring (k= 450 N/m). How much displacement is caused by the weight of the crate?

$F = -kx \quad 76N = -(450 N/m)\,x \quad x = -0.17m$

12. A pendulum is 5.2 m long, what is its period?

$T = 2\pi\sqrt{\frac{L}{g}} \quad T = 2\pi\sqrt{\frac{5.2m}{9.81 m/s^2}} = 4.6 s$

13. The period of a pendulum is 6.2 s, what is its length?

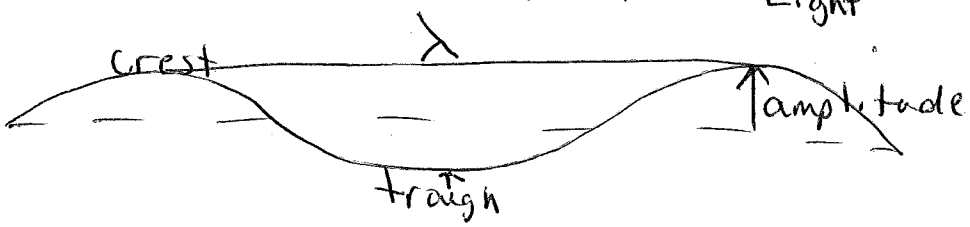
$6.25 s = 2\pi\sqrt{\frac{L}{9.81 m/s^2}} \quad L = 9.6 m$

14. A 1.0 kg mass attached to one end of a spring completes one oscillation every 2.0 s. Find the spring constant.

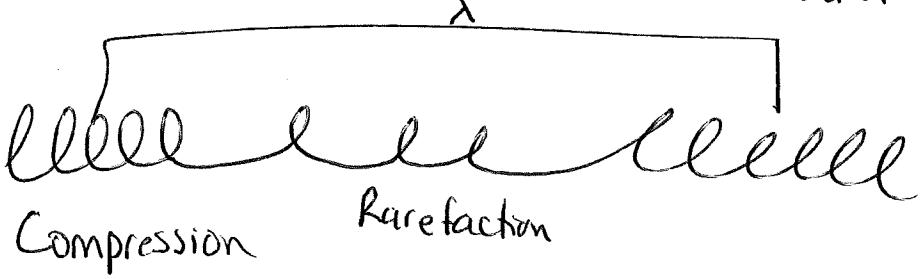
$T = 2\pi\sqrt{\frac{m}{k}} \quad 2.0 s = 2\pi\sqrt{\frac{1.0kg}{k}} \quad k = 9.9 N/m$

15. The period of a 261-Hertz sound wave is _____. $T = \frac{1}{f} = \frac{1}{261 Hz} = 0.00383 s$

16. Draw a transverse wave and label important parts. Light



17. Draw a longitudinal wave and label important parts. Sound



Ch11+12

18. The frequency of visible light is about 4.8×10^{14} Hz. What is the approximate wavelength of the light in nm?

$C = f\lambda \quad 3.00 \times 10^8 m/s = (4.8 \times 10^{14} Hz)\lambda \quad \lambda = 6.3 \times 10^{-7} m$

630nm

19. A sound wave has a frequency of 500. Hz and travels in air at a speed of 343.6 m/s. What is its wavelength?

$V = f\lambda \quad 343.6 m/s = (500. Hz)\lambda \quad \lambda = 0.687 m$

20. A sound wave in a steel rail has a frequency of 620.0 Hz and a wavelength of 10.5 m. What is the speed of sound in steel?

$V = (620.0 Hz)(10.5 m) = 6510 m/s$

21. Determine the frequency of a microwave 6.0 cm in length. (A microwave is an electromagnetic wave.)

$3.00 \times 10^8 m/s = f(0.060 m) \quad f = 5.0 \times 10^9 Hz$

Ch12

22. A balloon is inflated until its surface area is $2.0 \times 10^2 m^2$. A 30.0 W speaker is placed at the center of the balloon. What is the sound intensity at the surface of the balloon?

$I = \frac{P}{4\pi r^2} \quad I = \frac{30.0 W}{(2.0 \times 10^2 m^2)} = 0.15 W/m^2$

23. One string on a guitar is 34.50 cm long. The string is plucked, and the speed of waves on the string is 410.0 m/s. What are the first three harmonics? (hint: is this open or closed??)

$f_n = \frac{V}{4L}$ odd

$f_n = \frac{V}{2L} \quad f_n = \frac{410.0 m/s}{2(0.3450 m)} = 594.4 Hz$

1188 Hz

1782 Hz

Ch.13

24. A light ray approaches a mirror at an angle of incidence of 25°. What is the angle of reflection?

25°

→ can be Real −M or Virtual

25. A **concave** spherical mirror has a focal length of 10.0 cm. Locate the image of a pencil that is placed upright 20.0 cm from the mirror. Find the magnification. Is the image real or virtual? Is the image upright or inverted?

$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$ $\quad \frac{1}{20.0cm} + \frac{1}{q} = \frac{1}{10.0cm}$ $\quad q = 20.0cm$

$M = \frac{-q}{p} = \frac{-(20.0cm)}{20.0cm} = -1.00$ Real Inverted

26. An upright pencil is placed 1.0 cm from **convex** spherical mirror with a radius of curvature of 12.0 cm, find the position of the image. Find the magnification of the image. Is the image real or virtual? Is the image upright or inverted?

Convex always Virtual $\quad \frac{1}{1.0cm} + \frac{1}{q} = \frac{1}{-6.0cm}$

+M, upright

−f

−q $\quad q = -0.86cm$

$R = 2f$

$12.0cm = 2f \quad f = 6.00cm$ $\quad M = \frac{-(-0.86cm)}{1.0cm} = 0.86$ Virtual Upright

Ch.14

27. A ray of light travels through air (n=1.00) and then water (n=1.333). The angle of incidence is 45.0°. Determine the angle of refraction.

$n_i \sin\theta_i = n_r \sin\theta_r$

$1.00 \sin 45.0° = 1.333 \sin\theta \quad \theta = 32.1°$

28. A light ray is passing through water towards the boundary with a transparent solid at an angle of 56.4°. The light refracts into the solid at an angle of refraction of 42.1°. Determine the index of refraction of the unknown solid.

$1.333 \sin 56.4° = n \sin 42.1°$

$n = 1.66$

Ch. 15

29. The distance between two slits in a double-slit experiment is 0.040 mm. The second-order bright fringe is measure on a screen at an angle of 2.2° from the central maximum. What is the wavelength of the light in nm?

$d \sin\theta = m\lambda$

$0.040\text{mm} \sin 2.2° = 2\lambda$

$\lambda = 7.68 \times 10^{-4}\text{mm}$ $\quad 770\text{nm}$

30. The distance between two slits in a double-slit interference experiment is 0.0050 mm. What is the angle of the third-order bright fringe produced with light of 550 nm?

$0.0050\text{mm} \sin\theta = 3(550 \times 10^{-6}\text{mm})$

$\theta = 19°$

31. Monochromatic light at 633.8 nm shines through a diffraction grating. At the first order maximum the angle is 5.47°. What is the distance between the slits and how many lines per cm are contained on the grating?

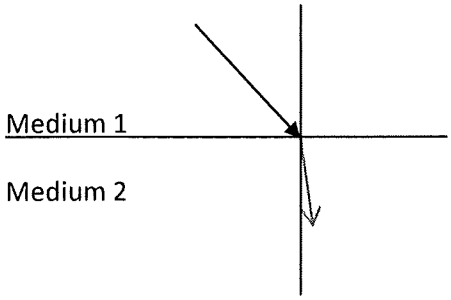
$d \sin 5.47° = 1(633.8 \times 10^{-7}\text{cm})$

$d = 6.65 \times 10^{-4}\text{cm}$

$\text{lines} = \frac{1}{d}$

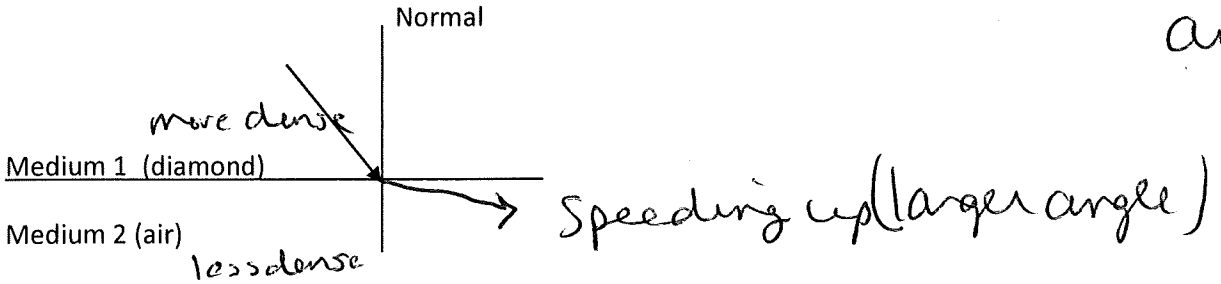
$\text{lines} = \frac{1}{6.65 \times 10^{-4}\text{cm}}$

$1504\ \text{lines/cm}$



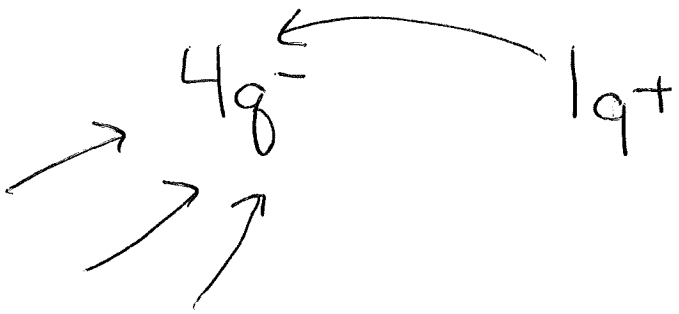
32. The arrows represent the path of light in the picture above. Is the light speeding up or slowing down?

Smaller angle



33. In the picture above draw the "missing" ray, show the appropriate direction of bending towards or away from the normal.

Ch.16 34. Draw the lines of force representing the electrical filed around a 4 C electron and a 1 C proton.



35. What is the magnitude of the electric force of attraction between two electrons separated by a distance of 7.20 x10 $^{-10}$ m?

$F_e \quad \frac{k_c q_1 q_2}{r^2} \quad F = \frac{\left(8.99 \times 10^9 \frac{N \cdot m^2}{C^2}\right)\left(1.60 \times 10^{-19} C\right)^2}{(7.20 \times 10^{-10} m)^2} = 4.44 \times 10^{-10} N$

36. How far apart are an electron and proton in an atom when the electric field is 5.20 x 10 ^{12} N/C?

$E = \frac{k_c q}{r^2} \qquad 5.20 \times 10^{12} N/C = \frac{\left(8.99 \times 10^9 \frac{N \cdot m^2}{C^2}\right)(1.60 \times 10^{-19} C)}{r^2}$

$r = 1.66 \times 10^{-11} m$

37. An electric field of 5.00 x 10^4 N/C is directed downward. If the electric force on a charge is 7.43 x 10 $^{-9}$ N, what is the charge?

$E = \frac{F}{q} \qquad 5.00 \times 10^4 N/C = \frac{7.43 \times 10^{-9} N}{q}$

$q = 1.49 \times 10^{-13} C$

Physics Equations Semester 2

$g = 9.81\ m/s^2$

$p = mv$

$F\Delta t = \Delta p = mv_f - mv_i$

$\Delta x = \frac{1}{2}(v_i + v_f)\,\Delta t$

$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$

$m_1v_{1i} + m_2v_{2i} = (m_1 + m_2)\,v_f$

$KE = \frac{1}{2}mv^2$

$a_c = v_t^2/r$

$F_c = mv_t^2/r$

$F_g = G(m_1m_2/r^2)$

$G = 6.673 \times 10^{-11}\ N \cdot m^2/kg^2$

$\tau = Fd\sin\Theta$

$MA = F_{out}/F_{in}$

$MA = d_{in}/d_{out}$

$ME = (W_{out}/W_{in}) \times 100\%$

$V_t = \sqrt{(G(m/r))}$

$T = 2\pi\sqrt{(r^3/Gm)}$

$T = 1/f$

$f = 1/T$

$v = \lambda f$

$F = -kx$

$T = 2\pi\sqrt{(L/g)}$

$T = 2\pi\sqrt{(m/k)}$

$v = \lambda f$

$I = P/(4\pi r^2)$

$f_n = n\,(v/4L)$

$f_n = n\,(v/2L)$

$c = 3.00 \times 10^8\ m/s$

$c = f\lambda$

$R = 2f$

$M = \frac{h'}{h} = \frac{-q}{p}$

$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$

$n_i \sin\theta_i = n_r \sin\theta r$

$\sin\theta_c = n_r/n_i$

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

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

$lines = 1/d$

$F_{electric} = k_C \frac{(q_1q_2)}{r^2}$

$k_C = 8.99 \times 10^9\ N \cdot m^2/C^2$

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

$q_p = +1.60 \times 10^{-19}\ C$

$E = F_{electric}/q_o$

$E = k_C \frac{q}{r^2}$