

HW #6 —Phy273—Fall 2000
Due before class, Friday, Oct. 13, 2000
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Read in RHK Chapter 19 (*Wave Motion*).

Questions (Q) and problems (P) in Chapter 19, RHK:

1. Q20 (*polarization of string waves*)
2. Q22 (*earthquake damage*)
3. P9 ($y = 6.0 \sin(0.020\pi x + 4.0\pi t)$)
4. P20 (*fastest transverse wave on steel wire*)—cf. section 14-5 (*Elasticity*)
5. P29 (*intensity and energy density*)
Part (b): What is the energy density at the earth in gravitational waves produced by the merger of two neutron stars 10^9 light years away? The neutron stars have a mass equal to 1.4 times the mass of the sun and a radius of about 20 kilometers, and are moving at around 10% of the speed of light when they collide. Assume the power output in gravitational waves is equal to 1% of the rest energy ($E = mc^2$) of the neutron stars, divided by the time it takes the stars to travel a distance equal to their own radius.
6. P33 (*interference of wave pulses*)
7. P40 (*guitar string*)
8. P51 (*standing waves with one fixed and one free end*)
9. P55 (*fundamental mode of a piano wire*)—cf. section 14-5 (*Elasticity*)
10. The wave equation for waves on a string is $\ddot{y} = v^2 y''$. (a) Confirm that $y(x, t) = f(x - vt) + g(x + vt)$ is a solution to this wave equation for any pair of functions f and g . (b) Actually, this is the form of the general solution. Find the expressions for the functions f and g in terms of the general initial conditions $y(x, 0)$ and $\dot{y}(x, 0)$.
11. Solve the wave equation written in the previous problem in the following way: Assume a function of the form $y(x, t) = \hat{A}e^{-i\omega t}e^{ikx}$, where \hat{A} is a complex constant, and find the relation between ω and k required for this to be a solution. Note that the real part of such a solution is a sinusoidal waves with wavenumber k and phase shift determined by the argument of \hat{A} .

Honors HW #6h

1. P24 (*waves on a rotating hoop of string*)
2. P37& 38 (*speed measurement of atmospheric (ionospheric?) layer using radio wave interference*)