K2.9   The thickness of lead needed to stop half of the neutrinos in a beam is about 3000 light years (which you may take as 3.0×10^{19} m). Calculate the fraction of neutrinos which would be stopped by 100 m of water assuming that the attenuation co-efficients for water and lead are about the same (which they're not).

Optional, but related, and useful:

K2.10   You start with a credit card debt of £150. For each month in which you don't pay it off, the debt increases by 3.0%. Assuming you pay nothing for 3.0 years, and then want to settle the debt in one go, how much would you have to pay?

K3   Black Body Radiation and Wien's Displacement Law $^7/_9$

K3.1   a) What intensity of radiation is emitted by a black body at 305 K?

            b) What thermal radiation power is emitted by a human, modelled as a black body of temperature 305 K and surface area 1.8 m^2?

K3.2   The temperature of a black body increases from 300 K to 800 K. By what factor does its thermal radiation power increase?

K3.3   An incandescent light bulb filament operates at a temperature of 3200 K. The total power of black-body radiation emitted from the filament is 5.0 W. What is the effective surface area of the filament?

K3.4   The Sun emits black-body radiation at its surface temperature of 5770 K. At what wavelength is the peak in the emission spectrum?

K3.5   A red dwarf star emits radiation in a black-body spectrum whose intensity peaks at 950 nm. What is the surface temperature of the star?

K3.6   Towards the end of its life, a main sequence star becomes a red giant. During this transition, its surface temperature changes from 5000 K to 3500 K and its radius increases from 650 000 km to 200 million km. By what factor does its power increase?

K3.7   Modern infrared temperature sensors must be able to identify whether a person has a fever. One way to do this might be to track changes in the wavelength λ_{max} at which their thermal radiation has a peak in intensity.

            a) What is the value of λ_{max} for a person without fever, whose forehead temperature is $35\,^{\circ}$C?

            b) By how much does λ_{max} change when a person develops a mild fever, and their forehead temperature rises to $37\,^{\circ}$C?