567.

Problem 41.42 (RHK)

We have to prove that for a plane wave at normal incidence on a plane surface the radiation pressure on the surface is equal to the energy density in the beam outside the surface; *and that this relation holds no matter what fraction of the incident energy is reflected*.

Solution:

Let the intensity of the incident plane wave be *I*. It is given that it falls on a plane surface at normal incidence. Let *f* be the fraction of the intensity of the incident radiation that is absorbed. The intensity of the reflected wave will therefore be $I(1-f)$. The energy density in the beam outside the plane surface will be the sum of energy density in the incident component of the plane wave, which is I/c , and the energy density in the reflected component of the wave, which is $I(1-f)/c$. Therefore, the energy density in the beam outside the plane surface will be $I(2-f)/c$.

We have calculated in problem **566.** Problem 41.41 (RHK) that the radiation pressure on an object that absorbs a fraction f of the incident radiation falling normally on it and reflects fraction $(1-f)$ is $I(2-f)/c$. Therefore, the total energy density outside the plane surface will be equal to the radiation pressure on the surface, irrespective of the fraction *f*.