144.

Problem 20.21 (RHK)

We have to find the energy density in a sound wave at a distance of 4.82 km *from a* 5.20-kW *nuclear emergency siren. We can assume the waves to be spherical and that propagation to be isotropic and without any absorption.*

Solution:

Power of the nuclear energy emergency siren is 5.20 kW. As the sound from the siren propagates as isotropic spherical waves without atmospheric absorption, the intensity of the sound waves at a distance of 4.82 km from the source will be

$$I = \frac{5.20\times10^{3}}{4\pi\left(4.82\times10^{3}\right)^{2}} \text{ J m}^{-2} \text{ s}^{-1},$$

$$= 1.78\times10^{-5} \text{ J m}^{-2} \text{ s}^{-1}.$$

The relation between energy density, u, speed of sound, v_s, and the intensity I is

$$I = uv_s \ .$$

Therefore,

$$u = \frac{I}{v_s} = \frac{1.78\times10^{-5}}{343}\ \text{J m}^{-3},$$
$$= 51.9\ \text{nJ m}^{-3}.$$