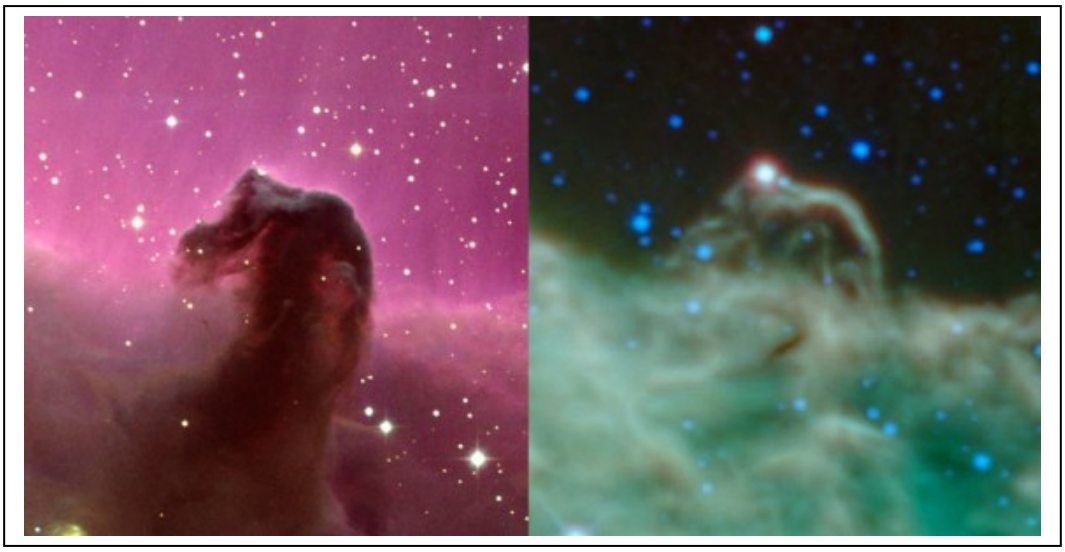

Although dust is normally dark and obscures light, because dust grains are warm, they also emit light. The picture above-left, shows an optical picture of the Horse Head Nebula in Orion, and you can see how the dust in the nebula hides background stars. On the right is an infrared image from NASA's WISE satellite that shows the dust grains glowing in infrared light even though they are only at a temperature of about 40 Kelvin. All of the dark areas have been replaced by light areas where infrared light is produced by the dust grains in the dark nebula.

Problem 1 – A typical dust grain has a diameter of about 1 micron (1.0×10^{-6} meters). The surface area of a sphere is just $4 \pi R^2$. What is the surface area of the dust grain in meters^2?

Problem 2 – A cold dust grain emits about 7.0×10^{-26} watts. If the Horsehead Nebula contains about 3.0×10^{56} dust grains. How many watts of light energy is the dark nebula emitting into space?

Problem 1 – A typical dust grain has a diameter of about 1 micron (1.0×10^{-6} meters). The surface area of a sphere is just $4 \pi R^2$. What is the surface area of the dust grain in meters^2?

Answer: $A = 4 \times 3.141 \times (1.0 \times 10^{-6})^2 =$ **1.3×10^{-11} meters^2**.

Problem 2 – A cold dust grain emits about 7.0×10^{-26} watts. If the Horsehead Nebula contains about 3.0×10^{56} dust grains. How many watts of light energy is the dark nebula emitting into space?

Answer: $L = 7.0 \times 10^{-26}$ watts/grain $\times 3.0 \times 10^{56}$ grains = **2.1×10^{31} watts**

By comparison, our sun emits $L = 3.8 \times 10^{26}$ watts, so the dust in this nebula emits 55,000 times as much infrared light as our sun emits across the entire electromagnetic spectrum!