25 Luminosity and flux – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
luminosity	光度			
radiant flux intensity	辐射通量密度			
inverse-square law	平方反比定律			

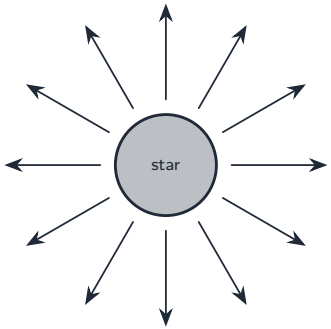
Recall

A star pours out energy in all directions. How bright it *looks* depends on how far away it is.

New ideas

Read these first. Each idea has a short worked example. Then do the Practice.

1 Luminosity

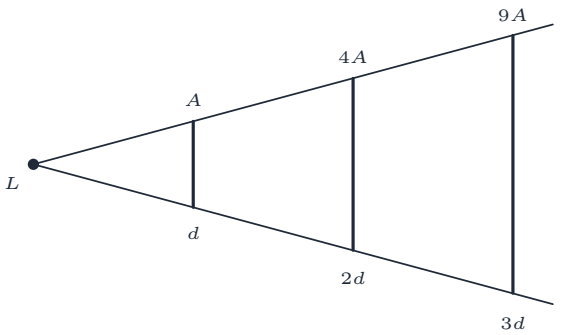


luminosity L = total power radiated

The **luminosity** 光度 L of a star is the total power it radiates, in watts — the energy given out per second in all directions.

Worked example. The Sun's luminosity is about 3.8×10^{26} W. That is its *own* output — it does not depend on how far away we sit from it.

2 Flux falls with distance



At distance d the power has spread over a sphere of area $4\pi d^2$, so the **radiant flux intensity** 辐射通量密度 $F = L/(4\pi d^2)$. This is the **inverse-square law** 平方反比定律: double the distance, quarter the flux.

Worked example. A star of luminosity $L = 4.0 \times 10^{26}$ W is at distance $d = 2.0 \times 10^{11}$ m.

The flux is $F = \dfrac{L}{4\pi d^2} = \dfrac{4.0 \times 10^{26}}{4\pi(2.0 \times 10^{11})^2} \approx 8 \times 10^{2}$ W m^{-2}.

Watch out: luminosity is the star's *own* power (the same wherever you are); flux is what *you* receive (it falls with distance). A star can be very luminous yet look faint because it is far away.

Practice

Try these in order.

25.1 What is the *luminosity* of a star? [1]

25.2 What is the unit of luminosity? [1]

25.3 Write the formula for *radiant flux intensity*. [1]

25.4 If the distance doubles, what happens to the flux? [1]

25.5 What is this relationship called? [1]

25.6 Star A and star B have the same luminosity, but B is three times further away. Compare the flux we receive from each. Explain. [2]

25.7 Challenge. Two stars look equally bright in our sky, but one is much further away. Explain which star is actually more luminous, and why. [2]