

## 24.1 Stars, radiation and scale

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 10 marks

KEY WORDS flux • luminosity

### Objective

Stars, radiation and scale. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

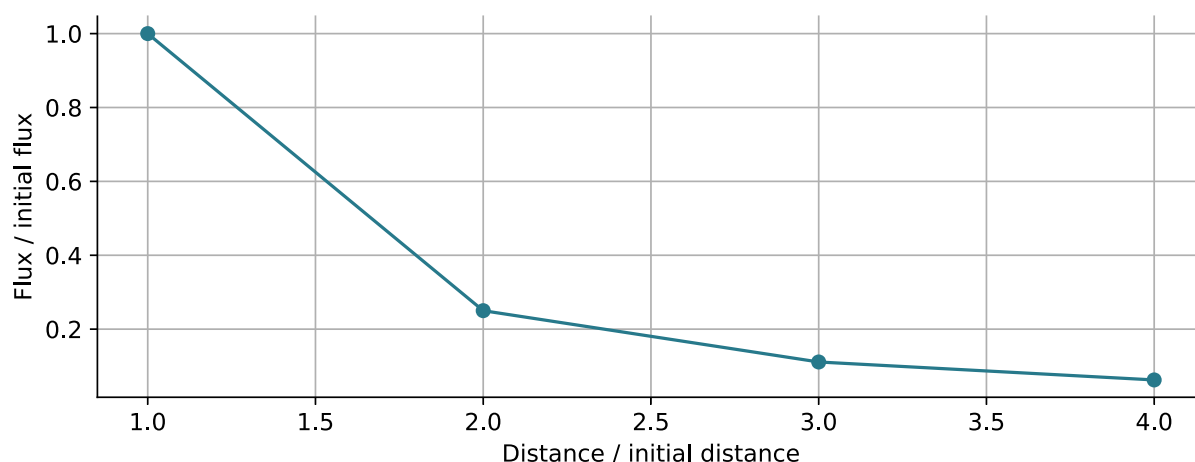
### 1 Key knowledge and worked examples

#### ■ What would explain this observation?

- Two stars can have the same apparent brightness while having different luminosities. Distance changes the **flux** reaching an observer.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

#### ■ Build the model

- **Luminosity** is total power emitted; flux is power received per area. A stellar spectrum carries information about surface temperature and composition. Fusion transfers energy as light nuclei combine.
- luminosity: Total emitted power; flux: Power received per unit area.



### ■ Choose evidence that can test it

- For isotropic emission without absorption, flux follows an inverse-square relationship with distance. Observed brightness alone therefore cannot establish luminosity.
  - Keep distance units consistent, identify which quantities are intrinsic to the star, and distinguish observational evidence from a model of stellar evolution. Do not confuse a red giant stage with every possible final remnant.
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### ■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: distance doubles while luminosity remains fixed. Use  $F$  proportional to  $1/d^2$ . Flux ratio =  $1/2^2 = 1/4$ . A flux of 12 units becomes 3 units. This assumes no change in absorption or source output.

#### Example:

A source gives flux 18 units. Find flux at three times the distance. Use the same sequence: known quantities  $\rightarrow$  model  $\rightarrow$  relation  $\rightarrow$  substitution  $\rightarrow$  unit and interpretation.

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### ■ Check the conclusion and its limits

- The Sun is not expected to become a supernova. Redshift can support cosmological expansion; it does not mean every nearby object must move away from every observer.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

#### Warn:

Apparent brightness alone always determines a star luminosity. This claim is false: The Sun is not expected to become a supernova. Redshift can support cosmological expansion; it does not mean every nearby object must move away from every observer.

#### Key:

Stars, radiation and scale: For isotropic emission without absorption, flux follows an inverse-square relationship with distance. Observed brightness alone therefore cannot establish luminosity.

## 2 Practice

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**2.1** At fixed luminosity, what happens to flux when distance doubles? Choose one answer.

- **A** It halves
- **B** It becomes one quarter
- **C** It doubles

[1]

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**2.2** A source gives flux 18 units. Find flux at three times the distance. Show the relation, substitution and units. [2]

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**2.3** Decide whether this claim is true and justify: Apparent brightness alone always determines a star luminosity. [2]

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**2.4** Total emitted power: write the technical term. [1]

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### 3 Exam-style questions

**3.1** Identical sources have fluxes 8 and 2 units. Find their distance ratio. What ambiguity arises if luminosity is not known? [4]

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