Starlight Clues

Use spectral patterns to investigate two stars.

ESS.2.c "Analyze spectroscopic data to determine the properties and motion of objects in space."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Circle the hydrogen wavelengths in the table, then underline the rules in the passage that help you use those numbers to determine each star's motion and compare their temperatures.

What Starlight Reveals

1. A spectrograph spreads starlight into a spectrum. Dark lines appear where atoms absorb particular wavelengths. Each element makes a distinctive pattern of lines. Laboratory measurements provide reference wavelengths for hydrogen. A star can contain hydrogen even if its lines shift away from those values. Compare a pair of lines, not just one, to identify an element.

2. Motion changes a line's observed wavelength through the Doppler effect. If both lines shift toward shorter wavelengths, their source is moving toward the observer. Longer wavelengths indicate motion away. Compare each star's two lines with the laboratory pair in the table. Check that both lines shift in the same direction before drawing a conclusion.

SPECTRA FROM TWO STARS

Source	Hydrogen line 1 (nm)	Hydrogen line 2 (nm)	Continuum comparison
Lab reference	486.1	656.3	Not measured
Star A	485.6	655.6	Blue brighter than red
Star B	487.1	657.6	Red brighter than blue

3. A spectrum also gives clues about temperature. For two stars viewed through similar amounts of dust, the one with a stronger blue continuum relative to its red continuum generally has the hotter visible surface. The continuum is the broad band of light beneath the absorption lines. Different amounts of dust can make this color comparison unreliable.

2 ANSWER WITH EVIDENCE

Use the passage

1. Is Star A moving toward or away from the observer? Use both hydrogen lines as evidence.

2. Is Star B moving toward or away from the observer? Use both hydrogen lines as evidence.

3. Which star likely has the hotter visible surface? Explain what you must assume for this comparison to be reliable.

4. Which star has the greater line-of-sight speed? Compare the shifts of corresponding hydrogen lines.

3 YOUR TURN

Your own words

Invent two plausible hydrogen-line wavelengths for Star C that show it moving away more slowly than Star B. Give Star C a blue-versus-red continuum pattern, then explain its motion and compare its likely temperature with one listed star, assuming similar amounts of dust.

ANSWER KEY

Starlight Clues

PART 1 · READ AND MARK

Circle the hydrogen wavelengths in the table, then underline the rules in the passage that help you use those numbers to determine each star's motion and compare their temperatures. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Is Star A moving toward or away from the observer? Use both hydrogen lines as evidence.	**Star A is moving toward the observer. Both lines have shorter wavelengths than their lab references: 485.6 versus 486.1 nm and 655.6 versus 656.3 nm.**
2	Is Star B moving toward or away from the observer? Use both hydrogen lines as evidence.	**Star B is moving away. Both lines have longer wavelengths than their lab references: 487.1 versus 486.1 nm and 657.6 versus 656.3 nm.**
3	Which star likely has the hotter visible surface? Explain what you must assume for this comparison to be reliable.	**Star A likely has the hotter visible surface because its blue continuum is brighter relative to its red continuum. The stars must be viewed through similar amounts of dust.**
4	Which star has the greater line-of-sight speed? Compare the shifts of corresponding hydrogen lines.	**Star B. Its lines shift by 1.0 and 1.3 nm, compared with Star A's shifts of 0.5 and 0.7 nm.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Star C has hydrogen lines at 486.6 nm and 657.0 nm. Both are longer than the lab values but shift less than Star B's lines, so Star C is moving away more slowly. Its red continuum is brighter than its blue continuum, suggesting a cooler visible surface than Star A's if both stars are viewed through similar amounts of dust.

Accept other invented wavelength pairs if both exceed the lab values and both shifts are smaller than Star B's corresponding shifts. Temperature comparisons must follow the chosen continuum pattern and acknowledge the dust assumption.