In the context of the Doppler Effect as it applies to light waves in astronomy, which of the following observations would indicate that a star is moving **towards** Earth?

(a) The star's absorption lines are shifted towards longer wavelengths, resulting in a redshift.

(b) The star's absorption lines remain at the same wavelengths as those measured in a laboratory on Earth.

(c) The star's absorption lines are shifted towards shorter wavelengths, resulting in a blueshift.

(d) The star's overall brightness decreases due to light scattering by interstellar dust.

(e) The star appears to move in a retrograde motion against the background stars.

**Answer: (c) The star's absorption lines are shifted towards shorter wavelengths, resulting in a blueshift.**

**Option (a):** *The star's absorption lines are shifted towards longer wavelengths, resulting in a redshift.*

* **Incorrect.** A redshift occurs when the wavelengths of light are stretched to longer wavelengths, which happens when an object is moving **away** from the observer. Therefore, a redshift indicates recession, not approach.

**Option (b):** *The star's absorption lines remain at the same wavelengths as those measured in a laboratory on Earth.*

* **Incorrect.** If the absorption lines appear at the same wavelengths as measured on Earth, it suggests that there is **no relative motion** along the line of sight between the star and Earth. Therefore, it does not indicate that the star is moving towards us.

**Option (c):** *The star's absorption lines are shifted towards shorter wavelengths, resulting in a blueshift.*

* **Correct.** A blueshift occurs when the wavelengths of light are compressed to shorter wavelengths. This happens when an object is moving **towards** the observer. Therefore, observing a blueshift in the star's absorption lines indicates that the star is moving towards Earth.

**Option (d):** *The star's overall brightness decreases due to light scattering by interstellar dust.*

* **Incorrect.** While interstellar dust can dim the light of a star (a phenomenon known as interstellar extinction), it affects the star's brightness, not the wavelengths of its spectral lines. This does not provide information about the star's motion towards or away from Earth.

**Option (e):** *The star appears to move in a retrograde motion against the background stars.*

* **Incorrect.** Retrograde motion refers to the apparent backward motion of a planet against the background stars due to the relative positions and motions of Earth and the planet in their orbits. This concept applies to the apparent motion of planets in the sky, not to the Doppler Effect or the actual motion of stars towards or away from Earth.

**Conclusion: Option (c)** correctly identifies that when a star's absorption lines are shifted towards shorter wavelengths—a blueshift—it indicates that the star is moving towards Earth. This is a manifestation of the Doppler Effect as it applies to light waves, where the motion of a light source towards an observer compresses the light waves, leading to a shift towards the blue end of the spectrum.