25. Astronomy and cosmology

Starter Quiz · 课前小测

A-Level Physics Name: _____ Score: _____

1. The luminosity of a star is:

   ☐ the total power it radiates

   ☐ its surface temperature

   ☐ its distance from Earth

   ☐ its mass

2. Hotter stars have their spectral peak (Wien's law) at a _____ wavelength.

   _____

3. Redshift means a galaxy's spectral lines are shifted to:

   ☐ longer wavelengths (it is moving away)

   ☐ shorter wavelengths (it is approaching)

   ☐ no change at all

   ☐ a higher temperature

4. Why might one star appear brighter than another? Select **all** that apply.

   ☐ it has a greater luminosity

   ☐ it is closer to us

   ☐ it is a bluer colour

   ☐ it is larger in radius

   Tick every correct option.

5. Which belong in a statement of Wien's displacement law? Select **all** that apply.

   ☐ the wavelength at which the intensity is a maximum

   ☐ is inversely proportional to the thermodynamic temperature

   ☐ the temperature is in kelvin

   ☐ it describes the positions of the spectral lines

   Tick every correct option.

6. In $\Delta\lambda/\lambda \approx v/c$, the λ on the bottom is the observed wavelength.

   ☐ True ☐ False

7. The flux received from a star falls as 1 over the distance _____.

_____

8. A star's spectrum peaks at $\lambda_{\max} = 500$ nm. What is its surface temperature? ($b = 2.9 \times 10^{-3}$ m·K)

   _____ K

9. A galaxy's lines show $\dfrac{\Delta\lambda}{\lambda} = 0.020$. What is its recession speed, as a fraction of c?

   _____

10. Doubling the distance to a star reduces the radiant flux intensity to one half.

    ☐ True ☐ False

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Answers · 答案

A-Level Physics

1. **the total power it radiates**

   Luminosity L is the energy radiated per second in all directions (watts).

2. **shorter**

   $\lambda_{\max} T = b$, so a higher T means a smaller $\lambda_{\max}$ — toward the blue.

3. **longer wavelengths (it is moving away)**

   A receding source stretches the wavelengths — a redshift, with $\dfrac{\Delta\lambda}{\lambda} \approx \dfrac{v}{c}$.

4. **it has a greater luminosity; it is closer to us**

   Colour and size only matter through the luminosity they produce. The two marked reasons are greater luminosity and smaller distance.

5. **the wavelength at which the intensity is a maximum; is inversely proportional to the thermodynamic temperature; the temperature is in kelvin**

   It is about the peak of the continuous black-body curve, not the lines. Saying only the wavelength loses the mark; say the wavelength of maximum intensity.

6. **False**

   It is the EMITTED, laboratory wavelength. At small v/c the difference is slight, but the mark scheme is specific about it.

7. **squared**

   $F = \dfrac{L}{4\pi d^2}$ — the inverse-square law.

8. **5800 K**

   $T = \dfrac{b}{\lambda_{\max}} = \dfrac{2.9 \times 10^{-3}}{500 \times 10^{-9}} \approx 5800$ K — about the Sun.

9. **0.02**

   For $v \ll c$, $\dfrac{v}{c} = \dfrac{\Delta\lambda}{\lambda} = 0.020$.

10. **False**

    To one QUARTER. The power spreads over a sphere of area 4 pi d^2, so flux goes as 1/d^2. Using pi d^2 instead is out by a factor of four.