# 2019 Ph H2 Q10

Section: Particles and Waves

Topic: Diffraction Gratings and Wavelength

(a) Three lasers (red, green, blue) pass through a diffraction grating, slit separation d = $3.3\times10^{-6}$ m. Which colour has the smallest angle θ to the first order maximum? Justify. (b) For one laser, θ = 8.9°. (i) Calculate λ. (ii) Determine colour. (iii) Explain why using a grating with larger slit separation ($5.0\times10^{-6}$ m) does not give more accurate λ.

**Worked solution**

(a) Diffraction grating equation: d sinθ = mλ (m=1).
So θ ∝ λ. The smallest λ gives the smallest angle.
• Blue has the shortest λ (~450 nm), so it gives the smallest θ.

Answer: Blue

(b)(i) Using d sinθ = λ:
λ = d sinθ = $(3.3\times10^{-6})$(sin 8.9°).
= 5.11e-07 m = 511 nm.

Answer: 511 nm

(b)(ii) {lam_nm:.0f} nm is in the {colour} region of the spectrum.

Answer: yellow-green

(b)(iii) Accuracy improves if maxima are further apart (larger θ).
From $d \sin\theta = m\lambda$, increasing d makes sinθ smaller, so angles are reduced. This gives less separation between fringes and less accurate measurement.

Answer: Incorrect suggestion — larger d decreases angular separation, not increases it.

**Final answers**

**(a) Blue laser → smallest θ**

**(b)(i) λ ≈ 511 nm**

**(b)(ii) yellow-green**

**(b)(iii) Larger d → less separation → less accuracy**

**Revision tips**

- Grating formula: $d \sin\theta = m\lambda$.
- Smaller λ → smaller θ.
- Convert λ to nm to compare with visible spectrum.
- For more accuracy, want maxima further apart (larger θ).
- Larger d gives smaller θ → reduces accuracy.