Interference + Diffraction Grating

1. D 2. A 3. D 4. D 5. E 6. B 7. D 8. C

9. $n\lambda = d\sin\theta \quad \therefore \sin\theta = \frac{n\lambda}{d} = \frac{2 \times 486 \times 10^{-9}}{2.16 \times 10^{-6}}$

$\therefore \sin\theta = 0.45 \quad \theta = \underline{26.7^\circ}$

10. $\lambda = \frac{d\sin\theta}{n} = \frac{5.0 \times 10^{-6} \times \sin 11}{2} = \underline{477\text{nm}} \ (4.77 \times 10^{-7}\text{m})$

11. a) i) maxima: constructive interference
minima: destructive interference

ii) $3\lambda = 766 - 682 = 84 \quad \therefore \lambda = \underline{28\text{mm}}$

12. i) bright fringe: constructive interference

ii) $\sin\theta = \frac{n\lambda}{d} = \frac{2 \times 650 \times 10^{-9}}{3.3 \times 10^{-6}}$

$\underline{\theta = 23^\circ}$

300 lines per mm
= 300,000 lines per metre
$\therefore d = \frac{1}{300{,}000}$
$d = \underline{3.33 \times 10^{-6}\text{m}}$

iii) Blue light has a shorter wavelength
$\therefore$ pattern of bright fringes will be closer together (since $n\lambda = d\sin\theta$
If λ decreases, θ must decrease!)

13) a) $n\lambda = d\sin\theta$ → $\theta = \frac{37}{2} = 18.5°$ between central max and 1st maximum

$\therefore d = \frac{n\lambda}{\sin\theta} =$

$= \frac{633\times10^{-9}}{\sin 18.5}$

$= 2\times10^{-6}$ m

$\therefore$ number of lines per metre

$= \frac{1}{2\times10^{-6}} = 500,000$

$\therefore$ 500 lines per mm.

b) Wavelength must be shorter

since $n\lambda = d\sin\theta$; if θ is reduced, λ is smaller

14) $\sin\theta = \frac{n\lambda}{d} = \frac{2\times635\times10^{-9}}{5\times10^{-6}} = 0.254$

$\therefore \theta = 14.7°$

15) a) minimum: crest meets trough
destructive interference occurs

b) blue light has a shorter λ $\therefore$ since $n\lambda = d\sin\theta$

If λ is reduced then θ is reduced.

$\therefore$ bright regions are closes together.