# 8. Superposition

## 8.4 The diffraction grating

## Paper 2

Marking Scheme

## Q1.

| | | |
|---|---|---|
| (a) | $n\lambda = d\sin\theta$ | **C1** |
| | $n = (3.8 \times 10^{-6} \times \sin 90°) / (520 \times 10^{-9})$<br>$( = 7.3)$ | **C1** |
| | number of bright fringes formed = 15 (given as an integer) | **A1** |
| (b)(ii) | (red light has) longer wavelength | **M1** |
| | (so) number (of bright fringes formed) is less / fewer (bright fringes are formed) | **A1** |

## Q2.

| | | |
|---|---|---|
| (c)(i) | $n\lambda = d\sin\theta$ | **C1** |
| | $d = (3 \times 4.3 \times 10^{-7}) / \sin 68°$<br>$= 1.4 \times 10^{-6}$ m | **A1** |
| (c)(ii) | $1.4 \times 10^{-6} \times \sin 68° = 2 \times \lambda$<br>**or**<br>$3 \times 4.3 \times 10^{-7} = 2 \times \lambda$ | **C1** |
| | $\lambda = 6.5 \times 10^{-7}$ m | **A1** |

## Q3.

| | | |
|---|---|---|
| (d)(i) | $n\lambda = d\sin\theta$ | **C1** |
| | $G = \sin\theta / \lambda$<br>$d = 4 / G$ | **A1** |
| (d)(ii) | straight line from 400 nm to 700 nm that is always below printed line | **M1** |
| | straight line has smaller gradient than printed line and is 5 small squares high at wavelength of 700 nm | **A1** |

## Q4.

| | | |
|---|---|---|
| (c)(ii) | $n\lambda = d\sin\theta$ | **C1** |
| | $3\lambda = d \sin 90°$ **or** $3\lambda = d$ | **C1** |
| | $d = 3 \times 630 \times 10^{-9}$<br>$= 1.9 \times 10^{-6}$ m | **A1** |
| (c)(iii) | wavelength of blue light is shorter (than 540 nm/630 nm/wavelengths of original light) | **M1** |
| | (so) third order diffraction maximum is produced | **A1** |

## Q5.

| | | |
|---|---|---|
| (b)(i) | $n\lambda = d\sin\theta$ | **B1** |
| | $d\sin\theta$ is the same **and** $3\lambda_1 = 4\lambda_2$ so $\lambda_2 / \lambda_1 = 0.75$ | **A1** |
| (b)(ii) | $\lambda_2 / \lambda_1 = 0.75$ and $\lambda_1 - \lambda_2 = 170$<br>$\lambda_1 = 680$ nm | **A1** |

**Q6.**

| | | |
|---|---|---|
| (a) | $n\lambda = d\sin\theta$ | **C1** |
| | $\lambda = 640 \times 10^{-9}$ (m) | **C1** |
| | $2 \times 640 \times 10^{-9} = 1.7 \times 10^{-6} \times \sin\theta$ so $\theta = 49(°)$ | **A1** |
| (b) | $2 \times 640 \times 10^{-9} = 3 \times \lambda$<br>**or**<br>$1.7 \times 10^{-6} \times \sin 49° = 3 \times \lambda$ | **C1** |
| | $\lambda = 4.3 \times 10^{-7}$ m | **A1** |