1. (a) (i) (since $d \sin \theta = n\lambda$) $d \sin 18.5^\circ = 632.8 \times 10^{-9}$ **(1)**

$d = 1.99 \times 10^{-6}$ **(1)**

number of lines per metre = $\frac{1}{d} = 5.01 \times 10^{5}$ **(1)**

(ii) $n\lambda = 1.99 \times 10^{-6} \sin 90^\circ$ **(1)**

$n = -\frac{1.99}{0.6328} = 3.1(5)$ **(1)**

hence highest order is third **(1)** 6

(b) $\lambda_{new} = \frac{632.8 \times 10^{-9} \times \sin 17.2^\circ}{\sin 18.5^\circ}$ $\left[\text{or } 1.994 \times 10^{-6} \times \sin 17.2^\circ\right]$ **(1)**

= 590nm **(1)** 2

[8]

2. (a) (i) displacement is distance of particle **(1)**

from mean [or equilibrium] position **(1)**

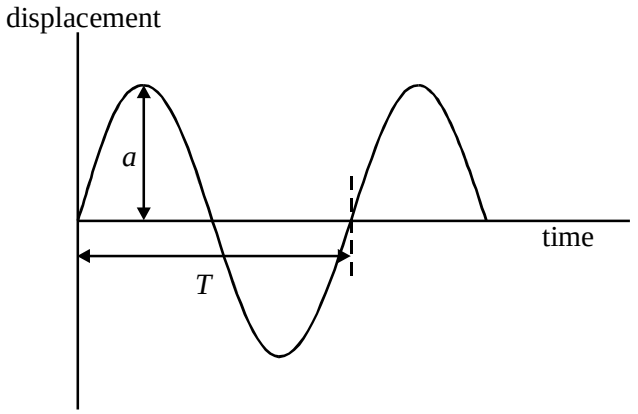
in direction of wave (energy) **(1)**

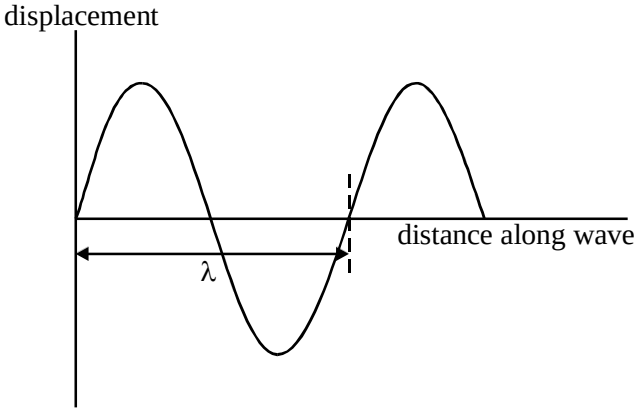
amplitude is maximum displacement **(1)**

wavelength is shortest distance **(1)**

between two points in phase **(1)** max 4

(b)





any two points $\frac{\lambda}{4}$ apart **(1)** 4

[8]

3. (a) (i) superposition **(1)**
between waves in phase **(1)**
gives constructive interference **(1)**

(ii) at D or E waves out of phase **(1)**
so destructive interference **(1)** max 4

(b) (i) $\lambda = \frac{330}{2\times10^3}$ = 0.165m **(1)**

separation between maxima = $\frac{\lambda D}{s}$ **(1)**

$\left(=\frac{0.165\times5}{0.75}\right)$ = 1.10(m) **(1)**

distance CE (= $\frac{1}{2}$ × separation)= 0.55 m **(1)** 4

[8]

4. (a)

	x/m	sin θ
1	0.173	0.086
2	0.316	0.156
3	0.499	0.242
4	0.687	0.325
5	0.860	0.395

If angles only calculated 1/2

at least 4 points plotted correctly **(1)**
best straight line **(1)**
gradient calculated from suitable triangle, 50% of each axis **(1)**
correct value from readings **(1)**
appropriate use of $d \sin\theta = n\lambda$ **(1)**
hence N (rulings per metre) = 1.25×10^5 m^{-1} (1.1 to 1.4 ok) **(1)**
max 2/6 if no graph and more than one data set used correctly,
1/6 only one set
if tan calc but plotted as sin, mark as scheme
tan or distance plotted, 0/6 max 6

(b) (i) maxima wider spaced [or pattern brighter] **(1)**
sin θ or θ increases with N [or light more concentrated] **(1)**

(ii) maxima spacing less **(1)**
sin θ or θ decreases with λ [or statement] **(1)**

(iii) maxima wider spaced [or pattern less bright] **(1)**
same θ but larger D [or light more spread out] **(1)** 6

[12]