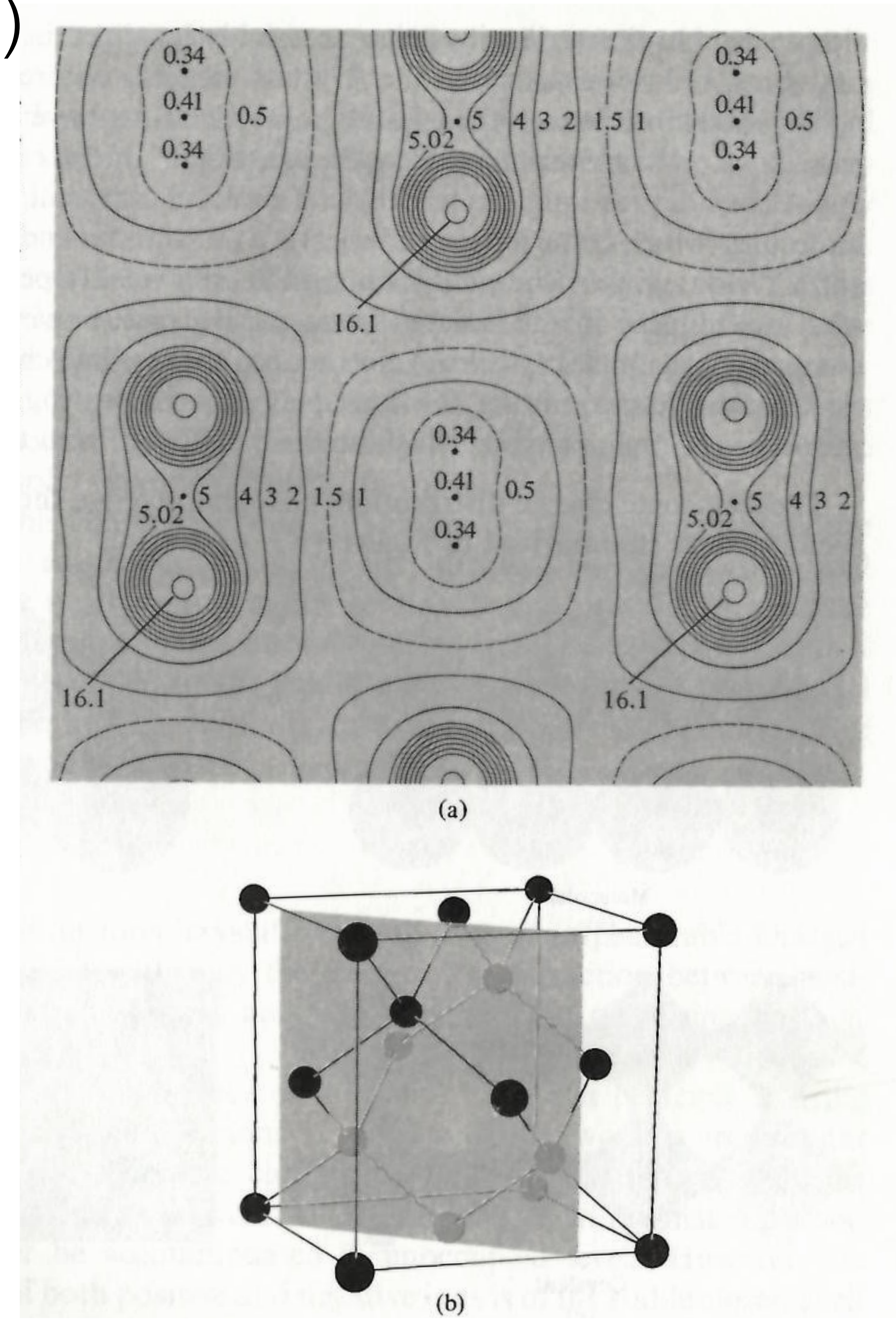
a)



Which charge density represents Covalent bonding?

b)

Question #1

What is the condition for constructive interference?

a) $2d\cos\theta = n\lambda$

b) $2d\sin\theta = n\lambda$

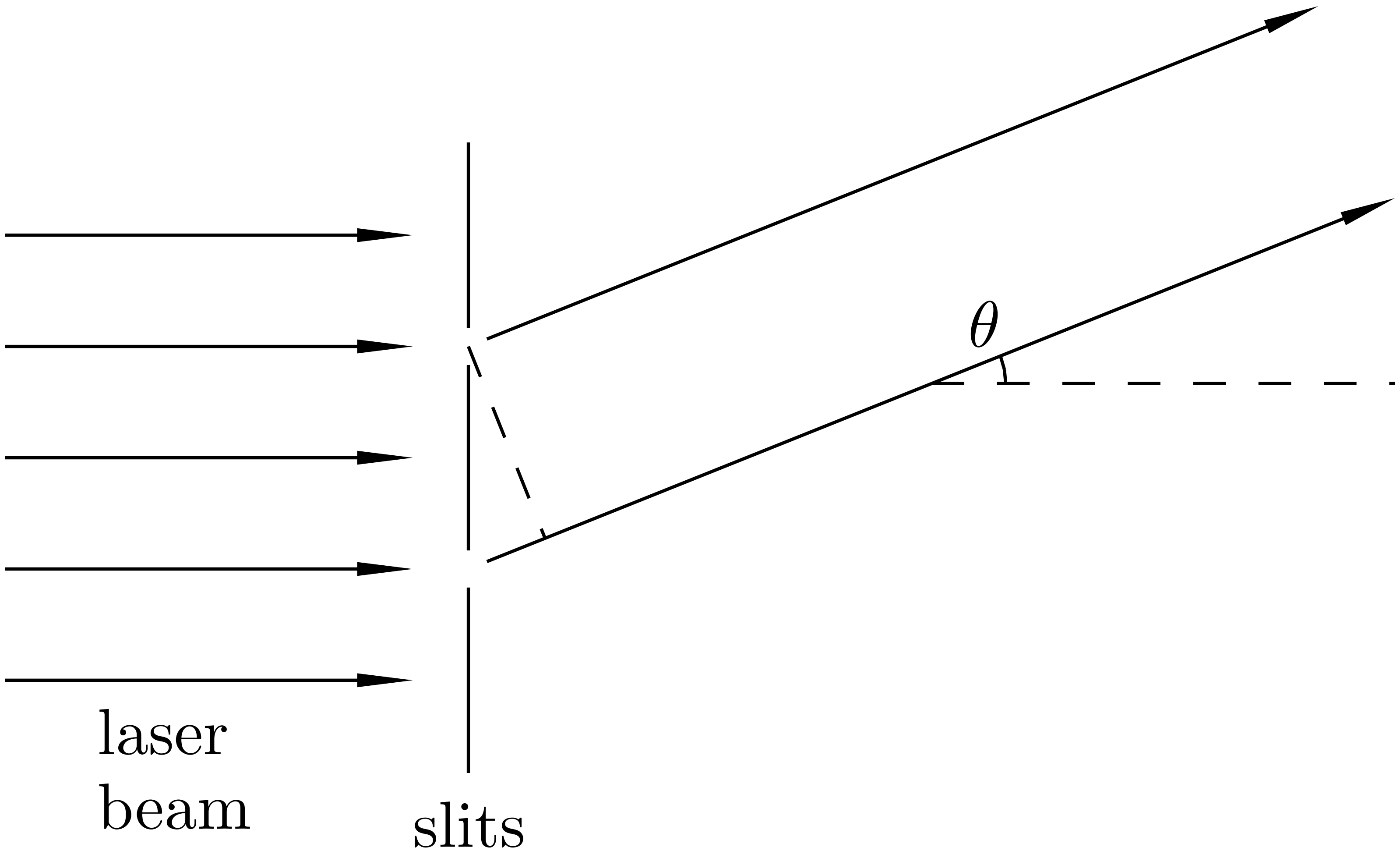
c) $\frac{d}{2}\sin\theta = n\lambda$

d) $d\cos\theta = n\lambda$

e) $d\sin\theta = n\lambda$

Question #1

What is the condition for constructive interference?



a) $2d\cos\theta = n\lambda$

b) $2d\sin\theta = n\lambda$

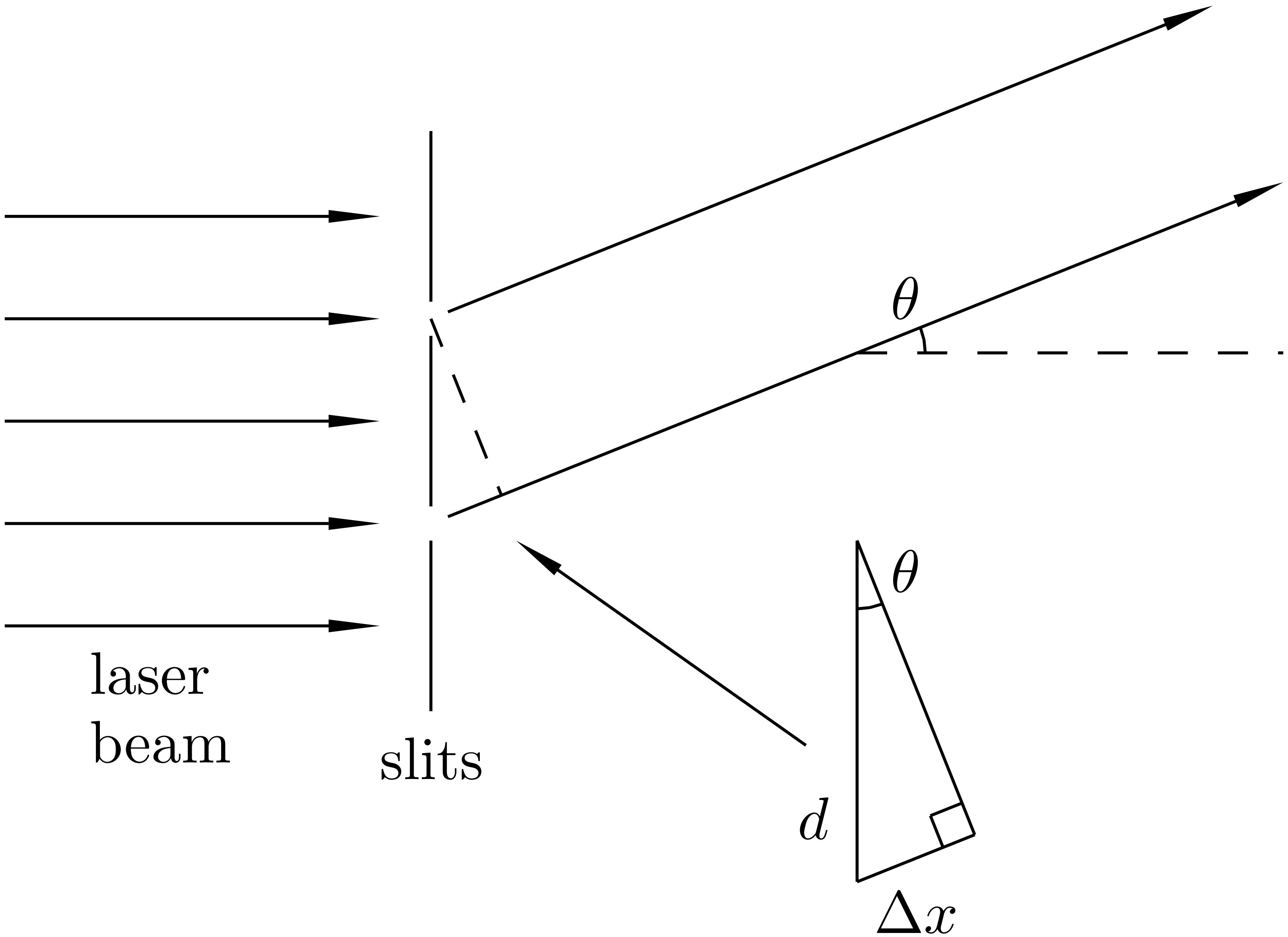
c) $\dfrac{d}{2}\sin\theta = n\lambda$

d) $d\cos\theta = n\lambda$

e) $d\sin\theta = n\lambda$

Question #1

What is the condition for constructive interference?



a) $2d\cos\theta = n\lambda$

b) $2d\sin\theta = n\lambda$

c) $\dfrac{d}{2}\sin\theta = n\lambda$

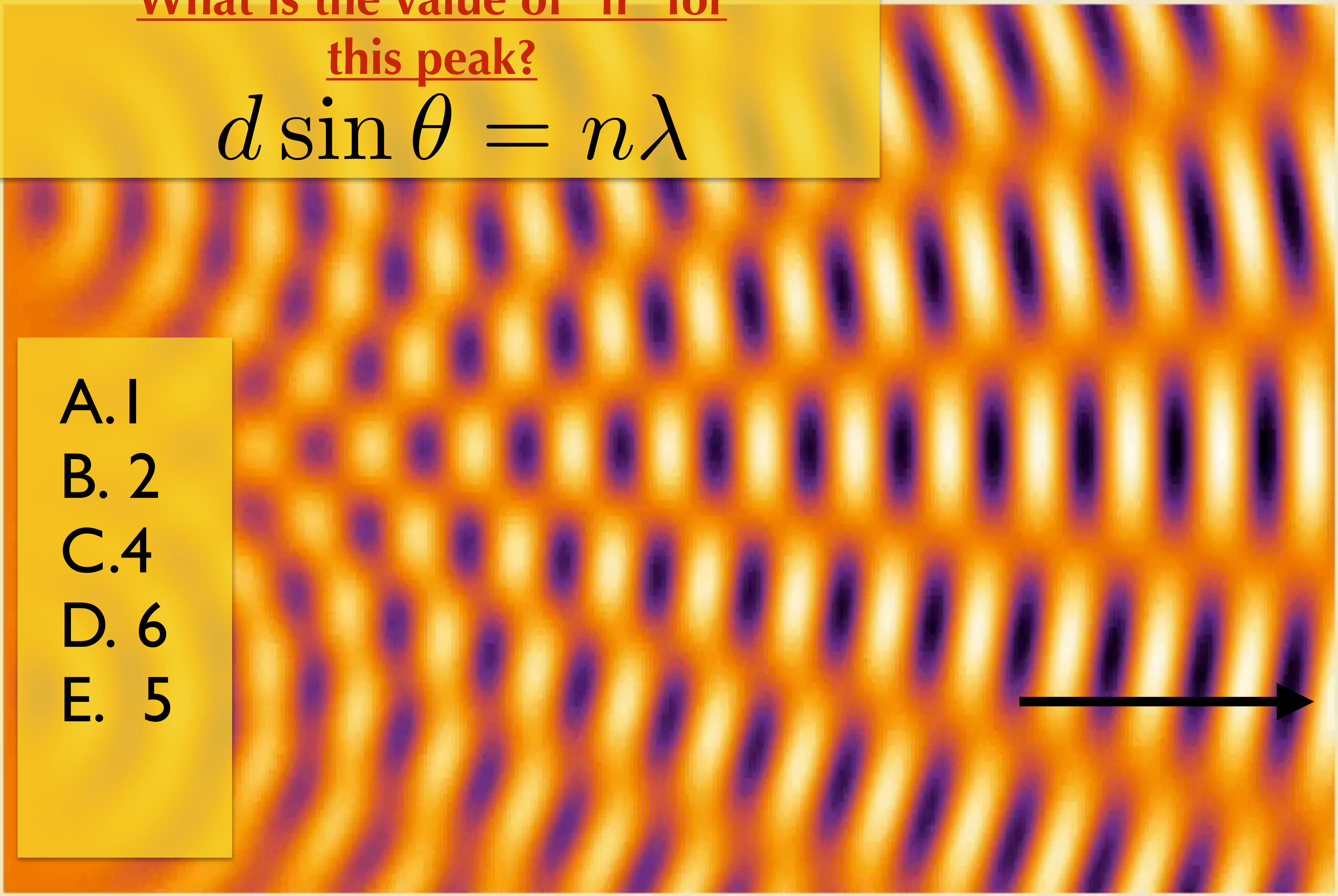
d) $d\cos\theta = n\lambda$

e) $d\sin\theta = n\lambda$

Question #2

What is the value of "n" for this peak?

$$d \sin\theta = n\lambda$$

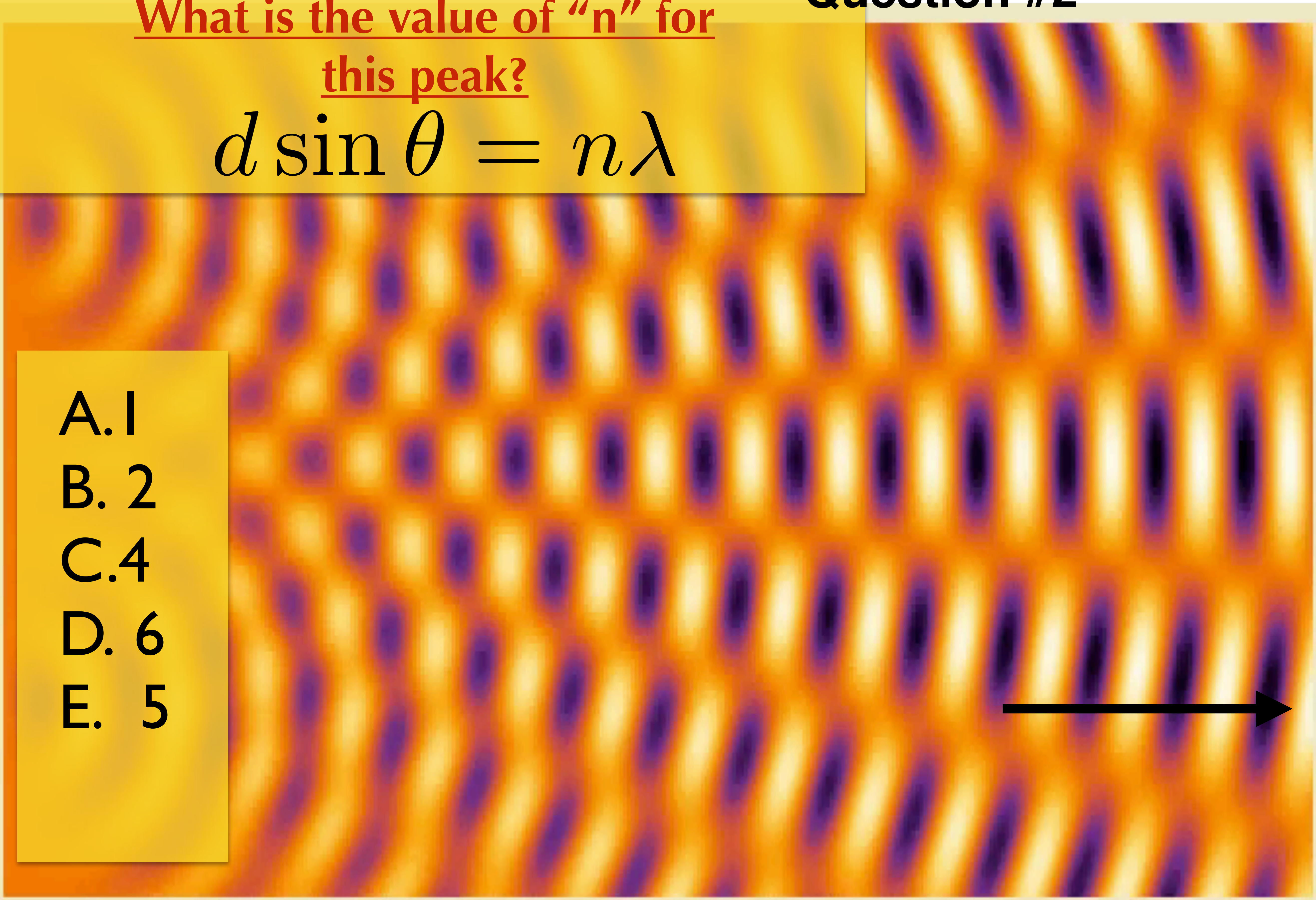


A. 1
B. 2
C. 4
D. 6
E. 5

Question #2

What is the value of "n" for this peak?

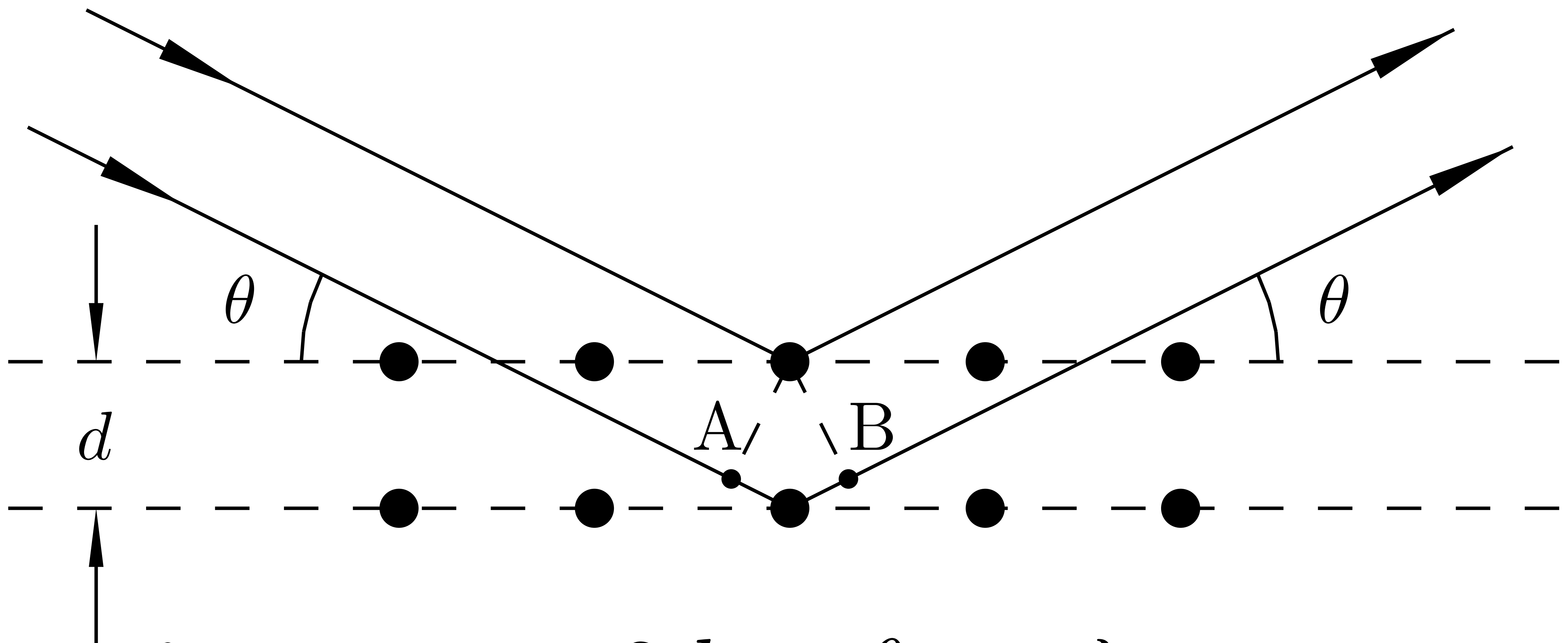
$$d \sin\theta = n\lambda$$



A. 1
B. 2
C. 4
D. 6
E. 5

Question #3

What is the condition for constructive interference between these two light rays?



A $d \sin\theta = n\lambda$

B $\dfrac{d}{2} \sin\theta = n\lambda$

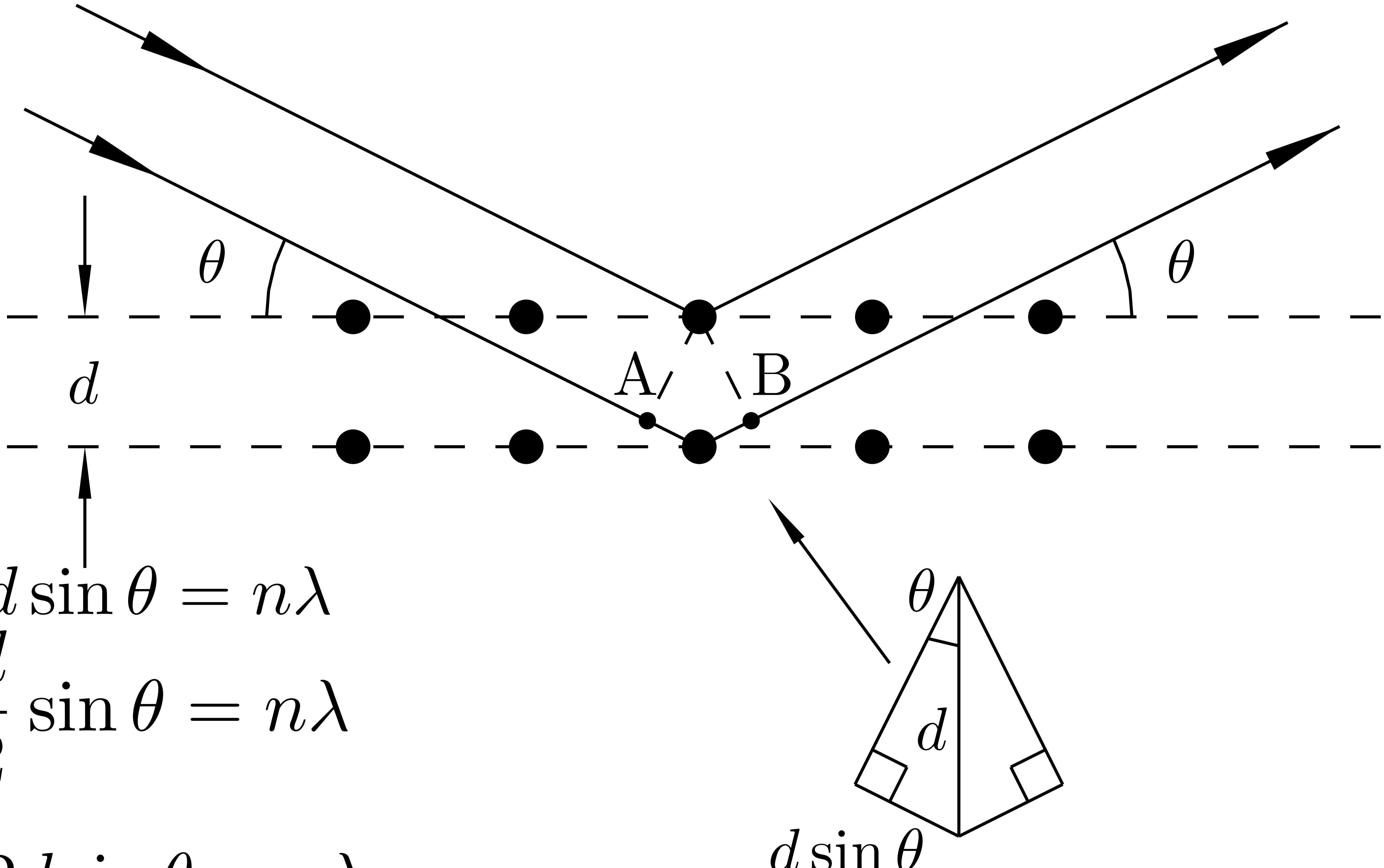
C $2d \sin\theta = n\lambda$

D $2d \cos\theta = n\lambda$

E $d \cos\theta = n\lambda$

Question #3

What is the condition for constructive interference between these two light rays?



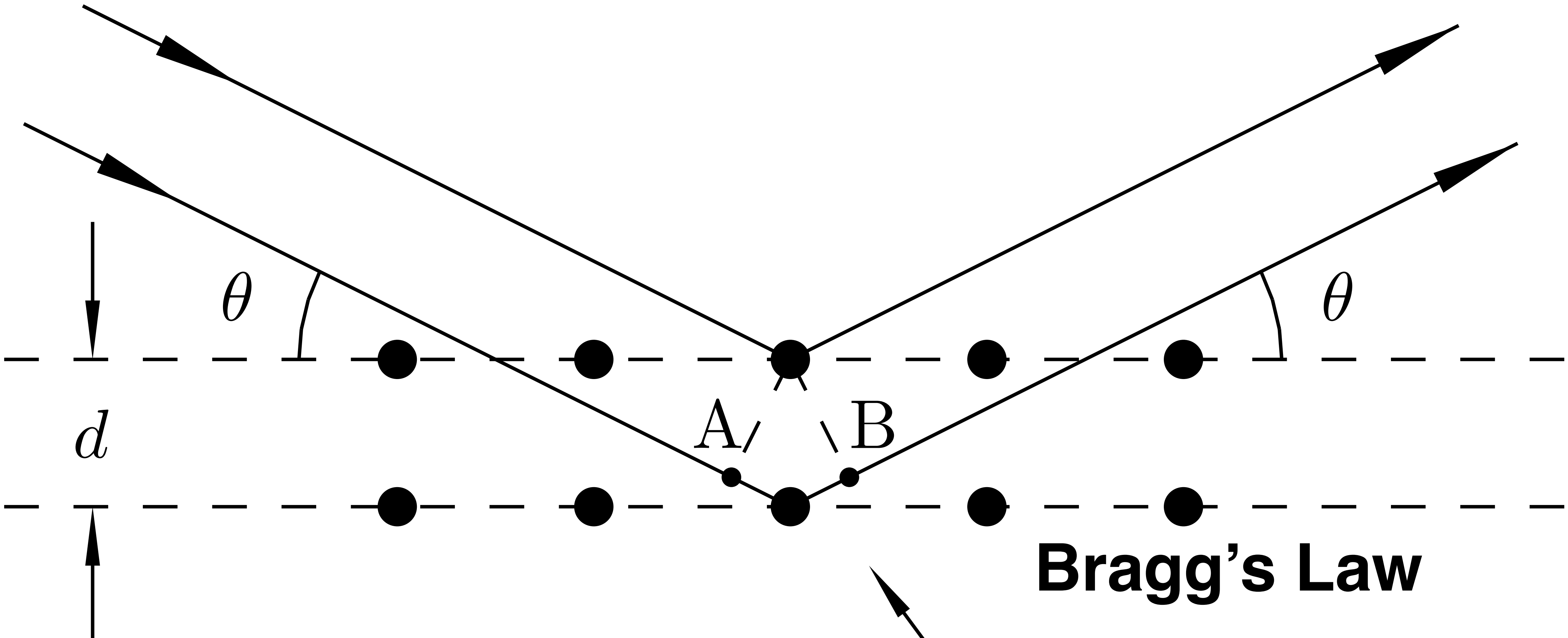
A $d\sin\theta = n\lambda$

B $\dfrac{d}{2}\sin\theta = n\lambda$

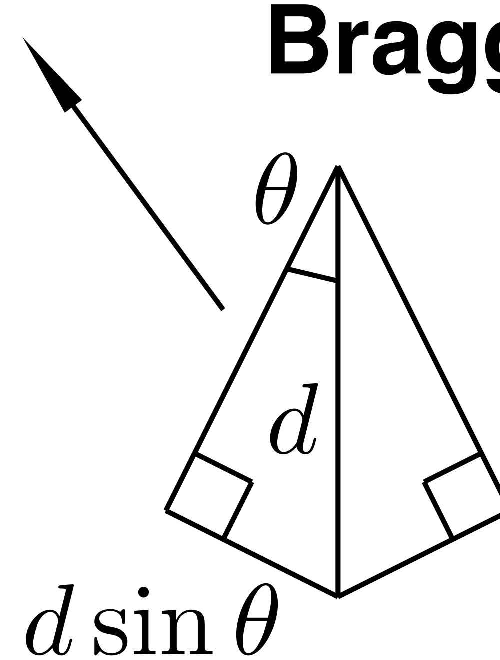
C $2d\sin\theta = n\lambda$

Question #3

What is the condition for constructive interference between these two light rays?



Bragg's Law



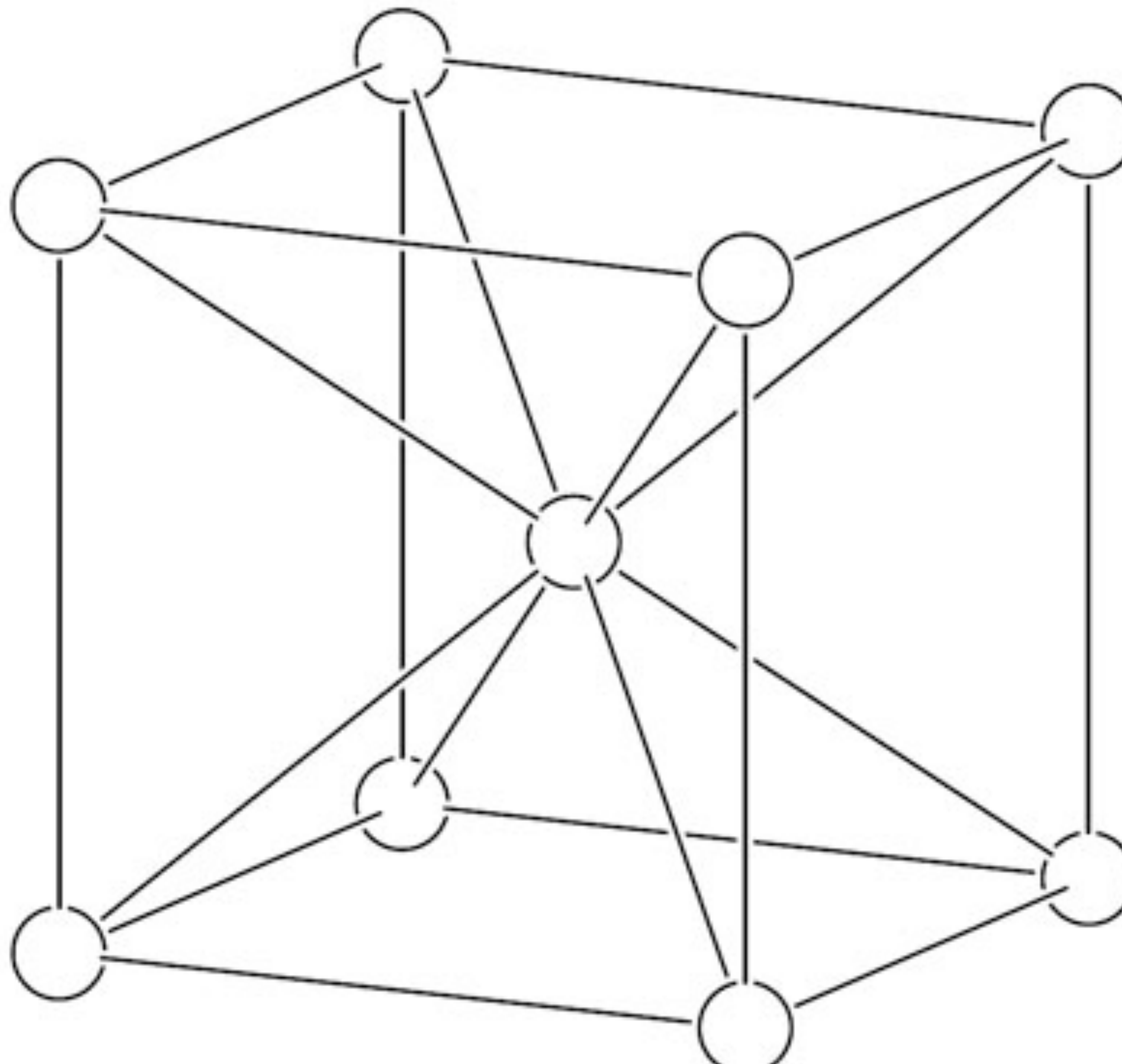
A $d\sin\theta = n\lambda$

B $\dfrac{d}{2}\sin\theta = n\lambda$

C $2d\sin\theta = n\lambda$

Question #4

Consider a bcc crystal with a lattice constant of 4.00 Å. Looking at the picture below, what is the spacing between (001) planes?

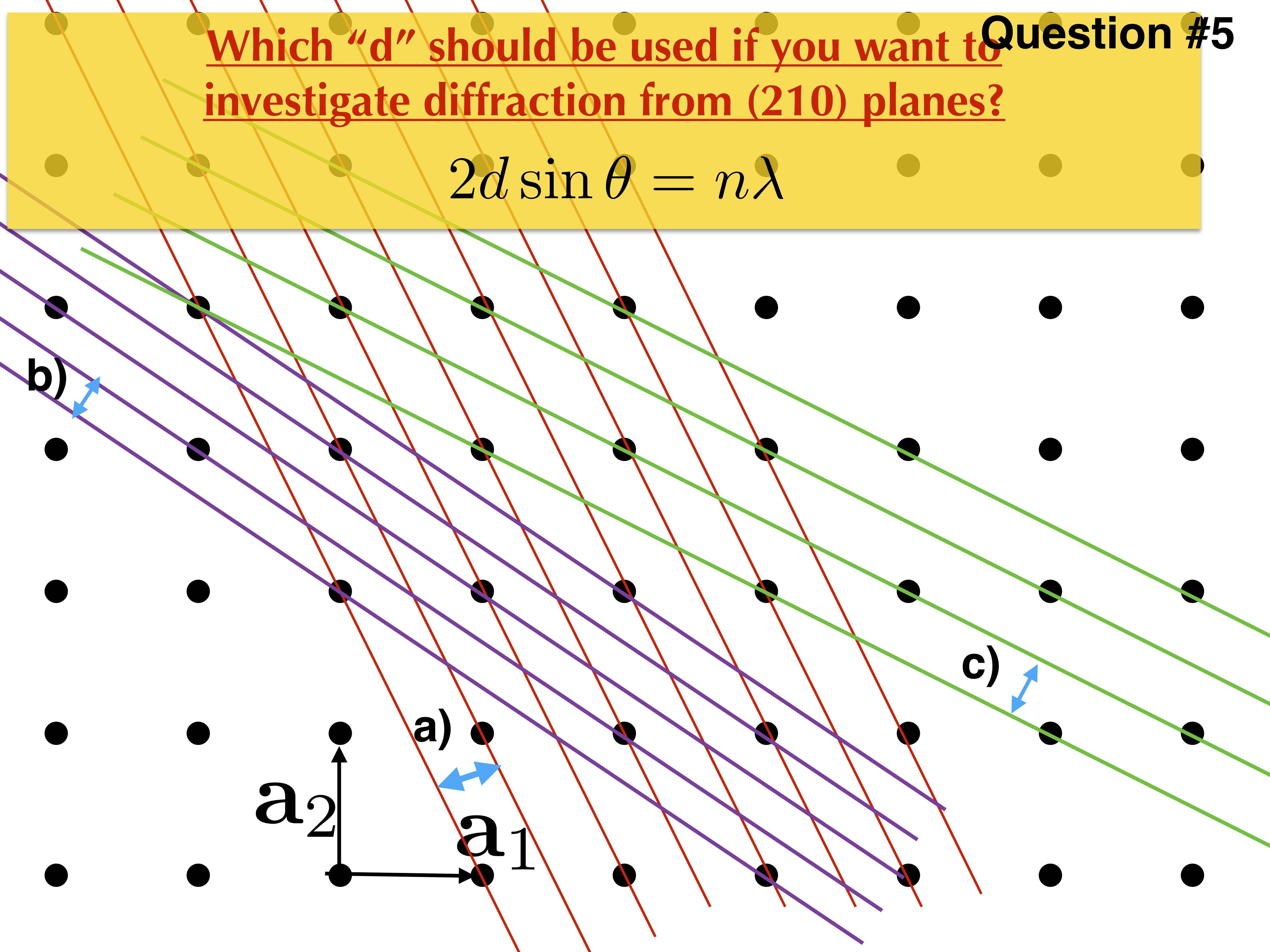


A. 4.00 Å
B. Sqrt(3)×3.00 Å
C. Sqrt(3)×4.00 Å
D. 2.00 Å
E. Sqrt(3)×2.00 Å

Question #5

Which "d" should be used if you want to investigate diffraction from (210) planes?

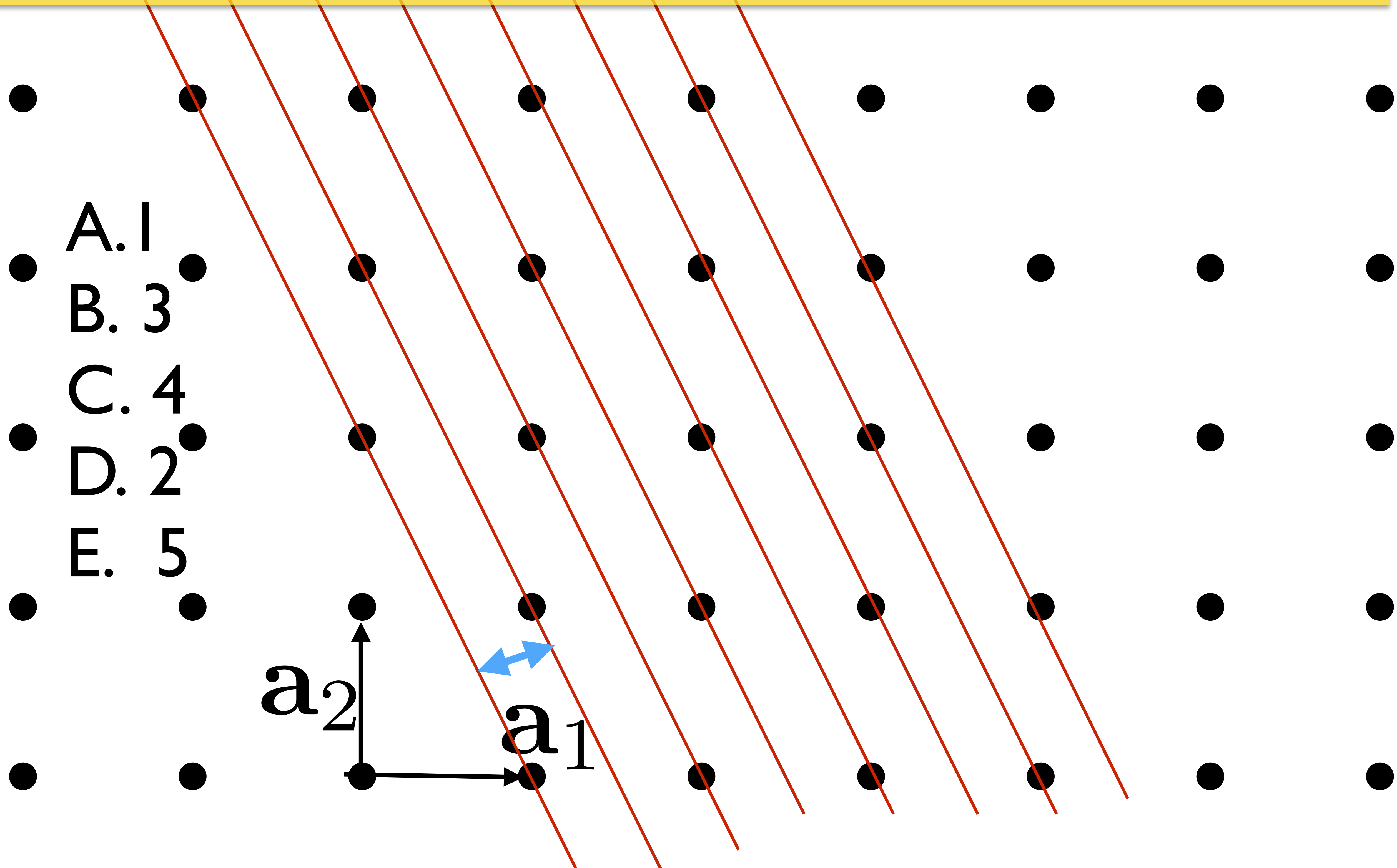
$$2d\sin\theta = n\lambda$$



Question #6

Let d = 2.5 Angstroms. At what angles do you observe Bragg peaks? How many angles did you find (X-ray wavelength is 1.542 Å)

$$2d\sin\theta = n\lambda$$

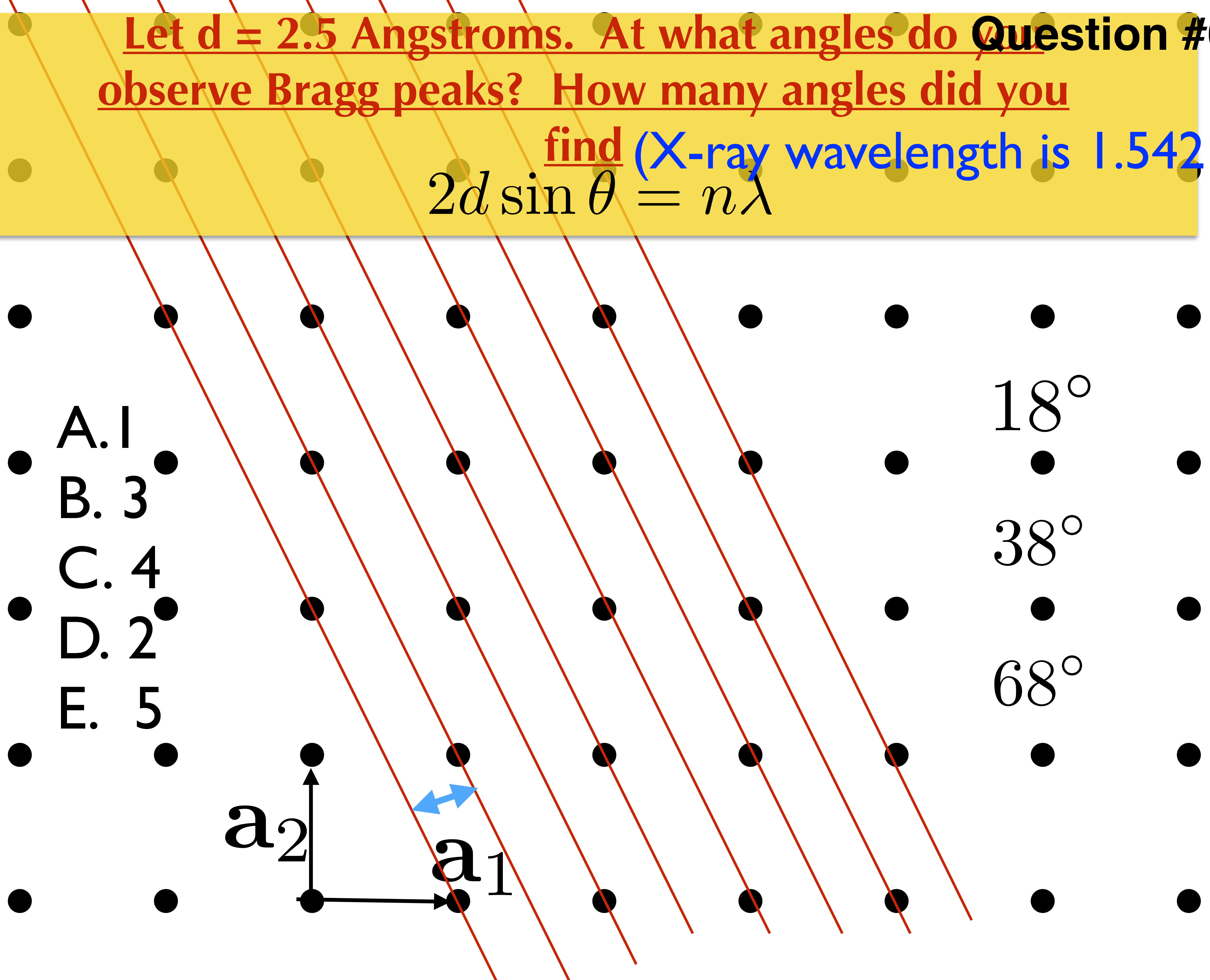


A. 1
B. 3
C. 4
D. 2
E. 5

Question #6

Let d = 2.5 Angstroms. At what angles do you observe Bragg peaks? How many angles did you find (X-ray wavelength is 1.542 Å)

$$2d\sin\theta = n\lambda$$



A. 1
B. 3
C. 4
D. 2
E. 5

18°

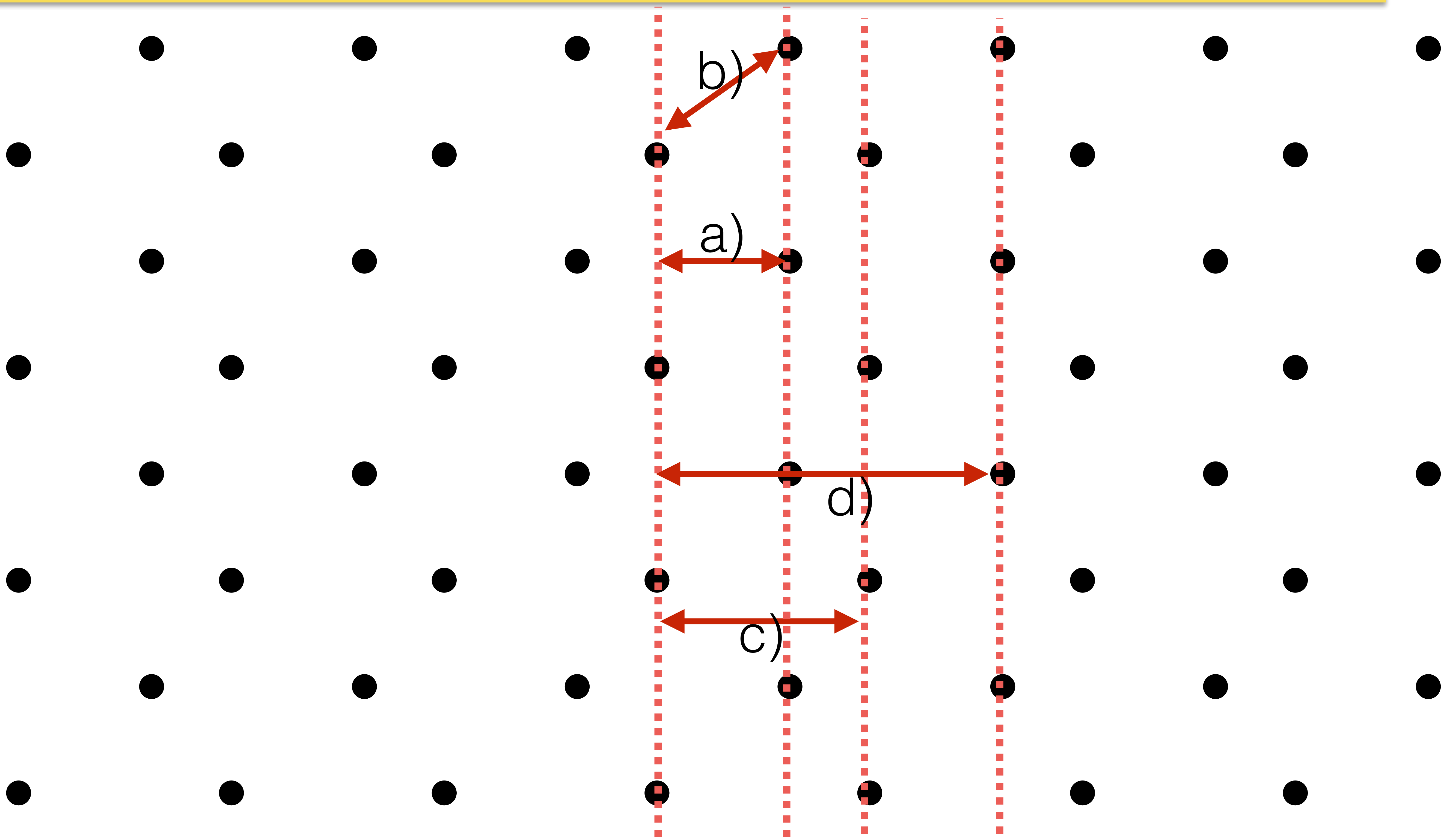
38°

68°

Question #7

Which “d” should be used if you want to investigate diffraction from (100) planes?

$$2d\sin\theta = n\lambda$$

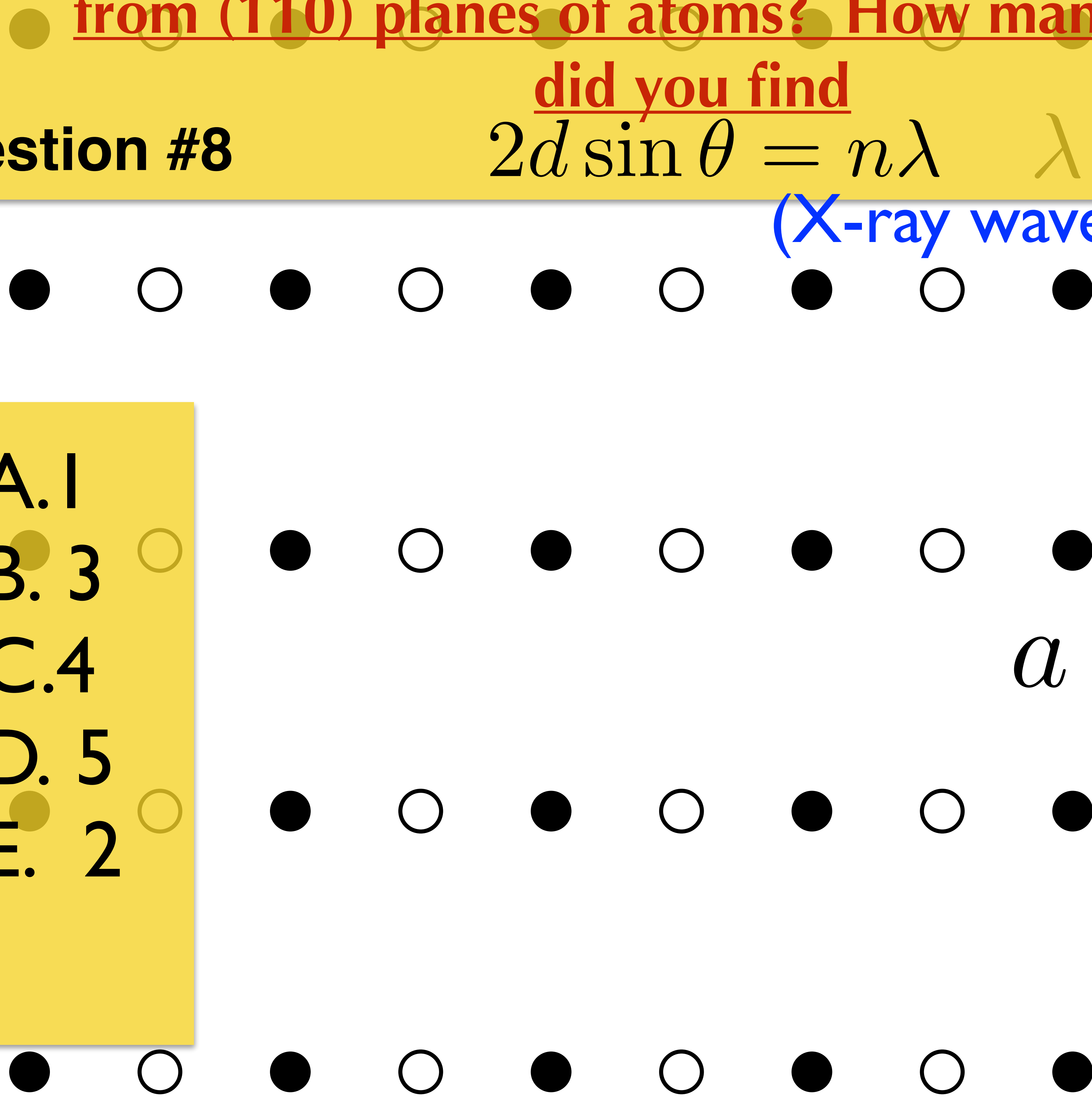


At what angles do you observe Bragg peaks from (110) planes of atoms? How many angles did you find

Question #8

$$2d\sin\theta = n\lambda \qquad \lambda = 1.542\ \text{Å}$$

(X-ray wavelength is 1.542 Å)



A. 1
B. 3
C. 4
D. 5
E. 2

$$a = 3.61\ \text{Å}$$

Consider a crystal with atoms at the lattice points of a simple cubic lattice. If the lattice constant is 3.50 Å, at what angles will we observe Bragg peaks, scattered from (001) planes, in an X-ray experiment? (X-ray wavelength is 1.542 Å)

Question #9

How many angles did you find?

A. 1
B. 3
C. 4
D. 2
E. 5

Consider a crystal with atoms at the lattice points of a body-centered cubic lattice. If the lattice constant is 3.50 Å, at what angles will we observe Bragg peaks, scattered from (001) planes, in an X-ray experiment? (X-ray wavelength is 1.542 Å)

Question #10

How many angles did you find?

A. 1

B. 5

C. 3

D. 4

E. 2

Consider a CsCl crystal with a lattice constant of 3.50 Å, at what angles will we observe Bragg peaks, scattered from (001) planes, in an X-ray experiment? (X-ray wavelength is 1.542 Å)

Question #11

How many angles did you find?

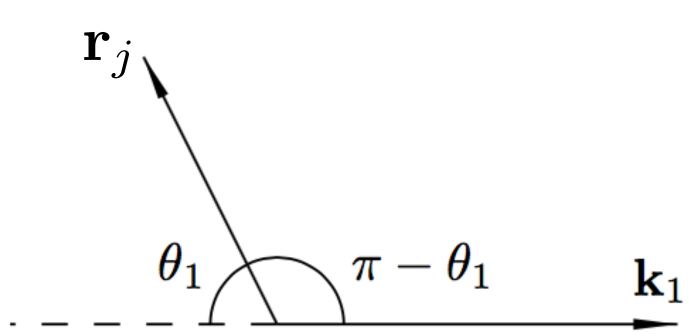
A. 1
B. 2
C. 3
D. 4
E. 5

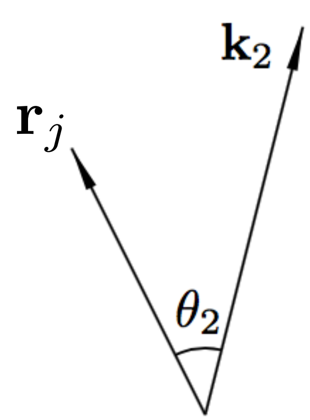
$$\mathcal{E}_1 \propto f_e(\theta) e^{ikr - i\omega t} \tag{1}$$

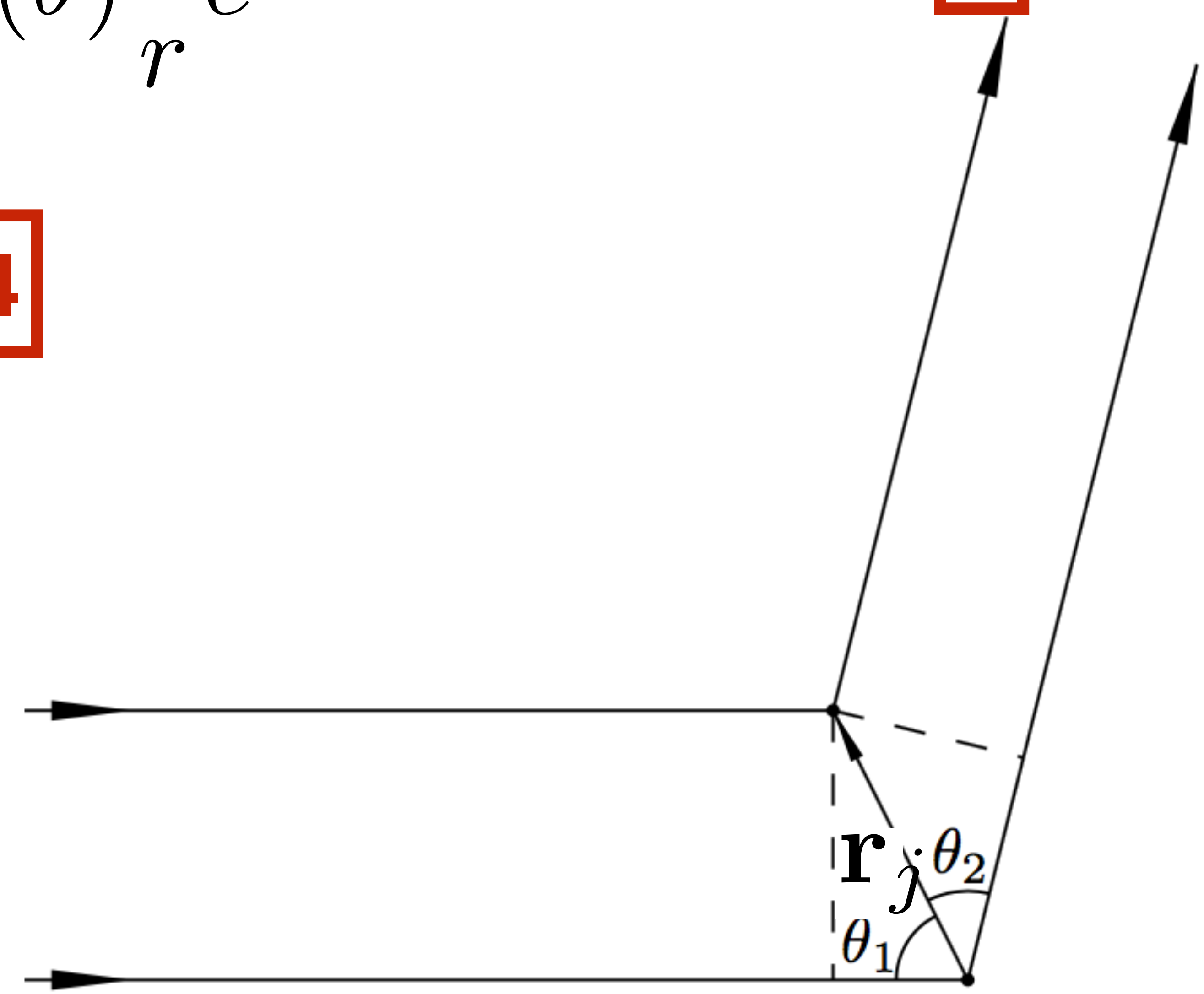
$$\mathcal{E}_2 \propto f_e(\theta) \frac{1}{r} e^{ikr - i\omega t + i\mathbf{r}_j \cdot \Delta\mathbf{k}} \tag{2}$$

$$\mathcal{E} \propto f_e(\theta) \frac{1}{r} e^{ikr - i\omega t} + f_e(\theta) \frac{1}{r} e^{ikr - i\omega t + i\mathbf{r}_j \cdot \Delta\mathbf{k}} \tag{3}$$

$$\mathcal{E} \propto f_e(\theta) \left[1 + e^{i\mathbf{r}_j \cdot \Delta\mathbf{k}}\right] \tag{4}$$







5 $$\mathcal{E} \propto f_e(\theta) \sum_j e^{i\mathbf{r_j}\cdot\Delta\mathbf{k}}$$

$$\mathcal{E} \propto f_e(\theta) \int \rho(\mathbf{r}) e^{i\mathbf{r}\cdot\Delta\mathbf{k}} d^3\mathbf{r}$$ 6

7 $$\mathcal{E} \propto f_e(\theta) \sum_{\mathbf{R}} \sum_{\mathbf{r}_p} \int \rho(\mathbf{R} + \mathbf{r}_p + \mathbf{r}') e^{i(\mathbf{R}+\mathbf{r}_p+\mathbf{r}')\cdot\Delta\mathbf{k}} d^3\mathbf{r}'$$

8 $$\mathcal{E} \propto f_e(\theta) \sum_{\mathbf{R}} \sum_{\mathbf{r}_p} \int \rho(\mathbf{R} + \mathbf{r}_p + \mathbf{r}') e^{i\mathbf{R}\cdot\Delta\mathbf{k}} e^{i\mathbf{r}_p\cdot\Delta\mathbf{k}} e^{i\mathbf{r}'\cdot\Delta\mathbf{k}} d^3\mathbf{r}'$$

9 $$\mathcal{E} \propto f_e(\theta) \sum_{\mathbf{R}} \sum_{\mathbf{r}_p} \int \rho(\mathbf{r}_p + \mathbf{r}') e^{i\mathbf{R}\cdot\Delta\mathbf{k}} e^{i\mathbf{r}_p\cdot\Delta\mathbf{k}} e^{i\mathbf{r}'\cdot\Delta\mathbf{k}} d^3\mathbf{r}'$$

10 $$\mathcal{E} \propto f_e(\theta) \left[\sum_{\mathbf{R}} e^{i\mathbf{R}\cdot\Delta\mathbf{k}}\right] \sum_{\mathbf{r}_p} \int \rho(\mathbf{r}_p + \mathbf{r}') e^{i\mathbf{r}_p\cdot\Delta\mathbf{k}} e^{i\mathbf{r}'\cdot\Delta\mathbf{k}} d^3\mathbf{r}'$$

11 $$\mathcal{E} \propto f_e(\theta) \left[\sum_{\mathbf{R}} e^{i\mathbf{R}\cdot\Delta\mathbf{k}}\right] \sum_{\mathbf{r}_p} f_{ap}(\theta) e^{i\mathbf{r}_p\cdot\Delta\mathbf{k}}$$

12 $$f_{ap}(\theta) = \int \rho(\mathbf{r}_p + \mathbf{r}') e^{i\mathbf{r}'\cdot\Delta\mathbf{k}} d^3\mathbf{r}'$$

Big Deal!!

$$\boxed{\mathcal{E} \propto f_e(\theta) \left[\sum_{\mathbf{R}} e^{i\mathbf{R}\cdot\Delta\mathbf{k}} \right]} \sum_{\mathbf{r}_p} f_{ap}(\theta) e^{i\mathbf{r}_p\cdot\Delta\mathbf{k}}$$

$$\mathbf{G} = \Delta\mathbf{k}$$

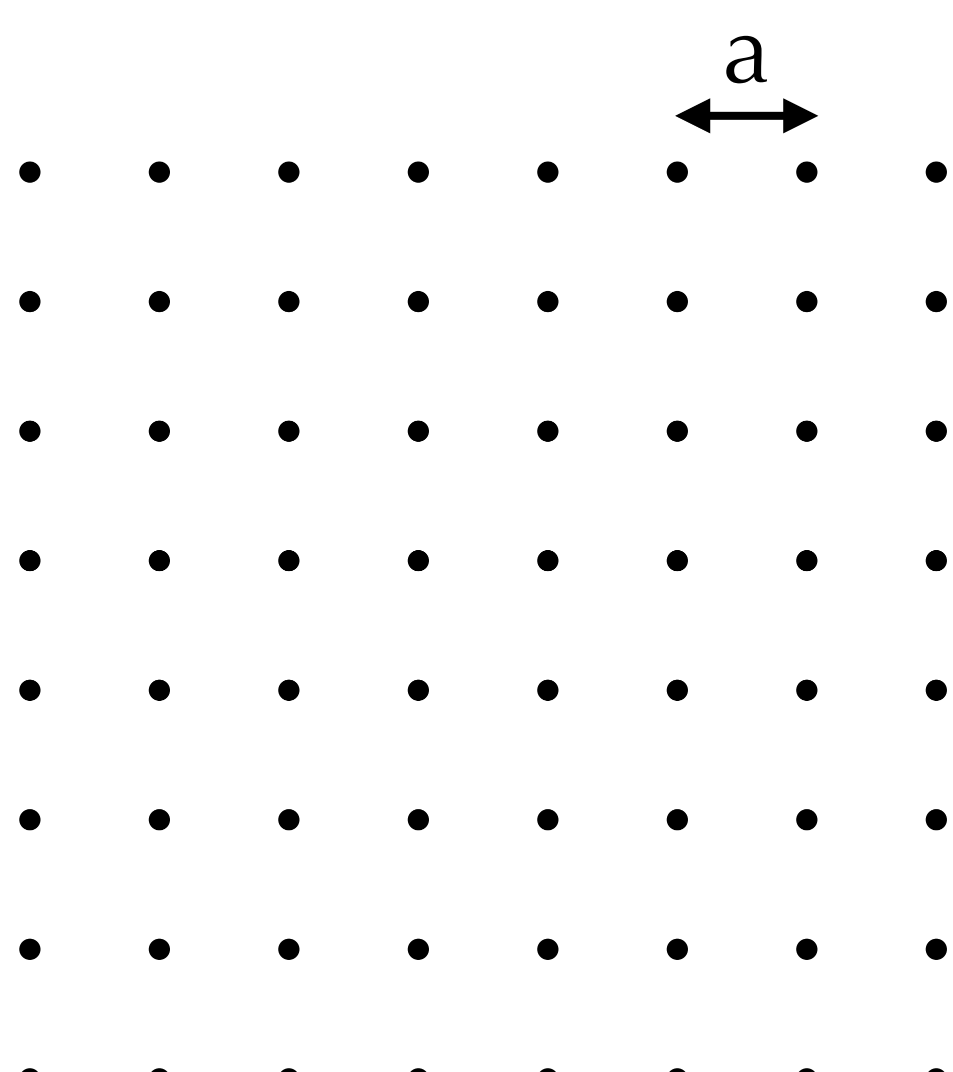
$$\mathbf{R}\cdot\mathbf{G} = ?$$

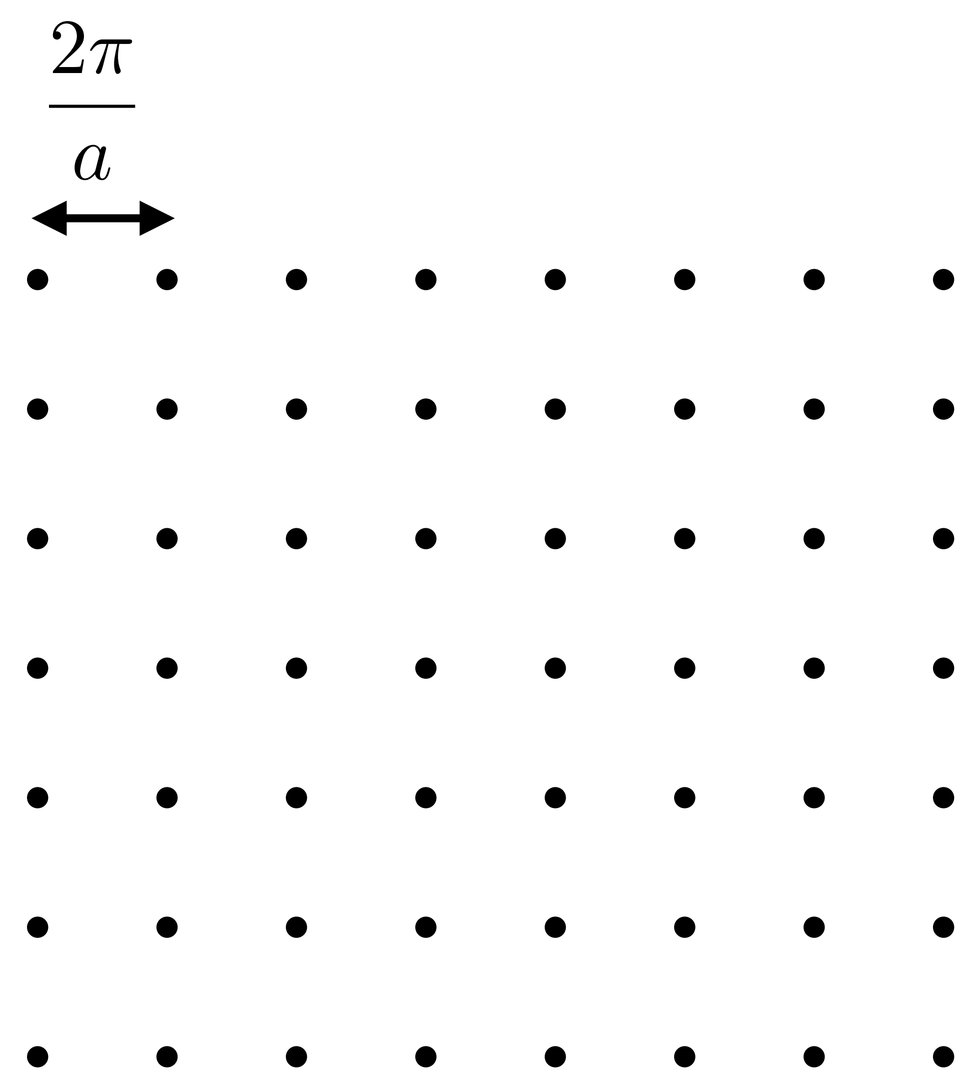
Big Deal!!

$$\boxed{\mathcal{E} \propto f_e(\theta) \left[\sum_{\mathbf{R}} e^{i\mathbf{R}\cdot\Delta\mathbf{k}} \right]} \sum_{\mathbf{r}_p} f_{ap}(\theta) e^{i\mathbf{r}_p\cdot\Delta\mathbf{k}}$$

$$\mathbf{G} = \Delta\mathbf{k}$$

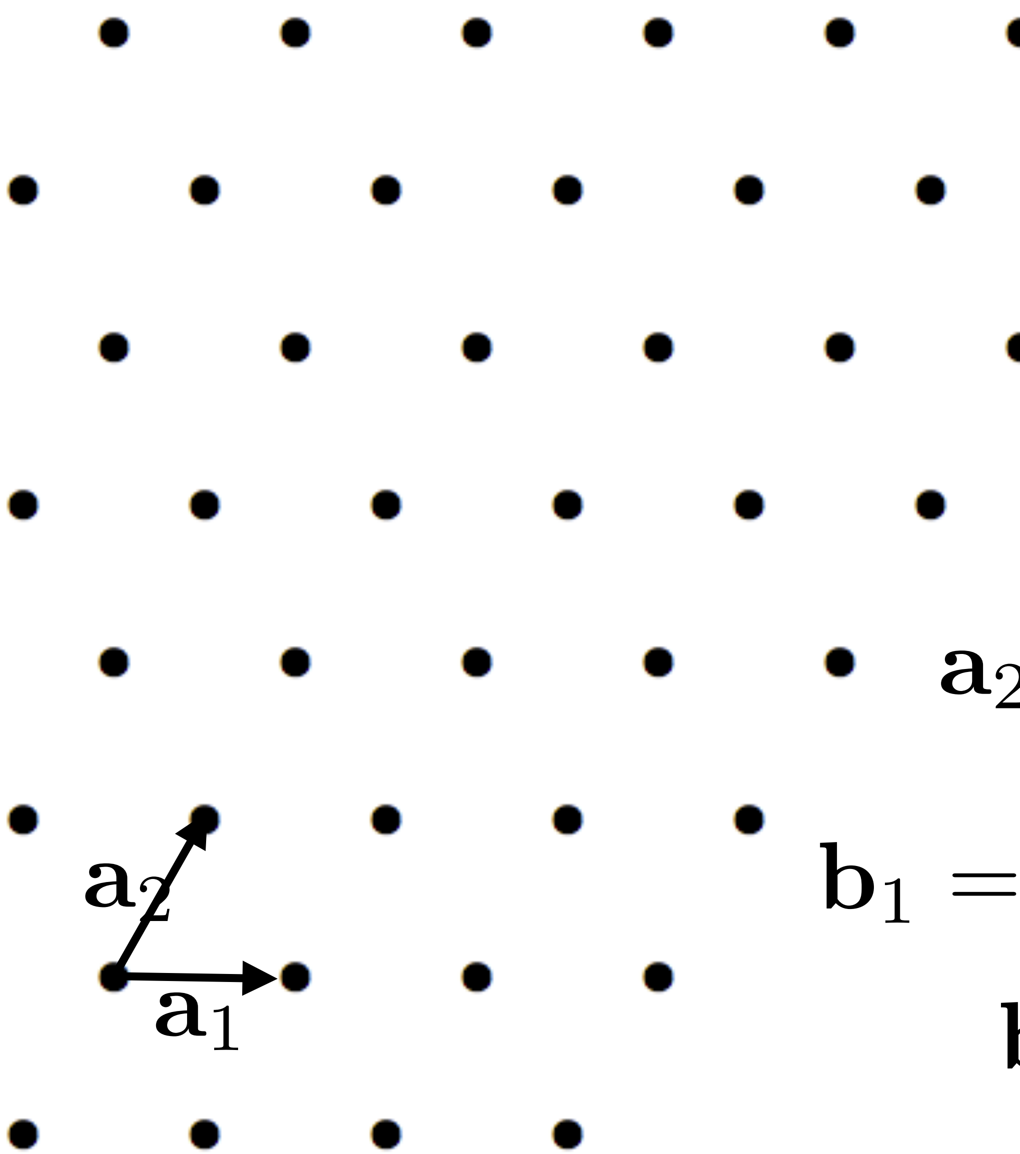
$$\mathbf{R}\cdot\mathbf{G} = ?$$





Big Deal!!

$$\boxed{\mathcal{E} \propto f_e(\theta)\left[\sum_{\mathbf{R}} e^{i\mathbf{R}\cdot\Delta\mathbf{k}}\right]}\sum_{\mathbf{r}_p} f_{ap}(\theta)e^{i\mathbf{r}_p\cdot\Delta\mathbf{k}}$$



$$\mathbf{G} = \Delta\mathbf{k}$$

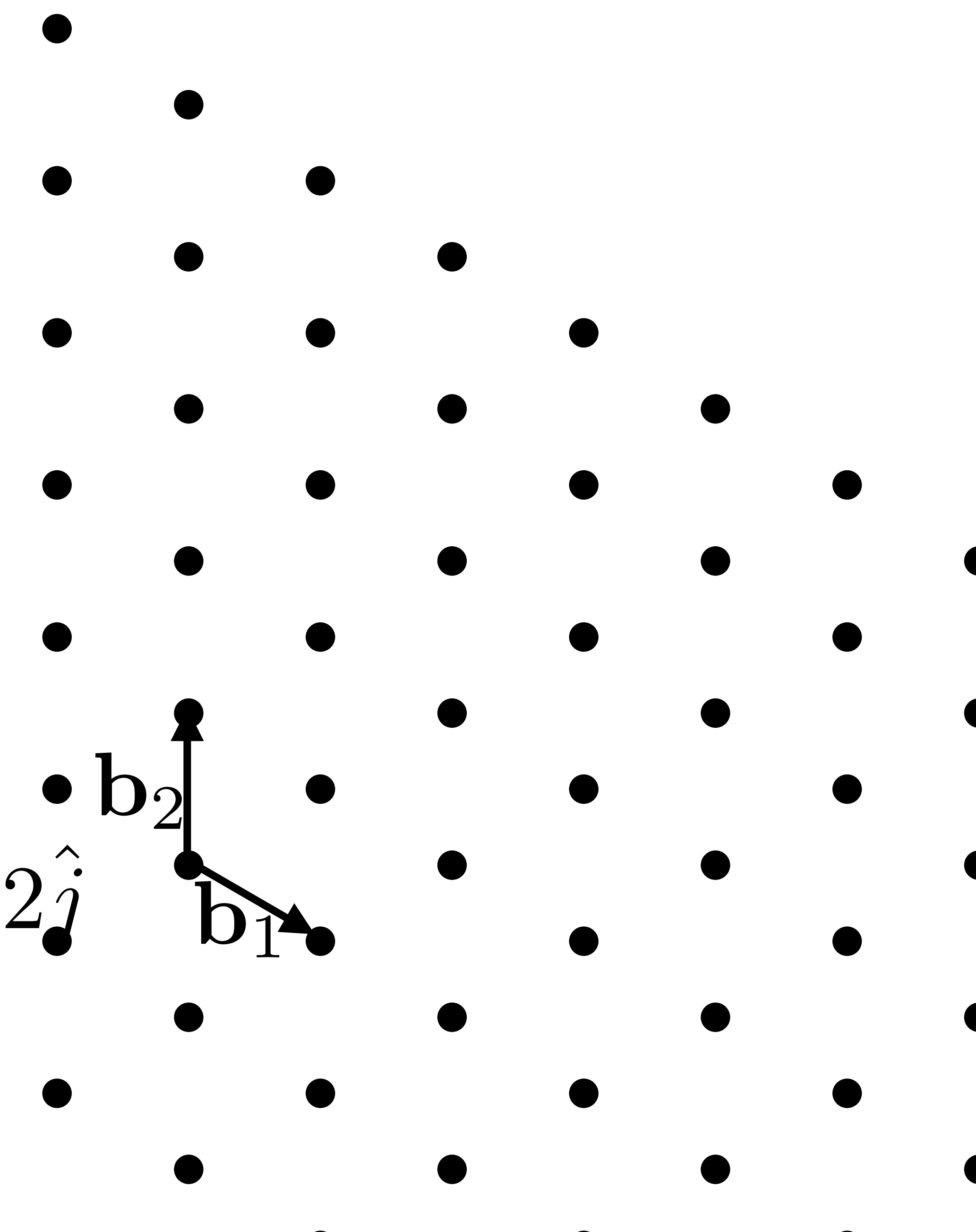
$$\mathbf{R}\cdot\mathbf{G} = ?$$

$$\mathbf{a}_1 = 3\hat{i}$$

$$\mathbf{a}_2 = 1.5\hat{i} + 2.6\hat{j}$$

$$\mathbf{b}_1 = 2.0944\hat{i} - 1.2092\hat{j}$$

$$\mathbf{b}_2 = 2.4184\hat{j}$$



Big Deal!!

$$\boxed{\mathcal{E} \propto f_e(\theta) \left[\sum_{\mathbf{R}} e^{i\mathbf{R}\cdot\Delta\mathbf{k}} \right]} \sum_{\mathbf{r}_p} f_{ap}(\theta) e^{i\mathbf{r}_p\cdot\Delta\mathbf{k}}$$

$$\mathbf{G} = \Delta\mathbf{k}$$

$$\mathbf{R} \cdot \mathbf{G} = ?$$

$$\mathbf{b}_1 = 2\pi \frac{\mathbf{a}_2 \times \mathbf{a}_3}{\mathbf{a}_1 \cdot (\mathbf{a}_2 \times \mathbf{a}_3)}$$

$$\mathbf{b}_2 = 2\pi \frac{\mathbf{a}_3 \times \mathbf{a}_1}{\mathbf{a}_2 \cdot (\mathbf{a}_3 \times \mathbf{a}_1)}$$

$$\mathbf{b}_3 = 2\pi \frac{\mathbf{a}_1 \times \mathbf{a}_2}{\mathbf{a}_3 \cdot (\mathbf{a}_1 \times \mathbf{a}_2)}$$