

# Wave Equation

1. Express each of the following in the form

$$k \cos(x - \alpha) \quad \text{where } k > 0 \quad \text{and} \quad 0 \leq \alpha^\circ \leq 360^\circ$$

a)  $3\cos x + 2 \sin x$       b)  $\cos x + \sin x$       c)  $2\cos x + 4\sin x$

d)  $5\cos x + 4 \sin x$       e)  $\cos x + \sqrt{2}\sin x$       f)  $\sqrt{3}\cos x + \sin x$

(i) Write down the maximum value of each of the above and the value of  $x$  at which this maximum occurs.

(ii) Write down the minimum value of each of the above and the value of  $x$  at which this minimum occurs.

2. Express each of the following in the form

$$k \cos(x + \alpha) \quad \text{where } k > 0 \quad \text{and} \quad 0 \leq \alpha^\circ \leq 360^\circ$$

a)  $2\cos x - \sin x$       b)  $3\cos x - 2\sin x$       c)  $6\cos x - \sin x$

d)  $2\cos x - 2 \sin x$       e)  $\cos x - \sqrt{2}\sin x$       f)  $\sqrt{3}\cos x - 2\sin x$

(i) Write down the maximum value of each of the above and the value of  $x$  at which this maximum occurs.

(ii) Write down the minimum value of each of the above and the value of  $x$  at which this minimum occurs.

3. Express each of the following in the form

$$k \sin(x + \alpha) \quad \text{where } k > 0 \quad \text{and} \quad 0 \leq \alpha^\circ \leq 360^\circ$$

a)  $\cos x + \sin x$       b)  $3\cos x + 5\sin x$       c)  $4\cos x + \sin x$

d)  $2\cos x + \sqrt{2} \sin x$       e)  $7\cos x + 3\sin x$       f)  $\sqrt{3}\cos x + 2\sin x$

(i) Write down the maximum value of each of the above and the value of  $x$  at which this maximum occurs.

(ii) Write down the minimum value of each of the above and the value of  $x$  at which this minimum occurs.

4. Express each of the following in the form

$$k \sin(x - \alpha) \quad \text{where } k > 0 \quad \text{and} \quad 0 \leq \alpha^\circ \leq 360^\circ$$

a)  $5\sin x - 3 \cos x$       b)  $\sin x - \cos x$       c)  $4\sin x - 2 \cos x$

d)  $3\sin x - 7\cos x$       e)  $-\cos x + 2\sin x$       f)  $-\sqrt{3}\cos x + 3\sin x$

(i) Write down the maximum value of each of the above and the value of  $x$  at which this maximum occurs.

(ii) Write down the minimum value of each of the above and the value of  $x$  at which this minimum occurs.