



Figure 2

The number of subscribers to two different music streaming companies is being monitored.

The number of subscribers, N_A , in thousands, to **company A** is modelled by the equation

$$N_A = |t - 3| + 4 \quad t \geq 0$$

where t is the time in years since monitoring began.

The number of subscribers, N_B , in thousands, to **company B** is modelled by the equation

$$N_B = 8 - |2t - 6| \quad t \geq 0$$

where t is the time in years since monitoring began.

Figure 2 shows a sketch of the graph of N_A and the graph of N_B over a 5-year period.

Use the equations of the models to answer parts (a), (b), (c) and (d).

- (a) Find the initial difference between the number of subscribers to **company A** and the number of subscribers to **company B**. (2)

(a) When $t=0$,

$$N_A = |0-3| + 4 = 3 + 4 = 7$$

$$N_B = 8 - |2(0)-6| = 8 - 6 = 2$$

$$N_A - N_B = 7 - 2 = 5$$

= 5,000 subscribers

When $t=T$ **company A** reduced its subscription prices and the number of subscribers increased.

- (b) Suggest a value for T , giving a reason for your answer. (2)

(b) N_A is decreasing until $t=3$ because $|t-3|$ is decreasing, and then starts increasing, so T could be 3.

- (c) Find the range of values of t for which $N_A > N_B$ giving your answer in set notation. (5)

(c) $N_A > N_B \Rightarrow |t-3| + 4 > 8 - |2t-6|$

$$|t-3| > 4 - 2|t-3|$$

$$3|t-3| > 4$$

$$|t-3| > \frac{4}{3}$$

$$t-3 > \frac{4}{3} \Rightarrow t > 4\frac{1}{3}$$

$$-t+3 > \frac{4}{3} \Rightarrow t < 1\frac{2}{3}$$

so, $\{t \in \mathbb{R} : t < 1\frac{2}{3}\} \cup \{t \in \mathbb{R} : t > 4\frac{1}{3}\}$

- (d) State a limitation of the model used for **company B**. (1)

(d) for $t > 7$, $N_B < 0$, and company B could not actually have a negative number of subscribers.