Railway Engineering Mathematics
Tutorial Sheet 10

1. There are many inter-relationships between the trigonometric functions. In the following, each of the functions on the left is identical to one of the functions on the right. By observing the graphs, or otherwise, match up the pairs:

$$y = \sin(-x) \qquad\qquad\qquad y = -\cos(x)$$

$$y = \tan(-x) \qquad\qquad\qquad y = \cos(x)$$

$$y = \cos(-x) \qquad\qquad\qquad y = -\sin(x)$$

$$y = \sin\left(x + \frac{\pi}{2}\right) \qquad\qquad\qquad y = -\tan(x)$$

$$y = \sin\left(x - \frac{\pi}{2}\right) \qquad\qquad\qquad y = \sin(x)$$

2. Download the `Picturebook.xlsx` from the module Blackboard site and navigate to the tab that plots sinusoidal functions of the form:

$$y = A\sin(\omega x + \phi) + B$$

Describe how changing each of the following affects the graph:

   (a) A (fix the values of the other parameters at: $\omega = 1$, $\phi = 0$, and $B = 0$)

   (b) ω (fix the values of the other parameters at: $A = 1$, $\phi = 0$, and $B = 0$)

   (c) ϕ (fix the values of the other parameters at: $A = 1$, $\omega = 1$, and $B = 0$)

   (d) B (fix the values of the other parameters at: $A = 1$, $\omega = 1$, and $\phi = 0$)

3. Plot the following functions using EXCEL (choose a sensible range of t):
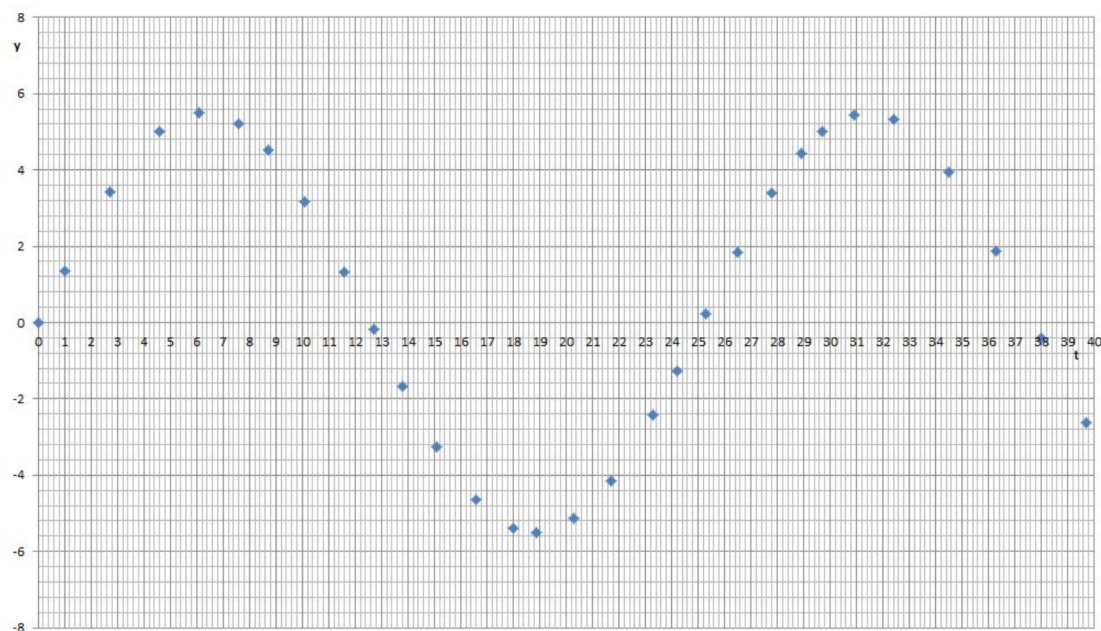
(a) $y = 4\sin(t)$

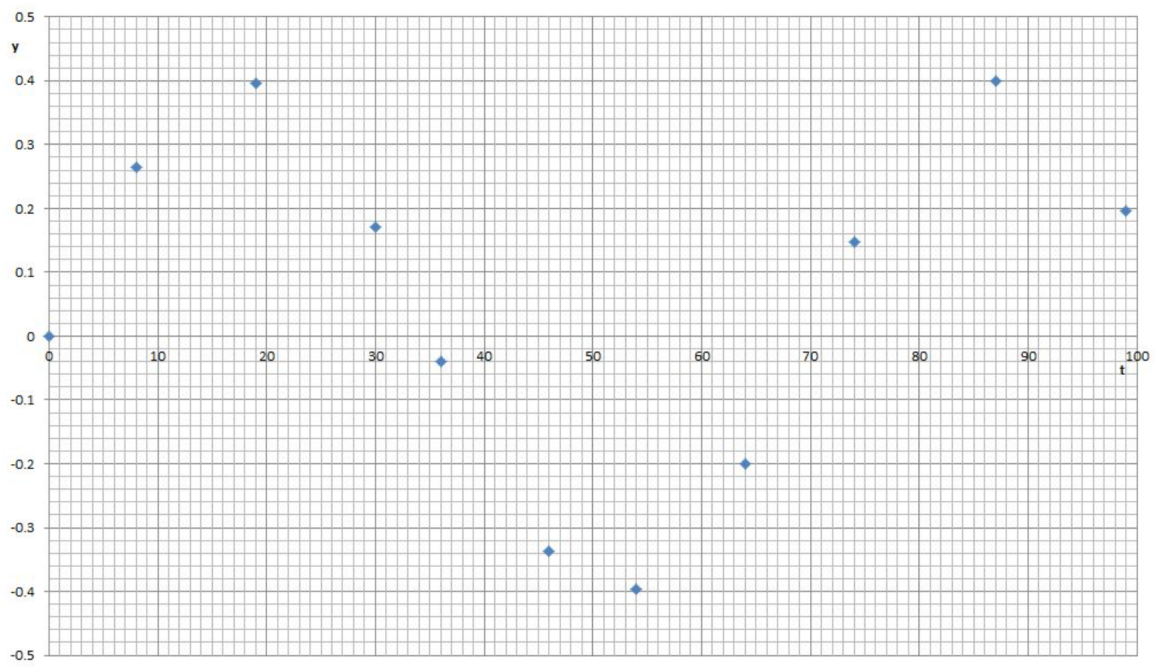(b) $y = 3.4\sin(2.4t - 3.2)$

(c) $y = 2.15\cos(3.6t + 0.5)$

(d) $y = 7\sin\left(\dfrac{t}{2} - \dfrac{3\pi}{4}\right)$

4. Determine an equation for each of the following sinusoidal curves:
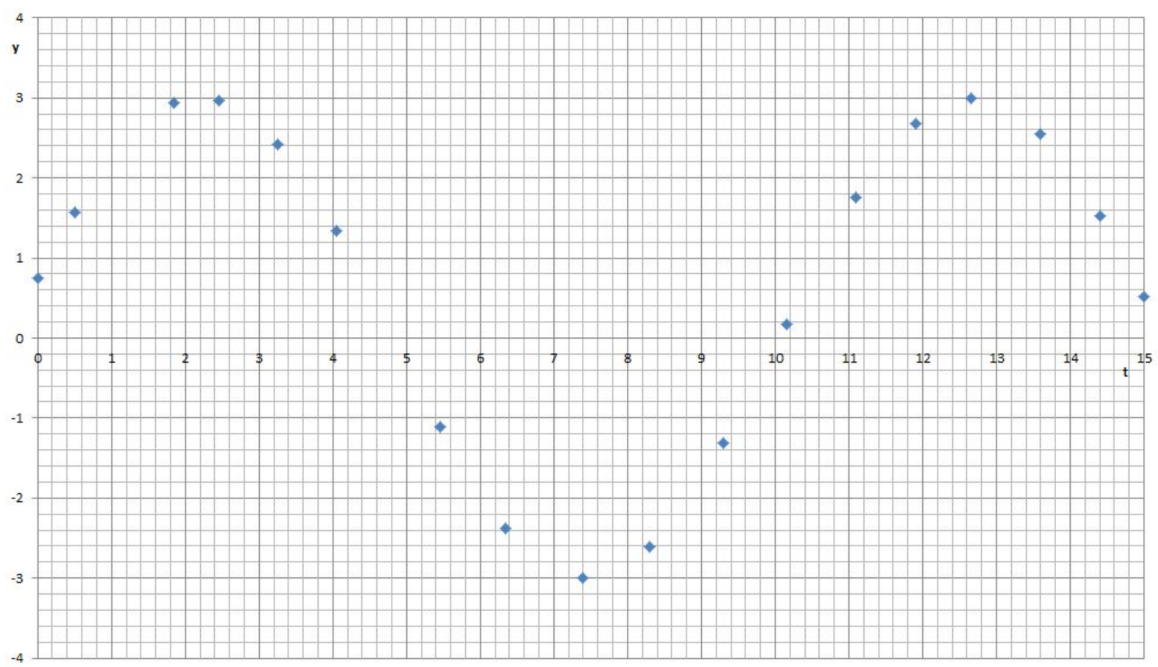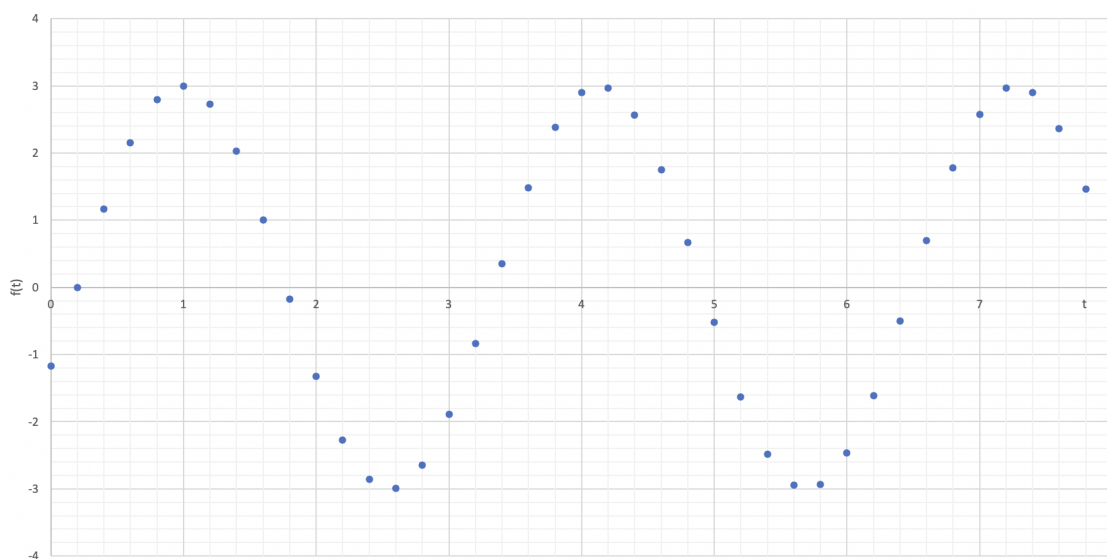
(a)

(b)

(c)

3

5. Find all solutions of the following:

   (a) $\sin\left(2t + \dfrac{\pi}{2}\right) = 0.5$ in the range $-\pi \le t \le \pi$.

   (b) $3\sin\left(5.1t - 1.12\right) = 0.75$ in the range $0 \le t \le \dfrac{2\pi}{3}$.

   (c) $\dfrac{7}{9}\sin\left(\pi t + 2.3\right) = \dfrac{3}{7}$ in the range $-\dfrac{\pi}{2} \le t \le \dfrac{\pi}{2}$.

6. Given the signal depicted below:

   (a) determine the equation of the function that passes through the points.

   (b) Hence, determine the solutions of t for when $f(t) = 1$ in the range $12 \le t \le 16$.