1. The functions f and g are given by $f(x) = \ln x$ and $g(x) = e^x + 3$
   a)   State the domain and range of f and g

   b)   Sketch the graphs of f and g. Label the x- intercept and y- intercepts

   c)   Find $(f \circ g)(x)$ and $(g \circ f)(x)$

2. The functions f and g are defined by

$$f(x) = x^2 + 1, \qquad x \in R$$

$$g(x) = x - 1, \qquad x \in R$$

   Find all roots of $2(g \circ f)(x) + (f \circ g)(x) = 7$

3. Given that $f(x) = 2x + 1$ and $h(x) = 2x^2 + 4x + 1$, find a function g such that $(f \circ g)(x) = h(x)$. Write $g(x)$ in the form of $a(x + b)^2 + c$, where a, b and c are constants.

   ANSWER :

1. a)
$$D_f = (0, \infty), R_f = (-\infty, \infty)$$
$$D_g = (-\infty, \infty), R_g = [3, \infty)$$

   b)   Graph

        c) $(f \circ g)(x) = \ln(e^x + 3)$, $(g \circ f)(x) = x + 3$

2. a)
$$x = \frac{5}{3}, -1$$

   b)   i) $(-\infty, -1) \cup (2, \infty)$

        ii) $f(x)$ is one to one function

        iii) $a = 2, b = -1$

3. $g(x) = x^2 + 2x$; $g(x) = (x + 1)^2 - 1$