

$$\begin{aligned}
 3. a) (i) \left(\frac{1+i}{1-i} \right)^3 &= \left(\frac{1+2i+i^2}{1-2i+i^2} \right) \left(\frac{1+i}{1-i} \right) \\
 &= \frac{2i}{-2i} = -1 \quad -1 \left(\frac{1+i}{1-i} \right) = \left(\frac{-1-i}{-1+i} \right) \\
 \left(\frac{-1-i}{-1+i} \right) \times \left(\frac{-1-i}{-1-i} \right) &= \frac{1+2i+i^2}{1-i^2} = \frac{2i}{2} \\
 &= i
 \end{aligned}$$

$$\begin{aligned}
 (ii) \frac{3}{(1+i)(2+i)} &= \frac{3}{2+3i+i^2} = \frac{3}{1+3i} \\
 \frac{3}{1+3i} \times \frac{1-3i}{1-3i} &= \frac{3-9i}{1-9i^2} = \frac{3-9i}{10} = \frac{3(1-3i)}{10}
 \end{aligned}$$

$$\begin{aligned}
 (iii) \frac{1+i}{1-i} - \frac{(1+2i)(2+2i)}{1+i} + \frac{3-i}{1+i} \\
 = \frac{1+i}{1-i} \times \frac{1+i}{1+i} = \frac{1+2i+i^2}{1-i^2} = \frac{2i}{2} = i \\
 (1+2i)(2+2i) = 2+6i+4i^2 = -2+6i \\
 \frac{3-i}{1+i} \times \frac{1-i}{1-i} = \frac{3-4i+i^2}{1-i^2} = \frac{2-4i}{2} = 1-2i \\
 = i - (-2+6i) + (1-2i) \\
 = 1-7i
 \end{aligned}$$

$$\begin{aligned}
 (iv) 2i(i-1) + (\sqrt{3}-i) + (1+i)(\overline{1+i}) \\
 = (2i^2-2i) + (\sqrt{3}-i) + (2) \\
 = (-2-2i) + (\sqrt{3}-i) + 2 \\
 = \sqrt{3} - 3i
 \end{aligned}$$