Problem 3)

$$\begin{aligned}\sin(x) &= 2\sin(x/2)\cos(x/2)\\ &= 2^2\sin(x/4)\cos(x/4)\cos(x/2)\\ &= 2^3\sin(x/8)\cos(x/8)\cos(x/4)\cos(x/2)\\ &\ \ \vdots\\ &= 2^n\sin(x/2^n)\cos(x/2^n)\cdots\cos(x/2^3)\cos(x/2^2)\cos(x/2^1).\end{aligned}$$

As n increases, $\sin(x/2^n) \to x/2^n$, which means that $2^n\sin(x/2^n) \to x$. Considering that $\cos(x/2^n) \to 1$ as $n \to \infty$, the above process can continue indefinitely, so that the approximation $2^n\sin(x/2^n) \cong x$ becomes exact in the limit of $n \to \infty$, yielding $\sin(x) = x\prod_{n=1}^{\infty}\cos(x/2^n)$.