1.1.i: (i) Let $\mathcal{A}$ be a category and $A, B \in \mathrm{ob}(\mathcal{A})$. Let $f \in \mathcal{A}(A, B)$ and assume $g, h \in \mathcal{B}, \mathcal{A}$ such that $fg = \mathbb{1}_B = fh$ and $gf = \mathbb{1}_A = hf$. Then

$$h = h\mathbb{1}_B = h(fg) = (hf)g = \mathbb{1}_A g = g.$$

(ii): Let $f\colon x \to y$ and $g, h\colon y \to x$ such that $gf = \mathbb{1}_x$ and $fh = \mathbb{1}_y$. Then

$$g = g\mathbb{1}_y = g\,(fh) = (gf)h = \mathbb{1}_x h = h$$

Thus we can denote $g = f^{-1} = h$ and we get $ff^{-1} = \mathbb{1}_y$ and $f^{-1}f = \mathbb{1}_x$, so f is an isomorphism by definition with f^{-1} as its inverse.

1.1.iii:
(i) Let $\mathrm{ob}\,(c/C)$ be all morphisms in C with domain c. Let $c/C\,(f, g)$ be all maps in C from the codomain of f to the codomain of g. For any $f, g, h \in \mathrm{ob}\,(c/C)$ and for any $\alpha \in c/C\,(f, g)$ and $\beta \in c/C\,(g, h)$, define the composition of α with β as the map $\beta \circ \alpha$ in C whose existence is guaranteed by C being a category. For the identity: since C is a category, we have that for each $x \in \mathrm{ob}(C)$, there exists an identity on x, and thus since for any map $f \in \mathrm{ob}(c/C)$, say $f\colon c \to x$, we have $f = \mathbb{1}_x f$ in C, so $\mathbb{1}_x \in c/C(f, f)$ where $\mathbb{1}_x$ represents the morphism $(f\colon c \to x) \to (f\colon c \to x)$; and since x was arbitary, all objects in c/C have an identity.

For associativity: let $\alpha \in c/C(f, g), \beta \in c/C(g, h), \gamma \in c/C(h, k)$. Then the $(\gamma\beta)\alpha = \gamma(\beta\alpha)$ follows from associativity of morphism composition in C.
Similarly, for the identity laws follow from the identity in $C :$ for any $\alpha \in c/C(f, g)$ where say $c \xrightarrow{f} x_f$ and $c \xrightarrow{g} x_g$, we have $\mathbb{1}_{x_f} \in c/C(f, f)$ and $\mathbb{1}_{x_g} \in c/C(g, g)$ and $\mathbb{1}_{x_g}\alpha = \alpha = \alpha\mathbb{1}_{x_f}$ since this is true in C.