1

$(((\lambda f.\lambda x.f(f(f(x))))(\lambda g.\lambda x.g(g(x))))(\lambda z.z+1))(0)$
$= (((\lambda f.\lambda x.f(f(f(x))))(\lambda g.\lambda y.g(g(y))))(\lambda z.z+1))(0)$
$= ((\lambda x.(\lambda g.\lambda y.g(g(y)))((\lambda g.\lambda y.g(g(y)))((\lambda g.\lambda y.g(g(y)))(x))))(\lambda z.z+1))(0)$
$= ((\lambda x.(\lambda g.\lambda y.g(g(y)))((\lambda g.\lambda y.g(g(y)))(\lambda y.x(x(y)))))(\lambda z.z+1))(0)$
$= ((\lambda x.(\lambda g.\lambda y.g(g(y)))((\lambda g.\lambda y.g(g(y)))(\lambda u.x(x(u)))))(\lambda z.z+1))(0)$
$= ((\lambda x.(\lambda g.\lambda y.g(g(y)))(\lambda y.(\lambda u.x(x(u)))((\lambda u.x(x(u)))(y))))(\lambda z.z+1))(0)$
$= ((\lambda x.(\lambda g.\lambda y.g(g(y)))(\lambda y.(\lambda u.x(x(u)))(x(x(y)))))(\lambda z.z+1))(0)$
$= ((\lambda x.(\lambda g.\lambda y.g(g(y)))(\lambda y.x(x(x(x(y))))))(\lambda z.z+1))(0)$
$= ((\lambda x.(\lambda g.\lambda y.g(g(y)))(\lambda v.x(x(x(x(v))))))(\lambda z.z+1))(0)$
$= ((\lambda x.(\lambda y.(\lambda v.x(x(x(x(v)))))((\lambda v.x(x(x(x(v)))))(y))))(\lambda z.z+1))(0)$
$= ((\lambda x.(\lambda y.(\lambda v.x(x(x(x(v)))))(x(x(x(x(y)))))))(\lambda z.z+1))(0)$
$= ((\lambda x.(\lambda y.x(x(x(x(x(x(x(x(y)))))))))(\lambda z.z+1))(0)$
$= (\lambda y.(\lambda z.z+1)((\lambda z.z+1)((\lambda z.z+1)((\lambda z.z+1)((\lambda z.z+1)((\lambda z.z+1)((\lambda z.z+1)((\lambda z.z+1)(y))))))))(0)$
$= (\lambda y.(\lambda z.z+8)(y))(0)$
$= (\lambda z.z+8)(0)$
$= 0 + 8$
$= 8$

2

$\omega = \lambda x.x(x)$

What is $\omega(\omega)$?

$\omega(\omega) = (\lambda x.x(x))(\lambda x.x(x)) = (\lambda x.x(x))(\lambda x.x(x)) = \omega(\omega)$

So, $\omega(\omega)$ is an infinite recursion which doesnt have a base case.