1

a

$$l - \text{ Link}$$
$$\forall x : \neg \text{scared}(l, x)$$

b

$$\forall p : \text{princess}(p) \Rightarrow \big[\forall s : \text{saved}(s, p) \Rightarrow \text{loves}(p, s)\big]$$

Though the phrasing *loves her saviour* perhaps makes a pressumption that there is at most one saviour and also that there exists one, resulting in a more complex version which requires the equality operator (hidden in the unique exists operator):

$$\forall p : \text{princess}(p) \Rightarrow \big[\big(\forall s : \text{saved}(s, p) \Rightarrow \text{loves}(p, s)\big) \wedge \exists! s : \text{saved}(s, p)\big]$$

c

Here we again require equality.

$$m - \text{ Master Sword}, a - \text{ Agahnim}$$
$$\text{sword}(m) \wedge \text{can\_defeat}(m, a) \wedge \big[\forall s : (\text{sword}(s) \wedge s \neq m) \Rightarrow \neg \text{can\_defeat}(s, a)\big]$$

d

We can either define the leader of the Dark World as a constant:

$$d - \text{ leader of the Dark World}, lw - \text{ Light World}$$
$$\text{is\_defeated}(d) \Rightarrow \text{is\_free}(lw)$$

Or by searching the universum of entities which however also requires the usage of equality since the article *the* is used. In prepositional logic we would use a specific function.

$$dw - \text{ Dark World}, lw - \text{ Light World}$$
$$\big(\exists! d : \text{is\_leader}(d, dw)\big) \wedge \big(\forall d : (\text{is\_defeated}(d) \wedge \text{is\_leader}(d, dw)) \Rightarrow \text{is\_free}(lw)\big)$$

2

2.1

a

$$\ldots = 1 \text{ iff } [\![R(x', x'')]\!]^{M_1, g_1} = 1 \text{ and } [\![R(x''', b)]\!]^{M_1, g_1} = 1$$
$$\ldots = 1 \text{ iff } (e_2, e_3) \in V_M(R) \text{ and } (e_5, e_6) \in V_M(R)$$
$$\ldots = 1 \text{ iff } 1 \text{ and } 1 \Rightarrow 1$$

b

$$\ldots = 1 \text{ iff there is } d \in U_M \text{ such that } [\![A(x'') \to R(x'', j)]\!]^{M_1, g_1[x''/d]} = 1$$
$$\ldots = 1 \text{ iff there is } d \in U_M \text{ such that } [\![A(d) \to R(d, j)]\!]^{M_1, g_1} = 1$$
$$\ldots = 1 \text{ iff there is } d \in U_M \text{ such that } [\![\neg A(d) \vee R(d, j)]\!]^{M_1, g_1} = 1$$
$$\text{set } d = e_1$$
$$\ldots = 1 \text{ iff } [\![\neg A(e_1) \vee R(e_1, j)]\!]^{M_1, g_1} = 1$$
$$\ldots = 1 \text{ iff } [\![\neg 0 \vee R(e_1, j)]\!]^{M_1, g_1} = 1$$
$$\ldots = 1 \text{ iff } [\![\neg 0]\!]^{M_1, g_1} = 1 \text{ or } [\![R(e_1, j)]\!]^{M_1, g_1} = 1$$
$$\Rightarrow 1$$

c

$$\ldots = 1 \text{ iff for all } d \in U_M : [\![B(x) \to (A(x) \lor \forall x'' \neg R(x'', x))]\!]^{M_1, g_1[x/d]} = 1$$

$$\ldots = 1 \text{ iff for all } d \in U_M : [\![B(x)]\!]^{M_1, g_1[x/d]} = 0 \text{ or } [\![(A(x) \lor \forall x'' \neg R(x'', x)))]\!]^{M_1, g_1[x/d]} = 1$$

for $d = e_4$:

$[\![B(x)]\!]^{M_1, g_1[x/e_4]} = 1 \qquad (e_4 \in V_M(B))$

$[\![(A(x) \lor \forall x'' \neg R(x'', x))]\!]^{M_1, g_1[x/e_4]} =$

$= [\![A(x)]\!]^{M_1, g_1[x/e_4]} = 1$ or for all $f \in U_M : [\![R(x'', x))]\!]^{M_1, g_1[x/e_4, x''/f]} = 0$

for $f = e_2 : [\![A(x))]\!]^{M_1, g_1[x/e_4]} = 0 \land [\![R(x'', x))]\!]^{M_1, g_1[x/e_4, x''/e_2]} = 1$

$\Rightarrow 0$

2.2

$$g(x) = e_1, g(x') = e_2$$