

$$\frac{d([cL\_m] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( q1 \cdot L \cdot [cP] \cdot gml + \frac{n1 \cdot gp7^2 \cdot g1^2}{gp7^2 \cdot g1^2 + ([cP9] + [cP7] + [cP5] + [cT])^2} \cdot gml - (m1 \cdot L + m2 \cdot (1-L)) \cdot [cL\_m] \right)$$

$$\frac{d([cL] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{(p2 + p1 \cdot L) \cdot [cL\_m]}{gml} \cdot gl - m3 \cdot [cL] - \frac{p3 \cdot gl \cdot [cL]^2}{[cL]^2 + gl^2 \cdot g3^2} \right)$$

$$\frac{d([cLmod] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{p3 \cdot gl \cdot [cL]^2}{[cL]^2 + gl^2 \cdot g3^2} - m3 \cdot [cLmod] \right)$$

$$\frac{d([cP] \cdot V_{cell})}{dt} = +V_{cell} \cdot (p7 \cdot (1-L) \cdot (1-[cP]) - m11 \cdot [cP] \cdot L)$$

$$\frac{d([cP9\_m] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( q3t \cdot L \cdot [cP] \cdot gm9 + \frac{\frac{nt1 \cdot (gl \cdot g1t + at1 \cdot [cLmod])}{gl \cdot g1t + [cLmod]} \cdot gl^2 \cdot g2t^2}{\frac{gl^2 \cdot g2t^2 + [cL]^2}{ge3 \cdot g3t + [cEC]}} \cdot ge3 \cdot g3t \cdot gp7^2 \cdot g4t^2 - gm9 - m1t \cdot [cP9\_m] \right)$$

$$\frac{d([cP9] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{p1t \cdot [cP9\_m]}{gm9} \cdot gp7 - mp1t \cdot [cP9] \right)$$

$$\frac{d([cP7\_m] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{\frac{nt2 \cdot gl^2 \cdot g5t^2}{gl^2 \cdot g5t^2 + [cL]^2} \cdot ge3 \cdot g6t}{\frac{ge3 \cdot g6t + [cEC]}{gp7^2 \cdot g7t^2 + ([cP5] + [cT])^2}} \cdot gp7^2 \cdot g7t^2 \cdot gm7 - m2t \cdot [cP7\_m] \right)$$

$$\frac{d([cP7] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{p2t \cdot [cP7\_m]}{gm7} \cdot gp7 - (mp2t + mp3t \cdot (1-L)) \cdot [cP7] \right)$$

$$\frac{d([cP5\_m] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{\frac{nt3 \cdot (gl \cdot g8t + at2 \cdot [cLmod])}{gl \cdot g8t + [cLmod]} \cdot gl^2 \cdot g9t^2}{\frac{gl^2 \cdot g9t^2 + [cL]^2}{ge3 \cdot g10t + [cEC]}} \cdot ge3 \cdot g10t \cdot gp7^2 \cdot g11t^2 - gm5 - m3t \cdot [cP5\_m] \right)$$

$$\frac{d([cP5] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{p3t \cdot [cP5\_m]}{gm5} \cdot gp7 - (mp4t + mp5t \cdot (1-L)) \cdot [cP5] \right)$$

$$\frac{d([cT\_m] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{\frac{nt4 \cdot (gl \cdot g12t + at3 \cdot [cLmod])}{gl \cdot g12t + [cLmod]} \cdot gl^2 \cdot g13t^2}{\frac{gl^2 \cdot g13t^2 + [cL]^2}{ge3 \cdot g14t + [cEC]}} \cdot ge3 \cdot g14t \cdot gp7^2 \cdot g15t^2 - gmt - m4t \cdot [cT\_m] \right)$$

$$\frac{d([cT] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{p4t \cdot [cT\_m]}{gmt} \cdot gp7 - (mp6t + mp7t \cdot (1-L)) \cdot [cT] \cdot \left( \frac{p5t \cdot [cZTL]}{ge3} + \frac{[cZG]}{dZG \cdot ge3} \right) - mp8t \cdot [cT] \right)$$

$$\frac{d([cE4\_m] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{n13 \cdot ge3 \cdot g2}{ge3 \cdot g2 + [cEC]} \cdot gl^2 \cdot g6^2 \cdot gm4 - m34 \cdot [cE4\_m] \right)$$

$$\frac{d([cE4] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{p23 \cdot ge3 \cdot [cE4\_m]}{gm4} - m35 \cdot [cE4] - \frac{p25}{ge3} \cdot [cE4] \cdot [cE3n] + p21 \cdot [cE34] \right)$$

$$\frac{d([cE3\_m] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{n3 \cdot gl^2 \cdot g16^2}{gl^2 \cdot g16^2 + [cL]^2} \cdot gm3 - m26 \cdot [cE3\_m] \right)$$

$$\frac{d([cE3c] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{p16 \cdot ge3 \cdot [cE3\_m]}{gm3} - m9 \cdot [cE3c] \cdot [cCOP1c] - \frac{p17}{ge3} \cdot [cE3c] \cdot [cGc] - p19 \cdot [cE3c] + p20 \cdot [cE3n] \right)$$

$$\frac{d([cE3n] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( p19 \cdot [cE3c] - p20 \cdot [cE3n] - \frac{p17}{ge3} \cdot [cE3n] \cdot [cGn] - m30 \cdot [cE3n] \cdot [cCOP1d] - m29 \cdot [cE3n] \cdot [cCOP1n] + p21 \cdot [cE34] - \frac{p25}{ge3} \cdot [cE4] \cdot [cE3n] \right)$$

$$\frac{d([cLUX\_m] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{n13 \cdot ge3 \cdot g2}{ge3 \cdot g2 + [cEC]} \cdot gl^2 \cdot g6^2 \cdot gm4 - m34 \cdot [cLUX\_m] \right)$$

$$\frac{d([cLUX] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{p27 \cdot ge3 \cdot [cLUX\_m]}{gm4} - m39 \cdot [cLUX] - \frac{p26}{ge3} \cdot [cLUX] \cdot [cE34] \right)$$

$$\frac{d([cCOP1c] \cdot V_{cell})}{dt} = +V_{cell} \cdot (n5 - p6 \cdot [cCOP1c] - m27 \cdot [cCOP1c] \cdot (1 + p15 \cdot L))$$

$$\frac{d([cCOP1n] \cdot V_{cell})}{dt} = +V_{cell} \cdot (p6 \cdot [cCOP1c] - n6 \cdot L \cdot [cP] \cdot [cCOP1n] - n14 \cdot [cCOP1n] - m27 \cdot [cCOP1n] \cdot (1 + p15 \cdot L))$$

$$\frac{d([cCOP1d] \cdot V_{cell})}{dt} = +V_{cell} \cdot (n14 \cdot [cCOP1n] + n6 \cdot L \cdot [cP] \cdot [cCOP1n] - m31 \cdot (1 + m33 \cdot (1-L)) \cdot [cCOP1d])$$

$$\frac{d([cEGc] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{p17}{ge3} \cdot [cE3c] \cdot [cGc] - m9 \cdot [cEGc] \cdot [cCOP1c] - p18 \cdot [cEGc] + p31 \cdot [cEGn] \right)$$

$$\frac{d([cEC] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{p26}{ge3} \cdot [cLUX] \cdot [cE34] - m36 \cdot [cEC] \cdot [cCOP1n] - m37 \cdot [cEC] \cdot [cCOP1d] - m32 \cdot [cEC] \cdot \left( 1 + \frac{p24 \cdot L \cdot cGn\_tot^2}{ge3^2 \cdot g7^2 + cGn\_tot^2} \right) \right)$$

$$\frac{d([cZTL] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( ge3 \cdot p14 - \frac{p12}{ge3} \cdot L \cdot [cZTL] \cdot [cGc] + p13 \cdot [cZG] \cdot (1-L) - m20 \cdot [cZTL] \right)$$

$$\frac{d([cZG] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{p12}{ge3} \cdot L \cdot [cZTL] \cdot [cGc] - p13 \cdot [cZG] \cdot (1-L) - m21 \cdot [cZG] \right)$$

$$\frac{d([cG\_m] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( L \cdot q2 \cdot [cP] \cdot gmg + \frac{n12 \cdot ge3 \cdot g14}{ge3 \cdot g14 + [cEC]} \cdot gl^2 \cdot g15^2 \cdot gmg - m18 \cdot [cG\_m] \right)$$

$$\frac{d([cGc] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{p11 \cdot ge3 \cdot [cG\_m]}{gmg} - \frac{p12}{ge3} \cdot L \cdot [cZTL] \cdot [cGc] + p13 \cdot [cZG] \cdot (1-L) - m19 \cdot [cGc] - \frac{p17}{ge3} \cdot [cE3c] \cdot [cGc] - p28 \cdot [cGc] + p29 \cdot [cGn] \right)$$

$$\frac{d([cGn] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( p28 \cdot [cGc] - \left( p29 + m19 + \frac{p17}{ge3} \cdot [cE3n] \right) \cdot [cGn] \right)$$

$$\frac{d([cEGn] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( p18 \cdot [cEGc] + \frac{p17}{ge3} \cdot [cE3n] \cdot [cGn] - (m9 \cdot [cCOP1n] + m10 \cdot [cCOP1d] + p31) \cdot [cEGn] \right)$$

$$\frac{d([cE34] \cdot V_{cell})}{dt} = +V_{cell} \cdot \left( \frac{p25}{ge3} \cdot [cE4] \cdot [cE3n] - \left( \frac{p26}{ge3} \cdot [cLUX] + p21 + m37 \cdot [cCOP1d] + m36 \cdot [cCOP1n] \right) \cdot [cE34] \right)$$

$$cGn\_tot = [cGn] + [cEGn]$$