

```

In[88]:= h[x_, t_] = a0 + a1 * Sech[k * (x - c * t)] ^ 2
u[x_, t_] = c * (1 - a0 / h[x, t])
G[x_, t_] = h[x, t] * u[x, t] - D[h[x, t]^3 / 3 * D[u[x, t], x], x]
h0 = h[x, 0]
u0 = u[x, 0]
G0 = G[x, 0]
H = 1 / 2 * (h0 * u0 * u0 + h0^3 / 3 * D[u0, x]^2 + g * h0 * h0)

```

```
Out[88]= a0 + a1 Sech[k (-c t + x)]^2
```

```
Out[89]= c (1 - a0 / (a0 + a1 Sech[k (-c t + x)]^2))
```

```
Out[90]= 2/3 a0 a1 c k^2 Sech[k (-c t + x)]^4 (a0 + a1 Sech[k (-c t + x)]^2) +
c (a0 + a1 Sech[k (-c t + x)]^2) (1 - a0 / (a0 + a1 Sech[k (-c t + x)]^2)) -
4/3 a0 a1^2 c k^2 Sech[k (-c t + x)]^4 Tanh[k (-c t + x)]^2 -
4/3 a0 a1 c k^2 Sech[k (-c t + x)]^2 (a0 + a1 Sech[k (-c t + x)]^2) Tanh[k (-c t + x)]^2
```

```
Out[91]= a0 + a1 Sech[k x]^2
```

```
Out[92]= c (1 - a0 / (a0 + a1 Sech[k x]^2))
```

```
Out[93]= 2/3 a0 a1 c k^2 Sech[k x]^4 (a0 + a1 Sech[k x]^2) + c (a0 + a1 Sech[k x]^2) (1 - a0 / (a0 + a1 Sech[k x]^2)) -
4/3 a0 a1^2 c k^2 Sech[k x]^4 Tanh[k x]^2 - 4/3 a0 a1 c k^2 Sech[k x]^2 (a0 + a1 Sech[k x]^2) Tanh[k x]^2
```

```
Out[94]= 1/2 (g (a0 + a1 Sech[k x]^2)^2 +
c^2 (a0 + a1 Sech[k x]^2) (1 - a0 / (a0 + a1 Sech[k x]^2))^2 + 4 a0^2 a1^2 c^2 k^2 Sech[k x]^4 Tanh[k x]^2 / (3 (a0 + a1 Sech[k x]^2)))
```

```
In[95]:= Integrate[h0, {x, xb, xe}]
```

```
Out[95]= -a0 xb + a0 xe + a1 (-Tanh[k xb] + Tanh[k xe]) / k
```

```
In[96]:= Integrate[u0 * h0, {x, xb, xe}]
```

```
Out[96]= a1 c (-Tanh[k xb] + Tanh[k xe]) / k
```

```
In[97]:= Integrate[G0, {x, xb, xe}]
```

```
Out[97]= -1/3 a1 c ((3 + 2 a0^2 k^2 Sech[k xb]^2 + 2 a0 a1 k^2 Sech[k xb]^4) Tanh[k xb] -
(3 + 2 a0^2 k^2 Sech[k xe]^2 + 2 a0 a1 k^2 Sech[k xe]^4) Tanh[k xe])
```

```
In[98]:= Integrate[g * h0 * h0 , x]
Integrate[h0 * u0 * u0 , x]
Integrate[h0^3 / 3 * D[u0, x]^2 , x]
```

$$\text{Out[98]} = \frac{1}{12 k} g \text{Sech}[k x]^3 \left(9 a_0^2 k x \cosh[k x] + 3 a_0^2 k x \cosh[3 k x] + 4 a_1 (3 a_0 + 2 a_1 + (3 a_0 + a_1) \cosh[2 k x]) \sinh[k x] \right)$$

$$\text{Out[99]} = \frac{\sqrt{a_1} c^2 \left(-\frac{a_0 \text{ArcTanh}\left[\frac{\sqrt{a_1} \tanh[k x]}{\sqrt{a_0 + a_1}}\right]}{\sqrt{a_0 + a_1}} + \sqrt{a_1} \tanh[k x] \right)}{k}$$

$$\text{Out[100]} = \left(2 a_0^2 c^2 k (a_0 + 2 a_1 + a_0 \cosh[2 k x]) \text{Sech}[k x]^2 \right. \\ \left. \left(-3 a_0 \sqrt{a_0 + a_1} \text{ArcTanh}\left[\frac{\sqrt{a_1} \tanh[k x]}{\sqrt{a_0 + a_1}}\right] + \sqrt{a_1} (3 a_0 + a_1 - a_1 \text{Sech}[k x]^2) \tanh[k x] \right) \right) / \\ \left(9 \sqrt{a_1} (a_0 + a_1 \text{Sech}[k x]^2) \right)$$