Lab Problem 14.5(a), Physics 430

```
> restart;
```

Write down the Korteweg-deVries equation

```
> kdv:=diff(v(x,t),t)+v(x,t)*diff(v(x,t),x)+alpha*diff(v(x,t),x$3)=0
  ;
```

$$kdv := \left(\frac{\partial}{\partial t} v(x,t)\right) + v(x,t)\left(\frac{\partial}{\partial x} v(x,t)\right) + \alpha\left(\frac{\partial^3}{\partial x^3} v(x,t)\right) = 0$$

Write down the soliton solution

```
> soliton:=12*k^2*alpha/cosh(k*(x-x0-4*alpha*k^2*t))^2;
```

$$soliton := 12\,\frac{k^2\,\alpha}{\cosh(k\,(x - x0 - 4\,\alpha\,k^2\,t))^2}$$

Substitute the soliton solution into the Korteweg-deVries equation

```
> subs(v(x,t)=soliton,kdv);
```

$$\left(\frac{\partial}{\partial t}\left(12\,\frac{k^2\,\alpha}{\cosh(k\,(x - x0 - 4\,\alpha\,k^2\,t))^2}\right)\right) + \frac{12\,k^2\,\alpha\left(\frac{\partial}{\partial x}\left(12\,\frac{k^2\,\alpha}{\cosh(k\,(x - x0 - 4\,\alpha\,k^2\,t))^2}\right)\right)}{\cosh(k\,(x - x0 - 4\,\alpha\,k^2\,t))^2} + \alpha\left(\frac{\partial^3}{\partial x^3}\left(12\,\frac{k^2\,\alpha}{\cosh(k\,(x - x0 - 4\,\alpha\,k^2\,t))^2}\right)\right) = 0$$

Evaluate the derivatives

```
> value(%);
```

$$96\,\frac{k^5\,\alpha^2\sinh(k\,(x - x0 - 4\,\alpha\,k^2\,t))}{\cosh(k\,(x - x0 - 4\,\alpha\,k^2\,t))^3} - \frac{288\,k^5\,\alpha^2\sinh(k\,(x - x0 - 4\,\alpha\,k^2\,t))}{\cosh(k\,(x - x0 - 4\,\alpha\,k^2\,t))^5} + \alpha\left(-288\,\frac{k^5\,\alpha\sinh(k\,(x - x0 - 4\,\alpha\,k^2\,t))^3}{\cosh(k\,(x - x0 - 4\,\alpha\,k^2\,t))^5} + \frac{192\,k^5\,\alpha\sinh(k\,(x - x0 - 4\,\alpha\,k^2\,t))}{\cosh(k\,(x - x0 - 4\,\alpha\,k^2\,t))^3}\right) = 0$$

And simplify to see if the left side vanishes, as it should for a solution

```
> simplify(%);
```

$$0 = 0$$

```
>
```