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In[1]:= (*omega := 10.0;*)
(*m := 4.0;*)
(*epsilon := 0.5;*)
(*amp = 18.0*)
f[x_] := -amp * Sin[omega * x] - m * x
oldf[x_] := -4 * x

In[3]:= v[x_] := Integrate[ -f[t] * (-t), {t, 0, x} ] + Integrate[ -f[t] * (-x), {t, x, 1} ];
Simplify[v[x]]

Out[4]= 
$$\frac{m \omega^2 x (-3 + x^2) + 6 \text{amp} \omega x \cos[\omega] - 6 \text{amp} \sin[\omega x]}{6 \omega^2}$$


In[5]:= u[x_] := v[x] + epsilon * x + 1

In[6]:= Simplify[u[x]]

Out[6]= 
$$1 + \epsilon x - \frac{m x}{2} + \frac{m x^3}{6} + \frac{\text{amp} x \cos[\omega]}{\omega} - \frac{\text{amp} \sin[\omega x]}{\omega^2}$$


In[7]:= Simplify[D[u[x], x]]

Out[7]= 
$$\epsilon - \frac{m}{2} + \frac{m x^2}{2} + \frac{\text{amp} \cos[\omega]}{\omega} - \frac{\text{amp} \cos[\omega x]}{\omega}$$


In[8]:= v[0] // N
D[v[x], x] /. x -> 1 // N
Simplify[D[D[v[x], x], x] + f[x]]

Out[8]= 0.

Out[9]= 
$$-1. m - 1. \text{amp} \sin[\omega] + \frac{0.5 (2. m \omega + 2. \text{amp} \omega \sin[\omega])}{\omega}$$


Out[10]= 0

In[11]:= u[0]
D[u[x], x] /. x -> 1
Simplify[D[D[u[x], x], x] + f[x]]

Out[11]= 1

Out[12]= 
$$\epsilon - m - \text{amp} \sin[\omega] + \frac{2 m \omega + 2 \text{amp} \omega \sin[\omega]}{2 \omega}$$


Out[13]= 0

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