In[∘]:=
```
u[y_] := Piecewise[{
     {y, 0 < y < 5},
     {5 Log[y] - 3.05, 5 < y < 30},
     {2.5 Log[y] + 5.5, y > 30}}];
```

In[∘]:=
```
data = Table[{y, u[y]}, {y, 1, 100}];
```

In[∘]:=
```
powerLawModel[y_, A_] := A y^(1/7);
```

In[∘]:=
```
fitResult = NonlinearModelFit[data, powerLawModel[y, A], {A}, y];
fitResult["RSquared"]
```

Out[∘]=

$$0.968906$$

In[∘]:=
```
fittedPowerLaw = Normal[fitResult]
```

Out[∘]=

$$8.26045\, y^{1/7}$$

In[∘]:=
```
powerLaw = u⁺ == fittedPowerLaw /. {y → y⁺}
```

Out[∘]=

$$u^{+} == 8.26045\, (y^{+})^{1/7}$$

In[∘]:=
```
bcs = {u⁺ → U∞/uτ, y⁺ → uτ δ[x]/ν};
```

In[∘]:=
```
Cf = Solve[{powerLaw /. bcs} /. {uτ → (Cf U∞^2/2)^(1/2)}, Cf] // #[[4]][[1]][[2]] &
```

Solve: There may be values of the parameters for which some or all solutions are not valid.

Out[∘]=

$$\frac{0.0496905\, \nu^{1/4}}{U_{\infty}^{1/4}\, \delta[x]^{1/4}}$$

In[∘]:=
```
f = (y/δ[x])^(1/7);
```

In[∘]:=
```
momInt = ∂x ∫_0^δ[x] f (1 - f) dy == Cf/2
```

Out[∘]=

$$\frac{7\, \delta'[x]}{72} == \frac{0.0248452\, \nu^{1/4}}{U_{\infty}^{1/4}\, \delta[x]^{1/4}}$$

In[∘]:=
```
sol = DSolve[{momInt, δ[0] == 0}, δ, x]
```

Out[∘]=

$$\left\{\left\{\delta \to \text{Function}\left[\{x\},\ 0.401338 \left(\frac{x\, \nu^{1/4}}{U_{\infty}^{1/4}}\right)^{4/5}\right]\right\}\right\}$$

In[∘]:=
```
Simplify[Cf /. sol] /. {x → Re_x ν/U∞} // Simplify[#, {U∞ > 0, ν > 0}][[1]] &
```

Out[∘]=

$$\frac{0.0624303}{\text{Re}_x^{1/5}}$$