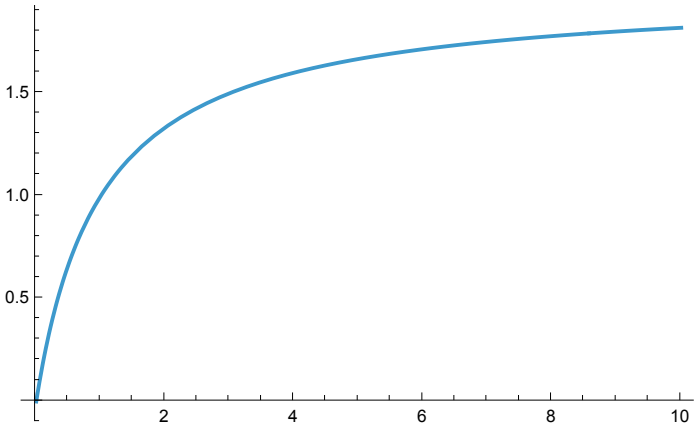
In[1]:=
```
(*Question 1a*)
params = {Vm → 2, Keq → 10^4, Ks → 1., Kp → 10^4, p → 0}
rate = Vm * s / Ks * (1 - p / s / Keq) / (1 + s / Ks + p / Kp)
Plot[rate /. params, {s, 0, 10}, PlotRange → All]
```

Out[1]= $\{Vm \to 2, Keq \to 10\,000, Ks \to 1., Kp \to 10\,000, p \to 0\}$

Out[2]=
$$\frac{\left(1 - \frac{p}{Keq\ s}\right)\ s\ Vm}{Ks\ \left(1 + \frac{p}{Kp} + \frac{s}{Ks}\right)}$$

Out[3]=



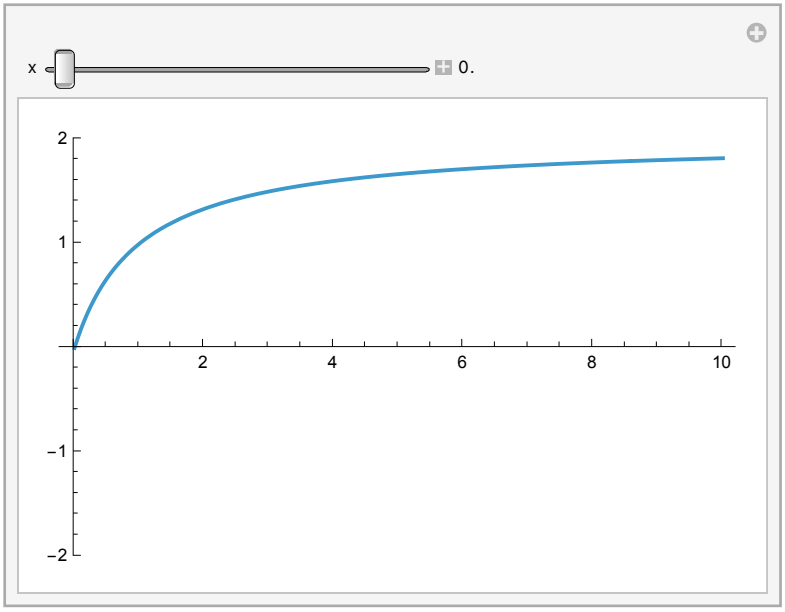
In[ ]:=

```
params2 = {Vm → 2, Keq → 10^4, Ks → 1., Kp → 10^4}
rate2 = Vm * s / Ks * (1 - p / s / Keq) / (1 + s / Ks + p / Kp)
Manipulate[Plot[rate2 /. params2 /. p → x, {s, 0., 10}, PlotRange → {-2, 2}],
 {x, 0, 10 000, Appearance → "Labeled"}]
```

Out[4]= $\{Vm \to 2, Keq \to 10\,000, Ks \to 1., Kp \to 10\,000\}$

Out[5]=
$$\frac{\left(1 - \frac{p}{Keq\ s}\right)\ s\ Vm}{Ks\ \left(1 + \frac{p}{Kp} + \frac{s}{Ks}\right)}$$

Out[6]=

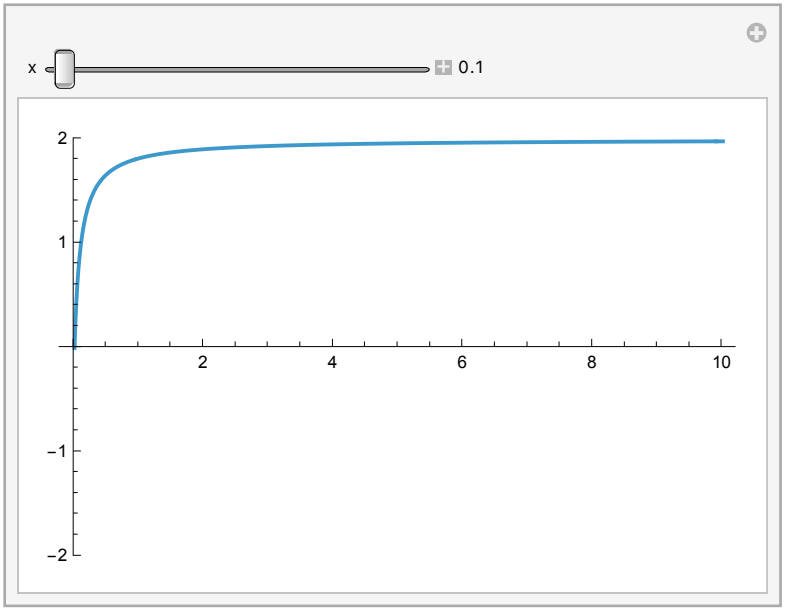


```
(*Question 1b*)
params3 = {Vm → 2, Keq → 10^4, Kp → 10^4, p → 0}
rate3 = Vm * s / Ks * (1 - p / s / Keq) / (1 + s / Ks + p / Kp)
Manipulate[Plot[rate3 /. params3 /. Ks → x, {s, 0., 10}, PlotRange → {-2, 2}],
 {x, 0.1, 10, Appearance → "Labeled"}]
```

Out[7]= $\{Vm \to 2, Keq \to 10\,000, Kp \to 10\,000, p \to 0\}$

Out[8]=
$$\frac{\left(1 - \frac{p}{Keq\ s}\right)\ s\ Vm}{Ks\ \left(1 + \frac{p}{Kp} + \frac{s}{Ks}\right)}$$

Out[9]=



```
(*Question 1c*)
params4 = {Keq → 10^4, Kp → 10^4, p → 0, Ks → 1}
rate4 = Vm * s / Ks * (1 - p / s / Keq) / (1 + s / Ks + p / Kp)
Manipulate[Plot[rate4 /. params4 /. Vm → x, {s, 0., 10}, PlotRange → {-2, 10}],
 {x, 0.1, 10, Appearance → "Labeled"}]
```

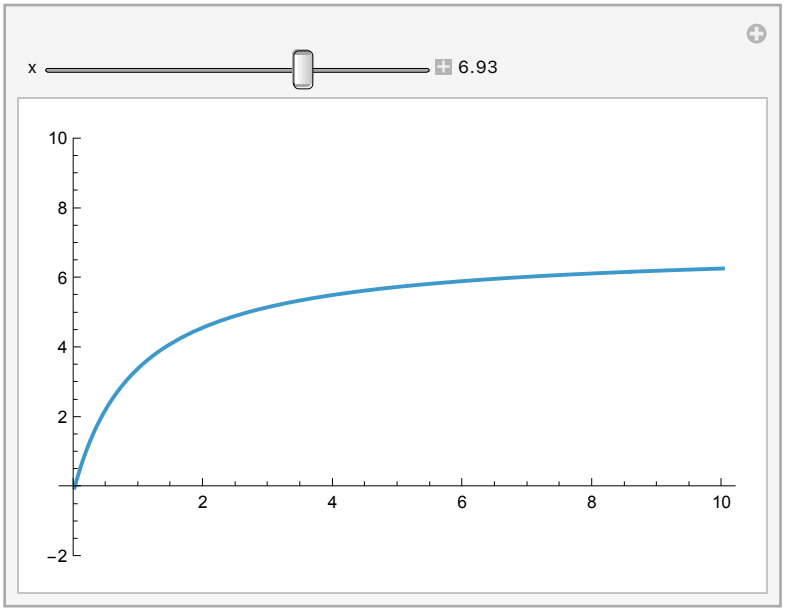
Out[123]=

$$\{\text{Keq} \to 10\,000,\ \text{Kp} \to 10\,000,\ \text{p} \to 0,\ \text{Ks} \to 1\}$$

Out[124]=

$$\frac{\left(1 - \frac{\text{p}}{\text{Keq s}}\right)\ \text{s Vm}}{\text{Ks}\left(1 + \frac{\text{p}}{\text{Kp}} + \frac{\text{s}}{\text{Ks}}\right)}$$

Out[125]=




```
(*Question 1d*)
```

In[126]:=

```
params5 = {Vm → 2, Keq → 10^4, Ks → 1., Kp → 10^4, p → 0};
rate5 = Vm * s / Ks * (1 - p / s / Keq) / (1 + s / Ks + p / Kp);
```

In[128]:=

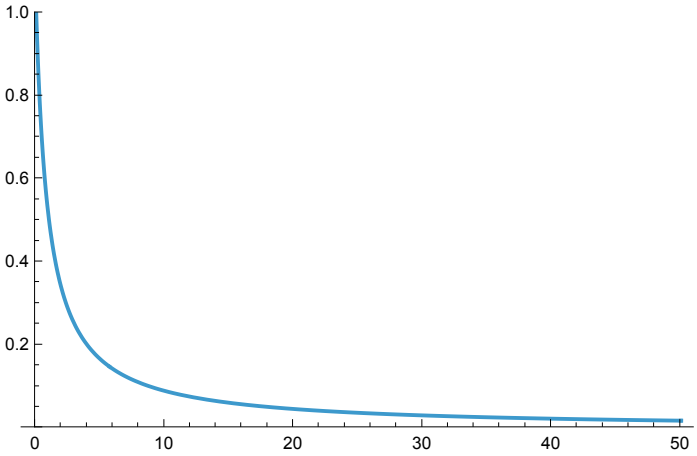
```
elas = FullSimplify[s / rate5 * D[rate5, s]]
```

Out[128]=

$$\frac{\text{p}}{-\text{p} + \text{Keq s}} + \frac{\text{Ks}\ (\text{Kp} + \text{p})}{\text{Ks p} + \text{Kp}\ (\text{Ks} + \text{s})}$$

In[129]:=
```
Plot[elas /. params5, {s, 0, 50}, PlotRange → {All, {0, 1}}]
```

Out[129]=



In[130]:=
```
(*Question 2a*)

params7 = {Vm → 2, Keq → 10^6, s05 → 1., p05 → 1, p → 0}
rate7 =
 Vm * s / s05 * (1 - p / s / Keq) * (s / s05 + p / p05)^(n - 1) / (1 + (s / s05 + p / p05)^n)
lp = Manipulate[Plot[rate7 /. n → x /. params7, {s, 0., 5}, PlotRange → {0, 2}],
   {x, 1., 4, Appearance → "Labeled"}]
```

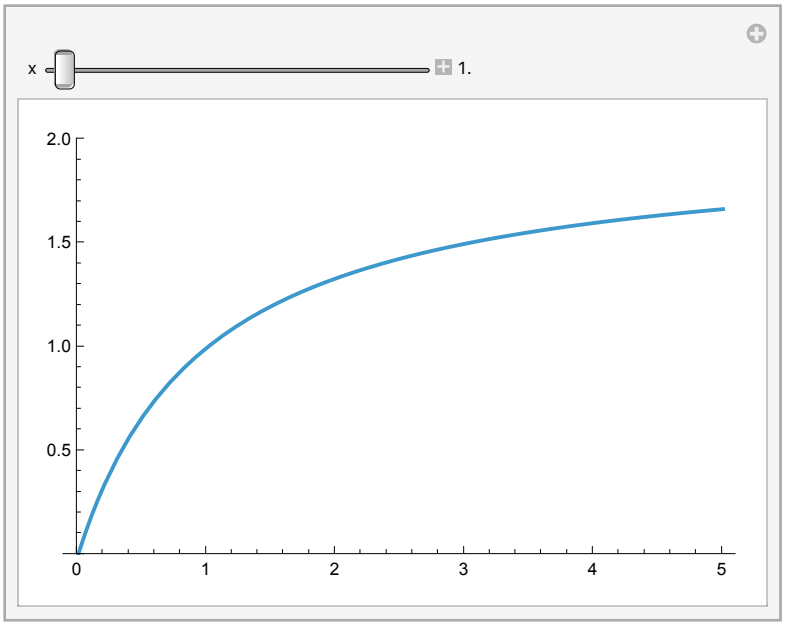
Out[130]=

$$\{Vm \to 2,\ Keq \to 1\,000\,000,\ s05 \to 1.,\ p05 \to 1,\ p \to 0\}$$

Out[131]=

$$\frac{\left(1 - \frac{p}{Keq\ s}\right)\ s\ \left(\frac{p}{p05} + \frac{s}{s05}\right)^{-1+n}\ Vm}{\left(1 + \left(\frac{p}{p05} + \frac{s}{s05}\right)^{n}\right)\ s05}$$

Out[132]=




```
(*Question 2ai*)
```

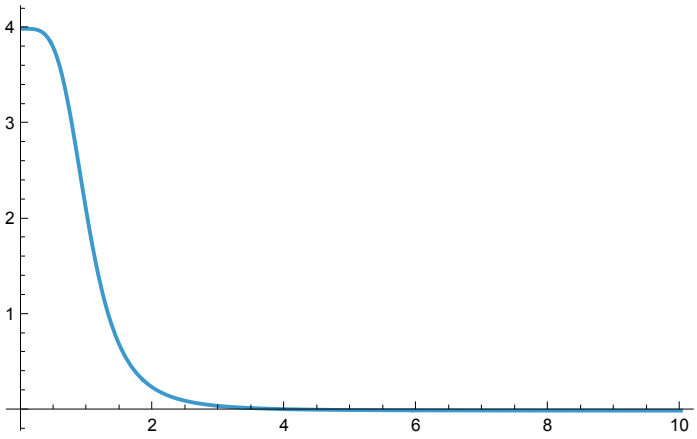
In[133]:=
```
params8 = {Vm → 2, Keq → 10^6, s05 → 1., p05 → 1, p → 0};
rate8 =
  Vm * s / s05 * (1 - p / s / Keq) * (s / s05 + p / p05)^(n - 1) / (1 + (s / s05 + p / p05)^n);
```

In[135]:=
```
elas = s / rate8 * D[rate8, s] /. n → 4
```

Out[135]=
$$\left(\left(1+\left(\frac{p}{p05}+\frac{s}{s05}\right)^4\right) s05 \left(\frac{3\left(1-\frac{p}{Keq\ s}\right) s \left(\frac{p}{p05}+\frac{s}{s05}\right)^2 Vm}{\left(1+\left(\frac{p}{p05}+\frac{s}{s05}\right)^4\right) s05^2} - \frac{4\left(1-\frac{p}{Keq\ s}\right) s \left(\frac{p}{p05}+\frac{s}{s05}\right)^6 Vm}{\left(1+\left(\frac{p}{p05}+\frac{s}{s05}\right)^4\right)^2 s05^2} + \frac{\left(1-\frac{p}{Keq\ s}\right)\left(\frac{p}{p05}+\frac{s}{s05}\right)^3 Vm}{\left(1+\left(\frac{p}{p05}+\frac{s}{s05}\right)^4\right) s05} + \frac{p\left(\frac{p}{p05}+\frac{s}{s05}\right)^3 Vm}{Keq\ s\left(1+\left(\frac{p}{p05}+\frac{s}{s05}\right)^4\right) s05}\right)\right) \Big/ \left(\left(1-\frac{p}{Keq\ s}\right)\left(\frac{p}{p05}+\frac{s}{s05}\right)^3 Vm\right)$$

In[136]:=
```
Plot[elas /. params8, {s, 0, 10}, PlotRange → All]
```

Out[136]=

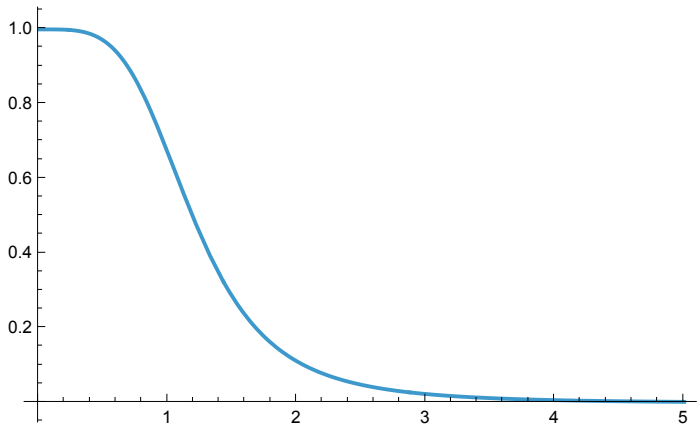


```
(*Question 2biA*)
params9 = {Vm → 2, Keq → 10^4, s05 → 1.,
    p05 → 10^4, p → 1, s → 1, n → 4, alpha → 10^-4, x05 → 1};
rate9 = Vm * s / s05 * (1 - p / s / Keq) * (s / s05 + p / p05)^(n - 1) /
    (((1 + (xx / x05)^n) / (1 + alpha * (xx / x05)^n)) + (s / s05 + p / p05)^n)
Plot[rate9 /. params9, {xx, 0, 5}, PlotRange → All]
```

Out[138]=

$$\frac{\left(1-\frac{p}{Keq\ s}\right)\ s\ \left(\frac{p}{p05}+\frac{s}{s05}\right)^{-1+n}\ Vm}{s05\ \left(\left(\frac{p}{p05}+\frac{s}{s05}\right)^{n}+\frac{1+\left(\frac{xx}{x05}\right)^{n}}{1+alpha\ \left(\frac{xx}{x05}\right)^{n}}\right)}$$

Out[139]=

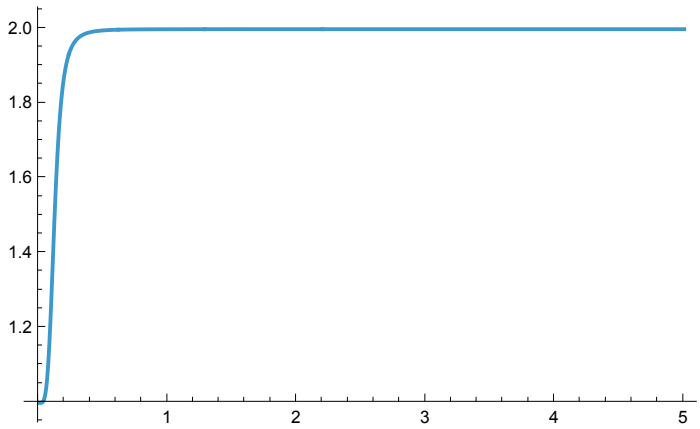



```
(*Question 2biB*)
params10 = {Vm → 2, Keq → 10^4, s05 → 1.,
    p05 → 10^4, p → 1, s → 1, n → 4, alpha → 10^4, x05 → 1};
rate10 = Vm * s / s05 * (1 - p / s / Keq) * (s / s05 + p / p05)^(n - 1) /
    (((1 + (xx / x05)^n) / (1 + alpha * (xx / x05)^n)) + (s / s05 + p / p05)^n)
Plot[rate10 /. params10, {xx, 0, 5}, PlotRange → All]
```

Out[141]=

$$\frac{\left(1-\frac{p}{Keq\ s}\right)\ s\ \left(\frac{p}{p05}+\frac{s}{s05}\right)^{-1+n}\ Vm}{s05\ \left(\left(\frac{p}{p05}+\frac{s}{s05}\right)^{n}+\frac{1+\left(\frac{xx}{x05}\right)^{n}}{1+alpha\ \left(\frac{xx}{x05}\right)^{n}}\right)}$$

Out[142]=



In[ ]:=

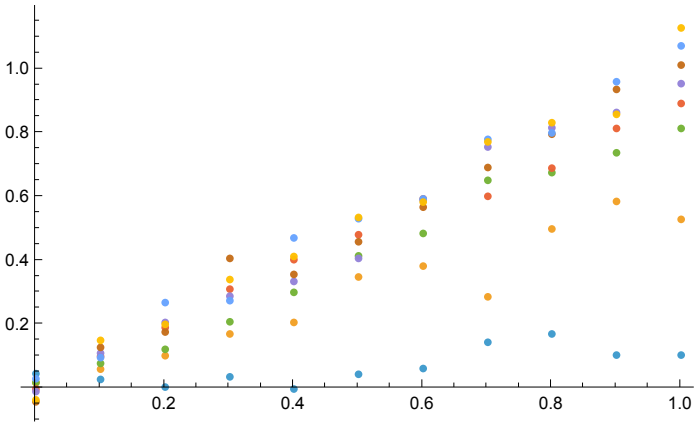
```
(*Question 3*)
```

In[87]:=
```
data1 = Import[NotebookDirectory[] <> "s0.5mM.csv"];
data2 = Import[NotebookDirectory[] <> "s4mM.csv"];
data3 = Import[NotebookDirectory[] <> "s8mM.csv"];
data4 = Import[NotebookDirectory[] <> "s12mM.csv"];
data5 = Import[NotebookDirectory[] <> "s16mM.csv"];
data6 = Import[NotebookDirectory[] <> "s20mM.csv"];
data7 = Import[NotebookDirectory[] <> "s24mM.csv"];
data8 = Import[NotebookDirectory[] <> "s36mM.csv"];

data = dataAll =
   Join[{data1}, {data2}, {data3}, {data4}, {data5}, {data6}, {data7}, {data8}];
```

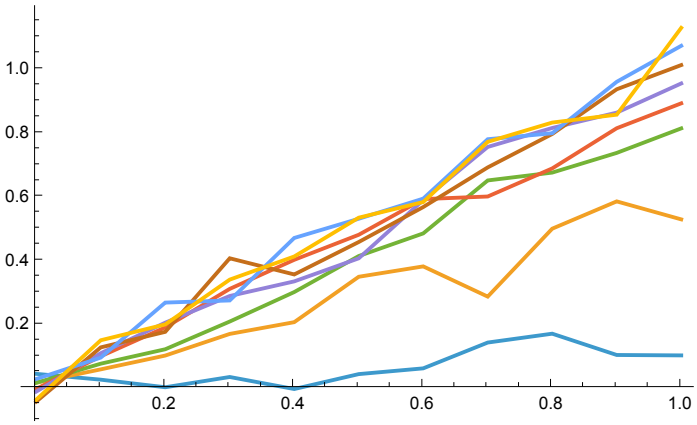
In[96]:=
```
ListPlot[dataAll]
```

Out[96]=



In[97]:=
```
ListLinePlot[dataAll]
```

Out[97]=



In[103]:=
```
lm1 = NonlinearModelFit[data[[1]], m x + c, {m, c}, x]
lm2 = NonlinearModelFit[data[[2]], m x + c, {m, c}, x]
lm3 = NonlinearModelFit[data[[3]], m x + c, {m, c}, x]
lm4 = NonlinearModelFit[data[[4]], m x + c, {m, c}, x]
lm5 = NonlinearModelFit[data[[5]], m x + c, {m, c}, x]
lm6 = NonlinearModelFit[data[[6]], m x + c, {m, c}, x]
lm7 = NonlinearModelFit[data[[7]], m x + c, {m, c}, x]
lm8 = NonlinearModelFit[data[[8]], m x + c, {m, c}, x]
```

Out[103]=
FittedModel[0.0049 + 0.126 x]

Out[104]=
FittedModel[0.00599 + 0.57 x]

Out[105]=
FittedModel[−0.0149 + 0.851 x]

Out[106]=
FittedModel[0.0259 + 0.873 x]

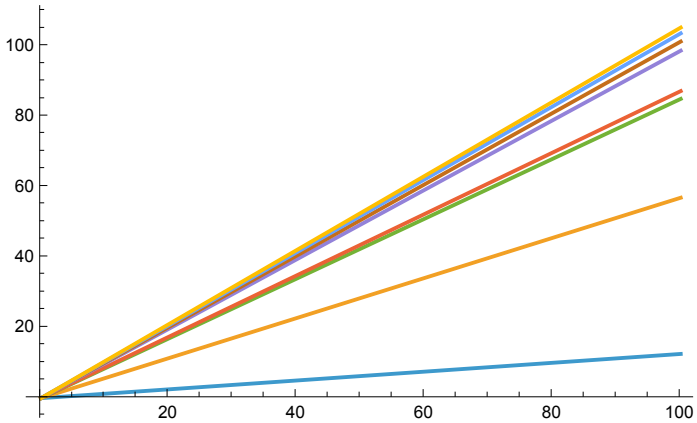
Out[107]=
FittedModel[−0.00967 + 0.988 x]

Out[108]=
FittedModel[−0.00674 + 1.01 x]

Out[109]=
FittedModel[0.0169 + 1.04 x]

Out[110]=
FittedModel[−0.000546 + 1.05 x]

In[112]:=
```
Plot[Evaluate[{lm1[x], lm2[x], lm3[x], lm4[x], lm5[x], lm6[x], lm7[x], lm8[x]}],
 {x, 0, 100}]
```

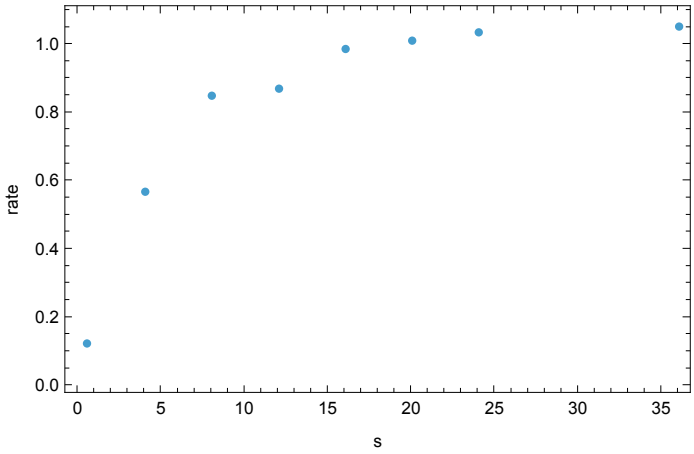
Out[112]=


In[113]:=
```
ratelist =
 {{0.5, m /. lm1["BestFitParameters"]}, {4, m /. lm2["BestFitParameters"]},
  {8, m /. lm3["BestFitParameters"]}, {12, m /. lm4["BestFitParameters"]},
  {16, m /. lm5["BestFitParameters"]}, {20, m /. lm6["BestFitParameters"]},
  {24, m /. lm7["BestFitParameters"]}, {36, m /. lm8["BestFitParameters"]}}
```

Out[113]=
```
{{0.5, 0.125731}, {4, 0.569776}, {8, 0.85089}, {12, 0.872682},
 {16, 0.987883}, {20, 1.01383}, {24, 1.03693}, {36, 1.05351}}
```

In[114]:=
```
lp = ListPlot[ratelist, Frame → True, FrameLabel → {"s", "rate"}]
```

Out[114]=



In[115]:=
```
nlm = NonlinearModelFit[ratelist, {s * vmax / (Ks + s)}, {Ks, vmax}, s]
```

Out[115]=

$$\text{FittedModel}\left[\frac{1.2\,s}{4.01+s}\right]$$

In[116]:=
```
nlm["BestFitParameters"]
```

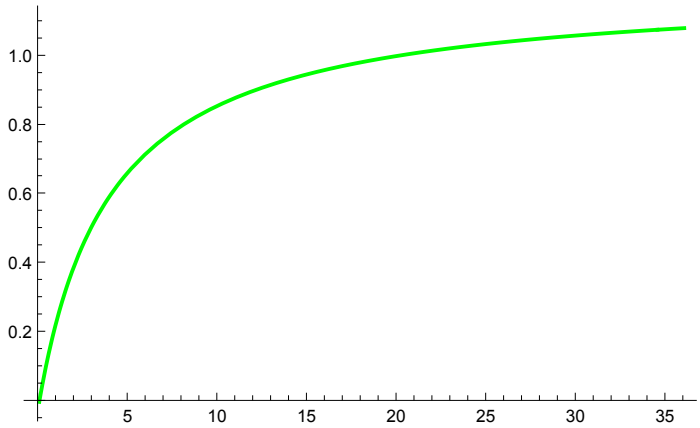
Out[116]=
```
{Ks → 4.00731, vmax → 1.20398}
```

In[117]:=
```
nlm["ParameterTable"]
```

Out[117]=

	Estimate	Standard Error	t-Statistic	P-Value
Ks	4.00731	0.476382	8.41197	0.000153829
vmax	1.20398	0.0333483	36.1033	3.01154×10^{-8}

In[120]:=
```
solp = Plot[nlm[s], {s, 0, 36}, PlotStyle → Green]
```
Out[120]=



In[121]:=
```
Show[solp, lp]
```
Out[121]=