Problem Set #2 - Answer Key

I. Simple Supply and Demand Diagrams.

Part a)

Here, we have the supply equation:

```
> S1:=Q1=10+2*p;
```

$$S1 := Q1 = 10 + 2\,p$$

and the demand equation:

```
> D1:=Q1=100-2*p;
```

$$D1 := Q1 = 100 - 2\,p$$

It's convenient to solve both of these for p, so we have:

```
> ps1:=solve(S1,p);
```

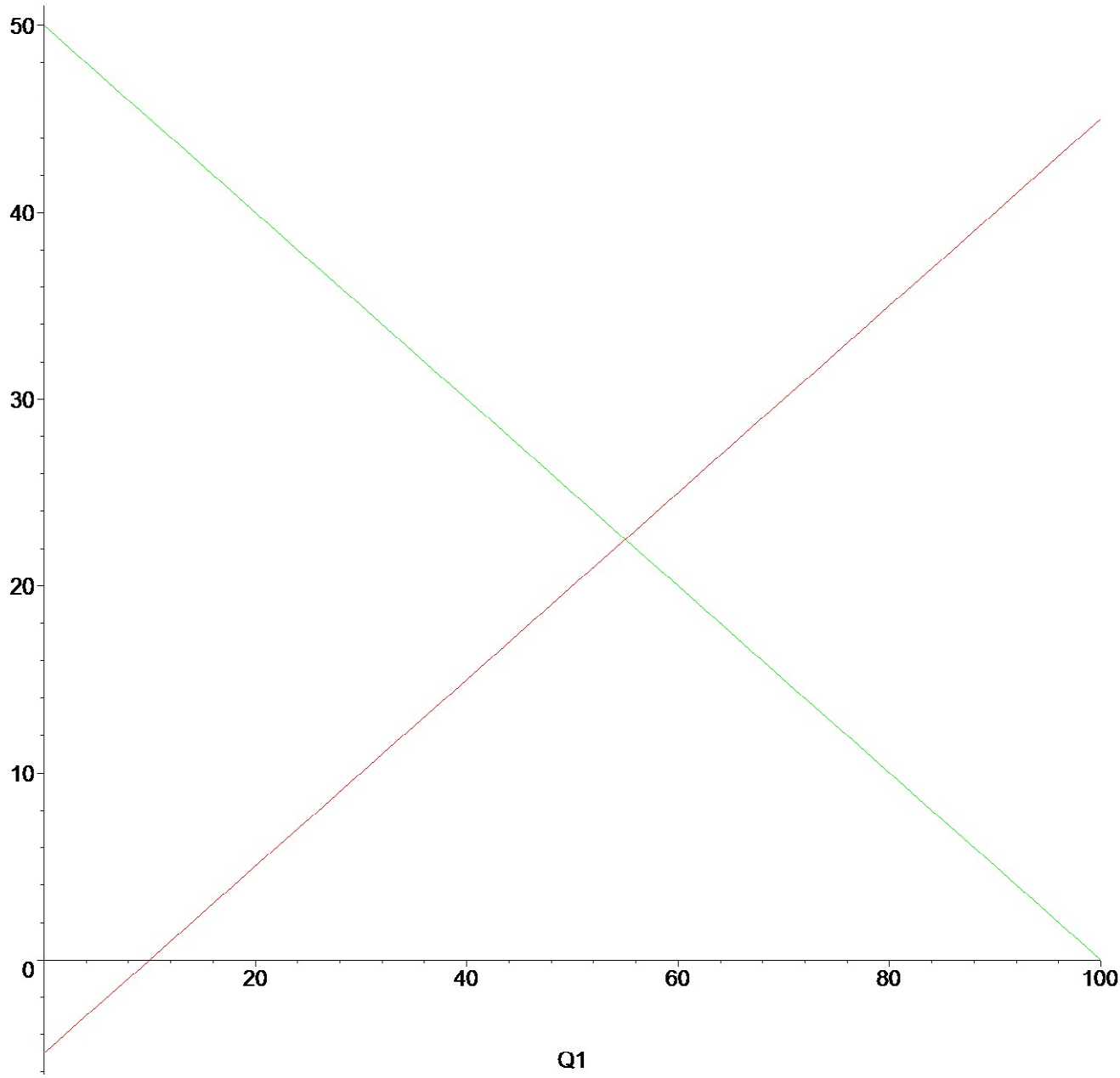
$$ps1 := \frac{Q1}{2} - 5$$

```
> pd1:=solve(D1,p);
```

$$pd1 := -\frac{Q1}{2} + 50$$

The plot of these two equations looks like:

```
> plot({ps1,pd1},Q1=0..100);
```



To solve for market equilibrium, we simply solve the two equations for p and q (note how easy this is with the multiple-equation solving feature of Maple!):

```
> solve({Q=100-2*p,Q=10+2*p},{Q,p});
```

$$\{p = \frac{45}{2}, Q = 55\}$$

Part b)

Here, we have the supply equation:

```
> S1:=Q1=4*p;
```

$$S1 := Q1 = 4\,p$$

and the demand equation:

```
> D1:=Q1=100/p;
```

$$\mathrm{D1} := Q1 = \frac{100}{p}$$

It's convenient to solve both of these for p, so we have:

```
> ps1:=solve(S1,p);
```

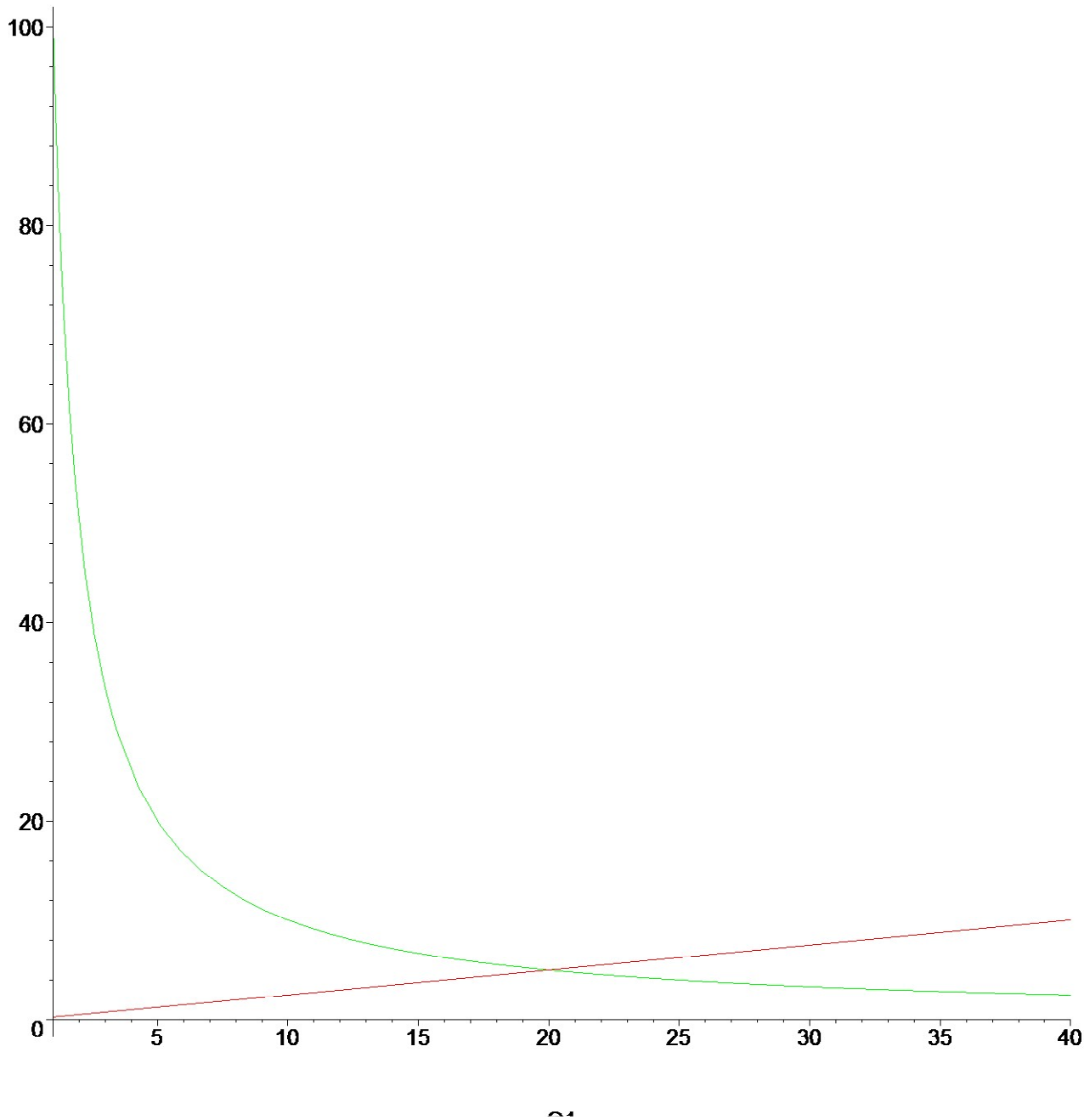
$$ps1 := \frac{Q1}{4}$$

```
> pd1:=solve(D1,p);
```

$$pd1 := \frac{100}{Q1}$$

The plot of these two equations looks like:

```
> plot({ps1,pd1},Q1=1..40);
```



To solve for market equilibrium, we simply solve the two equations for p and q (of course, ignore the negative solutions).

```
> solve({Q=100/p,Q=4*p},{Q,p});
```

$$\{p = 5, Q = 20\}, \{p = -5, Q = -20\}$$

Part c)

Here, we have the supply equation:

```
> S1:=Q1=1000+200*p;
```

$$S1 := Q1 = 1000 + 200\,p$$

and the demand equation:

```
> D1:=Q1=10000-200*p;
```

$$D1 := Q1 = 10000 - 200\,p$$

It's convenient to solve both of these for p, so we have:

```
> ps1:=solve(S1,p);
```

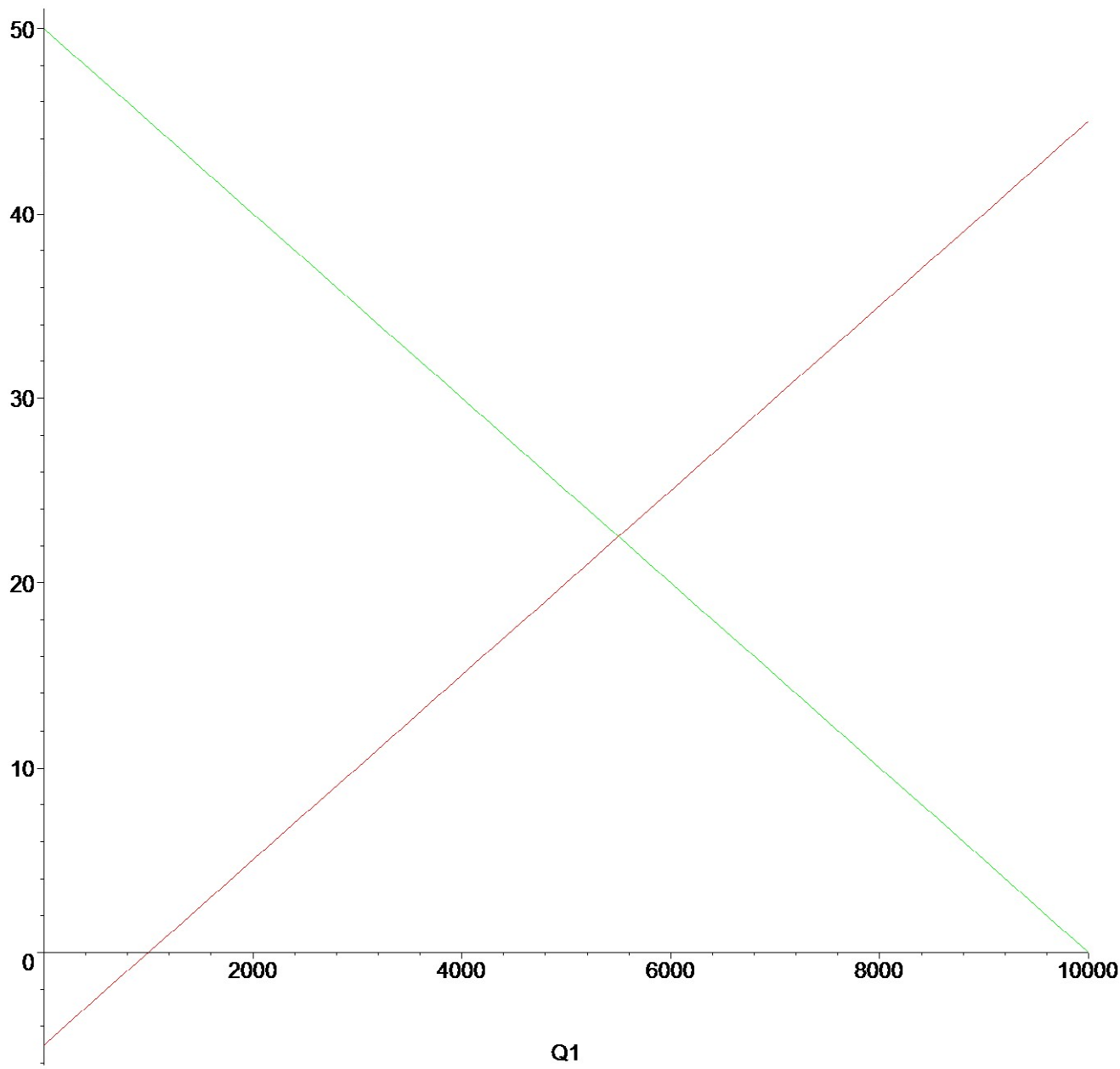
$$ps1 := \frac{Q1}{200} - 5$$

```
> pd1:=solve(D1,p);
```

$$pd1 := -\frac{Q1}{200} + 50$$

The plot of these two equations looks like:

```
> plot({ps1,pd1},Q1=0..10000);
```



To solve for market equilibrium, we simply solve the two equations for p and q :

```
> solve({Q=10000-200*p,Q=1000+200*p},{Q,p});
```

$$\{p = \frac{45}{2}, Q = 5500\}$$

Number 2.

Part a)

Here, we have the new supply equation:

```
> S1:=Q1=20+2*p;
```

$$S1 := Q1 = 20 + 2\,p$$

and the demand equation:

```
> D1:=Q1=100-2*p;
```

$$\mathrm{D1} := Q1 = 100 - 2\,p$$

It's convenient to solve both of these for p, so we have:

```
> ps1:=solve(S1,p);
```

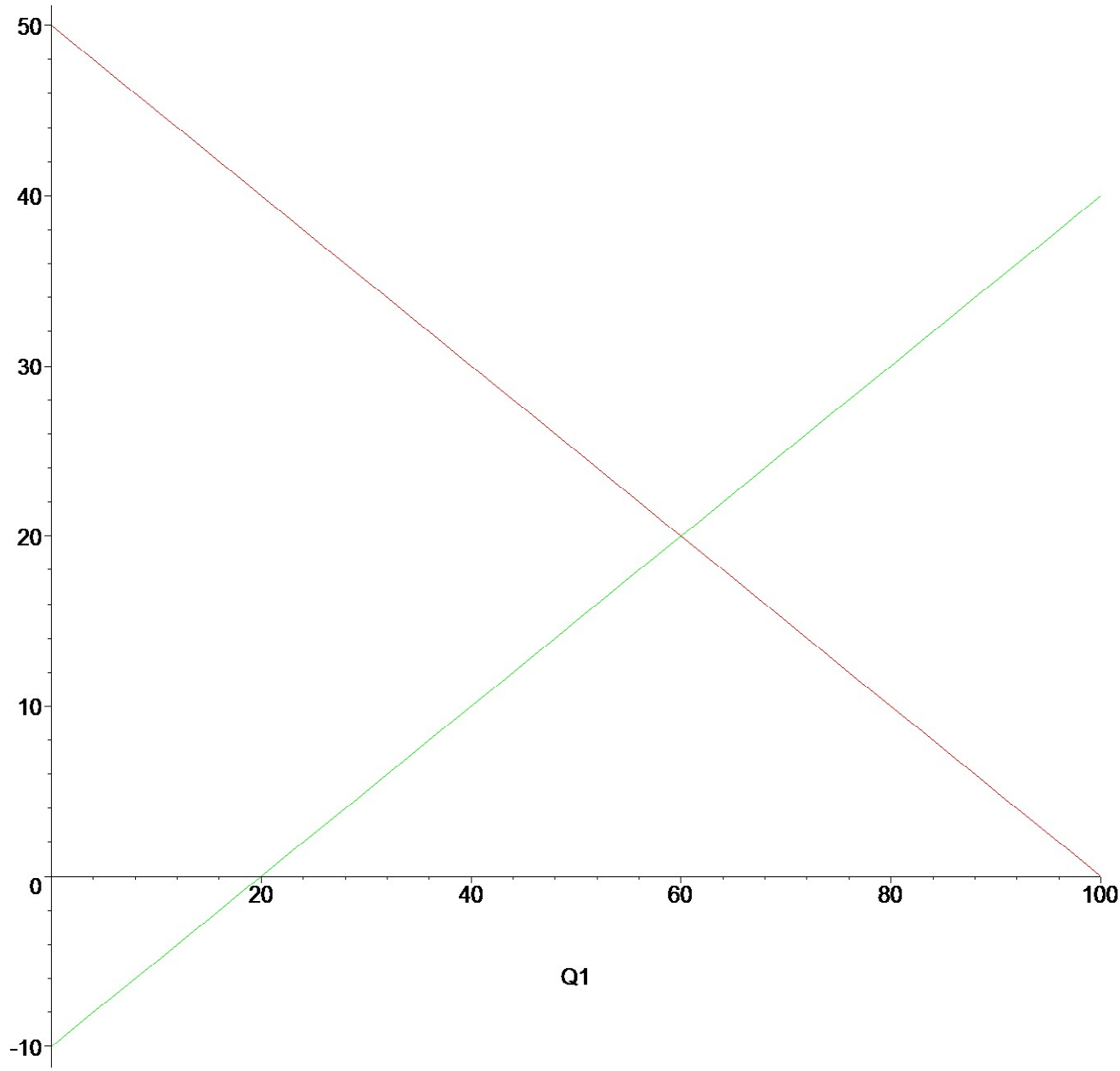
$$ps1 := \frac{Q1}{2} - 10$$

```
> pd1:=solve(D1,p);
```

$$pd1 := -\frac{Q1}{2} + 50$$

The plot of these two equations looks like:

```
> plot({ps1,pd1},Q1=0..100);
```



To solve for market equilibrium, we simply solve the two equations for p and q (note how easy this is with the multiple-equation solving feature of Maple!):

```
> solve({Q=100-2*p,Q=20+2*p},{Q,p});
```

$$\{p = 20, Q = 60\}$$

Number 3:

Here, we have the supply equation:

```
> S1:=Q1=4*p;
```

$$S1 := Q1 = 4\,p$$

and the demand equation:

```
> D1:=Q1=120/p;
```

$$D1 := Q1 = \frac{120}{p}$$

It's convenient to solve both of these for p, so we have:

```
> ps1:=solve(S1,p);
```

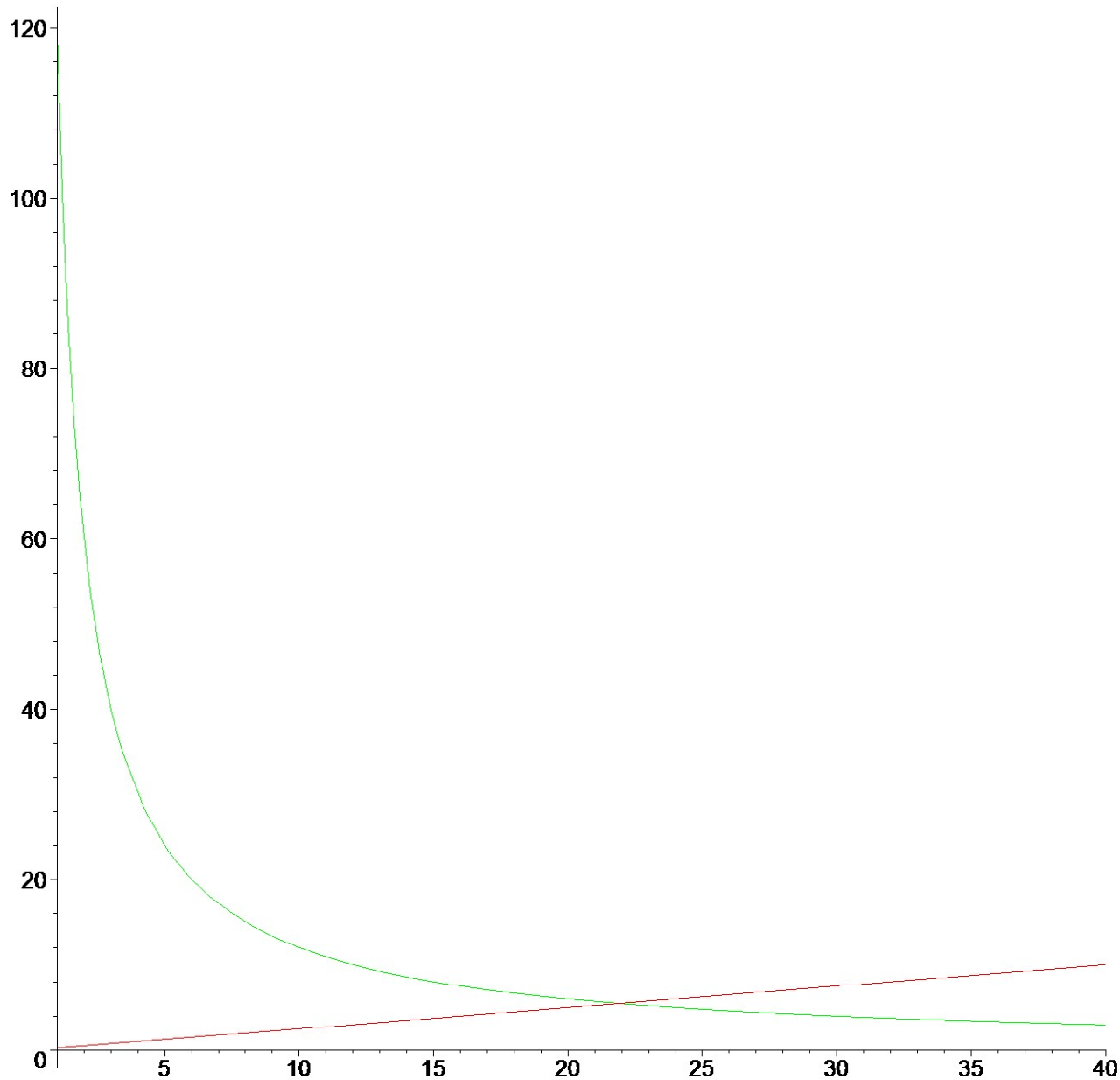
$$ps1 := \frac{Q1}{4}$$

```
> pd1:=solve(D1,p);
```

$$pd1 := \frac{120}{Q1}$$

The plot of these two equations looks like:

```
> plot({ps1,pd1},Q1=1..40);
```



To solve for market equilibrium, we simply solve the two equations for p and q (note how easy this is with the multiple-equation solving feature of Maple!):

```
> solve({Q=120/p,Q=4*p},{Q,p});
```

$$\{p = \mathrm{RootOf}(_Z^2 - 30, label = _L3),\ Q = 4\ \mathrm{RootOf}(_Z^2 - 30, label = _L3)\}$$

What the hell is that? We'll do it by solving:

```
> ps:=evalf(solve(120/p=4*p,p));
```

$$ps := -5.477225575,\ 5.477225575$$

so we have quantity

```
> 120/ps[2];
```

$$21.90890230$$

Number 4:

Here, we have the supply equation:

```
> S1:=Q1=1000+200*p;
```

$$S1 := Q1 = 1000 + 200\,p$$

and the demand equation:

```
> D1:=Q1=10000-300*p;
```

$$D1 := Q1 = 10000 - 300\,p$$

It's convenient to solve both of these for p, so we have:

```
> ps1:=solve(S1,p);
```

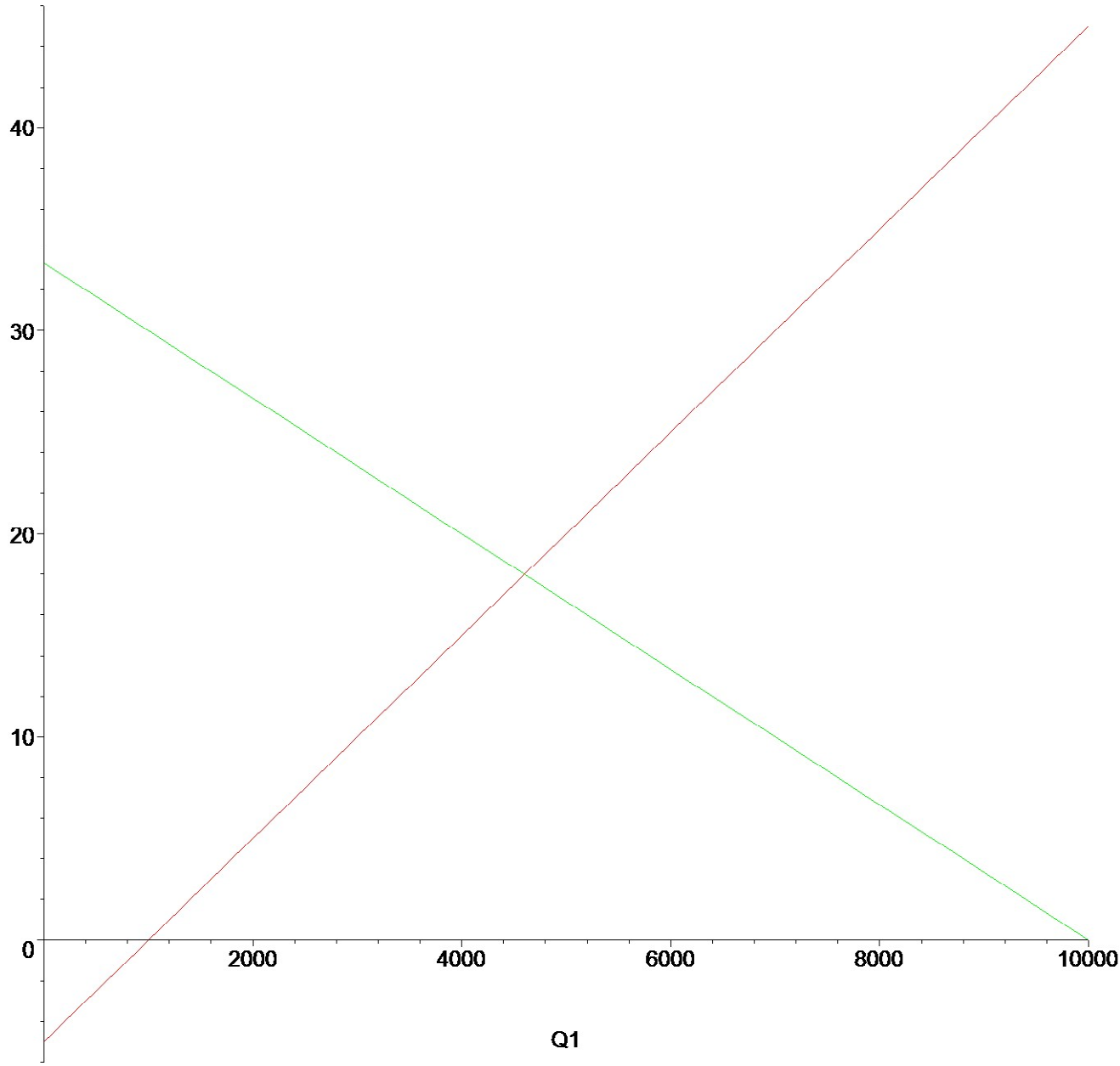
$$ps1 := \frac{Q1}{200} - 5$$

```
> pd1:=solve(D1,p);
```

$$pd1 := -\frac{Q1}{300} + \frac{100}{3}$$

The plot of these two equations looks like:

```
> plot({ps1,pd1},Q1=0..10000);
```



To solve for market equilibrium, we simply solve the two equations for p and q (note how easy this is with the multiple-equation solving feature of Maple!):

```
> solve({Q=10000-300*p,Q=1000+200*p},{Q,p});
```

$$\{p = 18, Q = 4600\}$$

II. Elasticities. Here, we have the following basic equations:

Here, we are given some prices, and must find the elasticity between two points.

Number 1:

We must use the demand function given above, Q=100-2p.

```
> Q:=100-2*p;
```

$$Q := 100 - 2\,p$$

Where we have:

```
> p1:=5;
```

$$p1 := 5$$

```
> p2:=6;
```

$$p2 := 6$$

Our first quantity is given by:

```
> Q1:=subs(p=p1,Q);
```

$$Q1 := 90$$

```
> Q2:=subs(p=p2,Q);
```

$$Q2 := 88$$

The formula for arc elasticity is :

```
> Arcelast:=(Q1-Q2)/((Q1+Q2)/2)/((p1-p2)/((p1+p2)/2));
```

$$Arcelast := \frac{-11}{89}$$

```
> evalf(%);
```

$$-0.1235955056$$

Number 2:

We are asked to repeat the analysis for the case in which the prices are given by 10 and 11. Then, we have:

```
> p1:=10;
```

$$p1 := 10$$

```
> p2:=11;
```

$$p2 := 11$$

Our first quantity is given by:

```
> Q1:=subs(p=p1,Q);
```

$$Q1 := 80$$

```
> Q2:=subs(p=p2,Q);
```

$$Q2 := 78$$

The formula for arc elasticity is :

```
> Arcelast:=(Q1-Q2)/((Q1+Q2)/2)/((p1-p2)/((p1+p2)/2));
```

$$Arcelast := \frac{-21}{79}$$

```
> evalf(%);
```

$$-0.2658227848$$

To do the last problem, we use the demand function:

```
> Q:=100-2*p;
```

$$Q := 100 - 2\,p$$

The formula for the point elasticity is given by DQ/DP*P/Q; this gives us:

```
> Pointelast:=diff(Q,p)*p/Q;
```

$$Pointelast := -\frac{2\,p}{100 - 2\,p}$$

To get this as a formula of quantity only, we must first solve the demand function for Q. We have:

```
> pstar:=solve(Q=Qd,p);
```

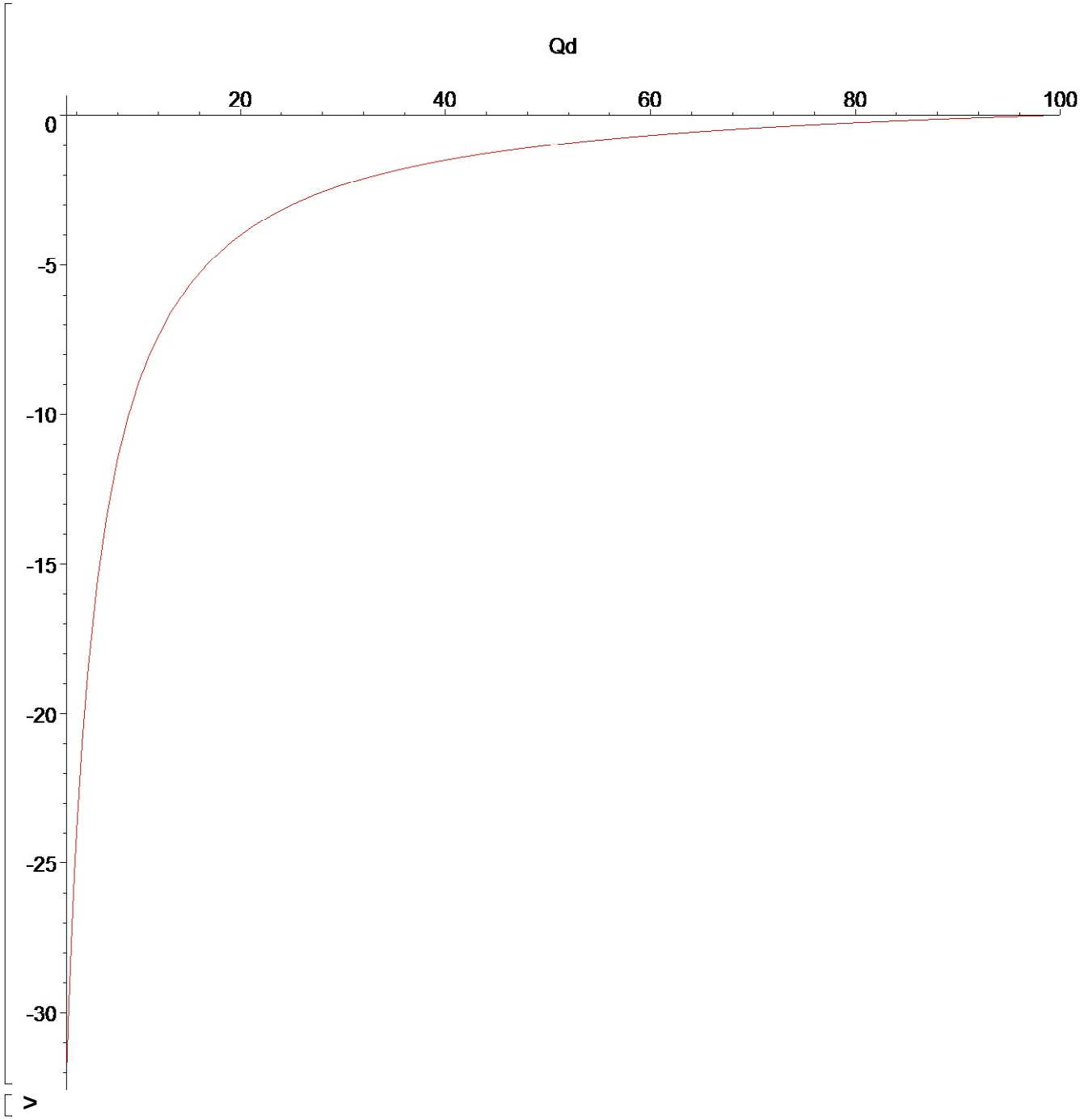
$$pstar := 50 - \frac{Qd}{2}$$

And then we can substitute the result into the Pointelasticity formula we developed above.

```
> Pointelast1:=subs(p=pstar,Pointelast);
```

$$Pointelast1 := -\frac{2\left(50 - \frac{Qd}{2}\right)}{Qd}$$

```
> plot(Pointelast1,Qd=3..100);
```


Qd
20
40
60
80
100
0
-5
-10
-15
-20
-25
-30
V