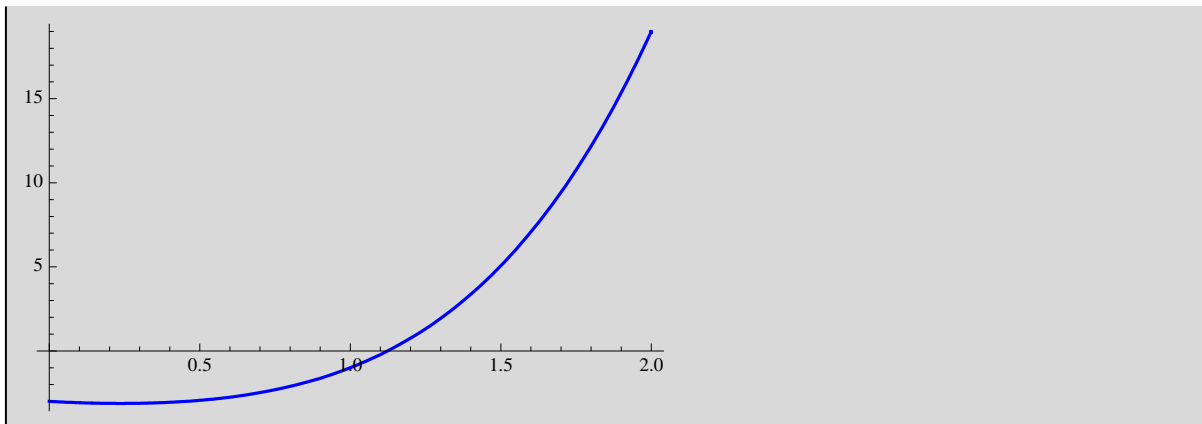```
(** ESERCIZIO 2.2.2 **)
```

```
Clear[f];
f[x_] := x^4 + 2 x^2 - x - 3;
Plot[f[x], {x, 0, 2}, PlotStyle → {RGBColor[0, 0, 1], Thickness[0.005]}]
```



```
a = 0.0; b = 2.0;
tol = 10^(-10);
fa = f[a];
fb = f[b];
an[0] = a; bn[0] = b;
cn[0] = 0.5 * (a + b);
test = b - a;
testbis[0] = bn[0] - an[0];
nmax = 10;
n = 1; While[test > tol, {fa = f[an[n-1]]; fc = f[cn[n-1]];
   If[fa * fc < 0, {an[n] = an[n-1]; bn[n] = cn[n-1]}, {an[n] = cn[n-1]; bn[n] = bn[n-1]}];
   cn[n] = 0.5 * (an[n] + bn[n]); test = Abs[bn[n] - an[n]]; n++}];
Print["Bisezione: n = ", n-1, "  c = ", cn[n-1]]
Clear[x]; test = 1.0; n = 0;
x[0] = 0.4;
While[test > tol, {x[n+1] = x[n] - f[x[n]] / f'[x[n]]; test = Abs[x[n+1] - x[n]]; n++}]
cc = x[n];
Print["Newton: n = ", n, "  c = ", cc]
```

```
Bisezione: n = 35  c = 1.12412
```

```
Newton: n = 10  c = 1.12412
```

```
g1[x_] := Sqrt[Sqrt[3 + x - 2 x^2]]
g2[x_] := Sqrt[(x + 3 - x^4) / 2]
g3[x_] := Sqrt[(x + 3) / (x^2 + 2)]
g4[x_] := (3 x^4 + 2 x^2 + 3) / (4 x^3 + 4 x - 1)
Plot[{g1[x], x}, {x, 0, 2}, PlotStyle → {RGBColor[0, 0, 1], Thickness[0.005]}]
Plot[{g2[x], x}, {x, 0, 2}, PlotStyle → {RGBColor[0, 0, 1], Thickness[0.005]}]
Plot[{g3[x], x}, {x, 0, 2}, PlotStyle → {RGBColor[0, 0, 1], Thickness[0.005]}]
Plot[{g4[x], x}, {x, 0, 2}, PlotStyle → {RGBColor[0, 0, 1], Thickness[0.005]}]
```
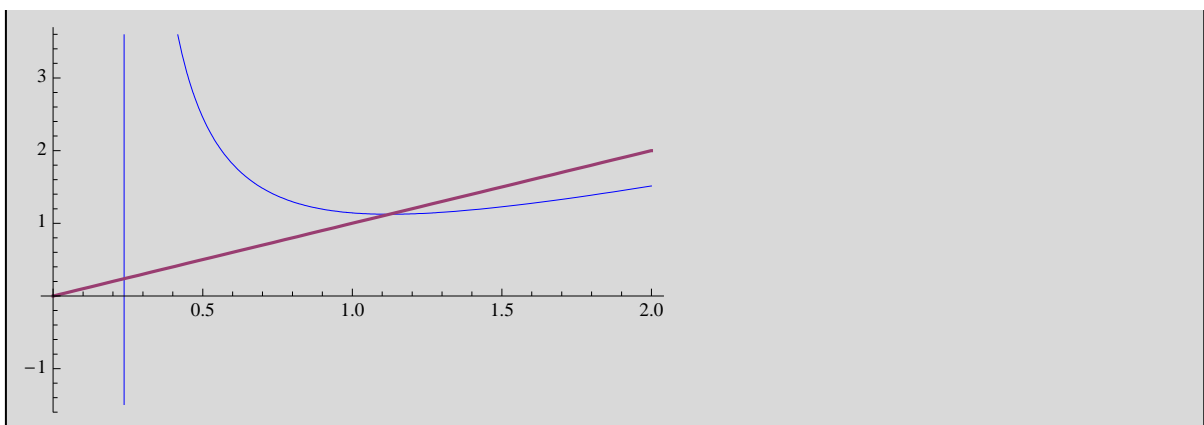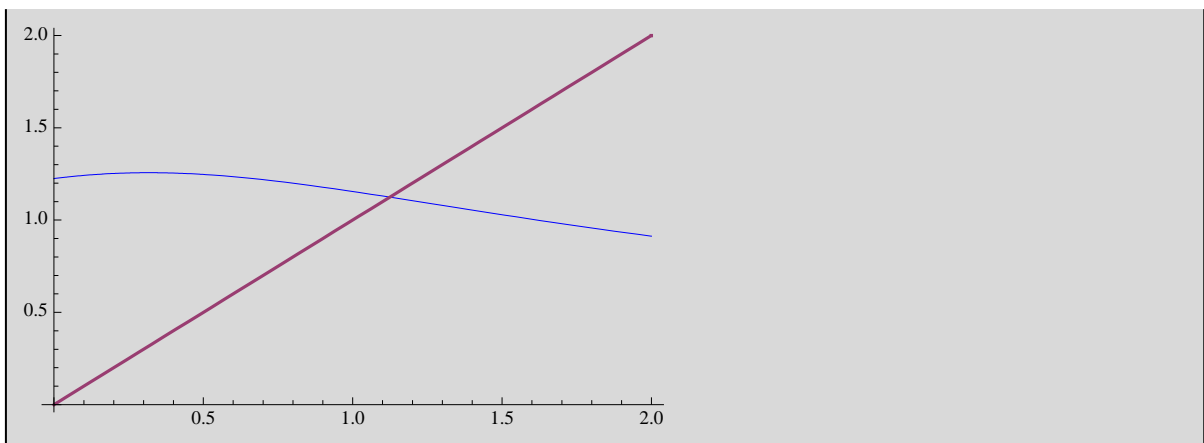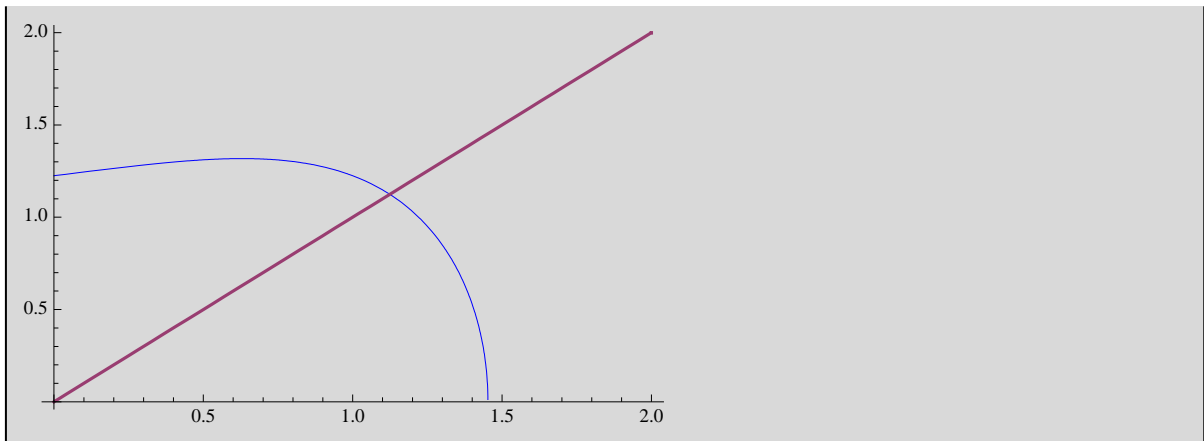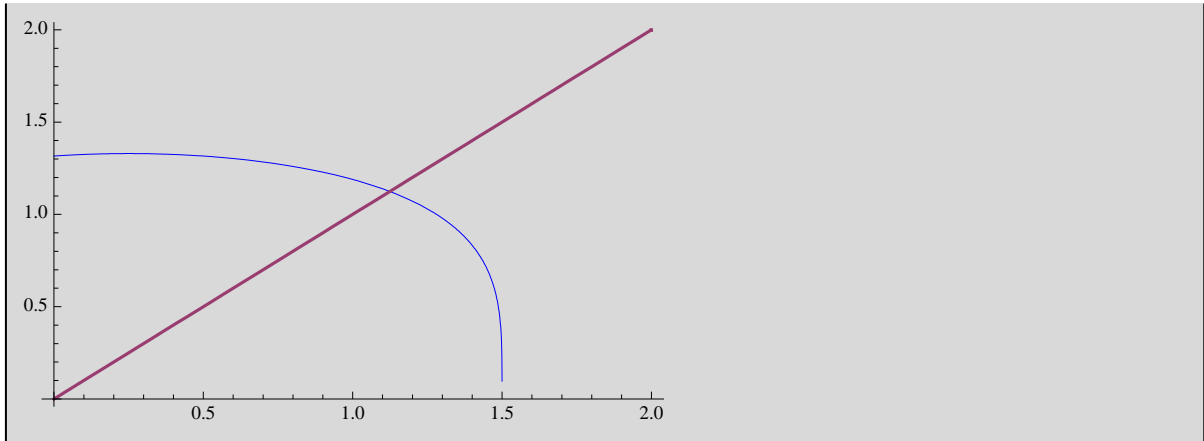
```
n = 4;
c[0] = 1.;
Do[c[k] = g1[c[k - 1]]; Print["k = ", k, "  c = ", c[k]], {k, 1, n}]
err1 = Abs[c[n] - cc]
```

k = 1 c = 1.18921

k = 2 c = 1.08006

k = 3 c = 1.14967

k = 4 c = 1.10782

```
0.0163025
```

```
n = 4;
c[0] = 1.;
Do[c[k] = g2[c[k - 1]]; Print["k = ", k, "  c = ", c[k]], {k, 1, n}]
err2 = Abs[c[n] - cc]
```

k = 1 c = 1.22474

k = 2 c = 0.993666

k = 3 c = 1.22857

k = 4 c = 0.987506

```
0.136617
```

```
n = 4;
c[0] = 1.;
Do[c[k] = g3[c[k - 1]]; Print["k = ", k, "  c = ", c[k]], {k, 1, n}]
err3 = Abs[c[n] - cc]
```

k = 1 c = 1.1547

k = 2 c = 1.11643

k = 3 c = 1.12605

k = 4 c = 1.12364

```
0.000484145
```

```
n = 4;
c[0] = 1.;
Do[c[k] = g4[c[k - 1]]; Print["k = ", k, "  c = ", c[k]], {k, 1, n}]
err4 = Abs[c[n] - cc]
```

```
k = 1  c = 1.14286
```

```
k = 2  c = 1.12448
```

```
k = 3  c = 1.12412
```

```
k = 4  c = 1.12412
```

1.86517×10^{-14}

```
(** ESERCIZIO 2.2.3 **)
```

```
cc = N[(21.) ^ (1 / 3), 10]
Clear[g1, g2, g3, g4]
```

```
2.75892
```

```
g1[p_] := (20.0 * p + 21. / p^2) / 21.
g2[p_] := p - (p^3 - 21.) / (3.0 * p^2)
g3[p_] := p - (p^4 - 21. * p) / (p^2 - 21.)
g4[p_] := Sqrt[21. / p]
```

```
n = 4;
c[0] = 1.;
Do[c[k] = g1[c[k - 1]]; Print["k = ", k, "  c = ", c[k]], {k, 1, n}]
err1 = Abs[c[n] - cc]
Do[c[k] = g2[c[k - 1]]; Print["k = ", k, "  c = ", c[k]], {k, 1, n}]
err2 = Abs[c[n] - cc]
Do[c[k] = g3[c[k - 1]]; Print["k = ", k, "  c = ", c[k]], {k, 1, n}]
err3 = Abs[c[n] - cc]
Do[c[k] = g4[c[k - 1]]; Print["k = ", k, "  c = ", c[k]], {k, 1, n}]
err4 = Abs[c[n] - cc]
```

```
k = 1  c = 1.95238
```

```
k = 2  c = 2.12175
```

```
k = 3  c = 2.24285
```

```
k = 4  c = 2.33484
```

```
1.21072
```

```
k = 1  c = 7.66667
```

```
k = 2  c = 5.2302
```

```
k = 3  c = 3.7427
```

```
k = 4  c = 2.99485
```

```
1.87073
```

```
k = 1  c = 0.
```

```
k = 2  c = 0.
```

```
k = 3  c = 0.
```

```
k = 4  c = 0.
```

```
1.12412
```

```
k = 1  c = 4.58258
```

```
k = 2  c = 2.1407
```

```
k = 3  c = 3.13208
```

```
k = 4  c = 2.58937
```

```
1.46524
```

```
(** ESERCIZIO 2.2.4 **)
```

```
cc = N[(7.) ^ (1 / 5), 10]
Clear[g1, g2, g3, g4]
```

```
1.47577
```

```
g1[p_] := Sqrt[1. + (7. - p^3) / p^2]
g2[p_] := p - (p^5 - 7.) / p^2
g3[p_] := p - (p^5 - 7.) / (5. p^4)
g4[p_] := p - (p^5 - 7.) / 12.
```
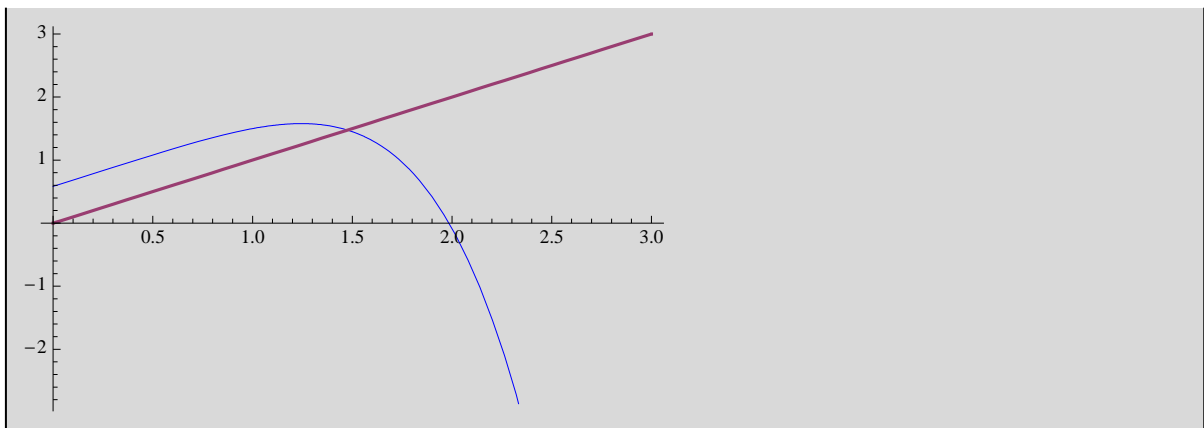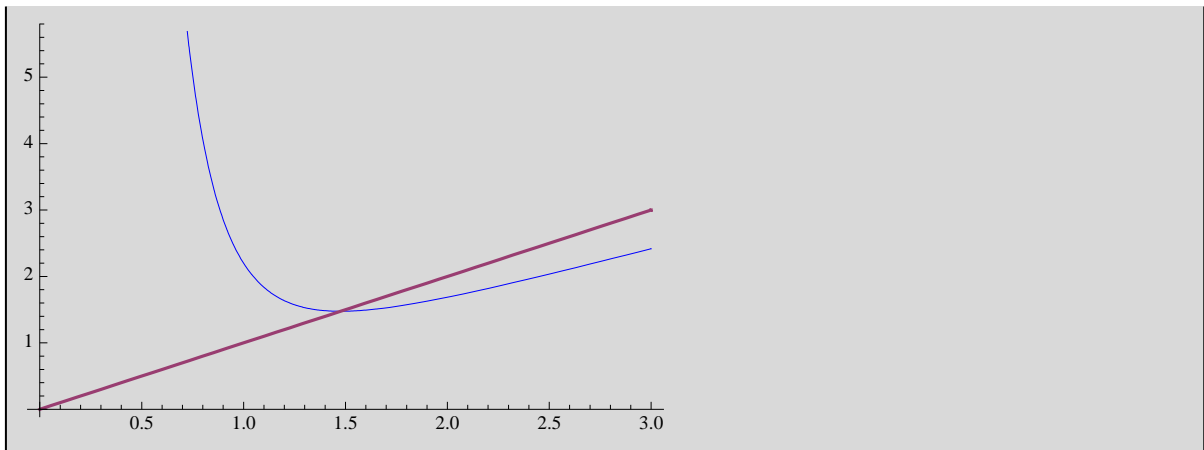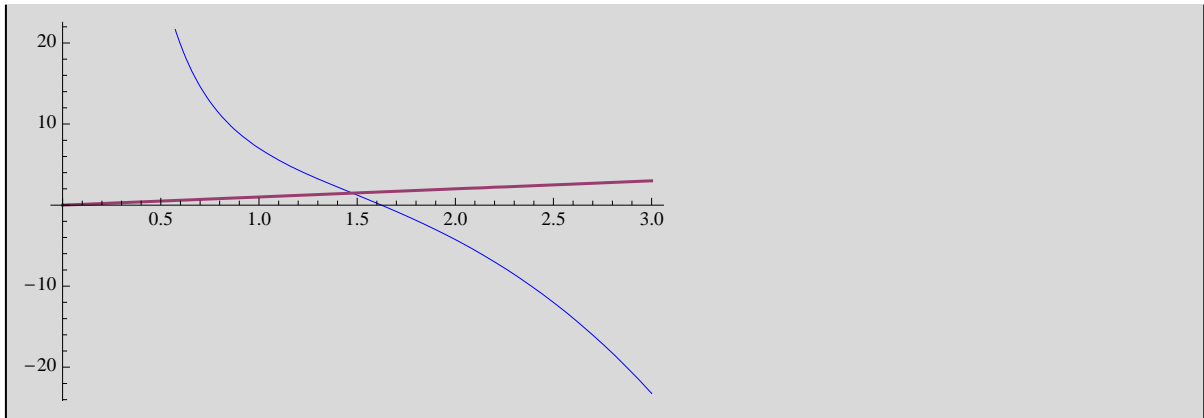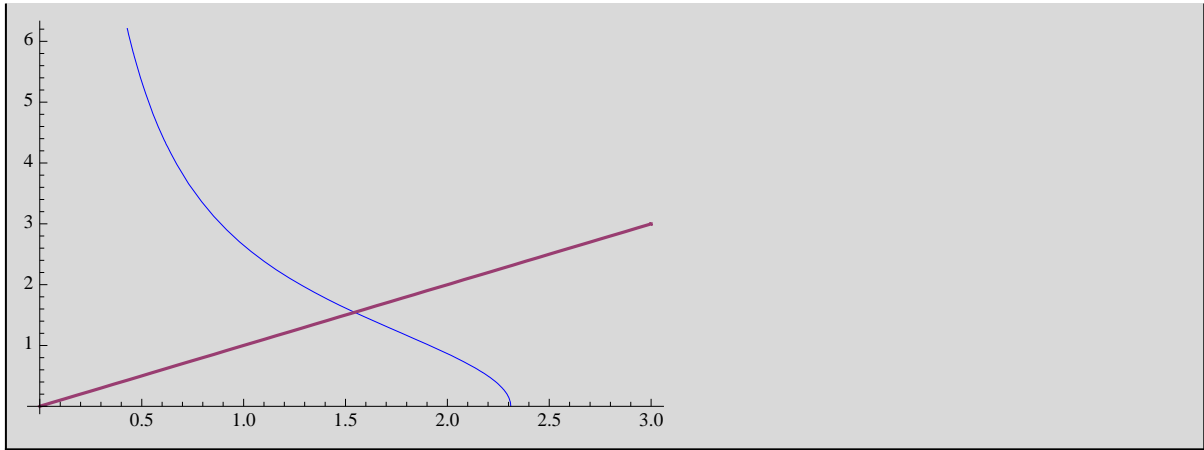
```
g1'[cc]
g2'[cc]
g3'[cc]
g4'[cc]
```

```
-1.61828
```

```
-9.88953
```

$$2.03012 \times 10^{-16}$$

```
-0.976365
```

```
Plot[{g1[x], x}, {x, 0, 3}, PlotStyle → {RGBColor[0, 0, 1], Thickness[0.005]}]
Plot[{g2[x], x}, {x, 0, 3}, PlotStyle → {RGBColor[0, 0, 1], Thickness[0.005]}]
Plot[{g3[x], x}, {x, 0, 3}, PlotStyle → {RGBColor[0, 0, 1], Thickness[0.005]}]
Plot[{g4[x], x}, {x, 0, 3}, PlotStyle → {RGBColor[0, 0, 1], Thickness[0.005]}]
```

```
n = 10;
c[0] = 1.;
Do[c[k] = g1[c[k - 1]]; Print["k = ", k, "  c = ", c[k]], {k, 1, n}]
err1 = Abs[c[n] - cc]
Do[c[k] = g2[c[k - 1]]; Print["k = ", k, "  c = ", c[k]], {k, 1, n}]
err2 = Abs[c[n] - cc]
Do[c[k] = g3[c[k - 1]]; Print["k = ", k, "  c = ", c[k]], {k, 1, n}]
err3 = Abs[c[n] - cc]
Do[c[k] = g4[c[k - 1]]; Print["k = ", k, "  c = ", c[k]], {k, 1, n}]
err4 = Abs[c[n] - cc]
```

k = 1 c = 2.64575

k = 2 c = 0. + 0.803587 i

k = 3 c = 0.12798 - 3.1395 i

k = 4 c = 1.29747 + 1.2321 i

k = 5 c = 1.27203 - 1.34261 i

k = 6 c = 1.22986 + 1.37659 i

k = 7 c = 1.22236 - 1.39806 i

k = 8 c = 1.21486 + 1.40329 i

k = 9 c = 1.2136 - 1.40664 i

k = 10 c = 1.21245 + 1.40743 i

> 1.43185

k = 1 c = 7.

k = 2 c = -335.857

k = 3 c = 3.78844×10^{7}

k = 4 c = -5.43726×10^{22}

k = 5 c = 1.60746×10^{68}

k = 6 c = -4.15353×10^{204}

k = 7 c = $7.165612061435244 \times 10^{613}$

k = 8 c = $-3.67925489784514 \times 10^{1841}$

k = 9 c = $4.98057667144769 \times 10^{5524}$

k = 10 c = $-1.23548902016202 \times 10^{16\,574}$

> $1.235489020162020 \times 10^{16\,574}$

```
k = 1  c = 2.2
k = 2  c = 1.81976
k = 3  c = 1.58347
k = 4  c = 1.48946
k = 5  c = 1.47602
k = 6  c = 1.47577
k = 7  c = 1.47577
k = 8  c = 1.47577
k = 9  c = 1.47577
k = 10  c = 1.47577
```

2.22045×10^{-16}

```
k = 1  c = 1.5
k = 2  c = 1.45052
k = 3  c = 1.49875
k = 4  c = 1.4519
k = 5  c = 1.49758
k = 6  c = 1.45319
k = 7  c = 1.49648
k = 8  c = 1.4544
k = 9  c = 1.49544
k = 10  c = 1.45552
```

`0.0202504`

```
(** ESERCIZIO 2.2.5 **)
```
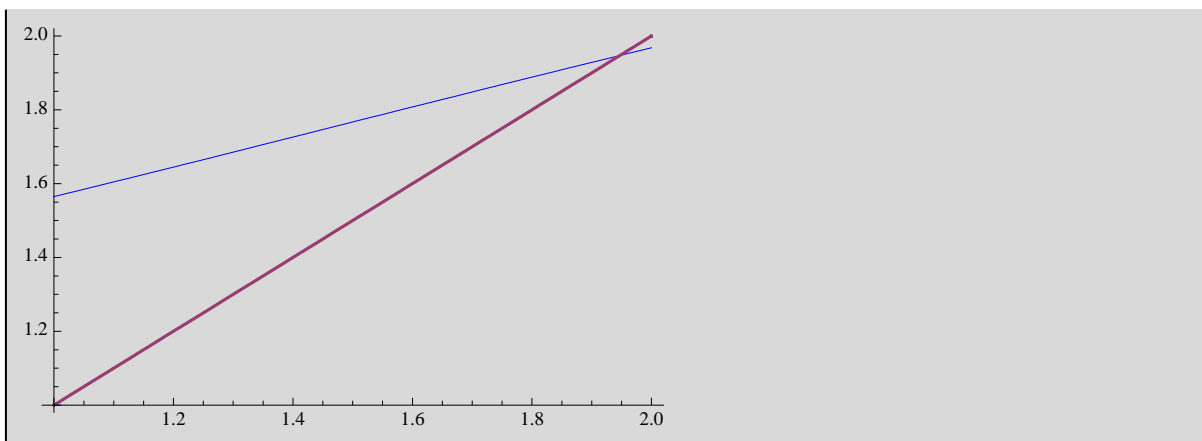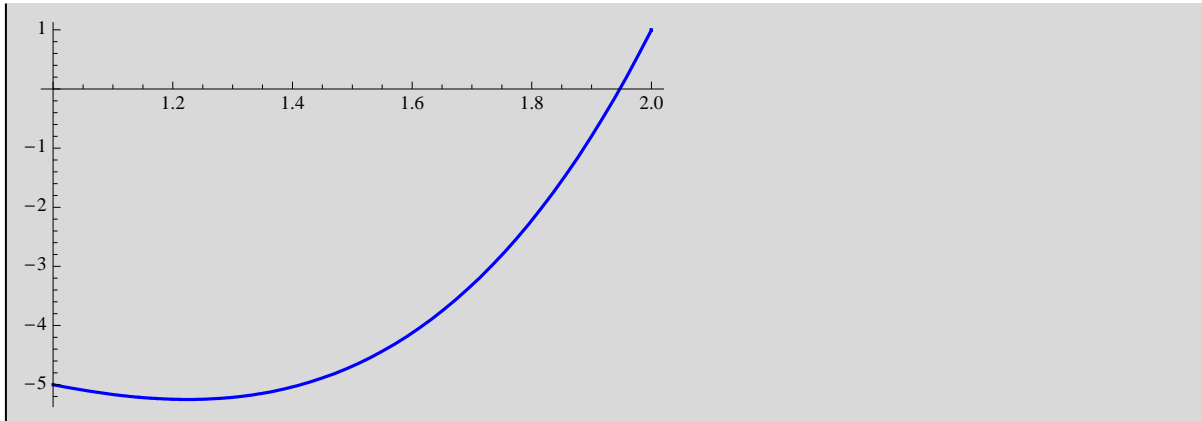
```
Clear[g, f];
f[x_] := x^4 - 3 x^2 - 3;
g[x_] := Sqrt[Sqrt[3 x^2 + 3]]
Plot[f[x], {x, 1, 2}, PlotStyle → {RGBColor[0, 0, 1], Thickness[0.005]}]
Plot[{g[x], x}, {x, 1, 2}, PlotStyle → {RGBColor[0, 0, 1], Thickness[0.005]}]
```



```
a = 1.; b = 2.;
tol = 10^(-10);
fa = f[a];
fb = f[b];
an[0] = a; bn[0] = b;
cn[0] = 0.5 * (a + b);
test = b - a;
testbis[0] = bn[0] - an[0];
nmax = 10;
n = 1; While[test > tol, {fa = f[an[n - 1]]; fc = f[cn[n - 1]];
   If[fa * fc < 0, {an[n] = an[n - 1]; bn[n] = cn[n - 1]}, {an[n] = cn[n - 1]; bn[n] = bn[n - 1]}];
   cn[n] = 0.5 * (an[n] + bn[n]); test = Abs[bn[n] - an[n]]; n++}];
Print["Bisezione: n = ", n - 1, "  c = ", cn[n - 1]]
Clear[x]; test = 1.0; n = 0;
x[0] = 0.4;
While[test > tol, {x[n + 1] = x[n] - f[x[n]] / f'[x[n]]; test = Abs[x[n + 1] - x[n]]; n++}]
cc = x[n];
Print["Newton: n = ", n, "  c = ", cc]
```

```
Bisezione: n = 34   c = 1.94712

Newton: n = 18   c = 1.94712
```

```
tol = 10.^(-2); nmax = 20;
c[0] = 1.; test = 1.; k = 1;
While[test > tol && k < nmax,
   {c[k] = g[c[k - 1]]; test = Abs[c[k] - c[k - 1]]; Print[k, "    ", test]; k++}];
Print["c = ", c[k - 1]]
err1 = Abs[c[k - 1] - cc]
```

1   0.565085

2   0.228488

3   0.0923709

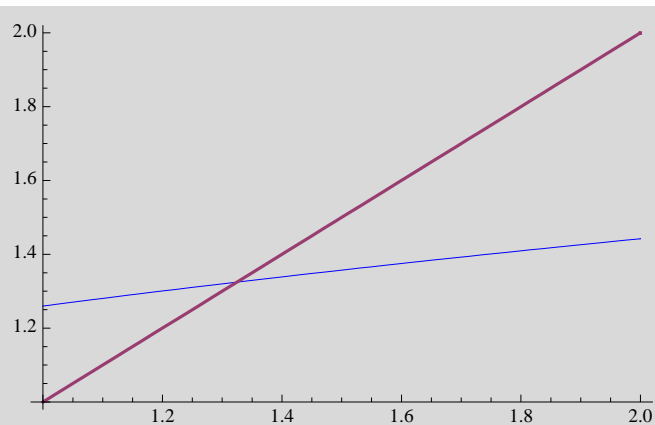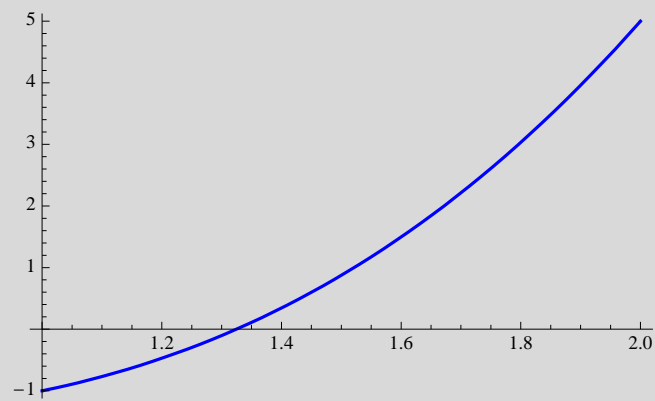4   0.0369041

5   0.0146597

6   0.00580939

c = 1.94332

```
0.00380604
```

```
(** ESERCIZIO 2.2.6 **)
```

```
Clear[g, f];
f[x_] := x^3 - x - 1;
g[x_] := (x + 1)^(1/3)
Plot[f[x], {x, 1, 2}, PlotStyle → {RGBColor[0, 0, 1], Thickness[0.005]}]
Plot[{g[x], x}, {x, 1, 2}, PlotStyle → {RGBColor[0, 0, 1], Thickness[0.005]}]
```

```
a = 1.; b = 2.;
tol = 10^(-10);
fa = f[a];
fb = f[b];
an[0] = a; bn[0] = b;
cn[0] = 0.5 * (a + b);
test = b - a;
testbis[0] = bn[0] - an[0];
nmax = 10;
n = 1; While[test > tol, {fa = f[an[n - 1]]; fc = f[cn[n - 1]];
   If[fa * fc < 0, {an[n] = an[n - 1]; bn[n] = cn[n - 1]}, {an[n] = cn[n - 1]; bn[n] = bn[n - 1]}];
   cn[n] = 0.5 * (an[n] + bn[n]); test = Abs[bn[n] - an[n]]; n++}];
Print["Bisezione: n = ", n - 1, "  c = ", cn[n - 1]]
Clear[x]; test = 1.0; n = 0;
x[0] = 0.4;
While[test > tol, {x[n + 1] = x[n] - f[x[n]] / f'[x[n]]; test = Abs[x[n + 1] - x[n]]; n++}]
cc = x[n];
Print["Newton: n = ", n, "  c = ", cc]
```

```
Bisezione: n = 34  c = 1.32472
```

```
Newton: n = 14  c = 1.32472
```

```
tol = 10.^(-2); nmax = 20;
c[0] = 1.; test = 1.; k = 1;
While[test > tol && k < nmax,
   {c[k] = g[c[k - 1]]; test = Abs[c[k] - c[k - 1]]; Print[k, "    ", test]; k++}];
Print["c = ", c[k - 1]]
err1 = Abs[c[k - 1] - cc]
```

```
1    0.259921
```

```
2    0.0523728
```

```
3    0.01006
```

```
4    0.00191493
```

```
c = 1.32427
```

```
0.000449213
```