Example of numerical integration using Runge-Kutta method for y"[x]= - omega^2 y[x]

In[1]:=
```
omega = 1.5;
omega2 = omega^2;
```

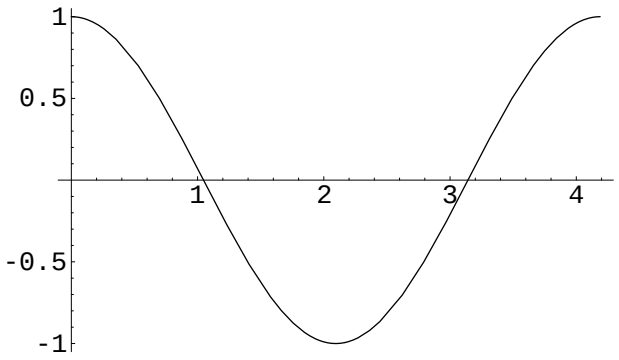
In[2]:=
```
i = 1;
f[i] = 1.;
f0 = 1.;
p0 = 0.;
h = 0.75;
t = 2 π / 1.5;
nstep = t / h;
```

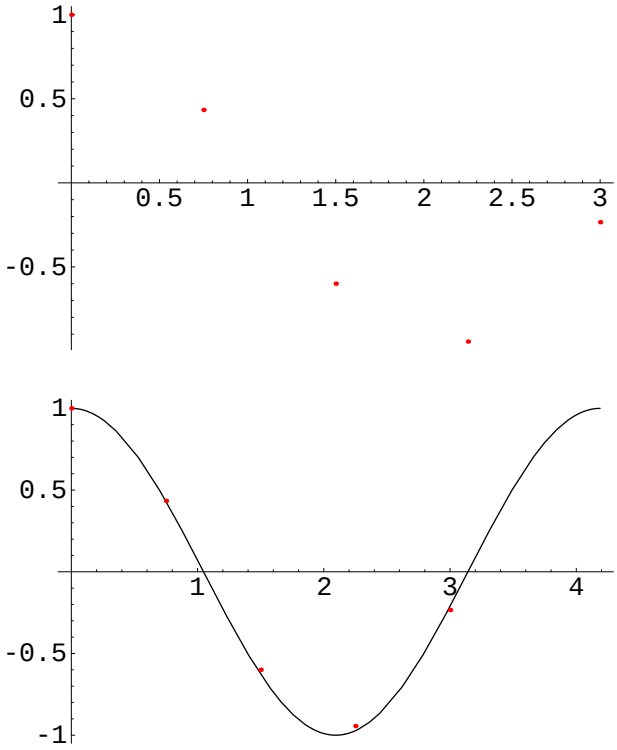
In[3]:=
```
Do[{
  K1 = p0 * h,
  Q1 = -omega2 * f0 * h,
  K2 = (p0 + Q1 / 2) * h,
  Q2 = (-omega2 * (f0 + K1 / 2)) * h,
  K3 = (p0 + Q2 / 2) * h,
  Q3 = (-omega2 * (f0 + K2 / 2)) * h,
  K4 = (p0 + Q3) * h,
  Q4 = (-omega2 * (f0 + K3)) * h,
  p0 = p0 + 1 / 6 * (Q1 + 2 * Q2 + 2 * Q3 + Q4),
  f0 = f0 + 1 / 6 * (K1 + 2 * K2 + 2 * K3 + K4),
  i = i + 1,
  f[i] = f0
}, {nstep}]
```

In[4]:=
```
Print["step number  ", nstep, "  step size  ", h];
sol = Table[{(i - 1) * h, f[i]}, {i, nstep}];
```

```
step number  5.58505  step size  0.75
```

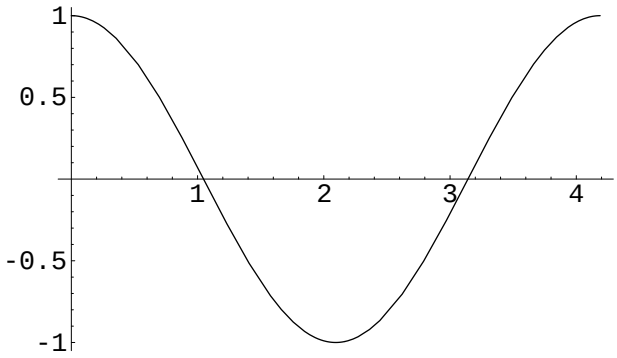
In[8]:=
```
Show[Plot[Cos[omega * x], {x, 0, h * nstep}], ListPlot[sol, PlotStyle -> Hue[1.0]] ]
```

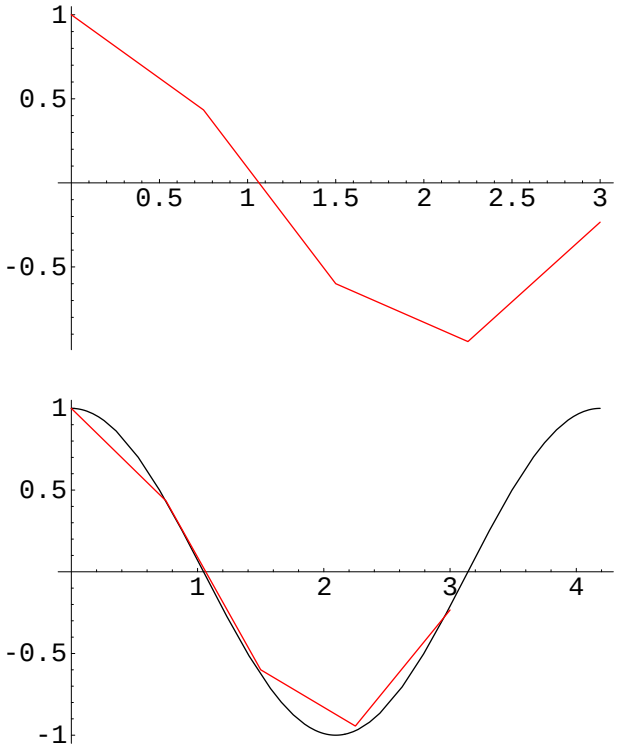




Out[8]= **-** Graphics **-**

In[9]:=
```
sol2 =
 NDSolve[{y''[x] == -omega2 * y[x], y[0.0001] == 1, y'[0.0001] == 0}, y, {x, 0, 2 π / 1.5}];
Show[Plot[y[x] /. sol2, {x, 0, 2 π / 1.5}],
 ListPlot[sol, PlotJoined -> True, PlotStyle -> Hue[1.0]] ]
```





Out[9]= **-** Graphics **-**

sol

{{0, 1.}, {0.75, 0.433929}, {1.5, −0.599708}, {2.25, −0.944106}, {3., −0.233857}}