```
In[1]:= (* MA39110 / Assignment 2.3 / 16MA20053 / NER ROHIT *)
        ClearAll["Global`*"];

In[2]:= Thomas[a_, b_, c_, d_] :=
          Module[{c1 = Range[Length[c]], d1 = Range[Length[d]], x = Range[Length[b]]},
           c1[[1]] = c[[1]] / b[[1]]; d1[[1]] = d[[1]] / b[[1]];
           Do[
            If[i ≠ Length[d], c1[[i]] = c[[i]] / (b[[i]] - a[[i - 1]] * c1[[i - 1]])];
            d1[[i]] = (d[[i]] - a[[i - 1]] * d1[[i - 1]]) / (b[[i]] - a[[i - 1]] * c1[[i - 1]]);
            , {i, 2, Length[d]}];
           x[[Length[b]]] = d1[[Length[b]]];
           Do[
            x[[i]] = d1[[i]] - c1[[i]] * x[[i + 1]];
            , {i, Length[b] - 1, 1, -1}];
           x];
        Model[n0_] := Module[{n = n0},
           x0 = 0; xf = 1; h = (xf - x0) / n;
           A = Table[0, {x, 0, n}, {y, 0, n}];
           X = Table[x0 + x * h, {x, 0, n}];
           B = Table[-4 * (x0 + x * h) * h^2, {x, 0, n}];
           For[i = 1, i < n + 2, i++,
            {
             A[[i, i]] = -(2 + 2 * h^2);
             If[i ≠ 1, A[[i, i - 1]] = 1 + X[[i]] * h];
             If[i ≠ n + 1, A[[i, i + 1]] = 1 - X[[i]] * h];
            }];
           A[[1, 1]] = A[[1, 1]] + (1 + X[[1]] * h) * (-2 * h);
           A[[1, 2]] = A[[1, 2]] + (1 + X[[1]] * h);
           A[[n + 1, n + 1]] = A[[n + 1, n + 1]] + (1 - X[[n + 1]] * h) * (4 * h);
           A[[n + 1, n]] = A[[n + 1, n]] + (1 - X[[n + 1]] * h);
           B[[n + 1]] = B[[n + 1]] + (1 - X[[n + 1]] * h) * (2 * h);
           Thomas[Diagonal[A, -1], Diagonal[A], Diagonal[A, 1], B]];
```

```
In[4]:= sol = N[Model[10]];
solt = DSolve[{y''[x] - 2 * x * y'[x] - 2 * y[x] == -4 * x,
   y[0] - y'[0] == 0, 2 * y[1] - y'[1] == 1}, y[x], x]
err1 = DSolveValue[{y''[x] - 2 * x * y'[x] - 2 * y[x] == -4 * x,
     y[0] - y'[0] == 0, 2 * y[1] - y'[1] == 1}, y[X], x] - sol;
perr1 = ListPlot[Transpose[{X, err1}], PlotStyle → Red];
N[Max[err1]]
p1 = Show[{Plot[Evaluate[y[x] /. solt], {x, x0, xf},
     PlotLabel → Style["h=0.1", FontSize → 18], PlotStyle → Black]},
   {ListPlot[Transpose[{X, sol}], PlotStyle → Red]}];
```

Out[5]= $\{\{y[x] \to e^{x^2} + x\}\}$

Out[8]= 0.345276

```
In[10]:= sol = Model[50];
err2 = DSolveValue[{y''[x] - 2 * x * y'[x] - 2 * y[x] == -4 * x,
     y[0] - y'[0] == 0, 2 * y[1] - y'[1] == 1}, y[X], x] - sol;
perr2 = ListPlot[Transpose[{X, err2}], PlotStyle → Green];
N[Max[err2]]
p2 = Show[{Plot[Evaluate[y[x] /. solt], {x, x0, xf},
     PlotLabel → Style["h=0.1/5", FontSize → 18], PlotStyle → Black]},
   {ListPlot[Transpose[{X, sol}], PlotStyle → Green]}];
```

Out[13]= 0.0157582

```
In[15]:= sol = Model[100];
err3 = DSolveValue[{y''[x] - 2 * x * y'[x] - 2 * y[x] == -4 * x,
     y[0] - y'[0] == 0, 2 * y[1] - y'[1] == 1}, y[X], x] - sol;
perr3 = ListPlot[Transpose[{X, err3}], PlotStyle → Blue];
N[Max[err3]]
p3 = Show[{Plot[Evaluate[y[x] /. solt], {x, x0, xf},
     PlotLabel → Style["h=0.1/10", FontSize → 18], PlotStyle → Black]},
   {ListPlot[Transpose[{X, sol}], PlotStyle → Blue]}];
```

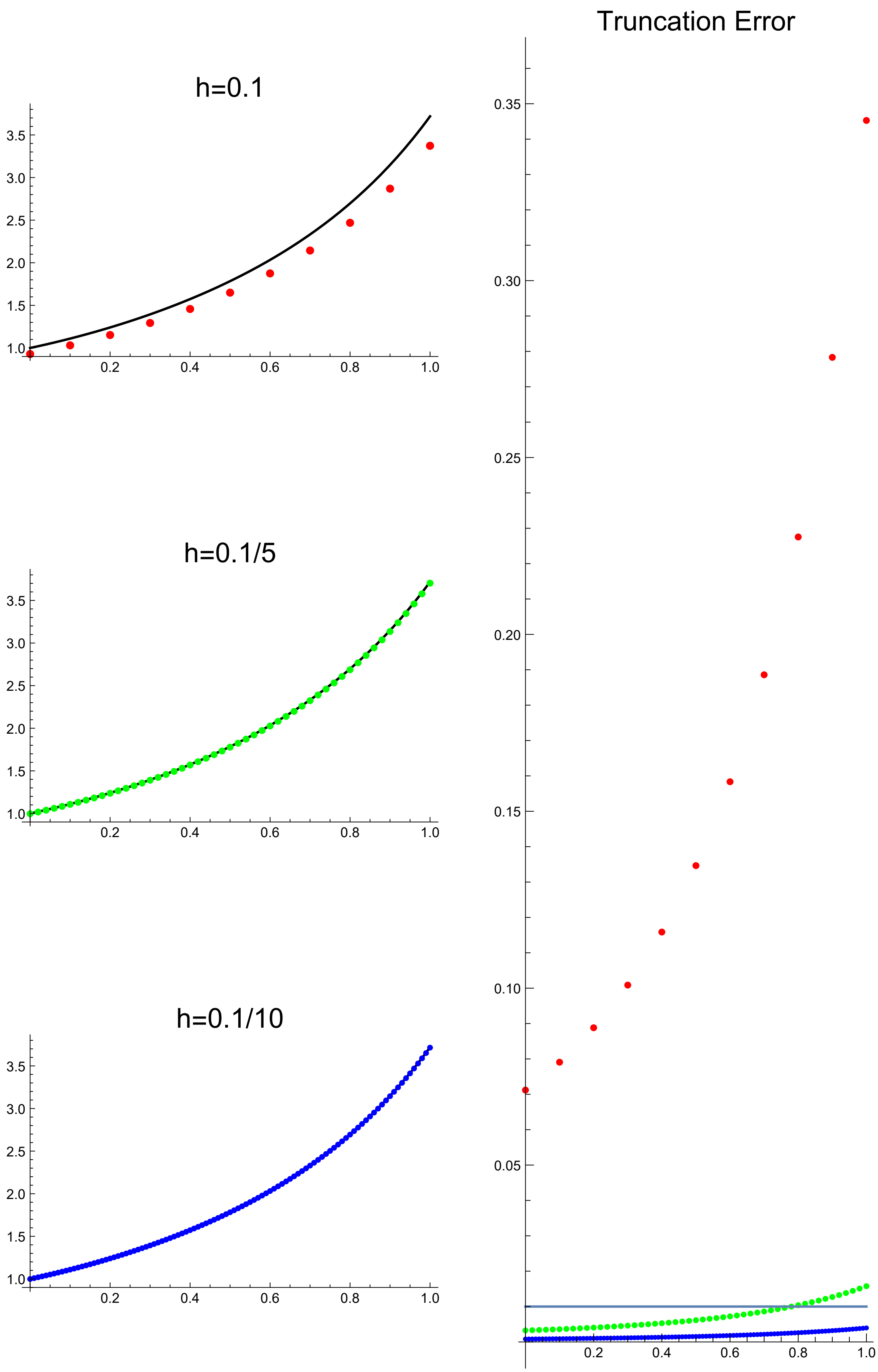
Out[18]= 0.00395698

```
In[20]:= p4 = Show[{perr1}, {perr2}, {perr3}, {Plot[y[x] = 10^-2, {x, 0, 1}]},
   PlotLabel → Style["Truncation Error", FontSize → 18],
   PlotRange → {{0, 1}, {0, 0.35}}, AspectRatio → 3.75];
N[
 sol[[-1]]]
```

Out[21]= 3.71432

```
In[22]:= GraphicsGrid[{{p1, p4}, {p2, SpanFromAbove}, {p3, SpanFromAbove}}]
```

Out[22]=


h=0.1
h=0.1/5
h=0.1/10
1.0
1.5
2.0
2.5
3.0
3.5
0.2
0.4
0.6
0.8
1.0
Truncation Error
0.05
0.10
0.15
0.20
0.25
0.30
0.35