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May 18, 2016

Phys 242 Homework 6

1.

```
In[1]:= sol1 = NRoots[x^7 + x^5 + 2 x^3 + x^2 + 1 == 0, x]
Out[1]= x == -0.812432 || x == -0.640787 - 1.07931 i || x == -0.640787 + 1.07931 i ||
         x == 0.254825 - 0.700968 i || x == 0.254825 + 0.700968 i ||
         x == 0.792178 - 0.881387 i || x == 0.792178 + 0.881387 i
```

2.

```
In[2]:= sol2 = NIntegrate[(HermiteH[4, x])^2 Exp[-x^2], {x, -Infinity, Infinity}]
Out[2]= 680.622
```

3a.

```
In[3]:= sol3a = NDSolve[ {y''[x] - 2 x - y[x] - 3
          y'[x] == 0, y'[2] == -1, y[2] == 1}, y, {x, 2, 2.3} ]
Out[3]= {{y → InterpolatingFunction[ Domain: {{2., 2.3}}
                                     Output: scalar ]}}
```

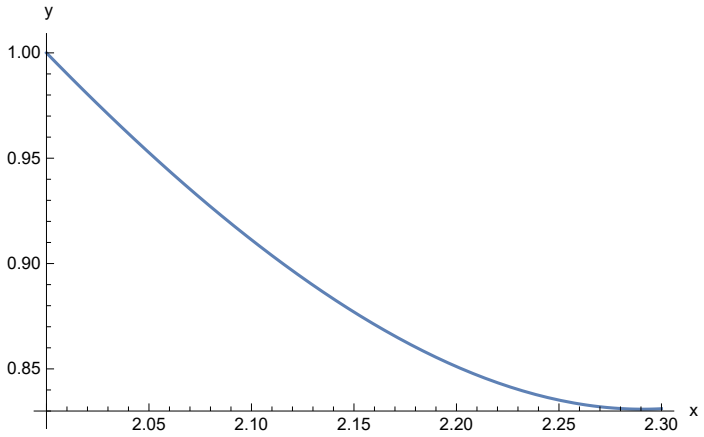
3b.

```
In[4]:= sol3b = y[2.2] /. sol3a[[1]]
Out[4]= 0.851094
```

3c.

```
In[5]:= Plot[y[x] /. sol3a, {x, 2, 2.3}, AxesLabel → {"x", " y" }]
```

Out[5]=



4.

In[6]:=
```
sol4 = Solve [ {4 x + 5 y == 5, 6 x + 7 y == 7}, {x, y} ]
```

Out[6]=
```
{{x → 0, y → 1}}
```

5.

In[7]:=
```
sol5 = Solve [ Sqrt[x + 2] + 4 == x, x]
```

Out[7]=
```
{{x → 7}}
```

Mathematica may convert the above to the polynomial equation $x + 2 = (x - 4)^2 = x^2 - 8x + 16$ and choose the solution which solves the orginal problem (that with $(x - 4)^2 \geq 0$).

6.

In[8]:=
```
sol6 = Limit[(Exp[x] - Exp[x - x^(-2)])^(-1), x → Infinity]
```

Out[8]=
```
0
```

7a.

In[9]:=
```
xlist = Table[x, {x, 0, 10}]
```

Out[9]=
```
{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10}
```

7b.

In[10]:=
```
ylist = xlist^2
```

Out[10]=
```
{0, 1, 4, 9, 16, 25, 36, 49, 64, 81, 100}
```

7c.

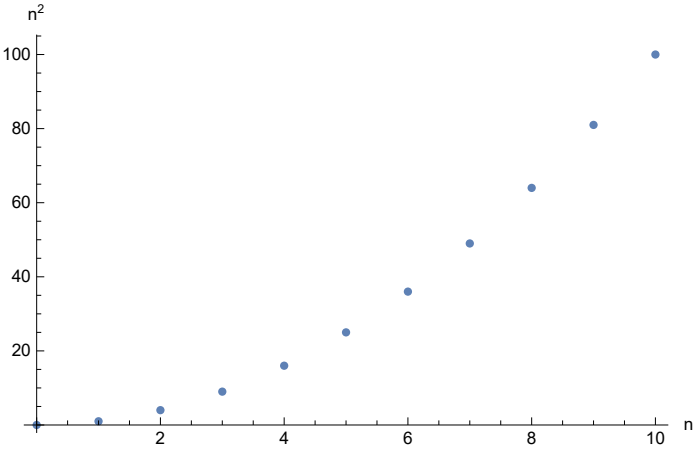
In[11]:=
```
xydata = Transpose[{xlist, ylist}]
```

Out[11]=
```
{{0, 0}, {1, 1}, {2, 4}, {3, 9}, {4, 16},
 {5, 25}, {6, 36}, {7, 49}, {8, 64}, {9, 81}, {10, 100}}
```

7d.

In[12]:=
```
ListPlot[xydata, AxesLabel → {"n", Superscript["n", "2"] }]
```

Out[12]=



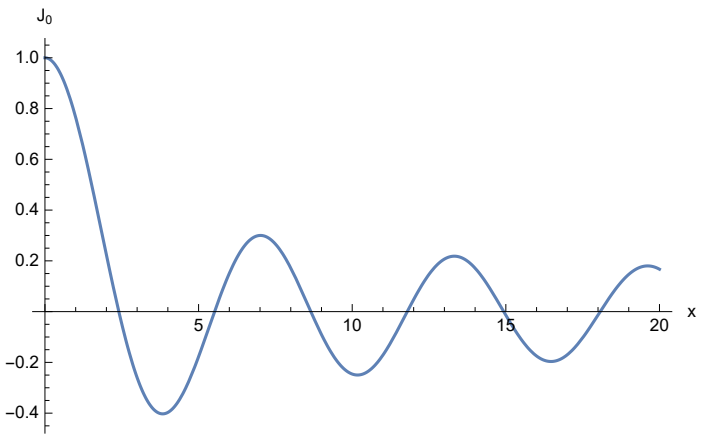
In[13]:=

In[14]:=

8.

In[15]:=
```
Plot[BesselJ[0, x], {x, 0, 20}, AxesLabel → {"x", Subscript["J", "0"] }]
```

Out[15]=



In[16]:=
```
sol8root1 = FindRoot[ BesselJ[0, x] == 0 , {x, 2.5} ]
```

Out[16]= {x → 2.40483}

In[17]:=
```
sol8root2 = FindRoot[ BesselJ[0, x] == 0 , {x, 5} ]
```

Out[17]= {x → 5.52008}

In[18]:=
```
sol8root3 = FindRoot[ BesselJ[0, x] == 0 , {x, 9} ]
```

Out[18]= {x → 8.65373}

In[19]:=
```
sol8root4 = FindRoot[ BesselJ[0, x] == 0 , {x, 12} ]
```

Out[19]= {x → 11.7915}

In[20]:=
```
sol8root5 = FindRoot[ BesselJ[0, x] == 0 , {x, 15} ]
```

Out[20]= {x → 14.9309}

9a.

In[21]:=
```
f[x_] := λ * Sin[Pi x] ;
lya[l_, xinit_, n_, ndrop_] := (λ = l;
 xlist = Drop[NestList[f, xinit, n], ndrop + 1];
 Apply[Plus, Log[Abs[f'[xlist]]]] / Length[xlist])


 lya[0.9 , 0.4 , 50 000, 1000]
```

Out[23]= 0.349229

9b.

In[24]:=
```
λ = 9 / 10; x0 = N[4 / 10, 1000];
N[sol9 = Nest[f, x0, 5000], 6]
```

Out[25]= 0.795585

In[26]:=
```
Precision[sol9]
```

Out[26]=
```
251.78
```

10.

In[27]:=
```
f[θ_] := Mod[θ + Ω + K * Sin[2 Pi θ] / (2 Pi) , 1];
Ω = 0.65;
iterate[m_, n_] := Drop[NestList[f, 0.1, n], m]
drawpt[y_] := Point[{K, y}]
graph[Kmin_, Kmax_, nK_, mdrop_, n_] := Graphics[{PointSize[0.001],
 Table[Map[drawpt, iterate[mdrop, n]], {K, Kmin, Kmax, (Kmax - Kmin) / nK}]}]
Show[graph[0, 6, 600, 75, 100], Axes → False, Frame → True,
 FrameLabel → {"K", "θ"}, PlotRange → {{0, 6}, {0, 1}}, AspectRatio → 1]
```

Out[32]=