Homework 14 - Caleb Powell

Problem 2

In[29]:=
```
A = -E^(q a) c Sin[k a];
Simplify[∫_-∞^-a Abs[A E^(q x)]^2 dx + ∫_-a^a Abs[c Sin[k x]]^2 dx + ∫_a^∞ Abs[A E^(-q x)]^2 dx,
  Assumptions → a ∈ ℝ && 1/k ∈ ℝ && Re[q] > 0] // Expand
```

Out[30]=
$$a\, c\, \text{Conjugate}[c] + \frac{\text{Abs}[c \text{Sin}[a k]]^2}{\text{Re}[q]} - \frac{c\, \text{Conjugate}[c]\, \text{Sin}[2 a k]}{2 k}$$

In[56]:=
```
q = -k Cot[k a];
f = a c^2 + c^2 Sin[a k]^2/q - c^2 Sin[2 a k]/(2 k) // Simplify;
Solve[f == 1, c]
```

Out[58]=
$$\left\{\left\{c \to -\frac{1}{\sqrt{a - \frac{\text{Tan}[a k]}{k}}}\right\}, \left\{c \to \frac{1}{\sqrt{a - \frac{\text{Tan}[a k]}{k}}}\right\}\right\}$$

Problem 3

Given That

In[ ]:=
```
v0 = 5 (*eV*); a = 1.5/2 (*nm*);
```

Find Allowed energies of the bound states in the well using (5.88)

In[ ]:=
```
f1[z_] := z Tan[z]
f2[z_] := -z Cot[z]
f3[z_] := Sqrt[z0^2 - z^2]
```

In[ ]:=
```
ħ = 1240/(2 π) (*eV nm*);
m = 511 * 10^3 (*eV*);
z0 = Sqrt[2 m v0 a^2/ħ^2]
```

Out[ ]=
```
8.59073
```

Find Intersections

```
In[ ]:= s1 = NSolve[f1[z] == f3[z] && z > 0 && z < 2 π, z];
        s2 = NSolve[f2[z] == f3[z] && z > 0 && z < 2 π, z];
        sn = Join[z /. s1, z /. s2](*Make a list of s1 & s2 values*)
        sr = Table[f3[z], {z, sn}](*Plug sn into f3*);
Out[ ]= {1.40635, 4.20138, 2.80854, 5.57671}
```