

Problem 6.3. Consider a hypothetical atom that has just two states: a ground state with energy zero and an excited state with energy 2 eV. Draw a graph of the partition function for this system as a function of temperature, and evaluate the partition function numerically at $T = 300$ K, 3000 K, 30,000 K, and 300,000 K.

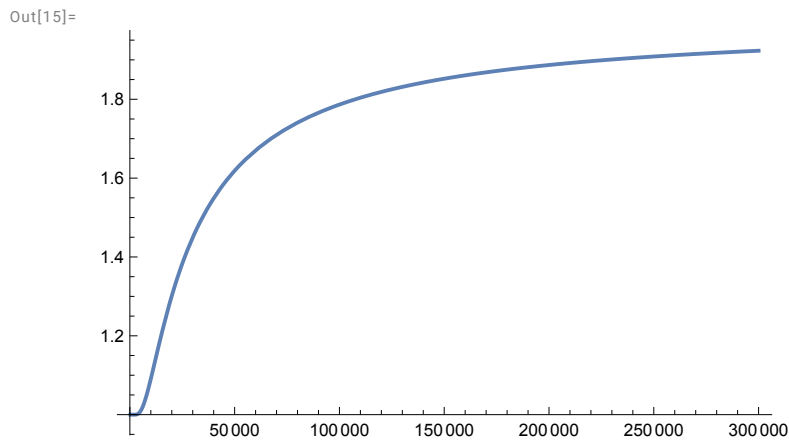
```
In[12]:= x[T_] :=  $\frac{1}{40} * \frac{T}{300}$  (* Handy scaling factor for 1/T, in eV *)
```

```
In[13]:= Z[T_] := Exp[-0/x[T]] + Exp[-2/x[T]]
```

```
In[14]:= Z[T]
```

```
Out[14]= 1. + e-24 000./T
```

```
In[15]:= Plot[Z[T], {T, 300, 300 000}]
```



```
In[16]:= FindRoot[x[T] == 2, {T, 300}] (* At what Temperature is kT = 2 eV? *)
```

```
Out[16]= {T -> 24 000.}
```

```
In[17]:= Table[{T, Z[T]}, {T, {300, 3000, 30 000, 300 000}}] // TableForm
```

```
Out[17]//TableForm=


|         |         |
|---------|---------|
| 300     | 1.      |
| 3000    | 1.00034 |
| 30 000  | 1.44933 |
| 300 000 | 1.92312 |


```