=> λ1 = 2 ; λ2 = 4  
Solving the homogenous linear system for λ1, , we get the general solution X1 = x1 where .

Solving the system for λ2, , we get the general solution X2 = x2 where .

=> λ1 = ; λ2 =   
Solving the homogenous linear system for λ1, , we get the general solution:  
 X1 = x1 where .

Solving the system for λ2, , we get the general solution X۲ = x۲ where .

Knowing that the trace is cyclic, we can write:

Assuming two distinct eigenvalues for Hermitian matrix A, Av = λv , Aw = μw, we set to prove v\*w = 0.  
Since the eigenvalues are distinct, working backwards we can write (λ−μ)v\*w = 0 iff v\*w = 0.  
(λ−μ)v\*w = 0 => λv\*w = μv\*w = v\*wμ . Knowing that eigenvalues of Hermitian matrices are real, we can write: λv\*w = v\*A\*w = v\*wμ => v\*A\*w = v\*Aw   
Therefore it’s only true if A\*=A which is the definition of a Hermitian matrix, therefore the initial statement is proved.

The electrostatic potential is non-linear. Given its formula, we see that the potential is dependent on , therefore . So it’s non-linear.

Assuming the computational basis and a random state for the second system, say we want to clone state then we can write:  
,  
But, if was to clone , it would result in   
Which, taking |e> = |0>, is the result of the CNOT gate. We know that the CNOT gate doesn’t copy a system’s state onto another, rather it just entangles the two.

Planck’s law gives the radiation intensity of a blackbody as: I(v, T) = ­­  
Sefan-Boltzmann law gives the total energy emitted per unit surface from a blackbody at temperature T as: ,  
Knowing that blackbodies are Lambertian, and setting as the solid angle, we can write:

= using we get:   
Which in turn can be written as: