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# Exercises

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## Exercise 3 :

The electric and magnetic fields  $\vec{E}_1$  and  $\vec{B}_1$ , measured by an observer  $\mathbf{O}$  linked to a Galilean reference frame  $\mathbf{R}$ , are given in terms of the scalar and vector potentials  $\phi_1, \vec{A}_1$  by the equations

$$\vec{E}_1 = -\vec{\text{grad}} \phi_1 - \frac{\partial \vec{A}_1}{\partial t}, \quad \vec{B}_1 = \text{rot} \vec{A}_1$$

1. Give the expression for the components of the fields  $\vec{E}_1$  and  $\vec{B}_1$  in the reference frame  $\mathbf{R}$ .
2. Find the components of the electromagnetic tensor.
3. What are the new values of the fields  $\vec{E}'_1$  and  $\vec{B}'_1$ , measured by an observer  $\mathbf{O}'$  linked to a Galilean reference frame  $\mathbf{R}'$  moving at a constant speed  $\vec{v}$  relative to  $\mathbf{R}$ ?

## Exercise 4 :

- Find the probability current of the Schrodinger equation  $\vec{j}$  which verifies the equation

$$\frac{\partial \rho}{\partial t} + \vec{\nabla} \cdot \vec{j} = 0$$

We give :  $\rho = \psi^*(\vec{r}, t)\psi(\vec{r}, t)$