1. (a) Both position and momentum flip sign under parity; $\Pi^{-1}x\Pi = -x$ and $\Pi^{-1}p\Pi = -p$.
   (b) We have
   $$\Pi^{-1}[x,p]\Pi = \Pi^{-1}xp\Pi - \Pi^{-1}px\Pi = \Pi^{-1}x\Pi\Pi^{-1}p\Pi - \Pi^{-1}p\Pi\Pi^{-1}x\Pi = (-x)(-p) - (-p)(-x) = xp - px = i\hbar$$
   This matches $\Pi^{-1}i\hbar\Pi = i\hbar$; $i\hbar$ is a scalar and does not change under parity.
   (c) Angular momentum is position times momentum; since both of these flip sign under parity, angular momentum is unchanged.
   (d) Position is unaffected by time reversal. Since momentum is (proportional to) the derivative of position with respect to time, it should change sign under time reversal.
   (e) We have
   $$\Theta^{-1}[x,p]\Theta = \Theta^{-1}xp\Theta - \Theta^{-1}px\Theta = \Theta^{-1}x\Theta\Theta^{-1}p\Theta - \Theta^{-1}p\Theta\Theta^{-1}x\Theta = x(-p) - (-p)x = -xp + px = -i\hbar$$
   As prophesied, we must have $\Theta^{-1}i\hbar\Theta = -i\hbar$ for everything to be consistent.
   (f) The complex conjugate of a complex conjugate takes one back to the original number; $\Theta^2\psi = \Theta\Theta\psi = \Theta\psi^* = \psi^{**} = \psi$. Θ^2 is thus the identity operator on bosons.
   (g) As stated earlier, position is unchanged under time reversal while linear momentum gets a minus sign. Angular momentum, which is position times momentum, thus changes sign under time reversal.
   (h) Applying Θ twice, both terms are once again proportional to their initial state, and each has picked up a phase shift of π; the second term picks it up on the first application of Θ and the first term on the second application. Both a, b have been conjugated twice and thus returned to their original value, so acting with Θ^2 on a spin-1/2 state gives minus the original state.

2. (a) Since acceleration flips sign under parity, force must do so as well. To maintain the equality, each term on the right-hand-side must change sign. Charge is unchanged, so **E** must change sign. Velocity flips sign under parity, so **B** must remain unchanged.
   (b) Since acceleration is a second time derivative of position, it is unchanged under time reversal; each derivative flips sign but this cancels overall since there are an even number of them. Charge is unchanged, so **E** must also be unchanged under time reversal. Velocity changes sign, so **B** must also change sign for the second term to remain unchanged under time reversal.
   (c) The right-hand-side changes sign under charge conjugation, so the left-hand-side must as well. The derivative is unchanged; it has nothing to do with charge. **E** therefore changes sign under charge conjugation.
   (d) Since **E** changes sign, and all the derivative are unaffected by charge conjugation, **B** must also change sign under charge conjugation.
   (e) Each of **E** and **B** flips sign under two of the transformations and is unchanged by the third. Both **E** and **B** are thus unchanged under the combined application of charge conjugation, parity, and time reversal.