1 Dirac Practice

For this problem, use the vectors $|a\rangle = 4|1\rangle - 3|2\rangle$ and $|b\rangle = -i|1\rangle + |2\rangle$.

(a) Find $\langle a|b\rangle$ and $\langle b|a\rangle$. Discuss how these two inner products are related to each other.

(b) For $\hat{Q} \doteq \begin{pmatrix} 2 & i \\ -i & -2 \end{pmatrix}$, calculate $\langle 1|\hat{Q}|2\rangle$, $\langle 2|\hat{Q}|1\rangle$, $\langle a|\hat{Q}|b\rangle$ and $\langle b|\hat{Q}|a\rangle$.

(c) What kind of mathematical object is $|a\rangle\langle b|$? What is the result if you multiply a ket (for example, $|a\rangle$ or $|1\rangle$) by this expression? What if you multiply this expression by a bra?