1) $A = \begin{bmatrix} 0 & -2 & 1 \\ 1 & -1 & 1 \\ 0 & 0 & 2 \end{bmatrix}$ so $|A| = 2 \cdot 1^6 \cdot 2 = 4$ $\quad |AB| = |A||B| = \boxed{24}$

$B = \begin{bmatrix} 3 & 0 & 0 \\ -2 & 1 & 0 \\ 4 & -4 & 2 \end{bmatrix}$ so $|B| = 3 \cdot 1^2 \cdot 2 = 6$

2) $A = \begin{bmatrix} 2 & -1 & 1 \\ 0 & 2 & 6 \\ 0 & 0 & 3 \end{bmatrix}$ so $|A| = 3 \cdot 1^6 \cdot 4 = 12$ so $|A^{-1}| = \boxed{\frac{1}{12}}$

3) $A = \begin{bmatrix} -1 & 2 \\ 2 & 3 \end{bmatrix}$ so $|A| = -3 - 4 = -7$ so $|3AA^T| = 3^2 \cdot -7 \cdot -7 = \boxed{441}$

$= |A^T|$

Check: $3AA^T = 3\begin{bmatrix} -1 & 2 \\ 2 & 3 \end{bmatrix}\begin{bmatrix} -1 & 2 \\ 2 & 3 \end{bmatrix} = \begin{bmatrix} -3 & 6 \\ 6 & 9 \end{bmatrix}\begin{bmatrix} -1 & 2 \\ 2 & 3 \end{bmatrix} = \begin{bmatrix} 15 & 12 \\ 12 & 39 \end{bmatrix} = \boxed{441}$

4) $A = \begin{bmatrix} 2 & 0 \\ 3 & 1 \end{bmatrix}$ so $|A| = 2$ so $|A^{-1}| = \boxed{\frac{1}{2}}$

b) find A^{-1}: $\left[\begin{array}{cc|cc} 2 & 0 & 1 & 0 \\ 3 & 1 & 0 & 1 \end{array}\right] \to \left[\begin{array}{cc|cc} 3 & 1 & 0 & 1 \\ 2 & 0 & 1 & 0 \end{array}\right] \to \left[\begin{array}{cc|cc} 1 & 1 & -1 & 1 \\ 2 & 0 & 1 & 0 \end{array}\right] \to \left[\begin{array}{cc|cc} 1 & 1 & -1 & 1 \\ 0 & -2 & 3 & -2 \end{array}\right] \to \left[\begin{array}{cc|cc} 1 & 0 & \frac{1}{2} & 0 \\ 0 & 1 & -\frac{3}{2} & 1 \end{array}\right]$

so $A^{-1} = \begin{bmatrix} \frac{1}{2} & 0 \\ -\frac{3}{2} & 1 \end{bmatrix}$ and $|A^{-1}| = \boxed{\frac{1}{2}}$

5) $A = \begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix}$ $\quad B = \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix}$ so $A + B = \begin{bmatrix} 2 & 2 \\ 2 & 6 \end{bmatrix}$ and $|A+B| = 12 - 4 = 8$

$|A| = 4 - 4 = 0$ $\quad |B| = 2$ $\quad |A| + |B| = 2$ $\quad |A| + |B| \neq |A+B|$

6) Singular when $|A| = 0$ $\quad (-5 - t)(7 - t) = 32$

$-35 + 7t - 5t + t^2 = 32$

$t^2 - 12t + 6 = 0$

$-35 + 5t - 7t + t^2 = -32$

$t^2 - 2t - 3 = 0$

$(t + 1)(t - 3) = 0$

$t = \{3, -1\}$