i)

$$\nabla\cdot(\vec F\times\vec G)=\nabla\cdot\left(\begin{vmatrix} i & j & k\\ F_x & F_y & F_z\\ G_x & G_y & G_z\end{vmatrix}\right)$$

$$=\nabla\cdot\left((F_yG_z-F_zG_y)-(F_xG_z-F_zG_x)+(F_xG_y-F_yG_x)\right)$$

$$=\nabla\cdot\left(\{F_yG_z-F_zG_y,\ F_zG_x-F_xG_z,\ F_xG_y-F_yG_x\}\right)$$

$$=\frac{\partial}{\partial x}F_yG_z-\frac{\partial}{\partial x}F_zG_y+\frac{\partial}{\partial y}F_zG_x-\frac{\partial}{\partial y}F_xG_z+\frac{\partial F_xG_y}{\partial z}-\frac{\partial}{\partial z}F_yG_x$$

we identification: $\vec\nabla\times\vec F=\begin{vmatrix} i & j & k\\ \partial_x & \partial_y & \partial_z\\ F_x & F_y & F_z\end{vmatrix}=\left\{\frac{\partial F_z}{\partial y}-\frac{\partial F_y}{\partial z},\ \frac{\partial F_x}{\partial z}-\frac{\partial F_z}{\partial x},\ \frac{\partial F_y}{\partial x}-\frac{\partial F_x}{\partial y}\right\}$

$$=\vec G(\vec\nabla\times\vec F)-\vec F(\vec\nabla\times\vec G)$$

ii) $\vec\nabla\times(\vec\nabla\varphi)=0$?

$$\begin{vmatrix} i & j & k\\ \partial_x & \partial_y & \partial_z\\ \partial_x\varphi & \partial_y\varphi & \partial_z\varphi\end{vmatrix}=\underbrace{\partial_y\partial_z\varphi-\partial_z\partial_y\varphi}_{0}+\dots \quad \dots=0$$

iii) $\nabla\cdot(f(\underbrace{|\vec x|}_{\text{magnitude of }\vec x})\,\vec x)$

$$=\nabla f(|\vec x|)\cdot\vec x+f(|\vec x|)\,\nabla\cdot\vec x$$

$\vec x \to (x,y,z)$

$$=\frac{\partial x}{\partial x}+\frac{\partial y}{\partial y}+\frac{\partial z}{\partial z}=3$$

$$f'(|\vec x|)\,\underbrace{\vec\nabla(|\vec x|)}\longrightarrow=\frac{\vec x}{|\vec x|}$$

$$=f'(|\vec x|)\cdot\frac{\vec x}{|\vec x|}\,\vec x=f'(|\vec x|)\cdot\frac{|\vec x|^2}{|\vec x|}=f'(|x|)\cdot|\vec x|$$

dres $=f'(|x|)\cdot|\vec x|+3\cdot f(|\vec x|)$