4.1) $J(x) = \delta^{(2)}(\vec{x}-\vec{x}_1) + \delta^{(2)}(\vec{x}-\vec{x}_2)$

$$W(J) = -\frac{1}{2}\int \frac{d^3k}{(2\pi)^3} J^*(k) \frac{1}{k^2-m^2+i\varepsilon} J(k)$$

$$J(k) = \int d^3x \, e^{-ikx} J(x) = \int dx^0 \, e^{-ik^0x^0}\left(e^{-i\vec{k}\cdot\vec{x}_1} + e^{-i\vec{k}\cdot\vec{x}_2}\right) = J_1(k) + J_2(k)$$

$$W(J) = -\int \frac{d^3k}{(2\pi)^3} J_2^*(k) \frac{1}{k^2-m^2+i\varepsilon} J_1(k)$$

$$= -\int dx^0 \int dy^0 \int \frac{d^3k}{(2\pi)^3} \frac{1}{k^2-m^2+i\varepsilon} e^{-ik^0(x-y)^0} e^{-i\vec{k}\cdot(\vec{x}_1-\vec{x}_2)}$$

$$= -\int dx^0 \int dy^0 \int \frac{dk^0}{2\pi} e^{-ik^0(x-y)^0} \int \frac{d^2k}{(2\pi)^2} \frac{1}{k^2-m^2+i\varepsilon} e^{-i\vec{k}\cdot(\vec{x}_1-\vec{x}_2)}$$

$$W(J) = \int dx^0 \int \frac{d^2k}{(2\pi)^2} \frac{1}{\vec{k}^2+m^2} e^{-i\vec{k}\cdot(\vec{x}_1-\vec{x}_2)}$$

$$Z[J] = Z[J=0]\, e^{iW(J)}$$

$$= \langle 0 | e^{-iHT} | 0 \rangle = e^{-iET}$$

$$E = -\int \frac{d^2k}{(2\pi)^2} \frac{1}{\vec{k}^2+m^2} e^{-i\vec{k}\cdot(\vec{x}_1-\vec{x}_2)}$$

$$= -\frac{1}{(2\pi)^2}\int_0^\infty dk\, k \int_0^{2\pi} d\vartheta \frac{1}{k^2+m^2} e^{-ik|\vec{x}_1-\vec{x}_2|\cos\vartheta}$$

$$= -\frac{1}{2\pi}\int_0^\infty dk \frac{k}{k^2+m^2} J_0(k|\vec{x}_1-\vec{x}_2|)$$

$$E = -\frac{1}{2\pi} J_0(m|\vec{x}_1-\vec{x}_2|)$$

$$x = |\vec{x}_1-\vec{x}_2|$$

$$\boxed{E = -\frac{1}{2\pi} J_0(mx)}$$

$$\vec{F} = -\vec{\nabla} E$$

$$\boxed{\vec{F} = -\frac{m}{2\pi} J_1(mx)\,\hat{x}}$$

$$J(x) = \delta^{(D)}(\vec{x}-\vec{x}_1) + \delta^{(D)}(\vec{x}-\vec{x}_2)$$

$$W(J) = -\frac{1}{2}\int \frac{d^{D+1}k}{(2\pi)^{D+1}} J^*(k) \frac{1}{k^2-m^2+i\varepsilon} J(k)$$

$$W(J) = \int dx^0 \int \frac{d^Dk}{(2\pi)^D} \frac{1}{\vec{k}^2+m^2} e^{-i\vec{k}\cdot\vec{x}}$$

$$E = -\int \frac{d^Dk}{(2\pi)^D} \frac{1}{\vec{k}^2+m^2} e^{-i\vec{k}\cdot\vec{x}}$$

$$= -\int_0^\infty \frac{dk}{2\pi} \frac{k^{D-1}}{k^2+m^2} \int \frac{d\Omega_{D-1}}{(2\pi)^{D-1}} e^{-i\vec{k}\cdot\vec{x}}$$

$$= -\int_0^\infty \frac{dk}{2\pi} \frac{k^{D-1}}{k^2+m^2} \cdot \frac{1}{(2\pi)^{D-1}} \int_{\varphi_1=0}^{\pi} d\varphi_1 \int_{\varphi_2=0}^{\pi} d\varphi_2 \cdots \int_{\varphi_{D-1}=0}^{2\pi} d\varphi_{D-1} \sin^{D-2}(\varphi_1)\sin^{D-3}(\varphi_2)\cdots\sin(\varphi_{D-2})\, e^{-i\vec{k}\cdot\vec{x}}$$

$$\boxed{E = -\frac{1}{(2\pi)^{D-1}}\int_0^\infty dk \frac{k^{D-1}}{k^2+m^2}\left(\prod_{j=1}^{D-2}\int_0^{\pi} d\varphi_j \sin^{D-j-1}(\varphi_j)\right) e^{-ikx\cos\vartheta}}$$