(1).

1.

$$f(t) = 64 + 26\cos\left(\frac{2*pi*k*t}{N}\right) + 13\sin\left(\frac{2*pi*k*t}{N}\right)$$

Here

$$A\cos\phi = 26 \quad \cdots (i)$$
$$A\sin\phi = 13 \quad \cdots (ii)$$

$(i)^2 + (ii)^2$

$$A^2 = 13^2 + 26^2$$
$$A = 29.069$$

$(ii) \div (i)$

$$\tan\phi = \frac{13}{26}$$
$$\cancel{\phi = \tan^{-1}}$$
$$\phi = \tan^{-1}\frac{1}{2} = 0.464 \text{ rad}$$

For getting the angular frequency ω

$$f(t) = 64 + 26\cos(2*pi*k*t/N) + 13\sin(2*pi*k*t/N)$$

Assuming $A\cos\phi = 26$

$A\sin\phi = 13$

$$f(t) = 64 + A\cos\phi\cos(2*pi*k*t/N) + A\sin\phi\sin(2*pi*k*t/N)$$

$$= 64 + A\cos(2*pi*k*t/N - \phi)$$

$$\omega = \frac{2*pi*k}{N}$$

$$= \frac{2*pi*1}{200} = \frac{pi}{100} = \frac{3.14}{100} = \cancel{0.0314}$$

$$= 0.0314 \text{ rad/s}$$

2.

$$F(\omega) = \int_{-\infty}^{\infty} f(t)\, e^{-i\omega t}\, dt$$

$$= \int_{0}^{a} -1 \cdot e^{-i\omega t}\, dt + \int_{a}^{\infty} 0 \cdot e^{-i\omega t}\, dt$$

$$= \left[\frac{-1}{-i\omega} e^{-i\omega t} \right]_{0}^{a}$$

$$= \frac{i^2}{-i\omega} \left[e^{-i\omega t} \right]_{0}^{a}$$

$$= \cancel{\frac{i}{\omega} \left(e^{-i\omega a} - 1 \right)}$$

$$= \frac{-i}{\omega} \left[e^{-i\omega t} \right]_{0}^{a}$$

$$= \frac{-i}{\omega} \left(e^{-i\omega a} - 1 \right)$$

$$= \frac{i}{\omega} \left(1 - e^{-i\omega a} \right).$$