H23
問2

(1)

$$\int H\,ds = I$$

$$H = \frac{I}{2\pi r} \quad [A/m]$$

(2)

$$d\Phi = \mu_0 H\,dS$$

$$= \mu_0 H\, c\,dr$$

$$= \frac{\mu_0 c}{2\pi r} I\,dr \quad [Wb]$$

(3)

$$\Phi = \int_x^{x+c} \frac{\mu_0 c}{2\pi r} I\,dr$$

$$= \frac{\mu_0 c}{2\pi} I \left[\log r\right]_x^{x+c}$$

$$= \frac{\mu_0 c I}{2\pi} \log\frac{x+c}{x} \quad [Wb]$$

(4)

$$\Phi = M I \text{ より}$$

$$M = \frac{\Phi}{I} = \frac{\mu_0 c}{2\pi} \log\frac{x+c}{x} \quad [H]$$

(5)

$$e = -\frac{\partial \Phi}{\partial t}$$

$$= -\frac{\partial \Phi}{\partial x}\frac{dx}{dt}$$

$$= -\frac{\partial \Phi}{\partial x} v$$

$$= -\frac{\mu_0 c}{2\pi}\left(-\frac{c}{x(x+c)}\right) v$$

$$= \frac{\mu_0 I c^2}{2\pi x(x+c)} v \quad [V]$$