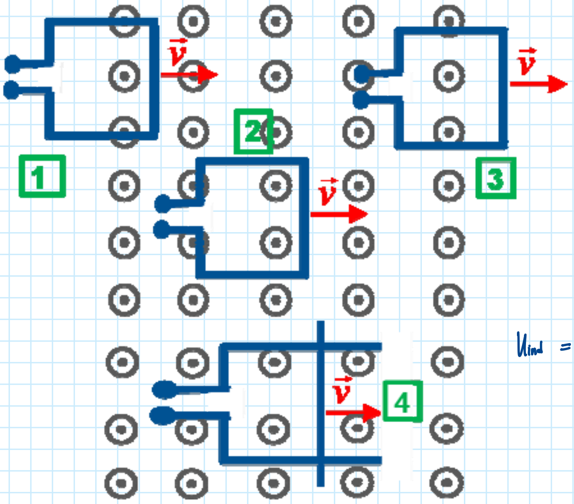
In which of the displayed cases a voltage is induced in the conductor loop and how do you termin this kind of induction?

$\phi = \int_{A(t)} \vec{B}(\vec{r},t)\, d\vec{a}$ $U_{ind} = -\frac{d\phi(A)}{dt}$

$$\vec{B}(\vec{r},t) = B_0 \vec{e}_z$$



① Yes, $U_{ind} \Rightarrow \phi$ is decreasing

② no, ϕ Const.

③ Yes, ϕ is decreasing

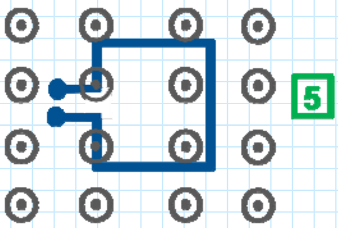
④ Yes, because $A = A(t)$ is increasing $\Rightarrow \phi$ is increasing

$\phi = A(t) \cdot B \Rightarrow U_{ind}$

$U_{ind} = \int_0^1 \vec{E}_{ind}\, d\vec{r} = \int_0^c (\vec{v} \times \vec{B})\, d\vec{r}$

①, ③, ④ : motional induction

$$\vec{B}(\vec{r},t) = B_0 e^{i\omega t} \vec{e}_z$$

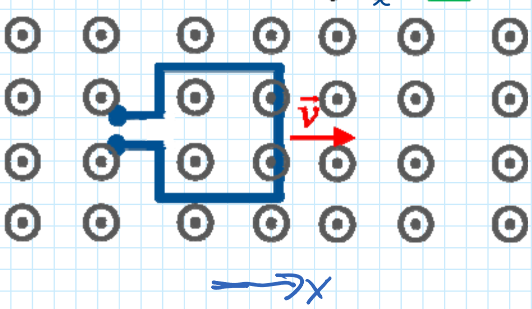


⑤ Yes, since $\vec{B}$ is varying with time

$\Rightarrow \phi = \phi(t) \Rightarrow U_{ind} \neq 0$

motionless induction

$$\vec{B}(\vec{r},t) = B_0 x \vec{e}_z$$



Yes, $U_{ind} \neq 0$

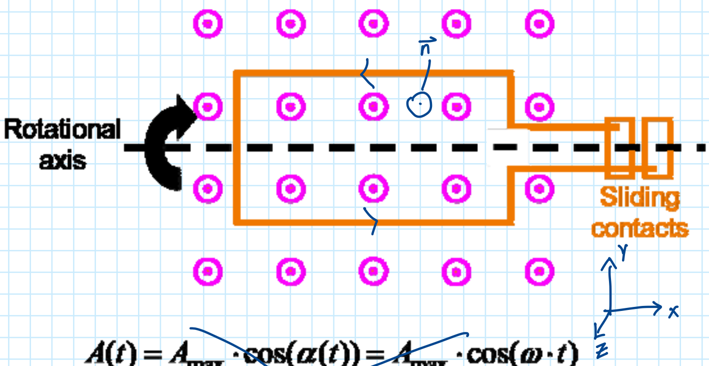
Since $\vec{B}$-field changes in x-direction (increase)

$\Rightarrow \phi$ is increasing

⑦ $B(\vec{r},t) = B_0 y \cdot \vec{e}_y$

no, $U_{ind} = 0$; $\vec{B}$-field changes only in y-direction; ϕ is constant

Generation of induced voltage in rotating conductor loop



$$\cancel{A(t) = A_{max} \cdot \cos(\alpha(t)) = A_{max} \cdot \cos(\omega \cdot t)}$$
$$\cancel{A_{max} = w \cdot l}$$
$$\cancel{\omega = 2\pi \cdot f = 2\pi / T}$$

$\vec{n} \uparrow\uparrow \vec{B}$ $\quad \vec{B} = B_0$

$\vec{n} = \vec{e_z}$

$$\phi(A) = \int_{A(t)} \vec{B} \cdot d\vec{a}$$

motional induction

$A = d \cdot l$

rotational frequency $\omega = 2\pi f$

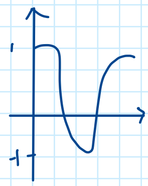
loop rotates with ω

$$\phi(A) = \vec{A(t)} \cdot \vec{B} = A \cdot \vec{n(t)} \cdot \vec{B}$$
$$= A \cdot \underbrace{|\vec{n}|}_{1} \cdot \cos\omega t \cdot \vec{e_z}$$
$$= A \cdot \cos\omega t \cdot B_0$$

$t = 0 \Rightarrow \vec{n}$ points in z-direction

$\Downarrow$

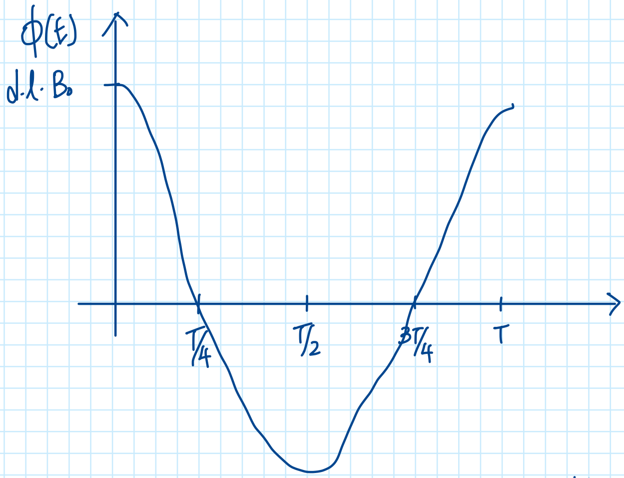
Starts to rotate at ω



$\omega = \frac{2\pi}{T} \quad t = \frac{T}{4}$

T = duration of an oscillation period

$$\phi(t) = A \cdot B_0 \cos\omega t = d \cdot l \cdot B_0 \cdot \cos\omega t$$



$$U_{ind} = \left(-A \cdot B_0\, \omega \sin\omega t\right) = -\frac{d\phi}{dt} = A \cdot B_0 \cdot \omega \sin\omega t$$