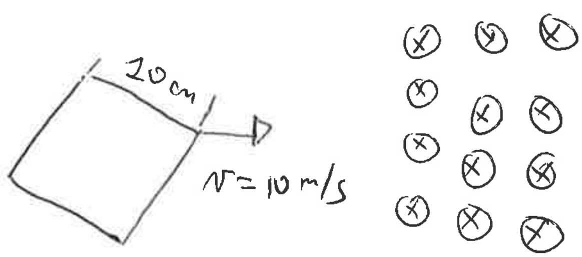
Solutions to Practice Quiz

Problem 1

$B = 0.8T$

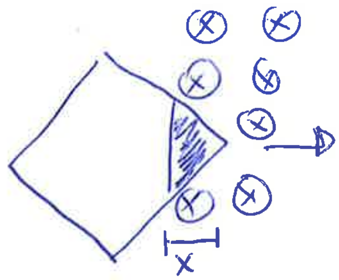


$$\mathcal{E} = -\frac{d}{dt}\iint \vec{B}\cdot d\vec{A}$$

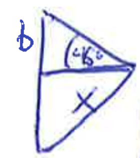
$$= -\frac{d}{dt}\iint B\,dA \qquad B \text{ is a constant}$$

$$= B\frac{d}{dt}\iint dA = B\frac{dA}{dt} \qquad \text{Equation 1}$$

what is A? A is the area imersed in the field.



→ what is this area ⟹



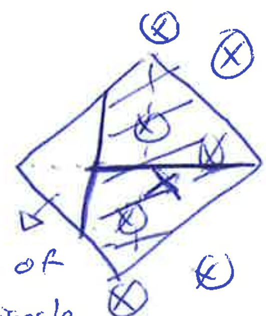
$\tan(45°) = \frac{b}{x}$

Area = bx

$$\boxed{Area = x^2}$$

but $x = vt$ since velocity is constant.

$$\mathcal{E} = B\frac{d(vt^2)}{dt} = 2Bv^2t \quad \text{for } x < \sqrt{2}\,5 \leftarrow \text{this is half the diagonal}$$



The area of this triangle is $(\sqrt{2}(10) - x)^2$

This is the diagonal of the square.

when the loop is passed the point where the B-field crossed the diagonal of the square, the triangle formula used above breaks down. We need a new formula for the area.

⟶ To get the shaded area, we get the unshaded area and substract it from the whole area of the square.

$$A_{square} = l^2$$

$$A = l^2 - (\sqrt{2}(10) - x)^2$$

Now we plug this into Eqn. 1

$$\mathcal{E} = B\frac{d}{dt}\left(l^2 - (10\sqrt{2} - x)^2\right)$$

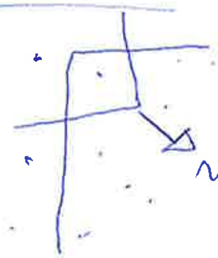
$$\mathcal{E} = B\,2(10\sqrt{2} - x)\dot{x}.$$

so,

$$\mathcal{E} = \begin{cases} 2Bv^2t & x < \sqrt{2}\,5 \\ B\,2(10\sqrt{2} - vt)v & x > \sqrt{2}\,5 \end{cases}$$

Problem 2

$B = 0.10\ T$



We can decompose the velocity

$v_x = 10\cos(45^\circ) = 10\left(\frac{\sqrt{2}}{2}\right) = 5\sqrt{2}$

$v_y = 10\sin(45^\circ) = 10\left(\frac{\sqrt{2}}{2}\right) = 5\sqrt{2}$

(same as Problem 1)

$$\mathcal{E} = B\frac{dA}{dt} = B\frac{d}{dt}(v_x v_y t^2) = 2Bv_x v_y t = 100\,Bt$$

what is A? $A = xy = v_x t\, v_y t$

Problem 3

Add the fluxes

This is positive.

This flux is negative because it goes into the page

$$-B_1(0.2)^2 + B_2(0.2)^2 = -2(0.2)^2 + (0.2)^2 = -1(0.2)^2$$

Problem 4

$BA = -(0.05)(0.1)\cos(45) - (0.05)(0.1)\cos(135^\circ)$

for the lower part — for the upper part