$$\boxed{20.59}$$

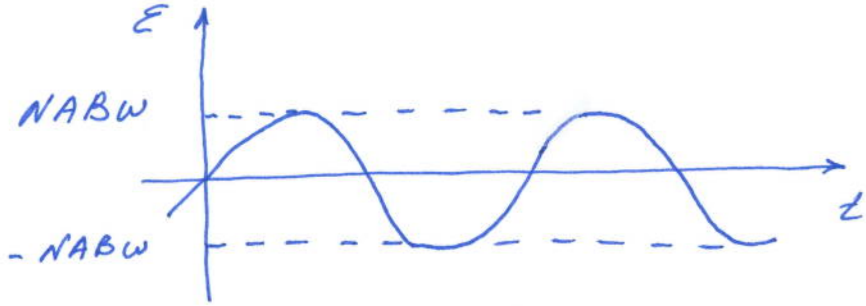
AC generator produces emf:

$$\mathcal{E} = 100 \sin(376.99t) \qquad (1)$$

General formula for AC generator's emf is Eq. (20.7)

$$\mathcal{E} = NAB\omega \sin(\omega t) \qquad (2)$$

if you draw a graphic then



$$\Rightarrow \mathcal{E}_{max} = NAB\omega$$

comparing (1) and (2):

(a) $\mathcal{E}_{max} = NAB\omega = 100$

$$\Rightarrow \boxed{\mathcal{E}_{max} = 100\text{ V}}$$ (i.e. maximal voltage)

(b) $\omega t = 376.99t$

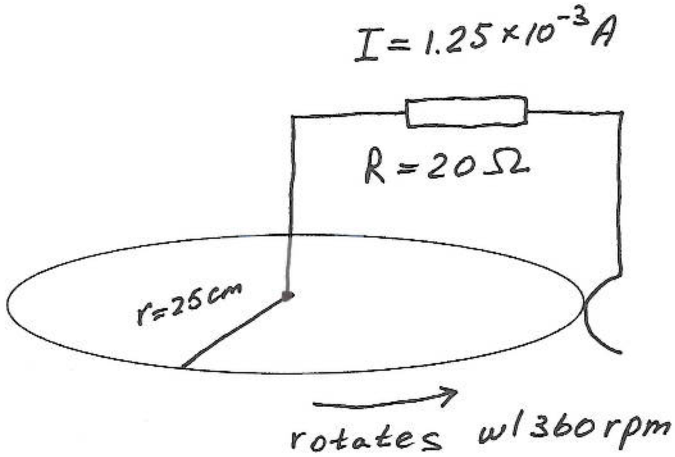
$\omega = 376.99$

but $\omega = 2\pi f$ where f - frequency

$$\Rightarrow f = \frac{376.99}{2\pi} \simeq 60\text{ Hz}$$

$$\Rightarrow \boxed{f = 60\text{ Hz}}$$

$\boxed{20.63}$



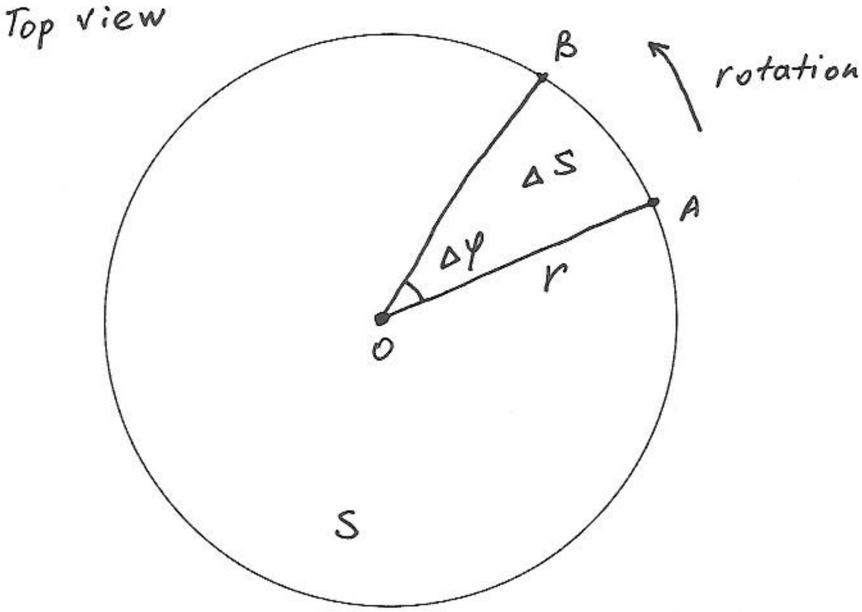
strip OA for time Δt moves to position OB and covers area ΔS. (covers angle $\Delta\varphi$)

We need to find eq. for

$$\Delta S = \Delta S(\Delta t)$$

(i.e. $\Delta S \sim \Delta t$)

It's important to notice that



$$\frac{\Delta S}{S} = \frac{\Delta\varphi}{2\pi}$$

(S - circle's area
2π - circle's angle)

(you can see this, for ex.:

$\Delta S = \frac{1}{2} S$

$\frac{\Delta S}{S} = \frac{\pi}{2\pi}$

$\frac{1}{2} = \frac{1}{2}$)

But ω by definition:

$$\omega \equiv \frac{\Delta\varphi}{\Delta t} \Rightarrow \Delta\varphi = \omega \Delta t$$

therefore

$$\frac{\Delta S}{S} = \frac{\omega \Delta t}{2\pi}$$

Note that S for circle is:

$$S = \pi r^2$$

$$\Rightarrow \quad \frac{\Delta S}{\pi r^2} = \frac{\omega \Delta t}{2\pi}$$

$$\Delta S = \frac{\pi r^2 \omega \Delta t}{2\pi} = \frac{1}{2} r^2 \omega \Delta t$$

$$\underline{\Delta S = \frac{1}{2} r^2 \omega \Delta t} \qquad (*)$$

EMF can be calculated by:

$$\mathcal{E} = -\frac{\Delta \Phi}{\Delta t} \qquad \text{(see Eq. 20.2 for example)}$$

but $\Delta \Phi = B \Delta S$ (by definition)

$$\Rightarrow \quad \mathcal{E} = -\frac{B \Delta S}{\Delta t}$$

plug in (*):

$$\mathcal{E} = -\frac{B}{\Delta t}\left(\frac{1}{2} r^2 \omega \Delta t\right) = -\frac{1}{2} r^2 \omega B$$

$$\Rightarrow \quad \underline{\mathcal{E} = -\frac{1}{2} r^2 \omega B} \qquad (1)$$

From other side Ohm's Law says:

$$I = \frac{\mathcal{E}}{R}, \quad \text{i.e.} \quad \underline{\mathcal{E} = I R} \qquad (2)$$

therefore (1) and (2) give us:

$$I R = -\frac{1}{2} r^2 \omega B$$

$$\Rightarrow \quad \underline{B = -\frac{2 I R}{r^2 \omega}} \qquad (3)$$

Note that we have ω in <u>rpm's</u> and we have to <u>convert it to rad/s</u> to plug in (3):

$$\omega = 360 \text{ rpm} = \frac{360 \cdot 2\pi}{60} = 37.7 \text{ rad/s}$$

(since 1 rotation $= 2\pi$ radians)
(1 minute = 60 seconds)

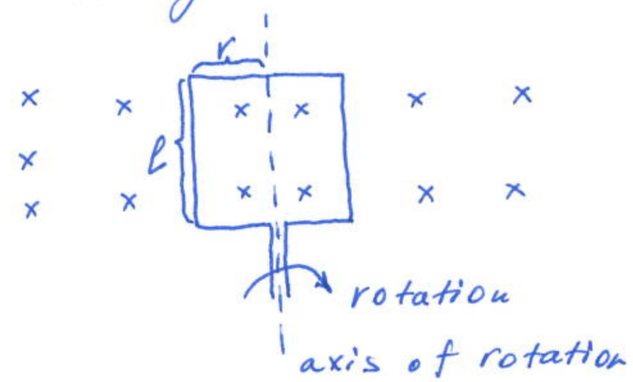
$$\underline{\omega = 37.7 \text{ rad/s}}$$

So plug in all #'s to (3) we can get

$$\boxed{B = 21 \times 10^{-3}\ T}$$

$\boxed{20.67}$

Simple AC generator's coil is



to calculate area of coil:

$$A = (2r)\cdot l$$

plug in #'s : $A = 2 \times 10^{-2}\ m^2$

We need to convert ω which is in rpm to rad/s:

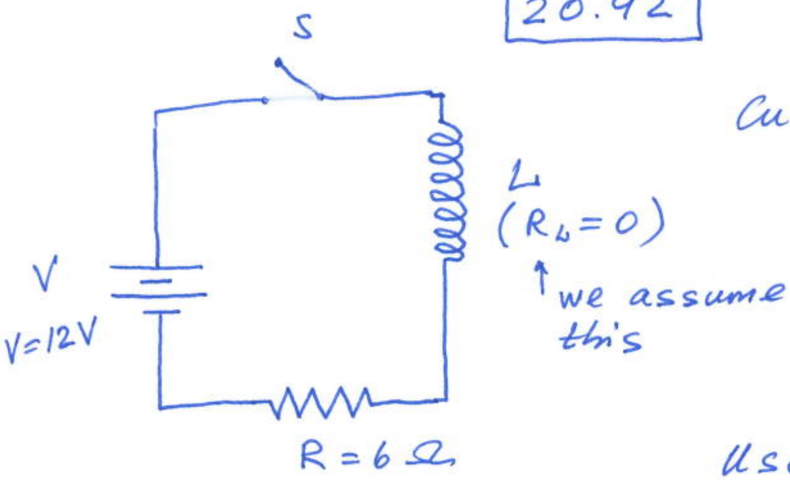
$$\omega = 6000\ rpm = \frac{6000 \cdot 2\pi}{60} = 628.3\ rad/s$$

Use Eq. (20.7) to calculate EMF:

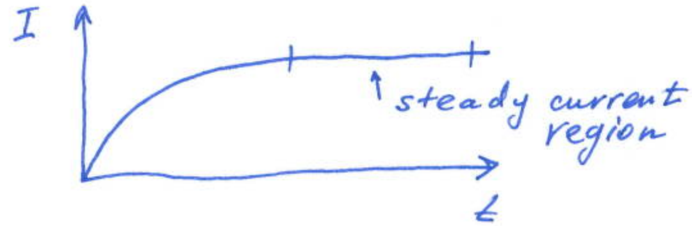
$$\mathcal{E} = NAB\omega \sin \omega t \qquad (N - \#\text{ of turns})$$

$$\Rightarrow \quad \boxed{\mathcal{E} = 1.3 \times 10^{3} \sin(628.3\, t)}$$

$\boxed{20.92}$



Current after switch is closed:



Use Ohm's Law

$$I = \frac{V}{R} \qquad (\text{Note } R_L = 0)$$

$$\boxed{I = 2\ A}$$