STAWA Set 8

16. $N_p = 300$
$N_s = 4800$
eff = 92 %
$(V_{rms})_p = 240V$
$I_s = 40 mA_{rms}$

a) Heat loss due to eddy currents in the iron core and to surroundings. Heat in wiring $P = I^2R$

b) $\frac{V_p}{V_s} = \frac{N_p}{N_s}$ $\quad \frac{240}{(V_{rms})_s} = \frac{300}{4800}$ $\quad (V_{rms})_s = \frac{240}{300} \times 4800 = 3840 V$

$V_{Rrms} = \frac{V_p}{\sqrt{2}}$ $\quad V_p = \sqrt{2} \times V_{rms} = \sqrt{2} \times 3840 = 5431 V$

$P_{rms} = VI = 3840 \times 40 \times 10^{-3} = 153.6 W$

$\frac{92}{100} \times P_p = P_s$

$P_p = \frac{153.6 \times 100}{92} = 167 W$

$P_p = VI$
$I_{rms} = \frac{P}{V} = \frac{167}{240} = 0.670A$
$V_{peak} = \sqrt{2} \times 240 = 339.4V$
$I_{peak} = \frac{167}{339.4} = 0.49$

17. $V_p^{rms} = 240 V$ $\quad V_s = 6.30V$, $I_s = 8.00A$, $N_s = 840$ $\quad V_s = 35\,000V$, $I_s = 15 \times 10^{-3} A$

a) $\frac{V_p}{V_s} = \frac{N_p}{N_s}$

$N_p = \frac{240}{6.3} \times 84 = 3200$ turns

b) $\frac{V_p}{V_s} = \frac{N_p}{N_s}$

$\frac{240}{35000} = \frac{3200}{N_s}$

$N_s = \frac{3200 \times 35000}{240} = 466\,667$ turns

c) $\frac{V_p}{V_s} = \frac{I_s}{I_p}$

$I_p = \frac{I_s \times V_s}{V_p} = \frac{8 \times 6.3}{240} = 0.21A$

$\frac{240}{35000} = \frac{15 \times 10^{-3}}{I_p}$

$I_p = \frac{15 \times 10^{-3} \times 35\,000}{240} = 2.1875A$

$I_T = 2.40A$

d) 8A coil would have thicker wiring - so prevent overheating. less resistance.

18. $R = 20.0\Omega$ a) Back Emf? When running $V = IR$
$V = 414V$ $= 9 \times 20$
$I = 9.00A$ $= \underline{180V}$ (operating voltage)

Back Emf $= 414 - 180 = \underline{234V}$

b) $R_T = \frac{V}{I} = \frac{414}{12} = 34.5\Omega$

$R_R = 34.5 - 20 = 14.5\Omega$

19. $R = 6.3\Omega$
$V = 240V$
Back emf $= 212V$

a) $I_{\text{start up}} = \frac{240}{6.3} = \underline{38.10A}$

b) Operating Voltage $= 240 - 212 = 28V$

$I_{\text{running}} = \frac{28}{6.3} = \underline{4.44A}$

20. $V = 12V$
$I = 5A \longrightarrow 1.2A$

$R = \frac{V}{I}_{\text{start up}} = \frac{12}{5} = 2.4\Omega$

$V_{\text{running}} = IR = 1.2 \times 2.4 = 2.88V$

Back emf $= 12 - 2.88 = \underline{9.12V}$

21. Current peaks high initially as full voltage at the motor's resistance. As motor starts to rotate, the motor starts behaving as a generator, creating a back emf so the operating voltage decreases = applied voltage - operating voltage and hence decrease in current (R constant)