Q.2a. What is hysteresis? Sketch hysteresis loop and indicate on it the coercive force and residual flux density.

Ans 8.9 of text book I

b.The flux in a magnetic core is varying sinusoidally at a frequency of 500 Hz. The maximum flux density is 0.5Tesla. The eddy- current loss then is 14 watts. Find the eddy-current loss in this core, when the frequency is 750 Hz, and flux density is 0.4Tesl

Q2 b. $W_e \propto B_{max}^2 f$ — 2

At 500 Hz: $14\ W \propto (0.5)^2 \times 500$ — (i)

At 750 Hz: $We' \propto (0.4)^2 \times 750$ — (ii) — 2

Dividing Eq (ii) by Eq (i)

$$\frac{We'}{14\ W} = \frac{(0.4)^2 \times 750}{(0.5)^2 \times 500}$$ — 2

$$We = \frac{(0.4)^2 \times 750}{(0.5)^2 \times 500} \times 14 = 13.44\ W$$ — 2 Ans.

Q.3a. Explain how can you determine the parameters of circuit model of a transformer, experimentally. (8)

Ans 8.9 of text book I

b. The primary and secondary windings resistances of a 40 KVA, 6600/250V, single-phase transformer are 10 ohm and 0.02 ohm respectively. The equivalent leakage reactance as referred to the primary winding is 35 ohm. Find the full load regulation for load power factor of 0.8 lagging.

Q3b $R_1 = 10\Omega$, $R_2 = 0.02\Omega$ $X_{01} = 35\Omega$

Turns Ratio $K = \frac{6600}{250} = 26.4$ — (1)

full load current, $I_2 = \frac{40000}{250} = 160A$

$R_{02} = R_2 + \frac{1}{k^2} \cdot R_1 = 0.02 + \frac{1}{(26.4)^2} \cdot 10 = 0.0344\Omega$ — (2)

and $X_{02} = \frac{1}{k^2} X_{01} = \frac{1}{(26.4)^2} \times 35 = 0.0502\Omega$ — (2)

at a p.f. of 0.8 lagging

$\cos\phi = 0.8$ and $\sin\phi = 0.6$

Regulation $= \frac{I_2 R_{02} \cos\phi + I_2 X_{02} \sin\phi}{V_2} \times 100$ — (3)

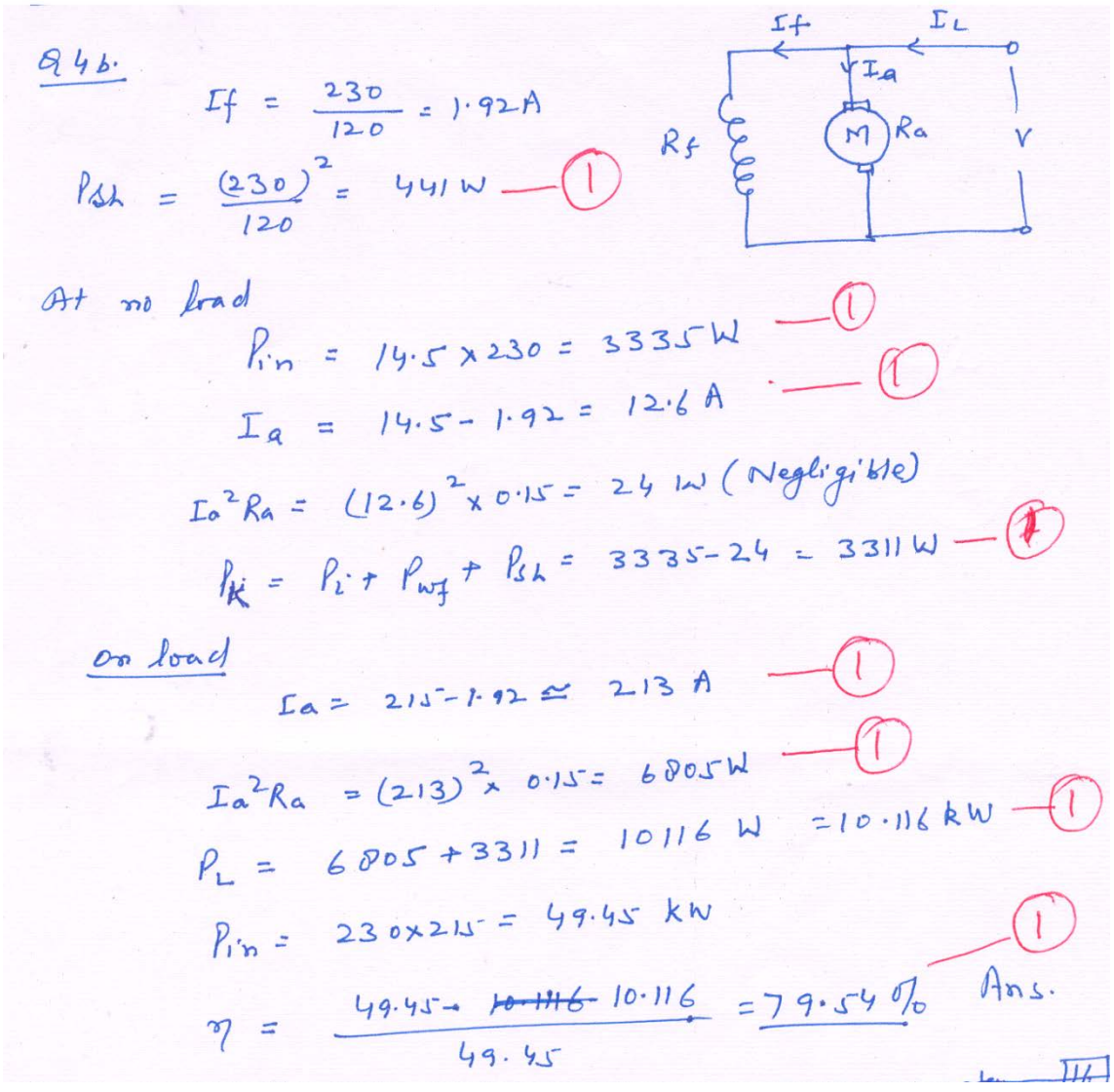
$= \frac{160 \times 0.0344 \times 0.8 + 160 \times 0.0502 \times 0.6}{250} \times 100 = 3.69\%$

Ans.

Q.4a. Explain the terms "critical resistance" and critical speed' of a DC shunt generator with reference to its relevant characteristics.

Ans 11.7 of text book I

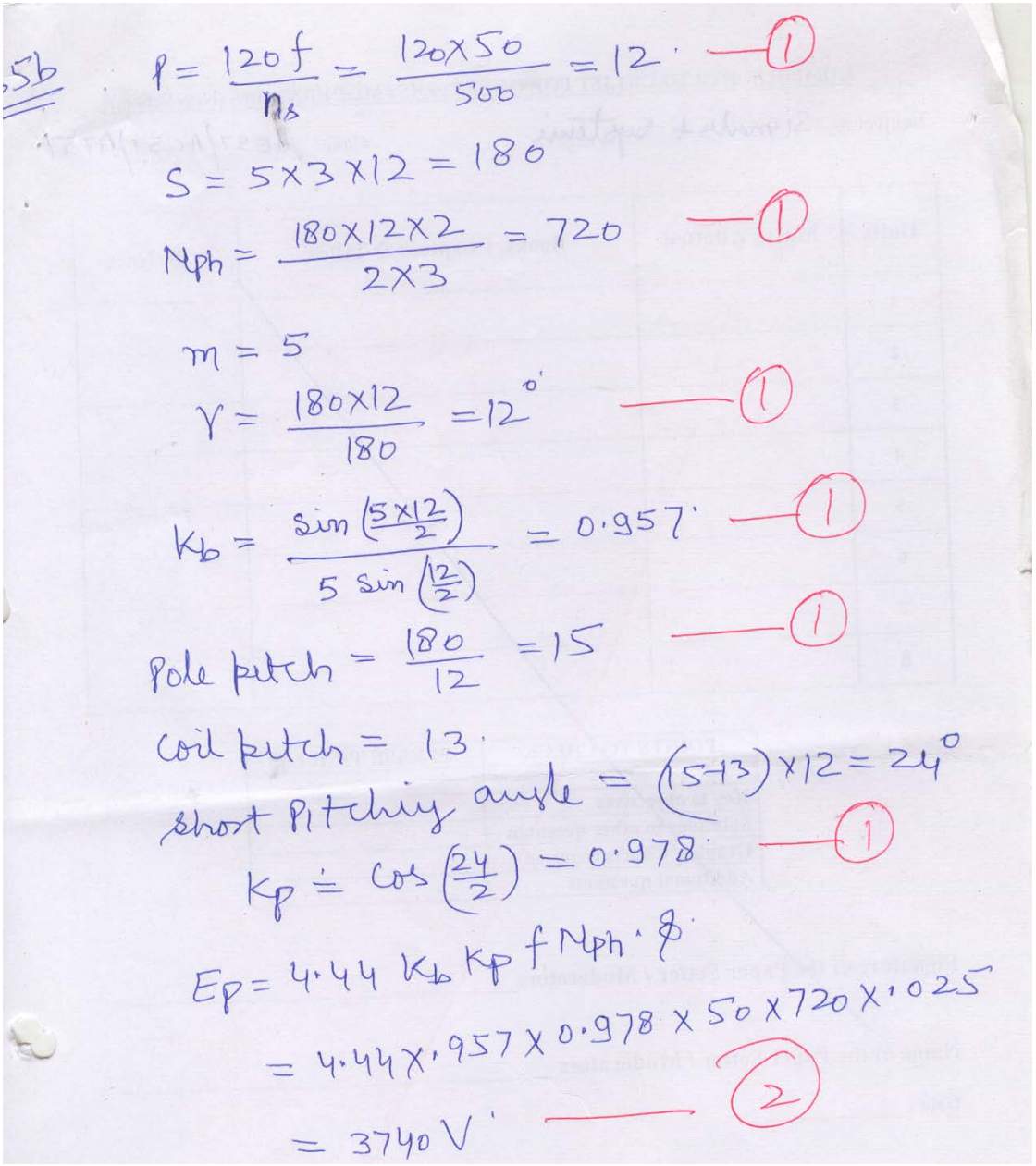
b. A 50kW, 230V dc shunt motor takes a current of 14.5 A when running at 1640 rpm. The armature and field resistances are 0.15Ω and 120Ω respectively. Estimate the motor efficiency when the motor is drawing 215A. What would be the maximum efficiency of the motor and the load current at which it would occur?



Q.5a. Write short note on V-curves for a synchronous motor.

Ans 12.2 of text book I

b.A 3 phase, 50Hz, star connected synchronous generator with double layer winding runs at 500 rpm. It has 12 turns / coil and 5 slots / pole / phase and coil pitch of 13 slots. If the flux per pole is 0.025 wb. Find phase emf induced.



5b

$P = \frac{120f}{N_s} = \frac{120 \times 50}{500} = 12$ — (1)

$S = 5 \times 3 \times 12 = 180$

$N_{ph} = \frac{180 \times 12 \times 2}{2 \times 3} = 720$ — (1)

$m = 5$

$\gamma = \frac{180 \times 12}{180} = 12^0$ — (1)

$K_b = \frac{\sin\left(\frac{5 \times 12}{2}\right)}{5 \sin\left(\frac{12}{2}\right)} = 0.957$ — (1)

Pole pitch $= \frac{180}{12} = 15$ — (1)

Coil pitch = 13

Short Pitching angle $= (15-13) \times 12 = 24^0$

$K_p = \cos\left(\frac{24}{2}\right) = 0.978$ — (1)

$E_p = 4.44 K_b K_p f N_{ph} \cdot \phi$

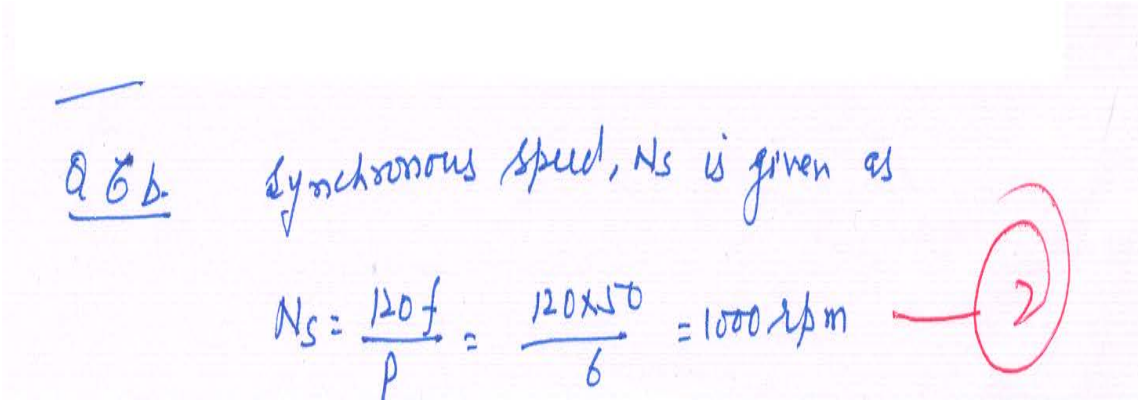
$= 4.44 \times .957 \times 0.978 \times 50 \times 720 \times .025$

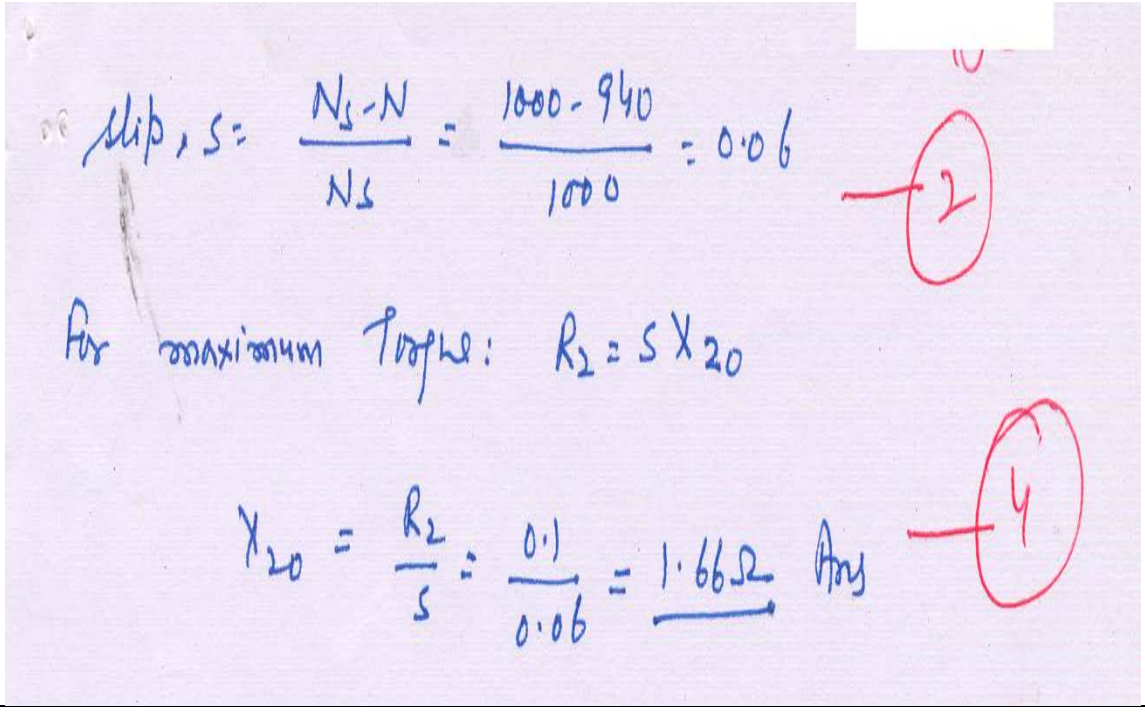
$= 3740\ V$ — (2)

Q.6a. Explain how a rotating magnetic field is produced by applying 3-phase currents to 3-phase windings of a 3-phase induction motor.

Ans 12.3 of text book I

b. A three-phase, 6-pole, 50Hz induction motor develops maximum torque at a speed of 940 rpm. If the rotor resistance per phase is 0.1Ω, determine the standstill rotor reactance.





Q.7 a. Explain the construction and principle of operation of split phase AC motor.

Ans 13.2 of text book I

b. Explain the construction and principle of operation of a single-phase universal motor.

Ans 13.2 of text book I

Q.8 Draw the block diagram representation of a thermal power generation unit. Explain the functions of its main components.

Ans 15.3 of text book I

Q.9 Write notes on any <u>TWO</u> of the following:

(i) Batteries
(ii) Energy storage
iii) HVDC Transmission

Ans 15.15 and 15.16 of text book I

Text Book

1. Basic Electrical Engineering, D.P. Kothari and I.J. Nagrath, Tata McGraw-Hill Publishing Company Limited, 2nd Edition, 13th Reprint 2006