higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ELECTRO-TECHNOLOGY N3

12 AUGUST 2019

This marking guideline consists of 7 pages.

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QUESTION 1

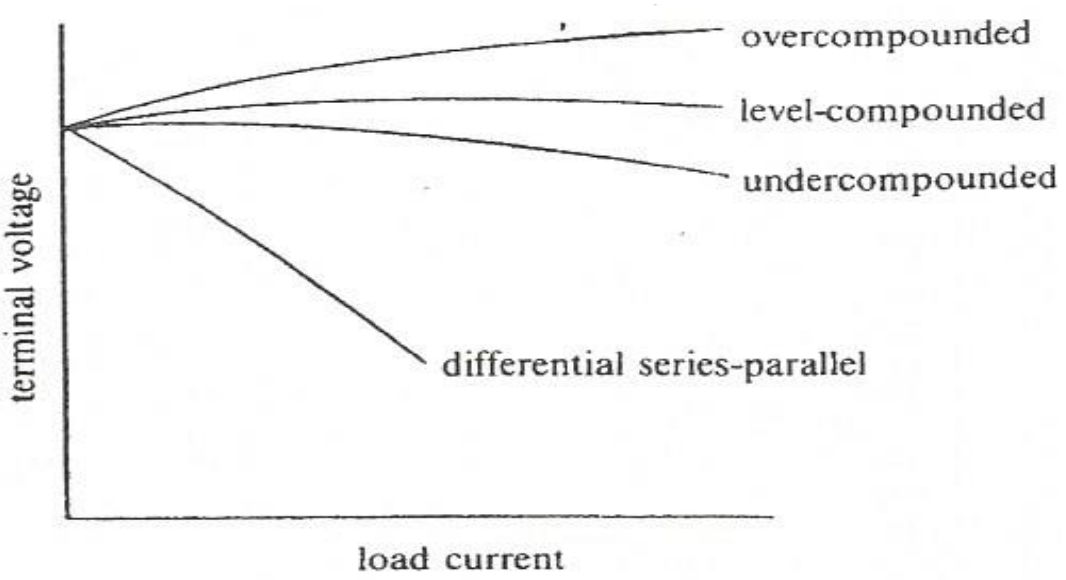
1.1 Brushes
1.2 Bedding
1.3 Lap winding
1.4 Air gap
1.5 Laminated plates
1.6 Pole shoe
1.7 Wave winding
1.8 Yoke
1.9 Bearings
1.5 Commutation

(10 × 1) **[10]**

QUESTION 2

2.1 The output of the generators are easily controlled by simply varying or changing its field current. (2)

2.2



1 mark for each curve
Half a mark each for correct labeling of the terminal voltage and load current (4)

2.3 2.3.1 $I_f = \frac{V}{R_f} = \frac{300}{175} = 1{,}714\ A$ ✓

$I_a = I_L + I_f = 90 + 1{,}714 = 91{,}714\ A$✓ (2)

2.3.2 $E = V + I_a R_a$ = 300 + (91,714)(0,2) = 318,343 V (1)

2.3.3 $P_o = VI_L = (300)(90) = 27\ kW$ (1)
[10]

QUESTION 3

3.1 3.1.1 False – They are variable speed motors.
DC shunt motors are constant speed motors. (2)

3.1.2 False – They produce high starting and operating torques.
DC shunt motors produce low starting and operating torque. (2)

3.1.3 True (1)

3.2 $E = V - I_a R_a = 400 - (32)(0{,}3) = 390{,}4\,V$ ✓✓

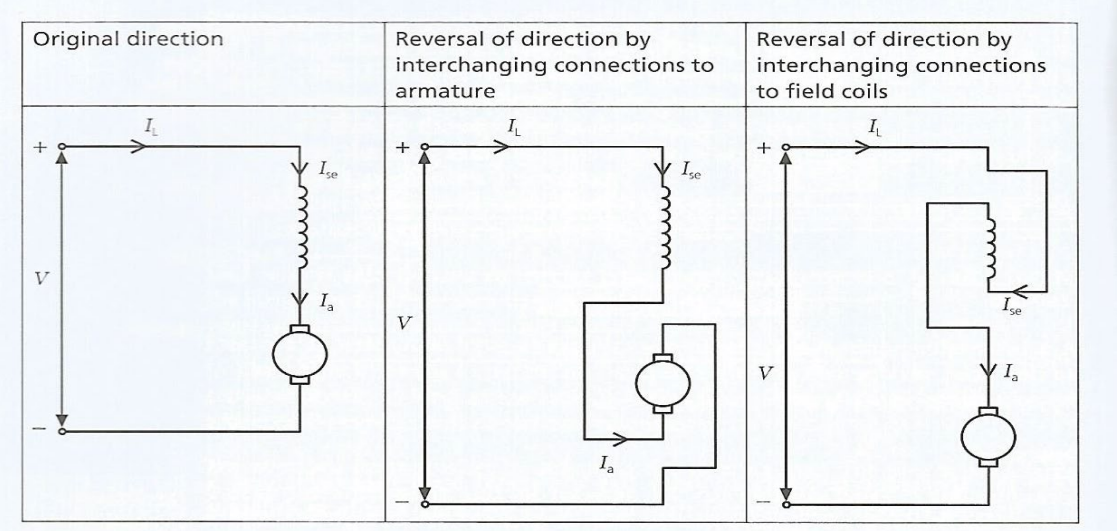
$Z = 44 \times 6 = 264$ ✓

$N = \frac{60Ec}{2\emptyset pZ} = \frac{(60)(390{,}4)(8)}{(2)(66 \times 10^{-3})(4)(264)} = 1\,344{,}353\,r/min$ ✓✓ (5)

[10]

QUESTION 4

4.1



1 mark for each correct connection of the field coils
1 mark for the armature
2 marks for each diagram (6)

4.2 4.2.1 $P_i = \frac{P_o}{\eta} \times 100\,\% = \frac{20}{0{,}92} \times 100\% = 21{,}739\,kW$ (1)

4.2.2 $Total\ losses = P_i - P_o = 1{,}739\,kW$ (1)

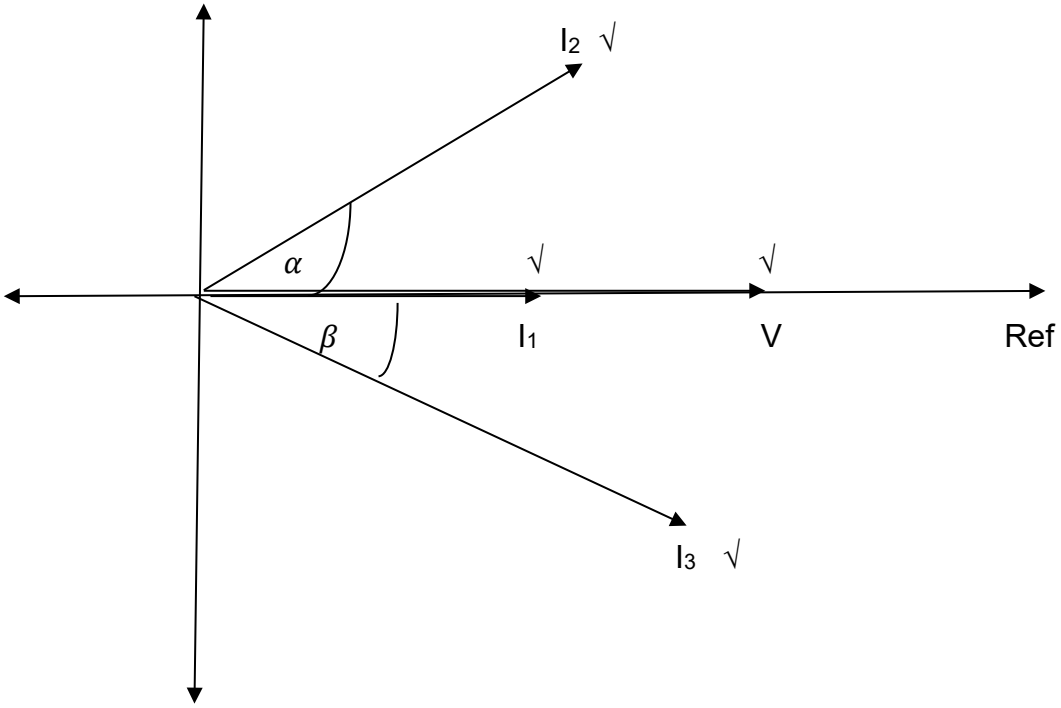
4.2.3 $I_L = \frac{20 \times 10^3}{400} = 50\,A$

$I_a = 50 + 2{,}7 = 52{,}7\,A$ (2)

[10]

QUESTION 5

5.1



(4 x 1 for each vector correctly drawn) (4)

5.2 5.2.1 $I_{rms} = \sqrt{\frac{3^2+9^2+22^2+37^2+18^2+5^2}{6}}$ = 19,545 A

5.2.2 $I_{avg} = \frac{3+9+22+37+18+5}{6}$ = 15,667 A

5.2.3 $Form\ _{Fator} = \frac{I_{rms}}{I_{avg}} = \frac{19,545}{15,667} = 1,248$

(3 × 2) (6)
[10]

QUESTION 6

6.1 $X_L = 2\pi fL = (2)(\pi)(50)(150 \times 10^{-3}) = 47,124\ \Omega$

$X_c = \frac{1}{2\pi fC} = \frac{1}{(2)(\pi)(50)(200\times10^{-6})} = 15,915\ \Omega$

$I_R = \frac{100}{30} = 3,33\ A$

$I_L = \frac{100}{47,124} = 2,122\ A$

$I_C = \frac{100}{15,915} = 6,283\ A$

(5)

6.2 $I_T = \sqrt{I_R^2 + (I_C - I_L)^2} = \sqrt{3{,}333^2 + (6{,}283 - 2{,}122)^2} = 5{,}331\ A$ (2)

6.3 $\emptyset = \tan^{-1}\left(\frac{6{,}283-2{,}122}{3{,}333}\right) = 51{,}305°$ (1)

6.4 S = VI = (100)(5,331) = 533,1 VA (2)
[10]

QUESTION 7

7.1 $V_p = \frac{525}{\sqrt{3}} = 303{,}109\ V$ (2)

7.2 $P_i = \frac{25}{0{,}85} = 29{,}412\ kW$✓

$I_L = I_p = \frac{29{,}412\times10^3}{\sqrt{3}(525)(0{,}8)}$ = 40,431 A✓✓ (3)

7.3 $V_p = V_L = 525\ V$ (1)

7.4 $I_p = \frac{40{,}431}{\sqrt{3}} = 23{,}343\ A$ (2)

7.5 $\cos\emptyset = 0{,}8 \quad \therefore \quad \emptyset = 36{,}87°$ ✓

$Q = \sqrt{3}(525)(40{,}431)(\sin 36{,}87°) = 22{,}059\ kVAr$ ✓ (2)
[10]

QUESTION 8

8.1
- Copper loss occurs in the primary and secondary windings
- Iron losses occurs in the iron core (2 × 2) (4)

8.2 8.2.1 $V_2 = V_1\frac{N_2}{N_1} = (240)\left(\frac{400}{1\,250}\right) = 76{,}8\ V$

8.2.2 $I_2 = I_1\frac{N_1}{N_2} = (12)\left(\frac{1\,250}{400}\right) = 37{,}5\ A$

8.2.3 $S = \frac{V_1 I_1}{1\,000} = \frac{(240)(12)}{1\,000} = 2{,}88\ kVA$

(3 × 2) (6)
[10]

QUESTION 9

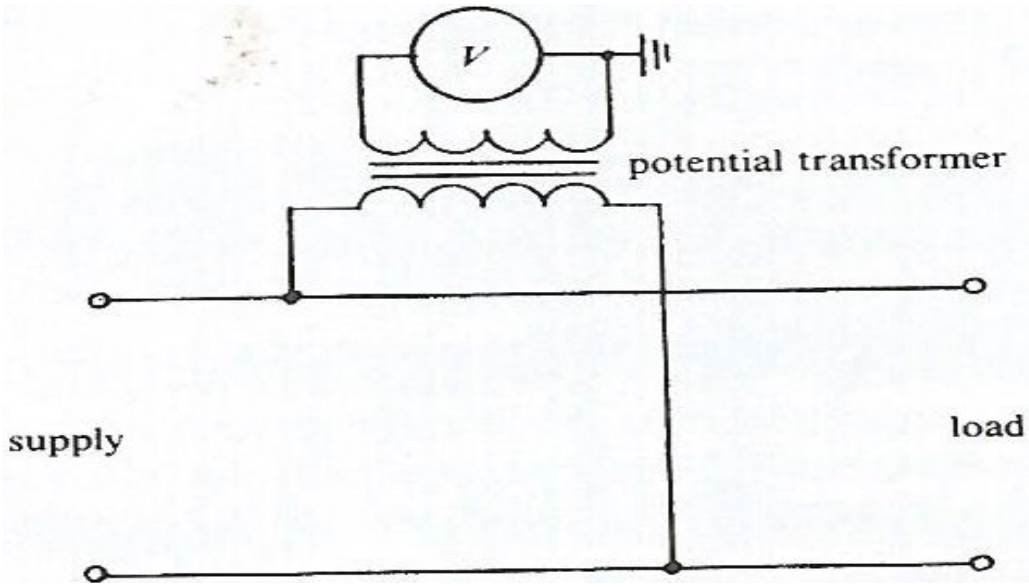
9.1
- Deflecting mechanism
- Controlling mechanism
- Damping mechanism (3)

9.2 9.2.1
- Relatively cheap
- Robust construction
- Can measure both AC and DC quantities (Any 2 × 1)

9.2.2
- Non-linear scales
- Reasonably difficult to calibrate
- Accuracy is influenced by stray magnetic fields and temperature

(Any 2 × 1)
(2 x 2) (4)

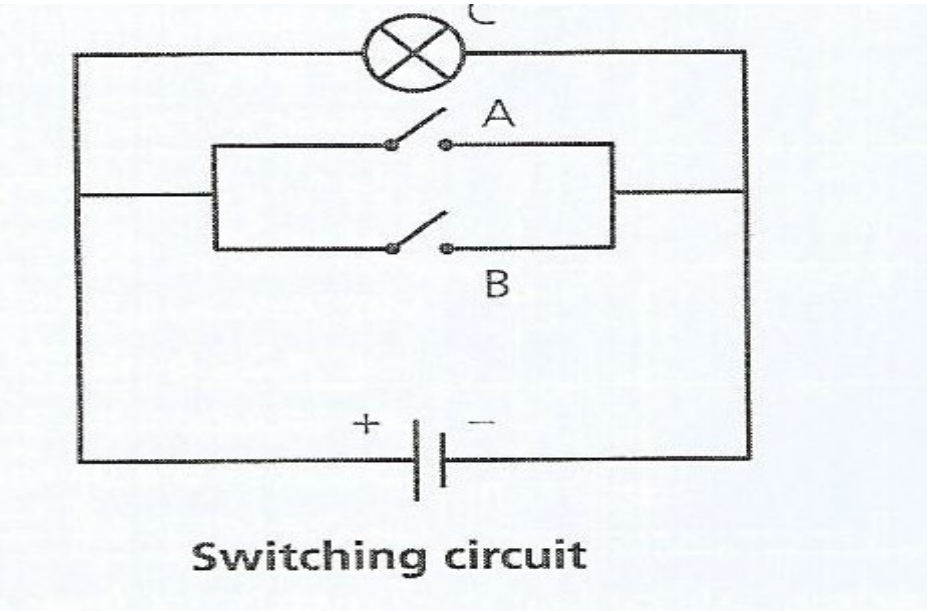
9.3



Windings 1
Supply 1
Load 1 (3)
[10]

QUESTION 10

10.1



(1 mark for each component) (4)

10.2 $111011{,}011_2 = (1 \times 2^5) + (1 \times 2^4) + (1 \times 2^3) + (0 \times 2^2) + (1 \times 2^1) + (1 \times 2^0) + (0 \times 2^{-1}) + (1 \times 2^{-2}) + (1 \times 2^{-3})$ ✓

$= 32 + 16 + 8 + 2 + 1 + \frac{1}{4} + \frac{1}{8}$ ✓

$= 59\frac{3}{8}$ or 59,375 ✓✓ (1 mark for whole number + 1 mark for fraction) (4)

10.3 A diode is said to be forward biased when the positive terminal of a battery is connected to the P-type material and the negative terminal is connected to the N-type material. (2)

[10]

TOTAL: 100

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