higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ARMATURE WINDING THEORY N2

5 August 2021

This marking guideline consists of 7 pages.

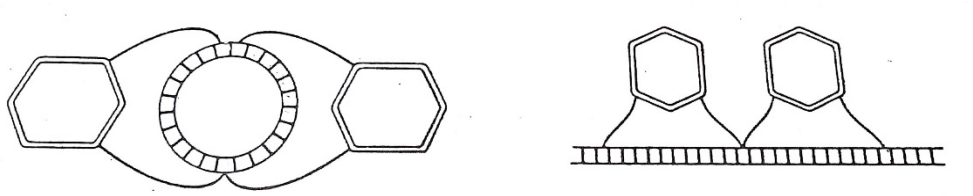
Copyright reserved

QUESTION 1

1.1 1.1.1 C
1.1.2 B
1.1.3 C

(3 × 2) (6)

1.2



(4)

1.3 When a conductor cuts a magnetic flux, an EMF is generated in the conductor and the magnitude of the generated EMF is proportional to the rate at which the conductor cuts the magnetic flux. (3)

1.4 The number of mica insulations between the coil ends is called commutator pitch. It is what decides the whole nature of an armature winding, and it is evident that it must be equal to the number of segments per pair of poles. (3)

1.5 1.5.1 $E = V - IR$
$= 220 - (65 \times 0{,}34)$
$= 197{,}9$ volts

1.5.2 $E = V + IR$
$= 220 + (0{,}34 \times 75)$
$= 245{,}5$ volts

(2 × 2) (4)
[20]

QUESTION 2

2.1 Torque is the twisting moment of a force and is measured in newton-metres. It is the product of the force on the conductors and the distance to the centre of the shaft in metres. (2)

2.2 Electro-graphite brushes are widely used for high surface speeds. (2)

2.3 2.3.1 $I = \frac{V}{R}$
$= \frac{240}{115}$
$= 2$ A

2.3.2 $P = \frac{V^2}{R}$

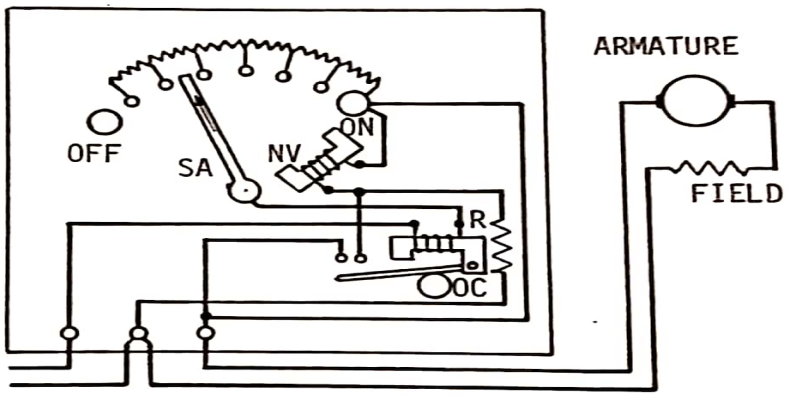
$P = \frac{V^2}{R}$

$= \frac{(240)^2}{115}$

$= 500,87\ \Omega$

(2 × 2) (4)

2.4



(5)

2.5 2.5.1 $E = \frac{2 \times Z \times N \times p \times \Ø}{C \times 60}$

$Z = \frac{E \times 60 \times C}{2 \times p \times N \times \Ø}$

$= \frac{380 \times 60 \times 6}{2 \times 3 \times 600 \times 0,0212}$

= 1792,453 conductors

Then (conductors/slot) = $\frac{1792,453}{76}$

23,585 = 24 conductors per slot (4)

2.5.2 $T = \frac{Z \times p \times \Ø \times I}{C\pi}$

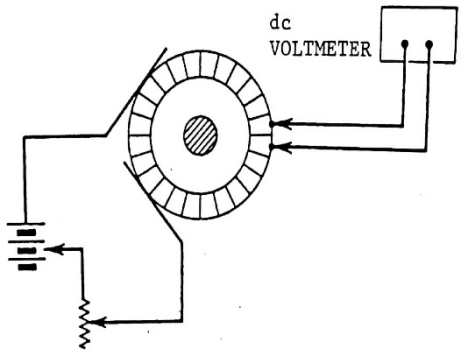
$= \frac{1792,453 \times 3 \times 0,0212 \times 100}{6 \times \pi}$

= 604,789 Nm (3)

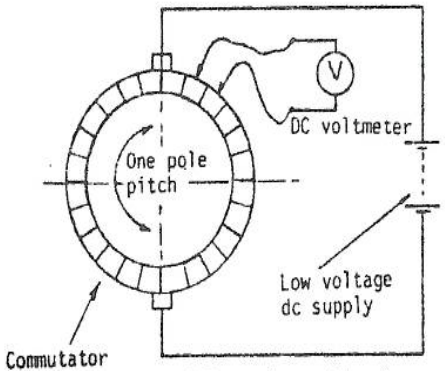
[20]

QUESTION 3

3.1



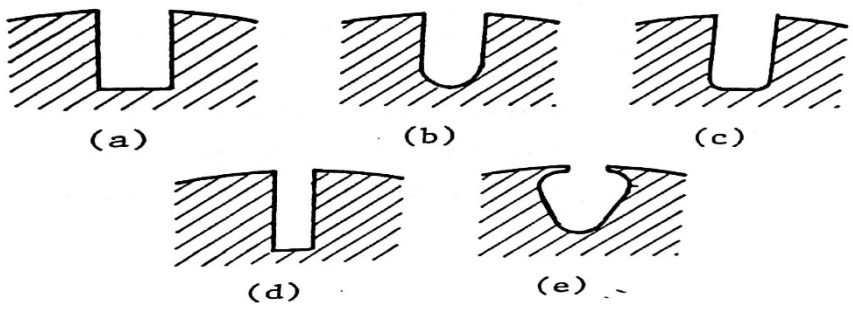
OR



(Award full marks for any of the above drawings or any drawing that captures the essence of the question.) (5)

3.2
- A short circuit of a coil or coils
- An open circuit in one of the coils
- An earth on one or more of the coils (3)

3.3



(5)

3.4
- First, the coil leads must emerge at the correct place and in the correct order.
- Second, the tension used in taping must be determined by the type of slot in the armature being wound. (2)

3.5
- Dirt within the machine
- An improperly operating fan
- Cooling vents not open (3)

3.6 The coil is not wound directly onto a diamond-shaped former but is first wound as a shuttle coil, which is subsequently pulled to the required shape. (2)

[20]

QUESTION 4

4.1
- Taking data
- Stripping the windings
- Insulating the slots
- Rewinding
- Connecting the winding
- Testing
- Baking and varnishing (7)

4.2
- Squirrel-cage rotor
- Wound rotor (2)

4.3 V = 150 + 180 + 90
= 420 V (1)

4.4 4.4.1 $XL = 2\Pi FL$
$= 2 \times \Pi \times 100 \times 0,014$
$= 8,796$ ohms

4.4.2 $Xc = 1/2\Pi fc$
$= 1/(2 \times \Pi \times 100 \times 0,00008)$
$= 19,894$ ohms

4.4.3 $Z = \sqrt{R^2 + (Xc - XL)^2}$
$= \sqrt{10^2 + (19,894 - 8,796)^2}$
$= 14,939$ ohms

4.4.4 $I = V/Z$
$= 420/14,939$
$= 28,114$ amps

4.4.5 $\theta = \cos^{-1} (10/14,939)$
$= 47,98°$

(5 × 2) (10)
[20]

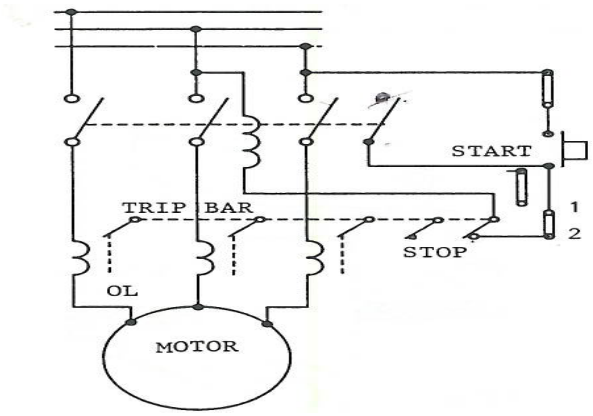
QUESTION 5

5.1 5.1.1 Individual parts of engines and machines, integrally connected with the complete machine in its normal operating condition (production electrical motors of up to approximately 15 kw are typical examples of machines in this category).

5.1.2 Medium-sized machines, particularly electrical motors between 15 and 75 kw power, without special foundations. Additionally, rigidly mounted components and machines (up to approximately 300 kw) with components and mounted on special foundations.

(2 × 2) (4)

5.2



(6)

5.3 5.3.1 $V_p/V_s = N_p/N_s$

$$N_s = \frac{V_s \times N_p}{V_p} = \frac{220 \times 3600}{11 \times 10^3}$$

$$= 72 \text{ turns}$$

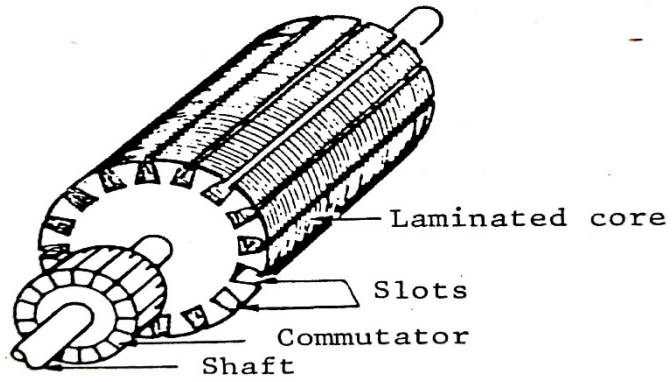
5.3.2 $V_p/V_s = I_s/I_p$

$$I_p = \frac{I_s \times V_s}{V_p} = \frac{200 \times 220}{11 \times 10^3}$$

$$= 4 \text{ A}$$

(2 × 2) (4)

5.4



(4)

5.5
- Power-supply transformer
- Radio-frequency transformer (2)

[20]

TOTAL: 100

Copyright reserved