GAUTENG DEPARTMENT OF EDUCATION

SENIOR CERTIFICATE EXAMINATION

POSSIBLE ANSWERS FOR : ELECTRICIANS WORK SG

QUESTION 1

1.1

1.1.1 $X1 = 2\pi FL$ (1)

$= 2 \times 3.14 \times 100 \times 0,02$

$= 12,566\ \Omega$

$= 12,57\Omega$ (1)

$Xc = 1 / 2\pi FC$ (1)

$= 1 / 2 \times 3,14 \times 100 \times 70 \times 10^{-6}$ (1)

$= 22,736\ \Omega$

$= 22,74\ \Omega$ (1)

$Zt = \sqrt{R^2 + (Xc-XL)^2}$ (1)

$= \sqrt{8^2 + (22,74-12,57)^2}$ (1)

$= \sqrt{167,43}$ (1)

$= 12,939\ \Omega$ (1)

$= 12,9\ \Omega$

$It = Vt / Zt$ (1)

$= 250 / 12,9$

$= 19,37\ A$ (1)

[11]

1.1.2 $COS\varnothing = R / Z = 0,62$ Or $\tan\varnothing = \frac{Xc - X_L}{R}$ (1)

$\varnothing = COS^{-1} R / Z$ (1)

$= COS^{-1} 8 / 12,9$ $\tan\varnothing = 1,271$ (1)

$= 51,67^{\circ}$ $= 51,81^{\circ}$ (1)

$= 51,80^{\circ}$ **[4]**

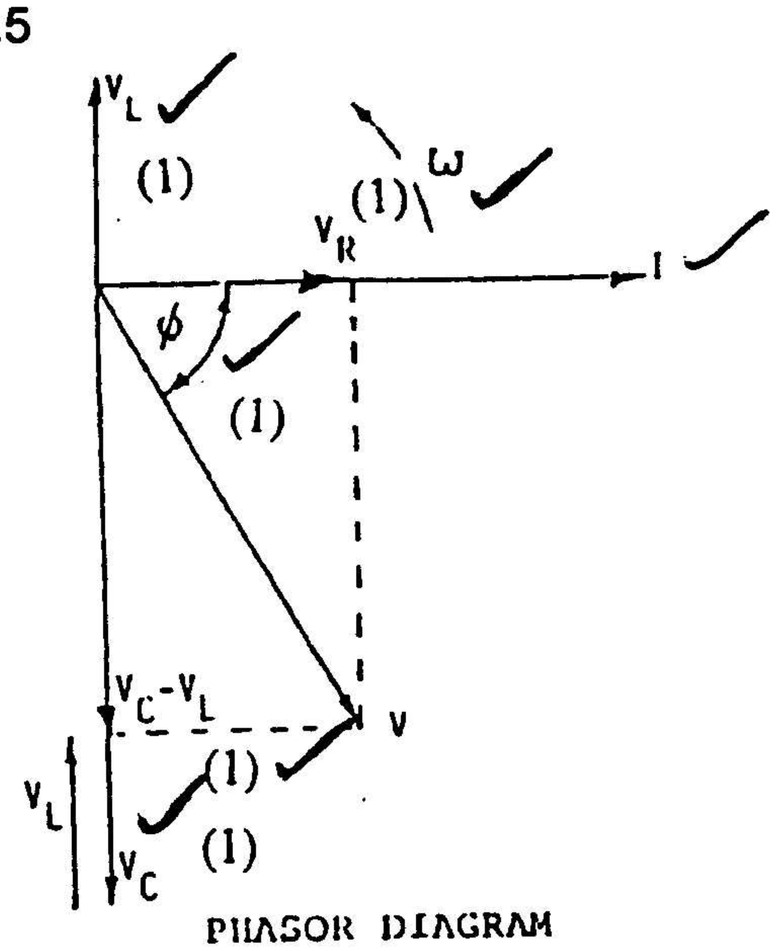
1.1.3 $Vr = I * R$ (1)
$= 19,37 * 8$
$= 154,96$ V. (1)

$Vl = I * XL$ (1)
$= 19,37 * 12,57$
$= 243,48$ V (1)

$Vc = I * Xc$ (1)
$= 19,37 * 22,74$
$= 440,43$ V (1)
[6]

1.1.4 $Pt = V * I * COS\varnothing$ (1)
$= 250 * 19,37 * 0,62$ (1)
$= 3002,35$ W (1)
[3]

1.1.5



PHASOR DIAGRAM

[6]

1.2
1.2.1 By increasing the total current for a given power it increases the resistance losses, and therefore decreases the efficiency of apparatus and supply system.
1.2.2 It limits the output of both generators and transformers.
1.2.3 It causes a greater fall in the terminal voltage.
(any 2) **[4]**

1.3 $$Iave = \frac{i1 + i2 + i3 + i4 + i5 + i6}{6}$$ (1)

= 2+5+7+9+6+3 / 6 (1)

= 32 / 6 (1)

= 5,33 A (1)

$$I\ rms = \sqrt{\frac{2^2 + 5^2 + 7^2 + 9^2 + 6^2 + 3^2}{6}}$$ (1)

(1)

$= \sqrt{204 / 6}$ (1)

(1)

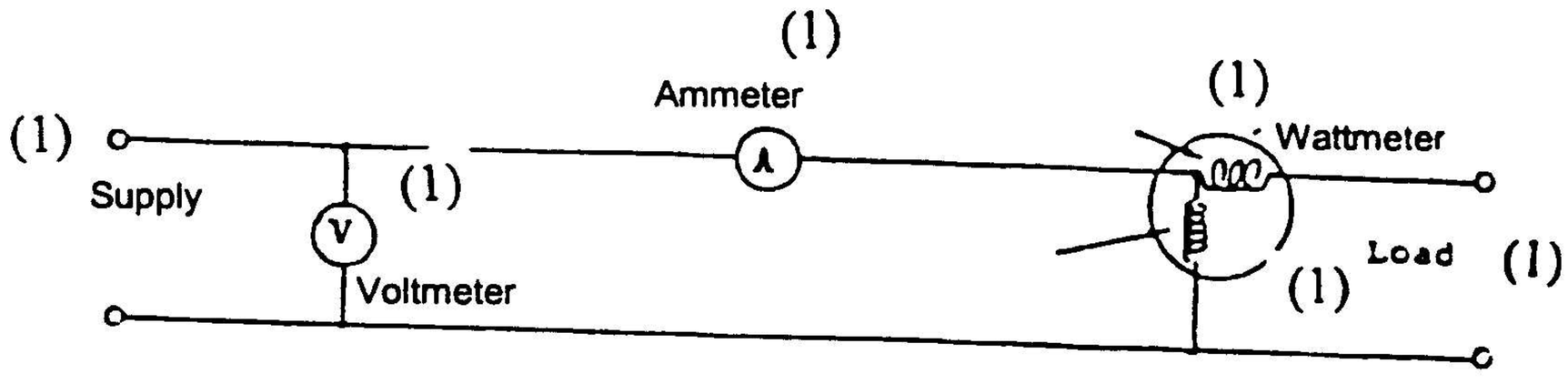
$= \sqrt{34}$ (1)

= 5,83 A

FORM FACTOR = RMS / AVE (1)
= 5,83 / 5,33 (1)
= 1,09 (1)
[11]

1.3.2 CREST FACTOR = MAX / RMS (1)
= 9 / 5,83 (1)
= 1,54 (1)
[3]

1.4 1. Ammeter (1)
2. Voltmeter (1)
3. Wattmeter (1)



(6)
[9]

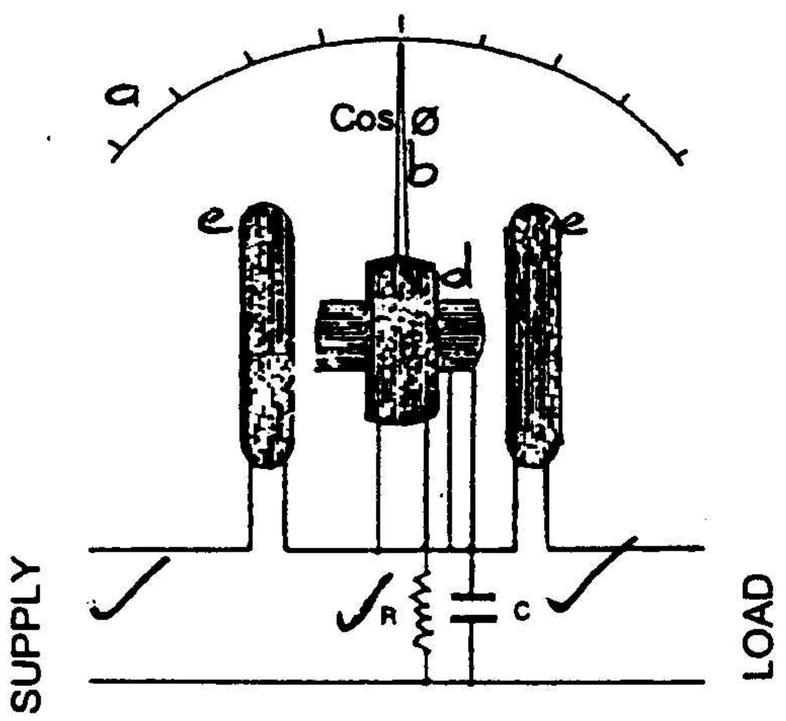
1.5 Effective value = 0,707 x max (1)
= 0,707 x 220 (1)
= 155,54 V. (1)
[3]
[60]

QUESTION 2

A three-phase machine delivers higher power for the same size frame, than does a single-phase machine.
In the case of alternators, the same size prime mover is required for both single and three-phase.
A three-phase motor generates a higher torque than does a single-phase motor of the same size.
A three-phase supply is more versatile since, when connected in star, it can deliver both line and phase voltages.
Cheaper.
Smaller.
They are self-starting (motors).
Three-phase motors only need 0,866 times the amount of copper than single-phase.

(any four) 4x2 = (8)

2.2 Electrostatic focusing
Electromagnetic focusing (2)



a – Scale
b – Pointer
c – Capacitor (can also be can inductor
d – Voltage coils
e – Current coils
R– Resistor

(10)

2.4 Efficiency = $\frac{\text{Output}}{\text{Input}} \times 100\%$

Input = $\frac{\text{Output}}{\text{Efficiency}} \times 100$

= $\frac{100 \times 10^3}{80}$

= 125 kW (4)

$P = \sqrt{3}\, V_L I_L \cos \varnothing$

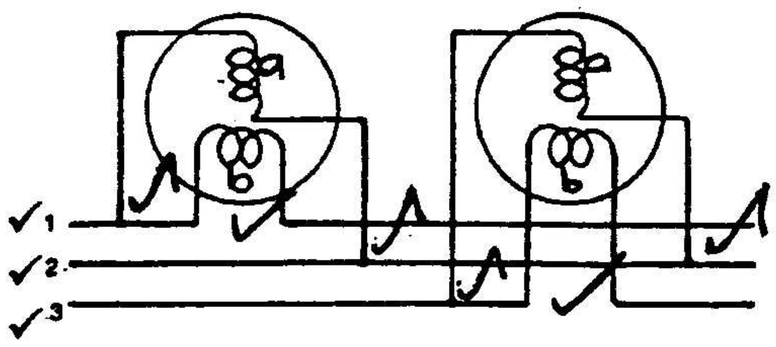
$I_L = \frac{P}{\sqrt{3}\, V_L \cos \varnothing}$

= $\frac{125 \times 10^3}{\sqrt{3}\,(380)(0,8)}$

= 237,397 A (4)

[8]

2.5



a – Voltage coil
b – Current coil

(7)

2.6

\# The fuse on the secondary of the voltage coil must be taken out.
\# The secondary side of the current coil must be short-circuited for the time that the meter is out.

2x2 = (4)

2.7 The meter must be positioned in a way that the reading can be taken easily. (1)

[40]

QUESTION 3

3.1 \# Air-cooled
\# Oil-cooled
\# Oil cooled with radiator tubes

3x2 = (6)

3.2 Eddy currents are reduced in the transformer's core by means of laminated plates that are electrically isolated from one another. (2)

3.3 3.3.1 E_p / E_s
$= 380 / 220$
$= 1,727$
$E_p : E_s$
$= 1,727 : 1$ (3)

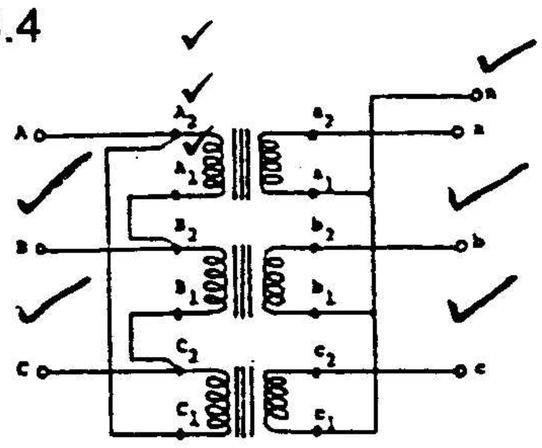
3.3.2 $P_s = E_p I_p$
$I_p = P_s / E_p$
$= 50 \times 10^3 / 380$
$= \underline{131,579\ A}$ (3)

3.3.3 $I_p / I_s = E_s / E_p$
$I_s = E_p I_p / E_s$
$= (380)(131,579) / 220$
$= \underline{227,273\ A}$ (3)

3.3.4 $I_c = I_s - I_p$
$= 131,579 + 227,273$
$= \underline{358,852\ A}$ (3)

(12)

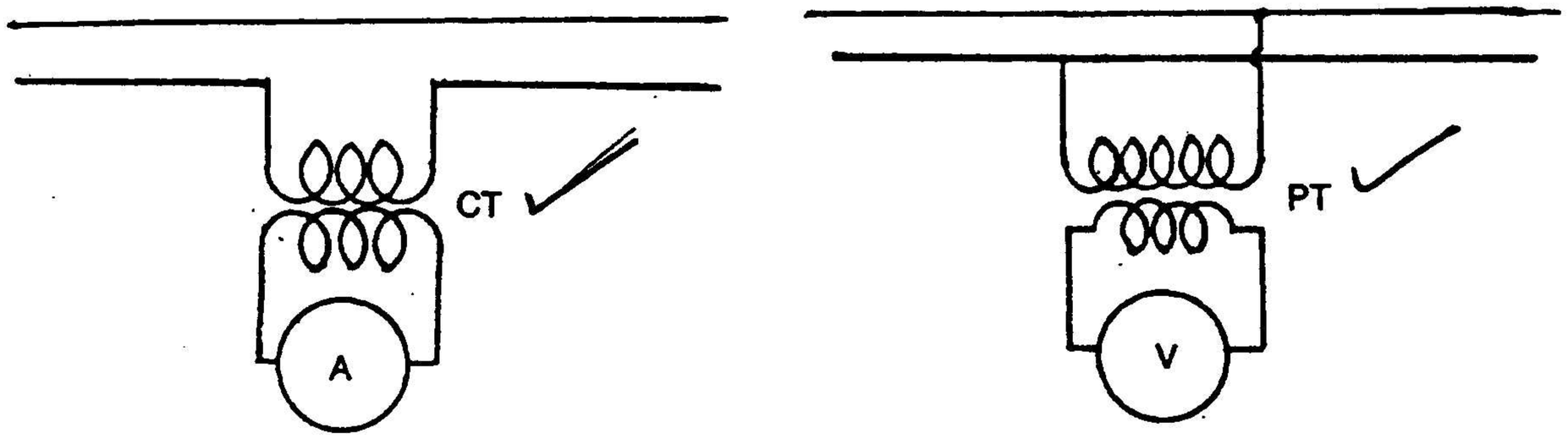
3.4



Delta Star

(5)

3.5 To be able to measure the high values of current and voltage in ac – circuits with an ordinary meter it is necessary to reduce the values. To achieve this we make use of instrument transformers. ✓✓✓

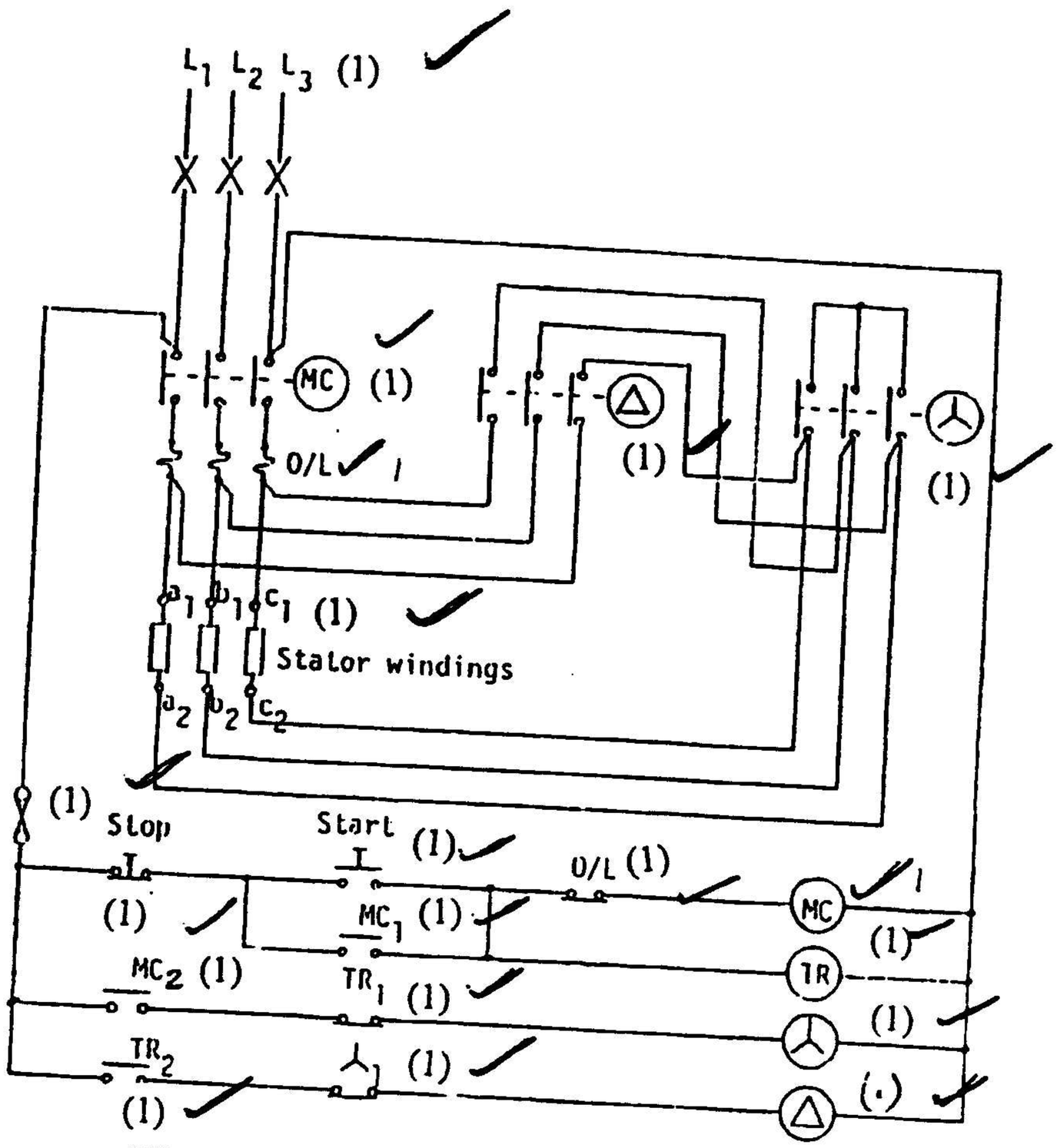


(5)
[30]

QUESTION 4

4.1 True speed = f / p (1 – slip) (1)
= 50 / 2 (1 – 5%) (1)
= 50 / 2 (1 – 5 /100) (1)
= 25 (0,95)
= 23,75 rev per sec (1)
= 23,75 * 60 (1)
= 1425 rev per min (1)
[6]

4.2



AUTOMATIC STAR-DELTA STARTER

[18]

4.3

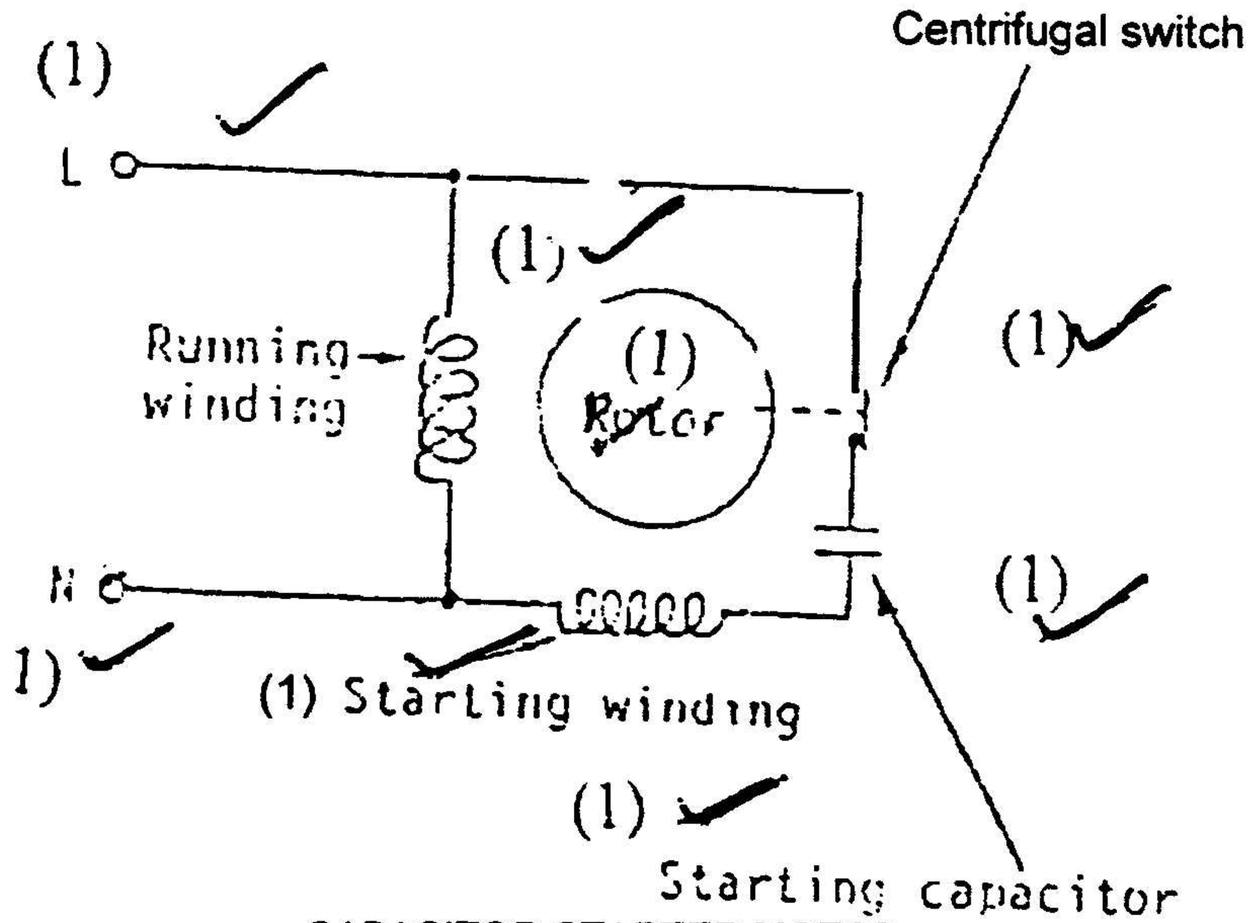
4.3.1 Speed (2)

4.3.2 Number of poles (2)

[4]

4.4 To disconnect the starting winding from the supply when the rotor reaches 70% to 80% of synchronous speed (4)

4.5



CAPACITOR STARTER MOTOR

(8)
[40]

QUESTION 5

5.1 Thermionic emission is thus the process in which electrons are emitted by means of the application of heat. (2)

5.2 5.2.1 Arsenic, Phosphorus, Antimony (any one)
5.2.2 Aluminium, Gallium, Indium (any one) (2)

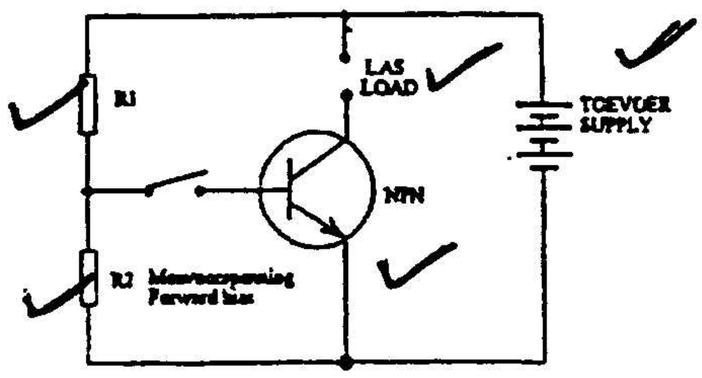
5.3 5.3.1
- # Positive on P- and negative on N-material – electrical current (forward bias)
- # Holes move to N- and electrons to P-material.
- # Electrons fill the holes at the depletion region only to form new holes.
- # Resistance at the depletion region is minimized and electrons can move to the positive pole of the cell. (4)

5.3.2
- # Positive on N- and negative on P-material (reverse bias)
- # Holes are drawn to the negative cell terminal and the electrons to the positive cell terminal.
- # The depletion region is maximized.
- # Depletion region acts like an isolator and no current flow is possible. (4)

[8]

5.4 The only difference between the two types of transistors is the difference in polarity of the supply. (3)

5.5



(5)

(20)

QUESTION 6

6.1
Switch off the power supply.
If supply can not be switched off the person must be pulled away by using an insulated material.
If necessary the conductors must be cut with pliers or hexed off with an axe.
Ensure that you do not get shocked as well.
Examine the person and if necessary you can perform basic treatment.
Call and wait for the doctor. (5)

6.2
Having sex with an infected person without protection
Sharing a needle for drugs with an infected person
Infected blood entering the body through an injury
From mother to child

(any three) (3)

6.3 Always use "Latex" gloves when treating a person for bleeding. (2)
(any acceptable answer) **[10]**

TOTAL 200

GAUTENGSE DEPARTEMENT VAN ONDERWYS

SENIORSERTIFIKAAT-EKSAMEN

MOONTLIKE ANTWOORDE VIR : ELEKTRISIËNSWERK SG

VRAAG 1

1.1

1.1.1 $X1 = 2\pi FL$ (1)

$= 2 \times 3.14 \times 100 \times 0,02$

$= 12,566\ \Omega$

$= 12,57\Omega$ (1)

$Xc = 1 / 2\pi FC$ (1)

$= 1 / 2 \times 3,14 \times 100 \times 70 \times 10^{-6}$ (1)

$= 22,736\ \Omega$

$= 22,74\ \Omega$ (1)

$Zt = \sqrt{R^2 + (Xc-XL)^2}$ (1)

$= \sqrt{8^2 + (22,74-12,57)^2}$ (1)

$= \sqrt{167,43}$ (1)

$= 12,939\ \Omega$ (1)

$= 12,9\ \Omega$

$It = Vt / Zt$ (1)

$= 250 / 12,9$

$= 19,37\ A$ (1)

[11]

1.1.2 $COS\varnothing = R / Z = 0,62$ Or $\tan\varnothing = \frac{Xc - X_L}{R}$ (1)

$\varnothing = COS^{-1} R / Z$ (1)

$= COS^{-1} 8 / 12,9$ $\tan\varnothing = 1,271$ (1)

$= 51,67^{o}$ $= 51,81^{o}$ (1)

$= 51,80^{o}$

[4]

1.1.3 $Vr = I \times R$ (1)
$= 19,37 \times 8$
$= 154,96$ V. (1)

$Vl = I \times XL$ (1)
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$= 243,48$ V (1)

$Vc = I \times Xc$ (1)
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[6]

1.1.4 $Pt = V \times I \times COS\varnothing$ (1)
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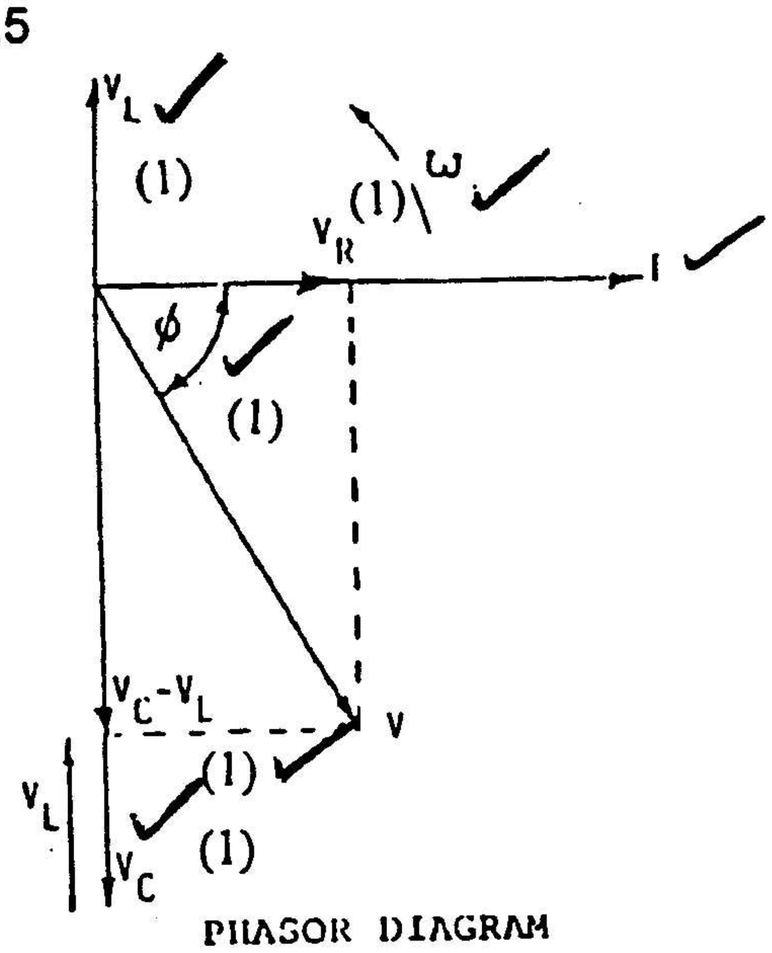
$= 3002,35$ W (1)
[3]

1.1.5



PHASOR DIAGRAM

[6]

1.2

1.2.1 Die weerstandsverliese word verhoog en dus word die rendement van beide die toevoernetwerk en die toestel verlaag.

1.2.2 Dit verlaag die leweringsvermoë van generators en transformators.

1.2.3 Dit veroorsaak 'n hoër aansluiterspanningsval.

(enige 2) **[4]**

1.3 $$Igem = \frac{i1 + i2 + i3 + i4 + i5 + i6}{6}$$ (1)

$= 2+5+7+9+6+3 / 6$ (1)

$= 32 / 6$ (1)

$= 5,33\ A$ (1)

$$I\ wgk = \sqrt{\frac{2^2 + 5^2 + ^2 7^2 + 9^2 + 6^2 + 3^2}{6}}$$ (1)

(1)

$= \sqrt{204 / 6}$ (1)

(1)

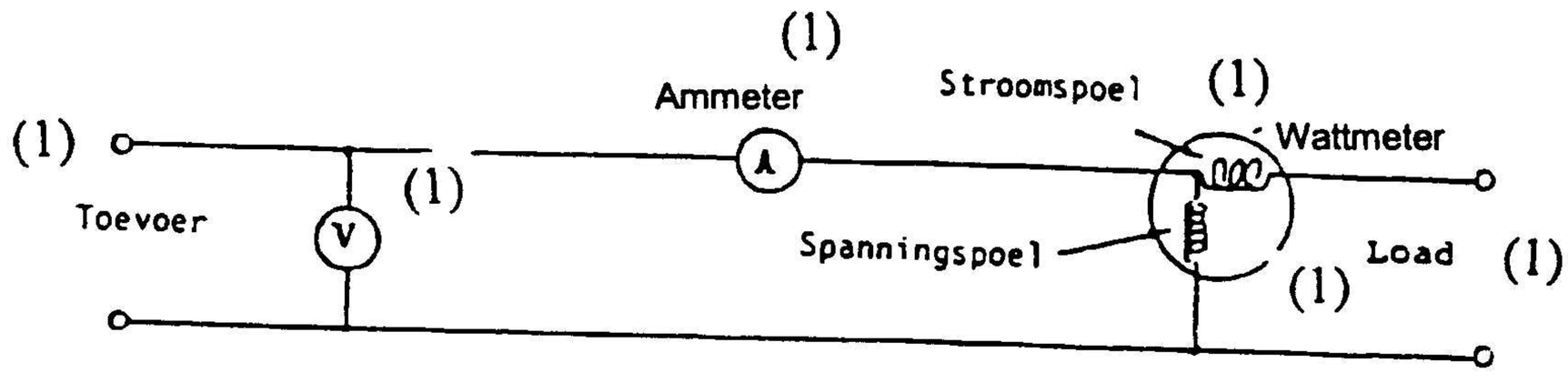
$= \sqrt{34}$ (1)

$= 5,83\ A$

VORM FAKTOR = WGK / GEM (1)
= 5,83 / 5,33 (1)
= 1,09 (1)
[11]

1.3.2 KRUIN FAKTOR = MAKS / WGK (1)
= 9 / 5,83 (1)
= 1,54 (1)
[3]

1.4 1. Ammeter (1)
2. Voltmeter (1)
3. Wattmeter (1)



(6)

[9]

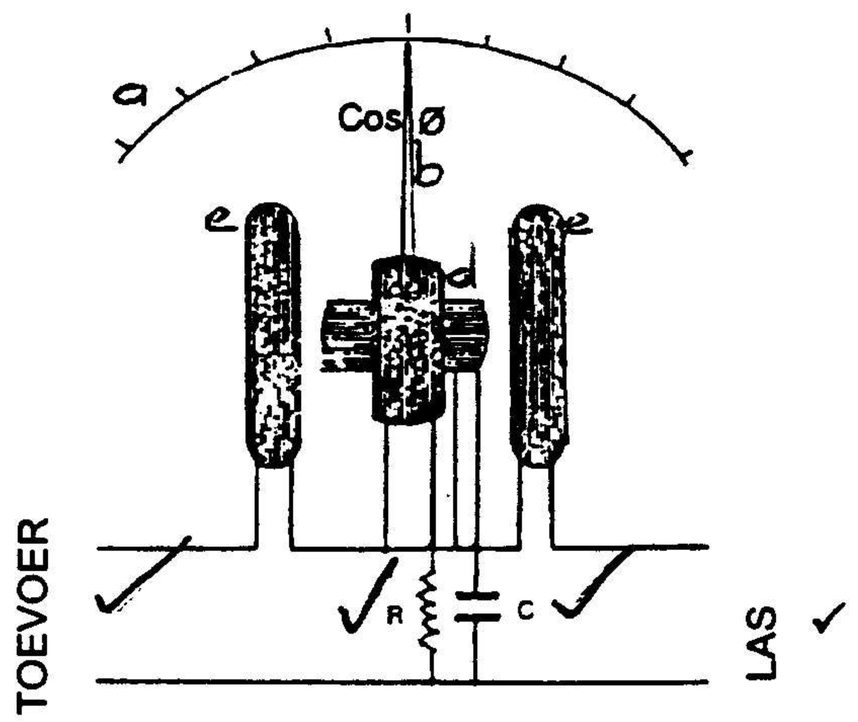
1.5 (WGK) Effektiewe waarde = 0,707 x maks (1)
= 0,707 x 220 (1)
= 155,54 V. (1)
[3]
[60]

VRAAG 2

Vir 'n masjien met dieselfde grootte raam, lewer 'n veelfasige masjien hoër drywing as enkelfasige masjiene.
In die geval van alternators, is dieselfde grootte aandrywing nodig vir enkel-en driefasige masjien.
Veelfasige motore het 'n beter draaimoment as enkelfasige motore.
Driefasige toevoer is veelsydiger omdat dit, wanneer dit in stervorm verbind is, lyn- sowel as fasespannings kan verskaf.
Goedkoper
Kleiner
Hulle is selfaansittend.
Driefasemotors benodig slegs 0,866 die hoeveelheid koper van eenfasemotors.

(enige vier) 4x2 = (8)

2.2 Elektrostatiese fokussering
Elektromagnetiese fokussering (2)



a – Skaal✓
b – Wysermaald✓
c – Kapasitor✓ (ka nook 'n speel wees)
d – Spanningspoele✓
e – Stroomspoele✓
R – Resistor✓

(10)

2.4 Rendement= $\frac{\text{Uitset}}{\text{Inset}} \times 100\%$

Inset = $\frac{\text{Uitset}}{\text{Rendement}} \times 100$

= $\frac{100 \times 10^3}{80}$

= 125 kW (4)

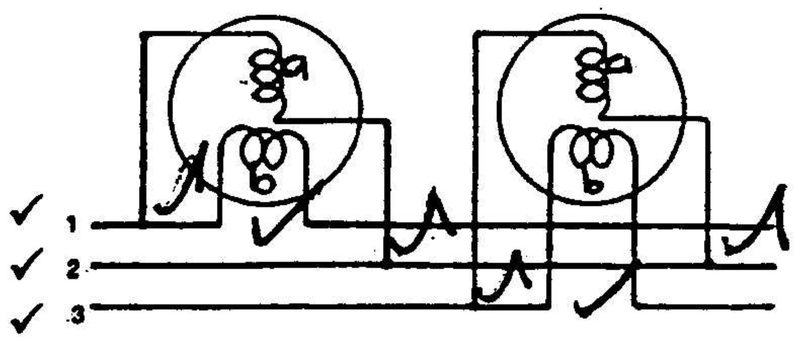
$P = \sqrt{3}\, V_L\, I_L \cos \varnothing$

$I_L = \frac{P}{\sqrt{3}\, V_L \cos \varnothing}$

= $\frac{125 \times 10^3}{\sqrt{3}\,(380)(0,8)}$

= 237,397 A (4) [8]

2.5



a – Spanningspoel
b – Stroomspoel

(7)

2.6

\# Die sekering op die sekondêr van die spanningspoel moet verwyder word.
\# Die sekondêr van die stroomspoel moet gekortsluit word vir die tydperk wat die meter verwyder is.

2x2 = (4)

2.7 Die meter moet so geplaas word dat die wyserplaat maklik gelees kan word. (1)
[40]

VRAAG 3

3.1 \# Lugverkoeling
\# Olieverkoeling
\# Verkoeling van olie deur middel van water

3x2 = (6)

3.2 Werwelstrome word in die kern van transformators beperk deur van lamelplate gebruik te maak en die plate elektries van mekaar te isoleer. (2)

3.3 3.3.1 E_p / E_s
= 380 / 200
= 1,727
$E_p : E_s$
= 1,727 : 1 (3)

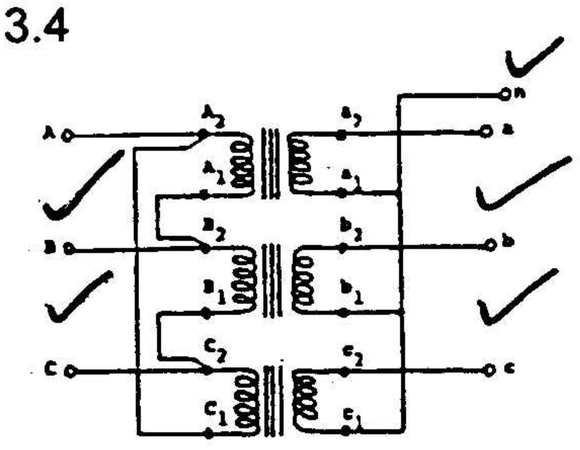
3.3.2 $P_s = E_p I_p$
$I_p = P_s / E_p$
$= 50 \times 10^3 / 380$
= <u>131,579 A</u> (3)

3.3.3 $I_p / I_s = E_s / E_p$
$I_s = E_p I_p / E_s$
= (380)(131,579) / 220
= <u>227,273 A</u> (3)

3.3.4 $I_g = I_s - I_p$
= 131,579 + 227,273
= <u>358,852 A</u> (3)

[12]

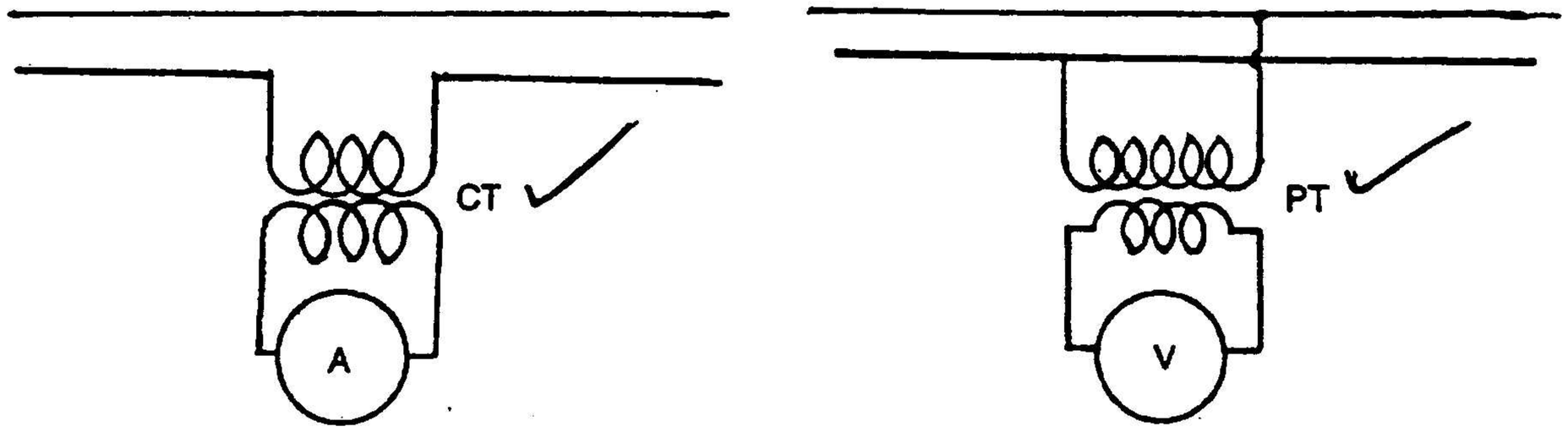
3.4



Delta Ster

(5)

3.5 Om hoë waardes van strome en spannings te meet in ws-kringe word daar van instrument transformators gebruik gemaak om die stroom en spanning waardes in verhouding te verlaag sodat dit met 'n gewone meter gemeet kan word. ✓✓✓

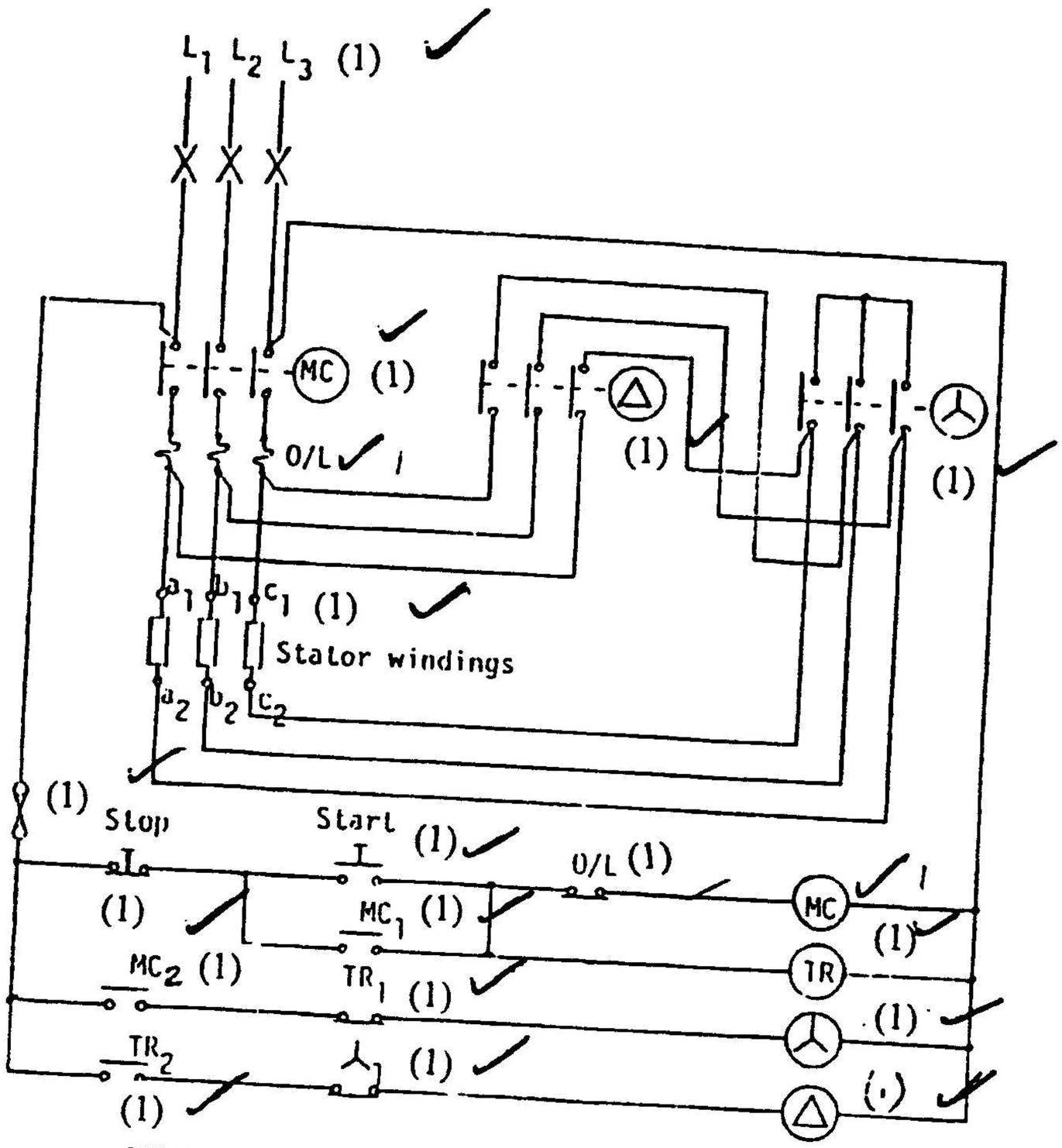


(5)
[30]

VRAAG 4

4.1 Ware spoed = f / p (1 – glip) (1)
= 50 / 2 (1 – 5%) (1)
= 50 / 2 (1 – 5 /100) (1)
= 25 (0,95)
= 23,75 rev per sek (1)
= 23,75 * 60 (1)
= 1425 rev per minuut (1)
[6]

4.2



AUTOMATIC STAR-DELTA STARTER

[18]

4.3

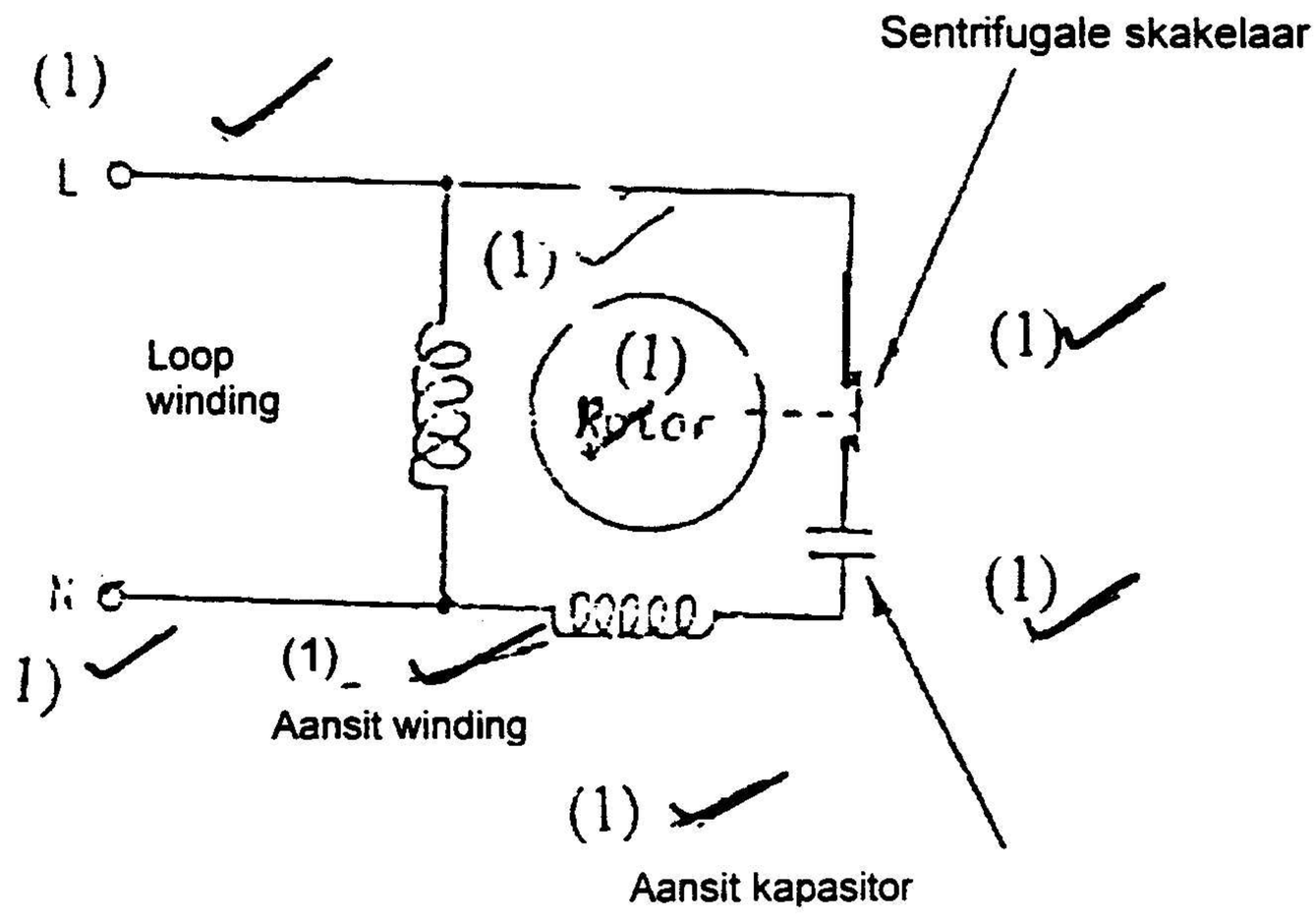
4.3.1 Spoed **(2)**

4.3.2 Frekwensie **(2)**

[4]

4.4 'n Sentrifugale skakelaar word gebruik om die aansitwinding af te skakel van die toevoer sodra die rotor <u>70% tot 80%</u> van sy sinkronespoed bereik. **(4)**

4.5



KAPASITOR-AANSITMOTOR (8)
[40]

VRAAG 5

5.1 Termioniese emissie is die proses waardeur elektrone deur middel van hitte uit 'n metal of ander stof gedryf word. (2)

5.2 5.2.1 Arseen, Fosfor, Antimoon (enige een)
5.2.2 Aluminium, Gallium, Indium (enige een) (2)

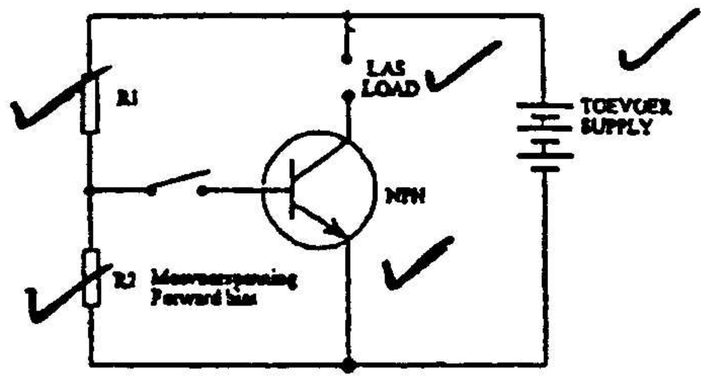
5.3 5.3.1
- # Positief aan P- en negatief aan N-materiale – stroomvloei (meervoorspanning)
- # Holtes beweeg na N- en elektrone na P-materiale.
- # Elektrone vul holtes by voeg om ander holtes te vorm.
- # Weerstand oor die voeg word uitgewis en elektrone beweeg na positiewe pool van sel. (4)

5.3.2
- # Positief aan N- en negatief aan P-materiaal (teenvoorspanning)
- # Holtes word na negatief en elektrone na positief getrek
- # Hierdie ontruiming van ladingdraërs vergroot die sperlaag
- # Sperlaag reageer soos 'n isolator en geen stroomvloei is moontlik nie. (4)

[8]

5.4 Die enigste verskil tussen hierdie twee soorte transistors is die polariteit van die toevoer verskil. (3)

5.5



(5)

[20]

VRAAG 6

6.1
- # Skakel so gou as moontlik die toevoer af.
- # Indien die krag nie afgeskakel kan word nie moet die persoon van die drade weg getrek of gestoot word met 'n isolasiemateriaal.
- # Indien niks byderhand is nie kan die geleiers met 'n tang geknip of selfs met 'n byl afgekap word.
- # Ondersoek die persoon en indien nodig kan eerstehulp op die persoon toegepas word.
- # Ontbied en wag vir 'n geneesheer. (5)

6.2
- # Deur seks te hê met 'n VIGS-leier sonder beskerming.
- # Deur 'n naald vir dwelms met 'n VIGS-leier te deel.
- # Deur besmette bloed wat deur 'n seerplek op die vel die liggaam binne gaan.
- # Van moeder na baba

(enige drie) (3)

6.3 Maak altyd gebruik van "Latex" handskoene wanneer 'n persoon vir bloeding behandel word. (2)
(enige aanvaarbare antwoord) **[10]**

TOTAAL 200