ELTT

# MEMORANDUM

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NASIONALE SENIOR SERTIFIKAAT-EKSAMEN

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## ELECTRICAL TECHNOLOGY

This examination paper consists of 12 pages.

## QUESTION 1: TECHNOLOGY, SOCIETY AND ENVIRONMENT.

1.1 Cell phone✓ / Television. ✓
Advantage: Immediate contact with your family in time of need.✓ OR
Bring the information in your house.
Disadvantage: Expose to undesirable material on phone such as pornography. ✓ OR
People do not socialize (TV keeps people indoors). ✓ (3)

1.2
- Communication.✓
- Marketing skills.✓
- Time management.✓
- Financial skills.✓ (ANY THREE) (3)

1.3 I have to attend that person. ✓ You must take every precaution to protect yourself from coming into contact with another person's blood. ✓ Wear protective clothes while helping any bleeding person. ✓ If this is not possible you still have a responsibility to report the incident and get immediate help. ✓ (4)

**[10]**

## QUESTION 2: TECHNOLOGICAL PROCESS

2.1
- Identify the problem.✓
- Investigate.✓
- Research.✓
- Access.✓
- Process.✓ (5)

2.2.1 Design ✓ and construct✓ an elevator✓ that will suit the needs of people with special needs.✓ (4)

2.2.2
- Both inside and outside buttons of the elevator must be easily reachable by people with special needs. ✓✓
- An elevator should be fitted with a sensor that will sense when a person is inside the elevator, instead of using the timer. ✓✓
- In the case of the power failure, the elevator must automatically move to the nearest level and open the doors. ✓✓

(Any reasonable answer will suffice.) (6)

2.2.3
- Observation: This includes analyzing the product in order to understand its design, and taking down notes about the product. ✓✓
- Interviews: This is about finding out from the targeted people, whether the product satisfies their needs. ✓✓ (4)

**[19]**

## QUESTION 3: OCCUPATIONAL HEALTH AND SAFETY

3.1
- No horseplay in the workshop. ✓
- Wear protective clothing at all times in the workshop. ✓
- No live conductors in the workshop. ✓ (3)

3.2
- Workshop must be clean and clear of any obstruction. ✓
- Tools must be properly packed in their places. ✓
- Beware of wet and moisture areas. ✓ (ANY TWO) (2)

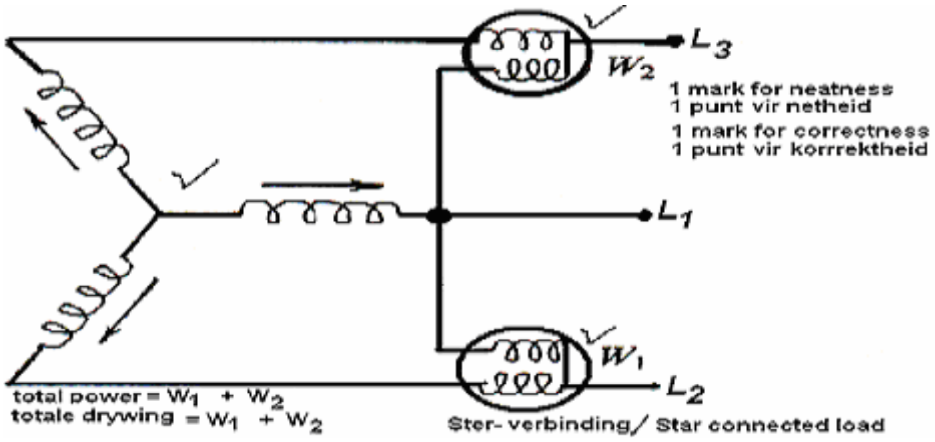
3.3
- Make sure that chuck key is removed from the chuck after loosening or tightening a drill bit. ✓
- Make sure that the work piece is tightly clamped and not held by hand. ✓
- Long loose hair and loose clothing is a great danger near the drill press. ✓
- Wear safety goggles. ✓ (ANY THREE) (3)

3.4 Because water is a conductor of electricity. ✓✓ (2)

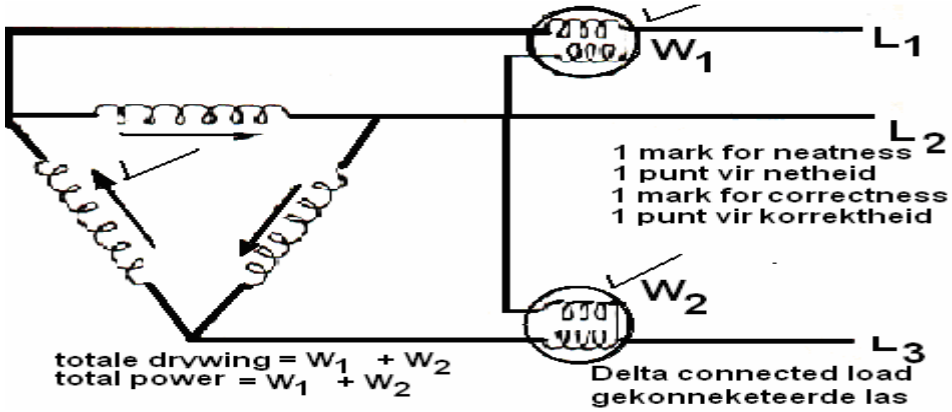
**[10]**

## QUESTION 4: THREE PHASE AC GENERATION

4.1




OR




(5)

4.2 4.2.1 For Delta connected system

$V_{Ph} = V_L$ ✓½

$= 380$ V✓½ (1)

4.2.2 $I_{Ph} = \frac{V_L}{R_{Ph}}$ ✓½

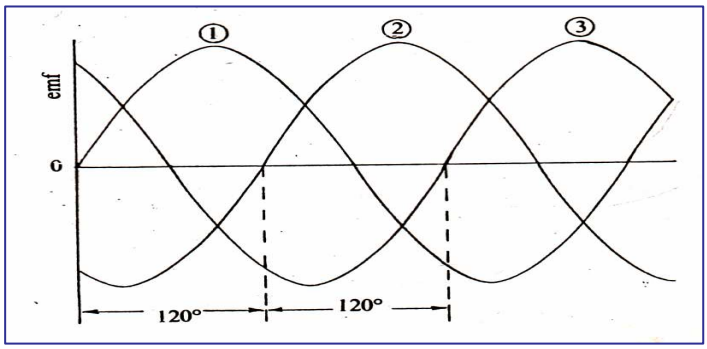
$= \frac{380}{60}$ ✓½

$= 6{,}33$ A✓ (2)

4.2.3 $I_L = \sqrt{3}\, I_{Ph}$ ✓½

$= \sqrt{3} \times 6{,}33$ ✓½ (2)

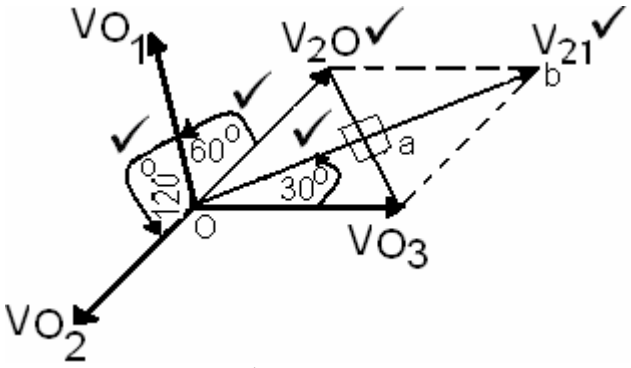
4.3




✓✓
(2 marks per wave)
(2 punte per golf
✓
(1 mark for angle)
(1 punt vir hoek)

$e_1 = E_m \text{Sin } \omega t$✓ (induced emf in coil 1)
$e_2 = E_m \text{Sin } (\omega t - 120°)$✓ (induced emf in coil 2)
$e_2 = E_m \text{Sin } (\omega t - 240°)$ ✓ (induced emf in coil3)
The above coil/coils can be connected two ways, thus star or delta. (10)

4.4




$V_{21} = V_{20} + V_{01}$✓
$= 2 \times oa$ ( $oa = \text{Cos}30^o$)✓½
$= 2 \times V_p \times \text{Cos}30^o$✓½
$= 2 V_p \frac{\sqrt{3}}{2}$✓½
$= \sqrt{3}\, V_p$ ( leading/ lei met $30^o$)✓½
$V_L = \sqrt{3}\, V_p$✓

(9)
**[29]**

## QUESTION 5: R, L AND C CIRCUIT

5.1 5.1.1 $Z = \sqrt{R^2 + (X_C - X_L)^2}$ ✓½

$= \sqrt{50^2 + (106{,}103 - 56{,}55)^2}$ ✓½

$= 70{,}4\ \Omega$ ✓

Where $X_C = \frac{1}{2\pi fC}$ ✓½

$= \frac{1}{2\pi x 50 x 30 x 10^{-6}}$ ✓½

$= 106{,}103\ \Omega$ ✓

And $X_L = 2\pi fL$ ✓½

$= 2\pi x 50 x\ 0{,}18$ ✓½

$= 56{,}55\ \Omega$ ✓ (6)

5.1.2 $I = \frac{V}{Z}$ ✓½

$= \frac{220}{70{,}4}$ ✓½

$= 3{,}125$ A ✓ (2)

5.1.3 $V_{COIL} = IZ_{COIL}$ ✓½

$= 3{,}125 \times 75{,}48$ ✓½

$= 235{,}88$ V ✓

here $Z_{COIL} = \sqrt{R^2 + X_L^2}$ ✓½

$= \sqrt{50^2 + 56{,}55^2}$ ✓½

$= 75{,}48\ \Omega$ ✓ (4)

5.1.4 $\theta = \cos^{-1}\frac{R}{Z}$ ✓

$= \cos^{-1} 1$ ✓

$= 0°$ leading ✓✓ (4)

5.2 5.2.1 $f = \frac{1}{2\pi f\sqrt{LC}}$ ✓

$= \frac{1}{2\pi x 50 x \sqrt{30 x 10^{-3} x\ 1 x 10^{-6}}}$ ✓

$= 18{,}38$ Hz ✓ (3)

5.2.2 $V_C = IX_C$ ✓½

$= 1 \times 8659{,}14$ ✓½

$= 8659{,}14$ V ✓

But $I = \frac{V}{Z}$ ✓½

$= \frac{10}{10}$ ✓½

$= 1$ A ✓

Where Z = R

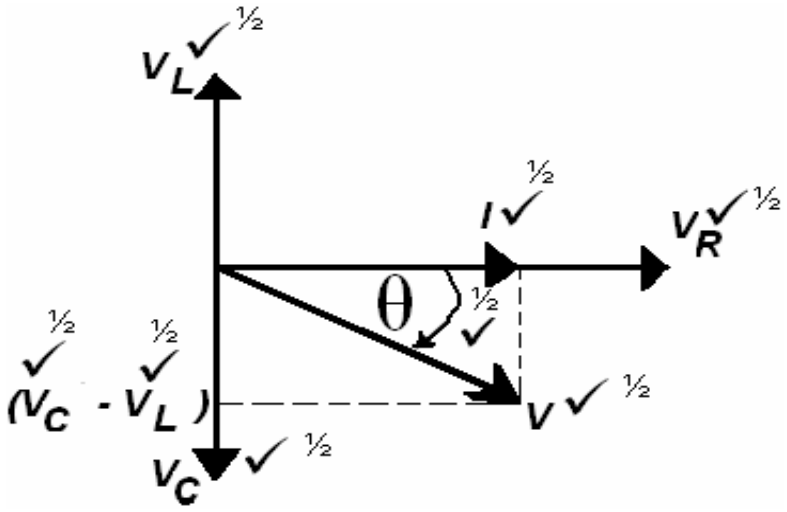
$Z = 10\ \Omega$ ✓

$X_C = \frac{1}{2\pi fC}$ ✓½

$= \frac{1}{2\pi x\ 18{,}38 \times 1 x 10^{-6}}$ ✓½

$= 8659{,}14\ \Omega$ ✓ (7)

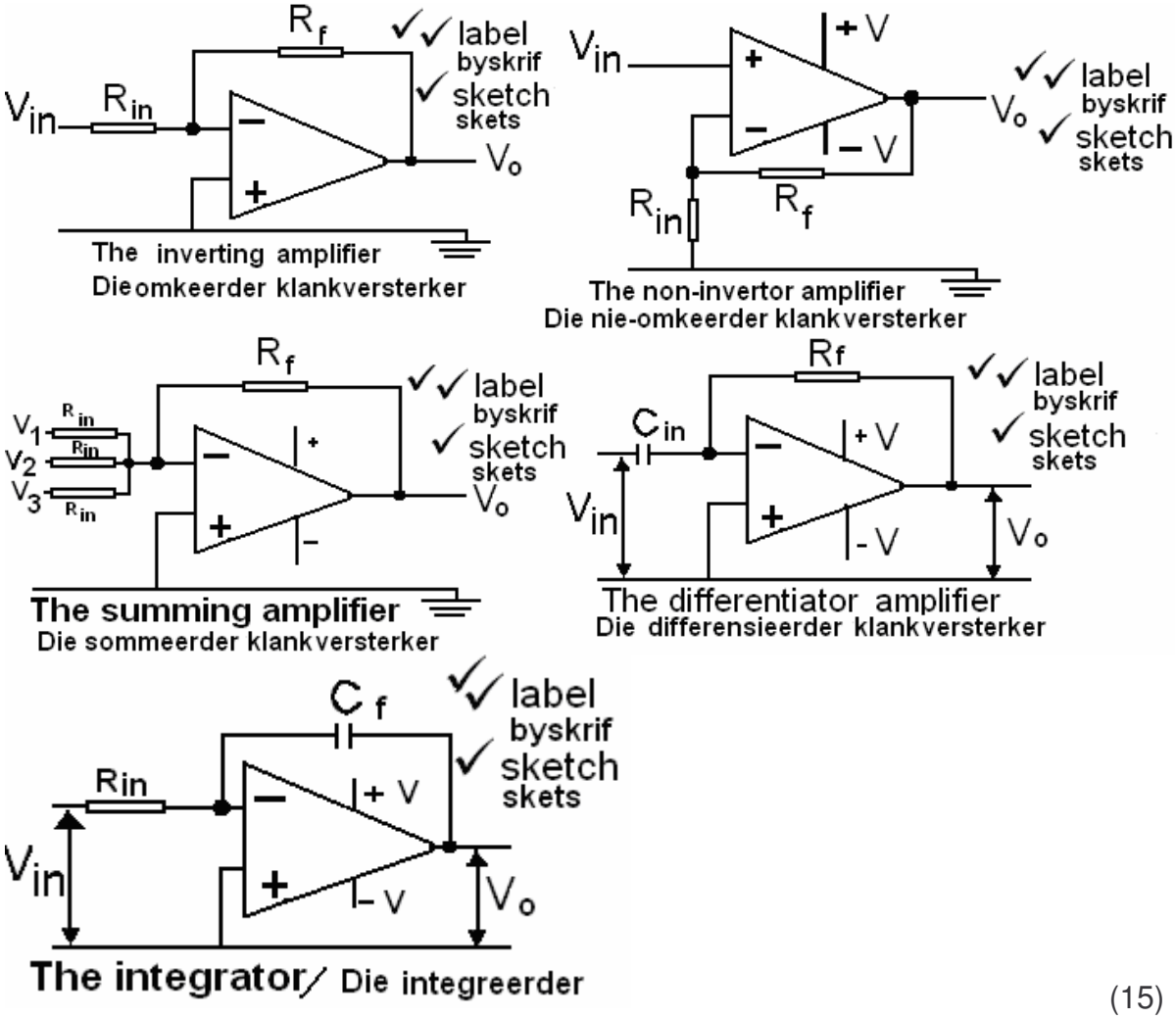
5.3




(4)
**[30]**

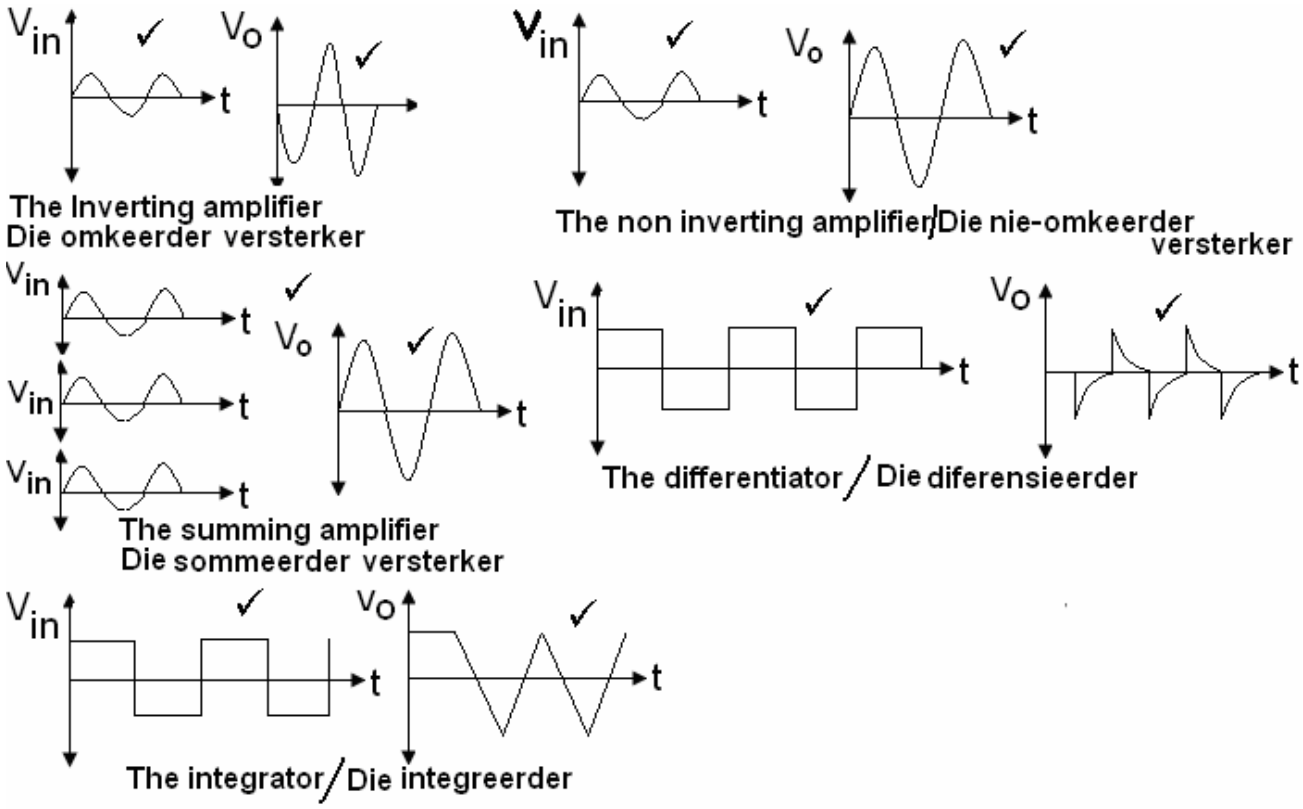
## QUESTION 6: AMPLIFIERS CIRCUITS

6.1.1




(15)

6.1.2




(10)

6.2 The inverting amplifier. ✓ (1)

6.3
- Input impedance is infinite. ✓
- Output impedance is zero. ✓
- Frequency response is infinite. ✓
- Open circuit voltage gain is infinite. ✓ (Any THREE) (3)

6.4
- Improve bandwidth. ✓
- Less distortion. ✓
- Less noise. ✓
- Increase gain stability. ✓ (Any THREE) (3)

6.5 Positive feedback**:** When the output of the circuit is fed back to the input of the same circuit in phase with the input signal, the resultant will be ever increasing output. The result will be distortion or over loading of the circuit. ✓

Negative feedback**:** When the output of a circuit is fed back to the input of the same circuit out of phase with the input, the result is that the output signal becomes smaller and may even disappear. ✓

Example of a positive feedback**:** When the micro phone of an audio amplifier is held close to the speaker positive feedback causes the amplifier to whistle causing great discomfort to the human ear. ✓

Example of a negative feedback**:** Is utilized in amplifiers to obtain volume control and gain control such as is used in oscilloscope. ✓ (4)

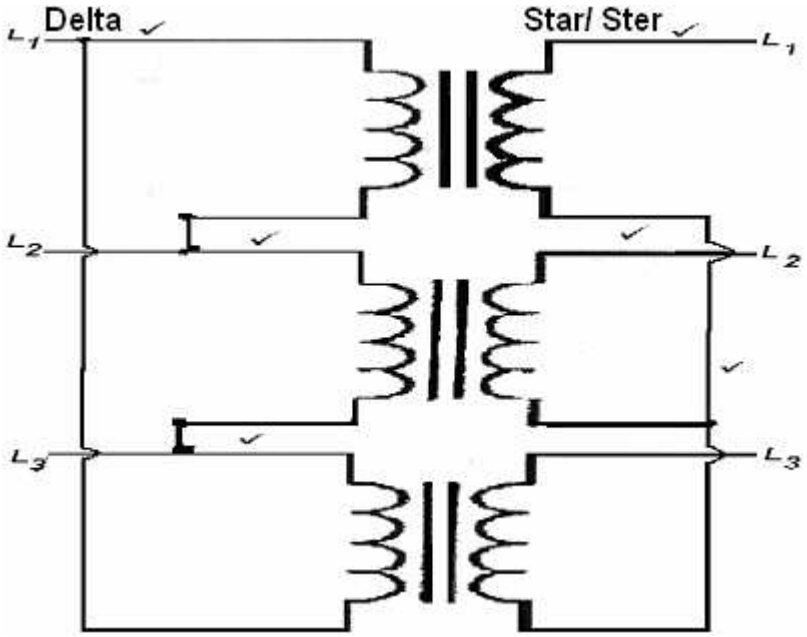
**[36]**

## QUESTION 7: THREE PHASE TRANSFORMER

7.1
- Star - delta✓
- Star - star✓
- Delta - star✓
- Delta - delta✓

(4)

7.2




(6)

7.3
- Eddy current losses.✓
- Hysteresis losses.✓
- Stray losses.✓
- Dielectric losses.✓
- Copper. ✓
- $I^2R$ losses.✓

(5)

(Any FIVE)

7.4 7.4.1 For Star

$I_L = I_{Ph}$ ✓

$= 200\ A$ ✓ (2)

7.42 $\frac{N_1}{N_2} = \frac{V_1}{V_2}$ ✓½

$V_2 = \frac{N_2 V_1}{N_1}$

$= \frac{1 \times 20\,000}{10}$ ✓½

$= 2000\ V$

$= 2\ kV$ ✓ (4)

$V_L = \sqrt{3}\ V_{Ph}$ ✓½

$= \sqrt{3}\ 2000$ ✓½

$= 3464{,}102 V$

$= 3{,}46\ kV$ ✓

7.4.3 $P = \sqrt{3}\ V_L\ I_L \cos \Phi$ ✓½

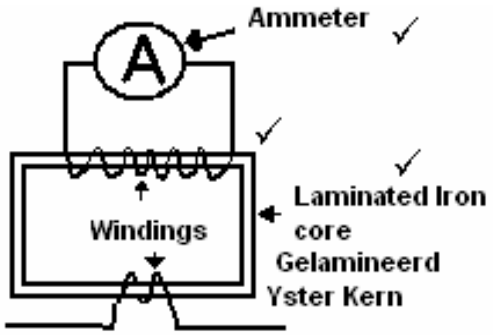
$= \sqrt{3} \times 3464{,}102 \times 200 \times 1$ ✓½

$= 1\,200\,000\ W$ ✓

$= 1{,}2\ MW$ ✓ (3)

7.5
- The power must be switched off.✓
- The secondary windings must first be short circuited.✓ (2)

7.6




(3)

7.7 It is practical impossible to measure voltage more than 1000 V and current more than 100 A.✓ Potential transformer is used for measuring voltages more than 1000 V and current transformer is used for measuring currents more than 100 A. ✓ This is done to bring the high voltage and high current to a safe value.✓ (3)

7.8 110V (2)

7.9 5 A (2)

**[36]**

## QUESTION 8: INSTRUMENTS.

8.1 Difference between synchronous speed✓ (Rotating field)✓ and rotor speed is called slip.✓
It is measured in percentage (%).✓ (4)

8.2 In a star-delta starter, the starting current is limited to =√3 of the maximum current. When it switches to delta, it draws full current. (4)

8.3 8.3.1 $P_T$ =82000W, $V_L$ = 2 200, power factor = 0,91 lagging

$P_T = \sqrt{3}\, V_L I_L \cos\Phi$ ✓½

$I_L = \dfrac{82\,000}{\sqrt{3} \times 2\,200 \times 0{,}91}$ ✓½

$= 23{,}65$ A✓ (2)

8.3.2 $I_P = \dfrac{I_L}{\sqrt{3}}$ ✓½

$= \dfrac{23{,}65}{\sqrt{3}}$ ✓½

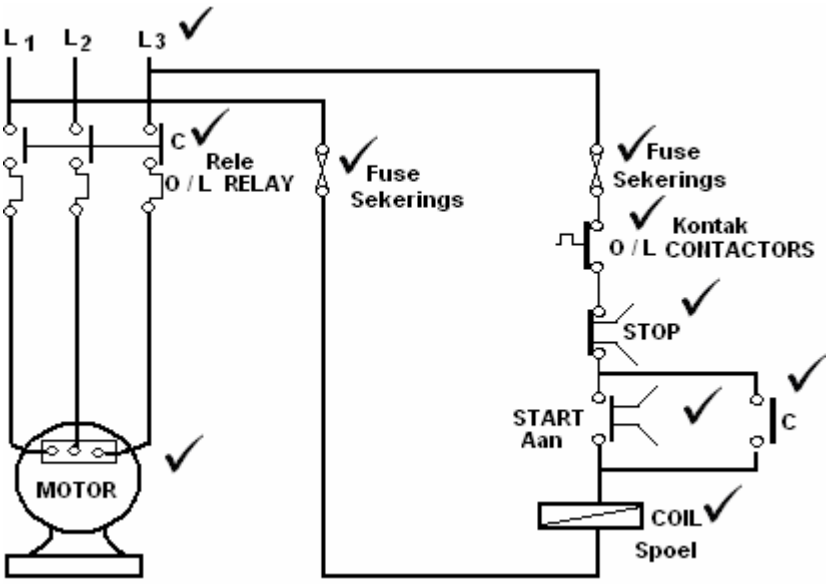
$= 13{,}65$ A✓ (2)

8.3.3 $W_1 = V_L I_L \cos(30° + \Phi)$ ✓½
$= 2\,200 \times 23{,}65 \cos 54.5°$ ✓½
$= 30{,}21$kW✓½

$\cos\Phi = 0{,}91$✓½
$\Phi = \cos^{-1} 0{,}91$✓½
$= 24{,}5°$✓½

$W_2 = V_L I_L \cos(30° - \Phi)$ ✓
$= 2\,200 \times 23{,}65 \cos 5{,}5°$✓
$= 51{,}79$ kW✓ (6)

8.4




(12)
**[30]**

**GRAND TOTAL: 200**