

**GAUTENG DEPARTMENT OF EDUCATION
GAUTENGSE DEPARTEMENT VAN ONDERWYS**

**SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN**

**ELECTRICIANS WORK SG
ELEKTRISIËNSWERK SG**

QUESTION / VRAAG 1

1.1

1.1.1

$$\begin{aligned} X_L &= 2\pi FL \\ &= 2\pi \cdot 50 \cdot 60 \cdot 10^{-3} \\ &= 18,85 \text{ ohms} \end{aligned}$$

$$\begin{aligned} X_C &= 1/2\pi FC \\ &= 1/2\pi \cdot 50 \cdot 150 \cdot 10^{-6} \\ &= 21,22 \text{ ohms} \end{aligned}$$

$$\begin{aligned} I_R &= V / R \\ &= 150/30 \\ &= 5A \end{aligned}$$

$$\begin{aligned} I_{XL} &= V / X_L \\ &= 150/18,85 \\ &= 7,9 \text{ A} \\ &= 7,96 \text{ A} \end{aligned}$$

$$\begin{aligned} I_{XC} &= V / X_C \\ &= 150/21,22 \\ &= 7,07 \text{ A} \\ &= 7,07 \end{aligned}$$

(10)

1.1.2

$$\begin{aligned} I_T &= \sqrt{I_R^2 + (I_L - I_C)^2} \\ &= \sqrt{25 + 0,792} \\ &= \sqrt{25,792} \\ &= 5,08 \text{ A} \end{aligned}$$

(3)

1.1.3

$$\begin{aligned} Z_T &= V_T / I_T \\ &= 150 / 5,08 \\ &= 29,54 \text{ ohms} \end{aligned}$$

(2)

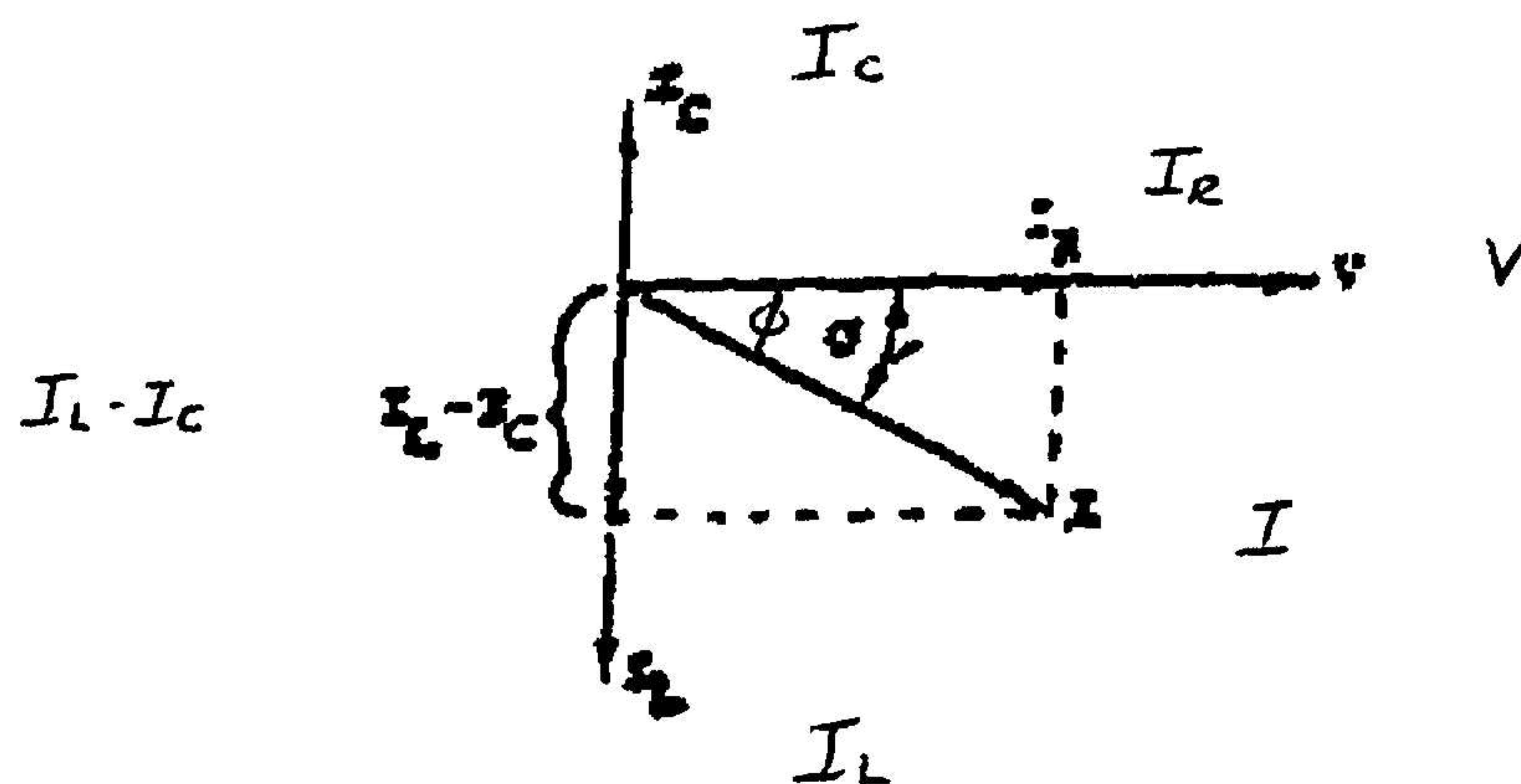
1.1.4

$$\begin{aligned} \cos\emptyset &= I_r/I_t \\ &= \cos^{-1} 5/5,08 \\ \emptyset &= 10,05^\circ \\ &= 10,18^\circ \end{aligned}$$

$$\begin{aligned} \text{OR } \tan\emptyset &= I_L - I_C / I_r \\ &= \tan^{-1} (7,95 - 7,07)/5 \\ &= 10,09^\circ \end{aligned}$$

(3)

1.1.5



(5)

1.2

1.2.1

RESONANCE

Resonance is defined as follows: when the inductive reactance equals the capacitive reactance (i.e. $X_L = X_C$) then their effects neutralize each other. Under these conditions the impedance is equal to the resistance and the circuit is said to be in resonance.

(3)

OR / OF**RESONANSIE**

Resonansie word soos volg gedefinieer: as die induktiewe reaktansie gelyk is aan die kapasitiewe reaktansie (d.w.s. $X_L = X_C$) dan neutraliseer hulle effekte mekaar. Onder hierdie omstandighede is die impedansie gelyk aan die weerstand en die kring is in resonansie.

(3)

1.2.2

IMPEDANCE

The total condition impeding the passage of an alternating current in a circuit comprising combinations of resistances and reactances is called impedance, which is measured in ohms.

(3)

OR / OF**IMPEDANSIE**

Die totale opposisie (toestand) wat uit 'n kombinasie van resistors en reaktansies bestaan, wat die vloei van stroom in 'n ws-stroombaan verhinder, word die impedansie genoem en in ohm gemeet.

(3)

1.2.3 EFFECTIVE VALUE

The effective value of an alternating current is equal to that direct current which will produce heat energy at the same rate when applied to the same resistance.

(3)

OR / OF

EFFEKTIEWE WAARDE

Die effektiwe waarde van 'n wisselstroom is gelyk aan daardie gelykstroom wat hitte teen dieselfde tempo sal produseer wanneer dit oor dieselfde resistor aangelê word.

(3)

1.2.4 FORM FACTOR

The form factor of a wave form is the ratio of the r.m.s. value to the average value of the wave.

(3)

OR / OF

VORMFAKTOR

Die vormfaktor van 'n golfvorm is die verhouding van die w.g.k.-waarde tot die gemiddelde waarde van die golf.

(3)
(12)

$$\begin{aligned}
 1.3 \quad V_r &= 1 \text{ div / getal} \\
 &= 1 \times 1 & (1) \\
 &= 1 \text{ volt (max / mak)} & (1) \\
 &= 1 \times 0,707 & (1) \\
 &= 0,707 \text{ volt (r.m.s./w.g.k.)} & (1)
 \end{aligned}$$

$$\begin{aligned}
 V_c &= 2 \text{ div/getal} \\
 &= 2 \times 5 & (1) \\
 &= 10 \text{ volt (max / maks)} & (1) \\
 &= 10 \times 0,707 & (1) \\
 &= 7,07 \text{ volt (r.m.s./w.g.k.)} & (1)
 \end{aligned}$$

Resistance / Weerstand

$$\begin{aligned}
 R &= V / I & (1) \\
 &= 0,707 / 0,350 \\
 &= 2,02 \text{ ohm} & (1)
 \end{aligned}$$

$$\begin{aligned}
 X_c &= V_c / I & (1) \\
 &= 7,07 / 0,350 \\
 &= 20,2 \text{ ohm} & (1)
 \end{aligned}$$

Frequency / Frekwensie

$$\begin{aligned}
 F &= 1 / t & (1) \\
 &= 1 / 0,003 \times 8 & (1) \\
 &= 41,67 \text{ Hz} & (1)
 \end{aligned}$$

Capacitance / Kapasitansie

$$\begin{aligned}
 C &= 1 / 2 \pi f X_c & (1) \\
 &= 1/2 * \pi * 41,67 * 20,2 & (1) \\
 &= 189,093 \text{ microfarad/mikrofarad} & (1)
 \end{aligned}
 \tag{18}$$

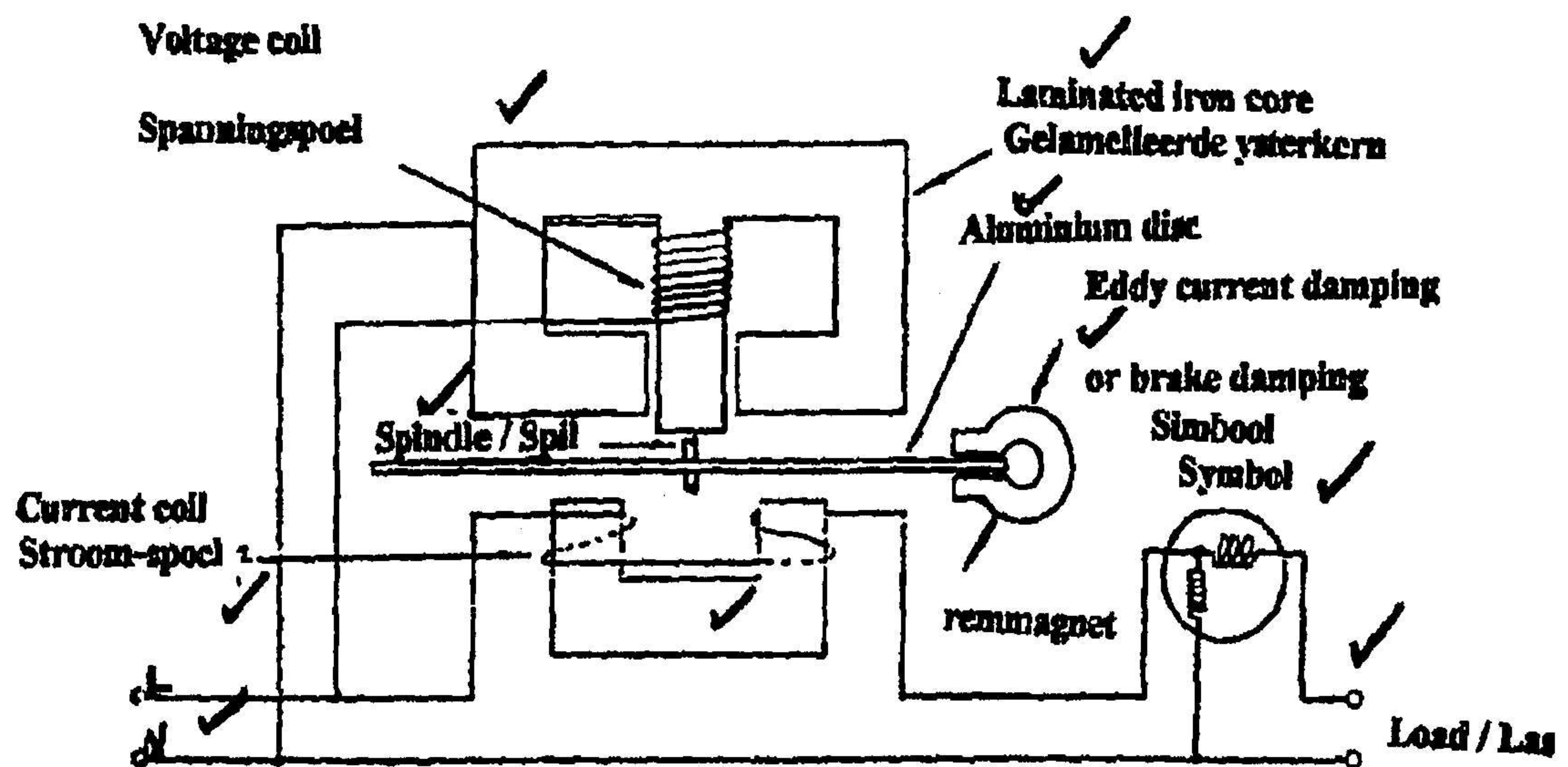
$$\begin{aligned}
 1.4 \quad \text{Effective value / Effektiewe waarde} &= 0,707 * (\text{max/maks}) & (1) \\
 &20 &= 0,707 * (\text{max/maks}) & (1) \\
 (\text{max/mak}) &= 20 / 0,707 & (1) \\
 &= 28,29 \text{ A} & (1)
 \end{aligned}
 \tag{3}$$

$$\begin{aligned}
 1.5 \quad e &= 200 \sin 628 t \\
 &= 200 \sin 628 * 0,0003 * 57,3 & (2) \\
 &= 200 \sin 10,795 & (1) \\
 e &= 37,5 \text{ V} & (1)
 \end{aligned}
 \tag{4}$$

(converting Radians to degrees / die omskakeling van Radiale na grade) [60]

QUESTION / VRAAG 2

2.1 Induction wattmeter (10)



(10)

- 2.2
1. The secondary winding must first be short-circuited. (2)
 2. Dangerously high e.m.f. might be induced in the secondary winding. (2)

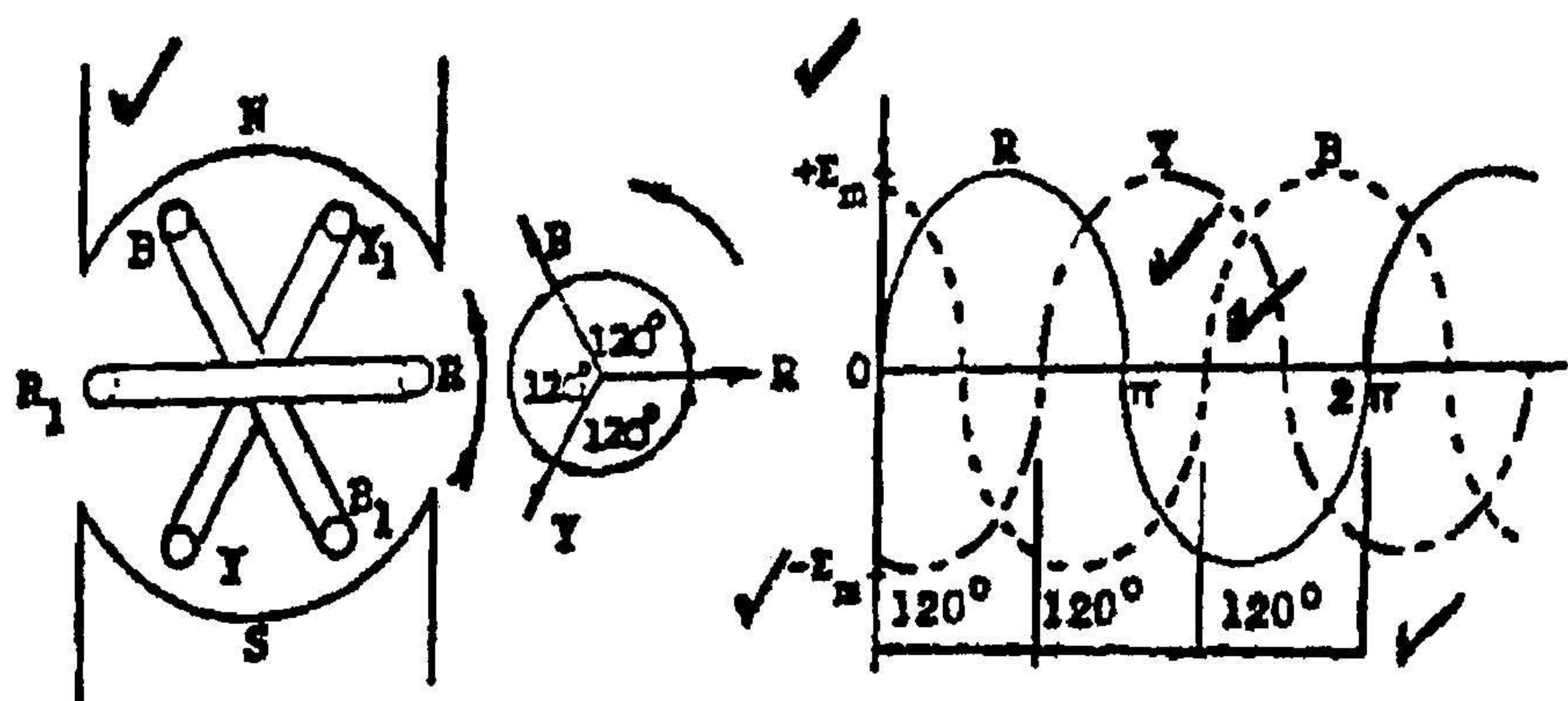
OR / OF

1. Die sekondêre wikkeling moet eers gekortsluit word. (2)
 2. Gevaarlike hoë emk kan in die sekondêre wikkeling geïnduseer word. (2)
- (4)

2.3

Three-phase waveforms

(6)



2.4

2.4.1

(efficiency / rendement)

= output power / input power

(1)

= lowering-drywing / inset-drywing

(input power / inset-drywing)

= output power / efficiency*100%

(1)

= lowering-drywing / rendement*100%

= 10 000 / 80*100

(1)

= 12 500

= 12,5 kW

(1)

(4)

2.4.2

$P_{in} = \sqrt{3} * V_L * I_L * \cos\phi$

(1)

$= 12\,500 / \sqrt{3} * 380 * 0,9$

(1)

$= 12\,500 / 592,36$

$= 21,102\text{ A}$

(1)

(3)

2.4.3

in delta

$I_L = \sqrt{3} I_p$

$I_p = I_L / \sqrt{3}$

(1)

$= 21,102 / \sqrt{3}$

(1)

$= 12,18\text{ A}$

(1)

(3)

2.4.4

in delta

$V_L = V_p$

(1)

$= 380\text{ V}$

(1)

(2)

2.5

(Efficiency / rendement)

= output power / lowering-drywing) /

= (input power / inset-drywing)

(1)

= (output / lowering) /

= (efficiency / rendement)

(1)

= 150 000 / 0,9

(1)

= 166,6 kW

(1)

$P_{in} = \sqrt{3} V_L * I_L * \cos\phi$

(1)

$I_L = P_{in} / \sqrt{3} V_L \cos\phi$

(1)

$= 166666,67 / \sqrt{3} * 3\,000 * 0,88$

(1)

$= 36,448\text{ A}$

(1)

(8)

[40]

QUESTION / VRAAG 3

3.1

$$\begin{aligned}
 3.1.1 \quad V_L &= \sqrt{3} * V_p & (1) \\
 &= \sqrt{3} * 220 \\
 &= 381,05 \text{ V} & (1)
 \end{aligned}$$

$$\begin{aligned}
 3.1.2 \quad S &= \sqrt{3} * V_{L2} * I_{L2} & (1) \\
 I_{L2} &= S / \sqrt{3} V_{L2} \\
 &= 400\,000 / \sqrt{3} * 381,05 & (1) \\
 &= 606,06 \text{ A} & (1)
 \end{aligned}$$

in star

$$\begin{aligned}
 I_L &= I_P & (1) \\
 &= 606,06 \text{ A} & (1)
 \end{aligned}$$

$$\begin{aligned}
 3.1.3 \quad P &= S \cos \phi & (1) \\
 &= 400 * 1\,000 * 0,85 & (1) \\
 &= 340 \text{ kW} & (1)
 \end{aligned}$$

OR / OF

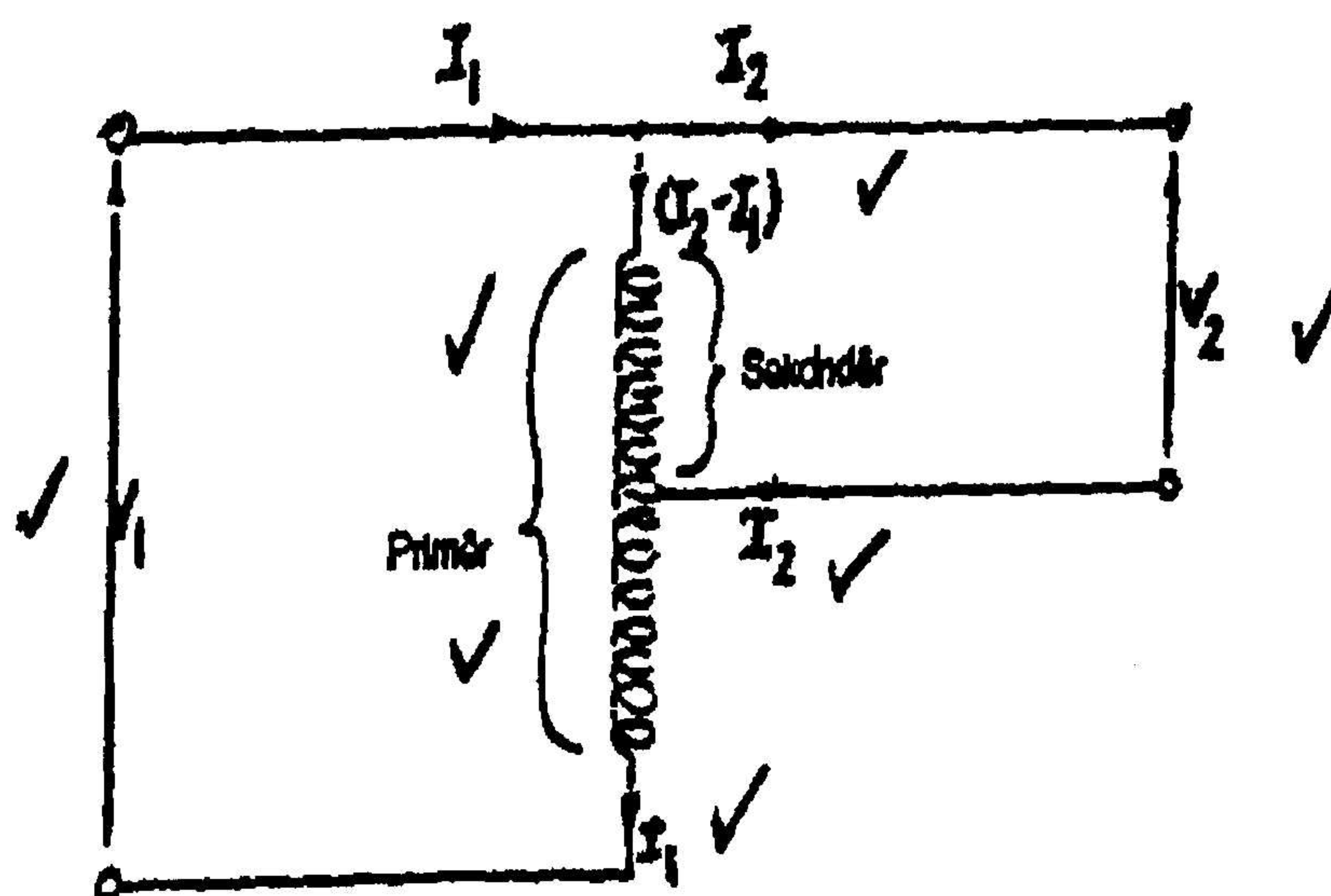
$$\begin{aligned}
 P &= \sqrt{3} * V_{L2} * I_{L2} * \cos \phi & (1) \\
 &= \sqrt{3} * 381,05 * 606,06 * 0,85 & (1) \\
 &= 340 \text{ kW} & (1)
 \end{aligned}$$

$$\begin{aligned}
 3.1.4 \quad V_{ip} / V_{2p} &= 10 / 1 & (1) \\
 V_{ip} &= 220 * 10 & (1) \\
 V_{ip} &= 2\,200 \text{ V} & (1) \\
 V_{ip} &= V_{1L} \\
 &= 2\,200 \text{ V} & (1)
 \end{aligned}$$

(14)

3.2 Single-phase auto-transformer

(7)



(7)

- 3.3 To switch on the alarm when there is a fault. (2)
 To isolate the transformer from the supply when there is a fault. (2)

OR / OF

- Om die alarm te aktiveer wanneer daar 'n fout is. (2)
 Om die transformator te isoleer van die toevoer wanneer daar 'n fout is. (2)
 (4)

3.4

3.4.1 $V_L = V_P$
 $= 15\,000\text{ V}$ (1)

$V_1 / V_2 = \text{RATIO}$ (1)
 $15\,000 / V_2 = 15$
 $V_{2P} = 15\,000 / 15$ (1)
 $V_{2P} = 1\,000\text{ V}$ (1)

3.4.2 $V_{2P} = 1\,000\text{ V}$ (1)
 $V_L = \sqrt{3} * V_P$ (1)
 $= \sqrt{3} * 1\,000$ (1)
 $= 1\,732,05\text{ V}$ (1) (8)

- 3.5 1. Copper losses / Koperverliese (1)
 2. Iron losses / Ysterverliese (1) (2)
 [35]

QUESTION / VRAAG 4

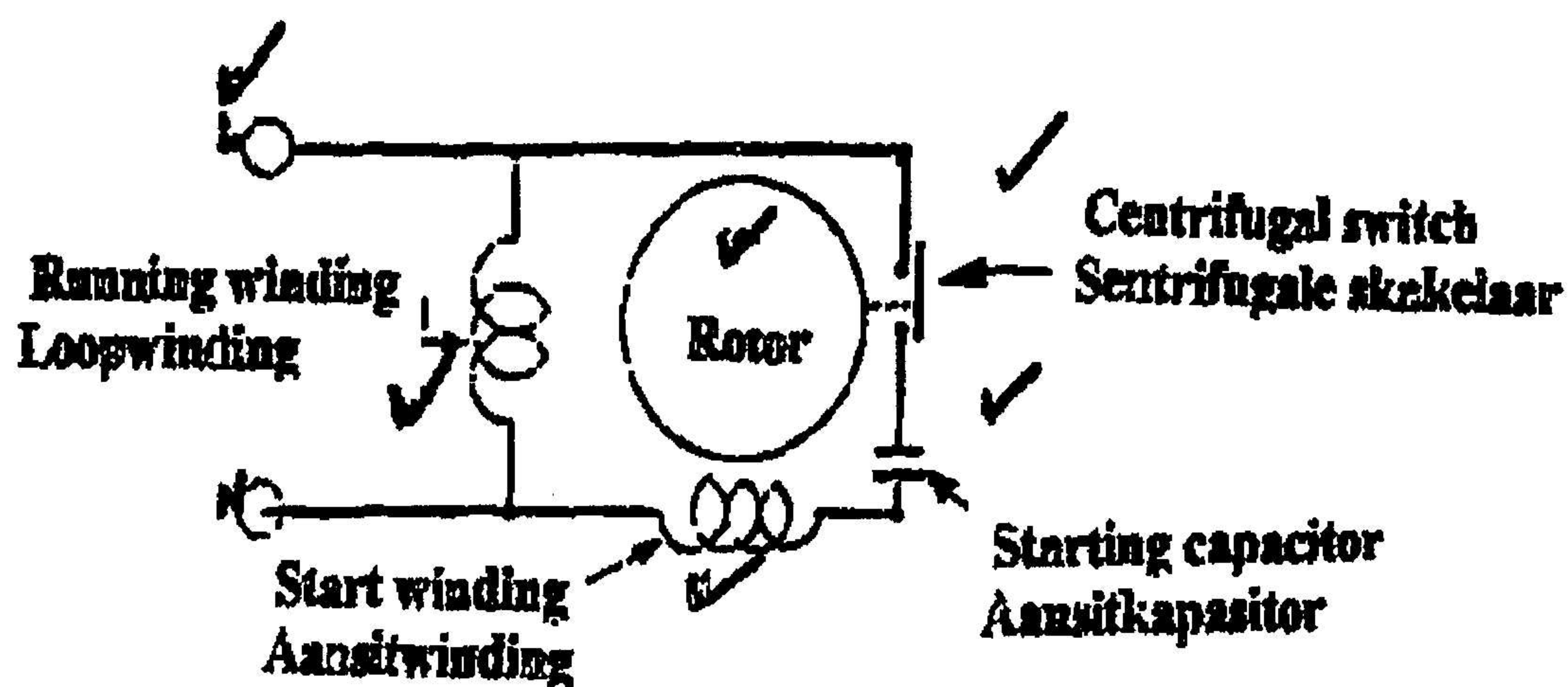
- 4.1 The speed of rotation of the magnetic flux is called synchronous speed. (2)
 The speed at which the Rotor rotates is called the Rotor speed and is
 always less than the synchronous speed. (2)

OR / OF

- Sinchrone spoed is die tempo waarteen die magneetveld roteer binne in
 die stator. (2)
 Die rotorspoed is die tempo waarteen die rotor in die roterende
 magneetveld roteer met die glip in aanmerking geneem. (2)
 (4)

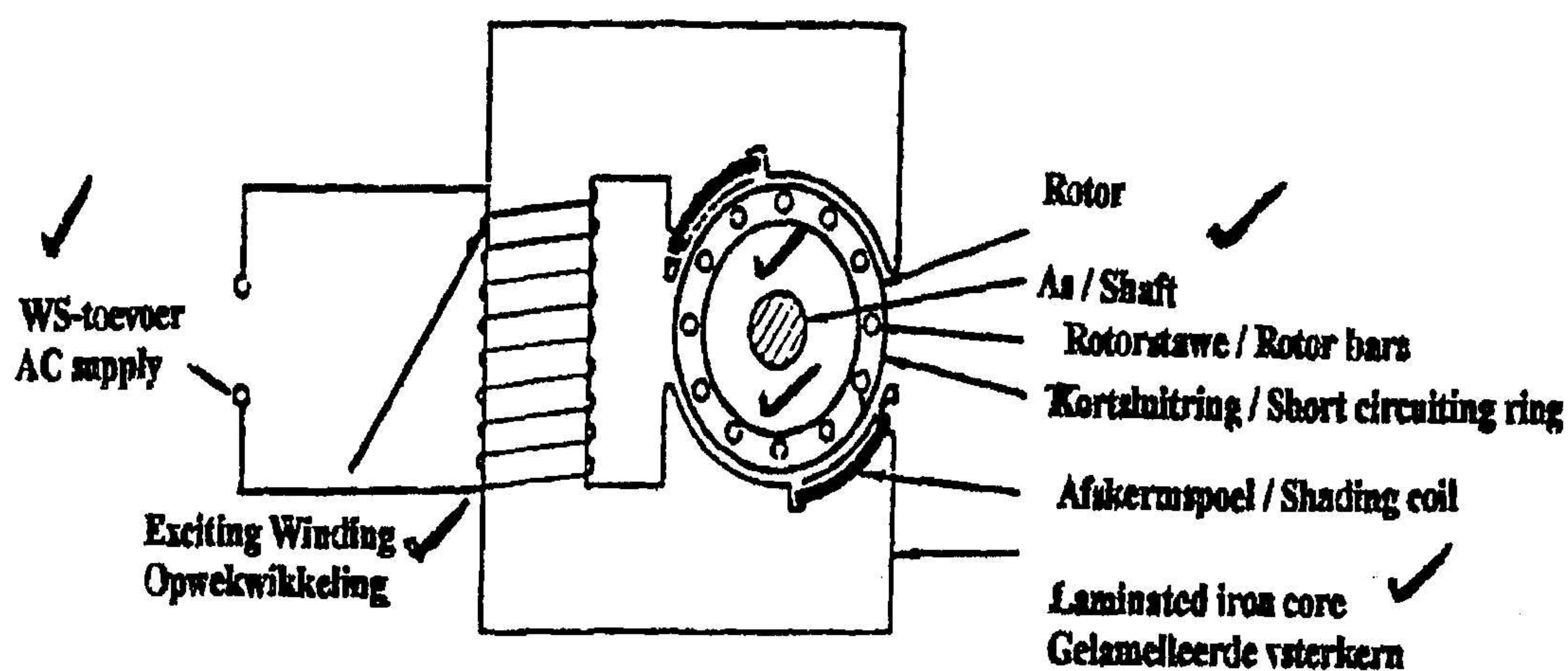
4.2 Capacitor-starter motor

(6)



Shaded pole motor

(6)



(12)

- 4.3
1. Lock-out switches / Uitsluit-skakelaars
 2. Isolator / Isoleerskakelaars
 3. No-volt coil / Nulspanning-spoel
 4. Overload coil / Oorlas-spoel
 5. Earth leakage device / Aardlek-toestel
 6. Isolating link / Isoleerskakel
 7. Interlock switches / Grendelskakelaars

(any 4 / enige 4)

(1)

(1)

(1)

(1)

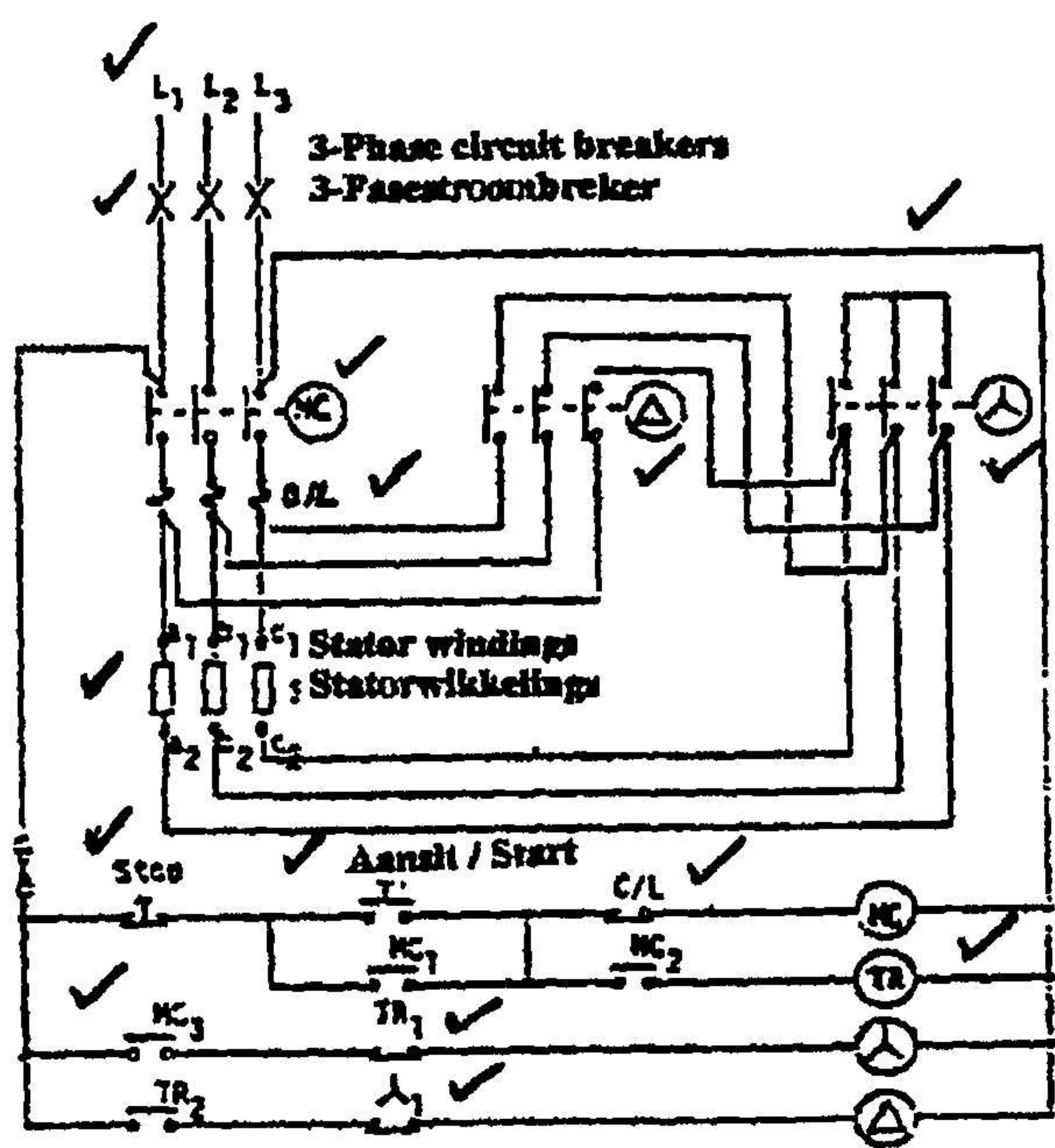
(1)

(1)

(1)

(4)

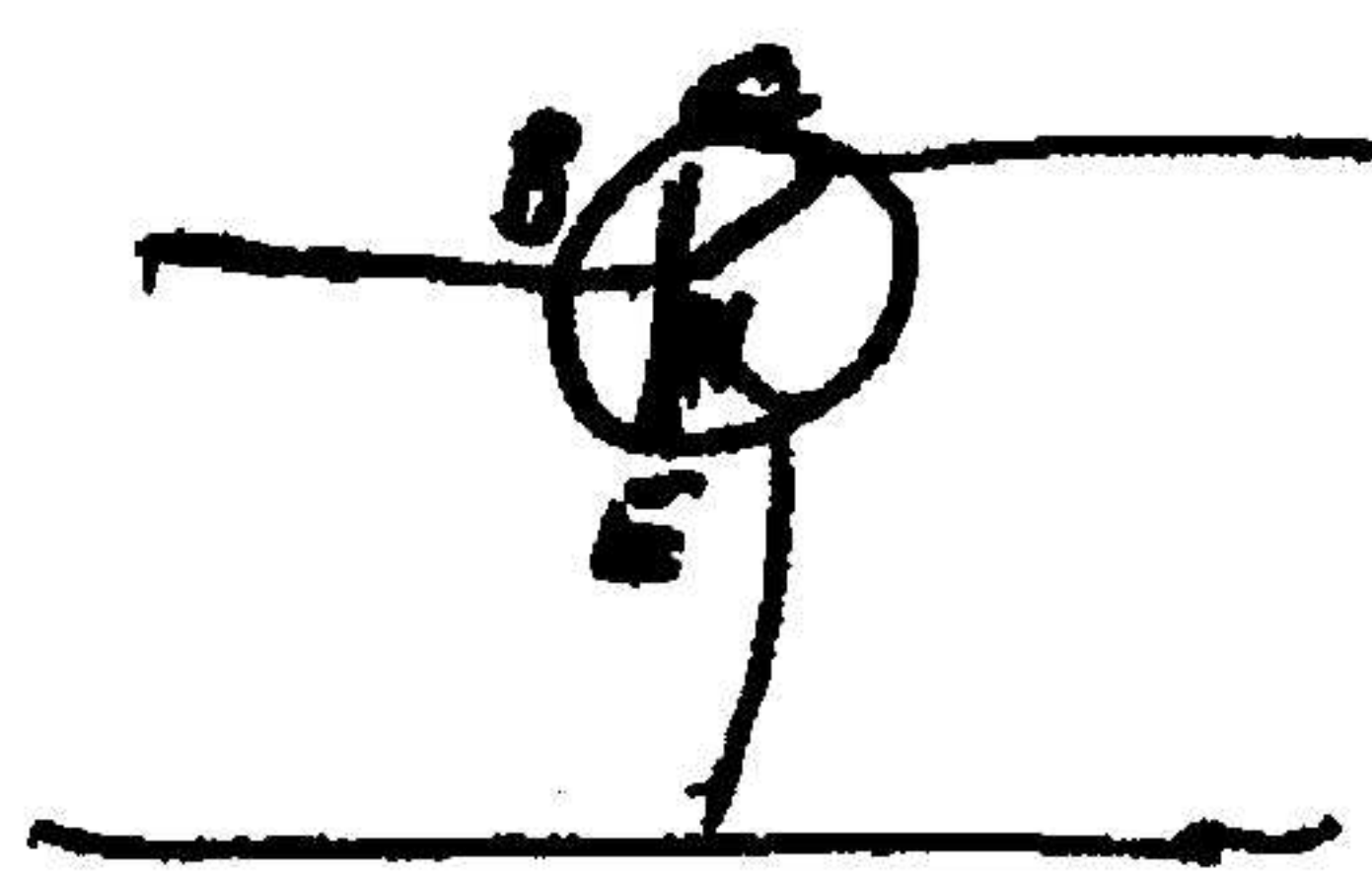
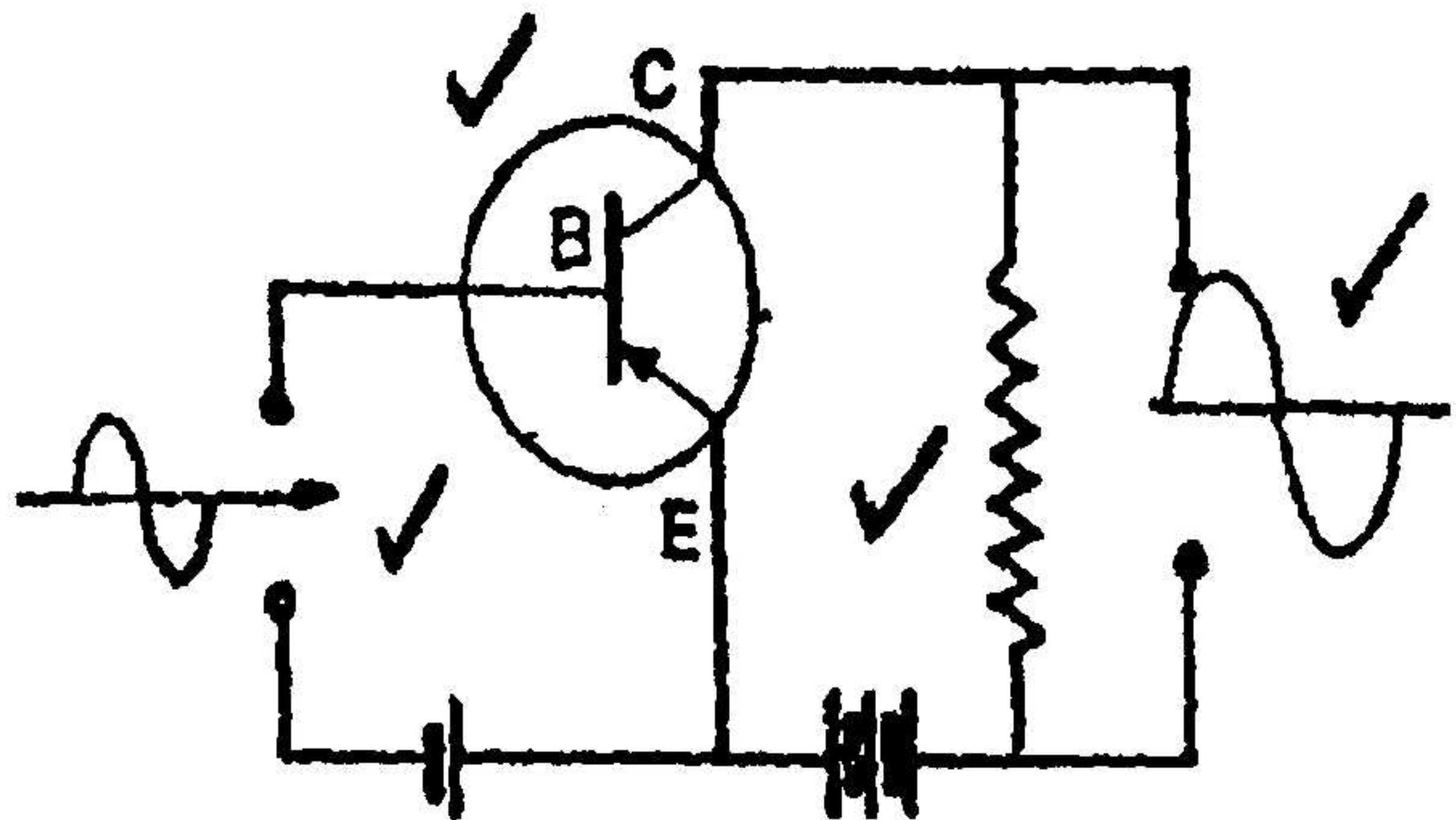
4.4 Automatic star-delta starter-control circuit (15)



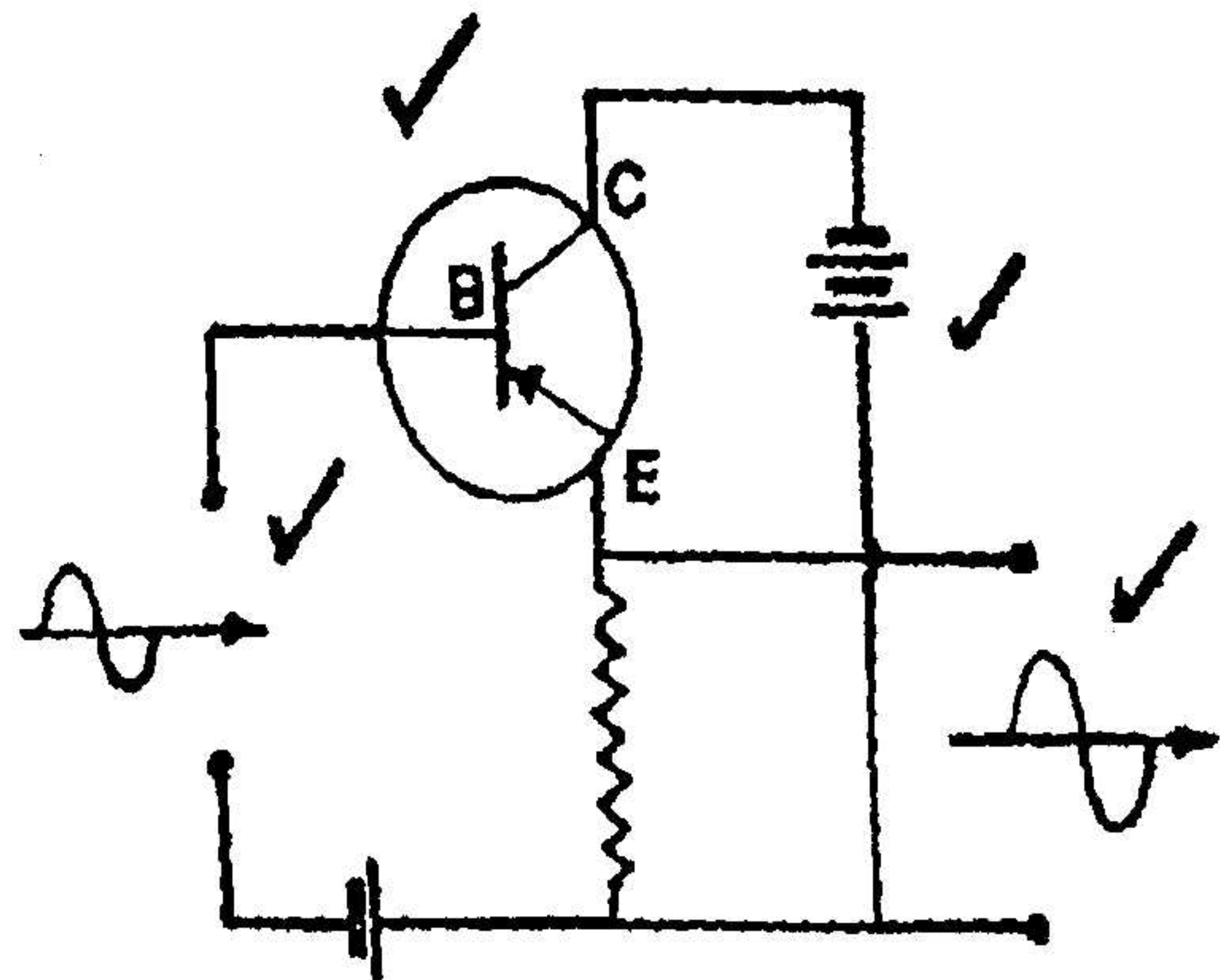
(15)
[35]

QUESTION / VRAAG 5

5.1 Common emitter (4)

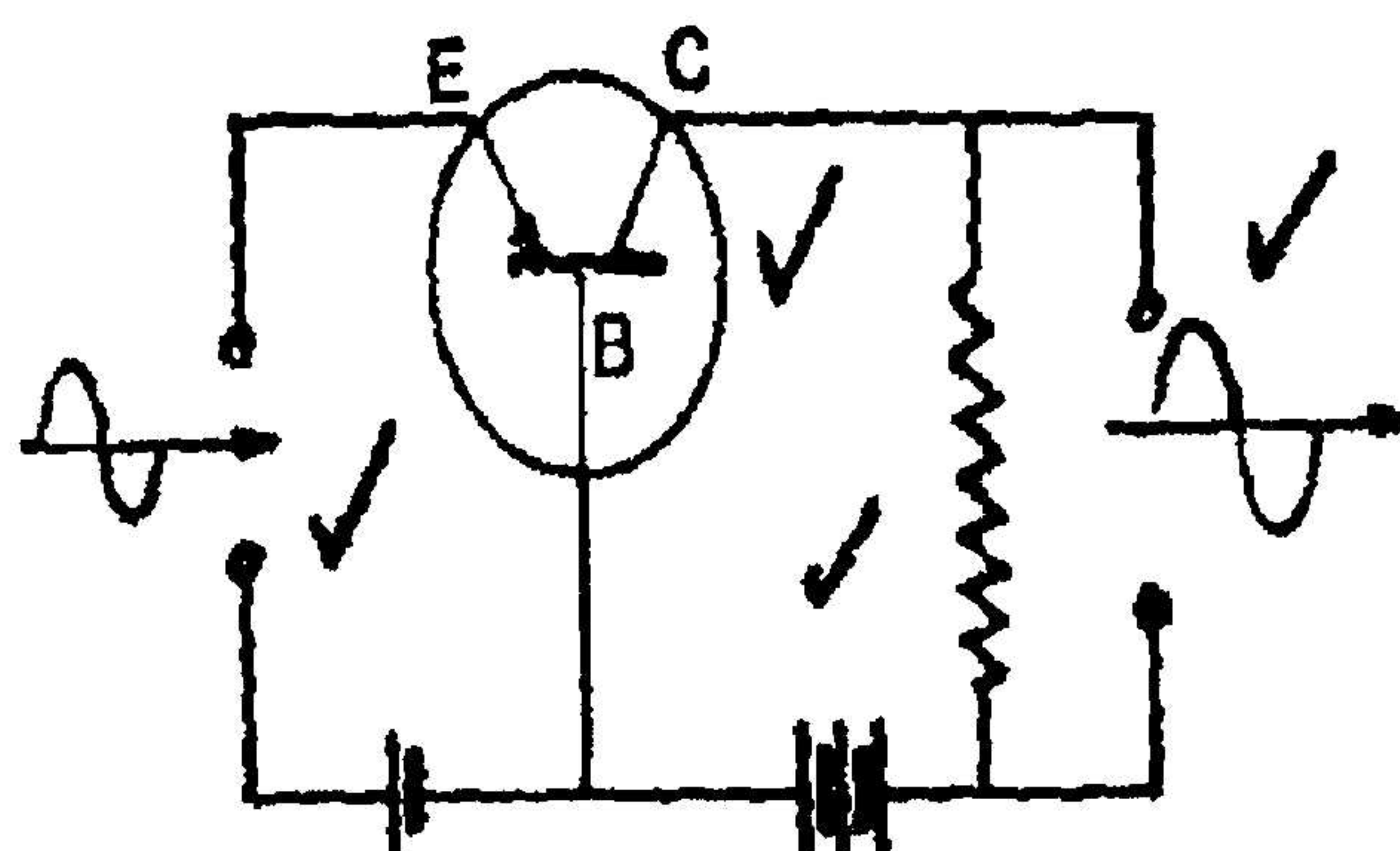


Common collector (4)



Common base

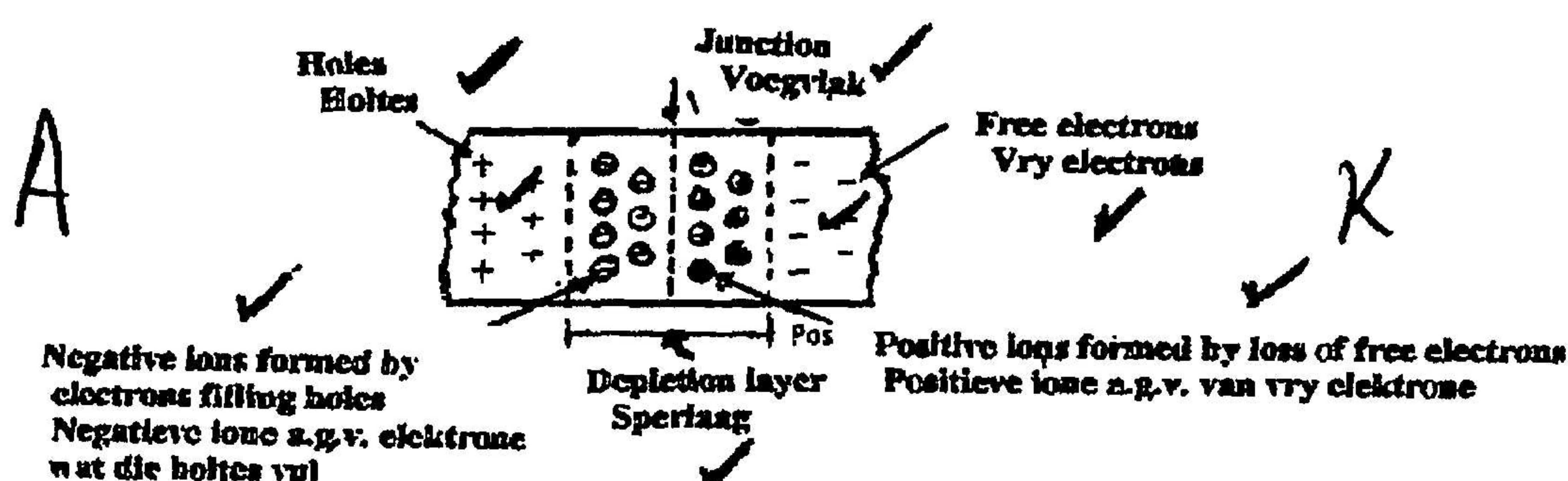
(4)



(12)

5.2 PN Junction diode

(8)



(8)

5.3

1. Since it is very sensitive to heat, suitable heat sinks must be employed, these are sometimes very bulky. (2)
2. It is very sensitive to voltage and current surges. (2)
3. The peak inverse voltage must be carefully limited to prevent destruction of the diode. (2)

OR / OF

1. Dit is baie gevoelig vir hitte en gevolglik moet daar groot hitte-afleiers gebruik word. (2)
2. Halfgeleier-diodes kan nie stuspanning en stroom so goed soos buisdiodes weerstaan nie. (2)
3. Truspannings moet goed beheer word om beskadiging van die diode te voorkom. (2)

(6)

- 5.4 Blood transfusion (infected blood). (1)
 Sharing of needles for drugs with a infected person. (1)
 Infected blood entering the body through an injury. (1)
 Not using latex gloves when a person is treated for blood loss. (1)
 Having sex with an infected person without protection. (1)
- Bloedoortapping (besmette bloed), (1)
 Deur 'n naald vir dwelms met 'n vigslyer te deel. (1)
 Deur besmette bloed wat deur 'n seerplek op die vel die liggaam binnedring. (1)
 Deur nie van lateks handskoene te dra nie, wanneer 'n persoon vir bloedverlies behandel word. (1)
 Deur seks te hê met 'n vigslyer sonder beskerming. (1)
- any 4 / enige 4 (4)
- Markers should consider all possible answers.
 Nasieners moet hier hulle eie diskresie gebruik. [30]