GAUTENG DEPARTMENT OF EDUCATION
GAUTENGSE DEPARTEMENT VAN ONDERWYS

SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

TECHNIKA (ELECTRICAL / *ELEKTRIES*) HG

POSSIBLE ANSWERS OCT / NOV 2006

Any other valid approach / answer should receive credit.
Enige ander geldige benadering / antwoord verdien krediet.

QUESTION / *VRAAG* 1

1.1
* The machine should have three-core wiring unless isolated doubly.
* The earth wire (green and yellow) should make proper contact with the metal casing of the appliance.
* Ensure that the insulation of the wires is in order.
* Check that the 3-prong plug is wired correctly.
* The earth wire should be connected to the earth prong and be long enough to ensure that it would be the last to come free if the cord is pulled.

(any 5 – one mark each)

* *Die masjien moet driekernbedrading hê, tensy dubbel geïsoleer.*
* *Die aarddraad (groen en geel) moet goeie kontak met die metaalomhulsel van die toestel maak.*
* *Maak seker dat die isolasie van die drade korrek is.*
* *Maak seker dat die 3-pen-prop korrek bedraad is*
* *Die aarddraad moet aan die aardpen van die prop verbind wees en lank genoeg wees om te verseker dat dit laaste sal losraak indien die koord getrek sou word.* *(enige 5 – 1 punt elk)* *(5)*

1.2

1.2.1 RC-coupled amplifier / *RC-gekoppelde versterker* (1)

1.2.2 Hartley oscillator with operational amplifier
Hartley-ossillator met operasionele versterker (1)

1.2.3 Power factor meter / *Drywingsfaktormeter / Arbeidfaktormeter* (1)

1.2.4 Capacitor-run motor / *Kapasitorloopmotor* (1)

1.2.5 Differential amplifier / *Differensiaalversterker* (1)
[10]

QUESTION / *VRAAG* 2

2.1

2.1.1 **Circuit impedance / *Impedansie van kring***

XL	=	$2\pi fL$	(1)
	=	$2\pi(50)(200 \times 10^{-3})$	(1)
	=	62,83 ?	(1)
XC	=	$\frac{1}{2\pi fC}$	(1)
	=	$\frac{1}{2\pi \times 50 \times 100^{-6}}$	(1)
	=	31,83 ?	(1)
Z	=	$\sqrt{R^2 + (XL - XC)^2}$	(1)
	=	$\sqrt{10^2 + (62{,}83 - 31{,}83)^2}$	(1)
	=	32,57 ?	(1)
			[9]

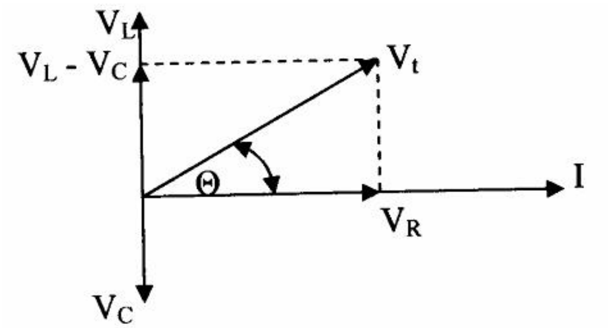
2.1.2 **Circuit power factor / *Drywingsfaktor van die kring***

Cos Ø	=	$\frac{R}{Z}$	(1)
	=	$\frac{10}{32{,}57}$	(1)
	=	0,307	(1)
			[3]

2.1.3 **Reactive component of the current / *Reaktiewe komponent van die stroom***

I	=	$\frac{V}{Z}$	(1)
	=	$\frac{250}{32{,}57}$	(1)
	=	7,67 A	(1)
Cos Ø	=	0,307	
Ø	=	72,12°	(1)
Ir	=	Im Sin Ø	(1)
	=	7,67 Sin 72,12°	(1)
	=	7,29 A	(1)
			[7]

2.1.4 Phasor diagram / *Fasordiagram*



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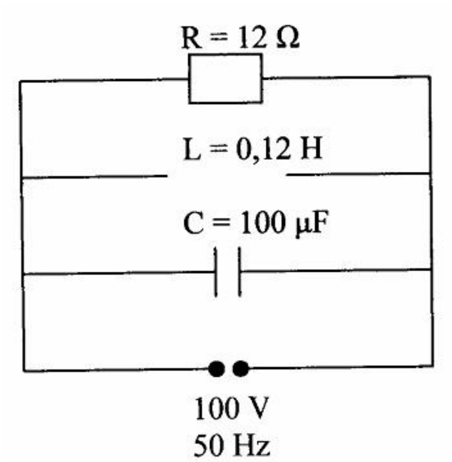
2.2

2.2.1 **Circuit diagram / *Kringdiagram***



(3)

2.2.2 **Current through each component / *Stroom in elke komponent***

$I_R = \frac{V_t}{R}$ (1)

$= \frac{100}{12}$

$= 8{,}33$ A (1)

$I_C = \frac{V_t}{X_c}$ (1)

$= \frac{100}{31{,}83}$

$= 3{,}14$ A (1)

$X_C = \frac{1}{2pfc}$ (1)

$= \frac{1}{2p(50)(100x10^{-6})}$

$= 31{,}83$? (1)

$I_L = \frac{V_t}{X_L}$ (1)

$X_L = 2p$fL (1)

$= \frac{100}{37,7}$ $= 2p(50)(0,12)$

$= 2,65$ A (1) $= 37,7$? (1)

[10]

2.2.3 **Total current in the circuit / *Totale stroom in die kring***

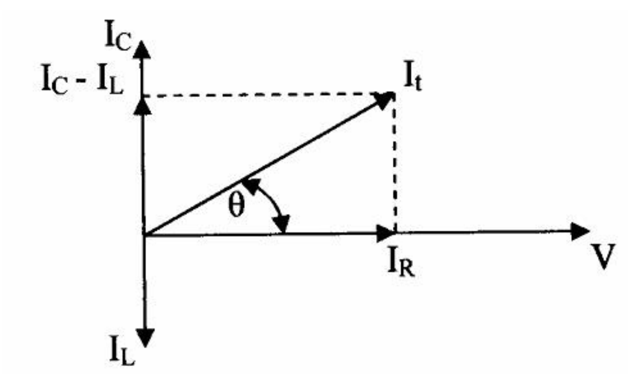
It $= \sqrt{I_R^2 + (I_L - I_C)^2}$ (1)

$= \sqrt{(8,33)^2 + (3,14 - 2,65)^2}$ (1)

$= 8,34$? (1)

[3]

2.2.4 **Phasor diagram / *Fasordiagram***



(3)

2.3

2.3.1 **Ampere**

It is the current that a force of 2 x 10^{-7} Nm exerts on each of two infinitely long conductors placed one metre apart in a vacuum.

Ampère

Dit is die stroom wat ? krag van 2 x 10^{-7} N.m. uitoefen op elk van twee oneindig lange geleiers wat een meter van mekaar in ? lugleë ruimte geplaas is. (5)

2.3.2 **Frequency**

Frequency is the amount of cycles an alternating current completes in one second and is measured in Hertz.

Frekwensie

Frekwensie is die aantal siklusse wat ? wisselstroom in een sekonde voltooi en word gemeet in Hertz. (2)

2.3.3 **Phasor**

It is a straight line with an arrow head indicating magnitude and direction.

Fasor

Dit is ? reguit lyn met ? pylpunt wat grootte en rigting aandui. (2)

2.3.4 **Period**
Period is the time it takes to complete one cycle of an alternating wave.

Periode
Periode is die tydsduur om een siklus van ? wisselgolf te voltooi. (2)

2.4
2.4.1 **Q factor**
The Q factor is the increase in current in a parallel resonant circuit or is the increase in the voltage of a series resonant circuit.

Die Q-faktor
Q-faktor is die stroomverhoging in ? parallelresonansiekring of is die spanningsverhoging in ? serieresonansiekring. (2)

2.4.2 **Active component of alternating current**
The active component of alternating current is that part of the current that is in phase with the voltage.

Aktiewe komponent van wisselstroom
Die aktiewe komponent van wisselstroom is die gedeelte van die stroom wat in fase met die spanning is. (2)

2.4.3 **Efficiency**
Efficiency is the percentage of the input power that is ackled to the output of the system.

Doeltreffendheid
Doeltreffendheid is die persentasie van die insetdrywing wat by die afvoer van ? stelsel gelewer word. (3)

2.4.4 **Resonant frequency**
Resonant frequency is the frequency where the capacitive and inductive reactances are equal to each other.

Resonante frekwensie
Resonante frekwensie is die frekwensie waar die kapasitiewe en induktiewe reaktansies gelyk is aan mekaar. (2)
[62]

QUESTION / *VRAAG* 3

3.1 FIVE advantages of a three-phase AC system over single-phase systems.
VYF voordele van driefasige wisselstroomstelsels bo eenfasestelsels

* At higher power, the load in a three-phase system is distributed across separate circuits, each of which carries a part of the current.
* *By hoë drywing word die las in ? driefasige stelsel oor aparte kringe versprei wat elk ? deel van die stroom dra.*

* In a machine with the same size of frame, a three-phase machine renders higher power.
* *Vir die masjien met dieselfde grootte raam lewer ? driefase masjien hoër drywing.*

* Alternators have the same size of power.
* *Alternators het dieselfde grootte aandrywing.*

* Three-phase is more efficient with a higher torque.
* *Driefase is doeltreffender met ? hoër draaimoment.*

* Three-phase is more versatile, line and phase values with voltage provision.
* *Driefasetoevoer is veelsydiger, lyn- en fasewaardes met spanning-voorsiening.*

* Cheaper
* *Goedkoper*

* Any other suitable answer.
* *Enige toepaslike antwoord.* any / *enige* (5)

3.2 Phase sequence of three-phase, three-wire AC-supply
Fasevolgorde van ? driefasige, driedraadwisselstroomtoevoer

Red, yellow, blue / *Rooi, geel, blou* (3)

3.3 Resistance and inductance of each coil
Weerstand en induktansie van elke spoel

$P = \sqrt{3}\, V_L I_L \cos Ø$ (1)

$I_L = \dfrac{1}{\sqrt{3}\, V_L \cos Ø}$ (1)

$= \dfrac{1{,}5\times10^3}{\sqrt{3}(400)(0{,}2)}$ (1)

$= 10{,}83$? (1)

But / *Maar* $I_L = I_f$ (1)

$\therefore I_f = 10{,}83$ A (1)

And / *En* $V_L = \sqrt{3}V_f$ (1)

$\therefore V_f = \dfrac{V_L}{\sqrt{3}}$

$= \dfrac{400}{\sqrt{3}}$ (1)

$= 231$ V (1)

Thus / *Dus* $Z^{coil}_{spoel} = \frac{V_f}{I_f}$ (1) and / *en* $\text{Cos } Ø = \frac{R}{Z}$ (1)

$= \frac{231}{10,83}$ (1) $\qquad R^{coil}_{spoel} = \text{Cos } Ø \times Z$ (1)

$= 231 \text{ V}$ (1) $\qquad = 0,2 \times 21,33$ (1)

$= 4,3$? (1)

Thus / *Dus* $Z^{coil}_{spoel} = \sqrt{R^2 + X_L{}^2}$ (1) and / *en* $X_L = 2p\text{fL}$ (1)

$X_L = \sqrt{2^2 + -R^2}$ $\qquad L = \frac{X_L}{2pf}$ (1)

$= \sqrt{21,33^2 - 4,3^2}$ (1) $\qquad = \frac{20,9}{2p \times 50}$ (1)

$= 20,9$? (1) $\qquad = 0,066 \text{ H}$

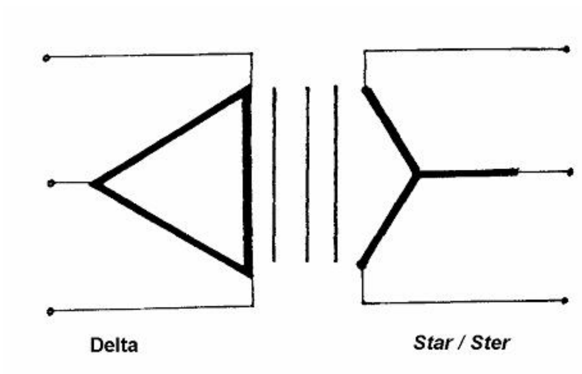
$= 66 \text{ mH}$ (1)

[31]

QUESTION / *VRAAG* 4

4.1

4.1.1 Diagram to show connection of transformers
Diagram om die koppeling van transformators te toon



(4)

4.1.2 Number of primary turns / *Getal primêre windings*

$V_{pL} = V_{pf}$

$= 3\ 000 \text{ V}$ (1)

$N_p = \frac{V_{pf}}{\text{Volt / turns / } windings}$ (1)

$= \frac{3\ 000}{4}$ (1)

= 750 turns / *windings* (1)

4.1.3 Number of secondary turns / *Getal sekondêre windings*

$$V_{sf} = \frac{V_{SL}}{\sqrt{3}} \quad (1)$$

$$= \frac{415}{\sqrt{3}} \quad (1)$$

$$= 239{,}6\ V$$

$$N_S = \frac{V_{sf}}{\text{Volt / turn / } \textit{winding}} \quad (1)$$

$$= \frac{239{,}6}{4} \quad (1)$$

$$= 59{,}9 \text{ turn / windings} \quad (1)$$

4.1.4 Current values in circuit / *Stroomwaardes in kring*

$$P = \sqrt{3}\ V_{SL}\ I_{SL}\ \text{Cos}Ø \quad (1)$$

$$I_{SL} = \frac{P}{\sqrt{3}\ V_{SL}\ CosØ} \quad (1)$$

$$= \frac{150\ 000}{\sqrt{3}(415)(0{,}8)} \quad (1)$$

$$= 260{,}85\ A \quad (1)$$

$$I_{SL} = I_{SF}$$

$$I_{SF} = 260{,}85\ A \quad (1)$$

$$\frac{I_{pf}}{I_{sf}} = \frac{N_2}{N_1} \quad (1)$$

$$I_{pf} = \frac{N_2 \times I_{sf}}{N_1} \quad (1)$$

$$= \frac{59{,}9 \times 260{,}85}{750} \quad (1)$$

$$= 20{,}84\ A \quad (1)$$

$$I_{PL} = \sqrt{3}\ I_{pf} \quad (1)$$

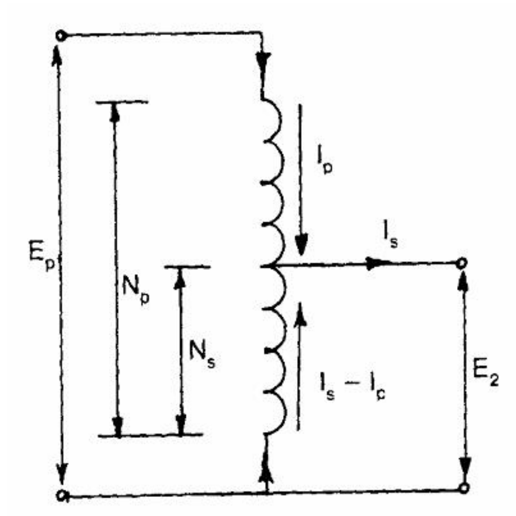
$$= \sqrt{3}(20{,}84) \quad (1)$$

$$= 36{,}08\ A \quad (1)$$

4.2
4.2.1 Disadvantage of autotransformer / *Nadeel van outotransformator*

Both the terminals of the secondary winding have dangerously high voltages to earth.
Albei die terminale van die sekondêre wikkeling besit gevaarlik hoë spannings na grond. (2)

4.2.2 Diagrammatic representation of transformer
Diagrammatiese voorstelling van transformator



(5)

4.2.3 Position of tap on winding where 20 volts are obtained
Posisie van tappunt op wikkeling waar 20 volt verkry word

$$\frac{N_P}{N_S} = \frac{V_P}{V_S}$$ (1)

$$N_S = \frac{V_S \times N_P}{V_P}$$ (1)

$$= \frac{20 \times 600}{220}$$ (1)

$= 54{,}55$ windings (1)

[36]

QUESTION / *VRAAG* 5

5.1
5.1.1 Rotor speed / *Rotorspoed*

Rotor speed is the speed at which the rotor of an electric motor turns.
Rotorspoed is die spoed waarteen die rotor van ? elektriese motor draai. (2)

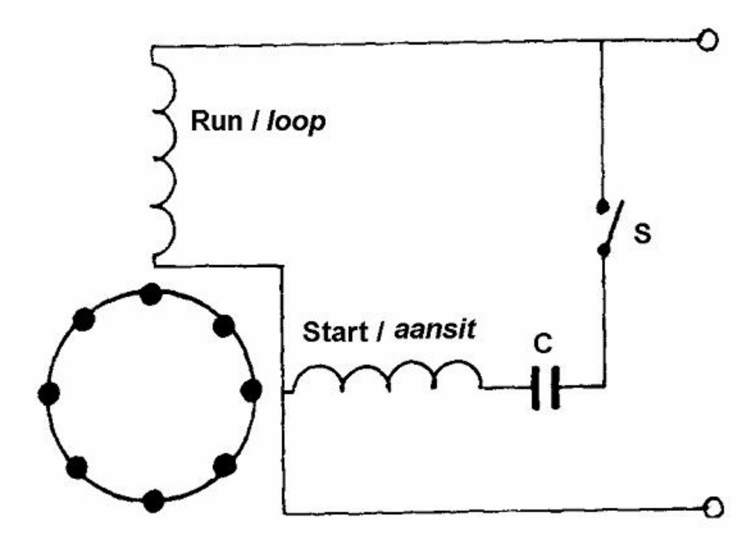
5.1.2 Synchronous speed / *Sinchrone spoed*

$$N_S = \frac{f \times 60}{P}$$ (1)

$$= \frac{50 \times 60}{2}$$ (1)

$= 1\ 500$ r/min (2)

5.2 Diagram of internal corrections of capacitor start motor
Diagram van interne verbindings van ? kapasitoraansitmotor



(7)

5.3 How to change the direction of rotation of a 3-phase motor
Hoe om die draairigting van ? driefasemotor te verander

By switching the supply to two of the terminals of the three-phase motor.
Deur die toevoer na twee van die aansluiters van op die driefasemotor om te ruil. (2)

5.4

5.4.1 Supply frequence / *Toevoerfrekwensie*

$$f = \frac{1}{T}$$ (1)

$$= \frac{1}{902}$$ (1)

$= 50$ Hz (1)

5.4.2 Rotor speed / *Rotorspoed*

$$N_S = \frac{f \times 60}{P}$$

$$= \frac{50 \times 60}{2}$$ (1)

= 1 500 r/min of 25 r/sec / *sek* (1)

$$4 = \frac{N_s - N_r}{N_s} \times 100$$ (1)

$$0,04 = \frac{N_s - N_r}{N_s}$$ (1)

$$0,04 = \frac{1\,500 - N_r}{1\,500}$$ (1)

60 = 1 500 - N_r

-1 500 + 60 = -N_r

1 440 r/min = N_r (1)

Of 24 r/sek = N_r

5.5 Safety devices for motor starters in use
Veiligheidstoestelle in motoraansitters in gebruik

(a) **Zero-voltage coil:**
- Switches on automatically in case of a decrease in voltage or a similar interruption.
- Motor has to be switched on again manually.

(a) ***Nulspanningspoel:***
- *Sit outomaties aan na daling in spanning of ? soortgelyke onderbreking*
- *Motor moet weer met die hand aangeskakel word.* (3)

(b) **Overload mechanism:**
- To isolate the motor from the source by means of the starter in the case of an overload for example when it is struck by lightning.

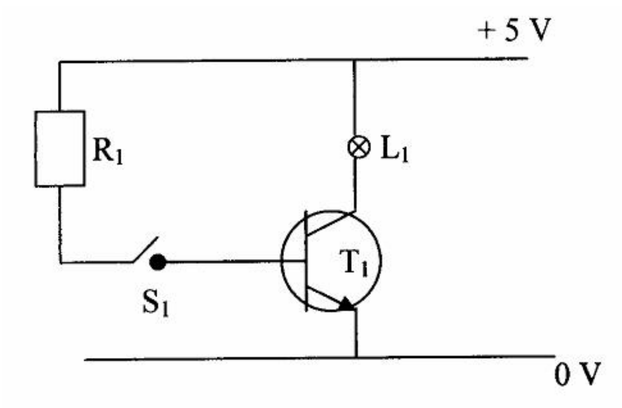
(b) ***Oorbeladingsmeganisme:***
- *Om die motor d.m.v. die aansitter van die toevoer te isoleer in die geval van ? oorbelading soos bv. as dit deur die weerlig raakgeslaan word.* (3)

[30]

QUESTION / *VRAAG* 6

6.1 How to use a transistor as a switch
Hoe ? transistor as ? skakelaar gebruik kan word

Circuit diagram / *Kringdiagram*



Description / *Beskrywing*

- S_1 must be closed before L_1 will light up.
- A reverse bias of at least 0,7 volt should be present between the base and the emitter.
- There should also be a supply voltage of ± 5 V between the base and the collector junction level (forward bias)

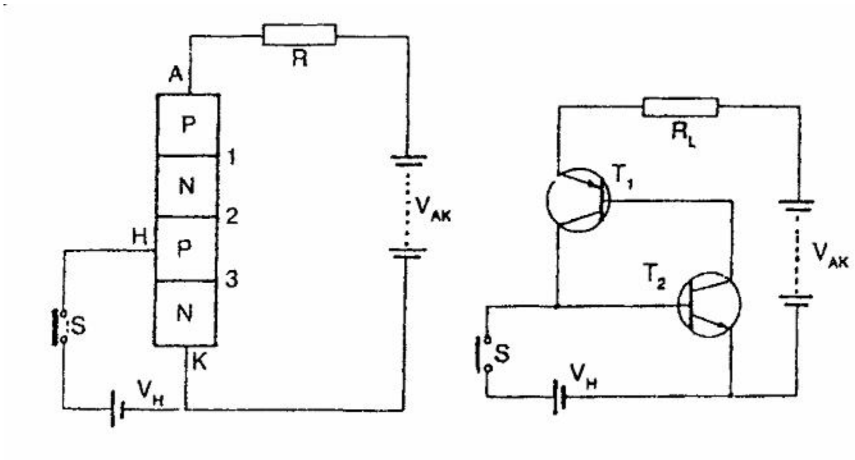
(4 marks sketch, 3 marks + description)

- *S_1 moet gesluit word voordat L_1 sal brand.*
- *Daar moet ? meevoorspanning tussen die basis en emitter wees van ten minste 0,7 volt.*
- *Daar moet ook ? toevoerspanning van ± 5 V tussen die basis en kollektor-voegvlak wees (teenvoorspanni ng).*

(4 punte skets; 3 punte beskrywing) (7)

6.2 Operation of a silicon controlled rectifier
Werking van ? beheerde silikongelykrigter

Sketch / *Skets*



Description / *Beskrywing*

- Conditions for switching

  (1) Anode should be positive i.r.o. cathode
  (2) Positive pulse must be placed on gate

- *Voorwaardes vir aanskakeling*

  (1) Anode moet positief wees m.b.t. katode
  (2) Positiewe puls moet op die hek geplaas word

- Conclusions

  (1) T_2 can only switch on if a positive pulse comes across the base.
  (2) Collector current from T_2 will switch on T_1.
  (3) Current would be conducted.

(4 marks sketch 3 marks description)

- *Gevolgtrekkings*

  (1) T_2 kan slegs aanskakel as ? positiewe puls op die basis kom.
  (2) Kollektorstroom van T_2 laat T_1 aanskakel.
  (3) Stroom sal gelei word. *(4 punte skets 3 punte beskrywing)* *(7)*

[14]

QUESTION / *VRAAG* 7

7.1
7.1.1 DC load-line coordinates of the amplifier / *GS-koördinate van die versterker*

$$I_C = \frac{V_{CC}}{R_L} \quad (1)$$

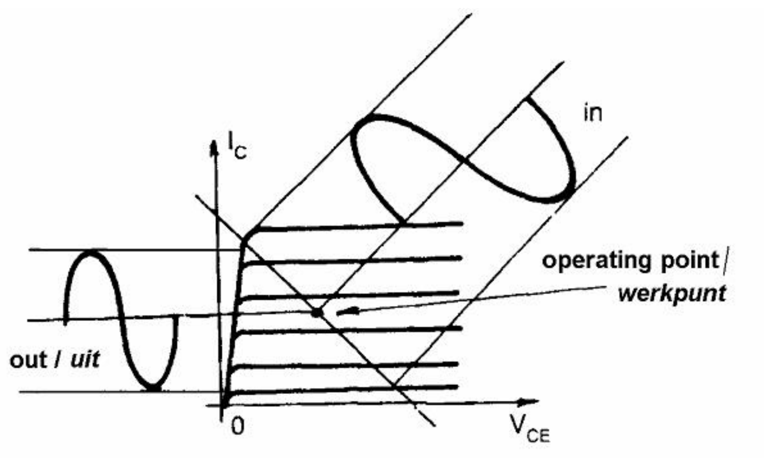
$$= \frac{12}{4\,000}$$

$$= 3 \text{ mA} \quad (1)$$

$$V_{CE} = V_{CC} \quad (1)$$

$$= 12 \text{ V} \quad (1)$$

7.1.2 Typical input and output characteristics curves for amplifier
Tipiese invoer- en afvoerkenkrommes van versterker



(6)

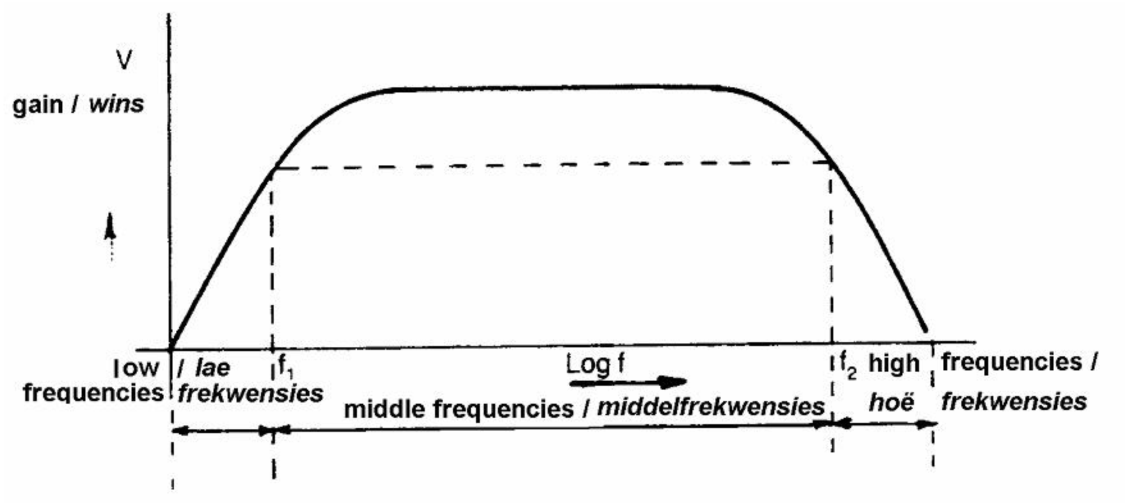
7.2
7.2.1 Purpose of T_1 /
Doel van T_1

NPN bipolar transistor – Level 1 amplification
NPN-bipolêre transistor – versterking van trap 1 (1)

7.2.2 Method to connect amplification steps / *Metode om versterkingtrappe te koppel*

Resistor / Capacitor coupling / *Resistor / kapasitorkoppeling* (1)

7.2.3 Frequency-response curve / *Frekwensieweergawekromme*



(6)

7.2.4 Bias-voltage method in circuit / *Voorspanningsmetode in kring*

Voltage divider forward-bias / *Spanningsverdeler-voorspanning* (1)

7.2.5 Transistor configuration / *Transistorkonfigurasie*

Common emitter amplification coupled in cascade.
Gemeenskaplike emmiterversterking gekoppel in kaskade. (1)

7.3 Power loss / *Drywingsverlies*

$$N = 10 \log \frac{P_2}{P_1}$$ (1)

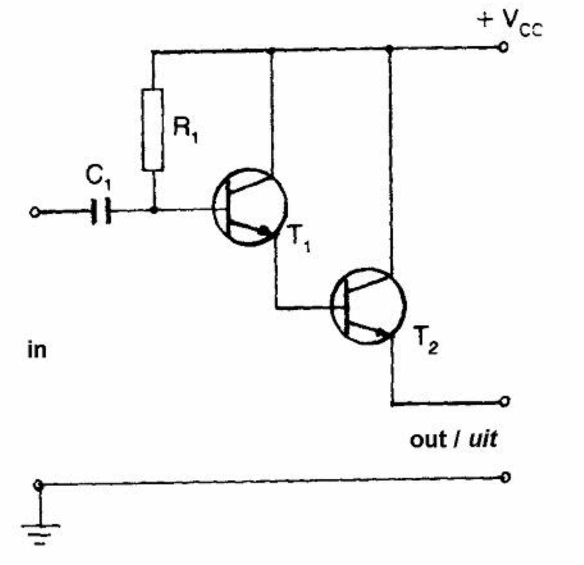
$$= 10 \log \frac{50 \times 10^{-3}}{100 \times 10^{-3}}$$ (1) (1)

$$= 3 \text{ dB}$$ (1)

7.4 Positive feedback / *Positiewe terugvoering*

Part of the output is coupled back to the t input, the feedback signal is in phase with the input signal, therefore the input signal will be amplified.
? Deel van die afvoer word teruggekoppel na die t-invoer, die terugvoersein is in fase met die invoersein, dus sal die invoersein versterk word. (2)

7.5 Diagram of Darlington amplifier with NPN transistors
Diagram van Darlington-versterker met NPN-transistors



(5)
[31]

QUESTION / *VRAAG* 8

8.1 Regulated power supply / *Gereguleerde kragbron*

A power source of which the output voltage remains constant, even if the value of the load resistance or supply voltage may differ.
? Kragbron waarvan die afvoerspanning konstant bly, selfs al varieer die waarde van die lasweerstand of toevoerspanning. (3)

8.2
8.2.1 Circuit in Figure 8.1 / *Kring in Figuur 8.1*

Shunt regulator / *Sjuntreguleerder* (1)

8.2.2 How the circuit will compensate for a reduction in R_L.
Hoe die kring sal kompenseer vir ? laer weerstand in R_L.

* Current through D_2 decreases because of an increase in internal resistance
  Stroom deur D_2 neem af a.g.v. toename in interne weerstand. (2)

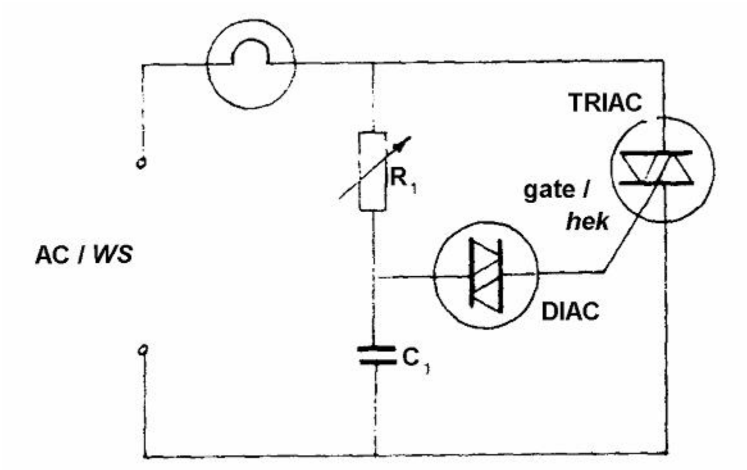
* Voltage decreases over R_2 and causes the V_{BE} to decrease accordingly.
  Spanning oor R_2 neem af en veroorsaak dat V_{BE} dienooreenkomstig afneem. (3)

* I_B decreases with a resulting decrease in V_{R1}.
  I_B neem af met ? gevolglike afname in V_{R1}. (3)

* V_{out} tends to maintain the original output voltage.
  V_{uit} neig om oorspronklike uitsetspanning te handhaaf. (2)

8.3 How to obtain full-wave lamp dimming in an AC circuit
Hoe volgolflampdemping in ? WS-kring verkry kan word

Circuit diagram / *Kringdiagram*



Description / *Beskrywing*

- If the supply voltage for example increases, C_1 would load through R, whereby V_r will let through the break-through voltage of the diac current and switch on the triac. The lamp burns for the rest of the half cycle.
  As toevoerspanning bv. positief sou toeneem, laai C_1 deur R, waardeur V_r die deurbreekspanning van diak-stroom deurlaat en die triak aanskakel. Die lamp brand vir die res van die halfsiklus.
- In the other half cycle, exactly the same takes place, except that C loads in the other direction.
  In die ander halfsiklus gebeur presies dieselfde, behalwe dat C in die ander rigting laai.
- By adjusting the value of R_1, the intensity of the lamp can be changed.
  Deur die waarde van R_1 te verstel kan die intensiteit van die lamp verander word.

(6 marks sketch 4 marks description) / *(6 punte skets 4 punte beskrywing)* (10)

[24]

QUESTION / *VRAAG* 9

9.1

9.1.1 Circuit in Figure 9.1 / *Kring in Figuur 9.1*.

Tuned-collector oscillator / *Ingestemdekollektor-ossillator* (1)

9.1.2 Components determining the frequency / *Komponente wat frekwensie bepaal*

C_1 and / *en* L_1 (2)

9.1.3 Component responsible for amplification
Komponent verantwoordelik vir versterking

T_1

9.1.4 Principle of operation step by step / *Werksbeginsel stapsgewys*

- As soon as the supply is switched on, R_1 and R_2 provide the necessary forward bias to allow T_1 to switch on.
  Wanneer die toevoer aangeskakel word, verskaf R_1 en R_2 die nodige voorspanning sodat T_1 aanskakel.
- The collector current flows through L_1 and induces an emf in L_2.
  Die kollektorstroom vloei deur L_1 en induseer ? emk in L_2.
- The induced emf supports the V_{BE} so that the transistor switches on harder.
  Die geïnduseerde emk ondersteun die V_{BE} sodat die transistor sterker aanskakel.
- This increases the collector current that once again increases the emf and the V_{BE}.
  Dit verhoog die kollektorstroom wat weer eens die geïnduseerde emk en V_{BE} verhoog.
- Once T_1 is saturated, I_C does not increase further and the EMF in L_2 is no longer induced.
  Sodra T_1 versadig is, verhoog I_C nie verder nie en die emk in L_2 word nie meer geïnduseer nie.
- V_{BE} decreases and the collector current therefore unloads through L_1.
  V_{BE} neem af en die kollektorstroom neem gevolglik af en C_1 ontlaai deur L_1.
- The magnetic field in L_1 decreases which induces an emf in L_2 in the other direction.
  Die magneetveld in L_1 neem af wat ? emk in die ander rigting in L_2 induseer.
- V_{BE} decreases further which causes I_C to decrease and subsequently lowering the V_{BE} even fruther.
  V_{BE} neem verder af wat I_C laat afneem en gevolglik V_{BE} verder verlaag.
- As soon as the transistor switches off because of the lowering in V_{BE}, C_1 unloads through L_1, which again induces an emf in L_2 which supports V_{BE}.
  Sodra die transistor a.g.v. die verlaging in V_{BE} afskakel, ontlaai C_1 deur L_1 wat weer ? emk in L_2 induseer wat V_{BE} ondersteun.
- The transistor switches on and the process is repeated.
  Die transistor skakel aan en die proses word herhaal. (5)

9.2 Function of the crystal in crystal-controlled Hartley oscillator
Funksie van die kristal in die kristalbeheerde Hartley-ossillator

To stabilise the output frequency. / *Om die afvoerfrekwensie te stabiliseer.* (2)

9.3

9.3.1 Positive feedback / *Positiewe terugvoering*

Occurs when the feedback signal is in phase with the input signal and thereby amplifies it.
Vind plaas wanneer die terugvoersein in fase is met die invoersein en dit dus versterk. (2)

9.3.2 Piezo electricity / *Piëso-elektrisiteit*

When mechanical pressure is exerted on the crystal, an emf would be developed across the opposite sides of the crystal.
Wanneer meganiese druk op die kristal uitgeoefen word, sal daar ? emk oor die teenoorgestelde sye van die kristal ontwikkel word. (2)

[15]

QUESTION / *VRAAG* 10

10.1

10.1.1 Figure 10.1 / *Figuur 10.1*

A-stable / a-*stabiele* multivibrator / *multivibrator* (1)

10.1.2 Function of R_1 / *Funksie van* R_1

Supplies the reference voltage / *Verskaf die verwysingspanning* (1)

10.1.3 Function of R_2 / *Funksie van* R_2

Supplies the positive feedback / *Verskaf die positiewe terugvoer* (1)

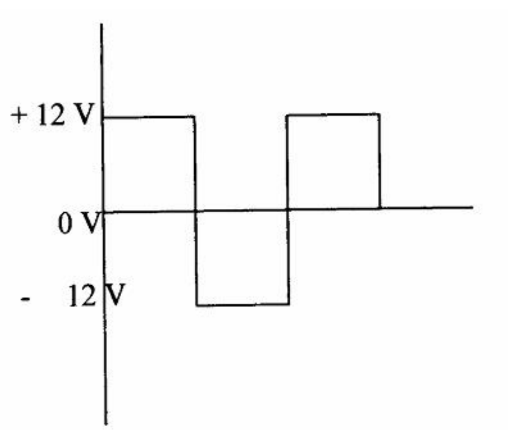
10.1.4 Function of R_f / *Funksie van* R_f

Feedback resistor through which **C** discharges
Terugvoerresistor waardeur ***C*** *ontlaai* (2)

10.1.5 Function of C / *Funksie van* ***C***

The charge rate of **C** determines how long the output will remain in a saturated or in a negatively saturated condition.
Die laaitempo van ***C*** *bepaal hoe lank die uitset in ? positiewe versadigingstoestand of in ? negatiewe versadigingstoestand sal verkeer.* (2)

10.1.6 Output waveform / *Afvoergolfvorm*



(4)

10.2 Characteristics of an operational amplifier
Kenmerke van ? operasionele versterker

- Voltage gain
  Spanningswins
- Input impedance of an op amp is infinitely large
  Invoerimpedansie van ? operasionele versterker oneindig groot
- Output impedance is zero
  Afvoerimpedansie is nul
- It amplifies signals with an infinitely high frequency without any drop in gain
  Dit versterk seine met ? oneindig hoë frekwensie sonder ? afname in wins
- Input balance voltage
  Invoerbalansspanning

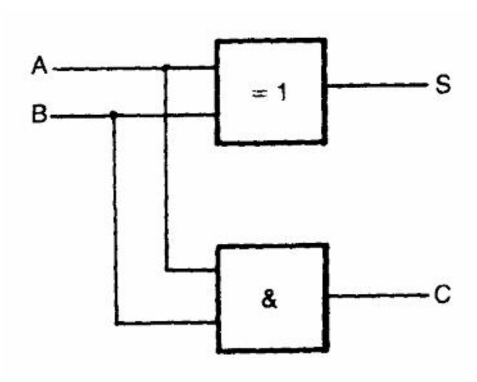
(Any two) / *(Enige twee)* (2)
[13]

QUESTION / *VRAAG* 11

11.1 Boolean expression for an exclusive OF-gate
Boole-uitdrukking vir ? eksklusiewe OF-hek

X = A ⊗ B (2)

11.2 Draw the logic diagram of a half adder (with two gates)
Teken die logikadiagram van ? halfopteller (met 2 hekke)



(4)

and give the truth table / *en gee die waarheidstabel*.

A	B	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

(4)

11.3

11.3.1 Draw up the truth table for the circuit / *Waarheidstabel vir die kring*

A	B	C	X
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

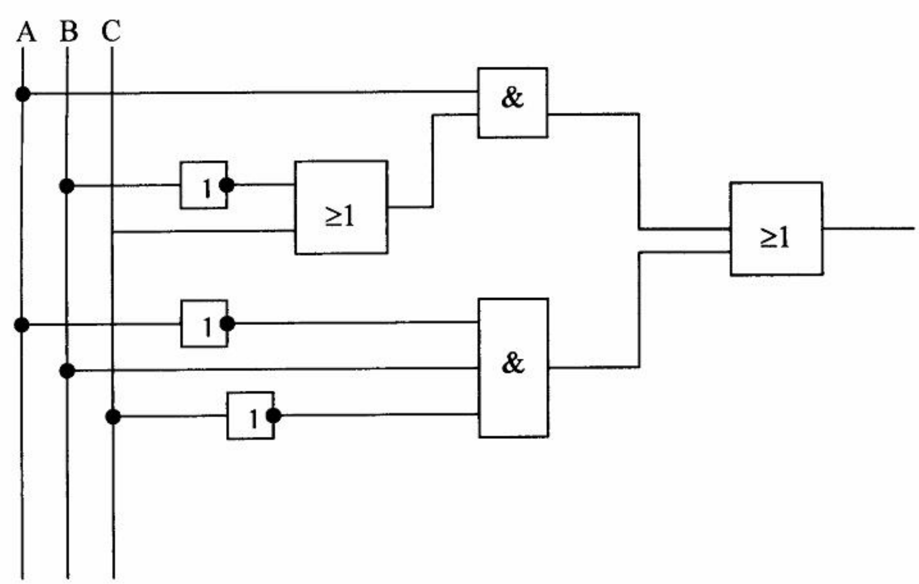
(8)

11.3.2 Simplify the Boolean expression from the truth table
Vereenvoudig die Boole-uitdrukking uit die waarheidstabel

$$(ABC + ABC) + (ABC + ABC) + ABC$$
$$= AB(C + C) + AC(B + B) + ABC$$
$$= AB + AC + ABC$$
$$= A(B + C) + ABC$$

(7)

11.3.3 Logic circuit of the expression
Logikastroombaan vir vereenvoudigde Boole-uitdrukking



(4)

[29]

QUESTION / *VRAAG* 12

12.1

12.1.1 Figure 12.1 / *Figuur 12.1*

Digital capacitance meter / *Digitale kapasitansiemeter* (1)

12.1.2 Function of a wave converter / *Funksie van golfomsetter*

Changes sinus waves to square waves
Omvorm sinusgolwe na vierkantgolwe (2)

12.1.3 Function of a quarts oscillator / *Funksie van ? kwartsossillator*

In the internal pulse generator, the quarts oscillator generates a very stable sinus wave.
In die interne pulsgenerator word ? sinusgolf met ? uiters stabiele frekwensie deur die kwartsossillator opgewek. (2)

[5]

TOTAL / *TOTAAL*: 300