higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N3

29 JULY 2019

This marking guideline consists of 7 pages.

SECTION A

QUESTION 1

1.1	1.1.1	False
	1.1.2	True
	1.1.3	False
	1.1.4	False
	1.1.5	True
	1.1.6	False
	1.1.7	True
	1.1.8	True
	1.1.9	True
	1.1.10	False

(10 × 1) (10)

1.2	1.2.1	I
	1.2.2	G
	1.2.3	J
	1.2.4	H
	1.2.5	C
	1.2.6	A
	1.2.7	D
	1.2.8	F
	1.2.9	E
	1.2.10	B

(10 × 1) (10)
[20]

TOTAL SECTION A: 20

SECTION B

QUESTION 2

Minimise the currents in the circuit: $I_3 = (I_1 – I_2)$

Loop ABDFA

$10 = 5I_1 + 6I_2$ ..... (1) ✓

Loop ACEFA

$10 = 4(I_1 – I_2) + 5I_1$

$10 = 4I_1 – 4I_2 + 5I_1$

$10 = 9I_1 – 4I_2$ ..... (2) ✓

(1) × 2: $20 = 10I_1 + 12I_2$ ..... (3) ✓

(2) × 3: $30 = 27I_1 - 12I_2$ ..... (4) ✓

(3) + (4) : $50 = 37I_1$

$I_1 = 1,351$ A ✓✓

For I_2, substitute $I_1 = 1,351$ A into..... (1)

$10 = 5(1,351) + 6I_2$

$\frac{3,245}{6} = I_2$

$I_2 = 0,5$ A ✓✓

AND: $I_3 = (I_1 – I_2)$

$= 1,351 – 0,541$

$I_3 = 0,81$ A ✓✓

$V_{R1} = I_3 \times R_1$

$= 0,81 \times 4$

$V_{R1} = 3,24$ V ✓✓

$P_{R1} = (I_3)^2 \times R_1$

$= (0,81)^2.4$

$P_{R1} = 2,624$ W ✓✓

[14]

QUESTION 3

3.1 3.1.1

$Z_{RL} = \sqrt{R^2 + X_L^2}$ therefore: $I_{RL} = \frac{V}{ZRL}$

$= \sqrt{5^2 + 80^2}$ $= \frac{240}{80,156}$ ✓

$Z_{RL} = 80,156\ \Omega$ ✓ $I_{RL} = 2,994\ A$ ✓ (3)

3.1.2 $I_C = \frac{V}{ZC}$

$= \frac{240}{60}$ ✓

$I_C = 4\ A$ ✓ (2)

3.1.3 $\theta = \tan^{-1} \frac{XL}{R}$

$= \tan^{-1} \frac{80}{5}$ ✓

$\theta = 86,424^\circ$ ✓ (2)

3.2 3.2.1 $X_L = 2\pi fL$ **AND:** $X_C = \frac{1}{2\pi fC}$

$L = \frac{XL}{2\pi f}$ $C = \frac{1}{2\pi \times 80 \times 60}$

$L = \frac{80}{2\pi \times 80}$ $C = 33,153\ \mu F$ ✓

$L = 159,134\ mH$ ✓ **THEREFORE:** $Z_d = \frac{L}{RC}$

$= \frac{159,134 \times 10^{-3}}{5 \times 33,153 \times 10^{-6}}$ ✓

$Z_d = 959,998\ \Omega$ ✓ (4)

3.2.2 $I_T = \frac{VT}{Zd}$

$= \frac{240}{959,998}$ ✓

$I_T = 0,25\ A$ ✓ (2)

3.2.3 I_C (at resonance) = I_{RL} Sin θ_L

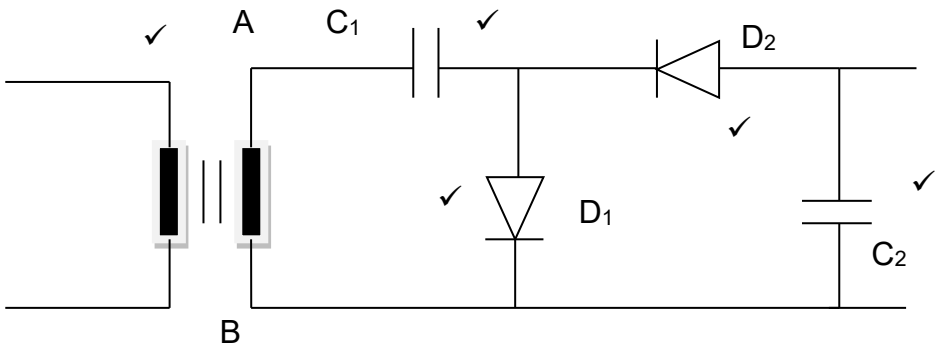
= 2,994 Sin 86,424✓

$I_{C(Res)} = 2,988\ A$✓ (2)

[15]

QUESTION 4

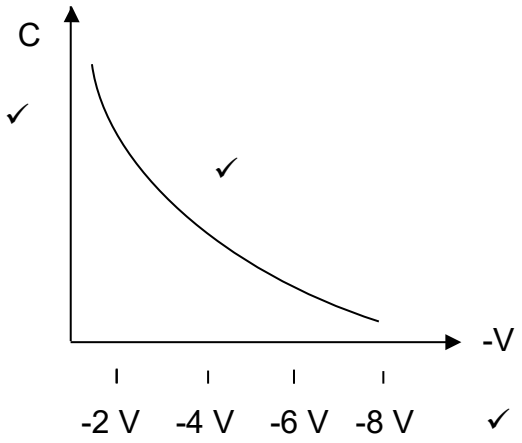
4.1



(5)

4.2
- During the positive half cycle of the input signal, point A is positive
- and diode D1 is forward biased
- and conducts charging up capacitor C1 to its maximum value. (3)

4.3

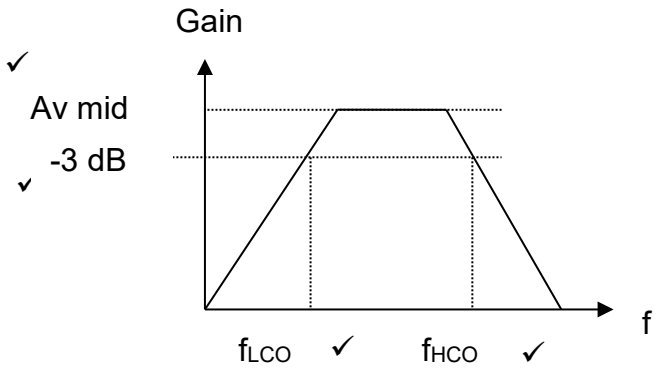


(3)
[11]

QUESTION 5

5.1
- No wear and tear on switch gears caused by arcing
- Much faster switching times
- Control over long distance
- Small base-emitter current can switch the transistor on and off (4)

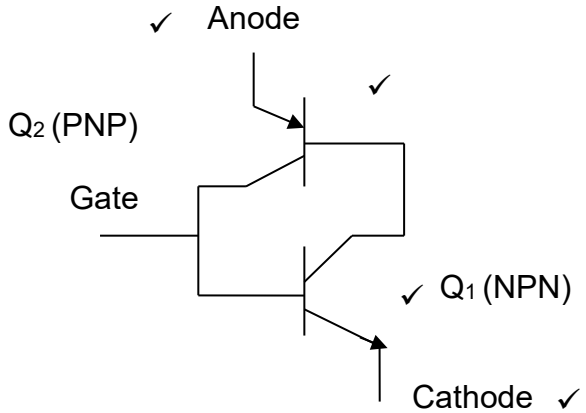
5.2



(4)
[8]

QUESTION 6

6.1



(4)

6.2
- When a positive signal is applied to the gate terminal, the NPN transistor Q_1 is forward biased
- and conducts, producing a collector current.
- This collector current forward biases the base-emitter of the PNP transistor Q_2 which produces the collector current on Q_2
- and this current becomes the base current to transistor Q_1. (4)

6.3
- Low 'On' resistance
- High 'Off' resistance
- Rapid switching
- Low-control power
- Long life (Any 3 × 1) (3)

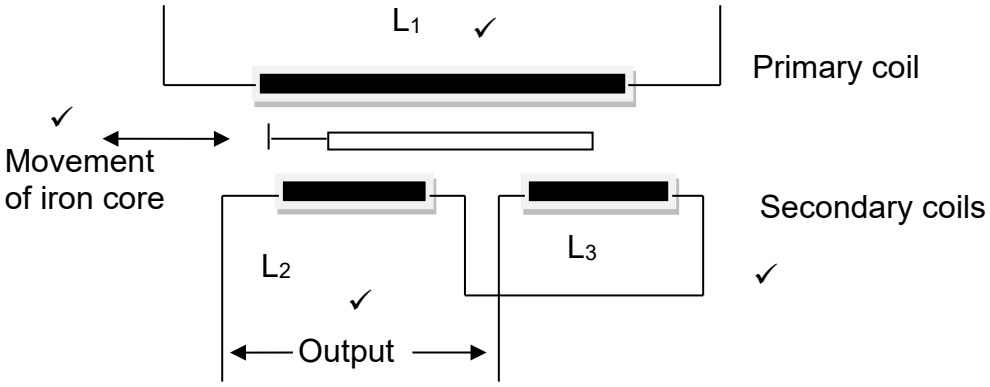
[11]

QUESTION 7

7.1 7.1.1 False
7.1.2 False
7.1.3 True

(3 × 1) (3)

7.2



(4)

7.3
- An external pressure applied to the core unbalances the voltages between the secondary coils.
- The size of the difference is the magnitude of the force and its direction. (4)

[11]

QUESTION 8

8.1
a. Attenuator
b. Vertical amplifier
c. Delay line
d. Trigger circuit
e. Time-base generator
f. Horizontal amplifier
g. CRT
h. Low voltage
i. High voltage (9)

8.2 It sets the gain of the vertical amplifier with the calibrated input volts/div. (1)

[10]

TOTAL SECTION B: 80
GRAND TOTAL: 100