



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N3

16 November 2022

This marking guideline consists of 10 pages.

SECTION A**QUESTION 1**

1.1	1.1.1	D		
	1.1.2	B		
	1.1.3	A		
	1.1.4	C		
	1.1.5	C	(5 × 1)	(5)
1.2	1.2.1	False		
	1.2.2	True		
	1.2.3	True		
	1.2.4	True		
	1.2.5	False	(5 × 1)	(5)
1.3	1.3.1	closed loop		
	1.3.2	accuracy		
	1.3.3	forced commutation		
	1.3.4	photosensitive cells		
	1.3.5	common base amplifier	(5 × 1)	(5)
1.4	1.4.1	A		
	1.4.2	I		
	1.4.3	D		
	1.4.4	C		
	1.4.5	B	(5 × 1)	(5)
				[20]

TOTAL SECTION A: 20

SECTION B**QUESTION 2: DC THEORY AND AC THEORY**

2.1 In loop EFAB:

$$\begin{aligned}
 V_T &= V_{R1} + V_{R2} + V_{R3} \\
 12 &= 750I_1 + 300I_1 + 800(I_1 + I_2) \\
 12 &= 1\,050I_1 + 800I_1 + 800I_2 \\
 12 &= 1\,850I_1 + 800I_2 \text{--- (1)}
 \end{aligned}$$

In loop EDCB:

$$\begin{aligned}
 V_T &= V_{R5} + V_{R4} + V_{R3} \\
 12 &= 250I_2 + 350I_2 + 800(I_1 + I_2) \\
 12 &= 600I_2 + 800I_1 + 800I_2 \\
 12 &= 800I_1 + 1\,400I_2 \text{--- (2)}
 \end{aligned}$$

$$(1) \times 7 \Rightarrow 84 = 12\,950I_1 + 5\,600I_2 \text{--- (3)}$$

$$(1) \times 4 \Rightarrow 48 = 3\,200I_1 + 5\,600I_2 \text{--- (4)}$$

$$\begin{aligned}
 (3) - (4) \quad 36 &= 9\,750I_1 \\
 I_1 &= 3,692 \text{ mA}
 \end{aligned}$$

Replace I_1 in (1):

$$\begin{aligned}
 12 &= 1\,850(3,692 \times 10^{-3}) + 800I_2 \\
 12 &= 6,830 + 800I_2 \\
 5,1698 &= 800I_2 \\
 I_2 &= 6,462 \text{ mA}
 \end{aligned}$$

(9)

2.2 2.2.1 $X_C = X_L$

$$X_C = \frac{1}{2\pi fC}$$

$$X_C = \frac{1}{2\pi(4\,000)(5 \times 10^{-6})}$$

$$\underline{X_C = 7,958 \, \Omega} \quad \text{OR} \quad f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$L = \frac{1}{4\pi^2 f_r^2 C}$$

$$L = \frac{1}{4\pi^2 \cdot 4\,000^2 \cdot 5 \times 10^{-6}}$$

$$\underline{L = 361,629 \, \mu\text{H}}$$

$$X_L = 2\pi fL$$

$$L = \frac{X_L}{2\pi f}$$

$$L = \frac{7,958}{2\pi(4\,000)}$$

$$\underline{L = 316,369\,\mu\text{H}}$$

(4)

2.2.2

$$I = \frac{V}{R}$$

$$I = \frac{24}{15}$$

$$\underline{I = 1,6\,\text{A}}$$

(2)

2.2.3

$$V_L = I \times X_L$$

$$V_L = 1,6 \times 7,958$$

$$\underline{V_L = 12,733\,\text{V}}$$

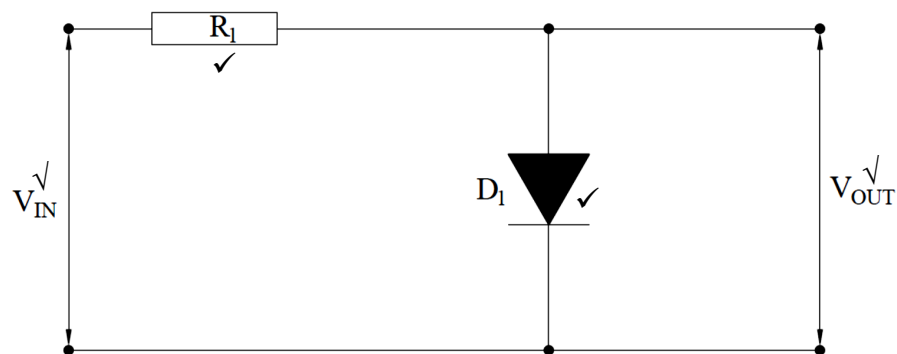
$$\underline{V_L = V_C = 12,733\,\text{V}}$$

(3)

[18]**QUESTION 3: SEMICONDUCTOR DIODES AND TRANSDUCERS**

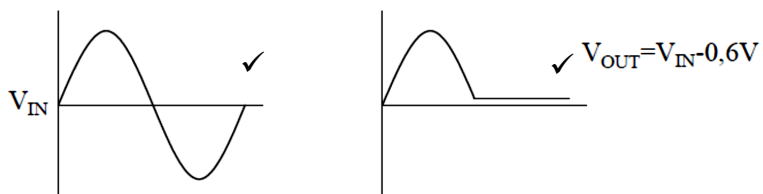
3.1

3.1.1



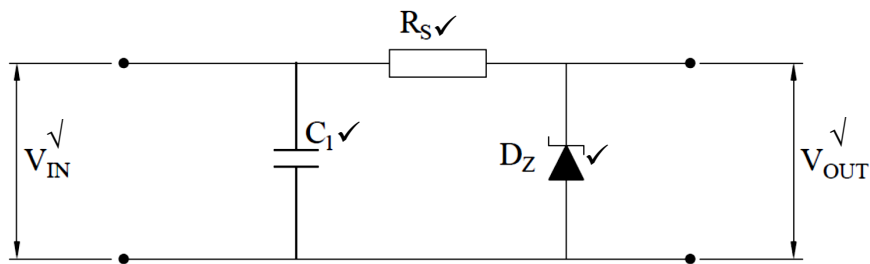
(3)

3.1.2



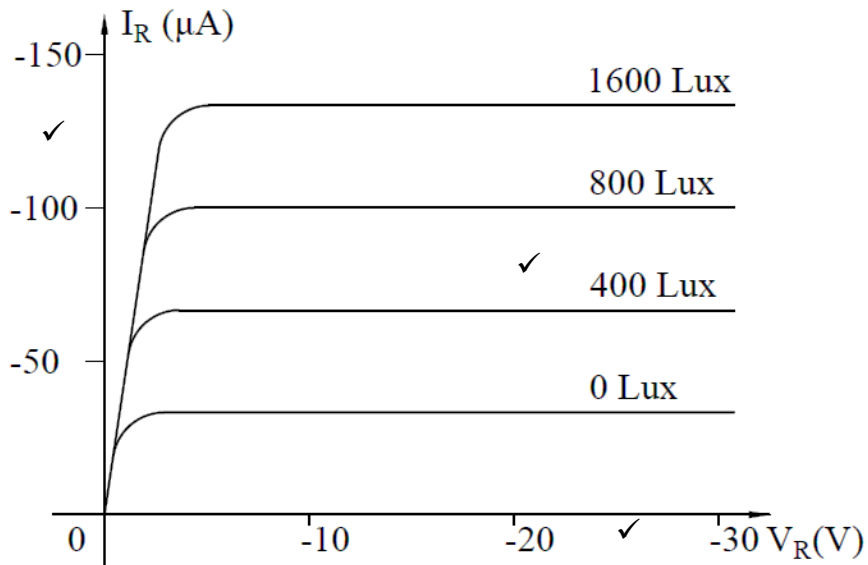
(2)

3.2



(4)

3.3



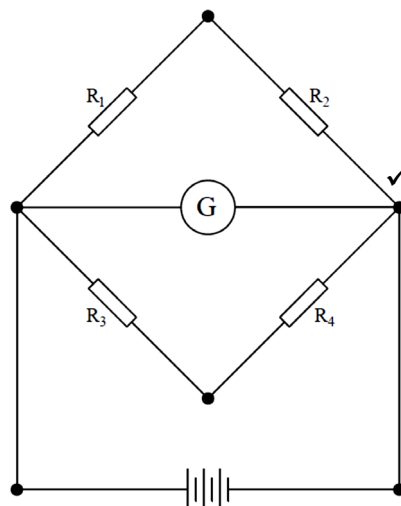
(3)

3.4

The optocoupler is a method of electrically isolating one part of a circuit from another.

(1)

3.5



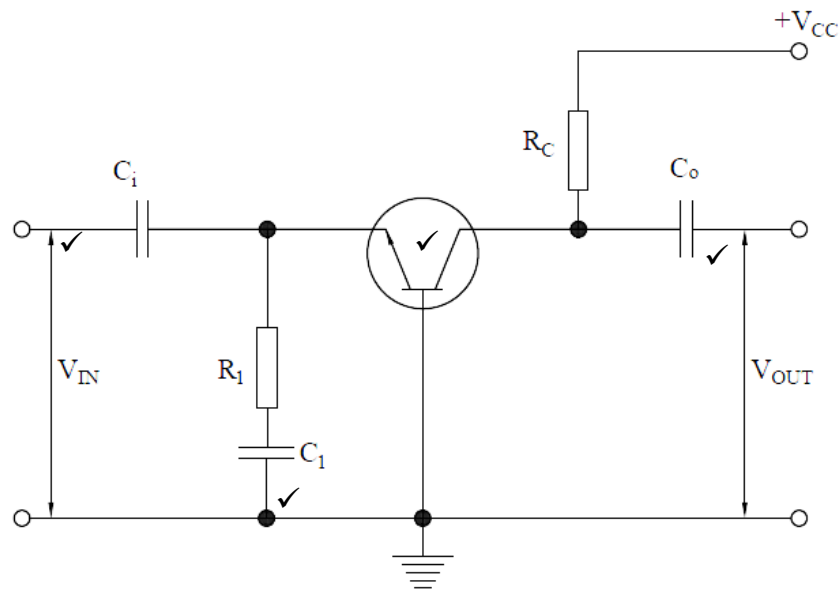
- The Wheatstone bridge consists of three known resistors and one unknown resistor connected in a series-parallel combination.
- The bridge is in balance as long as the resistor ratio is equal to each other.
- If the ratio is not equal to each other, the difference will show as a potential difference over the galvanometer.

(4)

- 3.6 3.6.1 The resistance of an electrical conductor can change with the expansion and contraction due to an external force applied. (1)
- 3.6.2 • Force/Pressure
• Displacement
• Torque (Any 2 × 1) (2)
- [20]**

QUESTION 4: SEMICONDUCTOR TRANSISTORS AND ELECTRONIC POWER CONTROL

4.1



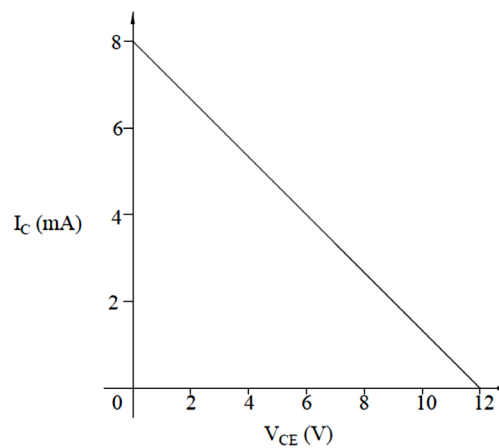
(4)

4.2

$$I_C = \frac{V_{CE}}{R_C}$$

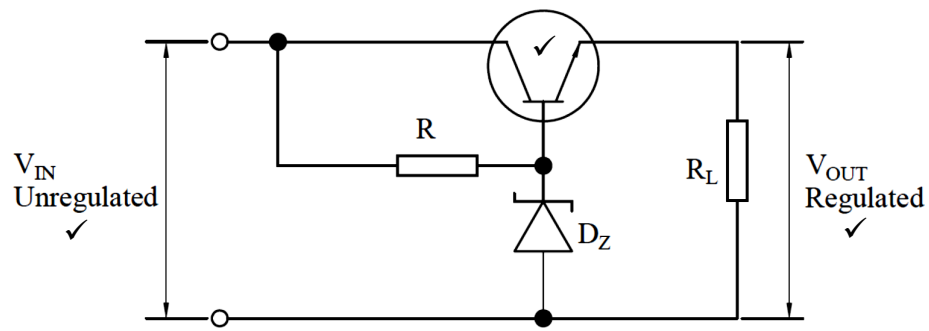
$$I_C = \frac{12}{1\,500}$$

$$\underline{I_C = 8\text{ mA}}$$



(3)

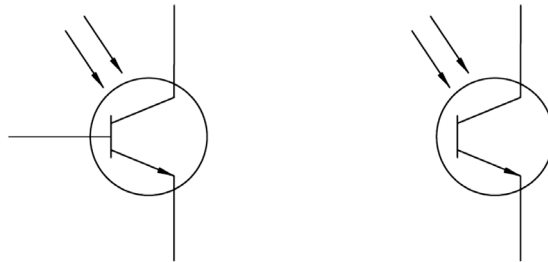
4.3



(3)

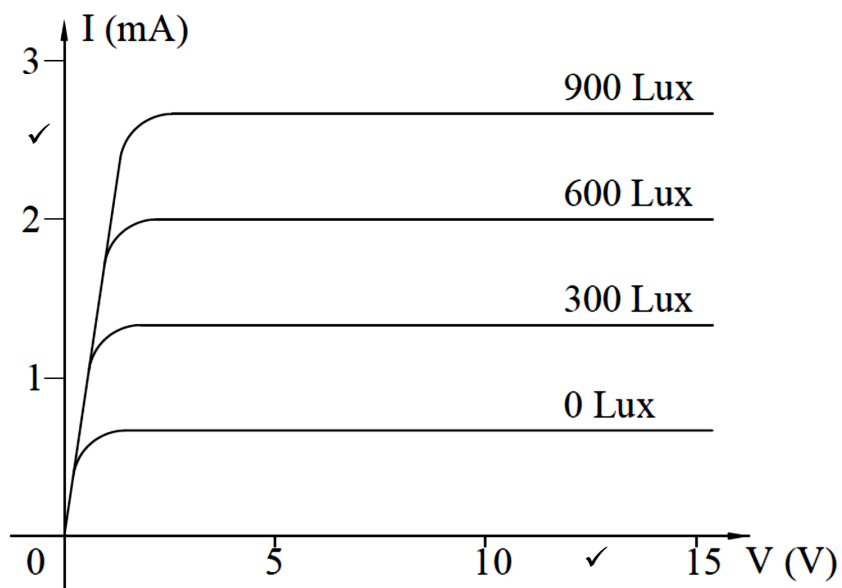
4.4

4.4.1



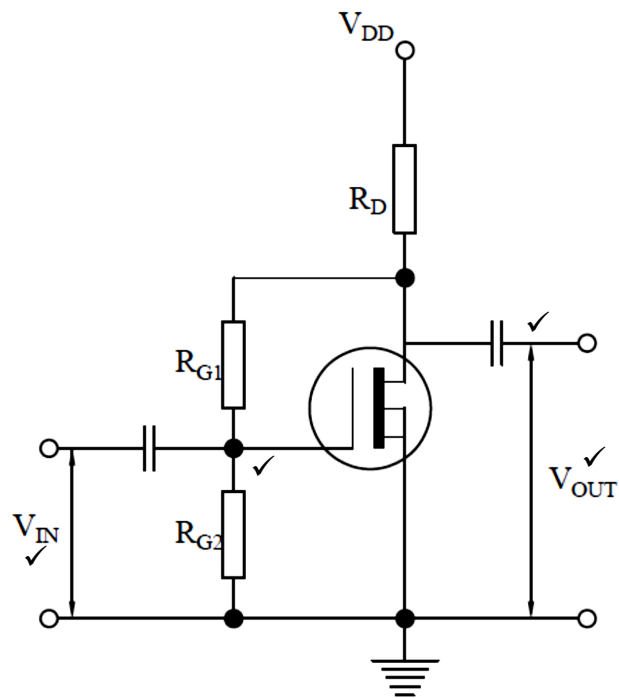
(1)

4.4.2



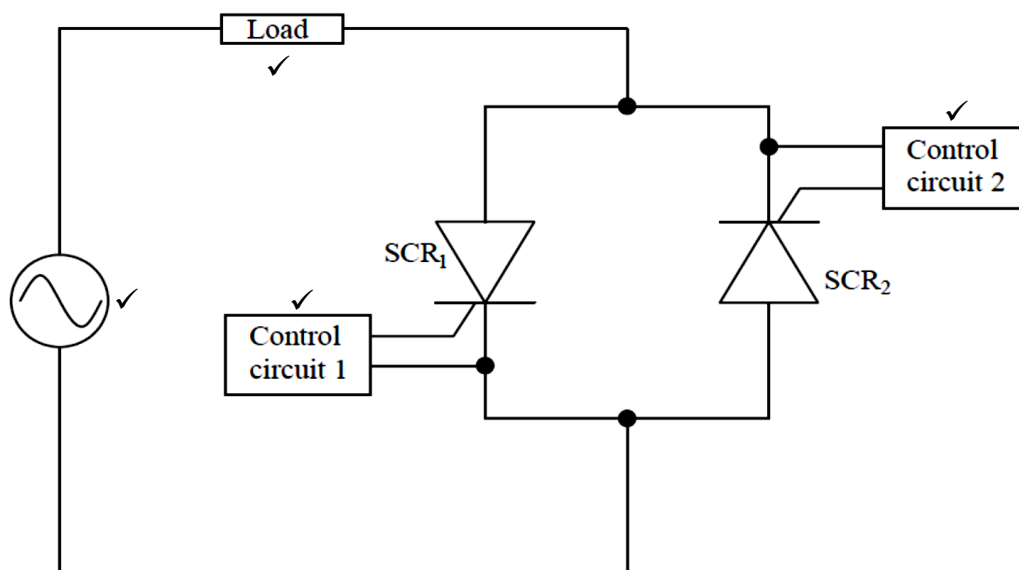
(2)

4.5



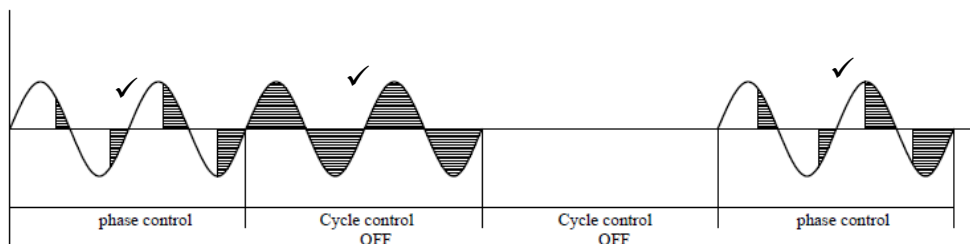
(4)

4.6



(4)

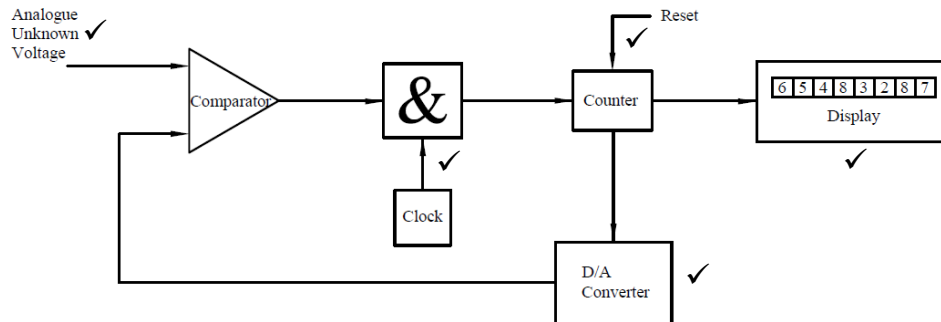
4.7



(3)
[24]

QUESTION 5: MEASURING INSTRUMENTS AND OPERATIONAL AMPLIFIERS

5.1



(5)

5.2

- When the signal from the vertical amplifier is fed to the vertical deflection plates, some part of the amplified signal is supplied to the time-based generator. This trigger pulse generated from the time-based generator is amplified with the help of the horizontal amplifier.
- After this, it is fed to horizontal deflection plates. This process requires approximately 100 ns. Thus, it is crucial to delay the signal generated by the vertical amplifier too in order to maintain synchronisation.
- The delay line is essential because there is a delay when any electronic signal passes through the electronic circuitry.

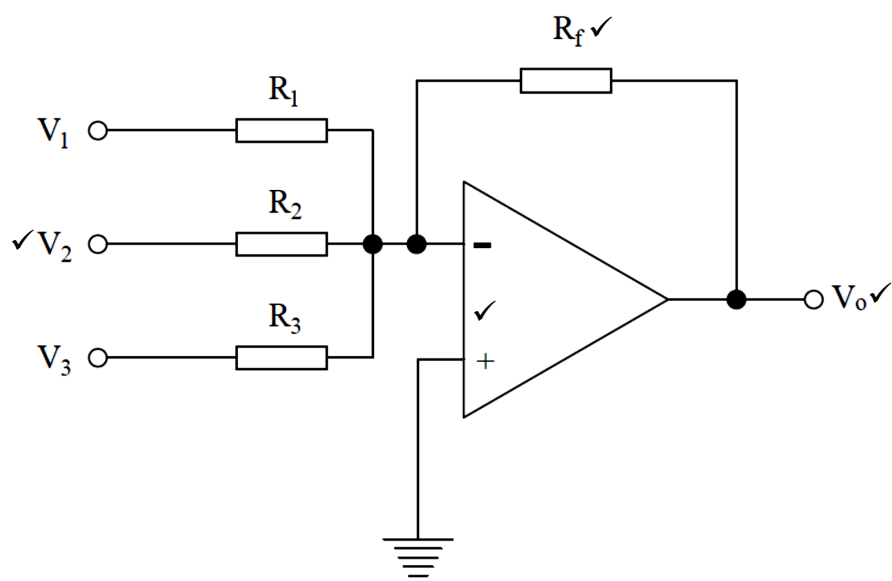
(3)

5.3

- The cathode is heated indirectly from which electrons are emitted.
- The emitted electrons further pass through a small hole present in the control grid.
- The electrons pass through the pre-accelerating anode through which the beam gets accelerated and then moves through a focusing anode that helps in focusing the electron beam.
- The highly focused beam moves towards vertical and horizontal deflection plates after which it reaches the fluorescent screen.

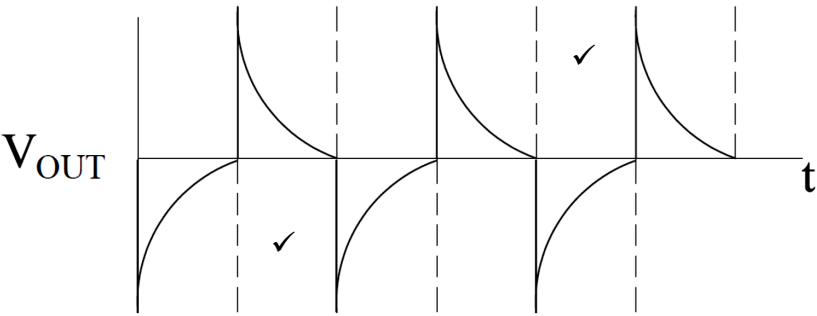
(4)

5.4 5.4.1



(4)

5.4.2



(2)
[18]

TOTAL SECTION B: 80

GRAND TOTAL: 100