



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE INDUSTRIAL ELECTRONICS N3

2 February 2022

This marking guideline consists of 12 pages.

SECTION A**QUESTION 1**

- 1.1
- 1.1.1 False
 - 1.1.2 False
 - 1.1.3 True
 - 1.1.4 False
 - 1.1.5 False
- (5 × 1) [5]
- 1.2
- 1.2.1 D
 - 1.2.2 E
 - 1.2.3 F
 - 1.2.4 A
 - 1.2.5 C
- (5 × 1) [5]
- 1.3
- 1.3.1 voltmeter
 - 1.3.2 unknown
 - 1.3.3 forward
 - 1.3.4 Zener breakdown
 - 1.3.5 minimum
- (5 × 1) [5]
- 1.4
- 1.4.1 B
 - 1.4.2 B
 - 1.4.3 A
 - 1.4.4 C
 - 1.4.5 D
- (5 × 1) [5]

TOTAL SECTION A: 20

SECTION B

QUESTION 2

2.1 $V_T = V_{R3} + V_{R1+R2} + V_{R5}$ $V_T = I_1 \cdot R_3 + I_2(R_1 + R_2) + I_1 \cdot R_5$ $12 = 20 I_1 + 25 I_2 + 33 I_1$ ✓
 $12 = 53 I_1 + 25 I_2 \dots \dots \dots (1)$ (2)

2.2 $V_T = V_{R3} + V_{R4} + V_{R5}$ $V_T = I_1 \cdot R_3 + (I_1 - I_2) R_4 + I_1 \cdot R_5$ $12 = 20 I_1 + 30(I_1 - I_2) + 33 I_1$ ✓
 $12 = 83 I_1 - 30 I_2 \dots \dots \dots (2)$ ✓ (2)

2.3 Equation 1 $\times 30$:
 $360 = 1590 I_1 + 750 I_2 \dots \dots \dots (3)$ ✓

Equation 2 $\times 25$:
 $300 = 2075 I_1 - 750 I_2 \dots \dots \dots (4)$ ✓

Equation 3 + 4:
 $360 = 1590 I_1 + 750 I_2 \dots \dots \dots (3)$ $300 = 2075 I_1 - 750 I_2 \dots \dots \dots (4)$ $660 = 3665 I_1$ ✓
 $I_1 = 0,18 A$ ✓

Replace I_1 in Equation 1:
 $12 = 53(0,18) + 25 I_1$ ✓ $12 = 9,54 + 25 I_1$ $25 I_1 = 2,46$
 $I_1 = \frac{2,46}{25}$
 $I_1 = 0,0984$ ✓

(6)
[10]

QUESTION 3

3.1
$$f_r = \frac{1}{2\pi\sqrt{LC}}$$
$$f_r = \frac{1}{2\pi\sqrt{250 \times 10^{-3} \cdot 125 \times 10^{-6}}}$$
$$\underline{f_r = 28,471 \text{ Hz}} \quad (2)$$

3.2
$$X_L = 2\pi f \cdot L \quad X_L = 2\pi \cdot 28,471 \cdot 250 \times 10^{-3} \quad \underline{X_L = 44,722 \Omega} \checkmark$$
$$I_L = \frac{V_T}{X_L}$$
$$I_L = \frac{240}{44,722}$$
$$\underline{I_L = 5,367 \text{ A}} \quad (3)$$

3.3
$$X_C = \frac{1}{2\pi f C} \quad X_C = \frac{1}{2\pi \cdot 28,471 \cdot 125 \times 10^{-6}}$$
$$\underline{X_C = 44,721 \Omega} \checkmark \quad I_C = \frac{V_T}{X_C}$$
$$I_C = \frac{240}{44,721}$$
$$\underline{I_C = 5,367 \text{ A}} \checkmark$$

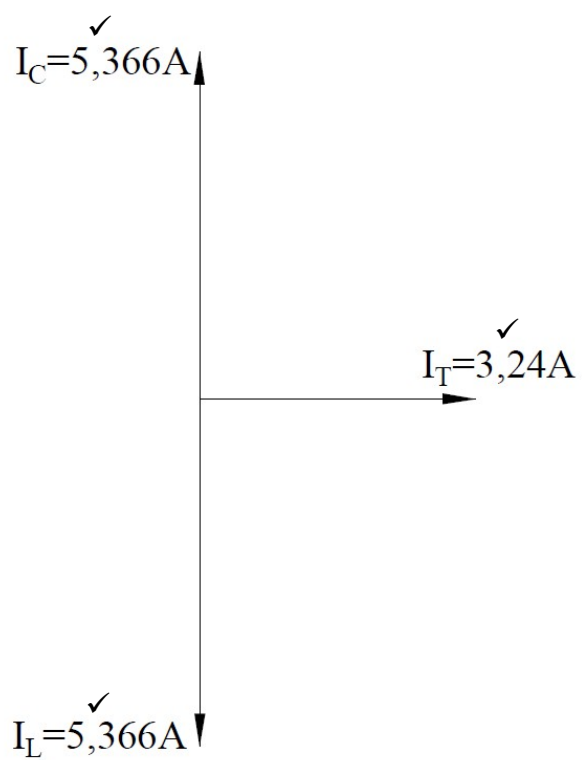
OR

$$X_L = X_C$$
$$\underline{I_L = I_C \quad I_C = 5,366 \text{ A}} \quad (2)$$

3.4
$$Z_D = \frac{L}{RC}$$
$$Z_D = \frac{250 \times 10^{-3}}{27 \cdot 125 \times 10^{-6}}$$
$$\underline{Z_D = 74,074 \Omega} \checkmark \quad I_T = \frac{V_T}{Z_D}$$
$$I_T = \frac{240}{74,074}$$
$$\underline{I_T = 3,24 \text{ A}} \checkmark$$

(3)

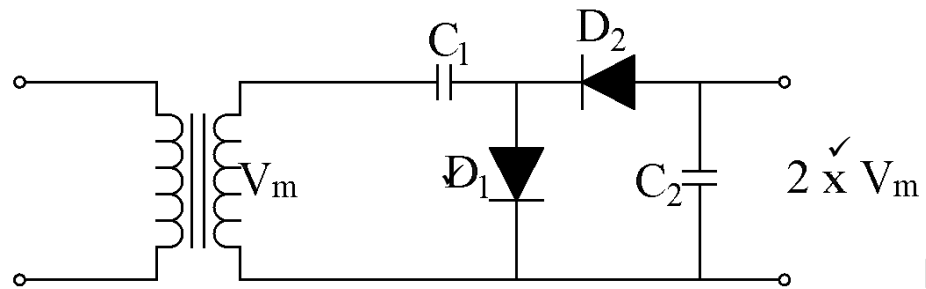
3.5



(3)
[13]

QUESTION 4

4.1



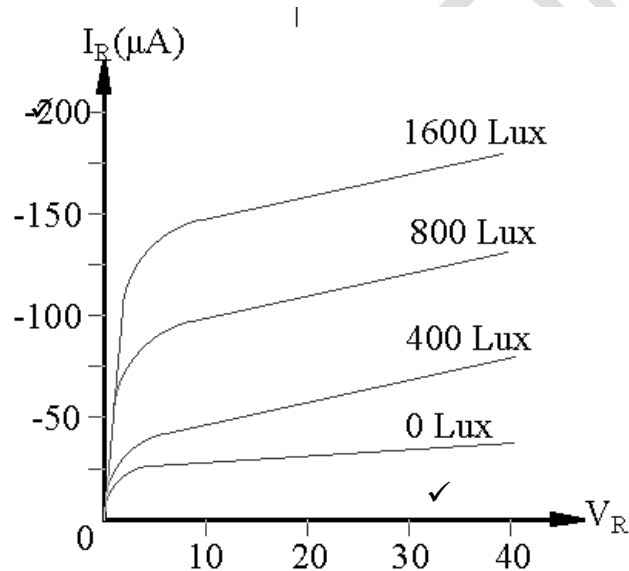
(2)

4.2 During the positive half cycle: Diode D_1 is forward biased and conducts, charging C_1 to V_m . ✓

During the negative half cycle: Diode D_2 is forward biased, charging C_2 to $2V_m$. ✓

(2)

4.3

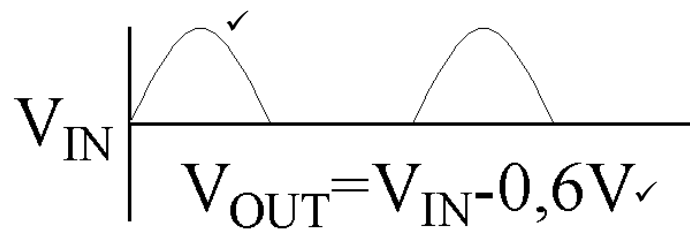


(2)

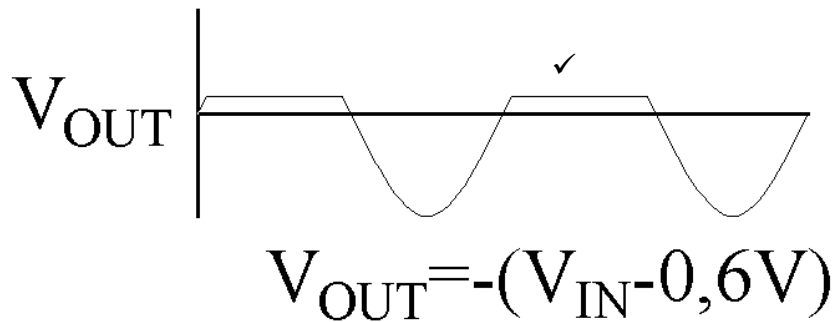
4.4 A photo diode operates under reverse biased conditions. When light falls on the PN junction the availability of minority carriers increase. The leakage current will increase. As the leakage current increases, the conductivity of the photo diode increases. ✓

(2)

4.5 4.5.1

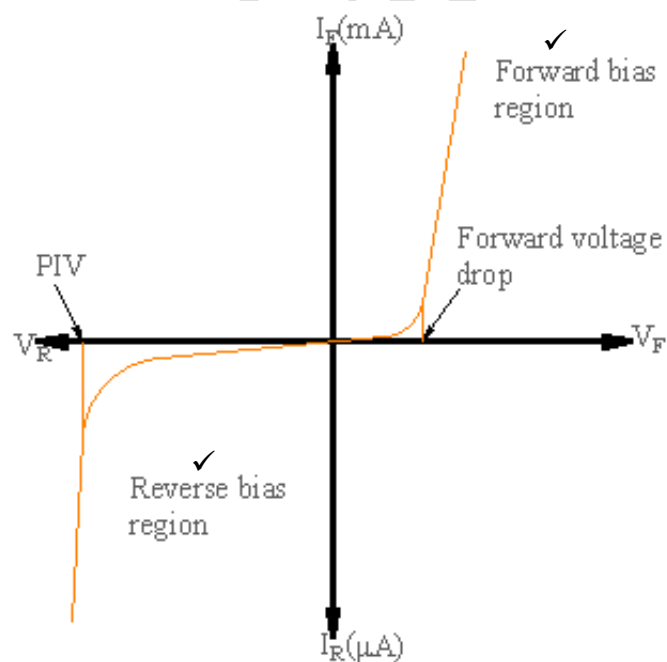


4.5.2



(2 × 2) (4)

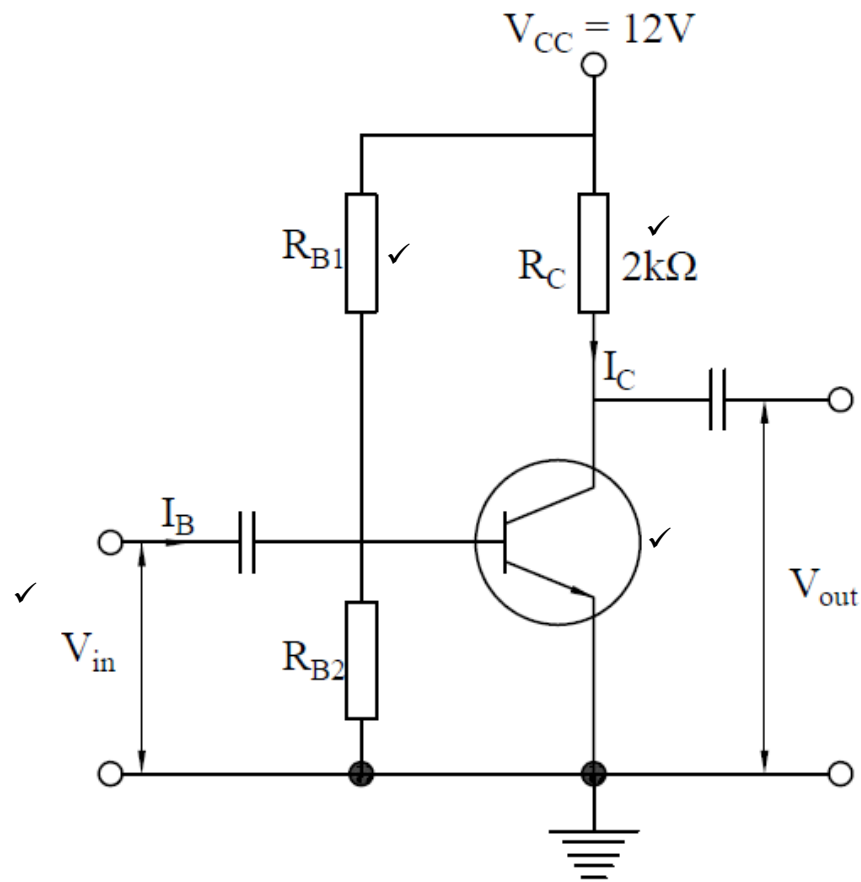
4.6



(2)
[14]

QUESTION 5

5.1 5.1.1



(4)

- 5.1.2
- 180° phase shift between input and output
 - Average input and output impedances
 - High current gain
 - High voltage gain

(Any 2 × 1) (2)

5.1.3 At cut-off:

$$V_{CE} = V_{CC} = 12 \text{ V}$$

At saturation:

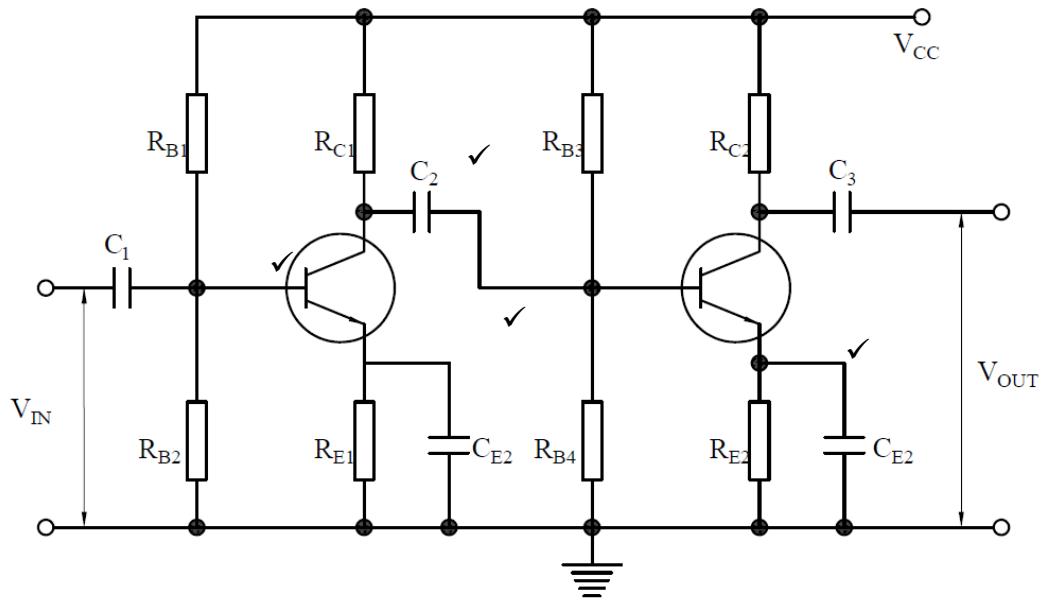
$$I_{C(SAT)} = \frac{V_{CC}}{R_C}$$

$$I_{C(SAT)} = \frac{12}{2000}$$

$$\underline{I_{C(SAT)} = 6 \text{ mA}}$$

(2)

5.2



(4)

5.3

- Improving stability
- Reducing distortion
- Reducing gain
- Reducing noise
- Increasing bandwidth
- Increasing input impedance
- Decreasing output impedance

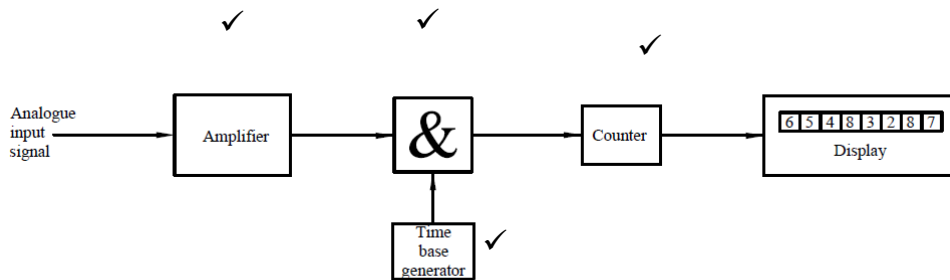
(Any 2 × 1)

(2)

[14]

QUESTION 6

6.1



- The amplifier amplifies the analogue input signal.
- The Schmitt trigger converts the analogue input to a digital signal.
- The time-base generator produces a pulse which opens the AND gate for a certain time.
- The counter counts the number of pulses.
- The count appears on the display. (max – 4 marks for 4 valid points) (8)

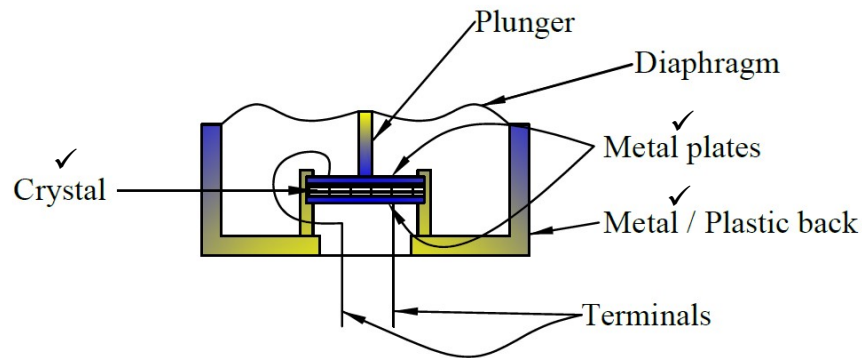
6.2

The resistance of the wire changes with the expansion and contraction because of an external applied force. (1)

6.3

- Force/Pressure: aircraft wings, concrete pylons
- Torque: torque bars
- Displacement: buildings, bridges (Any 2 × 1) (2)

6.4



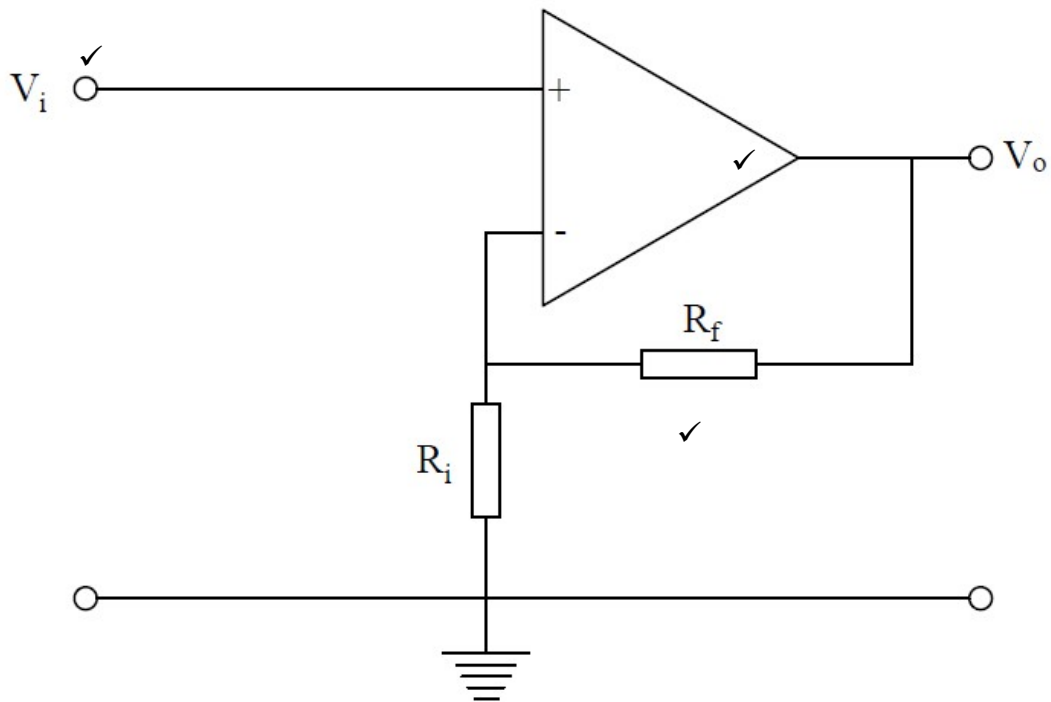
6.5

When an external force is applied to the crystal an emf is generated. (1)

[15]

QUESTION 7

7.1

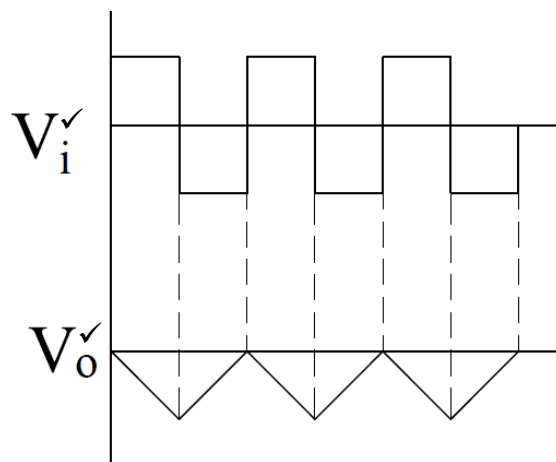


(3)

7.2 The output wave is 90° out of phase with the input wave.

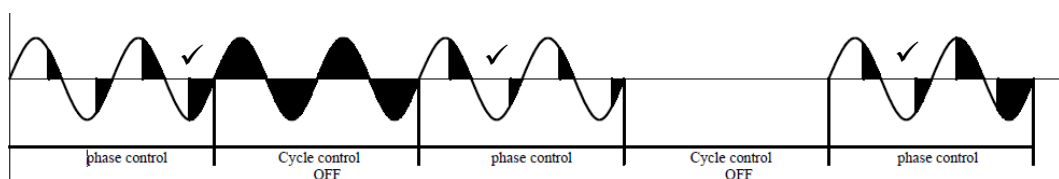
(1)

7.3



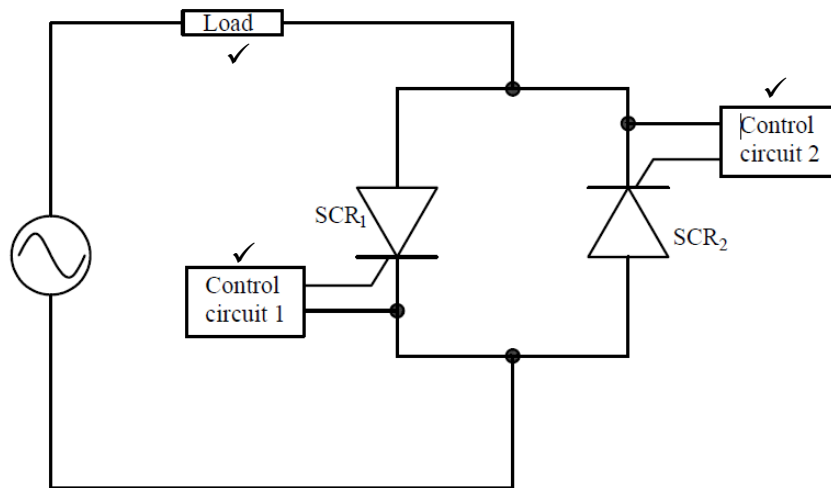
(2)

7.4



(3)

7.5



(3)

7.6

Line commutation occurs when an AC signal crosses zero from positive to negative and the anode becomes more negative with respect to the cathode.✓

Forced commutation occurs when a current is forced to flow in a direction opposite to the forward current.✓

(2)
[14]

TOTAL SECTION B: 80

GRAND TOTAL: 100