higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

COMMUNICATION ELECTRONICS N4

31 MARCH 2020

This marking guideline consists of 8 pages.

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QUESTION 1: TRUE OR FALSE

1.1 True
1.2 True
1.3 True
1.4 False
1.5 False
1.6 True
1.7 True
1.8 True
1.9 False
1.10 True

(10 × 1) **[10]**

QUESTION 2: MULTIPLE-CHOICE QUESTIONS

2.1 C
2.2 D
2.3 A
2.4 C
2.5 B
2.6 A
2.7 D
2.8 D
2.9 B
2.10 A

(10 × 1) **[10]**

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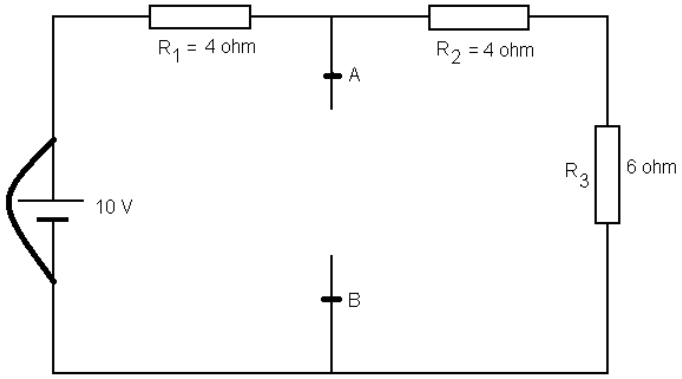
QUESTION 3: NETWORK THEOREMS

3.1 3.1.1 Superposition theorem: In any network with two or more supplies, the current in different circuits may be calculated by considering each supply separately.

3.1.2 Norton's theorem: Any two-terminal network of generators and impedances may be replaced by a single constant current generator (I_N) in parallel with a single Norton resistance R_N.

(2 × 2) (4)

3.2 Remove the load between A and B and the short-circuit battery.

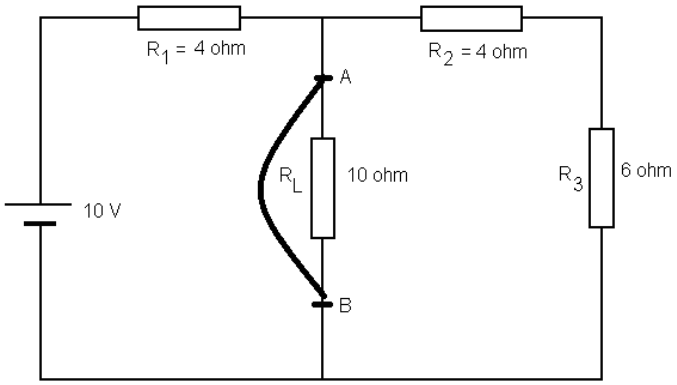


$$R_{AB} = R_N = \frac{R_1(R_2 + R_3)}{(R_1 + R_2 + R_3)}$$

$$= \frac{4(4+6)}{4+4+6} \checkmark$$

$$= 2{,}85 \text{ ohm} \checkmark$$

Replace the battery and the short-circuit AB



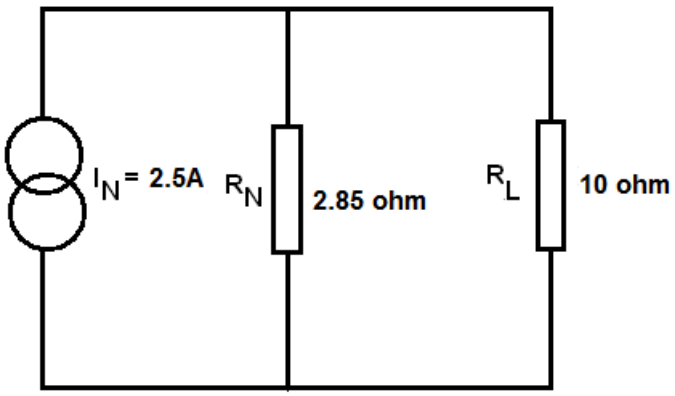
$R_T = R_1 = 4$ ohm

$$I_T = \frac{V}{R_T} = \frac{10}{4} \checkmark$$

$$= 2{,}5 \text{ A}$$

and $I_T = I_N = 2{,}5$ A✓

Norton's equivalent circuit✓✓



(3 × 2) (6)
[10]

QUESTION 4: ALTERNATING-CURRENT THEORY

4.1 $XL = 2\pi fL$
$= 2 \times \pi \times 12 \times 10^{3} \times 10 \times 10^{-3}$ ✓
$= 753{,}982\ \Omega$✓

4.2 $Xc = \frac{1}{2\pi fc}$
$= \frac{1}{2x\pi x12x10^{3}x10x10^{-9}}$ ✓
$= 1\ 326{,}291\ \Omega$✓

4.3 $Z = \sqrt{R^2 + (X_L - X_C)^2}$
$= \sqrt{500^2 + (753{,}982 - 1326{,}291)^2}$ ✓
$= 759{,}959\ \Omega$✓

4.4 $I = \frac{V}{Z}$
$= \frac{20}{759{,}959}$ ✓
$= 0{,}026\ A = 26\ mA$✓

4.5 $\vartheta = Cos^{-1}\frac{R}{Z}$
$= Cos^{-1}\frac{500}{759{,}959}$ ✓
$= 48{,}858^{o}$✓

4.6 $VL = I \times XL$
$= 0{,}026 \times 753{,}982$✓
$= 19{,}604\ V$✓

4.7 Q-factor = $R^{-1}(\sqrt{L/C})$
= 500^{-1} ($\sqrt{10 \times 10^{-3} / 10 \times 10^{-9}}$)✓
= 1,508 ✓

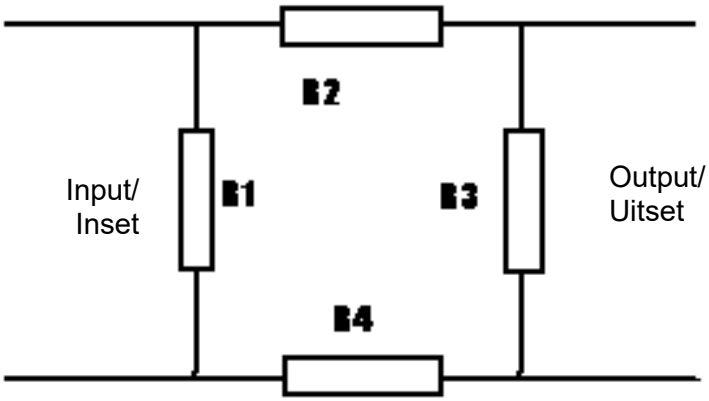
4.8 Q-factor = $2 \times \pi \times f \times \frac{L}{R}$
= $2 \times \pi \times 12 \times 10^{3} \times \frac{10x10^{-3}}{500}$ ✓
= 1,508 ✓

(8 × 2) **[16]**

QUESTION 5: ATTENUATORS AND FILTERS

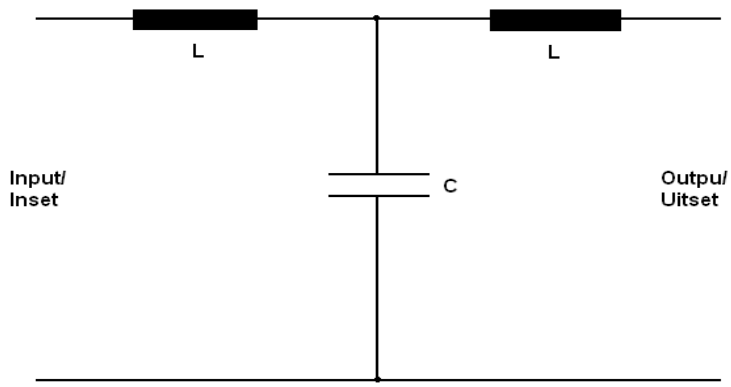
5.1 It is a resistive network designed to reduce voltage, current or power to controllable amounts and is independent of frequency. (2)

5.2 **O-type attenuator**



(1)

5.3 **Low-pass filter**



(1)

5.4 Ceramic filter (1)
[5]

QUESTION 6: MODULATION

6.1 A process whereby the position of the pulse carrier wave is made to vary in accordance with the instantaneous value of the modulating signal.

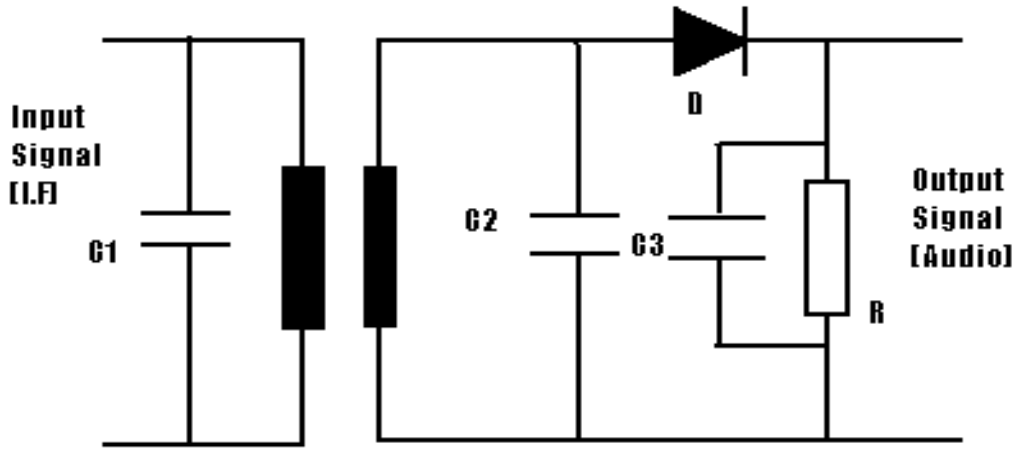
6.2 A process whereby the width of the pulse carrier wave is made to vary in accordance with the instantaneous value of the modulating signal.

6.3 A process whereby the amplitude of the pulse carrier wave is made to vary in accordance with the instantaneous value of the modulating signal.

(3 × 2) **[6]**

QUESTION 7: DEMODULATION

7.1



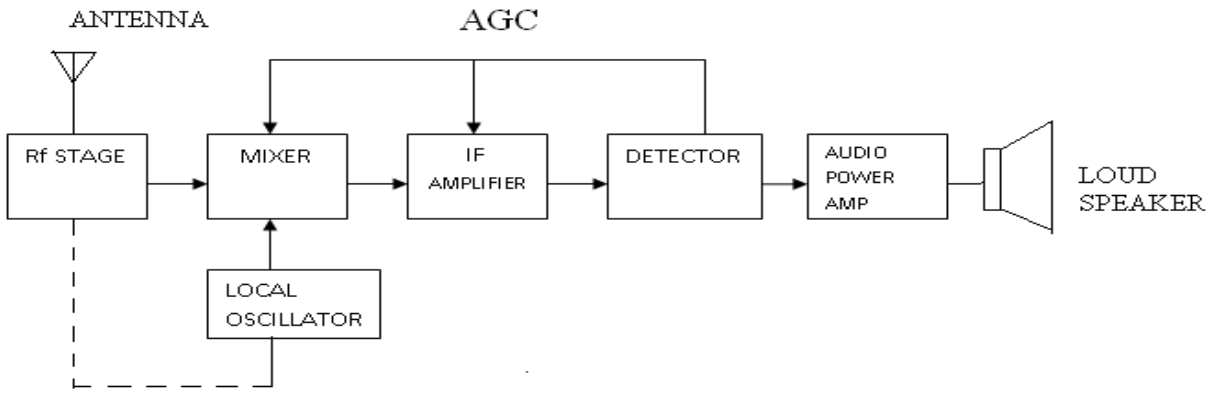
(3)

7.2
- During the positive half-cycle of the modulated signal,
- capacitor C2 will charge to the peak value of the modulated signal through diode D.
- During the negative half-cycle of the modulated signal, capacitor C2 will discharge across resistor R,
- producing a voltage drop in accordance with the modulating signal.
- The tuning circuit consisting of coils L1, L2 and capacitor C2, is tuned to the incoming signal.
- Diode D rectifies the modulated signal.
- Capacitor C3 filters off the radio frequency RF and resistor R produces a voltage drop proportional to the audio frequency AF modulated wave. (7)

[10]

QUESTION 8: COMMUNICATION SYSTEMS

8.1 Diagram of AM superheterodyne receiver



(6)

8.2
- Antenna: Electromagnetic waves are converted into electric current.
- RF amplifier: Amplifies the signal to which it is tuned.
- Oscillator: Supplies RF signal (carrier) of constant amplitude and frequency.
- Mixer: Input: RF + carrier (oscillator frequency), Output: IF, 3 other frequencies + noise.
- IF amplifier: Amplifies the intermediate frequency.
- Detector: Converts IF to audio.
- AF amplifier: Amplifies the audio signal.
- Loudspeaker: Converts audio frequency to sound waves.
- Automatic gain control: Varies the overall gain of the radio receiver automatically with the changing strength of the received signal. (9 × 1) (9)

[15]

QUESTION 9: RADIO-WAVE PROPAGATION

9.1
$$\lambda = \frac{V}{f}$$
$$= \frac{3x10^8}{60x10^6} \checkmark$$

= 5 m✓

Length of the antenna is 5/2 = 2,5 m✓ (3)

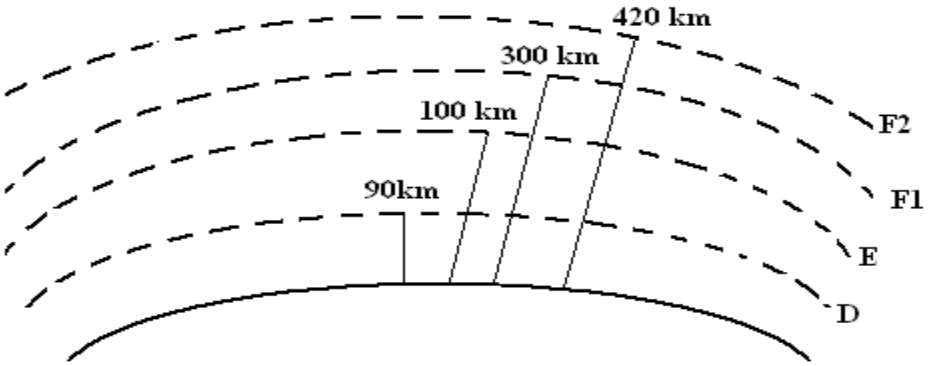
9.2 Electric field is vertical parallel to the antenna. (2)

9.3 It is the region in the upper atmosphere in which radio waves are bent back to the earth's surface. It is an area where the air pressure is so low that 'free' electrons and ions exist for long periods without getting close enough to recombine into a neutral atom. (2)

9.4

Day: F region spilts up into F_1 and F_2

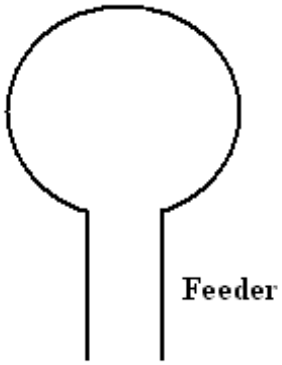
Night: F_1 layer disappears causing F_2 layer to drop (2)



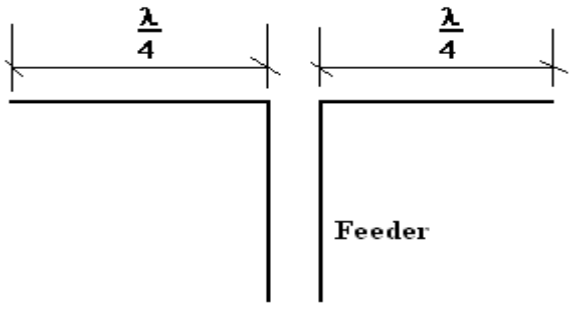
(3)

9.5 It is the angle between the norm and the radiated sky wave for a given M.U.F, where the wave is first refracted back without penetration. (2)

9.6 9.6.1 **Loop antenna**



9.6.2 **Folded dipole antenna**



(2 × 2) (4)
[18]

TOTAL: 100

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