higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

RADIO THEORY N2

(11040862)

23 November 2022 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

This question paper consists of 5 pages and 1 formula sheet.

174Q1E2223

Copyright reserved

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
RADIO THEORY N2
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer all the questions.
2. Read all the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Use only a blue or black pen.
5. Sketches, diagrams and graphs should be neat, clear and labelled. A pencil may be used.
6. Write neatly and legibly.

Copyright reserved

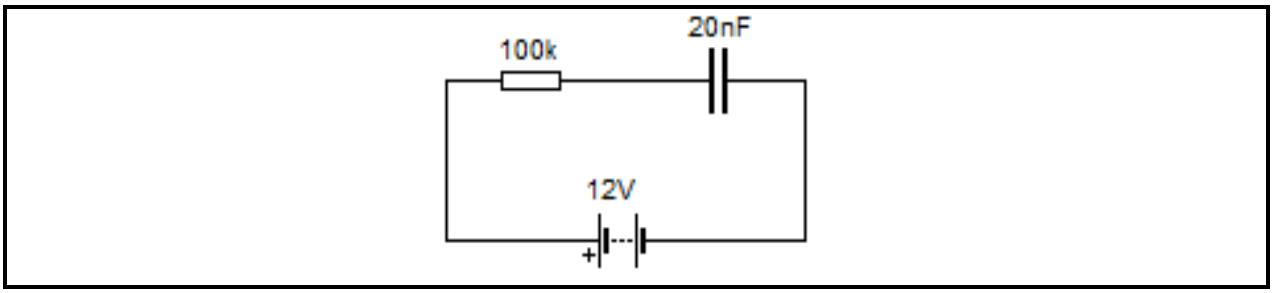
QUESTION 1

Choose an item from COLUMN B that matches a description in COLUMN A. Write only the letter (A–Q) next to the question number (1.1–1.15) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.1	Blocks DC	A	oscillator
1.2	Capacitors in parallel	B	transistor
1.3	Generates a frequency	C	inductor
1.4	Displays a waveform	D	Class B amplifier
1.5	Resonance	E	antenna
1.6	Three-terminal device	F	detector
1.7	High impedance to high frequencies	G	Z = R
1.8	Current flows for half of the input signal	H	oscilloscope
1.9	Output of a detector	I	common emitter
1.10	180^0 phase shift	J	$C_T = C_1 + C_2$
1.11	Voltage-controlled device	K	vacuum tube
1.12	High-operating voltage	L	mixer
1.13	Converts electromagnetic waves	M	AF
1.14	Extracts AF from the AM	N	capacitor
1.15	Adds and subtracts two frequencies	O	FET
		P	Diode
		Q	Common collector

(15 × 1) **[15]**

QUESTION 2



Calculate the following for the circuit above:

2.1 The time constant (2)

2.2 The voltage across the capacitor after 2 ms (5)

2.3 The voltage across the resistor after 2 ms (2)
[9]

QUESTION 3

Draw ONE comparative graph for each of the following to show the relationship between current and voltage waveforms:

3.1 A circuit that contains only resistance

3.2 A circuit that contains only inductance

3.3 A circuit that contains only capacitance

(3 × 3) **[9]**

QUESTION 4

4.1 4.1.1 Draw a full-wave power supply using a bridge rectifier.

4.1.2 Draw the cycles of the input and output waveforms.

(2 × 4) (8)

4.2 Name TWO semiconductor materials that diodes are made of. (2)
[10]

QUESTION 5

5.1 Draw the circuit diagram of a common collector amplifier that uses an NPN transistor. (6)

5.2 State the characteristics of the emitter follower for the following:

5.2.1 Current gain

5.2.2 Voltage gain

5.2.3 Power gain

5.2.4 Input impedance

(4 × 1) (4)
[10]

☆

QUESTION 6

6.1 Differentiate between the following:

6.1.1 A conductor

6.1.2 An insulator

(2 × 3) (6)

6.2 Draw a fully labelled circuit diagram of a push-pull amplifier that uses TWO NPN transistors. (8)
[14]

QUESTION 7

Draw a neat, labelled diagram and explain the operation of a carbon microphone.
(2 × 5) **[10]**

QUESTION 8

8.1 If the input frequency to an AM receiver is 2 000 kHz, give the value of the FOUR signals that will appear in the mixer. (4)

8.2 Draw a neat, labelled block diagram of a tuned radio frequency receiver. (6)

8.3 Give a brief description of the process of amplitude modulation. (1 × 2) (2)
[12]

QUESTION 9

9.1 Name THREE forms of damping of a moving-coil meter. (3)

9.2 An oscilloscope displays an AC signal (one cycle) that covers 4 vertical divisions and 6 horizontal divisions. The volts/division control is set at 5 V/division. The time/division control is set to 2 mSeconds/division.

Calculate the following:

9.2.1 Peak-to-peak voltage

9.2.2 Average voltage

9.2.3 Time period

9.2.4 Frequency

(4 × 2) (8)
[11]

TOTAL: 100

☆

Copyright reserved

FORMULA SHEET

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + ... \qquad C_T = C_1 + C_2 + ...$$

$$R_T = R_1 + R_2 + ... \qquad \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + ...$$

$$\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2} + ... \qquad L_T = L_1 + L_2 + \ldots$$

$$R_{SH} = \frac{I_m x R_m}{I_T - I_m} \qquad R_S = \frac{V}{I_m} - R_m$$

$$\tau = R \times C \qquad Q = C \times V$$

$$V_C = V\left(1 - e^{\frac{-t}{RC}}\right) \qquad i = \frac{V}{R} \times e^{\frac{-t}{RC}}$$

$$X_L = 2.\pi.F.L \qquad X_C = \frac{1}{2.\pi.F.C}$$

$$Z = \sqrt{R^2 + X_L{}^2}: \qquad Z = \sqrt{R^2 + X_C{}^2}: \qquad Z = \sqrt{R^2 + (X_L \approx X_C)^2}$$

$$I_T = \frac{V_T}{X_L}: \qquad I_T = \frac{V_T}{X_C}: \qquad I_T = \frac{V_T}{Z}$$

$$V_R = I \times R: \qquad V_L = I \times X_L: \qquad V_C = I \times X_C$$

$$\cos\theta = \frac{R}{Z}$$

$$f_r = \frac{1}{2.\pi.\sqrt{LC}} \qquad Q = \frac{1}{R}\sqrt{\frac{L}{C}} \qquad Q = \frac{X_L}{R}$$

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

$$\text{Frequency} = \frac{1}{\text{Period}}$$

RMS voltage = 0,707 × Peak

Average voltage = 0,637 × Peak

Copyright reserved