higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

RADIO THEORY N2

(11040862)

28 November 2024 (X-paper)
09:00–12:00

Scientific calculators and drawing instruments may be used.

This question paper consists of 6 pages and a formula sheet of 3 pages.

149Q1E2428

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. Start each question on a new page.
5. Use only a blue or black pen.
6. Write neatly and legibly.

Copyright reserved

QUESTION 1

Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.1–1.10) in the ANSWER BOOK.

1.1 Transistors can be used as switches.

1.2 In a purely capacitive circuit, the current lags the voltage by 90°.

1.3 In radio wave communication, information is transmitted in the form of an electrical wave.

1.4 Voltage is measured in parallel with a voltmeter.

1.5 The output signal of a common emitter amplifier is in phase with the input signal.

1.6 Oscillators generate a frequency.

1.7 The IF of an AM radio is 455 kHz.

1.8 The time constant of an RC circuit can be defined as the time it takes to charge a capacitor to 63,2% of the maximum applied voltage.

1.9 A Hartley oscillator uses one inductor and two capacitors in the feedback circuit.

1.10 Speakers convert electrical signals to electromagnetic signals.

(10 × 1) **[10]**

Copyright reserved

QUESTION 2

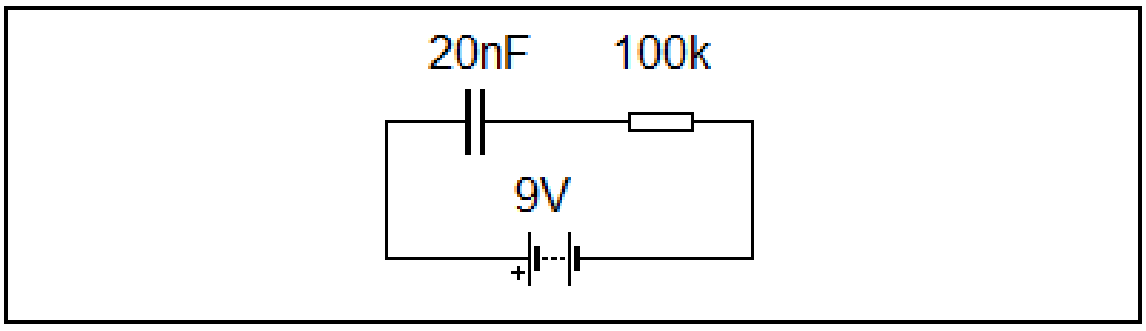
Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–M) next to the question number (2.1–2.10) in the ANSWER BOOK.

COLUMN A		COLUMN B	
2.1	Attenuates high frequency	A	AF
2.2	Blocks DC	B	resistor
2.3	Changes AC to DC	C	transistor
2.4	Measures frequency	D	180° phase shift
2.5	Selectivity	E	speaker
2.6	Attenuates current	F	diode
2.7	Converts sound waves to electrical waves	G	capacitor
2.8	Common emitter amplifier	H	oscilloscope
2.9	Output of a detector	I	microphone
2.10	RF amplifier	J	IF
		K	90° phase shift
		L	inductor
		M	sensitivity

(10 × 1) **[10]**

QUESTION 3

3.1



Calculate:

3.1.1 The time constant (2)

3.1.2 The voltage across the capacitor after 2 ms (4)

3.1.3 The voltage across the resistor after 2 ms (3)

3.2 A series resonant circuit consists of a coil with a resistance of 10 Ω and an inductance of 100 mH as well as a 50 µF capacitor.

Calculate:

3.2.1 The resonant frequency

3.2.2 The quality factor (Q) of the coil

(2 × 3) (6)

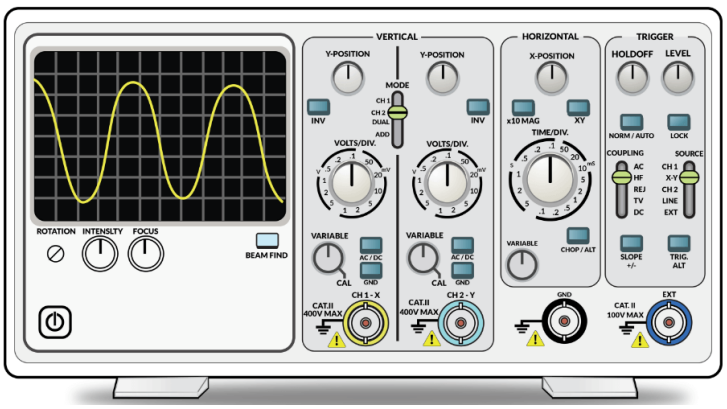
3.3 List FIVE characteristics of a series RLC circuit that is in resonance. (5)

[20]

QUESTION 4

4.1 Explain the operation of a moving coil meter. (5)

4.2 Briefly explain the function of each of the following controls in an oscilloscope:



4.2.1 Volts/Division

4.2.2 Time/Division

4.2.3 Intensity control

4.2.4 Y-shift/position

4.2.5 X-shift/position

(5 × 1) (5)

[10]

QUESTION 5

Draw a full-wave power supply. The drawing must include a transformer, bridge rectifier, load resistor, polarity and TWO cycles of the input and output waveforms. **[10]**

QUESTION 6

6.1 Draw a circuit diagram of a common emitter NPN-transistor audio amplifier. The circuit diagram must include a microphone, speaker and battery. (10)

6.2 Complete the following table by writing only the answer next to the letter (a–e) in the ANSWER BOOK.

	Common Emitter	Common Base	Common Collector
Current gain	high	(a)	high
Voltage gain	high	high	(b)
Power gain	high	low	(c)
Input impedance	(d)	low	high
Output impedance	medium	high	low
Phase shift	(e)	0°	0°

(5 × 1) (5)

[15]

QUESTION 7

Explain, with the aid of a neat, labelled diagram, the operation of a ribbon microphone. **[10]**

QUESTION 8

8.1 Make a neat, labelled block diagram of a tuned radio frequency receiver. (5)

8.2 Name SIX instruments or pieces of equipment used in a radio repair shop. (6)

8.3 Explain *selectivity* with regard to radio receivers. (2)

8.4 Explain *sensitivity* with regard to radio receivers. (2)

[15]

TOTAL: 100

Copyright reserved

FORMULA SHEET

CAPACITORS, RESISTORS AND INDUCTORS

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

$$C_T = C_1 + C_2 + ...$$

$$R_T = R_1 + R_2 + ...$$

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

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

$L_T = L_1 + L_2 + \ldots$

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

$$R_S = \frac{V}{I_m} - R_m$$

Instantaneous voltage across a capacitor:

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

Initial charging current through a capacitor:

$$i = \frac{V}{R} \times e^{\frac{-t}{RC}}$$

Time constant:

$$\tau = R \times C$$

Charge of capacitor:

$$Q = C \times V$$

Copyright reserved

AC THEORY

Inductive reactance:

$X_L = 2.\pi.f.L$

Capacitive reactance:

$X_C = \frac{1}{2.\pi.f.C}$

Impedance for RL, RC and RLC circuits:

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

Circuit current for RL, RC and RLC circuits:

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

Voltage drop across components:

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

Power factor:

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

Phase angle:

$\phi = \cos^{-1}\frac{R}{Z}$

Resonant frequency:

$f_r = \frac{1}{2.\pi.\sqrt{LC}}$

Q-factor:

$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$

Copyright reserved

OHM'S LAW

Voltage drop:

$$V = I \times R$$

Circuit current:

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

OSCILLOSCOPE CALCULATIONS

Period = Time/Division × Horizontal divisions

Amplitude = Volts/Division × Vertical divisions

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

RMS = 0,707 × peak

Average voltage = 0,637 × peak

Voltage (peak to peak) = 2 × peak

Copyright reserved