higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

ELECTRICAL PRINCIPLES AND PRACTICE
NQF LEVEL 2

(12041002)

27 February 2018 (X-Paper)
09:00–12:00

This question paper consists of 6 pages and 1 formula sheet.

NCV

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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. ALL final answers must be accurately approximated to THREE decimals.
5. Write neatly and legibly.

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QUESTION 1

1.1 A charity fundraiser fits 12 students into a small car.

If the combined mass of the car and students is 1 600 kg and the combined area of the wheels touching the ground is 0,08 square meters, calculate the pressure exerted on the ground by the car and the students. (5)

1.2 Give the SI units for each of the following physical quantities:

1.2.1 Luminous intensity

1.2.2 Temperature

1.2.3 Amount of a substance

1.2.4 Time

1.2.5 Electric current

(5 × 1) (5)
[10]

QUESTION 2

2.1 State Fleming's left-hand rule. (3)

2.2 Calculate the resistance of a copper conductor with a length of 3 km and a diameter of 5 mm. Take the resistivity of the copper as 0,0173 μΩm. (5)

2.3 Explain *electron current flow* as it relates to electrical circuits. (2)

2.4 List FOUR requirements for sketching the magnetic field lines around a bar magnet. (4)

2.5 State Joule's law. (2)

2.6 An electric iron with a power rating of 3 kW is connected across a 240 V supply.

Calculate:

2.6.1 The current drawn from the supply

2.6.2 The resistance of the iron element

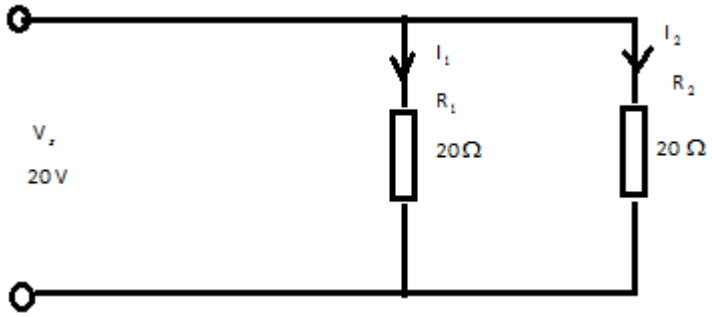
2.6.3 The energy consumed after 1 hour in MJ

(3 × 3) (9)
[25]

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QUESTION 3

3.1 Refer to the figure below and calculate:



3.1.1 The total resistance of the circuit (3)

3.1.2 The total current flowing through the circuit (2)

3.1.3 The magnitude of the current through R_2 if R_1 is an open circuit (2)

3.2 Transformers are used in AC circuits to step up or step down voltage with a corresponding decrease or increase in the current.

3.2.1 Briefly explain the principle of operation of a single-phase transformer. (3)

3.2.2 Differentiate between a *step-up* and a *step-down* transformer. (2 + 2) (4)

3.3 The SANS 10142 requires that all single-phase loads be equally distributed among the three phases of a three-phase four-wire system.

Give THREE advantages of load balancing. (3)

3.4 An ideal transformer has a supply voltage of 220 V and a primary current of 5 A. The number of windings on the primary coil is 200 turns and 50 turns on the secondary coil.

Calculate:

3.4.1 The ratio of the turns (2)

3.4.2 The secondary voltage (3)

3.4.3 The secondary current (3)

[25]

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QUESTION 4

4.1 Moving-iron instruments are generally used to measure alternating voltages and currents.

Briefly explain the principle of operation of a moving-iron repulsion-type instrument. (3)

4.2 A measuring instrument is a device used for measuring a physical quantity.

List FOUR precautionary measures to take when using measuring instruments. (4)

4.3 How would one connect each of the following instruments in electrical circuits in relation to the load:

4.3.1 Frequency meter

4.3.2 Voltmeter

4.3.3 Ammeter

4.3.4 Ohmmeter

(4 × 1) (4)

4.4 Copy and complete the table below in the ANSWER BOOK.

	Moving-iron instruments	**Moving-coil instruments**
Controlled by	4.4.1	4.4.2
Damping method	4.4.3	4.4.4

(4 × 1) (4)

[15]

QUESTION 5

5.1 Give FIVE requirements to be met when drawing a typical electrical circuit diagram. (5)

5.2 You are tasked to install a geyser in a four-room house.

Draw up a complete parts list with ALL component ratings for this circuit. (5)

5.3 Draw a neat, labelled subcircuit diagram of TWO luminaires controlled from ONE switch. (5)

[15]

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QUESTION 6

6.1 A simmerstat switch is used to control the temperature of a stove plate.

Make a neat, labelled sketch of a simmerstat switch. (5)

6.2 Briefly explain the operating principle of lead-acid batteries during the charging process. (3)

6.3 Give TWO practical applications of a flat button-shaped mercury cell. (2)
[10]

TOTAL: 100

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FORMULA SHEET

1	$v = \frac{d}{t}$	2	$\bar{v} = \frac{d}{t}$	3	$a = \frac{\Delta v}{\Delta t}$
4	$F = m \times a$	5	$W = m \times g$	6	$w = F \times s$
7	$\tau = F \times r$	8	$\rho = \frac{m}{V}$	9	$\mathrm{P} = \frac{F}{A}$
10	$E = V + Ir$	11	$V = IR$	12	$P = VI$
13	$P = I^2 R$	14	$P = \frac{V^2}{R}$	15	$\mathrm{E} = P \times t$
16	$R = \frac{\rho \ell}{A}$	17	$A = \pi r^2$	18	$A = \frac{\pi D^2}{4}$
19	$R_t = R_0(1 + \alpha_0 T)$	20	$t = \frac{1}{f}$	21	$\beta = \frac{\phi}{A}$
22	$mmf = NI$	23	$H = \frac{mmf}{\ell}$	24	$H = \frac{NI}{\ell}$
25	$F = \beta I \ell$	26	$\frac{N_1}{N_2} = \frac{V_1}{V_2} = \frac{I_2}{I_1}$	27	$S = V_1 I_1 = V_2 I_2$
28	$R_T = R_1 + R_2 + R_3$	29	$\frac{1}{R_T} = \frac{1}{R_1} = \frac{1}{R_2} = \frac{1}{R_3}$	30	$R_T = \frac{R_1 \times R_2}{R_1 + R_2}$
31	$I_T = I_1 = I_2 = I_3$	32	$I_T = I_1 + I_2 + I_3$	33	$I_T = \frac{V_T}{R_T} R$
34	$V_T = V_1 + V_2 + V_3$	35	$V_T = V_1 = V_2 = V_3$	36	$V_T = I_T R_T$
37	$E = V + Ir$	38	$P = VI$	39	$Q = I^2 Rt$
40	$R_{sh} = \frac{I_m R_m}{I_{sh}}$	41	$V_m = I_m R_m$	42	$R_{se} = \frac{V}{I} - R_m$

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