higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

RENEWABLE ENERGY TECHNOLOGIES
NQF LEVEL 2

(12041042)

17 November 2022 (Y-paper)
13:00–16:00

This question paper consists of 7 pages and 1 formula sheet.

513Q1N2217

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

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QUESTION 1

1.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.1.1–1.1.8) in the ANSWER BOOK.

The National Energy Efficiency Strategy outlines the following goals for the Republic of South Africa:

1.1.1 To improve the health of the nation

1.1.2 To reduce jobs

1.1.3 To increase environmental pollution

1.1.4 To reduce carbon-dioxide emission

1.1.5 To alleviate energy poverty

1.1.6 To improve industrial competitiveness

1.1.7 To enhance energy security

1.1.8 To delay the need to build power stations

(8 × 1) (8)

1.2 Give ONE advantage and ONE disadvantage of the following renewable energy:

1.2.1 Hydro

1.2.2 Wind

1.2.3 Concentrated solar power

1.2.4 Photovoltaic

(4 × 2) (8)

1.3 Calculate the illuminance of a device of which the power consumption is 60 W, luminous efficacy is 15 lm/W with a surface area of 18 m^2. (4)

1.4 Name TWO factors that tilt angle are depended upon. (2)

1.5 List two factors that affect the amount of available solar energy. (2)

[24]

QUESTION 2

2.1 In South Africa, an energy audit is a systematic survey of a facility or residential home, aimed at establishing how energy is currently used and identifying areas of potential saving.

List THREE main segments of energy audits. (3)

2.2 Study the power circuit for a typical fluorescent light in FIGURE 1. Name the labelled components by writing only the answer next to the letter (A–G) in the ANSWER BOOK. (7)

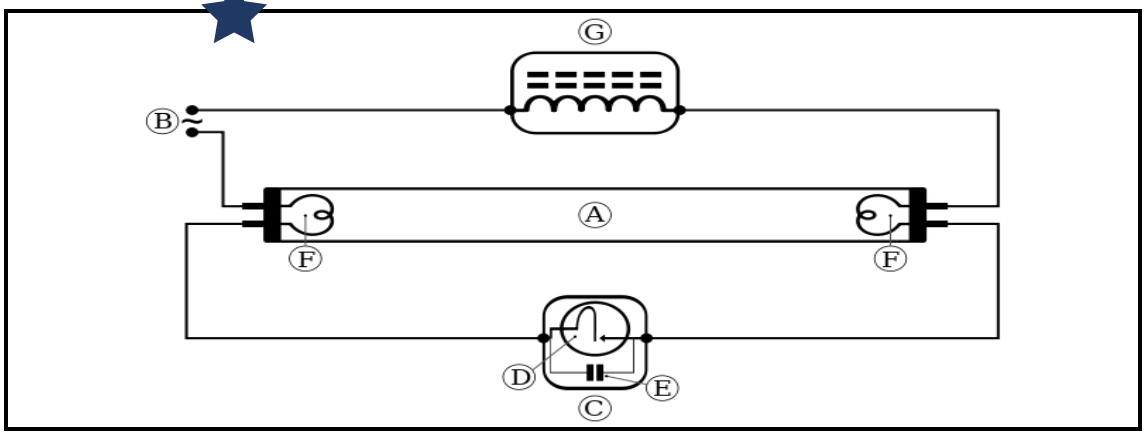


FIGURE 1

2.3 Two resistors of 2 Ω and 6 Ω respectively are connected in parallel. This combination is then connected in series with a 4 Ω resistor. The potential of the whole circuit is 24 V.

2.3.1 Draw and label the circuit diagram. (2)

Calculate the following:

2.3.2 The total resistance (R_{eq}) of the circuit (3)

2.3.3 Total current (I_T) through the circuit (2)

2.3.4 Voltage across each resistor (4)

2.3.5 Current through 20 Ω and 30 Ω resistors (4)

[25]

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QUESTION 3

3.1 Explain how one would arrange a work area to minimise accidents and injuries. (4)

3.2 You are the photovoltaic (PV) technician working on a photovoltaic (PV) farm shown in the image below. You have done physical and visual inspection and discovered that some photovoltaic (PV) panels have burnout. Your task is to replace the modules.

Indicate the FOUR main steps that one would take to isolate photovoltaic (PV) arrays or strings when the electrical equipment is locked-out or tagged-out. (4)



(Image source: *http://kormorant.co.za/2504/first-nw-solar-energy-farm/*)

3.3 You are newly employed at a factory that assembles photovoltaic (PV) modules.

Mention FOUR possible workplace hazards that you may encounter. (4)

[12]

QUESTION 4

4.1 Choose a description from COLUMN B that matches an item in COLUMN A. Write only the letter (A–J) next to the question number (4.1.1–4.1.10) in the ANSWER BOOK.

COLUMN A		COLUMN B	
4.1.1	Bypass diode	A	condition under which a module is typically tested in a laboratory
4.1.2	Charge controller	B	any material that has a limited capacity for conducting electric current
4.1.3	Diode	C	an autonomous photovoltaic (PV) system not connected to the national-grid
4.1.4	Grid-connected	D	an electronic device which regulates the electrical potential applied to a battery system from the photovoltaic (PV) system
4.1.5	Inverter	E	a diode connected across one or more solar cells in a photovoltaic module to protect solar cells from thermal destruction
4.1.6	I-V curve	F	a photovoltaic (PV) system acting as an energy generator supplying power to the national grid
4.1.7	Reverse bias	G	an electronic device that converts direct current (DC) into alternating current (AC)
4.1.8	Semiconductors	H	a semiconductor device with two terminals that allows the flow of current in only one direction
4.1.9	Stand-alone	I	the graphic representation of the relationship between the voltage applied across an electrical device and the current flowing through it
4.1.10	Standard test condition	J	a condition where the current producing capability of a photovoltaic (PV) cell is significant less

(10 × 1) (10)

4.2 Sketch the symbol for each of the following components:

4.2.1 Inverter

4.2.2 Solar panel

4.2.3 Battery

(3 × 1) (3)

4.3 One sometimes finds diagrams where current-voltage (I-V) and power-voltage (P-V) curves of modules are plotted together. Sketch a diagram to illustrate the current-voltage (I-V) and power-voltage (P-V) curves on the same scale of axis showing all values of output parameters. (10)

4.4 Assume four identical modules with potential differences at maximum power (V_{MP}) of 17,5 V and current maximum power (I_{MP}) of 5 A.

4.4.1 Draw a circuit/connection diagram to show how output voltage of a photovoltaic (PV) module can be increased. (5)

4.4.2 Calculate the total output voltage of the photovoltaic (PV) modules. (3)

4.4.3 Draw a circuit/connection diagram to show how output current of a photovoltaic (PV) module can be increased. (5)

4.4.4 Calculate the total output current of the photovoltaic (PV) modules. (3)

[39]

TOTAL: 100

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FORMULA SHEET

$$W = F \times s$$

$$P = \frac{W}{t}$$

$$E = P \times t$$

$$\eta = \frac{Output}{Input} \times 100 \qquad Output = Input - Losses$$

$$Q = I \times t$$

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

$$P = V \times I \qquad P = I^2 \times R \qquad P = \frac{V^2}{R}$$

$$V_T = V_1 + V_2 + V_3 \qquad V_T = V_1 = V_2 = V_3$$

$$I_T = I_1 + I_2 + I_3 \qquad I_T = I_1 + I_2 + I_3$$

$$R_T = R_1 + R_2 + R_3 \qquad \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$R = \frac{\rho \times l}{A}$$

$$E_v = \frac{P \times K_\lambda}{A} \qquad lux = \frac{watts \times (lumens\ per\ watt)}{squaremetres}$$

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