higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

RENEWABLE ENERGY TECHNOLOGIES
NQF LEVEL 2

(12041042)

22 November 2024 (Y-paper)
13:00–16:00

Calculators may be used.

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

499Q1N2422

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
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RENEWABLE ENERGY TECHNOLOGIES
NQF LEVEL 2
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. Sketches must be large, neat and fully labelled.
6. Show all steps of all calculation.
7. Write neatly and legibly.

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QUESTION 1

1.1 Explain the term *global warming*. (2)

1.2 List and describe THREE critical commitments according to the Green Economy Accord. (6)

1.3 Discuss the current limitations associated with the continued use of fossil fuel energy (gas or coal energy). (8)

1.4 Choose a description from COLUMN B that matches an item in COLUMN A. Write only the letter (A–F) next to the question number (1.4.1–1.4.4) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.4.1	Sunlight	A	the rate of solar radiation falling on a given area at a moment in time
1.4.2	Irradiance	B	broad spectrum of electromagnetic rays
1.4.3	Irradiation	C	light reflected or scattered by the ground or nearby surfaces
1.4.4	Wave-particle duality	D	ability of sunlight to appear as either a wave or as a particle
		E	any type of inverter that produces utility-quality sine wave power
		F	the amount of solar radiation over time

(4 × 1) (4)

[20]

QUESTION 2

2.1 A family member is interested in upgrading their current television (TV) to a more efficient set and asks you to help her choose the correct TV.

Compare the data in TABLE 1 and answer the questions.

TABLE 1

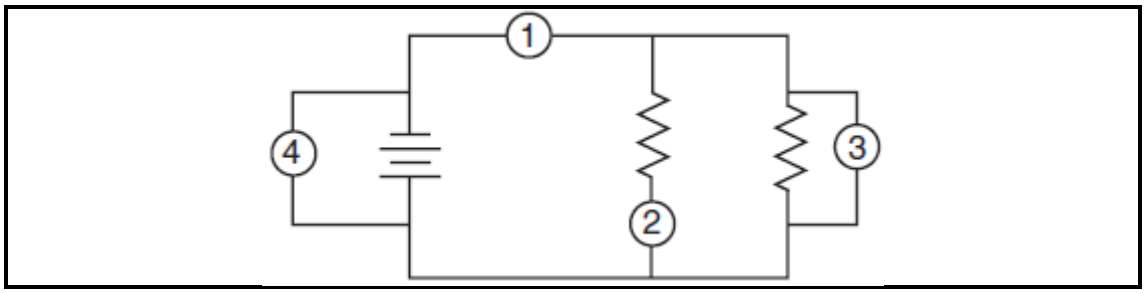
	LED	LCD	OLED
Lifespan (hours)	100 000	75 000	100 000
Cost per TV	R18 000	R 12 000	R26 000
Watts	57 W	70 W	98 W

NOTE: Daily and annual costs assume that each 55-inch TV runs for 5 hours a day at a cost of R1,20 per kWh.

2.1.1 Select the most energy efficient TV. (1)

2.1.2 Substantiate the answer in QUESTION 2.1.1 by calculating the annual operating costs. (7)

2.2 Study FIGURE 1 below and answer the questions.



[Source: *https://www.aplusphysics.com/courses/honors/circuits/meters.html*]

FIGURE 1

2.2.1 Discuss at which position an ammeter should be placed to measure the total current in the circuit.

2.2.2 Discuss at which position a voltmeter should be placed to measure the total voltage in the circuit.

2.2.3 Redraw FIGURE 1 in your ANSWER BOOK (with the correct placing of the ammeter and voltmeter) and include TWO filament bulbs connected in parallel.

(3 × 3) (9)

2.3 Answer questions (2.3.1–2.3.4) with reference to Ohm's law.

2.3.1 Describe the relationship between *current, potential* and *resistance*. (2)

2.3.2 Name the instrument which is designed to measure current, potential and resistance. (1)

2.3.3 Calculate the resistance if a current of 15 amperes flows through a 230-volt lamp. (3)

2.3.4 Describe the effect that increasing the number of 230-volt bulbs would have on the current and overall resistance in QUESTION 2.3.3. (2)

[25]

QUESTION 3

3.1 The company you are working at has standard safety procedures when any electrical work is performed. However, one of your colleagues feels because he is doing a 'quick' motor change-over, it is not necessary to adhere to the safety procedures.

3.1.1 Discuss the effects and consequences, if any, the electrical current could have on your colleague. (6)

3.1.2 State the purpose of lockout/tagout (LOTO) procedures. (2)

3.1.3 Explain how the LOTO procedures could ensure your colleague's safety when performing the motor change-over. (4)

[12]

QUESTION 4

4.1 The I–V (current-voltage) curve of a PV module describes its energy conversion capability at the existing conditions of irradiance and temperature.

4.1.1 Explain the importance of using an I–V (current-voltage) curve. (2)

4.1.2 Explain what the I-V curve represents. (2)

4.1.3 Discuss the effects a decrease in irradiance and an increase in temperature would have on an I-V curve. (4)

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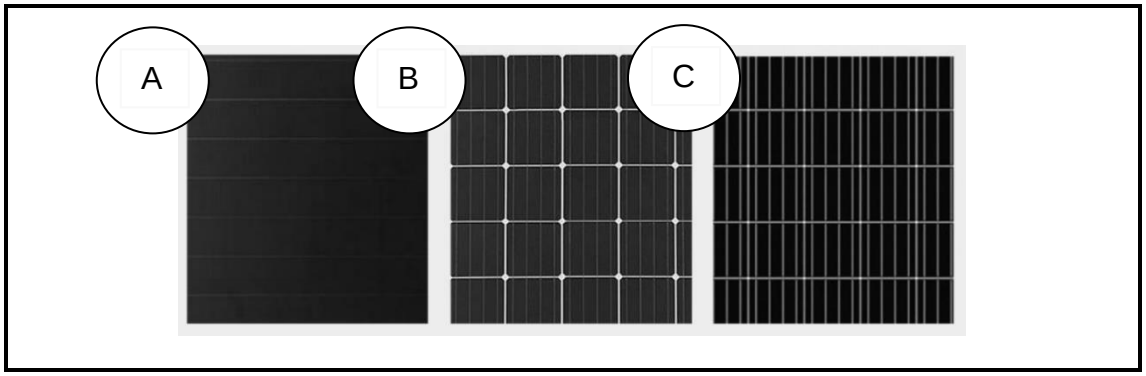
4.2 A grid-connected photovoltaic system is classified as a SSEG.

4.2.1 What is meant by SSEG? (1)

4.2.2 Explain how a grid-connected PV system operates. Include the benefits and disadvantages of such a system in your answer. (5)

4.2.3 Provide a schematic illustration of the essential components of a grid-connected PV system. (8)

4.3 FIGURE 2 shows three different types of PV modules available.



[Source: *https://www.newsouthernenergy.com/pv-solar*]

FIGURE 2

Study FIGURE 2 to answer the following questions.

4.3.1 Name the THREE types of PV modules in order from A–C. (3)

4.3.2 Give the module efficiency range for each module type in order from A–C. (3)

4.3.3 Which module type is the most commonly used/has the highest global market share? (1)

4.3.4 Explain the key effect the module efficiency will have on the design of the PV system. (2)

4.3.5 When comparing Module A to modules B and C, give the main advantage Module A has with respect to climate conditions. (3)

4.3.6 What is the primary resource used for the fabrication of modules B and C? (1)

4.3.7 Explain the difference in appearance of modules B and C. (4)

4.3.8 The function of all three modules is to generate electrical energy.

Provide a simplified explanation of the photovoltaic effect, describing how energy is generated. (4)

[43]

TOTAL: 100

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FORMULA SHEET

Any other applicable equation or formula may also be used.

$$W = F \times s$$

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

$$E = P \times t$$

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

$$Q = I \times t$$

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

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

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

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

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

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

$$E_v = \frac{P \times K_\lambda}{A}$$

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