higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

RENEWABLE ENERGY TECHNOLOGIES
NQF LEVEL 2

(12041042)

2 December 2020 (X-paper)
09:00–12:00

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

229Q1N2002

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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 question on a new page.
5. Sketches must be large, neat and fully labelled.
6. Show all calculation steps where calculations should be done.
7. Write neatly and legibly.

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QUESTION 1

1.1 During the 2019 Easter weekend, the coastal city of Durban, South Africa, experienced severe flooding caused by torrential rain. The floods resulted in approximately 70 deaths caused by collapsed buildings, mudslides and sinkholes. It is one of the deadliest disasters to hit the country in the 2010s and it became necessary for the city to adapt to climate change.

1.1.1 Define the term *adaptation*. (2)

1.1.2 Give TWO examples of adaptation practices that can be applied in Durban. (2)

1.2 List THREE priorities of the National Strategy for Sustainable Development. (3)

1.3 1.3.1 Discuss the THREE criteria used to classify an energy source as renewable. (3)

1.3.2 Why is renewable energy technologies a viable investment for South Africa? (3 × 2) (6)

1.4 Briefly explain the TWO coordinates (angles) used to describe the position of the sun at any given time. (4)

[20]

QUESTION 2

2.1 2.1.1 Define the term w*ork* as it relates to electrical energy. (2)

2.1.2 Define the term e*nergy*. (1)

2.1.3 Explain the relationship between *work* and *energy*. (3)

2.1.4 Calculate the amount of work done if an electric kettle with a power rating of 2 kW boils for 20 seconds. (3)

2.2 2.2.1 Explain the *law of conservation of charge (energy)*. (3)

2.2.2 Explain how a neutrally charged plastic ruler can become negatively charged when rubbed against neutrally charged human hair. (3)

2.3 Three resistors of 5 Ω, 10 Ω and 20 Ω are connected in parallel across a 24 V battery.

2.3.1 Draw and label the circuit diagram. (4)

2.3.2 Calculate the total resistance of the circuit. (3)

2.3.3 Calculate the total current of the circuit. (3)

[25]

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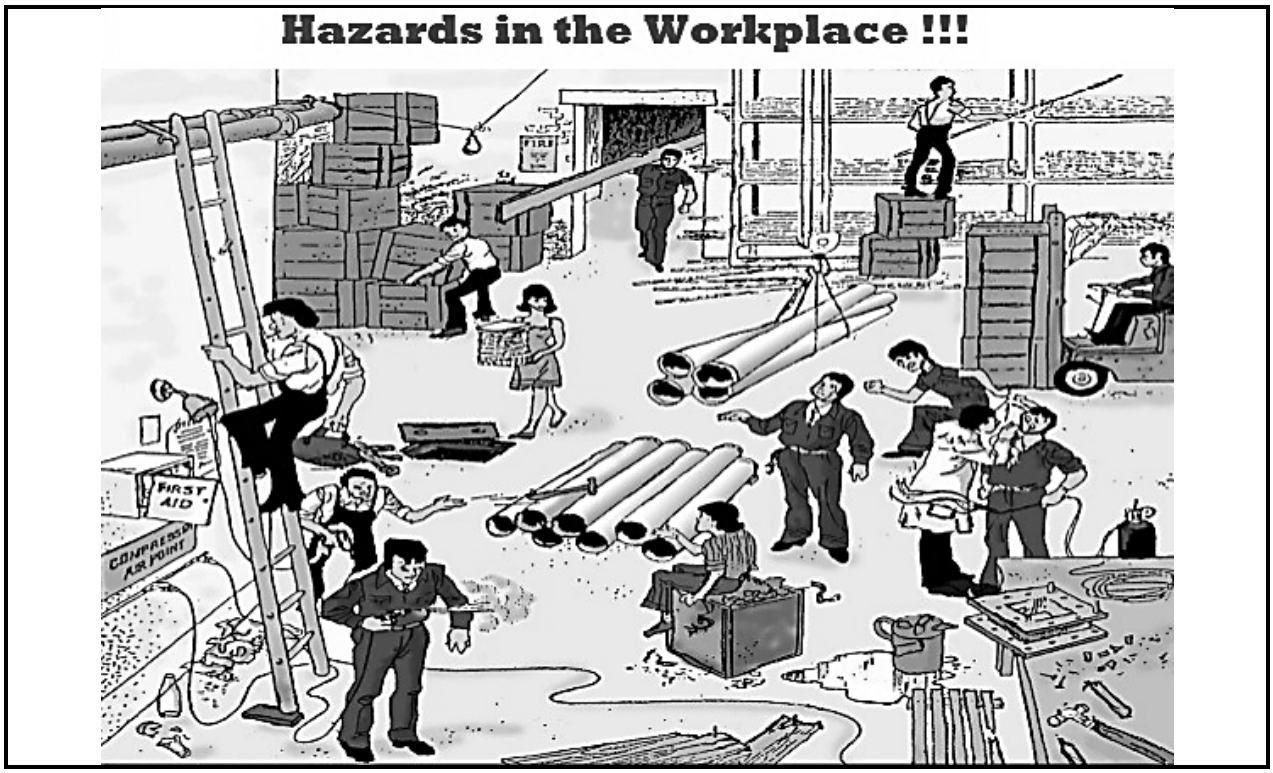
QUESTION 3



[Source: *https://safetyhelpline.wordpress.com/2015/07/27/safety-toolbox-talk-hazards-in-the-workplace/*]

FIGURE 1

3.1 Identify SIX workplace hazards in FIGURE 1. (6)

3.2 Design a health and safety checklist that can be used to prevent the accidents in FIGURE 1. (6)

[12]

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QUESTION 4

4.1 Study the solar panel specifications in FIGURE 2 and answer the questions.

Mechanical Data

Product Code	**CS3W-390P | CS3W-395P | CS3W-400P | CS3W-405P**
Cell Type	Poly-crystalline
Cell Arrangement	144 [2 x (12 x 6)]
Dimensions	2108 x 1048 x 40mm
Weight	24,9kg
Front Cover	3,2mm tempered glass
Frame Material	Anodised aluminium alloy, crossbar enhanced
J-Box	IP68, 3 bypass diodes
Connectors	T4 series

Ordering Information | STC*

Product Code	Nominal Max. Power	Opt. Operating Voltage	Opt. Operating Current	Open Circuit Voltage	Short Circuit Current	Max. Series Fuse Rating	Module Efficiency
CS3W-390P	390W	38.3V	10.19A	46.8V	10.74A	20A	17.65%
CS3W-395P	395W	38.5V	10.26A	47V	10.82A	20A	17.88%
CS3W-400P	400W	38.7V	10.34A	47.2V	10.90A	20A	18.11%
CS3W-405P	405W	38.9V	10.42A	47.4V	10.98A	20A	18.33%

* Under Standard Test Conditions (STC) of irradiance of 1000 W / m², spectrum AM 1,5 and Cell temperature of 25°C.

[Source: *https://www.rubiconsa.com/files/2019/04/Solar-panels.pdf*]

FIGURE 2

4.1.1 Name and distinguish between the different cell structures of TWO types of PV panels. Which would be the most efficient? (5)

4.1.2 Explain the function of a bypass diode. (2)

4.1.3 How many of these PV panels can be installed on a 300 m^2 effective roof surface? (3)

4.1.4 How many solar cells are within one PV panel? (2)

4.1.5 Calculate the open-circuit voltage if FOUR CS3W-390P panels are connected in series. (2)

4.1.6 Calculate the open-circuit voltage if EIGHT CS3W-405P panels are connected in parallel. (2)

4.1.7 Calculate the short-circuit current if FOUR CS3W-395P panels are connected in parallel. (2)

4.1.8 Calculate the short-circuit current if FIVE CS3W-400P panels are connected in series. (2)

4.1.9 Differentiate between *operating voltage* and *open-circuit voltage*. (2)

4.1.10 Explain the effect that ambient temperature has on module performance (efficiency). (3)

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4.2 Study the components below and answer the questions.

A



B



C



D



E



[Source: *https://www.rubiconsa.com/solar-solutions/*]

4.2.1	List FOUR requirements to consider when selecting component D.	(4)
4.2.2	Explain the purpose of component A.	(3)
4.2.3	List THREE factors to consider when selecting component A.	(3)
4.2.4	Explain why component E is highly recommended.	(2)
4.2.5	Which TWO components are usually integrated? 	(2)
4.2.6	What is the difference between component B and component C?	(2)
4.2.7	Give the correct name of component C.	(2)
		[43]
	TOTAL:	**100**

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FORMULA SHEET

Any 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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