higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

RENEWABLE ENERGY TECHNOLOGIES
NQF LEVEL 2

(12041042)

12 March 2018 (X-Paper)
09:00–12:00

This question paper consists of 9 pages and 1 formula sheet.

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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. Round off values to THIRD decimal place.
5. Write neatly and legibly.

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QUESTION 1

1.1 State ONE advantage and ONE disadvantage of each of the following renewable energy resources:

1.1.1 Hydropower

1.1.2 Wind energy

1.1.3 Concentrated solar power

1.1.4 Photovoltaic technology

(4 × 2) (8)

1.2 With respect to climate change, give possible adaptation practices that could be implemented in a region that is experiencing drought. (4)

1.3 The capacity to mitigate effectively depends on certain factors such as the socio-economic and environmental circumstances, and the availability of information and technology to a region.

1.3.1 With respect to the statement in QUESTION 1.3, give TWO ways to stop increasing the amount of GHG emissions in the atmosphere.

1.3.2 With respect to the statement in QUESTION 1.3, give TWO ways in which the reduction of GHG emissions in a region is usually accomplished.

(2 × 2) (4)

1.4 The Green Economy Accord was signed in November 2011. The Green Economy Accord is used to guide the South African government and its social partners in implementing various projects and initiatives to secure the nation's energy demand.

Give a description for TWO of the twelve commitment areas which were identified in the Green Economy Accord. (4)

[20]

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QUESTION 2

2.1 An energy analysis is completed to compare the cost-effectiveness when using three different light bulbs.

Study the following TABLE and provide the missing information by answering questions 2.1.1–2.1.5 below.

	LED	CFL	Incandescent
Name	Ellies	PnP no name	Eurolux
Price (R)	R 75,60	R 32,75	R 11,50
Life span (hrs)	25000	8000	1200
Power (W)	10	24	100
Voltage (V)	220	220	220
Energy costs (R/kWh)	R 1,04	R 1,04	R 1,04
Daily energy cost (R)	2.1.1.	R 0,22	R 0,93
Annual energy cost (R)	R 34,11	2.1.3.	R 341,15
Energy cost for LED life span (R)	R 259,63	R 623,10	R 2 596,25
Replacement bulbs compared to LED	1	3,1	2.1.4.
Total cost for LED hours including bulb price	2.1.2.	R 725,44	2.1.5.

[Image source: *Self-supplied*]

TABLE

Calculate the following:

2.1.1 The daily energy cost if the LED lamp is on for 9 hours per day. (2)

2.1.2 The total energy cost if the LED lamp is on for its full life span of 25 000 hours. (2)

2.1.3 The annual energy cost if the CFL lamp is on for 9 hours per day. (2)

2.1.4 How many incandescent lamps are required when replacing them with one LED lamp? (2)

2.1.5 The total energy cost for using incandescent lamps instead of using one LED lamp. (3)

2.1.6 Write a brief conclusion on what you observed with the data provided in the TABLE above and your answers to the above questions. (3)

2.2 Describe the following scientific terms:

2.2.1 Work

2.2.2 Electric current

(2 × 2) (4)

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2.3 An electric kettle is connected to a 230 V supply. The resistance of its heating element is 20 Ω.

Determine the following:

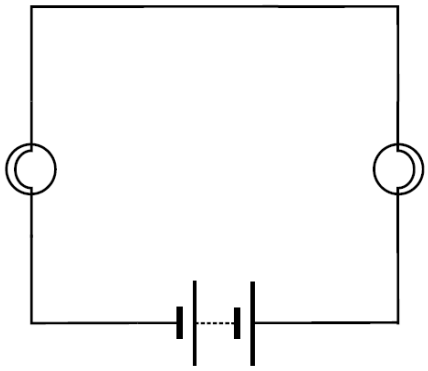
2.3.1 Electric current in ampere

2.3.2 Power rating of the kettle in watts

2.3.3 The electrical energy consumed if the kettle heats up water for 2,5 minutes

(3 × 2) (6)

2.4 In the circuit shown in FIGURE 1 below, two lamps are connected in series to a battery.



[Image source: *RET Level 2 textbook*]

FIGURE 1

2.4.1 Redraw the circuit in FIGURE 1 illustrating how you would connect the ammeter in order to measure the current through the circuit.

2.4.2 Redraw the circuit in FIGURE 1 illustrating how you would connect the voltmeter in order to measure the potential difference across a lamp.

(2 × 2) (4)

[28]

QUESTION 3

3.1 Choose a description from COLUMN B that matches an item in COLUMN A. Write only the letter (A–F) next to the question number (3.1.1–3.1.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
3.1.1	Risk	A	the occurrence of an undesirable event which causes or could cause an injury, illness or disease to a person or damage to equipment or property
3.1.2	Hazard	B	are incidents where no injury or property damage has occurred, but could potentially have happened
3.1.3	Incident	C	an unplanned or uncontrolled event caused by unsafe acts or unsafe conditions, resulting in physical harm to a person or damage to property
3.1.4	Near misses	D	the probability of a worker being injured or suffering from a workplace-related incident
3.1.5	Accident	E	any damaging physical force which is applied to the human body, leaving a person harmed or weakened in any way
		F	the potential of any machine, equipment, process, material or physical factor to cause harm to people or damage to property or the environment

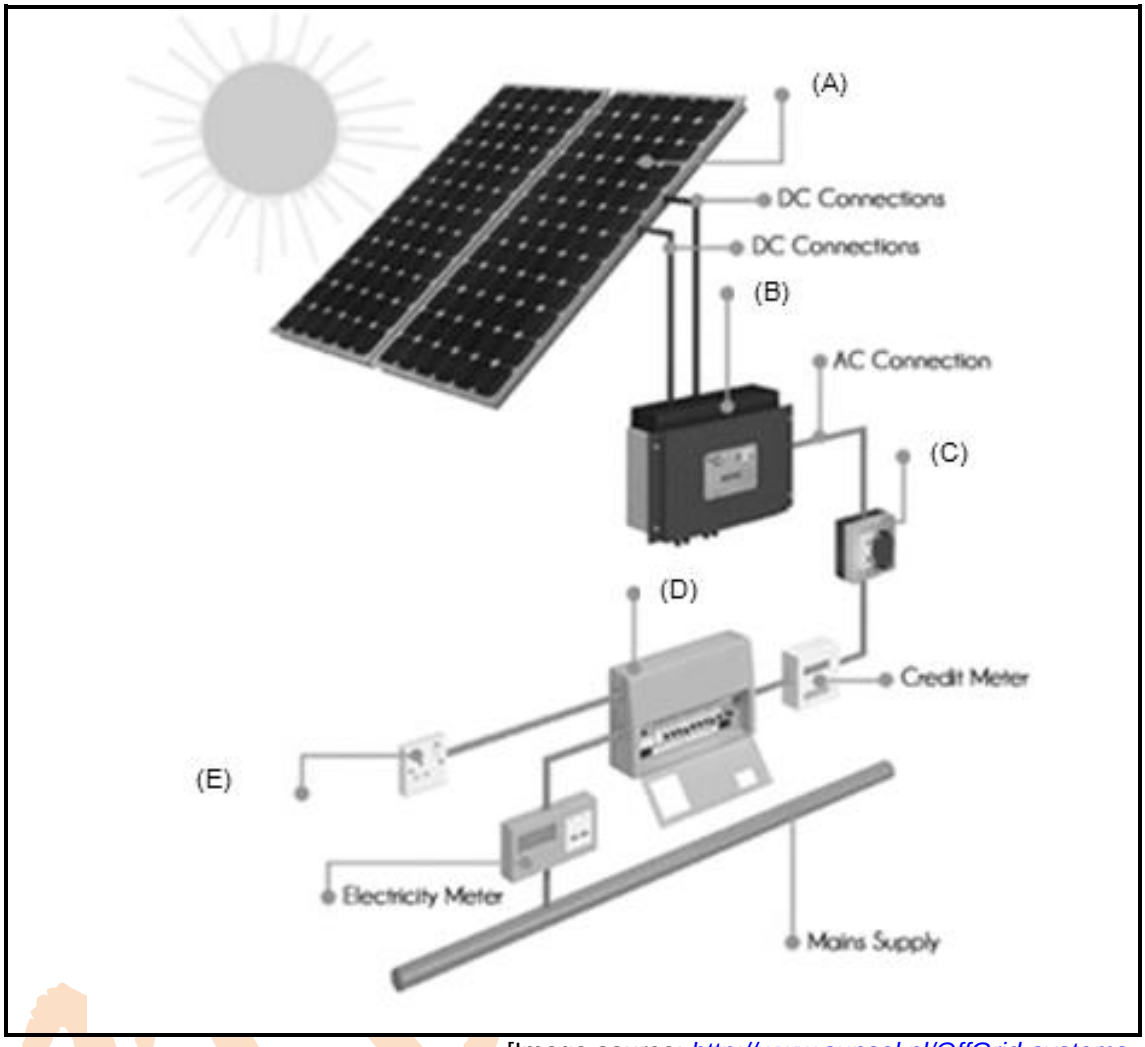
(5 × 1) (5)

3.2 State the SEVEN steps that should be followed during lockout/tagout (LOTO) procedures. (7)

[12]

QUESTION 4

4.1 Study FIGURE 2 below and answer the questions.



[Image source: *http://www.sunsol.pl/OffGrid-systems*

FIGURE 2

4.1.1 Name the type of PV system depicted in FIGURE 2. (1)

4.1.2 Describe the function and operation of the device/component labelled (A) in FIGURE 2. (7)

4.1.3 List SEVEN factors that may improve the performance of the device/component labelled (A) in FIGURE 2. (7)

4.1.4 Name the device labelled (B) in FIGURE 2. (1)

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4.1.5 An important device is required in order to safely replace or service the device/component labelled (B) in FIGURE 2. Give the name of the required device.

HINT: the required device is to be installed between (A) and (B). (2)

4.1.6 Describe the function and operation of the device/component labelled (B) in FIGURE 2. (4)

4.1.7 State the FOUR requirements to be considered when selecting the device/component labelled (B) in FIGURE 2 for a PV system. (4)

4.1.8 Draw the IEC schematic symbol for the device labelled (B) in FIGURE 2. (1)

4.1.9 Describe the function of the device labelled (C) in FIGURE 2. (2)

4.1.10 If (E) in FIGURE 2 is found in a typical South African household, what should the expected voltage output and the expected current type be? (2)

4.2 The data sheet for the Shuco SPV 200 and SPV 210 is provided in FIGURE 3 below.
Study the data sheet and answer the questions.

Electrical specifications	Module output classes	
Power output under standard test conditions (STC)*	SPV 200 SMAU-1	SPV 210 SMAU-1
Rated power (P_{mpp})	200 W	210 W
Effective output tolerance (ΔP_{mpp})	+ 3 % / - 3 %	+ 3 % / - 3 %
Guaranteed minimum output ($P_{mpp\ min}$)	194 W_p	203.7 W_p
Number, layout and size of cells	54 (6x9) 6" monocrystalline cells	
Rated voltage (U_{mpp})	25.38 V	26.3 V
Rated current (I_{mpp})	7.89 A	7.98 A
Open-circuit voltage (U_{oc})	33.53 V	33.68 V
Short circuit current (I_{sc})	8.24 A	8.35 A
Cell efficiency	16.0%	16.8 %
Module efficiency	14.2%	14.9%
Temperature coefficient α (P_{mpp})	-0.5028 % / K	-0.5028 % / K
Temperature coefficient β (I_{sc})	+0.03456 % / K	0.03456 % / K
Temperature coefficient χ (U_{oc})	-0.3313 % / K	-0.3313 % / K
Temperature coefficient δ (I_{mpp})	+ 0.03456 % / K	+ 0.03456 % / K
Temperature coefficient ξ (U_{mpp})	-0.3313 % / K	-0.3313 % / K
Normal Operating Cell Temperature (NOCT)**	109.4 °F (+/-35.6 °F) / 43° C (+/- 2°C)	109.4 °F (+/-35.6 °F) / 43° C (+/- 2°C)
Maximum system voltage permitted	600 V	600 V
Series fuse rating	15 A	15 A

[Image source: *https://www.solarelectricsupply.com/schuco-spv-210-smau-1-monocrystalline-photovoltaic-solar-panels-318*]

FIGURE 3

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4.2.1 Explain the difference between *rated voltage* and *open-circuit voltage.* (6)

4.2.2 What is the value of the current at maximum power for the SPV 200 SMAU-1 PV module? (1)

4.2.3 Explain what is meant by *short-circuit current.* (2)
[40]

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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