higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

RENEWABLE ENERGY TECHNOLOGIES
NQF LEVEL 3

(12041043)

10 March 2020 (X-paper)
09:00–12:00

This question paper consists of 6 pages.

409Q1S2010

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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 blue or a black pen.
6. Use the formulae below.
7. Write neatly and legibly.

FORMULAE

RENEWABLE ENERGY TECHNOLOGIES L3

$\Delta = V \times C \times \Delta T$

$Q = C \times m \times \Delta T$

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QUESTION 1

1.1 List THREE ways in which South Africa intends to reduce CO_2 levels. (3)

1.2 Explain the aims of the national solar water heating programme (2010–2014). (2)

1.3 Give FOUR factors which will help to effect financial returns from the installation of a solar water heating system. (4)

1.4 List THREE issues addressed in SANS 10252-1 – Water Supply and Drainage for Buildings. (3)

1.5 Choose an act from COLUMN B that matches the description in COLUMN A. Write only the letter (A–C) next to the question number (1.5.1–1.5.3) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.5.1	Regulates a person's right to use water and gives details about fair distribution and responsible use of water resources	A	Occupational Health and Safety Act
1.5.2	Explains workers' rights in terms of health and safety	B	Water Services Act (108 of 1977)
1.5.3	Ensuring safe installation and usage of solar water heating systems	C	National Building Regulations and Building Standards Act (103 of 1977)

(3 × 1) (3)

1.6 Study the information in the table below and calculate the following:

VARIABLES	DATA AND CALCULATIONS
Electricity usage of household per month	2500 kWh
Electrical usage of geyser per month	625 kWh
Cost per kWh	R2,50
Electricity saved for hot water generation per month	350 kWh
System and installation costs for 200 liters high-pressure solar water heating system	R32 500,00
Cost of electric geyser	R9 000,00

1.6.1 Total extra cost of solar water heating system (1)

1.6.2 Monthly saving in rands (2)

1.6.3 Payback period (2)

[20]

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QUESTION 2

2.1 Name FIVE components of a flat-plate collector. (5)

2.2 Define *shading* in relation to the collector and system performance. (2)

2.3 Give ONE term for each of the following descriptions by writing it next to the question number (2.3.1–2.3.8) in the ANSWER BOOK.

2.3.1 Mounting used on homes with a flat or low-pitched roof (<10°)

2.3.2 Radiation reflected off a surface and redirected to its medium of origin without being absorbed

2.3.3 Collectors mounted directly onto roof surface

2.3.4 Two brackets normally required per collector for mounting

2.3.5 When a substance emits heat energy by releasing it into its surrounding medium

2.3.6 Type of mounting that can be placed into roof construction itself

2.3.7 Mounting which slightly elevates collector from surface of roof allowing air and rainwater to pass underneath it

2.3.8 Two substances of different temperatures in direct contact with each other

(8 × 1) (8)

2.4 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (2.4.1–2.4.7) in the ANSWER BOOK.

2.4.1 Radiation is energy emitted in the form of light.

2.4.2 Convection is the most efficient way to transfer heat.

2.4.3 Frost can affect the efficiency of a solar water heating system.

2.4.4 Experiment design and planning of hands-on activities should follow the scientific method.

2.4.5 The collector orientation must always face north in the Southern Hemisphere.

2.4.6 Rafters are not used to lend support to a solar water heating system.

2.4.7 Shading is a great way to increase collector efficiency and system performance.

(7 × 1) (7)

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2.5 Define *absorptance* as a form of energy conversion. (2)

2.6 As water is heated it expands in volume as the temperature increases.

Determine the quantity of energy in kWh required to raise the temperature of 1120 litres of water from 15° to 95°. Assume 1 litre of water has a mass of 1 kg.

Given:

m = 1120
C = 3.5 J/g/°C
$T_{initial}$ = 15 °C
T_{final} = 9 °C
Conversion factor: 1 Wh = 4.2 kJ (4)

2.7 State any TWO general instructions for roof work and solar water heating installations. (2)
[30]

QUESTION 3

3.1 What is a *chemical hazard*? (4)

3.2 Explain each of the following terms:

3.2.1 Risk

3.2.2 Hazard

(2 × 1) (2)

3.3 Give FOUR guidelines how a solar heating installer can use safe work practice to gain access to a roof to install a solar water heating system. (4)

3.4 Why would a solar heating installer consider the use of a suitable fall arrest system when working at heights? (5)
[15]

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QUESTION 4

4.1 Flat-plate collectors usually come in two configurations, either with harp-shaped absorber pipes or with meander absorbers.

Make TWO neat line drawings to illustrate each configuration. (6)

4.2 Give a brief analysis of the construction of an evacuated tube collector and how it works. (3)

4.3 Why is it important to install an air release valve in an evacuated tube system? (3)

4.4 Name TWO types of fittings used to make a nonpermanent and permanent connection on a solar water heating installation. (2)

4.5 Name the main types of valves used to complete the installation of a low-pressure system. (3)

4.6 What measures are available for frost protection? (2)

4.7 Name a few basic items required for a site inspection where you have to take notes, pictures, measurements and make drawings. (6)

4.8 What is the difference between a *low-* and *high-pressure system*? (4)

4.9 What are the minimum installation standards for a domestic solar thermal application? (6)

[35]

TOTAL: 100

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