higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

RENEWABLE ENERGY TECHNOLOGIES
NQF LEVEL 3

(12041043)

27 November 2023 (X-paper)
09:00–12:00

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

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)
RENEWABLE ENERGY TECHNOLOGIES
NQF LEVEL 3
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. Use only a black or blue pen.
6. Write neatly and legibly.

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QUESTION 1

1.1 List the THREE objectives of the revised National Solar Water-heating Programme. (3)

1.2 Because of various challenges, the National Solar Water-heating Programme (NSWHP 2010-2014) had to be re-engineered.

State THREE challenges that the NSWHP 2010-2014 were faced with. (3)

1.3 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.3.1–1.3.2) in the ANSWER BOOK.

1.3.1 Greenhouse gases (GHGs) are not responsible for global warming and weather extremes – instead it has a positive effect on South Africa's economy and environment.

1.3.2 Installing solar water-heating (SWH) systems are one of the ways to reduce CO2 emissions and improve energy efficiency to address the national reduction targets.

(2 × 1) (2)

1.4 Give THREE benefits of solar water-heating for home owners. (3)

1.5 Use the following data to calculate the payback time in years for a solar water-heating system.

Variables	Data and calculations
Average consumption of electrical energy per month (household)	1 850 kWh
Electrical energy consumption of a geyser per month	500 kWh
Cost per kWh (cost depends on region/year and municipality)	R3
Electrical energy for hot-water generation saved per month by conversion from electric geyser to solar water system	250 kWh
System and installation costs for a 200 litre high-pressure solar water-heating system	R26 500
Cost of equally sized electric geyser	R7 500
Total extra cost for the solar water-heating system	1.5.1
Monthly kWh saving in rand	1.5.2
Payback period in years	1.5.3

(3 × 2) (6)

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1.6 Explain why each of the following acts is relevant for a solar water-heater installer:

1.6.1 National Building Regulations and Building Standards Act

1.6.2 Occupational Health and Safety Act

1.6.3 Water Services Act

(3 × 1) (3)
[20]

QUESTION 2

2.1 Choose ONE term from the list below for each of the following descriptions and write it next to the question number (2.1.1–2.1.7) in the ANSWER BOOK.

density; thermal energy; transmittance; potential energy; convection; direct irradiation; absorptance; insolation; diffused irradiation

2.1.1 Energy that is stored and becomes noticeable only when it is released and transformed into another form of energy

2.1.2 Radiation converted into sensible heat within a material

2.1.3 Occurs when lower warmer fluids rise to cooler upper areas in a liquid

2.1.4 Radiation received on the surface of an object or substance and passing through the material

2.1.5 Beam of sunlight travelling straight from the sun directly to the ground or a receiver surface

2.1.6 Measures the solar energy received at a specific area over time

2.1.7 Physical property of matter – mass per unit volume

(7 × 1) (7)

2.2 Briefly define each of the following modes of heat transfer:

2.2.1 Conduction

2.2.2 Convection

2.2.3 Radiation

(3 × 2) (6)

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2.3 Explain each of the following types of mounting:

2.3.1 Rack mounting

2.3.2 Standoff mounting

2.3.3 Direct mounting

(3 × 2) (6)

2.4 List FOUR ways to improve the performance of a solar water-heating system. (4)

2.5 Name THREE ways to deal with the effects of shading. (3)

2.6 List THREE noble metals that are very good heat conductors. (3)

2.7 Explain the purpose of an expansion vessel. (1)

[30]

QUESTION 3

3.1 Briefly explain the precautionary measures to protect yourself against falls through skylights and penetrations. (2)

3.2 Complete the following sentences by choosing a word or words from the list below. Write only the answer next to the question number (3.2.1–3.2.4) in the ANSWER BOOK.

competent; scaffolds; firm; platform; hazards

3.2.1 All workers using a scaffold should be trained on how to use the scaffold and how to recognise … associated with the type of scaffold they are working on.

3.2.2 A … person must be available to set up the scaffold.

3.2.3 There are different kinds of … and the one used must be suitable for the specific job and must be able to carry the necessary load (tools, equipment, workers, etc.).

3.2.4 Use a … foundation to set up the scaffold.

(4 × 1) (4)

3.3 Explain, by means of a neat sketch, how to correctly set up a ladder against a wall. (4)

3.4 Explain the purpose of a safety harness. (5)

[15]

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QUESTION 4

4.1	Explain a low-pressure system by means of a neat, labelled sketch.		(10)
4.2	Make a neat, labelled drawing of a double-walled heat pipe tube.		(6)
4.3	List THREE typical plumbing tools and give their uses.	(3 × 2)	(6)
4.4	Briefly explain how to fit a compression fitting to a copper pipe.		(4)
4.5	List the FIVE steps to verify system operation after it has been flushed.		(5)
4.6	Compare the main differences in operation of *active heating systems* and *passive heating systems*.	(2 + 2)	(4)
			[35]

TOTAL: 100

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FORMULA SHEET

$\Delta = V \times Ce \times \Delta T$

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

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