higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

RENEWABLE ENERGY TECHNOLOGIES
NQF LEVEL 3

(12041043)

16 November 2022 (X-paper)
09:00–12:00

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

407Q1N2216

Copyright reserved

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 black or blue pen.
6. Write neatly and legibly.

Copyright reserved

QUESTION 1

1.1 Why is South Africa considered a significant contributor to greenhouse gas emissions? (2)

1.2 List the THREE main objectives of the revised NSWP (2015-2019) programme. (3)

1.3 State TWO reasons why municipalities would choose to use solar water-heating technologies. (2)

1.4 Convince a potential client to convert from using a conventional electric geyser to a solar water-heating system by explaining the benefits of solar thermal systems. (4)

1.5 Name any FOUR factors that affect the financial returns (savings) of installing a solar water-heating system. (4)

1.6 Give a brief explanation of your understanding of the Water Services Act (No. 8 of 1977). (2)

1.7 List any THREE important references to solar water-heating systems reflected in SANS 10400 XA. (3)

[20]

QUESTION 2

2.1 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (2.1.1–2.1.7) in the ANSWER BOOK.

2.1.1 Emittance is when radiation is converted into sensible heat within the material.

2.1.2 Building the equipment is a step included in conducting an experiment using the scientific method.

2.1.3 Conduction is energy emitted in the form of light.

2.1.4 The quality of water can affect the efficiency of a solar water-heating system.

2.1.5 Four hanger brackets are usually required per collector.

2.1.6 Density is commonly referred to as the mass per unit of volume.

2.1.7 Glazing is a transparent cover that forms part of a flat-plate collector.

(7 × 1) (7)

Copyright reserved

2.2 You are required to install a solar water-heating system. Your client, Mr Blue, demands that you install the system even though a few of his roof tiles are broken. Mr Blue also states that he will not cut down a big tree that has been growing on his property for the past twenty years. Furthermore, Mr Blue insists on using plastic mounting frames when installing the solar thermal system as it will be more cost effective. Mr Blue has a pitched roof with a low inclination.

Consider the above and answer the following questions:

2.2.1 Will you install the solar water-heating system? (1)

2.2.2 Give reasons for your answer to QUESTION 2.2.1. (2)

2.2.3 What advice can you give Mr Blue to deal with the shading caused by his tree? (3)

2.2.4 How will you ensure that the rafters and trusses support the solar water-heating installation at Mr Blue's house? (4)

2.3 Determine the volume increase of 100 litres of water based on a temperature increase of 90 °C. The water temperature must be increased from 10 °C to 100 °C.

Known quantities:

Cubic expansion coefficient for water = Ce: 0,0007
Temperature increase (ΔT) = 90 °C (3)
Volume of water (V) = 100 litres

2.4 Study FIGURE 1 below and answer the questions that follow.

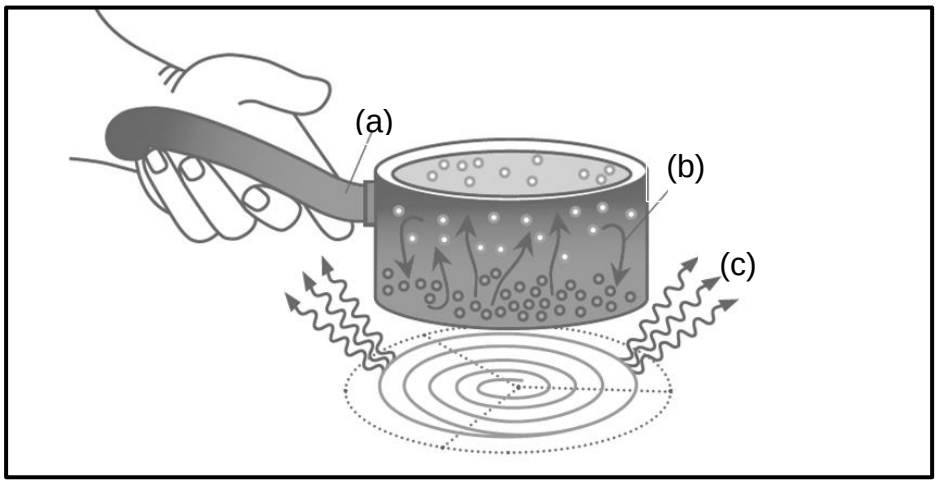


FIGURE 1 [Source: GIZ/S4GJ]

2.4.1 In your own words, define TWO of the heat transfer methods illustrated in FIGURE 1 above. (4)

2.4.2 What common criteria is required for heat transfer? (1)

2.5 As an SWH installer, you would be required to calculate the approximate collector area that would ensure adequate water heating as per your customer's requirements.

Determine the required collector area by utilising the information provided below.

Known quantities:

Sunshine duration = 8 hours (8 h)
Average irradiance = 1 kW/m^2
System efficiency (η) = 0,4 (40%)
Q_u = 5,75 kWh/day (5)
[30]

QUESTION 3

3.1 Complete the following sentences by giving the missing word regarding risk and hazards while working on SWH systems. Write only the word next to the letter (a-f) and the question number (3.1.1–3.1.3) in the ANSWER BOOK.

3.1.1 Safety hazards include working at (a) …, around unguarded and moving machinery, burning-, scalding- and (b) … hazards. (2)

3.1.2 Ergonomic hazards include (c) …of heavy objects, collectors and (d) …, poor posture and awkward movements. (2)

3.1.3 Chemical hazards caused by (e) … transfer (f) …, for instance. (2)

3.2 As an SWH installer, you will frequently have to work at heights. You should therefore use adequate fall-arrest equipment to ensure that you are safe and to prevent the pendulum effect when using a harness system.

List THREE methods to prevent the *pendulum effect*. (3)

3.3 Make a labelled sketch of the correct setup when using a secured straight ladder. (6)
[15]

Copyright reserved

QUESTION 4

4.1 Describe the basic function of the following valves:

4.1.1 Tempering or mixing valve

4.1.2 Vacuum breaker

4.1.3 Non-return valve

(3 × 2) (6)

4.2 Consult and complete the table for valve testing and fault finding below. Write only the correct answer next to the question number (4.2.1–4.2.5) in the ANSWER BOOK.

Valves	Possible causes	Remedies/Corrective actions
Fault: System does not produce enough hot water		
Check valve	4.2.1	Inspect valve and repair or replace
Isolation valves	4.2.2	4.2.3
Fault: No water		
Cold water supply valve	4.2.4	4.2.5

(5)

4.3 What is a *direct (open loop) system*? (4)

4.4 Define at least TWO advantages and TWO disadvantages of a direct system. (4)

4.5 Study FIGURE 2 below and identify the illustrated tools commonly used by SWH installers. Write only the correct answer next to the letter (a–c) in the ANSWER BOOK. (3)

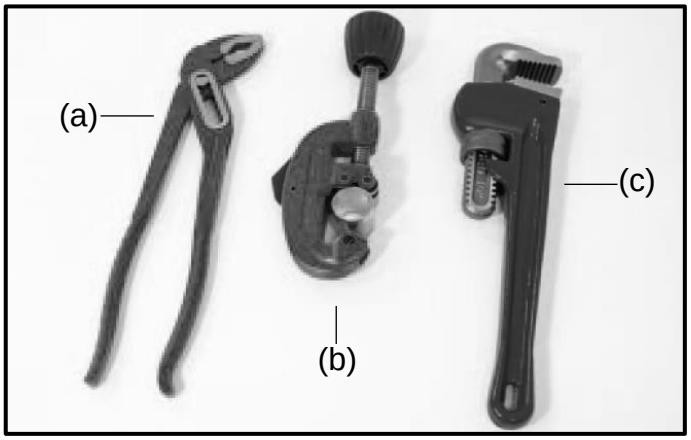


FIGURE 2 [Source: GIZ/S4GJ

4.6 In your own words, describe the chronological process related to a capillary soldered joint being done when using copper pipe. (8)

4.7 Illustrate, by means of a simple line drawing, the installation of a collector bracket mounted onto a rafter of a metal or corrugated roof. (5)

[35]

TOTAL: 100

Copyright reserved

(12041043)

FORMULA SHEET

RENEWABLE ENERGY TECHNOLOGIES L3

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

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

Copyright reserved