higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

RENEWABLE ENERGY TECHNOLOGIES
NQF LEVEL 4

(12041044)

22 November 2018 (Y-Paper)
13:00–16:00

This question paper consists of 8 pages.

NCV

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. Write neatly and legibly.

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QUESTION 1

1.1 A few years from now you could be a potential investor in wind-power projects. Answer the following questions as someone interested in investing in wind-power projects in South Africa.

1.1.1 Write each of the following acronyms in full:

(a) WASA

(b) SANERI

(c) CSIR

(3 × 1) (3)

1.1.2 Would it be wise to invest in wind-power projects in South Africa? Give a reason for the answer. (4)

1.1.3 Name THREE regions in South Africa most favourable for the installation of wind farms. (3)

1.2 Costs of wind projects are different compared to conventional fossil-fuel technologies because 90% of the total project costs are upfront costs. COLUMN A is a list of some of the divisions required for installing a wind farm and COLUMN B is a list of the percentage (%) share of the total costs of the wind farm.

Choose the correct share of total costs (%) from COLUMN B that matches the division of the wind-farm project in COLUMN A. Write only the letter (A–F) next to the question number (1.2.1–1.2.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.2.1	Grid connection	A	75,6%
1.2.2	Electric installation	B	0,9%
1.2.3	Turbine (ex works)	C	8,9%
1.2.4	Road construction	D	3,9%
1.2.5	Foundation	E	6,5%
		F	1,5%

(5 × 1) (5)

1.3 With respect to an overview of the hydrogen economy:

1.3.1 Write a paragraph to explain how hydrogen may be used as an alternative fuel, (5)

1.3.2 State TWO benefits of using hydrogen as an alternative fuel. (2)

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1.4 Answer the following questions about South Africa's participation in the fuel-cell industry.

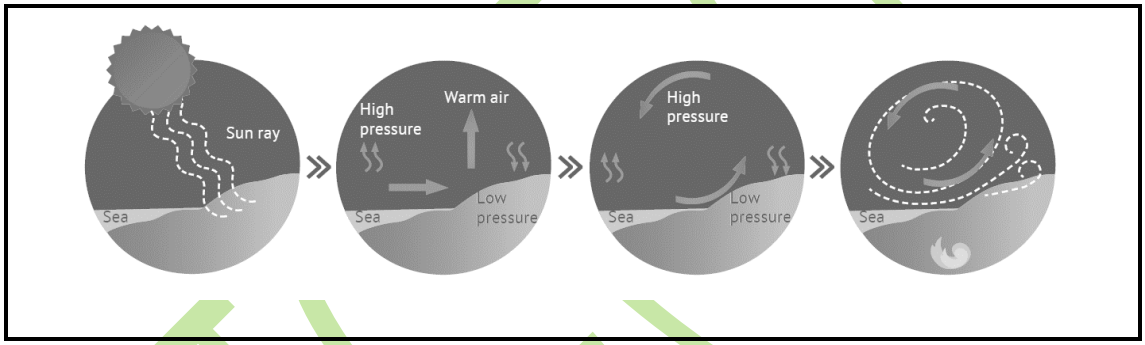
Name THREE opportunities that could arise if South Africa becomes a fuel-cell deployment hub to the rest of the world. (3)

[25]

QUESTION 2

2.1 A family decided to go the beach at 14:00 on a warm, sunny day. After settling down and getting ready for a swim, they were unhappy to find that a sudden sea breeze was blowing.

Use FIGURE 1 to explain how this sudden sea breeze was caused.



[Source: *S4GJ Renewable Energy Technologies Level 4 Textbook*]

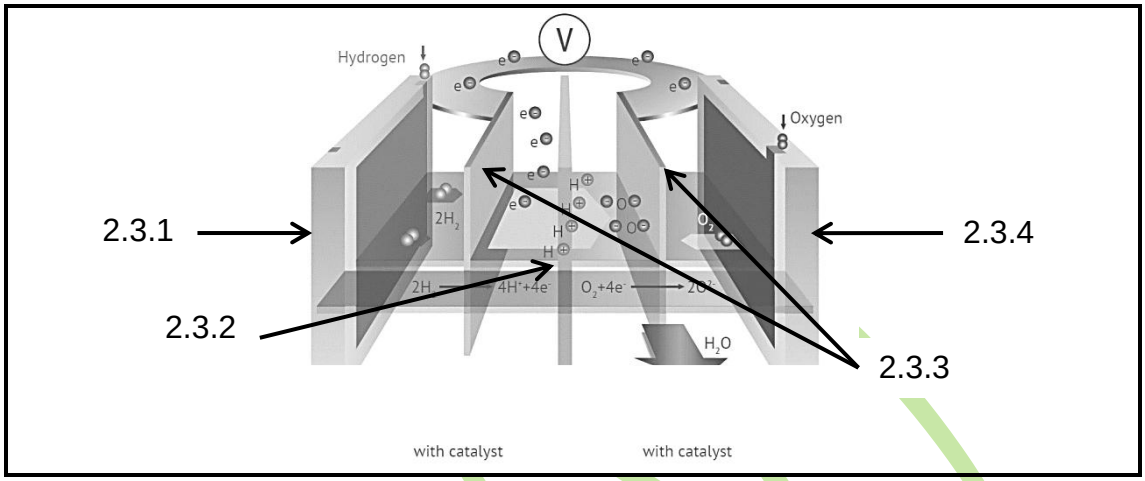
FIGURE 1 (10)

2.2 Make a labelled sketch of a typical large-scale horizontal-axis wind turbine. Clearly indicate the following components in the sketch:

- Tower
- Nacelle
- Blades
- Low-speed shaft
- Brakes
- Gearbox
- Generator
- High-speed drive
- Hub (11)

2.3 Study the schematic diagram of a proton exchange membrane fuel cell (PEMFC) in FIGURE 2.

Label the components by writing the answer next to the question number (2.3.1–2.3.4) in the ANSWER BOOK.



[Source: *S4GJ Renewable Energy Technologies Level 4 Textbook*]

FIGURE 2 (4 × 1) (4)

[25]

QUESTION 3

3.1 List FOUR hazards associated with the transport of wind-turbine components. (4)

3.2 You are a wind-turbine service technician working on the wind farm shown in FIGURE 3. You have completed physical and visual inspection and concluded that there is an electrical fault at the wind-farm substation. Your task is to shutdown (isolate) the electrical energy supplied by the turbines.

List, in order, the first SIX steps to complete a lock-out tag-out procedure at the substation.



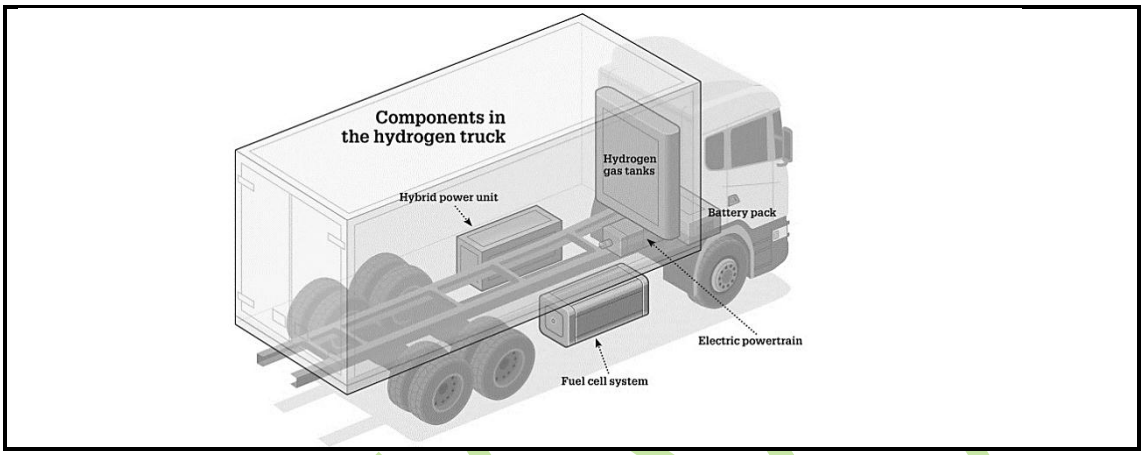
(6)

[Source: http://www.tdworld.com/renewables/thailand-integrates-large-scale-wind-farms]

FIGURE 3

3.3 A truck driver has been driving conventional internal combustion-powered trucks for many years. He is now asked by the owner of the company to drive a hydrogen fuel-powered truck. The driver and his family are concerned about the safety of driving hydrogen-powered trucks.

Give FIVE important properties of hydrogen that makes the gas so volatile.



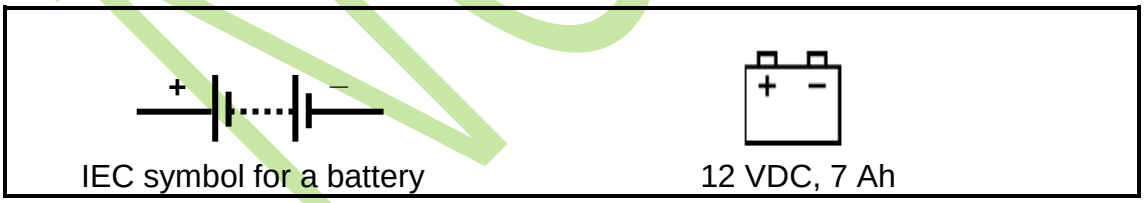
[Source: *https://www.scania.com/group/en/hydrogen-a-fuel-of-the-future/*]

FIGURE 4

(5)
[15]

QUESTION 4

4.1 Study the battery specifications given in FIGURE 5.



IEC symbol for a battery 12 VDC, 7 Ah

FIGURE 5

4.1.1 Design a circuit diagram using EIGHT batteries to produce a potential of 24 VDC. Use the IEC symbol in the circuit. (8)

4.1.2 Give the current output of the circuit designed in QUESTION 4.1.1. (1)

4.1.3 Design a circuit diagram using THREE batteries to produce an output current of 7 A. (3)

4.1.4 Give the output potential of the circuit designed in QUESTION 4.1.3. (1)

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4.2 Indicate whether the following statements regarding battery technology are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (4.2.1–4.2.5) in the ANSWER BOOK.

4.2.1 Overcurrent protection usually uses disconnectors or isolators placed between the load, such as an inverter or consumers, and the battery system.

4.2.2 A fuse is a device that has a fusible/meltable conductor between its ends.

4.2.3 The fuse rating should always be lower than the current rating of the battery cables.

4.2.4 A thermal circuit breaker heats up when the current drawn exceeds its rating and then trips.

4.2.5 A magnetic circuit breaker generates a magnetic field as the current increases so that the contacts of the breaker trip separately.

(5 × 1) (5)

4.3 List FIVE safety precautions to consider when handling and maintaining batteries. (5)

4.4 The following results were obtained during a mini wind-turbine practical task.

Wind speeds (m/s)	2,9	3,6	4,5	5,3	6,62	X
Output voltage (V)	1,8	2,4	3,3	3,98	5,3	Y

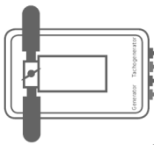
4.4.1 Draw, to scale, a Voltage/Speed graph containing the results obtained during the practical task. (5)

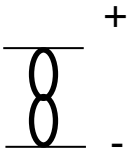
4.4.2 Describe the relationship between the output voltage and wind speeds analysed during the practical task. (2)

4.5 Use the symbols below to draw the connection of a turbine generator that powers the electrolyser.

Wind machine 

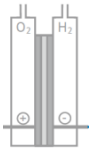


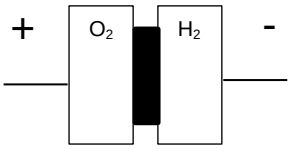
Turbine generator 



Multimeter 



Electrolyser 



(5 × 1) (5)
[35]

TOTAL: 100

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