higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

RENEWABLE ENERGY TECHNOLOGIES
NQF LEVEL 4

11 March 2020

This marking guideline consists of 7 pages.

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QUESTION 1

1.1 1.1.1
- Visual impact
- Noise impact
- Land use
- Impact on biodiversity
- Electromagnetic interference
- Air safety
- Impact on cultural heritage
- Habitat fragmentation (Any 5 × 1) (5)

1.1.2 The National Environmental Management Act (NEMA, Act 107 of 1998) (1)

1.1.3 To avoid or minimise negative effects from the beginning of a project rather than trying to mitigate them later (1)

1.2
- Wind turbine (excluding installation labour)
- Grid connection
- Foundation
- Land rent
- Electrical installation (5)

1.3 1.3.1
- Reduction of CO_2 emissions, thus helping to mitigate climate change
- Reduction of energy import
- Diversification of energy supplies, reducing dependence on fossil fuels
- Improvement of local air quality
- High efficiencies in conjunction with new fuel-cell technologies
- Emits only water as a by-product. (Any 5 × 1) (5)

1.3.2
- The current key limitation in implementing a hydrogen economy is not so much production, as storage.
- The primary difficulty in using hydrogen for grid energy storage is that converting power to hydrogen and back is not cheap under current market conditions. (2)

1.4 1.4.1 South Africa could participate in the fuel-cell industry as a major platinum group metal (PGM) producer.✓ PGMs are the key catalytic materials used in most fuel cells and with over 75% of the world's known PGM reserves found in South Africa,✓ the country could position itself as a fuel-cell deployment hub with opportunities for manufacturing, systems integration and ancillary services. (2)

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1.4.2 Hydrogen South Africa (HySA) stimulates and guides innovation along the value chain of hydrogen and fuel-cell technologies in South Africa.✓ The HySA strategy addresses elements of fuel-cell innovation that are likely to provide valuable opportunities for global industry participation.✓ (2)

1.4.3
- Create knowledge, skills and infrastructure to allow the growth of fuel-cell technology.
- Provide valuable opportunities for global participation.
- Investigate commercialisation opportunities.
- Create viable local industry by encouraging local deployment in key applications. (Any 2 × 1) (2)

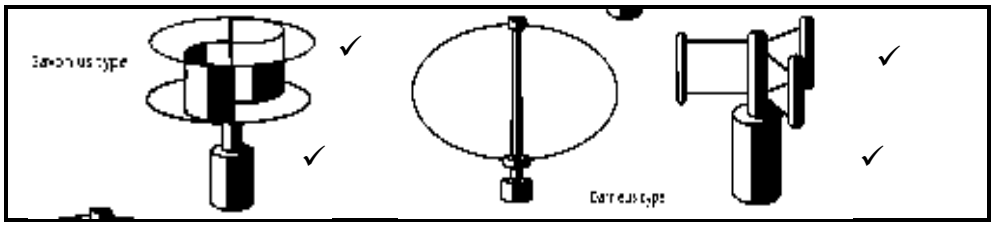
[25]

QUESTION 2

2.1 2.1.1 Vertical-axis wind turbine (1)

2.1.2 The axis of rotation in a VAWT is perpendicular✓ to the wind stream and the ground.✓ (2)

2.1.3



Savonius type✓ Darrieus type✓ (6)

2.1.4 Currently, the trend around the world is to combine the two mechanisms on the same axis✓ to utilise the Savonius's drag ability which then provides sufficient torque✓ to start a Darrieus wind turbine.✓ In other words, these turbines are combined in an effort to minimise the limitations of each of them.✓ (4)

2.2 The fuel gas (usually hydrogen) and the oxidant✓ (air or pure oxygen) are supplied to the membrane electrode assembly (MEA).✓ Here fuel and oxidant pass through a series of plate,✓ which diffuse them in the most uniform way to the two membrane sides.✓ A PEMFC transforms the chemical energy liberated during the electrochemical reaction of hydrogen and oxygen into electrical and thermal energy.✓ A stream of hydrogen is delivered to the anode side of the MEA.✓ At the anode side it is catalytically split into protons and electrons, conducting the oxidation reaction.✓ These protons permeate the polymer electrolyte membrane to the cathode side. The electrons travel along an external load circuit to the cathode side of the MEA, thus creating the current output of the FC.✓ In the meantime, a flow of oxygen is delivered to the cathode side of the MEA. There, oxygen molecules are reduced and, subsequently, react with the protons permeating the membrane to form water molecules✓ and also setting free heat.✓ (10)

2.3 2.3.1 True
2.3.2 True

(2 × 1) (2)
[25]

QUESTION 3

3.1
- Suitability of communication equipment available for the work crew
- The training and competence of personnel working remotely and the readiness of all necessary safety equipment at the location
- Means for managers to track the exact location of the working crew
- Local emergency plan in place
- Provision of suitably qualified first-aid personnel in the work crew (5)

3.2 3.2.1 True
3.2.2 True
3.2.3 False
3.2.4 True
3.2.5 True
3.2.6 True
3.2.7 False
3.2.8 True
3.2.9 False
3.2.10 True

(10 × 1) (10)
[15]

QUESTION 4

4.1 4.1.1
- Pointed end of the dowel binding in the wood screw positioned in the centre of the base board
- Wind machine too far away from the turbine (2)

4.1.2
- Resharpen the dowel or smooth it with sandpaper.
- Bring the wind machine closer to the turbine or replace it with a blower with a higher power rating. (2)

4.1.3
- Magnetic force too weak.
- Magnets not positioned in accordance with coils
- Coils not positioned clockwise
- Turbine turns too slowly or only with difficulty.
- Poor multimeter/load connections.
- Multimeter setting.
- Multimeter readings sufficient but loads (LEDs, buzzer etc.) not functioning. (Any 4 × 1) (4)

4.1.4
- Substitute with stronger magnets.
- Magnets are not positioned in accordance with coils.
- Recheck and correct magnet orientation on rotor disk.
- Recheck and correct coil orientation on stator/baseboard.
- Turbine turns too slowly or only with difficulty. See above.
- Ensure proper insulation-free connections.
- Set to low AC (before rectifier) or DC (after rectifier).
- Use different loads such as LEDs or buzzers activating in the millivolt range. (Any 2 × 1) (2)

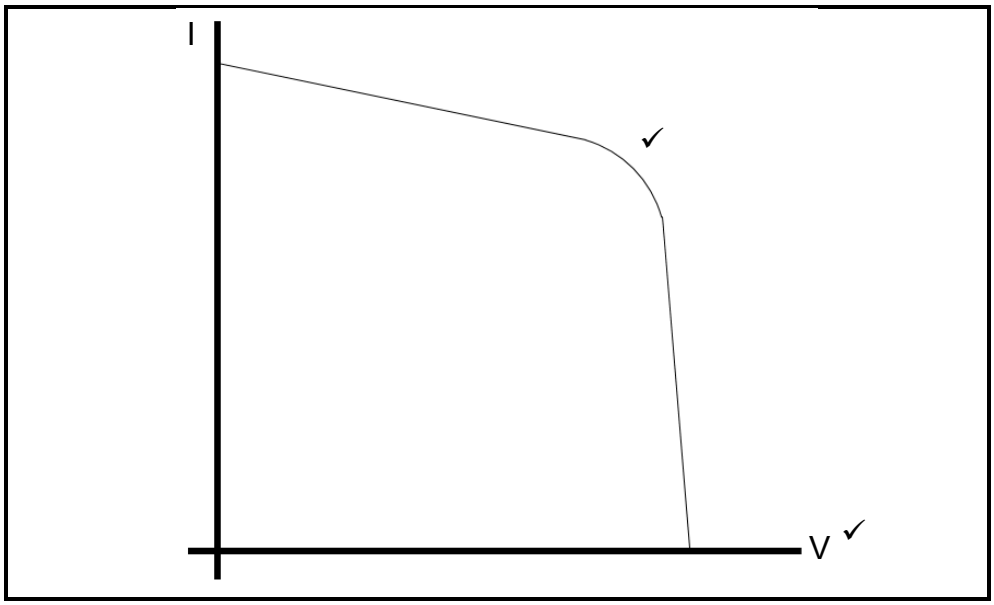
4.2 4.2.1 The electrolyser powered by 2–4 PV cells connected in series. (1)

4.2.2 (a) Spotlight (sun simulator)
(b) PV cells
(c) Multimeter
(d) Electrolyser

(4 × 1) (4)

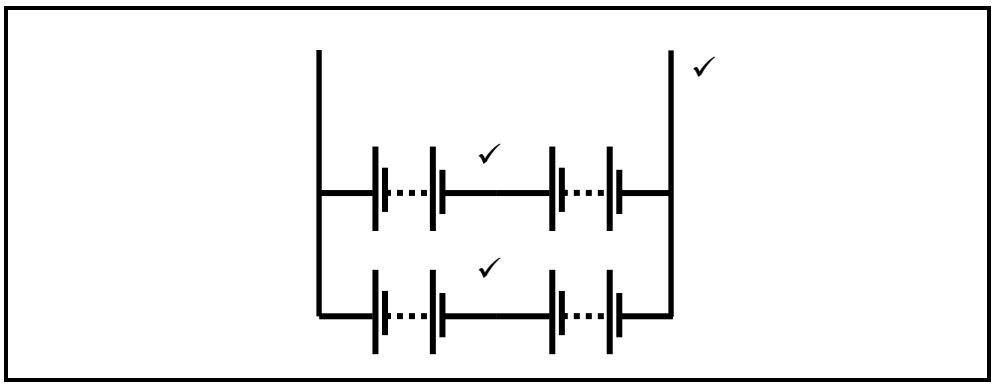
4.2.3 Direct current electrical energy is produced by the solar cells✓ when the radiation energy emitted from the halogen spotlight✓ falls on the PV material.✓ The electrical energy is then used by the electrolyser to split water into oxygen and hydrogen molecules.✓ (4)

4.2.4



(3)

4.3 4.3.1



(3)

4.3.2 12 + 12 = 24 Vdc
7 + 7 = 14 A (4)

4.3.3
- Never work alone. Always have someone near you when working around batteries.
- Wear appropriate PPE.
- Use proper lifting techniques.
- Never use old or untested batteries. Check each battery label for age, type and date to ensure all batteries are identical.
- Batteries are sensitive to changes in temperature. Always install batteries in a stable environment.
- Install batteries in a well-ventilated area. Batteries can produce explosive gases. For compartment or enclosure installations, always vent batteries to the outside.
- Provide sufficient space between batteries in a battery bank to provide cooling.
- Use appropriate insulated tools at all times.
- Always verify proper polarity before connecting batteries. To reduce the chance of fire or explosion, do not short-circuit the batteries.
- In the event of accidental exposure to battery acid, wash thoroughly with water. In the event of exposure to the eyes, flood them for at least 15 minutes with running water and seek immediate medical attention. (Any 6 × 1) (6)

[35]

TOTAL: 100

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