higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

RENEWABLE ENERGY TECHNOLOGIES
NQF LEVEL 4

28 November 2023

This marking guideline consists of 7 pages.

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QUESTION 1

1.1.1.(a) Life Cycle Assessment √ (1)

1.1.1.(b) National Renewable Energy Laboratory √ (1)

1.1.2 China √, USA √, (2)

1.1.3 It can help determine environmental burdens from "cradle to grave" √ and facilitate comparisons of energy technologies. √ Comparing life cycle stages and proportions of GHG emissions from each stage for wind power and coal shows √ (3)

1.1.4 (4)

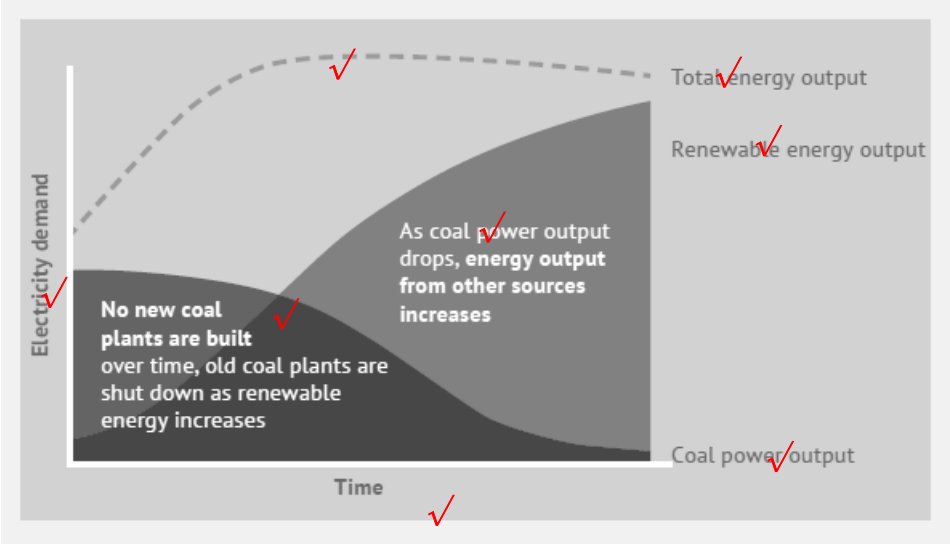


Image Source: S4GJ/ GIZ

(8 x ½ = 4)

1.1.5 (4)

- Wind is a renewable resource. Unlike fossil fuel reserves such as coal, oil and gas, wind energy offers sustainable power supply. Wind power can reduce a country's dependency on fossil fuel and increases the energy mix and thus also energy security. √
- The majority of GHG emissions are upstream of operation. √
- Wind energy reduces the need to burn fossil fuel. This can help to conserve these resources, allowing them to support future generations. √
- Unlike some other energy sources, wind energy is free. √
- Wind turbines have a relatively small environmental footprint. Their tower is high above the ground but the impact on the land area at the base is minimal.
- Wind turbines are not limited to industrial-scale installations but can also be installed on a domestic scale and can be coupled with other clean energy technologies.
- Wind turbines can bring power to remote locations.
- Wind turbines are relatively low maintenance and have fairly low running costs.

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- In many countries where the wind energy industry has boomed, jobs have been created, i.e. for the manufacture of turbines, installation and maintenance and also in wind energy consulting, where specialist consultants will determine whether or not a wind turbine installation will provide a return on investment

Any FOUR suitable answers.

1.2.1 The current key limitation in implementing a hydrogen economy is not so much production, but storage. ✓ (1)

1.2.2 Compared to oil and other fossil fuel hydrocarbons, hydrogen is quite expensive to store or transport with current technology. The reason for this is that albeit hydrogen gas has good energy density per weight, it has poor energy density per volume compared to hydrocarbons. Hydrogen thus requires larger tanks for storage. Increasing hydrogen gas pressure would improve the energy density per volume but compressing a gas will require energy to power the compressor. (6)

1.2.3 Submarines, buses, space shuttles, delivery trucks, storage systems for regenerative energies, passenger cars (3)

Any THREE suitable answers.

[25]

QUESTION 2

2.1 During the day the Sun's rays (radiation) heat up the Earth's surfaces. Land and sea surfaces heat up differently. Radiation heats the air above the land faster than the air above the sea. Thus wind, air in motion, often moves from areas where it is colder to areas where it is warmer. (5)

2.2 1-Hub, 2-Main Bearing, 3-Main Shaft, 4-Gearbox, 5-Brake, 6-High Speed Shaft, 7-High Speed Coupling, 8-Generator, 9-Gearbox Suspension, 10-Nacelle (4)

Any Four relevant answers.

2.3 $2H_2$ + O_2 (2)

2.4 Fuel cells need to be supplied with fuel and oxidants from an external source. Batteries on the other hand contain their chemical components, i.e. electrodes and electrolytes. Fuel-cell operation is based on reversing electrolysis, generating an electrical current as long as external fuel, such as hydrogen, methanol etc. and oxidants such as air, are available. (6)

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2.5 2.3.1 Gearbox ✓ (4)
2.3.2 Internal combustion engine ✓
2.3.3 Motor ✓
2.3.4 Battery pack ✓

2.6.1 Hybrid Electric Vehicles can either be partly fossil ✓ fuel (or biofuel) powered and partly electric ✓ or hydrogen powered. (One mark for either electric or hydrogen reference) (2)

2.6.2 FCEVs use an electric ✓-only motor and use hydrogen ✓ gas as fuel. (2)

[25]

QUESTION 3

3.1.1
- Falling structures, loads or objects during lifting operations ✓ (5)
- Falls from heights. ✓
- Mechanical hazards, such as contact with moving parts ✓
- Ergonomic physiological effects as a result of heavy lifting and repeated movements ✓
- Fatigue from climbing ladders or working in confined spaces ✓
- Working with dangerous substances
- Time pressure
- Insufficient or lack of safety equipment
- Lack of competence or skills
- Lack of communication between different actors/companies involved in the operation
- Exposure to noise and vibration

Or any suitable answer(s).

3.1.2 Safety checklists are a great ✓ way to determine compliance ✓ with industry specific standards ✓ and to ensure consistency. ✓ Many companies use checklists as documentary evidence ✓ that they have a system in place to identify and control hazards and risks. ✓ (5)

3.2
- Ensure all relevant information is known about the load, e.g. the size, weight, method of slinging and attachment points. ✓ (5)
- Ensure all lifting equipment is suitable, capable of supporting the load, is in good condition, and in receipt of any statutory inspections required. ✓
- Ensure all supervisors, equipment operators and slingers are trained and competent in the operation of lifting equipment and intended lifting techniques. ✓
- Exclusion zones are to be established and maintained in order to prevent any unauthorised access to lifting areas. ✓
- When lifting large loads, ensure weather conditions are favourable for the task. ✓

Or any suitable answer(s).

[15]

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QUESTION 4 (10)

4.1.1 H ✓

4.1.2 B ✓

4.1.3 G ✓

4.1.4 F ✓

4.1.5 A ✓

4.1.6 I ✓

4.1.7 J ✓

4.1.8 C ✓

4.1.9 E ✓

4.1.10 L ✓

4.2.1 a) Electrolyser ✓ (5)
b) Regulator ✓
c) Gas storage ✓
d) Fuel cell ✓
e) Multimeter ✓

4.2.2 Electrolysers are electrochemical devices ✓ which work like a fuel cell in reverse and can split water ✓ into its constituent molecules, hydrogen (H2) and oxygen (O2) ✓, by passing an electric current through water. ✓ (4)

4.2.3 (a) 112 mW ✓ (2)

(b) 0.7 V ✓

4.3 Pb (porous lead) ✓ and PbO_2 (lead dioxide) ✓ are the electrodes and H_2SO_4 (sulfuric acid) is the electrolyte. ✓ (3)

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4.4 (4)

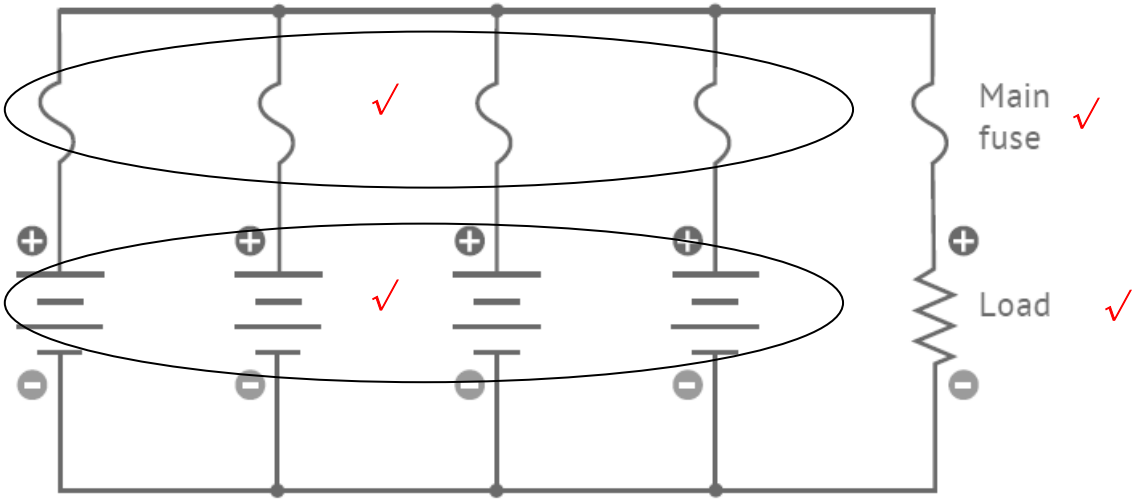


IMAGE SOURCE: S4GJ/GIZ

4.5 (3)

- Never work alone. Always have someone near you when working around batteries.
- Wear appropriate PPE when working with batteries.
- Use proper lifting techniques when working with batteries.
- 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.

Or any suitable answers.

4.6 (4)

- Loss of electrolyte due to heat or overcharging
- Lead sulfation
- Undercharging
- Age, i.e., positive plate shedding
- Freezing or high temperatures
- Use of domestic water, causing for example calcium sulfation
- Positive grid corrosion or growth due to high temperatures
- Fast recharging rates

Or any suitable answers.

[35]
TOTAL: 100

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