VCE Systems Engineering

Sample questions

Written examination – End of year

These sample questions are examples of extended-response questions related to some aspects of Units 3 and 4 VCE Systems Engineering. They do **not** constitute a full examination.

Section B

Question 1 (5 marks)

A greenhouse is a system made of glass, or another clear material, which traps sunlight to create a warm and controlled environment for growing plants. Vents in a greenhouse, like those shown in Figure 1, help plants grow by controlling temperature, humidity and airflow.

During hot days, the temperature inside a greenhouse can increase up to 15 °C higher than the outside temperature. If the vents are not opened, plants can dry out and wilt, growth may slow and, in extreme cases, the plants can die. Manually opening the vents requires someone to be physically present, which is not always possible. Automated systems address this limitation by regulating the greenhouse environment automatically.

Source: VPales/Shutterstock.com

Figure 1

February 2026

Design a functional automated system that operates a single vent. Use electrical components to detect temperature changes and mechanical components to open or close the vent in response to sensor readings.

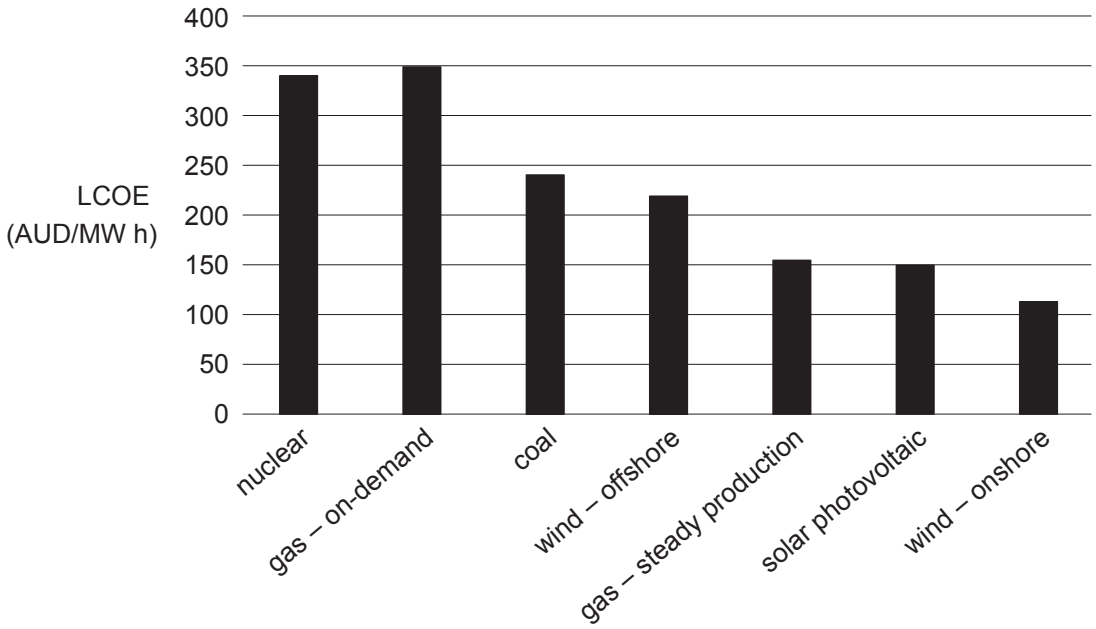
Your design should include a drawing, with annotations, showing the electrical and mechanical components. Listed below are examples of components that could be included:

- gears
- linkages
- sensors
- motors
- a microcontroller

Question 2 (8 marks)

The levelised cost of electricity (LCOE) is a method of measuring how much it costs to generate electricity. It calculates the total cost of building, running and maintaining a power plant over its lifetime, then divides this by the total amount of electricity the power plant produces.

In Figure 2, the LCOE is expressed in Australian dollars per megawatt hour (AUD/MW h). This example, which was prepared by an independent authority, shows the LCOE for various energy sources.



Source: Adapted from I Hugall et al., 'Levelised cost of electricity', report, Clean Energy Council, 7 March 2024, p. 22 <assets.cleanenergycouncil.org.au/documents/LEOC-Review-Report.pdf>

Figure 2

Discuss the economic and environmental impacts of nuclear and wind energy sources. In your response, include:

- reference to the information in Figure 2
- **one** advantage and **one** disadvantage of nuclear energy
- **one** advantage and **one** disadvantage of wind energy
- a cradle-to-cradle (C2C) analysis.

Question 3 (6 marks)

A gravity battery system stores energy by lifting heavy masses using surplus electricity and then lowering the masses when energy is needed.

The gravity battery system shown in Figure 3 operates by lifting four masses using identically constructed mechanical mechanisms.

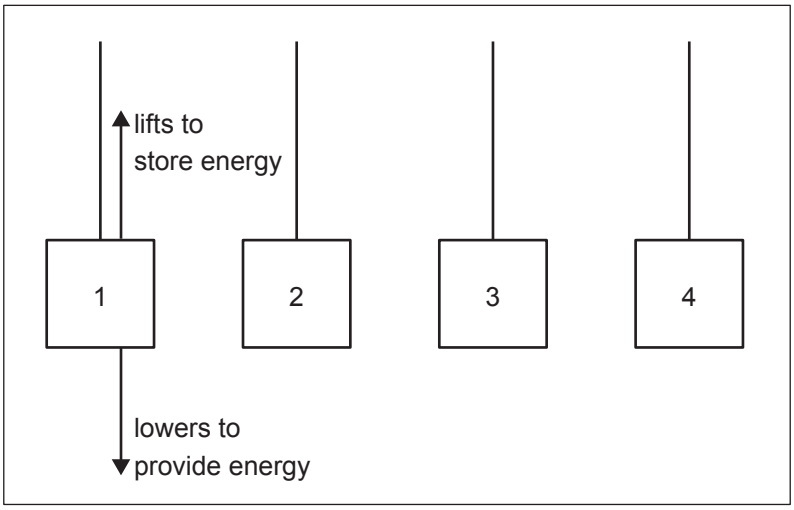


Figure 3

A schematic of the mechanical mechanism for lifting mass 3 is shown in Figure 4.

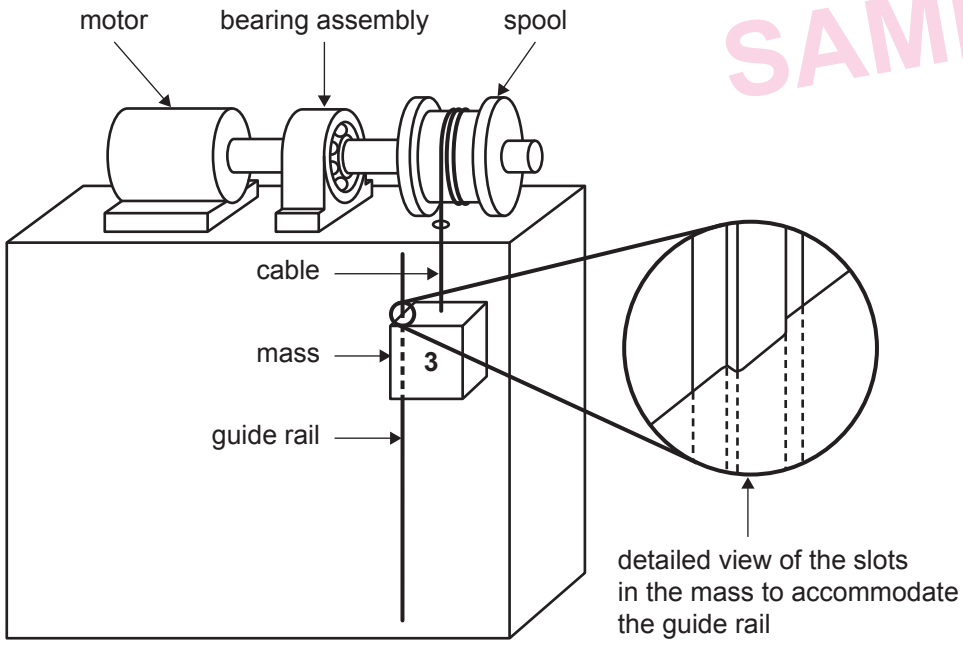


Figure 4

The gravity battery system operates by lifting the mass using a cable connected to an electric motor, converting excess electrical energy into gravitational potential energy. The cable is wound onto a spool mounted on the motor's axle, which is supported by a bearing assembly. A guide rail keeps the mass aligned to ensure smooth movement.

The mechanical mechanism for mass 3 draws significantly more current than the other mechanisms. To prevent motor burnout, the mechanism for mass 3 automatically shuts down.

Diagnose **one** possible fault related to the mechanical mechanism. In your response, include:

- a description of the fault and the reason the fault may have occurred
- an outline of a parameter and how it can be monitored.

Question 4 (5 marks)

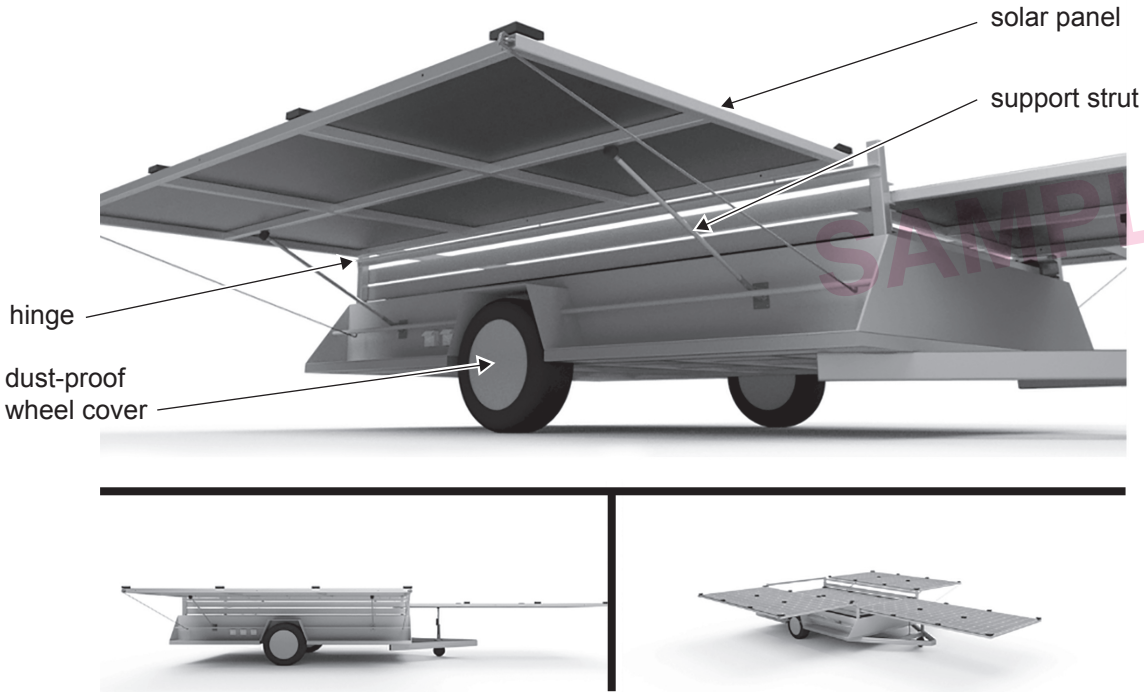
Aboriginal and Torres Strait Islander communities often live and work on Country in remote areas where access to a reliable supply of energy is limited. Many communities rely on petrol or diesel generators, or rooftop solar systems, for their energy needs.

However, petrol and diesel generators are expensive to run and maintain, and their use has significant environmental impacts. Rooftop solar systems can also be costly to install and maintain, especially in remote areas.

The Portable Renewable Energy System Project works alongside Aboriginal and Torres Strait Islander Peoples to support their aspirations to live and thrive on Country. This project aims to provide remote communities with a sustainable and reliable power source through trailer-mounted solar panels, shown in Figure 5.

The system must be able to withstand harsh environmental conditions, including extreme heat, and exposure to dust and salt. It must also be able to be transported on rough roads over long distances. In some cases, the nearest qualified electrician or mechanic may be hundreds of kilometres away.

Because the solar panels are heavy and prone to tipping, they require an integrated and controlled mechanism to safely unfold them from their stored position.



Source: Adapted from Engineers Without Borders Australia, 'Increasing access to energy on Country', 1 June 2020 <ewb.org.au/blog/2020/06/01/increasing-access-to-energy-on-country/>

Figure 5

Two factors that can influence the creation of an integrated and controlled system are 'materials and components' and 'environment use'.

Explain how these factors could relate to the mechanism that unfolds the solar panels. In your response, refer to:

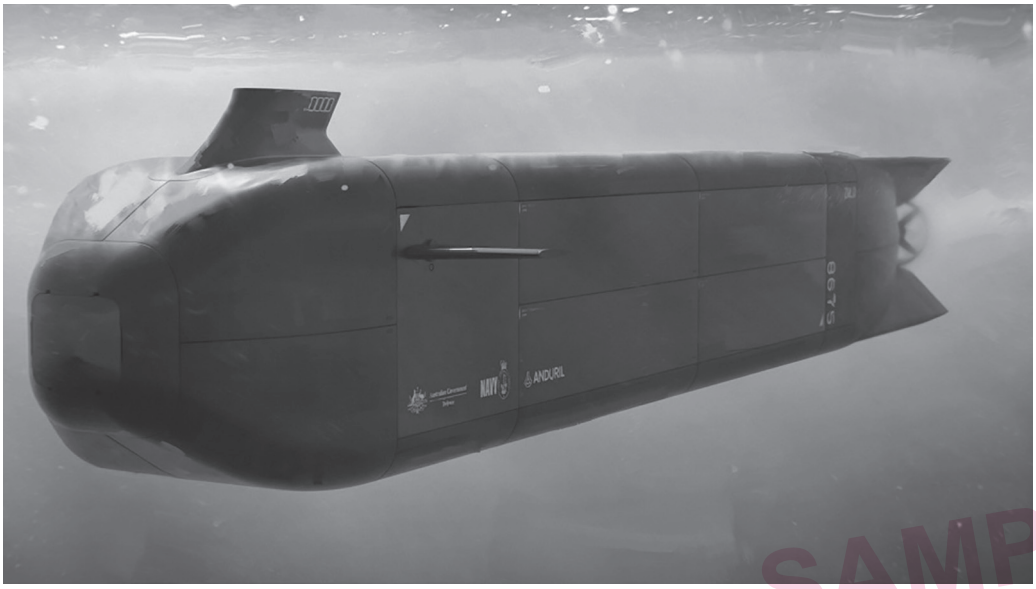
- **two** materials and/or components
- how the materials and/or components are selected to suit the environment.

Question 5 (8 marks)

Ghost Shark, shown in Figure 6, is an Australian underwater robot developed by the Royal Australian Navy. The Ghost Shark project is estimated to cost about $1.7 billion. A key feature of Ghost Shark is its modular design, which allows it to be easily modified.

Ghost Shark uses artificial intelligence (AI) to navigate, make decisions and carry out missions autonomously (without people on board). This allows it to move quietly and work for long periods collecting information or completing missions.

This project shows how engineers are using AI to design advanced systems that improve safety, efficiency and national security.



Source: Advanced Strategic Capabilities Accelerator <asca.gov.au/activities/missions/ghost-shark-mission-zero>

Figure 6

Critique the development and use of the autonomous underwater robot Ghost Shark. In your response, include:

- **one** positive environmental or economic impact of Ghost Shark
- **one** negative environmental or economic impact of Ghost Shark
- **one** future potential application of Ghost Shark.