Queensland Curriculum and Assessment Authority

Engineering 2019 v1.1

IA3: Sample assessment instrument

Project — folio (25%)

This sample has been compiled by the QCAA to assist and support teachers in planning and developing assessment instruments for individual school settings.

Student name

Student number

Teacher

Issued

Due date

Marking summary

Criterion	Marks allocated	Provisional marks
Retrieving and comprehending	5	
Analysing	7	
Synthesising and evaluating	9	
Communicating	4	
Overall	**25**	

Conditions

Technique	Project — folio
Unit	Unit 4: Machines and mechanisms
Topic/s	Topic 1: Machines in society Topic 2: Materials Topic 3: Machine control
Duration	5–7 weeks
Mode/length	Part A — Documents the development of an engineered solution • Multimodal: 7–9 single-sided A3 pages or equivalent digital media Part B — Summary report • Multimodal: 2–3 single-sided A4 pages or equivalent digital media
Individual/group	Individual
Other	The table of contents and reference list are not included in the page count.

Context

A food processing company currently uses one production line to deposit various food products into round and hexagon-shaped glass jars. The production line is capable of filling 30 glass jars per minute. The jar-feeder line can move glass jars to the production line at twice this rate.

The company has decided to increase its output capacity by introducing an additional production line above the existing production line. Both production lines will be fed by the existing jar-feeder line and will each fill 30 glass jars with product per minute.

The company requires a mechanism that will evenly distribute glass jars from the jar-feeder line to each production line. Each production run will only fill either round or hexagonal jars during that run.

Requirements for the glass jar distribution system:

- round glass jars have dimensions of 75 millimetres outside diameter and 150 millimetres overall height
- hexagonal glass jars are the same height as the round glass jars and hold the same volume
- shape and size of the screw lid area of the jar is irrelevant to the development of the glass jar distribution system
- empty glass jars have a mass of 250 grams
- glass jars have smooth exterior surfaces
- glass jars need to be raised 1.5 metres to align with the new production line, which sits above the existing production line.

Task

There are two parts to this assessment.

Part A

Your task is to create a folio to document a solution to the glass jar distribution system problem, which meets the food processing company's requirements.

In your folio, document the Engineering problem-solving process used to develop and predict a solution. Include pictures, sketches and/or CAD drawings of the virtual or actual prototype glass jar distribution mechanism to provide performance data concerning the part of the system that evenly distributes glass jars to each production line from the existing jar-feeder line.

Part B

Your task is to provide the Production Manager at the food processing company with a summary report of the preferred solution to the glass jar distribution system problem.

To complete this task, you must:

Part A

- recognise and describe
  - characteristics of the glass jar distribution system problem, including knowns, unknowns, assumptions and boundaries
  - engineering mechanics, materials science and control technologies fundamentals of the glass jar distribution system problem

  - mitigation of environmental and sustainability impacts associated with the glass jar distribution system problem, including corrosion, life-cycle assessment, safety, pollution, maintenance and energy efficiency
- symbolise and explain ideas and the solution to the glass jar distribution system problem using annotated sketching, drawings including basic drawing standards (hand or CAD), logic and electrical circuit diagrams, flow charts and free-body diagrams, graphs, tables and/or schemas
- analyse the glass jar distribution system problem and engineering mechanics, materials science, control technologies, technology and research information in relation to machines and mechanisms, to identify the elements, components and features, and their relationship to the structure of the problem, including project management milestones (i.e. resource and time constraints)
- determine solution success criteria, considering the identified elements, components and features, and their relationship to the structure of the glass jar distribution system problem, including for example performance index, speed, weight, aerodynamics, power
- synthesise engineering mechanics, materials science, control technologies, technology and research information and ideas to predict a possible solution to the glass jar distribution system problem
- evaluate and refine idea and solution development in relation to solution success criteria including
  - testing of materials and processes e.g. pulleys and gear testing, friction, solar panel efficiency, motor efficiency
  - calculations using mechanics concepts and principles to predict prototype solution performance, including predicted mass, velocity, acceleration and efficiency
  - evaluation of prototype solution performance data and the reliability of the prototype solution, including use of the performance index, speed, weight, aerodynamics and power
- generate the prototype solution for testing including
  - virtual and/or physical manipulation of materials, scaled modelling, 3D printing, laser cutting
  - annotations on photographs or screen captures of the prototype solution prior to and after testing
  - performance of destructive, non-destructive and/or virtual testing of the prototype solution to provide performance data
- recommend and justify future modifications or enhancements to ideas and the solution to the glass jar distribution system problem
- communicate the development of ideas and the solution for the glass jar distribution system problem using written and visual features, e.g. PMI (plus, minus, interesting) charts, sketches, drawings, diagrams, graphs, tables and/or schemas
- communicate data using diagrams, tables and/or spreadsheets.

Part B

- develop a summary report that includes key pictures, tables, graphs, sketches and drawings that provide a concise account of the preferred solution to the glass jar distribution system problem, including key features and any recommendations made to inform future solution development.

Checkpoints

☐ Term 3 Week 3: The student is required to submit a draft demonstrating exploration of the glass jar distribution system problem, the development of ideas and an indication of a proposed solution.

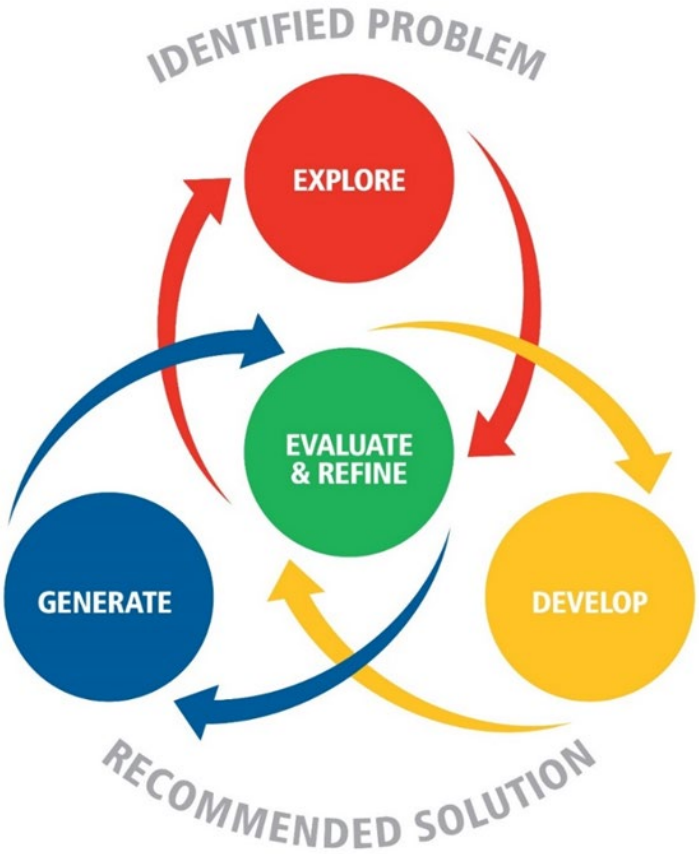
Authentication strategies

- The teacher will provide class time for task completion.
- Students will each produce a unique response through teacher monitoring of student problem identification and problem-solving.
- Students will provide documentation of their progress at the indicated checkpoint.
- The teacher will collect and annotate one draft.
- The teacher will conduct interviews or consultations with each student as they develop the response.
- Students must acknowledge all sources.
- Students must submit a declaration of authenticity.
- The teacher will ensure class cross-marking occurs.

Scaffolding

In this unit, the student is required to prepare a folio documenting how they apply the problem-solving process in Engineering in response to an identified real-world machine and/or mechanism problem.

The problem-solving process in Engineering



The response will include the following folio and referencing conventions:

- headings that organise and communicate the student's thinking through the iterative phases of the problem-solving process in Engineering
- a table of contents page
- a reference list and a recognised system of in-text referencing.

Instrument-specific marking guide (IA3): Project — folio response (25%)

Criterion: Retrieving and comprehending

Assessment objectives

1. recognise and describe the machine and/or mechanism problem, engineering technology knowledge, and mechanics, materials science and control technologies concepts and principles in relation to machines and/or mechanisms
2. symbolise and explain ideas and a solution in relation to machines and/or mechanisms

The student work has the following characteristics:	Marks
• accurate and discriminating recognition and discerning description of the machine and/or mechanism problem, engineering technology knowledge, and mechanics, materials science and control technologies concepts and principles in relation to machines and/or mechanisms • adept symbolisation and discerning explanation of ideas and a solution in relation to machines and/or mechanisms with sketches, drawings, diagrams, graphs, tables and/or schemas.	4–5
• accurate recognition and appropriate description of the machine and/or mechanism problem, engineering technology knowledge, and some mechanics, materials science and control technologies concepts and principles in relation to machines and/or mechanisms • competent symbolisation and appropriate explanation of some ideas and a solution in relation to machines and/or mechanisms with sketches, drawings, diagrams, graphs, tables and/or schemas.	2–3
• variable recognition and superficial description of aspects of the machine and/or mechanism problem, concepts or principles in relation to machines and mechanisms • variable symbolisation or superficial explanation of aspects of ideas or a solution in relation to machines and/or mechanisms.	1
• does not satisfy any of the descriptors above.	0

Criterion: Analysing

Assessment objectives

3. analyse the machine and/or mechanism problem and information in relation to machines and/or mechanisms
4. determine solution success criteria for the machine and/or mechanism problem

The student work has the following characteristics:	Marks
• insightful analysis of the machine and/or mechanism problem, and relevant engineering mechanics, materials science, control technologies, technology, and research information in relation to machines and/or mechanisms, to identify the relevant elements, components and features, and their relationship to the structure of the problem • astute determination of essential solution success criteria for the machine and/or mechanism problem.	6–7
• considered analysis of the machine and/or mechanism problem, and relevant engineering mechanics, materials science, control technologies, technology, and research information in relation to machines and/or mechanisms, to identify the relevant elements, components and features, and their relationship to the structure of the problem • logical determination of effective solution success criteria for the machine and/or mechanism problem.	4–5
• appropriate analysis of the machine and/or mechanism problem, and engineering mechanics, materials science, control technologies, technology, and research information in relation to machines and/or mechanisms, to identify some of the elements, components or features of the problem • reasonable determination of some solution success criteria for the machine and/or mechanism problem.	2–3
• statements about the machine and/or mechanism problem, or information in relation to machines and/or mechanisms • vague determination of some solution success criteria for the machine and/or mechanism problem.	1
• does not satisfy any of the descriptors above.	0

Criterion: Synthesising and evaluating

Assessment objectives

5. synthesise information and ideas to predict a possible machine and/or mechanism solution
6. generate a machine and/or mechanism prototype solution to provide data to assess the accuracy of predictions
7. evaluate and refine ideas and a solution to make justified recommendations

The student work has the following characteristics:	Marks
• coherent and logical synthesis of relevant engineering mechanics, materials science, control technologies, technology and research information, and ideas to predict a possible machine and/or mechanism solution • purposeful generation of a machine and/or mechanism prototype solution to provide valid performance data to critically assess the accuracy of predictions • critical evaluation and discerning refinement of ideas and a solution using success criteria to make astute recommendations justified by data and research evidence.	8–9
• logical synthesis of relevant engineering mechanics, materials science, control technologies, technology and research information, and ideas to predict a possible machine and/or mechanism solution • effective generation of a machine and/or mechanism prototype solution to provide valid performance data to effectively assess the accuracy of predictions • reasoned evaluation and effective refinement of ideas and a solution using success criteria to make considered recommendations justified by data and research evidence.	6–7
• simple synthesis of engineering mechanics, materials science, control technologies, technology and research information, and ideas to predict a possible machine and/or mechanism solution • adequate generation of a machine and/or mechanism prototype solution to provide relevant performance data to assess the accuracy of predictions • feasible evaluation and adequate refinement of ideas and a solution using some success criteria to make fundamental recommendations justified by data and research evidence.	4–5
• rudimentary synthesis of partial engineering mechanics, materials science, control technologies, technology or research information, or ideas to predict a machine and/or mechanism solution • partial generation of a machine and/or mechanism prototype solution to provide elements of performance data to partially assess the accuracy of predictions • superficial evaluation of ideas or a solution using some success criteria to make elementary recommendations.	2–3
• unclear combinations of information or ideas • generation of elements of a machine and/or mechanism prototype solution • identification of a change about an idea or the solution.	1
• does not satisfy any of the descriptors above.	0

Criterion: Communicating

Assessment objectives

8. make decisions about and use mode-appropriate features, language and conventions to communicate development of the prototype solution

The student work has the following characteristics:	Marks
• discerning decision-making about, and fluent use of, – written and visual features to communicate about a solution – language for a technical audience – grammatically accurate language structures – folio and referencing conventions.	3–4
• variable decision-making about, and inconsistent use of, – written and visual features – suitable language – grammar and language structures – folio or referencing conventions.	1–2
• does not satisfy any of the descriptors above.	0