Queensland Government | QCAA Queensland Curriculum & Assessment Authority

Queensland Curriculum and Assessment Authority

Engineering 2025 v1.4

IA2: Sample assessment instrument

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	sample only
Student number	sample only
Teacher	sample only
Exam date	sample only

Marking summary

Criterion	Marks allocated	Provisional marks
Engineering knowledge and problem-solving	25	
Overall	**25**	

260366

Conditions

Technique	Examination — combination response
Unit	Unit 3: Civil structures
Topic/s	Topic 1: Civil structures in society Topic 2: Civil structures and forces Topic 3: Civil engineering materials
Time	2 hours + 5 minutes perusal
Seen / Unseen	Unseen
Other	The teacher must provide the QCAA Engineering formula book. Students may use: • a non-programmable scientific calculator • a protractor and a ruler. Students must not bring notes into the examination.

Instructions

- Answer all questions in the space provided.
- For multiple choice questions, circle the letter next to the correct answer. If you want to change your answer, cross out your initial choice and circle the letter next to your new answer.
- Write responses using black or blue pen.
- Show all working for questions requiring calculations.

Section 1 — multiple choice, single word and sentence response items

Question 1 (1 mark)

Steel-reinforced concrete is used in the construction of multistorey buildings because it has the combined properties of

A hardness and workability.

B hardness and tensile strength.

C compressive and tensile strength.

D compressive strength and workability.

Question 2 (1 mark)

The ultimate tensile strength (UTS) value is located on a stress–strain graph at the

A end of the elastic region where deformation begins to be permanent.

B point where the material fractures.

C maximum stress value recorded before necking occurs.

D initial linear portion of the graph.

Question 3 (1 mark)

A 3.0 cm diameter steel rod has a 2.5 kN tensile force applied to its ends. What stress does the steel rod experience?

A 2.7 MPa

B 3.5 MPa

C 11.1 MPa.

D 88.4 MPa

Question 4 (1 mark)

Which sub-discipline of civil engineering would model the safe movement of people or goods between, or within, cities?

A transport engineering

B structural engineering

C environmental engineering

D water resource engineering

Question 5 (1 mark)

Which property describes a material's ability to absorb energy and plastically deform under predominantly tensile forces without fracturing?

A ductility

B hardness

C brittleness

D toughness

Question 6 (1 mark)

A concrete sample is known to have a compressive Young's modulus of 25 GPa. What is the strain experienced by a sample when it is under 875 MPa of stress?

A 2.9 %

B 3.5 %

C 28 %

D 35 %

Question 7 (1 mark)

The most suitable material to use as a sacrificial anode for a steel structure is

A iron.

B zinc.

C copper.

D stainless steel.

Question 8 (1 mark)

A cylindrical steel test specimen with a diameter of 10 mm is subjected to a tensile test. The maximum force recorded before fracture is 78 kN. What is the ultimate tensile strength of the material?

A 100 MPa

B 500 MPa

C 993 MPa

D 785 MPa

Question 9 (1 mark)

A polymer with a yield strength of 55 MPa is used in an application which requires a factor of safety of 3.2. What is the maximum allowable working stress for this polymer?

A 0.58 MPa

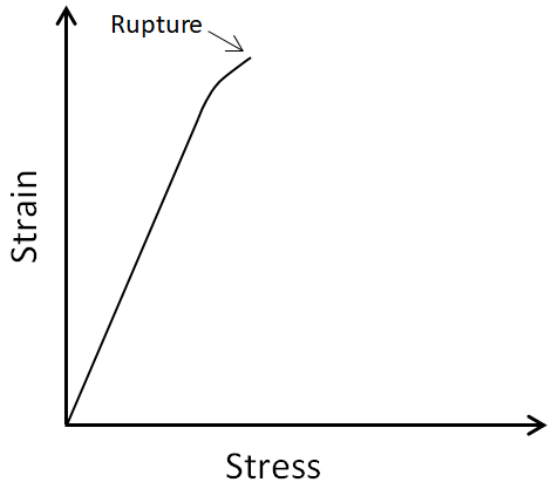
B 1.72 MPa

C 5.8 MPa

D 17.2 MPa

Question 10 (1 mark)

A stress-strain diagram is shown.



Identify which mechanical property is best represented by the stress–strain graph.

A hard

B tough

C brittle

D ductile

Question 11 (2 marks)

Laminated veneer lumber (LVL) is an engineered product that has the defined and reliable material properties of …… and……

Question 12 (2 marks)

Dry corrosion of metals is evident when .....

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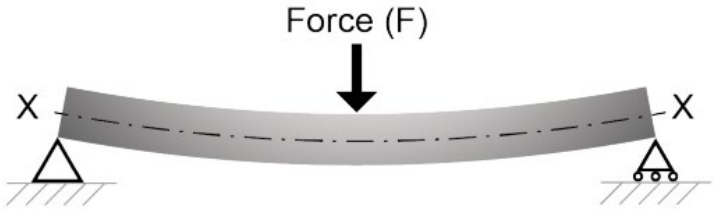
Question 13 (1 mark)

A simply supported beam is shown.



Identify the effect of the applied force F on the length of the beam's neutral axis X–X.

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Question 14 (4 marks)

Identify two civil engineering sub-disciplines and briefly describe the scope of each one.

…… engineering

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…… engineering

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Section 2 — short paragraph and calculation items

Question 15 (3 marks)

Civil structures are constructed using a variety of materials. Identify a commonly used construction material and describe an effect on the environment and on society that occur during the material's life cycle.

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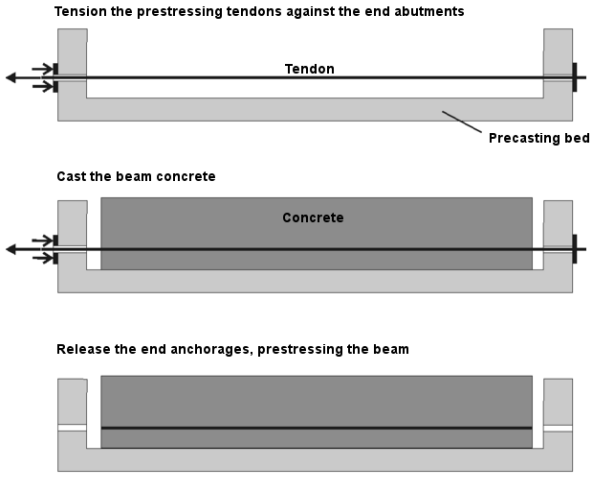
Question 16 (5 marks)

The diagram shows how a concrete beam is prestressed.



Explain how and why concrete beams are prestressed with reference to the diagram.

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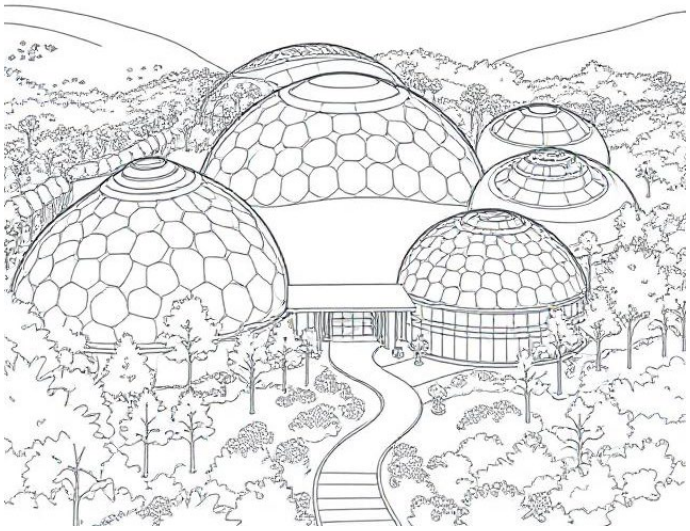
Question 17 (8 marks)

Technological developments are changing the way structures are developed and constructed.



Analyse the mechanics, materials science and engineering technology developments of the dome structures shown to describe the benefits of this type of structure for a community experiencing extreme weather conditions.

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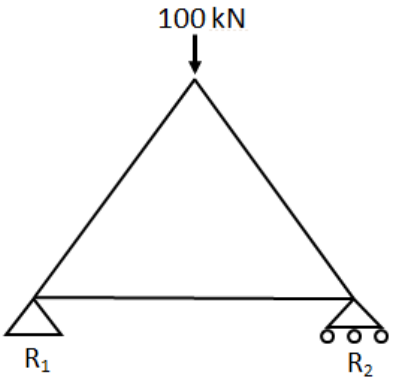
Question 18 (3 marks)

A simple truss is shown.



Calculate the reaction at supports R_1 and R_2. The length of each member is 2.5 metres. Include a force diagram to support your response.

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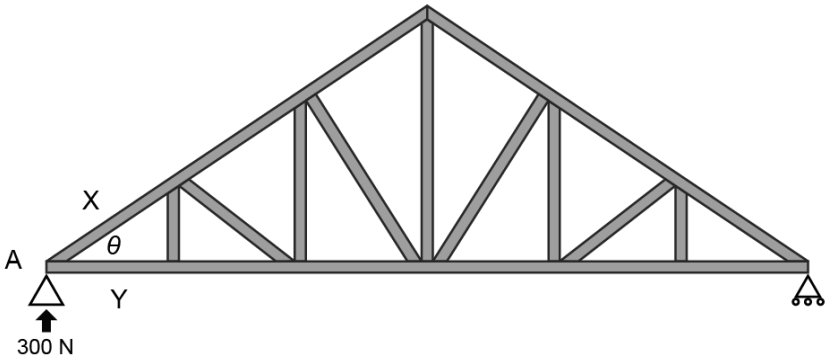
Question 19 (5 marks)

A truss structure is shown.



The truss is in static equilibrium. The reaction force R_A at support A is 300 N and θ is 30°. Calculate the force in members X and Y and identify whether the members are in tension or compression. Include a force diagram to support your response.

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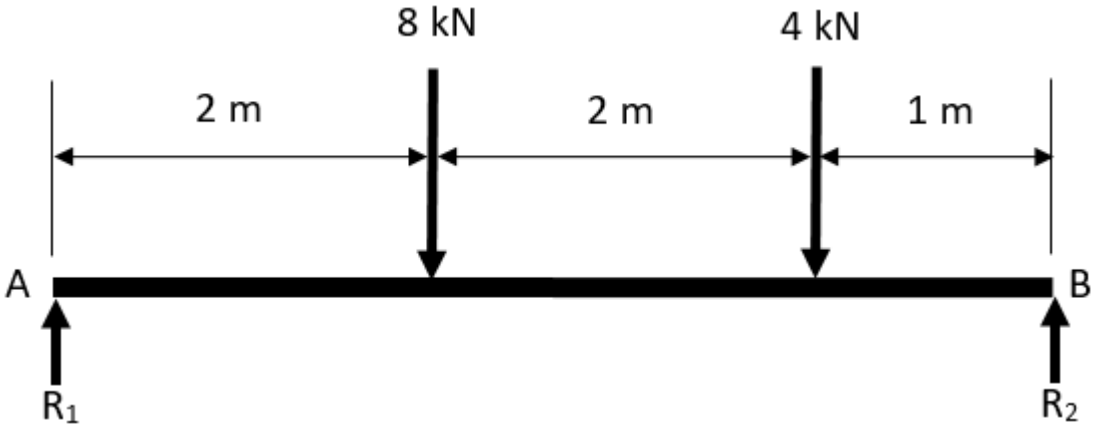
Question 20 (4 marks)

A simply supported beam is shown.



Calculate the reactions at supports R_1 and R_2. Assume that the beam is without mass.

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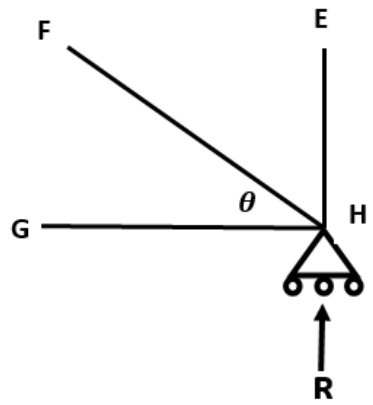
Question 21 (5 marks)

A diagram of a roller joint is shown.



The roller joint has a reaction R of 35 kN. The compressive force in member GH is 12 kN and θ is 40°.

Calculate the force in member EH and identify whether the member is in tension or compression. Include a force diagram with your working.

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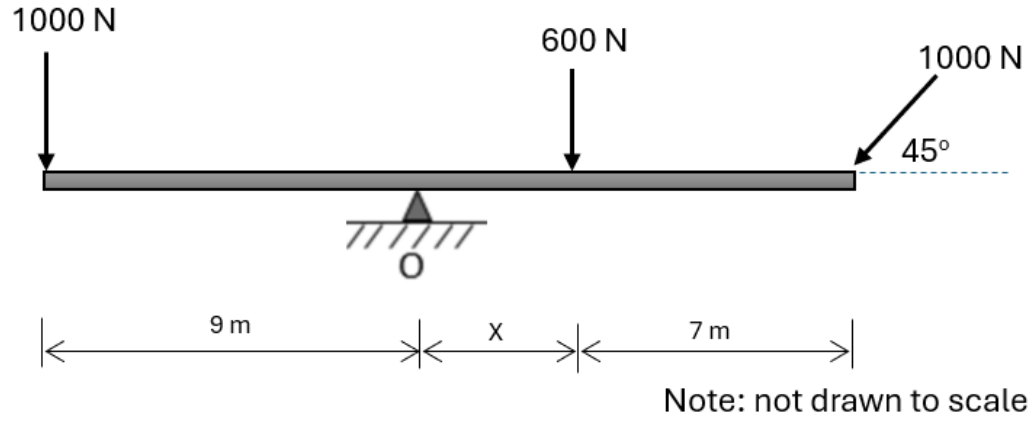
Question 22 (4 marks)

A simply supported beam is shown.



The beam is balanced at point O.

Calculate the total length of the beam. Assume that the beam is without mass.

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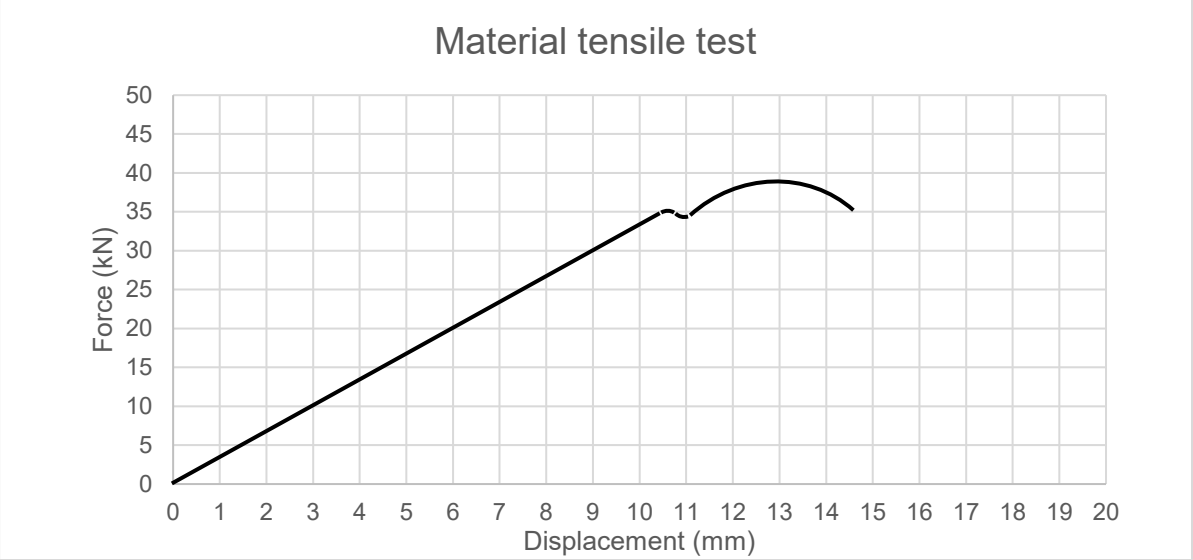
Question 23 (4 marks)

A cylindrical test specimen with an original length of 125 mm and a diameter of 10 mm is subjected to a tensile test shown in the graph.



Determine the Young's modulus of the material.

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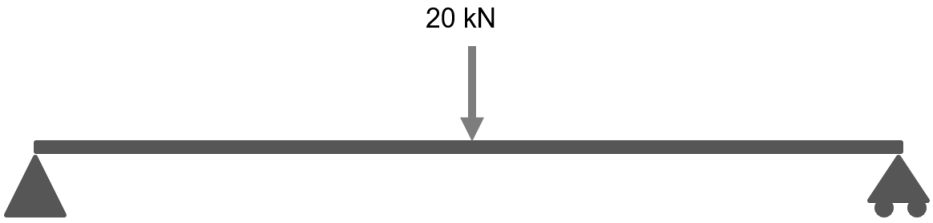
Question 24 (4 marks)

A 10 m long beam is shown below, with a 20 kN point load acting at the midpoint of the beam.



Draw shear force and bending moment diagrams for the beam. Show your calculations. Assume that the beam is without mass.

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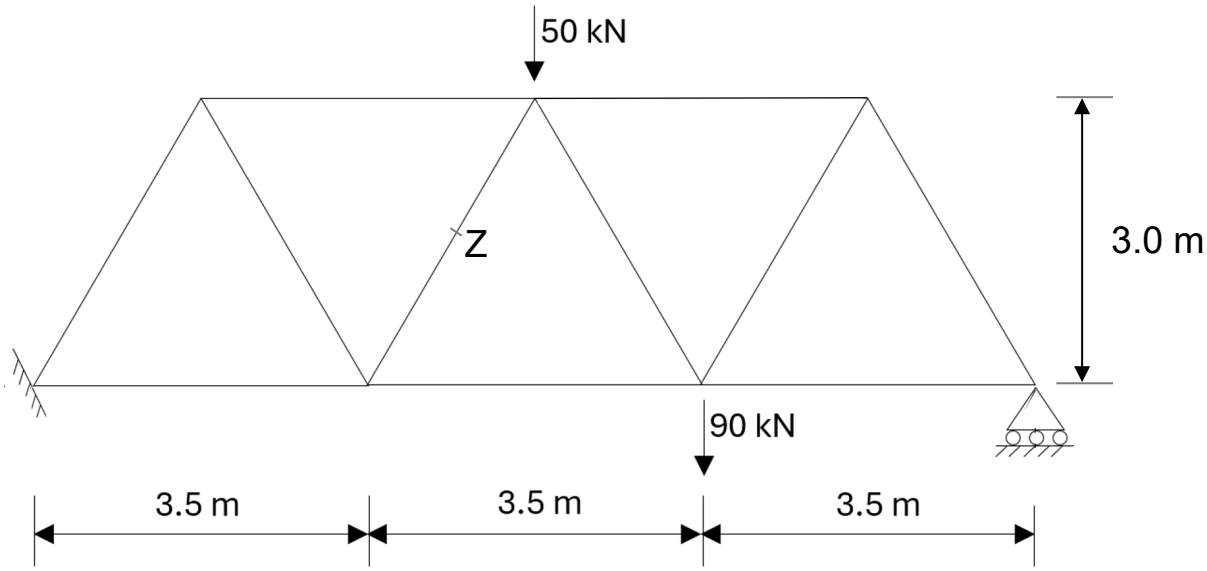
Question 25 (6 marks)

A truss is shown.



Calculate the force in member Z and identify whether the member is in tension or compression. Include a force diagram to support your response.

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Question 26 (8 marks)

A construction company is engineering a suspended concrete slab floor with plan dimensions of 10 m × 10 m and a thickness of 750 mm. The slab must be supported by four identical solid cylindrical concrete pillars, positioned at each corner.

Each pillar must safely support the applied load while minimising material usage. A factor of safety of 2 is required.

Using the concrete properties provided in the table, determine the required dimensions of each pillar so that, after the slab is poured and fully cured, the underside of the slab is positioned 3 m above ground level, within a tolerance of ±1 mm.

Property	Value	Units
Ultimate tensile strength	5	MPa
Compressive strength	32	MPa
Young's modulus	25	GPa
Density (ρ)	2400	kg/m³

Assume:

- the slab load is shared equally by the four pillars
- the pillars are solid cylinders
- the self-weight of the pillars is negligible
- The slab is poured only after the pillars have been formed and fully cured

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Instrument-specific marking guide (IA2): Examination — combination response (25%)

Engineering knowledge and problem-solving	Cut-off	Marks
The student response has the following characteristics:		
• across the full range of simple familiar, complex familiar and complex unfamiliar situations – accurate and discriminating recognition and discerning description of structural problems, knowledge, concepts and principles; adept symbolisation and discerning explanation of ideas and solutions; insightful and accurate analysis of problems and information; coherent and logical synthesis of information and ideas to propose possible solutions	>96%	25
	>93%	24
• in a comprehensive range of simple familiar, complex familiar and complex unfamiliar situations – accurate and discriminating recognition and discerning description of structural problems, knowledge, concepts and principles; adept symbolisation and discerning explanation of ideas and solutions; insightful and accurate analysis of problems and information; coherent and logical synthesis of information and ideas to propose possible solutions	>89%	23
	>86%	22
• in a comprehensive range of simple familiar situations, and in complex familiar and complex unfamiliar situations – accurate recognition and effective description of structural problems, knowledge, concepts and principles; methodical symbolisation and effective explanation of ideas and solutions; considered analysis of problems and information; logical synthesis of information and ideas to propose possible solutions	>82%	21
	>78%	20
• in a range of simple familiar situations, and in complex familiar and complex unfamiliar situations – accurate recognition and effective description of structural problems, knowledge, concepts and principles; methodical symbolisation and effective explanation of ideas and solutions; considered analysis of problems and information; logical synthesis of information and ideas to propose possible solutions	>75%	19
	>71%	18
• in a range of simple familiar situations and in complex familiar situations – appropriate recognition and description of structural problems, knowledge, concepts and principles; competent symbolisation and appropriate explanation of ideas and solutions; appropriate analysis of problems and information; simple synthesis of information and ideas to propose possible solutions	>68%	17
	>64%	16
• in a range of simple familiar situations and in some complex familiar situations – appropriate recognition and description of structural problems, knowledge, concepts and principles; competent symbolisation and appropriate explanation of ideas and solutions; appropriate analysis of problems and information; simple synthesis of information and ideas to propose possible solutions	>60%	15
	>57%	14

Engineering knowledge and problem-solving	Cut-off	Marks
• in simple familiar situations – appropriate recognition and description of structural problems, knowledge, concepts and principles; inconsistent symbolisation and appropriate explanation of ideas and solutions; appropriate analysis of problems and information; simple synthesis of information and ideas to propose possible solutions	>53%	13
	>50%	12
• in simple familiar situations – inconsistent recognition and superficial description of structural problems, knowledge, concepts and principles; inconsistent symbolisation and superficial explanation of ideas and solutions; superficial analysis of problems and information; rudimentary synthesis of information and ideas to propose possible solutions	>46%	11
	>42%	10
• in some simple familiar situations – inconsistent recognition and superficial description of aspects of structural problems, knowledge, concepts and principles; superficial explanation of ideas and solutions; superficial analysis of problems and information; rudimentary synthesis of information and ideas to propose partial possible solutions	>37%	9
	>33%	8
• in a limited range of simple familiar situations – inconsistent recognition and superficial description of aspects of structural problems, knowledge, concepts and principles; superficial explanation of ideas and solutions; superficial analysis of aspects of problems and information; unclear combination of information and ideas	>28%	7
	>24%	6
• disjointed recognition and statements about aspects of structural problems, knowledge, concepts and principles; identification of a change about ideas, solutions and information; unclear combination of information and ideas	>19%	5
	>14%	4
• statements about aspects of structural problems, knowledge, concepts and principles; statements about ideas, solutions and information; isolated and unclear combination of information and ideas	>10%	3
	>5%	2
• isolated and unclear statements about aspects of structural problems, knowledge, concepts and principles.	>0%	1
The student response does not satisfy any of the descriptors above.		0