2007 HSC Notes from the Marking Centre Engineering Studies

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2007 HSC NOTES FROM THE MARKING CENTRE ENGINEERING STUDIES

Introduction

This document has been produced for the teachers and candidates of the Stage 6 course in Engineering Studies. It contains comments on candidate responses to the 2007 Higher School Certificate examination, indicating the quality of the responses and highlighting their relative strengths and weaknesses.

This document should be read along with the relevant syllabus, the 2007 Higher School Certificate examination, the marking guidelines and other support documents which have been developed by the Board of Studies to assist in the teaching and learning of Engineering Studies.

General Comments

Teachers and candidates should be aware that some questions require candidates to respond by integrating the knowledge and skills they have developed through a comprehensive understanding of the entire course.

Section I

Question	Correct Response
1	C
2	A
3	C
4	D
5	B
6	A
7	D
8	B
9	B
10	D

Section II

General Comments

Candidates are advised that the answer space allocated for each question is a guide to the length of the required response. Marks are awarded for correct method even when incorrect answers are given, so all working should be shown. Candidates are also advised that when drawings are labelled as being drawn 'to scale' they may be used for calculations or graphical solutions to problems. It is also acceptable to use the provided drawings as part of the solution.

Question 11 – Historical and Societal Influences, and the Scope of the Profession

(a)(i) Better responses identified a material used in the modern vehicle but weaker responses did not describe an appropriate development in that material, or one that the material had replaced from the older vehicle. Appropriate material developments included: annealed glass to toughened glass side windows, grey cast iron engine blocks to cast aluminium with cast iron cylinder sleeves, mild steel and timber interiors to polymer interior trimmings and fabrics.

(ii) Better responses identified and outlined features of an appropriate system but weaker responses did not display sound understanding of the engineering characteristics for that system. Appropriate responses included outlines of: anti-lock braking systems, power steering, computer-controlled engine and fuel injection, automatic transmission, disk brakes, and global positioning systems.

(b)(i) Typical responses provided explanations of the engineers' role but only the better responses related this to the safe operation of the winch system. Weaker responses displayed a poor understanding of the engineers' role in the design process.

(ii) Better responses described the role of the engineer with regard to safety or described a safety issue, but weaker responses failed to provide an appropriate set of actions the engineer should take to resolve the issue. Some responses repeated the answer given to part (i).

Question 12 – Civil Structures

(a)(i) Efficient responses correctly calculated the left reaction by summing moments about the right. Less efficient responses summed moments about the left reaction and then summed forces vertically to get an answer – thereby wasting time.

(ii) Correct responses used either a 'method of sections' or 'method of joints' approach: both requiring two steps. Weaker responses demonstrated a lack of understanding of the 'method of sections' process where forces from both sides of the section plane were included or some forces were omitted completely.

(b)(i) Better responses demonstrated a sound understanding of shear force diagrams and how they are constructed. The major error was drawing the diagram as a uniformly distributed load beam rather than as a point-loaded beam.

Weaker responses to the bending moment diagram displayed little knowledge and understanding. Many simply transferred shear force values, while others drew general curved diagrams.
Candidates are reminded that significant points for both diagrams should be labelled with force and/or moment values or the vertical scale for both diagrams labelled.

(ii) Correct responses gave the advantages of 'greater resistance to bending' or 'increased load capacity' to the hollow beam shape and then linked these to its larger second moment of area value. Weaker responses incorrectly stated that the beam was lighter than the solid beam. Candidates are reminded that 'stronger' is not an acceptable response without a qualifier, such as 'stronger in tension'.

(c) The best responses related good compressive strength for concrete with improved tensile strength due to the steel reinforcing for the composite material, and, in addition, referred to the need to overcome bending and tensile stresses caused by earth movement.

Question 13 – Personal and Public Transport

(a) Better responses identified the rapid cooling of the glass surface as the cause of the outer layers being placed in compression. However, the best responses correctly identified the subsequent cooling and contraction of the inner layers of glass as the real reason the already solidified surfaces are placed in compression. The better responses also described some changes in the characteristics of toughened glass, identifying impact resistance and safer fracture patterns. Many weaker or incorrect responses referred to the production process of laminated glass or discussed the heat treatment processes for steels.

(b) Typical responses successfully compared the properties of mild steel and aluminium such as weight, tensile and compressive strengths and corrosion resistance, but failed to consider the fabrication processes for each. Better responses compared fabrication processes such as welding, extrusion, rolling and surface protection.

(c) (i) Better responses correctly substituted power, time and distance values into the correct equation using appropriate SI units. Weaker responses used the correct formula, but failed to convert values to the standard units: watts, seconds and metres. Some responses did not extract the force required after correctly determining the work done by the vehicle.

(ii) Correct responses linked the work done stopping the vehicle with changes in energy values – potential and kinetic – for the vehicle, to determine a suitable distance. Weaker responses demonstrated little or no understanding of these concepts.

Question 14 – Lifting Devices

(a) (i) Better responses took measurements directly from the diagram to determine the answer. Weaker responses displayed calculations based on measurements taken from an incorrectly identified pivot point for the system. Graphical solutions for this question were more successful in determining the correct force than analytical solutions. Candidates are reminded that they may draw on, or use, the supplied drawing/stimulus material to assist their solution.

(ii) Better responses substituted data provided in the question into the appropriate formula, leading to the required force. Weaker responses indicated a lack of understanding in the rearrangement of formula to find one of the variables: in this case the force. Some responses failed to recognise that the pin was in 'double shear', or did not include the factor of safety in the calculations.

(b) Better responses from candidates clearly described an appropriate manufacturing process for each product. Weaker responses typically provided descriptions of property changes to the high tensile steel as well as incorrect or unrelated processes.

(c) Better responses generally revealed a sound understanding of the system and provided appropriate reasons for the use of an electrical control. Weaker responses provided only one reason or offered poor explanations.

Question 15 – Aeronautical Engineering

(a) Better responses linked airflow with the use of flaps (down) and elevators (up) in controlling the aircraft while coming in to land. The best responses included the need for an increase in thrust supplied by the engines to compensate for the increased drag caused by extended flaps and elevators. Weaker responses linked the use of other control surfaces to the required change in aerodynamics while landing or assumed the aircraft had landed and the control surfaces were being used to help stop the aircraft.

(b) (i) Typical responses identified one of the two major defects, but weaker responses did not describe the conditions that led to the defect. Better responses suggested appropriate methods of preventing the nominated defect. Better responses also incorporated correct aviation terminology and procedures.

(ii) Better responses named and described a suitable non-destructive test that could be used to identify a defect. Weaker responses named an inappropriate test or gave an incomplete description of the named test.

(c) (i) Better responses used a free-body diagram to simplify the forces acting on the plane. These responses then used 'moments' to determine the missing force, *F*. Weaker responses did not identify the correct fulcrum point and therefore used incorrect data in calculations.

(ii) Better responses used correct engineering terms when providing reasons for the use of duralumin in preference to pure aluminium and also demonstrated a good understanding of the different mechanical and physical properties for each. Weaker responses included incorrect engineering terms such as 'strength' and 'cost' as possible reasons for selection.

(d) Better responses provided a good pictorial view of the guide in either isometric or oblique projection to the scale required. Weaker responses failed to complete the view from the direction specified or failed to show the curve at the bottom of the guide. A significant number of candidates were unable to visualise the guide as a three-dimensional object from the orthogonal drawing.

Question 16 – Telecommunication

(a) (i) Better responses identified the ability to send signals over longer distances as the primary reason, but the best responses went on to include the ability to operate with more frequencies in the one area, greater noise reduction and reduced antennae size. Weaker responses frequently provided a description of the process rather than the reasons for it.

(ii) Better responses generally revealed a sound understanding of modulation using correct terminology and providing sketches to illustrate the answer. Weaker responses gave reasons for modulation or repeated their answers from part (i).

(iii) Weaker responses displayed a poor understanding of both the output from a demodulated signal and the effect a diode has on an electric circuit.

(b) Weaker responses generally revealed confusion between different satellite orbits, with the better responses indicating an orbit where the satellite remained above the same point on earth.

(c) Better responses indicated a good knowledge of cable types and uses, but weaker responses indicated that distances to be covered and frequency range of signals were not considered in the selection of the appropriate cable.

(d) Typical responses linked a suitable material with an appropriate manufacturing process, but many used a general classification, such as ‘polymer’ instead of a specific material. Weaker responses listed either the material or the manufacturing process and therefore did not adequately answer the question. A number of responses also displayed confusion between metal forming processes and those used to form polymers.

(e) Better responses displayed a good understanding of component assembly and the use of scales when applied to drawings. However, weaker responses displayed inadequate depth of knowledge. They displayed errors relating to the Australian Drawing Standards, AS1100, including representation of threads, nuts and the sectioning of components.

Section III

Question 17

(a) Better responses correctly identified and justified five relevant criteria, such as charging rate, OHS issues, durability, maintenance, availability of fuels, efficiency, cost effectiveness and environmental impact for evaluating the recharging system.

(b) Medium range responses identified and justified injection moulding for the indicator light cover and then identified a process for the mudguard, but often failed to justify it. The better responses were also able to identify and justify the stages in the manufacture of the suspension spring.

Candidates are reminded that the manufacture of a component, such as the spring and mudguard, may involve multiple forming processes and not just one step, as in the indicator light cover.

(c) Better responses provided appropriate occupational health and safety issues that should have been considered during the design of the trailer.

(d) Better responses correctly gave the output voltage of 12 volts and also identified that the batteries were connected in series and parallel configurations.

Question 18

(a) (i) Better responses used a graphical method to determine the magnitude, direction and sense of the reaction. Responses that attempted analytical solutions were less successful achieving a correct reaction force. Weaker responses involved incorrect interpretations of where the 900N force was applied and incorrect data gathered from the scaled drawing.

(ii) Better responses correctly substituted values from the data provided into the correct formula. Units for values used in a formula need to be consistent with SI standards.

(b) Better responses showed a thorough knowledge of tensile tests, the information they provide and how that information may be used in the selection of engineered components and materials. Weaker responses only addressed one or two pieces of data obtained from the test.

(c) Better responses showed a broad knowledge of composite materials and their possible use as a rotor blade. Weaker responses provided general properties of a composite material without linking the properties to those required of the rotor blade.

Engineering Studies

2007 HSC Examination Mapping Grid

Question	Marks	Content	Syllabus outcomes
Section I			
1	1	Personal and public transport – engineering materials	H1.2, H2.1
2	1	Lifting devices – engineering mechanics and hydraulics	H6.1
3	1	Lifting devices – engineering mechanics and hydraulics	H3.1, H3.3
4	1	Personal and public transport – engineering materials	H1.2
5	1	Personal and public transport – engineering mechanics and hydraulics	H1.2, H3.1
6	1	Lifting devices – engineering mechanics and hydraulics	H1.2, H6.1
7	1	Civil structures – engineering mechanics and hydraulics	H1.2, H2.1, H3.1
8	1	Civil structures – engineering mechanics and hydraulics	H1.2, H6.1
9	1	Civil structures – communication	H3.1, H3.3
10	1	Lifting devices – engineering mechanics and hydraulics	H3.1, H6.1
Section II **Question 11 — Historical and Societal Influences, and the Scope of the Profession**			
11 (a) (i)	2	Historical and societal influences	H1.1, H4.1
11 (a) (ii)	2	Historical and societal influences	H1.1, H4.1
11 (b) (i)	3	Scope of the profession	H1.1, H2.2, H4.3
11 (b) (ii)	3	Scope of the profession	H4.2, H4.3
Section II **Question 12 — Civil Structures**			
12 (a) (i)	1	Engineering mechanics and hydraulics	H3.1
12 (a) (ii)	2	Engineering mechanics and hydraulics	H3.1
12 (b) (i)	3	Engineering mechanics	H3.1
12 (b) (ii)	2	Engineering mechanics	H3.1
12 (c)	2	Engineering materials	H1.2, H2.1
Section II **Question 13 — Personal and Public Transport**			
13 (a)	3	Engineering materials	H3.1
13 (b)	3	Engineering materials	H1.2, H2.1
13 (c) (i)	2	Engineering mechanics	H1.2, H2.1
13 (c) (ii)	2	Engineering mechanics	H3.1

Question	Marks	Content	Syllabus outcomes
Section II **Question 14 — Lifting Devices**			
14 (a) (i)	3	Engineering mechanics	H3.1, H6.2
14 (a) (ii)	3	Engineering mechanics	H3.1, H6.2
14 (b)	2	Engineering materials	H1.2, H2.1
14 (c)	2	Engineering mechanics and hydraulics, Engineering electricity/electronics	H2.1, H6.2
Section II **Question 15 — Aeronautical Engineering**			
15 (a)	2	Engineering mechanics and hydraulics	H1.2, H3.1
15 (b) (i)	3	Engineering materials	H1.2, H2.1
15 (b) (ii)	2	Engineering materials	H1.2, H2.1
15 (c) (i)	1	Engineering mechanics	H1.2, H3.1
15 (c) (ii)	3	Engineering materials	H1.2, H2.1
15 (d)	4	Communication	H3.3
Section II **Question 16 — Telecommunication**			
16 (a) (i)	2	Electricity and electronics	H6.2
16 (a) (ii)	2	Electricity and electronics	H6.2
16 (a) (iii)	2	Electricity and electronics	H6.2
16 (b)	1	Electricity and electronics	H4.1
16 (c)	2	Electricity and electronics	H2.2
16 (d)	1	Engineering materials	H1.2
16 (e)	5	Communication	H3.2
Section III **Question 17 — Engineering and the Engineering Report**			
17 (a)	3	Engineering report	H1.1, H2.1, H2.2
17 (b)	3	Engineering materials	H1.2, H2.1
17 (c)	2	Engineering report	H2.2
17 (d)	2	Electricity and electronics	H2.1, H2.2
Section III **Question 18 — Engineering and the Engineering Report**			
18 (a) (i)	2	Engineering mechanics	H3.1
18 (a) (ii)	2	Engineering mechanics	H3.1
18 (b)	3	Engineering materials	H2.2
18 (c)	3	Composite materials	H2.1

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Marking Guidelines

Section II

Question 11 (a) (i)

Outcomes assessed: H1.1, H4.1

MARKING GUIDELINES

Criteria	Marks
• Describes characteristics and features of an appropriate development	2
• Describes limited characteristics or features of an appropriate development OR • Describes characteristics and features of an inappropriate development	1

Question 11 (a) (ii)

Outcomes assessed: H1.1, H4.1

MARKING GUIDELINES

Criteria	Marks
• Outlines the main features of an appropriate system	2
• Outlines limited features of an appropriate system OR • Outlines the main features of an inappropriate system	1

Question 11 (b) (i)

Outcomes assessed: H1.1, H2.2, H4.3

MARKING GUIDELINES

Criteria	Marks
• Provides a detailed explanation linking the role of the engineer with aircraft safety	3
• Provides a limited explanation linking the role of the engineer with aircraft safety OR • Provides an explanation of the role of the engineer and aircraft safety without linking them	2
• Provides a limited explanation of the role of the engineer or aircraft safety	1

Question 11 (b) (ii)

Outcomes assessed: H4.2, H4.3

MARKING GUIDELINES

Criteria	Marks
• Proposes more than two detailed and relevant actions	3
• Proposes one detailed and relevant action OR • States more than one relevant action	2
• States one relevant action	1

Question 12 (a) (i)

Outcomes assessed: H3.1

MARKING GUIDELINES

Criteria	Marks
• Uses appropriate method AND/OR correct solution	1

Question 12 (a) (ii)

Outcomes assessed: H3.1

MARKING GUIDELINES

Criteria	Marks
• Uses a correct method with minor error	2
• Uses a correct method with a significant error	1

Question 12 (b) (i)

Outcomes assessed: H3.1

MARKING GUIDELINES

Criteria	Marks
• Provides correct shape of shear force AND bending moment diagrams	3
• Provides correct shape of shear force OR bending moment diagram OR • Provides shear force and bending moment diagrams with minor errors	2
• Provides one diagram with minor errors	1

Question 12 (b) (ii)

Outcomes assessed: H3.1

MARKING GUIDELINES

Criteria	Marks
• Provides a detailed explanation	2
• Provides a limited explanation	1

Question 12 (c)

Outcomes assessed: H1.2, H2.1

MARKING GUIDELINES

Criteria	Marks
• Provides a detailed explanation	2
• Provides a limited explanation	1

Question 13 (a)

Outcomes assessed: H3.1

MARKING GUIDELINES

Criteria	Marks
• Provides a correct explanation linking the production process to the characteristics of toughened glass	3
• Provides a limited explanation linking the production process to the characteristics of toughened glass OR • Provides an explanation of the production process	2
• Provides a limited explanation of the production process OR • Provides a characteristic of toughened glass	1

Question 13 (b)

Outcomes assessed: H1.2, H2.1

MARKING GUIDELINES

Criteria	Marks
• States similarities AND/OR differences relating to the choice of materials for in-service AND fabrication	3
• States similarities AND/OR differences relating to the choice of materials for in-service OR fabrication OR • States the similarities AND/OR differences for the choice of ONE material for in-service AND fabrication OR • Provides limited similarities AND/OR differences for the choice of materials	2
• Provides a relevant statement	1

Question 13 (c) (i)

Outcomes assessed: H1.2, H2.1

MARKING GUIDELINES

Criteria	Marks
• Uses a correct method with a minor error OR • Correctly determines the solution	2
• Uses an appropriate method with concept error/s	1

Question 13 (c) (ii)

Outcomes assessed: H3.1

MARKING GUIDELINES

Criteria	Marks
• Uses a correct method leading to a correct solution OR determines a correct solution	2
• Uses an appropriate method with concept error/s	1

Question 14 (a) (i)

Outcomes assessed: H3.1, H6.2

MARKING GUIDELINES

Criteria	Marks
• Uses a correct method AND/OR gives a correct solution	3
• Uses a correct method with minor errors	2
• Uses a correct method with significant errors	1

Question 14 (a) (ii)

Outcomes assessed: H3.1, H6.2

MARKING GUIDELINES

Criteria	Marks
• Uses appropriate methods AND/OR gives correct solution	3
• Uses appropriate methods with minor errors	2
• Uses appropriate methods with significant errors	1

Question 14 (b)

Outcomes assessed: H1.2, H2.1

MARKING GUIDELINES

Criteria	Marks
• Describes BOTH appropriate process	2
• Describes ONE appropriate process OR • Limited description of processes for each item	1

Question 14 (c)

Outcomes assessed: H2.1, H6.2

MARKING GUIDELINES

Criteria	Marks
• Describes appropriate characteristics and features of the control system	2
• Provides limited characteristics OR features of an appropriate electrical system	1

Question 15 (a)

Outcomes assessed: H1.2, H3.1

MARKING GUIDELINES

Criteria	Marks
• Describes TWO appropriate adjustments	2
• Describes ONE appropriate adjustment	1

Question 15 (b) (i)

Outcomes assessed: H1.2, H2.1

MARKING GUIDELINES

Criteria	Marks
• Correctly names a defect, describes the cause and suggests prevention	3
• Correctly names a defect, with an incomplete cause and prevention	2
• A correct statement referring to a defect, cause or prevention	1

Question 15 (b) (ii)

Outcomes assessed: H1.2, H2.1

MARKING GUIDELINES

Criteria	Marks
• Names and correctly describes an appropriate test	2
• Names and describes an inappropriate test OR • Describes OR names an appropriate test	1

Question 15 (c) (i)

Outcomes assessed: H1.2, H3.1

MARKING GUIDELINES

Criteria	Marks
• Correctly calculates magnitude of force	1

Question 15 (c) (ii)

Outcomes assessed: H1.2, H2.1

MARKING GUIDELINES

Criteria	Marks
• Discusses correct reasons for selection of duralumin	3
• Limited discussion for the selection	2
• One correct comment/statement related to selection of duralumin	1

Question 15 (d)

Outcomes assessed: H3.3

MARKING GUIDELINES

Criteria	Marks
• Provides a pictorial drawing to correct (or almost correct) size and shape	4
• Provides a substantially correct pictorial drawing, mostly complete	3
• Provides a pictorial drawing with some aspects correct	2
• Provides a limited AND/OR incomplete (pictorial) sketch	1

Question 16 (a) (i)

Outcomes assessed: H6.2

MARKING GUIDELINES

Criteria	Marks
• Provides TWO or more clear and relevant reasons for modulation	2
• Provides ONE appropriate reason for modulation	1

Question 16 (a) (ii)

Outcomes assessed: H6.2

MARKING GUIDELINES

Criteria	Marks
• Explains the process of amplitude modulation using appropriate technical terms and concepts	2
• Indicates some knowledge of amplitude modulation	1

Question 16 (a) (iii)

Outcomes assessed: H6.2

MARKING GUIDELINES

Criteria	Marks
• Shows only appropriate sine wave	2
• Shows a sine wave at an incorrect amplitude or includes carrier	1

Question 16 (b)

Outcomes assessed: H4.1

MARKING GUIDELINES

Criteria	Marks
• Correctly describes a geosynchronous satellite orbit	1

Question 16 (c)

Outcomes assessed: H2.2

MARKING GUIDELINES

Criteria	Marks
• Correctly names appropriate cable types for each situation	2
• Correctly names TWO appropriate cable types for BOTH situations OR • Names THREE appropriate cable types but inappropriate situations	1

Question 16 (d)

Outcomes assessed: H1.2

MARKING GUIDELINES

Criteria	Marks
• Names an appropriate material and method of manufacture	1

Question 16 (e)

Outcomes assessed: H3.2

MARKING GUIDELINES

Criteria	Marks
• Provides correct assembly and proportion of components with correct standards	5
• Provides correct assembly and proportion of components with substantially correct standards	4
• Provides correct assembly and proportion of components with some correct standards	3
• Provides basic assembly and proportion of components	2
• Provides limited assembly and proportion of components	1

Question 17 (a)

Outcomes assessed: H1.1, H2.1, H2.2

MARKING GUIDELINES

Criteria	Marks
• Identification and justification of relevant criteria	3
• Identification of relevant criteria with limited justifications OR • Identification of some relevant criteria with justifications	2
• Identification of some relevant criteria with limited justifications	1

Question 17 (b)

Outcomes assessed: H1.2, H2.1

MARKING GUIDELINES

Criteria	Marks
• Identifies and justifies THREE appropriate manufacturing processes	3
• Identifies and justifies TWO appropriate manufacturing processes OR • Identifies THREE manufacturing processes	2
• Identifies and justifies ONE appropriate manufacturing process OR • Identifies TWO manufacturing processes	1

Question 17 (c)

Outcomes assessed: H2.2

MARKING GUIDELINES

Criteria	Marks
• Relates relevant OHS issues in the design of the trailer	2
• Provides a relevant OHS issue in the design of the trailer	1

Question 17 (d)

Outcomes assessed: H2.1, H2.2

MARKING GUIDELINES

Criteria	Marks
• Identifies electrical connections and determines the output voltage	2
• Identifies electrical connection OR • Determines the output voltage	1

Question 18 (a) (i)

Outcomes assessed: H3.1

MARKING GUIDELINES

Criteria	Marks
• Uses correct method AND/OR gives correct solution	2
• Uses correct method with errors	1

Question 18 (a) (ii)

Outcomes assessed: H3.1

MARKING GUIDELINES

Criteria	Marks
• Uses correct method AND/OR gives worked solution	2
• Uses correct methods with errors	1

Question 18 (b)

Outcomes assessed: H2.2

MARKING GUIDELINES

Criteria	Marks
• Provides TWO mechanical properties and explains their relevance	3
• Provides TWO mechanical properties OR • Provides ONE mechanical property and explains relevance	2
• Provides ONE mechanical property or explains relevance of testing with no specific mechanical properties	1

Question 18 (c)

Outcomes assessed: H2.1

MARKING GUIDELINES

Criteria	Marks
• Provides several properties for composite choice	3
• Provides TWO properties for composite choice	2
• Provides some justification of choice of materials OR • Provides ONE property for composite choice	