2002 HSC Notes from the Marking Centre Engineering Studies

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2002 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 provides comments with regard to responses to the 2002 Higher School Certificate Examination, indicating the quality of candidate responses and highlighting the relative strengths and weaknesses of the candidature in each section and each question. Comments have often been made that are intended to indicate how candidates could have improved their responses.

It is essential for this document to be read in conjunction with the relevant syllabus, the 2002 Higher School Certificate Examination, the Marking Guidelines and other support documents that have been developed by the Board of Studies to assist in the teaching and learning of Engineering Studies. Electronic copies of all these documents can be found on the Board of Studies website (www.boardofstudies.nsw.edu.au). Simply go to the home page then follow the links.

General Comments

In 2002, approximately 1350 candidates attempted the Engineering Studies HSC examination.

Teachers and candidates should be aware that each examination includes a number of different question styles. These range from questions that require the simple recall of knowledge through to those that expect candidates to respond by integrating the knowledge and skills they have developed through a comprehensive understanding of the entire course.

In this examination paper, all questions were compulsory and candidates were expected to complete eighteen questions that followed the format outlined below.

	Question/s	Mark Value	Syllabus Area
Section I	1-10	1 mark/question	Application modules
Section II	11	10 marks	Historical and Societal Influences, and the Scope of the Profession
	12	10 marks	Civil Structures
	13	10 marks	Personal and Public Transport
	14	10 marks	Lifting Devices
	15	15 marks	Aeronautical Engineering
	16	15 marks	Telecommunication
Section III	17	10 marks	Engineering and the Engineering Report
	18	10 marks	Engineering and the Engineering Report

Section I

General Comments

This section contains ten multiple-choice questions that covered the application modules. In several of these questions candidates were expected to complete calculations to achieve an answer while in the others candidates were required to select the most appropriate response from the four choices given.

Multiple Choice

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

Section II

General Comments

Overall, the candidates' responses indicated that the majority had a good grasp of engineering concepts, appropriate for HSC candidates. Candidates need to be aware that the answer space allocated is a guide to the length of the required response.

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

Engineers not only develop solutions to problems and integrate technical knowledge within a team of engineers but are also required to communicate how technology affects the development of those solutions. Through effective leadership, engineers manage projects, resources and teams of people and must also be critically aware of the effects that solutions and innovations have on our environment and society.

This question gave candidates the opportunity to outline and describe the managerial tasks performed by engineers and then to describe the historical affects that the development of telecommunication technology has had on product development. Candidates were also engaged in a discussion of a particular telecommunication innovation and its effects on the individual and the wider community.

(a) Candidates were required to outline specific managerial tasks performed by an engineer in a large telecommunications company. Many candidates were able to identify and demonstrate a sound understanding of the managerial role and specific management tasks performed by such an engineer. Candidates were able to identify tasks such as setting goals; organising; delegation of duties; supervision of other engineers; coordinating project teams; progress reporting; project budgeting; developing occupational health and safety procedures and monitoring the implementation of those procedures. Some candidates had difficulty fully outlining the tasks that would be performed but were able to identify tasks without giving specific detail.

(b) Candidates were asked to identify a telecommunications product and describe how changes in technology allowed the ongoing development of that product. The majority of candidates identified the telephone or mobile phone as a telecommunications device and were able to correctly describe how that device has changed significantly over time. A range of other devices was chosen and candidates also produced suitable descriptions for these products. Candidates were able to describe the technologies that affected the changes in the chosen product such as changes in telecommunication transmission media; miniaturisation of electrical components; development of integrated circuits and the change from analogue to digital systems. A number of candidates found difficulty in relating the changing telecommunication technology with the product. These candidates were also often unable to identify influencing factors that instigated historical changes and the ongoing development of that product.

(c) This question highlighted the inability of many candidates to produce an in-depth description of how engineering innovation has a direct effect on members of society as individuals and as a community. Many candidates were able to describe an example of an innovation or device that controls another electronic device. A majority of those candidates were also able to develop a limited discussion of the effects on the individual and on the wider community. Some candidates discussed telecommunication-engineering innovations that were not used for the control of an electronic device from a distance. Some candidates concentrated on describing the control device innovation but failed to develop relevant high-level discussions about the effects on individuals and the wider community.

Future candidates will be well advised to thoroughly examine innovations in engineering. They should be able to critically describe and discuss the influencing technologies and the effects those innovations have on the individual and the wider community. Candidates should examine in detail the role of an engineer including the important tasks within a managerial role.

Question 12 – Civil Structures

This question involved the analysis of two structures and the application of various materials including the identification of specific materials, manufacturing processes and structural properties. Candidates displayed some general knowledge of the various areas examined by this question, but often lacked the ability to provide the specific details required in the responses.

(a) In order to answer this part of the question, candidates had to realise they must first identify the reactions at the supports. Most candidates were able to achieve this and scored well, however many launched into a long moments equation, rather than using simple observation. Candidates using the Method of Sections to find the force in member A, should first have

identified the correct point to apply the moments equation. Many candidates achieved this and scored well. Others tried several attempts but were unsuccessful. To gain full marks candidates had to calculate the height of the truss and apply it to the moments equation. Candidates wishing to use measured distances must first determine if the diagram is to scale.

(b) Candidates using the Method of Joints scored equally well under the marking guidelines. Many were able to find the force acting on the external sloping member and apply this force to the joint involving member A.

The vast majority of candidates gained marks for realising the member is in compression.

b) (i) This part of the question used knowledge of Young's modulus, and the formula given in the question, to calculate the length of a cable. Many candidates scored full marks, and were clearly well prepared and practised in answering this type of question. Some candidates had difficulty in manipulating the formula, to make the required length the subject of the equation. Errors were also made in substituting the relevant data and incompatible units were also a problem.

(ii) This question required the identification of a suitable metal for the support cable, and TWO reasons for the choice. Generally speaking this part was answered extremely well. Many steels and alloys were correctly nominated, however some candidates chose inappropriate expensive or exotic materials. Low replacement cost was considered a valid reason.

(iii) When comparing glazed and unglazed ceramics, many candidates scored marks for discussing porosity and conductivity. When comparing the glazed ceramic and the polymer, the negative effect of ultraviolet light on the durability of the polymer was often compared to the environmental stability of the glazed ceramic. Simple terms such as cheap or strong need to be qualified. Unfortunately some candidates lost time by comparing all three materials.

Question 13 – Personal and Public Transport

This question focused on power, the interpretation of a relay circuit, environmental and social issues relating to electric transport and how technological developments may improve public transport.

(a) This part involved a relatively straightforward calculation where the majority of candidates either showed a good understanding or didn't understand the concept of power at all. Many responses did not have the correct units required (Watts or Kilowatts). Numerous candidates also confused 'W' in the power equation as representing 'weight', which led to many incorrect answers. Another common error was the substitution of incorrect data into correctly derived equations as well as basic computational errors.

(b) This section was the most poorly answered of all the parts in Question 13. Most candidates appeared to appreciate that circuit 'A' in some way influenced circuit 'B'. However, a significant number of responses indicated there was a misconception that a transformer was present in the simple circuit, despite the fact that the existence of a battery meant circuit 'A' operated entirely under direct current. Few candidates indicated the existence of an induction coil, which opened the N/C switch in circuit 'B'. This lack of understanding extended to the

relationship between the switches in the circuits. Few candidates correctly stated that when the switch in circuit 'A' closed current flowed in 'A' thereby inducing a magnetic field in the coil that actuated the switch in circuit 'B' thereby ceasing current flow in that circuit.

(c) (i) The issue of pollution as an 'environmental issue' was often referred to in the answer but was often discussed in a very superficial manner. Many candidates often mentioned 'social issues' almost as an afterthought. Confusion between the two issues was often evident and clear gaps in knowledge and understanding were especially associated with the social issue.

(ii) Many candidates made sketchy reference to technological developments such as 'new materials' rather than qualifying new materials as 'lighter, stronger, more resistant to corrosion, better mechanical properties' etc. Where candidates did mention a specific technological development, it was often not linked to improved public transport. The reverse was often the case where particular improvements in public transport were cited but then not linked to a specific technological development or developments that made the improvement possible. Many candidates could not disassociate this question from the previous part and subsequently dwelt too much on related environmental issues rather than the key point of links between technological development and improvements to public transport.

Question 14 – Lifting Devices

This question looked at the analysis of materials, mechanical structures and included a pictorial sketch.

(a) This question was well answered by the majority of candidates who were able to calculate the volume of the pontoon that would be under water and convert that volume to a load. They were then also able to deduct the load of the crane and pontoon from this load to arrive at the final answer.

The most common error displayed by candidates for this question was the failure to deduct the crane and pontoon load from the required load to cause it to submerge by 70%. Many candidates tried to use Archimedes' Principle and lost their way in the calculations leading to incorrect solutions.

(b) This part involved candidates interpreting an orthogonal drawing of a sliding door mechanism and then completing a pictorial sketch of the mechanism, without including the roller. Candidates generally achieved good marks for this question, however it was evident that many could not interpret the orthogonal drawing, or had trouble communicating their perception of the mechanism in the form of a pictorial drawing. A large percentage of candidates included the roller in their sketches and not only wasted valuable examination time, but made the drawing considerably more difficult.

Candidates displayed many varied forms of pictorial drawings in their responses, most conventional, some not. Those responses that achieved the best marks tended to be either isometric or oblique, as these projections provided the simplest opportunities for completing a correct solution.

Many candidates presented responses that had obviously been completed with drawing instruments, or at least set squares and templates. While these responses were generally good, the three marks available for the question did not warrant the time required to complete them to the standard presented. The question asked for a sketch, and it became clear that many candidates need practice in doing quality sketches in a short period of time.

(c) (i) The basic method (energy lost being equal to the difference in potential energies for the hammer), used by the majority of candidates to solve this question, was generally well presented, however a significant number of candidates failed to score maximum marks. Common mistakes included using millimetres for the units of height in the calculations rather than the standard SI unit of metres, or substituting the weight force of the hammer (mg) into the equation for the potential energy (mgh) to effectively present an answer (mg)gh.

An alternate solution, equally correct, for this question was presented by some candidates where they determined the percentage of energy lost by the hammer as a result of the test. (71.25%)

(ii) This question was poorly answered by the majority of candidates, with very few correctly combining an outline of the changes in the structure and toughness of steel in their response. The majority of responses simply outlined changes in the structure of the steel, referring to changing proportions of pearlite, ferrite and cementite. A large group of responses indicated knowledge of the mechanical properties of cementite and outlined that the steel would reduce in toughness as the proportion of cementite increased. These candidates seemed unaware of the presence of the pearlite structure and of its mechanical properties.

A small group of responses gave a correct outline of the changes to toughness of the steel, indicating that it would increase to around 0.8% carbon and then start to decrease as the carbon content continued to increase. A large percentage of candidates responded too simply indicating that the toughness either increased, or decreased, as the carbon content of the steel was increased.

A significant number of incorrect responses unnecessarily included outlines of common heat treatment processes used to alter the properties of steel.

Question 15 – Aeronautical Engineering

This question involved aspects related to the frame materials of aircraft, an analysis of turboprop and jet systems and questions related to helicopters in flight.

(a) Most candidates gave ‘aluminium alloy’ as the selected alloy but the question specifically asked to identify an alloy. Al – Cu (Duralumin) is the most common alloy used for this application. Precipitation or Age Hardening was the correct heat treatment for this alloy with many candidates unable to state the 3 stages for this process: 1. solution treatment, 2. quench to room temperature, 3. precipitation harden.

(b) Most candidates could identify the advantages of turboprop and jet systems, however many were confused about their operation. The correct response required candidates to mention that

the turboprop derives thrust from the propeller driven by the gas turbine and a jet derives thrust from the exhaust of high-energy gas from the rear of the engine.

(c) Most candidates scored well for this question, being able to determine the correct weight-force from the given mass and then draw at least a partial force vector diagram. Many candidates confused the resultant with the equilibrant. Accuracy was a problem, with small scales being chosen or inaccurate lengths drawn for the force vectors. Other common errors included missed arrowheads to indicate the sense of vectors. A small number of candidates presented analytical solutions even though the question specifically asked for a graphical solution.

(d) A poorly answered question. Some candidates showed an understanding of the aerodynamic concepts related to angle of attack/lift, but were unable to apply these concepts to the question. The difference in airflow velocity between the advancing blade and the retreating blade was not identified very well, and, although many candidates were able to refer to Bernouilli's Principle, it was poorly explained in the context of the question. A significant number of responses simply repeated much of the information provided in the question statement.

Question 16 – Telecommunication

This question tested the candidates' knowledge of the types of cables used in telecommunications, the methods of microwave and satellite transmission, the communication bands in the electromagnetic spectrum and concepts of AM and FM radio transmission.

(a) (i) The twisting in unshielded twisted pair wires and its effects were not understood by the majority of candidates. Many related the twisting to increased strength, a change in resistance, better mechanical properties or simply restated the question as improved performance. Very few candidates answered correctly in terms of a protective electromagnetic field being created.

(ii) This question was reasonably well answered although a significant number of candidates displayed a misunderstanding of the type of cable shown. Nearly all candidates could identify an appropriate material for the outer jacket and gave a reason for its suitability. Those candidates who interpreted the cable as optic fibre had difficulty in identifying a material and a reason for its suitability in relation to the shield and dielectric. Many responses for the shield suggested mechanical rather than electrical properties. The term dielectric was poorly understood with many candidates believing this to be the conducting core and incorrectly identifying copper as a suitable material. The dielectric is an insulator and made from foamed polyethylene.

(b) Overall this was quite well answered and a simple explanation of the diagram enabled candidates to score some marks. The diagram showed linkage of the systems but many candidates assumed linkage and had difficulty in stating clearly a reason for the link. The application of both microwave and satellite technology was well understood but many candidates had difficulty in drawing out the relative comparisons of the two systems in their discussions.

(c) Most candidates attempted this question and many scored reasonable marks. The most common error was placing Mobile Phone in the lowest position of the electromagnetic

spectrum; it should have been in the highest position. The overlap of the UHF/FM/VHF bands caused some ambiguity in responses though the marking scheme accommodated this overlap.

(d) This question was not well answered although most candidates were able to gain some marks for their explanation of AM or FM. A significant number of candidates were able to identify the sources of noise such as lightning or solar activity. Many candidates incorrectly attempted to explain purely in terms of FM having a higher frequency than AM. Only a small number of candidates correctly identified static noise as being a change in amplitude.

Section III

This section of the examination paper includes Questions 17 and 18 and relates to engineering and the engineering report.

Question 17 – Engineering and the Engineering Report

This question looked at the design of a hoist system, analysis then calculation to determine a force and the completion of an orthogonal sketch.

(a) This part was very well answered with candidates demonstrating a comprehensive knowledge of what engineers should consider in the design, manufacture and placement of a structure. A range of ideas from differing disciplines of engineering contributed to the quality of student responses. The interpretation of the word 'discuss' was not clearly understood by some candidates. These candidates were unable to elaborate after selecting valid engineering considerations. Simply repeating the same considerations for different components of the structure was evident in some of the poorer responses.

(b) Most candidates were able to demonstrate basic understanding of turning moments by selecting a force and multiplying it by a distance. However a majority of candidates experienced difficulty identifying the correct pivot point for the structure and had further difficulty identifying the correct distances (moment arms). Common errors included taking moments about the centre of the base plate or neglecting the fact that that there were two bolts anchoring the structure. Better candidates completed a detailed 'free body diagram' and used this information to formulate a correct moments equation to derive the answer.

(c) Only a low percentage of candidates were able to complete sufficient drawing work correctly in order to gain full marks. Those candidates who made a serious attempt at the drawing displayed a reasonable understanding of standard nut, bolt and washer proportions and thread representation as defined in AS1100. The most common errors included failure to section the mounting bracket and/or the bush, non-completion of the linework that joined the candidate's drawing to the initial sketch provided in the question, incorrect location of the washer and failure to dimension the bolt.

Question 18 – Engineering and the Engineering Report

This question focused on power poles and involved evaluating the suitability of materials, an explanation of and suggestions for the prevention of concrete cancer and a discussion on recycling of timber and concrete poles.

(a) Generally a well-answered question, with many candidates demonstrating a good understanding of the properties of the materials and their suitability. Some candidates had difficulty identifying specific engineering (manufacturing, mechanical, service etc) properties and answered in general terms such as strong, cost and weight instead of specific properties such as tensile or compressive strength, toughness, etc. Some candidates correctly identified other reasons such as environmental issues and availability of materials particularly in reference to hardwoods.

(b) Most candidates were able to demonstrate knowledge and understanding of spalling (concrete cancer) although the quality of the responses was varied. Many candidates gave excellent answers to this question. Some candidates identified steel reinforcement corroding as the initial cause of concrete cancer but did not relate this to expansion, cracking and failure of the concrete allowing more moisture to contact the steel. Of the candidates that identified steel corroding as the initial cause, most were able to provide good methods of prevention. Some candidates, who did not mention the corrosion of steel, were still able to recognise concrete cracking and failing as indicators of concrete cancer.

(c) Generally well answered, although some candidates failed to identify suitable advantages of recycling. In discussing the recycling methods of reinforced concrete, some candidates did not mention the separation of steel from the concrete and the subsequent uses of the recycled steel. Most candidates were able to identify good uses of the recycled products, although some candidates incorrectly suggested that seasoned hardwood would be pulped for use as recycled paper products.

Engineering Studies

2002 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	Civil Structures: Engineering mechanics and hydraulics	H1.2, H2.1
3	1	Civil Structures: Engineering mechanics and hydraulics	H1.2, H2.1
4	1	Personal and Public Transport: Engineering materials	H1.2, H2.1
5	1	Lifting Devices: Engineering mechanics and hydraulics	H3.1
6	1	Civil Structures: Engineering mechanics and hydraulics	H3.1, H6.2
7	1	Personal and Public Transport: Engineering mechanics and hydraulics	H3.1
8	1	Civil Structures: Engineering mechanics and hydraulics	H3.1, H3.3, H6.2
9	1	Civil Structures: Engineering mechanics and hydraulics	H3.1, H6.2
10	1	Personal and Public Transport: Engineering electricity/electronics	H6.1
Section II			
11 (a)	3	Telecommunication: Scope of the profession	H1.1, H5.2
11 (b)	3	Telecommunication: Historical and Societal Influences	H1.1, H2.2, H3.2, H4.1
11 (c)	4	Telecommunication: Scope of the profession, Historical and Societal Influences	H1.1, H2.2, H3.2, H4.3
12 (a)	3	Civil Structures: Engineering mechanics and hydraulics	H3.1, H3.3, H6.1
12 (b) (i)	3	Civil Structures: Engineering mechanics and hydraulics	H3.1, H6.1, H6.2
12 (b) (ii)	2	Civil Structures: Engineering mechanics and hydraulics	H1.2, H2.1
12 (b) (iii)	2	Civil Structures: Engineering mechanics and hydraulics	H2.1
13 (a)	2	Personal and Public Transport: Engineering materials	H3.1, H6.1
13 (b)	2	Personal and Public Transport Engineering electricity/electronics	H3.3, H6.2
13 (c) (i)	3	Personal and Public Transport: Engineering materials	H4.2, H4.3
13 (c) (ii)	3	Personal and Public Transport: Engineering materials	H4.2, H4.3
14 (a)	2	Lifting Devices: Engineering mechanics and hydraulics	H3.1, H6.2
14 (b)	3	Lifting Devices: Engineering mechanics and hydraulics	H3.1, H3.3

Question	Marks	Content	Syllabus outcomes
14 (c) (i)	3	Lifting Devices: Engineering mechanics and hydraulics	H3.1, H6.2
14 (c) (ii)	2	Lifting Devices: Engineering mechanics and hydraulics	H1.2, H2.1
15 (a)	3	Aeronautical Engineering: Engineering materials	H1.2
15 (b)	4	Aeronautical Engineering: Engineering mechanics and hydraulics	H1.2, H4.1
15 (c)	4	Aeronautical Engineering: Engineering mechanics and hydraulics	H3.1, H3.3, H6.2
15 (d)	4	Aeronautical Engineering: Engineering mechanics and hydraulics	H3.1, H3.2, H3.3, H6.2
16 (a) (i)	2	Telecommunication – Engineering electricity/electronics	H1.2, H4.1
16 (a) (ii)	3	Telecommunication – Engineering materials	H1.2, H6.2
16 (b)	4	Telecommunication – Engineering electricity/electronics	H4.1, H6.2
16 (c)	3	Telecommunication – Engineering electricity/electronics	H6.2
16 (d)	3	Telecommunication – Engineering electricity/electronics	H2.2, H3.2, H4.1
Section III			
17 (a)	3	Lifting Devices – Engineering Reports	H3.2, H6.2
17 (b)	3	Lifting Devices – Communication and Engineering Reports	H3.1, H6.2
17 (c)	4	Civil structures – Engineering Reports	H3.3, H6.2
18 (a)	3	Civil structures – Engineering and the Engineering Report, Engineering materials	H1.2, H2.1
18 (b)	3	Civil structures – Engineering and the Engineering Report, Engineering materials	H1.2, H2.1, H6.1
18 (c)	4	Civil structures – Engineering and the Engineering Report, Engineering materials	H1.2, H2.1, H6.1

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2002 HSC Engineering Studies
Marking Guidelines

Question 11 (a)

Outcomes assessed: H1.1, H5.2

MARKING GUIDELINES

Criteria	Marks
• Clearly outlines TWO specific managerial tasks	3
• Clearly outlines ONE specific managerial task OR • Briefly outlines TWO specific managerial tasks	2
• Briefly outlines ONE specific managerial task OR • Names TWO specific managerial tasks	1

Question 11 (b)

Outcomes assessed: H1.1, H2.2, H3.2, H4.1

MARKING GUIDELINES

Criteria	Marks
• Selects a product that has changed over time, and clearly describes how changes in technology have allowed the ongoing development of this product	3
• Selects a telecommunications product and describes its related changes in technology OR • Describes how a telecommunications product has changed over time	2
• Selects a telecommunications product that has changed	1

Question 11 (c)

Outcomes assessed: H1.1, H2.2, H3.2, H4.3

MARKING GUIDELINES

Criteria	Marks
• Describes innovation/device • Discusses an effect, positive and/or negative, on an individual at a higher level of response • Discusses a broader effect on community (may involve predictions, possible effects)	4
• Describes innovation/device • Discusses a negative and/or positive effect on community and individual	3
• Describes innovation/device • Discusses a positive and/or negative effect on individual or community	2
• Describes innovation/device OR • Discusses one positive and/or negative effect on individual or community	1

Question 12 (a)

Outcomes assessed: H3.1, H3.3, H6.1

MARKING GUIDELINES

Criteria	Marks
• Answer correct in both magnitude and nature	3
• Magnitude correct, nature incorrect OR • Correct technique used but inaccuracies lead to incorrect answer OR • One mistake somewhere in working out – rest is correct	2
• Multiple mistakes but some evidence of applying acceptable technique	1

Question 12 (b) (i)

Outcomes assessed: H3.1, H6.1, H6.2

MARKING GUIDELINES

Criteria	Marks
• Correct answer *Note:* Rounding off of area may produce slight but acceptable variations	3
• Correct formulae used for determining length of cable but student has made one mistake somewhere, eg: – incorrect value for area used – incorrect manipulation of formula but data correct – incorrect conversion of unit indices leading to answers such as 117 mm	2
• Recognises only one step in the calculation, eg calculates a value for the area of the cable OR • Makes multiple mistakes after substituting relevant data	1

Question 12 (b) (ii)

Outcomes assessed: H1.2, H2.1

MARKING GUIDELINES

Criteria	Marks
• Identifies a suitable metal for the cable and gives TWO valid reasons to support its selection	2
• Identifies a suitable metal for the cable but only gives ONE valid reason to support its selection OR • Gives two valid reasons WITH a good explanation but does not name a suitable metal for the cable	1

Question 12 (b) (iii)

Outcomes assessed: H2.1

MARKING GUIDELINES

Criteria	Marks
• Provides a good explanation of why glazed ceramic is the preferred material, highlighting the relationship between glazed ceramics, its performance and its superiority over one of the other two materials.	2
• Shows some understanding of superior properties of glazed ceramic but explanation does not relate glazed ceramic to unglazed ceramic or polymers eg lists some relevant factors but without explanation *Note:* 'Glazed Ceramic is a good insulator' is not acceptable as all three materials are insulators	1

Question 13 (a)

Outcomes assessed: H3.1, H6.1

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Correct equations derived for power with incorrect computation	1

Question 13 (b)

Outcomes assessed: H3.3, H6.2

MARKING GUIDELINES

Criteria	Marks
• Correct and clear explanation of how circuit *A* controls circuit *B* with associated terminologies	2
• Vague explanation of how circuit *A* controls circuit *B*, without terminologies OR • Explanation of only circuit *A* or circuit *B*, not related	1

Question 13 (c) (i)

Outcomes assessed: H4.2, H4.3

MARKING GUIDELINES

Criteria	Marks
• Provides points for and/or against one environmental issue and one social issue associated with the ongoing development of electric transport	3
• Provides points for and/or against either an environmental issue or a social issue OR • Lists one environmental and one social issue	2
• Lists, but does not discuss, one environmental or one social issue • Discusses either an environmental or social issue using generalities, unrelated to electric transport	1

Question 13 (c) (ii)

Outcomes assessed: H4.2, H4.3

MARKING GUIDELINES

Criteria	Marks
• Explanation must relate technological development and improved public transport. Technological developments that could be related well are: – power sources – lightweight materials – computer systems for management of public transport	3
• Explains technological developments but does not relate to improved public transport in the future OR • Discusses improved public transport but not clearly linked to technological development	2
• Indicates a relevant technological development, with no explanation	1

Question 14 (a)

Outcomes assessed: H3.1, H6.2

MARKING GUIDELINES

Criteria	Marks
• Correct answer given (answer can be in tonnes or Newtons (or kN))	3
• Makes one mistake leading to an incorrect answer, such as student: – finds correct mass of water displaced but does not subtract mass of pontoon and crane – calculates incorrect mass of water but does subtract mass of crane and pontoon from this incorrect value	2
• Recognises only one step in calculation, eg calculates volume displaced but does not relate to mass of water	1

Question 14 (b)

Outcomes assessed: H3.1, H3.3

MARKING GUIDELINES

Criteria	Marks
• Bracket and bolt assembly drawn pictorially • Most sizes, shape and proportions correct	3
• Substantial progress made towards correct solution	2
• Some features drawn correctly but majority of drawing is missing, wrong size or wrong shape	1

Question 14 (c) (i)

Outcomes assessed: H3.1, H6.2

MARKING GUIDELINES

Criteria	Marks
• Correct answer	2
• Correct equation derived for energy lost, with incorrect computation	1

Question 14 (c) (ii)

Outcomes assessed: H1.2, H2.1

MARKING GUIDELINES

Criteria	Marks
• Effect on structure and toughness is clearly outlined	2
• Effect on structure and toughness is vaguely outlined OR • Effect on structure is clearly outlined OR • Effect on toughness is clearly outlined	1

Question 15 (a)

Outcomes assessed: H1.2

MARKING GUIDELINES

Criteria	Marks
• Identifies an appropriate alloy and provides characteristics and features of an appropriate heat treatment process that will achieve desired properties (light and strong)	3
• Identifies an appropriate alloy and names an appropriate heat treatment process OR • Provides characteristics and features of an appropriate heat treatment process that will achieve desired properties	2
• Identifies an appropriate alloy OR • Names an appropriate heat treatment process	1

Question 15 (b)

Outcomes assessed: H1.2, H4.1

MARKING GUIDELINES

Criteria	Marks
One mark for each of followings • Describes turboprop correctly • Describes jet system correctly • Outlines a turboprop advantage • Outlines a jet system advantage	4
• One mark for any three of the above	3
• One mark for any two of the above	2
• One mark for any one of the above	1

Question 15 (c)

Outcomes assessed: H3.1, H3.3, H6.2

MARKING GUIDELINES

Criteria	Marks
• Correct resultant force and direction	4
• Correct principles shown with one error OR • Correct analytical solution	3
• Partial force diagram drawn	2
• Correct conversion of mass to force	1

Question 15 (d)

Outcomes assessed: H3.1, H3.2, H3.3, H6.2

MARKING GUIDELINES

Criteria	Marks
Four of the following points: • Lift increased with angle of attack • Lift increased with velocity of airflow over aerofoil • In forward flight, airflow over advancing blade is faster than over retreating blade • Advancing blade generates more lift than retreating blade	4
Three of the following points: • Lift increased with angle of attack • Lift increased with velocity of airflow over aerofoil • In forward flight, airflow over advancing blade is faster than over retreating blade • Advancing blade generates more lift than retreating blade	3
Two of the following points: • Lift increased with angle of attack • Lift increased with velocity of airflow over aerofoil • In forward flight, airflow over advancing blade is faster than over retreating blade • Advancing blade generates more lift than retreating blade	2
One of the following points: • Lift increased with angle of attack • Lift increased with velocity of airflow over aerofoil • In forward flight, airflow over advancing blade is faster than over retreating blade • Advancing blade generates more lift than retreating blade	1

Question 16 (a) (i)

Outcomes assessed: H1.2, H4.1

MARKING GUIDELINES

Criteria	Marks
• Clear explanation using terminologies such as creates protective electromagnetic shield around wire, improving reliability of data transmission	2
• Brief explanation, such as protection of wire from interference	1

Question 16 (a) (ii)

Outcomes assessed: H1.2, H6.2

MARKING GUIDELINES

Criteria	Marks
• Outer jacket, shield, dielectric have all been allocated a suitable material and corresponding reason for the material suitability	3
• Only two components have been allocated a correct material and reason OR • Three appropriate reasons OR • Three suitable materials	2
• Any two correct responses	1

Question 16 (b)

Outcomes assessed: H4.1, H6.2

MARKING GUIDELINES

Criteria	Marks
• Both advantages and/or disadvantages well discussed in both systems and conclusions drawn to complete analysis on when each system would be used and linked	4
• Advantages and/or disadvantages for both the microwave and satellite system briefly discussed without link OR • Discusses one system well with link	3
• Advantages and/or disadvantages for one of the two systems (microwave/satellite) without link	2
• Describes system or systems very basically OR • Gives reason for linkage of system	1

Question 16 (c)

Outcomes assessed: H6.2

MARKING GUIDELINES

Criteria	Marks
• All in correct position	3
• Any THREE in correct position	2
• Any TWO in correct position	1

Question 16 (d)

Outcomes assessed: H2.2, H3.2, H4.1

MARKING GUIDELINES

Criteria	Marks
• Makes clear the relationship between static noise, FM and AM by describing nature of static noise, FM signals and AM signals	3
• Describes AM and FM signals clearly, but no relationship to static noise developed	2
• Shows some knowledge of FM signals or AM signals or static noise	1

Question 17 (a)

Outcomes assessed: H3.2, H6.2

MARKING GUIDELINES

Criteria	Marks
• Discusses THREE valid and appropriate considerations concerning the mechanical hoist system. Discussion must identify issues and provide points for and/or against	3
• Discusses TWO valid considerations OR • THREE valid issues mentioned but inadequately discussed	2
• ONE valid issue discussed OR • TWO valid considerations mentioned but not discussed	1

Question 17 (b)

Outcomes assessed: H3.1, H6.2

MARKING GUIDELINES

Criteria	Marks
• Correct answer	3
• Shows reasonable understanding but makes up to two simple errors eg not dividing by two to determine force in each bolt, incorrect distance calculated or some similar error	2
• Shows a basic understanding of moments but has a number of mistakes in calculations or substitutions	1

Question 17 (c)

Outcomes assessed: H3.3, H6.2

MARKING GUIDELINES

Criteria	Marks
• Shows a comprehensive understanding of assembly, sectioning, AS1100 standards, proportions and dimensioning (may make some minor errors)	4
• Shows a reasonable understanding of the question but omits, or makes errors in approximately 25% of the work	3
• Shows a basic understanding of the question but omits, or makes errors in approximately 50% of the work	2
• Shows a limited understanding, completing only approximately 25% of the work correctly	1

Question 18 (a)

Outcomes assessed: H1.2, H2.1

MARKING GUIDELINES

Criteria	Marks
• Makes an appropriate evaluation of the suitability of each of the three materials • The three materials do not need to be compared or rated against each other	3
• Evaluates suitability of only two of the materials OR • Suitability of three materials evaluated but not with detail or accuracy	2
• Student evaluates suitability of only one material OR • Suitability of two materials evaluated but not with detail or accuracy	1

Question 18 (b)

Outcomes assessed: H1.2, H2.1, H6.1

MARKING GUIDELINES

Criteria	Marks
• Explains corrosion of steel reinforcement, expansion and cracking, which lead to further entry of moisture • Identifies methods of prevention	3
• Explains concrete cancer well OR • Gives a reasonable explanation of concrete cancer and a preventative measure	2
• Explains concrete cancer in basic terms OR • Gives preventative measures	1

Question 18 (c)

Outcomes assessed: H1.2, H2.1, H6.1

MARKING GUIDELINES

Criteria	Marks
All of the following points: • Discusses a method of recycling hardwood power poles • Discusses a method of recycling reinforced concrete power poles • Identifies uses for the recycled hardwood and reinforced concrete power poles • Identifies advantages of recycling power poles	4
Three of the following points: • Discusses a method of recycling hardwood power poles • Discusses a method of recycling reinforced concrete power poles • Identifies uses for the recycled hardwood and reinforced concrete power poles • Identifies advantages of recycling power poles	3
Two of the following points: • Discusses a method of recycling hardwood power poles • Discusses a method of recycling reinforced concrete power poles • Identifies uses for the recycled hardwood and reinforced concrete power poles • Identifies advantages of recycling power poles	2
One of the following points: • Discusses a method of recycling hardwood power poles • Discusses a method of recycling reinforced concrete power poles • Identifies uses for the recycled hardwood and reinforced concrete power poles • Identifies advantages of recycling power poles	1