LEAVING CERTIFICATE EXAMINATION 1999

ENGINEERING

HIGHER LEVEL CHIEF EXAMINER'S REPORT

ORDINARY LEVEL CHIEF EXAMINER'S REPORT

CONTENTS

Overview

Organisation of Examination

The examination was provided at Higher and Ordinary levels and a total of 5,067 candidates presented for the examination of which 3,381 (66.7%) took the Higher Level and 1,686 (33.3%) took the Ordinary Level. This represents 79 candidates less than 1998.

The examination format was as follows:

ENGINEERING	
EXAMINATION	**MARKS**
Higher Level	
Technology Project: Design	150
Practical	150
Written (Materials and Technology)	300
TOTAL	600
Ordinary Level	
Technology Project: Manufacture	150
Practical	150
Written (Materials and Technology)	200
TOTAL	500

1. TECHNOLOGY PROJECTS – HIGHER AND ORDINARY LEVELS

The briefs for both Technology Projects were sent to schools in October 1998. Each candidate selected one Technology Project and completed it as part of the examination. The projects were completed before March 1998. They were presented for assessment in the schools and marked by a team of visiting examiners in June 1999.

2. PRACTICAL EXAMINATION

The practical examination is a six-hour test undertaken by candidates, in the school, under examination conditions. Lists of required equipment and materials were sent to schools in October 1998, together with drawings and specifications for the parts, which each candidate was required to make prior to examination day in May 1999. On completion of examination the test pieces were sent to Examinations Branch, Athlone for marking. A team of examiners carried out the marking in June/July 1999.

3. WRITTEN EXAMINATION

3.1 HIGHER LEVEL

Candidates are required to answer:
Question 1, Sections A and B (compulsory question at 100 marks), and
any four other questions (at 50 marks each.) out of a total of seven questions.

Section A: 50 marks. Thirteen short questions, answer any ten.
Section B: 50 marks. Based on *special topic* notified to schools in 1997.
Five questions, answer all five.

Time: 3 hours – 300 marks

3.2 ORDINARY LEVEL

Candidates are required to answer:
Answer Question 1, Sections A and B (compulsory question at 65 marks), and
any three other questions (at 45 marks each) out of a total of six questions.

Section A: 30 marks. Eight short questions, answer any six.
Section B: 35 marks. Four short questions, answer any three.

Time: 2 ½ hours – 200 marks

1. TECHNOLOGY PROJECTS

Introduction

A total of 3,786 candidates selected the Higher Level project and 1,242 candidates opted for the project at Ordinary Level.
The following tables show the distribution of Grades at both Higher and Ordinary Levels

Grade	A	B	C	D	E	F	N/G
1999	28.45	36.1	23.7	7.92	2.8	0.71	0.32
1998	28.6	37.23	22.68	8.68	2.17	0.71	0.32

Table 1. Graph showing distribution of Grades – Higher Level

Grade	A	B	C	D	E	F	N/G
1999	20.21	37.12	27.21	9.18	4.67	1.29	0.32
1998	26.49	34.33	23.85	10.82	3.49	0.94	0.08

Table 2. Graph showing distribution of Grades – Ordinary Level

COMMENT AND ANALYSIS.

1.1 ENGINEERING - HIGHER LEVEL

DESIGN BRIEF

Design a Model Hoist that will lift at least its own weight vertically and be capable of moving in a circular path.

The breadth and scope of the brief was searching and provided a challenge, which the examiners confirmed, was fair for this level. Success was achieved chiefly where candidates demonstrated good communication ability and sound skills in designing and making. Weaknesses resulted primarily from inadequate scheduling of the design and make process. A diverse variety of projects were presented. There was a marked improvement in the content and presentation of design folders, which adhered closely to the marking criteria, demonstrating that teachers and candidates are keenly aware of course demands. Many candidates efficiently exploited the opportunity presented to express their creativity and innovation and combined this with a planned approach to the development of their solutions. This resulted in high standards of presentation and finish.

The more common solutions included model cranes, lifts and forklifts. Where candidates lost marks, it was due to poor finish, poor electronic circuit building and failure to satisfy the constraints and inclusions requested in the design brief. Some excellent designs were encountered and examiners were very pleased with the general standard. The less successful candidates could have benefited from more timely intervention and guidance from the teacher.

Examiners reported that, in the use of adhesives, many candidates were heavy handed resulting in hazing and spillage and giving a poor quality finish. Many candidates selected materials with inefficient weight to strength ratios or manufactured the model with little heed to balance, sturdiness and strength.
Timely intervention by the teacher can result in adjustments and refinements by the candidate through negotiation and can result in more realistic, effective and efficient outcomes.

Under the criteria “suitability of assembly techniques” and “suitability of parts and functions” many of the less successful candidates lost marks due to the use of heavy screws holding very light materials together or very light temporary fixing arrangements where more robust assembly techniques were necessary for the efficient structure of the model. The ability of the model to lift its own weight caused problems for many of the weaker candidates. Examiners still point to poor attempts by the less successful candidates in compiling a design folder, though an improvement on last year was evident.
The most common weakness was under the marking criteria “Analysis of brief”. “Testing /Evaluation” and though improved, were often neglected by the less successful candidate.

1.2 ENGINEERING - ORDINARY LEVEL

PROJECT BRIEF

Make a Model Helicopter according to the example shown in the drawing (given) or according to an alternative design.

This project was considered by the examiners to be very fair and appropriate for this level. Rates of success were slightly down on 1998 but considerably better than in 1997. Variation in alternative designs was not as common as in previous years with some centres working according to a "master plan" or "set model".
Teachers should discourage this working environment, as project work for examination purposes is part of the activity - based learning of coursework.
A poor finish and a lack of attention to safety as the more common features of the work presented by the less successful candidates. Loose propellers and sharp edges were common faults. While the majority of projects examined resembled very closely the given drawing, there were exceptions.
Attention to the presentation of folders/reports is less apparent at this level. Examiners reported little evidence of adherence to the marking scheme and criteria. Where candidates followed the marking criteria more successful outcomes resulted. There is still evidence of superfluous material being included in folders/reports. Examiners saw the use of the Internet as innovative and impressive but candidates must offer some analysis of the data downloaded. This applies to both levels. Examiners suggest that Ordinary Level candidates generally need guidance in planning.

Recommendations for teachers and candidates:

- *It would be helpful if teachers could ensure that each candidate had access to and was familiar with the marking scheme for project work which is issued to schools each year**;***

- *The examination paper itself, a copy of which must be given to each candidate, should be included in each folder in order to focus the presentation of the folder and sharpen the thrust of the communication therein(appropriate headings etc.,)*

With regard to folders particular attention is needed in the following areas:

- *Analysis of brief;*
- *Criteria for selection of solution;*
- *Testing and evaluation.*

2. ENGINEERING - PRACTICAL EXAMINATION.

Introduction

A total of 5084 test pieces were examined. The Valve Mechanism was completed successfully by most candidates and was considered by examiners to have been a challenging for all. There were some excellent fully functional models produced to a very high quality of accuracy and finish. The following table shows the distribution of Grades obtained from a random sample of 271 Candidates from 15 Schools.

A	B	C	D	E	F	N/G
51	92	92	26	9	1	0
18.8%	34%	34%	9.6%	3.2%	0.4%	0%

Table 3. Distribution of Grades from Random Sample of 271 Candidates from 15 Schools

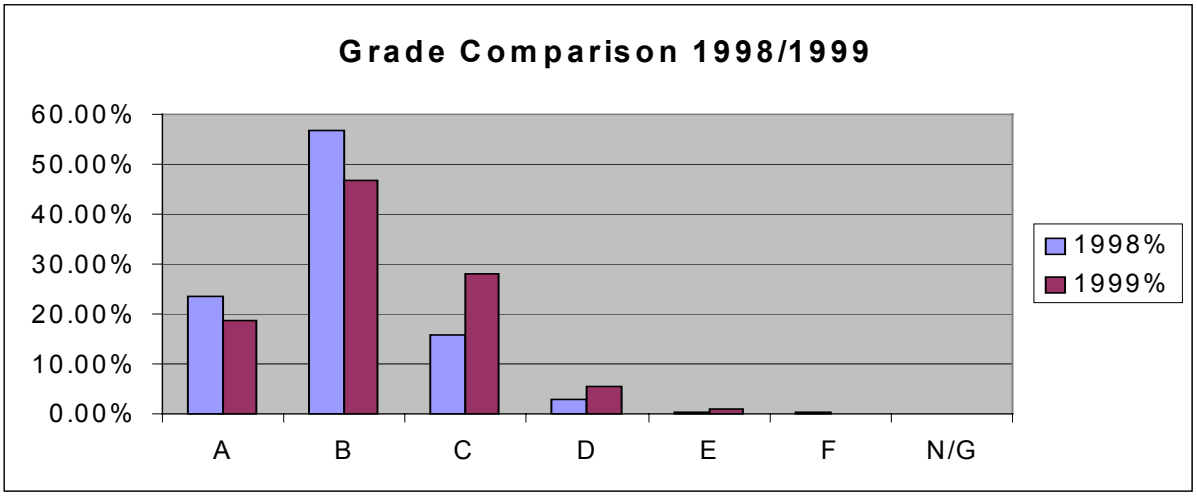
Overall Results.

The following table shows a comparison of Grades awarded in 1999 and 1998:

	A	B	C	D	E	F	N/G
1998 (%)	23.59	56.87	15.88	3	0.40	0.17	0
1999 (%)	18.84	46.66	28.13	5.33	0.96	0.08	0.00

Table 4. Distribution of Grades for 1999 /1998.

Bar Chart showing Distribution of Grades for 1998/1999



ENGINEERING - PRACTICAL EXAMINATION

Overview.

Preparation of blanks.
Almost all schools provided high quality specified materials. However a small number of candidates used bent, rusty steel, cut on a guillotine. There was also some evidence of metal being cut on a grinding machine.

Assembly & Finish:
Over 90% of candidates were successful in assembling the test piece. The quality of finish was generally good; however, many students could gain extra marks if edges were draw-filed with a smooth file, particularity after final assembly.

Function:
About 60% of pieces functioned well. Loss of marks was mainly due to inaccuracies in drill hole alignment, reversing of pieces after drilling or insufficient clearance between sliding parts. Candidates should be made aware that "function" is a major marking criterion in the Engineering Practical Examination, as shown on the marking scheme issued to schools each year.

Part 1.
This part was generally well done. Marks were lost due to inaccurate marking out, which resulted in incorrect positioning of holes or slot. Marks were also lost because burrs were left on drilled holes and for poor quality finish.

Part 2.
This part proved the most difficult to manufacture accurately. Candidates lost marks due to incorrect angle on valve seat, inaccurate alignment of drilled holes and general poor internal profile. Warping, caused by the release of internal stresses, disfigured the piece when the centre was removed and this amplified alignment difficulties for candidates.
Examiners took these difficulties into consideration when marking this piece.

Parts 3 & 4.
These parts were well made by most candidates and consequently marks awarded were high. Marks were lost mainly due to a poor profile and finish on the slot in part 4. The use of Polycarbonate reduced the amount of work on these pieces. Candidates should be advised to remove the protective paper before final assembly.

Parts 5 & 6.
Part 5 was generally well made. Part 6 was generally well marked out and well made. Marks were lost mainly due to incorrect angle on the valve and inaccurate profile.

Part 7
The standard in this piece was both uniform and high, indicating the use of a C.N.C. lathe in its production. Most candidates filed the cam profile. Candidates lost marks due to excessive polishing, which resulted in rounded edges and inaccurately shaped cams.

Recommendations for teachers and candidates:

- *Accurately sharpened tools and quality equipment are essential for the production of precision parts and must be available to candidates during examination.*

- *The use of unsuitable rust preventatives should be discouraged and a moisture repellent - such as WD40 - be made available instead.*

3. ENGINEERING - WRITTEN EXAMINATION

3.1 HIGHER LEVEL

Overview

The statistical comparison with last year shows a 1.28% increase in the A grade category, however the percentage failing to achieve a D grade has increased by 1.26%. This increase occurs in the F and N/G grade category and indicates selection of inappropriate level by candidates. Examiners received scripts with only one or two questions attempted and with very weak answering. A total of 55.31% achieved a C grade or higher (honours) and this constitutes a marginal decline of 0.99% since 1998. The examination paper this year tested the candidates' theoretical knowledge and their activity based workshop experiences. The majority of candidates presented precise answers with clear diagrams, displaying their knowledge to good effect. It was a searching, challenging paper and reported as being a very fair test. It presented the higher level candidate a wide variety of topics from the syllabus and afforded all candidates an opportunity to display their knowledge and preparation to full effect.

Question Popularity

The order of popularity in answering questions, as indicated by an analysis of a random sample of 4.7% of the total number of scripts, is indicated in the following table:

Order of popularity:	Question number:	Topics:
1	2 (94%)	Testing of materials
2	4 (65%)	Non Ferrous metals and Equilibrium diagram
3	3 (64%)	Iron/carbon and heat treatment.
4	5 (59.7%)	Welding.
5	8 (56.9%)	General mechanisms
6	7 (41.6%)	Machining
7	6 (31.9%)	Plastics

Question one, being compulsory, was attempted by all candidates.
Section B (prescribed topic) was not attempted by 1.5 % of candidates.

General Comments

The increased use of graphics and diagrams together with the expanded level of choice in the paper provided a more focused, student friendly and thought provoking paper this year. A majority of candidates responded with clear, diagrammatically aided solutions. It was a searching, challenging paper and was reported as being fair and appropriate to this level.

Overall the standard of answering was good. Many centres presented large numbers of candidates whose work was excellent. These candidates displayed a thorough understanding of the subject and an obvious high standard of study and preparation. There continues to be a significant number of candidates who perform poorly. A total of 20.43% obtained a grade E or lower, with an increase in both the N/G and F grade categories.
Candidates who performed badly did so for one or more of the following reasons:

- Many of the weaker candidates displayed not only a technically poor knowledge, but also an inability to read and note key words in questions.
- Poor basic exam techniques and an apparent disinterest in attempting the prescribed number of questions. Often questions were only partly answered.
- In some cases candidates selected small portions of all questions and displayed a lack of knowledge or interest in paper layout and content. In other cases candidates attempted one or two questions only.
- An inability to follow the instructions clearly given in questions.
- Little or no preparation or study of the prescribed topic.
- An inability to select and attempt to answer ten questions in Question One, Section A, reduced the candidate's opportunity to obtain a good overall mark.
- Candidates in certain centres doing higher level despite an apparent lack of suitability for this level.

Question 1- Section A:

(a) Very well answered.
(b) Generally well answered, with magnetic attraction and density the more common solutions.
(c) Well answered with diagrammatically supported answers, however weaker candidates could not explain why slippage occurs in FCC structures.
(d) Some excellent answers were obtained, however weaker candidates had difficulty with the effects the metallic bond structure has on properties.
(e) Very well answered.
(f) The abbreviations caused little or no problems for candidates with VDU, RAM and PTFE the more popular selections. The abbreviation LCD caused greatest difficulty for candidates.
(g) Generally very well answered with the bench vice and G-cramp the more popular selections.
(h) Very poor answers, with candidates regularly suggesting a resistor for part (i) and various inaccurate suggestions for part (ii). However there were many excellent solutions.
(i) Very well answered.
(j) A majority of candidates had difficulty with the dial gauge despite its appearance on the examination paper in previous years.
(k) Some excellent descriptions examined here, but many candidates had difficulty.

(l) Surprisingly many poor answers with many candidates suggesting an electrical tester as the purpose of the go/ no go gauge with obvious loss of marks.
(m) Michael Faraday was the most popular selection and examiners encountered good descriptions of his contributions to technology.

Question 1 - Section B (prescribed topic)

(n) Very well answered.
(o) Good answers.
(p) Very good descriptions for the NO and NC types of relay.
(q) Candidates offered poor descriptions generally for DPDT and SPDT relay, but made good use of the given diagrams for identification purposes.
(r) The circuit diagram caused greatest difficulty for candidates; the purpose of the diode was reasonably well answered. Generally, candidates had difficulty interpreting the relatively straightforward circuit diagram.

Question 2.

Testing of materials.

This was the most popular question selected (94%) and was generally very well answered with many candidates achieving full marks.

(a) Weaker candidates had difficulty with the correct terminology for the given forces and this points to the need for more encouragement to use correct vocabulary at this level. Some excellent answers were examined however, with many candidates redrawing the given diagrams to aid their solutions.
(b) Very well answered with the Charpy or Izod specimen the more popular of the two. The majority of candidates followed the itemised key words given in the question resulting in high levels of marks attainment.
(c) Very well answered with Ultrasonic and Magnetic the more popular selections.

Question 3.

Iron/carbon and heat treatment.

The third most popular selection (64%) and in the main well answered.

(a) The identification of the microstructures was generally well answered, however the less successful candidates often left their redrawn graphs blank. A significant number of candidates were not clear about a solid to solid change as opposed to a liquid to solid transformation.
(b) The less successful candidates displayed a poor understanding as to the effects of rapid cooling as opposed to slow cooling, despite similarities in this style of question on previous examination papers in recent years.
(c) Some excellent answers were presented with diagrammatically aided solutions of the optical pyrometer and thermo- electric pyrometer.

Question 4.

Non Ferrous Metals and Equilibrium Diagram

The second most popular question, with a 65% attempt rate.

(a) The less successful candidates failed to identify close packed hexagonal or its association with brittleness. The term allotropic was very clearly understood by all candidates that selected part (iii). Candidates displayed some difficulty in associating a metal with close packed hexagonal. The terms amorphous and crystalline were very well understood.
(b) The majority of candidates had no difficulty in naming the curves and explained the areas on the graph very well. The composition of the phases caused various levels of difficulty for the less successful candidates.
(c) This part was very well answered with some very good diagrams offered.

Question 5.

Welding.

This question was attempted by 59.7% of candidates.
(a) Some excellent answers were presented for option (i) with many candidates giving a description supported by chemical formulae. Part (ii) was less a popular selection and when selected lacked sufficient detail. Many candidates failed to read this part of the question correctly and answered both parts.
(b) Very good diagrammatically aided descriptions for MIG welding but applications were often omitted.
(c) The weld protection option was the more popular choice of candidates with some excellent answers. In the case of the few candidates selecting the robotic control part of the question answers lacked content and sufficient thought.

Question 6.

Plastics

The least popular question with a percentage uptake of 31.9% and was generally poorly answered with only a minority of exceptional responses. The lack of structure in candidates approach to section (a) was noted by examiners, candidates failed to observe the key words given and explain accordingly. Plastics appear to cause difficulty for candidates and basic information regarding structures not well understood by candidates.
(b) This part was generally well answered, with good descriptions of principles and features, but a minority did not name the process correctly as extrusion and lost some marks.
(c) The terms Catalysts and Fillers were the more popular selections and were generally well answered.

Question 7.

Machining.

This question was the second least popular question and was attempted by 41.6% of candidates.

(a) Very good answers examined here.

(b) The fixed steady and the grinding terms were the most common selections. When candidates did select the two milling operations very few identified both gang and straddle milling and some poor answers were encountered. The lathe steady was well answered by candidates. Only a small minority of candidates successfully described fully both loading and glazing.

(c) There were very good answers for gauges with the screw pitch gauge and feeler gauge the more popular selections. The less successful candidates guessed that the screw pitch gauge was used for checking the teeth on hacksaws. The gauge option was more often selected as opposed to the CNC terminology.

(c) When candidates did select this optional part C, the terminology posed problems. Common errors included confusion regarding the X and Z-axes. Canned Cycle was not selected by the majority and poorly explained when selected. Descriptions for Stepper Motors were also disappointing for this level.

Question 8.

General mechanisms

This question was attempted by 56.9% of candidates.

(a) The pressure release valve with non-return capacity was the more common selection with some exceptional answers. The IC, when selected, was poorly answered.

(b) The mechanisms were very popular selections with the majority presenting correct answers. The less successful candidates omitted the type of motion requested in part (ii) and treated the question in a similar fashion to part (i) resulting in some loss of marks. This points to the need for candidates to highlight key words in questions in order to read more carefully, as would be expected from a higher level candidate.

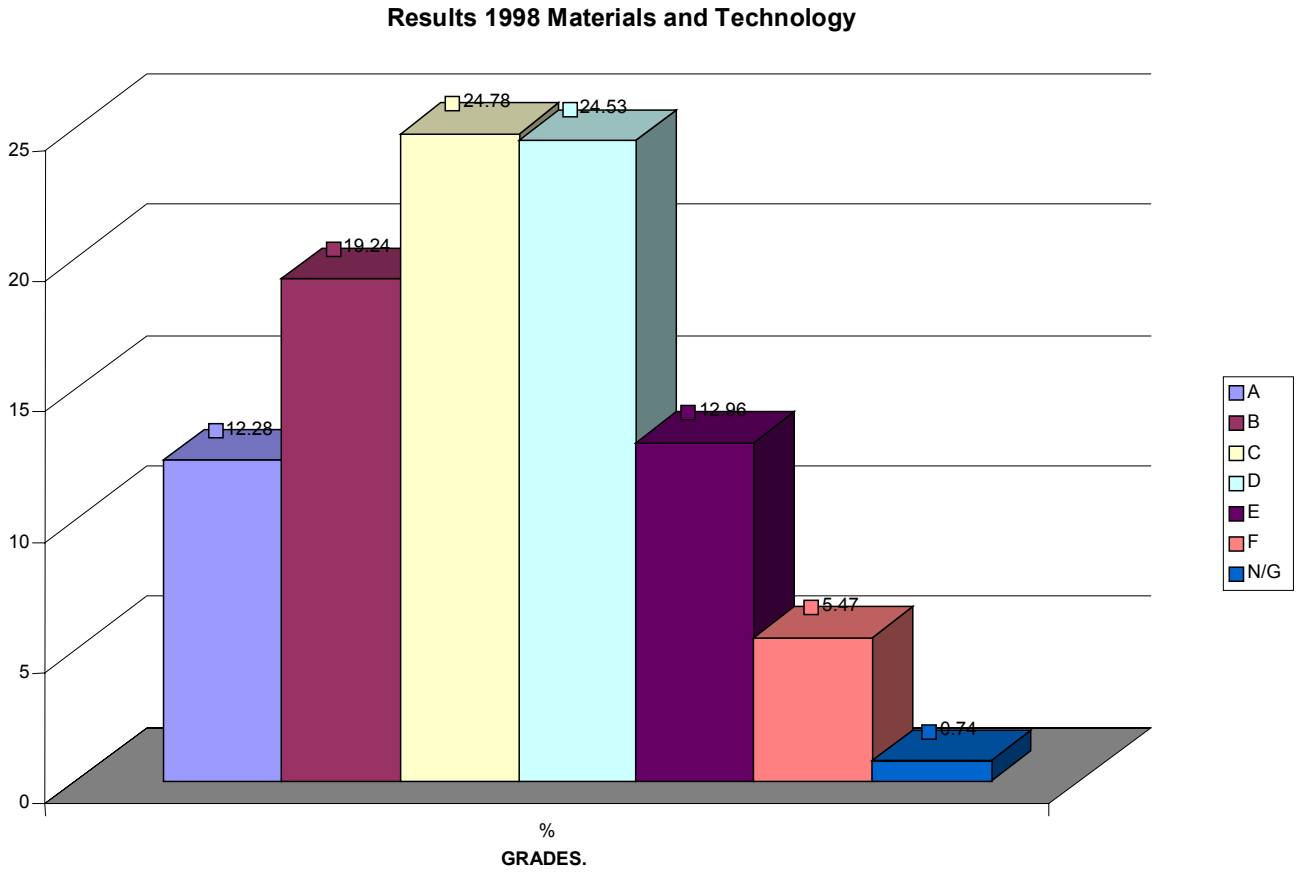
(c) Some candidates displayed very little understanding of the electronic components and frequently guessed the responses. However there were many exceptional responses. Common errors included component D being referred to as a Light Emitting Diode rather than a Light Dependant Resistor and the Transistor incorrectly referred to as a Capacitor. This was very disappointing considering the candidate's practical use of these basic components in project work. Only a small minority of candidates correctly described the application of the circuit only.

(c) This optional part C was far more popular among the cohort. Many candidates failed to describe how maximum and minimum speeds were achieved and presented vague answers unsupported by diagrams, which resulted in loss of marks. Some candidates failed to present a clear description of which pulley is driver or driven.

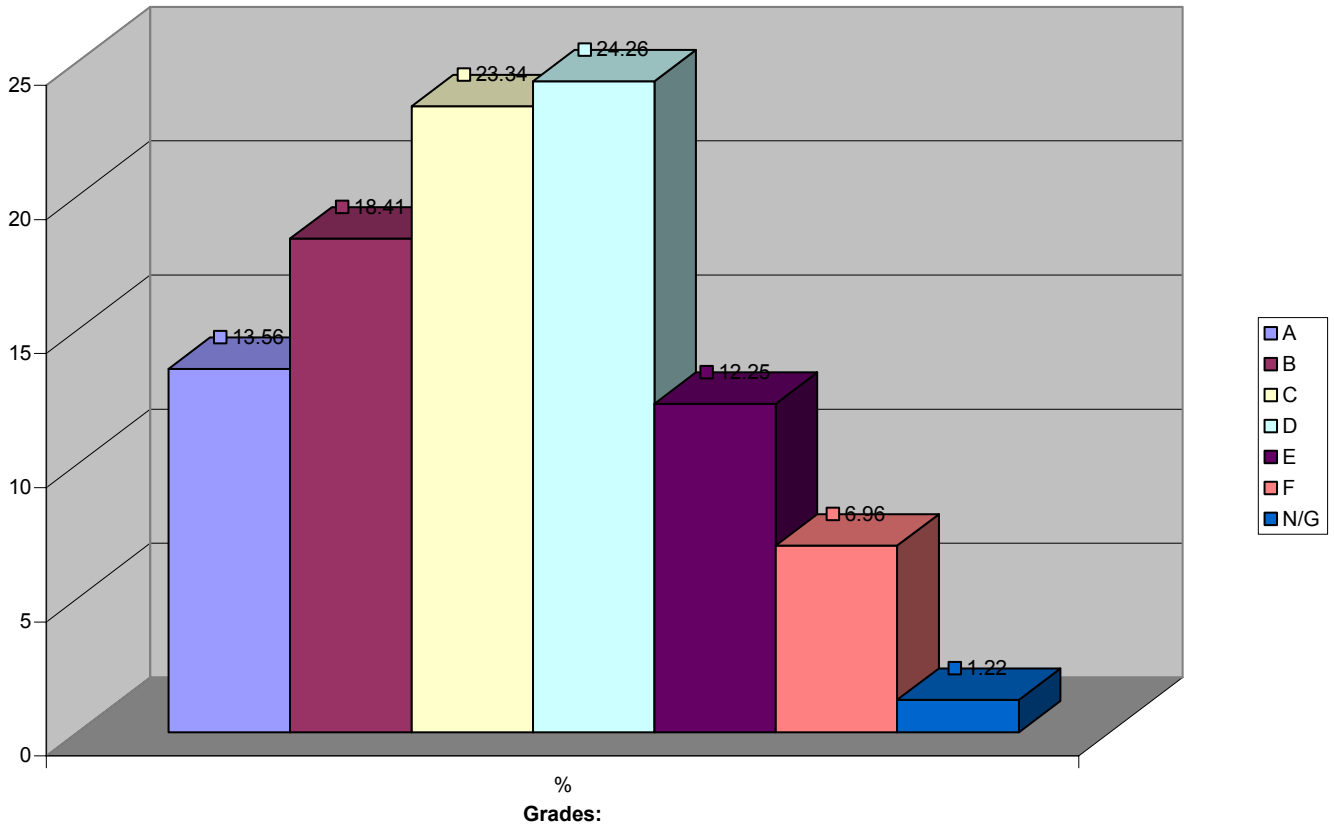
Recommendations for teachers and candidates**:**

- *Within each center, candidates must select the most suitable level for their experience, amount of study completed and ability.*
- *Candidates would benefit greatly from guidance in examination techniques.*
- *Candidates should attempt the required number of questions, support their answers with sketches where required and number and label answers correctly.*

5 CHARTS:



Results 1999:

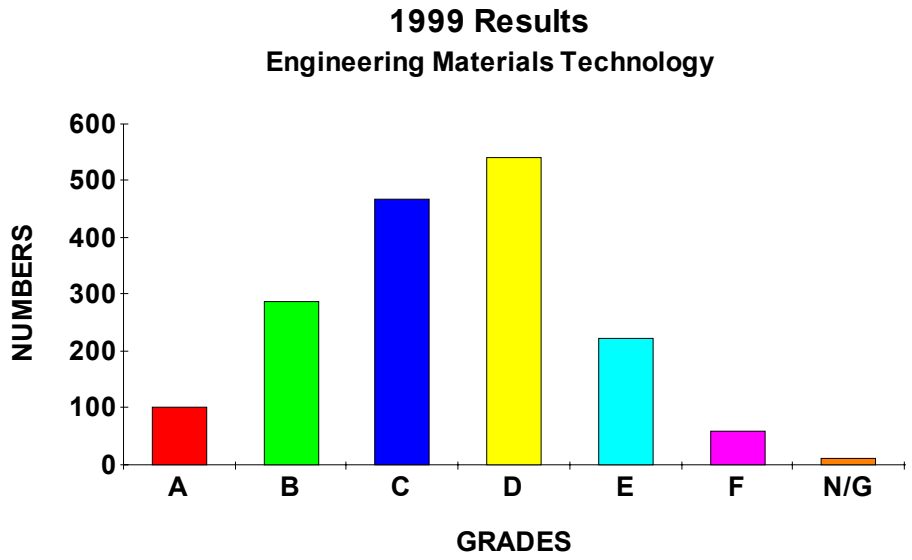


3.2 ENGINEERING - ORDINARY LEVEL

MATERIALS AND TECHNOLOGY

Overview

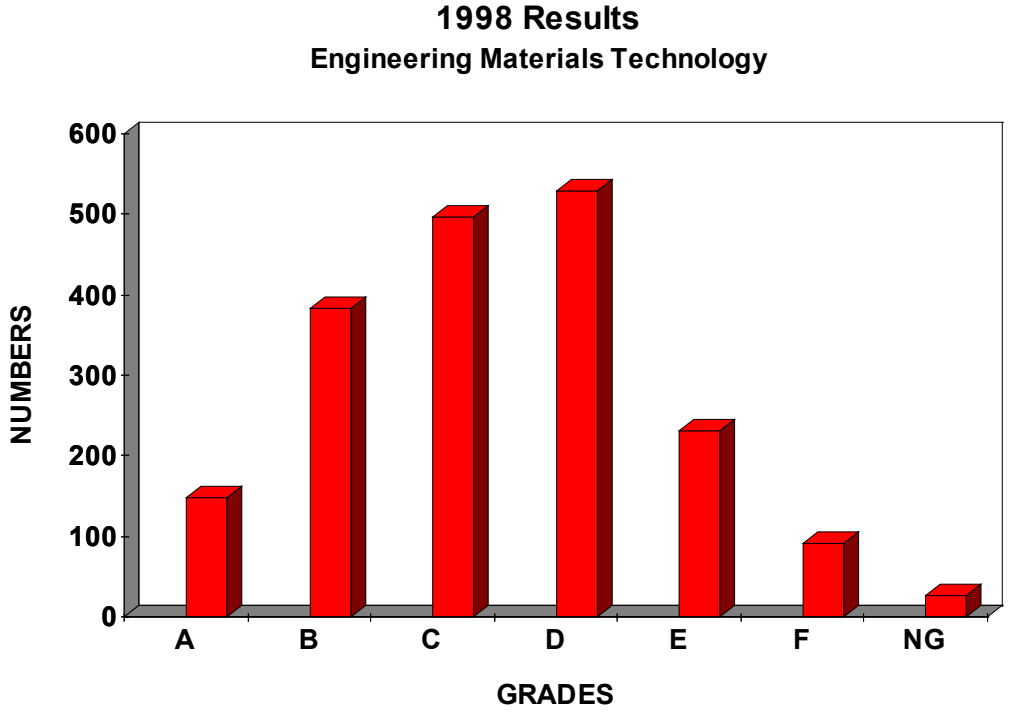
The overall standard of answering this year was very good.
Of the 1690 scripts examined, the following are the overall grades.



Graph showing distribution of Grades

A	B	C	D	E	F	N/G
102	288	468	540	223	58	11
6.03%	17.04%	27.7%	31.95%	13.2%	3.43%	0.65%

Table 1. Showing Distribution of Grades - numbers and percentages



A	B	C	D	E	F	N/G
147	383	497	529	231	91	27
7.7%	20%	26.1%	27.8%	12.2%	4.8%	1.42%

Table 2 Distribution of Grades -Total number of scripts 1905

Many candidates experience ddifficulties in writing coherently and often did not support their solutions with sketches/diagrams. With regard to syllabus content, the candidates' lack of knowledge in some areas raises a number of issues:

(a) Suitability of a large percentage of candidates for the Ordinary Level Programme.

(b) The ratio of class time devoted to theory and practical (it appears that the time being devoted to theory is insufficient).
The time devoted to practical demonstrations in the workshop also appears to be insufficient and this was evident from the answering of Question No. 6 (candidates were not familiar with the names or uses of these toolposts).

Candidates scored well, particularly in the grade ranges from B to D. However the standard of answering by some candidates was disappointing. There was confusion and lack of clarity in describing common workshop techniques, processes and terminology.

Q.	*Part*	*Commentary on individual Questions*
1	a	Most identified some electrical component. Some said some type of resistor – Very few identified LDR.
	b	Most mentioned insulator without using the term.
	c	Most referred to good finish - few mentioned accuracy.
	d	The most common responses were Lock nut, two nuts and welding -
	e	Goggles and hand protection most common.
	f	Very well answered by most candidates.
	g	Drilling / centre drilling always mentioned. Supporting a long shaft sometimes mentioned - Taper turning rarely mentioned.
	h	A wide variety of input devices were mentioned.
	i	Multimeter - not one gave all 3 uses. Strip Heater – well answered, Solar Panel - very general answers.
	j	Excellent answering.
	k	Most candidates who answered this understood the term.
	l	Conductor - well answered; Brittleness - adequate answering.
	m	Both Magnetic Switch and Compressor were poorly answered. Depth Gauge - adequate answering; Radius Gauge - poor answering.

2	a	Elastic bands mentioned a lot for Elasticity. Ductility not well understood**.**
	b	Confusion about the type of heat treatment required, most candidates described hardening as the solution.
	c	Poorly answered. Nobody indicated Induction Hardening for the Lathe bed. Annealing of copper dish not well answered.
3	a	Most candidates were able to name at least two of the three furnaces, usually the Blast Furnace and the Electric Arc furnace.
	b	Candidates often named one furnace but described a different one or even gave a "mixed" description, comprising two processes.
	c	A lot of guesswork evident, in general not well answered by all.
	d	Cars, planes and household goods were common types of answers.
4	a	General difference well understood. Brass rod mentioned frequently.
	b	Excellent answering.
	c	Very good answering - oxidising mentioned often.
	d	(i) Well answered (ii) very well answered (iii) fairly well answered (iv) fairly well answered.
	d	In general the standard of answering for this part was fair.
5	a	Most gave Compression or Blow moulding for (i.) although many gave Vacuum Forming. Extrusion was well answered. Injection Moulding was rarely answered.
	b	Well answered, with Compression Moulding being the most common answer.
	c	Very poor answering for a CD. The other two were well answered.
	d	Excellent answering, candidates had excellent knowledge of terms.

6	a	Very few could name all three toolposts. Many referred to 'Parting off tool post'. Poor answering in general to this part of the question.
	b	Not well answered a small percentage of candidates discussed offsetting the topslide. A small number of candidates only mentioned using the tailstock. No candidate mentioned form cutting or compound slide.
	c	Excellent answering.
	d	Excellent answering with good knowledge of CNC.
7	a	Well answered.
	b	Poor answering -'Plug for plugging holes and Gap Gauge for measuring gaps' were the general type of answers.
	c	Candidates did score well on this part of the question and a lot of guesswork was inevidence.
	d	Dial Gauge not well answered. Pneumatic Cylinder fairly well answered. Solenoid - Most who attempted this part of the question chose the solenoid with a very wide range of answers being given.

STATISTICS

YEAR/COMPONENT	A	B	C	D	E - NG	TOTAL N0.
1998						
Project	28.6	37.2	22.6	8.6	2.8	3822
Practical	23.5	56.8	15.8	3.1	0.8	5125
Written	12.2	19.24	24.78	24.53	19.17	3233
Overall	8.9	34.1	37.4	17.2	2.4	3242
1999						
Project	28.45	36.1	23.7	7.92	3.83	3786
Practical	18.84	46.66	28.13	5.33	1.04	5084
Written	13.56	18.41	23.34	24.26	20.43	3363
Overall	11.2	31.3	35.9	18.0	3.6	3381