Coimisiún na Scrúduithe Stáit
State Examinations Commission

JUNIOR CERTIFICATE EXAMINATION 2006

METALWORK

ORDINARY LEVEL CHIEF EXAMINER'S REPORT

HIGHER LEVEL CHIEF EXAMINER'S REPORT

CONTENTS

Metalwork Examination 2006

1. General Introduction

1.1 The Syllabus

The present Junior Certificate Metalwork syllabus is in existence for many years. It is examined at two levels – Ordinary Level and Higher Level.

1.2 The Examination

At Ordinary Level the examination comprises the following two components:

(i) Techniques and Design, Project;

(ii) Written examination.

Candidates are required to attempt both components at Ordinary Level.

The examination, at Higher Level, comprises three components as follows:

(i) Techniques and Design, Project;

(ii) Techniques and Design, Practical examination;

(iii) Written examination.

Candidates, at Higher Level, are required to attempt all three components.

The examination format and mark allocation for each component are outlined in Table 1 below.

METALWORK	
EXAMINATION	**MARKS**
Higher Level	
Techniques and Design, Project	150
Techniques and Design, Practical examination	150
Written examination (Materials and Technology)	100
TOTAL	400
Ordinary Level	
Techniques and Design, Project	300
Written examination (Materials and Technology)	100
TOTAL	400

Table 1: Junior Certificate Metalwork examination format

1.2.1 Techniques and Design, Project

Each candidate, at both Ordinary Level and Higher Level, is required to submit an artefact which they have manufactured based on the Techniques and Design, Project examination paper. The project examination paper is issued to schools by the State Examination Commission (SEC) in the first week of November of year three of the Junior Certificate programme. Candidates are required to complete the project by the following April. The examination paper includes the instructions for making the project, drawing details and specifications for all components in the project. Also included in the instructions are details of a design feature which is to be incorporated in the final manufactured artefact.

All project work must be the candidate's own individual work, carried out under the supervision of the class teacher. At both Higher Level and Ordinary Level the candidates own individual work is intended to include the intellectual activity of design, along with the practical activities of making the artefact. On completion, all project work is securely stored by the relevant school authority until June, when it is laid out in the school, and marked by a team of visiting examiners who are appointed and trained by the SEC.

1.2.2 Techniques and Design, Practical Examination

The Practical examination is a three-hour test which takes place in schools, under examination conditions, in early May. Candidates take this component at Higher level only. Lists of required equipment and specified materials are sent by the SEC to the schools in November, along with drawings and specifications for parts which each candidate is required to make prior to the examination. The examination paper for the Practical examination requires candidates to interpret a drawing, and mark out, process, finish and assemble an artefact. On completion of this examination, all test artefacts are securely stored in the schools. The artefacts are marked in June by a team of visiting examiners who are appointed and trained by the SEC.

1.2.3 The Written Examination

The written examination, which is offered at two levels, Ordinary and Higher, takes place in June and is marked by examiners appointed and trained by the SEC.

Ordinary Level

The written examination at Ordinary level is of 1.5 hours duration and consists of a total of six questions. Candidates are required to answer Question 1, Sections A and B, and any three other questions from the remaining five.

Higher Level

The written examination at Higher Level is of two hours duration and consists of a total of seven questions. Candidates are required to answer Question 1, Sections A and B and any three other questions from the remaining six.

1.2.4 Weightings and Mark Allocations

Ordinary Level

At Ordinary Level the written examination represents 25% of the Junior Certificate Metalwork examination, while the practical examination represent 75%. This weighting is reflected in the mark allocation for each component. The following table and chart show the mark allocation and weighting for each component:

Written	Project	Total
100 marks	300 marks	400

Table 2: Allocation of marks - Ordinary Level

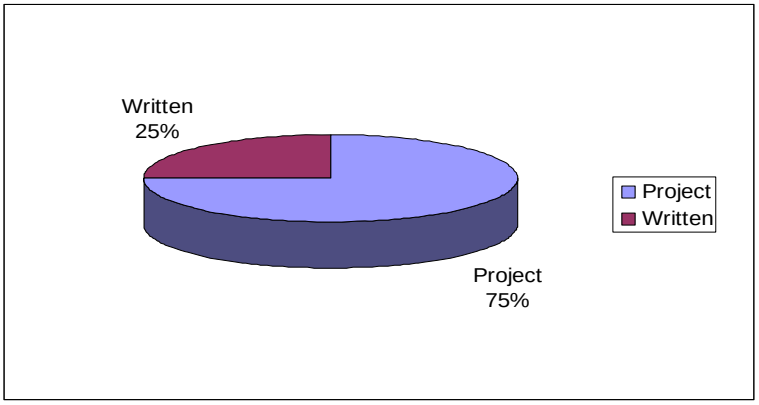


Table 3: Distribution of marks - Ordinary Level

Higher Level

The written examination represents 25% of the Junior Certificate Metalwork examination, while the project and the practical examination represent 37.5% respectively. The following table and chart show the mark allocation and weighting for each component:

Written	Project	Practical	Total
100 marks	150 marks	150marks	400

Table 4: Allocation of marks - Higher Level

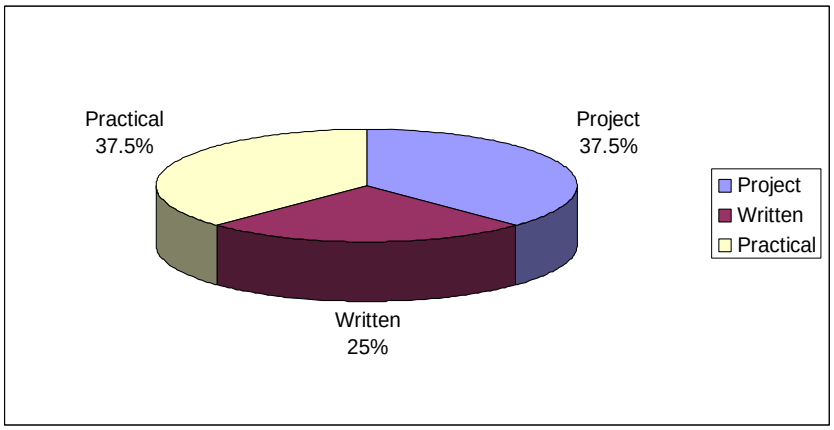


Table 5: Distribution of marks - Higher Level

1.3 Candidature

The number and percentage of candidates taking Junior Certificate Metalwork is represented in Table 6 below. The number of candidates taking Metalwork has remained relatively constant from 2004 to 2006.

Year	Junior Certificate candidates	Metalwork candidates	Percentage of cohort taking Metalwork
2004	56865	8037	14.1%
2005	56640	7873	13.9%
2006	57784	8028	14.0%

Table 6: Number and percentage of candidates taking Junior Certificate Metalwork for the four year period 2004 – 2006

Table 7 shows the number of candidates taking Metalwork at Higher Level and Ordinary Level from 2004 to 2006. The number of candidates taking Higher Level increased by 2.9% from 2004 to 2005, when approximately 70% of the total candidature opted for this level in 2005. This increase has remained constant in 2006. Slightly less than 30% of Metalwork students opted for Ordinary Level over the past two years. This reflects a decrease of approximately 3% from 2004.

Year	Total	Higher Level		Ordinary Level	
		Candidature	%	Candidature	%
2004	8037	5424	67.5	2613	32.5
2005	7873	5541	70.4	2332	29.6
2006	8028	5628	70.1	2400	29.9

Table 7: Number and percentage of candidates taking Metalwork at Higher Level and Ordinary Level 2004 – 2006.

2. Performance of Candidates.

2.1 Performance of candidates at Ordinary Level

The overall performance of candidates at Ordinary Level over the past three years is shown in Table 8 below. The table shows the percentage of candidates achieving each grade when marks for the two examination components are combined.

	Total	A	B	C	ABC	D	E	F	NG	EFNG
2004	2613	7.6	39.8	28.7	76.1	12.7	4.2	5.0	1.9	11.1
2005	2332	5.7	41.7	23.2	70.6	14.6	6.9	6.2	1.7	14.8
2006	2400	8.1	43.0	23.2	74.3	14.0	5.3	5.2	1.2	11.7

Table 8: Percentage breakdown of candidates achieving each grade at Ordinary Level 2004 – 2006

The percentage of candidates achieving the A grade has increased by 2.4% from 2005 but is very much in line with the A grades achieved in 2004. The percentage of the cohort achieving grade C or higher decreased significantly from 76.1% in 2004 to 70.6% in 2005, but recovered in 2006 with 74.3% of candidates achieving in the combined A/B/C grade range. The combined E/F/NG grades decreased by 3.1% from 2005. However, the relatively high percentage of candidates failing to achieve grade D or higher at this level is still a cause for concern.

2.1 Performance of candidates at Higher Level

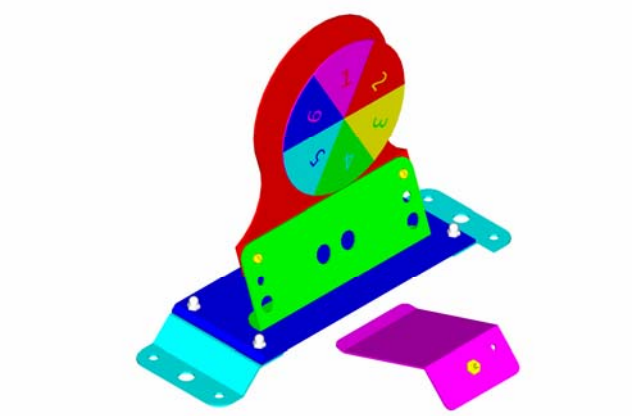
The overall performance of candidates at Higher Level over the past three years is shown in Table 9 below. The table shows the percentage of candidates achieving each grade when marks for each of the three examination components are combined.

	Total	A	B	C	ABC	D	E	F	NG	EFNG
2004	5424	11.4	49.6	28.9	89.9	7.9	1.5	0.4	0.2	2.1
2005	5541	10.6	52.0	27.5	90.1	8.0	1.5	0.3	0.1	1.9
2006	5628	13.8	48.1	26.0	87.9	9.4	2.0	0.5	0.1	2.6

Table 9: Percentage breakdown of candidates achieving each grade at Higher Level 2004 – 2006

The percentage of candidates achieving an A grade shows an increase 3.2% from 2005. The percentage of candidates achieving grade C or higher in 2006 was 87.9% and this strong performance is in line with 2004 and 2005. The combined E/F/NG grades in 2006, remains very much in line with the E/F/NG grades obtained in 2004 and 2005. This low failure rate combined with the percentages achieving the A, B, and C grades show that candidates are performing consistently very well at Higher Level.

3. Techniques and Design, Project – Ordinary Level



Solar Powered Dice Game

3.1 Introduction

The Techniques and Design, Project is designed to assess a range of skills and competencies as designated in the syllabus. These skills are obtained by engagement with the syllabus content through a practically based learning process. Project work accounts for 75% of the overall total at Ordinary Level.

In 2006, a total of 2,216 candidates submitted the Techniques and Design, Project, at Ordinary level. Candidates were required to make and assemble a Solar Powered Dice Game similar to that shown above. This also included a design element where candidates were asked to design, make and attach a Pointer to indicate where the Disc stops. All project work must be the candidates' own individual work, carried out under the supervision of the class teacher.

Projects were marked by application of the marking scheme (Appendix 1) in conjunction with high precision marking gauges, which were specially designed and manufactured for the SEC for the marking process. Examiners commenced the marking process in schools on Tuesday June 6th and it was completed on Friday June 16th 2006. The work of each examiner was monitored by an advising examiner during the marking process in order to ensure accuracy in marking and inter-rater reliability.

Examiners noted that in most centres teachers and candidates put considerable effort into the layout and presentation of the manufactured artefacts. Such an effort is to be

commended as it values the effort of the candidates and offers a showcase within the school for the creativity and skills of the candidates. In a small number of centres, projects were presented in an untidy and cluttered manner.

3.2 Performance of candidates at Ordinary Level

A summary of the results achieved by candidates in this component at Ordinary Level for the years 2004 to 2006 is presented in Table 10 below.

Table 10: Candidate performance Ordinary Level project 2004 – 2006

Year	Total	A	B	C	ABC	D	E	F	NG	EFNG
2004	2430	22.1	41.9	19.4	83.5	9.5	4.2	2.5	0.4	7.0
2005	2153	19.2	39.3	16.3	74.8	11.3	8.8	4.2	0.9	13.9
2006	2216	23.1	38.2	18.2	79.5	10.6	6.5	2.6	0.8	9.9

Note*: The grades here are indicative only. The grades awarded to candidates in Junior Certificate Metalwork are computed from the combined results of the relevant components completed by candidates.*

The percentage of the cohort achieving an A grade in 2006 has increased by 3.9% from 2005 but is in line with 2004. The combined ABC grade at 79.5% shows an increase of 4.7% from 2005. This is welcomed as it is more in line with the strong performance of candidates in 2004. The combined E/F/NG grades have improved by 4.0% from 2005.

3.3 Analysis of Candidate Performance at Ordinary Level

Examiners reported that the Techniques and Design, Project, at Ordinary Level, was a fair yet challenging test for candidates. The standard of work produced varied from excellent to poor. Many candidates attempted to satisfy all aspects of the project and availed of the opportunity to demonstrate high level practical and design skills. However, in some centres candidates failed to pay attention to finish and some candidates omitted the design element from the final artefact.

The following commentary is based on the observations of the team of examiners and it follows the criteria outlined in the marking scheme shown in Appendix 1 of this report.

Section 1: Complete Model - Assembly Finish & Function

Assembly – The vast majority of projects presented were assembled. The quality of each individual component did affect the degree of success achieved in the overall assembly of the artefact.

Finish – Examiners reported some evidence of a lack of attention to this element of project manufacture. Generally the quality of finishing was unsatisfactory. Some candidates' project components had not been draw-filed or polished and there was little emphasis placed on the removal of burrs from project parts. Paint, applied to specified components, was in some cases messy and this detracted from the overall appearance of the artefact. In a minority of centres steel was left unpainted and had rusted, resulting in a loss of marks for the candidates concerned. Greater care in finishing of examination pieces/project work, would result in improved marks for the candidates.

Function – Most candidates achieved high marks for the mechanical function of the project. However, examiners noted that the electrical function proved problematic for some candidates. Problems encountered included the following:

- faulty electrical circuit due to holes in the support panel being too small causing short-circuiting between the connecting pins of the solar panel
- failure of some solar panels to work when tested with a light source
  Note: Failure of solar panels did not result in lost marks for the candidates.

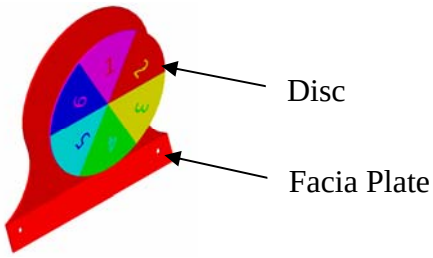
Section 2: Design Feature

As stated previously candidates were asked to design, make and attach a Pointer to indicate where the Disc stops. This section of the project was allocated 20% of the overall marks for this examination component. Under this section marks are allocated for the design stage, the make/manufacture stage and the attach/assembly stage.

Some examiners were of the view that the design feature was insufficiently challenging for candidates and did not merit the quantity of marks allocated to it. Examiners were also of the view that many candidates treated this section as an add-on feature rather than an integral part of the project. In some instances candidates did not attempt/complete this section of the

project. Examiners reported a lack of diversity of design solutions within some specific centres. However, some candidates produced solutions which demonstrated high levels of both creativity and practical skill.

Section 3: Disc (Part 3) & **Facia Plate** (Part 4)

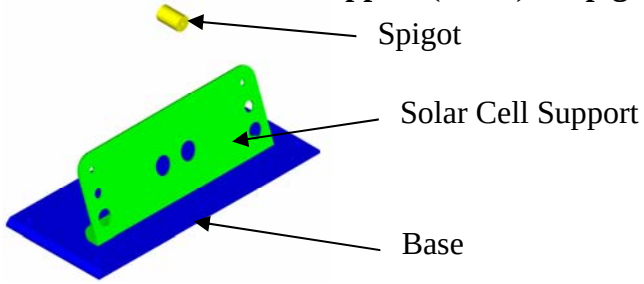


Disc – Many candidates had little difficulty in producing the circular profile. However, some candidates lost marks as they failed to paint or section the disc.

Facia Plate - This part was the most challenging component for candidates to complete. Typically, marks were gained or lost due to candidate's skill level in relation to some of the following:

- the accurate marking out the profile
- difficulty with the 20º bend
- producing an accurate profile with a good quality finish.

Section 4: Base (Part 1), **Solar Cell Support** (Part 5) & **Spigot** (Part 6)

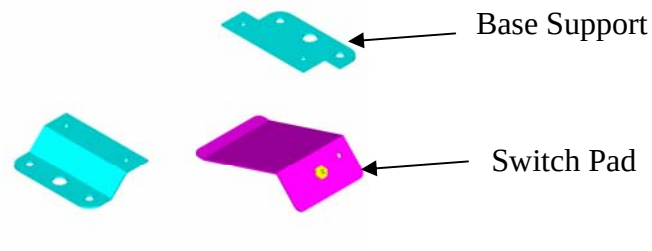


Base – The chamfered edges proved difficult for some candidates.

Solar cell support – This part proved challenging and less successful candidates had difficulties with the accurate alignment of holes and the accuracy of the 110º bend.

Spigot – This component was well produced by the majority of candidates.

Section 5: Base Supports (Part 2) & **Switch Pad** (Part 7)



Base supports - The accurate positioning of the Ø4.5 drilled holes was critical to the assembly of the finished artefact. Marks were gained by candidates who:

- accurately marked out each support
- drilled each of the ten holes accurately
- successfully completed the 45º bends.

Switch Pad – Some candidates found it challenging to accurately complete each of the two bends required for this component. However, many candidates achieved full marks for this component.

3.4 Conclusions

- The Techniques and Design, Project, at Ordinary Level effectively assessed the ability of candidates to work on a wide range of skills and competencies as designated in the syllabus.

- Many candidates demonstrated excellent practical skills producing project artefacts which were manufactured to very high standards.

- Some candidates failed to pay adequate attention to the finishing of each individual component and the overall presentation of the finished artefact.

- Some examiners were of the view that the design feature was insufficiently challenging for the candidates and did not merit the quantity of marks allocated to it.

- Responses to the design feature were in many instances poor with some candidates failing to demonstrate creativity and inventiveness in their designs.

- The bends involved in Parts 2, 4, 5 and 7 proved challenging for some candidates.

- The SEC acknowledges the assistance of the teachers of Metalwork and the school authorities in the preparation and layout of centres for marking the projects.

3.5 Recommendations to Teachers and Students

It is recommended that teachers:

- ensure that all candidates have a full copy of the issued Techniques and Design, Project examination paper and that they fully understand the *General instructions to candidates* and each of the *Instructions for making the project*

- guide candidates in planning their work in advance and in devising a basic project management log to help them set targets and make optimal use of the time spent on project work

- advise candidates of the importance of accurately marking out each component manufactured and the significant mark allocation for same

- advise candidates of the importance of achieving a good finish on each component manufactured and the significant mark allocation for same

- inform candidates of the importance of the design feature and mark allocation for same

- provide candidates with frequent opportunities to engage with the design process over the three years of study leading to the examination

- familiarise candidates with the requirements of past Techniques and Design, Projects and provide them with frequent opportunities to apply the inherent manufacturing processes and finishing techniques to coursework over the three years of study leading to the examination

- display the relevant posters relating to project work in the Metalwork room and bring to the attention of all candidates the regulations contained in the relevant circulars and posters

- ensure that all candidates complete and sign the necessary documentation prior to leaving the school

- securely store all project work on completion and arrange layout in ascending numerical order for the visiting examiner.

It is recommended that students:

- read the *General Directions to Candidates* and each of the *Instructions for making the project* which are issued by the SEC with the Techniques and Design, Project, examination paper, and follow these in the execution of their project work

- manage their time carefully so that they do not spend an excessive amount of time on project work at the expense of the theory component

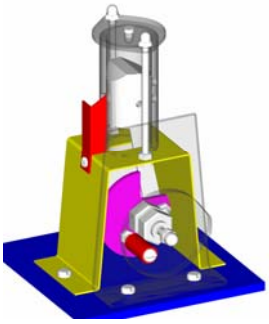
- check the marking out of each component for accuracy prior to commencing its manufacture

- pay particular attention to the finishing of the individual components that make up the artefact as well as the overall finish and presentation of the artefact

- be aware of the importance of the design feature and the significant quantity of marks allocated to it

- ensure that the solution to the design feature provides an opportunity to demonstrate both design and practical skills

4. Techniques and Design, Project – Higher Level



Model 2-Stroke Engine

4.1 Introduction

The Techniques and Design, Project is designed to assess a range of skills and competencies as designated in the syllabus. These skills are obtained by engagement with the syllabus content through a practically based learning process. Project work accounts for 37.5% of the overall total at Higher Level.

In 2006, a total of 5,664 candidates submitted the Techniques and Design, Project, at Higher Level. Candidates were required to make and assemble a Model 2-Stroke Engine, similar to that shown above. This also included a design element where candidates were asked to design, make and attach a suitable switch bracket to hold the push to make switch. All project work must be the candidates' own individual work, carried out under the supervision of the class teacher.

Projects were marked by application of the marking scheme in conjunction with high precision marking gauges which were specially designed and manufactured for the SEC for the marking process. Examiners commenced the marking process in schools on Tuesday June 6th and it was completed on Friday June 16th 2006. The work of each examiner was monitored by an advising examiner during the marking process in order to ensure accuracy in marking and inter-rater reliability.

Examiners noted that in most centres teachers and candidates put considerable effort into the layout and presentation of the manufactured artefacts. Such an effort is to be commended as it values the effort of the candidates and offers a showcase within the

school for the creativity and skills of the candidates. In a small number of centres, projects were presented in an untidy and cluttered manner.

4.2 Performance of candidates at Higher Level

A summary of the results achieved by candidates in this component at Higher level for the years 2004 to 2006 is presented in Table 10 below.

Table 11: Candidate performance in the Techniques and Design, Project, Higher level, 2004 – 2006

Year	Total	A	B	C	ABC	D	E	F	NG	EFNG
2004	5441	24.1	47.1	18.1	89.2	4.7	3.4	2.6	0.2	6.1
2005	5543	24.7	48.0	16.8	89.5	6.8	2.7	0.9	0.1	3.7
2006	5664	24.0	46.4	14.4	84.8	9.4	4.3	1.4	0.2	5.8

Note: *The grades here are indicative only. The grades awarded to candidates in Junior Certificate Metalwork are computed from the combined results of the relevant components completed by candidates*.

The percentage of the cohort achieving an A grade in 2006 is very much in line with previous years. However, the number of candidates achieving a grade C or higher (combined ABC) is 4% lower than in 2005 and 2004. Examiners were of the view that the level of accuracy demanded by specific components in this year's project differentiated effectively between candidates of different levels of ability and contributed to this outcome.

There is also an increase of 2.6% and 1.6% respectively in the percentage of the cohort achieving a D grade or an E grade. The combined E/F/NG grade is 2.1% higher than in 2005 but slightly lower than 2004.

4.3 Analysis of Candidate Performance at Higher Level

Examiners reported that the Techniques and Design, Project, at Higher Level, was a fair yet challenging test for candidates. The examination paper required candidates to interpret a drawing, complete a design task and mark out, process, finish and assemble a Model 2-Stroke Engine. The standard of work produced varied from excellent to poor. Successful candidates availed of the opportunity to display excellent manufacturing skills and a

thorough understanding of the design process with creativity, inventiveness in evidence. However, in some centres candidates failed to pay attention to finish, with some candidates paying little attention to, or omitting, the design element from the final artefact.

The following commentary is based on the observations of the team of examiners and it follows the criteria outlined in the marking scheme shown in Appendix 2 of this report.

Section 1: Complete Model - Assembly Finish & Function

Assembly – The vast majority of candidates presented assembled, functioning projects with varying degrees of finish applied. Candidates used the wide variety of materials available on the parts list. The quality of each individual component did affect the degree of success achieved in the overall assembly of the artefact. Examiners noted that in the case of some candidates, poor marking out led to inaccurate shaping, drilling, bending and assembly.

Finish – High quality finishes significantly improved the efficiency in movement, the potential for accurate assembly and the aesthetic appearance of the component as well as overall presentation of the complete artefact. Examiners reported standards of finish and presentation ranging from very high quality to very poor. Marks were lost due to:

- insufficient time spent draw-filing edges to remove burrs
- surfaces left unpolished and no attempt made to remove burrs from drilled holes
- steel components left untreated.

Greater emphasis on finishing of each individual component would result in improved marks for the candidates.

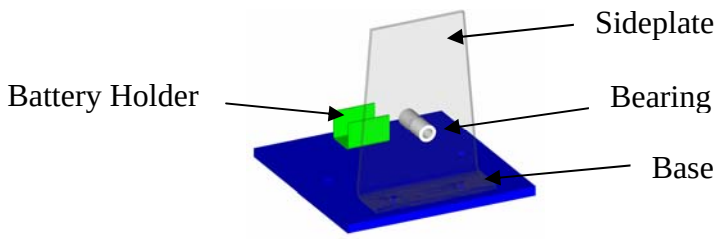
Function – Most candidates achieved high marks for both the electrical and the mechanical function of the project. However, some candidates lost marks generally due to one or a combination of the following:

- fitting the cylinder (Part 5) upside-down
- poor marking out leading to poor mechanical function
- no electrical circuit
- untidy soldering and electrical wiring
- inaccurate bending of the Crankcase (Part 9).

Section 2: Design Feature

Candidates were asked to design, make and attach a suitable switch bracket to hold the push-to-make switch. Many candidates demonstrated that they clearly understood the function of the design feature and showed excellent inventiveness, creativity and high level manufacturing skills in their solutions. Some candidates failed to position the switch bracket correctly or securely and some design solutions were poorly manufactured with little evidence of any finishing techniques. Examiners noted that some candidates failed to fulfil the design element therefore reducing their capacity to achieve a high grade for the project. Some examiners also noted that the design element was not sufficiently demanding to merit the quantity of marks allocated to it.

Section 3: Base (Part 1), **Battery Holder** (Part 2), **Sideplate** (Part 8) and **Bearing** (Part 16)



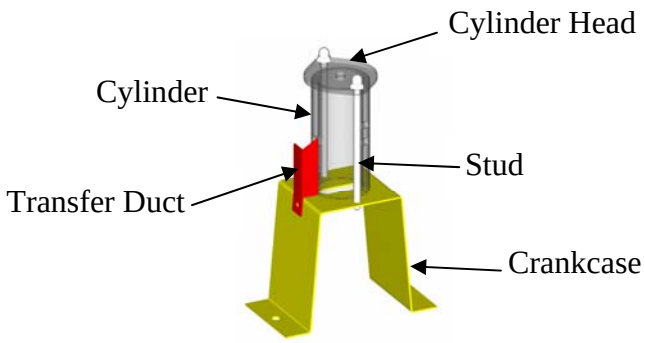
Base – Most candidates achieved good marks as the base generally was the correct size and was drilled and tapped correctly. Some candidates failed to engrave their examination number on the top surface of the base as per the *Instructions for making the project*.

Battery Holder – This was well manufactured. Examiners noted that a minority of candidates had difficulty with the 90º bends with inaccurate bending leading to asymmetrical sides on the battery holder.

Sideplate – Candidates who scored high marks on this component accurately marked out, drilled and shaped the component prior to forming an accurate 90º bend. Some candidates made the sideplate from coloured acrylic and this took from the overall appearance of the project.

Bearing – This component was generally well manufactured.

Section 4: Cylinder Head (Part 3), **Studs** (Parts 4), **Cylinder** (Part 5), **Crankcase** (Part 9) and **Transfer Duct** (Part 10)



Cylinder Head – Many candidates achieved good marks for this component. Some of the less able candidates found marking out of this component challenging.

Studs – These were well produced by the majority of candidates.

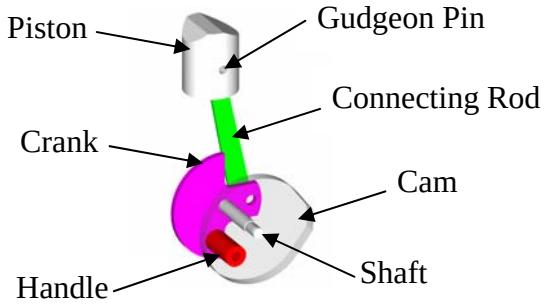
Cylinder – Most candidates correctly machined the 65mm length on the cylinder. However there were candidates who did not drill the Ø4.5 holes in the cylinder.

Crankcase – Some excellent work was noted in relation to this component with many candidates demonstrating high precision skills in the production of the slot. This part proved challenging for some candidates and common difficulties included:

- inaccurate marking out
- holes for the slots not aligned after drilling
- poor or inaccurate bending
- some oversized and unfinished end products.

Transfer Duct – This component generally caused few problems. A minority of candidates placed it on the wrong side of the crankcase.

Section 5: Gudgeon Pin (Part 6), **Piston** (Parts 7), **Connecting Rod** (Part 11), **Cam** (Part 12) and **Handle** (Part 13) **Crank** (Part 14) and **Shaft** (Part 15)



Gudgeon Pin – Candidates generally had little difficulty with this part.

Piston – The accurate filing of the top deflectors proved challenging for many candidates. Some candidates drilled the gudgeon pin hole out of alignment and lost some marks accordingly.

Connecting Rod – This part was a deceptively challenging component for candidates to complete. Typically, marks were gained or lost due to candidate's skill level in relation to the following:

- accurate marking out of the profile
- drilling both holes on centre
- accurate and well finished shaping on the profile.

Cam – In some centres the finish achieved on the edges of the acrylic or polycarbonate was exceptional. However, some of the less able candidates found this component difficult to mark out accurately. Some candidates tended to over file the profile and examiners noted that many candidates failed to achieve a good finish on the acrylic or polycarbonate.

Handle – This component caused few if any problems for candidates.

Crank – This component was also deemed challenging but many candidates produced accurate and well finished work. Successful candidates were reported to have turned the Ø50 for the lower portion of the crank and used a Ø8 drill for the two radius 4 curves.

Shaft – This component was well produced by the majority of candidates.

4.4 Conclusions

- The Techniques and Design Project, Higher level, provided a suitable challenge for candidates and effectively assessed the ability of candidates to work on a wide range of skills and competencies as designated in the syllabus.

- Many candidates demonstrated excellent practical skills producing project artefacts which were manufactured to very high standards.

- The quality of each individual component of the project affected the degree of success achieved in the overall assembly of the artefact. In the case of some candidates, poor marking out led to inaccurate shaping, drilling, bending and assembly.

- High quality finishes significantly improved the efficiency in movement, the potential for accurate assembly and the aesthetic appearance of the component as well as contributing to the overall presentation of the complete artefact.

- It was evident that some candidates were not fully aware of the importance of good finish in project manufacture.

- Many candidates demonstrated to great effect their understanding of the design feature and showed excellent inventiveness, creativity and high level manufacturing skills in their solutions.

- In a minority of examination centres the response to the design feature was generally poor with candidates failing to demonstrate creativity and inventiveness in their designs.

- Some examiners were of the view that the design feature was insufficiently challenging for the candidates and that it did not merit the quantity of marks allocated to it.

- Some candidates failed to engrave their examination number on the top surface of the base as per *Instructions for making the project*, number 5.

- The SEC acknowledges the assistance of the Metalwork teachers and the school authorities in the preparation and layout of centres for marking the projects.

4.5 Recommendations to Teachers and Students

It is recommended that teachers:

- ensure that all candidates have a full copy of the issued Techniques and Design, Project and that they fully understand the *General instructions to candidates* and each of the *Instructions for making the project*

- guide candidates in planning their work in advance and in devising a basic project management log to help them set targets and make optimal use of the time spent on project work

- advise candidates of the importance of accurately marking out each component manufactured and the significant mark allocation for same

- advise candidates of the importance of achieving a good finish on each component manufactured and the significant mark allocation for same

- inform candidates of the importance of the design feature and mark allocation for same

- provide candidates with frequent opportunities to engage with the design process over the three years of study leading to the examination

- familiarise students with the requirements of past Techniques and Design, Projects and provide them with frequent opportunities to apply the inherent manufacturing processes and finishing techniques to coursework over the three years of study leading to the examination

- display the relevant posters relating to project work in the Metalwork room and bring to the attention of all candidates the regulations contained in the relevant circulars and posters

- ensure that all candidates complete and sign the necessary documentation prior to leaving the school

- securely store all project work on completion and arrange layout in ascending numerical order for the visiting examiner.

It is recommended that students:

- read the *General Directions to Candidates* and each of the *Instructions for making the project* which are issued by the SEC with the Techniques and Design, Project, examination paper, and follow these in the execution of their project work

- manage their time carefully so that they do not spend an excessive amount of time on project work, at the expense of the theory component

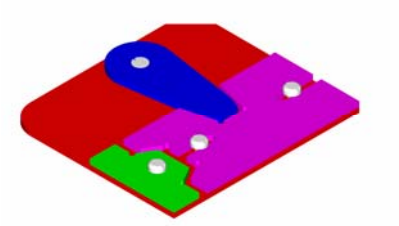
- check the marking out of each component for accuracy prior to commencing it's manufacture

- pay particular attention to the finishing of the individual components that make up the artefact as well as the overall finish and presentation of the artefact

- be aware of the importance of the design feature and the significant quantity of marks allocated to it

- ensure that the solution to the design feature provides an opportunity to demonstrate both design and practical skills.

5. Techniques and Design, Practical Examination – Higher Level



5.1 Introduction

The Techniques and Design, Practical Examination consists of interpreting a drawing, marking out, processing, finishing and assembling an artefact, to a given specification according to the examination paper issued by the SEC. The Practical Examination which is offered at Higher Level only, represents 37.5% of the Metalwork examination and has a mark allocation of 150 marks. This examination, which is of 3 hours duration, takes place in schools in May.

On completion, all test artefacts are securely stored by the relevant school authority until June, when they are laid out in the school, and marked by a team of visiting examiners who are appointed and trained by the SEC. The test artefacts are marked by application of the marking scheme in conjunction with high precision marking gauges which are specially designed and manufactured for the SEC for the marking process. See Appendix 4 for an example of one of the marking gauges.

A total of 5654 candidates presented for the Practical examination in 2006. Examiners commenced the marking process in schools on Tuesday June 6th and it was completed on Friday June 16th 2006. The work of each examiner was monitored by an advising examiner during the marking process in order to ensure accuracy in marking and inter-rater reliability.

5.2 Performance of Candidates

Table 12 shows the percentage of candidates achieving each grade in the Practical Examination for the years 2004 to 2006.

Table 12: Candidate Performance in the Practical examination 2004 – 2006

Year	Total	A	B	C	ABC	D	E	F	NG	EFNG
2004	5722	25.6	48.1	22.2	96.0	3.1	0.7	0.1	0.1	1.0
2005	5526	28.8	50.3	15.9	95.0	4.3	0.6	0.1	0.0	0.7
2006	5654	25.8	48.7	17.4	91.8	6.0	1.7	0.4	0.1	2.2

Note*: The grades here are indicative only. The grades awarded to candidates in Junior Certificate Metalwork are computed from the combined results of the relevant components completed by candidates.*

Although the percentage of candidates achieving an A grade shows a reduction of 3% when compared with the outcomes of 2005, it is very much in line with the result achieved in 2004. The combined ABC grades are also down slightly on previous years, however, 91.8% of candidates achieved a C or higher still reflects well on the candidates' performance in the practical examination.

Candidate achievement levels were very high in both the Higher Level practical examination and the project. Both teachers and candidates are to be commended for their excellent preparation for these examination components and the high level practical skills displayed in many of the finished artefacts.

5.3 Analysis of Candidate Performance

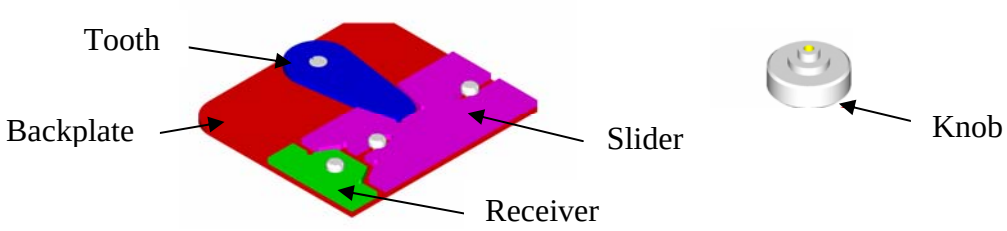
The purpose of this examination is to assess a range of practical skills and competencies, as designated in the syllabus. This year's examination was similar in style and format to previous years. Examiners, generally, reported favourably on the level of the candidates' achievement stating that the examination was a suitable test for Higher Level candidates.

Examiners also reported that the examination provided ample opportunity for candidates to demonstrate skills in precision filing, drilling, fitting and accuracy, using a good range of materials. The test was relatively straightforward to mark out with no hidden difficulties. A high level of accuracy was required for the artefact to function properly and for candidates to achieve a high score.

Most candidates completed the examination in the allocated time with some excellent fully-functional models produced to a very high degree of accuracy and finish. However, some examiners reported that candidates who achieved lower scores found the accuracy and detail required challenging and may not have had sufficient time for finishing the test artefact.

The following commentary is based on the observations of the team of examiners and it follows the criteria outlined in the marking scheme shown in Appendix 3 of this report.

Section 1: Complete Model - Assembly Finish & Function



Assembly – Most candidates had assembled the mechanism. Some candidates lost marks due to one or a combination of the following:

- the backplate was assembled the wrong way around
- the M5 holes on the backplate and the slots on the slider were not aligned properly
- the receiver did not fit into the trapezium A on the slider
- the hole on the receiver was not aligned with hole on the backplate
- the slider was incorrectly marked out, i.e. some candidates marked out from both ends of the prepared blank resulting in the slider being oversized.

Finish – Many candidates produced artefacts where the quality of finish was very good. However, some candidates would have gained more marks had edges been draw-filed with a smooth file and fine grade emery cloth and burrs removed, particularly after the final assembly. Examiners noted that some candidates found some aspects of the examination challenging and may not have had sufficient time to adequately finish components. Mild steel was used by some candidates but the instructions regarding mild steel parts had not been adhered to in some centres. The failure to lightly spray completed mild steel parts

with a clear rust preventative aerosol caused components in some finished artefacts to rust and this detracted from the overall finish of the examination artefact.

Function – Many candidates produced accurate, well finished, fully-functional artefacts. Less successful candidates lost some marks for functionality due to one or more of the following:

- countersinking too deep in the Ø5.5 hole on the tooth
- the Ø8 section of the knob machined below 3.5mm
- over tightening of the slider and the receiver not secured properly
- slots either too narrow or too wide on the slider
- inaccurate marking out techniques on the slider or receiver resulting in oversized components.

Section 2: Backplate (Part 1) and **Knob** (Part 5)

Backplate – The vast majority of candidates were successful in marking out, drilling, tapping and shaping this component. Some candidates overfilled the chamfer resulting in some lost marks.

The Knob – This component was prepared prior to the examination with candidates having the option of using either Computer Numerical Control (CNC) or manual machining to manufacture it. Many candidates achieved full marks for this component. Some candidates either failed to include the 45º chamfers or produced the Ø8 section below the required 3.5mm. Some examiners were of the view that some consideration should be given towards incorporating additional work on this component during the actual examination.

Section 3: Slider (Part 2)

This was the most challenging component for candidates to complete. Typically, marks were gained or lost due to candidates' skill level in relation to some of the following:

- the accurate marking out of the component especially the two trapeziums
- the accurate drilling of the Ø5 holes for the slots

- the accurate shaping of the slots ensuring correct alignment with one another and with the M5 holes on the backplate.

Some candidates lost marks as they damaged the edges of the slider when cutting the slots.

Section 4: Tooth (Part 3)

This part was challenging with the more able candidates scoring highly in dimensional accuracy and shape. Some candidates had problems with the marking out in terms of the two radius 24mm arcs and the tangents. The countersunk hole was drilled too deeply on a significant number of components examined.

Section 5: Receiver (Part 4)

This component was again a good test of the skill level of the Higher Level candidate as it included a range of angles in it's profile. Some candidates responded excellently and produced an accurate, high quality polished finish on all edges of this profile. Less successful candidates lost some marks due to one or more of the following:

- failing to accurately shape the four 90º corners
- inaccurate marking out technique resulting in an oversized component
- poor, and sometimes undersized, shaping of the 60º angles resulting in ineffective function of the assembly.

5.4 Conclusions

- The Techniques and Design Practical examination, at Higher Level provided an opportunity for candidates to demonstrate different levels of skills in precision filing, drilling, fitting and accuracy within the given time.

- Candidates were generally well prepared for the Practical Examination and the overall results reflect this preparation.

- The examination effectively discriminated between candidates of different levels of achievement.
- The examination effectively assessed the ability of candidates to work on a range of materials and to use the machine tools prescribed in the syllabus, including the C.N.C. lathe.

- Most candidates completed the test in the allocated time and some excellent fully functional models were produced to a very high degree of accuracy and finish.

- The quality of each individual component did affect the degree of success achieved in the overall assembly of the examination artefact. Examiners noted that for some candidates, poor marking out led to inaccurate, drilling, shaping, assembly and ineffective functioning of the examination artefact.

- The SEC acknowledges the assistance of the Metalwork teachers and the school authorities in the preparation and layout of centres for marking the projects.

5.5 Recommendations to Teachers and Students

It is recommended that teachers:

- ensure that an adequate time provision is made for teaching and learning the skills associated with the Practical Examination
- remind students of the importance of completing the marking out of all pieces prior to processing and of the significant mark allocation for completing the marking out process
- advise students of the importance of accuracy and good finish of machined pieces and prepared blanks made prior to, or during, the examination and the significant mark allocation for same
- inform students that 'function' is a major objective in a precision Metalwork examination
- encourage students to place a special emphasis on the removal of burrs from parts and to use fibre jaws, or similar, to prevent vice jaws marks on examination pieces
- ensure, if selecting mild steel, that only bright mild steel blank is used, that this is cut on a power saw, not a guillotine, and that it is given a light coating of lubricant WD40 or similar spray
- advise students to use only the materials and equipment specified on the materials list issued by the SEC for the Practical Examination
- ensure that examination numbers are clearly stamped or engraved in the position indicated on the drawing

It is recommended that students:

- read the instructions with the examination paper carefully and ensure that they have all the specified materials, tools and equipment

- process the marking out of all the pieces as one sequence of operations at the beginning of the examination and check the marking out for accuracy prior to commencing the processing

- be aware of the importance of accuracy and good finish of machined pieces and prepared blanks made prior to, or during, the examination and the significant mark allocation for same

- remove burrs from parts and always use fibre jaws, or similar, to prevent vice jaws marks on examination pieces

- use only the materials and equipment specified on the materials list for the Practical Examination

- on completing the assembly and functioning of the test artefact use any further time available for final finishing and polishing

- use the full, three hour, time allocation available for the examination.

6. Written Examination – Ordinary Level

6.1 Introduction

At Ordinary Level, the written paper is allocated 100 marks and represents 25% of the Metalwork examination at this level. In 2006, 2,339 candidates sat the written examination in Metalwork at Ordinary Level, this represents 29% of the cohort who sat Junior Certificate Metalwork. A total of 344 (15%) of these candidates were female.

There was broad agreement among the team of examiners that the presentation and content of the examination material was well suited for this level and that the paper offered candidates opportunities to demonstrate their knowledge of the syllabus.

This part of the report should be read in conjunction with the examination papers and marking schemes, which are available on the State Examinations Commission website **www.examinations.ie**

6.2 Performance of Candidates

Table 13 below shows the percentage of candidates achieving each grade in the Ordinary level written examination for the years 2004 to 2006.

Table 13: Candidate Performance Ordinary Level written examination 2004 – 2006

Year	Total	A	B	C	ABC	D	E	F	NG	EFNG
2004	2541	4.9	22.1	36.4	63.4	26.4	8.5	1.7	0.0	10.2
2005	2270	6.1	24.9	36.7	67.7	24.1	7.1	1.0	0.0	8.1
2006	2339	4.4	22.3	36.5	63.2	29.2	6.8	0.6	0.1	7.6

Note: *The grades here are indicative only. The grades awarded to candidates in Junior Certificate Metalwork are computed from the combined results of the relevant components completed by candidates*.

As can be seen from the above table, there is very little variation in the distribution of grades over the past three years at Ordinary Level. The percentage of candidates achieving an A grade is down by 1.7% from 2005 but is very much in line with 2004.

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The number of candidates who failed to achieve a D grade or higher was slightly lower than 2005 and almost 3% lower than 2004 and this is to be welcomed.

6.3 Analysis of Candidate Performance

The written examination consists of a total of six questions. Question 1, allocated 40 marks, is compulsory and candidates are required to select any other three questions from the remaining five, each weighted equally at 20 marks.

Examiners reported that the paper layout was similar in style and format to previous years and welcomed the widespread use of graphics throughout the paper. Examiners also noted that the range of options within questions and the emphasis on the broad practical range of Metalwork processes and equipment provided a well balanced and testing examination of candidates' knowledge of the Ordinary Level Metalwork syllabus.

The table below shows the frequency of attempts and average mark achieved per question. These and all following statistics are based on an analysis of 30% of all scripts.

Table 14: Frequency of attempts and average mark for Ordinary Level questions

Question No.	Attempts (%)	Rank Order	Average Mark	Topic
1 A	100%	Compulsory	12	General
1 B	99.7%	Compulsory	13	Engine/Mechanisms
2	98.7%	1	9	Materials
3	89.0%	4	8	Mechanisms
4	92.1%	3	11	Techniques and Design Project
5	98.6%	2	13	Electronics/Computers
6	82.6%	5	10	Design/Manufacture

A further analysis of the sample of scripts showed that:

- All candidates attempted Q1
- 12.2% attempted less than the required four questions
- 73.1% attempted more than four questions
- 0.03% of candidates obtained full marks in Q1.

The standard of answering was generally good, and was comparable to the standard of answering in recent years. Examiners reported that the majority of candidates attempted

the required number of parts in the compulsory Question 1. This is reflected in a satisfactory average score achieved for this question. Even though Question 2, on materials, was the most popular question, the average mark was the second lowest achieved at 9 marks from a possible 20. Attempt rates were relatively high for all questions, with Question 5 eliciting the best results, averaging at 13 marks. Question 6, which includes a design element, was the least popular question but candidates who attempted it generally scored well.

As previously stated a significant number of candidates did not attempt four questions as required and many candidates failed to answer all of the required parts within individual questions. Examiners were of the view that some of these candidates may have rushed through the paper and may not have used the full time available to complete the examination.

The following commentary is based on the observations of the team of examiners.

Question 1 Section A

Attempt Rate 100% (from Sample) Average mark 12

The majority of candidates attempted all sections of this question.

Parts (a), (i) and (l) were very well answered. Candidates achieved varying rates of success in parts (b), (c), (e), (h) and (k) with some guess work evident on the part of some candidates. Candidates' knowledge of parts (d), (f), (g) and (j) was relatively poor. Very few candidates recognised the 'screw pitch gauge' in part (j). It was also noted that very few candidates achieved the full twenty marks.

Question 1 Section B

Attempt Rate 99.7% (from Sample) Average mark 13

(m) Candidates generally found this part difficult. Many descriptions as to the working of the engine were not clear. Some candidates did not use the labels, as directed, and a wide variety of answers were encountered as a result. Some candidates suggested diesel as the fuel.

(n) In answering this part some candidates ignored the requirement that the inventor had

to be relevant to transport. Examiners noted that a significant proportion of candidates did not attempt this part.

(o) Many candidates provided four excellent safety features.

(p) (i) This part was generally well answered.

(ii) Most candidates indicated that rubber had 'good grip' and achieved full marks for this part.

(q) This was generally well answered.

Question 2

Attempt Rate 98.7% Average mark 9

(a) Some candidates demonstrated an excellent knowledge of both 'ferrous and non ferrous metals' and of 'alloys'. However, many candidates found parts of this section difficult, in particular parts (iii), (v) and (viii). Some examiners felt that parts of this section were beyond the scope of Ordinary level candidates.

(b) In this section part (iv) was answered correctly in most instances. Parts (v) and (vii) were generally poorly answered.

(c) The standard of answering improved greatly in part (c) and the four marks were generally awarded.

Question 3

Attempt Rate 89.0% Average mark 8

(a) Many candidates were unable to name more than two of the mechanisms. The 'bearing' and the 'worm / wheel' were best identified.

Very few candidates knew the purpose of the 'idler' gear.

(b) This section was well answered with many candidates achieving full marks.

(c) This was well answered, but some candidates named the mechanisms instead of an appropriate machine.

Question 4

Attempt Rate 92.1% Average mark 11

This question was based on the Techniques and Design, Project, at Ordinary level, This was a popular selection and well attempted.

(i) This part was well answered.

(ii) In answering this part very few candidates mentioned the need to drill a 'pilot hole' and the necessity for 'clamping'.

(iii) This part was poorly answered with only one energy source often mentioned.

(iv) This was well answered.

(v) Many candidates only described the marking out process with no reference to how the curve is formed.

(vi) The bending procedure was described using a bending machine but candidates omitted a method of checking the 20º bend.

(vii) This part was very well answered with the majority of candidates achieving full marks.

Question 5

Attempt Rate 98.6% Average mark 13

This question was a very popular choice with many candidates achieving high marks.

(a) (i) The quality of the circuit drawing was reported to have improved this year. However, some candidates included all of the given symbols in the circuit while others inserted the bulb instead of the 'LED'.

(ii) and (iii) The 'LED' was not understood by many candidates.

(b) This part was very well answered.

(c) Candidates generally responded well to this section. However, some candidates tended to repeat the same answers for parts (i) and (ii).

Question 6

Attempt Rate 82.6% Average mark 10

The design/manufacture question was not as popular as other questions.

(i) The reasons given for selecting the material were quite varied but generally good.

(ii) The standard of drawings presented was generally very poor, often the shelf or holes were omitted. Some candidates just reproduced the given drawing.

(iii) Many candidates demonstrated a poor knowledge of finishing, with ‘filing’ the most common response. However, there were candidates who suggested ‘draw-filing’, polishing and the use of ‘emery paper’.

(iv) Most candidates mentioned drilling but many did not develop their answer. Some candidates provided excellent responses which included stages such as ‘chain drilling’, using a ‘coping saw’, filing the profile using a ‘half-round file’ and ‘draw- filing’. A ‘hole saw’ was also suggested.

(v) The response to this part was most often along the lines of bending of sheet metal rather than ‘acrylic’ and as a result no mention was made of any heating process.

6.4 Conclusions

- Many candidates demonstrated a good knowledge of the syllabus and an excellent level of preparedness for the examination.
- Examiners reported that a high percentage of 73.1% attempted an extra question(s).
- Examiners noted that some candidates demonstrated poor knowledge of ferrous metals, non-ferrous metals and mechanisms.
- Approximately 12.2% of candidates did not attempt the required four questions and many candidates failed to answer all of the required parts within individual questions.
- Many candidates responded well, to the question regarding the 2006 Ordinary Level Techniques and Design Project, demonstrating to good effect their knowledge of the manufacturing process involved.
- It was evident that some candidates did not use the full time allocation available to complete the examination.

6.5 Recommendations to Teachers and Students

It is recommended that teachers:

- advise students to attempt **four** questions as required as well as all required parts within each question

- encourage students to read the full examination paper at the start of the examination, before attempting any questions

- familiarise students with the requirements of the examination

- encourage students to familiarise themselves with past examination papers , marking schemes and sample solutions which are available on the SEC website **www.examinations.ie**

- encourage students to practice freehand sketching and line diagrams and advise them to use diagrams / sketches to support their answers as appropriate

- advise students to use the full allocation of time to sit the examination.

It is recommended that students:

- read all the examination questions carefully at the beginning of the examination

- attempt the required **four** questions and thus maximise their chances of doing well in this component

- be familiar with past examination papers , marking schemes and sample solutions which are available on the SEC website **www.examinations.ie**

- use the full allocation of time to sit the examination

- use sample solutions to practice and become familiar with the requirements of the Ordinary Level written examination.

7. Written Examination - Higher Level

7.1 Introduction

The written paper at Higher level is allocated 100 marks which represents 25% of the Metalwork examination at this level. In 2006, 5,603 candidates sat the written examination at Higher level, this represents 70% of the total cohort of candidates who sat Junior Certificate Metalwork. 335 (5.9%) of these candidates were female.

This part of the report should be read in conjunction with the examination paper and marking scheme, which are available on the State Examinations Commission website **www.examinations.ie** .

7.2 Performance of Candidates

Table 15 shows the percentage of candidates achieving each grade in the Higher Level written examination for the years 2004 to 2006.

Table 15: Candidate performance Higher Level written examination 2004 – 2006

Year	Total	A	B	C	ABC	D	E	F	NG	EFNG
2004	5386	10.7	25.9	30.0	66.5	20.8	8.7	3.5	0.4	12.7
2005	5459	11.2	24.7	28.8	64.7	22.1	9.3	3.5	0.5	13.3
2006	5603	12.0	27.0	28.6	67.6	21.1	8.5	2.6	0.2	11.3

Note: *The grades here are indicative only. The grades awarded to candidates in Junior Certificate Metalwork are computed from the combined results of the relevant components completed by candidates*.

The majority of candidates fulfilled the requirement of the examination by answering Question 1 and three other questions from the remaining six on the paper. The results achieved in 2006 are very much in line with those of recent years. A statistical comparison with 2005 shows a 0.8% increase in the candidates achieving grade A in 2006, and an increase of 1.3% when compared to 2004. The percentage of candidates achieving grade C or higher in 2006 is 67.6%; this shows an increase of 2.9% in comparison with 2005 but only a marginal increase of 1.1% compared with the 2004 figures. The combined percentage of E/F/NG grades has reduced by 2.0% compared with 2005 and this is welcomed.

A comparison of the percentage of candidates achieving an A or a B grade in the three examination components shows: 74.5% achieving these grades in the Practical examination, 70.4% in the Project and 39.0% in the written. It is apparent from this comparison that there is a disproportionate reliance by some candidates on the project and practical components to enhance their overall grade. A more balanced performance across all three components would be more satisfactory outcome.

7.3 Analysis of Candidate Performance

The written examination consists of a total of seven questions. Candidates are required to attempt Question 1, which has a mark allocation of 40 marks, and any other three questions from the remaining six, each weighted equally at 20 marks.

The table below shows the frequency of attempts and average mark per question. These and all following statistics are based on an analysis of 11.4% of all scripts.

Table 16: Frequency of attempts and average mark for Higher Level questions

Question No.	Attempts (%)	Rank order	Average mark	Topics
1	100	Compulsory	28.22	General knowledge
2	62.3	4	13.81	Design
3	63.0	3	14.28	Machining (Lathe)
4	68.9	2	11.66	Metal Production/Properties
5	60.2	5	10.44	Mechanisms and Machines
6	75.9	1	11.33	Electricity/Polymers/Soldering
7	21.9	6	7.03	CNC/Computers/Micrometer

Question 6 was the most popular of the option questions although candidates scored better in some of the other questions. Question 7 proved by far the least popular question.

A further analysis of the sample of scripts showed that:

- 3.0% attempted less than the required four questions
- 32.4% attempted at least one extra question
- 7.3% attempted all seven questions
- All candidates attempted Question 1
- 2.5% of candidates obtained full marks in Q1.

Examiners noted that some candidates did not attempt the required number of parts within questions. However, the standard of answering was generally good and was comparable to the standard of answering in recent years. The responses to Question 1, the compulsory question, were of a particularly high standard, especially in relation to the question based on the Techniques and Design Project which candidates had made during the year. Examiners noted that many candidates made excellent use of appropriately labelled diagrams to support their answers and in many centres candidates demonstrated high levels of knowledge, skills and preparation.

With approximately one in ten candidates failing to achieve grade D or higher in the written examination, the underperformance of candidates in this examination component continues to be a cause for concern. Examiners have identified a number of factors that can be attributed to this as follows:

- some candidates were ill equipped to deal with the academic demands of Higher Level and would have been more suited to Ordinary Level
- poor preparation for the examination by a small percentage of the cohort.
- incorrect selection of questions, not enough questions attempted or too many questions partly attempted
- poor quality of sketches and diagrams and a failure to use diagrams when requested to do so.

There was also some evidence of candidates not using the full time allocation for the examination

The following commentary on candidate performance is based on the observations of the team of examiners.

Question 1 Section A

Attempt Rate 100% (from Sample) *Average mark 28.22*

Candidates tended to attempt more than the five required parts of this section.

(a) Most candidates selected William Siemens but incorrectly suggested the mobile phone as his invention. A minority of candidates correctly identified Dugald Clerk as the inventor of the ‘2-stroke’ engine.

(b) Most candidates correctly identified ‘ports’ A and B. Most candidates correctly identified a function of one of these ‘ports’.

(c) This part was well answered with most candidates explaining that the spark plug ignites the fuel/air mixture.

(d) This part was generally well attempted with most candidates suggesting cooling as the function of the ‘fins’.

(e) Candidates in general described the motion of the ‘crankshaft’ as circular and the movement of the ‘piston’ as up and down.

(f) This part was fairly well answered. Common incorrect answers included aluminium and tin. Most candidates correctly suggested two properties for brass.

(g) Most candidates correctly matched the ‘LED’ with symbol 2. Much guesswork was evident with the ‘transistor’ often matched incorrectly with symbols 3 and 4. Most candidates chose to give the function of the ‘LED’. Many suggested it was to give off light when powered.

Question 1, Section B

Candidates, again, tended to attempt more than the five required parts of this section.

(a) The majority of candidates outlined how the ‘crankcase’ was bent in a ‘vice’ or bending machine or with a ‘folding bar’. Many candidates did not describe the use of the ‘protractor’ to measure the required angles.

(b) This part was well answered with most candidates able to list four processes used to make the ‘piston’.

(c)(i) A majority of candidates suggested a suitable drill size. Some candidates incorrectly listed 3mm or smaller as a suitable size.

(ii) Many candidates correctly identified the ‘pilot hole’. Some candidates did not read the question correctly and suggested a drill size rather than the name as required by the question. ‘Countersunk hole’ was sometimes incorrectly suggested.

(d)(i) Given that candidates were required to make this circuit earlier in their project, this part was poorly answered. Most candidates failed to identify that the ‘cam’ activated the circuit.

(ii) Most candidates correctly identified the purpose of the ‘resistor’.

(e) The design solutions offered by candidates varied very much according to ability. Some excellent diagrams and solutions were presented. However, in many instances the quality of diagrams was poor and some design solutions were also unclear in presentation. Some design solutions used only one hole to secure to the 'sideplate'.

(f) Candidates offered a wide variety of good solutions including hedge trimmers, motorcycles and small outboard engines for boats.

Question 2

Attempt Rate 62.3% (from Sample) *Average mark 13.81*

This was the fourth most popular of the option questions and the second highest average mark of the option questions.

(a) (i) This was well answered by most candidates with a wide variety of safety factor suggested. Some candidates did not interpret the question correctly and described manufacturing stages rather then safety during manufacturing.

(ii) In general this was well answered, with candidates making good use of the 'model' given on the question paper.

(b) (i) Most candidates suggested extra 'supports', vertically, horizontally or diagonally, in the gate frame to help make them more rigid. Some suggested extra hinges. A small number of candidates did not understand the meaning of the word rigid and suggested 'decorative features' which could be added to the gates.

(ii) Candidates offered excellent solutions of methods which could be used to lock the gates. These included sliding legs into the ground and catches from one side onto the other. The quality of some sketching was poor with biro used in some instances.

(iii) Correct materials suggested included Steel, 'PVC', Stainless Steel and wood. Incorrect suggestions included brass and copper.

iv) Many candidates suggested painting or 'galvanising' as possible finishes for the gates.

Question 3

Attempt Rate 63% (from Sample) *Average mark 14.28*

This was the third most popular of the option questions. Candidates scored highest on this option question.

(a)(i) Most candidates were able to outline three 'lathe' processes used to produce the component. Many candidates were able to name the processes while others gave a description of the process.

(ii) The standard of answering was average for this part with many candidates not identifying the need to use a 'centre drill'.

(iii) This part was very well answered with most candidates able to suggest two safety precautions to be observed when using the 'lathe'.

(b) This part was well attempted. Most candidates were able to substitute correctly into the formula. Some candidates got the subsequent calculation wrong. A small number of candidates simply gave the final answer without showing any working of the formula.

(c)(i) Many candidates were able to identify one of the two tools shown. The 'odd leg callipers' were the more popular option. Some incorrect answers included a 'scriber' and a 'dividers'.

(ii) The 'callipers' was identified as a tool use to 'mark out on the lathe', while the 'knurling tool' was suggested as a possible tool used to make a grip on a bar.

Question 4

Attempt Rate 68.9% (from Sample) *Average mark 11.66*

This was the second most popular option question and it attracted the third highest average mark of the option questions.

(a)(i) The majority of candidates correctly identified the 'blast' furnace. A small number incorrectly suggested the 'oxygen' furnace.

(ii) This part was well answered with most candidates correctly listing the elements of the 'charge'.

(iii) Candidates generally correctly identified where on the furnace heat loss is

prevented. However many failed to explain the process as required by the question.

(iv) Some candidates simply stated that the 'slag' and iron came out the bottom 'tap holes'. Candidates who described in more detail where each material came out, scored better.

(b)(i) Most candidates correctly identified the 'basic oxygen furnace'.

(ii) Many candidates correctly identified that the 'lance' is used to pump in the oxygen. Some incorrectly suggested air was pumped in.

(iii) Most candidates correctly suggested that steel was produced. Some incorrectly named iron as the metal produced.

(c)(i) Most candidates stated that kitchen sinks were made from stainless steel. However, many candidates were unable to identify the properties of stainless steel and frequently this part was not attempted.

(ii) Many candidates had difficulty in suggesting an application for 'high speed' steel. Some suggested drills and 'tool bits'. The properties were rarely identified and, again in many instances, this part was not attempted.

Question 5

Attempt Rate 60.2% (from Sample) *Average mark 10.44*

This was the second least popular option question and it attracted the second lowest average mark.

(a)(i) Many candidates had difficulty suggesting suitable materials for each part of the forklift. Much guesswork was evident in materials suggested for the forks and body. Aluminium was frequently incorrectly suggested for the body while iron was often incorrectly suggested as a suitable material for the forks. Most candidates correctly suggested steel for the frame and rubber for the wheels. A small number incorrectly suggested that the wheels were made from alloy.

(ii) This part was well answered with candidates offering safety features such as the frame, wide wheels and mirrors as safety features of the forklift. A small number

of candidates outlined safety precautions to be observed when using the machine rather than the safety features of the machine as asked in the question.

(b) In general this part was well answered.

(c)(i) This was poorly answered with candidates often incorrectly identifying Mechanism 1 as a 'chain and sprocket'. Mechanism 2 was mostly identified correctly as 'gears'.

(ii) This part elicited many poor responses, with much guesswork in evidence.

(iii) Candidates who had identified the mechanisms correctly were able to suggest suitable applications for both. Candidates identified that the 'belt and pulley' system is used in the car cooling system. The gears were often identified as being found on the 'lathe' and drilling machine.

(iv) Very few candidates were able to identify the 'idler gear' as required. Many candidates incorrectly suggested just reversing the drive.

Question 6

Attempt Rate 75.9% (from Sample) *Average mark 11.33*

This was the most popular option question attempted but it attracted only the fourth best average mark.

(a)(i) Candidates in general correctly identified the three plug terminals. Some confused the terminals and other candidates named terminals as positive and negative.

(ii) While a small number of candidates mixed up the wiring most candidates provided the correct answer for wiring the plug.

(iii) Most candidates were able to outline the purpose of the fuse.

(b)(i) Some candidates correctly explained the difference between 'thermosetting' and 'thermoplastic'. In general, however, this part was poorly answered with much guesswork in evidence.

(ii) This was poorly answered with only a small number of candidates able to name a suitable material for the plug casing. Plastic and 'PVC' were frequently given as incorrect answers.

(c)(i) In general, this was well answered with many candidates able to list two safety precautions to be observed when 'soldering'. A small number listed general safety precautions such as not running in the workshop and did not relate the safety procedure to the process of 'soldering'.

(ii) This part was poorly answered with 'tinning the bit' and 'active flux' the parts most commonly attempted. The protective effect of the 'active flux' was rarely identified. Some candidates incorrectly suggested that 'tinning the bit' was filing to make the bit thinner.

Question 7

Attempt Rate 21.9% (from Sample) *Average mark 7.03*

This was by far the least popular question and when attempted it scored the lowest average mark.

(a)(i) Candidates frequently identified 'A' as a motor. Very few candidates identified it as a 'stepper' motor. The 'tool post' was rarely identified.

(ii) Diagrams were often poorly drawn. Candidates often mixed up the positions of co-ordinates on the graph.

(iii) In general candidates correctly identified that the 'chuck' should rotate in reverse.

(iv) Most candidates identified at least two safety features of the 'CNC lathe'. The clear/transparent safety guard and the emergency stop were most commonly suggested.

(v) Most candidates correctly outlined the effect of a 'virus' on a computer. Many candidates made reference to 'floppy disks' and CDs rather than 'memory sticks' when answering the 'removable disk'. The terms 'ROM' and 'menu' were less frequently attempted.

(b)(i) This part was not popular, with most candidates unable to identify the parts of the 'micrometer'.

(ii) Most candidates did not know the function of the 'ratchet'.

(iii) Many candidates seemed to guess the value of the 'micrometer' reading with very few stating the correct value.

7.4 Conclusions

- Many candidates demonstrated a good knowledge of the syllabus and excellent levels of preparedness for the examination.

- Examiners reported that the vast majority of candidates attempted at least the required four questions.

- Many candidates attempted at least one more than the required four questions but many of these candidates failed to answer all of the required parts within each question.

- While many candidates used appropriately labelled diagrams to support their answers, some candidates presented poor quality of sketches and diagrams and others failed to use diagrams where requested to do so.

- Many candidates responded well to the question regarding the Techniques and Design Project, demonstrating to good effect their knowledge of the manufacturing and design processes involved.

- 'Polymers', the 'CNC lathe', the 'micrometer' and 'properties of materials' were identified as areas where standard of answering was weakest.

- Some candidates were ill equipped to deal with the academic challenges of Higher Level and would have been more suited to Ordinary Llevel.

- Some candidates did not use the full time allocation of three hours to complete the examination.

7.5 Recommendations to Teachers and Students

It is recommended that teachers:

- encourage students to read the full examination paper at the start of the examination before selecting and attempting any questions

- advise students to attempt all **four** questions and all required parts within each specific question

- advise and guide students in relation to their choice of level

- ensure that students are familiar with the terminology used in past exam papers. They should understand what is meant by common question cues such as *"identify", "design", "describe", "outline", "explain", "state", "name"* and *"list"*

- encourage students to familiarise themselves with past examination papers , marking schemes and sample solutions which are available on the SEC website **www.examinations.ie**

- encourage students to practice freehand sketching and line diagrams and advise them to use diagrams / sketches to support their answers as appropriate

- advise students to use the full allocation of time to sit the examination.

It is recommended that students:

- read all the examination questions carefully at the beginning of the examination, taking note of key words and give careful consideration to the selection of questions

- attempt the required **four** questions and thus maximise their chances of doing well in this component

- be familiar with past examination papers , marking schemes and sample solutions which are available on the SEC website **www.examinations.ie**

- Practice freehand sketching and drawing line diagrams and use this skill in the examination to convey information on technical detailing and thus gain the marks that are allocated for clear, well-drawn, labelled diagrams

- use past papers and sample solutions to practice and become familiar with the terminology used in the examination paper and to understand the significance of common question cues such as *"identify"*, *"design"*, *"describe"*, *"outline"*, *"explain"*, *"state"*, *"name"* and *"list"*

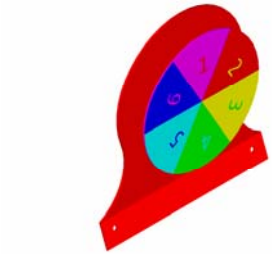
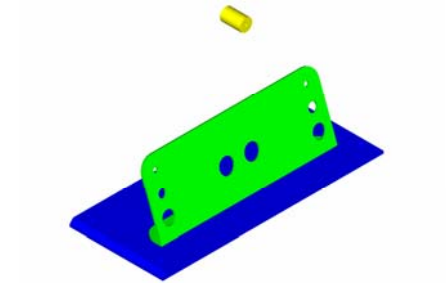
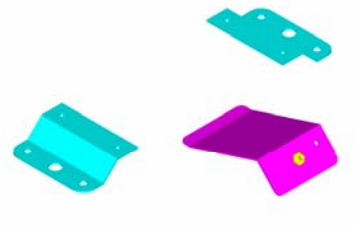
- use the full allocation of time to sit the examination.

Appendix 1

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate Ordinary Level Metalwork Project - Marking Scheme 2006

Subjective Grading /10	9-10 Excellent	7-8 Very Good	5-6 Good	3-4 Poor	1-2 Very Poor
Subjective Grading /5	5 Excellent	4 Very Good	3 Good	2 Poor	1 Very Poor

Section	Part Number	Pictorial Sketch / Description	Concept			Mark	Mark
1	**Complete Model**	**Assembly Finish & Function**	Assembly			5	20
			Finish Subjective Grade 1- 5			5	
			Mechanical Function			5	
			Electrical Function			5	
2	**Design Feature**	**Design make and attach a Pointer**	Design Subjective Grade 1-10			10	20
			Make			5	
			Attach			5	
3	**Part 3 & 4**		**Disc**	7	Marking Out	2	20
					Drilling	1	
					Shape Disc	4	
			Facia Plate	13	Marking Out	4	
					Drilling	4	
					Shape & Bend	5	
4	**Parts 1, 5, & 6**		**Base**	12	Marking Out	4	20
					Shape	4	
					Drilling	4	
			Solar Cell Support	6	Marking Out	2	
					Shape & Bend	2	
					Drilling	2	
			Spigot	2	Lathe Work	2	
5	**Parts 2 & 7**		**Base Supports**	15	Marking Out	5	20
					Shape & Bend	5	
					Drilling	5	
			Switch Pad	5	Marking Out	2	
					Shape & Bend	1	
					Drilling	2	

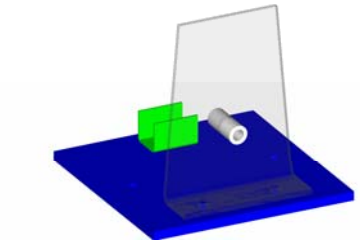
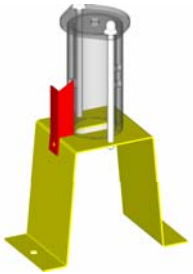
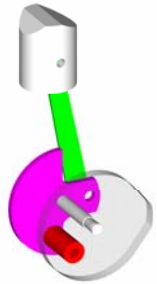
Total Marks 100

Appendix 2

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate Higher Level Metalwork Project - Marking Scheme 2006

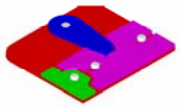
Subjective Grading /10	9-10 Excellent	7-8 Very Good	5-6 Good	3-4 Poor	1-2 Very Poor	
Subjective Grading /5	5 Excellent	4 Very Good	3 Good	2 Poor	1 Very Poor	

Section	Part Number	Pictorial Sketch / Description	Concept			Mark	Mark
1	**All Parts of Project**	**Assembly Finish Function**	Assembly			5	20
			Finish Subjective Grade 1-5			5	
			Mechanical Function			5	
			Electrical Function			5	
2	**Part 18**	**Design Make & Attach a Switch Bracket**	Design Subjective Grade 1-10			10	20
			Make			5	
			Attach			5	
3	**Parts 1, 2, 8, & 16.**		**Base**	7	Marking Out	2	20
					Drilling & Tapping	3	
					Length & Width	2	
			Battery Holder	3	Marking Out	1	
					Bend Drill & Shape	2	
			Sideplate	8	Marking Out	2	
					Bend Drill & Shape	6	
			Bearing	2	Length Drill & Ream	2	
4	**Parts 3, 4, 5, 9, & 10**		**Cylinder Head**	4	Marking Out	2	20
					Drill & Shape	2	
			Studs 2 Off	2	Length & Thread	2	
			Cylinder	2	Drill & Length	2	
			Crankcase	10	Marking Out	2	
					Bend Shape & Width	5	
					Drilling & Slot	3	
			Transfer Duct	2	Marking Out	1	
					Bend Drill & Shape	1	
5	**Parts 6, 7, 11, 12, 13, 14, & 15**		**Piston & Pin**	5	Drill & Height	2	20
					Shape	3	
			Connecting Rod	2	Marking Out	1	
					Drill & Shape	1	
			Cam & Handle	5	Marking Out	2	
					Drill Tap & Shape	3	
			Crank	6	Marking Out	2	
					Drill & Shape	4	
			Shaft	2	Length & Thread	2	

Total: 100 Marks

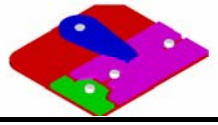
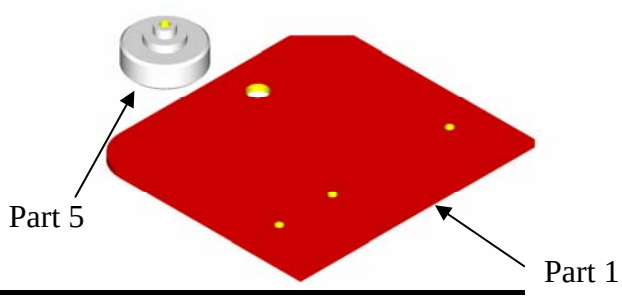
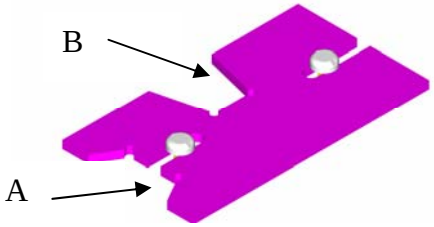
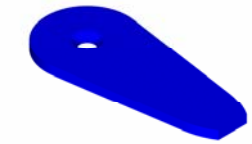
Appendix 3

Coimisiún na Scrúduithe Stáit
State Examinations Commission



Junior Certificate Higher Level Metalwork Practical Examination - Marking Scheme 2006

Subjective Grading /10	9-10 Excellent	7-8 Very Good	5-6 Good	3-4 Poor	1-2 Very Poor
Subjective Grading /5	5 Excellent	4 Very Good	3 Good	2 Poor	1 Very Poor

Section	Part Number	Pictorial Sketch / Description	Concept		Mark	Mark
1	**Parts 1, 2, 3, 4, and 5**		**Complete Piece**	Assembly	5	**20**
				Finish Grade 1 - 5	5	
				Function Grade 1 - 10	10	
2	**Part 1 & 5**		**Knob**	30mm Diameter	1	**20**
				1mm Chamfers	1	
				12mm Diameter	2	
				8mm Diameter	2	
				Lengths Part 5	2	
				Drilling & Tapping	2	
			Backplate	Marking Out	3	
				Profile	3	
				Drilling & Tapping	4	
3	**Part 2**		**Slider**	Marking Out	4	**20**
				Slots	6	
				Length & Width	2	
				Trapezium A	4	
				Trapezium B	4	
4	**Part 3**		**Tooth**	Marking Out	6	**20**
				15mm Radius	4	
				Tooth Profile	4	
				Tangents	4	
				CSK Hole	2	
5	**Part 4**		**Receiver**	Marking Out	5	**20**
				Length & Width	2	
				60 Degree Angles	6	
				90 Degree Angles	4	
				Drilling	3	

Total: 100 Marks

Appendix 4 – Application of Marking Gauges