

# **IMPORTANT NOTICE**

## **Cambridge International Examinations (CIE) in the UK and USA**

With effect from the June 2003 examination Cambridge International Examinations will only accept entries in the UK and USA from students registered on courses at CIE registered Centres.

UK and USA private candidates will not be eligible to enter CIE examinations unless they are repatriating from outside the UK/USA and are part way through a course leading to a CIE examination. In that case a letter of support from the Principal of the school which they had attended is required. Other UK and USA private candidates should not embark on courses leading to a CIE examination after June 2003.

This regulation applies only to entry by private candidates in the UK and USA. Entry by private candidates through Centres in other countries is not affected.

Further details are available from Customer Services at Cambridge International Examinations.

# **METALWORK**

## **GCE Ordinary Level/School Certificate**

### **Subject 6040**

*This syllabus is available for examination in November only.*

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The examination is designed for candidates who have followed a general course of metalwork based on fitting, forging, sheet metalwork, hammered metalwork, casting and elementary turning.

Candidates retaking this subject may not carry forward the marks of any paper from a previous examination.

### **INTRODUCTION**

The syllabus is concerned with giving the opportunity to develop a range of practical metalworking and related drawing skills and understanding of associated materials, tools and techniques.

### **1 AIMS**

The aims set out the purpose of the course which is in preparation for the ordinary level GCE examination in metalwork. The aims are not listed in order of priority.

The aims are to:

- 1.1 Develop the ability to communicate their knowledge of techniques, processes and materials by developing their graphical skills including freehand sketching and measured drawing
- 1.2 Develop practical bench based skills to manipulate a range of common metals directed to the realisation of ideas and the production of artefacts
- 1.3 Provide experience in the use of some common machine tools
- 1.4 Establish a capacity to read and interpret formal working drawings and diagrammatic illustrations
- 1.5 Acquire a body of knowledge to inform practical work and give a broad base of understanding of metalworking
- 1.6 Nurture a safe approach to practical work with materials using hand and machine tools
- 1.7 Promote a capacity to solve specified technical design problems

### **2 ASSESSMENT OBJECTIVES**

The objectives, which are not listed in order of priority, describe what a candidate should be able to do at the culmination of the course.

Candidates should be able to:

- 2.1 Describe materials, tools and processes associated with the use of a range of ferrous and non ferrous metals.
- 2.2 Apply knowledge of materials, tools and processes to explain common applications and methods of working and joining.
- 2.3 Read and interpret drawings conforming to standard drawing practice.
- 2.4 Illustrate concepts, processes and technical detail by freehand sketches and projected measured drawings.
- 2.5 Solve specified technical design problems by completing given but incomplete solutions.

- 2.6 Make an artefact using metal to a specification expressed as a working drawing using a range of processes including marking, cutting, forming, fitting, joining and basic lathe work.
- 2.7 Understand the value of design, planning and drawing in the completion of a practical test.
- 2.8 Describe and implement appropriate safe working methods in hand and machine practice.

### 3 SCHEME OF ASSESSMENT

#### 3.1 Examination components

Component Number	Title	Duration	Weighting
1	Paper 1 Theory, Drawing and Design	2 hours 45 minutes	50%
2	Paper 2 Practical Test	3 hours	50%

#### 3.2 Component 1

##### **Theory, Drawing and Design (2 hrs 45 mins, 100 marks)**

The examination paper will have two sections:

##### **Section A. Theory**

This section will have five questions from which candidates select and answer three. Questions will be structured, having a number of parts, and will be drawn from across the syllabus. Candidates will be expected to illustrate their answers using freehand sketches where appropriate. They should spend approximately 1¼ hours answering this section.

##### **Section B. Drawing and Design**

An incomplete solution to a design situation will be given for the candidate to complete. There will be two related parts. The first will require the candidate to show design ideas for completing the design by freehand sketches and added notes. The second will require formal measured orthographic drawings of the complete solution using their preferred choice of 1st or 3rd angle projection. Questions will be presented in 1st angle or isometric or oblique projection or a combination of these.

#### 3.3 Component 2

##### **Practical Test (3 hrs, 100 marks)**

The test, using previously prepared material, will consist in the main of marking out, shaping and fitting by hand tool methods plus drilling by using the drilling machine. Other processes, particularly lathe turning, brazing, silver soldering and soft soldering may be included but to a limited extent. For instance lathe work, when included, will involve a maximum of fifteen minutes at the lathe, or preparation prior to the examination.

## 4 SYLLABUS CONTENT

Students should be able to:

### 4.1 Drawings and Design

Make freehand sketches to communicate information and ideas. Read and interpret drawings projected in 1st or 3rd angle, isometric and oblique views conforming to standard practice\*. Show simple sections, prepare simple scales and use them for constructing drawings, draw an ellipse, and draw the development of a cylinder.

Design detail parts and devices to complete given specified but incomplete designs of items or systems. Typically, this might be a component to link a column to a stand or provide a means of adjusting and/or clamping one component to another.

### 4.2 Materials

Show a broad basic knowledge of the processing of ore to form the following ferrous materials: cast iron, wrought iron, mild steel, tool steel.

Identify and describe, with reasons, some common uses of cast iron, mild steel, wrought iron, tool steel, copper, gilding metal, aluminium, aluminium alloy (eg duralumin), zinc, lead, brass, bronze.

### 4.3 Tools

Sketch and describe common hand tools and explain basic care and maintenance methods for keeping the tools in good order.

### 4.4 Processes

#### 4.4.1 Heat treatment

Understand and apply the following modifications to material using heat: annealing, normalising, hardening and tempering, case hardening (open method using brazing hearth or similar).

#### 4.4.2 Marking and measuring

Mark out lines and centres. Establish and use datum edges and surfaces. Measure and test with straight edge, surface gauge and micrometer.

#### 4.4.3 Forming/deforming

##### a) Hand

- cut, file, fit and bend using simple formers
- form safe edge, wired edge and flange on disc, lap and folded seam joints in sheet metal
- shape by hollowing, flaring and planishing

##### b) Forging

Describe the following processes:

- heating material;
- drawing down, upsetting, fullering, swaging, punching, drifting, twisting.

c) Machine

i Centre lathe

Use a lathe for turning:

- with three jaw self centring chuck and independent four jaw chuck;
- between centre parallel cylinders;
- short tapers by setting over top slide;
- faces and spigots;
- components to length by parting off.

Describe cutting screw threads in the lathe using taps and dies and explaining reasons for doing this on a lathe.

Use the tailstock for holding a drill chuck and taper shank drills, describe drilling to specific depths. Forming knurled surfaces.

ii Drilling machine

Use the drilling machine for drilling through and stopped holes in workpieces held in a machine vice or clamped direct to the table with waste packing when appropriate. Understand the reason for and use different drill speeds.

Describe:

- the principle of the mechanism that provides drill feed (axial movement of spindle);
- the following features of drills: cutting angle, land, chisel point.

iii Bench/pedestal grinder

Describe the general principles for safe use of machine for sharpening tools such as a cold chisel.

4.4.4 Joining

Join metals by:

- soft soldering using active and passive (resin) fluxes,
- silver soldering,
- brazing,
- riveting using flat, countersunk and snap head rivets,
- cutting threads with taps and dies,
- using common preformed threaded fixings including machine screws, hexagon bolts and coach bolts with associated nuts, washers or threaded components.

Describe basic principles of forge welding.

4.4.5 Finishing

Describe methods for finishing surfaces and applying protective and decorative treatments to hammered metalwork, forgework, and general benchwork.

4.4.6 Foundrywork

Describe how to make a casting in aluminium alloy using a simple one piece pattern.

Explain the purpose of the following features of a pattern: draft (taper), contraction allowance, fillet.

4.4.7 Lubricants, coolants and cutting compounds

Explain the purpose and describe the use of coolants, lubricants and cutting compounds.

4.4.8 Safety

Use and explain safe working methods and precautions applicable to the processes identified in the syllabus.

\* Engineering Drawing Practice for Schools and Colleges PP7308. British Standards Institute

**Notes**

- 1 Recent past examination question papers may be used as specimen papers
- 2 Metric units will be used in examination questions
- 3 Reports on the work of candidates are published after each examination
- 4 Instructions about materials and equipment requirements for an examination are issued before each examination