



STUDENT NUMBER

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CENTRE NUMBER

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HIGHER SCHOOL CERTIFICATE EXAMINATION

1997

# INDUSTRIAL TECHNOLOGY

2 UNIT

## SECTION III—METAL

*Total time allowed for Sections I, II, and III—One hour and a half  
(Plus 5 minutes reading time)*

### DIRECTIONS TO CANDIDATES

- Write your Student Number and Centre Number at the top right-hand corner of this page.
- Where appropriate, show working for solutions neatly and clearly.
- You may use Board-approved drawing instruments and calculators.

### Section III—Metal

- Attempt ALL questions.
- Answer questions in the spaces provided in this paper.

### EXAMINER'S USE ONLY

Question			
13			
14			
15			

**QUESTION 13.** (5 marks)EXAMINER'S  
USE ONLY

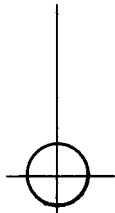
Figure 1 shows the detail drawings of a small clamp.

**DUE TO COPYRIGHT RESTRICTIONS THIS  
IMAGE COULD NOT BE REPRODUCED.**

## QUESTION 13. (Continued)

EXAMINER'S  
USE ONLY

- (a) Using the details given in Figure 1 and a scale of 2 : 1, complete the front view of the hand screw and swivel shoe, showing these parts assembled with the swivel shoe half sectioned. The  $\varnothing 4$  hole in the hand screw and the centre line of the assembly are given below.
- (b) Use correct dimensioning standards to indicate on the drawing below the following sizes.
- The  $\varnothing 4$  hole in the hand screw
  - The length of the threaded section of the hand screw
  - The chamfer on the swivel shoe

FRONT VIEW  
SCALE 2 : 1

Question 13 continues on page 4

## QUESTION 13. (Continued)

For the following questions, refer to the detail drawings of the clamp (Figure 1) on page 2.

- (c) Why was sectioning used on the clamp body?

.....

- (d) What is the maximum thickness of bright mild steel plate that could be clamped to a 40 mm thick bench top using this clamp?

Thickness: ..... mm

- (e) Calculate the overall manufacturing cost of one small clamp, given the following details.

• Materials costs		\$4.50
• Machine time	10 minutes @ \$18/hour	
• Labour, including assembly	12 minutes @ \$20/hour	

Total cost: .....

- (f) With the aid of a sketch, briefly outline a method that could be used to prevent the swivel shoe separating from the hand screw, while still allowing it to rotate independently of the hand screw.

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## QUESTION 13. (Continued)

EXAMINER'S  
USE ONLY

(g) A prototype clamp body is to be machined from a block of bright mild steel.

- (i) What are the minimum dimensions of the block that could be used?
- 
- Do NOT allow for wastage.

Length ..... mm

Width ..... mm

Thickness ..... mm

- (ii) State a suitable marking out medium for marking out the profile of the clamp body, and list the marking out hand tools required.

Marking out medium

.....

Marking out hand tools

.....

.....

(h) A mass produced clamp body may be die-cast in aluminium alloy. In order to obtain sufficient strength, the original clamp body design must be modified.

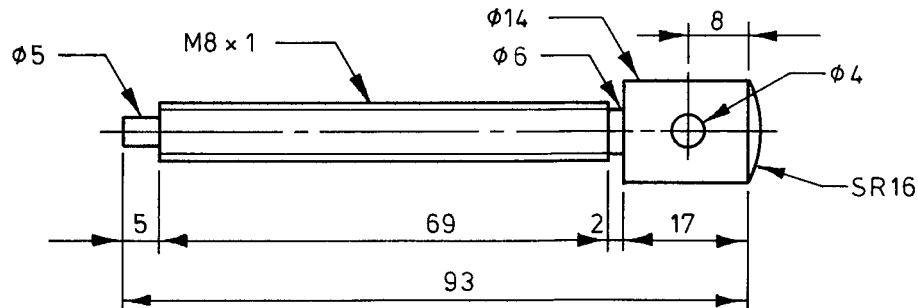
Describe one modification that would increase the strength of a die-cast clamp body.

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**QUESTION 14.** (5 marks)EXAMINER'S  
USE ONLY

Details of a hand screw are given below.



**HAND SCREW**

FIG. 2

'Investigating Technical Graphics', George Stubby, McGraw Hill 1987, p172.

- (a) A manufacturer is required to construct a prototype of this hand screw from a 120 mm length of Ø16 mild steel rod. A bench lathe, drill press, and associated hand tools and accessories are available for this task.

- (i) In terms of depth of cut and feed rate, explain how a good surface finish may be achieved on the parallel turned sections.

.....  
 .....

- (ii) Name and sketch the cutting tool that would be used to form the stepped down Ø6 section.

Cutting tool .....

Sketch

- (iii) Describe a method that could be used to turn the spherical radius on the end of the hand screw.

.....  
 .....

## QUESTION 14. (Continued)

EXAMINER'S  
USE ONLY

- (iv) After the centre position is marked out, the  $\varnothing 4$  hole is to be drilled using the drill press. List the equipment required, and outline the procedure to be followed to perform this task.

Equipment

.....  
 .....

Procedure

.....  
 .....  
 .....  
 .....  
 .....

- (b) The  $M8 \times 1$  thread could be cut on the lathe.

- (i) Briefly explain the role of the lead screw in the cutting of threads.

.....  
 .....

- (ii) How would you ensure that each successive pass of the tool follows the same thread path?

.....

- (iii) What is the role of cutting fluid in the cutting of this thread?

.....

- (iv) Explain why the  $\varnothing 6$  section is important when cutting the thread.

.....  
 .....

## QUESTION 14. (Continued)

EXAMINER'S  
USE ONLY

- (c) In industry, computer numerically controlled machines would be used for the manufacture of the hand screw. Discuss the advantages of using this type of machinery over hand operated machines.

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- (d) Metallic arc welding techniques are used widely in industry.

- (i) Name the joint types illustrated below.

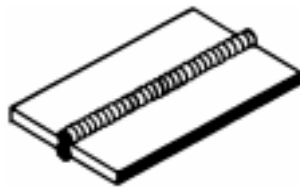


FIG. 3

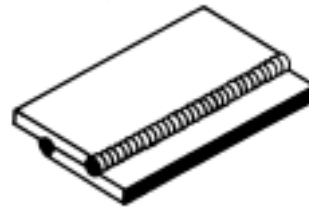


FIG. 4

Name: .....

Name: .....

- (ii) Briefly outline TWO major differences between manual arc welding and MIG welding.

.....

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.....

- (iii) List THREE personal safety precautions that must be taken when arc welding.

1. ....

2. ....

3. ....



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**QUESTION 15.** (5 marks)EXAMINER'S  
USE ONLY

A manufacturer has been contracted, by a chain of retail stores, to supply metal boxes as shown in Figure 5.

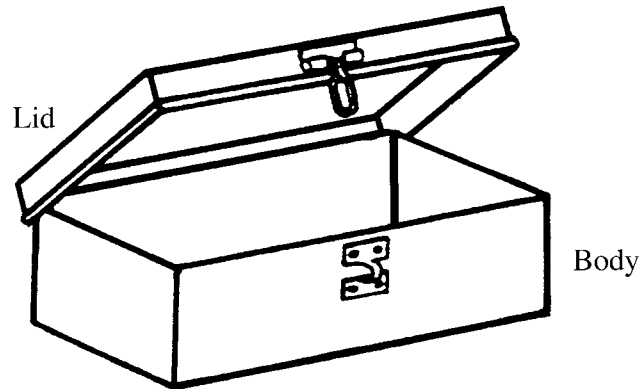


FIG. 5

'Metalwork for High School 3', K Westover, Pittman, 1984, p9.

- (a) Boxes, which are to be formed from sheet metal, may be made from aluminium, black mild steel, or galvanised steel. State ONE advantage and ONE disadvantage of each material when used for this application.

- (i) Aluminium

Advantage

.....

Disadvantage

.....

- (ii) Black mild steel

Advantage

.....

Disadvantage

.....

- (iii) Galvanised steel

Advantage

.....

Disadvantage

.....

## QUESTION 15. (Continued)

EXAMINER'S  
USE ONLY

- (b) The manufacturer must decide the best way to cut out the body of the box.

Make a neat freehand sketch of one method of developing the body of the box.

- NOTE.
- Include allowances for seams and safe edges.
  - Good sheet metal design encourages folding rather than joining while using materials economically.

## QUESTION 15. (Continued)

EXAMINER'S  
USE ONLY

- (c) The manufacturer decides to make the boxes from black mild steel and then paint them to prevent surface corrosion. Outline the steps taken to prepare the surface, and then to apply an oil-based enamel finish.

Preparation

.....

Painting

.....

.....

- (d) A handle is to be designed to fit to the centre of the lid. Any or all of the following materials may be used:

- Ø12 plated rod;
- M6 round-head plated machine screws and plated washers;
- pop rivets;
- plated sheet metal.

On page 13, make a freehand pictorial sketch of a suitable handle.

- The handle may be rigid or may fold.
- Indicate how the handle will be attached to the lid.
- Include any other notes that may be necessary to explain your design.

QUESTION 15. (Continued)

EXAMINER'S  
USE ONLY

FREEHAND SKETCH OF HANDLE

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