DIRECTIONS TO CANDIDATES

• Write your Student Number and Centre Number at the top right-hand corner of this page.

• Where appropriate, show all working for solutions neatly and clearly.

• You may use Board-approved drawing instruments and calculators.

Section II—Metals and Engineering (15 marks)

• Question 4 is COMPULSORY.

• Attempt TWO questions from Questions 5, 6, and 7.

• Answer the questions in the spaces provided in this paper.

<table>
<thead>
<tr>
<th>Question</th>
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<tr>
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<td>5</td>
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<td>6</td>
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</table>
QUESTION 4 This question is COMPULSORY. (5 marks)

Figure 1 shows a fishing reel and a detailed view of a crank and handle that will be used for the fishing reel.

(a) Accurately sketch, in proportion, the view of the assembled crank and handle, in the direction of the arrow.
QUESTION 4 (Continued)

(b) Figure 2 shows the shape of the slot at one end of the crank.

![Figure 2](image)

FIG. 2

Explain the purpose of this design feature.

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(c) (i) Explain the term *working drawings*.

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(ii) What is the purpose of detail drawings in metals and engineering industries?

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(d) Explain the term *tolerance* when applied to metals engineering.

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QUESTION 4 (Continued)

(e) State the engineering terms for the abbreviations listed.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Engineering term</th>
</tr>
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<tr>
<td>ASSY</td>
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<tr>
<td>CSK HD</td>
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<td>SPEC</td>
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<td>CHAM</td>
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(f) Figure 3 shows an internal threaded hole.

(i) Explain what is meant by ‘M 12 × 1.75’.

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(ii) State the length of the thread.

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QUESTION 5 (5 marks)

(a) The fishing reel crank and handle shown in Figure 4 is to be mass produced.

![Figure 4](image)

(i) Name a suitable material for manufacturing the crank. Give TWO reasons for your choice.

Material ..........................................................

1 Reason for choice ..........................................................

2 Reason for choice ..........................................................

(ii) Name and describe a suitable method for manufacturing the crank.

Method ..........................................................

Description ..................................................................

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(iii) Identify an appropriate surface finish for the material named in part (i), and describe how it would be produced.

Surface finish ..................................................

Description ..................................................................

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QUESTION 5 (Continued)

(b) Describe how technological advances in materials and equipment have improved production processes in the metals engineering industry. Give specific examples of technological advances in relation to the manufacture of the crank.

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(c) Figure 5 shows a handle locking ring and handle locking screw.

![Figure 5](image)

**FIG. 5**

Explain the purpose of the locking ring and screw.

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Question 5 continues on page 8
QUESTION 5 (Continued)

(d) The spool of the fishing reel shown in Figure 1 is machined from a solid piece of alloy on an automated lathe.

![Diagram of a spool with a fillet marked]

FIG. 6

Explain why a fillet is used in the design of the spool.

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QUESTION 6 (5 marks)

Figure 7 shows the frame of the fishing reel pictured in Figure 1. Engineers are considering whether to manufacture the frame in one piece.

(a) Explain TWO advantages of manufacturing the frame in one piece.
   Advantage 1 ..............................................................
   Advantage 2 ..............................................................

(b) (i) Name and describe a suitable method for manufacturing the frame in one piece.
   Method ..............................................................
   Description ................................................................
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(ii) Suggest a suitable material for the frame, and give reasons for your choice.
   Material ..............................................................
   Reasons for choice ..............................................................
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Question 6 continues on page 10
QUESTION 6 (Continued)

(c) The frame requires threaded holes for the assembly of components.

Outline the steps involved in producing a hand-cut thread in a blind hole.

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(d) Name the following techniques, and describe their application in the manufacture of the frame.

Technique ............................................................................................................................
Application ............................................................................................................................
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Technique ............................................................................................................................
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Technique ............................................................................................................................
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FIG. 8

FIG. 9

FIG. 10
QUESTION 6 (Continued)

(e) (i) Produce a sketch of a pop rivet and a solid rivet.

(ii) Describe ONE benefit of using rivets over machine screws in the fishing reel.

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(f) (i) What is meant by the term anodising?

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(ii) Explain the anodising process.

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QUESTION 7 (5 marks)

Figure 11 shows the main gear of the fishing reel pictured in Figure 1.

(a)  The main gear is to be manufactured from a single piece of stainless steel.

   (i)  What are the benefits of using stainless steel in this application?

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   (ii) A quadrant of the main gear is shown in Figure 12. Complete the drawing to
        represent an appropriate shape for the teeth.

   FIG. 12
QUESTION 7  (Continued)

(iii) Name and describe a process that would be used for cutting this gear.

Process ......................................................................................................................................
Description ................................................................................................................................
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(iv) Explain why gears are used in fishing reels.
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(v) Name the gear shown in Figure 13, and state its application in the engineering field.

![FIG. 13]

Gear name ................................................................................................................................
Application ................................................................................................................................
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Question 7 continues on page 14
QUESTION 7 (Continued)

(b) The CAD/CAM system is used extensively in the engineering industry.

(i) Explain the relationship between CAD and CAM.
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