



Please write clearly in block capitals.

Centre number

Candidate number

Surname \_\_\_\_\_

Forename(s) \_\_\_\_\_

Candidate signature \_\_\_\_\_

# Level 3 Technical Level DESIGN ENGINEERING MECHATRONIC ENGINEERING

## Unit 3 Mathematics for Engineers

Friday 18 January 2019

Afternoon

Time allowed: 1 hour 45 minutes

### Materials

For this paper you must have:

- pens
- pencils
- simple drawing instruments
- a scientific calculator (non-programmable)
- the formula sheet, which is provided as an insert inside this paper.

### Instructions

- Use black ink or black ball-point pen. Use pencil only for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this answer book. Cross through any work you do not want to be marked.
- Answer to 3 significant figures unless otherwise instructed.

### Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80. There are 50 marks for **Section A** and 30 marks for **Section B**.
- Both sections should be attempted.

### Advice

- Do not spend too long on one question.
- Read all questions thoroughly before starting your answer.
- Show all working in the spaces provided.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
<b>TOTAL</b>	



J A N 1 9 J 5 0 6 5 9 5 3 0 1

IB/M/Jan19/E7

**J/506/5953**



0 1 . 2

It takes a CNC welding machine 3 minutes 42 seconds to weld each container together.

Calculate how much it will cost to weld the whole batch if the company charges £150 per hour for the use of the machine.

**[3 marks]**

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**10**

**Turn over for the next question**

**Turn over ►**



0	2	.	2
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Use the formula method to solve the following quadratic equation:

$$x^2 + 6x + 8 = 0$$

**[3 marks]**

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13
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**Turn over for the next question****Turn over ►**





**0 5****Table 1** shows the tightening torque (Nm) of a series of bolts on a machine tool.**Table 1**

10.5	10.6	10.5	10.4	10.6
10.4	10.5	10.6	10.5	10.5

**0 5 . 1**

Calculate the mean torque value (Nm) of the data set.

**[2 marks]**

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**0 5 . 2**

Calculate the median torque value (Nm) of the data set.

**[4 marks]**

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**0 6**

The data, contained in **Table 2**, is wear rate values taken from a turbine's bearing measured over a period of time.

**Table 2**

<b>Wear rate – microns</b>	5	10	15	20	25	28	31	33	35	36
<b>Time – seconds</b>	0–1000	1000–2000	2000–3000	3000–4000	4000–5000	5000–6000	6000–7000	7000–8000	8000–9000	9000–10 000

**0 6 . 1**

Plot a graph of the data set wear rate against time.

**[3 marks]**



**0 6 . 2**

Explain what is happening to the wear rate between 0 and 5000 seconds.

**[2 marks]**

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**0 6 . 3**

Explain what is happening to the wear rate between 5000 and 10 000 seconds.

**[2 marks]**

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**7****Turn over for Section B****Turn over ►**





0	9
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The velocity,  $v$ , of a robot,  $t$  seconds after changing a tool is  $(2t^2 + 5)\text{ms}^{-1}$

0	9	.	1
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By the use of integration, calculate the distance that the robot has travelled between  $t = 0$  to  $t = 4$  seconds.

Answer to 2 significant figures.

**[7 marks]**



0 9 . 2

Explain what this area represents by showing how you got to this solution.

**[3 marks]**

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**10****END OF QUESTIONS**

**There are no questions printed on this page**

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ANSWER IN THE SPACES PROVIDED**

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