1 1 4 5 5 3 0 0 6 1 8

City & Guilds

1145-530 JUNE 2018
Level 3 Advanced Technical Certificate in Engineering (360)
Level 3 Advanced Technical Diploma in Engineering (540)
Level 3 Advanced Technical Extended Diploma in Engineering (720)

If provided, stick your candidate barcode label here.

Tuesday 19 June 2018
09:30 – 12:30

Candidate name (first, last)

First

Last

Candidate enrolment number

Date of birth (DDMMYYYY)

Gender (M/F)

Assessment date (DDMMYYYY)

Centre number

Candidate signature and declaration*

- If any additional answer sheets are used, enter the additional number of pages in this box. ➡ 0 0
- Please ensure that you **staple** additional answer sheets to the **back** of this answer booklet, clearly labelling them with your full name, enrolment number, centre number and qualification number in BLOCK CAPITALS.
- All candidates need to use a **black/blue pen. Do not** use a pencil or gel pen.
- If provided with source documents, these documents **will not** be returned to City & Guilds, and will be shredded. **Do not** write on the source documents.

***I declare that I had no prior knowledge of the questions in this assessment and that I will not divulge to any person any information about the questions.**

You should have the following for this examination
- non-programmable scientific calculator

General instructions
- Round to three significant figures unless otherwise stated.

ST00051646 A3 PO4500131193 10343570

1 a) State the mechanical property that means the ability of a material to resist wear, abrasion and being scratched. (1 mark)

b) State the term that refers to how easily a material melts. (1 mark)

(Total marks 2)

2 a) Explain the difference between a ferrous and a non-ferrous metal. (2 marks)

b) In the table below, give an example of a ferrous metal and a non-ferrous metal. For **each**, give an example of a typical application. (4 marks)

Type of metal	**Example**	**Typical Application**
Ferrous		
Non-ferrous		

c) Explain why thermochromic pigment is a smart material. (2 marks)

(Total marks 8)

3 a) Describe the process of quenching a high carbon steel tool. (3 marks)

b) Explain why it is often necessary to carry out tempering after quenching. (4 marks)

(Total marks 7)

4 State **three** health and safety considerations when manufacturing composite materials. (3 marks)

(Total marks 3)

See next page

5 Describe how a plasma conducts electricity. (3 marks)

(Total marks 3)

6 Name **three** common types of electrical cable. (3 marks)

(Total marks 3)

7 a) Explain why jigs and fixtures are used during batch manufacturing. (6 marks)

b) Explain why a manufacturer might carry out quality control by sampling rather than 100 % inspection. (3 marks)

c) Explain **one** advantage to a manufacturing company of using 'six sigma' as a strategy to improve quality. (2 marks)

(Total marks 11)

See next page

8 A company is to design and manufacture a bottle that will package a new fruit juice drink. They hope to sell 5,000 bottles per day.
Suggest a suitable material to make the bottle and the main process needed to manufacture it. Give reasons for your suggestions. (4 marks)

(Total marks 4)

9 a) Explain what is meant by an 'iterative' design process. (3 marks)

b) State **three** methods used to evaluate design ideas. (3 marks)

c) Give **two** advantages of using CAD software compared to manual drawing. (2 marks)

d) Explain **two** advantages and **one** limitation of using block modelling to make a prototype. (6 marks)

(Total marks 14)

See next page

10 Discuss how the development of the steam engine contributed to social and economic development. (9 marks)

(Total marks 9)

See next page

11 a) An engineer measured an electrical waveform, Figure 1, and identified that it was a sine function.

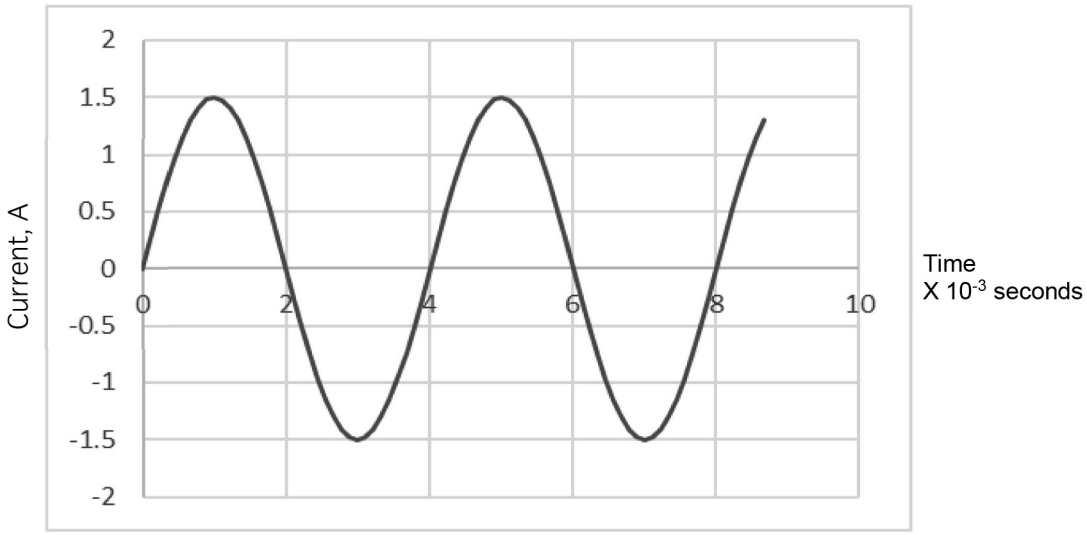

Figure 1

For the waveform shown, determine the

i) amplitude (1 mark)

ii) frequency (1 mark)

iii) periodic time. (1 mark)

b) Multiply the following complex numbers.
(4 + 3j) (2 – 2j) (3 marks)

c) An inspection was carried out on a trial batch of cast products.
- 90 % of the products were satisfactory and contained no defects.
- 5 % of the total quantity of products contained inclusion defects.
- 8 % of the total quantity of products contained crack defects.

Some of the products contained both types of defect.
Calculate the probability that a product selected at random contained only one defect. (4 marks)

d) A machine tool moves from A to B then, after turning at a right angle, from B to C as shown on Figure 2.

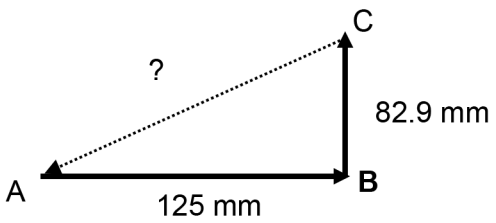

Figure 2 – Not to scale

Calculate the magnitude of the polar vector for the tool to return directly to A from C. (2 marks)

e) The linear acceleration of a tool in a machine in mm s^{-2} is given by the function: Acceleration, $a = 6t^2 - 6 \sin(3t)$. Using integration, determine the velocity of the tool at $t = 4$ s. (3 marks)

f) Using the Chain rule, differentiate $y = (x + 3)^4$. (3 marks)

(Total marks 18)

12 Figure 3 is a plot of the rate of tool wear for a machining operation. The variables x and y have been plotted as logarithms to base 10. Determine an equation for the relationship between x and y. (6 marks)

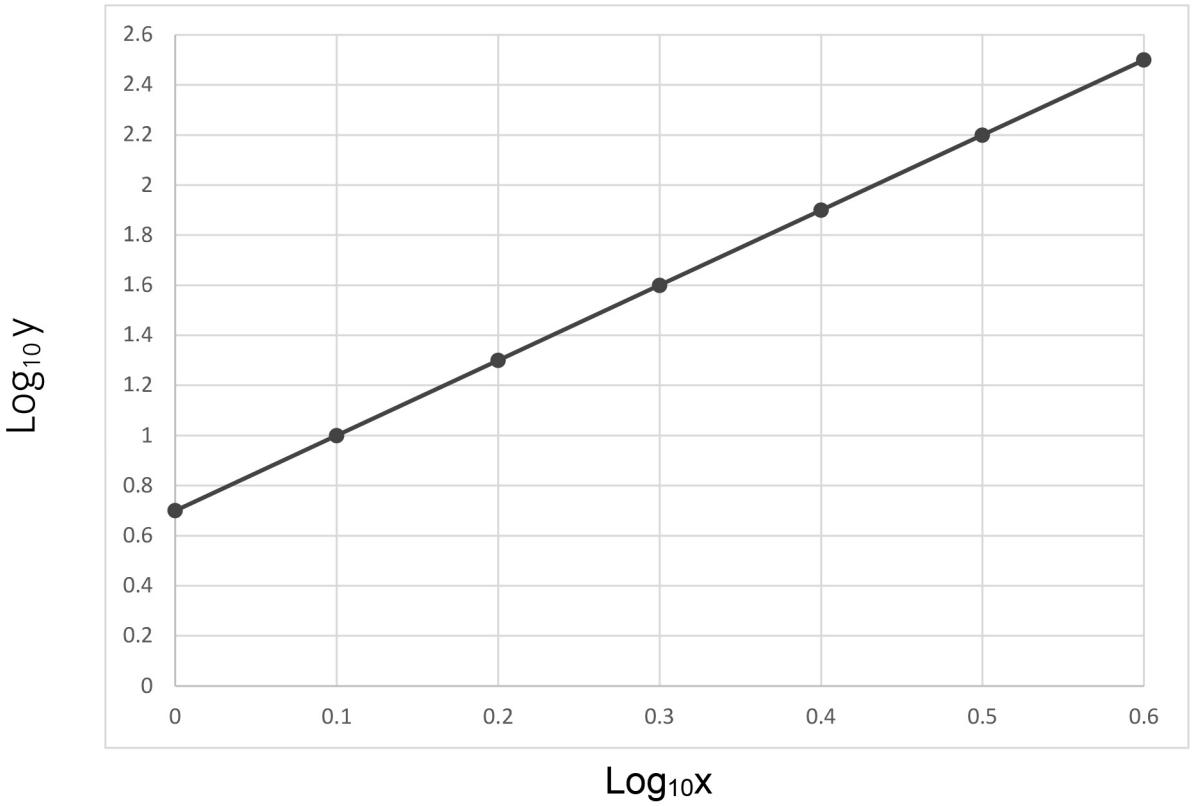

Figure 3

(Total marks 6)

13 Mobile phones have changed substantially over the last 30 years.

- They are now much smaller.
- They weigh less.
- In real terms, they cost less.
- They have many more functions.

Discuss the possible reasons for these changes. (12 marks)

(Total marks 12)

End of examination