1145-530 MARCH 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)
Level 3 Engineering – Theory Test (1)

If provided, stick your candidate barcode label here.  

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.
• 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 assessment
• a non-programmable calculator

General instructions
• Use black or blue ball-point pen.
• The marks for questions are shown in brackets.
• There are 13 questions in this examination paper. Answer all questions.
• Answer the questions in the spaces provided. Answers written in margins will not be marked.
• Cross through any work you do not want to be marked.
• Round numbers to three significant figures where appropriate.
• Show all calculations. If you use a calculator, show sufficient steps to justify your answer.
• Write all your working out and answers in this booklet.
• If extra space is required then the blank pages at the back of the pack should be used, clearly identifying the question.
1  a) State the mechanical property that means the ability of a material to resume its normal shape after being stretched or compressed. (1 mark)

b) State the term that means the tendency of a material to move slowly and deform permanently under the influence of mechanical stress. (1 mark)

(Total marks 2)
2 a) Describe the process of case hardening low carbon steel. (4 marks)

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

b) Explain how precipitation hardening changes the properties of an aluminium alloy. (4 marks)

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

(Total marks 8)
3 Describe the test used to determine the hardness of a low carbon steel. (4 marks)

(Total marks 4)
4  a) State **two** different types of defect typically found in composite products.  
   b) For **each**, name a different test that could be used to detect the defect. 
   Complete the table below with your responses.

<table>
<thead>
<tr>
<th>Defect</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Total marks 4)
5 Explain how a semiconductor material conducts electricity. (5 marks)

(Total marks 5)
6 a) State two welding processes that are used to join metal parts together. (2 marks)

b) Explain the difference between quality control and quality assurance. (4 marks)

c) State two methods used to protect assembled products from damage. (2 marks)

d) Explain two advantages to a company of using a 'lean' strategy for quality improvement. (4 marks)
e) A company wants to design and manufacture a small toy car for children aged 3-5 years old. The length of the car is 75 mm and the quantity to be manufactured is 10,000.
Suggest a suitable material to make the toy car and the main process needed to manufacture it. Give reasons for your suggestions. (4 marks)

(Total marks 16)
7 a) State two different types of need that should be included in a specification. (2 marks)

b) Explain, using a product example, the difference between design constraints and design wants. (5 marks)

(Total marks 7)
8  a) State **three** types of drawings that can be used to represent product designs.  

b) Explain **two** advantages and **one** disadvantage of using virtual modelling to test the design of an electronic circuit.
Discuss how the development of automated machines and robotics has influenced social and economic development. (9 marks)
10 a) Solve the equation
\[ 12^n = 8 \] (3 marks)

b) Solve the quadratic equation
\[ x^2 - 8x + 7 = 0 \] (4 marks)
c) Convert the following polar vector into Cartesian form.
R = 450 at 70° to the horizontal.  

(Total marks 11)
11 The movement of a mass oscillating on a spring is given by the formula \( x = 50 \sin (5t) \), where movement is in mm and \( t \) is in seconds.

a) Determine the amplitude of the oscillation. (1 mark)

b) Determine the angular frequency. (1 mark)

c) Calculate the frequency of oscillation. (2 marks)

d) Calculate the time period needed to complete one cycle. (2 marks)
e) Calculate the time needed for the mass to travel from zero to the amplitude. (1 mark)

(Total marks 7)
12 Using the process of integration by substitution, find an equation for the area under the curve

\[ y = \int 4xe^{(x^2 - 1)} \, dx \]

Use the substitution \( u = x^2 - 1 \). 

(Total marks 6)
Discuss how the scale of manufacture affects the manufacture of a product. (12 marks)
Question 13 continued

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

(Total marks 12)