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**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.

**Tuesday 20 March 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. 
- 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)

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- 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)

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(Total marks 2)

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

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

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(Total marks 8)

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

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(Total marks 4)

- 4 a) State **two** different types of defect typically found in composite products. (2 marks)  
b) For **each**, name a different test that could be used to detect the defect. (2 marks)  
Complete the table below with your responses.

Defect	Test

(Total marks 4)

5 Explain how a semiconductor material conducts electricity.

(5 marks)

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(Total marks 5)

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

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

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

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d) Explain **two** advantages to a company of using a 'lean' strategy for quality improvement. (4 marks)

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- 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)

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(Total marks 16)



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

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

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(Total marks 7)

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

(3 marks)

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b) Explain **two** advantages and **one** disadvantage of using virtual modelling to test the design of an electronic circuit.

(6 marks)

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(Total marks 9)





10 a) Solve the equation  
 $12^n = 8$

(3 marks)

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b) Solve the quadratic equation  
 $x^2 - 8x + 7 = 0$

(4 marks)

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- c) Convert the following polar vector into Cartesian form.  
R = 450 at  $70^\circ$  to the horizontal.

(4 marks)

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(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)

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b) Determine the angular frequency. (1 mark)

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

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d) Calculate the time period needed to complete one cycle. (2 marks)

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e) Calculate the time needed for the mass to travel from zero to the amplitude. (1 mark)

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(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  $u = x^2 - 1$ .

(6 marks)

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(Total marks 6)





**Additional space**

A series of horizontal lines providing additional writing space, consisting of 20 lines.





A series of horizontal lines spanning the width of the page, intended for writing or drawing.





