



1 1 4 5 5 3 0 0 6 1 7

1145-530 JUNE 2017

Level 3 Advanced Technical Certificate in Engineering/

Level 3 Advanced Technical Diploma in Engineering (540)/

Level 3 Advanced Technical Extended Diploma in Engineering (720)

Level 3 Engineering – Theory Exam (1)

If provided, stick your candidate barcode label here.

Monday 19 June 2017
09:00 – 12:00

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 examination

- non-programmable calculator
- a pen with blue or black ink

General instructions

- Where required, use the value $\pi = 3.142$
- 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.

The test specifications for the 2018 exams have changed. See the latest qualification handbook for the updated test specification.



1 Define **each** of the following terms.

a) Plasticity.

(1 mark)

b) Specific gravity.

(1 mark)

(Total marks 2)

- 2 State the names of **two** different non-metallic materials, giving a typical application of **each**.

Complete the table below with your responses.

(4 marks)

Non-metallic material	Typical application

(Total marks 4)

- 3 A tensile test was carried out on a specimen of material with a cross sectional area of 78.55 mm and a gauge length of 90 mm.
The results are shown in Figure 1.

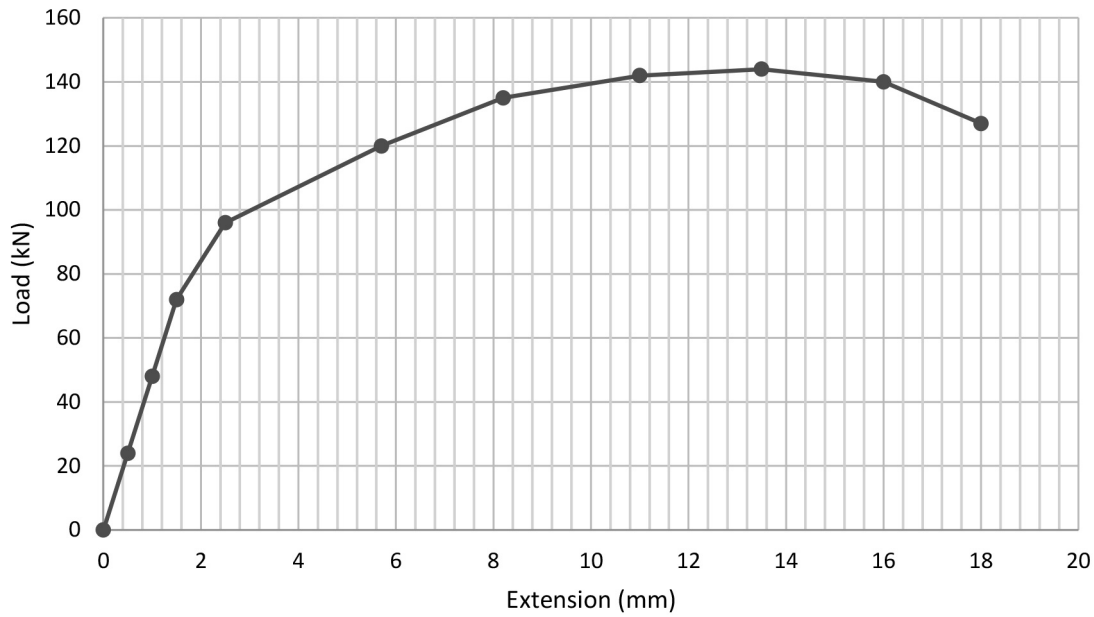


Figure 1

Calculate the Young's modulus of the material.

You may find the following equation useful: $E = \sigma / \epsilon$

(5 marks)

(Total marks 5)

4 Describe the stages involved in manufacturing a product from pre-preg composite materials.

(4 marks)

(Total marks 4)

5 a) State Faraday's Law. (1 mark)

b) Name **three** types of safety sensor used in robotic systems. (3 marks)

c) State the meaning of integral control of a controller output. (1 mark)

d) Explain how a true value input can be used in a measurement system. (4 marks)

e) Explain why the magnitude and stability of the current must be considered when connecting a controller to a circuit.

(6 marks)

(Total marks 15)

- 6 a) A flywheel of radius 0.2 m is turning at a frequency of 8 revolutions per second. Calculate the centripetal acceleration at the edge of the wheel.

(4 marks)

- b) A cylinder contains 1000 cm^3 of gas at a pressure of 2 bar and a temperature of 20°C . A piston compresses the gas to 800 cm^3 . The temperature remains at 20°C . Calculate the new pressure in the cylinder.

(4 marks)

(Total marks 8)

7 a) State the **first** law of thermodynamics. (1 mark)

b) State what is meant by
i) static friction (1 mark)

ii) simple harmonic motion. (1 mark)

(Total marks 3)

8 a) Name **two** manufacturing techniques that use heat to mould plastic products. (2 marks)

b) Explain why jigs and templates are more commonly used for batch manufacture than for bespoke (one-off) manufacture. (4 marks)

(Total marks 6)

9 a) Describe how to output a plot of a drawing from a 3D CAD package.

(3 marks)

b) Explain, using examples, why a design specification may include conflicting requirements.

(5 marks)



- 10 a) A trolley has been designed to support a maximum mass of 108 newtons. The maximum safe load is marked on the trolley as 18 newtons. Calculate the safety factor.

(2 marks)

- b) A factory collected data on the operational life of the tools on one of their machines. The time to failure of 50 tools was recorded as shown in the table and graph in Figure 2.

Hours	0 < 10	10 < 20	20 < 30	30 < 40	40 < 50	50 < 60
Number of failed tools	1	5	12	12	14	6

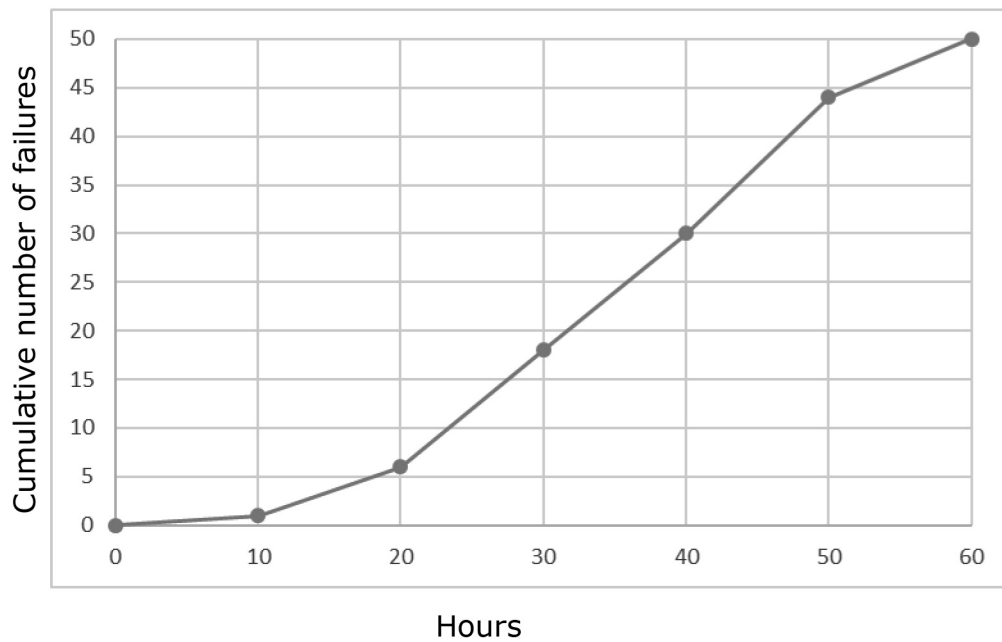


Figure 2

i) Calculate the mean number of hours until tool failure. (2 marks)

ii) Determine the median value of the tool life. (1 mark)

iii) To minimise the risk of damage to the product, the company have decided to change tools after a set time, before the average tool fails. They have decided that the operational life of the tool should be set at the value when 20% of the tools failed. Determine this value for the operational life of the tool. (2 marks)

(Total marks 7)

- 11 a) ABC is a right angled triangle. For the angle at C, $\sin C = 0.8$ and $\cos C = 0.6$
Using the relationship between the sine and cosine, find the value of $\tan C$. (2 marks)

- b) Convert $\frac{4}{3}\pi$ radians into degrees. (2 marks)

- c) Convert the polar coordinates $(110, -35^\circ)$ to Cartesian form. (4 marks)

(Total marks 8)

12 a) Using the chain rule, differentiate $y = (2x - 4)^6$

(4 marks)

b) Divide $5x^2 + 4x - 6$ by $(x + 1)$ and find the remainder using the remainder theorem.

(5 marks)

(Total marks 9)

Lined writing area consisting of 25 horizontal lines.

