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1145-530 MARCH 2022

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)

Wednesday 9 March 2022

09:30 – 12:30

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 additional answer sheets are used, enter the additional number of pages in this box. 
- Before taking the examination, **all candidates** must check that their barcode label is in the appropriate box. Incorrectly placed barcodes may cause delays in the marking process.
- Please ensure that you staple additional answer sheets to the **back** of this answer booklet, clearly labelling these 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, unless otherwise instructed.
- 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 examination and that I will not divulge to any person any information about the questions.**

You should have the following for this examination

- a non-programmable scientific calculator

General instructions

- Use black or blue ballpoint pen. Use pencil for drawing only.
- Any pencil drawings **must** be bold and clear for scanning purposes.
- The marks for questions are shown in brackets.
- Answer **all** questions.
- Write **all** of your working out and answers in this booklet.
- Answer the questions in the spaces provided.
- Answers written in margins or on blank pages **cannot** be marked.
- Cross through any work you do **not** want to be marked.



- 1 a) State the mechanical property that describes the non-reversible change in shape that occurs when the tensile stress is exceeded. (1 mark)

- b) Give the meaning of the term 'fracture' when referring to the failure of a material. (1 mark)

- c) Figure 1 shows the results of a tensile test.

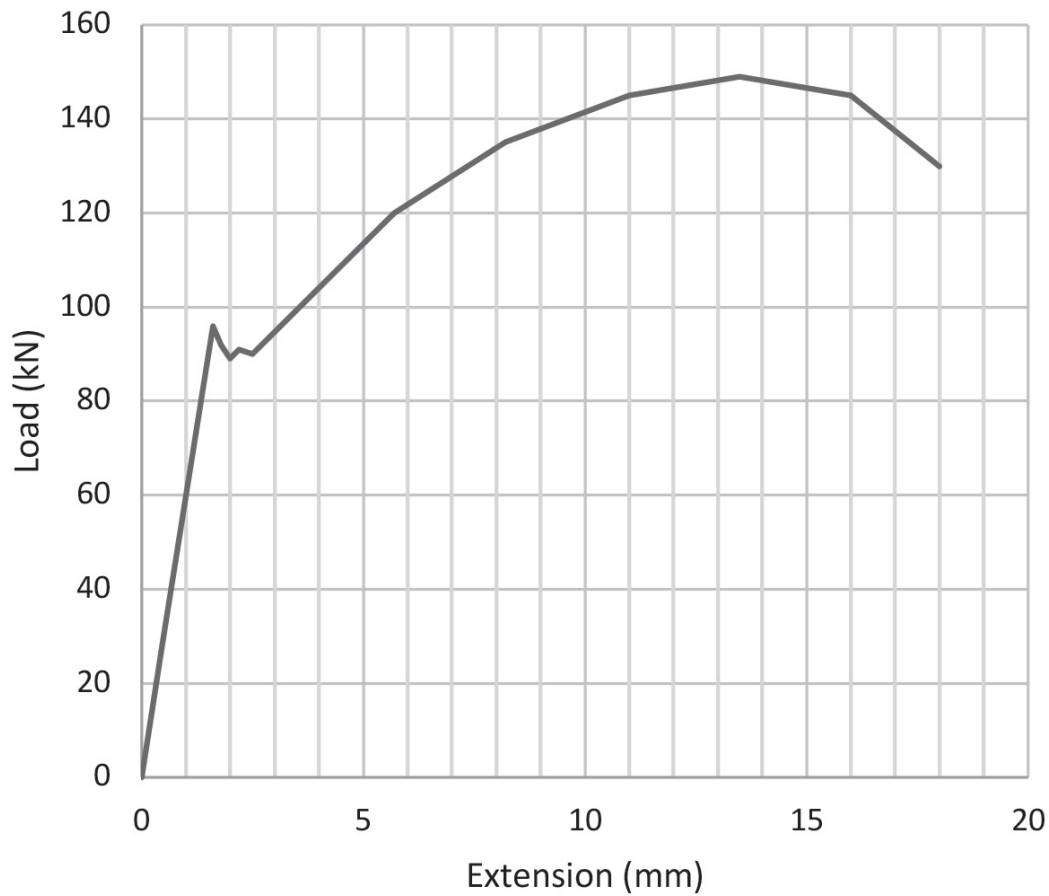


Figure 1

Label Figure 1 to identify:

- i) ultimate tensile strength (1 mark)
- ii) yield strength. (1 mark)

2 a) Describe the process of induction hardening.

(4 marks)

b) Explain why induction hardening may be used in preference to case hardening.

(3 marks)

- 3 a) Complete Table 1 below, stating **three** health and safety measures that should be considered when manufacturing a composite material. For **each**, give a different reason why it is necessary. An example has been completed for you. (6 marks)

Health & Safety Measure	Reason
<i>Fire protection – sprinklers available</i>	<i>Resins used are highly flammable</i>

Table 1

- b) Explain the purpose of an autoclave when manufacturing a composite material. (3 marks)

4 Explain how metals conduct electricity. (3 marks)

5 a) Name **two** finishing methods used to protect metal products from damage. (2 marks)

b) Describe how a product is manufactured by powder compaction and sintering. (4 marks)

8 a) State **three** different types of criteria that may be included in a design specification. (3 marks)

b) State the **most** appropriate type of drawing or diagram to communicate the following:
i) how electrical components are arranged and connected to each other. (1 mark)

ii) the input, process and output of a device and the signals between them. (1 mark)

iii) the layout of the parts in an assembled product. (1 mark)

c) Give **four** advantages of using CAD compared to manual drawing. (4 marks)

- 11 a) Figure 2 shows a plot of the relative position of a mechanical linkage with time.

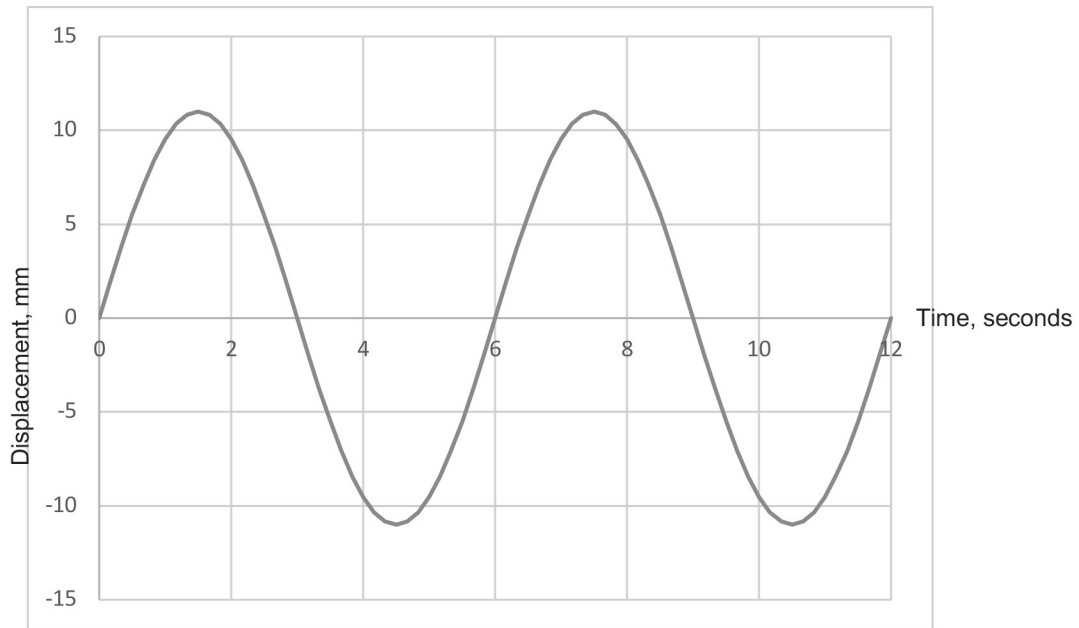


Figure 2

Determine the:

- i) amplitude (1 mark)

- ii) periodic time (1 mark)

- iii) frequency (1 mark)

b) Using logarithms, solve the following equation:
 $9^n - 12 = 15$

(4 marks)

c) Describe how a cause and effect diagram is used in engineering quality control.

(3 marks)

- b) The angular displacement in degrees of a shaft is given by the function $x = -12 \cos 2t$

Using differentiation, determine the angular velocity at $t = 3$ seconds. (3 marks)

- 13 When a sample batch of 250 manufactured parts was inspected, it was found that 18 parts had porosity defects and 27 contained crack defects. No other defects were found.

Assuming that the defects are mutually exclusive, determine the probability that a part selected at random from the batch:

- a) will contain a crack defect. (2 marks)

- b) will not contain a defect. (4 marks)
