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3849-301 MAY18
Level 3 Certificate in Using and Applying Mathematics
Paper 2: Mathematical Comprehension and Communicating with Mathematics
Written

If provided, stick your candidate barcode label here.

Wednesday 23 May 2018
09:30 – 11:30

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
- a clean copy of the pre-release material
- normal distribution table
- pen with black or blue ink
- pencil
- 30 cm ruler
- calculator
- graph paper.

General instructions
- There are **60 marks** for this paper.
- You have 2 hours to complete this paper.
- Answer all of the questions.
- Write all working out and answers in this booklet.
- There are **two** parts to this paper
  Part 1: Mathematical comprehension
  Part 2: Communicating with mathematics.
- You are advised to divide your time equally between the two parts.
- Final answers should be given to 3 significant figures unless otherwise stated.

You may use
- A scientific or graphical calculator.
- A PC installed with the following standard application office software
  – word processor
  – spreadsheet
  – database
  – graphics and presentation packages.

You must not use
- internet
- email
- internally or externally saved files
- mobile phones.

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Marks available and weighting:

Paper 2	**Component**	**Maximum raw mark**	**Scaling Factor**	**Maximum scaled mark**
Part 1 a) 31 marks b) 29 marks	Mathematical comprehension	60	0.5	**30 marks**
Part 2 30 marks	Communicating with mathematics	30	1	**30 marks**

Part 1: Mathematical comprehension.
You should spend about one hour working on this part.

(a) Refer to *Half-life* in the pre-release material.

1. A radioactive substance has a half-life of 5 months. Its radioactive emissions are measured to have a count of 64 units per minute. After a certain length of time the count has decreased to 4 units per minute. Find this length of time.

(3 marks)

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2. Find λ for a substance with a half-life of 6 years.

(2 marks)

3. The article states that after 10 half-lives the emissions from radioactive carbon is so low that it can't be measured. How many years is this?

(2 marks)

4. (a) Explain why you know the following statement is true:
"If a scientist tested a sample of material that was emitting 20% of the radioactive carbon of living material, we would immediately know that it was between about 11,000 and 17,000 years old."

(4 marks)

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(b) Show calculations that lead to the more accurate value for the age of the sample of material in the article to be about 13,300 years.

(3 marks)

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5. An object is 50,000 years old.
What percentage of the emissions of radioactive carbon of living material would be emitted by the object?

(3 marks)

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6. (a) The diagram below shows sketches of graphs of the decay of two radioactive substances *A* and *B*.
One has a value of $\lambda = 2$
The other has a value of $\lambda = 1.5$

Which substance, A or B, has a value of $\lambda = 2$?
Explain your reasoning.

(3 marks)

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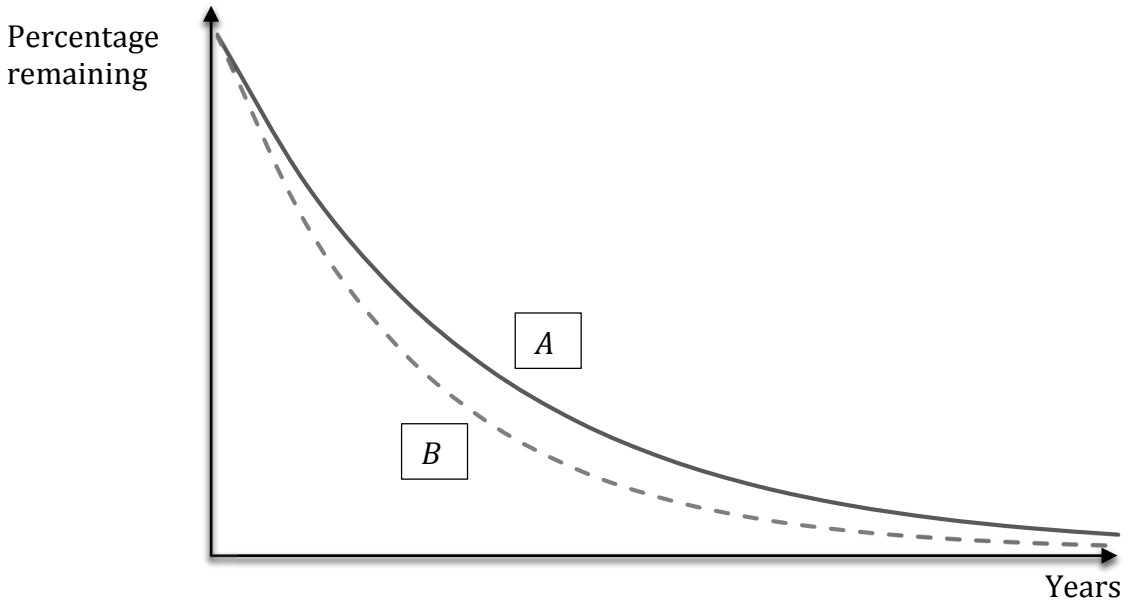
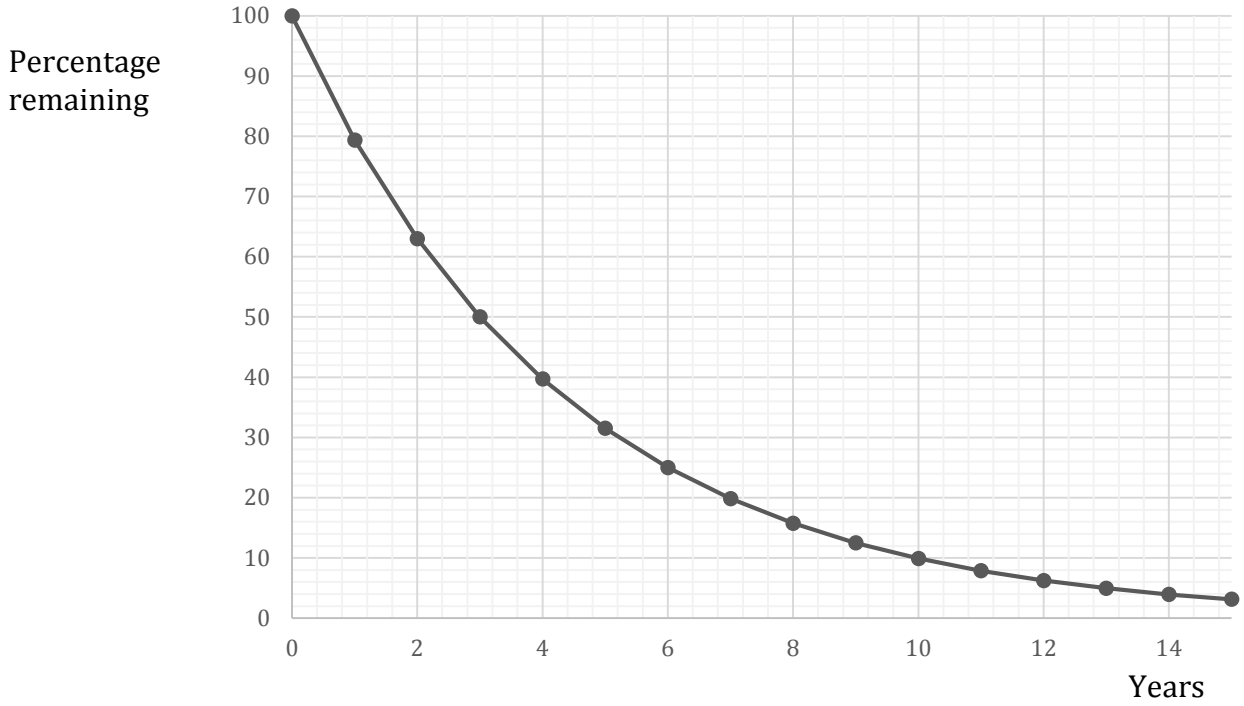


(b) On the diagram sketch a graph of a radioactive substance, *C*, that has a value of $\lambda = 5$

(2 marks)

7. The graph of the decay of a radioactive substance is shown below.
It passes through the point (9,12.5).



(a) What is the half-life of the radioactive substance?

(1 mark)

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(b) Explain how you know this from the information you are given about the point (9,12.5).

(2 marks)

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(c) The curve passes through the point (12, P). State the value of P accurate to 2 decimal places.

(2 marks)

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8. The granite rock of Cornwall is considered to have been formed about 300,000,000 (300 million) years ago.

(a) Find this as a decimal fraction of the half-life of Potassium-40.

(2 marks)

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(b) What will be the fraction of emissions of Potassium-40 detected in this rock now when compared with the full level of emissions when the rock was formed?

(2 marks)

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(b) Refer to *Anthropometry* in the pre-release material.

9. **Figure 5** is repeated below.

(a) Using the scales shown, find the total area of the bars.

(3 marks)

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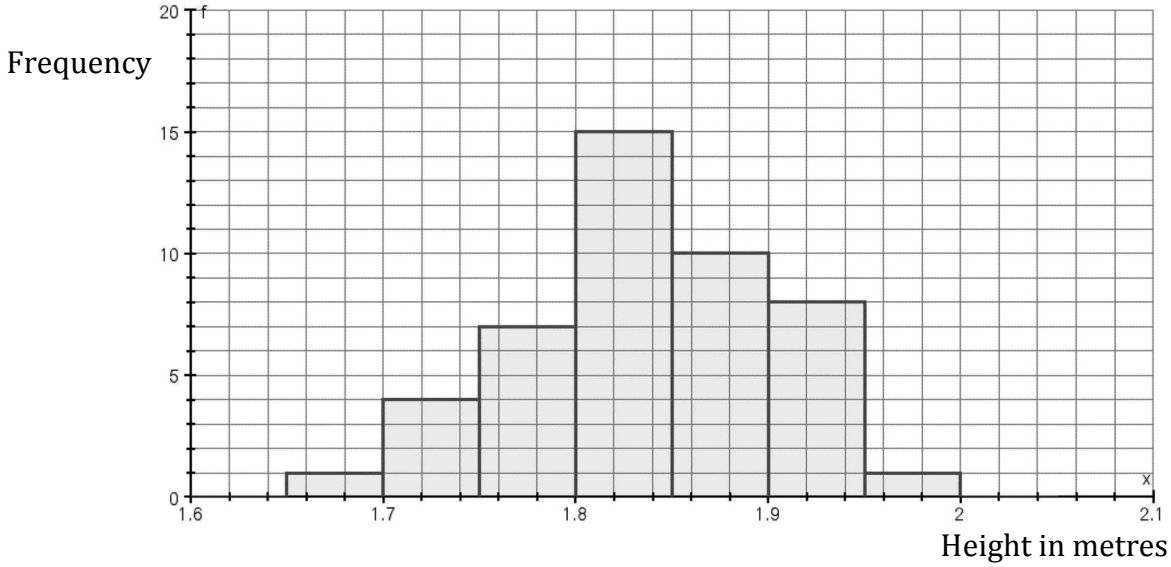

Figure 5. Frequency diagram for the heights of male 18 year olds.

(b) Explain why the height of the bars was divided by 2.3 to redraw **Figure 5** to obtain **Figures 6** and **7**.

(3 marks)

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10. Use the grouped frequency data for 18 year old **males**. Show calculations that confirm that their mean height is 1.84 metres.

(4 marks)

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11. In the article it is stated,
"A carpenter may be making a door in a place where the height of the door has to be restricted to just 1.94 metres high. In such a case all 18 year old **females** would be able to pass through."
Explain why, in reality, this is unlikely to be true.

(2 marks)

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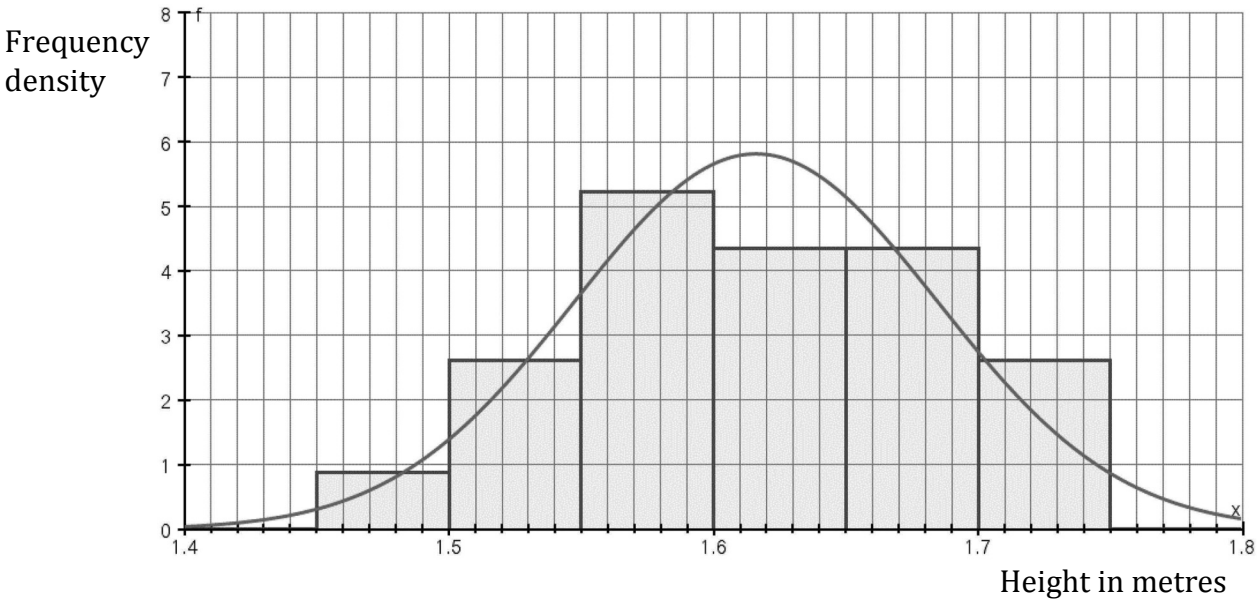
12. It is decided that the door will be 1.9 metres high. Use the normal distribution to calculate the percentage of 18 year old **males** who are likely to be taller than the door height.
Use a mean of 1.84 metres and standard deviation 0.0661 metres in your calculations.

(5 marks)

13. The graph of **Figure 8** is repeated below.



(a) Use the normal distribution curve to find the median height for this population of 18 year old females.

(2 marks)

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(b) Explain why it is this value.

(1 mark)

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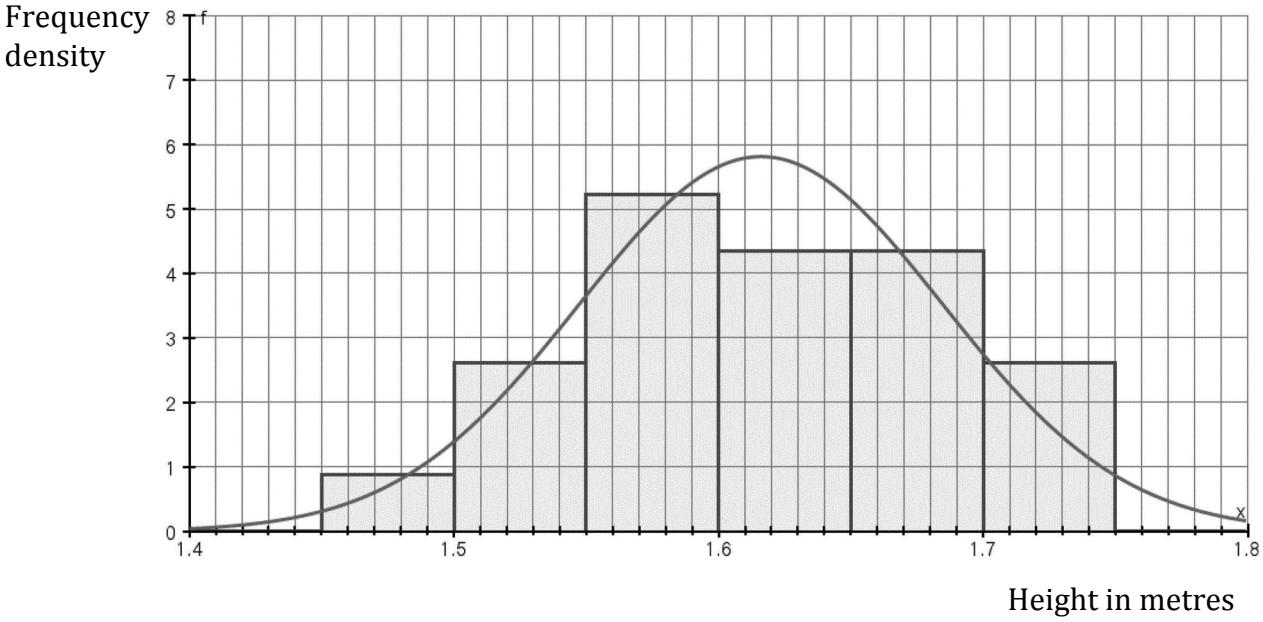
14. In an old building, a door is 1.7 metres high. Use the normal distribution to calculate the percentage of 18 year old **females** who are likely to be smaller than the door height.
Use a mean of 1.616 metres and standard deviation 0.0686 metres in your calculations.

(4 marks)

15. On the copy of **Figure 8** repeated below shade the area under the normal distribution curve that represents the tallest 10% of the 18 year old females. Work as accurately as you can using the normal distribution. Assume that the female population can be modelled by a normal distribution with mean 1.616 metres and standard deviation 0.0686 metres.

(5 marks)



End of Part 1.

Part 2: Communicating with mathematics.
You should spend about one hour working on this part.

Refer to *Smoking* in the pre-release material.

Imagine that you are a journalist.

You are asked to use the information and data supplied by the Office for National Statistics about smoking to write an article that highlights issues about smoking

- in different countries of the UK, and,
- how it affects people's health.

Your article should be no more than a single side of A4 including any diagrams.

(30 marks)

There is space on the following pages for your article and workings, or additional inserts/printouts can be used.

End of Paper 2.