



Oxford Cambridge and RSA

Level 3 Certificate Quantitative Reasoning (MEI)

H866/01 Introduction to Quantitative Reasoning

Wednesday 16 May 2018 – Morning

Time allowed: 2 hours



You must have:

- the Insert (inserted)

You may use:

- a scientific or graphical calculator



First name

Last name

Centre
number

Candidate
number

INSTRUCTIONS

- The Insert will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.

INFORMATION

- The total mark for this paper is **72**.
- The marks for each question are shown in brackets [].
- This document consists of **16** pages.
- Final answers should be given to a degree of accuracy appropriate to the context.

Answer **all** the questions.

- 1** The flow rate of a pipe is a measure of how much water goes through it in a given time. A simple way to estimate the flow rate is called the bucket method.

- Take a bucket of known volume, V , and place it at the end of the pipe.
- Measure the time, t , it takes for the water to fill the bucket.
- The flow rate, Q , is given by the formula $Q = \frac{V}{t}$.

In order to obtain a more reliable estimate the experiment can be repeated several times, and the mean time used in the formula.

Rose uses the bucket method to find the flow rate for a hosepipe. She uses a 10 litre bucket and repeats the time measurement five times. The results are given in the table below.

trial number	time (seconds)
1	12.6
2	13.1
3	12.5
4	12.8
5	13.0

- (i)** Calculate the mean of the five times in the table. **[1]**

- (ii)** Use your result to estimate the flow rate of the hosepipe in litres per second. **[2]**

1 (i)	
1 (ii)	

Rose uses the hosepipe to fill a fishpond. The volume of the fishpond is 6000 litres.

- (iii)** Use your estimate of the flow rate to find how long it will take to fill the fishpond. Give your answer in hours, correct to the nearest hour. **[5]**

1 (iii)	

- 2 A pizza company advertises the following deal.

9 inch “Medium” pizza

12 inch “Large” pizza

£10

£14

Anya asks which pizza is better value for money.

(i) State one of the assumptions she needs to make in order to answer her question. [1]

(ii) Which pizza provides better value for money? Show your working. [4]

2 (i)	
2 (ii)	

- 3** This question refers to the article ‘Determining the age of a foetus’. This was given out as pre-release material and is available as an insert.

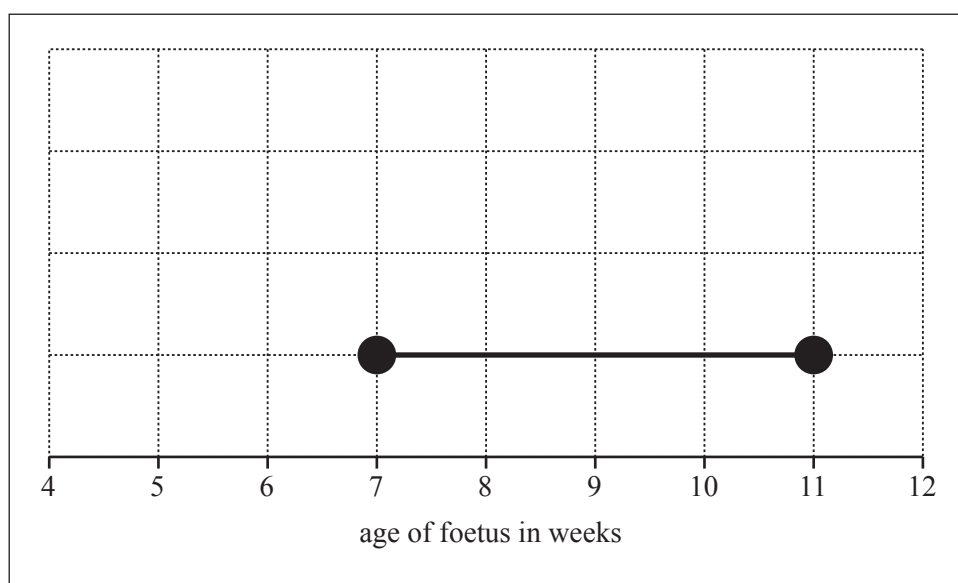
Various tests are used to determine the age of a foetus. They all have different levels of accuracy. Jane is trying to determine the age of her foetus.

Test A: Based on menstrual cycles she knows that the age is between 7 and 11 weeks.

Test B: Based on urine samples she knows that it is 8 ± 2 weeks.

Test C: Based on ultra-sound measurements she knows that it is 10 weeks with an error margin of 10%.

- (i) One of the tests is illustrated below. Draw lines to illustrate the other two tests and label all three lines. [4]



- (ii) Write down the minimum and maximum ages that are consistent with all three tests. [2]

3 (ii)	

- 4 The information in the table below is displayed at a bank in England.

Currency	Sell at	Buy at
Euro	1.31	1.48
US dollar	1.46	1.60
Indian rupee	96.88	103.46

- (i) Jamie buys £200 worth of rupees for a trip to India. How many rupees does she receive?

[2]

4 (i)	

- (ii) The holiday is cancelled. She changes all of her rupees back to pounds. The buy and sell rates have not changed. What percentage loss does she make?

[4]

4 (ii)	

Charmaine wants to purchase a book. She finds the book she wants in the UK and the US. The costs quoted are given in the table below. Charmaine's American friend is visiting her; she offers to buy the book in the US if Charmaine gives her the correct money in dollars.

Country	Cost of book	Delivery cost (including taxes)
UK	40 pounds	Free
US	55 dollars	8 dollars

- (iii) Which deal will result in the cheaper book? You will need to use an appropriate bank exchange rate from the table given on the previous page. [3]

4 (iii)	

- (iv) This question refers to the article 'Credit card commission'. This was given out as pre-release material and is available as an insert.

The advert below shows an offer advertised by a credit card company.

$\text{£}1 = \text{€}1.34$ We add 3% commission
--

Dean is going abroad to a country which uses Euros. Which is better value: changing money at the bank before going abroad or using the credit card abroad?

Support your answer with relevant working. [4]

4 (iv)	

- 5** An engineering manual states that the maximum safe acceleration or deceleration a human can safely withstand is 200 m s^{-2} .

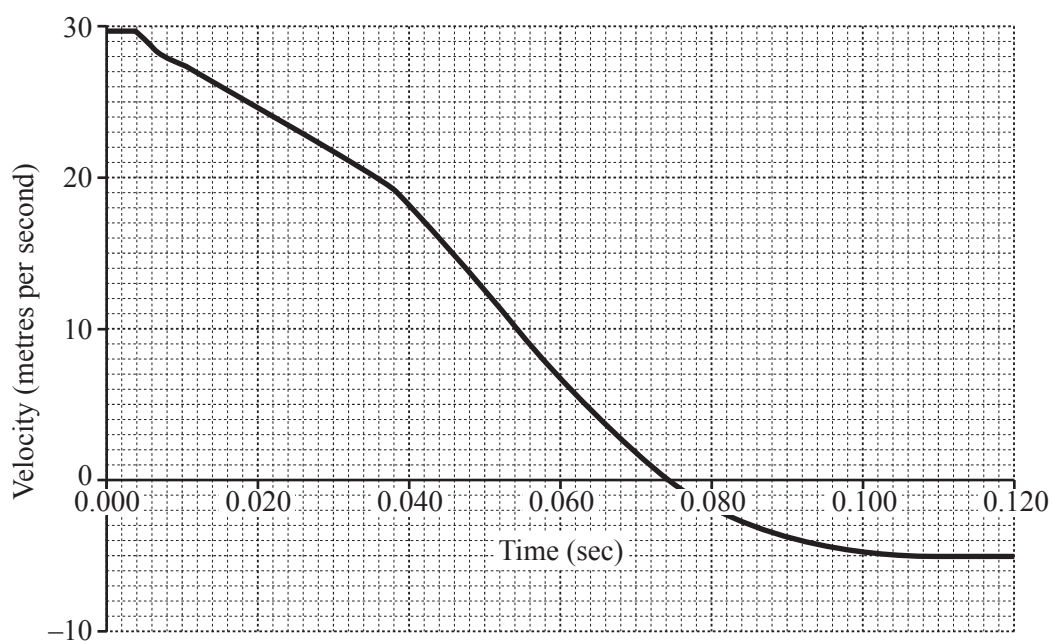
An advert for a car states that the car can accelerate from 0 to 60 miles per hour in 3.2 seconds.

- (i)** Using the approximation that 5 miles is about the same as 8 kilometres, write 60 miles per hour in metres per second. **[3]**

- (ii)** Show that the acceleration of the car is safe (assuming the acceleration is constant). **[3]**

5 (i)	
5 (ii)	

At a road research facility, cars (with nobody in them) are deliberately crashed to test their safety. The graph below shows the result of a particular car crash test.



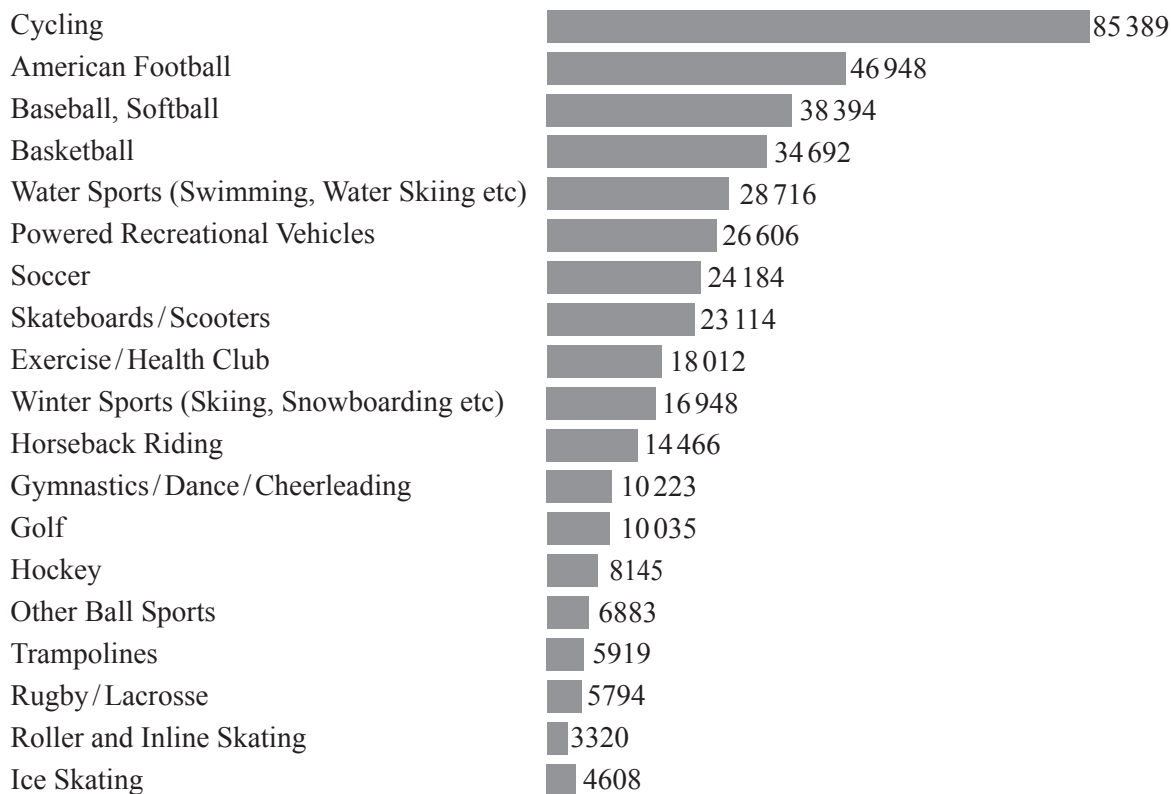
Adapted from A Chawla: Fundamental Principles for Vehicle Occupant System Analysis.

- (iii) Draw an appropriate tangent to estimate the maximum deceleration. Does the crash exceed the maximum safe deceleration? [6]

5 (iii)

- 6 The graph below shows the number of admissions to the Emergency Room (Accident and Emergency department) for head injuries sustained while playing sport in the USA in 2011. These data are being used to determine which sports are most dangerous.

Number of admissions to Emergency Room for head injuries



Source: The Guardian Newspaper

- (i) Do these data provide an overestimate or underestimate of the number of head injuries sustained while doing these sports? Explain your answer. [2]

6(i)	

The table below shows the number of participants in three of these sports.

Sport	Participation in 2011
American football	18.3 million
Winter sports	10.8 million
Cycling	46.8 million

- (ii) Which of the three sports in the table above has the greatest number of admissions per participant for head injuries? Support your answer with relevant calculations. [3]

6 (ii)	

- (iii) State two further pieces of information which might be needed to answer the question about which sport is most dangerous. [2]

6 (iii)	

- 7 Some athletes cheat by taking testosterone. A scientist wants to model how quickly the testosterone leaves the athlete's body. She models the level of testosterone in the blood stream using an exponential model

$$C = C_0 \times 0.5^{0.25t}$$

where

- C is the concentration of testosterone in nanograms per millilitre (ng/ml)
- C_0 is the initial concentration in ng/ml
- t is the time in days after the testosterone is taken.

Immediately after taking testosterone, an athlete's testosterone level is 60 ng/ml so $C_0 = 60$.

The scientist uses a spreadsheet to model the concentration at the beginning of each day. It is shown below.

(i) Fill in the remaining values in the spreadsheet below. [2]

(ii) What is the formula in cell B3? [3]

7(i)			
		A	B
	1	t	C
	2	0	60
	3	1	50.45
	4	2	42.43
	5	3	35.68
	6	4	
	7	5	
	8	6	
	9	7	
	10	8	15.00
7(ii)			

(iii) According to the model, what is the half life of testosterone in the blood stream? [1]

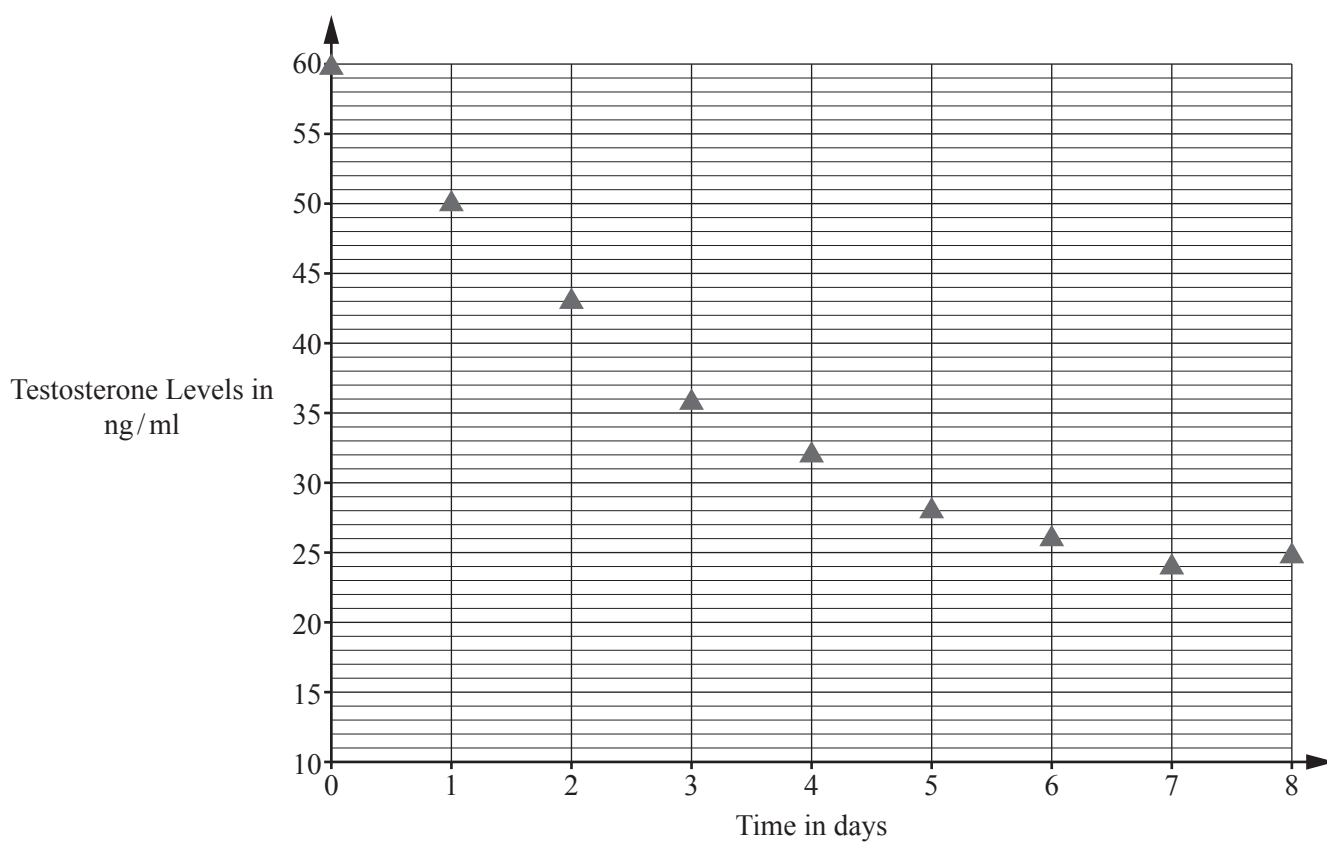
7(iii)			

- (iv) A test for testosterone records a positive result if the level is above 20 ng/ml. According to the model, on what day after taking the testosterone will this test first give a negative result? [2]

7 (iv)	

The scientist decides to check her model by doing an experiment. The data from her experiment are shown on the graph below.

- (v) Plot the predictions from the model on the graph below. [2]

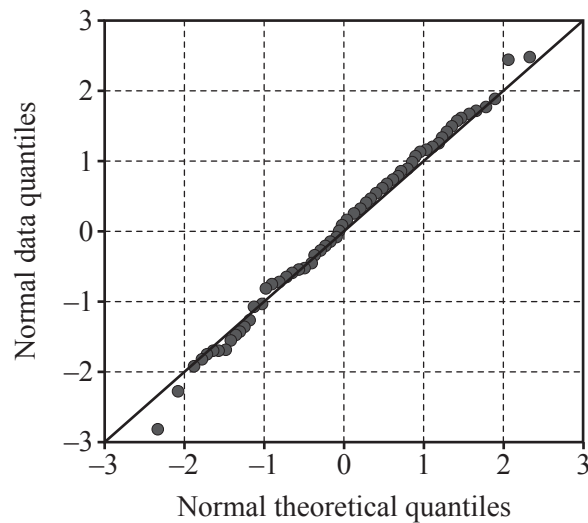


- (vi) Comment on the appropriateness of the model. [1]

7 (vi)	

- 8 A survey of 7 to 12 year old Malaysian girls showed that their mean hip circumference is 59.0 cm with standard deviation 9.9 cm.

A Normal probability plot of a sample of 200 girls in this age range is shown below.



- (i) State what feature of this probability plot suggests that the Normal distribution is an appropriate model for the data. [1]

8(i)	

A company wants to make skirts for Malaysian girls in this age range. It wants to create products that will fit 95% of these girls.

- (ii) Find the smallest and largest hip circumferences which the company needs to consider when designing skirts. [3]

8(ii)	

The company creates large numbers of skirts that will fit girls with hip circumferences within this range.

(iii) Two girls in the age range 7 to 12 want to buy a skirt.

(A) What is the probability that both girls will find a skirt that fits them? **[3]**

(B) State one assumption required for your calculation in part **(iii)(A)**. **[1]**

8 (iii)(A)	
(B)	

(iv) One girl in this age range wants to buy two skirts. What is the probability that she will find two skirts that fit? **[1]**

8 (iv)	

(v) The company decides to produce 10 discrete sizes of skirt. Explain why they should not produce the same number of each size. **[1]**

8 (v)	

END OF QUESTION PAPER

This image shows a blank sheet of white paper designed for writing. It features a series of evenly spaced horizontal blue lines across its entire width. A single vertical red line runs down the left side, creating a narrow margin. The paper is otherwise completely empty, with no text or markings.

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