RECOGNISING ACHIEVEMENT

**Oxford Cambridge and RSA Examinations**

**Advanced Subsidiary General Certificate of Education**
**Advanced General Certificate of Education**

# MEI STRUCTURED MATHEMATICS
CONCEPTS FOR ADVANCED MATHEMATICS, C2

**4752**

**Specimen Paper**

Additional materials: Answer booklet
Graph paper
MEI Examination Formulae and Tables (MF 2)

**TIME** 1 hour 30 minutes

## INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and candidate number in the spaces provided on the answer booklet.
- Answer **all** the questions.
- You **may** use a graphical or scientific calculator in this paper.

## INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- 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.
- Final answers should be given to a degree of accuracy appropriate to the context.
- The total number of marks for this paper is **72**.

## Section A (36 marks)

**1** Find the values of $x$ for which $\sin x = 2\cos x$ given that $0° < x < 360°$. **[3]**

**2** A sector of a circle has radius 15 cm and angle 0.6 radians.
Find the perimeter and area of the sector. **[4]**

**3** Given that $y = 6x^2 + \sqrt{x} - 17$, find $\frac{dy}{dx}$. **[4]**

**4** The first two terms of a geometric sequence are 6144, 1536.

**(i)** Find the exact value of the $10^{th}$ term. **[2]**

**(ii)** Find the sum of the first ten terms, giving your answer to 4 decimal places. **[2]**

**(iii)** Find the sum to infinity of the sequence. **[1]**

**5** Some values of the function $f(x) = \frac{1}{1+x^2}$ are given in the table below.

The figures are rounded to 5 decimal places.

| $x$ | 0.0 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 |
|---|---|---|---|---|---|---|
| $f(x)$ | | 0.96154 | 0.86207 | | 0.60976 | |

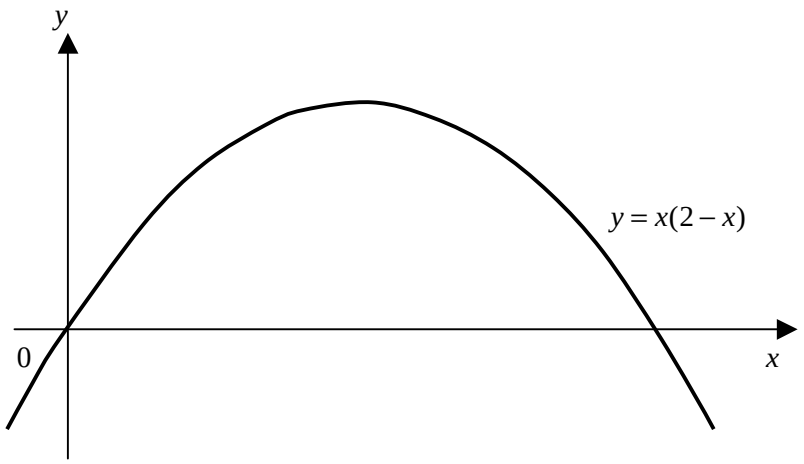
**(i)** Find the values of $f(x)$ missing from the table. **[1]**

**(ii)** Use the trapezium rule with 5 strips to estimate the value of: $\int_0^1 \frac{1}{1+x^2}\,dx$. **[4]**

**6** The gradient of a curve is given by: $\frac{dy}{dx} = 6x^2 - \frac{5}{x^2}$.

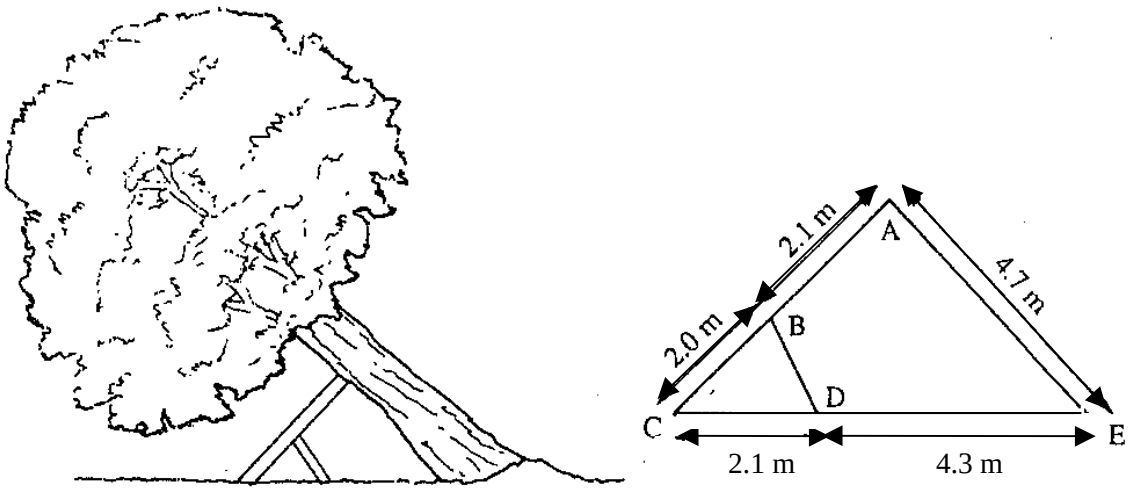
The curve passes through the point (-1, 3).
Find the equation of the curve. **[5]**

**7**




The graph shows the curve with equation $y = x(2-x)$.
Find the area of the region enclosed between the curve and the $x$-axis. **[5]**

**8**

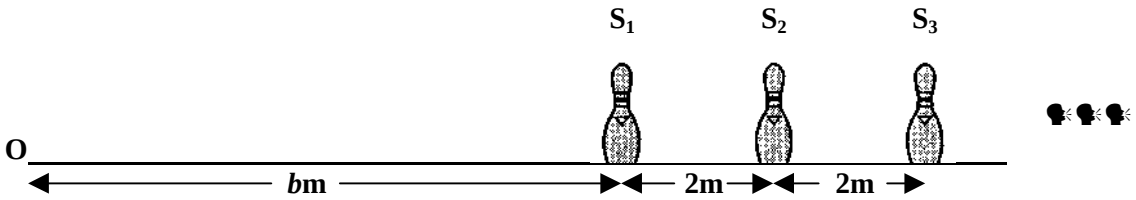



In the gales last year, a tree started to lean and needed to be supported by struts that were wedged as shown above. There is also a simplified diagram giving dimensions.
Calculate the angle the tree makes with the vertical, giving your answer to the nearest degree. **[5]**

## Section B (36 marks)

**9** In a race, skittles $S_1$, $S_2$, $S_3$, …are placed in a line, spaced 2 metres apart.

Contestants run from the starting point O, $b$ metres from the first skittle. They pick up the skittles, one at a time and in order, returning them to O each time.




**(i)** Show that the total distance of a race with 3 skittles is $6(b+2)$ metres. **[1]**

**(ii)** Show that the total distance of a race with $n$ skittles is $2n(b+n-1)$ metres. **[4]**

**(iii)** With $b=5$, the total distance is 570 metres. Find the number of skittles in this race. **[3]**

A football coach uses this race for training the team. The total distance for each contestant is exactly 1000 metres. The skittles are still 2 metres apart and the value of $b$ is a whole number less than 20.

**(iv)** How many skittles are there in this form of the race? **[3]**

**10** A virus is spreading through a population and so a vaccination programme is introduced.

Thereafter, the numbers of new cases are as follows:

| **Week number, *x*** | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **Number of new cases, *y*** | 240 | 150 | 95 | 58 | 38 |

The number of new cases, $y$, in week $x$ is to be modelled by an equation of the form $y = pq^x$, where $p$ and $q$ are constants.

**(i)** Copy and complete this table of values.

| $x$ | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| $\log_{10} y$ | | | | | |

**[1]**

**(ii)** Plot a graph of $\log_{10} y$ against $x$, taking values of $x$ from 0 to 8. **[2]**

**(iii)** Explain why the graph confirms that the model is appropriate. **[2]**

**(iv)** Use the graph to predict the week in which the number of new cases will fall below 20.
Explain why you should treat your answer with caution. **[3]**

**(v)** Estimate the values of $p$ and $q$.
Use your values of $p$ and $q$, and the equation $y = pq^x$, to calculate the value of $y$ when $x = 3$.
Comment on your answer. **[5]**

**11** The equation of a curve is given by $y = x^4 - 8x^2 + 7$.

**(i)** Use calculus to show that the function has a turning point at (2, -9) and find the coordinates of the other turning points. **[7]**

**(ii)** Sketch the curve. **[2]**

**(iii)** Show that the line $y = -12x + 12$ is a tangent to the curve at one of the points where it crosses the $x$-axis. **[3]**