OCR
Oxford Cambridge and RSA

F

Thursday 25 May 2017 – Morning

GCSE APPLICATIONS OF MATHEMATICS

A381/01   Applications of Mathematics 1 (Foundation Tier)

Candidate forename		Candidate surname	

Centre number					Candidate number				

INSTRUCTIONS TO CANDIDATES

• Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
• Use black ink. HB pencil may be used for graphs and diagrams only.
• Answer **all** the questions.
• Read each question carefully. Make sure you know what you have to do before starting your answer.
• Your answers should be supported with appropriate working. Marks may be given for a correct method even if the answer is incorrect.
• Write your answer to each question in the space provided. If additional space is required, you should 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.

INFORMATION FOR CANDIDATES

• The number of marks is given in brackets **[ ]** at the end of each question or part question.
• Your quality of written communication is assessed in questions marked with an asterisk (*****).
• The total number of marks for this paper is **60**.
• This document consists of **20** pages. Any blank pages are indicated.

You are permitted to use a calculator for this paper

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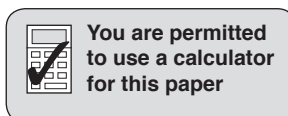
Formulae Sheet: Foundation Tier

Area of trapezium $= \frac{1}{2}(a + b)h$
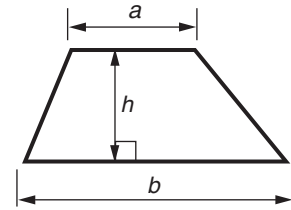
Volume of prism = (area of cross-section) × length
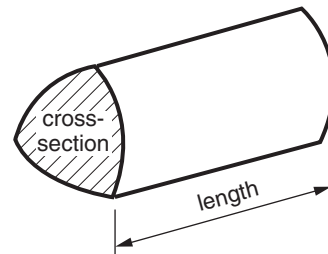
PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

1 Handmade carpets are made by knotting silk or wool.

(a) The oldest carpet known is 2500 years old.

It was rectangular when new.
It measured 283 cm by 200 cm.

There are 36 knots in every square centimetre of the carpet.
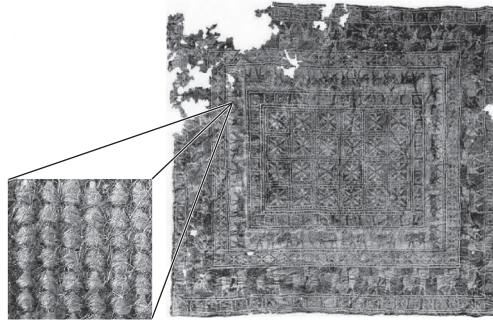
(i) How many knots were there in the carpet altogether?

(a)(i) .... **[3]**

(ii) A skilled carpet maker can make 6000 knots in a day.
Use your answer to **part (i)** to calculate how many days it might have taken to make the carpet above.

(ii) .... days **[2]**

Turn over

(b) Carpet makers in Iran use the RAJ number to measure carpet quality.

The RAJ number is the number of knots in a 7 cm long straight line.

(i) This is part of a carpet.
What is the RAJ number of this carpet?
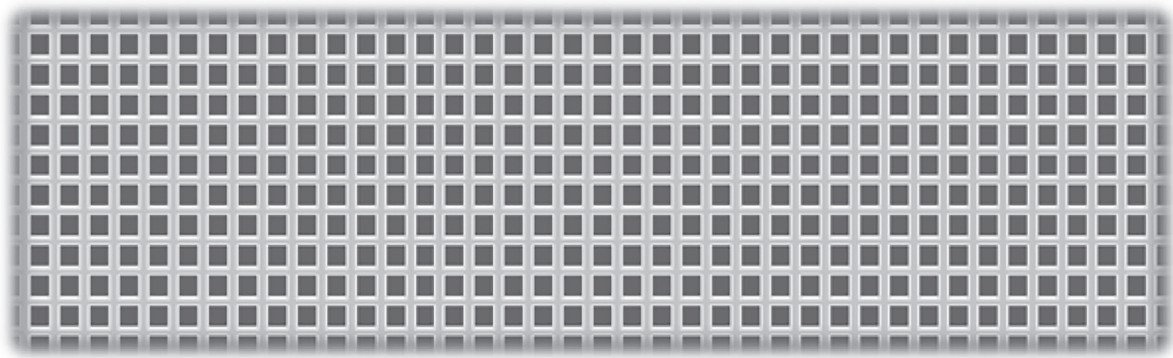
(b)(i) .... **[1]**

(ii) This calculation changes RAJ numbering into knots per square centimetre.

$$0.131 \times (19^2)$$

Complete the calculation.
Do not round your answer.

(ii) .... knots per square centimetre **[2]**

(iii) Write your answer to **part (ii)** to the nearest whole number.

(iii) .... knots per square centimetre **[1]**

Various designs are used in Persian and Oriental carpets.

(c) Tick the designs that have reflection symmetry.

....

....

[2]

Turn over
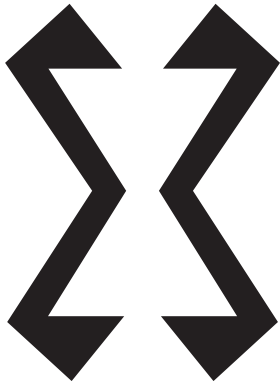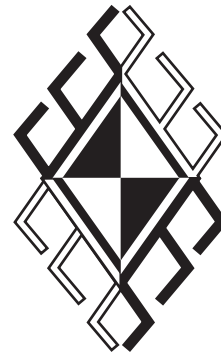
Designs may be planned on a grid.
The squares are labelled like points on a coordinate grid.

(d) This design has black squares positioned at (2, 2) and (6, 8).
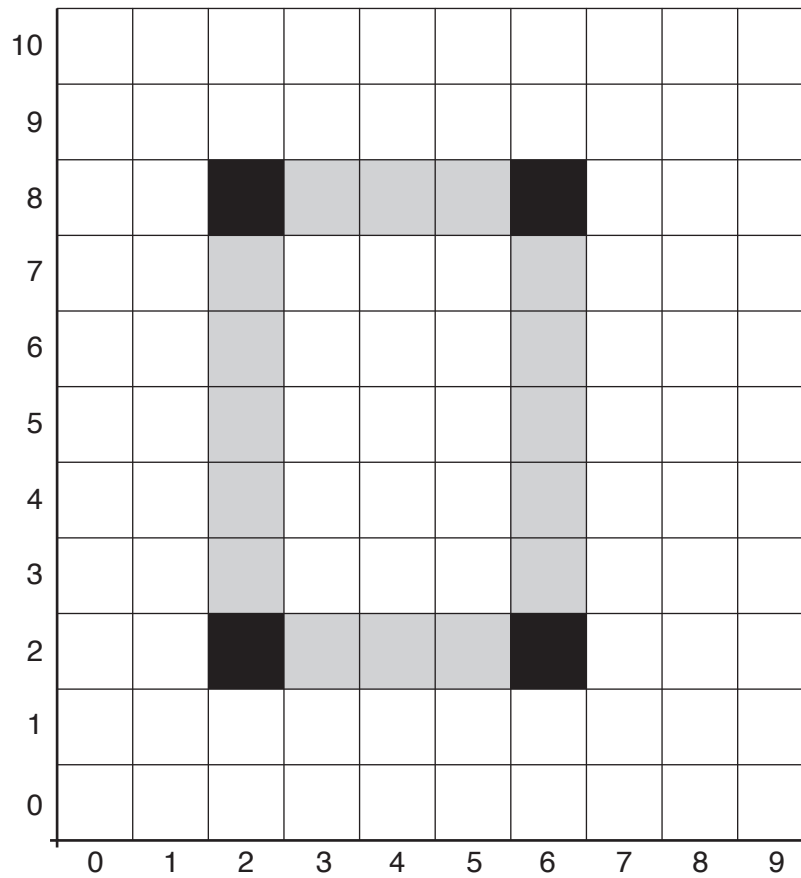
(i) What are the positions of the other two black squares?

(d)(i) (............. , ...) and (............. , ...) **[1]**

(ii) Shade **one** small square so that the design still has rotation symmetry. **[1]**

(e) This is part of a different design.
What is the position of the next black square in the pattern after (5, 5)?

(e) (............. , ...) **[1]**

Turn over
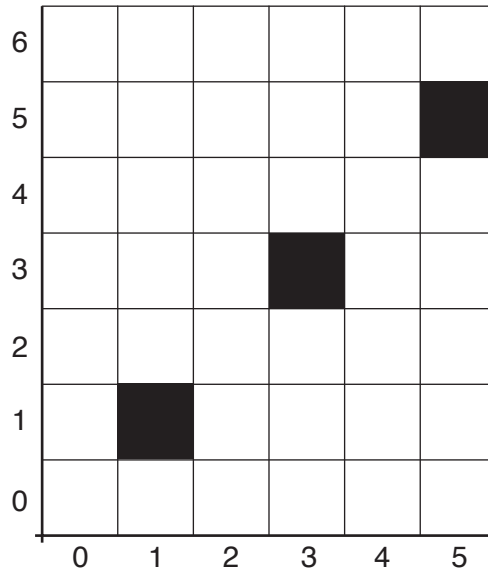
(f) Many Persian carpets have the date when they were made shown on the carpet.
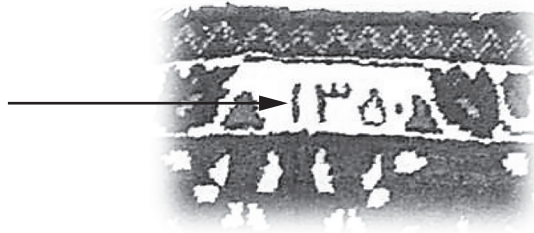
These dates use the Islamic year (AH).

This number machine changes an Islamic year (AH) into a modern European year (AD).

Islamic year (AH) → ×0.970229 → +621.5643 → Modern European year (AD)
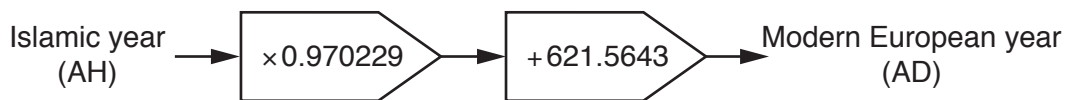
The modern European year (AD) is the whole number part of the final answer.

Jan is at a car boot sale in September 2016.
She sees what she thinks might be an old Persian carpet.
It has the date, in Arabic on it. She thinks it is 1391 AH.

Use the number machine to work out how old the carpet is.
Show your working.

(f) .... years old **[3]**

2

(a) The Mach number is used to show how fast a plane is travelling.
Concorde was the first supersonic passenger plane.

(i) What Mach number is displayed on this photo?

(a)(i) .... **[1]**

(ii) The Mach number is the speed of the plane divided by the speed of sound.

Concorde's highest speed was 2443 kilometres per hour.
The speed of sound is 1062 kilometres per hour correct to the nearest whole number.

Work out the Mach number for Concorde's highest speed.

(ii) .... **[1]**

Turn over

(b) The speed of sound in air depends on the air temperature.
At an air temperature of $T°C$ the speed of sound, S kilometres per hour, is given by:

$$S = 72.2\sqrt{T + 273}.$$

(i) What is the speed of sound when the air temperature is 20 °C?
Give your answer correct to 1 decimal place.

(b)(i) .... kilometres per hour **[3]**

(ii) This formula shows approximately how S depends on T.

$$S = 1193 + 2.2T$$

Find the difference in speed of sound at 20 °C using this formula and the formula you used in **part (i)**.

(ii) ....kilometres per hour **[3]**

(c) The front of a Concorde could be dropped down.
This was to help the pilot landing and taking off.

Use the two photos below to find how many degrees the front of a Concorde dropped down.
You will need to draw some lines – don't rub these out!

Before the front dropped.

After the front dropped.
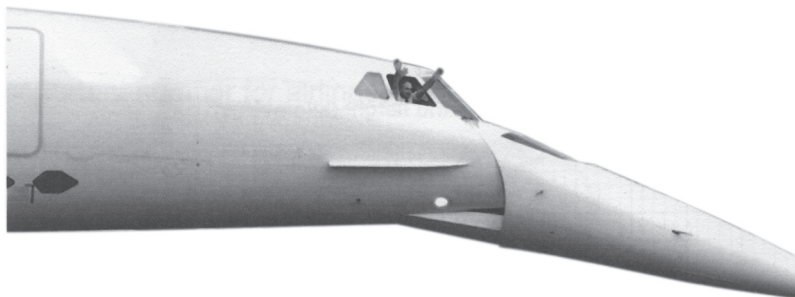
(c) .... ° **[2]**

(d) This is a photo of the cabin of a Concorde.

Estimate the real width of the cabin.
Remember to state the units of your answer.

(d) .... **[2]**

(e) This is a photo taken in the passenger cabin during a Concorde flight.
It shows the height in feet, the outside temperature in °C and the speed
in miles per hour (mph).

Item removed due to third party copyright restrictions.
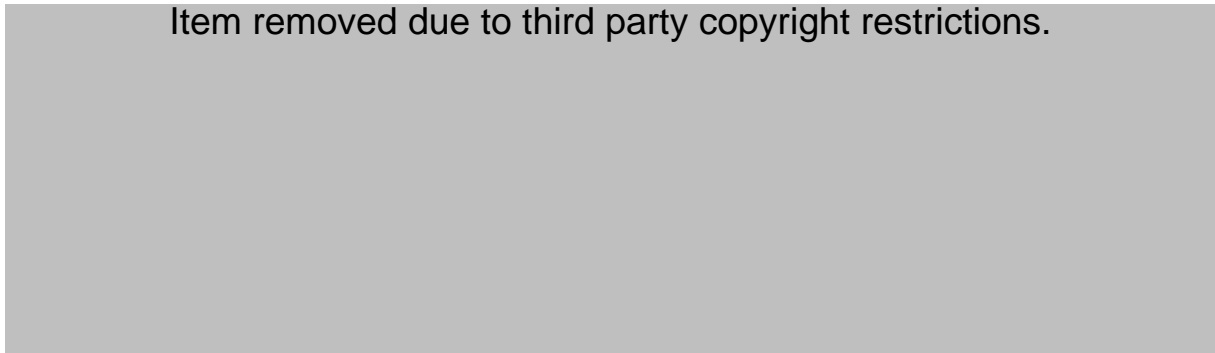
(i) Use this conversion graph to find how high, in kilometres, the plane is flying.
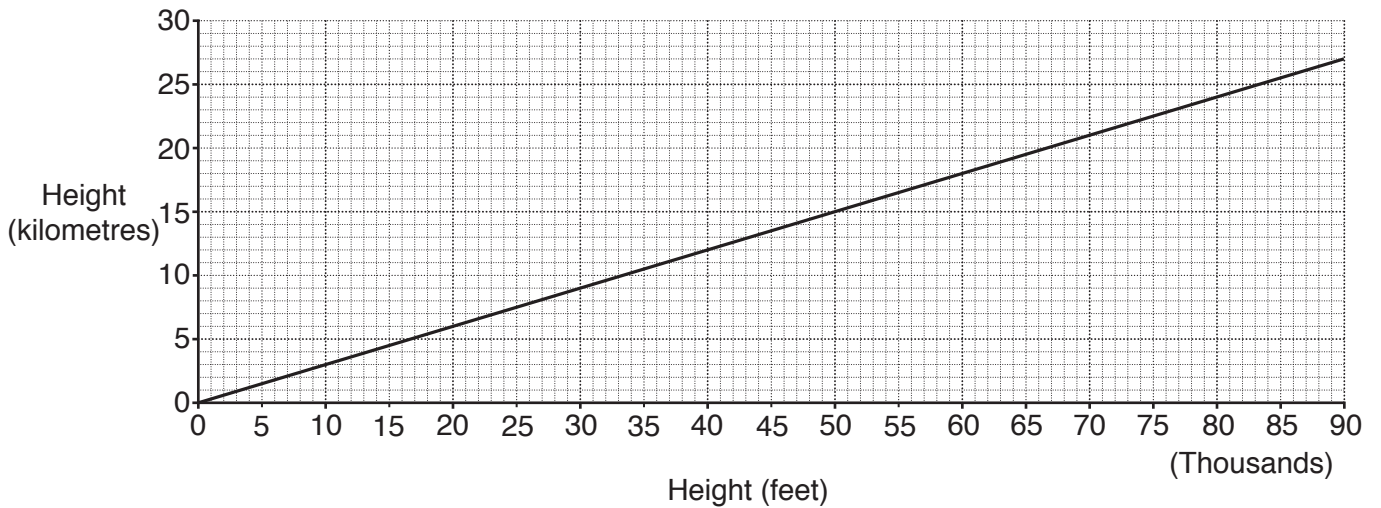
(e)(i) .... kilometres **[1]**

(ii) The temperature inside the passenger cabin is 20 °C.

Write down the calculation and the answer for the difference in temperature between the
passenger cabin and the outside temperature.

(ii) .... = ...°C **[2]**

(f) Concorde passenger flights began in 1976. They continued for the next 27 years.

In what year was Concorde's last passenger flight?

(f) .... **[1]**

(g) Each Concorde cost about £100 000 000.
Write this number as a **power** of ten.

(g) 100 000 000 is the same as 10··············· **[1]**

(h) The **load factor** is the percentage of passenger seats which are sold.
A **load factor** of 80 means that 80% of the seats are sold.

(i) Concordes had seats for 100 passengers.
There were 60 passengers on a particular flight.

What was the load factor for this flight?

(h)(i) .... **[1]**

(ii) What is the load factor for a flight that has $\frac{3}{4}$ of its seats sold?

(ii) .... **[1]**

Turn over

Concordes made a total of 50 000 passenger flights.
Each of these had 100 passenger seats.
In total 2 500 000 seats on Concordes were sold.

(i)* A load factor of at least 55 was needed for Concorde to make a profit.
Use the figures above to decide whether or not Concorde made a profit.

Show your reasons and working clearly.

....

....

....

....

.... **[4]**

(j) Some friends are talking about the CO_2 pollution of Concorde compared with a Boeing 707.

They gathered this information from the internet.

	Cruising speed (km per hour)	Fuel consumption (litres per hour)	Fuel capacity (litres)	Passengers	CO_2 produced (per litre of fuel)	Time to fly London to New York (hours)
Boeing 707	890	8000	111000	189	2.6 kg	6.5 hours
Concorde	2167	14000	120000	100	2.5 kg	3 hours

A tonne is 1000 kg.

(i) Erik says.

> Concorde was a lot dirtier, it produced $14\,000 \times 2.6 = 35\,000$ kg or 35 tonnes of CO_2 an hour.

> The same figure for a Boeing 707 was only 20.8 tonnes.
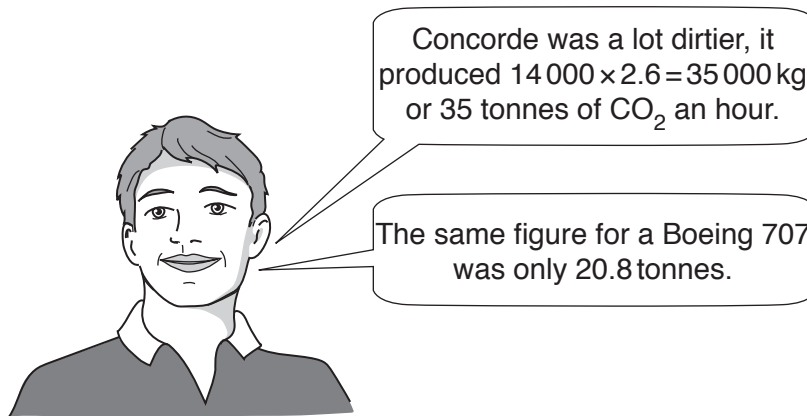
Check Erik's working. Correct any errors.

....

....

....

.... **[2]**

Turn over

(ii) Evie says

You're not being fair.
Yes, Concorde uses more than 1.5 times as much fuel an hour, but it takes less than half the time to fly to New York.

Check Evie's working and if there are any errors correct them.

....

....

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.... **[2]**

(iii) Use the figures to make a fairer comparison of CO_2 pollution between the Boeing 707 and Concorde.

....

....

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.... **[4]**

(k)* There may be passenger planes which fly at Mach 5 in 30 years time.

PAPER NEWS

www.dailynews.com   **THE WAY NEWS USED TO BE**   - Since 2040

London to Sydney
in Under $3\frac{1}{4}$ Hours
Item removed due to third party copyright restrictions.   at MACH 5!!!!

It is 16 983 kilometres from London to Sydney.
Decide whether this headline is an exaggeration.

Remember: Mach number = $\dfrac{\text{Plane's speed}}{\text{Speed of sound}}$.

Take the speed of sound to be 1062 kilometres per hour.
You must justify your answer fully.

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.... **[4]**

New designs of planes are tested by using a model in a wind tunnel.

These models are mathematically similar to the real plane.

(I) Here are sketches of a real plane and its model.
(The plane is symmetrical.)

Not to scale

Real plane

Model plane

Find the sizes of lengths *a* and *c* and angle *b*.

(I) *a* = ... m **[1]**

b = ... ° **[1]**

c = ... m **[1]**

(m) Here is another design.
Remember the plane is symmetrical, so the dotted line is a line of symmetry.

Not to scale

35°

r

105°

s

t
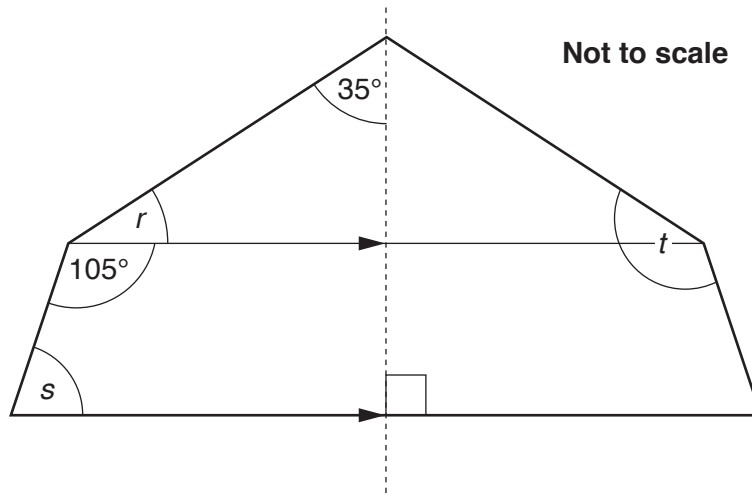
Work out the sizes of the angles marked with letters.

(m) $r =$ .... °

$s =$ .... °

$t =$ .... ° **[3]**

(n) The shaded section is a rectangle in this design.

Not to scale

g

e

f
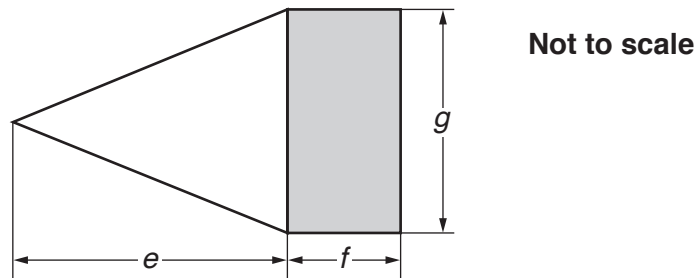
Find an expression in terms of *e*, *f* and *g* for the area of this design.

(n) .... **[2]**

END OF QUESTION PAPER

20

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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