MINISTRY OF EDUCATION, SINGAPORE
in collaboration with
UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE
General Certificate of Education Ordinary Level

MATHEMATICS

4048/02

Paper 2

October/November 2018

2 hours 30 minutes

READ THESE INSTRUCTIONS FIRST

An answer booklet and a graph paper booklet will be provided with this question paper. You should follow the instructions on the front cover of both booklets. If you need additional answer paper or graph paper ask the invigilator for a continuation booklet or graph paper booklet.

Answer **all** questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 100.

This document consists of **10** printed pages and **2** blank pages.

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1 (a) Write as a single fraction in its simplest form

(i) $\frac{5t^2}{v} \div \frac{25t}{v^3}$, [1]

(ii) $\frac{4}{3-2y} - \frac{5}{y+3}$. [2]

(b) Simplify $\frac{16x^2-9}{4x^2-9x-9}$. [3]

(c) Solve the equation $\frac{20}{x+1} = 2x+5$. [3]

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2 (a) In 2016, Ken earned a total of $44 000.
In 2017, he earned $3900 each month.

Calculate the percentage increase in his earnings from 2016 to 2017. [2]

(b) A bank offers a savings account with a rate of compound interest of 2.35% per year.
Ken invests $6500 in this account.
He leaves the money in the account for 6 years.

Calculate the total amount of interest he has earned after 6 years.
Give your answer correct to the nearest cent. [3]

(c) The exchange rate between Singapore dollars ($) and euros (€) is $1 = €0.66.
The exchange rate between pounds (£) and Singapore dollars is £1 = $1.97.

Ken is planning a trip to Europe.
He finds these hotel prices on a website.

London Hotel £145 per night
Paris Hotel €145 per night

(i) By comparing the exchange rates, explain how you can tell that the hotel in London costs more per night than the hotel in Paris. [1]

(ii) Ken books 3 nights in the hotel in London and 4 nights in the hotel in Paris.
He pays using his credit card.
The credit card company converts the prices to Singapore dollars.
Ken is charged a fee of 1.8% for the currency conversion.

Calculate the total amount Ken pays for the two hotels, including the credit card fee.
Give your answer correct to the nearest dollar. [4]

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3 A bakery makes fruit pies.
The bakery operates for 7 days a week.
The matrix, **M**, shows the number of pies of different types that are made each day.

$$\mathbf{M} = \begin{matrix} \\ \text{Apple} \\ \text{Cherry} \end{matrix} \begin{matrix} \begin{matrix} \text{Small} & \text{Medium} & \text{Large} \end{matrix} \\ \begin{pmatrix} 70 & 40 & 30 \\ 50 & 30 & 30 \end{pmatrix} \end{matrix}$$

(a) Evaluate the matrix $\mathbf{P} = 7\mathbf{M}$. [1]

(b) Small pies cost \$0.75 each to make.
Medium pies cost \$1.50 each to make.
Large pies cost \$2.25 each to make.

Represent these amounts in a 3×1 column matrix **N**. [1]

(c) Evaluate the matrix $\mathbf{T} = \mathbf{PN}$. [2]

(d) State what each of the elements of **T** represents. [1]

(e) The bakery sells each pie for 40% more than it costs to make.
One week they sold $\frac{6}{7}$ of each size of the apple pies and $\frac{4}{5}$ of each size of the cherry pies made that week.
The unsold pies were given away.

Calculate the total amount of profit the bakery made that week. [4]

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4 **(a)** These are the first four terms in a sequence.

11 17 23 29

(i) Find an expression, in terms of n, for the nth term of the sequence. [2]

(ii) Explain why it is not possible for a term in the sequence to be a multiple of 3. [1]

(b) The nth term of a different sequence is given by $T_n = \frac{4n-1}{205-5n}$.

(i) Use the formula to find T_5.
Give your answer as a fraction. [1]

(ii) The value of T_k can be simplified to $\frac{7}{32}$.

Find the value of k. [3]

(iii) Find the least value of n for which $T_n > 1$. [3]

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5 $ABCD$ is a parallelogram.

$\overrightarrow{AB} = \begin{pmatrix} 6 \\ 2 \end{pmatrix}$ and $\overrightarrow{BC} = \begin{pmatrix} 4 \\ -3 \end{pmatrix}$.

The coordinates of vertex C are $(3, -1)$.

(a) Find the position vector of vertex B. [1]

(b) Find the coordinates of vertex A and vertex D. [2]

(c) Calculate angle BAD. [3]

(d) Calculate the length of diagonal BD. [3]

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6 An empty water tank has a capacity of 3500 litres.

Pump A can fill the tank at a rate of x litres per minute.
Pump B can fill the tank at a rate of $(x - 10)$ litres per minute.

(a) Write down an expression, in terms of x, for the number of minutes it would take to fill the tank using pump A. [1]

(b) Write down an expression, in terms of x, for the number of minutes it would take to fill the tank using pump B. [1]

(c) It takes 21 minutes longer to fill the tank using pump B than it does using pump A.

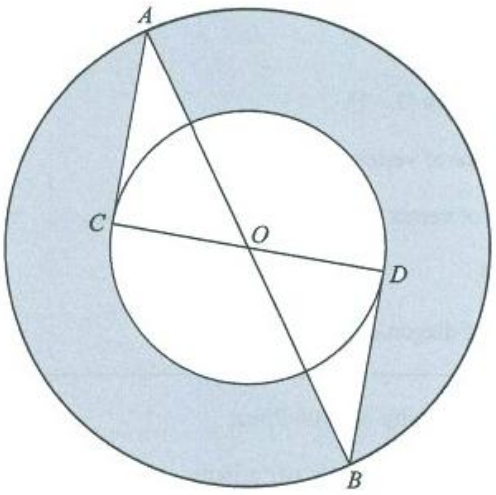
Write down an equation to represent this information and show that it reduces to

$$3x^2 - 30x - 5000 = 0 .$$ [3]

(d) Solve the equation $3x^2 - 30x - 5000 = 0$, giving your solutions correct to two decimal places. [4]

(e) Calculate how long it would take to fill the tank from empty using pump A and pump B together. Give your answer in minutes and seconds, correct to the nearest ten seconds. [2]

7



AB is a diameter of the large circle, centre O.
CD is a diameter of the small circle, centre O.
AC and BD are tangents to the small circle.

(a) Show that triangle OAC is congruent to triangle OBD.
Give a reason for each statement you make. [3]

(b) The radius of the large circle is 7 cm and $O\hat{A}C = 30°$.

(i) Calculate the area of triangle OAC. [3]

(ii) Calculate the shaded area. [3]

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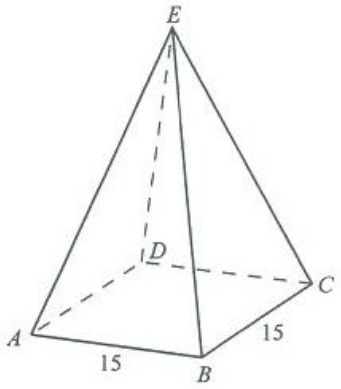
8



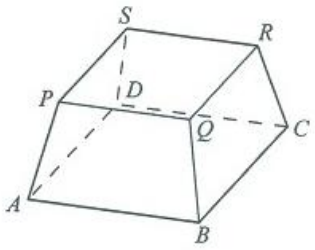
The diagram shows a pyramid $ABCDE$.
The base of the pyramid is a square of side 15 cm.
E is vertically above the centre of the square base.
The vertical height of the pyramid is 20 cm.

(a) Show that $AE = 22.6$ cm, correct to three significant figures. [3]

(b) Calculate angle BAE. [3]

(c) Calculate the total surface area of the pyramid. [3]

(d) A smaller, similar pyramid is removed from the top of the original pyramid.
The diagram below shows the solid remaining.

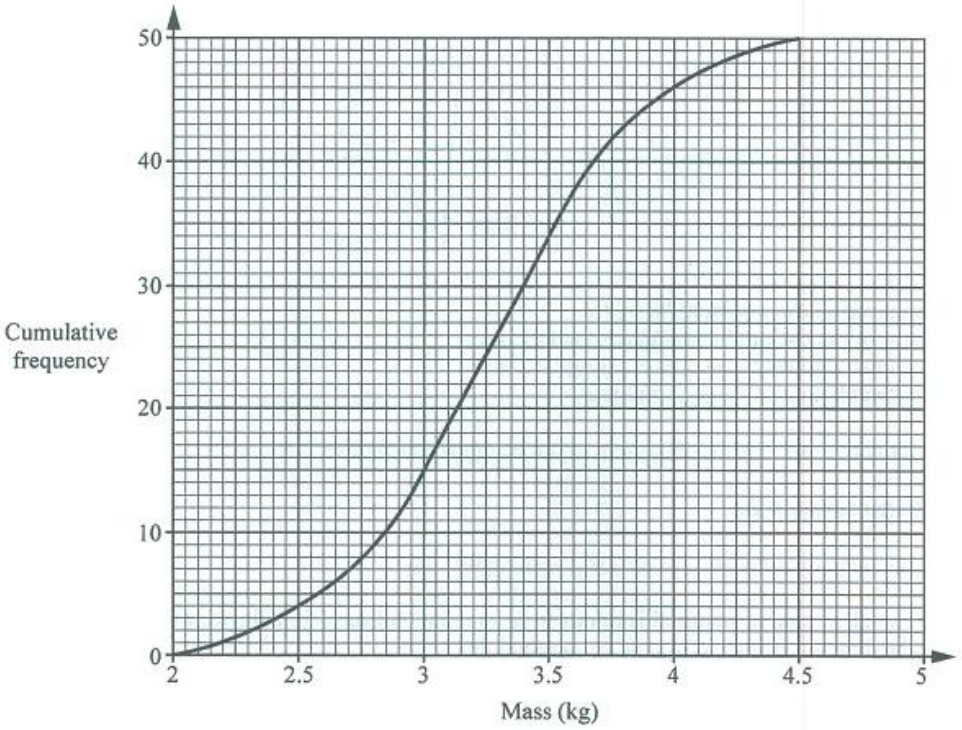


The vertical height of the solid remaining is 4 cm.

Calculate the area of the top, $PQRS$, of the remaining solid. [2]

9 Jiao is researching maternity care in a hospital.
She searches the internet to find some information.

(a) She finds information about the masses of 50 newborn babies born in the hospital.
The cumulative frequency curve shows the distribution of the masses.



(i) **Copy** and complete the grouped frequency table for the masses of the babies.

Mass (m kg)	$2.0 \leqslant m < 2.5$	$2.5 \leqslant m < 3.0$	$3.0 \leqslant m < 3.5$	$3.5 \leqslant m < 4.0$	$4.0 \leqslant m < 4.5$
Frequency	4	11			

[1]

(ii) Calculate an estimate of the mean mass of each baby. [1]

(iii) Calculate an estimate of the standard deviation. [1]

(iv) Explain why the mean and standard deviation are estimates. [1]

(v) A newspaper article states that 90% of newborn babies have a mass greater than 2.8 kg.

Comment on whether the data from the hospital supports this claim. [2]

(b) This table gives information about the ages of the mothers of the babies born in the hospital on one day and the sexes of their babies.
Each of the mothers gave birth to only one baby.

	Mother aged under 30	Mother aged 30 or over
Boy	3	9
Girl	7	6

(i) One of these mothers is selected at random.

Find, as a fraction in its lowest terms, the probability that she is under 30. [1]

(ii) Two of the mothers are selected at random.

Find the probability that

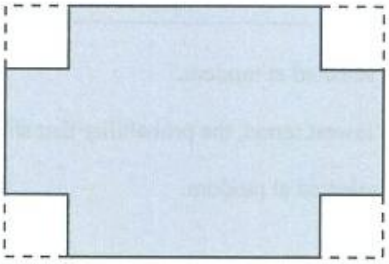
(a) they both have a baby girl, [2]

(b) they are both aged 30 or over, but only one has a baby boy. [2]

10 Answer the whole of this question in the graph paper booklet.

Huan runs a business selling sweets.
She is designing a container to hold the sweets.

She uses rectangular pieces of cardboard measuring 20 cm by 30 cm.
The mass of 1 square metre of the cardboard is 210 grams.



She cuts a square from each corner of a piece of cardboard.
She then folds the cardboard to make an open box.

By changing the size of the square she cuts out, Huan can change the volume of the box.

(a) Work out the mass of the box made when she cuts a square of side 5 cm from each corner. [2]

(b) Huan cuts a square of side x from each corner of the cardboard.

(i) Explain why the volume of the box she makes is given by $x(20-2x)(30-2x)$. [1]

(ii) Explain why $0 < x < 10$. [1]

(c) Huan wants to make a box with a volume of at least 900 cm^3.
She wants the mass of the box to be as small as possible.

By drawing a suitable graph, work out the mass of the box she will make. [7]