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MATHEMATICS (US)

0444/43

Paper 4 (Extended)

October/November 2020

2 hours 30 minutes

You must answer on the question paper.

You will need: Geometrical instruments

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, center number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a calculator where appropriate.
- You may use tracing paper.
- You must show all necessary work clearly.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.
- For π , use either your calculator value or 3.142.

INFORMATION

- The total mark for this paper is 130.
- The number of marks for each question or part question is shown in parentheses [].

This document has **20** pages. Blank pages are indicated.

Formula List

For the equation $ax^2 + bx + c = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Lateral surface area, A , of cylinder of radius r , height h . $A = 2\pi rh$

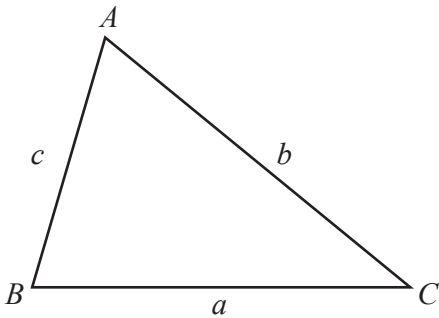
Lateral surface area, A , of cone of radius r , sloping edge l . $A = \pi rl$

Surface area, A , of sphere of radius r . $A = 4\pi r^2$

Volume, V , of pyramid, base area A , height h . $V = \frac{1}{3}Ah$

Volume, V , of cone of radius r , height h . $V = \frac{1}{3}\pi r^2 h$

Volume, V , of sphere of radius r . $V = \frac{4}{3}\pi r^3$

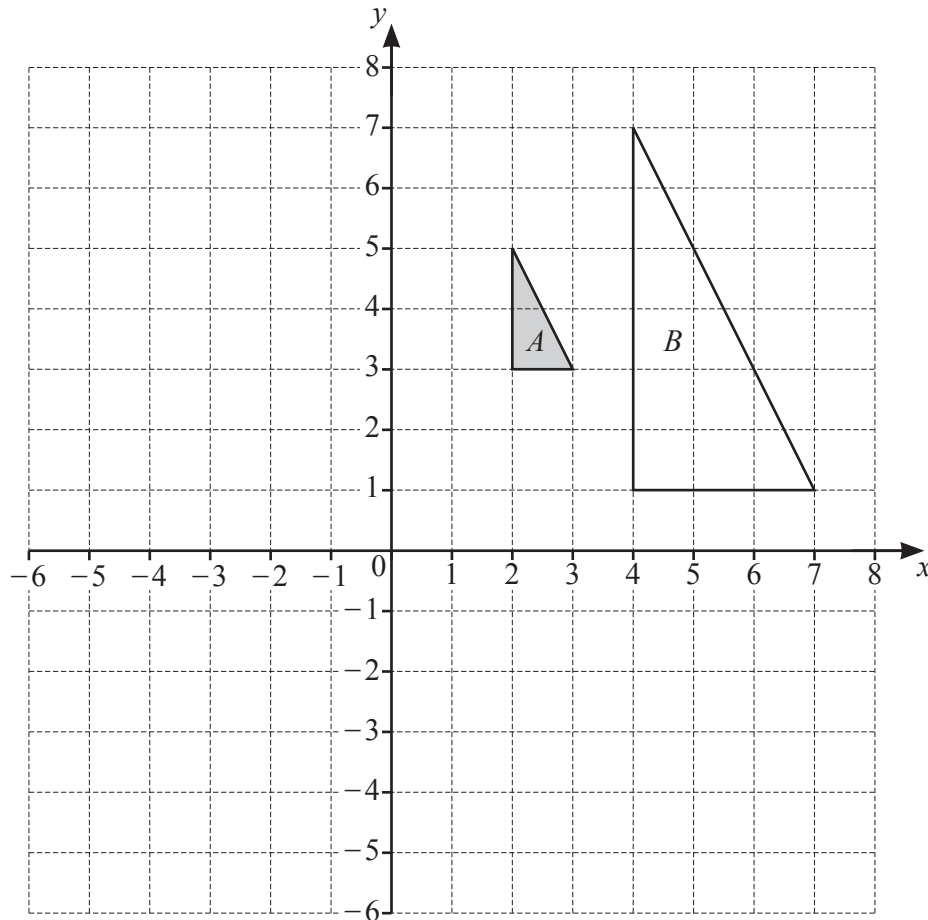


$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\text{Area} = \frac{1}{2}bc \sin A$$

1



(a) On the grid, draw the image of

(i) triangle A after a rotation of 90° counter-clockwise about $(0, 0)$, [2]

(ii) triangle A after a translation by the vector $\begin{pmatrix} 3 \\ -5 \end{pmatrix}$. [2]

(b) Describe fully the **single** transformation that maps triangle A onto triangle B .

.....

..... [3]

2 (a) The Earth has a surface area of approximately $510\,100\,000\text{ km}^2$.

(i) Write this surface area in scientific notation.

..... km^2 [1]

(ii) Water covers 70.8% of the Earth's surface.

Work out the area of the Earth's surface covered by water.

..... km^2 [2]

(b) The table shows the surface area of some countries and their estimated population in 2017.

Country	Surface area (km^2)	Estimated population in 2017
Brunei	5.77×10^3	433 100
China	9.60×10^6	1 388 000 000
France	6.41×10^5	67 000 000
Maldives	3.00×10^2	374 600

(i) Find the total surface area of Brunei and the Maldives.

..... km^2 [1]

(ii) The ratio surface area of the Maldives : surface area of China can be written in the form $1 : n$.

Find the value of n .

$n =$ [2]

(iii) Find the surface area of France as a percentage of the surface area of China.

..... % [2]

- (iv) Find the population density of the Maldives.
[Population density = population \div surface area]

..... people/km² [2]

- (c) The population of the Earth in 2017 was estimated to be 7.53×10^9 .

The population of the Earth in 2000 was estimated to be 6.02×10^9 .

- (i) Work out the percentage increase in the Earth's estimated population from 2000 to 2017.

..... % [2]

- (ii) Assume that the population of the Earth increased exponentially by $y\%$ each year for these 17 years.

Find the value of y .

$y =$ [3]

3



Morgan picks two of these letters, at random, **without** replacement.

(a) Find the probability that he picks

(i) the letter Y first,

..... [1]

(ii) the letter B then the letter Y,

..... [2]

(iii) two letters that are the same.

..... [3]

(b) Morgan now picks a third letter at random.

Find the probability that

(i) all three letters are the same,

..... [2]

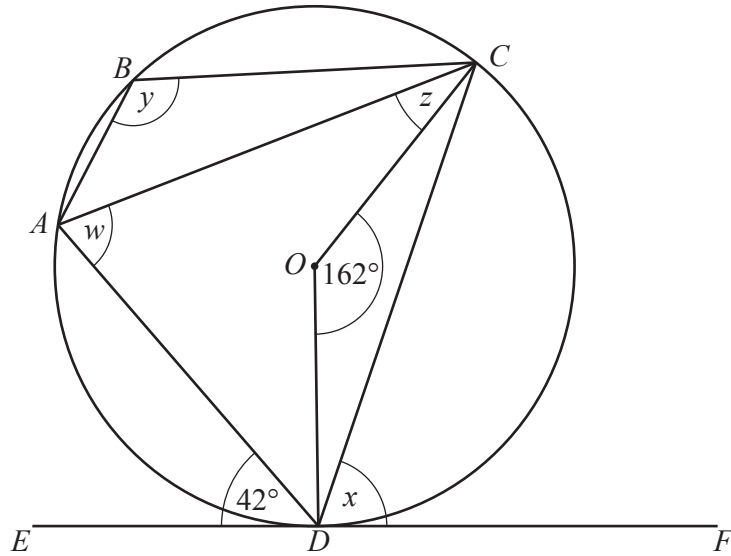
(ii) exactly two of the three letters are the same,

..... [5]

(iii) all three letters are different.

..... [2]

4 (a)

NOT TO
SCALE

A, B, C and D are points on the circle, center O .
 EF is a tangent to the circle at D .
 Angle $ADE = 42^\circ$ and angle $COD = 162^\circ$.

Find the values of $w, x, y,$ and z .

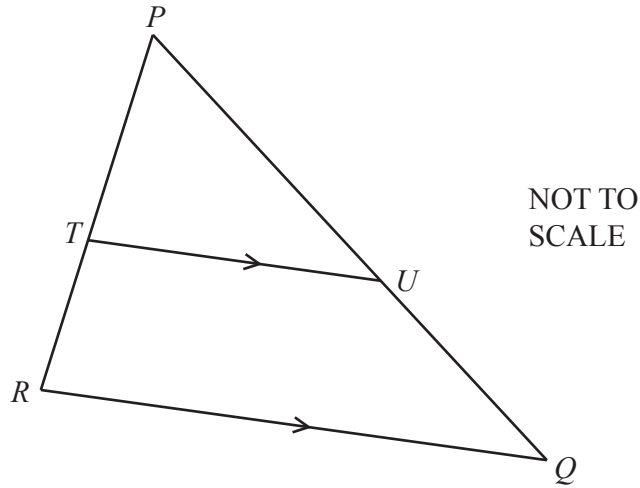
$w = \dots\dots\dots$

$x = \dots\dots\dots$

$y = \dots\dots\dots$

$z = \dots\dots\dots$ [7]

(b)



PQR is a triangle.
 T is a point on PR and U is a point on PQ .
 RQ is parallel to TU .

- (i) Explain why triangle PQR is similar to triangle PUT .
 Give a reason for each statement you make.

.....

 [3]

- (ii) $PT : TR = 4 : 3$

- (a) Find the ratio $PU : PQ$.

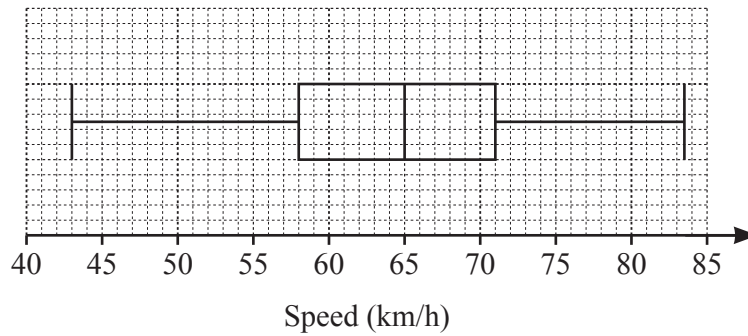
..... : [1]

- (b) The area of triangle PUT is 20 cm^2 .

Find the area of the quadrilateral $QRTU$.

..... cm^2 [3]

- 5 (a) The average speeds, in km/h, of cars traveling along a road are recorded. The box plot shows this information.



Find

- (i) the lowest speed recorded,

..... km/h [1]

- (ii) the median,

..... km/h [1]

- (iii) the interquartile range.

..... km/h [1]

- (b) Another car takes 18 seconds to travel 400 m along this road.

Calculate the average speed of this car in km/h.

..... km/h [3]

- 6 (a) Find the integer values that satisfy the inequality $2 < 2x \leq 10$.

..... [2]

- (b) Factor.

(i) $6y^2 - 15xy$

..... [2]

(ii) $y^2 - 9x^2$

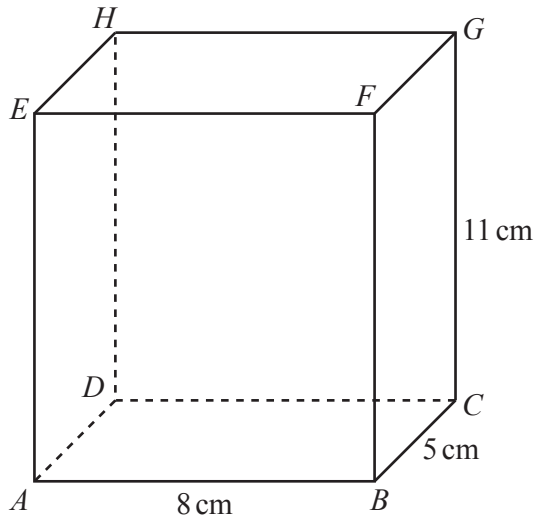
..... [2]

- (c) Simplify.

$$\frac{3}{x-1} - \frac{2}{2x+1}$$

..... [3]

7



NOT TO SCALE

ABCDEFGH is a closed hollow cuboid.
 $AB = 8\text{ cm}$, $BC = 5\text{ cm}$ and $CG = 11\text{ cm}$.

(a) (i) Work out the total surface area of the cuboid.

..... cm^2 [2]

(ii) The cuboid is made from thin metal and 1 cm^2 of this metal has a mass of 0.73 grams.

Work out the mass of the cuboid.

..... g [1]

(b) Ivana has a rod of length 13 cm.

(i) The total mass of this rod and the cuboid is 0.3 kg.

Find the mass of the rod, giving your answer in grams.

..... g [2]

(ii) Show that the rod fits completely inside the cuboid.

[4]

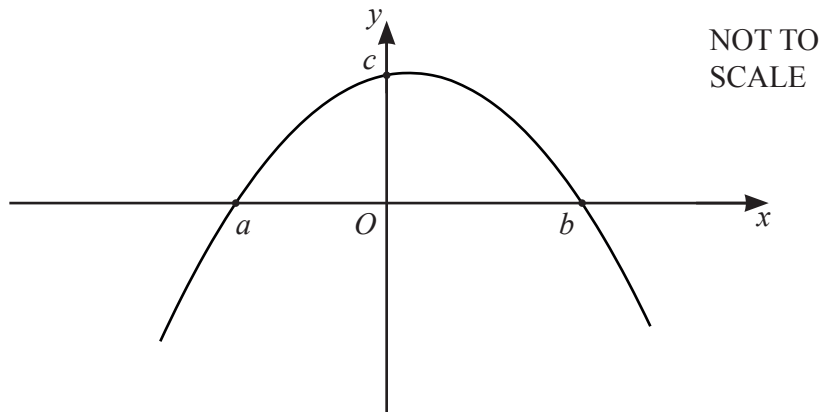
(c) Calculate angle CAB .

Angle $CAB = \dots\dots\dots$ [2]

8 (a) (i) Factor $24 + 5x - x^2$.

..... [2]

(ii) The diagram shows a sketch of $y = 24 + 5x - x^2$.



Work out the values of a , b , and c .

$a =$

$b =$

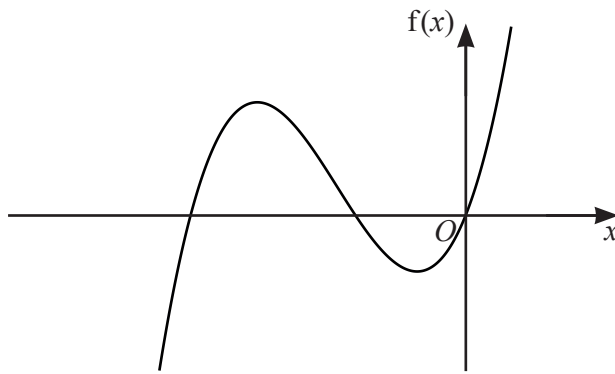
$c =$ [3]

(iii) The line $y = 18$ intersects the graph of $y = 24 + 5x - x^2$ at P and Q .

Find the length of PQ .

$PQ =$ [4]

(b)

NOT TO
SCALE

The diagram shows a sketch of the graph of a cubic function $f(x)$.
The graph passes through the points $(-5, 0)$, $(-2, 0)$, $(0, 0)$, and $(1, 36)$.

Find $f(x)$ in the form $ax^3 + bx^2 + cx$.

..... [6]

$$9 \quad (a) \quad \vec{AB} = \begin{pmatrix} 6 \\ -1 \end{pmatrix} \quad \vec{BC} = \begin{pmatrix} -2 \\ 5 \end{pmatrix} \quad \vec{DC} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$$

Find

(i) \vec{AC} ,

$$\vec{AC} = \begin{pmatrix} \quad \\ \quad \end{pmatrix} [2]$$

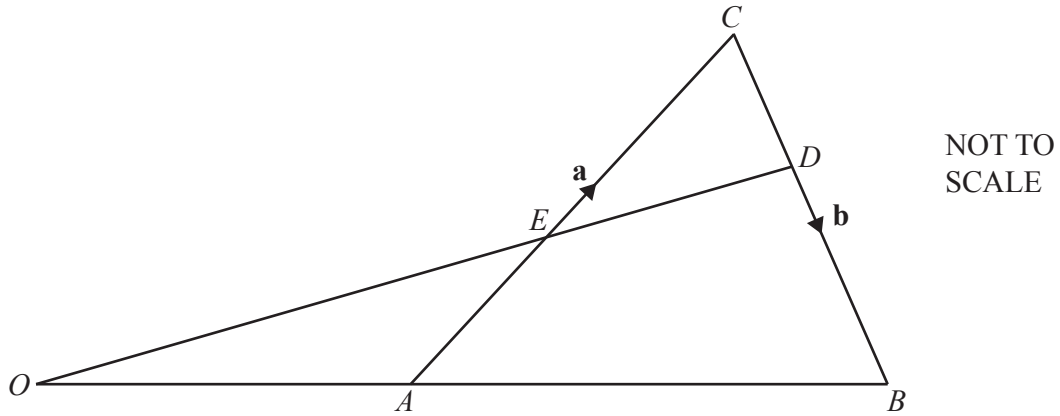
(ii) \vec{BD} ,

$$\vec{BD} = \begin{pmatrix} \quad \\ \quad \end{pmatrix} [2]$$

(iii) $|\vec{BC}|$.

..... [2]

(b)



In the diagram, OAB and OED are straight lines.
 O is the origin, A is the midpoint of OB and E is the midpoint of AC .
 $\vec{AC} = \mathbf{a}$ and $\vec{CB} = \mathbf{b}$.

Find, in terms of \mathbf{a} and \mathbf{b} , in its simplest form

(i) \vec{AB} ,

$$\vec{AB} = \dots\dots\dots [1]$$

(ii) \vec{OE} ,

$$\vec{OE} = \dots\dots\dots [2]$$

(iii) the position vector of D .

$$\dots\dots\dots [3]$$

18

10 $f(x) = 4 - 3x$ $g(x) = x^2 + x$ $h(x) = 3^x$

(a) Find $f(h(2))$.

..... [2]

(b) Find $f^{-1}(x)$.

$f^{-1}(x) =$ [2]

(c) Simplify.

(i) $f(1 - 2x)$

..... [2]

(ii) $g(f(x)) - 9g(x)$

..... [4]

(d) $\frac{1}{h(x)} = 9^{kx}$

Find the value of k .

$$k = \dots\dots\dots [2]$$

(e) $j(x) = (x+1)(x+2)$

The graph of $g(x)$ is mapped onto the graph of $j(x)$ by a translation.

Find the column vector that represents this translation.

$$\begin{pmatrix} \\ \end{pmatrix} [2]$$

Question 11 is printed on the next page.

- 11 The table shows the first four terms in sequences A , B , C and D .

Sequence	1st term	2nd term	3rd term	4th term	5th term		n th term
A	4	9	14	19			
B	3	10	29	66			
C	1	4	16	64			
D	$\frac{3}{17}$	$\frac{4}{26}$	$\frac{5}{37}$	$\frac{6}{50}$			

Complete the table.

[12]

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