KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education

121/2

Paper 2

Serial No.
12122024

MATHEMATICS Alt. A

Nov. 2024 – 2½ hours

Name: ……..... Index Number: ……..…..……..…....

Candidate's signature: …….. Date: ……..……..

Instructions to candidates

(a) Write your name and index number and class in the spaces provided above.

(b) Sign and write the date of examination in the spaces provided above.

(c) The paper consists of **two** sections. **Section I** and **Section II.**

(d) Answer **ALL** the questions in Section I and any **FIVE** questions in Section II.

(e) **Show all the steps in your calculations, giving your answer at each stage in the spaces provided below each question.**

(f) Marks may be given for correct working even if the answer is wrong.

(g) **Non-programmable** silent electronic calculators and KNEC Mathematical tables may be used except where stated otherwise.

(h) ***This paper consists of 19 printed pages.***

(i) ***Candidates must check the question paper to ascertain that all pages are printed as indicated and that no questions are missing***

(j) **Candidates should answer the questions in English.**

For Examiner's Use Only

SECTION I

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	**Total**

SECTION II

17	18	19	20	21	22	23	24	**Total**

Grand Total

SECTION I (50 marks)

*Answer **all** the questions in this section in the spaces provided.*

1. An arithmetic progression (AP) is given as $600+650+700+750+...$ Determine:
(a) the 30^{th} term of the AP; (2 marks)

(b) the sum of the first 30 terms of the AP. (2 marks)

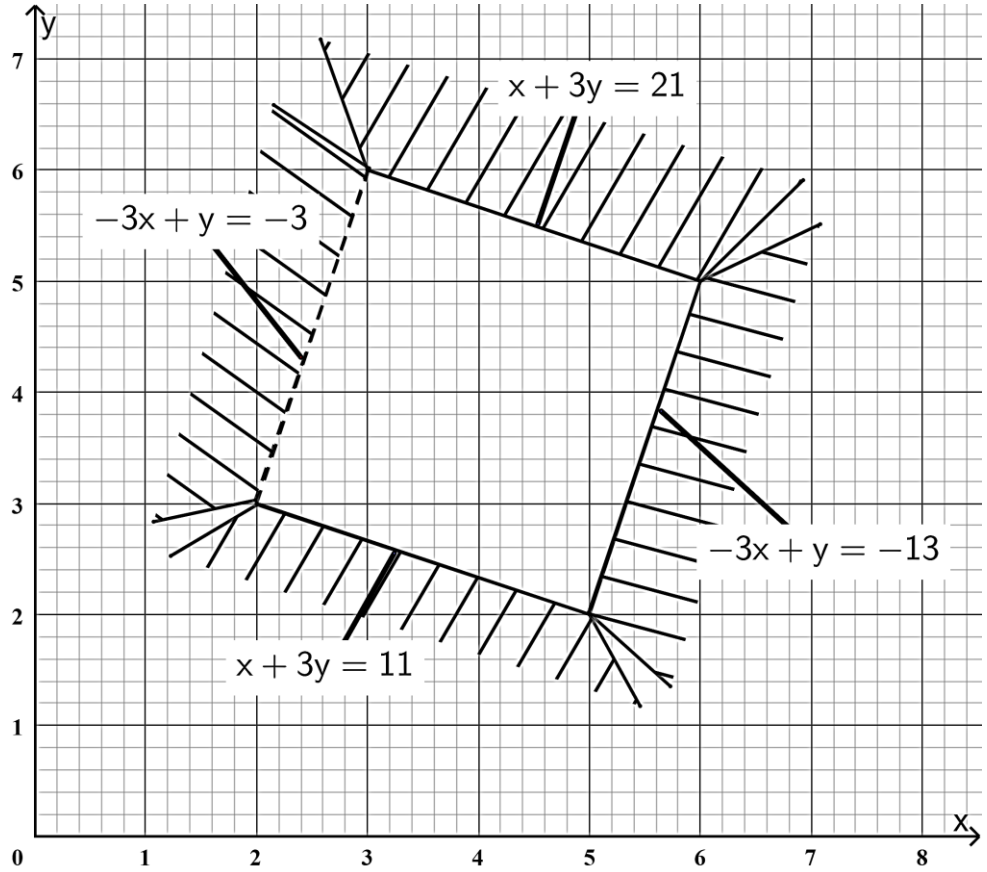
2. The quadratic equation $5x^2+kx+20=0$ has only one root. Determine the possible values of k. (2 marks)

3. Without using mathematical tables or a calculator, evaluate $\dfrac{\log 125+\log 64}{\log \sqrt[6]{5}+\log \sqrt[3]{2}}$.

(3 marks)

4. Make x the subject of the formula $y = \frac{a}{b^x}$. (3 marks)

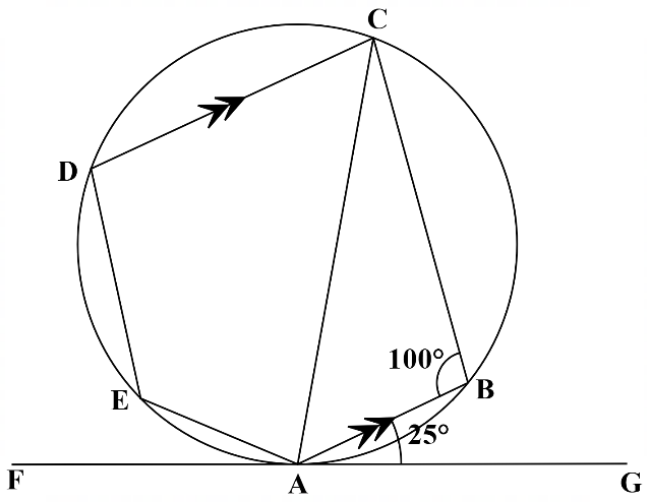
5. The unshaded region on the Cartesian plane satisfies the inequalities $x + 3y \leq 21, -3x + y < -3, -3x + y \geq -13$ and $x + 3y \geq 11$.



Find the maximum value of $(x + 4y)$ for the integral coordinates $P(x, y)$ lying in the unshaded region. (3 marks)

6. An aircraft flew due west from point $A(39.64°N, 50°E)$ to $B(39.64°N, 20°W)$.
Calculate the distance covered by the aircraft correct to the nearest km.
$\left(\text{Take } \pi = \frac{22}{7} \text{ and R} = 6370 \text{ km}\right)$ (3 marks)

7. In the following figure; A, B, C, D and E are points on the circumference of the circle. Line AB is parallel to line DC and line FAG is tangent to the circle at A.
Angle GAB = 25° and $\angle ABC = 100°$.



Determine the size of:

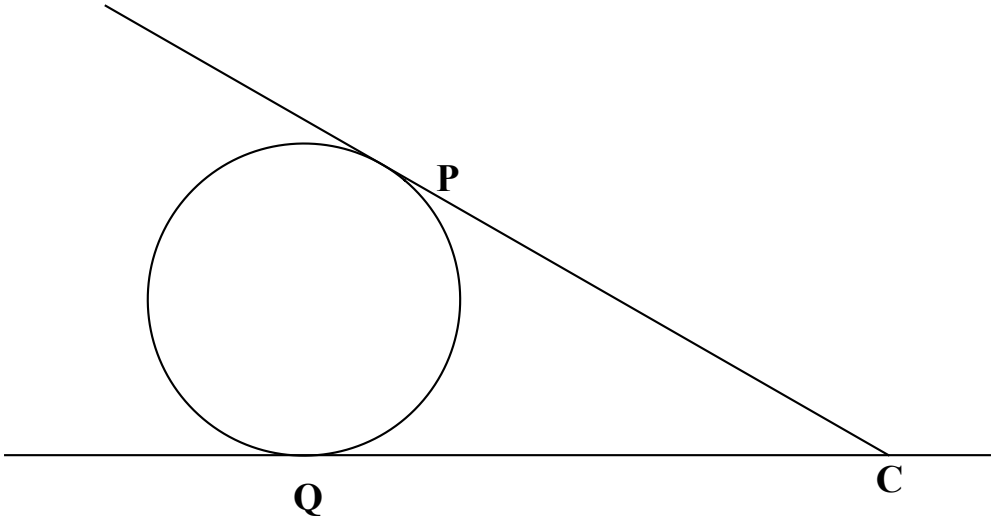
(a) $\angle BAC$; (1 mark)

(b) $\angle AED$. (2 marks)

8. The triangle ABC with vertices $\mathrm{A}(1,0), \mathrm{B}(3,0)$ and $\mathrm{C}(1,2)$ is transformed by the matrix $\mathbf{T} = \begin{pmatrix} 3k & 1.6 \\ 3k & -0.9 \end{pmatrix}$ onto triangle $\mathrm{A'B'C'}$. Given that the area of triangle $\mathrm{A'B'C'}$ is 6 square units, determine the value of *k*. (3 marks)

9. Solve the equation $6\cos^2 x + \sin x = 4$ for $0° \leq x \leq 180°$, giving the answer correct to 2 decimal places. (3 marks)

10. The figure below shows a circle. Lines CP and CQ are tangents to the circle at points P and Q respectively.



The circle is to be inscribed in a triangle ABC. Point B lies on CQ produced and $\angle CBA = 90°$. Use a ruler and a pair of compasses only to:

(a) locate point O, the centre of the circle; (2 marks)

(b) complete triangle ABC. (2 marks)

11. The deviations of the masses of 10 students from an assumed mean are:

$-10,\ -5,\ -2,\ 1,\ 4,\ 5,\ 7,\ 8,\ 9,\ 13$

The mass of the heaviest student was 58 kg. Calculate the mean mass of the students.

(3 marks)

12. The following table shows part of a monthly income tax rates for a certain year.

Monthly taxable income (Ksh.)	Tax rate (%)
0 to 11 180	10
11 181 to 21 714	15
21715 to 32 248	20

In a certain month an employee paid a net tax of Ksh. 2 200 after getting a tax relief of Ksh. 1 280. Calculate the employee's taxable income that month. (3 marks)

13. The equation of a circle is given by $x^2 + y^2 - 3x + 4y = 0$. Determine:

(a) the coordinates of the centre of the circle; (2 marks)

(b) the area of the circle in terms of π. (1 mark)

14. The position vectors of points A, B and C are such that $\mathbf{OA} = 3\mathbf{i} - 5\mathbf{j} - 4\mathbf{k}, \mathbf{OB} = \mathbf{j} + 8\mathbf{k}$ and $\mathbf{OC} = -2\mathbf{i} + 5\mathbf{j} + 16\mathbf{k}$.
Show that the points A, B and C are collinear. (3 marks)

15. A particle starts from point O and moves in a straight line so that its velocity v ms^{-1} after time t seconds is given by $v = 9t^2 - 18t + 10$. Calculate the distance covered by the particle between the time $t = 1$ second and $t = 2$ seconds. (3 marks)

16. The following table shows the number of units (U) of water consumed by 6 households in a month. The corresponding amount (A) charged is also given.

No. of units (U)	0.8	1.7	2.2	2.9	3.5	4.2
Amount (A) charged in Ksh.	200	340	380	480	600	720

(a) Using the scale 2 cm to represent 1 unit on the *x*-axis and 1 cm to represent Ksh. 100 on the *y*-axis, draw the line of best fit for the data on the grid provided. (3 marks)

(b) Estimate the cost of 1.5 units of water. (1 mark)

SECTION II (50 marks)

*Answer only **five** questions in this section in the spaces provided.*

17. A poultry dealer has to types of chicken feeds: type A and type B. He sells 1 kg of type A at Ksh. 45 and 1 kg type B at Ksh. 30. He makes a profit of 20% per kg of type A feed sold and 25% per kg of typer B feed sold. He also sales mixtures of type A and type B feeds.

(a) Determine the amount of profit made by the dealer for selling 1 kg of:

(i) type A feed. (1 mark)

(ii) type B feed. (1 mark)

(b) Type A and type B feeds were mixed in the ratio $3:7$. Calculate:

(i) the selling price of 1 kg of the mixture; (2 marks)

(ii) the profit made by the dealer in selling 50 kg of the mixture. (2 marks)

(c) The dealer made a profit of Ksh. 1 387.50 for the sale of 200 kg of a different mixture of type A and type B feeds. Determine the ratio of type A feed to that of type B feed in the mixture. (4 marks)

18.

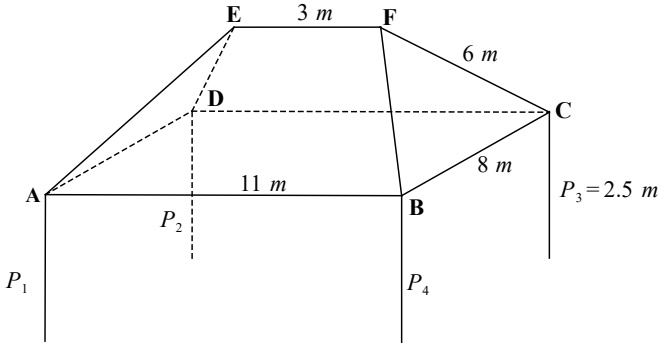
(a) A quantity P is partly constant and partly varies as the square root of a quantity Q. Given that P = 20 when Q = 4 and that P = 60 when Q = 100, find Q when P = 22. (4 marks)

(b) Three quantities, T, U and V are such that T varies directly as the square of $(10-U)$ and inversely as the cube root of V. When T = 12, U = 4 and V = 8.

(i) Determine the equation connecting T, U and V. (3 marks)

(ii) Find U when $T=5\frac{2}{5}$ and $V=15\frac{5}{8}$. (3 marks)

19. The following figure shows a tent erected on a level ground. The roof ABCDEF of the tent is supported by four vertical posts P_1, P_2, P_3 and P_4 each of height 2.5 m. The ridge EF = 3 m is centrally placed.
Further, AB = 11 m, BC = 8 m and FB = FC = ED = EA = 6 m.



Calculate:

(a) the length of the projection of FC on the ground correct to 4 significant figures. (3 marks)

(b) the height of the ridge EF above the ground. (3 marks)

(c) the angle between edge FB and edge FC. (2 marks)

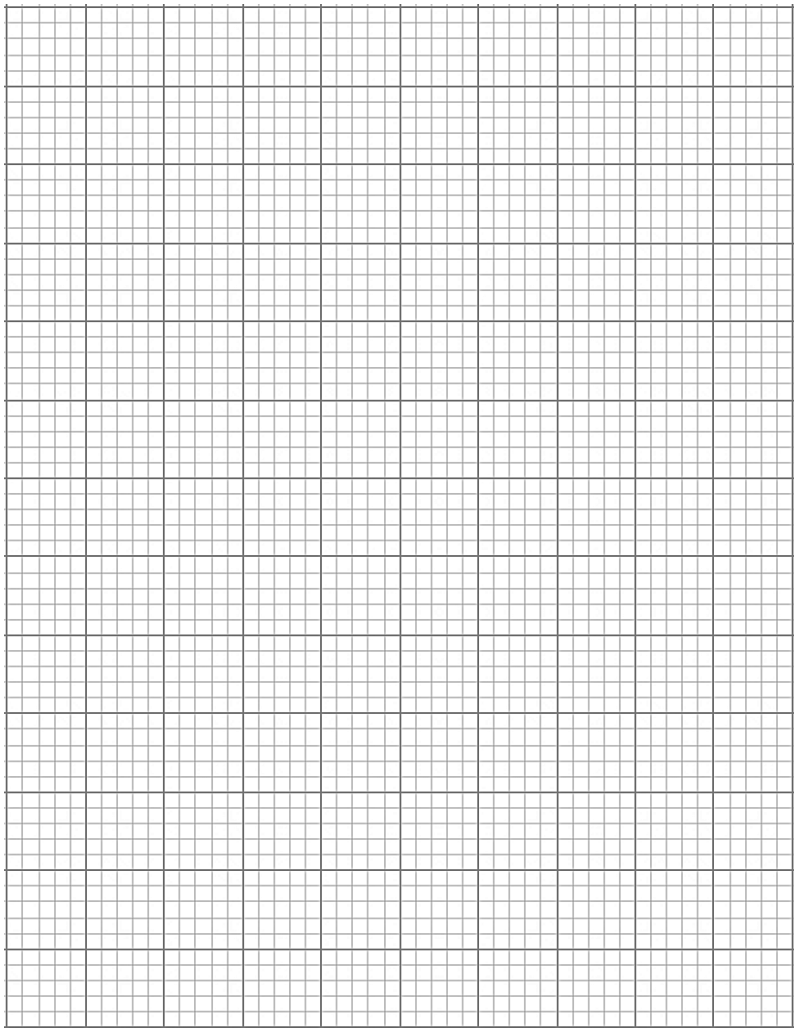
(d) the angle between the plane FBC and the ground. (2 marks)

20. The table below shows values of x and some values of y for the curve $y = 3x^3 + x^2 - 7x$ in the range $-2 \leq x \leq 2$.

(a) Complete the table by filling the missing values of y correct to 1 decimal place. (2 marks)

x	–2	–1.5	–1	–0.5	0	0.5	1	1.5	2
y		2.6	5			–2.9			14

(b) On the grid provided, draw the graph of $y = 3x^3 + x^2 - 7x$ for $-2 \leq x \leq 2$. Use the scale: 2 cm for 1 unit on the x-axis and 2 cm for 5 units on the y-axis. (3 marks)



(c) Use the graph to solve the equation:

(i) $3x^3 + x^2 - 7x - 4 = 0$ (2 marks)

(ii) $3x^3 + x^2 - 10x = 0$ (3 marks)

21.

(a) Fadhili deposited Ksh. 400 000 in an account that paid compound interest on deposits at a rate of 7% p.a. At the end of 3 years, he withdrew all the money from the account.

(i) Calculate the amount that Fadhili withdrew. (2 marks)

(ii) Fadhili invested the withdrawn amount in shares. The value of the shares depreciated at a rate of 1.5% every 6 months. Determine the value of the shares at the end of 2 years correct to 2 decimal places. (3 marks)

(iii) Determine the gain or loss from Fadhili's investments in the 5 years. (1 mark)

(b) Nyambuto invested Ksh. 400 000 in a financial institution that paid compound interest at the rate of 6% per annum. After n years, the amount had accumulated to Ksh. 500 000. Calculate the value of n, correct to the nearest whole number. (4 marks)

22. The probabilities of obtaining scores 1, 2, 3, 4 and 5 using a biased pentagonal spinner were recorded as shown in the following table.

Score	1	2	3	4	5
Probability	k	0.1	0.25	$2k$	0.2

(a) Determine:

(i) the value of k. (2 marks)

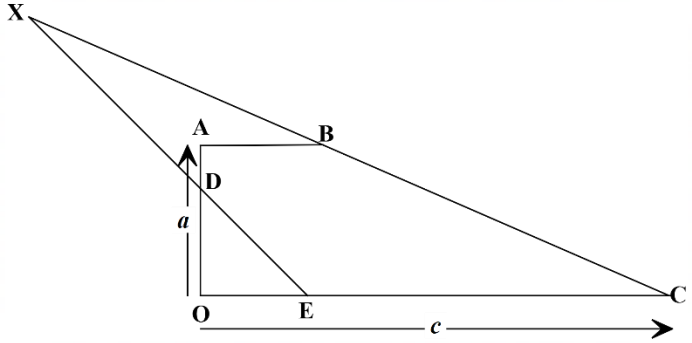
(ii) the probability of obtaining a score of 4. (1 mark)

(b) The spinner was span twice.

(i) Work out the probability of obtaining an even number in the first spin and an odd number in the second spin. (4 marks)

(ii) The total score, S, for the two spins was obtained. Determine the probability that $S \geq 9$. (3 marks)

23. In the figure below, OABC is a trapezium. **AB** is parallel to **OC** and **OC** = 4 **AB**. D is point on **OA** such that OD : DA = 3: 1 and E is a point on **OC** such that OE : EC = 1 : 3.



(a) Given that **OC** = **c** and **OA** = **a**, express in terms of **a** and **c**:

(i) **ED.** (1 mark)

(ii) **CB.** (1 mark)

(b) Line ED and CB produced intersect at X such that **EX** = *h***ED** and **CX** = *k***CB**, where *h* and *k* are scalars.

(i) Express **EX** in terms of **a**, **c** and *h*. (1 mark)

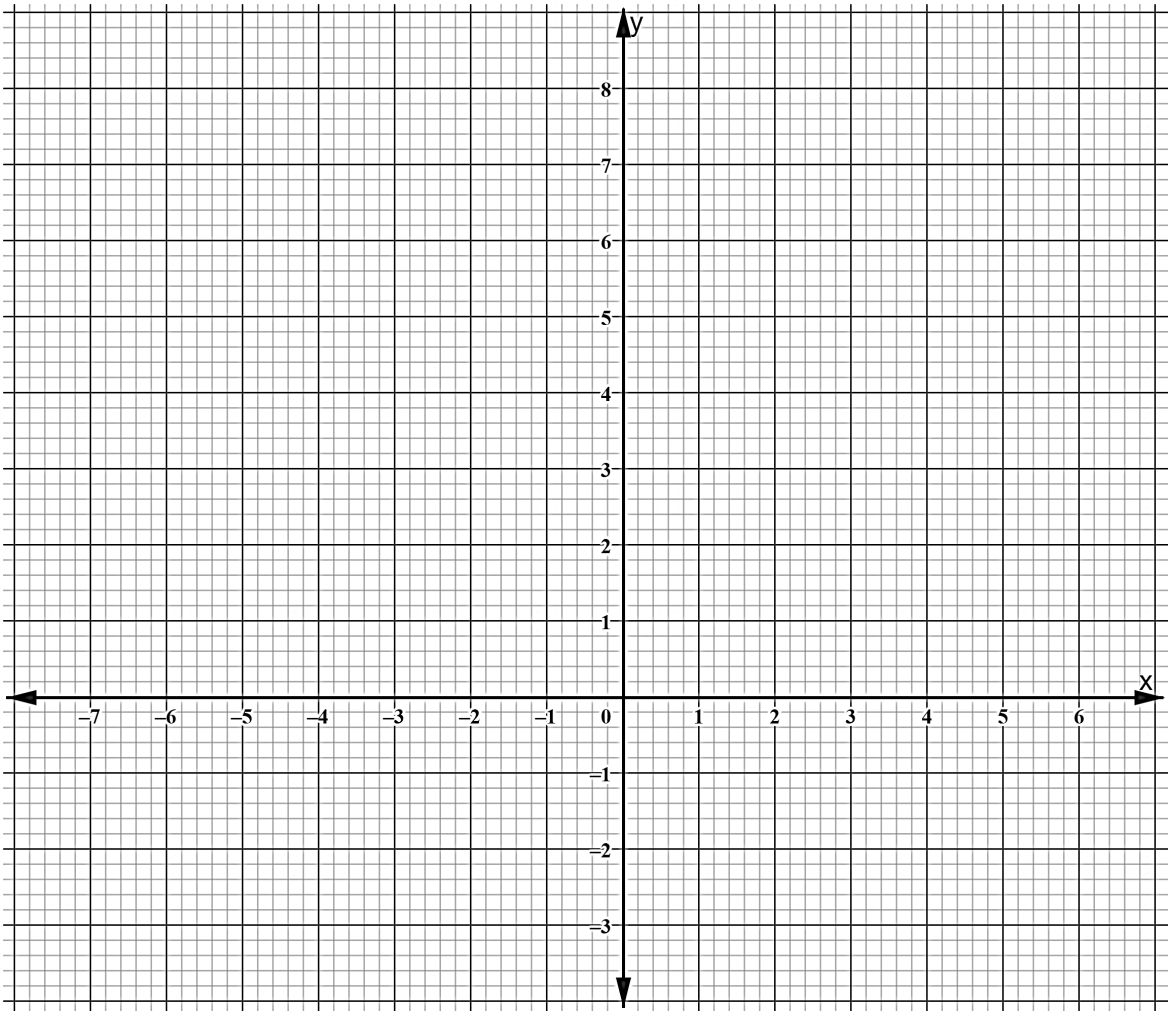
(ii) Express **CX** in terms of **a**, **c** and *k*. (1 mark)

(c) Determine the values of h and k. (5 marks)

(d) Determine the ratio of ED : DX. (1 mark)

24. PQR is a triangle with vertices $P(5,-1)$, $Q(3,-1)$ and $R(3,-3)$.

(a) On the grid provided, draw triangle PQR. (1 mark)



(b) On the same grid, draw $\Delta P'Q'R'$ the image of ΔPQR under a reflection in the line $y = x$. (3 marks)

(c) $\Delta P''Q''R''$ is the image of $\Delta P'Q'R'$ under a transformation matrix $\mathbf{T} = \begin{pmatrix} 1.5 & -0.5 \\ -0.5 & 1.5 \end{pmatrix}$.

(i) Find the coordinates of $P''Q''R''$. (2 marks)

(ii) On the same grid, draw triangle $P''Q''R''$. (1 mark)

(d) Determine a single transformation matrix that maps ΔPQR directly to $\Delta P''Q''R''$.
(3 marks)

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