# KCSE 2024

# MATHEMATICS

**121/1**

**PAPER 1**

**TIME: 2½ HRS**

**NAME……..**

**INDEX NO…….....…..…… CANDIDATE'S SIGN……..**

**DATE ……**

## *Kenya Certificate of Secondary Education.*

**INSTRUCTIONS:**

1. *Write your name, Index number in the space provided at the top of the page.*
2. *Sign and write the date of examination in the spaces provided above.*
3. *This paper consists of **Two** sections 1 and II.*
4. *Answer all the questions in section **1** and only **five** questions from section II*
5. *All answers and working must be written on the question paper in the spaces provided below each question.*
6. *Show all the steps in your calculation, giving your answers at each stage in the space provided.*
7. *Marks may be given for correct working even if the answer is wrong.*
8. *Non programmable silent electronic calculator and KNEC Mathematical table may be used, except when stated otherwise.*

**FOR EXAMINER'S USE ONLY**

**SECTION 1**

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

**SECTION 2**

| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | Total |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

## SECTION 1 (50 MARKS) COMPULSORY

**1.** Without using calculators evaluate: **(3 marks)**

$$\frac{\frac{1}{2}+2\frac{4}{5}\,of\,8\div 6(2\times 4\frac{2}{5})}{\frac{1}{2}\,of\,6\left(8\div 7\frac{1}{3}\right)}$$

**2.** Simplify the expression **(3 marks)**

$$\frac{y^4 - x^4}{y^3 - yx^2}$$

**3.** Solve for x in the equation **(3 marks)**

$$2^{(2x-1)} \times \frac{1}{8}^{(1+x)} = 4^{(3x+1)}$$

**4.** The marked price of a modern camera is Ksh. 24,000. A trader sold it to a customer at a 10% discount. If the trader still made a profit of 20% on the cost price, what was its cost price. **(3 mks)**

**5.** A two – digit number is such that the sum of the digit is 12. If the digits are interchanged the value of the new number formed is fifteen more than twice the value of the original number. Find the original number? **(4 marks)**

**6.** Using reciprocal and square – root tables only. Evaluate. **(3 marks)**

$$9.452^2 + \frac{1}{63.37}$$

**7.** Two similar container hold $2000cm^3$ and 6.75 litres respectively. If the smaller container has a diameter of 15.50cm. What is the radius of the larger container correct to 1 decimal place?**(3 mks)**

**8.** Given that **OA** = i + 3j - 4k and **OB** = 3i - j - k. **(3 marks)**

Find /AB/

**9.** Three schools A, B, and C are such that B is 12km due south of A and C is 15km from A. C is on a bearing of $N30^0W$ from B. Calculate the bearing of C from A. **(3 marks)**

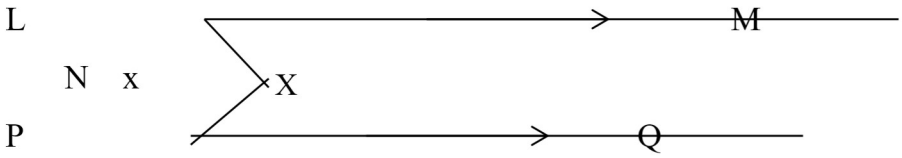
**10.** Solve the inequality

$$3 - 2x < x \leq \frac{2x + 5}{3}$$

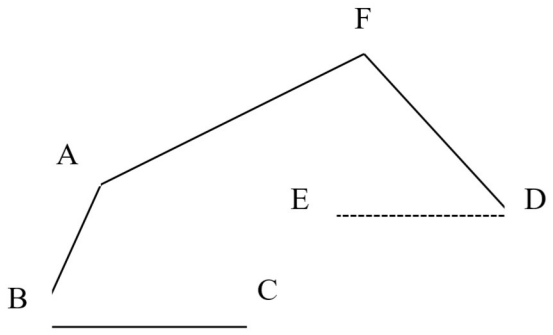
State the integral values which satisfy these inequalities **(3 marks)**

**11.** The gradient of a line L through A (2x, 4) and B (-1, x) is $^1/_7$. Find the equation of line perpendicular to L through B. **(3 marks)**

**12.** On the figure below LM is parallel to PQ. Angle MLN = $30^0$ and Angle NPQ = $70^0$. Find the value of $X^0$ **(3 marks)**




**13.** Complete the sketch below for the prism, ABCDEF **(3 marks)**



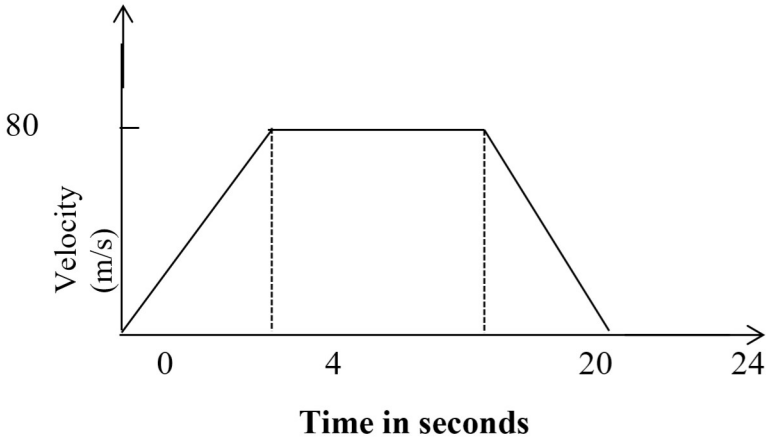
**14.** A Jua Kali artisan has 63000g of metal of density 7g/cm$^3$. He intends to use it to make a rectangular pipe with external dimensions 120mm by 150mm and internal dimensions of 100mm by 120mm. Calculate the length of the pipe in metres. **(3 marks)**

**15.** Jane and Mary started a business whereby contributed Ksh. 25000 and 20000 respectively. At the end of the year a profit of Ksh. 8100 was realized. From the profit funds for development, dividends and reserves were set aside in the ration 4:5:6 respectively. If the dividends were shared in the ration of their contribution, determine:

**(a)** The amount set aside for development **(2 marks)**

**(b)** The dividends Mary received **(2 marks)**

**16.** The figure below is a velocity time - graph for car




**(a)** Find total distance traveled by the car **(2 marks)**

**(b)** Calculate the deceleration of the car. **(1 mark)**

## SECTION II (50 MARKS)

**Answer any five questions in this section**

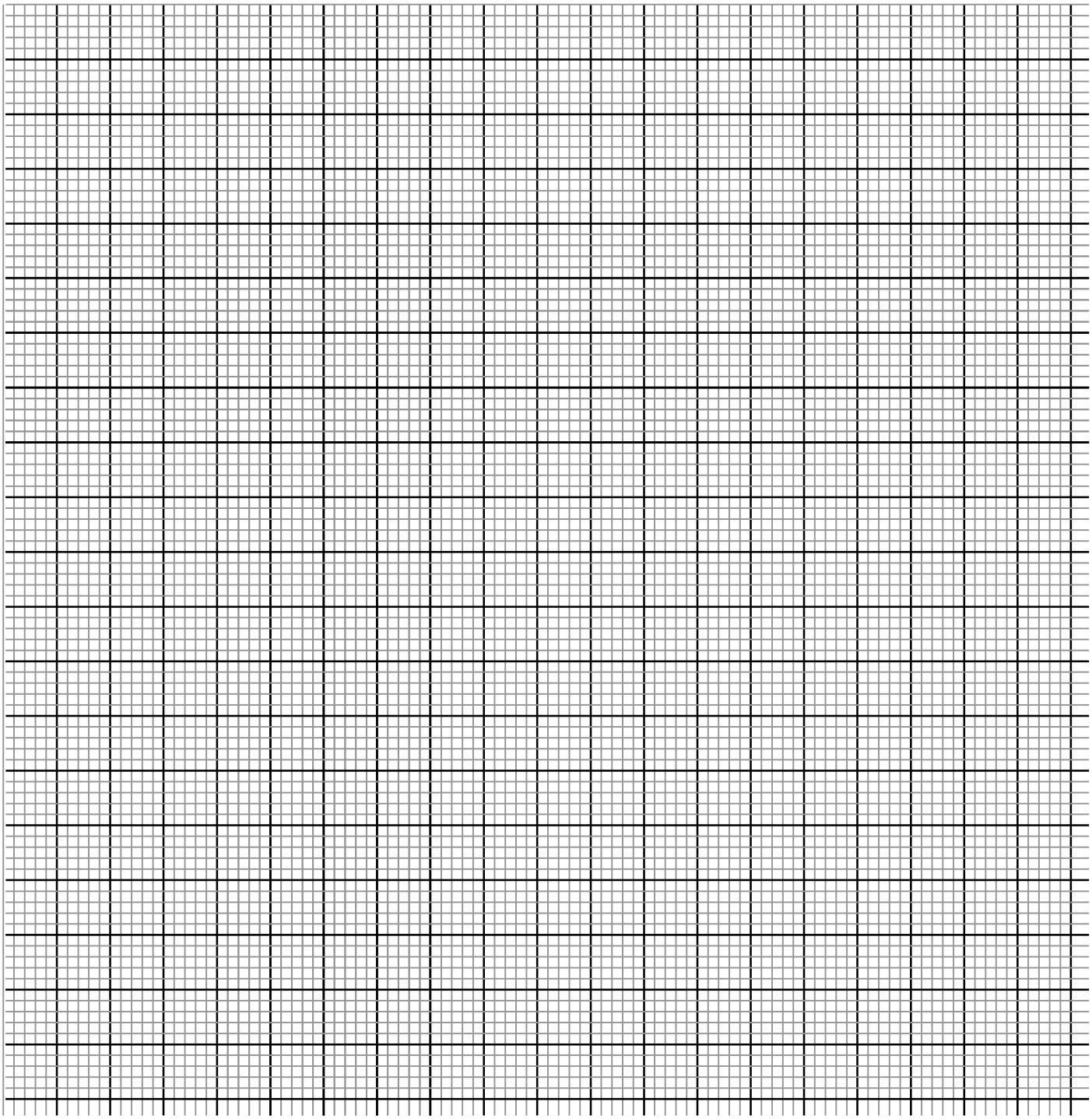
**17.** Five members of a self-supporting enterprise Peter, John, Esther, Brian and Caro were given a certain amount of money to share amongst themselves. Peter got 3/8 of the total amount while John got 2/5 of the remainder. The remaining amount was shared equally among Esther, Brian and Caro each of which received Ksh. 6,000;

**(a)** How much was shared among the five business women? **(3 marks)**

**(b)** How much did John get? **(2 marks)**

**(c)** Peter, John and Caro invested their money and earned a profit of Ksh. 12,000. A third of the profit was left to maintain the business and the rest was shared according to their investments. Find how much each got. **(5 marks)**

**18.** (a) On the grid provided draw the square whose vertices are A(6, -2), B(7, -2), C(7, -1) and D(6, -1) **(1 mark)**



**(b)** On the same grid draw

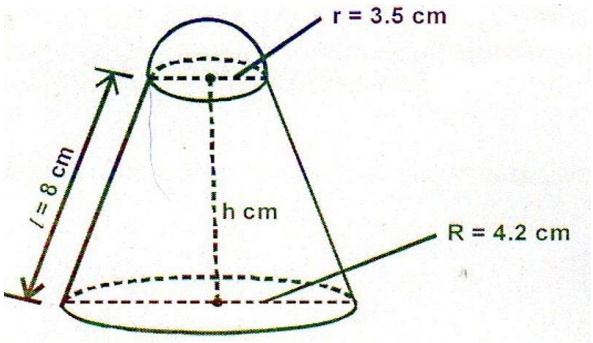
**(i)** $A^1B^1C^1D^1$ the image of ABCD, under an enlargement scale factor 3, Centre (9, -4) **(3 marks)**

**(ii)** $A^{11}B^{11}C^{11}D^{11}$, the image $A^1B^1C^1D^1$ under a reflection in the line x = 0 **(2 marks)**

**(iii)** $A^{111}B^{111}C^{111}D^{111}$, the image of $A^{11}B^{11}C^{11}D^{11}$ under a rotation of $+90^0$ about the origin. **(2 marks)**

**(c)** Describe a single transformation that maps $A^1B^1C^1D^1$ onto $A^{111}B^{111}C^{111}D^{111}$. **(2 marks)**

**19.** The figure below shows a solid made up of a conical frustum and a hemispherical top. The dimensions are as indicated.




The top radius r = 3.5cm, bottom radius R = 4.2cm, slant height l = 8cm and the height of the frustum part is h cm.

**(a)** Find the surface area of the solid (Take $\pi = {}^{22}/_{7}$) **(5 marks)**

**(b)** If a similar solid has a total surface area of 81.51cm$^2$, determine the radius of its base, to the nearest whole number **(1 mark)**

**(c) (i)** Find the height h of the frustum. **(1 mark)**

**(ii)** Hence determine the volume of the solid **(3 marks)**

**20.** Two towns A and B are 80km apart. Juma started cycling from town A to town B at 10.00am at an average speed of 40km/h. Mutuku started his journey from town B to town A at 10.30am and traveled by car at an average speed of 60km/h

Calculate:

**(i)** The distance from town A when Juma and Mutuku met **(5 marks)**

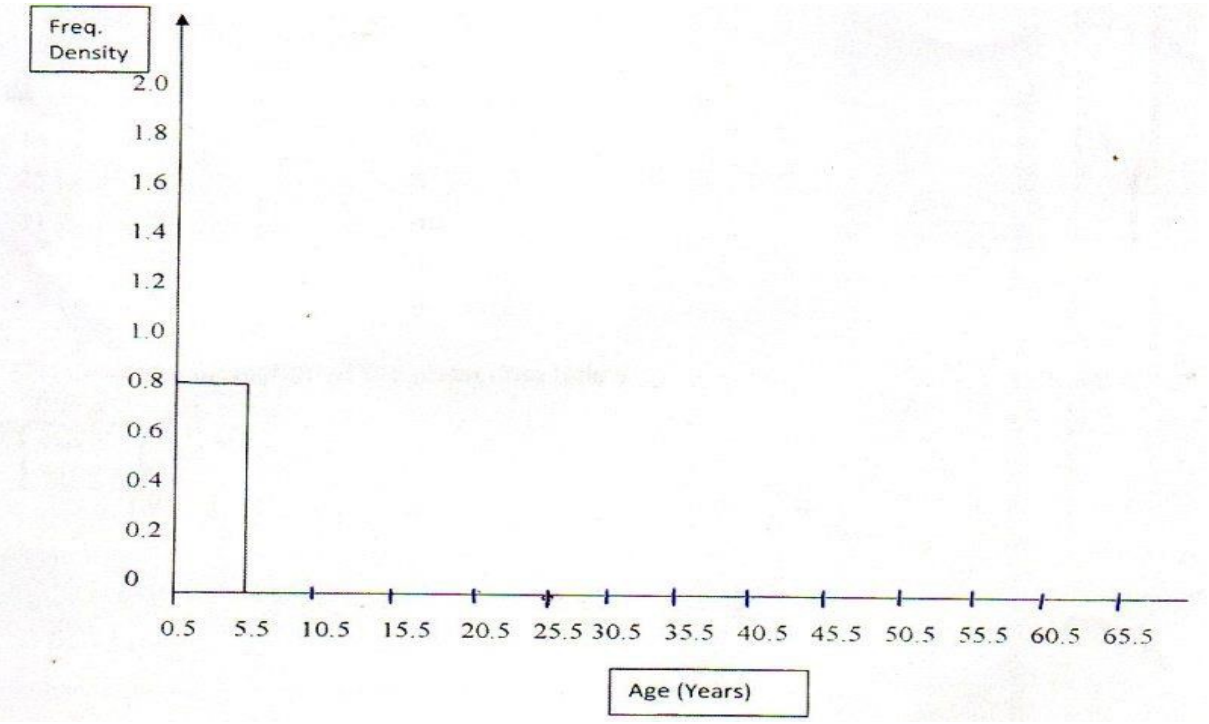
**(ii)** The time of the day when the two met **(2 marks)**

**(b)** Kamau started cycling from town A to town B at 10.20am. He met Mutuku at the same time as Juma did. Determine Kamau's average speed. **(3 marks)**

**21.** The following data shows the sample of age distribution of the people who reside in a certain village in years, in Nandi County

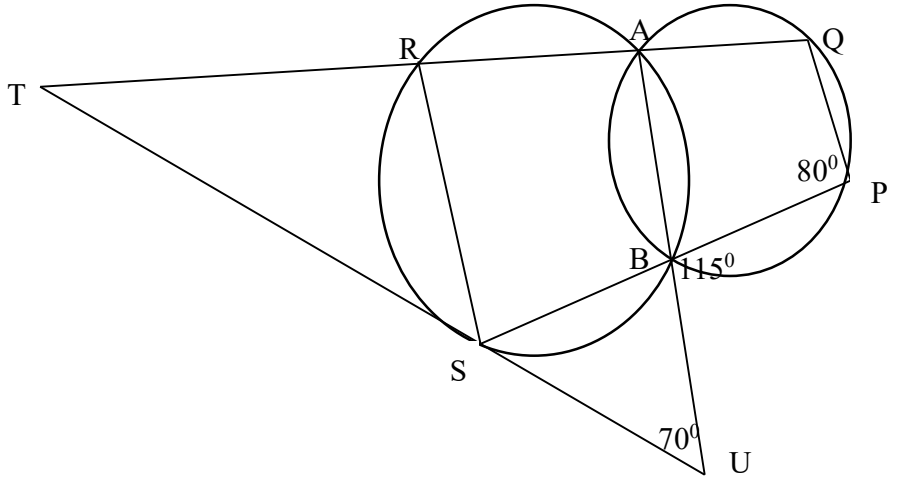
| Age group | Frequency |
|---|---|
| 1 ……5 | 4 |
| 6 ……10 | 8 |
| 11 …… .20 | 8 |
| 21 ……30 | 6 |
| 31 ……50 | 40 |
| 51 ……55 | 3 |
| 56 ……65 | 3 |

**(a)** Complete the histogram of the given data below **(6 marks)**




**(b)** Calculate the mean age of the given sample in the village **(4 marks)**

**22.** The figure below shows two circles ABPQ and ABSR intersecting at A and B. PBS, QART and ABU are straight lines. The line UST is a tangent to the circle ABSR at S. Angle BPQ = $80^0$, angle PBU = $115^0$ and angle BUS = $70^0$




Find the values of the following angles, stating your reasons in each case.

**(a)** <BAR **(2 marks)**

**(b)** <STR **(2 marks)**

**(c)** <BSU **(2 marks)**

**(d)** <BRS **(2 marks)**

**(e)** <SBU **(2 marks)**

**23.** Using a pair of compasses and ruler only,

**(a)** Construct triangle XYZ such that XY = 8cm, YZ = 6cm and angle XYZ = $30^0$ **(3 marks)**

**(b)** Measure the length of XZ **(1 mark)**

**(c)** Draw a circle that touches the vertices X, Y and Z. **(2 marks)**

**(d)** Measure the radius of the circle **(1 mark)**

**(e)** Calculate the area of the circle outside the trangle to 2 d.p. **(3 marks)**

**24.** The function $y = x^3 + x^2 - 3x + 2$ represents a curve.

**a)** Find the gradient function of the curve **(1 mark)**

**b)** Find the turning points of the curve and distinguish between them. **(6 marks)**

**c)** Hence sketch the curve $y = x^3 + x^2 - 3x + 2$ **(3 marks)**

# KCSE 2024

# MATHEMATICS

**121/2**

**PAPER 2**

**TIME: 2½ HRS**

**NAME……..**

**INDEX NO…….....….....…… CANDIDATE'S SIGN……..**

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**SECTION 2**

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| | | | | | | | | |

## SECTION 1 (50 MARKS) COMPULSORY

### SECTION I (50 Marks)

**1.** A quadratic equation has roots as $x = -4$ and $x = \frac{2}{3}$. Write the equation in the form $ax^2 + bx + c = 0$, where $a, b$ and $c$ are integers. **(3 marks)**

**2.** Given that $2 \leq p \leq 8$ and $3 \leq q \leq 10$, find the maximum value of: **(2 marks)**

$$\frac{p-q}{q+p}$$

**3.** Without using a mathematical table or a calculator, write the expression below in the form $a\sqrt{3} + c$, where $a$ and $c$ are constants **(3 marks)**

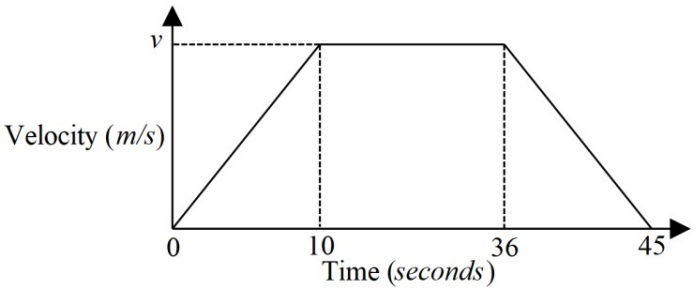
$$\frac{2}{\sin 90^0 + \tan 60^0}$$

**4.** Solve for $x$ in the equation $\log_2(x-3)+2=\log_2(8-x)$ **(3 marks)**

**5.** A truck is bought at Kshs. 1,800,000. It depreciates by 10% per annum in the first 2 years, thereafter its annual depreciation rate is 15%. Find the value of the truck after 5 years. **(4 marks)**

**6.** The position vectors of points A and B are $4\boldsymbol{i}-5\boldsymbol{j}+6\boldsymbol{k}$ and $-2\boldsymbol{i}+3\boldsymbol{j}+8\boldsymbol{k}$ respectively. Calculate the magnitude of $\boldsymbol{AB}$ correct to 3 decimal places. **(3 marks)**

**7.** The figure below shows the velocity-time graph of a particle that moves for 60 seconds and covered a distance of 852 metres.




Calculate the value of $v$ **(2 marks)**

**8.** Make $x$ the subject of the formula: **(3 marks)**

$$px = \sqrt{x^2 + \frac{m}{Q}}$$

**9.** The equation of a circle is $x^2 + y^2 + 6x - 10y - 2 = 0$. Determine the co-ordinates of the centre and the area of the circle in terms of $\pi$ **(3 marks)**

**10.** (a) Expand $(1 + 3x)^6$ in ascending powers of $x$ up to the term in $x^3$ **(1 mark)**

(b) Use your expansion to evaluate $(0.997)^6$ correct to 5 decimal places. **(2 marks)**

**11.** (a) Complete the table below for the function $y = x^2 - 4x + 5$ for $1 \leq x \leq 5$ **(1 mark)**

| $y$ | 1 | 1.5 | 2 | 2.5 | 3 | 3.5 | 4 | 4.5 | 5 |
|---|---|---|---|---|---|---|---|---|---|
| $x$ | 2 | | | | 2 | | 5 | | |

**(b)** Use the mid-ordinate rule with 4 strips to find the area bound by the function, the x-axis and the lines $x = 1$ and $x = 5$. **(2 marks)**

**12.** A town T lies on latitude $37^0$N and longitude $50^0$E. An airport is located on another town R whose longitude is $10^0$W on the same latitude as T. An aeroplane leaves town T and flies westwards to R. Calculate the distance covered by the plane in km. (Take R = 6370km and $\pi = \frac{22}{7}$)

**(3 marks)**

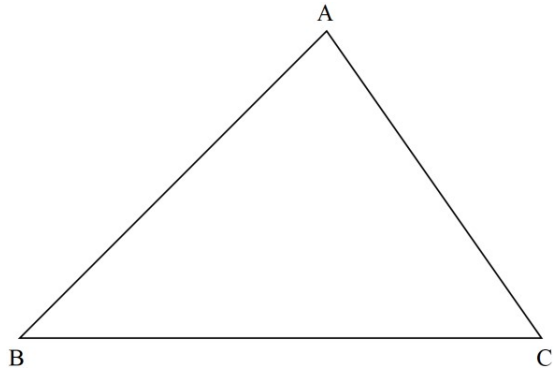
**13.** The diagram below shows a plot of land. Shade the region R enclosed under the following conditions:

(i) $CR \geq 1.5$ cm

(ii) R is more than 2 cm from line AB

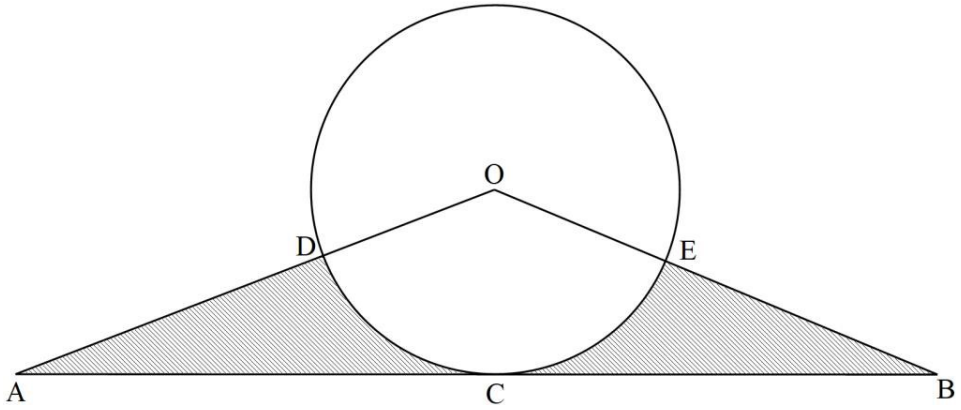
(iii) $\angle CRA \geq \angle CRB$

(iv) R is nearer to CB than CA




By construction and using a scale of 1 cm to represent 10 metres, shade the region where the borehole lies. **(5 marks)**

**14.** In the figure below, O is the centre of the circle. AB is a tangent to the circle at C. AD=17cm and AO=24cm



Calculate the shaded area correct to 4 significant figures. **(4 marks)**

**15.** A trader makes two types of chairs; ordinary and special. The cost of each ordinary chair is Kshs. 300 while the cost of a special chair is Kshs. 700. He is prepared to spend not more than Kshs. 21, 000. It is not viable for him to make less than 20 chairs. Ordinary chairs must be less than twice the special chairs but more than 15. By taking the number of ordinary chairs as $x$ and the special chairs as $y$; Write down all the inequalities representing the above information. **(4 marks)**

**16.** A construction firm has two tractors; P and Q. tractor P completes a job in 4 days while tractor Q completes the work in 6 days. The two tractors start working together and after 2 days, tractor P breaks down. How long does it take Q to complete the remaining work? **(3 marks)**

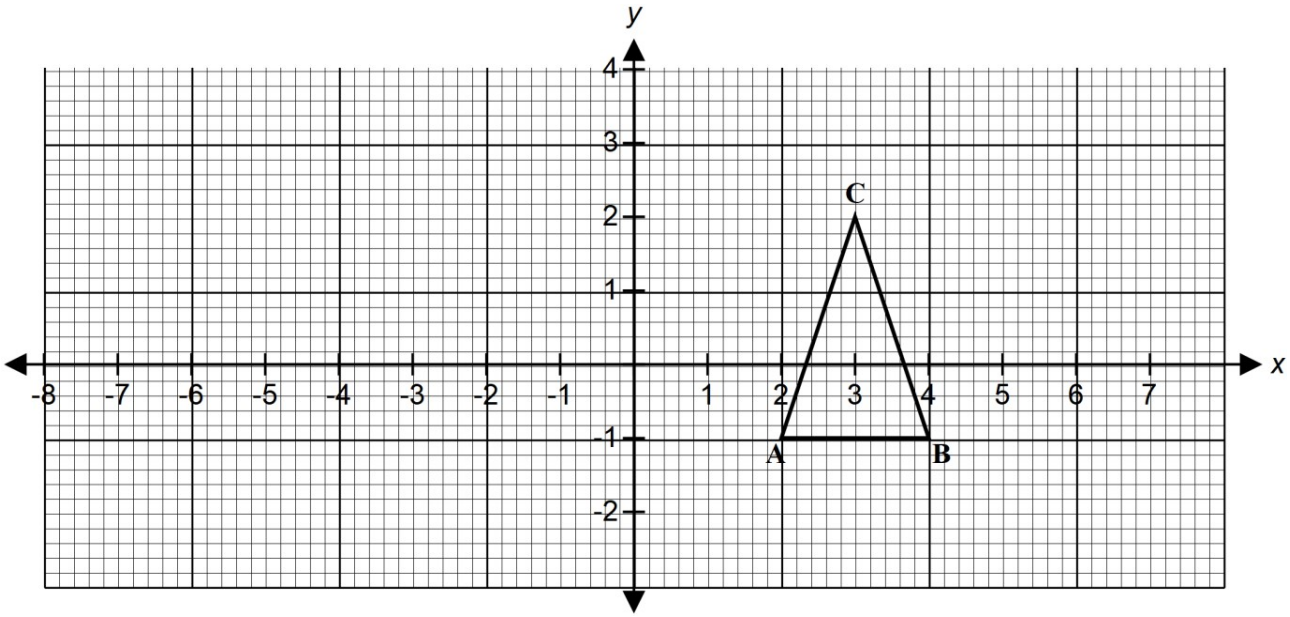
## SECTION II (50 marks)

Answer any ***five*** questions in this section

**17.** The graph below shows a triangle $ABC$ with vertices $A(2,-1), B(4,-1)$ and $C(3,2)$

**(a)** $\Delta A'B'C'$ is the image of $\Delta ABC$ under a transformation given by the matrix $\begin{pmatrix}1 & 2\\ 0 & 1\end{pmatrix}$. Determine the coordinates of $A', B'$ and $C'$ **(2 marks)**

**(b)** On the grid provided draw $\Delta A'B'C'$ and describe the transformation fully **(3 marks)**



**(c)** $\Delta A''B''C''$ is the image of $\Delta A'B'C'$ under a reflection along the line $y = 0$. Draw $\Delta A''B''C''$ on the same pair of axes and state its coordinates **(2 marks)**

**(d)** Determine the matrix representing a single transformation that maps $\Delta ABC$ onto $\Delta\ A''B''C''$ **(3 marks)**

**18. (a)** Write down the first three terms of the sequence whose n$^{th}$ term is given by $T_n = 5n - 2$

**(1 mark)**

**(b)** The third and the sixth terms of a geometric sequence are 18 and 486 respectively. Find the first term and the common ratio of the sequence. **(3 marks)**

**(c)** The first and the last terms of an arithmetic progression are $8$ and $-190$ respectively. If the sum of the first $n$ terms of this arithmetic progression is $-3094$, find the number of terms in the progression **(2 marks)**

**(d)** The second, fourth and seventh terms of an arithmetic progression are the first three terms of a geometric progression. Find the common ratio of the geometric progression if the first term of the arithmetic progression is 2 **(4 marks)**

**19.** (a) Three variables $P, Q$ and $R$ are such that $P$ varies partly as the square of $Q$ and partly inversely as the square root of $R$. Determine:

**(i)** The relationship between $P, Q$ and $R$ given that when $P = 11\frac{1}{3}, Q = 2$ and $R = 9$ and also when $P = 14.75$, $Q = 5$ and $R = 64$ **(4 marks)**

**(ii)** $Q$ when $P = 145\frac{11}{18}$ and $R = 1.44$ **(2 marks)**

**(b)** Four quantities $A, B, C$ and $D$ are such that $A$ varies jointly with $B$, the square root of $C$ and inversely as the square of $D$. Find the percentage change in $A$ if $B$ increases by 21%, $C$ decreases by 36% and $D$ increases by 10% **(4 marks)**

**20.** A particle moves along a straight line such that its displacement $S$ metres from a given point $S = t^3 - 5t^2 + 4$ where $t$ is time in seconds. Calculate:

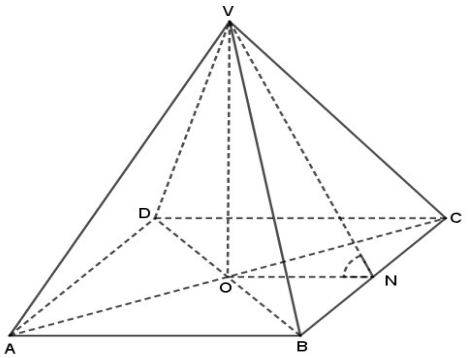
**(a)** The displacement of the particle at $t = 5$ **(2 marks)**

**(b)** The velocity of the particle when $t = 5$ **(3 marks)**

**(c)** The values of $t$ when the particle is momentarily at rest **(3 marks)**

**(d)** The acceleration of the particle $t = 2$ **(2 marks)**

**21.** The figure below shows a right pyramid standing on a rectangular base ABCD. AB=8 cm, BC=15 cm and each slant edge is 12 cm long. N is the midpoint of BC




Calculate to two decimal places

**(a)** The vertical height of the pyramid **(3 marks)**

**(b)** The volume of the pyramid. **(1 mark)**

**(c)** The obtuse angle between the planes VBC and VAD of the pyramid **(4 marks)**

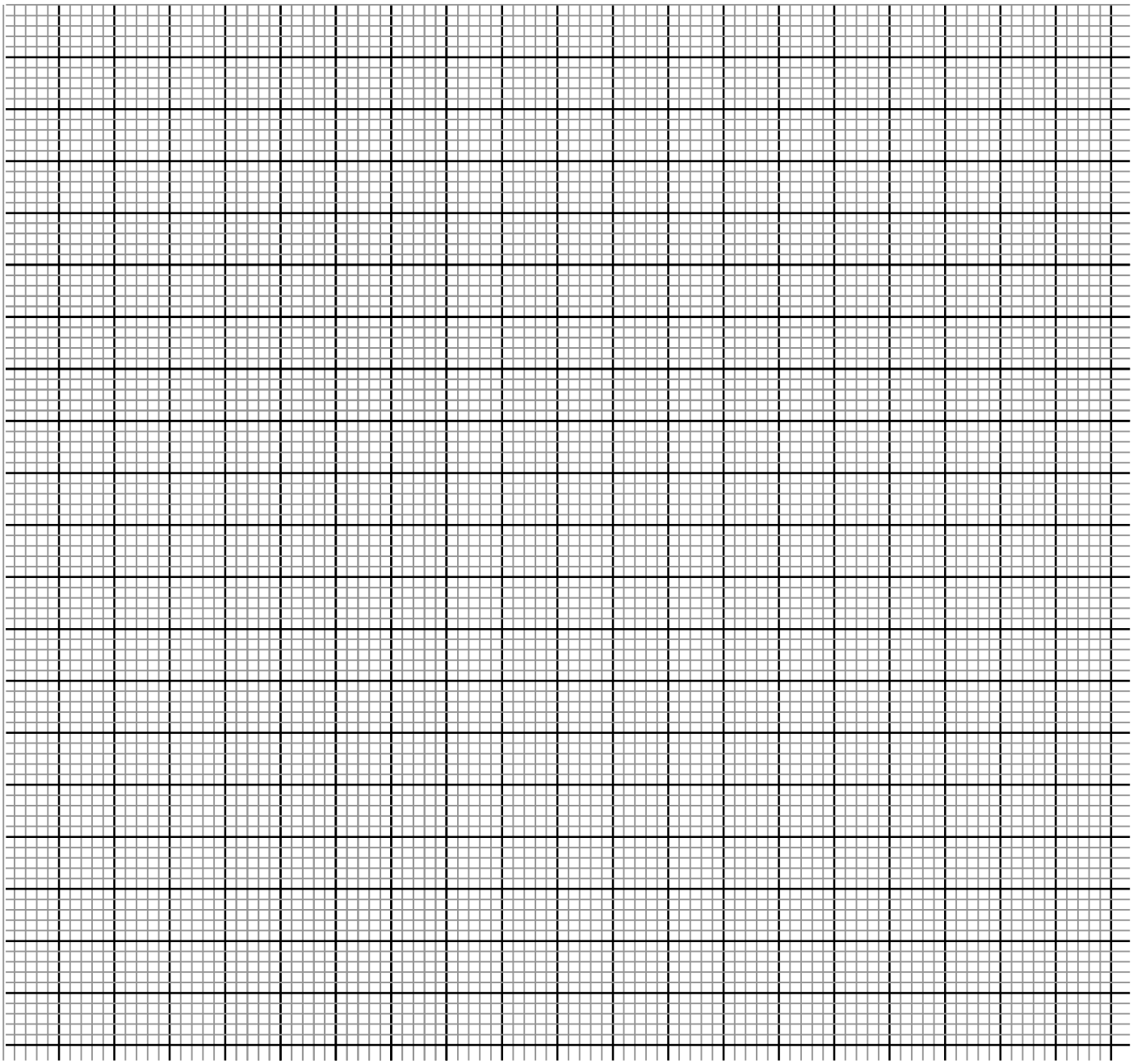
**(d)** The angle between line VD and the base **(2 marks)**

**22.** (a) Complete the table below giving the values correct to 2 decimal places. **(2 marks)**

| $x$ | $0^0$ | 30 | 60 | 90 | $120^0$ | 150 | $180^0$ | $210^0$ | 240 | 270 | $300^0$ | 330 | 360 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $y = \sin(x + 30^0)$ | 0.50 | | | 0.87 | | 0.00 | | -0.87 | | | -0.50 | | 0.50 |
| $y = 2\cos(x + 30^0)$ | 1.73 | | 0.00 | | -1.73 | | -1.73 | | 0.00 | | | 2.00 | 1.73 |

**(b)** On the same set of axes, draw the graphs of $y = \sin(x + 30^0)$ and $y = 2\cos(x + 30^0)$ for $0^0 \leq x \leq 360^0$.

Use the scales $x$-axis; 1 cm to represent $30^0$ and $y$-axis; 2 cm to represent 1 unit. **(5 marks)**



**(a)** Use you graphs to solve the equation $2\cos(x + 30^0) - \sin(x + 30^0) = 0$ **(2 marks)**

**(b)** State the amplitude of $y = 2\cos(x + 30^0)$ **(1 mark)**

**23.** A triangle OPQ, R and S are points on $\boldsymbol{OP}$ and $\boldsymbol{OQ}$ respectively, such that $\boldsymbol{OR}: \boldsymbol{RP} = 2:3$ and $\boldsymbol{OS}: \boldsymbol{SQ} = 2:1$. $\boldsymbol{PS}$ and $\boldsymbol{QR}$ intersect at T. Given that $\boldsymbol{OP} = \boldsymbol{p}$ and $\boldsymbol{OQ} = \boldsymbol{q}$.

**(a)** Express in terms $\boldsymbol{p}$ and $\boldsymbol{q}$

(i) $\boldsymbol{QR}$ **(1 mark)**

(ii) $\boldsymbol{PS}$ **(1 mark)**

**(b)** Given that $\boldsymbol{QT} = h\boldsymbol{QR}$ and $\boldsymbol{PT} = k\boldsymbol{PS}$, express $\boldsymbol{OT}$ in terms of

(i) $h, \boldsymbol{p}$ and $\boldsymbol{q}$ **(2 marks)**

(ii) $k, \boldsymbol{p}$ and $\boldsymbol{q}$ **(2 marks)**

**(c)** Find the values of $h$ and $k$ **(4 marks)**

**24.** The test scores obtained by 40 students were recorded as shown in the table below

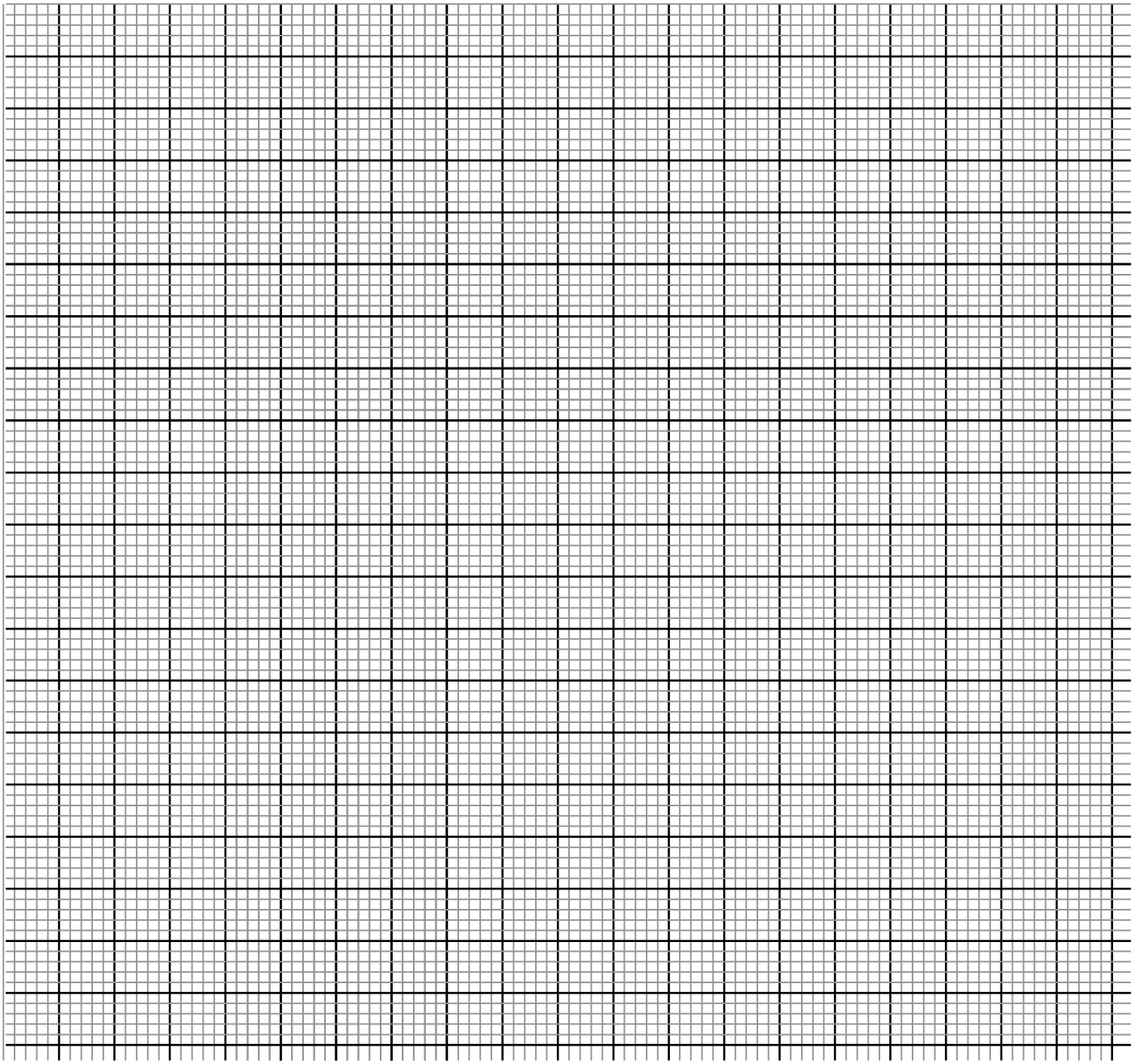
| Marks | No. of Students |
|---|---|
| 61 – 65 | 4 |
| 66 – 70 | 5 |
| 71 – 75 | 9 |
| 76 – 80 | 8 |
| 81 – 85 | 8 |
| 86 – 90 | 6 |

**(a)** Using a working mean of 73, calculate

**(i)** the mean mark **(4 marks)**

**(ii)** the standard deviation **(3 marks)**

**(b) (i)** On the grid provided, draw an ogive to represent the information in the table **(3 marks)**



**(ii)**Us the ogive to estimate the marks scored by the 25th student. **(1 mark)**