

Scheme 1

NAME..... INDEX NO..... ADM NO.....

CANDIDATE'S SIGN.....DATE.....

SCHOOL.....

MOKASA 2 JOINT EXAMINATIONS

Kenya Certificate of Secondary Education (K.C.S.E)

121/2

MATHEMATICS

PAPER 1

JULY 2018

TIME: 2 ½ HOURS

INSTRUCTIONS TO CANDIDATES.

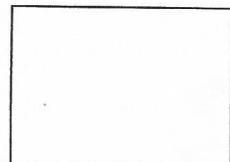
- ❖ Write your name and index number in the spaces provided above.
 - ❖ Sign and write the date of examination in the spaces provided above.
 - ❖ This paper consists of two section I and II.
 - ❖ Answer ALL questions in section I and only five questions from section II.
 - ❖ Answers and working must be written on the question paper in the spaces provided below each question.
 - ❖ Marks may be given for correct working even if the answer is wrong.
 - ❖ Non-programmable electronic calculators may be used.

FOR EXAMINERS' USE ONLY.

SECTION I

SECTION II

Grand Total



SECTION A – 50 MARKS

1. Evaluate without using a calculator or mathematical tables (3mks)

$$\frac{0.36 - 0.8 - 4.5 - 1.2 \div 0.03}{0.03 \times -3.5 + -0.5(0.3 - 2.4)}$$

BODMAS

<p>Num $-4.94 - 40.$ -44.94</p> <p>Den $-0.105 - 0.5(-2.1)$ $-0.105 + 1.05$ 0.945</p>	$\frac{-44.94}{0.945}$ $= -47.5$
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2. Use the table of logarithms to evaluate to 4 s.f $\sqrt[3]{\frac{0.3215 \times 21.98}{384.7}}$ (4 marks)

No	Std form	Log
0.3215	3.215×10^{-1}	0.5072
21.98	2.198×10^1	1.3420
384.7	3.847×10^2	0.8492 0.5851 <u>2.2641</u>

$10^{-2} \times 10^{0.2641}$
 $10^{-2} \times 1.837$
 0.01837

3. Simplify: $\frac{-4ab + 6ac + 6b - 9c}{4ab - 6b - 6ac + 9c}$ (3 marks)

Num
 $-2a(2b-3c) + 3(2b-3c)$
 $(3-2a)(2b-3c)$

Den.
 $2b(2a-3) - 3c(2a-3)$
 $(2b-3c)(2a-3)$

$\frac{- (3-2a) (2b-3c)}{(2b-3c)(2a-3)}$
 $= -1$

4. A metal A is an alloy of two metals B and C. Metal B has a mass of 68g and a density of 17g/cm^3 . Metal C has a mass of 18g and a density of 3g/cm^3 . Find the density of the alloy.

$$D = \frac{m}{V}$$

$$\text{Total mass } 68 + 18 \\ = 86.$$

$$\text{Volume of B} = \frac{68}{17} \\ = 4.$$

$$\text{Volume of C} = \frac{18}{3} \\ = 6.$$

$$\text{total volume } 4 + 6 \\ = 10.$$

$$D = \frac{86}{10} \\ = 8.6\text{g/cm}^3.$$

(3mks)

5. Use the tables of squares, square roots and reciprocal tables to evaluate the following to 2 dp (3mks)

$$\frac{\sqrt{0.8133}}{0.327} + 4.412^2$$

$$(81.33 \times 10^{-2})^{\frac{1}{2}} \\ = \frac{9.0167}{17} \\ = 9.0184 \\ = 9.0184 \times 10 \\ = 90.184.$$

$$4.412^2 = 19.466.$$

$$\frac{1}{0.327} = \frac{1}{3.27 \times 10^{-1}} \\ = 0.3058 \times 10 \\ = 3.058$$

$$90.184 \times 3.058 + 19.466,$$

$$275.782672 + 19.466$$

$$295.248672.$$

$$295.25$$

6. Three interior angles of a pentagon are 110° , 130° and 90° . The other two interior angles x and y are in the ratio 1:2. Calculate the sizes of the other two interior angles. (3mks) 2.

$$\frac{1}{x} : \frac{2}{y}$$

$$\frac{x}{y} = \frac{1}{2}$$

$$x = \frac{1}{2}y$$

$$(2n - 4)90^\circ$$

$$\begin{aligned} n &= 5 \\ [(2 \times 5) - 4]90^\circ &= 540^\circ \\ 6 \times 90^\circ &= 540^\circ \end{aligned}$$

$$110 + 130 + 90 + y + \frac{1}{2}y = 540^\circ$$

$$330 + \frac{3}{2}y = 540$$

$$\frac{3}{2}y = 210$$

$$y = 210 \times \frac{2}{3} \\ = 140.$$

$$y = 140$$

$$x = \frac{1}{2} \times 140 \\ = 70.$$

7. A Kenyan bank buys and sells foreign currencies as shown below;

Buying in Kshs.	B.	Selling in Kshs.
1 Hongkong dollar		9.77
1 South African rand		12.11

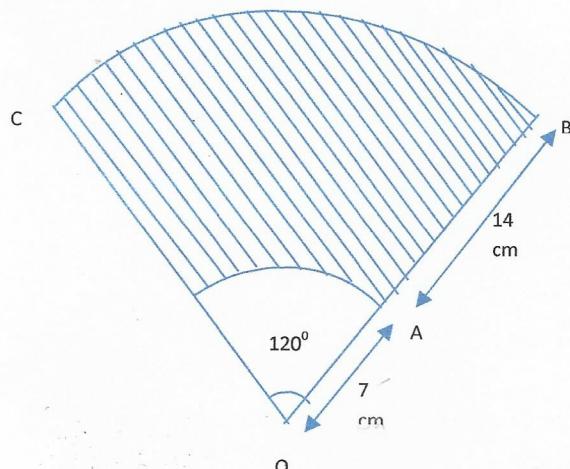
A tourist arrived in Kenya with 105,000 Hong Kong dollars and changed the whole amount to Kenya shillings while in Kenya, she spent Ksh. 403,879 and changed the balance to South African Rand before leaving for South Africa. Calculate the amount in South African Rand that he received.

$$\begin{aligned}
 1 \text{ H\$} &= 9.77 \\
 105,000 & \\
 105,000 \times 9.77 & \\
 1,025,850. & \\
 1,025,850 - 403,879 & \\
 \text{Sh. } 621,971 &
 \end{aligned}$$

$$\begin{aligned}
 1 \text{ S.AR} &= 12.11 \\
 621,971 & \\
 12.11 \times 621,971 & \\
 7,532,068.81 &
 \end{aligned}$$

8. A wind screen wiper of a car sweeps through an angle of 120° . The shaded region in the figure below represents the area swept clean by the blade of the wiper AB. If OA = 14 cm and OD = 21 cm. find the exact area of the glass swept clean

(3 marks)



$$\frac{120}{360} \times \frac{22}{7} \times 21^2 = 462.$$

$$\begin{aligned}
 \frac{120}{360} \times \frac{22}{7} \times 7^2 & \\
 = 51\frac{1}{3} &
 \end{aligned}$$

$$462 - 51\frac{1}{3} = 410\frac{2}{3} \text{ cm}^2.$$

9. Find all the integral values of x which satisfy the inequality

$$3x - 6 \leq 9x + 3 < 3x + 33$$

$$3x - 6 \leq 9x + 3$$

$$\begin{aligned} -6 &\leq 6x \\ -\frac{6}{6} &\leq \frac{6x}{6} \\ -1.5 &\leq x. \end{aligned}$$

$$9x + 3 < 3x + 33$$

$$\begin{aligned} 6x &< 30 \\ x &< 5 \end{aligned}$$

$$-1.5 \leq x < 5 \quad (3 \text{ mks})$$



$$-1, 0, 1, 2, 3, 4.$$

10. In 2007 the ratio of male population to female population in a certain town was 7:9. Between 2007 and 2009, the male population increased by 3%. If the total population was 186,000 and overall population increase during the period was 2.5%. Calculate the female population in 2009. (3 mks)

$$\begin{matrix} m : F \\ 7 : 9 \end{matrix}$$

$$\begin{aligned} F &= \frac{9}{16} \times 186,000 \\ &= 104,625 \end{aligned}$$

$$\begin{aligned} \text{T. P.} &= 1.025 \times 186,000 \\ \text{b/w} &= 190,650 \\ \text{2009.} & \end{aligned}$$

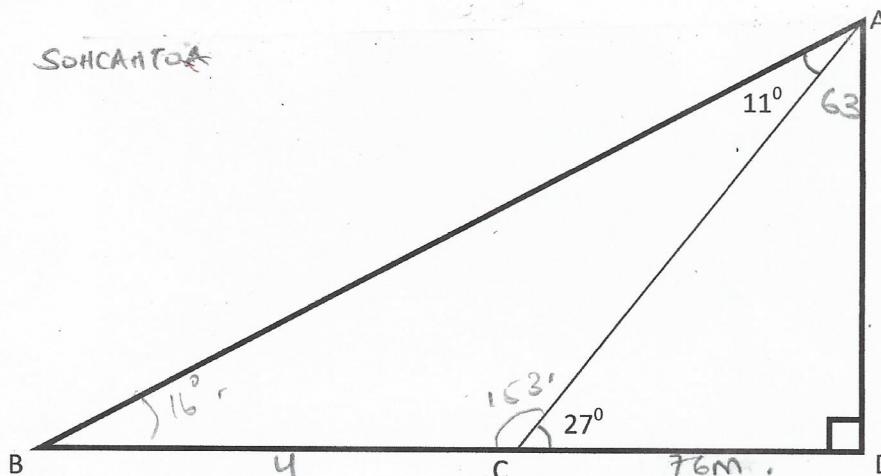
Population for men.

$$\begin{aligned} 186,000 &- 104,625 \\ &= 81,375 \\ 1.025 \times 81,375 & \\ &= 84,630 \end{aligned}$$

$$190,650 - 84,630$$

$$106,020.$$

11. Find the length of BC in the figure below correct to 2 decimal places. (3 marks)



$$0.2867y + 21.7892 = 38.7239$$

$$0.2867y = 16.9347$$

$$y = 59.0677.$$

$$= 59.07 \text{ m.}$$

$$\tan 16^\circ = \frac{H}{y+76}.$$

$$H = 0.2867(y+76).$$

$$H = 0.2867(y+76)$$

$$\tan 27^\circ = \frac{H}{76}.$$

$$H = 76 \times \tan 27^\circ$$

$$38.7239$$

12. Evaluate:

(3mks)

$$\int \left(4r^3 + \frac{3}{4}r^2 - \frac{2}{r} \right) dr$$

$$\int (4r^3 - \frac{3}{4}r^2 - 2r^{-1}) dr$$

$$r^4 - \frac{1}{4}r^3 + \frac{2r^{-1}}{-1+1} + C$$

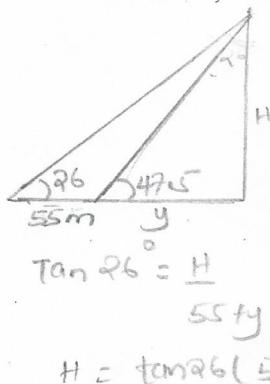
$$r^4 - \frac{1}{4}r^3 + \frac{2}{0} + C$$

$$r^4 - \frac{1}{4}r^3 + C$$

13. A security guard observes that the angle of elevation to the top of an observation tower is 26° .

If he walks 55m towards the base of the tower, the angle of elevation becomes 47.5° . By

calculation, find the height of the tower.



$$H = 0.4877(55+y) \\ = 26.8235 + 0.4877y$$

$$\tan 47.5^\circ = \frac{H}{y} \\ H = 1.0913y \quad \text{--- (i)}$$

$$26.8235 + 0.4877y = 1.0913y$$

$$26.8235 = 0.6036y \\ \frac{26.8235}{0.6036} = \frac{0.6036}{0.6036}$$

$$y = 44.4392$$

$$H = 1.0913 \times 44.4392 \\ 48.4965m$$

14. A positive two digit number is such that the sum of its digits is a third the difference between the original number and the number formed when the digits are reversed. When the number is

multiplied by 3, the product is 4 times the sum of the digits. What is the number? (3 marks)

$$x+y = \frac{1}{3}[(10y+x)-(10x+y)]$$

$$x+y = \frac{1}{3}[10y+x-10x-y]$$

$$x+y = \frac{1}{3}(9y-9x)$$

$$x+y = 3y-3x$$

$$4x = 2y$$

$$\frac{4}{4}x = \frac{2}{4}y$$

$$x = \frac{1}{2}y \quad \text{--- (i)}$$

$$3(xy) = 4(x+y)$$

$$3(\frac{1}{2}y \cdot y) = 4(\frac{1}{2}y + y)$$

$$\frac{3}{2}y^2 = 2y + 4y$$

$$3y^2 = 12y$$

$$\frac{3}{3}y = \frac{12}{3}$$

$$y = 4$$

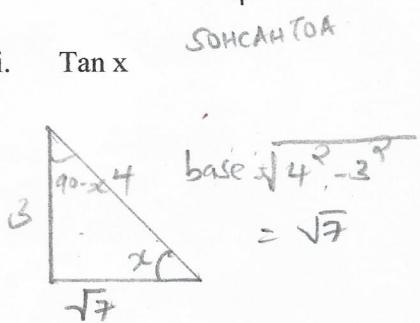
$$x = \frac{1}{2} \times 4 \\ = 2$$

$$= 2$$

the no is 24.

15. Given that $\sin x = \frac{3}{4}$, where x is an acute angle, find without using a calculator or table the value of;

i. $\tan x$



$$\tan x = \frac{3}{\sqrt{7}}$$

(2mks)

ii. $\sin(90-x)$

$$\sin(90-x) = \frac{\sqrt{7}}{4}$$

(1mk)

16. Ivy and Rita have sweets. When Rita gives out one of her sweets, Ivy will have twice as many sweets as Rita. If Ivy gives out one of her sweets, they will have equal number of sweets. Find the number of sweets each has. (3mks)

$$Ivy - x \quad | \quad x-1 \quad | \quad x-1$$

$$Rita - y \quad | \quad y-1 \quad |$$

$$x = 2(y-1)$$

$$x = 2y - 2$$

$$x - 2y = -2, \dots \text{(i)}$$

$$x-1 = y.$$

$$x-y = 1 \quad \dots \text{(ii)}$$

$$\begin{array}{r} x - 2y = -2 \\ x - y = 1 \\ \hline -y = -3 \end{array}$$

$$y = 3$$

$$x - 3 = 1$$

$$x = 4.$$

$$Ivy = 4$$

$$Rita = 3.$$

SECTION B - ANSWER FIVE QUESTIONS ONLY

17. Jane is a shoe sales lady on a basic salary of ksh 25000 per month. On top of her salary, she gets a commission of 2% on sales upto ksh.50000, 5% on sales between ksh.50000 to ksh.150,000 and 12% for any sales above ksh.150,000. In a certain month, Jane had a total pay of ksh.41620.

- a) Determine the total sales she made during the month (4marks)

$$\begin{aligned} & \frac{2}{100} \times 50,000 = 1,000 \\ & \frac{5}{100} \times 100,000 = 5,000 \\ & 25,000 + 1,000 + 5,000 \\ & = 31,000 \\ & 41,620 - 31,000 \\ & = \text{Sh. } 10,620. \end{aligned}$$

$$\begin{aligned} & \frac{12}{100} \times x = 10,620 \\ & x = \frac{10,620 \times 100}{12} \\ & = 88,500 \end{aligned}$$

- b) If she sold each pair of shoes at ksh.4500, how many pairs did she sell that month

$$\begin{aligned} & \frac{103,500}{4500} \\ & = 23. \end{aligned}$$

- c) On selling a pair at ksh.4500, she made a profit of 20% instead of 28% had she sold with the marked price. Find:

- i) The marked price

$$\begin{aligned} & 4500 - 120\% \\ & 100 - 120 \\ & \frac{100 \times 4500}{120} = \text{Sh. } 3750. \end{aligned}$$

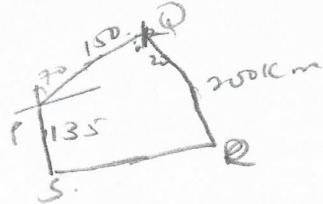
- ii) The manufacturers price

$$\text{Sh. } 3750.$$

$$\begin{aligned} & 3750 - 100\% \\ & - 128\% \end{aligned}$$

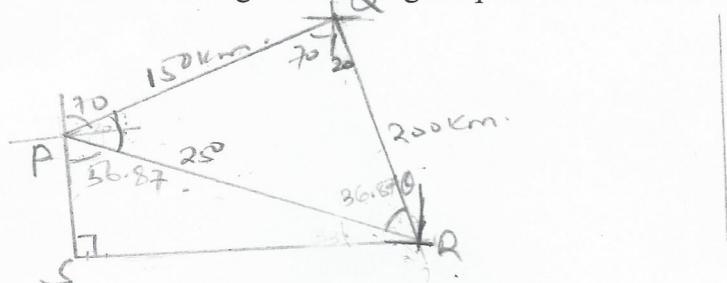
(2marks)

$$\begin{aligned} & \frac{3750 \times 128}{100} \\ & = \text{Sh. } 4800 \end{aligned}$$



18. Four towns P, Q, R and S are such that town Q is 150km on a bearing of 070° from town P. Town R is 200km on a bearing of 160° from town Q. Town S is due west of town R and 135km due south of town P.

- (a) Draw a sketch diagram showing the positions of towns P, Q, R and S. (1 mark)



- (b) Without using scale drawing calculate:

- (i) The distance PR (3 marks)

$$\begin{aligned} PR &= \sqrt{150^2 + 200^2} \\ &= \sqrt{62,500} \end{aligned}$$

$$= 250 \text{ m.}$$

- * (ii) To 2 s.f the bearing of P from R (3 marks)

$$\angle QRP = \frac{150}{\sin R} = \frac{250}{\sin 90^{\circ}}$$

$$250 \sin R = 150 \sin 90^{\circ}$$

$$\sin R = \frac{150 \times \sin 90^{\circ}}{250}$$

$$= 0.6$$

$$R = \sin^{-1}(0.6)$$

$$= 36.87^{\circ}$$

$$\angle QPR = 180 - 90 - 36.87 \\ = 53.13^{\circ}$$

$$\angle RPS = 56.87^{\circ}$$

$$\angle PRS = 33.13^{\circ}$$

$$\theta = 90 - (36.87 + 33.17) \\ = 20.0^{\circ}$$

$$\text{Bearing of } P \text{ from } R \\ 360 - (20 + 36.87)$$

$$= 303.13^{\circ}$$

- (c) Calculate to the nearest whole number the distance RS (3 marks)

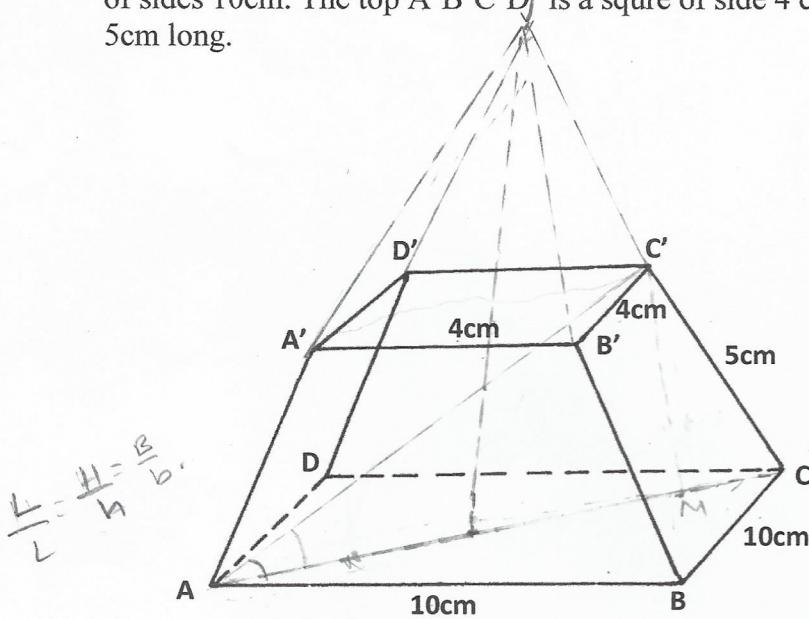
$$\frac{250}{\sin 90^{\circ}} = \frac{RS}{\sin 56.87^{\circ}}$$

$$RS \sin 90^{\circ} = 250 \times \sin 56.87^{\circ}$$

$$RS = \frac{250 \times \sin 56.87^{\circ}}{\sin 90^{\circ}}$$

$$= 209.3582 \text{ km.}$$

19. The figure below shows a frustum of a square based pyramid. The base ABCD is a square of sides 10cm. The top A'B'C'D' is a square of side 4 cm and each slant edge of the frustum is 5cm long.



(not drawn to scale).

$$L = 8.3333,$$

$$H = \sqrt{8.333^2 - 7.071^2}$$

$$= \sqrt{19.4448}$$

$$= 4.4096,$$

$$\frac{10}{4} = \frac{4.4096}{h}$$

$$\frac{10h}{10} = \frac{4 \times 4.4096}{10}$$

$$h = 1.7638$$

$$4.4096 - 1.7638$$

$$= 2.6458$$

Determine

- a) The height of the frustum (2mks)

$$\begin{aligned} AC &= \sqrt{10^2 + 10^2} \\ &= \sqrt{200} \\ &= 14.1421\ldots \\ &= 14.1421\ldots \\ &= 7.0710\ldots \end{aligned}$$

$$\frac{4+5}{L} = \frac{10}{4}$$

$$L = 8.3333$$

- b) The volume of the frustum (3mks)

$$\left[\frac{1}{3} \times 10 \times 10 \times 4.4096 \right] - \left[\frac{1}{3} \times 4 \times 4 \times 1.7638 \right]$$

$$[146.9867] - [9.4069]$$

$$137.5798 \text{ cm}^3$$

s(3-6)

- c) The total surface area of the frustum (3mks)

$$\begin{aligned} \text{Area } &8.3333 \quad 8.3333 \\ &\triangle = \sqrt{13.333(13.3333 - 8.3333)(13.3333 - 10)} \\ &\text{triangle} = \sqrt{111.097222} \\ &33.3331 \ldots \\ &S = (8.3333 \times 2) + 10 \\ &= 13.3333 \ldots \end{aligned}$$

$$\begin{aligned} A &= \sqrt{13.333(13.3333 - 8.3333)(13.3333 - 10)} \\ &33.3331 \ldots \\ &S = (3.3333 \times 2) + 4 \\ &= 5.3333 \ldots \end{aligned}$$

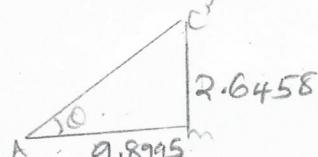
$$\begin{aligned} &33.3331 - 5.3333 \\ &27.9998 \\ &27.9998 \times 4 \\ &- 111.9992 \end{aligned}$$

- d) The angle between AC' and the base ABCD (2mks)

$$A'C' = \sqrt{4^2 + 4^2}$$

$$\sqrt{32}$$

$$= 5.6569$$



$$= 227.9992$$

? 226.

$$\begin{aligned} AM &= 14.1421 - \frac{(14.1421 - 5.6569)}{2} \\ &= 9.8995 \end{aligned}$$

$$\tan \theta = \frac{2.6458}{9.8995}$$

$$\theta = 14.9635^\circ$$

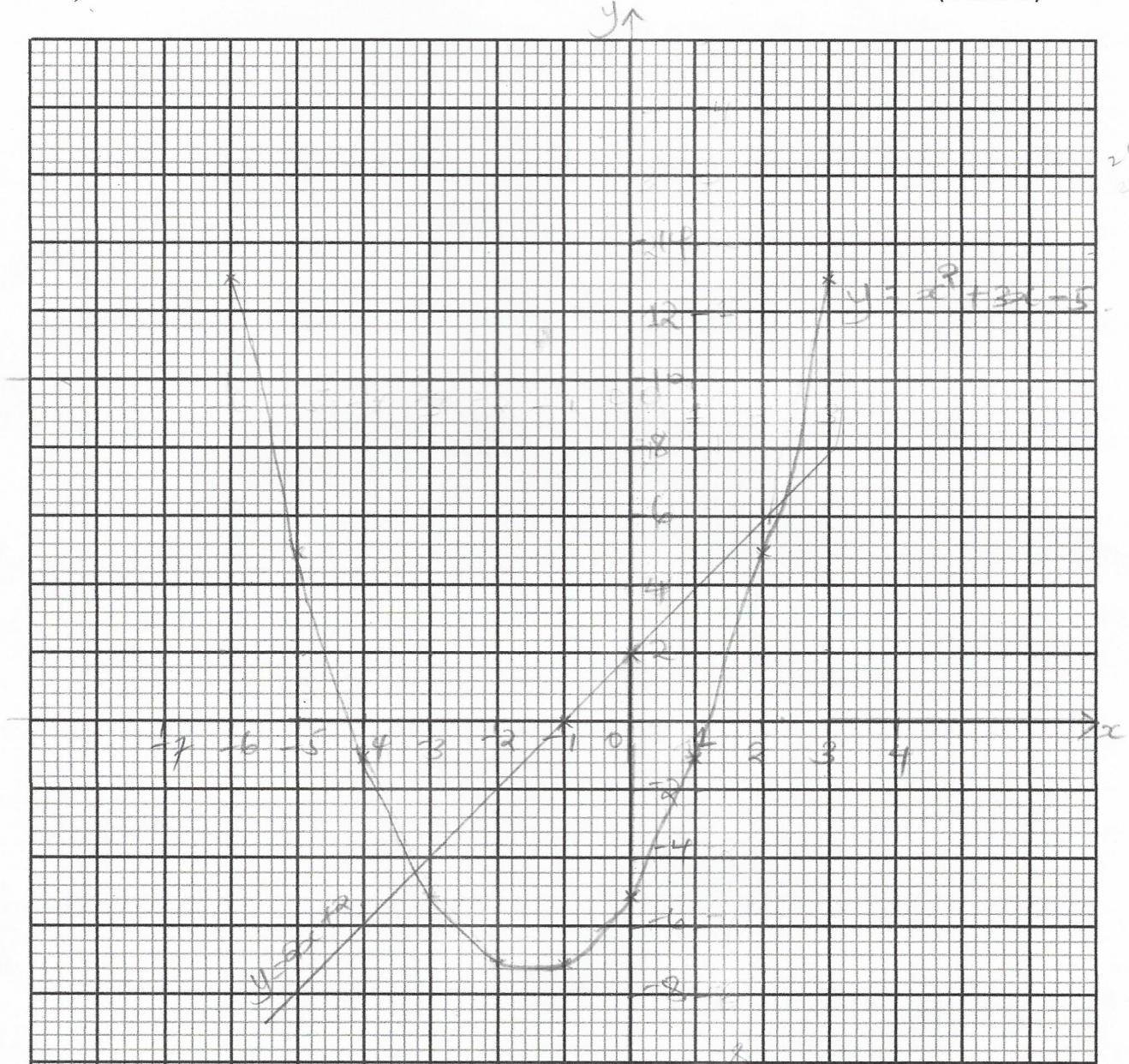
20. a) Complete the table below for the function: $y = x^2 + 3x - 5$

X	-6	-5	-4	-3	-2	-1	0	1	2	3
Y	13	5	-1	-5	-7	-7	-5	-1	5	13

b) On the grid provided, draw the graph of: $y = x^2 + 3x - 5$ for $-6 \leq x \leq 3$

(use 1 cm to represent 1 unit on the horizontal axis and 2cm to represent 5 units on the vertical axis.)

(3 marks)



c) Using the graph, estimate the values of x when $y = 0$ (2marks)

$$x_1 = -4.2 \pm 0.1 \text{ or}$$
$$x_2 = 1.2 \pm 0.1$$

d) On the same axes, draw the line $y = 2x + 2$ and use it to determine the root of the function

$$y = x^2 + x - 7$$

$$\begin{aligned} y &= 2x + 2 && \text{when } y = 0 \\ \text{when } x &= 0 && x = -1 \\ y &= 2 && (-1, 0) \\ (0, 2) & & & \end{aligned}$$

$$x_1 = -3.2 \text{ or}$$
$$x_2 = 2.3$$

21. (a) A rectangle PQRS has vertices P(1, 2), Q(3, 2), R(3, 5) and S(1, 5). Plot PQRS on the grid
 provided. (2mk)

(b) Find the co-ordinates of P', Q', R' and S' the image of PQRS after a translation $\begin{bmatrix} -1 \\ 2 \end{bmatrix}$ and plot rectangle P'Q'R'S'

$$\begin{bmatrix} P & Q & R & S \\ 1 & 3 & 3 & 1 \\ 2 & 2 & 5 & 5 \end{bmatrix} + \begin{bmatrix} -1 \\ 2 \end{bmatrix} = \begin{bmatrix} P' & Q' & R' & S' \\ 0 & 2 & 2 & 0 \\ 4 & 4 & 7 & 7 \end{bmatrix} \quad P'(0, 4) \quad Q'(2, 4) \quad R'(2, 7) \quad S'(0, 7) \quad (3\text{mks})$$

(c) Rectangle P'Q'R'S' above is mapped onto rectangle P''Q''R''S'' under the matrix $\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$

. Find the co-ordinates of this image, and plot on the same axes above. (3mks)

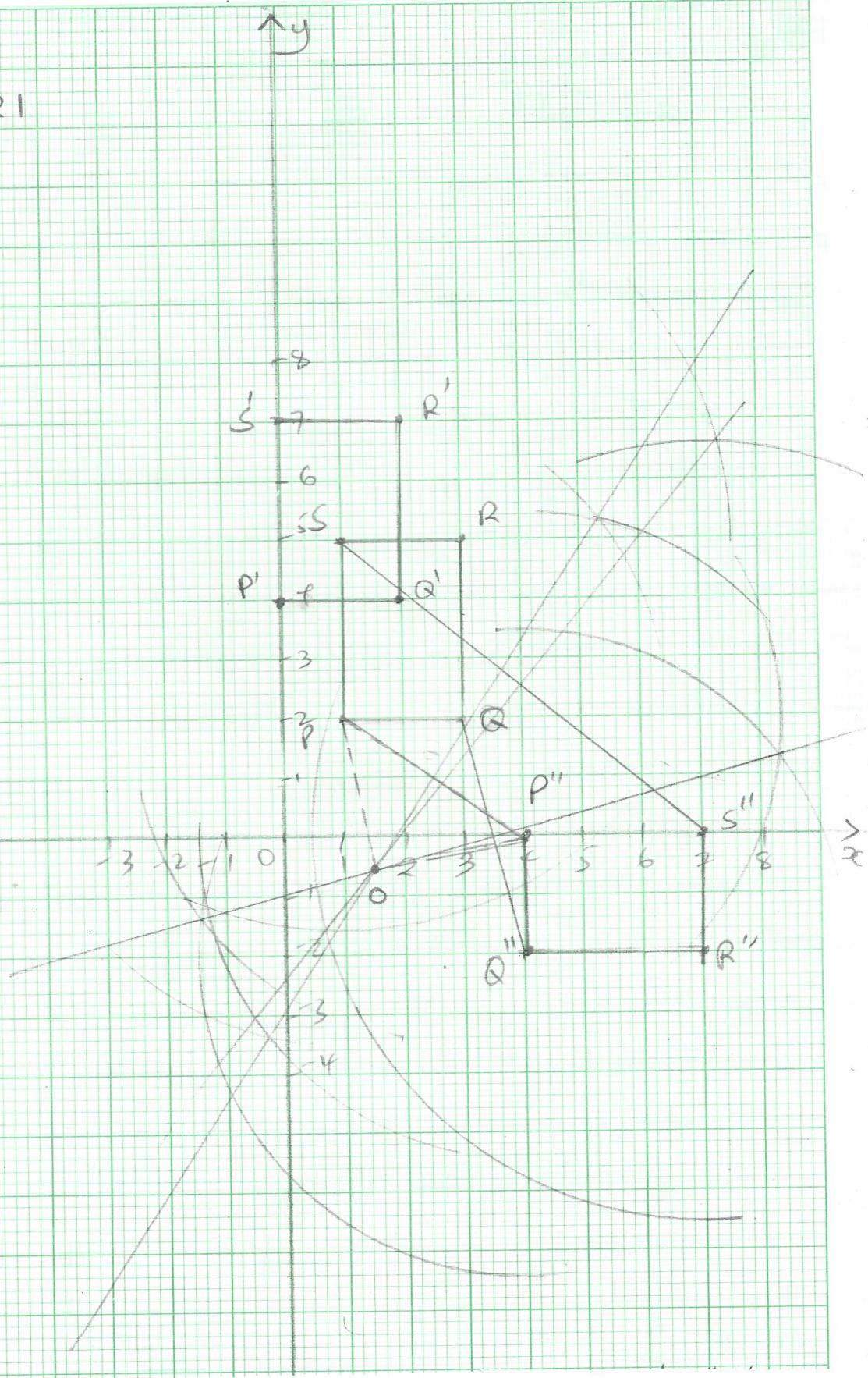
$$\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} \begin{bmatrix} P' & Q' & R' & S' \\ 0 & 2 & 2 & 0 \\ 4 & 4 & 7 & 7 \end{bmatrix} = \begin{bmatrix} P'' & Q'' & R'' & S'' \\ 4 & 4 & 7 & 7 \\ 0 & -2 & -2 & 0 \end{bmatrix} \quad P''(4, 0) \quad R''(7, -2) \\ Q''(4, -2) \quad S''(7, 0)$$

(d) using the diagrams in (b) and (c) determine the centre and angle of rotation that map PQRS onto P''Q''R''S''. (2mks)

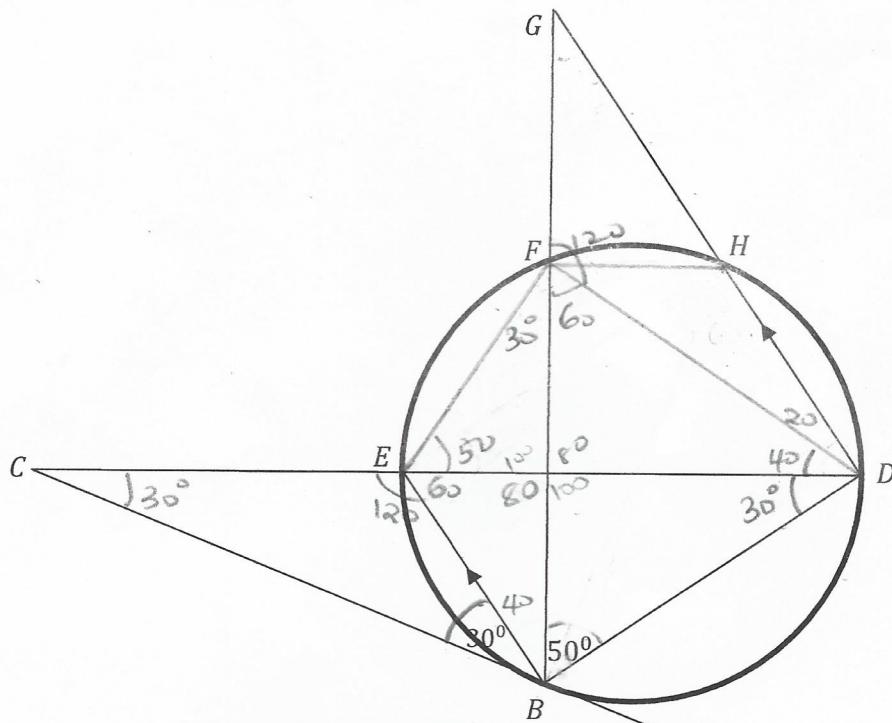
COR $(1.5, 0.5)$

AoR -90° .

Qn 21



22. In the figure below ABC is a tangent to the circle at B. DE is a diameter and DEC and BFG are straight lines. BE is parallel to DG. Angle EBC = 30° and angle DBG = 50°



Find the following angles giving reasons for each answer;

a) $\angle BDE$

(2mks)

30° - Angles in alternate segment are equal.

b) $\angle BCE$

(2mks)

30° - sum of angles in a triangle
are supplementary.

c) $\angle BGD$

(2mks)

40° - Angles in a triangle are
supplementary.

d) $\angle FDG$

(2mks)

$60^\circ - 40^\circ = 20^\circ$

Alternate angles are equal.

e) $\angle BED$

(2mks)

60° - sum of angles in a triangle are
supplementary

23. A body is s metres from its starting point O after time t where $s = 4t^3 - 3t^2 - 6t$. Find:

- a) The value of s when $t = 2$ seconds (2 marks)

$$s = (4 \times 2^3) - (3 \times 2^2) - (6 \times 2)$$

$$= 8$$

- b) Expressions for velocity and acceleration of the body after t seconds (2 marks)

$$s = 4t^3 - 3t^2 - 6t$$

$$v = \frac{ds}{dt} = 12t^2 - 6t - 6$$

$$a = \frac{dv}{dt} = 24t - 6.$$

- c) The value of t when the particle is at rest (3 marks)

$$v = 0$$

$$12t^2 - 6t - 6 = 0$$

$$\frac{12}{6} \frac{-6}{6} \frac{-6}{6}$$

$$2t^2 - t - 1 = 0$$

$$2t^2 - 2t + t - 1 = 0$$

$$2t(t-1) + 1(t-1) = 0$$

$$(2t+1)(t-1) = 0$$

$$2t+1 = 0$$

$$t = -\frac{1}{2}$$

$$t-1 = 0$$

$$t = 1$$

$$\therefore t = 1$$

- d) The maximum velocity the particle attains (3 marks)

$$a = 0$$

$$24t - 6 = 0$$

$$24t = 6$$

$$\frac{24}{24} \frac{6}{24}$$

$$t = \frac{1}{4}$$

$$v = 12\left(\frac{1}{4}\right)^2 - 6\left(\frac{1}{4}\right) - 6$$

$$= -6.75$$

$$6.75 \text{ m/s}$$

24. The weights to the nearest kilogram, of 200 pupils were recorded as shown below;

Mass	Frequency	x	fx	CW	$fd = f/CW$
41-50	21	47 R1	45.5	955.5	10 2.1
51-55	62	83	53	3286	5 16.6
56-65	y	55 138	60.5	3327.5	10 5.5
66-70	50	188	68	3400	5 10
71-85	12	200	78	936	15 0.8
				11,905	

a) Find the value of y (1mk)

$$y = 200 - (R1 + 62 + 50 + 12) \\ = 55$$

b) Estimate the mean weight (2mks)

$$\frac{11905}{200}$$

$$= 59.525$$

c) Estimate the median (3mks)

$$55.5 + \left(\frac{17}{55} \times 10 \right)$$

$$= 58.5909$$

d) Draw a histogram to represent the information above. (4mks)

24 d.



fd.
30

20

10

40.5

50.5 55.5

65.5 70.5 75.5



Mass

