

SECTION 1 (50 MARKS) Answer all questions in this section

1. Solve the equation $\frac{1}{3}(2x+1) + \frac{1}{4}(5x-1) = \frac{1}{2}$

(3mks)

$$12 \times \frac{1}{3}(2x+1) + \frac{1}{4}(5x-1) \times 12 = \frac{1}{2} \times 12$$

$$4(2x+1) + 3(5x-1) = 6 \quad \checkmark M_1$$

$$8x + 4 + 15x - 3 = 6$$

$$23x + 1 = 6 \quad \checkmark M_1$$

$$\frac{23x}{23} = \frac{5}{23} \quad x = \frac{5}{23} \quad \checkmark A_1$$

2. a). Expand $(1-2x)^4$

(1mk)

$$1 - 4(2x) + 6(2x)^2 - 4(2x)^3 + (2x)^4$$

$$1 - 8x + 24x^2 - 32x^3 + 16x^4 \quad \dots B_1$$

b). Use your expansion to find the value of $(0.96)^4$ correct to 4 s.f

(2mks)

$$1 - 2x = 0.96$$

$$\frac{0.04}{2} = \frac{2x}{2}$$

$$x = 0.02$$

$$1 - 8(0.02) + 24(0.02)^2 - 32(0.02)^3 + 16(0.02)^4 \quad \dots M_1$$

$$1 - 0.16 + 0.00096 - 0.000256 + 0.00000256$$

$$0.84985856$$

$$0.8499 \quad \checkmark A_1$$

3. The expression $1 + \frac{x}{2}$ is taken as an approximation for $\sqrt{1+x}$. Find the percentage error in doing so if $x = 0.44$

(3mks)

$$\text{True value } \sqrt{1+x} = \sqrt{1.44} = 1.2 \quad \checkmark B_1$$

$$\text{Approx } 1 + \frac{x}{2} = 1 + \frac{0.44}{2} = 1.22$$

$$1.22 - 1.2 = 0.02 \quad \checkmark M_1$$

$$\frac{0.02}{1.2} \times 100 = 1.67\% \quad \checkmark A_1$$

4. Solve for x in the equation

$$\log_8(x+6) - \log_8(x-3) = \frac{2}{3}$$

(4mks)

$$3\log_8(x+6) - 3\log_8(x-3) = 2 \quad \checkmark M_1$$

$$\log_8(x+6)^3 - \log_8(x-3)^3 = \log_8 64$$

$$\log_8\left(\frac{x+6}{x-3}\right)^3 = \log_8 64$$

$$3\log_8\left(\frac{x+6}{x-3}\right) = \log_8 64 \quad \checkmark M_1$$

$$\log_8\left(\frac{x+6}{x-3}\right) = \frac{1}{3}\log_8 64$$

$$\log_8\left(\frac{x+6}{x-3}\right) = \log_8 64^{\frac{1}{3}} \quad \checkmark M_1$$

$$\log_8 \frac{x+6}{x-3} = \log_8 4$$

$$\frac{x+6}{x-3} = 4$$

$$x+6 = 4x-12$$

$$18 = 3x$$

$$x = 6$$

(3mks)

5. Make p the subject of the formula

$$E + x = x + \sqrt{\frac{p^2 - 3y}{y - 3xp^2}}$$

$$E = \sqrt{\frac{p^2 - 3y}{y - 3xp^2}} \quad \checkmark M_1$$

$$E^2 = \frac{p^2 - 3y}{y - 3xp^2}$$

$$E^2 y - 3E^2 x p^2 = p^2 - 3y$$

$$E^2 y + 3y = p^2 + 3E^2 x p^2 \quad \checkmark M_1$$

$$E^2 y + 3y = p^2(1 + 3E^2 x)$$

$$p^2 = \frac{E^2 y + 3y}{1 + 3E^2 x}$$

$$p = \pm \sqrt{\frac{E^2 y + 3y}{3E^2 x + 1}} \quad \checkmark A_1$$

± sign is missing
A0

6. Mr Chitechi deposited sh. 24,000 in a fixed account for a period of 24 months. The bank pays compound interest on quarterly basis. At the end of this period, Mr. Chitechi's account had ksh.64,200. Determine the rate at which interest is paid per annum. (3mks)

$$\frac{64,200}{24,000} = \frac{24,000}{24,000} \left(1 + \frac{r}{100} \times \frac{1}{4}\right)^8 \quad \checkmark M_1$$

$$2.675 = \left(1 + \frac{r}{400}\right)^8$$

$$1.130577$$

$$\sqrt[8]{2.675} = 1 + \frac{r}{400}$$

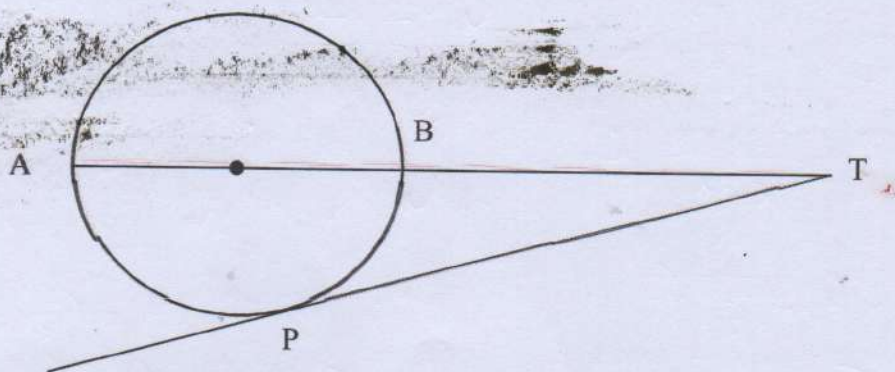
$$1.131 = 1 + \frac{r}{400} \quad \checkmark$$

$$400 \times 0.131 = \frac{r}{400} \times 400$$

$$r = 52.4\% \quad \checkmark$$

A1

7. In the figure below PT is a tangent to the circle at P and AT passes through the centre of the circle.



If PT = 9cm and AT = 12cm, find the radius of the circle correct to 1 d.p.

(3mks)

$$AT \times BT = (PT)^2 \quad \checkmark M_1$$

$$12 \times BT = 9^2$$

$$BT = \frac{81}{12}$$

$$BT = 6.75 \text{ cm}$$

$$AB = 12 - 6.75 \quad \checkmark M_1$$

$$AB = 5.25 \text{ cm}$$

$$\text{Radius} = \frac{5.25}{2} = 2.62$$

$$\checkmark A_1$$

2.6 cm

8. Find the radius and the centre of the circle whose equation is

(3mks)

$$\frac{3x^2}{3} + \frac{3y^2}{3} - \frac{6x}{3} + \frac{3}{3} + \frac{12y}{3} = 0$$

$$x^2 + y^2 - 2x + 1 + 4y = 0$$

$$x^2 + y^2 - 2x + 4y = -1 \quad \checkmark M_1$$

$$x^2 + 2x + \left(-\frac{2}{2}\right)^2 + y^2 + 4y + \left(\frac{4}{2}\right)^2 = -1 + \left(-\frac{2}{2}\right)^2 + \left(\frac{4}{2}\right)^2$$

$$(x-1)^2 + (y+2)^2 = -1 + 1 + 4 \quad \checkmark M_1$$

$$(x-1)^2 + (y+2)^2 = 4$$

$$\text{Centre } (1, -2) \quad \checkmark A_1$$

$$\text{Radius } 2$$

for both
centre &
radius.

9. Without using a calculator or mathematical tables express $\frac{\sqrt{3}}{1 - \cos 30^\circ}$ in surd form and simplify

(3mks)

$$\frac{\sqrt{3}}{1 - \frac{\sqrt{3}}{2}} \times \frac{1 + \frac{\sqrt{3}}{2}}{1 + \frac{\sqrt{3}}{2}}$$

$$= \frac{\sqrt{3}(1 + \frac{\sqrt{3}}{2})}{(1 - \frac{\sqrt{3}}{2})(1 + \frac{\sqrt{3}}{2})}$$

$$= \frac{\sqrt{3} + \frac{3}{2}}{1 - \frac{3}{4}} \quad \checkmark M_1$$

$$\frac{\sqrt{3} + \frac{3}{2}}{1/4}$$

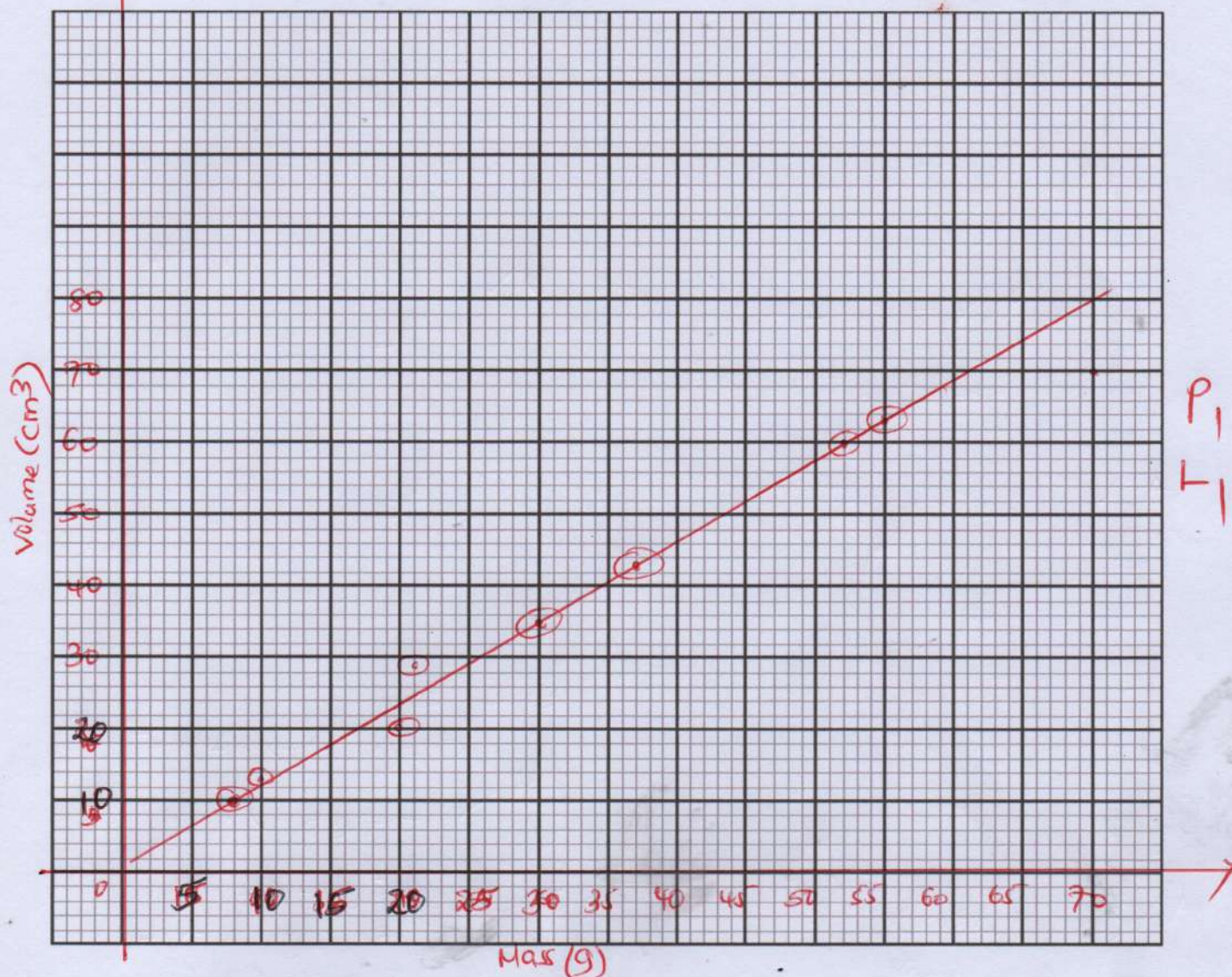
$$4(\sqrt{3} + \frac{3}{2})$$

$$= 4\sqrt{3} + 6 \quad \checkmark A_1$$

10. The table below represents the mass and volume of a liquid measured at room, temperature.

Mass (g)	8	10	20	21	30	37	52	55	70
Volume (cm ³)	10	13	20	29	35	43	60	63	70

a). By plotting the points and drawing the line of best fit, estimate the density to the liquid. (2mks)



b). Determine the equation of your graph. (2mks)

$$\frac{52 - 30}{60 - 35} = \frac{22}{25} \quad \checkmark$$

B1

$$\frac{y - 30}{x - 35} = \frac{22}{25}$$

$$25y - 750 = 22x - 770$$

5

$$\frac{25y}{25} = \frac{22x}{25} + \frac{20}{25}$$

$$y = \frac{22}{25}x - \frac{20}{25} \quad \checkmark$$

B1

11. The population of two towns Kathwana and Siakago for three years was as follow.

	1 st year	2 nd year	3 rd year
Kathwana	40,000	48,000	56,000
Siakago	40,000	48,000	57,600

Calculate the difference in population of the two after six years.

(3mks)

Kathwana $d = 8000$ $a = 40,000$ ✓ M
 $40000 + (5 \times 8000) = 80,000$

Siakago $r = \frac{48,000}{40,000} = 1.2$ ✓ M
 $40000(1.2)^5 = 40000 \times 2.488$
 $= 99,533$

Difference
 $99533 - 80,000$
19533 ✓ A₁

12. Solve for α in the equation $6 \sin^2 \alpha - \cos \alpha - 5 = 0$

(3mks)

For $0 \leq \alpha \leq 300^\circ$



$6(1 - \cos^2 \alpha) - \cos \alpha - 5 = 0$
 $6 - 6\cos^2 \alpha - \cos \alpha - 5 = 0$ ✓ M₁
 $-6\cos^2 \alpha - \cos \alpha + 1 = 0$
 $6a^2 - a - 1 = 0$ ✓ M₁
 $6a^2 + 3a - 2a - 1 = 0$
 $3a(2a+1) - 1(2a+1) = 0$
 $3a-1=0$ $2a+1=0$
 $a = \frac{1}{3}$ $a = -\frac{1}{2}$

$\cos \alpha = \frac{1}{3}$

$\alpha = 120^\circ, 240^\circ$

$\cos \alpha = -\frac{1}{2}$

$\alpha = 210^\circ \text{ and } 285^\circ$ ✓ A₁

13. Arabic coffee costing sh90 per kilogram is mixed with rubusta coffee costing sh.75 per kilogram in the ration 2:3. Calculate the selling price of the mixture per kilogram if a profit of 15% is to be realized to the nearest shilling.

(3mks)

A R
 90 75
 2 3

$\frac{(90 \times 2) + (75 \times 3)}{2+3}$ ✓ M

$= \frac{180 + 225}{5}$ M₁

$= \text{sh } 81 \text{ per kg}$

$\frac{115}{100} \times 81$ ✓ A₁

= sh 93.00

14. The gradient of a curve at any point is given by $2x-1$. Given that the curve passes through point $(1,5)$. Find the equation of the curve. (3mks)

$$\frac{dy}{dx} = 2x - 1$$

$$y = \int (2x-1) dx \quad \checkmark M_1$$

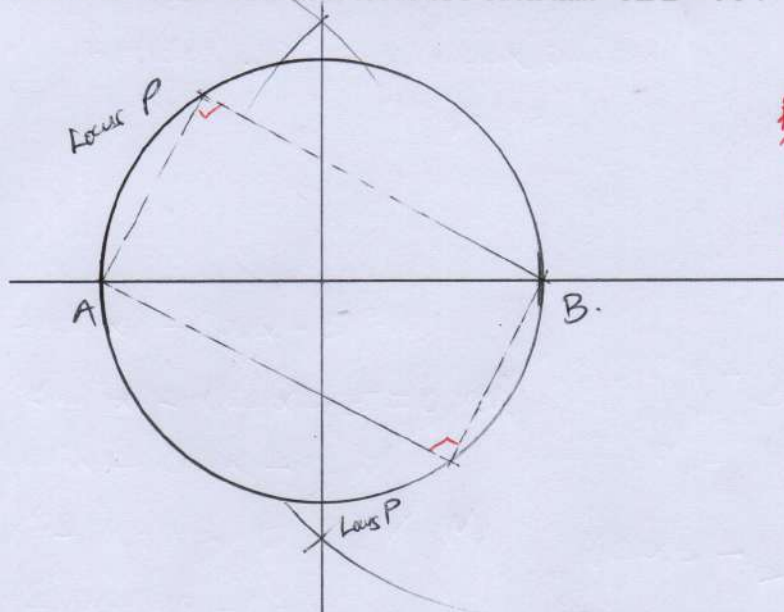
$$y = x^2 - x + C$$

$$5 = (1)^2 - 1 + C \quad \checkmark M_2$$

$$5 = C$$

$$y = x^2 - x + 5 \quad \checkmark A_1$$

15. a). Given that $AB=6\text{cm}$. Construct locus of P such that $\angle APB = 90^\circ$. (2mks)



B_1 - locating centre
 B_1 - completed the circle

- b). Hence determine the area enclosed by the locus of P. (2mks)

$$A = \pi r^2$$

$$= \frac{22}{7} \times 3 \times 3$$

$$= 28.2857$$

16. Given the vectors $\mathbf{a} = 3\mathbf{j} + 2\mathbf{k}$ and $\mathbf{b} = 4\mathbf{i} - 7\mathbf{k}$

Find $\mathbf{p}$ if $\mathbf{p} = 3\mathbf{a} - \mathbf{b}$

(2mks)

$$3 \begin{pmatrix} 0 \\ 3 \\ 2 \end{pmatrix} - \begin{pmatrix} 4 \\ 0 \\ 7 \end{pmatrix}$$

$$\begin{pmatrix} 0 \\ 9 \\ 6 \end{pmatrix} - \begin{pmatrix} 4 \\ 0 \\ 7 \end{pmatrix} = \begin{pmatrix} -4 \\ 9 \\ -1 \end{pmatrix}$$

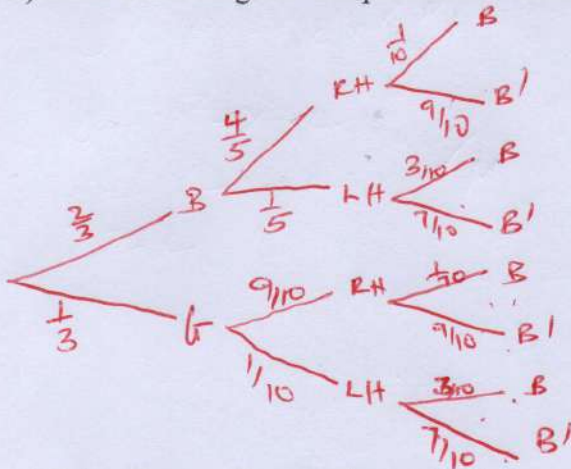
$$\mathbf{p} = \begin{pmatrix} -4 \\ 9 \\ -1 \end{pmatrix}$$

SECTION II 50 MARKS (Answer any five questions only in this section)

17. In a science class $\frac{2}{3}$ of the class are boys and the rest are girls. 80% of the boys and 90% of the girls are right handed. The probability that the right handed student will break a test tube in any session is $\frac{1}{10}$ and that for the left handed student is $\frac{3}{10}$ regardless of whether boy or girl.

a) Draw a tree diagram to represent this information

(2 marks)



b) Using the tree diagram drawn, find the probability that:

i) A student chosen at random from the class is left handed

(2 marks)

$$\left(\frac{2}{3} \times \frac{20}{100}\right) + \left(\frac{1}{3} \times \frac{10}{100}\right)$$

$$\frac{4}{30} + \frac{1}{30} = \frac{5}{30} = \frac{1}{6}$$

ii) A test tube is broken by a left handed student

(2 marks)

$$\left(\frac{2}{3} \times \frac{1}{5} \times \frac{3}{10}\right) + \left(\frac{1}{3} \times \frac{1}{10} \times \frac{3}{10}\right)$$

$$\frac{4}{300} + \frac{1}{100} = \frac{5}{300} = \frac{1}{60}$$

iii) A test tube is broken by a right handed student

(2 marks)

$$\left(\frac{2}{3} \times \frac{4}{5} \times \frac{1}{10}\right) + \left(\frac{1}{3} \times \frac{9}{10} \times \frac{1}{10}\right)$$

$$\frac{4}{75} + \frac{3}{100} = \frac{16}{300} + \frac{9}{300} = \frac{25}{300} = \frac{1}{12}$$

iv) A test tube is not broken in any session

(2 marks)

$$\left(\frac{2}{3} \times \frac{4}{5} \times \frac{9}{10}\right) + \left(\frac{2}{3} \times \frac{1}{5} \times \frac{7}{10}\right) + \left(\frac{1}{3} \times \frac{9}{10} \times \frac{9}{10}\right) + \left(\frac{1}{3} \times \frac{1}{10} \times \frac{7}{10}\right)$$

$$\frac{24}{50} + \frac{7}{75} + \frac{27}{100} + \frac{7}{300}$$

$$= \frac{13}{18}$$

18. The following table shows the rate at which income tax was charged during a certain year.

Monthly taxable income in Ksh.	Tax rate %
0 - 9860	10
9861 - 19720	15
19721 - 29580	20
29581 - 39440	25
39441 - 49300	30
49301 - 59160	35
over 59160	40

A civil servant earns a basic salary of Ksh.35750 and a monthly house allowance of sh.12500 and non taxable allowance of ksh 10000. The civil servant is entitled to a personal relief of sh.1062 per month. Calculate:

a) Taxable income

(2 marks)

$$35750 + 12500 = 48250$$

sh 48,250

M, A

b) Calculate his net monthly tax

(5 marks)

$$9860 \times \frac{10}{100} = 986$$

$$9860 \times \frac{15}{100} = 1479$$

$$9860 \times \frac{20}{100} = 1972$$

$$8810 \times \frac{25}{100} = 2202.5$$

$$\text{Gross tax} = 6639$$

$$\text{Net tax} = 5577.50$$

Ksh 5577.50

M,
M,
M,
M,
A,

c) Apart from the salary the following deduction are also made from his monthly income.

WCPS at 2% of the basic salary, Loan repayment Ksh.1325, NHIF sh.480

Calculate his net monthly earning.

(3 marks)

$$\text{Add ded} = \left(\frac{2}{100} \times 35750 + 1325 + 480 + 5577 \right)$$

$$(48250 + 10000) - (8077.5)$$

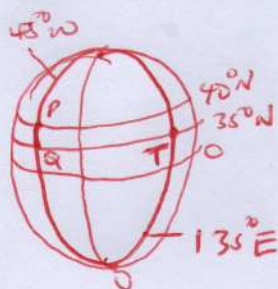
$$= \text{sh } 50,152.50$$

M,
A

10

19. A plane S flies from a point P (40°N, 45°W) to a point Q (35°N, 45°W) and then to another point T (35°N, 135°E).

a) Given that the radius of the earth is 6370 km find the distance from P to Q in km. Take $\pi = \frac{22}{7}$



$$K = \frac{\alpha}{360} \times 2\pi R$$

$$= \frac{5}{360} \times \frac{22}{7} \times 6370 \times 2$$

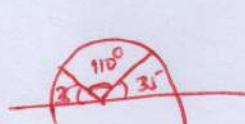
$$= 556.1111 \text{ km}$$

(2 marks)

b) Find in nm

i) The shortest distance between Q and T

(2 marks)



$$110^\circ$$

$$0 \times 60$$

$$110 \times 60 = 6600 \text{ nm}$$

ii) The longest distance between Q and T (to the nearest tens)

(2 marks)

$$\alpha \times \cos \theta \times 60$$

$$60 \times 180 \times \cos 35$$

$$8846.842078$$

$$\underline{\underline{8840 \text{ nm}}}$$

c) Find the difference in time taken when S flies along the shortest and longest routes if its speed is 420 knots

(4 marks)

$$t_1 = \frac{6600}{420} = 15.71428571 \text{ hrs}$$

$$t_2 = \frac{8840}{420} = 21.047619 \text{ hrs}$$

$$= 5 \frac{1}{3} \text{ hrs}$$

$$\underline{\underline{5 \text{ hrs } 20 \text{ min}}}$$

10

20. The marks obtained by 50 students in an examination were recorded in the table below

Marks	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79
Number of student	3	6	10	12	9	5	3	2

Using 44.5 as the assumed mean, calculate

i) The actual mean mark

Marks	f	x	d = x - A	fd	fd ²	c.f.
0-9	3	4.5	-40	-120	4800	3
10-19	6	14.5	-30	-180	5400	9
20-29	10	24.5	-20	-200	4000	19
30-39	12	34.5	-10	-120	1200	31
40-49	9	44.5	0	0	0	40
50-59	5	54.5	10	50	500	45
60-69	3	64.5	20	60	1200	48
70-79	2	74.5	30	60	1800	50
	Σf = 50			Σfd = -450	Σfd ² = 18900	

(4 marks)

B - fd
B₁ - fd²

Actual $\bar{x} = \frac{44.5 - \frac{450}{50}}{1}$
 $= 35.5$
 A₁

ii) The standard deviation to 2 decimal place

$$S.d = \sqrt{\frac{\Sigma fd^2}{\Sigma f} - \left(\frac{\Sigma fd}{\Sigma f}\right)^2}$$

$$= \sqrt{\frac{18900}{50} - \left(\frac{-450}{50}\right)^2}$$

$$378 - 81$$

$$\sqrt{297} = 17.23$$

iii) The quartile deviation

(3 marks)

Lower Quartile = $19.5 + \left(\frac{19.5 - 9}{12}\right)10 = 23$ M₁

Upper Quartile = $39.5 + \left(\frac{37.5 - 31}{9}\right)10 = 46.72$ M₁

Quartile Deviation = $\frac{46.72 - 23}{2} = 11.86$ M₁

21. Given that $y = 2 \sin 2x$ and $y = 3 \cos (x+45^\circ)$

a) Complete the table below

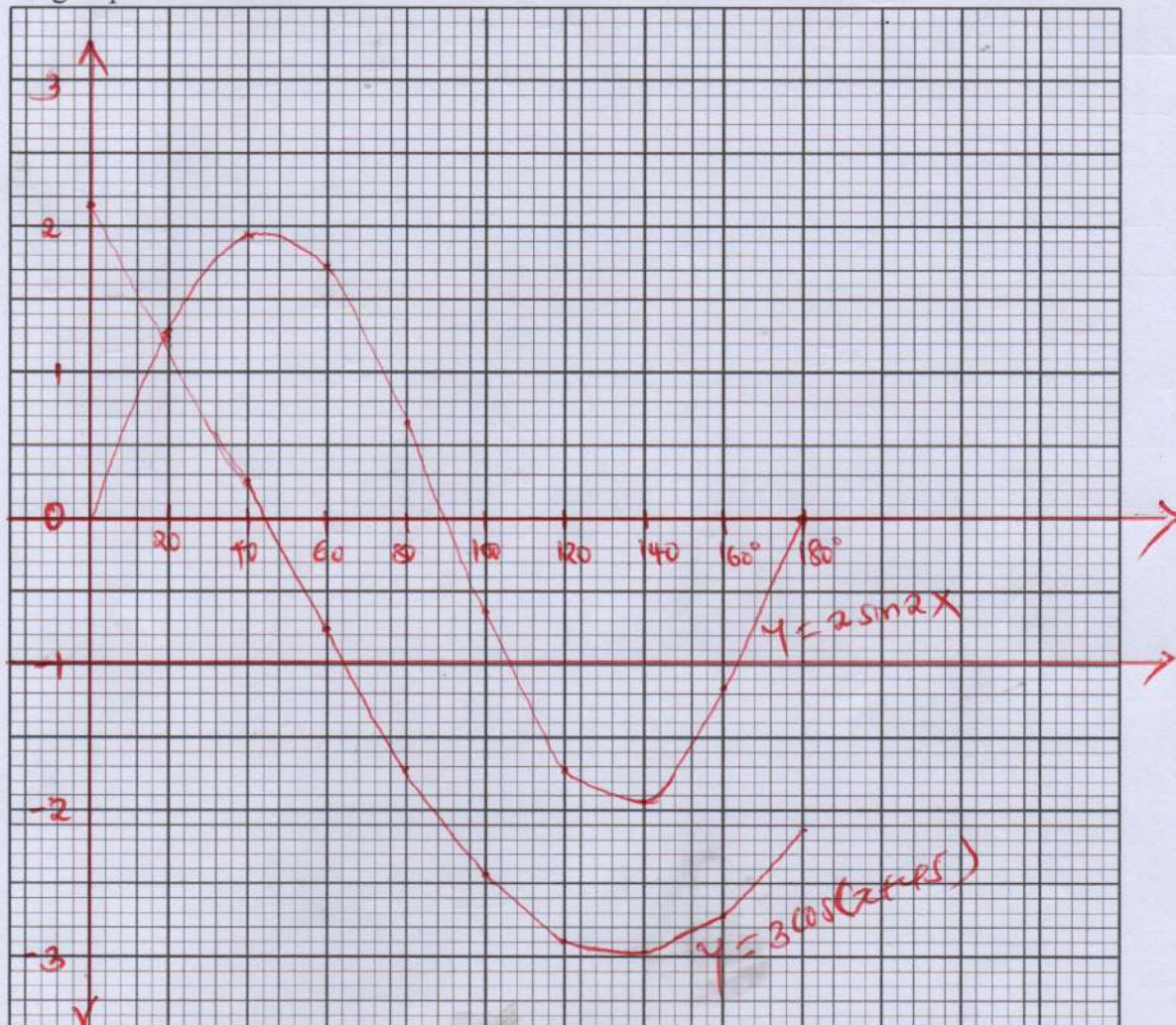
(2 marks)

X	0°	20°	40°	60°	80°	100°	120°	140°	160°	180°
$2 \sin 2x$	0	1.29	1.97	1.73	0.68	-0.68	-1.73	-1.97	-1.28	0
$3 \cos (x+45^\circ)$	2.12	1.27	0.26	-0.78	-1.72	-2.46	-2.90	-2.99	-2.72	-2.12

B₂
for all
B for 4
correct

b) Use the data to draw the graph of $y = 2 \sin 2x$ and $y = 3 \cos (x+45^\circ)$ for $0^\circ \leq x \leq 180^\circ$ on the same axis on the grid provided below

(5 marks)



S
P
C
P
C

c) State the amplitude and period of each curve

(2 marks)

$$A_1 = 2 \quad A_2 = 3$$

B₁ B₁

d) Use the graph to solve the equation $2 \sin 2x - 3 \cos (x+45^\circ) = 0$ for $0^\circ \leq x \leq 180^\circ$

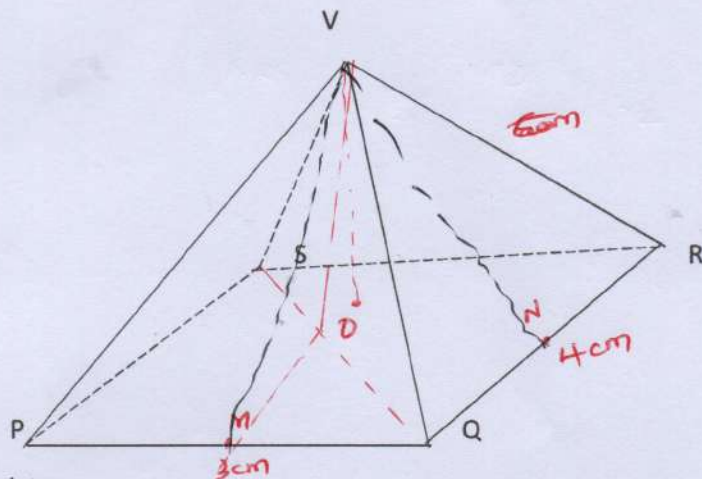
(1 mark)

$$20^\circ$$

B₁

10

22. The diagram below shows a right pyramid VPQRS with V as the vertex and rectangular base PQRS. PQ=3cm, QR=4cm and the height of the pyramids is 6cm. M and N are the mid-points of PQ and QR respectively.



a). Calculate

i). the length PV

(3mks)

$$OP = \frac{1}{2} (\sqrt{3^2 + 4^2})$$

$$= \frac{1}{2} \times 5 = 2.5$$

$$PV = \sqrt{6^2 + 2.5^2}$$

$$= 6.964 \text{ cm}$$

ii). the angle between face VPQ and the base PQRS

(2mks)



$$\tan \theta = \frac{6}{2.5}$$

$$= 3$$

$$\tan^{-1}(3) = 71.56^\circ$$

b). i) the slant height VM and VN.

(2mks)

$$VM = \sqrt{6^2 + 2^2}$$

$$= 6.325 \text{ cm}$$

$$VN = \sqrt{6^2 + 1.5^2}$$

$$= 6.185 \text{ cm}$$

ii) the surface area of the pyramid.

(3mks)

$$(3 \times 4) + \left(\frac{1}{2} \times 2 \times 6.325 \times 3 \right) + \left(\frac{1}{2} \times 6.185 \times 4 \times 2 \right)$$

$$12 + 18.98 + 24.74$$

$$= 55.72 \text{ cm}$$

23. A small scale farmer wishes to buy some sheep and goat for rearing. Sheep cost sh 400 and goat cost sh.300. The farmer has enough space for only 20 animals and may spend at most sh 6,800.

The number of goats should not exceed twice the number of sheep.

- a) By letting x and y to represent the number of sheep and goats he can buy respectively, write down all inequalities from the above information (4 marks)

$$400x + 300y \leq 6800 \checkmark$$

$$x + y \leq 20 \checkmark$$

$$y \leq 2x \checkmark$$

$$y > 0 \text{ and } x > 0 \checkmark$$

$$4x + 3y = 68 \quad \begin{array}{r|l} x & 5 \quad 2 \\ y & 16 \quad 20 \end{array}$$

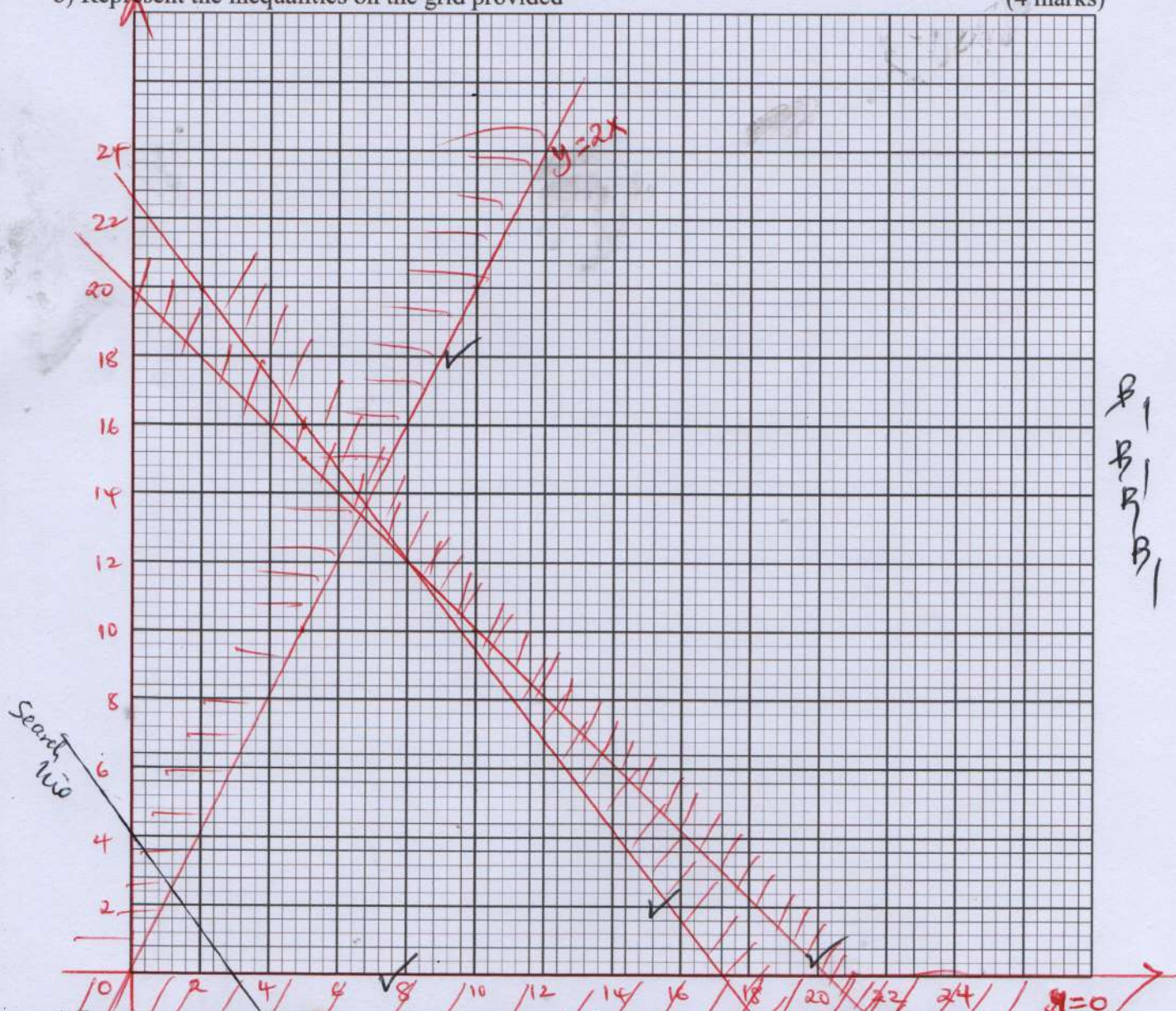
$$x + y = 20 \quad \begin{array}{r|l} x & 5 \quad 10 \\ y & 15 \quad 10 \end{array}$$

$$y = 2x \quad \begin{array}{r|l} x & 5 \quad 10 \\ y & 10 \quad 20 \end{array}$$

$$x = 0 \quad y = 20$$

B
B
B
B
B

- b) Represent the inequalities on the grid provided (4 marks)



B
B
B
B
B

- c) From your graph, find the maximum number of animals he can buy at the lowest cost (2 marks)

$$(8, 12) \checkmark$$

8 Sheep

12 Goats

20 Animals

14

$$400x + 300y = 1200$$

$$4x + 3y = 12 \quad \begin{array}{r|l} x & 0 \quad 3 \\ y & 4 \quad 0 \end{array}$$

B
B
B

10

24. The initial velocity of a particle was 1 m/s and its acceleration is given by $(2-t)$ m/s² every second after the start.

a). i). Determine the equation representing its velocity.

(2mks)

$$a = 2 - t \quad \checkmark \quad V = 1 \quad t = 0$$

$$\int a = \int (2 - t) dt \quad \checkmark$$

$$V = 2t - t^2 + C$$

$$1 = 2(0) - (0)^2 + C$$

$$C = 1$$

$$V = 2t - t^2 + 1 \quad \checkmark$$

ii). Find the velocity of the particle during the third second.

(2mks)

$$V = 2t - t^2 + 1 \quad \int_2^3 \quad \checkmark$$

$$\left[2(3) - (3)^2 + 1 \right] - \left[2(2) - (2)^2 + 1 \right]$$

$$6 - 9 + 1 - 4 + 4 - 1$$

$$-2 - 1 = -3 \text{ m/s} \quad \checkmark$$

b). i). Find the equation representing its distance t seconds after the start.

(2mks)

$$\int V = \int (2t - t^2 + 1) dt \quad \checkmark \quad s = 0 \quad t = 0$$

$$s = \frac{2t^2}{2} - \frac{t^3}{3} + t + C$$

$$= t^2 - \frac{t^3}{3} + t \quad \checkmark$$

ii). What was the distance covered by the particle during the first three seconds.

(2mks)

$$s = t^2 - \frac{t^3}{3} + t \quad \checkmark \quad t = 3$$

$$= (3)^2 - \frac{(3)^3}{3} + 3$$

$$= 9 - 9 + 3$$

$$= 3 \text{ m} \quad \checkmark$$

c). Determine the time when the particle was momentarily at rest.

(2mks)

$$\text{rest} \quad V = 0$$

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

$$t^2 - 2t - 1 = 0 \quad \checkmark$$

$$t = \frac{2 \pm \sqrt{(-2)^2 - (4 \times 1 \times -1)}}{2}$$

$$= \frac{2 \pm 2.828}{2}$$

$$= 2.414 \text{ sec} \quad \checkmark$$

CONFIDENTIAL

G8 MID-TERM TWO EXAMINATION 2026

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

**MATHEMATICS FORM 4
PAPER 2
MARKING SCHEME**