

Teachers' Network presents **Motivating Mathematics**

# *Motivating* **MATHEMATICS**

Secondary; Revision

# Questions & Answers

**Motivating Mathematics**

**INCLUDING: MOTIVATING TIPS**

**How to get from the grade you are in to the grade you want in sciences and mathematics**

The Six basic principles of success – The 'CPP squared formula of success'\*

**Karanja .N**

With Muchiri G. S

Muchiri D. N

Mburu C

Mung'ara J

**Motivating Mathematics**

For Secondary School Students of All Classes

# The CPP squared formula of success\* (CPP)<sup>2</sup>



**Choice**

-Choose success  
-Take 100% Responsibility for your studies

**Power of choice**  
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**Planning**

Set goals, -  
-make a study plan

**Power of planning**  
Page 177

**Positive mental attitude**

-Think in terms of success, abundance and eliminate misconception

**Power of positive attitude**  
Page 184

**Concentration**

-Focus on your goals

**Power of concentration**  
Page 191

**Practice**

-Study, listen, solve 10 maths problems daily and ask questions

**Power of practice**  
Page 195

**Persistence**

-Don't despair  
-have resilience

**Power of persistence**  
Page 202

## Paper 1 Questions

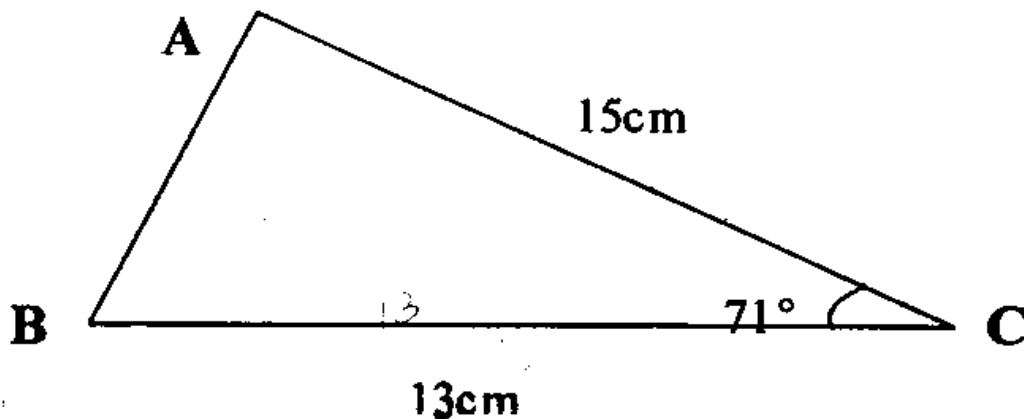
### SECTION I

1. Evaluate

$$\frac{1}{2} \left[ \frac{32 \div 4 \text{ of } (-4) \times 6 + 28}{-40 \div 5 \times 2} \right] \quad (3 \text{ marks})$$

2. Find all the integral values of  $x$ , which satisfy the following inequalities.  $2x - 7 < x + 2 \leq 2(x - 2)$  (3 marks)

3. In the triangle below length  $BC = 13\text{cm}$ ,  $AC = 15\text{cm}$  and angle  $C = 71^\circ$ . Determine length  $AB$  (3 marks)



4. The gradient function of a curve is

$$\frac{dy}{dx} = 2x - 3.$$

If the points  $(2,5)$  lie on this curve, find the value of  $y$  when  $x = -1$  on this curve. (3 marks)

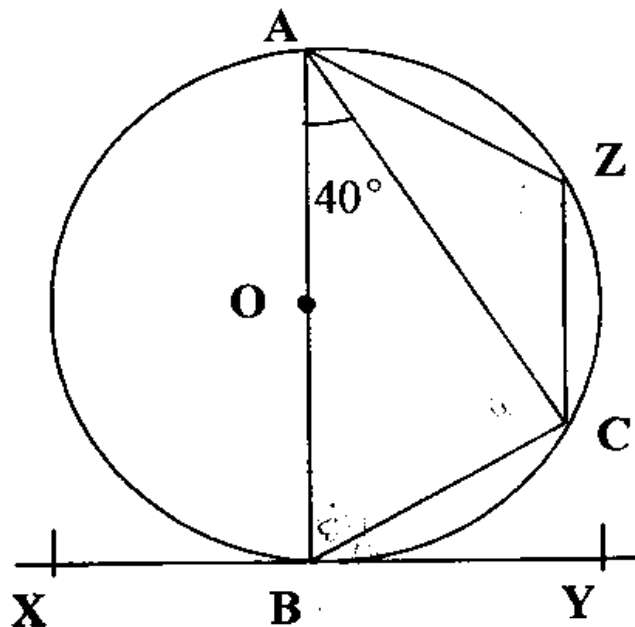
5. Using the method of completing the square, find the values of  $x$  that satisfy the quadratic equation below.

$$x^2 + x - 6 = 0 \quad (4 \text{ marks})$$

6.  $R$  varies partly as the square of  $V$  and partly as the cube of  $V$ . When  $V = 2$ ,  $R = -20$  and when  $V = -3$ ,  $R = 135$ . Find the relationship between  $R$  and  $V$ . (3 marks)

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7. The diagram below shows a circle with diameter AB and a tangent XY. Given that angle BAC = 40°.



Find the value of

(i) Angle CBY

(2 marks)

(ii) Angle AZC

(2marks)

8. The angle of depression of a hen on a horizontal surface on the ground to a crow perched on top of a building is 28°. The building is 8m tall vertically. When the hen sees the crow, the hen moves directly towards the base of the building to a point B, such that the angle of elevation of the crow from B is 32°.

Calculate the distance moved by the hen. (3 marks)

9. Use elimination method to solve the simultaneous equation.

$$4x + 3y = 18$$

$$5x - 2y = 11$$

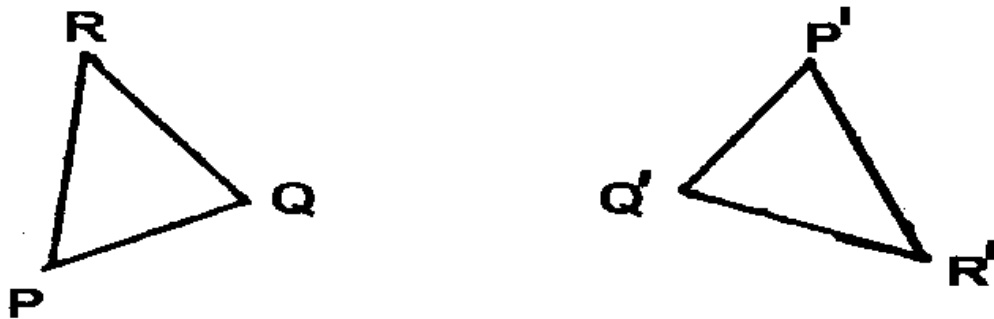
(3 marks)

10. Given the quadratic trigonometric equation

$$8\sin^2 y + 2\cos y - 5 = 0 \text{ find}$$

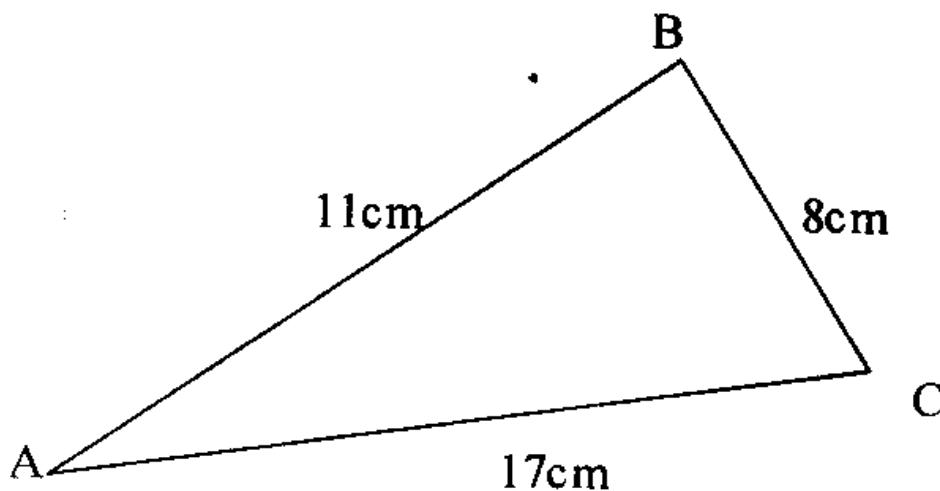
- (i)  $\cos y^\circ$  (1 mark)
- (ii)  $\sin y^\circ$  (1 mark)
- (iii) The value of  $y^\circ$  (1 mark)
- (iv)  $\tan y^\circ$  (1 mark)

11. The figure below shows a triangle PQR and its image P'Q'R' after a rotation through a given negative angle and a certain centre x.



By construction on this diagram show the centre of rotation and indicate the angle of rotation. (3 marks)

12. The triangle below has  $AB = 11\text{cm}$ ,  $BC = 8\text{cm}$  and  $AC = 17\text{cm}$ . Find the area of the triangle ABC. (3 marks)



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13. The position vectors of points P and Q are

$$OP = \begin{pmatrix} 3 \\ 4 \\ -6 \end{pmatrix} \quad \text{and} \quad OQ = \begin{pmatrix} -5 \\ -1 \\ 2 \end{pmatrix}$$

Find the position vector of point X which divides line PQ internally in the ratio 2:3. (3 marks)

14. Three villages X, Y and Z are such that Y is 12km south of X and Z is 15km from X. Village Z is on a bearing of  $330^\circ$  from Y. Calculate the bearing of Z from X. (3 marks)

15. A sheep farmer has 210m of fencing wire to fence three sides of a rectangular paddock. The fourth side is a wall. Find the dimensions that will give maximum possible area of the paddock. (3 marks)

16. A triangle PQR is such that  $\angle PQR = 60^\circ$  length QR = 600cm and length QP = 540cm. Find the area of triangle PQR and leave your answer in  $m^2$  (4 marks)

### **SECTION TWO: 48 MARKS**

**Answer any six questions.**

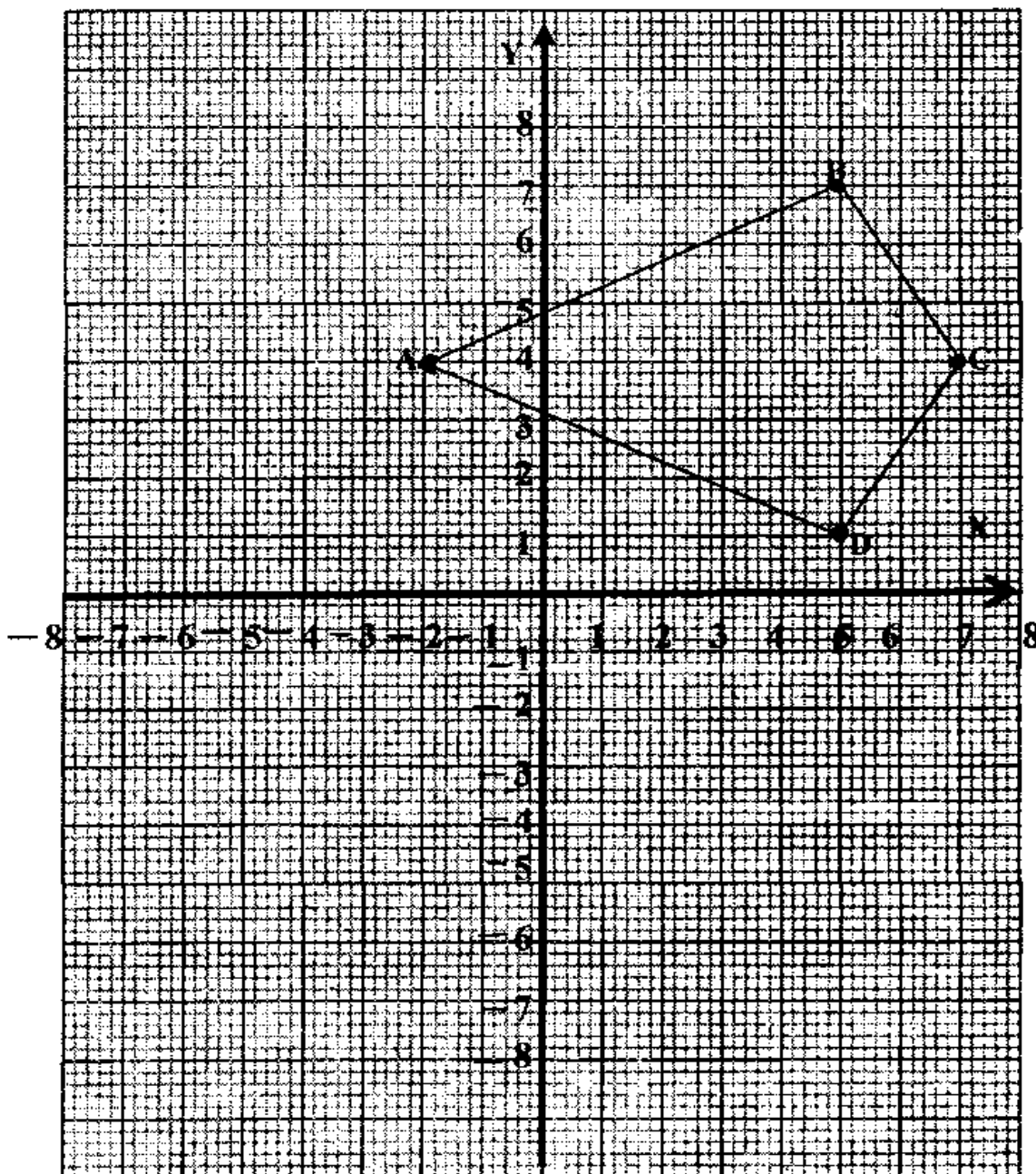
17. The kite shown on the figure below has vertices, A (-2,4) B (5,7) C (7,4) and D (5,1). The kite ABCD is rotated about the origin through  $-90^\circ$  to obtain its first image A'B'C'D'. The kite A'B'C'D' is then reflected along the line  $X = 0$  to obtain A''B''C''D''. Find

(a) The equation of the mirror line that reflects point A onto itself, B on to D and C on to itself (2 marks)

(b) Draw kite A'B'C'D' and state its coordinates.

(3 marks)

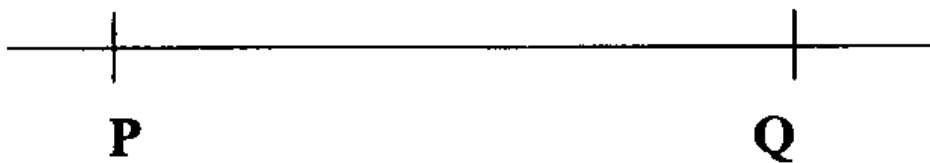
(c) Draw kite  $A''B''C''D''$  and state its coordinates  
(3 marks)



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18. (a) Find the coordinates of the stationary points on the curve  $y = x^3 - 3x^2 - 9x$  (4 marks)  
(b) At each coordinate state, whether  $y$  has a maximum or minimum value (4 marks)

19. P and Q are fixed points 6cm away from each other as shown on the line PQ drawn. Construct the locus of line B above and below line PQ such that  $\angle PBQ$  is always  $60^\circ$ . (8 marks)



20. Three men Juma, Ali and Choge compete to hit the bull's eye in a game of dart. The probabilities of each hitting the bull's eye are Juma  $\frac{3}{5}$ , Ali  $\frac{2}{3}$  and Choge  $\frac{3}{4}$ . Using the probability space diagram find the probability of:
- (a) None of them hitting the bull's eye. (2 marks)
  - (b) Exactly one gets to hit the bull's eye (2 marks)
  - (c) At least one gets to hit the bull's eye (2 marks)
  - (d) Exactly two men get to hit the bull's eye given that Ali is one of them in both cases. (2 marks)

21. The table below shows the marks obtained by 60 students in an exam.

Marks	30-39	40-49	50-59	60-69	70-79
Number of students	10	12	18	17	3

- (a) Construct a frequency distribution table showing.
- (i) Marks (class interval)
  - (ii) Frequency(f)



- (iii) Midpoint(x)
- (iv) Deviation  $d$  ( $x-A$ ) Where  $A$  is assumed mean.  
 $A = 54.5$
- (v)  $fd$
- (vi)  $d^2$
- (vii)  $Fd^2$  (4 marks)

(b) Using the distribution above calculate

- (i) The mean  $\bar{x}$  (1 mark)
- (ii) The variance of distribution (2 marks)
- (iii) The standard deviation of distribution. (1 mark)

22. An auto spares dealer sells two types of lubricants A and B in his shop. While purchasing type A cost sh. 40 per 100ml tin and type B cost sh.60 per 100ml tin. He decides to buy at least 30 tins altogether of type A and B with Sh. 1500 available. He decides that at least one third of the tins should be of type B He buys  $x$  tins of type A and  $y$  tins of type B.

- (a) Write down three inequalities, which represent the above information (3 marks)
- (b) On a graph paper, draw a graph to show the three inequalities (a) above. (3 marks)
- (c) Determine how many tins of each type that he should buy to maximise his profit if he makes a profit of Sh.10 of each type A tin and a profit of Sh.20 on each type B tin (1 mark)
- (d) Calculate his maximum possible profit (1 mark)

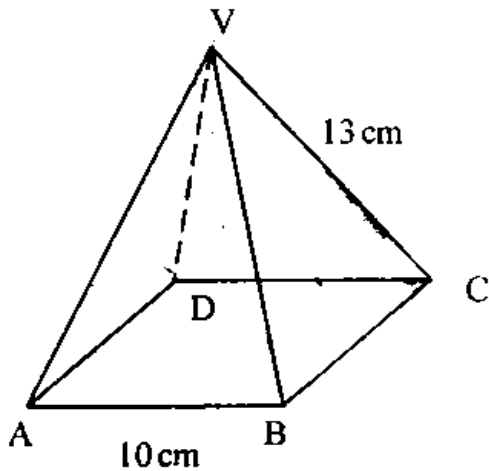
23. Two towns P and Q lie on the earths surface such that P ( $65^\circ\text{N}$ ,  $96^\circ\text{E}$ ) and Q ( $65^\circ\text{N}$ ,  $84^\circ\text{W}$ )

- (a) Find the distance between P and Q in kilometres and nautical miles along a parallel of latitude (4 marks)
- (b) Find the distance between P and Q along a great circle. (Take  $\pi = 22/7$  and radius of earth = 6370km) (4 marks)

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24. The figure below shows a square-based pyramid. Point V is vertically above the middle of the base ABCD.

Length  $AB = 10\text{cm}$  and  $VC = 13\text{cm}$ .



Find

- (a) Length of diagonal AC (2 marks)
- (b) The height of the pyramid (2 marks)
- (c) The acute angle between VB and base ABCD. (2 marks)
- (d) The acute angle between BVA and ABCD. (2 marks)

## Answers to Paper 1

$$\begin{aligned}
 1. & \frac{1}{2} \left[ \frac{32 \div 4 \text{ of } (-4) \times 6 + 28}{-40 \div 5 \times 2} \right] \\
 &= \frac{1}{2} \left[ \frac{32 \div -16 \times 6 + 28}{-8 \times 2} \right] \\
 &= \frac{1}{2} \left[ \frac{-2 \times 6 + 28}{-16} \right] \\
 &= \frac{1}{2} \left[ \frac{-12 + 28}{-16} \right] = \frac{1}{2} \left[ \frac{16}{-16} \right] = -\frac{1}{2}
 \end{aligned}$$

2.  $2x - 7 < x + 2 \leq 2(x - 2)$

split the compound inequality into 2 parts.

(i)  $2x - 7 < x + 2$

$$2x - x < 7 + 2$$

$$x < 9$$

$$x < 9$$

$$x + 2 \leq 2(x - 2)$$

$$x + 2 \leq 2x - 4$$

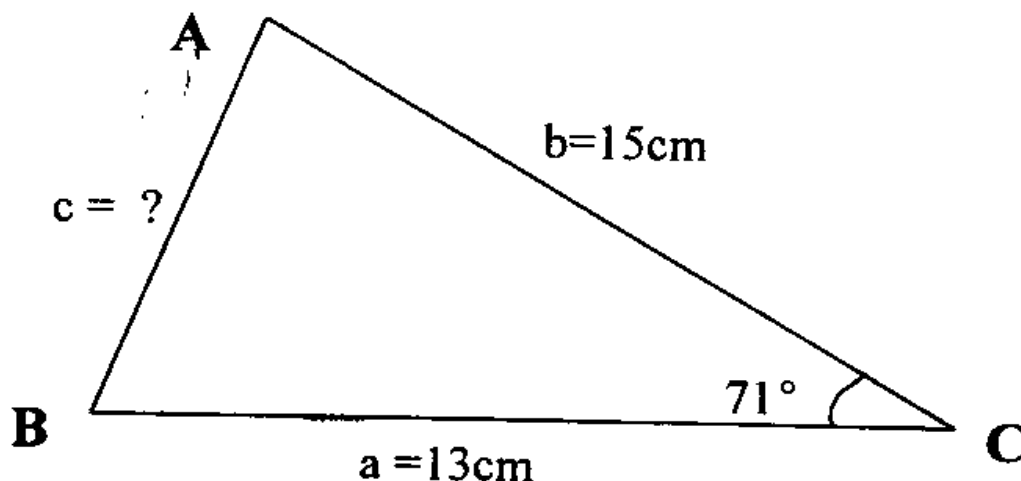
$$2 + 4 \leq 2x - x$$

$$6 \leq x$$

Integral values are whole numbers lying between 6 and 9, such that 6 is inclusive and 9 is exclusive.

Hence  $x = 6, 7, 8$ .

3.



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$$\begin{aligned}c^2 &= a^2 + b^2 - 2.a.b.\cos C \\&= 13^2 + 15^2 - 2 \times 13 \times 15 \times \cos 71^\circ \\&= 169 + 225 - 390 \times 0.3256 \\&= 169 + 225 - 126.97 \\c^2 &= 267.03 \\c &= \sqrt{267.03} \\AB = c &= 16.34\text{cm}\end{aligned}$$

4.  $\frac{dy}{dx} = 2x - 3$

$$\begin{aligned}y &= \int (2x - 3) dx \\&= \frac{2x^2}{2} - 3x + c\end{aligned}$$

$$y = x^2 - 3x + c \quad \text{when } x = 2, y = 5$$

$$\text{Then } 5 = 4 - 3(2) + c$$

$$5 = 4 - 6 + c$$

$$5 = -2 + c$$

$$7 = c$$

$$y = x^2 - 3x + 7$$

$$\text{When } x = -1$$

$$y = (-1)^2 - 3(-1) + 7$$

$$= 1 + 3 + 7$$

$$y = 11.$$

5.  $x^2 + x - 6 = 0$

$$x^2 + x = 6$$

$$x^2 + x + \left(\frac{1}{2}\right)^2 = 6 + \left(\frac{1}{2}\right)^2$$

$$(x + \frac{1}{2})^2 = 6 + 0.25$$

$$\sqrt{(x + 0.5)^2} = \pm \sqrt{6.25}$$

$$(x + 0.5) = \pm 2.5$$

$$\text{Either } (x + 0.5) = +2.5$$

$$x = 2.5 - 0.5$$

$$x = 2$$

$$\text{or } (x + 0.5) = -2.5$$

$$x = -2.5 - 0.5$$

$$x = -3$$

$$\text{Hence } x = 2, \text{ or } x = -3$$

6.  $R = KV^2 + MV^3$

$$-20 = K(4) + M(8)$$

$$135 = K(-3)^2 + M(-3)^3$$

$$-20 = 4K + 8M$$

$$135 = 9K - 27M$$

$$540 = 36K - 108M$$

$$\underline{-180 = 36K + 72M}$$

$$720 = -180M$$

$$M = \frac{720}{-180} = -4$$

$$-20 = 4K + 8(-4)$$

$$-20 = 4K - 32$$

$$-20 + 32 = 4K$$

$$12 = 4K$$

$$4K = 12$$

$$K = 3$$

Hence the relationship is  $R = 3V^2 - 4V^3$

7. (i) angle  $CBY = 40^\circ$  (alternate angle theorem ; the angle between a chord and a tangent is equal to the angle in the alternate segment of that chord.)

$$\angle ABC = (180 - 40 - 90) \text{ (angle sum in a triangle)}$$

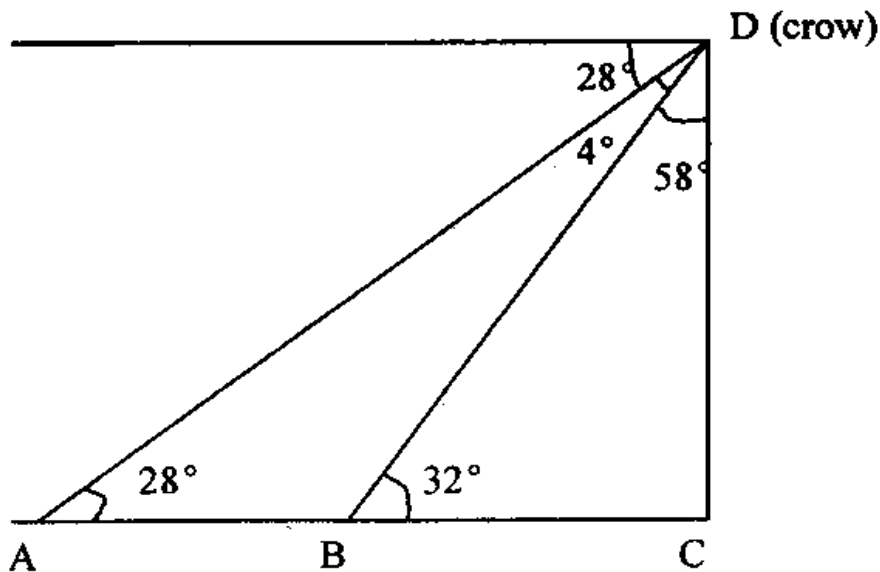
$\angle ABC + \angle AZC = 180^\circ$  (angles in a cyclic quadrilateral add up to  $180^\circ$ )

$$50^\circ + \angle AZC = 180^\circ$$

$$\angle AZC = 180^\circ - 50^\circ = 130^\circ$$

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8.



$$\frac{AC}{8} = \tan 62^\circ$$

$$\begin{aligned} AC &= 8 \tan 62^\circ \\ &= 8 \times 1.8807 \\ &= 15.045\text{m} \end{aligned}$$

$$\frac{BC}{8} = \tan 58^\circ$$

$$\begin{aligned} BC &= 8 \tan 58^\circ \\ &= 8 \times 1.6003 \\ &= 12.803\text{m} \end{aligned}$$

Distance moved by the hen is  $15.045 - 12.803 = 2.242\text{m}$

9.  $4x + 3y = 18$

$$5x - 2y = 11$$

$$20x + 15y = 90$$

$$20x - 8y = 44$$

$$\hline 23y = 46$$

$$y = \frac{46}{23} \quad y = 2$$

Substitute  $y = 2$  into equation (i)

$$4x + 3y = 18$$

$$4x + 3(2) = 18$$

$$4x + 6 = 18$$

$$4x = 18 - 6$$

$$4x = 12$$

$$x = 3; \quad y = 2$$

10.  $8 \sin^2 y + 2 \cos y - 5 = 0$

use the identity  $\cos^2 y + \sin^2 y = 1$

$\sin^2 y = 1 - \cos^2 y$ .

$8(1 - \cos^2 y) + 2 \cos y - 5 = 0$

$8 - 8 \cos^2 y + 2 \cos y - 5 = 0$

$3 - 8 \cos^2 y + 2 \cos y = 0$

$8 \cos^2 y - 2 \cos y - 3 = 0$

let  $\cos y = x$

$8x^2 - 2x - 3 = 0$                        $pq = -24$

$p+q = -2$

$p = -6, 4.$

$8x^2 - 6x + 4x - 3 = 0$

$2x(4x-3) + 1(4x-3) = 0$

$(2x + 1)(4x-3) = 0$

either

or  $4x-3 = 0$

$2x + 1 = 0$

$4x = 3$

$2x = -1$

$x = \frac{3}{4}$

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

$x = 0.75$

$y = 120^\circ$

$\cos y = 0.75$

Disqualify

$y = 41.40^\circ$

(a)  $y = 41.40^\circ$

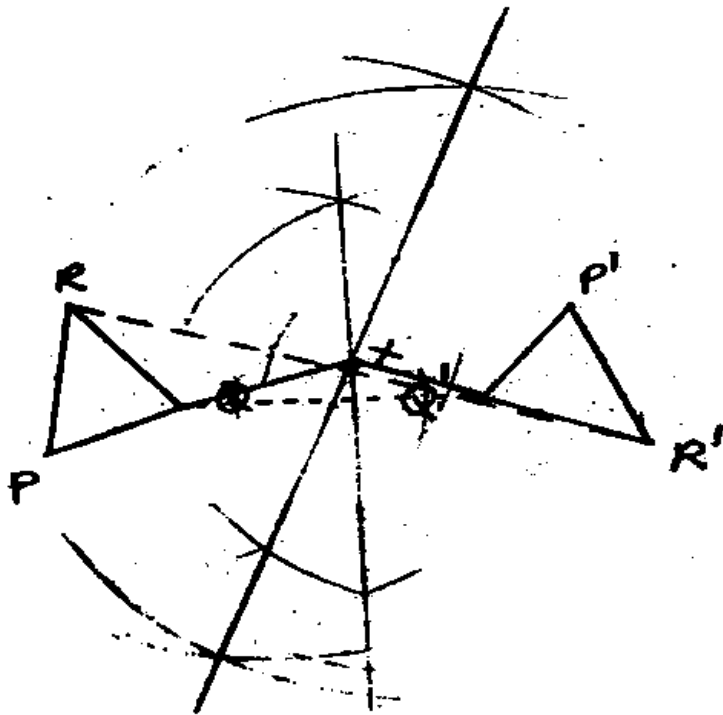
(b)  $\cos y = 0.75$

(c)  $\tan y = \tan 41.40^\circ = 0.8816$

(d)  $\sin y = \sin 41.40^\circ = 0.6613$

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11.



**Steps**

- (i) Join P to P' or Q to Q' or R to R'
  - (ii) Bisect any two lines above
  - (ii) Label the meeting point of bisectors as X
  - (iv) Measure  $\angle QXQ'$  or  $\angle RXR'$  or  $\angle PXP'$
  - (v) Each should be  $140^\circ \pm 1^\circ$
- Hence centre X and angle of rotation is  $-140^\circ$**

12. Using Herons' formula area =  $\sqrt{s(s-a)(s-b)(s-c)}$

Where  $S = \frac{1}{2}(a+b+c)$

$$S = \frac{1}{2}(11 + 17 + 8) = 18$$

$$\text{Area of } \triangle ABC = \sqrt{18(18-11)(18-17)(18-8)}$$

$$= \sqrt{18 \times 7 \times 1 \times 10}$$

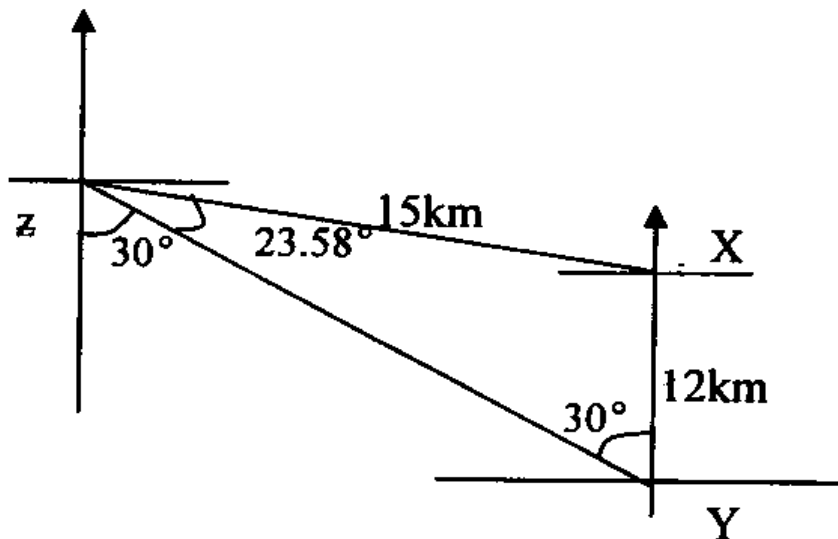
$$= \sqrt{1260}$$

$$= 35.5 \text{ cm}^2$$



$$\begin{aligned}
 \underline{13.} \quad \underline{OX} &= \frac{n}{m+n} \underline{OP} + \frac{m}{m+n} \underline{OQ} \\
 &= \frac{2}{5} \begin{pmatrix} -5 \\ -1 \\ 2 \end{pmatrix} + \frac{3}{5} \begin{pmatrix} 3 \\ 4 \\ -6 \end{pmatrix} \\
 &= \begin{pmatrix} -10/5 \\ -2/5 \\ 4/5 \end{pmatrix} + \begin{pmatrix} 9/5 \\ 12/5 \\ -18/5 \end{pmatrix} = \begin{pmatrix} -1/5 \\ 10/5 \\ -14/5 \end{pmatrix}
 \end{aligned}$$

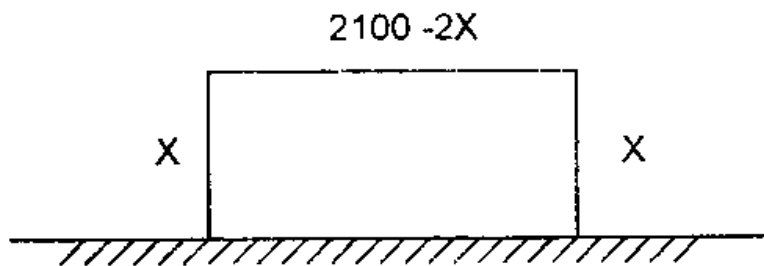
14.



$$\begin{aligned}
 \frac{15\text{km}}{\sin 30^\circ} &= \frac{12\text{km}}{\sin Z} \\
 \sin Z \cdot 15\text{km} &= 12\text{km} \times \sin 30^\circ \\
 \sin Z &= \frac{12\text{km} \times \sin 30^\circ}{15\text{km}} \\
 &= 0.4 \longrightarrow Z = \sin^{-1} 0.4 = 23.58^\circ \\
 \angle YXZ &= (180^\circ - 30^\circ - 23.58^\circ) = 126.42^\circ \\
 \text{Bearing of } Z \text{ from } X &\text{ is } 180^\circ + 126.42^\circ \\
 &= 306.42^\circ \text{ NW}
 \end{aligned}$$

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15.



$$\text{Area} = (2100 - 2x) x$$

$$A = 2100x - 2x^2$$

$$\frac{dA}{dx} = 2100 - 4x$$

$$\text{At maximum area } \frac{dA}{dx} = 0$$

$$2100 - 4x = 0$$

$$\frac{2100}{4} = \frac{4x}{4}$$

$$\text{Width } x = 525\text{m}$$

$$\text{Length} = 2100 - 2(525)$$

$$= 2100 - 1050$$

$$= 1050\text{m}$$

$$\text{Maximum area} = 1050 \times 525$$

$$= 55125\text{m}^2$$

$$= 55.125 \text{ ha.}$$

16. Using the formula  $\text{Area} = \frac{1}{2} a. b. \sin C$

$$A = \frac{1}{2} r. p. \sin Q$$

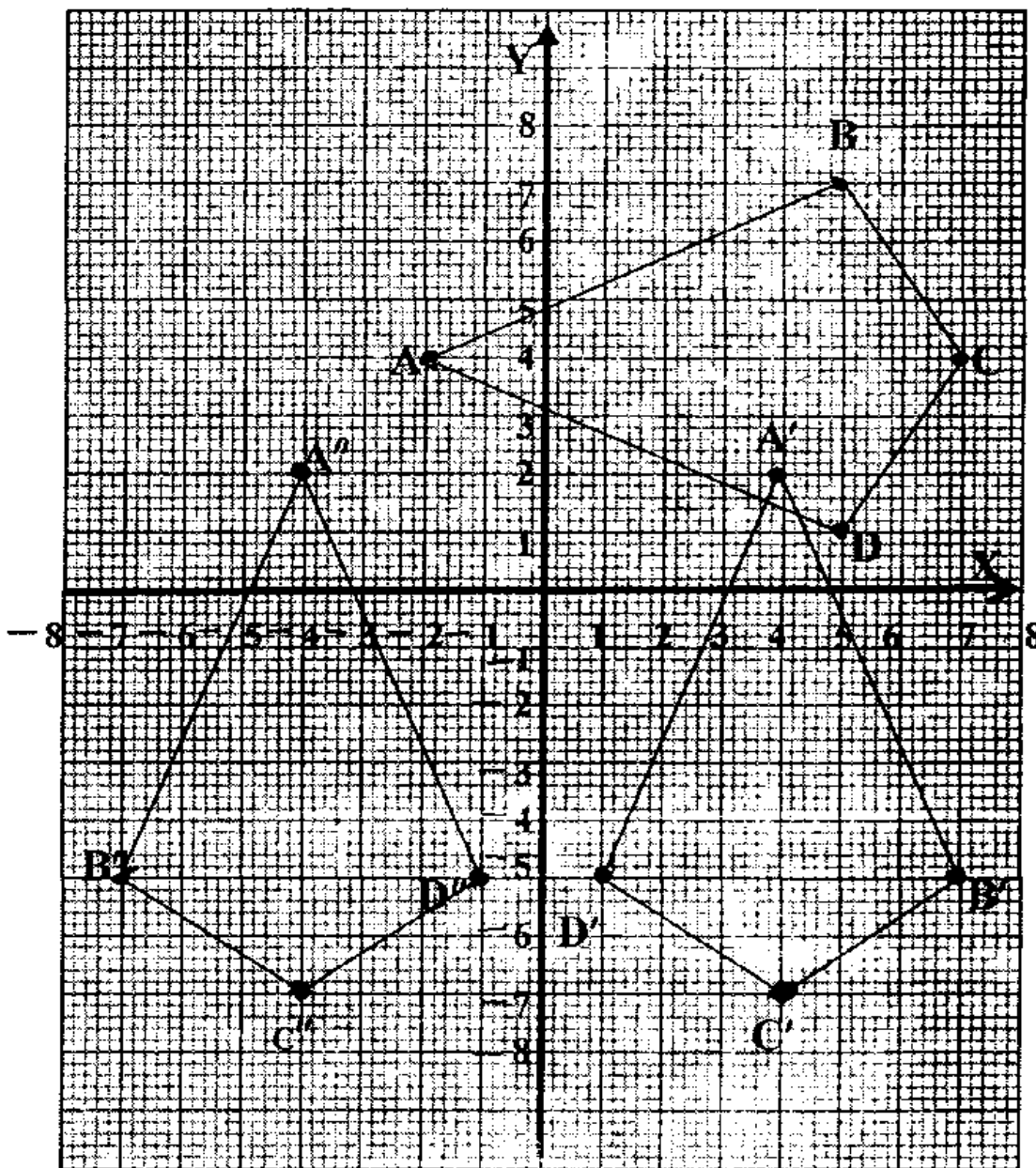
$$A = \frac{1}{2} \times 540 \times 600 \times \sin 60^\circ$$

$$A = \frac{1}{2} \times 540 \times 600 \times 0.8660$$

$$A = 140292\text{cm}^2$$

$$A = 14.029\text{m}^2$$

17. See graph below.



(b)  $A'(4, 2)$   $B'(7, -5)$   $C'(4, -7)$   $D'(1, -5)$

(c)  $A''(-4, 2)$   $B''(-7, -5)$   $C''(-4, -7)$   $D''(-1, -5)$ .

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$$18. \frac{dy}{dx} = 3x^2 - 6x - 9$$

At maximum point  $\frac{dy}{dx} = 0$

$$3x^2 - 6x - 9 = 0 \quad pq = -27, p+q = -6 \quad \left. \vphantom{3x^2 - 6x - 9 = 0} \right\} -9, 3$$

$$3x^2 - 9x + 3x - 9 = 0$$

$$3x(x-3) + 3(x-3) = 0$$

$$(3x+3)(x-3) = 0$$

Either

$$\begin{array}{l|l} 3x+3=0 & x-3=0 \\ 3x=-3 & x=3. \end{array}$$

$$x = -1$$

At  $x = -1$

$$y = (-1)^3 - 3(-1)^2 - 9(-1)$$

$$y = -1 - 3 + 9$$

$$y = 5$$

At  $x = 3$

$$y = (3)^3 - 3(3^2) - 9(3)$$

$$y = -27.$$

Stationary points at  $(-1, 5)$  and  $(3, -27)$

(i) At  $x = -1$

$$\frac{d^2y}{dx^2} = 6x - 6$$

At  $x = -1$

$$\frac{d^2y}{dx^2} = 6(-1) - 6$$

$$y'' = -6 - 6 = -12.$$

2<sup>nd</sup> derivative  $y''$  at

$x = -1$  is negative.

Hence  $(-1, 5)$  maximum

at  $x = 3$

$$\frac{d^2y}{dx^2} = 6(3) - 6$$

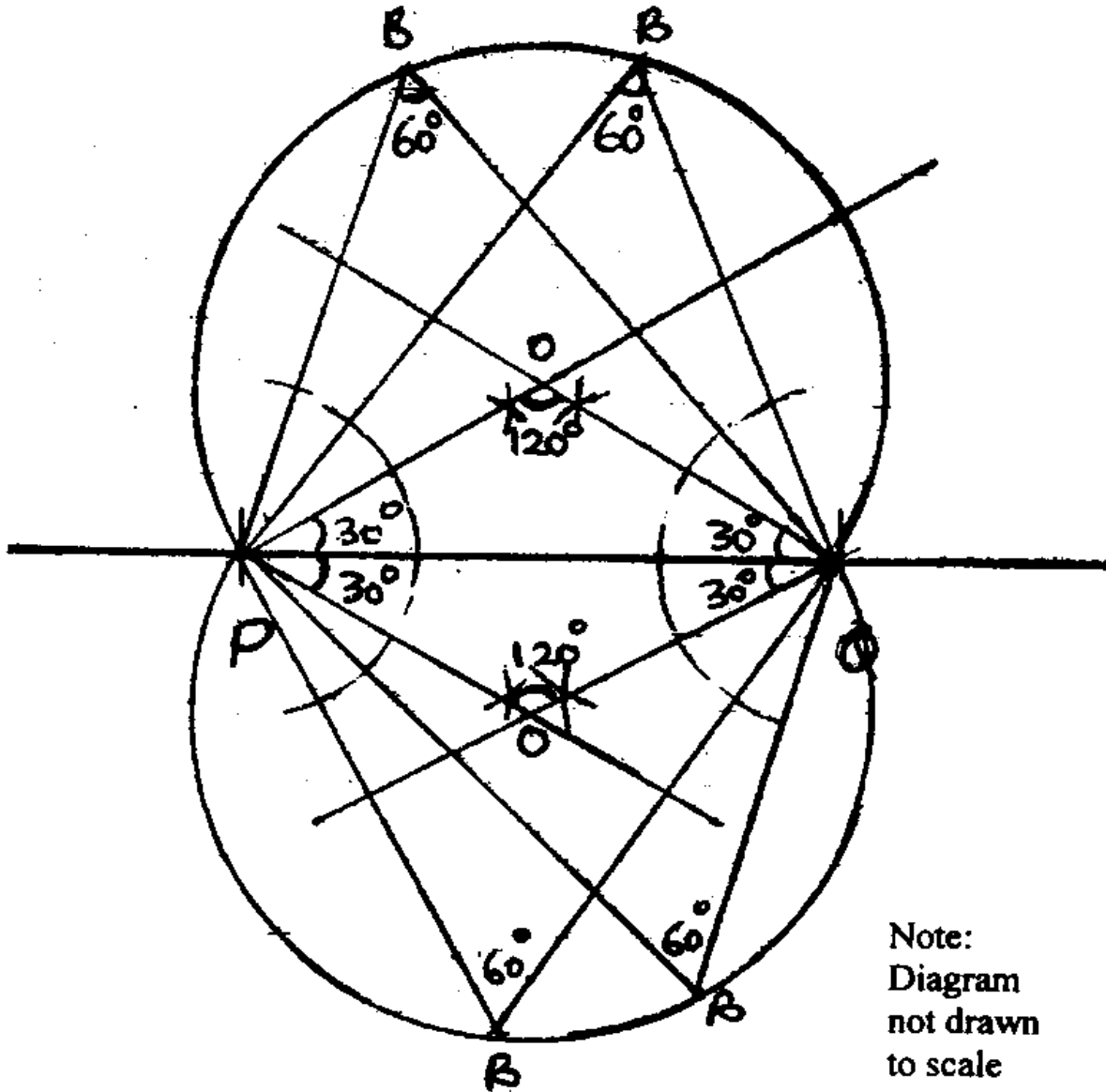
$$= 18 - 6$$

$$= 12$$

$y''$  at  $x = 3$  is positive

hence  $(3, -27)$  is maximum

19.



Steps

*NB:* Angle subtended by chord PQ on to the circumference must be twice the angle subtended by the same chord at the centre.

- (a) Construct  $\angle QPO = \angle PQO = 30^\circ$
- (b) Using O as centre and radius OP, draw the upper curve and curve below PQ
- (c) On any point on this curve draw and measure  $\angle PBQ = \angle QBP = 60^\circ$

## 20 Motivating Mathematics

### 20. (a)

Men	Hit's bulls' eye	Misses to hit
Juma	$\frac{3}{5}$	$\frac{2}{5}$
Ali	$\frac{2}{3}$	$\frac{1}{3}$
choge	$\frac{3}{4}$	$\frac{1}{4}$

$$(a) P(\text{none get to hit}) = \frac{2}{5} \times \frac{1}{3} \times \frac{1}{4} = \frac{1}{30}$$

$$(b) P(\text{Exactly one get to hit}) = P(\text{Juma hit others fail}) + P(\text{Ali hit others fail}) + P(\text{Choge hit others fail})$$

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

$$= \frac{1}{20} + \frac{1}{15} + \frac{1}{10}$$

$$= \frac{3 + 4 + 6}{60} = \frac{13}{60}$$

$$(c) P(\text{at least one gets to hit the bulls eye})$$

$$= 1 - P(\text{none gets to hit it})$$

$$= 1 - \left( \frac{2}{5} \times \frac{1}{3} \times \frac{1}{4} \right)$$

$$= 1 - \frac{1}{30}$$

$$= \frac{29}{30}$$

$$(d) P(\text{Exactly two got it correct given that Ali gets to hit})$$

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

$$= \frac{1}{10} + \frac{1}{5}$$

$$\frac{1 + 2}{10} = \frac{3}{10}$$

21.

Marks class interval	f	X	D=x-a	Fd	d <sup>2</sup>	Fd <sup>2</sup>
30-39	10	34.5	-20	-200	400	4000
40-49	12	44.5	-10	-120	100	1200
50-59	18	54.5	0	0	0	0
60-69	17	64.5	10	170	100	1700
70-79	3	74.5	20	60	400	1200
	$\sum f = 60$			$\sum fd = -90$		$\sum fd^2 = 8100$

$$\begin{aligned} \text{(a) } \bar{x} &= A + \frac{\sum fd}{\sum f} \\ &= 54.5 + \frac{-90}{60} \\ &= 54.5 - 1.5 \\ &= 53.0 \end{aligned}$$

$$\begin{aligned} \text{Variance} &= \frac{\sum fd^2}{\sum f} \\ &= \frac{8100}{60} = 135 \end{aligned}$$

$$\begin{aligned} \text{(c) Standard variation} &= \sqrt{\frac{\sum fd^2}{\sum f}} = \sqrt{135} \\ &= 11.62 \end{aligned}$$

## 22 Motivating Mathematics

**22. (a)**  $40x + 60y \leq 150$

$2x + 3y \leq 75$  .....(i)

$x + y \geq 30$  .....(ii)

$y \geq \frac{1}{3}(x + y)$

$2y \geq x$  .....(iii)

**(b)** See graph on next page.

**(i)**  $2x + 3y = 75$

x	0	30	37.5
y	25	5	0

**(ii)**  $x + y = 30$

x	0	30
y	30	0

**(iii)**  $2y = x$

x	0	4	10	20
y	0	2	5	10

**(c)**  $10x + 20y = \text{profit}$

**(i)**  $x = 15, y = 15$

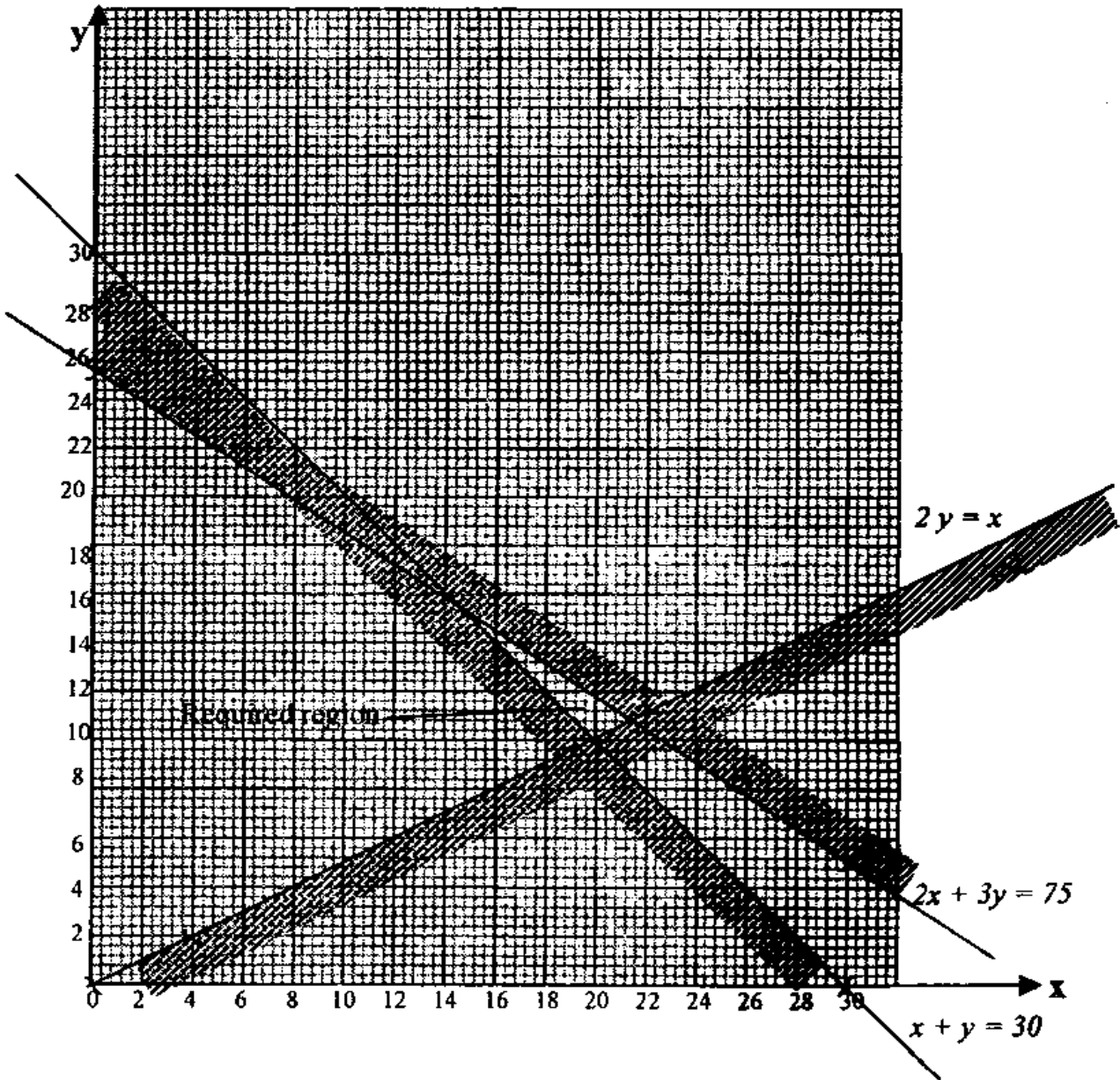
**(ii)** Profit =  $10(15) + 20(15)$

=  $150 + 300$

Ksh. 450/=

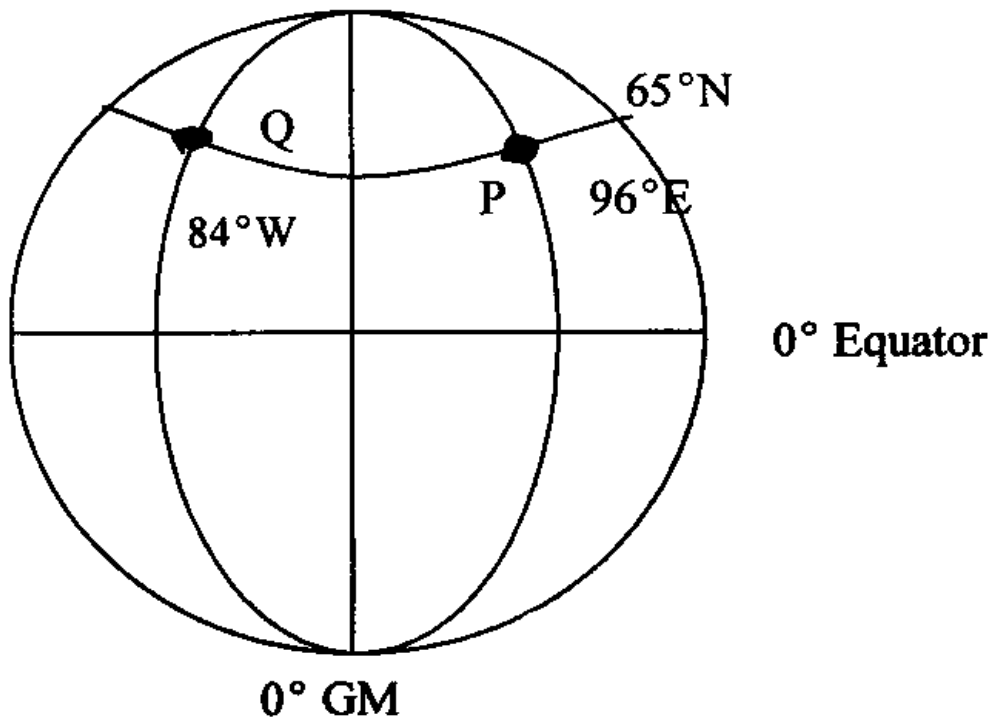


Graph for question 22



24 *Motivating Mathematics*

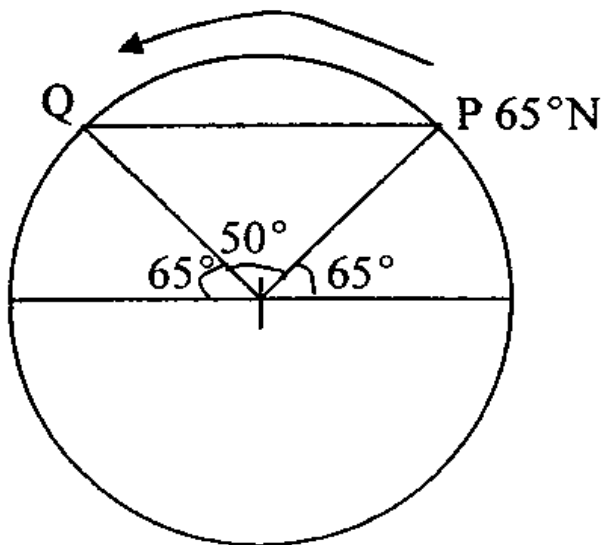
23.



longitude difference  $\alpha = 84 + 96 = 180^\circ$   
 distance PQ along latitude  $= \frac{\alpha}{360} \times 2\pi R \cos \theta$   
 $= \frac{180}{360} \times 2 \times \frac{22}{7} \times 6370 \cos 65^\circ$   
 $= \frac{1}{2} \times 2 \times \frac{22}{7} \times 6370 \times 0.4226$   
 $= 8460.45 \text{ km}$

- (ii) Distance PQ along latitude in nautical miles  
 $= 60\alpha \cos \theta$   
 $= 60 \times 180 \times \cos 65^\circ$   
 $= 60 \times 180 \times 0.4226$   
 $= 4564.27 \text{ n.m.}$

(b) distance along the great circle since P and Q are along the great circle i.e. same meridian.

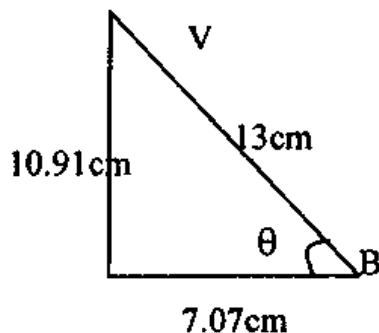


$$\begin{aligned} \text{Distance PQ} &= \frac{50}{360} \times 2 \times \frac{22}{7} \times 6370 \\ &= 5561.1\text{km} \end{aligned}$$

24.  $AC = \sqrt{100 + 100}$   
 $= \sqrt{200}$   
 $= 14.14\text{cm}$

(b) Height ( $\perp$ height) of pyramid  $= \sqrt{(VC)^2 - (\frac{1}{2} AC)^2}$   
 $= \sqrt{13^2 - 7.07^2}$   
 $= \sqrt{69 - 49.98}$   
 $= 10.91\text{cm}$

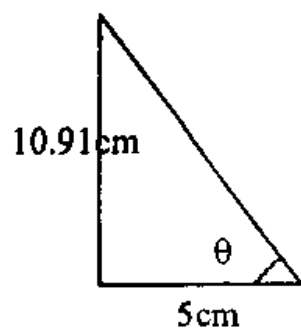
(c) Angle between VB and ABCD



$$\begin{aligned} \cos \theta &= \frac{7.07}{13} \\ &= 0.5438 \\ \theta &= 57.05^\circ \end{aligned}$$

## 26 *Motivating Mathematics*

(d)



$$\begin{aligned}\tan\theta &= \frac{10.91}{5} \\ &= 2.182 \\ \theta &= 65.37^\circ\end{aligned}$$

## Paper 2 Questions

### SECTION 1

Answer all questions in this section.

1. Use logarithms to evaluate,

$$\sqrt[3]{\frac{239.5 \times 0.004832}{\sin 30^\circ}} \quad (4 \text{ marks})$$

2. Solve the equation for the values of X. (3 marks)

$$\frac{3}{x+1} - \frac{1}{x+2} = \frac{5}{2}$$

3. A line AB is formed by co-ordinates A (1,2) and B(4,6). Another line 2 is the perpendicular bisector to line AB. Find the equation of line 2. (3 marks)

4. Juma, Ali and Choge are three masons and together complete building a stone wall together in 12 hours. Juma and Ali working together complete the work in 18 hours while Juma and Choge working together complete the work in 24 hours. Find how long each would take to complete the building of the stone wall while alone. (4 marks)

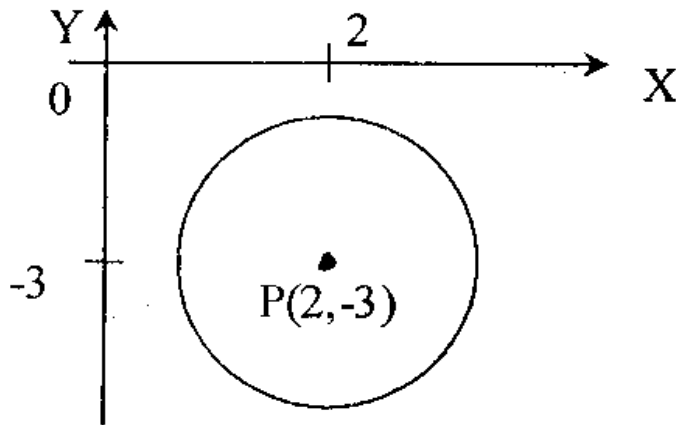
5. Find the equation of the tangent to the curve  $y = 2x^3 + x^2 - 6x$  if the curve passes through a point X = 1. (3 marks)

6. Use reciprocal, square and cube root tables to evaluate to four significant figures the expression below. (3 marks)

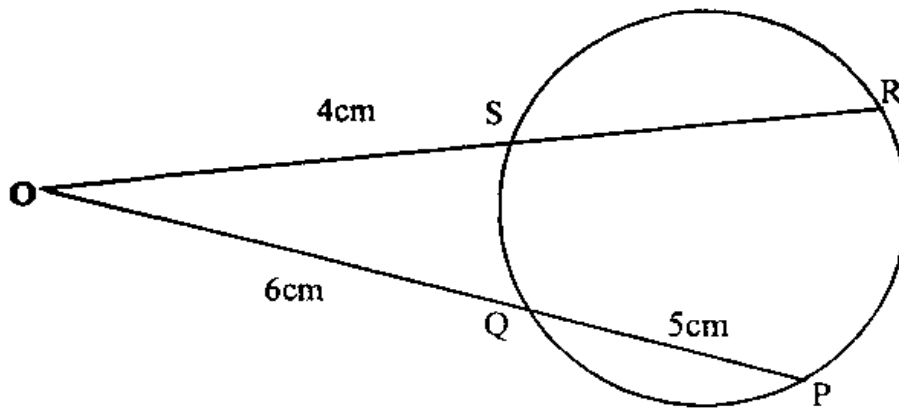
$$\frac{1}{42.95} + 26.64^2 + \sqrt[3]{65.45}$$

## 28 Motivating Mathematics

7. The figure below shows a circle of radius 4 units and is centred at a point P (2, -3). Determine the equation of the circle in simplified form. (4 marks)



8. The average rate of depreciation in value of a new generator is 8% per year. After use for four years, its value was found to be sh. 107,459. Find its value at the beginning of the four year period (4 marks)
9. Ann bought four pens and three exercise books for a total of sh.17 while peter bought five similar pens and two exercise books for a total of sh.16.  
Find the cost of a pen and an exercise book using the inverse matrix method. (3 marks)
10. Make  $x$  the subject of the formula. (3 marks)
- $$P = \frac{\sqrt{x+2w}}{\sqrt{4x+3R}}$$
11. Find the value of  $x$  that satisfy the equation  
 $\text{Log}(x+5) + \text{log}(x+2) = \text{log} 4$ . (3 marks)
12. The figure below shows a pair of chords PQ and RS which intersects externally at point O. if  $PQ = 5$  cm,  $OS = 4$ cm and  $OQ = 6$ cm. Calculate the length of chord RS. (3marks)



- 13.** The quantity A is directly proportional to the square of B and inversely proportional to C and the square root of D. If B is increased by 40%, C is increased by 60% and D is reduced by 36%, find the percentage change in A. (4 marks)
- 14.** A businessman bought maize flour, millet flour and sorghum flour at sh.12, sh15 and sh18 per kilogram respectively. He mixed them in the ratio 1:2:3 respectively and sold the mixture to make a profit of 20%. Find the selling price per Kg of the mixture. (4 marks)
- 15.** Expand and simplify the binomial expression  $(2 - x)^6$ . Hence use your expression and expansion above to the term in  $x^2$  to estimate the value of  $1.99^6$  (3 marks)
- 16.** Three villages are situated such that they form 3 sides of a triangle. The distance of village P to R is 40 km while R to Q is 60 km. When represented on a paper angle PRQ is  $78^\circ$ . Find the distance of village P to Q. (4 marks)

**SECTION 2: 52 MARKS**

**Answer any six questions.**

17. The table below shows income tax rates for a certain year.

Monthly taxable pay in Ksh.	Rate Ksh for every sh. 20
1-8700	2
8701-17400	3
17401-26100	4
26101-34800	5
Over 34801	6

Mrs Njoroge a company's secretary earns a basic salary of Ksh.32000 and a house allowance of Ksh3500 per month.

(a) Calculate her total income tax. (3 marks)

(b) The employee is entitled to a personal tax relief of Ksh1056 per month. Determine the net tax that she pays.

(2 marks)

(c) Mrs Njoroge has the following deductions made from her monthly income

(i) Cooperative shares.....sh1,000.00

(i) Cooperative loan.....sh850.00

(ii) Insurance premium.....sh1200.00

Determine her net monthly salary. (3 marks)

18. A pharmacist added  $300\text{cm}^3$  of a solution A containing 15% alcohol to  $450\text{cm}^3$  of another solution B containing 10% alcohol. (4 marks)

(a) What percentage of the resulting mixture is alcohol?

(b) If  $x\text{cm}^3$  of the mixture is then poured out and replaced by  $x\text{cm}^3$  of pure alcohol, the solution is found to contain 20% alcohol. Determine the value of x. (4 marks)

19. Draw on the same axis the graph of



(a)  $y = \cos x$  and  $y = \cos 2x$  for  $0^\circ \leq x \leq 360^\circ$ . (6 marks)

(b) Hence determine the value of  $x$  for which

$$\cos x - \cos 2x = 0 \quad (2 \text{ marks})$$

20. Two towns are on the same latitude. Town P is on  $(50^\circ \text{ N}, 20^\circ \text{ E})$  and town Q is on  $(50^\circ \text{ N}, 140^\circ \text{ E})$ . Two aircraft leave airport P simultaneously flying to an airport in town Q. One aircraft A flies along parallel of latitude while the other aircraft B fly via North pole to town Q.

(a) Calculate the distance covered by each aircraft A and B.

(Take  $\pi = 22/7$  R = 6400km) (4 marks)

(b) If the speed of an aircraft that flies via North Pole is 800km/hr and the speed of the other aircraft is 600km/hr, what will be the difference in time on arrival at town Q?

(4 marks)

21. A trapezium has vertices O (0,0) A (1,2) B (3, 2) C (4, 0).

(a) Draw on a graph paper the trapezium OABC.

(2 marks)

(b) Trapezium OABC is transformed by matrix  $P = \begin{bmatrix} -2 & 0 \\ 0 & -2 \end{bmatrix}$  to its image

O'A'B'C'. Plot the trapezium O'A'B'C' and mark it as  $I_1$ . state the coordinates of each point. (2 marks)

(c) Reflect trapezium O'A'B'C' along the line

$y = 0$  and mark it O''A''B''C''. State the coordinates of each point. (2 marks)

(d) Find the matrix that transforms O''A''B''C'' and maps it onto OABC. (2 marks)

22. The velocity of a particle moving in a straight line after  $t$  seconds is given by  $V = 3t^2 - 4t - 4$  calculate

(a) Its acceleration after 2 seconds. (2 marks)

(b) Distance moved by the particle between

$t = 1$  second and  $t = 4$  seconds. (3 marks)

(c) The time taken by the particle for it to go to rest. (3 marks)

### 32 *Motivating Mathematics*

23. On a graph paper, draw the;

- (a) Graph of  $y = -2x^2 + 3x + 4$  for values of  $x$  in the range  $-3 \leq x \leq 4$  by completing the table below. (4 marks)

$x$	-3	-2	-1	0	1	2	3	4
$x^2$								
$-2x$								
$3x$								
$-2x^2 + 3x$								
$y = -2x^2 + 3x + 4$								

(b) Use the graph drawn in (a) above to solve the quadratic equations below

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

(ii)  $-2x^2 + x + 6 = 0$

(4 marks)

24. A water tank is cylindrical in shape is filled by a pipe P in 6 hours. This same tank is emptied when filled in 12 hours by a pipe R. When someone starts with the tank empty, both pipes are opened at the same time and then pipe Q turned off after 4 hours. Find

(a) The time taken to fill the tank. (4 marks)

(b) The volume of tank if pipe P delivered 1260 litres.

(4 marks)

## ANSWERS to Paper 2

1.  $\sqrt[3]{\frac{239.5 \times 0.004832}{\sin 30^\circ}}$

No	Log
$2.395 \times 10^2$	2.3793
$4.832 \times 10^{-3}$	$\overline{3.6841} +$
$\sin 30^\circ = 0.5$	$\overline{0.0634} -$
$\sqrt[3]{\frac{N}{D}}$	$\overline{1.6990}$
	0.3644
	$\overline{0.3644}$
	3
1.322 ←	0.1214

2. Solve the equation for the value of x.

$$\frac{3}{x+1} - \frac{1}{x+2} = \frac{5}{2}$$

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

$$2(3x + 6 - x - 1) = 5[(x+1)(x+2)]$$

$$2[2x + 5] = 5[x^2 + 2x + x + 2]$$

$$4x + 10 = 5x^2 + 10x + 5x + 10$$

$$5x^2 + 15x + 10 - 10 - 4x = 0$$

$$5x^2 + 11x = 0$$

$$x(5x + 11) = 0$$

Either  $x = 0$

Or  $5x + 11 = 0$

$$5x = -11$$

$$x = \frac{-11}{5}$$

34 Answers to Paper 2

3. Line AB; Gradient AB =  $\frac{6-2}{4-1} = \frac{4}{3}$

Equation of line 2  $\frac{y-2}{x-1} = \frac{4}{3}$

$$3(y-2) = 4(x-1)$$

$$3y - 6 = 4x - 4$$

$$3y = 4x + 2$$

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

Let gradient of  $L_2 = M$

$$= M \times \frac{4}{3} = -1$$

$$M = \frac{-3}{4}$$

Line  $l_2$  is a perpendicular bisector passing through the

Midpoint of AB. Midpoint AB =  $\left(\frac{1+4}{2}, \frac{6+2}{2}\right) = (2.5, 4)$

Hence  $\frac{y-4}{x-2.5} = \frac{-3}{4}$

$$4(y-4) = -3(x-2.5)$$

$$4y - 16 = -3x + 7.5$$

$$4y = -3x + 23.5$$

$$y = \frac{-3x}{4} + \frac{23.5}{4}$$

4. In 1 hour Juma and Ali complete  $\frac{1}{18}$  of the job. Hence

$$\text{Work done by Choge in 1 hour} = \frac{1}{12} - \frac{1}{18} = \frac{6-4}{72} = \frac{2}{72} = \frac{1}{36}$$

Hence, Choge takes 36 hours to complete the job.

Amount of work done by Juma in 1 hour

$$= \frac{1}{24} - \frac{1}{36} = \frac{3-2}{72} = \frac{1}{72}$$

Hence, Juma takes 72 hours to complete the job.

Amount of work done by Ali in 1 hour.

$$\frac{1}{12} - \left( \frac{1}{36} + \frac{1}{72} \right) = \frac{1}{12} - \frac{1}{36} - \frac{1}{72} = \frac{6-2-1}{72} = \frac{3}{72} = \frac{1}{24}$$

Ali takes 24 hours to complete the job.

5.  $y = 2x^3 + x^2 - 6x$  : obtain the gradient function

$$\frac{dy}{dx} = 6x^2 + 2x - 6.$$

Hence gradient (When  $x = 1$ ) =  $6(1^2) + 2(1) - 6 = 2$

Value of  $y$  if  $x = 1$ ; we substitute  $x = 1$  onto

$y = 2x^3 + x^2 - 6x$  we get

$$y = 2(1^3) + (1^2) - 6(1)$$

$$= 3 - 6 = -3$$

The curve passes through  $(1, -3)$

The equation of a tangent is  $y = mx + C$ , to get

$$C, -3 = 2(1) + C$$

$$-5 = C$$

Equation of tangent is  $y = 2x - 5$ .

6. Evaluate using reciprocal, square and cube root tables.

$$\frac{1}{42.95} + 26.64^2 + \sqrt[3]{65.45}$$

$$\begin{aligned} \text{(a)} \frac{1}{42.95} &= \frac{1}{4.295 \times 10^1} = \frac{1}{4.295 \times 10^1} \times \frac{10^{-1}}{10^{-1}} = \frac{1 \times 10^{-1}}{4.295} \\ &= 0.2328 \times 10^{-1} \\ &= 0.02328. \end{aligned}$$

$$\text{(b)} \quad 26.64^2 = 709.7$$

$$\text{(c)} \quad \sqrt[3]{65.64} = 4.03$$

$$\begin{aligned} \text{Hence } \frac{1}{42.95} + 26.64^2 + \sqrt[3]{65.45} &= 0.02328 \\ &\quad + 709.0 \\ &\quad \hline &\quad 709.02328 \\ &\quad + 4.03 \\ &\quad \hline &\quad 713.05328 \end{aligned}$$

$$= 713.1 \text{ (4 s.f.)}$$

36 Answers to Paper 2

7. Equation of a circle  $(x-a)^2 + (y-b)^2 = r^2$  centre  $(a, b)$

Hence  $(x-2)^2 + (y-3)^2 = 4^2$

$$x^2 - 4x + 4 + y^2 + 6y + 9 = 16$$

$$x^2 + y^2 - 4x + 6y + 13 = 16$$

$$x^2 + y^2 - 4x + 6y - 3 = 0$$

8.  $A = P \left(1 - \frac{R}{100}\right)^n$

$$107,459 = P \left(1 - \frac{8}{100}\right)^4$$

$$107,459 = P (0.92)^4$$

$$P = \frac{107459}{0.92^4}$$

No	Log
107459	5.0314
$(9.2 \times 10^{-1})^4$	$\bar{1}.9638$
	$\frac{\times 4}{\quad}$
	$\bar{1}.8552$
	5.1762
<b>N</b>	
<b>D</b>	

$1.500375 \times 10^5 \leftarrow 5.1762$

$P = \text{Sh } 150,037.50$

9. Let  $x$  be the cost of a pen and  $y$  be the cost of an exercise book

$$4x + 3y = 17$$

$$5x + 2y = 16$$

Expressing the equation in matrix form.

$$\begin{pmatrix} 4 & 3 \\ 5 & 2 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 17 \\ 16 \end{pmatrix}$$

matrix det =  $8 - 15 = -7$

matrix inverse =  $\frac{-1}{7} \begin{pmatrix} 2 & -3 \\ -5 & 4 \end{pmatrix}$

Hence  $\frac{-1}{7} \begin{pmatrix} 2 & -3 \\ -5 & 4 \end{pmatrix} \begin{pmatrix} 4 & 3 \\ 5 & 2 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \frac{-1}{7} \begin{pmatrix} 2 & -3 \\ -5 & 4 \end{pmatrix} \begin{pmatrix} 17 \\ 16 \end{pmatrix}$

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \frac{-1}{7} \begin{pmatrix} 34 + -48 \\ -85 + 64 \end{pmatrix}$$

$$\begin{bmatrix} x \\ y \end{bmatrix} = \frac{-1}{7} \begin{bmatrix} -14 \\ -21 \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$$

Hence  $x = 2, y = 3$

A pen costs Sh.2 while an exercise book cost Sh. 3

10.  $P = \sqrt{\frac{x + 2W}{4x + 3R}}$

$$P^2 = \frac{x + 2W}{4x + 3R}$$

$$P^2 (4x + 3R) = x + 2W$$

$$4xP^2 + 3RP^2 = x + 2W$$

$$4xP^2 - x = 2W - 3RP^2$$

$$x(4P^2 - 1) = 2W - 3RP^2$$

$$x = \frac{2W - 3RP^2}{4P^2 - 1}$$

11.  $\log(x + 5) + \log(x + 2) = \log 4$

$$\log[(x + 5)(x + 2)] = \log 4$$

$$(x + 5)(x + 2) = 4$$

$$x^2 + 2x + 5x + 10 = 4$$

$$x^2 + 7x + 6 = 0$$

$$x^2 + 6x + x + 6 = 0$$

$$x(x + 6) + 1(x + 6) = 0$$

$$(x + 1)(x + 6) = 0$$

$$x = -6 \quad \text{OR} \quad x = -1$$

Disqualify  $x = -6$  since obtaining logs of negative values is not possible.

Hence  $x = -1$

12. let  $RS = x$

$$(PQ + QO)QO = (OS + RS)SO$$

$$(5 + 6)6 = (x + 4)4$$

38 Answers to Paper 2

$$11 \times 6 = 4x + 16$$

$$66 = 4x + 16$$

$$50 = 4x$$

$$12.5 = x$$

$$RS = 12.5 \text{ cm}$$

$$13. A \propto \frac{B^2}{C\sqrt{D}} \qquad A = \frac{KB^2}{C\sqrt{D}}$$

$$A^1 = \frac{K(1.4)^2 B^2}{1.6C \sqrt{0.64D}}$$

$$A^1 = \frac{1.96KB^2}{1.28 C\sqrt{D}}$$

$$A^1 = 1.53125 \frac{KB^2}{C\sqrt{D}}$$

$$\text{Change in } A = A^1 - A = 1.53125 - 1 \frac{KB^2}{C\sqrt{D}}$$

$$= 0.53125 \frac{KB^2}{C\sqrt{D}}$$

$$\% \text{ change} = \frac{0.53125 \frac{KB^2}{C\sqrt{D}}}{\frac{1KB^2}{C\sqrt{D}}} \times 100$$

$$= 0.53125 \times 100 = 53.125\%$$

15. To expand  $(2-x)^6$ ; obtain Pascal's coefficients for power 6 as 1,6,15,20,15,6,1.

$$(2-x)^6 = 2^6 - 6.2^5.x + 15.2^4.x^2 - 20.2^3.x^3 + 15.2^2.x^4 - 6.2^1.x^5 + x^6.$$

$$6 = 64 - 192x + 240x^2 - 160x^3 + 60x^4 - 12x^5 + x^6$$

$$(1.99) = (2 - 0.01)^6 \quad \text{here } x = 0.01$$

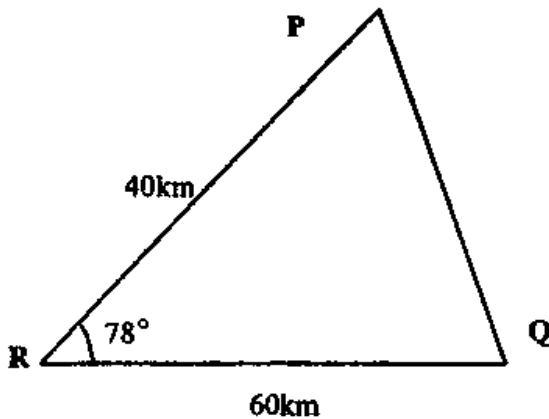
$$= 64 - 192(0.01) + 240(0.01)^2$$

$$= 64 - 1.92 + 0.024$$

$$= 62.104$$



16.



$$\begin{aligned} \text{Cosine rule, } a^2 &= b^2 + c^2 - 2bc \cos A \\ (PQ)^2 &= 40^2 + 60^2 - 2 \cdot 40 \cdot 60 \cos 78^\circ \\ (PQ)^2 &= 1600 + 3600 - 4800 \cos 78^\circ \\ &= 1600 + 3600 - 4800 \times 0.2079 \\ &= 5200 - 997.97 \\ &= 4202 \text{ km} \\ PQ &= \sqrt{4202} \text{ km} \\ &= 64.82 \text{ km.} \end{aligned}$$

17. Taxable income per month = 32,000 + 3,500 = Sh.35,500.

$$\text{Taxation 1}^{\text{st}} \text{ bracket} = \frac{8700 \times 2}{20} = \text{Sh } 870.00$$

$$\text{2}^{\text{nd}} \text{ bracket} = \frac{8700 \times 3}{20} = \text{Sh. } 1305.00$$

$$\text{3}^{\text{rd}} \text{ bracket} = \frac{8700 \times 4}{20} = \text{Sh } 1740.00$$

$$\text{4}^{\text{th}} \text{ bracket} = \frac{8700 \times 5}{20} = \text{Sh } 2175.00$$

$$\text{5}^{\text{th}} \text{ bracket (remaining amount)} = \frac{699 \times 2}{20} = \text{Sh. } 209.70$$

Total taxable income per month = Sh 6299.70

(b) The employee is entitled to personal tax of Ksh1056 per month.

$$\begin{array}{r} \text{Net tax} = \text{Sh. } 6299.70 \\ - \quad 1056.00 \\ \hline \text{Sh. } 5243.70 \end{array}$$

40 Answers to Paper 2

(c) Total deductions = net tax + deductions  
 $= 5243.70 + 1000 + 850 + 1200 = \text{Sh.}8293.70.$

Net monthly salary = Sh.35, 500.00  

$$- \underline{\text{Sh.}8,293.70}$$

$$\text{Sh.}27,206.30$$

18.(a) Amount of alcohol from solution A =  $\frac{15 \times 300}{100} = 45\text{cm}^3$

Amount of alcohol from solution B  $\frac{10 \times 450}{100} = 45\text{cm}^3$

Total volume of alcohol =  $90\text{cm}^3$

Total volume of mixture =  $300 + 450 = 750\text{cm}^3$

Percentage of alcohol in the mixture

$= \frac{90}{750} \times 100 = 12\%$

(b)  $x \text{ cm}^3$  of the mixture poured out contains  $\frac{12}{100}x = 0.12x \text{ cm}^3$

of alcohol of  $90 \text{ cm}^3$

$x \text{ cm}^3$  of pure alcohol added to the  $90 \text{ cm}^3$

$$\frac{90 - 0.12x + 1x}{750 - x + x} = \frac{20}{100} = \frac{1}{5}$$

$$\frac{90 + 0.88x}{750} = \frac{1}{5}$$

$5(90 + 0.88x) = 750$

$450 + 4.4x = 750$

$4.4x = 300$

$$x = \frac{300}{4.4}$$

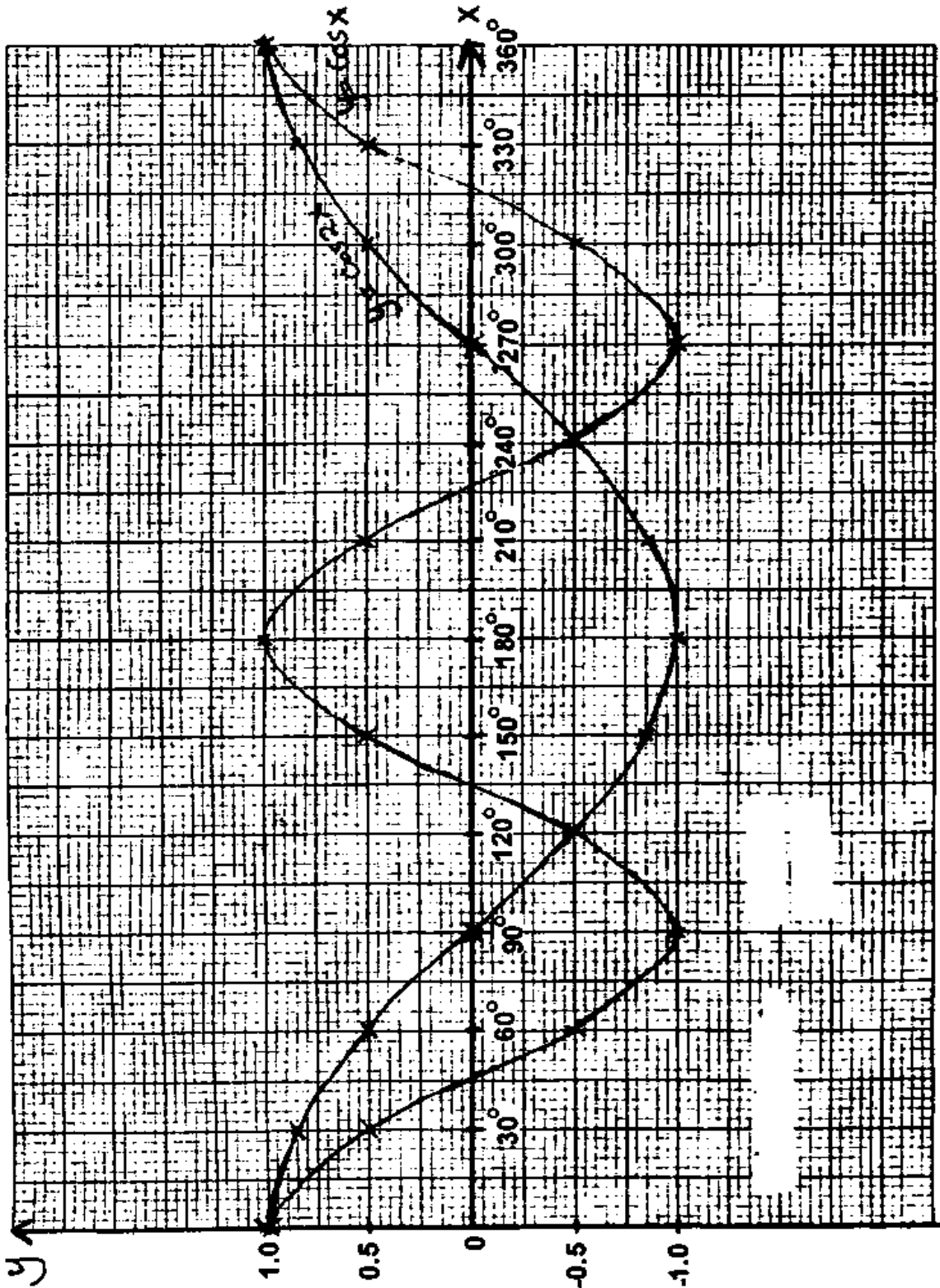
$x = 68.18\text{cm}^3$

19.  $y = \cos X$

X	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°	360°
y	1	0.87	0.5	0	-0.5	-0.87	-1	-0.87	-0.5	0	0.5	0.87	1.0

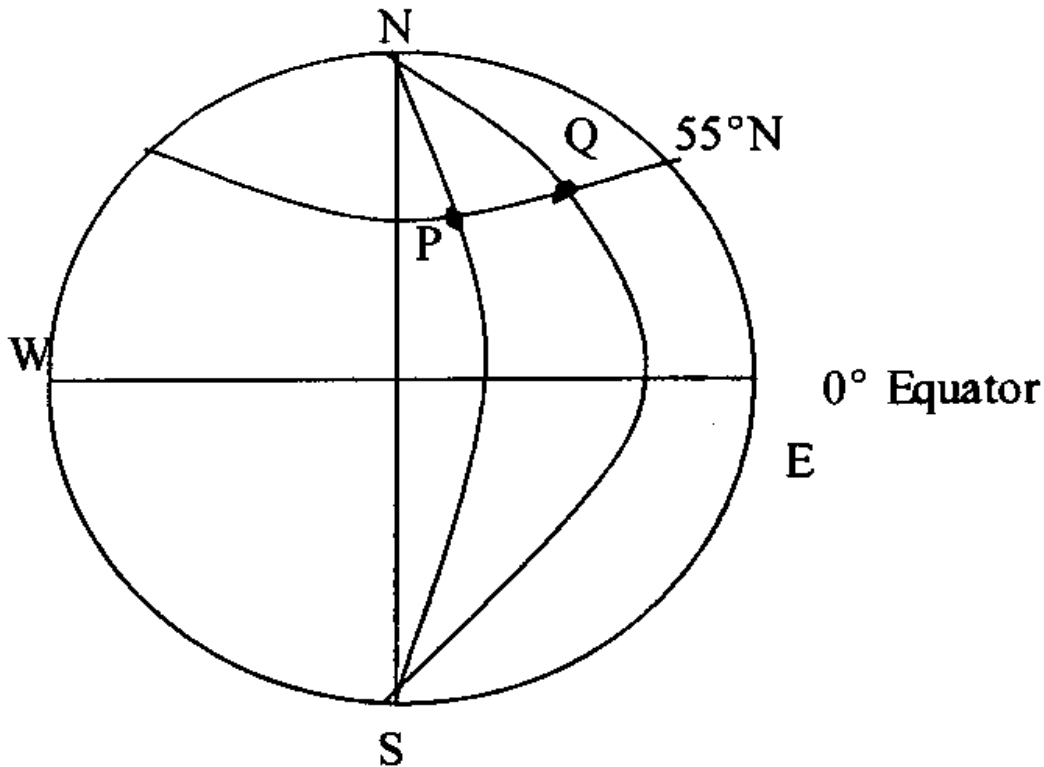
(b)  $y = \cos 2x$

x	0	30	60	90	120	150	180	210	240	270	300	330	360
2x	0	60	120	180	240	300	360	420	480	540	600	660	720
Y=Cos 2x	1	0.5	-	-1	-	0.5	1	0.5	-	-1	-	0.5	1
			0.5		0.5				0.5		0.5		1



(b)  $X = 120^\circ, 240^\circ, 360^\circ$

20.



P (50°N, 20°E)

Q (50°N, 140°E)

$$\begin{aligned} \alpha &= \text{longitude difference} \\ &= 140^\circ - 20^\circ \\ &= 120^\circ \end{aligned}$$

(a) Distance covered by aircraft A along latitude

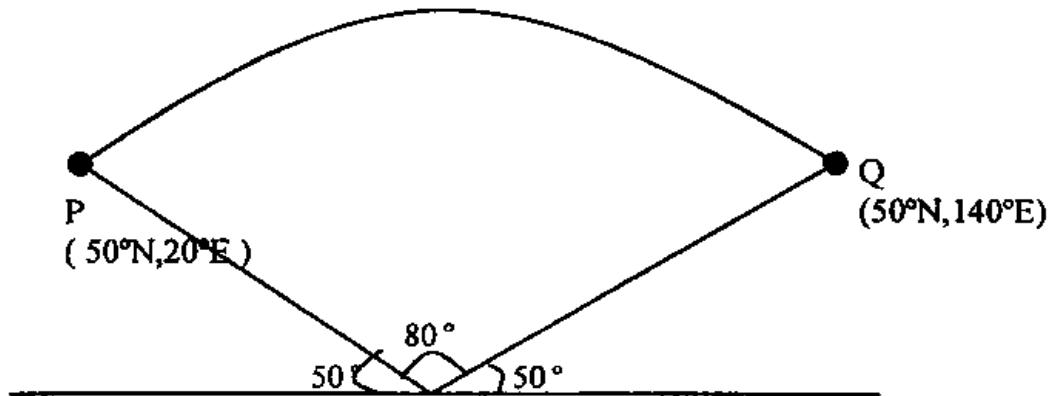
(i) Distance PQ =  $\frac{\alpha}{360^\circ} \times 2 \pi R \text{ Cos } \theta$

$$= \frac{120}{360} \times 2 \times \frac{22}{7} \times 6400 \times \text{Cos } 50^\circ$$

$$= \frac{1}{3} \times \frac{44}{7} \times 6400 \times 0.6428$$

$$= 8619.64 \text{ km}$$

**(ii)** Distance covered by aircraft B via North pole.



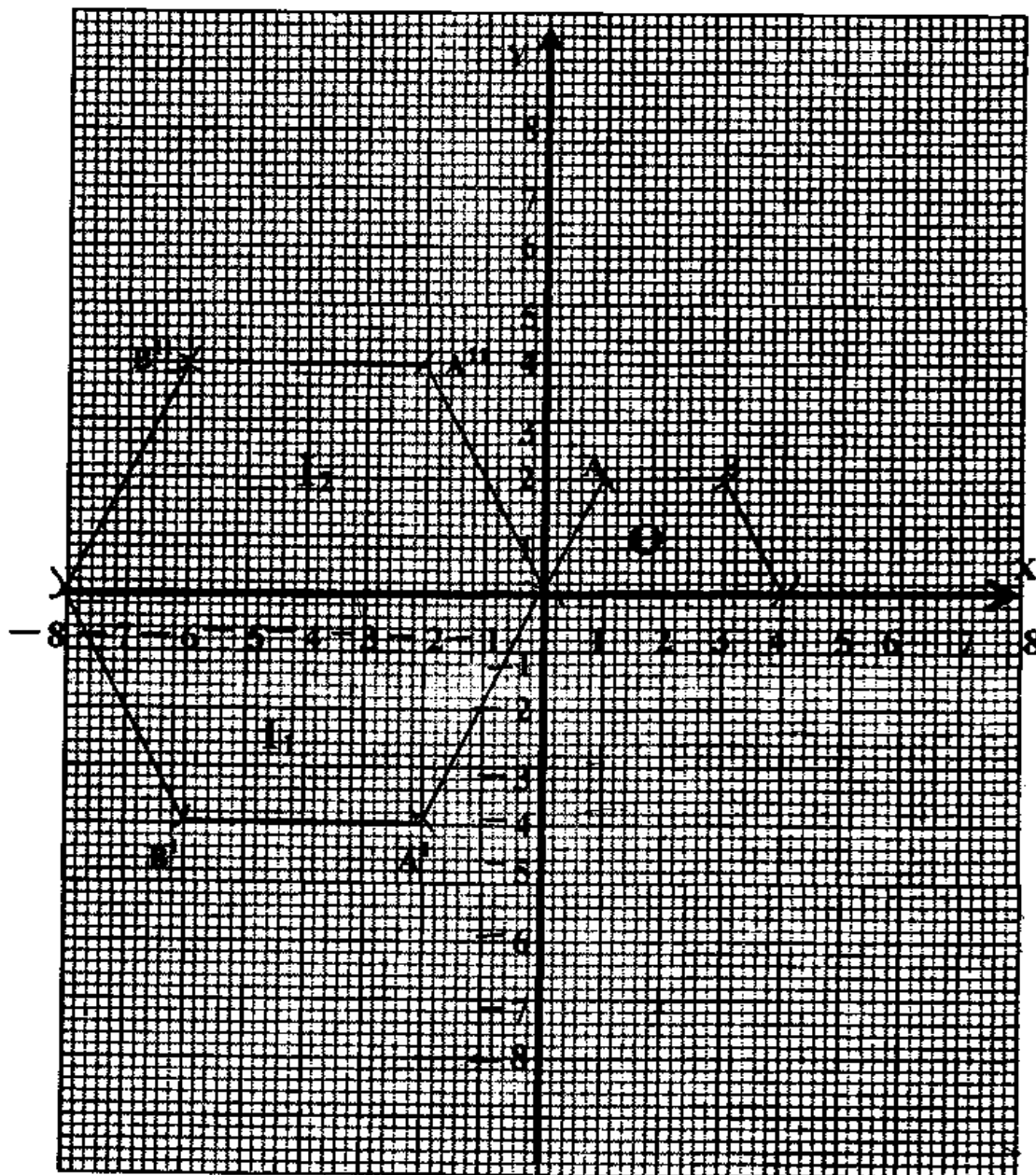
$$\begin{aligned} \text{Distance PQ} &= \frac{\theta}{360} 2\pi R \\ &= \frac{80}{360} \times 2 \times \frac{22}{7} \times 6400 \\ &= 8939.68 \text{ km} \end{aligned}$$

**(b)(i)** Time for aircraft A along latitude  
 =  $\frac{8619.64 \text{ km}}{600 \text{ km/hr}}$   
 = 14 hrs 21 min 57 seconds  
 = 14 hrs 22min.

**(ii)** Time for aircraft B along North pole  
 =  $\frac{8939.68 \text{ km}}{800 \text{ km/hr}} = 11 \text{ hrs, } 10 \text{ min } 28 \text{ seconds}$   
 = 11 hrs, 11 minutes

Time difference = 14 hrs 22min - 11 hrs, 11 minutes  
 = 3 hrs, 11 minutes

21. (a)



(b) Drawing trapezium OABC

$$\begin{matrix} & O & A & B & C \\ \begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix} & \begin{pmatrix} 0 & 1 & 3 & 4 \\ 0 & 2 & 2 & 0 \end{pmatrix} & \begin{matrix} O' & A' & B' & C' \\ \begin{pmatrix} 0 & -2 & -6 & -8 \\ 0 & -4 & -4 & 0 \end{pmatrix} \end{matrix} \end{matrix}$$

Vertices of trapezium  $I_1$

$O' (0,0) A' (-2, -4) B' (-6, -4) C' (-8, 0)$

(c) Drawing image  $I_2$

Vertices of trapezium  $I_2$

$O'' (0,0) A'' (-2,4) B'' (-6, 4) C'' (-8,0)$

(d) Let the matrix transforming  $I_2$  onto object trapezium be  $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{matrix} A' & B' \\ -2 & -6 \\ 4 & 4 \end{matrix} = \begin{matrix} A & B \\ 1 & 3 \\ 2 & 2 \end{matrix}$$

$$\begin{aligned} -2a + 4b &= 1 \\ -6a + 4b &= 3 \\ \hline 4a &= -2 \\ a &= \frac{-2}{4} \\ a &= -\frac{1}{2} \\ -2a + 4b &= 1 \\ -2(-\frac{1}{2}) + 4b &= 1 \\ 1 + 4b &= 1 \\ 4b &= 0 \\ b &= 0 \end{aligned}$$

$$\begin{aligned} -2c + 4d &= 2 \\ -6c + 4d &= 2 \\ \hline 4c &= 0 \\ c &= 0 \\ -2c + 4d &= 2 \\ 0 + 4d &= 2 \\ 4d &= 2 \\ d &= \frac{1}{2} \end{aligned}$$

hence  $\begin{pmatrix} a & b \\ c & d \end{pmatrix} = \begin{pmatrix} -\frac{1}{2} & 0 \\ 0 & \frac{1}{2} \end{pmatrix}$

22.  $v = 3t^2 - 4t - 4$

(a)  $a = \frac{dv}{dt} = 6t - 4$

$a =$  (at  $t = 2$ )

$= 6(2) - 4$

$= 12 - 4$

$= 8\text{m/s}^2$

(b)  $S = \int_1^4 (3t^2 - 4t - 4) dt$

$\left[ t^3 - 4t^2/2 - 4t \right]_1^4$

$= [4^3 - 2 \cdot (4^2) - 4 \times 4] - [1 - 2 \cdot (1) - 4(1)]$

$(64 - 32 - 16) - (1 - 2 - 4)$

$= 16 - (-5)$

$= 21\text{m}$

(c)  $3t^2 - 4t - 4 = 0$  (V = 0 at rest)

$3t^2 - 6t + 2t - 4 = 0$

$3t(t - 2) + 2(t - 2) = 0$

$(3t + 2)(t - 2) = 0$

(i)  $3t + 2 = 0$

$3t = -2$

$t = -\frac{2}{3}$

or  $t - 2 = 0$

$t = 2$

Disqualify  $t = -\frac{2}{3}$  since we can't have negative time.

Hence  $t = 2$  seconds.

23.

x	-3	-2	-1	0	1	2	3	4
$x^2$	9	4	1	0	1	4	9	16
$-2x^2$	-18	-8	-2	0	-2	-8	-18	-32
3x	-9	-6	-3	0	3	6	9	12



$-2x^2 + 3x$	-27	-14	-5	0	1	-2	-9	-20
$y = -2x^2 + 3x + 4$	-23	-10	-1	4	5	2	-5	-16

- (b) (i)  $-2x^2 + 3x + 4 = 0$   
 give the value of x when  $y = 0$   
 $x = -0.8$   
 $x = 2.4$

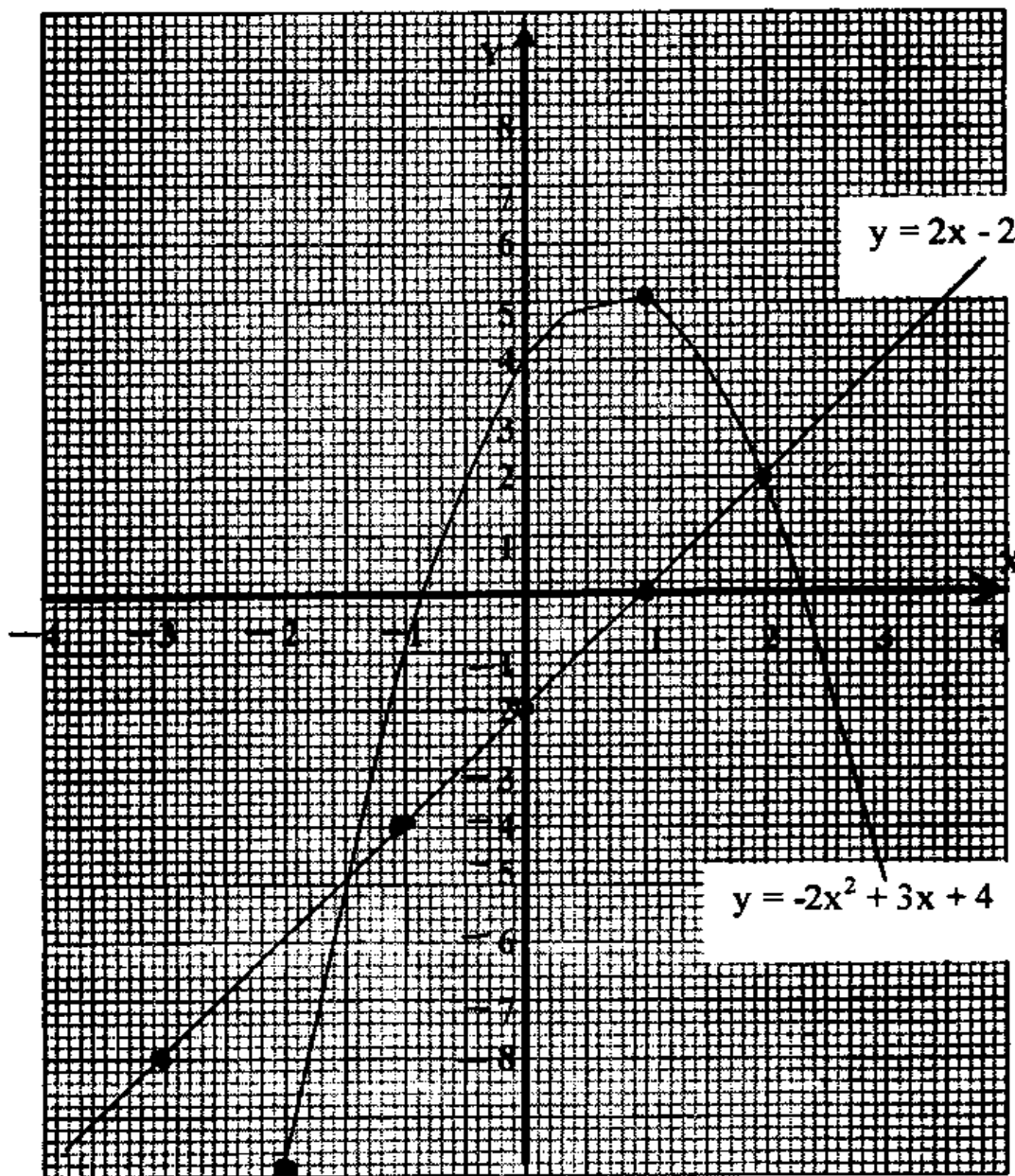
- (ii)  $-2x^2 + x + 6 = 0$   
 Compare this with the drawn equation  
 $y = -2x^2 + 3x + 4$   
 $-0 = -2x^2 + x + 6$   
 $y = 2x - 2$

draw this straight line.

<b>x</b>	-3	-2	-1	0	1	2	3
<b>2x</b>	-6	-4	-2	0	2	4	6
<b>Y = 2x - 2</b>	-8	-6	-4	-2	0	2	4

Point of intersection

$X = -1.5$   
 $X = 2$



24. In one-hour pipe P delivers  $\frac{1}{6}$  of total volume  
 In one hour, R empties  $\frac{1}{12}$  of the total volume  
 Hence in one hour the volume left in the tank

$$= \frac{1}{6} - \frac{1}{12} = \frac{2}{12} - \frac{1}{12} = \frac{1}{12} \text{ of the volume}$$

The volume of the water in the tank after 4 hours is

$$\frac{1}{12} \times 4 = \frac{1}{3} \text{ of total volume.}$$

$$\text{Volume left not filled } \frac{3}{3} - \frac{1}{3} = \frac{2}{3} \text{ of the volume}$$

Hence, after Q is turned off, P fills the tank continuously.  
 $\frac{1}{6}$  of total volume is filled in one hour by P

$\frac{2}{3}$  of total volume is filled in x hours.

$$6 \left( \frac{2}{3} \times 1 \text{ hr} \right) = \frac{(1x) 6}{6}$$

$$x = 4 \text{ hrs.}$$

P takes 2 hrs to fill  $\frac{2}{3}$  of the tank

Total time taken to fill the tank = 4 hrs + 4hrs = 8 hrs.

$$\text{(b) Pipe P delivers } \frac{1}{6} \times 4 \text{ hrs} + \frac{1}{6} \times 4 \text{ hrs}$$

$$\frac{4}{6} + \frac{4}{6} = \frac{8}{6} \text{ of total volume.}$$

$$\text{if } \frac{8}{6} \text{ of total volume} = 2060 \text{ litres.}$$

$$\frac{6}{6} \text{ of total volume} = x$$

$$\frac{8x}{6} = \frac{6 \times 1260}{6}$$

$$x = 945 \text{ litres}$$

## Paper 3 Questions

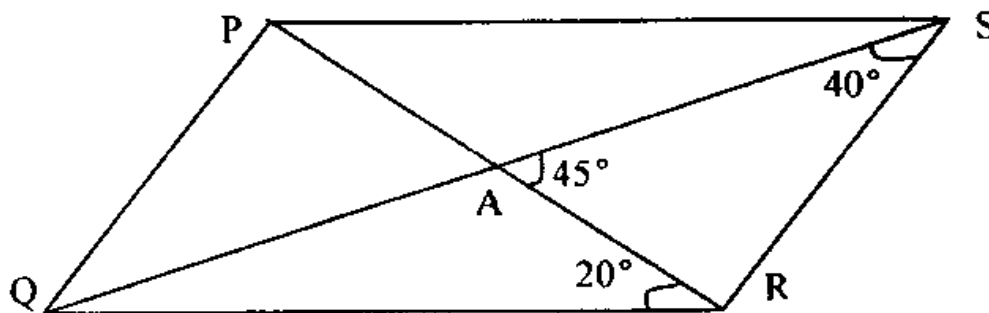
### SECTION I: answer all Questions (52 marks)

1. Find the value of  
 $\frac{3}{8} \div 4$  of  $\frac{25}{12}$

(2 marks)

2. Simplify  $\frac{x}{x+2} + \frac{3x-2}{x^2-4}$  (3 marks)

3. The diagonals of a parallelogram PQRS intersect at A. If angle PSR = 40° angle PRQ = 20° and angle SAR = 45°. Calculate angle (i) SQR (1 mark)  
 (ii) SPR (2 marks)



4. A series is given as  $S_n = -3 + 3 + 9 + 15 + \dots + 45$   
 Where  $S_n$  denotes the sum of the first  $n$  terms.  
 Find  $n$  and  $S_n$  (4 marks)

5. Solve the equation without use of the four figure tables  
 $\log_3 (x + 23) - \log_3 (\log_2 32) = \log_3 (9 - 2x)$  (4 marks)

6. If  $\tan \theta = \frac{1}{\sqrt{3}}$  find without using tables

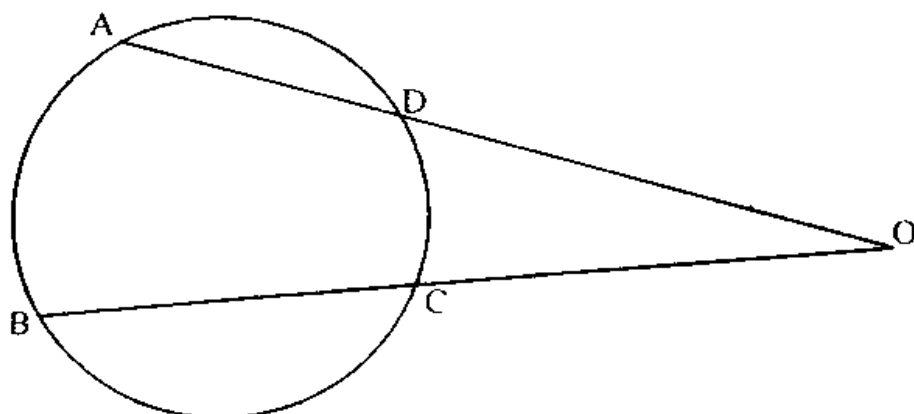
$\sin (90 - \theta) + \cos (90 - \theta)$ . Leave your answer in surd form. (3 marks)

7. Given that  $AB = \begin{pmatrix} 2 \\ 3 \\ 5 \end{pmatrix}$  and  $CD = \begin{pmatrix} 6 \\ k-1 \\ 15 \end{pmatrix}$  are parallel, find  $k$  hence evaluate  $|CD|$  (4 marks)

8. Two equal sides of a triangular plot are 40m long. Given that the angle enclosed by these sides is obtuse and that the area of the plot is  $400\text{m}^2$ . Find the perimeter of the plot. (3 marks)

9. The length and the width of a rectangle are given as 6.1cm and 5.3 cm respectively. Calculate the percentage error in the perimeter of the rectangle (3 marks)

10.



In the figure AD and BC are chords of a circle that intersect at O

- (a) Show that triangle ACO and triangle BDO are similar. (2 marks)
- (b) If  $AO = 7$  cm,  $AD = 3$  cm and  $BC = 12$  cm Find line BO (2marks)

11. Solve the simultaneous inequalities hence illustrate the solution on a number line.

$$1 - 3x \leq 7$$

$$-3 + 2x < 7 \quad (3 \text{ marks})$$

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12. Make  $x$  the subject of the equation.

$$\frac{E}{P} = \frac{m-2}{q - p\sqrt{x}} \quad (3 \text{ marks})$$

13. Calculate the surface area of a rectangular prism of sides 4 cm by 5 cm and 11 cm long (2 marks)

14. A cooker was bought on hire purchase terms. A down payment of Sh.1500 was required and 15 monthly instalments of 500 each. Calculate the total amount paid in this system. If it is 20% higher than the cash price, find the cash price. (4 marks)

15. A perpendicular to the line  $\frac{x}{4} + \frac{y}{3} = 1$  passes through the point (4, -5). Determine its equation. (3 marks)

16. From two points A and B are 27m apart on the same level ground and in line with a tree, the angles of elevation of the top of the tree are  $25^\circ$  and  $40^\circ$  respectively. Find the height of the tree. (4marks)

### SECTION II

ANSWER any SIX Questions.

17. A transport company is required to transport 800 passengers and 60 tonnes of luggage. It has 2 kinds of vehicles, Buses which can carry 60 passengers and 8 tonnes of luggage each, and Lorries which can carry 90 passengers and 40 tones of luggage each. Only 10 buses and 8 Lorries are available.

(i) Write down the inequalities that satisfy the facts given above. Let  $x$  be the number of buses and  $y$  the number of Lorries. (3marks)

- (ii) Represent them graphically (4 marks)  
 (iii) What is the least number of vehicles that can be used?  
 (1 mark)

18. Mwau bought a plot of land for Sh 300,000 per hectare. The value of this piece of land appreciated at a constant rate of 10% per annum. After two years, he sold the whole plot to a customer who paid him Shs.500, 000 per hectare. In the transaction he received Sh.274,000 more than the present value of the plot. Determine

- (a) The present land value per hectare (3 marks)  
 (b) The size of Mwau's plot in hectares (5 marks)

19. The location of two cities A and B are A( 07°N, 30° E) and B( 13° S, 30° E). A plane flies from A to B by the shortest route between the two cities

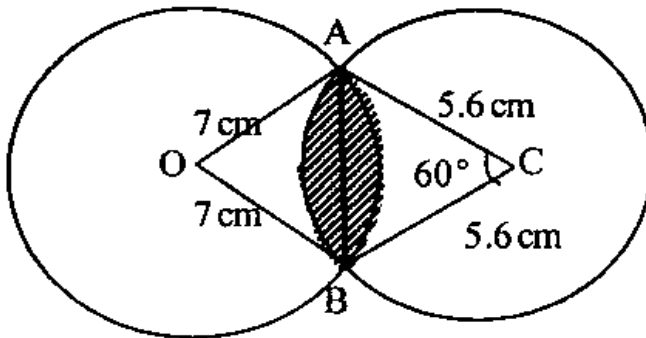
- (a) Calculate the shortest distance between A and B in km. (4marks)  
 (b) Find this distance in nautical miles (2 marks)  
 (c) The speed of the plane is 360 knots. Determine how long it takes to fly from A to B. (Earth's radius = 6370km) (2 marks)

20. On the same axis draw the graph of  $y = \sin x$  and  $y = 2 \sin(x - 30^\circ)$  in the domain  $-180^\circ \leq x \leq 180^\circ$ . What transformation would map the graph of  $y = \sin x$  onto the graph of  $y = 2\sin(x - 30^\circ)$ ? (8 marks)

21. In the figure below AB is the common chord of intersecting circles with centre O and C and radii 7cm and 5.6cm respectively. Determine

- (a) (i) Length of chord of AB (1 mark)  
 (ii) The size of angle AOB (2 marks)  
 (b) Hence calculate the shaded area (5 marks)

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22. The variables  $x$  and  $y$  are known to satisfy a law of the form  $y = kt^x$ , Where  $k$  and  $t$  are constants.

The data collected from an experiment was recorded as in the table below. One of the recorded values of  $y$  is wrong

$x$	1	2	2.5	3	4
$y$	9.6	19.2	27.1	45.4	76.8

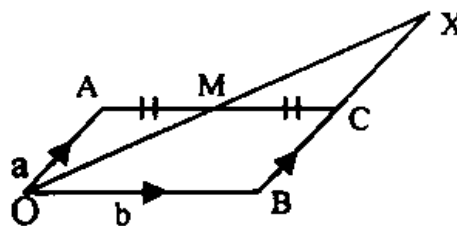
- (a) Obtain a linear equation connecting  $y$  and  $x$ . (1 mark)  
 (b) Draw a suitable linear graph and identify the wrong values of  $y$ . (5 marks)  
 (c) Use your graph to estimate values of  $k$  and  $t$ . (2 marks)

23. A father has a son and a daughter who will sit for their final exam this year. The probability that the son will fail is 0.1 and that the daughter will fail, is 0.2. Calculate the probability that

- (a) Both pass their final exams (2 marks)  
 (b) Non passes their final exams (2 marks)  
 (c) Only one passed the final exams (2 marks)  
 (d) The daughter passes but the son fails the final exams (2 marks)

24. In the figure,  $OACB$  is a parallelogram in which  $M$  is the midpoint of  $AC$  and  $OM$  produced meets  $BC$  also produced at  $X$ . Given that  $OA = a$ , and  $OB = b$ , find the values of  $r$  and  $s$  such that  $OX = rOM$  and  $CX = sBC$ .

Hence, determine the ratio  $BC : BX$  (8 marks)





## Answers to Paper 3

$$1. \frac{3}{8} \div \frac{4 \times 25}{\frac{12}{3}} = \frac{3}{8} \times \frac{3}{25} = \frac{9}{200}$$

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

$$\frac{x+x-2}{(x-2)(x+2)} = \frac{\cancel{(x+2)}(x-1)}{(x-2)\cancel{(x+2)}} = \frac{(x-1)}{(x-2)}$$

3. Angle PQR = 40°, ∠QAR = (180 - 45) = 135°

(i) angle SQR = 180 - (20 + 135)  
= 180 - 155 = 25°

(ii) Angle SPR = 180 - (120 + 40)  
= 180 - 160 = 20°

4. a = -3                      d = 3 - (-3) = 6

$$T_n = a + (n-1)d = -3 + (n-1)6 = 45$$

$$= -3 + 6n - 6 = 45$$

$$6n = 45 + 9 = 54$$

$$n = 9$$

$$S_9 = \frac{9}{2} (2a - 3 + (9-1)d)$$

$$= \frac{9}{2} (-6 + 48)$$

$$= \frac{9}{2} \times 42 = 189.$$

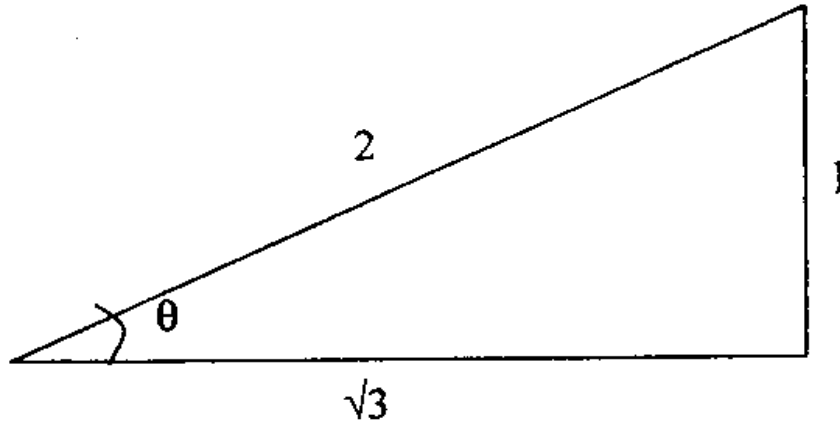
5.  $\log_{\left\{ \log_2 32 \right\}} \left\{ \frac{x+23}{5} \right\} = \log_3 (9-2x) = \log \frac{x+23}{5} = \log_3 (9-2x)$   
 $x + 23 = 45 - 10x$

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$$11x = 22$$

$$x = 2$$

6.



$$\sin(90 - \theta) = \frac{\sqrt{3}}{2}$$

$$\cos \theta = \frac{1}{2}$$

$$\sin(90 - \theta) + \cos(90 - \theta) = \sqrt{\frac{3}{2}} + \frac{1}{2}$$

$$= \frac{\sqrt{3+1}}{2}$$

7.  $\frac{6}{2} = \frac{k-1}{3} \quad k = 10$

$$CD = \begin{pmatrix} 6 \\ 9 \\ 15 \end{pmatrix}$$

$$|CD| = \sqrt{(6^2 + 9^2 + 15^2)} = \sqrt{342} = 18.49$$

8.  $A = \frac{1}{2} 40 \times 40 \sin \theta = 400$

$$\sin \theta = \frac{400}{800} = 0.5 = \frac{1}{2}$$

$$800$$

$$\theta = 180 - 30 = 150^\circ$$

$$\frac{x}{\sin 30^\circ} = \frac{40}{\sin 15^\circ}$$

$$x = \frac{40 \times 0.5}{0.2583} = 7.743 \times 10$$

$$P = 80 + 77.43 = 157.4 \text{ m}$$

9. Actual perimeter =  $2(6.1 + 5.3) = 22.8$

$$\text{Max. } P = 2(6.15 + 5.35) = 23$$

$$\text{Error} = 23.0 - 22.8 = 0.2$$

$$\% \text{ error} = \frac{0.2 \times 100}{22.8} = 0.88\%$$

10. Angle DAC = angle DBC (subtended by same chord DC)

Angle ADC = angle DBC (subtended by same chord DC)

Angle O is common for both triangles.

$$OD \times OA = OC \times OB.$$

$$4(4 + 3) = x(x + 12)$$

$$28 = x^2 + 12x$$

$$x^2 + 12x - 28 = 0 \text{ i.e. } x^2 + 12x - 28 = 0$$

$$(x + 14)(x - 2) = 0$$

$$x = 2$$

$$BO = 2 + 12 = 14 \text{ cm}$$

11.  $1 \leq 7 + 3x$

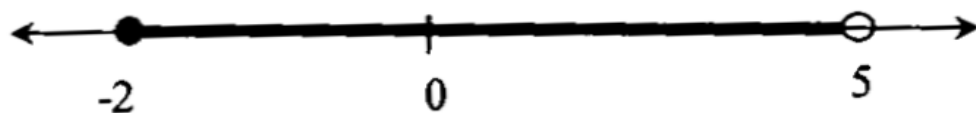
$$-6 \leq 3x$$

$$-2 \leq x$$

$$2x < 7 + 3$$

$$x < \frac{10}{2}$$

$$x < 5$$



12.  $E(q - p\sqrt{x}) = pm - 2p$

$$Eq + 2p - pm = Ep\sqrt{x}$$

$$x = \frac{(Eq + 2p - pm)^2}{p^2 E^2}$$

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$$13. A = 2(4 \times 5) + 2(4 \times 11) + 2(5 \times 11) \\ = 238\text{cm}^2$$

$$14. \text{Amount paid} = 1500 + 15 \times 500$$

KSh 9000

$$120 \longrightarrow 9000$$

$$100 \longrightarrow x$$

$$x = \frac{9000 \times 100}{120}$$

$$= \text{Sh.}7,500.$$

$$15. 4y + 3x = 12.$$

$$y = 3 - \frac{3x}{4}$$

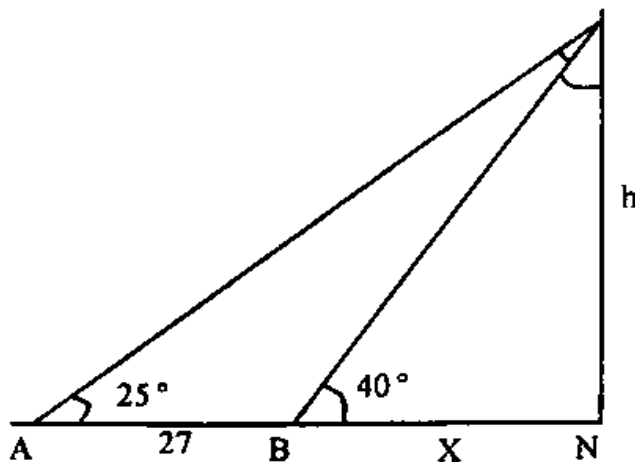
$$\text{grad.} = \frac{4}{3}$$

$$\frac{y - 5}{x - 4} = \frac{4}{3}$$

$$3y + 15 = 4x - 16$$

$$3y - 4x = -31.$$

16.



$$\text{Tan } 25 = \frac{h}{x + 27} \longrightarrow \text{tan } 25 (x + 27) = h$$

$$\text{Tan } 40 = \frac{h}{x}$$

$$x \text{ tan } 40 = h.$$

$$\begin{aligned}
 x \tan 25 + 27 \tan 25 &= x \tan 40. \\
 x (\tan 40 - \tan 25) &= 27 \tan 25 \\
 x &= \frac{27 \times 0.4663}{0.3728} \\
 &= 10^1 \times 2.628
 \end{aligned}$$

17. (i)  $x$  - busses  $y$  - lorries  $x \leq 10, \quad y \leq 8,$   
 $6x + 9y \geq 80, \quad 2x + 10y \geq 15$   
 (ii) Check graph page 63  
 (iii) 2 busses, 8 Lorries.

18. Value of land per hectare after 2 yrs.

$$\begin{aligned}
 \text{(a)} \quad &300,000 \left(1 + \frac{10}{100}\right)^2 \\
 &= 300,000 (1.1)^2 \\
 &= 300,000 \times 1.21 \\
 &= 363,000
 \end{aligned}$$

(b) Let the size be  $x$  hectares  
 Nzau received Sh.  $500,000x$   
 Present value Sh.  $363,000x$   
 $500,000x - 363,000x = 274,000.$   
 $137,000x = 274,000$

$$x = \frac{274000}{137000} = 2 \text{ hectares}$$

19. (a) Angle between A and B =  $7 + 13 = 20^\circ$   
 Distance of arc AB =  $\frac{20}{360} \times 2 \times \frac{22}{7} \times 6370$   
 $= 2224\text{km}.$

$$\begin{aligned}
 \text{(b)} \quad d &= 60x = 60 \times 20 \\
 &= 1200\text{nm}.
 \end{aligned}$$

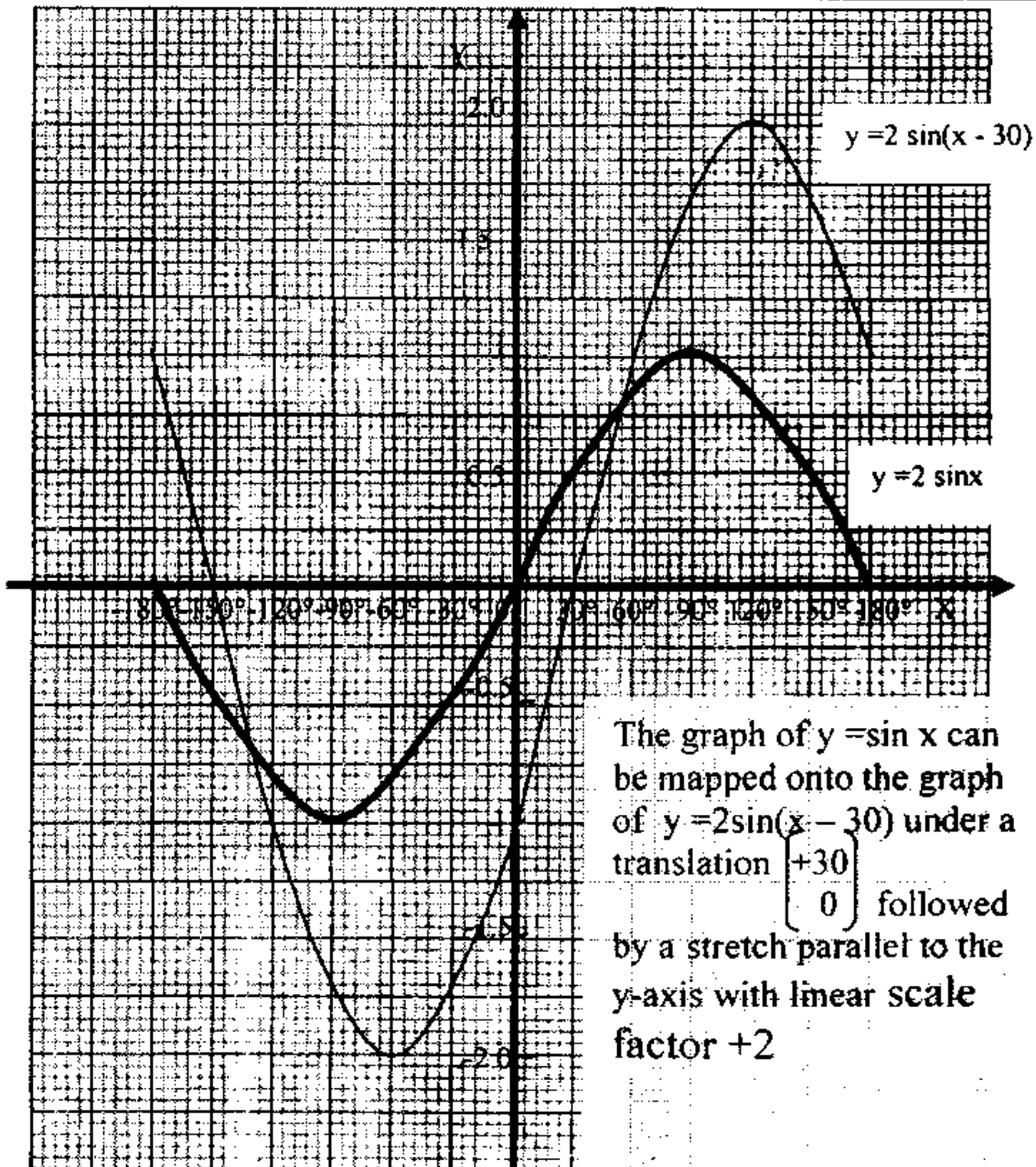
$$\text{(c)} \quad \text{Time taken} = \frac{1200}{360} = 3\frac{1}{3} \text{ hrs}$$

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20.

x	-180	-150	-120	-90	-60	-30
y=sinx	0	-0.5	-0.866	-1	-0.866	-0.5
y -30	-120	-180	-150	-120	-90	-60
sin(x-30°)	0.5	0	-0.5	-0.866	-1	-0.866
2sin(x-30°)	1	0	-1	-1.73	-2	-1.73

x	0	30	60	90	120	150	180
y=sinx	0	0.5	0.866	1	0.866	0.5	0
x-30	-30	0	30	60	90	120	150
sin(x-30)	-0.5	0	0.5	0.866	1	0.866	0.5
2sin(x-30)	-1	0	1	1.73	2	1.73	1



The graph of  $y = \sin x$  can be mapped onto the graph of  $y = 2 \sin(x - 30)$  under a translation  $\begin{pmatrix} +30 \\ 0 \end{pmatrix}$  followed by a stretch parallel to the y-axis with linear scale factor +2

21. (a) (i)  $AB = 5.6\text{cm}$  – equilateral  $\Delta$

(ii)  $\text{Cos } \theta = \frac{7^2 + 7^2 - 5.6^2}{2 \times 7 \times 7}$

$\theta = 47.2^\circ$

(b) Sector I area =  $\frac{60}{360} \times \frac{22}{7} \times 5.6 \times 5.6 = 16.43 \text{ cm}^2$

$\Delta_1 A = \frac{1}{2} \times 5.6 \times 5.6 \sin 60 = 13.58$

Seg.1 =  $16.43 - 13.58 = 2.85 \text{ cm}^2$

Sector II area =  $\frac{47.2}{360} \times \frac{22}{7} \times 7 \times 7 = 20.19 \text{ cm}^2$

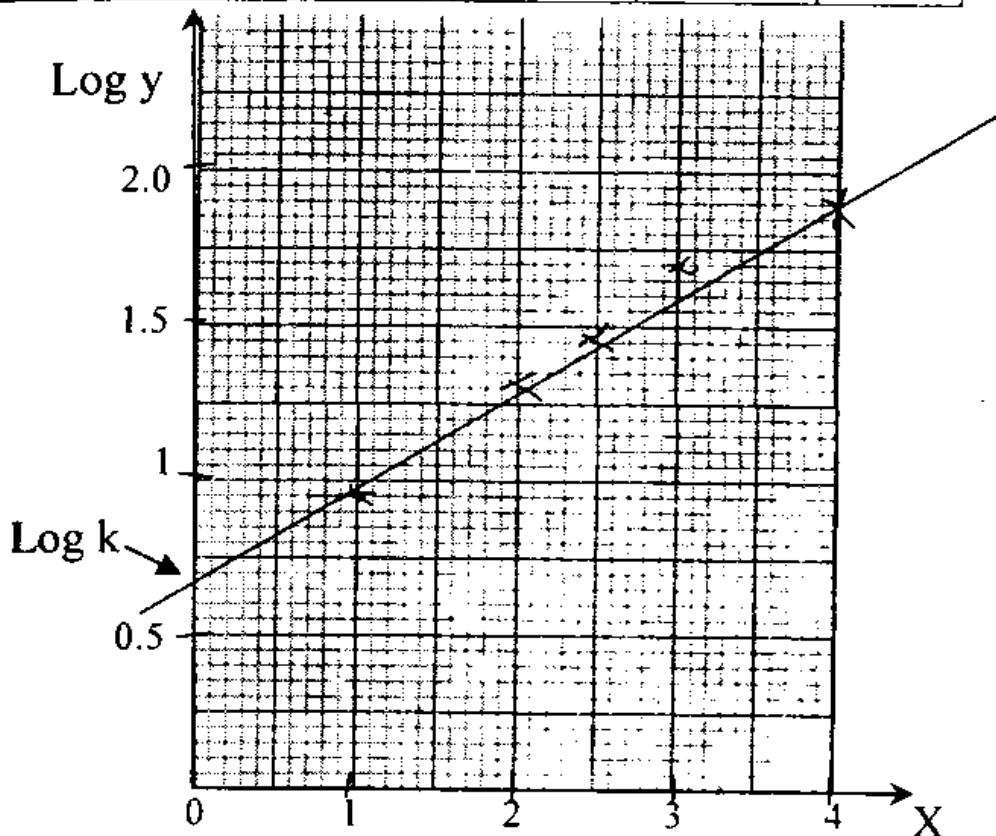
$\Delta_2 A = \frac{1}{2} \times 7 \times 7 \sin 47.2 = 17.98$

Seg<sub>2</sub> =  $20.19 - 17.98 = 2.21$

Total area =  $2.85 + 2.21 = 5.06 \text{ cm}^2$

22.  $\log y = (\log t) x + \log k$

<b>x</b>	1	2	2.5	3	4
<b>y</b>	9.6	19.2	27.1	45.4	76.8
<b>Log y</b>	0.98	1.28	1.43	1.66	1.89



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(a) The wrong value of  $y$  is 45.4

$$\log k = 0.65$$

$$K = 4.4668$$

$$\begin{aligned} \text{(b) grad.} &= \frac{1.89 - 0.98}{4 - 1} \\ &= \frac{0.91}{3} \end{aligned}$$

$$\log t = 0.3033$$

$$t = \text{antilog } 0.3033$$

$$t = 2.01$$

23.  $P(S) = 0.9$                        $P(D) = 0.8$

$P(S') = 0.1$                        $P(D') = 0.2$

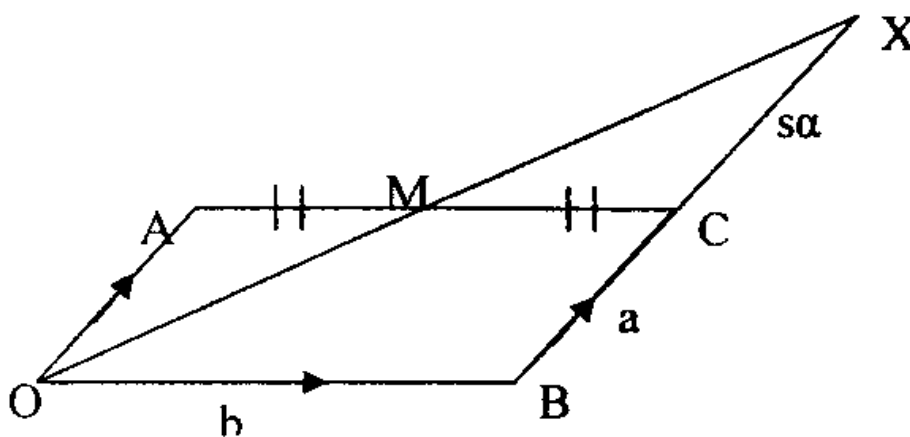
(a)  $P(\text{both pass}) = 0.9 \times 0.8 = 0.72$

(b)  $P(\text{non passes}) = 0.1 \times 0.2 = 0.02$

(c)  $P(\text{only one passes}) = 0.9 \times 0.2 + 0.1 \times 0.8 = 0.26$

(d)  $P(\text{daughter pass but son fails}) = 0.8 \times 0.1 = 0.08.$

24.



$$OM = OA + AM$$

$$= a + \frac{b}{2}$$

$$OX = r OM$$

$$= r \left( a + \frac{b}{2} \right)$$

from  $\triangle OBX$



$$\begin{aligned} \text{OX} &= \text{OB} + \text{BX} = \text{OB} + \text{BC} + \text{CX} \\ &= b + a + sa \\ &= (1 + s)a + b. \end{aligned}$$

$$\therefore r \left( \frac{a+b}{2} \right) = (1 + s)a + b.$$

$$r = 1 + s \text{ and } \frac{1}{2}r = 1$$

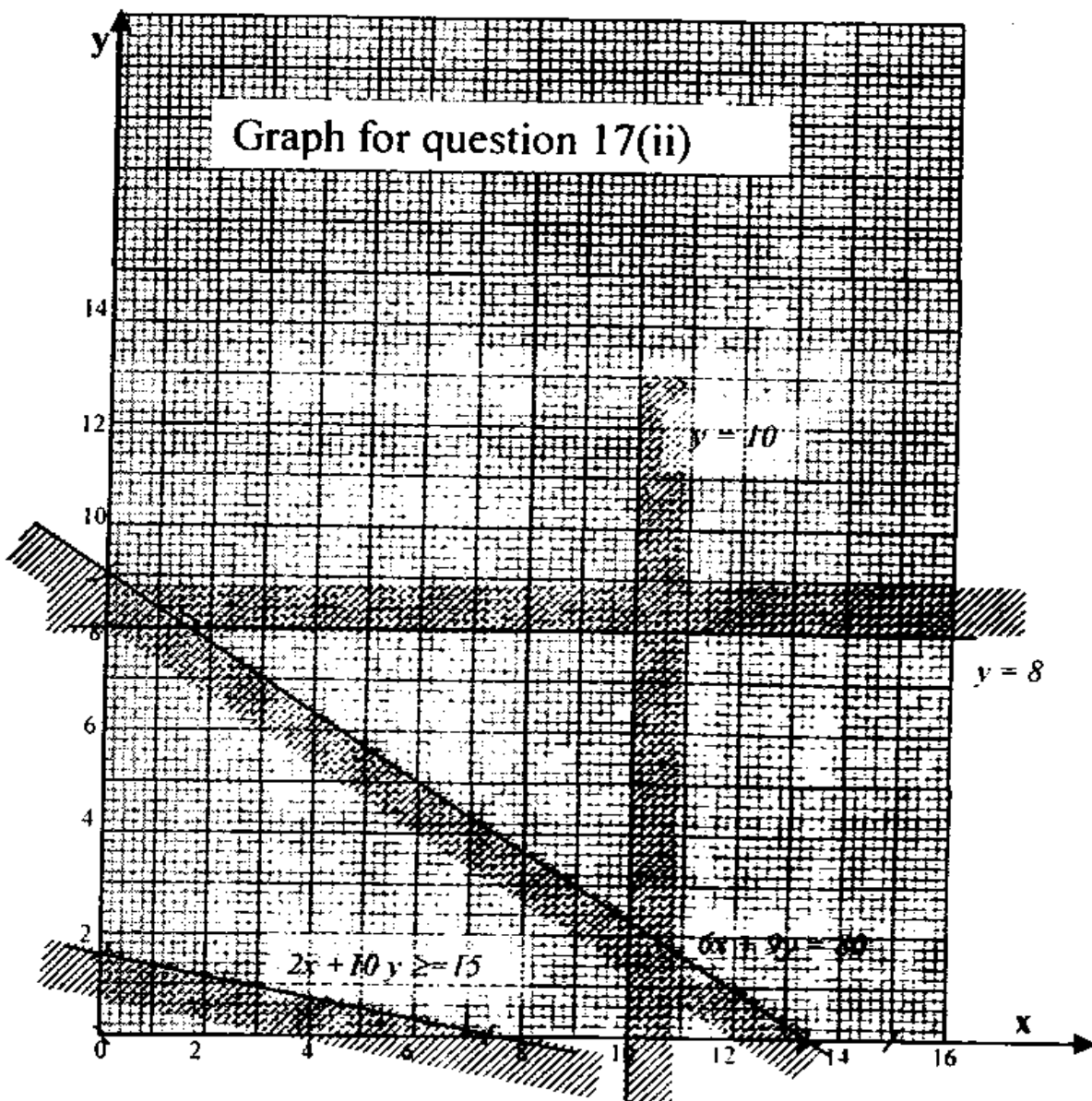
$$r = 2$$

$$2 = 1 + s \quad s = 1$$

$$\text{Now } \text{BX} = \text{BC} + \text{CX}$$

$$= a + a = 2a$$

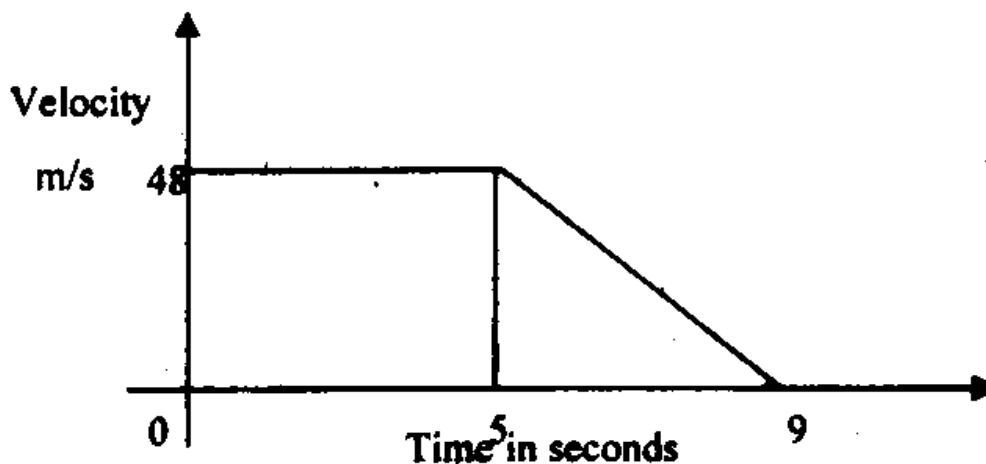
$$\text{BC: BX } 1: 2$$



## Paper 4 Questions

### Section One (52 marks) Answer all questions.

- Evaluate  $\frac{2\frac{1}{2} \times 1\frac{3}{4} - 5\frac{1}{4}}{1\frac{2}{5} + 2(1\frac{1}{4} - 2\frac{3}{4})}$  (3 marks)
- A 14-seater *matatu* charges Sh.20 per passenger during normal hours and Sh.30 per passenger during rush hours. If it made 10 trips and earned Sh.3640. How many rush hour trips did it make? (3 marks)
- Solve for  $\theta$   $2\cos(2\theta + 10)^\circ + 1 = 0$   
For  $0 \leq \theta \leq 360^\circ$  (3 marks)
- A trader marks his goods 20% above the cost price. He gives 10% discount to a customer and sells the goods at Ksh.486. Calculate the cost price of the goods. (3 marks).
- Study the diagram below and answer the questions that follow,



- Calculate the distance travelled. (2marks)
- The average velocity of the object for the 9 seconds of motion. (2 marks)

**6. Evaluate**

$$\left( \frac{3.453 + 8.635}{786 \times 0.0007} \right)^{1/4} \quad (3 \text{ marks})$$

**7. Simplify the following expression.**

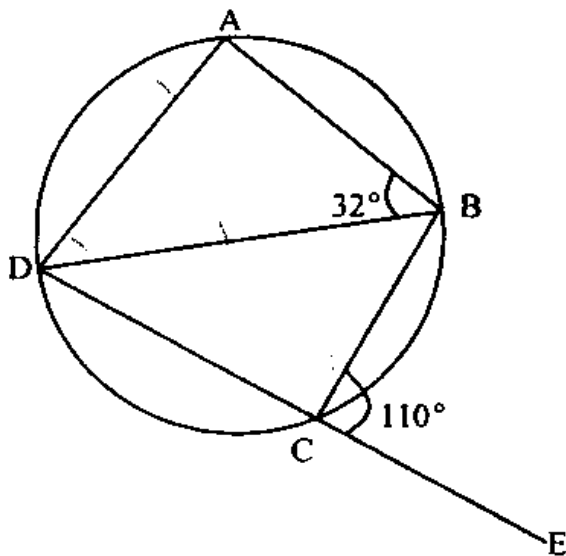
$$\frac{x^2 - 4}{3} - \frac{x + 3}{4}$$

Hence

$$\frac{x^2 - 4}{3} - \frac{x + 3}{4} = -\frac{1}{2} \quad (2 \text{ marks})$$

- 8. Two towns P and Q are 30 km apart, Q being due East of P. Town R is situated at a bearing of  $150^\circ$  from P, and  $240^\circ$  from Q. Draw a sketch to show the positions of the three towns and measure distance  $\overline{RQ}$ . (4 marks)**

- 9. In the figure below ABCD is a cyclic quadrilateral. DCE is a straight line.  $\angle BCE = 110^\circ$  and  $\angle ABD = 32^\circ$ . Calculate  $\angle ADB$  giving reasons for your answer. (3 marks)**



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10.  $\int_{-1}^2 \frac{(1-x^2)}{(x+1)} dx$  (3 marks)

11. Find the value of  $x$  for which the matrix  $\begin{pmatrix} x & -5 \\ -3 & x-2 \end{pmatrix}$  has no inverse (3 marks)

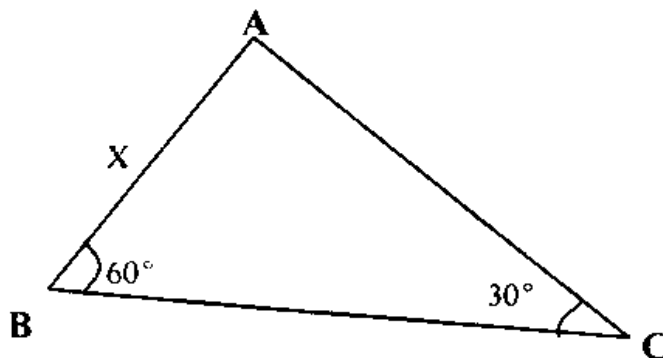
12. Ali deposited Sh. 10,000 in bank at the beginning of every year. The bank paid interest at 16% p.a compounded annually. He withdrew all his money at the end of the third year. Find the total amount that he withdrew. (3 marks)

13. Type A of sugar costs Sh. 50 per kg while type B costs sh. 60 per kg. In what ration will type A be mixed with type B to produce a blend costing sh.56 per kg. (3 marks)

14. Bag A contains 3 red marbles and 5 white ones. A second bag B contains 4 red marbles and 6 white ones. A bag is chosen at random and a marble is picked from it. Find the probability that a marble picked is white. (3 marks)

15. Find the equation of the normal to the curve  $y = x^3 - 3x - 7$  at the point  $(-2, 5)$  (4 marks)

16. Find an expression for BC in terms of  $x$ . (2 marks)



**SECTION B 48 MARKS**

**Answer any six questions in this section.**

**17.** Musaimo obtained a loan in which the rate of interest was charged at 3.5% quarterly. He cleared this loan by paying Ksh.24, 805 at the end of 1½ yrs

- (a)** How much was the loan if the rate was on -
  - (i)** Simple interest (3 marks)
  - (ii)** Compound interest (3 marks)
- (b)** Calculate the difference between simple and compound interest. (2 marks)

**18.** The cumulative frequencies of the heights of 200 students are given in the table below

<b>Height(cm)</b>	≤152	≤156	≤160	≤164	≤168	≤172	≤176	≤180	≤184	≤188
<b>Frequency</b>	0	2	4	14	44	95	155	187	199	200

Using a scale of 1 cm to represent 5 on the horizontal axis and 1 cm to represent 20 on the vertical axis, draw the cumulative frequency graph to illustrate the above information. Use your graph to estimate the median height.

- (i)** Determine the interquartile deviation.
- (ii)** Calculate the mean.

**19.** A particle moves in a straight line such that  $t$  seconds after passing a fixed point  $O$  on the line, its velocity  $v$  m/s is given by  $v = 48t - 6t^2$ . Calculate

- (a)** (i) The time when maximum velocity is achieved (2 marks)
- (ii) The acceleration of the particle at  $t = 2$  seconds. (1mark)
- (b)** The average velocity of the particle for the first 9 seconds. (3 marks)
- (c)** The time when the particle is momentarily at rest. (2 marks)

**20.** A motorist cycles to a town B on the bearing of  $050^\circ$  and 180 km from town A. He then cycles to a town C, which is on a bearing  $150^\circ$  from town B and on bearing of  $110^\circ$  from town A and later cycles to town D which is 240km and on a bearing of  $320^\circ$  from town A, where he stops for repairs before heading back straight to town A. Calculate to the nearest kilometre

- (i) the distance of town A to town C (4 marks)
- (ii) the distance of town C to town D (4marks)

**21.** A straight line  $L_1$  has a gradient  $-\frac{1}{2}$  and passes through the point P ( -1, 3), another straight line  $l_2$  passes through the points Q ( 1, -3) and R ( 4, 5) find

- (i) The equation of  $L_1$
- (ii) Gradient of  $L_2$
- (iii) The equation of  $L_2$
- (iv) The coordinates of the point of intersection of  $L_1$  and  $L_2$
- (v) The equation of a line through R and parallel to  $L_1$
- (vi) The equation of a line passing through, point S(0, 5) and perpendicular to  $L_2$ . (8 marks)

**22.** Triangle PQR have vertices at P ( 2, 2) Q ( 5, 3) and R(4, 1) it is mapped into triangle P' Q' R' by a transformation whose matrix is  $\begin{pmatrix} 1 & -1 \\ -2 & 1 \end{pmatrix}$

- (i) On the grid, draw triangles PQR and P' Q' R' (3marks)
- (ii) Triangle P'Q'R' is then mapped onto triangle P'' (-2, -2) Q'' (-5, -3) and R'' (-4,-1). On the same axis draw the triangle P''Q''R'' and describe the transformation, which maps triangle P' Q' R' onto triangle P''Q''R''. (2marks)
- (iii) If triangle PQR is mapped onto triangle P''Q''R'', find the matrix of this transformation. (3 marks)

- 23.** A factory manager pays a tax of ksh.3420 per month. He is married and he is entitled to a family relief of K£. 800 per annum. He receives a house allowance of Ksh.12, 000 a month, pays an insurance premium of Ksh.2000 per month for which he claims a tax relief of K£ 528 per annum.
- (i)** Use the taxation table below to calculate the manager's taxable income. (5 marks)

Taxable income	Rate Ksh. Per £
1- 8400	2
8401-16800	3
16801-25200	5
25201-33600	7
Over 33600	9

- (ii)** The manager has the following deductions
- (a) Cooperative loan repayment of Ksh 4,000.
  - (b) W.C.P.S 2% of gross salary.
- Calculate the principal's monthly net salary. (3 marks)

- 24.** A hot water tap can fill a tank in 5 minutes while a cold-water tap can fill the same tank in 3 minutes. The drainpipe can empty the full tank in  $3\frac{3}{4}$  minutes. The two inlet taps and the drain pipe are fully opened for  $1\frac{1}{2}$  hours after which the drain pipe is closed. How much longer will it take to fill the tank?  
(8 marks)

**Answers to Paper 4**

$$1. \frac{5}{2} \times \frac{7}{4} = \frac{35}{8}$$

$$\frac{35}{8} - \frac{21}{4} = \frac{-7}{8}$$

$$2\left(\frac{5}{4} - \frac{11}{4}\right) = \frac{-6}{4} \times 2 = \frac{-12}{4}$$

$$\frac{7}{5} - \frac{12}{4} = \frac{-32}{20}$$

$$\frac{-7}{8} \times \frac{20}{-32} = \frac{35}{64}$$

2. Let  $x$  be number of normal trips

Rush hour trips  $(10 - x)$

$$280x + 420(10 - x) = 3640$$

$$280 + 4200 - 420x = 3640$$

$$-140x = -560$$

$$x = \frac{560}{140} = 4$$

$$\text{Rush hour trips} = 10 - 4 = 6$$

$$3. \sin(2\theta + 10) = -0.5$$

$$\theta = 30^\circ$$

$$2\theta + 10 = 210, 330, 570, 690^\circ,$$

$$2\theta = 200, 320, 560, 680,$$

$$\theta = 100^\circ, 160^\circ, 280^\circ, 340^\circ,$$

$$4. \frac{120c}{100} \times \frac{90}{100} = 486$$

$$c = \frac{486 \times 100}{108} = \text{Ksh.450}$$



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5. Distance =  $\frac{1}{2} (5 + 9) \times 48$

= 336m or 0.336Km

Average velocity =  $\frac{336}{9} = 37.33^{-1}\text{ms}$

6.  $4\sqrt{\frac{12.088}{0.5502}}$

No	Log
12.088	1.0823
0.5502	<u>-1.7406</u>
	<u>1.3417</u>

$4 = 0.335425 = 2.164(5)$

7. (i)  $\frac{x^2 - 4}{3} - \frac{x - 3}{4} = \frac{4(x^2 - 4) - 3(x - 3)}{12}$

=  $\frac{4x^2 - 16 - 3x + 9}{12}$

=  $\frac{4x^2 - 3x - 7}{12}$

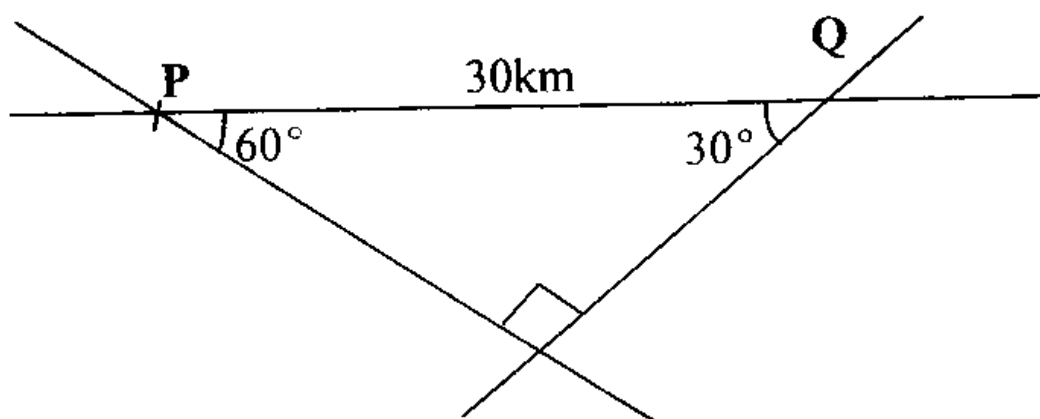
(ii)  $4x^2 - 3x - 7 = -6$

$4x^2 - 3x - 1 = 0$

$(4x + 1)(x - 1) = 0$

$x = -\frac{1}{4}$  or 1

8.



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$$\frac{30}{\sin 90^\circ} = \frac{P}{\sin 60^\circ}$$

$$= \frac{30 \times 0.8660}{1}$$

$$P = \frac{30^\circ \sin 60^\circ}{\sin 90^\circ}$$

$$= 25.98 \text{ km}$$

9.  $\angle BCD = 70^\circ$   $\angle BAD = 180^\circ - 70^\circ = 110^\circ$   
 (Opposite angles of cyclic quadrilaterals)  
 $\angle ADB = 180^\circ - (110^\circ + 32^\circ)$   
 $= 38^\circ$

10.  $\int_{-1}^2 \frac{(1-x)(\cancel{1+x})}{(\cancel{x+1})} dx$

$$0 - \left[ \frac{-3}{2} \right] = \frac{3}{2}$$

$$\left. x - \frac{x^2}{2} \right]_{-1}^2 = 2 - \frac{2^2}{2} - (-1 - \frac{1}{2})$$

11.  $x(x-2) - 15 = 0$   
 $x^2 - 2x - 15 = 0$   
 $(x-5)(x+3) = 0$   
 $x = 5$  or  $-3$ .

12. 1<sup>st</sup> year  $A = 1.16 \times 10,000$   
 2<sup>nd</sup> year  $A = 1.16 (10,000 + 1.16 \times 10,000)$   
 3<sup>rd</sup> year  $= 1.16 \times 10,000 (1.16)^2 \times 10,000 + 1.16^3 \times 10,000$   
 $= 10,000 (1.16 + 1.16^2 + 1.16^3)$   
 $= 10,000 \times 4.067$   
 $= 40,670$ .

13. Let the ratio be  $x : y$   
 $\frac{50x + 60y}{x + y} = 56$

$$50x + 60y = 56x + 56y$$

$$6x = 4y : \frac{x}{y} = \frac{4}{6}$$

$$x : y = 2 : 3$$

14.  $P(\text{white marble}) = (\frac{1}{2} \times \frac{5}{8}) + (\frac{1}{2} \times \frac{6}{10})$

$$= \frac{5}{16} + \frac{3}{10} = \frac{49}{80}$$

15.  $\frac{dy}{dx} = 3x^2 - 3$

$$g = 3(-2)^2 - 3 = 9$$

$$\frac{y - 5}{x - -2} = \frac{-1}{9}$$

$$9y - 45 = -x - 2$$

$$9y + x = 43.$$

16.  $\sin 30 = \frac{x}{BC}$

$$BC = \frac{x}{\sin 30^\circ}$$

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

17. Interest periods = 6

(i) Total interest = 21%

$$\frac{121P}{100} = 24805$$

$$P = \frac{24805}{121} \times 100 = 20,500$$

(ii)  $A = (1 + \frac{r}{100})^n$

$$24805 = P (1 + \frac{3.5}{100})^6$$

$$= P (1.035)^6$$

$$P = \frac{24805}{(1.035)^6} = \text{Sh.}20190$$

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- (b)  $SI = 24805 - 20500 = 4,305$   
 $CI = 24805 - 20190 = 4610.$   
 Difference =  $4610 - 4305 = \text{Sh.}305$

18. (i) See graph next page.

Class	Mid-points X	Frequency f	cf	Xf
148-152	150	0	0	0
153-156	154.5	2	2	309
157-160	158.5	2	4	317
161-164	162.5	10	14	1625
165-168	166.5	30	44	4995
169-172	170.5	51	95	8695.5
173-176	174.5	60	155	10470
177-180	178.5	32	187	5712
181-184	182.5	12	199	2190
185-188	186.5	1	200	186.5
		200		34500

Median height = 173

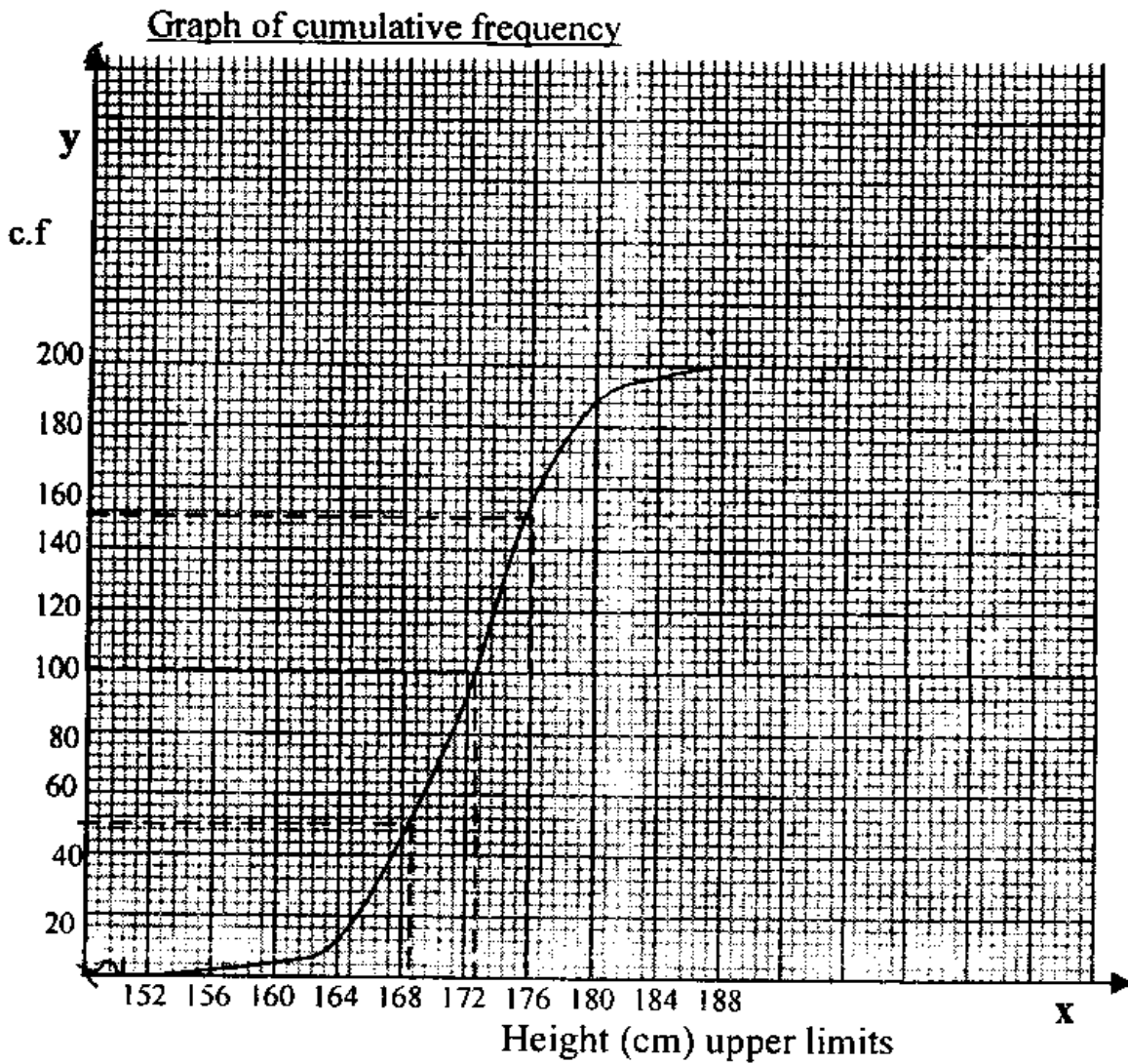
(ii) interquartile deviation

$$= U.Q - L.Q$$

$$= 176 - 169$$

$$= 7$$

(iii) Mean =  $\frac{34500}{200} = 172.5$



19. Maximum velocity when

$$\frac{dv}{dt} = 0, \quad \frac{dv}{dt} = 48 - 12t$$

$$48 - 12t = 0$$

$$t = 4 \text{ seconds}$$

(ii) Acceleration =  $\frac{dv}{dt} = 48 - 12t$

$$\begin{aligned} \text{When } t=2 \quad 9 &= 48 - 12(2) \\ &= 24\text{ms}^{-2} \end{aligned}$$

(b) Distance travelled in 9 secs.

$$\begin{aligned} \int_0^9 (48t - 6t^2) dt &= \left[ 24t^2 - 2t^3 \right]_0^9 \\ &= 24(9)^2 - 2(9)^3 = 486\text{m}. \end{aligned}$$

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$$\text{Average velocity} = \frac{486}{9} = 54\text{ms}^{-1}$$

(c) At rest when  $v = 0$

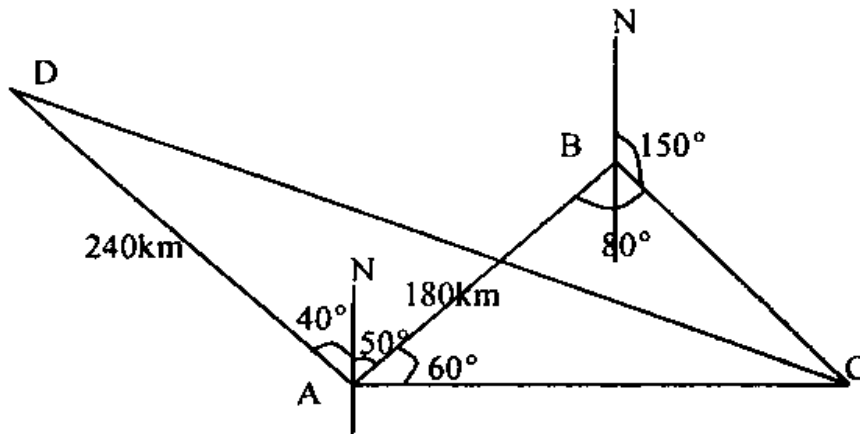
$$48t - 6t^2 = 0$$

$$6t(8 - t) = 0$$

$$t = 0 \text{ or } 8$$

Time required = 8 seconds

20.



Take  $\Delta ABC$

$$\frac{AC}{\sin 80} = \frac{180}{\sin 40} \quad \Rightarrow \quad AC = 275.8 \text{ km}$$

$$\begin{aligned} CD^2 &= 240^2 + 275.8^2 - 2 \times 240 \times 275.8 \cos 150 \\ &= 57600 + 76,066 + 132384 (0.866) \\ &= 248,313 \end{aligned}$$

$$CD = \sqrt{248,313} = 498.3 \text{ km.}$$

21. L1

$$(i) \frac{y-3}{x+1} = -\frac{1}{2}$$

$$2y - 6 = -x - 1$$

$$2y + x = 5.$$

$$(ii) M = \frac{5+3}{4-1} = \frac{8}{3}$$

$$(iii) \frac{y-5}{x-4} = \frac{8}{3}$$

$$3y - 15 = 8x - 32$$

$$3y - 8x = 17$$

$$(iv) y = \frac{-x+5}{2}$$

and

$$y = \frac{8x-17}{3}$$

$$\frac{-x + 5}{2} = \frac{8x - 17}{3}$$

$$x = +\frac{49}{19} = \frac{49}{19}$$

$$y = -\frac{49}{19} + 5 = \frac{22}{19} = \left(\frac{49}{19}, \frac{22}{19}\right)$$

(v)  $\frac{y-5}{x-4} = -\frac{1}{2}$ .

$$2y - 10 = 4 - x$$

$$2y + x = 14$$

(vi)  $\frac{y-5}{x} = \frac{-3}{8}$

$$8y + 3x = 40$$

22. (i)

$$\begin{pmatrix} 1 & -1 \\ -2 & 1 \end{pmatrix} \begin{matrix} P & Q & R \\ \begin{pmatrix} 2 & 5 & 4 \\ 2 & 3 & 1 \end{pmatrix} \end{matrix} = \begin{matrix} P' & Q' & R' \\ \begin{pmatrix} 0 & 2 & 3 \\ -2 & -7 & -7 \end{pmatrix} \end{matrix}$$

$$P' (0, -2)$$

$$Q' (2, -7)$$

$$R' (3, -7)$$

(ii)

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{matrix} P' & Q' & R' \\ \begin{pmatrix} 0 & 2 & 3 \\ -2 & -7 & -7 \end{pmatrix} \end{matrix} = \begin{matrix} P'' & Q'' & R'' \\ \begin{pmatrix} -2 & -5 & -4 \\ -2 & -3 & -1 \end{pmatrix} \end{matrix}$$

$$-2b = -2$$

$$b = 1$$

$$a = 1$$

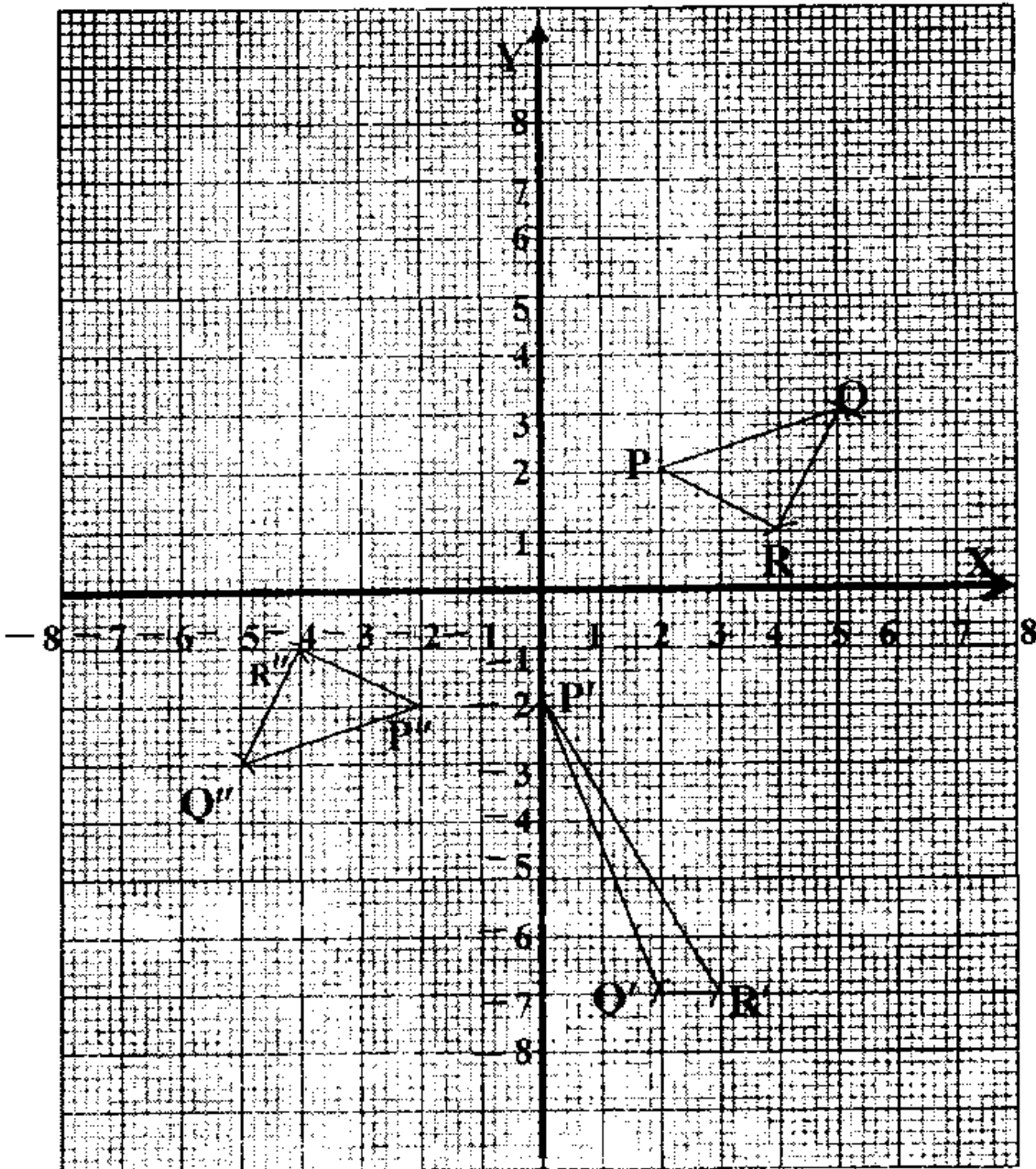
$$-2d = -2$$

$$d = 1$$

$$c = 2$$

$$\text{Matrix} \begin{pmatrix} 1 & 1 \\ 2 & 1 \end{pmatrix}$$

(iii) Half turn about the origin



23. Tax payable p.a =  $3420 \times 12 = \text{Sh. } 41040$

Tax relief per year =  $800 \times 20 = 16,000$

Insurance relief =  $528 \times 20 = 10560$

26,560

total tax p.a =  $41040 + 26560 = 67,600$

Income	Rate	Amount Shs.
1-8400	$8400 \times 2$	16800
8401-16800	$8400 \times 3$	25200
16801-25200	$x \times 5$	$5x = 25600$



$$x = 5120.$$

$$\begin{aligned} \text{Taxable income} &= 8400 + 8400 + 5120 = \text{£}21920 \\ &= \text{Sh } 438,400 \end{aligned}$$

$$\text{(ii) Total deductions} = 4000 + \frac{2}{100} \times 36,533.30 = 4730.70$$

$$\begin{aligned} &\text{sh.}4730.70 + \text{insurance (sh.}2000) + \text{tax (sh.}3420) \\ &= 10,150.70/= \end{aligned}$$

$$\begin{aligned} \text{Net monthly salary} &= 36,533.30 - 10150.70 \\ &= \text{Ksh. } 26,382.60 \end{aligned}$$

24. Amount left in  $1\frac{1}{2}$  min.

$$\begin{aligned} &= \frac{3}{2} \left( \frac{1}{3} + \frac{1}{5} - \frac{4}{15} \right) \\ &= \frac{3}{2} \left( \frac{8}{15} - \frac{4}{15} \right) = \frac{2}{5} \end{aligned}$$

$$\text{Amount in 1 minute} = \frac{1}{3} + \frac{1}{5} = \frac{3}{15} + \frac{5}{15} = \frac{8}{15}$$

$$\begin{aligned} \text{Time needed} &= \frac{3}{5} \times \frac{15}{8} = \frac{9}{8} \\ &= 1\frac{1}{8} \text{ minutes} \end{aligned}$$

**Paper 5 Questions****SECTION I**

1. Use logarithms to evaluate leaving your answer to 2 s.f

$$3 \sqrt{\frac{324.2 + 0.0052}{121.3 \times 6.8}} \quad (4 \text{ marks})$$

2. Use matrices to solve the simultaneous equation

$$5x + 2y = 1$$

$$8x + 3y = 1 \quad (4 \text{ marks})$$

3. Kamau spent  $\frac{3}{5}$  of his money on buying food, and  $\frac{1}{2}$  of what was left on rent. After that, he finds that He has Sh.1400 left in his pocket. Determine the amount of money spent on buying food . (3 months)

4. The position of vectors of P, Q, R are as follows

$$OP = \begin{pmatrix} 3 \\ 2 \end{pmatrix} \quad OQ = \begin{pmatrix} 7 \\ -3 \end{pmatrix} \quad OR = \begin{pmatrix} 9 \\ -5.5 \end{pmatrix}$$

Show that PQR are collinear (4 marks)

5. Find the equation of the line perpendicular to

$$2y - 6x + 7 = 0 \text{ and passes through point } (2, 1) \quad (3 \text{ marks})$$

6. Make P the subject of the formula

$$Q = \frac{\sqrt{P+1}}{\sqrt{P-1}} \quad (3 \text{ marks})$$

7. Five men each working for eight hours a day can cultivate a piece of land in 7 days. How long would 7 men take each taking 3 hrs to cultivate the same piece of land? (3 marks)

8. Solve for  $x$  in the equation  $\sin (2x - 30) = \frac{\sqrt{3}}{2}$   
 for  $0 \leq x \leq 360$  (3 marks)

9. Find the centre of enlargement if  $P_1 ( 0, -1 )$  is the image of  $P ( 2, 3 )$  under enlargement scale factor 3 (3 marks)

10. The table below shows a field book entry made when surveying a plot of land ABCDE.

Left offside	Point on surveying line	Right offside
	To C 200km	
	160	40 to E
80 to B	100	
	70	70 to D
	A	

Estimate the area of the plot in hectares ( 3 marks)

11. The area of a school compound on a map whose scale is 1: 100,000 is  $5.4 \text{ cm}^2$ . Find the area of the same compound on a map whose scale is 1:50,000. (3 marks)

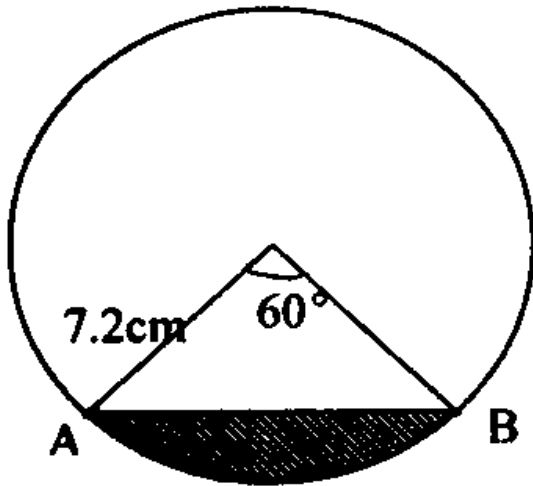
12. The table below shows the weight and price relatives of four items.

Item	Weight	Price relative
A	7	30
B	3	42
C	5	54
D	6	37

Determine the weighted index for the four items correct to 2 decimal places. (3 marks)

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13. Find the area of the shaded segment (take  $\pi = 3.142$ )  
correct to 2 decimal places. (4marks)



14. Simplify the expression  $\frac{x-1}{x} - \frac{2x+1}{3x}$  (3marks)

15. The sides of an equilateral triangle are increased by 10%.  
What is the percentage increased in its perimeter. (3 marks)

16. Use the reciprocal tables to evaluate to 3 decimal places,  
 $\frac{2}{0.4821} - \frac{3}{24.71}$  (3 marks)

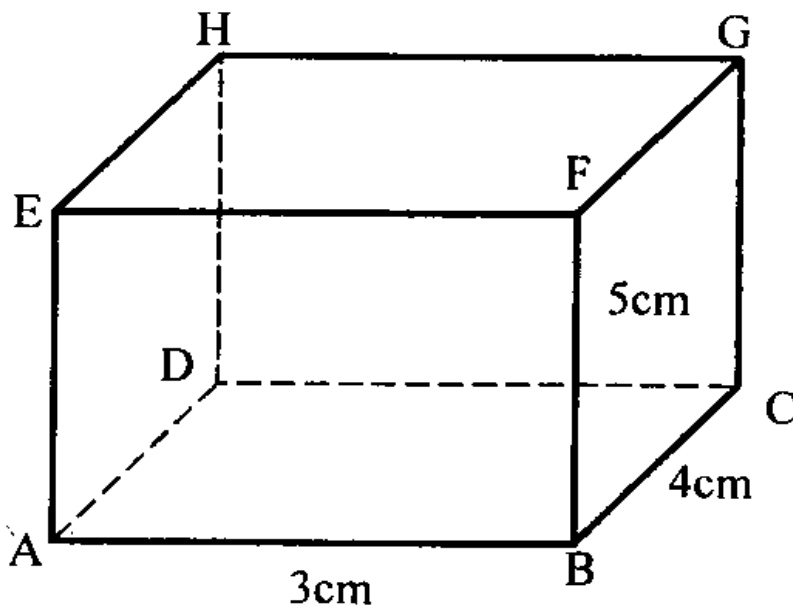
**SECTION II**

17. The marks obtained by form 4 students in a physics test are as shown below

Marks	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
No. of students	1	3	6	9	10	8	7	6	8	2

- (a) Draw an ogive using this information. (4 marks)
- (b) Use your graph to estimate
  - (i) The median (2 marks)
  - (ii) The quartiles (2marks)

18. The figure below shows a cuboid.



Calculate;

- (i)  $\angle HBA$ . (2 marks)
- (ii) The angle between  $HA$  and plane  $ABCD$ . (3 marks)
- (iii) The angle between  $AFC$  and  $ABCD$ . (3 marks)

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19. The income tax charged at the rate shown below.

Total income per year in £	rate in Shs per £
1- 1980	2
1981 - 3960	3
3961- 5940	5
5941 – 7920	7
7921 – 9900	10
over 9900	12

Mr. Njoroge earns a basic salary of 22,440 per month. He is housed by his employer and therefore 15% of his monthly salary is added to his basic salary as taxable income. He is entitled to a family relief of 720 per month. Calculate how much income tax he pays per month (8 marks)

20. Plot the graph of  $y = x^2 - 4x + 6$  for  $-4 \leq x \leq 5$  (4 marks)

Use your graph to solve

(i)  $x^2 - 4x + 6 = 0$  (1 mark)

(ii)  $x^2 - 6x + 2 = 0$  (3 marks)

21. ABC is a triangle whose vertices are

A ( 2, 0) B( 2, 3) C (0, 3).  $A_1B_1C_1$  is the image of ABC under a translation  $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$

(a) Find the coordinates  $A_1B_1C_1$  (2marks)

(b)  $A_2B_2C_2$  is the image of  $A_1B_1C_1$  under a transformation represented by reflection in the line  $x = 0$ .

Find the coordinates  $A_2B_2C_2$  (2 marks)

(c) Plot ABC and  $A_2B_2C_2$  on the graph paper. (2 marks)

(d) Obtain a single transformation that would map ABC directly to  $A_2B_2C_2$  (2 marks)

- 22.** An aircraft left airport A and flew to airport B 120 km away in the bearing of  $050^\circ$  from A. the aircraft then flies to airport C on the bearing of  $170^\circ$  from B where C is 210 km from B. The aircraft then returned to A at a speed of 85 km/hr. Calculate;
- (a) the time taken to travel from C to A. (5marks)  
 (b) the bearing of C from A. (3 marks)
- 23.** A box contains 3 green, 5 blue and two red marbles. A marble is taken out at random its colour noted and then returned into the box. Another marble is taken out and returned into the box after noting its colour. Using tree diagrams, determine the probability that the two marbles will be
- (a) Both green (2 marks)  
 (b) Of the same colour (2 marks)  
 (c) different colours (3marks)
- 24.** A Stone is thrown vertically upward with a velocity of  $v = 20t - t^2$
- (a) Find an expression for acceleration and distance travelled after t seconds (4 marks)  
 (b) Find the maximum height reached (2 marks)  
 (c) Find the time taken before the stone hit the ground (2marks)

## Answers to Paper 5

1. 324.2

$$\begin{array}{r} 0.0052+ \\ \hline 324.2052 \end{array}$$

No	Log
121.3	2.0839
6.8	0.8325 +
	2.9164
324.2052	2.5108
	2.9164
	<u>1.5944</u>
	3
	$\overline{1} + \overline{2} + 2 + 0.5944$
	3
	$\overline{1} + 0.8648$
7.3249 x 10 <sup>-1</sup>	
0.7325	

2.  $\begin{pmatrix} 5 & 2 \\ 8 & 3 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$

The inverse

$$\frac{1}{5 \times 3 - 8 \times 2} \begin{pmatrix} 3 & -2 \\ -8 & 5 \end{pmatrix}$$

$$-1 \begin{pmatrix} 3 & -2 \\ -8 & 5 \end{pmatrix}$$

$$\begin{pmatrix} -3 & 2 \\ 8 & -5 \end{pmatrix}$$



$$\begin{pmatrix} -3 & 2 \\ 8 & -5 \end{pmatrix} \begin{pmatrix} 5 & 2 \\ 8 & 3 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} -3 & 2 \\ 8 & -5 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} -1 \\ 3 \end{pmatrix}$$

$x = -1$   
 $y = 3$

3. Food =  $\frac{3}{5}$

rent,  $\frac{1}{2}$  of  $\frac{2}{5} = \frac{1}{5}$

Balance =  $1 - \left( \frac{3}{5} + \frac{1}{5} \right) = \frac{1}{5}$

$\frac{1}{5} = 1400/=$   
 $\frac{3}{5} = ?$

$1400 \times 3 = 4200 \text{ sh}$

4.  $PQ = \begin{pmatrix} 7 \\ -3 \end{pmatrix} - \begin{pmatrix} 3 \\ 2 \end{pmatrix} = \begin{pmatrix} 4 \\ -5 \end{pmatrix}$

$QR = \begin{pmatrix} 9 \\ -5.5 \end{pmatrix} - \begin{pmatrix} 7 \\ -3 \end{pmatrix} = \begin{pmatrix} 2 \\ -2.5 \end{pmatrix}$

$PQ = 2 \text{ QR}$

Hence collinear as they share a common point and PQ can be expressed as a scalar multiple of QR

5.  $2y - 6x + 7 = 0$

$2y = 6x - 7$

$y = 3x - \frac{7}{2}$

The gradient of the perpendicular line is  $-\frac{1}{3}$

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$$y = -\frac{1}{3}x + C$$

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

$$2 = -\frac{1}{3} + C$$

$$2 + \frac{1}{3} = C$$

$$2\frac{2}{3} = C$$

$$\frac{7}{3} = C$$

$$y = -\frac{1}{3}x + \frac{7}{3}$$

$$6. Q = \sqrt{\frac{p+1}{p-1}}$$

$$Q^2 = \frac{p+1}{p-1}$$

$$Q^2(p-1) = p+1$$

$$Q^2p - Q^2 = p+1$$

$$Q^2p - p = Q^2 + 1$$

$$p(Q^2 - 1) = Q^2 + 1$$

$$p = \frac{Q^2 + 1}{Q^2 - 1}$$

7. Men	hours	days
5	8	7

Total man hours worked  $5 \times 8 \times 7 = 280$  hrs

7 men, 3 hours

Man hours worked = 21 hrs

$$\text{No. of days} = \frac{280}{21}$$

$$= 13\frac{1}{3} \text{ days}$$

$$8. \text{ Let } 2x - 30 = \theta$$

$$\sin \theta = \frac{\sqrt{3}}{2}$$

$$\sin \theta = 0.866$$

$$\theta = 60^\circ$$

$\theta$  can be in first or second Quadrant

1<sup>st</sup> quadrant  $\theta = 60^\circ$

2<sup>nd</sup> quadrant  $\theta = 120^\circ$

$$2x - 30 = 60 \quad \text{or} \quad 2x - 30 = 120$$

$$2x = 60 + 30 \quad 2x = 120 + 30$$

$$2x = 90 \quad 2x = 150$$

$$x = 45 \quad x = 75$$

$$x = 45^\circ \text{ or } 75^\circ$$

9. Let the centre be  $C(x, y)$

$$3 \left\{ \begin{pmatrix} 2 \\ 3 \end{pmatrix} - \begin{pmatrix} x \\ y \end{pmatrix} \right\} = \begin{pmatrix} 0 \\ -1 \end{pmatrix} - \begin{pmatrix} x \\ y \end{pmatrix}$$

$$3 \begin{pmatrix} 2 - x \\ 3 - y \end{pmatrix} = \begin{pmatrix} -x \\ -1 - y \end{pmatrix}$$

$$\begin{pmatrix} 6 - 3x \\ 9 - 3y \end{pmatrix} = \begin{pmatrix} -x \\ -1 - y \end{pmatrix}$$

$$6 - 3x = -x$$

$$9 - 3y = -1 - y$$

$$6 = -x + 3x$$

$$9 + 1 = -y + 3y$$

$$6 = 2x$$

$$10 = 2y$$

$$\frac{6}{2} = x$$

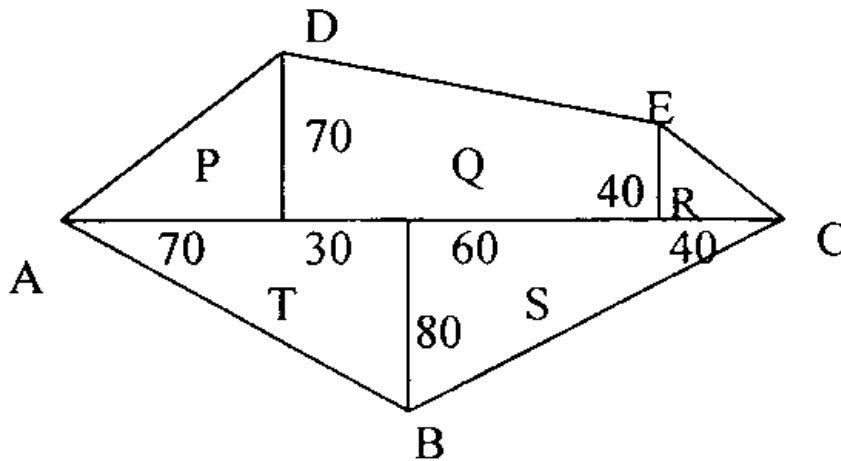
$$5 = y$$

$$x = 3$$

$$x = 3$$

$$(3, 5)$$

10.



Area of

$$P = \frac{1}{2} \times 70 \times 70 = 2450\text{m}^2$$

$$Q = \frac{1}{2} \times 90 (70 + 40) = 4950\text{m}^2$$

$$R = \frac{1}{2} \times 40 \times 40 = 800\text{m}^2$$

$$S = \frac{1}{2} \times 100 \times 80 = 4000\text{m}^2$$

$$T = \frac{1}{2} \times 80 \times 100 = 4000\text{m}^2$$

$$(2450 + 4950 + 800 + 4000 + 4000)\text{m}^2$$

$$\frac{16200}{10000} = 1.62\text{ha.}$$

11. 1: 100,000

$$1\text{cm}^2 = 100,000 \times 100,000 \\ = 10^{10} \text{cm}^2$$

1: 50,000

$$1\text{cm}^2 = 50,000 \times 50,000\text{cm}^2 \\ = 25 \times 10^8$$

$$1\text{cm}^2 = 10^{10} \text{cm}^2$$

$$5.4\text{cm}^2 = ?$$

$$5.4 \times 10^{10} \text{cm}^2$$

$$1\text{cm} = 25 \times 10^8$$

$$? = 5.4 \times 10^{10} \text{ cm}$$

$$\frac{5.4 \times 10^{10}}{25 \times 10^8} = \frac{540}{25}$$

$$= 21.6\text{cm}^2$$

$$12. \frac{7 \times 30 + 3 \times 42 + 5 \times 54 + 6 \times 37}{7 + 3 + 5 + 6}$$

$$\frac{210 + 126 + 270 + 222}{21} = \frac{828}{21} = 39.43$$

$$13. \frac{3.142 \times 60 \times 7.2 \times 7.2 - \frac{1}{2} \times 7.2 \times 7.2 \sin 60}{360}$$

$$27.14688 - 22.44738$$

$$= 4.6995 \approx 4.70 \text{ cm}^2$$

$$14. \frac{\frac{x-1}{x} - \frac{2x+1}{3x}}{\frac{3(x-1) - (2x+1)}{3x}}$$

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

$$\frac{x-4}{3x}$$

15. Let the side of length be x

Old	new
x	1.1x
Old perimeter	$x + x + x = 3x$
New perimeter	$1.1x + 1.1x + 1.1x = 3.3x$
Change in perimeter	$= 3.3x - 3x = 0.3$

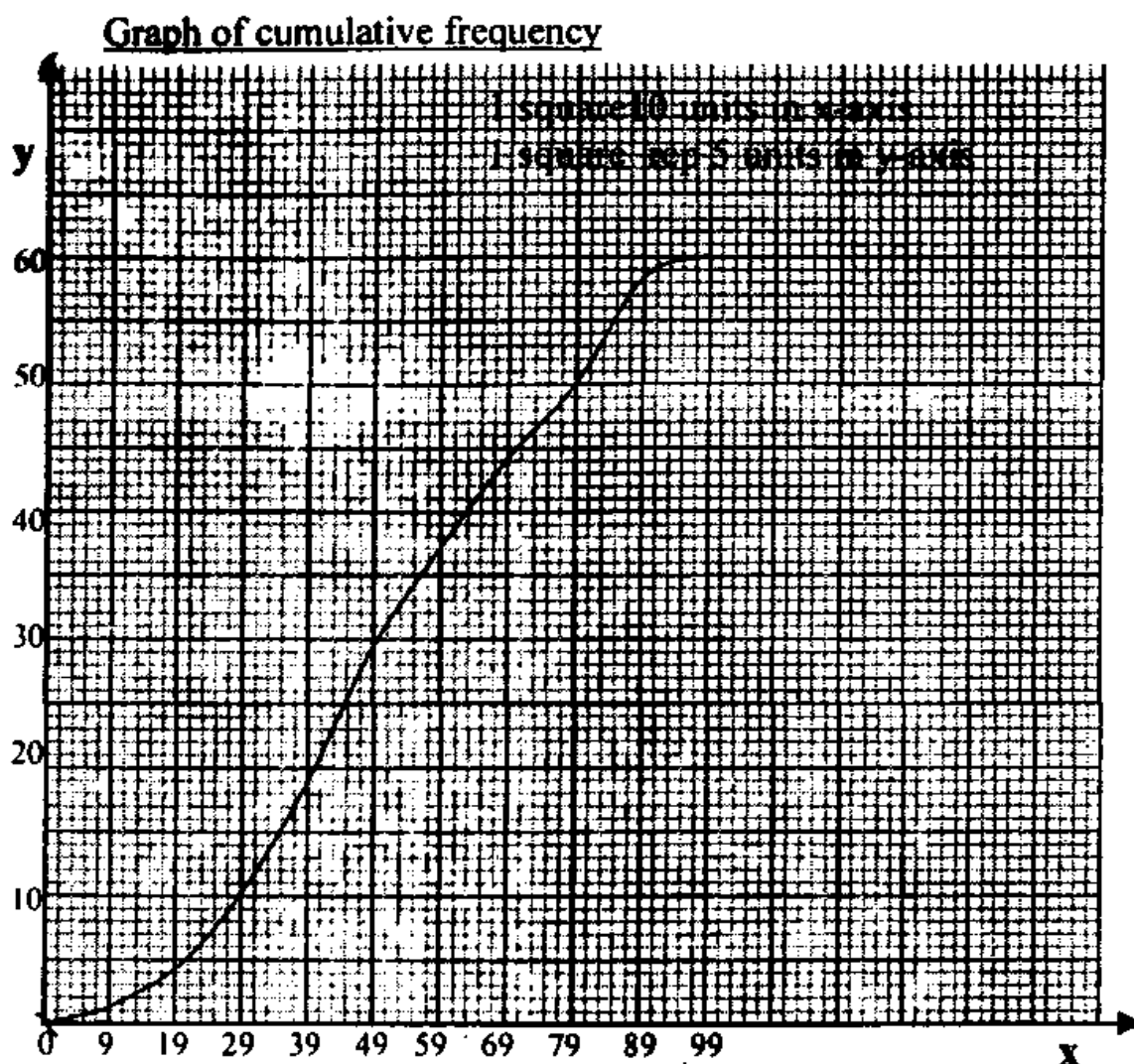
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$$\text{Percentage change } \frac{0.3x \times 100}{3x} = 10\%$$

$$\begin{aligned} 16. & 2 \left( \frac{1}{0.482} \right) - 3 \left( \frac{1}{24.71} \right) \\ & 2 \times (0.2074 \times 10^1) - 3 (0.4047 \times 10^{-1}) \\ & 2 \times 2.074 - 3 \times 0.04047 \\ & 4.148 - 0.12141 \\ & 4.02659 \end{aligned}$$

### SECTION B

17. (a)



(b)(i) median =  $50 \pm 1$

(ii) Lower quartile =  $35 \pm 1$ , upper quartile =  $75 \pm 1$ .

$$18. \text{ DB} = \sqrt{3^2 + 4^2} = \sqrt{9 + 16}$$

$$\text{HB} = \frac{= \sqrt{25}}{\sqrt{5^2 + 5^2}} = 5 = \sqrt{25+25}$$

$$= \sqrt{50}$$

$$= 7.071$$

(ii) The angle is HAD

$$\tan\theta = \frac{5}{4}$$

$$\tan\theta = 1.25$$

$$\theta = 51.3^\circ$$

(iii)  $\text{FD} = \text{HB} = 7.07\text{cm}^2$

The angle is FDB

$$\text{Tan}\theta = \frac{5}{5}$$

$$\tan\theta = 1$$

$$\theta = 45^\circ$$

$$19. \frac{22440 \times 115}{100} = 25806$$

$$\frac{25806 \times 12}{20} = \text{£ } 15483.6$$

$$1980 \times 2 = 3960$$

$$1980 \times 3 = 5940$$

$$1980 \times 5 = 9900$$

$$1980 \times 7 = 13860$$

$$1980 \times 10 = 19800$$

$$5583.6 \times 12 = \underline{67003.2}$$

$$120463.2$$

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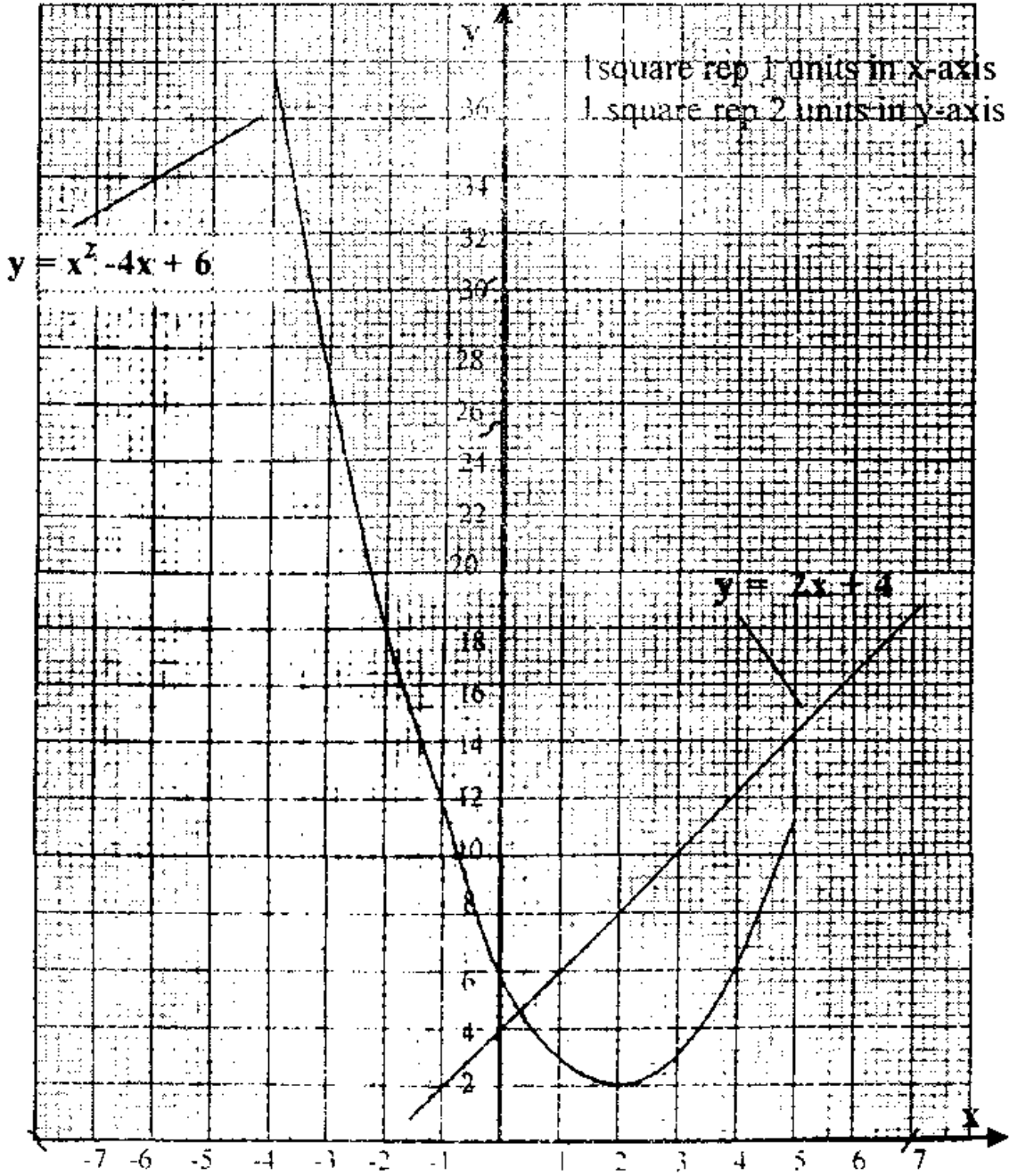
$$\frac{120463.2}{12} = 10,038.6$$

Less relief

$$10,038.6 - 720 = \text{sh.}9318.60$$

20.

Graph of  $y = x^2 - 4x + 6$





(i) no solution

(ii)  $y = x^2 - 4x + 6$

$$0 = x^2 - 6x + 2$$

$$y = 2x + 4$$

x	1	2
y	6	8

$$x = 0.4 \pm 0.1$$

21. (a)

$$\begin{pmatrix} A & B & C \\ 2 & 2 & 0 \\ 0 & 3 & 3 \end{pmatrix} + \begin{pmatrix} 2 \\ -3 \end{pmatrix} = \begin{pmatrix} A_1 & B_1 & C_1 \\ 4 & 4 & 2 \\ -3 & 0 & 0 \end{pmatrix}$$

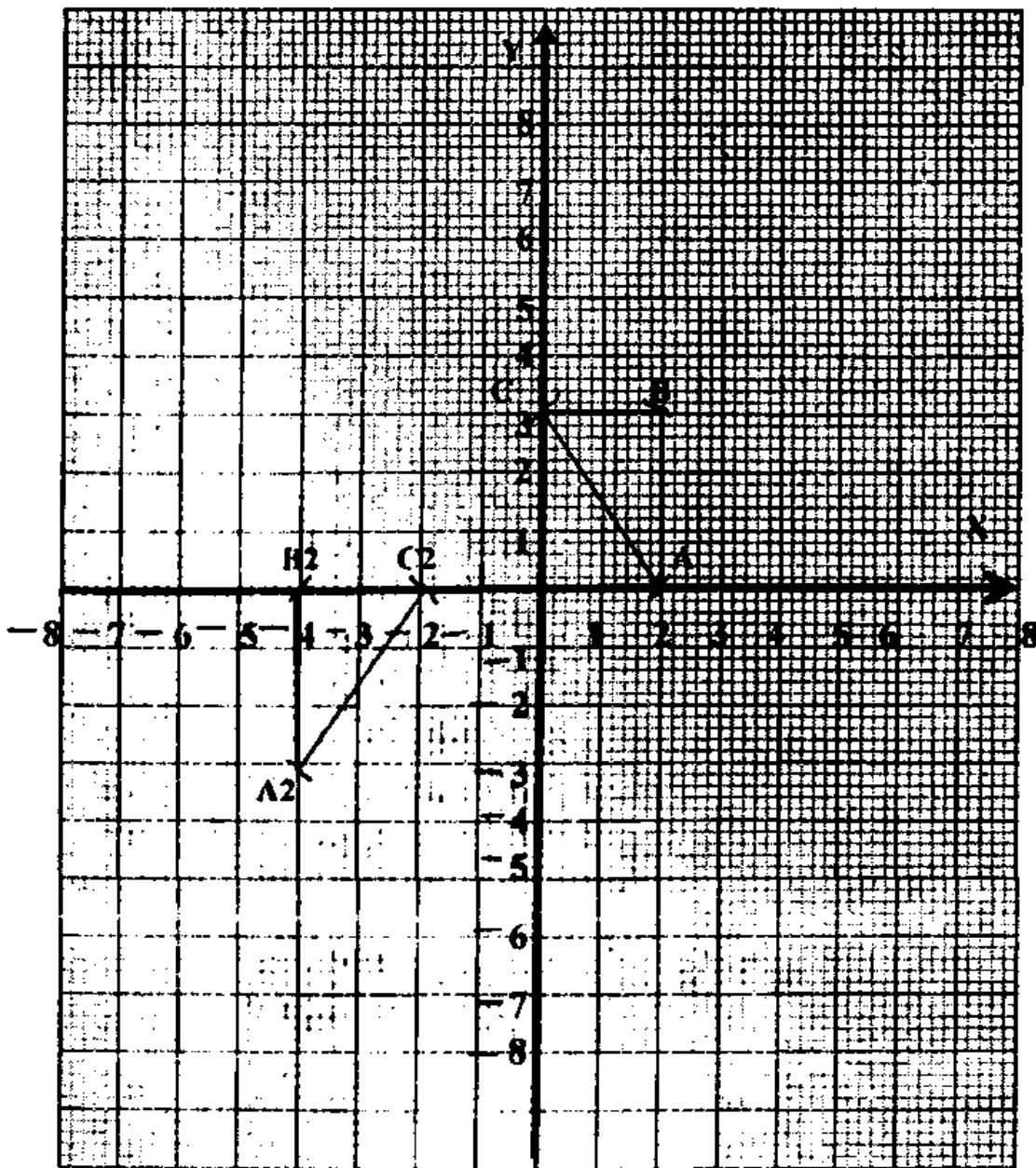
$$\Rightarrow A_1 (4, -3) \quad B_1 (4, 0) \quad C_1 (2, 0)$$

(b)

$$\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} A_1 & B_1 & C_1 \\ 4 & 4 & 2 \\ -3 & 0 & 0 \end{pmatrix} = \begin{pmatrix} A_2 & B_2 & C_2 \\ -4 & -4 & -2 \\ -3 & 0 & 0 \end{pmatrix}$$

$$\Rightarrow A_2 (-4, -3) \quad B_2 (-4, 0) \quad C_2 (-1, 0)$$

(c) See graph next page.



$$(d) \quad \begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{pmatrix} A & B & C \\ 2 & 2 & 0 \\ 0 & 3 & 3 \end{pmatrix} = \begin{pmatrix} A_2 & B_2 & C_2 \\ -4 & -4 & -2 \\ -3 & 0 & 0 \end{pmatrix}$$

$$\begin{pmatrix} 2a & 2a + 3b & 3b \\ 2c & 2c + 3d & 3d \end{pmatrix} = \begin{pmatrix} -4 & -4 & -2 \\ -3 & 0 & 0 \end{pmatrix}$$

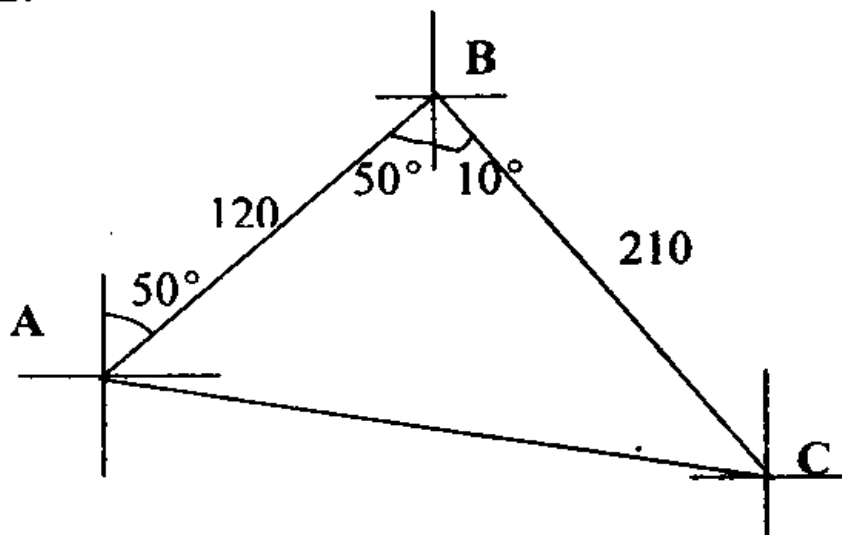
$$\begin{aligned} 2a &= -4 & a &= -2 \\ 2c &= -3 & c &= -\frac{3}{2} \end{aligned}$$

$$3b = -2 \quad b = -\frac{2}{3}$$

$$3d = 0 \quad d = 0$$

$$\begin{pmatrix} -2 & -\frac{2}{3} \\ -\frac{3}{2} & 0 \end{pmatrix}$$

22.



$$\begin{aligned} AC^2 &= 120^2 + 210^2 - 2 \times 120 \times 210 \cos 60 \\ &= 14400 + 44100 - 50400 \times 0.5 \\ &= 58500 - 25200 \\ &= 33300 \\ &= 182.5 \text{ km} \end{aligned}$$

$$\text{Time taken} = \frac{\text{distance}}{\text{speed}}$$

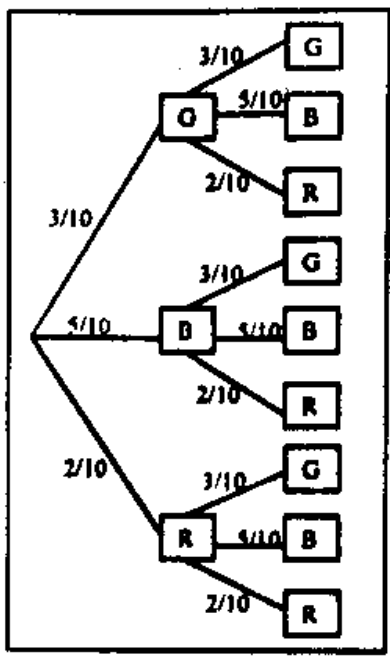
$$= \frac{182.5}{85}$$

$$= 2 \text{ hours } 9 \text{ minutes}$$

$$(b) \frac{210}{\sin \theta} = \frac{182.5}{\sin 60}$$

$$\begin{aligned} \sin \theta &= \frac{210 \times \sin 60}{182.5} \\ &= \frac{210 \times 0.866}{182.5} \\ &= \frac{103.9}{182.5} \\ \sin \theta &= 0.9965 \\ \theta &= 85.2^\circ \\ \text{Bearing of C from A} &= 50^\circ + 85.2^\circ = 135.2^\circ \end{aligned}$$

23.



(a)  $P(GG) = \frac{3}{10} \times \frac{3}{10} \times \frac{3}{10} = \frac{9}{100}$

(b) Same colours  
 $P(GG) \text{ or } P(BB) \text{ or } P(RR)$   
 $\frac{9}{100} + \frac{5 \times 5}{100} + \frac{2 \times 2}{100}$   
 $\frac{9}{100} + \frac{25}{100} + \frac{4}{100} = \frac{38}{100}$

(c)  $1 - \frac{38}{100} = \frac{62}{100}$

24.  $V = 20t \rightarrow t^2$

distance =  $\int 20t - t^2$

$S = 10t^2 - \frac{t^3}{3}$

$\frac{dv}{dt} = 20 - 2t$

(b)  $20 - 2t = 0$

$$2t = 20$$

$$t = 10$$

$$S = 10t^2 - \frac{t^3}{3}$$

$$10(10^2) - \frac{10^3}{3}$$

$$1000 - \frac{1000}{3}$$

$$\frac{3000 - 1000}{3} = \frac{2000}{3} = 666 \frac{2}{3} \text{m}$$

**(c)** Time taken = 20s

10s for going up and 10s for coming down.

## Paper 6 Questions

### SECTION I

1. Evaluate; 
$$\frac{-21 \div (-7) \times 3 - (-5)}{-4 \times 4 \div 2 + 1}$$
 (3 marks)
2. Factorise;  $8x^2 - 2yx - y^2$  (3 marks)
3. Two cyclists moving towards each other take two hours to meet. If one cycles at a speed of 25 km/hr and the other at  $y$  km/hr, find the value of  $y$  if their distance apart is 92 km. (2 marks)
4. Ecofair bank charges compound interest on money borrowed. The interest rate is 16% compound interest per annum. If Otumba paid back sh.80, 000 after 3 years, find the amount of money he had borrowed. (4 marks)
5. Find the equation of a straight line passing through the point  $(-4, 0)$  and is perpendicular to a line whose equation is  $x + 4y - 8 = 0$   
(Leave your answer in the form;  $y = mx + c$ ) (3 marks)
6. Two lines whose equations are  $2y + 3x = 3$  and  $6y - x = 19$  intersect at a point P. If the distance between point P and point M  $(2, b)$  is 5 units, find the value(s) of  $b$ . (5 marks)
7. The number  $v$  of students joining university is partly constant and partly varies as  $g$  the form four enrolment. Given that  $v = 10,000$  when  $g = 25,000$  and  $v = 12,000$  when  $g = 32,000$ . Determine the equation connecting  $v$  and  $g$ . (4 marks)

8. On a single number line, show the section defined by the following inequalities;

$$5 + 4x < 29$$

$$2 + 3x \geq -1$$

(3 marks)

9. make P the subject of the formula

$$y = \frac{pn}{p-n}$$

(2 marks)

10. Three students shared a certain amount of money. The first got Sh.120 more than the second and thrice what the third student got. If the second got sh.300, how much did each of the other two get?

(3 marks)

11. A dealer buys 40 radios all at the same price. He sells 20 of them at 15% profit and the remaining at 16% loss. What % loss/profit does he make?

(4 marks)

12. If third and fifth terms of an arithmetic progression are 0 and 6 respectively, determine the first term and the common difference.

(2 marks)

13. A shopkeeper mixes sugar worth sh.55 per kg with sugar worth 43 per kg. How many kilograms of each should she use to obtain 50 kg of a mixture worth sh 50 per kg.

(4 marks)

14. Given that  $\sin a = \frac{2}{\sqrt{10}}$  where  $a$  is an acute angle,

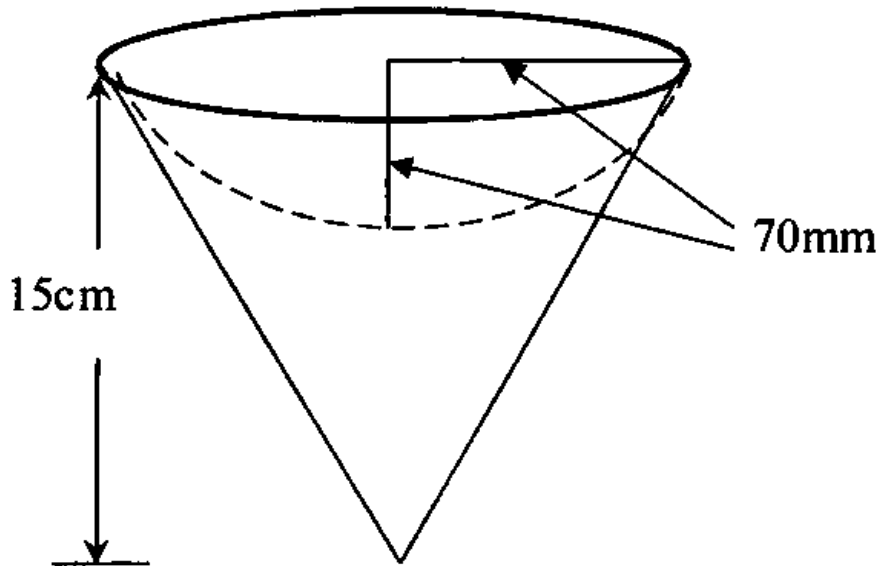
find without using mathematical tables;

(i)  $\cos a$  in the form  $\sqrt{\frac{m}{n}}$

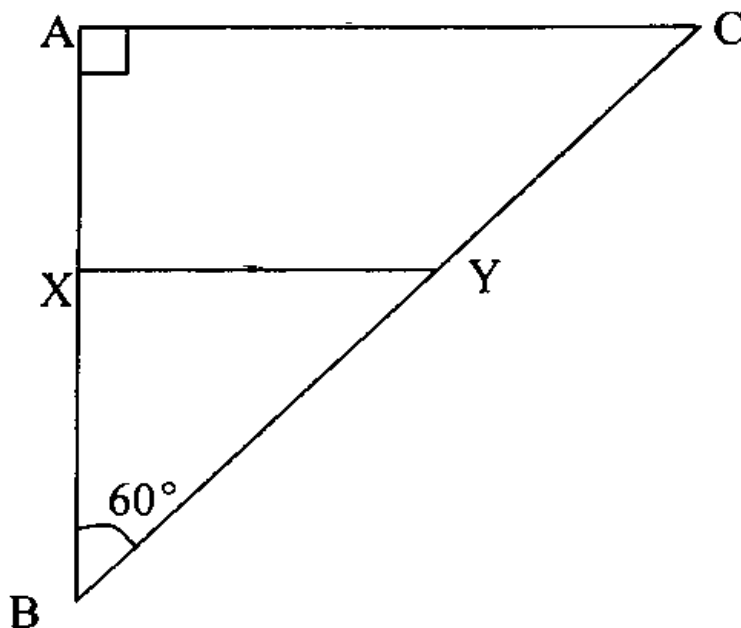
where  $m$  and  $n$  are rational numbers (2 marks)

(ii)  $\tan a$  (1 mark)

15. The diagram below represents a solid cone with a hemispherical depression. The cone and hemisphere have a radius of 70 mm. If the cone has a perpendicular height of 15 cm, find the volume of the solid (3 marks)



16. In the figure below where angle BAC is a right angle,  $AB = 20$  cm and  $BC = 50$  cm. If X divides AB in the ratio 3:2 and XY is parallel to AC find the area of AXYC given that  $\angle XBY = 60^\circ$  (4 marks)





**SECTION B**

**Attempt any six questions from this section**

17. A quadrilateral Q whose vertices are A (2, 3) B (-3, 1) C (-1, -2) and D (2, -2) is mapped onto a quadrilateral Q1 whose vertices are A<sub>1</sub> (11, 1) B<sub>1</sub> (0, -7) C<sub>1</sub> (f, g) and D<sub>1</sub> (-4, 6) by a transformation m whose matrix is

$$\begin{pmatrix} a & c \\ b & d \end{pmatrix}$$

- find, (i) matrix m (4 marks)  
 (ii) Coordinates of C<sub>1</sub> (2 marks)  
 (iii) A single matrix that map Q onto Q<sub>2</sub> given that Q<sub>2</sub> is the image of Q<sub>1</sub> under reflection in the line y = 0. (2 marks)

18. The table below shows the relationship between m and n in which it is suspected that, the relationship is of the form  $n = km^2$

m	1	2	3	4	5
n	2.6	9.8	22.7	40.1	62.4

Write the relationship in the form  $y = px + c$  where p and c are constants. Hence, by drawing suitable straight line, find the values of k. (8marks)

19. Complete the table below for the function  $y = x^2 + 2x + 3$

x	-6	-5	-4	-3	-2	-1	0	1	2	3	4
x <sup>2</sup>	36				-4		0				16
2x		-10			4	-2			4		8
3	3	3	3	3	3	3	3	3	3	3	3
y					3						27

(2 marks)

(a) Draw the graph of  $y = x^2 + 2x + 3$

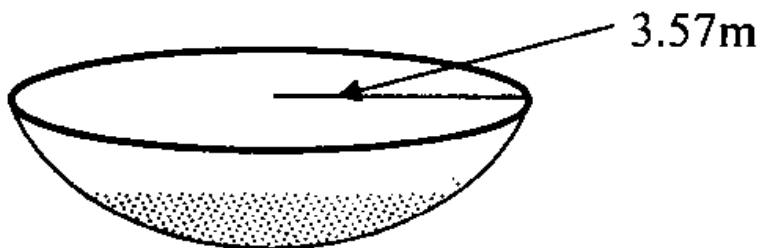
(3 marks)

- (b) By drawing a suitable straight line, use the graph to solve the equation;

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

(3 marks)

20. The hemispherical trough shown below of radius 3.57m is  $\frac{3}{4}$  full of water. When a cone of height 2 m, is fully immersed in the water, 120 litres of water spills. Find the base radius of the cone. (8 marks)



21. Draw a line MN 6 cm long. With O as the mid point.
- Construct the locus of the point R below line MN such that the area of triangle MRN is  $9 \text{ cm}^2$  (2marks)
  - Given that R is equidistant from M and N, show the position of R (2marks)
  - Construct all the possible loci of a point T such that angle RMO = angle RTO (4marks)
22. (a) The acceleration of a particle t seconds after passing a fixed point p is given by  $a = 3t - 3$ . Given that the velocity of the particle when  $t = 2$  is 5 m/s, find
- its velocity when  $t = 4$
  - its displacement at this time (4 marks)
- (b) By integration method, find the area bounded by the graph of  $y = 4x + x^3$  and the X axis (4 marks)

23. The table below shows marks obtained by a hundred candidates in an examination.

Marks	1-10	11-20	21-30	31-40	41-50
Freq.	4	9	16	24	18

Marks	51-60	61-70	71-80	81-90	91-100
Freq.	12	8	5	3	1

(a) Determine the median and the inter quartile range.  
(5 marks)

(b) Determine the range of marks obtained by the middle 50%  
(3 marks)

24. Write down the first four terms of the series  $(2 - 2x)^8$ . Use your expansion of  $(2 - 2x)^8$  to find the value of  $(1.98)^8$  correct to four significant figures. (8 marks)

**Answers to Paper 6**

$$1. \frac{3 \times 3 + 5}{-4 \times 2 + 1}$$

$$\frac{9 + 5}{-8 + 1} = \frac{14}{-7} = -2$$

$$2. \text{ If } m \times n = -8y^2$$

$$m + n = -2y$$

$$\text{Then } m = -4y \text{ and } n = 2y$$

$$\therefore 8x^2 - 4yx + 2yx - y^2$$

$$\Rightarrow 4x(2x - y) + y(2x - y)$$

$$(4x + y)(2x - y)$$

$$3. \text{ In one hour both travel } (25 + y) \text{ km}$$

$$\therefore \frac{92}{25 + y} = 2$$

$$92 = 50 + 2y$$

$$42 = 2y$$

$$y = 21 \text{ km/h}$$

$$4. A = P \left( 1 + \frac{R}{100} \right)^n$$

$$80,000 = P \left( 1 + \frac{16}{100} \right)^3$$

$$80,000 = P (1.16)^3$$

$$P = \frac{80,000}{(1.16)^3}$$

No	Log
80,000	4.9030
$(1.16)^3$	$0.0645 \times 3 = 0.1935$
$10^4 \times 5.1239$	$\leftarrow \quad \underline{4.7096}$

$\therefore P \approx \text{sh.}51239 \quad \approx \text{sh.}51,240$

5.  $4y = 8 - x$

$y = 2 - \frac{1}{4}x$

from  $m_1 \times m_2 = -1$

$m_1 \times -\frac{1}{4} = -1$

$\therefore m_1 = 4$

Taking any point  $(x, y)$  and the point  $(-4, 0)$

$\frac{y - 0}{x + 4} = 4$

$y = 4x + 16$

6.  $2y + 3x = 3 \dots\dots\dots(i)$

$6y - x = 19 \dots\dots\dots(ii)$

$6y + 9x = 9 \quad -$

$\underline{6y - x = 19}$

$10x = -10$

$x = -1$

from equation (i) and substituting  $x$  for  $-1$ , have

$2y - 3 = 3$

$2y = 6$

$y = 3$

$\therefore$  the point of intersection  $(p)$  is  $(-1, 3)$ .

Taking the points  $P(-1, 3)$  and  $m(2, b)$  have

$(2 - -1)^2 + (b - 3)^2 = 25$

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$$\begin{aligned} z^2 + b^2 - 6b + 9 &= 25 \\ b^2 - 6b + 18 - 25 &= 0 \\ b^2 - 6b - 7 &= 0 \end{aligned}$$

$$\begin{aligned} b^2 - 7b + b - 7 &= 0 \\ b(b - 7) + 1(b - 7) &= 0 \end{aligned}$$

$$(b + 1)(b - 7) = 0$$

$$b = -1 \text{ or } b = 7$$

7. The relationship is of the form;

$v = c + kg$  where  $c$  and  $k$  are constants

$$10000 = c + 25000k \dots\dots\dots(i)$$

$$12000 = c + 32000k \dots\dots\dots(ii)$$

$$-2000 = -7000k$$

$$k = \frac{2}{7}$$

From (i) above

$$10000 = c + \frac{2}{7} \times 25000$$

$$\begin{aligned} \therefore c &= 10,000 - \frac{50,000}{7} = \frac{70,000}{7} - \frac{50,000}{7} \\ &= \frac{20,000}{7} \end{aligned}$$

Hence the equation connecting  $V$  and  $g$  is

$$V = \frac{20,000}{7} + \frac{2g}{7}$$

$$\therefore \Rightarrow 7V = 20,000 + 2g$$

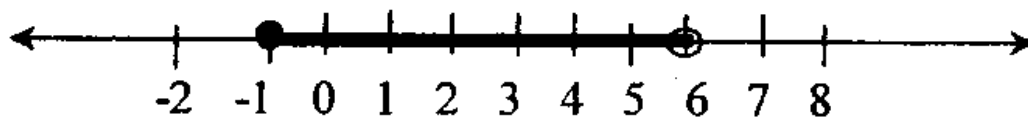
8.  $4x < 29 - 5$

$$4x < 24$$

$$x < 6$$

$$3x \geq -3$$

$$x \geq -1$$



9.  $y(p - n) = pn$

$$yp - yn = pn$$

$$(yp - pn) = yn$$

$$p(y - n) = yn$$

$$p = \frac{yn}{y - n}$$

10. If the second got sh. x then,

1<sup>st</sup> got sh (x + 120)

3<sup>rd</sup> got. Sh.  $\frac{(x + 120)}{3}$

Then x = sh.300

1<sup>st</sup> got 300 + 120 = sh.420

3<sup>rd</sup> got 420 × 1/3 = sh.140

11. Let buying price be b. then 40 radios bought at 40b.

20 radios at 15% profit;  $\frac{20b \times 115}{100} = 23b$ .

20 radios at 16% loss;  $\frac{20b \times 84}{100} = 16.8b$

Total sale becomes 23b + 16.8b = 39.8b.

∴ Makes a loss of 40b - 39.8b = 0.2b

$$= \frac{0.2b}{40b} \times 100 = \frac{1}{2}$$

$$= 0.5\% \text{ loss}$$

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$$12. T_n = a + d(n - 1)$$

$$T_3 = a + 2d = 0$$

$$T_5 = a + 4d = 6 -$$

$$\frac{-2d = -6}{d = 3}$$

substituting 3 for d get,

$$a + 12 = 6$$

$$a = -6$$

$$\therefore 1^{\text{st}} \text{ term} = -6.$$

Common difference = 3.

13. Let n kg of sugar costing sh.55 per kg be mixed with m kg of sugar costing 43 per kg. Each should cost

$$\frac{55n + 43m}{n + m}$$

$$n + m$$

$$\frac{55n + 43m}{n + m} = 50$$

$$n + m$$

$$55n + 43m = 50n + 50m.$$

$$5n = 7m.$$

$$\frac{n}{m} = \frac{7}{5}$$

$$\frac{n}{m} = \frac{7}{5}$$

$\therefore$  should be mixed in the ratio; n: m = 7:5

sugar costing sh55 per kg should be  $(\frac{7}{12} \times 50)$  kg

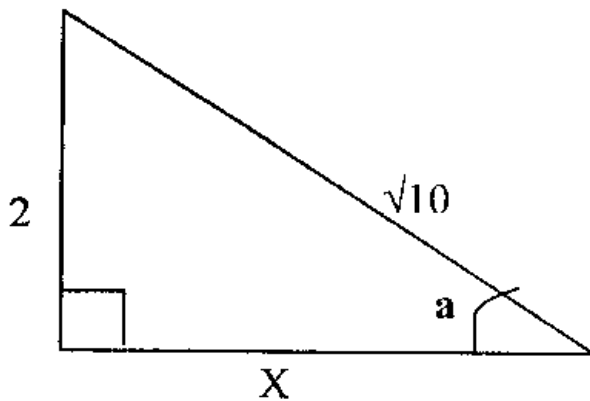
$$= \frac{175}{6} = 29 \frac{1}{6} \text{ kg}$$

sugar costing sh.43 per kg should be

$$= \frac{5}{12} \times 50 = \frac{125}{6} = 20 \frac{5}{6} \text{ kg}$$



14.



$$(i) 2^2 + x^2 = (\sqrt{10})^2$$

$$x^2 = (\sqrt{10})^2 - 4$$

$$x^2 = 10 - 4$$

$$x = \sqrt{6}$$

$$(i) \cos a = \frac{\sqrt{6}}{\sqrt{10}} = \frac{\sqrt{2}}{\sqrt{2}} \times \frac{\sqrt{3}}{\sqrt{5}} = \sqrt{\frac{3}{5}}$$

$$(ii) \tan a = \frac{2}{\sqrt{6}}$$

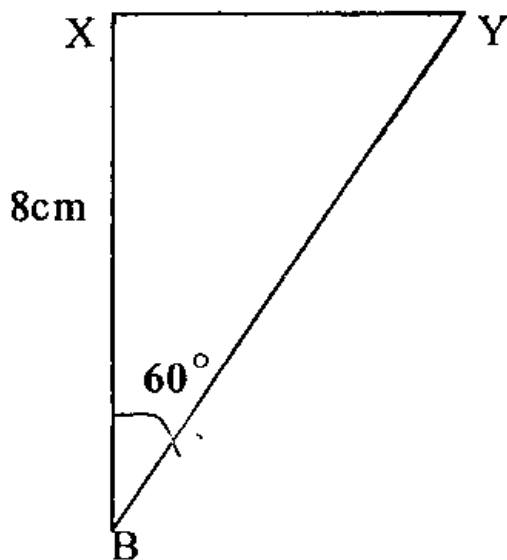
$$15. V(\text{cone}) = \frac{1}{3} \pi r^2 h., V(\text{hemisphere}) = \frac{1}{2} \times \frac{4}{3} \pi r^3$$

$$\therefore \text{Volume of solid} = (\frac{1}{3} \times \frac{22}{7} \times 7^2 \times 15) - (\frac{1}{2} \times \frac{4}{3} \times \frac{22}{7} \times 7^3)$$

$$= 770 - 718.7$$

$$\text{Volume} = 51.3 \text{cm}^3 \text{ (1 d.p)}$$

$$16. BX = \frac{2}{5} \times 20 = 8 \text{cm}$$



$$\cos 60 = \frac{8}{BY}$$

$$\therefore BY = \frac{8}{\cos 60}$$

Area of  $\Delta X Y C$ ; ( from  $A = \frac{1}{2} ab \sin \theta$  ) becomes;  
 $\frac{1}{2} \times 20 \times 50 \sin 60 - \frac{1}{2} \times 8 \times \frac{8}{\cos 60} \times \sin 60$

$$\begin{aligned} & \sin 60 ( 500 - 4 \times 16 ) \\ & = \sin 60 ( 500 - 64 ) \\ & = 0.866 \times 436 \\ & = 377.58 \text{cm}^2 \text{ (2 d.p)} \end{aligned}$$

17.

	A	D		A <sub>1</sub>	D <sub>1</sub>
(i)	$\begin{pmatrix} a & c \\ b & d \end{pmatrix}$	$\begin{pmatrix} 2 & 2 \\ 3 & -2 \end{pmatrix}$	=	$\begin{pmatrix} 11 & -4 \\ 1 & 6 \end{pmatrix}$	
	$2a + 3c = 11 -$			$2b + 3d = 1 -$	
	$2a - 2c = -4$			$2b - 2d = 6$	
	<hr style="width: 50%; margin: 0 auto;"/>			<hr style="width: 50%; margin: 0 auto;"/>	
	$5c = 15$			$5d = -5$	
	$c = 3$			$d = -1$	
	$\Rightarrow 2a + 9 = 11$			$\Rightarrow 2b - 3 = 1$	
	$2a = 2$			$2b = 4$	
	$a = 1$			$b = 2.$	

$$\therefore \begin{pmatrix} a & c \\ b & d \end{pmatrix} = \begin{pmatrix} 1 & 3 \\ 2 & -1 \end{pmatrix}$$

$$(ii) \begin{pmatrix} 1 & 3 \\ 2 & -1 \end{pmatrix} \begin{pmatrix} C \\ -1 \\ -2 \end{pmatrix} = \begin{pmatrix} C_1 \\ f \\ g \end{pmatrix} = \begin{pmatrix} C_1 \\ -7 \\ 0 \end{pmatrix}$$

$$\therefore C_1 = (-7, 0)$$

(iii) The matrix of reflection in the line  $y = 0$  is

$$m_1 = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$

pre-multiplying  $M = \begin{pmatrix} 1 & 3 \\ 2 & -1 \end{pmatrix}$

we get;  $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \begin{pmatrix} 1 & 3 \\ 2 & -1 \end{pmatrix} = \begin{pmatrix} 1 & 3 \\ -2 & 1 \end{pmatrix}$

$\therefore$  the single matrix that maps  $Q$  and  $Q_2$

is ;  $\begin{pmatrix} 1 & 3 \\ -2 & 1 \end{pmatrix}$

18.  $\log n = \log (km^2)$

$$\log n = \log k + 2\log m$$

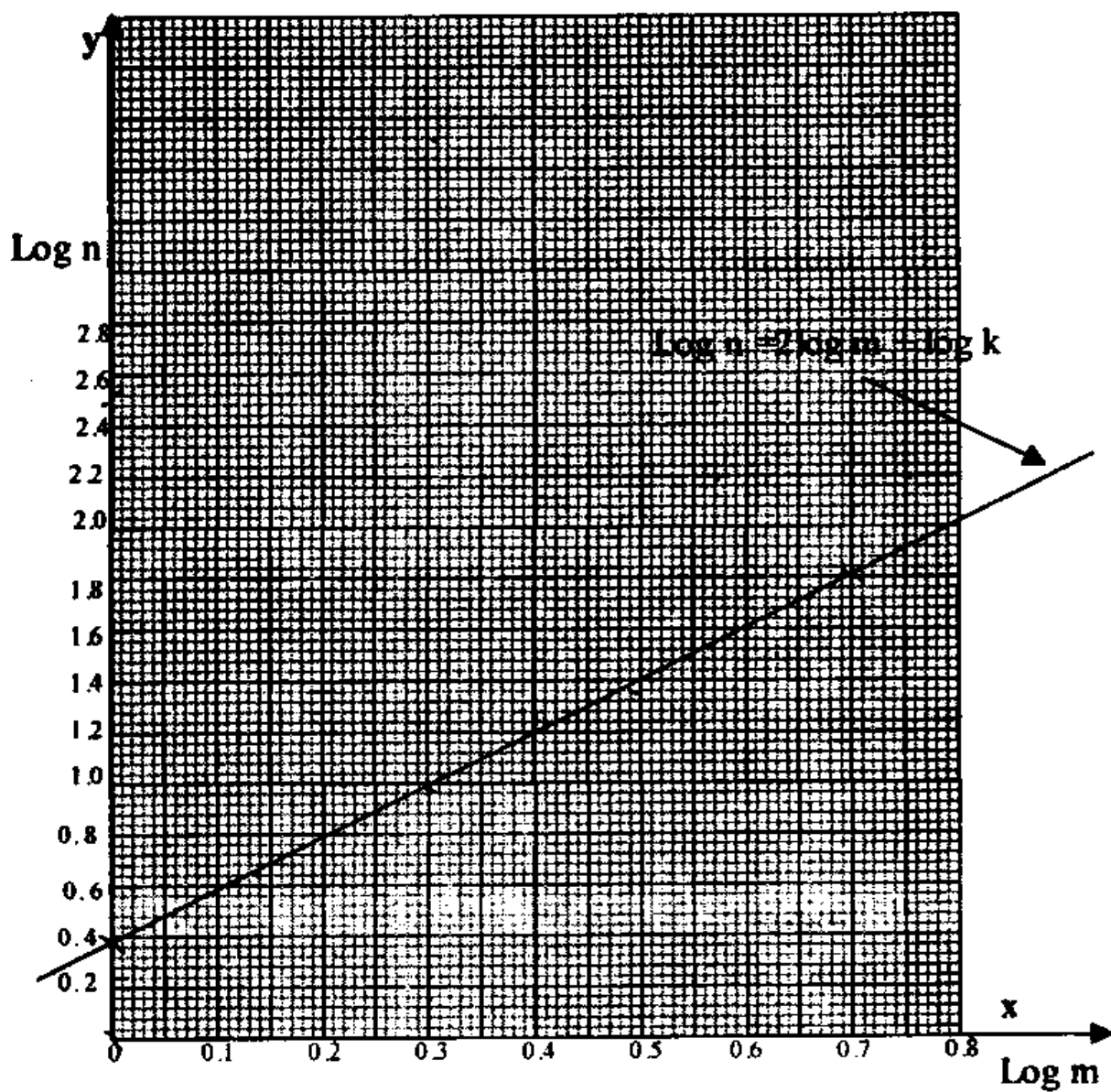
$$\log n = 2 \log m + \log k$$

Log m	0	0.30	0.48	0.60	0.7
Log n	0.41	0.99	1.36	1.6	1.8

From the graph the  $\log k$  is given by the  $y$  - intercept i.e.

$$\log k = 0.4$$

$$\therefore k = 2.5 \text{ (1 d.p.)}$$



19.

X	-6	-5	-4	-3	-2	-1	0	1	2	3	4
X <sup>2</sup>	36	25	16	9	4	1	0	1	4	9	16
2x	-12	-10	-8	-6	-4	-2	0	2	4	6	8
3	3	3	3	3	3	3	3	3	3	3	3
y	27	18	11	6	3	2	3	6	11	18	27

(b)  $x^2 + 2x + 3 = y$  -

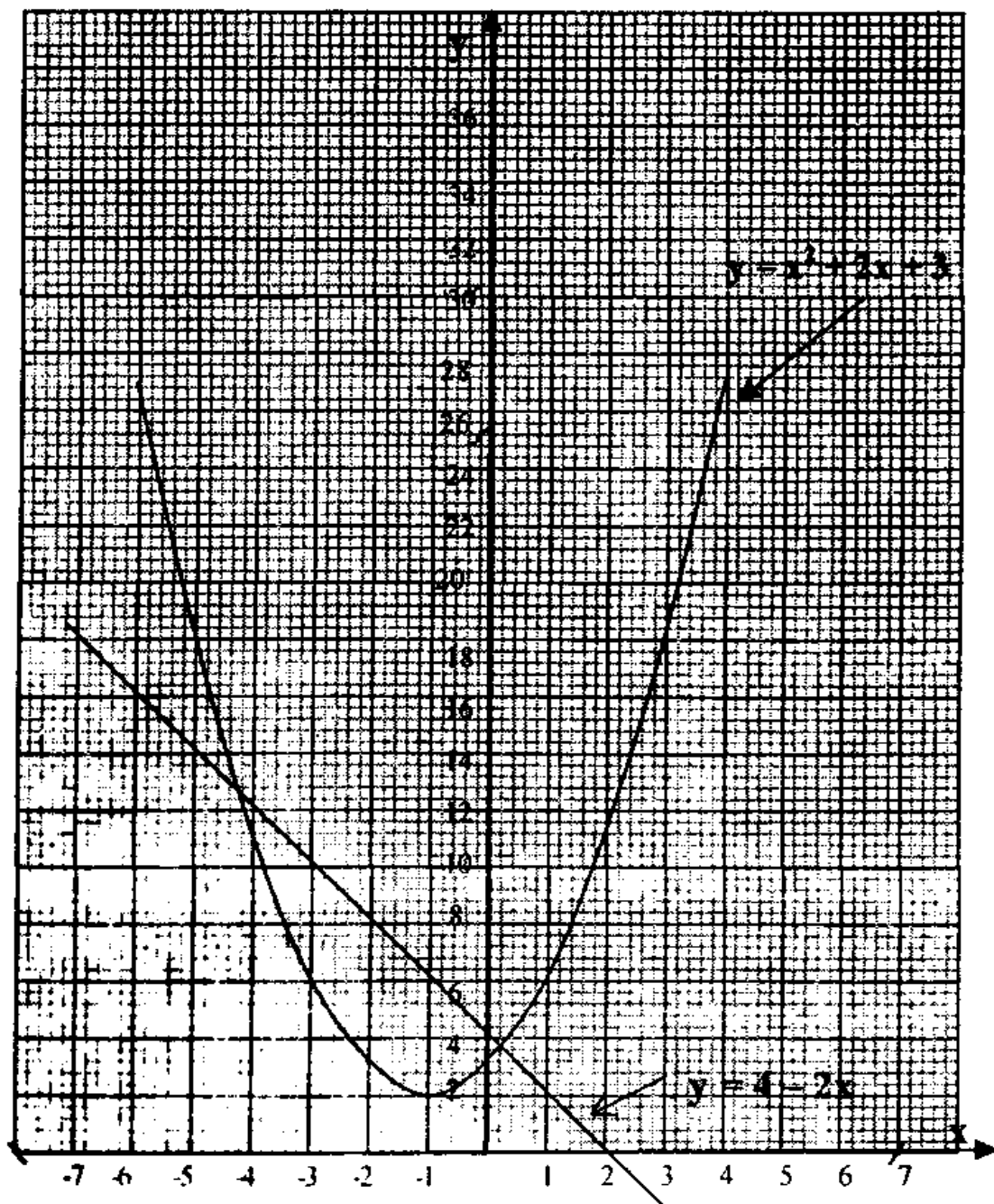
$x^2 + 4x - 1 = 0$

$-2x + 4 = y$

∴ Graph for  $y = 4 - 2x$

x	-5	0	2
y	14	4	0

From the graph,  
the solution to  $x^2 + 4x - 1 = 0$  is  $x = -4.2$  or  $x = 0.2$



20. Volume of the trough is given by;

$$\frac{1}{2} \times \frac{4}{3} \times \frac{22}{7} \times 3.57^3 = 95.33 \text{m}^3$$

$$\begin{aligned} \text{Volume in litres} &= 95.33 \text{m}^3 \times 1000 \quad (1 \text{m}^3 = 1000 \text{litres}) \\ &= 95330 \text{ litres} \end{aligned}$$

capacity of the cone is given by;

$$(\frac{1}{4} \times 95330 + 120) \text{ L} = 23,953 \text{ L}$$

$$\text{volume of the cone} = \frac{23,953}{1000} \text{ m}^3$$

$$= 23.95 \text{ m}^3$$

$$\therefore \frac{1}{3} \times 3.142 \times r^2 \times 2 = 23.95$$

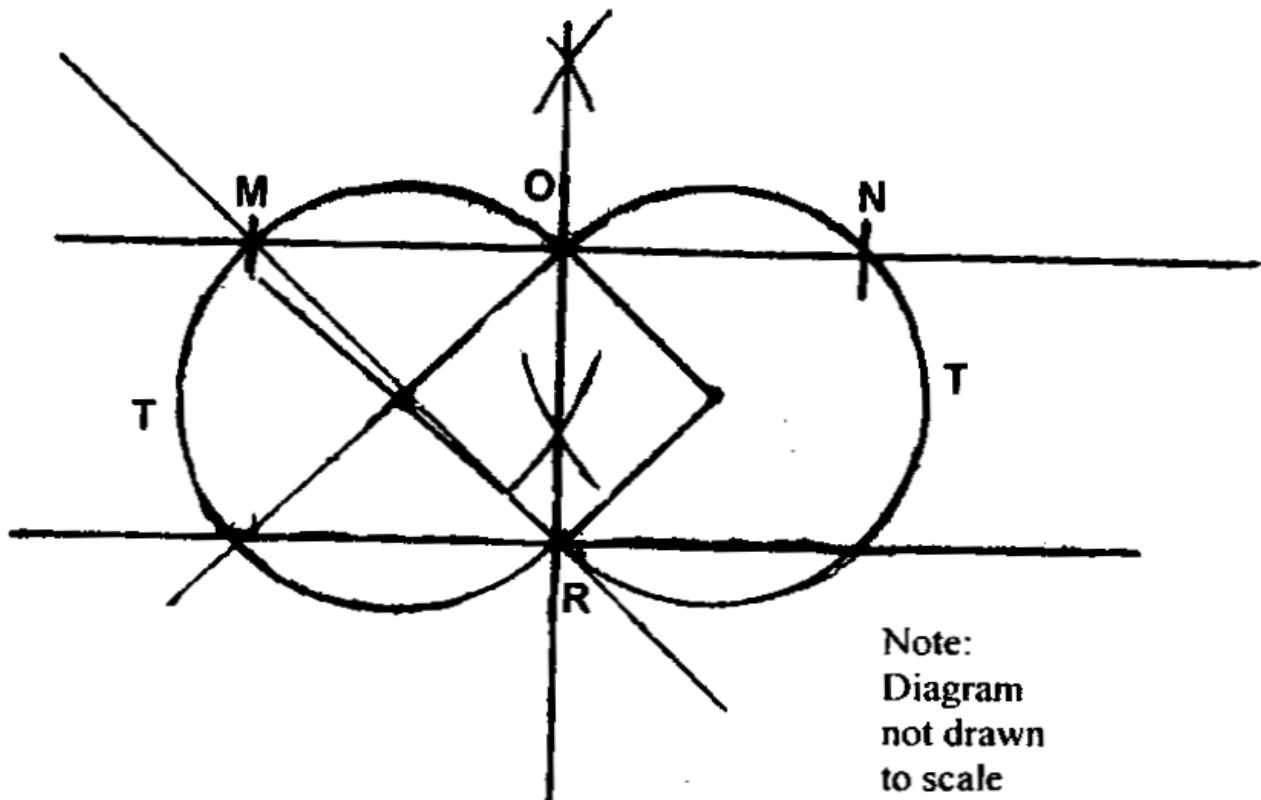
$$r^2 = \frac{23.95 \times 3}{3.142 \times 2}$$

$$r^2 = 11.43$$

$$r = 3.381 \text{ m}$$

hence the base radius  $\approx 3.381 \text{ m}$

21.



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from the area of the triangle ;  $\frac{1}{2} bh$ ;

$$9 = \frac{1}{2} \times 6 \times h .$$

$$\therefore h = 3\text{cm} \quad (\perp \text{ height of the triangle})$$

$$\text{(iii) } \angle \text{RMO} = 44^\circ$$

Angle at the circumference =  $\frac{1}{2}$  angle at the centre

$$\therefore \angle \text{ at the centre} = 44 \times 2 = 88^\circ$$

$$\text{base angles} = (180 - 88) \div 2 = 46^\circ$$

22. (i)  $a = 3t - 3$

Since  $\frac{dv}{dt} = a = 3t - 3$

$$\text{Then } v = \frac{3}{2}t^2 - 3t + C$$

$$= \frac{3}{2}(2)^2 - 3(2) + C = 5 \quad \text{when } t = 2$$

$$\frac{3}{2} \times 4 - 6 + C = 5$$

$$6 - 6 + C = 5$$

$$C = 5$$

$$\therefore v = \frac{3}{2}t^2 - 3t + 5$$

When  $t = 4$ ,  $v = \frac{3}{2} \times 16 - 3 \times 4 + 5 = 17\text{m/s}$

(ii) Since  $\frac{ds}{dt} = \frac{3}{2}t^2 - 3t + 5$

$$\text{Then } s = t^3 - 3t^2 + 5t + C$$

Displacement from  $t = 0$  to  $t = 4$  is given by

$$\left[ (t^3 - 3t^2 + 5t + C) \right]_0^4$$

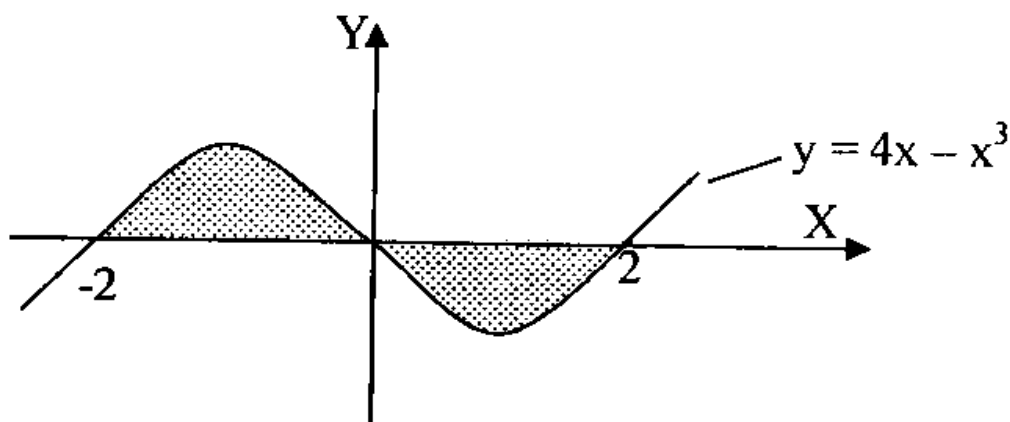
$$= (4^3 - 3 \times 4^2 + 5 \times 4 + C) - (0 - C)$$

$$= 64 - 48 + 20 = 36\text{m}.$$



(b)  $4x - x^3 = 0$  (where the graph meets the X axis)  
 $\Rightarrow x(4 - x^2) = 0$   
 $x = 0$  or  $4 - x^2 = 0$   
 $4 = x^2$   
 $x = \pm 2$ .

The area to be worked out is the shaded region;



$$\begin{aligned} \text{Area} &= 2 \int_0^2 (4x - x^3) dx \\ &= 2 \left[ 2x^2 - \frac{x^4}{4} + c \right]_0^2 \\ &= 2 \left( 2(2)^2 - \frac{2^4}{4} \right) \\ &= 2 \left( 8 - \frac{16}{4} \right) \\ &= 2(8 - 4) \\ &= 8 \text{ sq. units} \end{aligned}$$

23.

Class limits	Frequency	Cumulative frequencies
0.5-10.5	4	4
10.5-20.5	9	13
20.5-30.5	16	29
30.5-40.5	24	53
40.5-50.5	18	71
50.5-60.5	12	83
60.5-70.5	8	91
70.5-80.5	5	96
80.5-90.5	3	99
90.5-100.5	1	100

(a) The median occurs between the 50<sup>th</sup> and 51<sup>st</sup> marks

$$50^{\text{th}} \text{ mark} = 30.5 + \frac{50 - 29}{24} \times 10$$

$$= 30.5 + \frac{21}{24} \times 10 = 30.5 + 8.75$$

$$= 39.25$$

$$51^{\text{st}} \text{ mark} = 30.5 + \frac{51 - 29}{24} \times 10$$

$$= 30.5 + \frac{22}{24} \times 10 = 30.5 + 9.17$$

$$= 39.67$$

$$\therefore \text{Median} = \frac{39.25 + 39.67}{2} = 39.46$$

interquartile range = upper quartile – lower quartile.

$$\text{QL} = 20.5 + \frac{25 - 13}{16} \times 10$$

$$= 20.5 + \frac{12}{16} \times 10 = 20.5 + 7.5$$

$$= 28$$

$$\begin{aligned} Q_u &= 50.5 + \frac{75 - 71}{12} \times 10 \\ &= 50.5 + \frac{4}{12} \times 10 = 50.5 + 3.3 \\ &= 53.8. \end{aligned}$$

$$\begin{aligned} \text{Inter quartile range} &= 53.38 - 28 \\ &= 25.8 \end{aligned}$$

(b) Range of marks by middle 50% = inter quartile range  
= 25.8.

$$\begin{aligned} 24. (2 - 2x)^8 &= 2^8 + 8(2)^7 (-2x) + 28(2)^6 (-2x)^2 + 56(2)^5 (-2x)^3 \\ &= 256 + 1024 (-2x) + 1792 (-2x)^2 + 1792 (-2x)^3 \\ &= 256 - 2048x + 7168x^2 - 14336x^3 \\ (1.98)^8 &= (2 - 0.02)^8 = [2 - 2(0.01)]^8 \end{aligned}$$

Then substituting  $x = 0.01$  in;

$$256 - 2048x + 7168x^2 - 14336x^3 \text{ we get}$$

$$\begin{aligned} (1.98)^8 &= 256 - 2048(0.01) + 7168(0.01)^2 - 14336(0.01)^3 \\ &256 - 20.48 + 0.7168 - 0.014336 \end{aligned}$$

$$= (256 + 0.7168) - (20.48 + 0.014336)$$

$$= 256.7168 - 20.4943$$

$$= 236.222464$$

$$= 236.2 \text{ (4 s.f)}$$

## Paper 7 Questions

### SECTION I

1. Without using mathematical tables evaluate;

$$\frac{2.7 \times 2.04}{300 \times 0.054} \quad (2 \text{ marks})$$

2. Factorise  $(m^2 - n^2)$  (1 mark)

Hence, find the  
Exact value of  $\sqrt{(10.88)^2 - (5.12)^2}$  (3 marks)

3. Simplify the following by rationalizing the denominator  $\frac{\sqrt{2} - 2}{4\sqrt{2} - 2}$

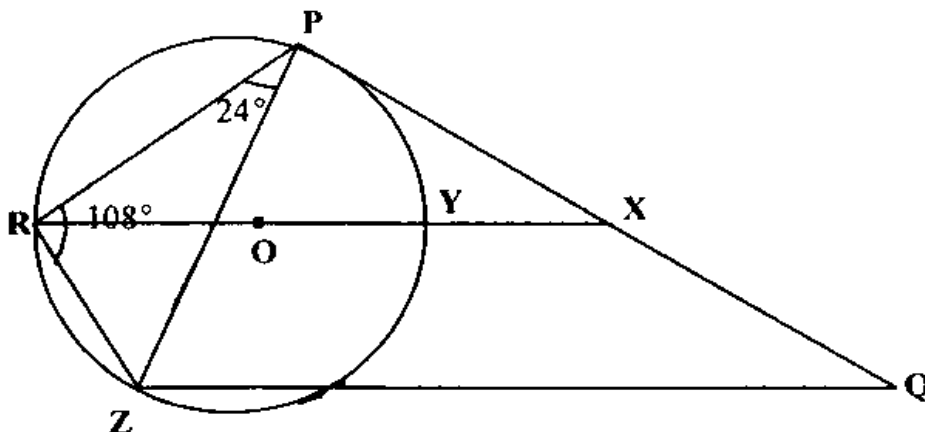
Hence evaluate the expression, given that

$$\sqrt{2} = 1.4142 \quad (3 \text{ marks})$$

4. A milk packet is in the form of a cuboid, 6 cm long 5 cm wide and 2 cm high. Milk packets are packed in a similar box. How many such packets can be packed in a box measuring 0.5 m by 20 cm and 42 cm high? (2 marks)

5. In the figure below, RY is the diameter with O as the centre.

If  $\angle PRZ$  is  $108^\circ$  and  $\angle RPZ = 24^\circ$ , find giving reasons  $\angle XPY$  (PQ is a tangent to the circle) (3 marks)



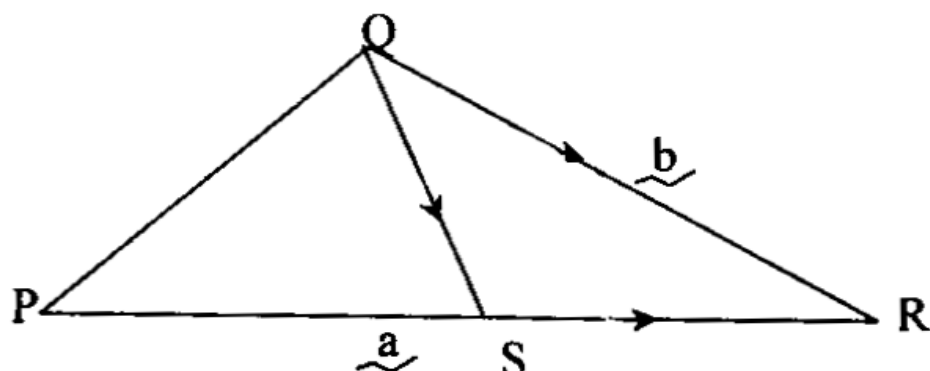
6. Alice bought 8 mangoes and 4 bananas at sh74 while Janet bought 2 mangoes less and 2 more bananas than Alice at sh.69 what was the cost of each type of fruit.(3 marks)

7. In the figure below, the ratio of  $\vec{PS}$  to  $\vec{SR}$  is 3:2.

If  $\vec{QS} = \vec{QR} + \vec{RS}$  show that

$$\vec{QR} + \vec{RS} = \vec{QP} + \vec{PS};$$

$$\vec{QR} = \vec{b} \quad \vec{PR} = \vec{a}$$



8. If  $(3x + 2y) : (x - y) = 4 : 1$ , find  $x : y$  (3 marks)

9. Expand  $(1 - \frac{2}{x})^4$  hence, evaluate;  $(0.98)^4$  giving your answer to 4 decimal places. (4 marks)

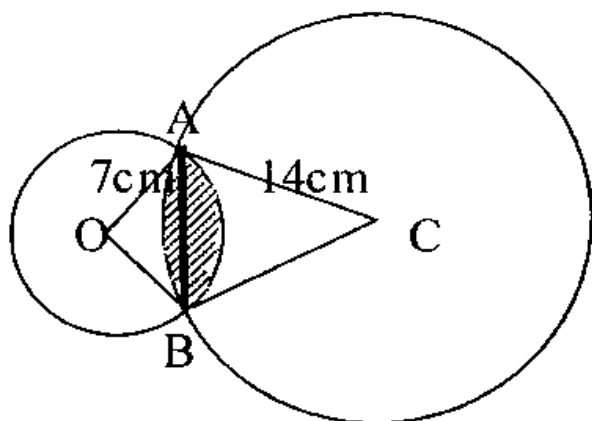
10. Triangle ABC is such that  $AB = 12$  cm,  $BC = 9$  cm and  $\angle ABC = 60^\circ$ . Find AC and the size of  $\angle BAC$  and  $\angle BCA$ . (4 marks)

11. Two similar prisms have lengths of corresponding sides 60 cm and 90 cm respectively. If the smaller prism has a volume of  $400 \text{ cm}^3$ , find the volume of the larger prism. (4 marks).

12. Two villages Geda and Kivote are on the same latitude. The difference in their longitude is  $36^\circ$ . If the shortest distance between them on the earth's surface along the latitude is 1600 km, what is their latitude? (Earths radius = 6400km) (3 marks)

13. If 12 tailors working for 12 hours can make 480 dresses, how many more dresses can 24 tailors make working 8 hours a day? (2marks)

14. Two circles of radii 7cm and 14cm intersect as shown below. O and C are centres.  $AB = 9\text{cm}$  and the line OC joins the two centres. Find the size of  $\angle AOB$  and  $\angle ACB$ . (3 marks)



15. A bus is travelling from Migori to Nairobi, its distance (km) from Migori at any time  $t$  (hrs) is given by  $s = t^3 - 8t^2 + 16t + 3$ . Find  
 (i) Time when its velocity is zero.  
 (ii) Acceleration when  $t = 5$ (hrs). (4 marks)
16. Under a translation the point  $p(3, -2)$  is mapped onto the point  $P^1(6, m)$  Under the same translation, a point  $V(4, 7)$  is mapped onto a point  $V^1(n, -1)$  find  
 (i) The values of  $m$  and  $n$   
 (ii) The coordinates of  $x_1$  the image of  $x(3, -8)$  under the same translation. (3 marks)

**SECTION B**

**17.** The table below shows monthly income tax rates

Income in pounds (£)	Tax in Ksh Per pound
1-342	2
343-684	4
685-1026	6
1027-1368	8
1369-1710	9
Over1710	10

A civil servant enjoys a married relief of sh.360 per month and is provided with a house at a nominal rent of sh.1200 per month. If his net tax per month is sh.5,360 calculate his basic salary. (8 marks)

**18.** Each interior angle of a regular polygon is  $150^\circ$

- (i) Find the number of sides of the polygon (2 marks)
- (ii) Find the area of the polygon given that each side is 15cm. (6 marks)

**19.** Matrix P is given by  $\begin{pmatrix} 4 & 7 \\ 5 & 8 \end{pmatrix}$

- (a) Find  $P^{-1}$  the inverse of P. (1 mark)
- (b) Two public hospitals Makupa and Nakuru purchased two types of painkillers. Type A at sh.  $x$  and type B at sh  $y$ . Makupa hospital purchased 8 cartons of type A and 14 cartons of type B at sh.23,800. Nakuru purchased 10 cartons of A and 16 of type B at 28,700
  - (i) Form a matrix to represent the above information
  - (ii) Find the cost of each pair of the tablets if each carton contains 100 sets with each set having 25 pairs (6 marks)

20. (a) Show the region represented by the following inequalities

$$2x + y > 3, x - y < 4 \text{ and } y \leq 3$$

(b) Find the area of the region represented above. (8 marks)

21. Depending on the previous observations the probability of Trans Nzoia district receiving high rainfall next season is  $\frac{3}{5}$ , if the rainfall shall be high the probability that the harvest will be high is  $\frac{3}{4}$ , otherwise it is  $\frac{1}{6}$ . If the harvest is high the probability that the prices will rise is  $\frac{1}{3}$  otherwise it is  $\frac{3}{5}$ .

(a) Represent the above information on a tree diagram.

(2 marks)

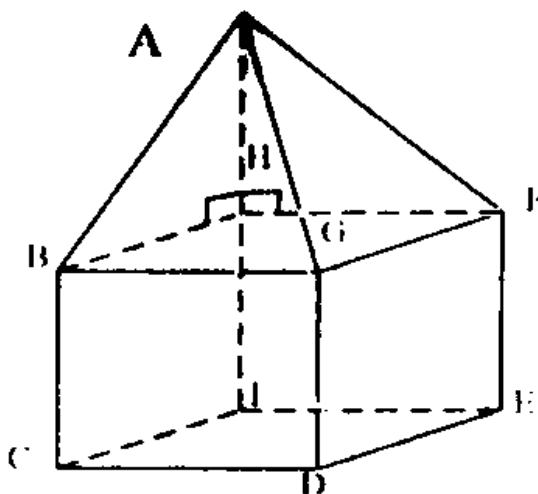
(b) Find the probability that;

(i) The rainfall shall be high and the harvest will be low

(3 marks)

(ii) The harvest will be low and the prices will fall (3 marks)

22. The figure below shows a right-angled pyramid mounted on a cuboid

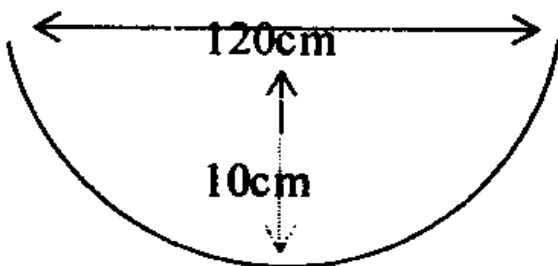


$CD = 5\text{cm}$ ,  $DE = 8\text{cm}$  and  $EF = 10\text{cm}$ . If  $AI$  is perpendicular to  $CI$ ,



- (a) Draw the net of the pyramidal mounting (2 marks)  
 (b) (i) Find the length of the diagonal CF (4 marks)  
 (ii) Calculate angle BFC (2 marks)

23. The minor segment of a circle shown below is a cross section of a model of an open trough of maximum depth 10cm: and a length of 100cm. Calculate to 1 decimal place;



- (a) The radius of its circle.  
 (b) The area of the cross section.  
 (c) Volume of the trough. (8 marks)
24. A tap A can fill a tank in 20 hours. Another tap B can empty the same tank in 25 hours.
- (i) After how long is the tank going to be half full of water if both are set on at the same time? (4 marks)
- (ii) If tap A is on for 8 hours then tap B is opened, how long is it going to take to fill the tank? (4 marks)

**Answers to Paper 7**

$$\begin{aligned}
 1. \quad & \frac{2.7 \times 2.04 \times 1000}{300 \times 0.054 \times 1000} \\
 & \frac{1 \quad 102}{= \frac{27 \times 204}{300 \times 54}} \qquad = \frac{102}{300} \qquad = 0.34
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & m^2 - n^2 = (m+n)(m-n) \\
 \therefore & \sqrt{(10.88)^2 - (5.12)^2} = \sqrt{(10.88 + 5.12)(10.88 - 5.12)} \\
 & = \sqrt{16 \times 5.76} \\
 & = \sqrt{16} \times \sqrt{5.76} \\
 & = 4 \times 2.4 \\
 & = 9.6
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & \frac{(\sqrt{2}-2) \times (4\sqrt{2}+2)}{(4\sqrt{2}-2) \times (4\sqrt{2}+2)} \\
 & = \frac{8 - 8\sqrt{2} + 2\sqrt{2} - 4}{32 - 4} \\
 & = 4 - \frac{6\sqrt{2}}{28} \\
 & = 4 - \frac{6 \times 1.41412}{28} \\
 & = 4 - \frac{8.4852}{28} \\
 & = -\frac{4.4852}{28} \\
 & = -\frac{1.1213}{7} = -0.1602
 \end{aligned}$$

4. Number of packets given by;

$$\frac{50 \times 20 \times 42}{6 \times 5 \times 2} = 700 \text{ packets}$$

5.  $\angle RPY = 90^\circ$  (angles subtended at circumference by diameter)

$$\therefore \angle ZPY = 90^\circ - 24^\circ = 66^\circ$$

$\angle ZQP = \angle PRZ = 108^\circ$  (angles in alt. segments are equal)

$$\therefore \angle XPY = 108^\circ - 66^\circ = 42^\circ$$

6.  $8m + 4b = 74$ .....(i)

$6m + 6b = 69$ .....(ii)

$$24m + 12b = 222 \text{ -}$$

$$\underline{12m + 12b = 138}$$

$$12m \qquad \qquad = 84$$

$$m = \text{sh.}7$$

Substituting 7 for m in (i) above

$$56 + 4b = 74$$

$$4b = 18$$

$$b = 4.5$$

$\therefore$  cost of a mango = sh.7.00

cost of a banana = sh.4.50

$$7. \vec{QR} + \vec{RS} = b + \frac{2}{5} \vec{RP}$$

$$= b - \frac{2}{5} a$$

$$\vec{QP} + \vec{PS} = \underline{b - a} + \frac{3}{5} \vec{PR}$$

$$= \underline{b - a} + \frac{3}{5} a$$

$$= \underline{b} + \frac{3\underline{a} - 5\underline{a}}{5} = b - \frac{2}{5}a$$

$$\therefore \vec{QR} + \vec{RS} = \vec{QP} + \vec{PS}$$

8.  $\frac{3x + 2y}{x - y} = \frac{4}{1}$

$$3x + 2y = 4x - 4y$$

$$-x = -6y$$

$$\frac{x}{y} = \frac{6}{1}$$

$$\therefore x : y = 6 : 1$$

9.  $(1 - \frac{2}{x})^4 = 1 + 4(\frac{-2}{x}) + 6(\frac{-2}{x})^2 + 4(\frac{-2}{x})^3 + (\frac{-2}{x})^4$

$$= 1 - \frac{8}{x} + \frac{24}{x^2} - \frac{32}{x^3} + \frac{16}{x^4}$$

$$(0.98)^4 = (1 - \frac{2}{100})^4$$

substituting 100 for x in the expression above;

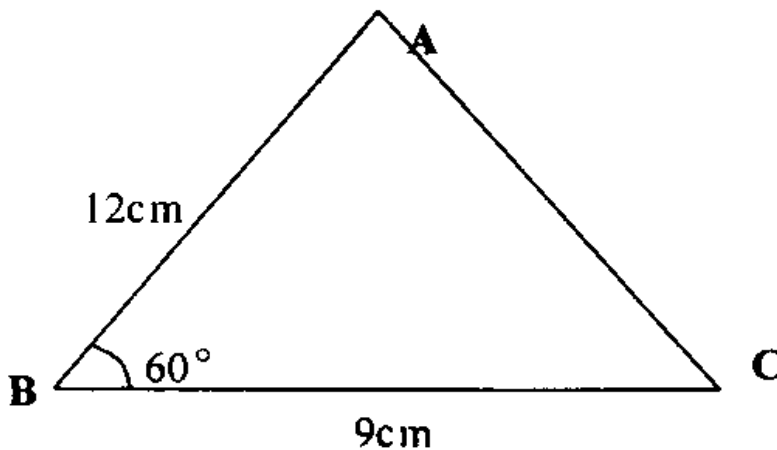
$$(1 - \frac{2}{100})^4 = 1 - \frac{8}{100} + \frac{24}{(100)^2} - \frac{32}{(100)^3} + \frac{16}{(100)^4}$$

$$= 1 - 0.08 + 0.0024 - 0.000032 + 0.00000016$$

$$= 0.92236816$$

$$= 0.9224 \text{ (4.d.p)}$$

10.



by cosine rule i.e

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

$$Ac^2 = 12^2 + 9^2 - 2 \times 12 \times 9 \cos 60^\circ$$

$$Ac^2 = 144 + 81 - 216 \cos 60^\circ$$

$$Ac^2 = 225 - 108$$

$$Ac = \sqrt{117}$$

$$= 10.82$$

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

$$\frac{10.82}{\sin 60} = \frac{9}{\sin \angle BAC}$$

$$\sin \angle BAC = \frac{9 \times \sin 60}{10.82}$$

$$\sin \angle BAC = 0.7203$$

$$\angle BAC = 46.08^\circ$$

$$\angle BCA = 180^\circ - (60^\circ + 46.08^\circ) = 73.92^\circ$$

11.  $L_s f = \frac{90}{60} = 1.5$

volume scale factor (v.s.f) =  $(1.5)^3 = 3.375$

$$\text{v.s. f} = \frac{\text{Image volume}}{\text{object volume}}$$

$$\therefore 3.375 = \frac{\text{Image volume}}{400}$$

volume of larger volume becomes;

$$(3.375 \times 400) \text{ cm}^3$$

$$= 1350 \text{ cm}^3$$

12. Distance (D) along latitude is given by,

$$\frac{\theta \times 2\pi R \cos \alpha}{360}$$

360

where;  $\theta$  = longitudinal difference

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$\alpha$  = latitude  
 taking  $R = 6400\text{km}$ .

$$1600 = \frac{36^\circ}{360^\circ} \times 2 \times 3.142 \times 6400 \cos \alpha$$

$$\cos \alpha = \frac{1600 \times 360}{36^\circ \times 2 \times 3.142 \times 6400} = 0.3978$$

$$\alpha = 66.56^\circ \text{N or } 66.56^\circ \text{S}$$

13. 1 tailor working 1 hour makes;

$$\frac{480}{12 \times 12} \text{ dresses}$$

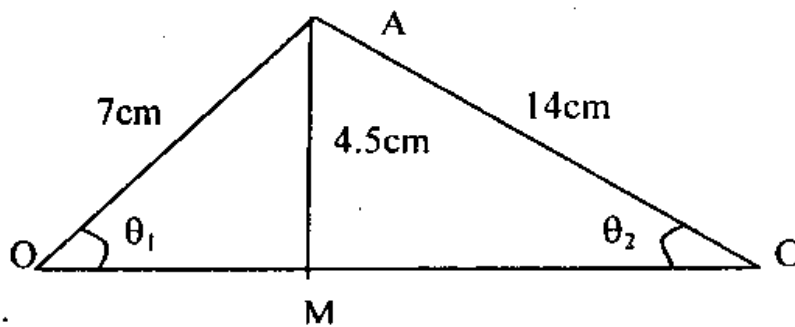
24 tailors working 8 hours will make

$$\left( \frac{480}{12 \times 12} \times 24 \times 8 \right) \text{ dresses}$$

$$= 640 \text{ dresses}$$

$\therefore$  They make  $640 - 480 = 160$  more dresses.

14. Let OC meet AB at M



$$\sin \theta_1 = \frac{4.5}{7} = 0.6429 \quad \sin \theta_2 = \frac{4.5}{14}$$

$$\theta_1 = 40.01^\circ$$

$$\therefore \angle AOB = 2\theta_1$$

$$= 40.01 \times 2$$

$$= 80.02^\circ$$

$$= 0.324$$

$$\theta_2 = 18.75^\circ$$

$$\therefore \angle ACB = 2\theta_2$$

$$= 2 \times 18.75$$

$$= 37.5^\circ$$

$$\begin{aligned}
 15. \text{ (i) } v &= \frac{ds}{dt} = 3t^2 - 16t + 16 \\
 &= 3t^2 - 16t + 16 = 0 \\
 3t^2 - 12t - 4t + 16 &= 0 \\
 3t(t - 4) - 4(t - 4) &= 0 \\
 (3t - 4)(t - 4) &= 0 \\
 t &= \frac{4}{3} \text{ hrs or } t = 4 \text{ hrs}
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii) } a &= \frac{dv}{dt} = 6t - 16 \\
 \therefore \text{ when } t &= 5, \\
 a &= 6t - 16 = 30 - 16 \\
 &= 14 \text{ km/hr}^2
 \end{aligned}$$

$$\begin{aligned}
 16. \text{ (i) } \begin{bmatrix} 3 \\ -2 \end{bmatrix} + \begin{bmatrix} x \\ y \end{bmatrix} &= \begin{bmatrix} 6 \\ m \end{bmatrix} & \therefore x = 3 \\
 \begin{bmatrix} 4 \\ 7 \end{bmatrix} + \begin{bmatrix} 3 \\ y \end{bmatrix} &= \begin{bmatrix} n \\ -1 \end{bmatrix} & \begin{matrix} ; n = 7 \\ ; y = -8. \end{matrix} \\
 \therefore m &= -2 - 8 = -10 \\
 n &= 7
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii) } X_1 &= \begin{bmatrix} 3 \\ -8 \end{bmatrix} + \begin{bmatrix} 3 \\ -8 \end{bmatrix} = \begin{bmatrix} 6 \\ -16 \end{bmatrix} \\
 \therefore X_1 &= (6, -16)
 \end{aligned}$$

$$\begin{aligned}
 17. \text{ Gross tax} &= \text{sh.}5,360 + 360 = \text{sh.}5720 \\
 \text{income tax from the brackets;} \\
 1^{\text{st}} \text{ bracket } (342 \times 2) &= 648 \\
 2^{\text{nd}} \text{ bracket } (342 \times 4) &= 1368 + \\
 3^{\text{rd}} \text{ bracket } (342 \times 6) &= \underline{2052} \\
 & \text{sh.}4104
 \end{aligned}$$

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tax in the 4<sup>th</sup> bracket ;

$$\text{sh}(5720 - 4104) = \text{sh.}1616$$

income in the 4<sup>th</sup> bracket;

$$x \times 8 = 1616$$

$$x = \frac{1616}{8} = \text{£ } 202$$

$\therefore$  taxable income;

$$= \text{£ } 202 + \text{£}1026 = \text{£}1228$$

$$1228 \times 20 = \text{sh}24560$$

let  $x$  be the basic salary; then,

$$\left( \frac{15x}{100} - 1200 \right) + x = 24560$$

$$\frac{3x}{20} - 1200 + x = 24,560$$

$$\frac{3x}{20} + x = 24,560 + 1200$$

$$= \frac{23x}{20} = 25760$$

$$23x = 515200$$

$$x = \text{sh.}22,400$$

$\therefore$  the basic salary = sh.22,400

18. (i) Each interior angle is given by;

$$\frac{(n - 2) 180}{n}$$

$$\frac{(n - 2) 180}{n} = 150$$

$$180n - 360 = 150n$$

$$180n - 150n = 360$$

$$30n = 360$$

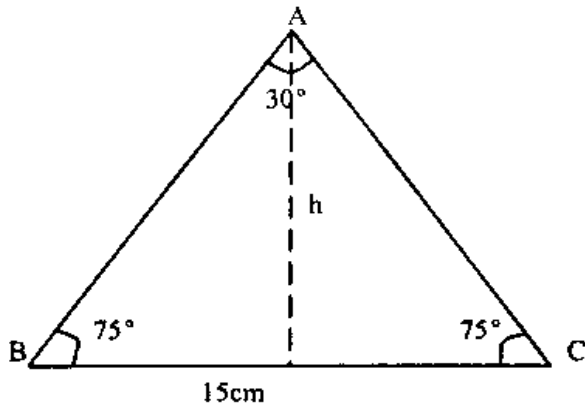
$$n = 12$$

Number of sides = 12

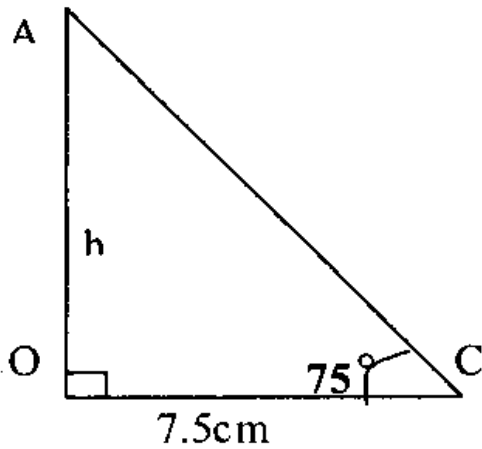


(ii) Angle at the centre is given by;

$$\frac{360}{12} = 30^\circ$$



$$\text{base angles} = \left( \frac{180^\circ - 30^\circ}{2} \right) = 75^\circ$$



$$= \tan 75^\circ = \frac{h}{7.5}$$

$$= h = 7.5 \tan 75^\circ$$

$$= 7.5 \times 3.732$$

$$h = 27.99\text{cm}$$

$$\text{area given by} = \frac{1}{2} bh \times 12$$

$$= \frac{1}{2} \times 15 \times 27.99 \times 12 = 2519.1$$

$$\approx 2519\text{cm}^2$$

19. (a) 
$$p^{-1} = -\frac{1}{3} \begin{pmatrix} 8 & -7 \\ -5 & 4 \end{pmatrix} = \begin{pmatrix} -\frac{8}{3} & \frac{7}{3} \\ \frac{5}{3} & -\frac{4}{3} \end{pmatrix}$$

(b) 
$$\begin{array}{l} \text{Makupa} \\ \text{Nakuru} \end{array} \begin{array}{cc} \text{A} & \text{B} \\ \begin{pmatrix} 8 & 14 \\ 10 & 16 \end{pmatrix} & \begin{pmatrix} x \\ y \end{pmatrix} \end{array} = \begin{pmatrix} 23,800 \\ 28,700 \end{pmatrix}$$

$$= \begin{pmatrix} 8 & 14 \\ 10 & 16 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 23,800 \\ 28,700 \end{pmatrix}$$

solving for x and y, from equations;

$$8x + 14y = 23,800 \quad \text{---} \times 10 \quad \dots\dots\dots \text{(i)}$$

$$10x + 16y = 28,700 \quad \text{---} \times 8 \quad \dots\dots\dots \text{(ii)}$$

$$80x + 140y = 238000$$

$$80x + 128y = 229600$$

$$\underline{12y = 8400}$$

$$y = \text{sh.}700$$

Substituting for y in (i) above

$$8x + 14 \times 700 = 23800$$

$$8x = 23800 - 9800$$

$$8x = 14000$$

$$x = \text{sh.}1750$$

∴ Each carton of type; A costs sh.1750

B costs sh.700

$$= \text{for type A each set costs } \frac{\text{sh.}1750}{100} = \text{sh.}17.50$$

$$\therefore \text{each pair costs } \frac{17.50}{25}$$

$$= \text{sh.}0.70$$

$$= 70 \text{ cents}$$

= for type B each set costs  $\text{sh.} \frac{700}{100} = \text{sh.} 7.00$

$\therefore$  each pair costs  $\frac{7.00}{25} = \text{sh.} 0.28 = 28 \text{ cents}$

20. (a) (i)  $2x + y = 3$        $\frac{x}{y} \left| \begin{array}{c|c|c} -2 & 0 & 3 \\ \hline 7 & 3 & -3 \end{array} \right.$

taking point (0, 0)  
 $2x + y > 3$  becomes  $0 > 3$   
 $\therefore (0, 0)$  is on the unwanted side

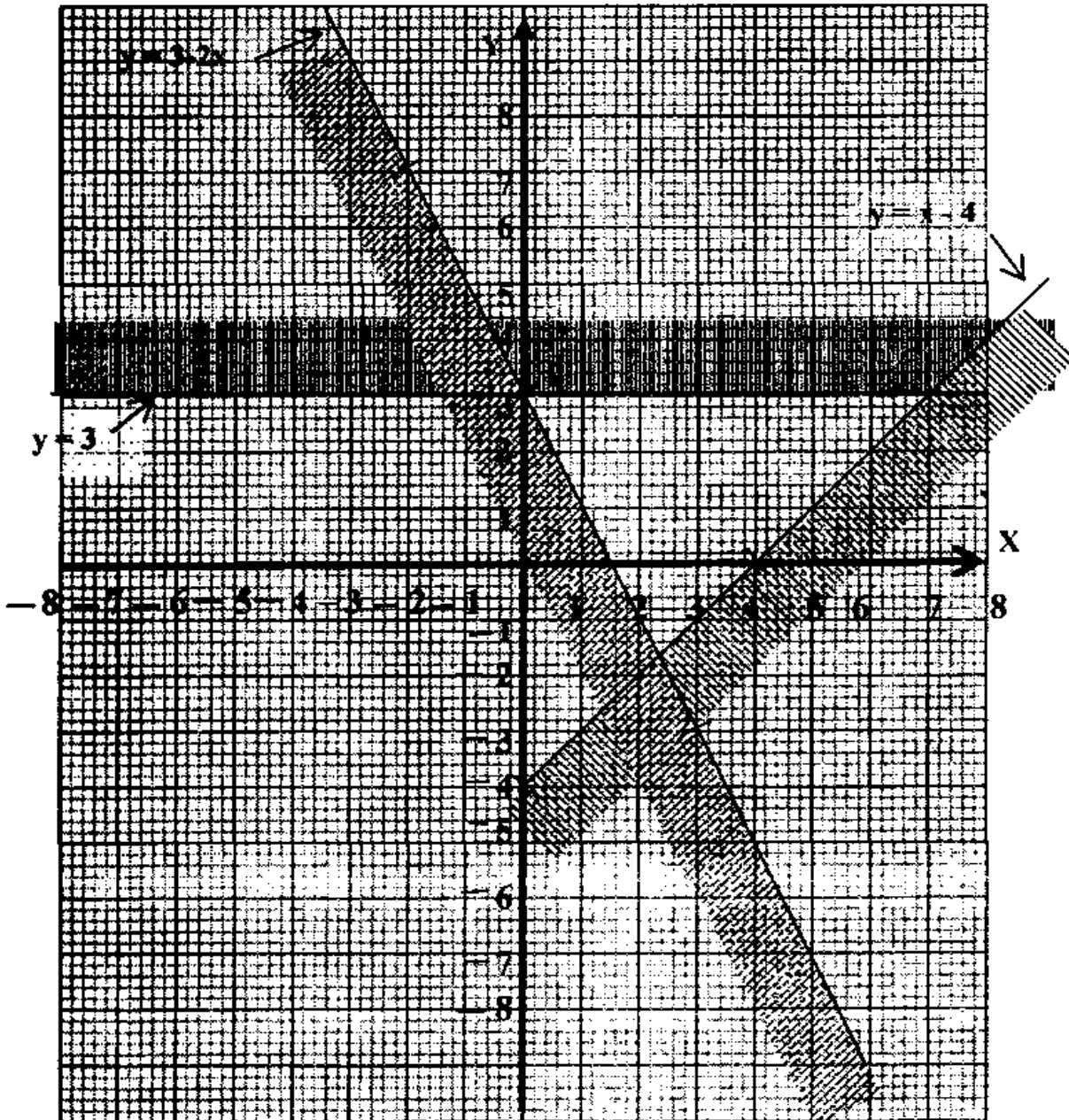
(ii)  $y = x - 4$        $\frac{x}{y} \left| \begin{array}{c|c|c} -2 & 0 & 4 \\ \hline -6 & -4 & 0 \end{array} \right.$

taking point (0, 0)  
 $x - y \geq 4$  becomes  $0 \geq 4$   
 $\therefore (0, 0)$  is on unwanted side.

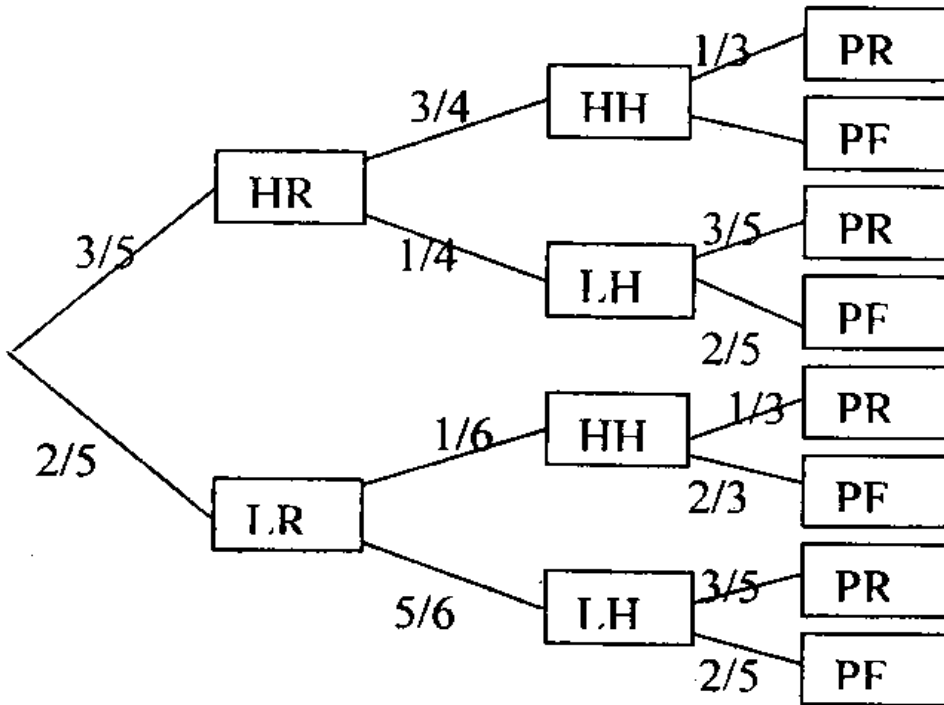
(ii)  $y = 3$

(b) The region is a triangle  $\therefore$   
 $h = 4.3$   
 Base = 7  
 Area becomes =  $\frac{1}{2} \times 7 \times 4.3$   
 = 15.05 square units

NB: see graph next page.



21(i)



**(b) (i)** P (high rainfall and low harvest) =  
 P ( HR and LH and PR) or P ( HR and LH and PF)  
 =  $(\frac{3}{5} \times \frac{1}{4} \times \frac{3}{5}) + (\frac{3}{5} \times \frac{1}{4} \times \frac{2}{5})$

$$= \frac{9}{100} + \frac{6}{100} = \frac{15}{100}$$

$$= \frac{3}{20}$$

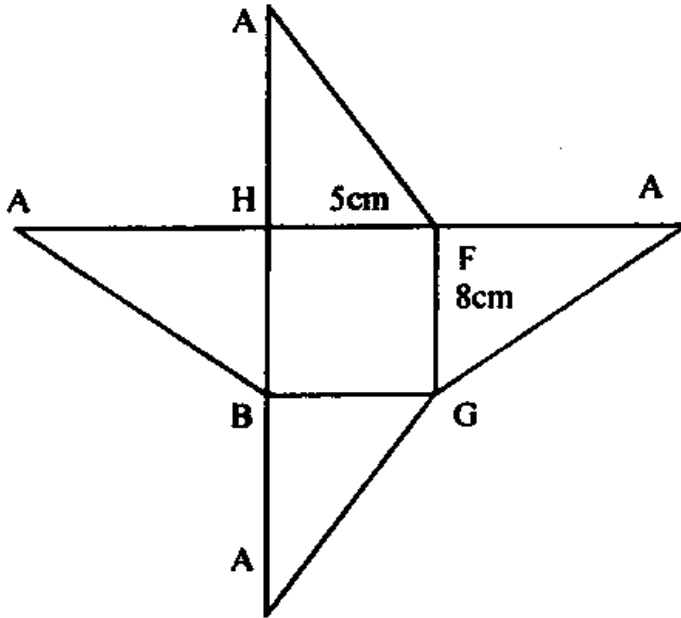
**(ii)** P ( low harvest and fall in price)  
 = P ( HR and LH and PF ) or P(LR and LH and PF)  
 =  $(\frac{3}{5} \times \frac{1}{4} \times \frac{2}{5}) + (\frac{2}{5} \times \frac{5}{6} \times \frac{2}{5})$

$$= \frac{6}{100} + \frac{20}{150} = \frac{18 + 40}{300}$$

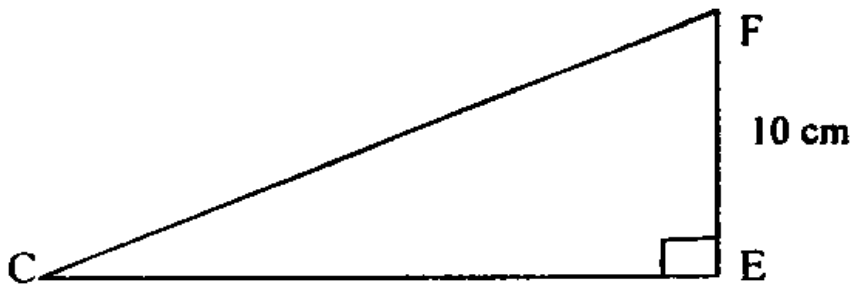
$$= \frac{58}{300}$$

$$= \frac{29}{150}$$

22.



(b)



by Pythagoras theorem;

$$CE^2 = CD^2 + DE^2$$

$$CE^2 = 5^2 + 8^2$$

$$CE^2 = 25 + 64$$

$$= 89$$

$$\therefore CE = \sqrt{89}$$

(ii)

$$CF^2 = CE^2 + EF^2$$

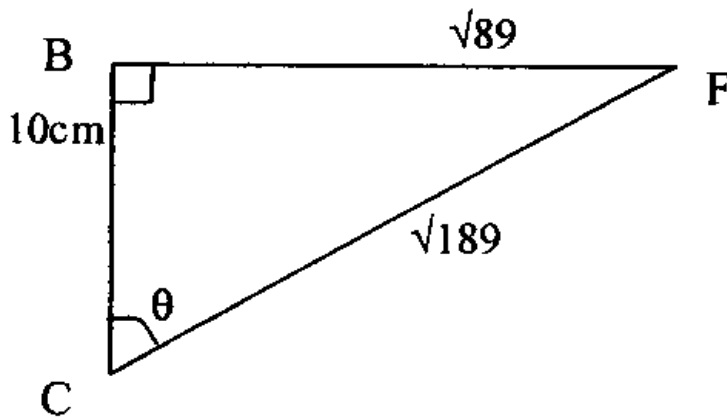
$$= (\sqrt{89})^2 + 10^2$$

$$= 89 + 100$$

$$CF^2 = 189$$

$$CF = \sqrt{189}$$

$$= 13.75 \text{ cm}$$



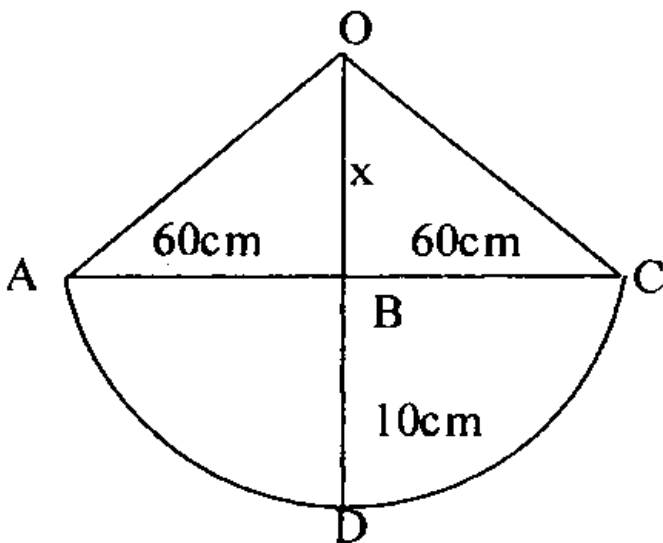
From the triangle above

$$\cos \theta = \frac{10}{\sqrt{189}} = \frac{10}{13.75} = 0.7273$$

$$\theta = 43.34^\circ$$

$$\text{Hence, angle BFC} = 90^\circ - 43.34^\circ = 46.66^\circ$$

23.



$$OC = OD = x + 10 = \text{radius}$$

By Pythagoras theorem,

$$x^2 + 60^2 = (10 + x)^2$$

$$x^2 + 60^2 = 100 + 20x + x^2$$

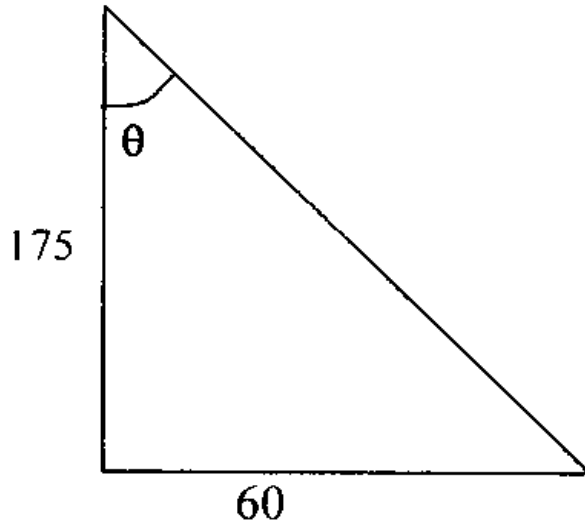
$$3600 - 100 = 20x$$

$$20x = 3500$$

$$x = 175$$

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$\therefore$  radius = 175cm + 10cm = 185cm  
 Area of cross section = area of segment.  
 From the triangle



$$\tan \theta = \frac{60}{175} = 0.3429$$

$$\theta = 18.93^\circ$$

$$2\theta = 37.86^\circ$$

$$\text{cross section area} = \text{area of sector} - \text{area of triangle};$$

$$= \left[ \frac{37.86^\circ}{360^\circ} \times 3.142 \times 185^2 \right] - \left[ \frac{1}{2} \times 185 \times 185 \sin 37.86 \right]$$

$$= 11309 - 10503$$

$$= 806 \text{ cm}^2$$

(c) Volume = cross section area  $\times$  length

$$= 806 \text{ cm}^2 \times 100 \text{ cm}$$

$$= 80600 \text{ cm}^3$$

24. (i) In one hour tap A fills;  
 $\frac{1}{20}$  of the tank and B empties  $\frac{1}{25}$  of the tank

Hence, in one hour the amount of water in the tank is

$$\frac{1}{20} - \frac{1}{25} = \frac{5-4}{100} = \frac{1}{100}$$



$\therefore$  the tank is  $\frac{1}{100}$  full

let the time taken to be half full be  $x$  then,

$$\frac{1}{100} \times x = \frac{1}{2}$$

$$x = 50$$

$\therefore$  the tank will be half full after 50 hrs

(ii) After 8 hours the tank is  $\frac{8}{100} = \frac{2}{25}$  full

$\therefore$  it is  $\frac{3}{5}$  empty

Both in one hour fill  $\frac{1}{100}$  of the tank

If  $M$  is the time it will take to fill  $\frac{3}{5}$  of the tank then

$$\frac{1}{100} \times m = \frac{3}{5}$$

$$m = \frac{3 \times 100}{5} \text{ hrs}$$

$$= 60 \text{ hours}$$

$\therefore$  it will take 60 hours to fill the tank.

# Paper 8 Questions

## SECTION I

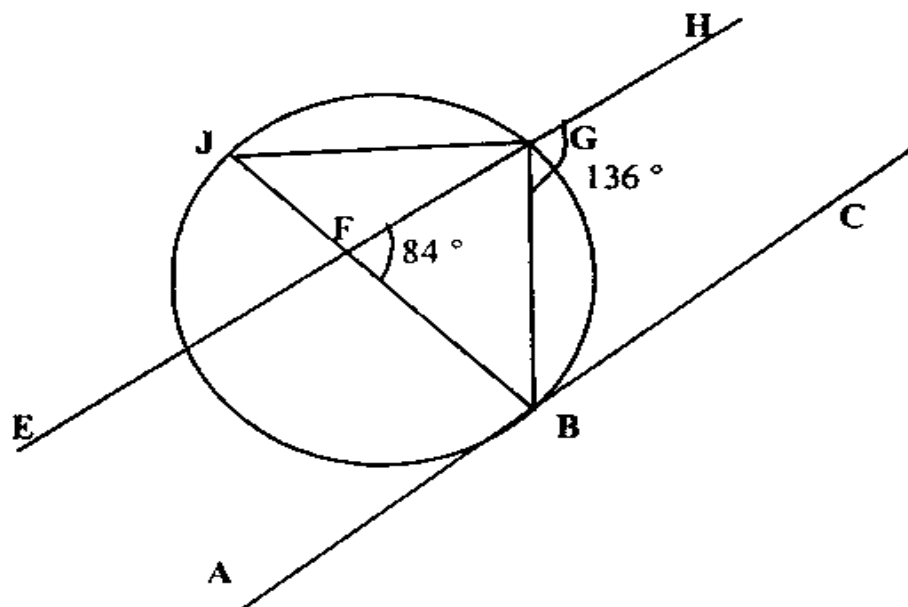
1. Evaluate

$$\frac{3}{4} \text{ of } \frac{1}{4} + \frac{1}{3} \div \frac{2}{3} - \frac{1}{6} \times \frac{3}{8} \quad (3 \text{ marks})$$

2. A man deposited sh.3240 in a bank offering interest at rate of 16% p.a. compounded semi annually. Find how long it will take this money to accumulate to an amount equal to sh.5141.50. (4 marks)

3. A varies directly as B and inversely as the square root of C. Find the percentage change in A if B is increased by 10% and C decreased by 19% (4 marks)

4. In the figure below ABC is a tangent to the circle at B. EFGH is a straight line. Angle GFB =  $84^\circ$



If EFGH bisect angle JGB and angle HGB is  $136^\circ$  find the size of angle GBC. (3 marks)

5. In three neighbouring schools the bells for the first lesson is rung at 8:00am on Monday. Thereafter the bell is rung to mark the end of the first lesson at interval of 35

minutes in the first school, 40minutes in the second school and 45 minutes in the third school. At what time will the three bells ring again simultaneously assuming that lessons are even conducted at night (3 marks)

6. A shopkeeper mixes two types of rice A and B in a ratio of 3:2. If A costs sh60 per kg and B costs sh50 per kg what would be the cost of 23kg of mixture. (4marks)

7. Expand  $(2 - x)^7$  up to the term in  $x^3$  and use your expansion to evaluate  $(1.98)^7$  correct to five significant figures. (4 marks)

8. Rationalize the denominators

$$\frac{3\sqrt{2} + \sqrt{3}}{4\sqrt{3} - \sqrt{2}} \quad (3 \text{ marks})$$

9. If  $a:b = 2:3$  and  $b = 5c$  find the ratio  $a:b:c$  (3 marks)

10. Find the integral value of  $x$  in  $2x - 5 < 7 \leq 3x - 8$  (2 marks)

11. The following is an extract from the table of exchange rate of a certain day in Nairobi stock exchange.

$$1\text{£} = \text{sh.}150.23$$

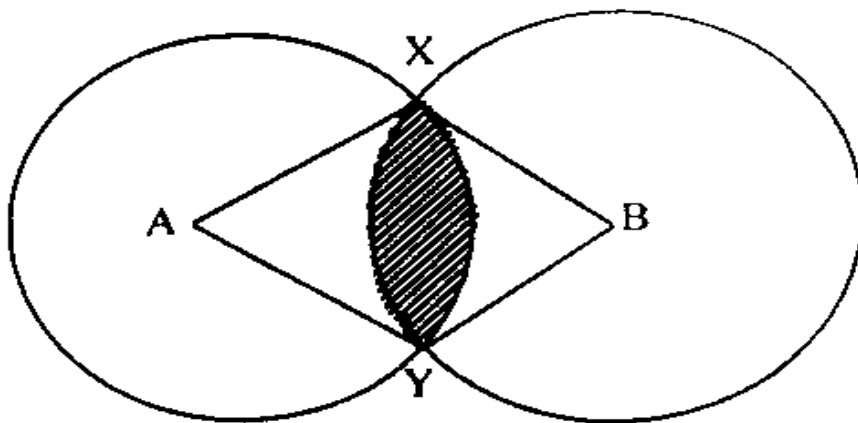
$$1\$ = \text{sh.}84.13$$

An American tourist came to Kenya with \$762 while in Kenya he spent sh.11240 on bed, sh.15,350 on food and sh.21,240 on transport. On his way back he had to pass through Britain so he changed whatever amount was left into British pounds. Find the amount he had in form of British pounds. (4 marks)

12. A book is marked sh.320 which is 45% above the cost price. If a discount of 15% of the marked price is allowed how much more would I pay for the book above the cost price? (3marks)
13. The second term of a G.P is 6 the fifth term is 48 find the common ratio and the third term. (3 marks)
14. A cylindrical water tank of radius 1.4m has a capacity of 3200litres. What is the radius of a similar tank whose capacity is 10,800litres? (3 marks)
15. Express as a fraction  $12.\overline{1237}$  (3 marks)
16. A circle of radius 5 cm has got its centre at  $(2 - 3)$   
Find the equation of a circle in the form of  $x^2 + y^2 + px + qy + c = 0$  (3 marks)

**SECTION II**

17.



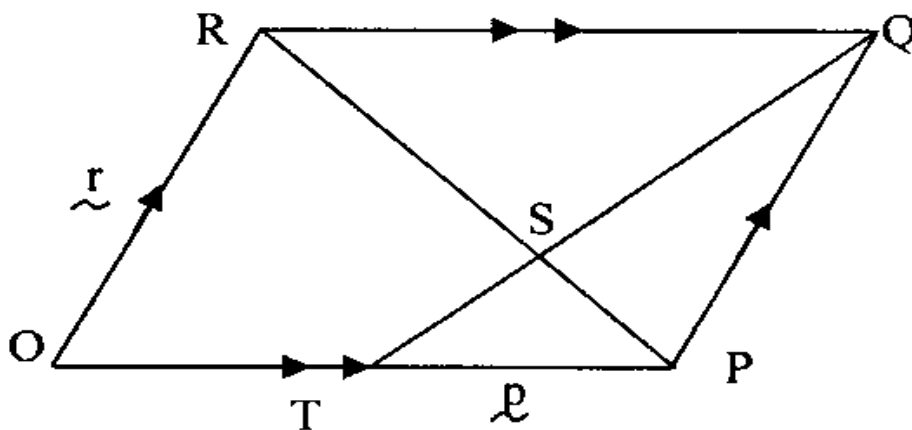
The figure above shows two circles with centres A and B of radii 3.5cm and 4.2cm respectively. The distance between their centres is 6cm. Calculate

- (a) Angle XAY and XBY (4marks)
- (b) The shaded area (4 marks)

18. (a) Find the distance in kilometres and in nautical miles between P(  $8^\circ$  S,  $31^\circ$  E) and Q (  $23^\circ$  N,  $31^\circ$  E) (4 marks)

(b) A ship sail due east from point R (  $43^\circ$  S,  $30^\circ$  E) for a distance of 1600km. Find its new position taking the radius of the earth to be 6370km (4 marks)

19.



In the parallelogram OPQR above  $OR = \underline{\underline{r}}$  and  $OP = \underline{\underline{p}}$ . T is the midpoint of OP. Express in terms of  $\underline{\underline{p}}$  and  $\underline{\underline{r}}$ .

- (a) PR (1 mark)
- (b) QT (2 marks)
- (c) OS (5 marks)

20. Three taps A, B and C can fill a tank in 30 minutes, 20 minutes and 15 minutes respectively. The three taps are turned on for two minutes and tap C is closed. After another three minutes tap B is closed. How long will it take tap A to fill the tank (8 marks)

**21. (a)** Complete the table given below by filling in the blank spaces. (2 marks)

x	0	15	30	45	60	75	90
$\sin(2x+30)$	0.5	0.87	1	0.87	0.5		-0.5
$\frac{1}{2}\cos 3x$	0.5	0.35		-0.35	-0.5	-0.35	0

x	105	120	135	150	165	180
$\sin(2x+30)$	-0.87		-0.87	-0.5	0	0.5
$\frac{1}{2}\cos 3x$	0.35	0.5	0.35		-0.35	-0.5

**(b)** On the grid provided draw the graph of  $y = \sin(2x + 30)$

And  $y = \frac{1}{2}\cos 3x$  for  $0 \leq x \leq 180$  (4 marks)

**(c)** Use your graph to estimate the ranges of values of  $x$  for which  $\sin(2x + 30) \geq \frac{1}{2}\cos 3x$  (2 marks)

**22.** Using a ruler and a pair of compass only construct a triangle in which  $AB$  is 7cm and  $BC = 9$ cm. and angle  $BAC = 75^\circ$  measure  $AC$ . Construct an inscribed circle in triangle  $ABC$  and measure its radius. Calculate the area of the triangle which is not enclosed by the inscribed circle. (8 marks)

**23. (a) (i)** Expand  $(t + 2)^2$  (2 marks)

**(ii)** Multiply  $(t + 2)^2 (t + 3)$  giving your answer in descending order (3 marks)

**(b) (i)** If  $s = (t + 2)^2 (t + 3)$  find  $\frac{ds}{dt}$  (1 mark)

**(ii)** Find the coordinate and the nature of the stationary point of the curve  $s = (t + 2)^2 (t + 3)$  (4 marks)

**24.** A boy has sh.168 and wishes to buy more than 24 fruits comprising of mangoes and oranges. An orange costs sh 4.80 and a mango costs sh 5.60. He decided to buy at least 6 mangoes and that the oranges should be at least twice as many as mangoes. If  $x$  and  $y$  represents the numbers of mangoes and oranges he should buy respectively

**(a)** Write down all possible inequalities and plot them  
(4 marks)

**(b)** Find the maximum number of fruits of each type he bought given the conditions (4 marks)

## Answers to Paper 8

$$1. \quad \frac{3}{4} \text{ of } \frac{1}{4} + \frac{1}{3} \div \frac{2}{3} - \frac{1}{6} \times \frac{3}{8}$$

$$\frac{3}{4} \times \frac{1}{4} + \frac{1}{3} \times \frac{3}{2} - \frac{1}{6} \times \frac{3}{8}$$

$$\frac{3}{16} + \frac{1}{2} - \frac{1}{16}$$

$$\frac{3}{16} - \frac{1}{16} + \frac{1}{2}$$

$$\frac{2}{16} + \frac{1}{2}$$

$$\frac{2+8}{16} = \frac{10}{16} = \frac{5}{8}$$

$$2. \quad A = P (1 + r/100)^n$$

$$5141.50 = 3240 (1 + 8/100)^n$$

$$5141.50 = 3240 (1.08)^n$$

$$\frac{5141.50}{3240} = (1.08)^n$$

$$1.5869 = (1.08)^n$$

$$\log 1.5869 = n \log 1.08$$

$$\log 1.5869 = n \log 1.08$$

$$\frac{\log 1.5869}{\log 1.08} = n$$

$$\log 1.08$$

$$\frac{0.2005}{0.0334} = n$$

$$0.0334$$

$$6 \text{ (semi years)} = n$$

$$\quad \quad \quad = 3 \text{ years}$$



$$3. A \propto \frac{B}{\sqrt{C}}$$

$$A \propto \frac{1.1B}{\sqrt{0.81C}}$$

$$A \propto \frac{1.1B}{0.9\sqrt{C}}$$

$$A \propto 1.22 \frac{B}{\sqrt{C}}$$

A is increased by 22.2%

$$4. \angle FGB = 180^\circ - 136^\circ = 44^\circ \text{ (angles in a straight line)}$$

$$\angle FBG = 180^\circ - (84^\circ + 44^\circ) \text{ (angles in a triangle)}$$

$$= 52^\circ$$

$$\angle JGB = 88^\circ$$

$$\angle BJG = 180^\circ - (52^\circ + 88^\circ)$$

$$= 180^\circ - 140^\circ$$

$$= 40^\circ$$

$$\angle GBC = 40^\circ \text{ (alternate segment theorem)}$$

$$5. 35 = 5 \times 7; \quad 40 = 2^3 \times 5; \quad 45 = 3^2 \times 5$$

$$\text{L.C.M} = 2^3 \times 3^2 \times 5 \times 7$$

$$= 8 \times 9 \times 5 \times 7$$

$$= \underline{2520} \text{ minutes}$$

$$60$$

$$= 42 \text{ hours.}$$

After 24 hrs it will be eight the next day (Tuesday)

After 12 hrs it will be 8 in the evening on Tuesday

$$24 + 12 = 36$$

Balance 6hrs

$$8. \text{ pm} + 6$$

$$= 2. \text{ am on Wednesday}$$

$$\begin{array}{r}
 \text{6.} \quad \text{A} \qquad \qquad \text{B} \\
 \quad \quad \frac{3}{5} \text{ kg} \qquad \quad \frac{2}{5} \text{ kg} \\
 \quad \quad \frac{3 \times 60}{5} \qquad \quad \frac{2 \times 50}{5} \\
 \quad \quad 36 \qquad \qquad \quad 20 \\
 \text{Cost of 1kg} = 36 + 20 = 56/= \\
 \text{23 kg will cost } 23 \times 56 = 1288/=
 \end{array}$$

$$\begin{array}{l}
 \text{7. } (2 - x)^7 \\
 2^7 - 7 \cdot 2^6 x + 21 \cdot 2^5 x^2 - 35 \cdot 2^4 x^3 \\
 128 - 448x + 672x^2 - 560x^3 \\
 (1.98)^7 = (2 - 0.02)^7 \\
 \quad \quad (2 - x)^7 \\
 \quad \quad x = 0.02 \\
 128 - 448(0.02) + 672(0.02)^2 - 560(0.02)^3 \\
 128 - 8.96 + 0.2688 - 0.00448 \\
 \begin{array}{r}
 128.0000 \qquad \qquad \qquad 8.96 \\
 \underline{0.2688 +} \qquad \qquad \underline{0.00448 +} \\
 128.2688 \qquad \qquad \qquad 8.96448 \\
 \underline{8.96448 -} \\
 119.30432 \\
 \qquad \qquad \qquad = 119.30
 \end{array}
 \end{array}$$

$$\text{8. } \frac{3\sqrt{2} + \sqrt{3}}{4\sqrt{3} - \sqrt{2}} \times \frac{4\sqrt{3} + \sqrt{2}}{4\sqrt{3} + \sqrt{2}}$$

$$\begin{array}{r}
 \frac{12\sqrt{6} + 6 + 12 + \sqrt{6}}{48 - 2} \\
 \frac{13\sqrt{6} + 18}{46}
 \end{array}$$

9. a                      b  
     2                      3

$b = 5c$

$\frac{b}{5} = c$

a              b              c  
 2              3               $\frac{3}{5}$

multiply by 5

10 : 15 : 3

10.  $2x - 5 < 7 \leq 3x - 8$

$2x - 5 < 7$                $7 \leq 3x - 8$

$2x < 7 + 5$                $7 + 8 \leq 3x$

$2x < 12$                    $15 \leq 3x$

$x < 6$                        $5 \leq x$

$5 \leq x < 6$

$x = 5$

11. Expenditure    11240  
                           15350  
                           21240 +  
                           47830

1£ = 150.23

? = 47830

47830  
 150.23

= £ 318.4

762 × 84.13  
 150.23

= 426.7

£426.7  
£318.4  
 £108.3

12.  $320 = 145\%$

$$\text{Cost price} = \frac{320 \times 100}{145}$$

$$\text{sh.220.70}$$

$$\text{Selling price} = \frac{85}{100} \times 320$$

$$\text{sh.272}$$

$$272 - 220.70 = \text{sh.51.30}$$

13

$$ar = 6$$

$$ar^4 = 48$$

$$a = \frac{6}{r}$$

$$\frac{6}{r} \times r^4 = 48$$

$$6r^3 = 48$$

$$r^3 = \frac{48}{6}$$

$$r^3 = 8$$

$$r = 2$$

$$3^{\text{rd}} \text{ term} = ar^2$$

$$a \times 2 = 6$$

$$2a = 6$$

$$a = 3$$

$$3 \times 2^2$$

$$3 \times 4 = 12$$

14.  $\frac{8}{\frac{3200}{10800}}$   
27

$$\text{v.s.f} = \frac{8}{27}$$

$$\text{LSF} = \frac{2}{3}$$

$$\frac{2}{3} = \frac{1.4}{x}$$

$$2x = 4.2$$

$$x = 2.1\text{m}$$

15.  $12.\overline{1237}$

let  $r = 12.12373737\dots\dots\dots(i)$

let  $100r = 1212.373737\dots\dots(ii)$

$10000r = 121237.373737\dots\dots(iii)$

Subtracting 2 from 3

$10000r = 121237.3737$

$\underline{100r = 1212.3737}$

$9900r = 120025.$

$R = \frac{120025}{9900r}$

$r = \frac{4801}{396}$

16.  $(x-a)^2 + (y-b)^2 = r^2$

$(x-2)^2 + (y+3)^2 = 5^2$

$(x-2)(x-2) + (y+3)(y+3) = 25$

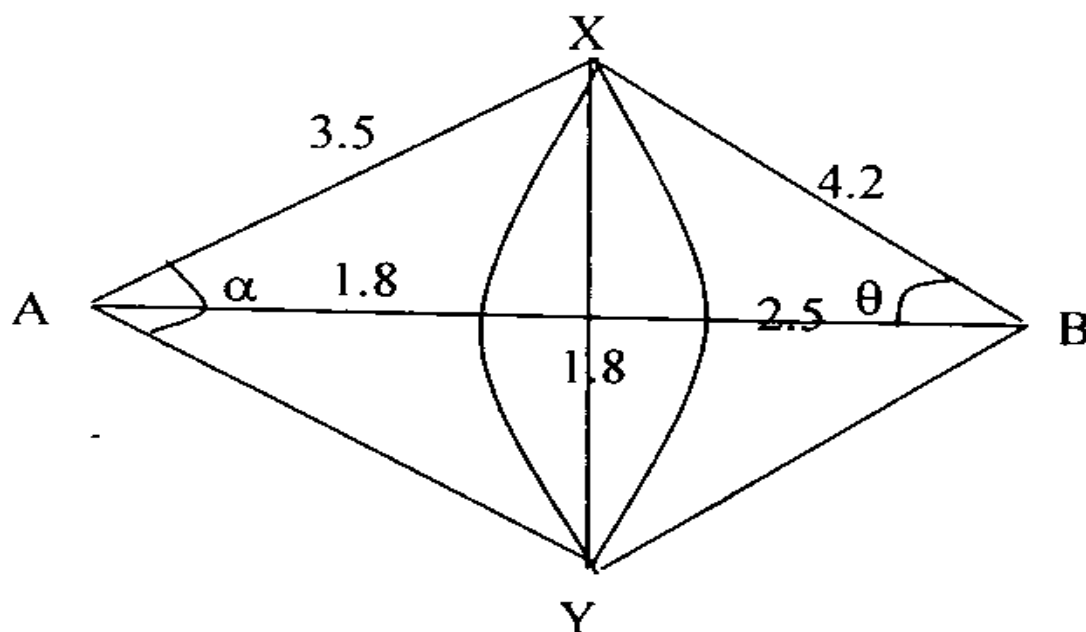
$x^2 - 4x + 4 + y^2 + 6y + 9 = 25$

$x^2 - 4x + y^2 + 6y + 13 - 25 = 0$

$x^2 - 4x + y^2 + 6y - 12 = 0$

$x^2 + y^2 - 4x + 6y - 12 = 0$

17.



$$\cos \alpha = \frac{2.7}{3.5}$$

$$\cos \alpha = 0.7714$$

$$\alpha = 39.5$$

$$\begin{aligned} \angle XAY &= 39.5 \times 2 \\ &= 79^\circ \end{aligned}$$

$$\begin{aligned} \text{Area (i)} &= \frac{79}{360} \times \frac{22}{7} \times 3.5 \times 3.5 - \frac{1}{2} \times 3.5 \times 3.5 \sin 79 \\ &= \frac{21290.5}{2520} - 6.01 \\ &= 8.45 - 6.01 = 2.44 \text{ cm}^2 \end{aligned}$$

$$8.45 - 6.01 = 2.44 \text{ cm}^2$$

$$\begin{aligned} \text{Area (ii)} &= \frac{72}{360} \times \frac{22}{7} \times 4.2 \times 4.2 - \frac{1}{2} \times 4.2 \times 4.2 \sin 72 \\ &= \frac{27941.76}{2520} - 8.39 \\ &= 11.09 - 8.39 \\ &= 2.7 \text{ cm}^2 \end{aligned}$$

$$11.09 - 8.39$$

$$= 2.7 \text{ cm}^2$$

$$\text{Total area} = 2.7 + 2.44 = 5.14 \text{ cm}^2$$

$$18. 8 + 23 = 31$$

$$\text{Distance in nm } 31 \times 60 = 1860 \text{ nm}$$

$$\text{Distance in km}$$

$$\frac{31}{360} \times 2 \times \frac{22}{7} \times 6370$$

$$= 3447.9 \text{ km.}$$

$$(b) \frac{\theta}{360} 2\pi R \cos \alpha$$

$$\frac{\theta}{360} \times 2 \times \frac{22}{7} \times 6370 \times \cos 43 = 1600$$

$$\frac{204983.8\theta}{2520} = 1600$$

$$204983.8\theta = 1600 \times 2520$$

$$204983.8\theta = 4032000$$

$$\theta = \frac{4032000}{204983.8}$$

$$\theta = 19.6 \approx 20^\circ$$

New position  $43^\circ$  S  $50^\circ$  E

19. (a)  $PR = PO + OR$

$$= \underline{p} + \underline{r} \qquad \qquad \qquad = \underline{r} - \underline{p}$$

(b)  $QT = QR + RO + OT$

$$= \underline{p} - \underline{r} + \frac{1}{2}\underline{p} \qquad \qquad \qquad = -\frac{1}{2}\underline{p} - \underline{r}$$

(c)  $QS = hQT$  and  $PS = kPR$

$$OS = OR + RQ = hQT$$

$$OS = OP + kPR$$

$$OS = r + p + h(\frac{1}{2}p - r)$$

$$= r + p - \frac{1}{2}hp - hr$$

$$= r - hr + p - \frac{1}{2}hp$$

$$r(1 - h) + p(1 - \frac{1}{2}h)$$

$$OS = \underline{p} + k(\underline{r} - \underline{p})$$

$$= \underline{p} + k\underline{r} - k\underline{p}$$

$$= p - kp + kr$$

$$= p(1 - k) + k\underline{r}$$

$$r(r - h) = k\underline{r} \quad \text{and} \quad \underline{p}(1 - \frac{1}{2}h) = p(1 - k)$$

$$1 - h = k \qquad \qquad \qquad 1 - \frac{1}{2}h = 1 - k$$

$$1 - \frac{1}{2}h = 1 - (1 - h)$$

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

$$1 = h + \frac{1}{2}h$$

$$1 = \frac{3}{2}h$$

$$\frac{2}{3} = h$$

$$OS = r(1 - h) + \underline{p}(1 - \frac{1}{2}h)$$

$$= r(1 - \frac{2}{3}) + \underline{p}(1 - \frac{1}{2} \times \frac{2}{3})$$

$$= \frac{1}{3}r + \frac{2}{3}\underline{p}$$

$$\begin{array}{ccc}
 \text{20. A} & \text{B} & \text{C} \\
 30 & 20 & 15 \\
 \frac{1}{30} & \frac{1}{20} & \frac{1}{15}
 \end{array}$$

$$1 \text{ min} = \frac{1}{30} + \frac{1}{20} + \frac{1}{15}$$

$$\frac{2+3+4}{60} = \frac{9}{60} = \frac{3}{20}$$

$$2 \text{ minutes} = \frac{3}{20} \times 2 = \frac{6}{20}$$

1 min A and B full

$$\frac{1}{30} + \frac{1}{20} = \frac{2+3}{60} = \frac{5}{60}$$

$$\text{In 3 minutes} = \frac{5}{60} \times 3 = \frac{15}{60}$$

Fraction of tank when is empty

$$1 - \left( \frac{6}{20} + \frac{15}{60} \right)$$

$$1 - \frac{18+15}{60}$$

$$1 - \frac{33}{60} = \frac{27}{60}$$

$$\begin{array}{l}
 \text{1 min A full } \frac{1}{30} \\
 ? \leftarrow \frac{27}{60}
 \end{array}$$

$$\frac{27}{60} \times \frac{30}{1}$$

$$= 13.5 \text{ minutes}$$

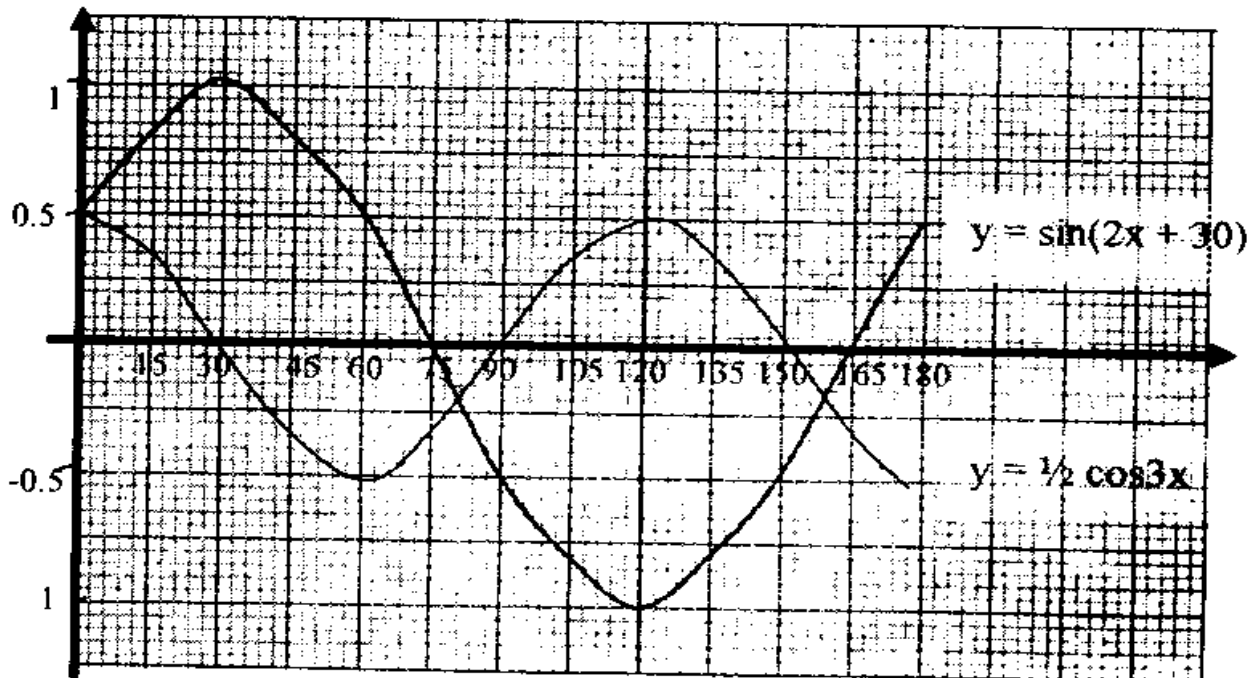


21. (a)

x	0	15	30	45	60	75	90
$\sin(2x+30)$	0.5	0.87	1	0.87	0.5	0	-0.5
$\frac{1}{2}\cos 3x$	0.5	0.35	0	-0.35	-0.5	-0.35	0

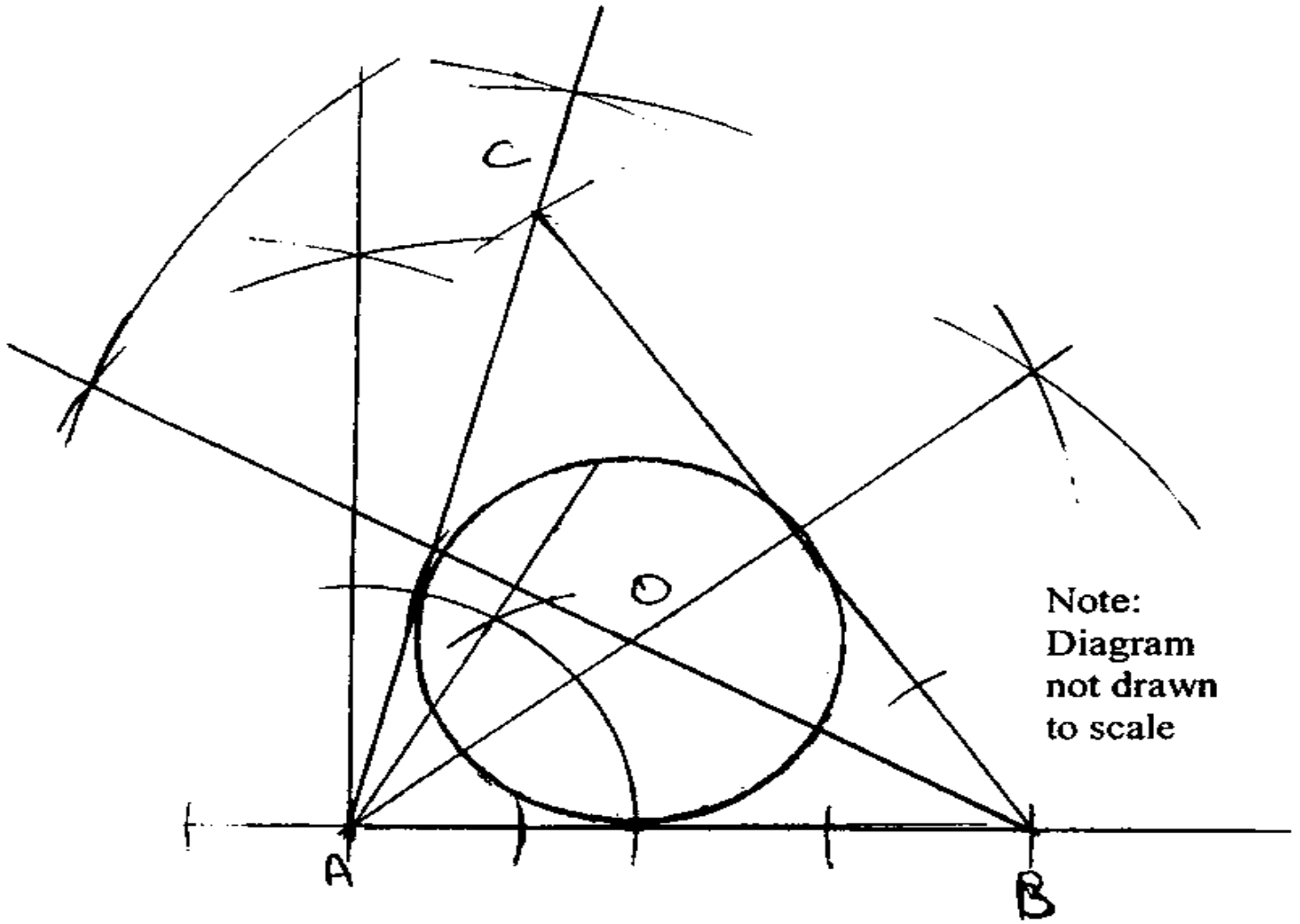
x	105	120	135	150	165	180
$\sin(2x+30)$	-0.87	-1	-0.87	-0.5	0	0.5
$\frac{1}{2}\cos 3x$	0.35	0.5	0.35	0	-0.35	-0.5

(b)



21. (c)  $0^\circ - 81^\circ, 159^\circ - 180^\circ$

22.



$$AC = 7.7 \text{ cm } \pm 1$$

$$\text{Radius } 2.2 \text{ cm } \pm 1$$

$$\begin{aligned} \text{Area of the circle} &= 3.14 \times 2.4 \times 2.4 \\ &= 18.09 \text{ cm}^2 \end{aligned}$$

Area of the triangle

$$A = \sqrt{s(s-a)(s-b)(s-c)}$$

$$\sqrt{13(13-10)(13-9)(13-7)}$$

$$\sqrt{13 \times 3 \times 4 \times 6}$$

$$\sqrt{936}$$

$$= 30.6 \text{ cm}^2$$

$$30.6 - 18.1 = 12.5 \text{ cm}^2$$

23. (i)  $(t + 2)^2$   
 $(t + 2)(t + 2)$   
 $t^2 + 2t + 2t + 4$   
 $t^2 + 4t + 4$

(ii)  $(t + 2)^2 (t + 3)$   
 $(t^2 + 4t + 4)(t + 3)$   
 $t^3 + 3t^2 + 4t^2 + 12t + 4t + 12$   
 $t^3 + 7t^2 + 16t + 12$

(iii)  $\frac{ds}{dt} = 3t^2 + 14t + 16$

(iv)  $3t^2 + 14t + 16 = 0$   
 $-14 \pm \sqrt{14^2 - 4 \times 3 \times 16}$   
 $\frac{-14 \pm \sqrt{196 - 192}}{2 \times 3}$   
 $\frac{-14 \pm \sqrt{4}}{6}$   
 $\frac{-14 \pm 2}{6}$   
 $-\frac{14 - 2}{6} = \frac{-16}{6} = -2\frac{2}{3}$  or  $-\frac{8}{3}$   
 $-\frac{14 + 2}{6} = \frac{-12}{6} = -2$

y.s =  $t^3 + 7t^2 + 16t + 12$

$t = -2 = -8 + 28 - 32 + 12 = 0$

$(-2, 0)$

$(-\frac{8}{3})^3 + 7(-\frac{8}{3})^2 + 16(-\frac{8}{3}) + 12$

$-18.96 + 49.77 - 42.66 + 12$   
 $= 0.15$

$(-\frac{8}{3}, -\frac{3}{20})$

$$\begin{array}{ccc|ccc}
 -3 & -2 & -1 & -3 & -\frac{8}{3} & -2.5 \\
 -ve & 0 & +ve & -ve & 0 & +ve
 \end{array}$$

Both points are at minimum points.

**24. (a)**

$$x + y > 24$$

$$x \geq 6$$

$$2y \geq x$$

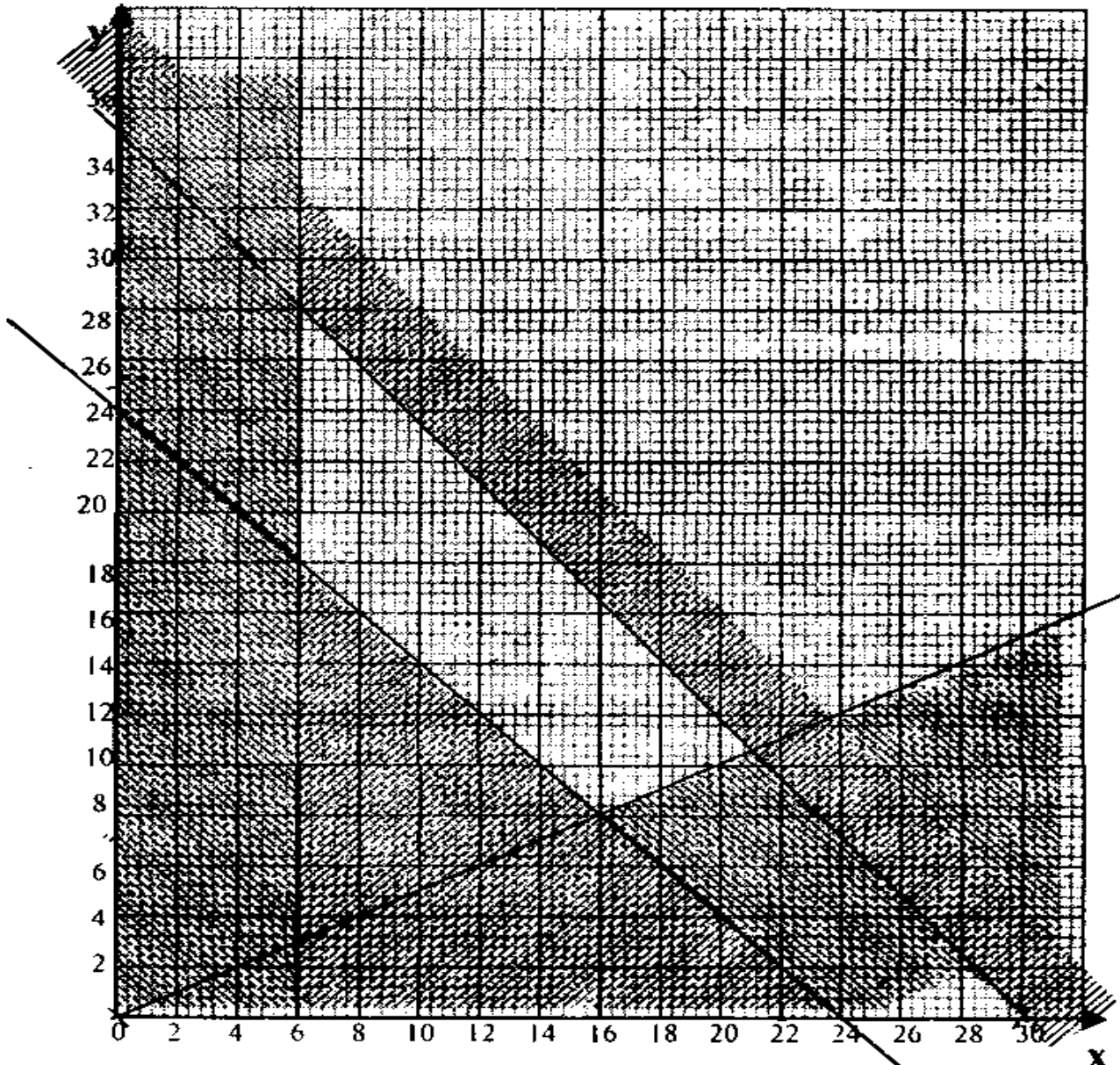
$$5.6x + 4.8y \leq 168$$

$$\Rightarrow 0.7x + 0.6y \leq 21$$

$$\Rightarrow 7x + 6y \leq 210$$

x	12	20
y	12	4

x	30	0
	0	35



(b) 28 oranges, 6 mangoes

# *Motivating TIPS*

**How to get from the grade you are in to the grade you want in sciences and mathematics**

The Six basic principles of success

## **The CPP squared formula of SUCCESS\*      Motiv a **ti**ng                                  **ti**ps**

Karanja .N

This book starts from page 164; it is an extract from *Motivating Mathematics*.

Contents	page
Introduction.....	165
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***If you keep on doing what  
you've always done,***

***You'll keep getting what  
you've always got.***

**Now is the time you change for the better.**

# 1

## INTRODUCTION

**CPP squared formula of success**

As a student, you are the most determining factor in your studies. You determine whether you will pass or fail. The part played by others although important is minimal and depends on your cooperation. In this book I have written about how you affect your results through your attitude and how you can improve your results.

I have talked about *choice* in the second chapter, how you can choose to succeed. I have stressed the point that your conscious choice to succeed is very important. Your life is determined by the many choices you make daily and you cannot runaway from choosing because even refusing to choose is a choice.

There is the chapter on *planning*. Here you are supposed to set up your goals. It is better to know your goal and know how to achieve it. In planning it is better you write down your plan state the goals you want to achieve and how you will achieve them and give yourself a time limit to ensure you don't relax.

There is a chapter on *positive mental attitude* (PMA). Your mental attitude affects the result you will get. Positive mental attitude attracts positive results and negative mental attitude attracts negative results.

Then follows the chapter on *power of concentration*. Here the point is that you should focus on your goals. There are many things, which will distract

you from your goals and reduce your chance of success. Identify the distractions and avoid them.

In the chapter on *practice*, you are supposed to do the actual work, which will bring your success. Read, read and read. Solve mathematical problems daily. Assist others in areas in which you are more conversant.

‘Do not despair, do not stop’ - that is the message on chapter on *power of persistence*. Success comes to those that hustle to the end. The only way to get ahead is to keep moving forward.

All the principles in the book can be summarised in a formula, which I will call **CPP squared formula of success** as explained below.

### CPP squared formula of success [CPP]<sup>2</sup>

The formula is derived from initials of the following words

**C** – Choose – choose success

**P**- Plan – Set goals

**P** – Positive attitude – Have a positive mental attitude

**C** – Concentrate – Concentrate on your goals

**P** – Practice – Practice, work / Take action

**P** – Persistence – Persist to the end, do not despair

The initials above form **CPP.CPP**, which can be written as **(CPP)<sup>2</sup>**

So always, remember the **CPP squared formula of success** and apply it in your studies. Ask your friend

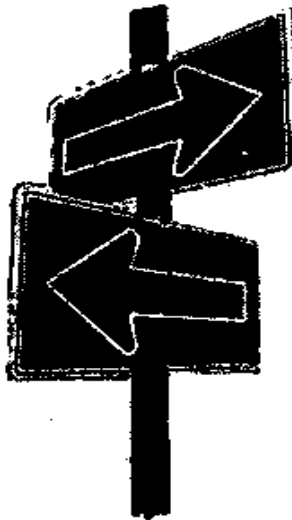


now, "have you heard of CPP squared formula of success?"



## 2

# Power of Choice



**"It is about choices we make. And how the direction of our lives comes down to the choices we choose."**

**Catherine Pulsifer,**

Who chooses whether you will do well in your exams? Is it your teacher? Is it your parents? Is it your school, books, classmates, examiner or you?

Passing exams is actually your choice. When you consciously choose to pass, your body will produce enough energy to enable you to fulfil your mission.

It is you who will actually sit for exams; in fact, it is you who will actually move your fingers to write the answers to the exam. If you have passion in passing, nothing will stop you. Your whole body will cooperate, your brain and memory.

**"Your attitudes and the choices you make today will be your life tomorrow: build it wisely."**

*by Author*

You can choose to pass your exams; you can choose to do better. You can also choose to fail, when you do not choose to pass then you have chosen to fail.

When you choose to pass then you have to do all the necessary things to ensure success.

You control the energy that animates your body. Therefore, after choosing to succeed all the energy in your body will be directed towards your goal.

"Once you make a decision, the universe conspires to make it happen."

*Ralph Waldo Emerson*

"How you react to situations is your personal choice. It is your decision, and yours alone, to determine the importance you give to any situation."

*Catherine Pulsifer,*

We choose our actions. We control our muscles and thoughts, therefore anything you do you choose it.

If you decide to walk, you control the muscle in your legs and you walk. If you decide to read, you look at the letters and your mind interprets what the letters mean.

If you choose not to walk or read, you can do so. When you are told by someone to do something and you do it then you have chosen to obey the order, so you can choose to obey the order or not.

You are in control of your action and no one can control you if you don't want to be controlled.

We choose our actions and influence the consequences of our actions.

When a farmer plants maize seed and offer the maize plant all the necessary care it require, he is likely to get a good harvest.

The action of the farmer was planting maize seed and caring for the plant and the consequence of the farmer's action is a good harvest.

We choose our action and influence the consequence, some times the consequence may not be favourable for example the maize may be stolen just before the harvest , rain may fail, maize pest and diseases may strike, excessive rain may rain and wash away the plants.

A good farmer act in a way that success will favour him e.g. he may water his plants, apply pesticides select best seeds, guard the plants against excess rain and fence the garden to keep out thieves.

Are you taking necessary actions to enable success to favour you? Or you are a farmer who does not sow but expect to harvest.

**"The two important things I did learn were that you are as powerful and strong as you allow yourself to be, and that the most difficult part of any endeavour is taking the first step, making the first decision."**

*Robyn Davidson*

There is a saying, which says, "you can take a camel to the river but you cannot force it to drink water". A camel, which is thirsty, will get its way to the river.

The same case would apply to you. Others may try to do everything to make you succeed in your studies but if you are not willing, success won't be realized.

You should be willing consciously. If you are not doing everything, possible to make it happen it seems you are not willing. If you are giving excuses for your failure, it

seems you are not willing. A person who is willing with the whole heart will use all the resources he has to succeed. You have many resources. Time, teachers, books, intelligence, brain, eyes, hands, pen, the list is endless.

"We can try to avoid making choices by doing nothing, but even that is a decision."

*Gary Collins*

"We know what happens to people who stay in the middle of the road. They get run over."

*Aneurin Bevan*

Knowledge of what is possible is the beginning of happiness.

You have the power to choose, the power to choose good over evil, to choose joy over sorrow to choose prosperity over failure. You can choose to pass your exams or you can allow circumstances to choose for you.

You have free will. Realize that the power to control comes from the power to choose, **choose success now**.

When you choose to work hard, when you choose to succeed and exert necessary effort you will obviously succeed. You will be different from a student who only takes up space in a classroom without any plan whatsoever.

You are responsible for **you**. Your mother and father can't make you pass. Your teachers can't make you pass. They won't sit for the exam for you. You must make **you** pass.

Get started, decide, choose to pass have faith, make a plan on how to study now, then follow the plan and persist,

"In any moment of decision, the best thing you can do is the right thing, the next best thing is the wrong thing, and the worst thing you can do is nothing."

*Theodore Roosevelt*

"It's in your moments of decision that your destiny is shaped."

*Anthony Robbins*

Choose to be positive about your education. If you are among the whining and miserable negative type who mourn, "I can't understand this subject" "maths is hard" "this topic is tough" if you fall in that group this is the time for you to make your attitude positive towards your studies.

Don't anticipate being successful in two months or two years. Be successful now. Right now, you can choose to be a hard worker, you can start facing the topics which previously you found hard with fresh confidence and persist without looking back. Prosperity awaits your choice.

The future starts today, not tomorrow. wake up now. There is an opportunity for you to get the high grade you always dreamt of. Too many students look at the low grades they get and imagine that this is where they must always be. They look at the students who always get high grades and think that they were somehow lucky or blessed.

### **What if you choose not to go for it?**

What if you see it as too much trouble to work harder? You feel you cannot just be bothered. You find it boring, you don't like to spend a lot of time reading books, you don't like to sacrifice for the sake of success.

You see it better just to stay where you are, you blame the teachers, you blame the school, you blame the subject, you blame the parents, you blame the government, and you blame your intelligence.

You find someone or something to blame for your lack of success. Many find comfort in accepting status quo and leading unsuccessful lives. You can tell yourself all that now, and might provide some temporary comfort. But how will you feel in some weeks, months or years to come when you look around and find that the students you know who made different decision, who did take action and who did take control of their future are now reaping the rewards while you remain forever a failure. When you look back at the action you never took, those dreams you abandoned, you will feel the pain of loss.

There is the pain of knowing what you gave up, the pain of knowing that giving up was a choice and that you are responsible for that choice. If that is bad, why willingly subject yourself to another year of inaction. Wake up now and get started, choose success and go for it.

"We all have choices to learn or not to learn. However, with choices come results. You can not expect positive results if we choose to limit ourselves to our existing knowledge."

*Catherine Pulsifer, from Are You Learning*

We become what we become because of the way we choose. Our choices influence our thoughts and our thoughts affect who we are, what we stand for, and what we accomplish in our lives.

Throughout our lives, we are faced with many choices. We are constantly faced with the responsibility of choosing. We cannot escape from this responsibility. Not deciding what to do in a given situation is, in itself, a choice.

Our beliefs about ourselves and our own capabilities and how we the world may determine what we see possible. These beliefs influence our choices.

One of our greatest gifts is our power to **choose**. What choices are you making today? Do you understand the power of choice?

Whatever we choose, whether it be healthy or unhealthy, we will experience the result of that choice.

"It is not our abilities that show who we truly are, it is our choices."

- Albus Dumbledore,  
"Harry Potter"

"We design our lives through the power of choices."

Richard Bach

"You are everything that is, your thoughts, your life, your dreams, come true. You are everything you choose to be. You are as

An awareness of choice is the first step towards growth. It is critical that we understand the importance of our choices. By focusing on our current actions, living in the moment, we develop certain mindfulness and can apply ourselves to do the very best job possible right now! Clarity of mind allows us to recognize the choices at hand and deal with them in a positive and proactive manner. You can create the future you desire based on the choices you make today!



## **Take 100% responsibility for your studies**

You are the person responsible for the results you get in your studies. If you want to be successful you have to take 100% responsibility for your studies.

To improve your results don't blame something outside you for bad results, you should look where the real problem is and that is in you.

If you fail your exams you should know it is you who caused failure in your exams.

You are the one who never revised.

You are the one who did not listen to your teachers.

You are the one who did not set goals.

You are the one who slept very late the night before the exam.

You are the one who never took your studies seriously.

You are the one who never had faith in your abilities.

You are the one who didn't manage your time during the exam.

You are the one who procrastinated.

You are the one who Lost hope.

You are the one who sat for the exam unprepared.

*It is time to stop looking outside your self for answers to why you haven't created the life and results you want for it is you who creates the quality of the life you lead and results you produce. - Jack Canfield*

If you take full responsibility in your studies, you will realise that you create the results you produce whether good or bad. Therefore you can take control of your results in future by doing the necessary to succeed instead of blaming others.

*If something doesn't turn out as planned you will ask yourself 'how did I create that? ..... what did I do or did not do to create that result..... What do I need to do differently next time to get the results I want?' - Jack Canfield*

Now it is time to choose formally. Fill the form below. If you don't fill the spaces then it means you are not serious about success. Seeing your name here will inspire you. If you are reading someone else's book, which is filled, then, get your own copy and fill.

I ..... (Name) choose to be successful in my studies,

I choose to plan how I will succeed.

I choose to have a positive mental attitude towards my studies.

I choose to concentrate on my studies to ensure success.

I choose to be solving ten mathematics problems daily.

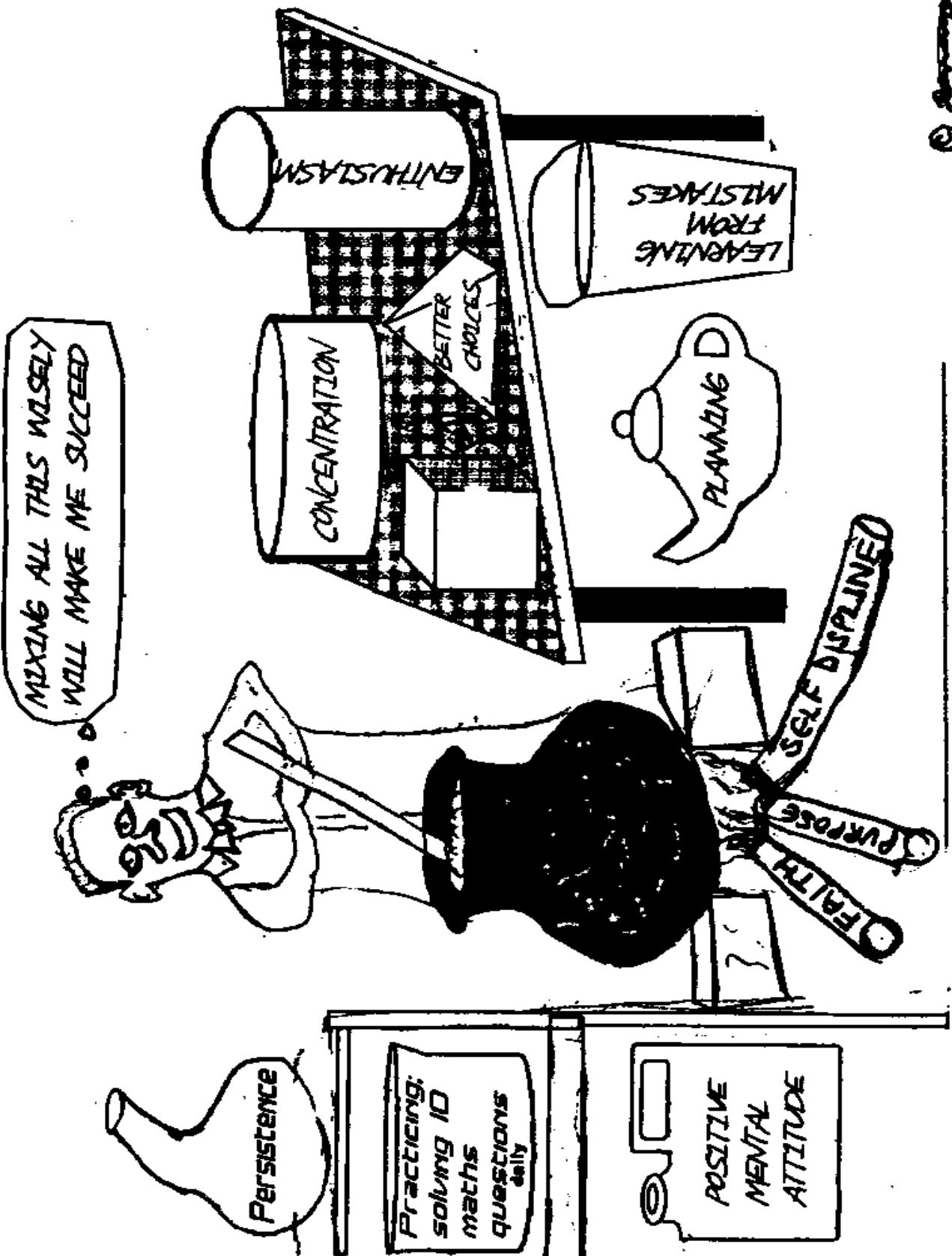
I choose to be persistent to ensure I achieve my goals.

Sign ..... Date .....

Look at this page daily, to remind you of the path you are taking, the path you have chosen.

To end this chapter I urge you to go back to the introduction chapter and read about the CPP squared formula of success to refresh your memory. Let me ask you a question, do you set goals? The next chapter talks of goal setting.

INGREDIENTS FOR SUCCESS



# 3

## Power of Planning

### SET YOUR GOALS

Some students go through school life as a mere routine. One day passes and another one comes without thinking the direction their studies are taking. They are in school because they were taken there. They are just passing time.

They don't set goals and they don't have any vision. Some don't know where they want to go after completing school or what course they would like to take after completing their secondary school education. They don't know what they want to be.

It is good to have a plan. Make conscious decision on the goals you want to achieve and write them down on a notebook and be looking at it daily. An example of the goal can be; I will get grade A in physics/mathematics through working hard daily.

When an architect wants to build a house he starts by visualising the house, he imagines how the house will look like, and then he draws a plan. He can be able to estimate the cost of the house to be made and how long it will take to build the house if all resources are available.

When you want to do well in a certain subject start by visualising the success, see the success in your mind then draw a plan on how to achieve it. State

the time in which you want to achieve it. Use all the resources available to make it successful.

Those students who only wish to pass will not pass but those who will succeed are those who will have burning desire to pass, and those who will plan definite ways to help them succeed and back those plans with persistence.

### **Ways to success**

1. Fix in your mind the exact desire, e.g. grade A.
2. Determine what you intend to do to get the success you desire. E.g. reading, solving 10 mathematics problems per day.
3. Establish a definite date when you intend to possess the success you desire. E.g. by the end of the week, I will complete revising the topic on linear motion.
4. Create a definite plan for carrying out your desire at the beginning (or at once whether you are ready or not).
5. Write out a clear concise statement of the grade you desire, name the time limit. State what you intend to give in return, and describe clearly the plan through which you intend to acquire it.
6. Read your statement twice daily once before retiring at night and once after arising in the morning.

Don't leave success to chance, good fortune and luck, work for it.

There is one quality, which one must possess to win and that is definiteness of purpose, the knowledge of what one wants and a burning desire to possess it. If at first you fail, know that every failure brings with it the seed of an equivalent success.

Remember, no more effort is required to aim high in life, to demand success and prosperity, than is required to accept failure and despondency. I bargained with life for fifty-cents, and life would pay no more.

Perfection will come through practice. It cannot come by merely reading instructions.



**FAILING TO PLAN IS  
PLANNING TO FAIL.**



## OVERCOMING RESISTANCE FOR CHANGE

When starting something new there is always a resistance, it is important that you overcome that resistance. You will find that if for example you start solving ten mathematical questions a day it will be difficult if you have not been doing so. If you start now and go on daily for more than a month you will find it easy. It will become a habit and hard to stop.

When you are starting something start a step at a time. A journey of a thousand miles starts with a single step. The first step is very important. Resistance to change is always there. In the physical world one law of physics, Newton's first law of motion, states that a body will remain at rest unless acted upon by an external force, and a moving body continues moving with the same speed in the same direction unless compelled by some external force to act otherwise.

So for you to overcome inertia there must be a force. When starting, take small steps at a time. Small step will make you progress gradually. If you take a single step it makes it easier to take the second step. Take small steps every day.

The book you are reading was written one word at a time until it was completed; you can build a big house by taking one stone at a time.

Now it is time for you to set goals in the spaces below,

1. State your goals. Example; *I will get grade A in maths*.....  
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2. State what you will do to attain the goals / steps you are going to take. *Example; solving 10 maths questions daily.*

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3. State the date(s) by which you intend to have achieved your specific goals. *Example; I will have finished revising all the mathematics topics by noon of 25<sup>th</sup> April 2006*

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4. Create a plan. *Example; your private timetable geared to achieving your goals.*

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5. Read this statement twice daily, in the morning and before retiring at night.

To end this chapter I urge you **not** to leave the spaces above empty. After filling the spaces, remind yourself about the **CPP squared formula of success** .

Let me ask you a question, how does the attitude affect the results you get from your action? The next chapter talks of **positive mental attitude**.

## 4

# Power of Positive Attitude

Attitudes originate from thoughts. Therefore, by changing your thoughts you can change your attitude. Positive mental attitude attracts positive results. If you create thoughts that focus on getting good outcome in your exams, you are likely to act in a way that will ensure the success you desire.

Have faith in your ability to succeed and eliminate all negative thoughts.

## Eliminating wrong ideas / misconceptions

There are wrong ideas, which may prevent you from advancing. Wrong ideas can prevent advancement. Long ago people in a certain Island thought there was no land beyond the seawater that surrounded their Island. This idea prevented them from exploring. ‘What is the need of making a boat and there is no earth beyond this sea?’ They would argue.

First, you should identify the wrong ideas which you have.

Some may be having wrong ideas like

- Mathematics and sciences are hard.
- sciences are for boys
- Am not intelligent enough to tackle this subject
- I don't have enough time for tackling all the subjects
- I do not have enough books for reference.
- The school failed me.

## **Puppies' story**

A man had two young beautiful and playful puppies named Chui and Simba. Some afternoons he would allow them to play on a small field behind his house. One day as his puppies were playing it started raining. As the rain increased, Chui went under a small roof, which was in the field to take shelter, and slept soundly.

Simba was left in the open field and never took any step to go to the shelter. As the rain became heavier Simba didn't move but started whining. He felt helpless and sorry for himself.

He sat there blaming the rain and he perceived himself as a victim of the rain.

The owner looked at Simba and said 'how foolish Simba is he can't move just two metres to take shelter'

There are students who accept failure; they don't take any action to move to success, they are more or less like Simba in the story. When they fail in tests, they accept the failure: they are voluntary victims who only complain. They enjoy the attention they get from whining.

By repeatedly moaning your fate, you cast yourself as victim, which is self-sabotage. Complainers attract other complainers, as misery loves company.

Playing the victim never solves anything. It only fuels the misery bonfire. It is better you wake up and plan, work, persist and succeed.

"You build on failure. You use it as a stepping stone. Close the door on the past. You don't try to forget the mistakes, but you don't dwell on it. You don't let it have any of your energy, or any of your time, or any of your space."

*Johnny Cash*

## Curing helplessness

If you try something and you fail, you try again and you fail, you try several times each time failing.

You may feel that

whatever you do you can't

succeed. In other words you become helpless about the situation.

"Success is going from failure to failure without losing your enthusiasm."

*Winston Churchill*

Helplessness is the opposite of power. Many students are stuck in helplessness and hopelessness when they fail tests several times and tend to think they can't improve their situation.

Helplessness can cause lack of motivation, negative emotions like anxiety and frustrations. It can also make you fail to recognize the link between your actions and the consequences they bring about. You can start blaming external factors for your situation.

Helplessness can be a pernicious trap. If you are helpless you also tend to be helpless about your helplessness.

Helplessness is learned so you can unlearn it. If always you get wrong results change the way you do things.

If you do what you always do, you will always get the same results, first change your attitude, think positively.

If you have not been taking your studies seriously, then change that. If you have not been keen when the teacher is teaching start being attentive. If you have not been solving physics, chemistry or mathematics calculations on your own then start today.



**Be optimistic**

There is an old story about a glass filled to the midpoint. An optimist sees it as being half-full. The pessimist thinks that it is half-empty.

Experiments show that optimists do much better in school, optimists believe defeat is just a temporary

setback, when confronted by a bad situation, they perceive it as a challenge and try harder, on the other hand, pessimists tend to believe bad events will last a long time and undermine everything they do.

You can learn to be optimistic. When you fail a test in class, see that as a temporary setback and work harder to improve your situation.

Practice reacting positively. Believe that every scar can be turned into a star, positive thoughts produce positive results. A negative thought always produces negative results.

Believe that anything is possible. You can improve your future if you set clear goals. Devote more time to achieve those goals. Work harder than you have worked before

You may not achieve your goal overnight, start by taking small steps at first but never lose sight of the result you want. You can shape your future until eventually; the outcome will be the success you wanted.

## Tom's story

Tom lived in a rural area; he would wake up early, milk the cows, cut grass for the cows for the day before taking a cup of tea. Then he would walk ten kilometres to school. In school, there weren't enough teachers and to make the matter worse there was frequent transfer of teachers. Therefore, he would see several faces in a year.

The classrooms had no windows and doors. The textbooks were few and old and the lab was not well equipped.

He would stay in school the whole day without lunch. His classmates were not much interested in studies, His school performed poorly in national exams. His home had no electricity and the kerosene lamp could not be used since there was no kerosene.

He could not afford candles. In the evening, he would study by the wood fire, but there was shortage of firewood. Therefore, he would be forced to read only before darkness fell.

Tom realised that he had potential despite all these problems. He did not think in terms of scarcity of resources. He thought in terms of abundance of resources. He realised he had so many resources; his body energy, his brain, his eyes, His books, his hands, the daylight, his teachers, his intelligence and many others.

Tom had a positive mental attitude. He planned how he will tackle his studies in the situation he was in and followed the plan faithfully. In the end Tom passed with flying colours.

## **Abundance versus scarcity**

Think in terms of hope not despair; think in terms of abundance not scarcity. Tom in the preceding story saw abundance of resources where many would see scarcity. He saw possibilities where many would see limitations and impossibilities.

Think about possibilities not limitations, never think in terms of scarcity. One who thinks in terms of scarcity will say 'what is the need of studying hard while only a small number will go to colleges. In fact if all of us pass we can never be accommodated in the colleges'.

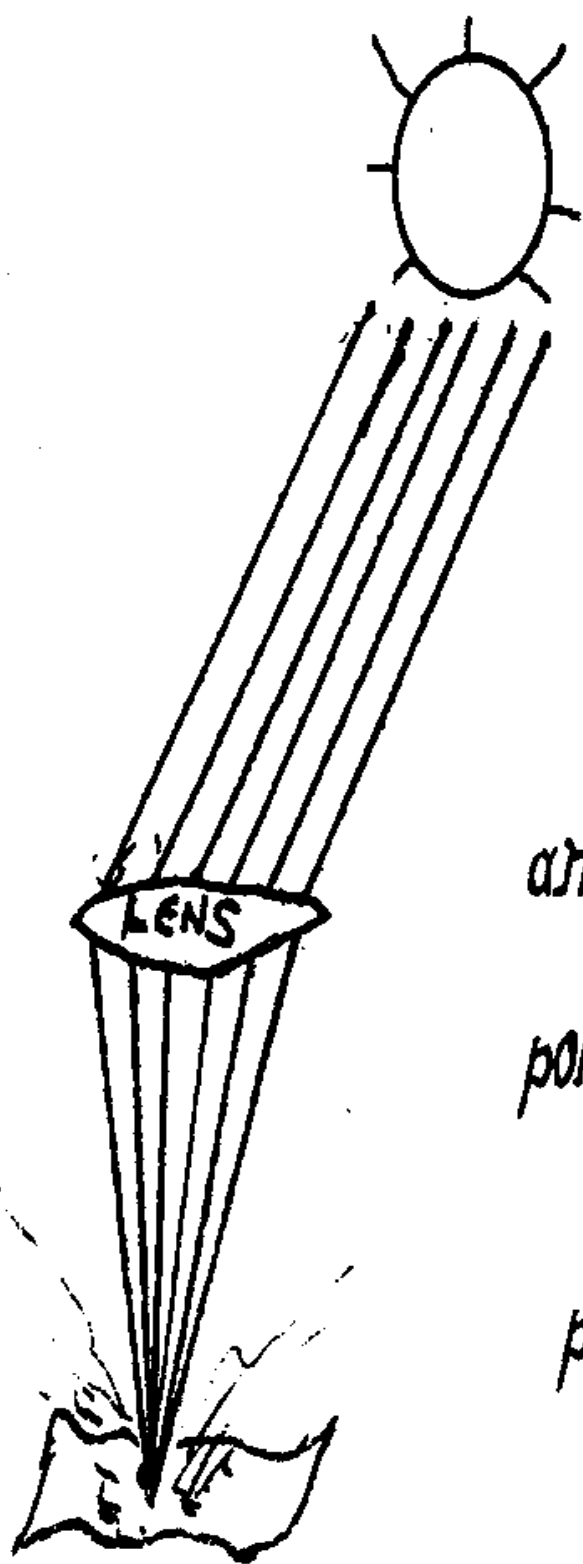
One who thinks in terms of abundance will say 'there will be enough resources for every body'.

Desire is the starting point of all achievement. You should have a strong desire not merely a hope or a wish. It should be a keen pulsating desire, which transcends everything else, it should be definite, if you do this, your desire will be translated into reality. - Napoleon Hill

Everything can be taken from a man but ... the last of the human freedoms - to choose one's attitude in any given set of circumstances, to choose one's own way. Viktor Frankl

The greatest discovery of our generation is that human beings can alter their lives by altering their attitudes of mind. As you think, so shall you be. William James





A magnifying glass  
burns a piece of paper  
when sunrays are  
focussed through it  
and concentrated to one  
point; this illustrates the  
power of concentration

## 5

# Power of Concentration

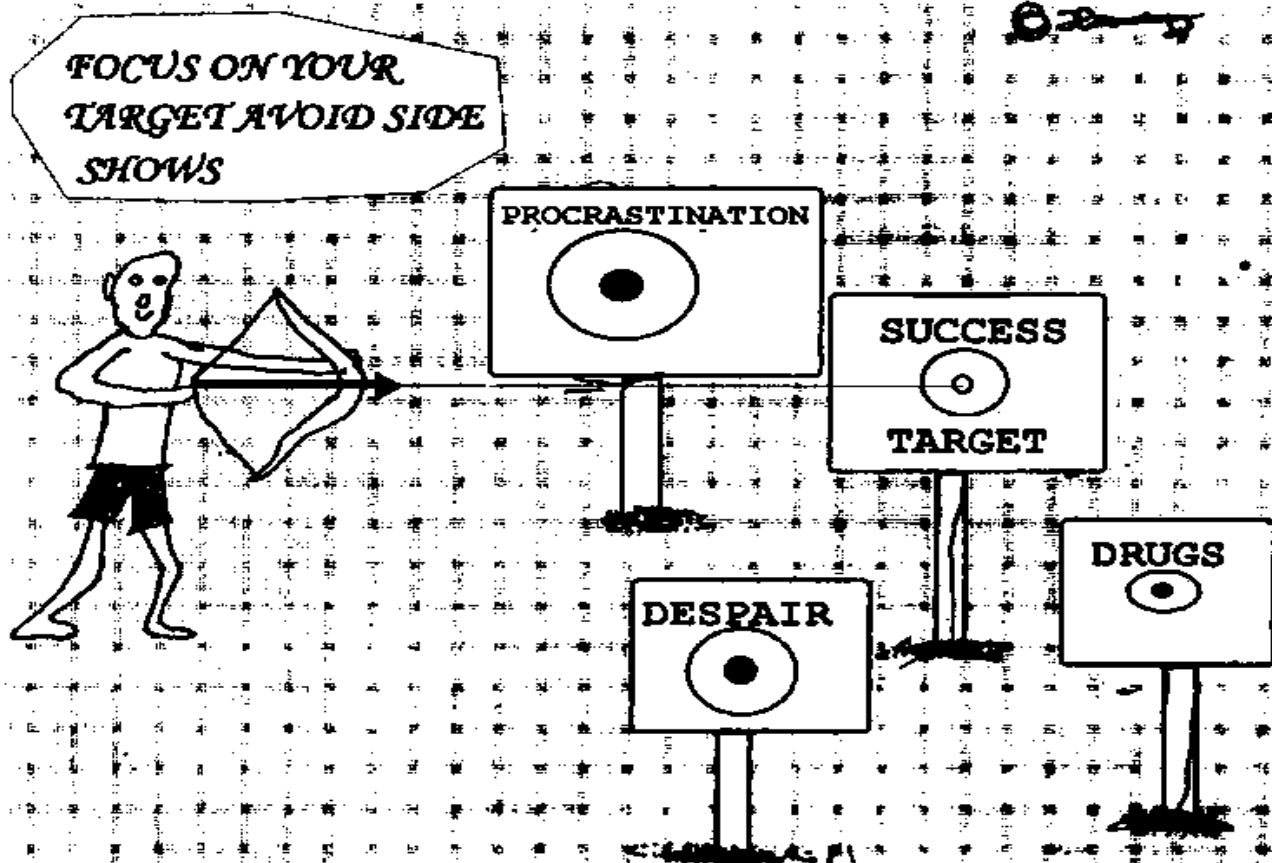
Concentration can be described as having a one pointed mind focused attention, or the ability to pay attention to one single thought or subject to the exclusion of everything else.

A magnifying glass (convex lens) can burn a piece of paper when the rays of the sun are focussed through it. The fire starts only when the rays are concentrated to a small point. When the magnifying glass is moved far away or too close, the rays are not focused and nothing happens

When our mind is focussed, we do not dissipate our energy on unnecessary activities. Developing concentration is essential to any one who aspires to take charge of his life. It is required in order to succeed in all occupations, without it our efforts are dissipated, with it we can accomplish a great deal.

"Do not look where you fell, but where you slipped."  
*African Proverb*

Concentration has many uses. Concentrating on your activities makes you perform them better, faster and successfully. Focussing on work makes it more efficient. A better concentration makes studying easier, understanding faster and improves the memory. It helps us to focus on our goals and achieve them more easily.



### Concentration problem

Let us say you are at home and you want to study. You sit comfortably on the chair with the book in your hands and you start reading. After a while, you feel thirsty and you go to drink some water. You return to read and hear some people talk outside, you listen to them for several minutes and then get your attention back to the book.

"Many of life's failures are people who did not realize how close they were to success when they gave up."  
*Thomas Edison*

After a short time, you remember something that happened last Friday and you start thinking about it. You continue reading and after several minutes, you feel restless and move out of the house for a moment.

You come back and continue reading. You then switch on the radio, by this time one and a half hours

have gone and you have not read anything. This is what happens when concentration is not strong enough to ward off all disturbances.

## Cultivate concentration

"It's not whether you get knocked down. It's whether you get up again."  
*Vince Lombardi*

Concentration is greatly worth cultivation. You can practice concentration everyday and gain control over your mind. Concentration ability increases through practice

Concentration can be fun if approached in the right way. It should be practiced with joy, fun, optimism and understanding of its great possibilities. It has to be approached in a positive manner and then success arises. When you are studying and then some thoughts disrupt you, put the thoughts aside and continue with your studies. Practice this always.

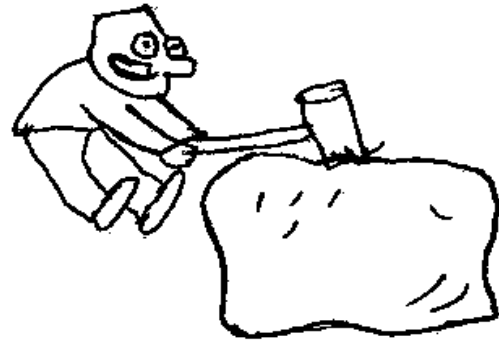
"Fall seven times,  
Stand up eight."  
*Japanese Proverb*

When you are reading concentrate on what you are reading. Don't think about the results at that time. Don't worry whether you are going to pass or not. Don't worry about other things when you concentrate on the work at hand. The results will be positive.

"I never could have done what I have done without the habits of punctuality, order, and diligence, without the determination to concentrate myself on one subject at a time."

**If at first you don't succeed try, try and try again**

**For 99th time**



**For 347th time**



**I have cracked it so you can.**

**Persistence pays**

# 6

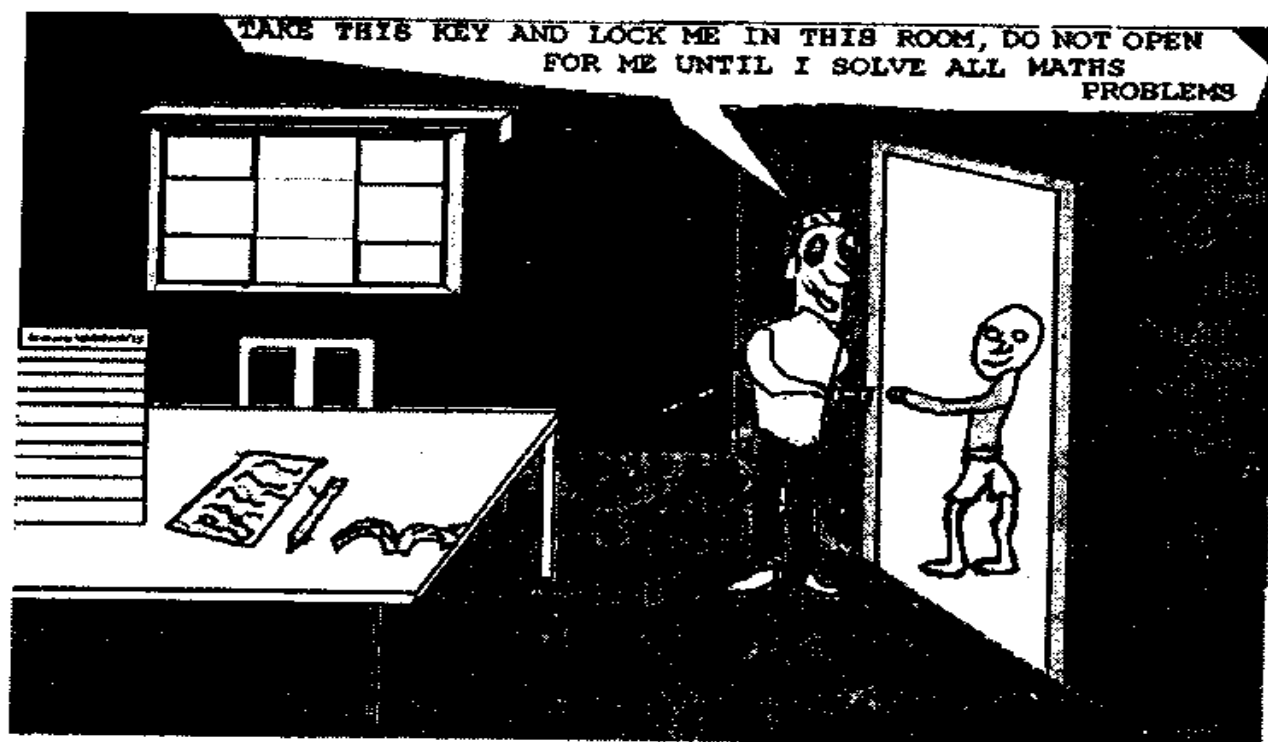
## Power of Practice

Be the best you can be in the 'NOW'. It does not take a rocket engineer to figure out the formula for success the formula is common sense.

Every one knows what is to be done but fails to do so, every one knows you require to practice regularly to pass exams, but many don't.

When you do not prepare early you may be inviting problems during exams. Lack of preparation may cause stress and anxiety when exam nears and during exams. When a person is stressed his subconscious mind experiences a threat, adrenalin is released to the blood.

A lot of energy is diverted to the muscles and the heart. This denies energy to the brain and now you cannot think well. You became nervous, restless, your vision may also be affected and you may see blurred images.



### Jomo's story

Jomo was a form three student who used to get low marks in chemistry. He was not happy about it. There is one topic he could not understand; 'mole concept'. During the April holiday he got determined to study the topic, but he was not able, he could not concentrate.

One morning he took his notebook and chemistry course book, he also had ten questions involving mole concept calculations. He gave the answers to the questions to his younger brother Saul, together with the key to his room and told him,

'Lock me in this room open for me only if I get the correct answers to all the questions. Make sure I have the right answers before you open'

Saul locked Jomo in the room immediately. Jomo sat on the chair and started studying seriously.

After ten minutes he called out "Saul open for me". Saul came near the window and asked 'do you have the answers to the questions'

Jomo didn't have the answers so Saul didn't open. Fifteen minutes later Jomo called out again but still did not have the answers. Saul refused to open. Jomo pleaded saying he wanted to go to the toilet but Saul said 'you told me to open only when you have the right answers'

Jomo went back to work and after 30 minutes he came back with answers and showed Saul through the window. Seven of the answers were correct but three were wrong. Saul refused to open. "Not all the answers are correct, all of them must be correct".

Jomo became angry and threatened Saul 'if you don't open you will regret when I come out of here'

Saul did not open so Jomo went back to work. After he had spent six hours, he still had one correct answer. By this time he was angry and hungry. He pleaded to Saul to open the door but Saul replied 'you have to get all the answers correct so you still have to go back to work'

Jomo had to spend three more hours to get the last question correct. He had stayed in that room the whole day. When Saul opened for him, he was a changed person. He had studied the topic, (which he always found difficult) together with four other topics. The reason why he took long to solve the last question was that the last question required knowledge from four other topics



*Desire is the beginning of  
all achievements.*

## **Discussion groups**

Some people like to do things in groups. You can form discussion groups with one or several students who have a similar purpose.

In the group you can discuss topics in different subjects, you can discuss questions in various subjects, you can discuss points raised in this book.

Some students are good in certain subjects but not others. In a discussion group, you can assist each other, if you understand a certain topic well for example in physics you can teach John. Then John will teach you biology.

When you teach someone, you increase your mastery of the subject, so it is to your advantage also. Let others experience what you have learned.

There is plenty for everyone.

They will thank you.

## **Improve yourself and help others.**

When you practice principles in this book, you will become successful. You will for example be able to solve mathematical problems. If others ask for your assistance, assist them.

By assisting other students by showing them what you know e.g. solving mathematical problems you will gain more as you become better.

When you are showing them how to solve problems, you are practising at the same time and you are improving your skills in problem solving.

So don't hesitate to assist others. You will improve your memory and be able to recall the formulas and how to apply them

## **Forget it if.....**

If you are not going to work hard, forget success.  
If you are lazy and go to school hoping to do as little as possible, forget it.

If you keep company with negative whiners, forget it.

If you are not focused on what you can get for yourself, forget it.

If you can't let go of the past, forget it.

You've got to be self-reliant and able to think for yourself. You've got to be able to see for yourself. You've got to believe in yourself and your special talent to better your world  
Additionally, seek opportunities to help others and become a mentor to others. You will learn by teaching others what you know.

Always keep learning and improving. What is it going to take to increase the success of your studies? Or, what is it going to take for you to get the grade you dream of? And, when? Find out. Study. Challenge yourself.

## Move out of your comfort zones

To some people comfort zones may be avoiding situations where hard work is required, avoiding trying something new and laziness. For success to be realized you must move from your comfort zones.

The status quo, which means "things as they are" has a tremendously strong pull. Habits are hard to change. Sometimes, it is painful to change. You may make a change and have to change again and once again. You may well feel discouraged. As you stumble along during the early stage of the learning/experimenting process. You will feel the pull drawing you, tempting you back to your old ways.

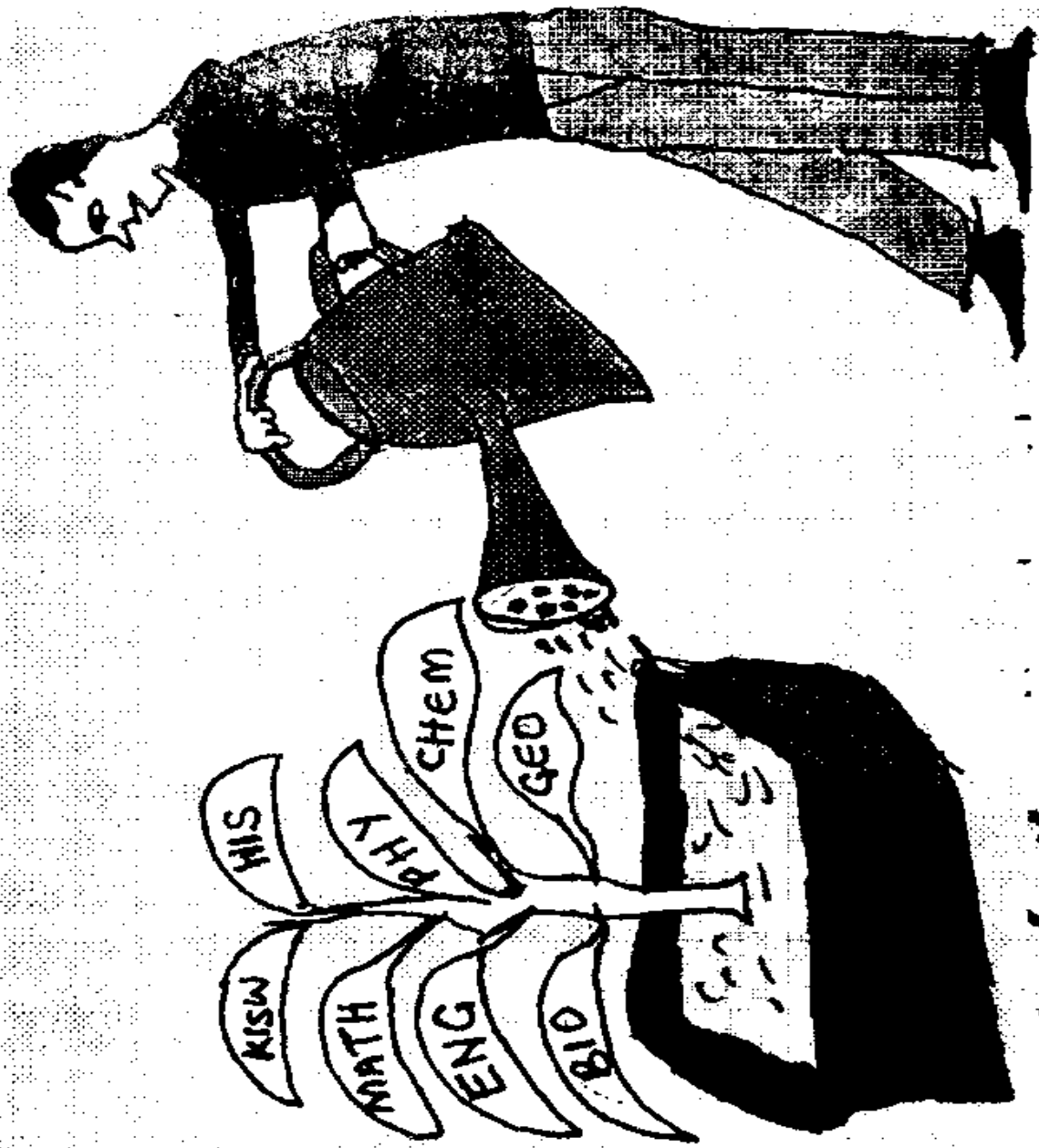
Be a person of action and become a success. So, decide. This is your life. This is your one life.

If you decide not to act now, then, when will you?

If you are lazy, you've got a serious problem.

If you can't think for yourself, you've got a serious problem.

Follow the words of former American President James Garfield, "*Ambition by itself never gets anyone anywhere until it forms a partnership with hard work.*"



*Watering your education 'plant' daily, will ensure that it grows strongly.*



# 7

## Power of Persistence

"Perseverance is not a long race; it is many short races one after another."

*Walter Elliott*

Permanence, perseverance and persistence in spite of all obstacles, discouragements, and impossibilities: It is this, that in all things distinguishes the strong soul from the weak."

*Thomas Carlyle*

"Never, never, never, never give up."

*Winston Churchill*

"I am a slow walker, but I never walk backwards."

*Abraham Lincoln*

Persistence is an essential factor in succeeding. The basis of persistence is will power. Persistent people don't give up when they see first sign of opposition. They carry on despite all difficulty, until they attain their goal.

Lack of persistence is one of major causes of failure, and it is a weakness in many people, lack of persistence can be overcome by effort and depend on the intensity of ones desire.

The starting point of all achievements is desire. Strong desire brings better results. Strong desire will keep you persisting. Success is attracted to those whose mind has been deliberately prepared to attract it.

I urge you to,  
Persist in your studies,  
Persist in planning  
Persist in reading  
Persist in concentration  
Persist in positive attitude  
Persist in your desire to succeed.

"Most people give up just when they're about to achieve success. They quit on the one yard line. They give up at the last minute of the game, one foot from a winning touchdown."  
*H. Ross Perot*

## **Mary's story**

Mary had passion for mathematics one day she solved a problem, which the teacher had solved incorrectly.

Mary spent most of her time solving mathematics problems; in fact, mathematics was her breakfast, lunch and dinner. She would wake up very early in the morning and solve several mathematical problems before doing anything else.

Initially she had a problem in solving mathematics problems, but she was lucky because naturally she had the ability to persist. She planned to be solving at least ten problems a day and it became a habit.

It came to a time that she had solved all the problems in the course book, she could tell you which questions in the book never worked out to answers. She

always searched for books to keep practising. She could read even the topics not yet covered in class.

One day the teacher came to class, introduced a new topic, and showed several examples. Mary raised her hand and asked the teacher to repeat the solution to the question he had just solved. The teacher repeated.

Mary raised the hand again and said that the answer was wrong. The teacher asked why? Mary explained why but the teacher maintained that his answer was right. However, Mary maintained the answer was wrong.

The teacher told Mary to solve the question on the blackboard. Mary solved the question step by step on the board as the teacher and other students listened attentively. When Mary completed the teacher realised that Mary was right, and told her she was right.

Due to human error, the teacher had not noticed a trick in the question. At that moment, the teacher went in the office to confirm something from the other teachers. As he was moving out, he felt as if he had been whipped. He had never been whipped that way in his twenty-year teaching career.

He came back after ten minutes, and continued teaching. He urged other students to be like Mary, to work hard and to be attentive in class.

The moral of the story is not that the teacher didn't do the work well; the moral is that Mary's passion, desire, practice and persistence were bearing fruits.

The story shows that what you can achieve through practice and persistence is very great; it is beyond your imagination.

## **Train yourself to be persistent**

Persistence is a state of mind. Any state of mind can be cultivated. In your pursuit to be persistent do the following

- Have a definite purpose, know what you want, e.g. getting grade A in maths
- Have an intense desire to fulfil your purpose.
- Have organised plans to fulfil your purpose e.g. solving at least ten mathematical problems daily
- Cooperate with others who have similar purpose e.g. forming a discussion group
- Have the habit to concentrate your thoughts upon attaining the purpose all the time. There are many things, which will tend to divert your attention.
- Build a habit of doing what will make you successful e.g. reading, using questions to help you revise, and asking questions where you do not understand. Remember the mind absorbs and becomes part of the daily experiences upon which it feeds.
- Avoid all negative and discouraging influences including negative suggestions from friends. Not all people would like you succeed.

## **Avoid the following**

- procrastination – Delaying starting something, saying you will start on it tomorrow
- Lack of interest in your studies.



- The habit of blaming others for your mistakes and your low grades in your exams
- Failure to recognize and define what you really want.
- Indecision.
- Weakness in desire
- Inaction- failing to act to improve your situation.
- Short-cuts, looking for success through unfair means, e.g. copying homework from friends instead of doing it yourself and cheating in exams.

Be patient and persistent concentrate on your major goal until you achieve it.

## **Motivational quotes**

"A jug fills drop by drop."

*Buddha*

"Life is not easy for any of us. We must have perseverance and above all confidence in ourselves. We must believe that we are gifted for something and that this thing must be attained."

*Marie Curie*

"If you want to get somewhere you have to know where you want to go and how to get there. Then never, never, never give up."

*Norman Vincent Peale*

**"Develop success from failures. Discouragement and failure are two of the surest stepping stones to success."**

*Dale Carnegie*

**"Our energy is in proportion to the resistance it meets. We attempt nothing great but from a sense of the difficulties we have to encounter, we persevere in nothing great but from a pride in overcoming them."**

*William Hazlitt*

**"Being able to see the end result, rather than just the task, eliminates obstacles, focuses your energy, and provides motivation to excel."**

*Catherine Pulsifer, from the Motivational Thought, THREE BRICKLAYERS*

**"First we form habits then they form us. Conquer your bad habits, or they'll eventually conquer you."**

*Dr. Rob Gilbert*

**"Habit, if not resisted, soon becomes necessity."**

*St. Augustine*

**"Habits are cobwebs at first; cables at last."**

*Chinese Proverb*

**"Sow an act and you reap a habit.  
Sow a habit and you reap a character.  
Sow a character and you reap a destiny."**

*Charles Reade*

**"Ninety-nine percent of failures come from people who have the habit of making excuses."**

*George W. Carver*

"Take control of your destiny. Believe in yourself. Ignore those who try to discourage you. Avoid negative sources, people, places, things and habits. Don't give up and don't give in."

*Wanda Carter*

"A speculator is a man who observes the future, and acts before it occurs."

*Bernard Baruch*

"The majority of men meet with failure because of their lack of persistence in creating new plans to take the place of those which fail."

*Napoleon Hill*

"It is no sin to attempt and fail. The only sin is not to make the attempt."

*SueEllen Fried*