CSSC 2025
SECONDARY SCHOOL
BASIC MATHEMATICS

1. (a) Student Population:

In 1998, the student population was 600, which was a 25% increase from 1997.
Let the number of students in 1997 be x:
x + 25% of x = 600 → x(1 + 0.25) = 600 → x = 600 / 1.25 = 480
So, population in 1997 = 480
In 1999, population dropped by 10% → 600 - 10% of 600 = 540
In 2000, population increased by 20% → 540 + 20% of 540 = 648
Answer:
(i) Year 1997: 480 students
(ii) Year 2000: 648 students

1. (b) Worker's Monthly Saving:

Salary = 250,000
Fuel = 1/5 of salary = 250,000 × 1/5 = 50,000
Remaining = 250,000 - 50,000 = 200,000
Food = 1/2 of 200,000 = 100,000
Remaining = 100,000
Miscellaneous = 1/2 of 100,000 = 50,000

(i) Remaining/Saving = 50,000
Answer: Monthly saving = 50,000

(ii) This is a rational number because it can be expressed as a fraction: 50,000 = $\frac{50{,}000}{1}$

Front bulbs (2): 2 × 4.328 = 8.656 W
Rear bulbs (2): 2 × 3.432 = 6.864 W
License bulb (1): 5.634 W
Total = 8.656 + 6.864 + 5.634 = 21.154 W
Rounded to 3 significant figures: 21.2 W
Answer: 21.2 W correct to 3 S.F

2. (a) (i) Exponents

$$\left(\frac{1}{9}\right)^{2x}\left(\frac{1}{3}\right)^{-x} \div \frac{1}{27} - \left(\frac{1}{243}\right)^{x} = 0$$

$$\left(\frac{1}{9}\right)^{2x}\left(\frac{1}{3}\right)^{-x} \times \frac{27}{1} - \left(\frac{1}{243}\right)^{x} = 0$$

Using 3 as a base for each term

$\left(\frac{1}{3^2}\right)^{2x}\left(\frac{1}{3}\right)^{-x} \times \frac{3^3}{1} - \left(\frac{1}{3^5}\right)^{x} = 0$

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

$(3^{-2})^{2x}(3^{-1})^{-x}(3)^3 = (3)^{-5x}$

$(3)^{-4x+x+3} = (3)^{-5x}$

$(3)^{-3x+3} = (3)^{-5x}$

Since bases are equal, exponents are equal too

$-3x + 3 = -5x$

$5x - 3x = -3$

$2x = -3$

Answer: $x = \frac{-3}{2}$

(ii)Logarithims:

Given, $\log_x 8 - \log_9 3 = 1$

Simplify, $\log_9 3 = \frac{\log 3}{\log 9} = \frac{\log 3}{\log 3^2} = \frac{\log 3}{2\log 3} = \frac{1}{2}$

Therefore, $\log_x 8 - \log_9 3 = \log_x 8 - \frac{1}{2} = 1$

$\log_x 8 = \frac{3}{2}$

Also, Simplify $\log_x 8 = \frac{\log 8}{\log x} = \frac{\log 2^3}{\log x} = \frac{3\log 2}{\log x}$

Therefore, $\frac{3\log 2}{\log x} = \frac{3}{2}$

$3lox = 6log2$

$logx = 2lo2$

$logx = log4$

Answer: $x = 4$

2. (b) Radicals

Given the expression $\frac{2}{2+2\sqrt{3}}$

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

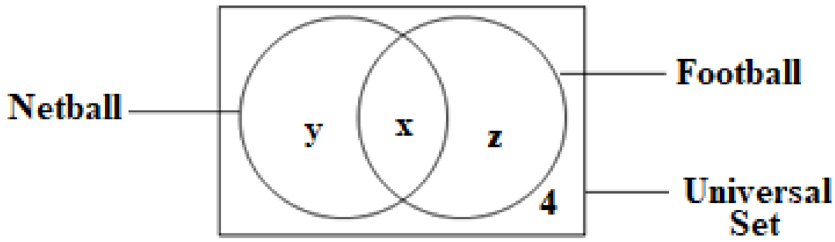
The square is $\left(\frac{1}{1+\sqrt{3}}\right)^2 = \frac{1}{4+2\sqrt{3}}$

Rationalize the denominator of $\frac{1}{4+2\sqrt{3}}$

It gives, $\frac{1}{4+2\sqrt{3}} = \frac{2-\sqrt{3}}{2} = 1 - \frac{\sqrt{3}}{2}$

3. (a) Sets

Using Venn Diagrams (or any alternative)



Let $x =$ Number of students who like both
$y =$ Number of students who like Netball only
$z =$ Number of students who like Football only

Equations:

$$x + y + z + 4 = 40$$

$$x + y + z = 36 \ldots\ldots\ldots\ldots\ldots\ldots\ldots (i)$$

$$x = 3y \ldots\ldots\ldots\ldots\ldots (ii)$$

$$z = 6 + 2y \ldots\ldots\ldots (iii)$$

Substitute (ii) *and* (iii) into (i)

To get, $(3y) + y + (6 + 2y) = 36$

$$6y + 6 = 36$$

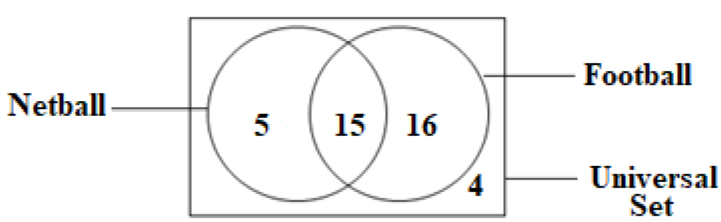
$$6y = 36 - 6 = 30$$

$$y = 5$$

$$x = 3y, \qquad x = 15.$$

$$z = 6 + 2y = 6 + 2(5) = 16$$

A complete Venn Diagram



The number of students who like football only = 16 students

3. (b) Probability

Step 1. Total number of students:
8 girls + 12 boys = 20 students

Step 2. Let:
B = event that the student is a boy = 12
S = event that the student plays sports = 5 (girls) + 8 (boys) = 13

Step 3. $B \cap S$ = event that the student is a boy and plays sports = 8

Step 4 Substituting values:
P(B) = 12/20
P(S) = 13/20
$P(B \cap S) = 8/20$

Step 5 Therefore:
$P(B \cup S) = 12/20 + 13/20 - 8/20 = 17/20$

Therefore,

The probability that a randomly selected student is either a boy or plays sports is sevent $\frac{17}{20}$.

4. (a) Equation of a Perpendicular Line

1. The line cuts the x-axis at (-3, 0) and the y-axis at (0, 5).

2. Calculate the slope (m) of the line through (-3, 0) and (0, 5):
   m = (5 - 0) / (0 - (-3)) = 5 / 3

3. The slope of a line perpendicular to another is the negative reciprocal.
   So, perpendicular slope = -3/5

4. Use the point-slope form of a line equation:
   y - y1 = m(x - x1)

   Here, (x1, y1) = (2, 3) and m = -3/5

   y - 3 = -3/5(x - 2)

5. Expand and simplify we get final answer
   Final Answer:
   The equation of the required line is $3x + 5y = 21$

4. (b) Displacement Problem Solution

First Movement:
- 400 meters in direction S45°E (i.e., 45° east of south).
- Resolving into components:
  $x_1 = 400\sin(45°) \approx 400\times0.7071 = 282.84$ m (east)
  $y_1 = -400\cos(45°) \approx -400\times0.7071 = -282.84$ m (south)

Second Movement:
- 100 meters due west:
  $x_2 = -100$ m (west), $y_2 = 0$ m

Total Displacement Vector:
$x\_total = 282.84 - 100 = 182.84$ m
$y\_total = -282.84$ m

Magnitude of Displacement:
$D = \sqrt{(182.84^2 + (-282.84)^2)} \approx \sqrt{(33430.47 + 79996.47)} = \sqrt{113426.94} \approx 336.61$ m

Direction of Displacement:
$\theta = \tan^{-1}(|y/x|) = \tan^{-1}(282.84 / 182.84) \approx \tan^{-1}(1.547) \approx 57.5°$
So direction is S57.5°E

Displacement is approximately 336.6 meters in the direction S57.5°E.

5. (a) Currency Conversion Problem

Problem 1

Two polygons are similar. A side of one is 5cm long. The corresponding side of the other is 1cm long. The area of the first is 100cm². What is the area of the second polygon in square meters?

Solution:

Scale factor (k) = 1 cm / 5 cm = 1/5

Since areas of similar polygons are proportional to the square of their corresponding sides:
$Area_2 = Area_1 \times (k)^2$
$= 100\ cm^2 \times (1/5)^2$
$= 100\ cm^2 \times 1/25$
$= 4\ cm^2$

Convert to square meters:
$Area_2 = 4\ cm^2 \times (1/10000) = 0.0004\ m^2$

Answer:
$0.0004\ m^2$

Problem 2

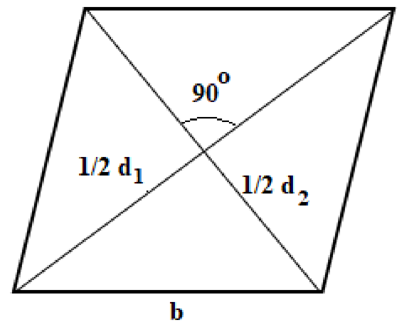
Given that, the area and height of rhombus are $24\ cm^2$ and 4.8 cm respectively

Solution:

Area of rhombus = base × height = bh

Let side length be 'b':

Area = b × height
24 = 4.8b
b = 24 / 4.8 = 5 cm



i) Perimeter = 4b = 4 × 5 = 20 cm

ii) Area = $(d_1 \times d_2) / 2 = 24$ cm²
Also, in a rhombus, $(d_1/2)^2 + (d_2/2)^2 = b^2$

Let:
$d_1 \times d_2 = 12$ (since $24 = \frac{1}{2} \times d_1 \times d_2$)
and
$(d_1/2)^2 + (d_2/2)^2 = (5)^2 = 25$ (Pythagoras Theorem)

This simplifies to:
$d_1^2 + d_2^2 = 4 \times 25 = 100$

Solve for d_1 and d_2 using:
$d_1^2 + d_2^2 = 100$ ……….(i)
$d_1 \times d_2 = 48$ …………(ii)

Solving (i) and (ii) gives $d_1=6$, $d_2=8$

Answer:
i) Perimeter = 20 cm
ii) The diagonals are of length 6 cm and 8 cm.

6. (a) Currency Conversion Problem

Given:

- 120 Sterling Pounds converted at 112 Ksh per pound
- Ksh 1000 spent on accommodation
- ¼ of remainder spent on transport

Solution:

- Total Ksh received: 120 × 112 = 13440 Ksh
- After accommodation: 13440 – 1000 = 12440 Ksh
- Transport: ¼ × 12440 = 3110 Ksh
- Remaining: 12440 – 3110 = 9330 Ksh
- Convert to pounds: 9330 ÷ 112 ≈ **83.3 pounds**

Answer: 83.3 pounds

5. (b) Mixture Ratio Problem

Given:

- Grade A: 6000/kg, Grade B: 4500/kg, Mix Price: 5000/kg

Solution:
(6000−5000): (5000−4500)=1000:500=2:1

(6000 - 5000) : (5000 - 4500) = 1000 : 500 = 2:1

Answer: 2:1 (Grade A : Grade B)

7. (a) Marked Price Problem

Given:

- Cost Price = 12000, Profit 20%, Discount 10%

Solution:
(90/100)×MarkedPrice=12000×1.2(90/100) × Marked Price = 12000 × 1.2
Marked Price = 12000×1.2÷0.9=1600012000 × 1.2 ÷ 0.9 = 16000

Answer: 16000

7. (b) Trading Account Problem

Given:
Opening stock: 34430
Purchases:
Closing stock: 26720
Gross Profit Mark-up: 50%
Expenses: 45880

Solution:
COGS: 34430 + 219290 – 26720 = 227000
Gross Profit = 0.5 × 227000 = 113500
Sales = 227000 + 113500 = 340500
Net Profit = 113500 – 45880 = 67620

Answer:
(i) COGS: 227000
(ii) Sales: 340500
(iii) Net Profit: 67620

8. (a) AP and GP Problem

AP and GP Problem
Given:
If a and d stand for first term and common difference of AP, then:
AP terms: a, a+d, a+3d form GP; sum of 3rd and 5th GP term = 20

Solution:

$(a+d)^2 = a(a+3d) \rightarrow a^2 + 2ad + d^2 = a^2 + 3ad$
$ad = d^2 \rightarrow a = d$
$2a + 6d = 20 \rightarrow 2d + 6d = 20 \rightarrow d = 2.5, a = 2.5$
GP: 2.5, 5, 10, 20

Answer: 2.5, 5, 10, 20

8. (b) Compound Interest Loan Problem

Given: $\mathrm{P} = 2000000, \mathrm{r} = 7\%$, payments=500000 annually.

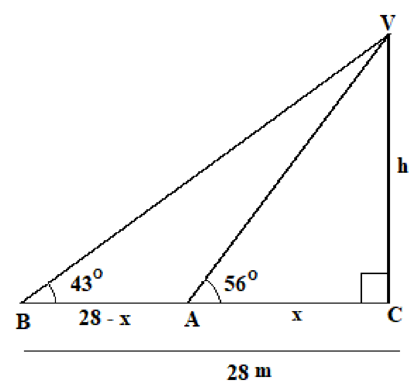
Solution:
Year 1: 2000000×1.07 – 500000 = 1640000
Year 2: 1640000×1.07 – 500000 = 1244800

Answer:

The company owes the bank Tsh 1244800/=

9. (a) Flagstaff Elevation Problem

Using the following Figure
Given: Angle A=56°, B=43°, B is 28m from flagstaff



Trigonometry Equations

$\tan 56° = \frac{h}{x} \quad \rightarrow h = x\tan 56° \ldots\ldots\ldots\ldots\ldots\ldots (i)$

$\tan 43° = \frac{h}{28} \quad \rightarrow h = 28\tan 43° \ldots\ldots\ldots\ldots\ldots\ldots (ii)$

$x\tan 56° = 28\tan 43° = h$

$x = \frac{28\tan 43°}{\tan 56°}, x = 17.6117$

$28 - x = 28 - 17.6117 \approx 10.4$

Answer: $\approx \mathbf{10.4\ m}$

11/9

9. (b) Radicals

b) Given: 3cos A – 4 sin A = 0, and

$\frac{\sin A + 2\cos A}{3\cos A - \sin A} = \frac{\sin A + 2\cos A}{4\sin A - \sin A}$ (since 3cos A =4 sin A)

$= \frac{\sin A + 2\cos A}{3\sin A}$

$= \frac{sinA}{3sinA} + \frac{2cosA}{3sinA} = \frac{1}{3} + \left(\frac{2}{3}\right)\left(\frac{\cos A}{\sin A}\right)$

From, $3\cos A - 4\sin A = 0$

$$3\cos \mathrm{A} = 4\sin \mathrm{A}$$

$$\frac{\cos A}{\sin A} = \frac{4}{3}$$

Therefore, $\frac{1}{3} + \left(\frac{2}{3}\right)\left(\frac{\cos A}{\sin A}\right) = \frac{1}{3} + \left(\frac{2}{3}\right)\left(\frac{4}{3}\right)$

$= \frac{1}{3} + \frac{8}{9}$

$= \frac{3+8}{9}$

$= \frac{11}{9}$

Answer: $\frac{11}{9}$

10. (a) Quadratic Equation

Given: Total cost 3600, cost per mango: x

Phase 1: Number of mangoes bought $= \frac{3600}{x}$

Phase 2: Number of mangoes he could buy $= \frac{3600}{x-50}$ (At this phase, mangoes are 6 more than the 1st one)
Therefore,

Phase 2 − Phase 1 = 6 Mangoes.

$\rightarrow \frac{3600}{x-50} - \frac{3600}{x} = 6$

$\rightarrow 3600x - 3600(x - 50) = 6x(x - 50)$ [Obtained by multiplying it by $x(x - 50)$]

$6x^2 - 300x = 180000$

$x^2 - 50x = 30000$

$x = 200$

Therefore, $\frac{3600}{200} = 18$

Answer: 18 mangoes

10. (b) Algebra

Given: Total 45, Avg=152, Girls=144, Boys=168
Solution:
$45 \times 152 = 6840$ (Total heght)

$144G + 168B = 6840 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(i)$

$G + B = 45 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(ii)$
Solve: B=15, G=30

Answer: 30 girls, 15 boys

11. (a) Statistics Problem

THE FREQUENCY TABLE

Class interval	Mid-Scores (x)	Frequency	Frequency	Cumulative Frequency	d=x-A	fd
51-55	53	2	**2**	2	-15	-30
56-65	58	10	**10**	12	-10	-100
61-65	63	∩	**n=22**	34	-5	**-5n**
66-70	68	34	**34**	68	0	0
71-75	73	15	**15**	83	5	75
76-80	78	t	**t=10**	93	10	**10t**
81-85	83	6	**6**	99	15	90
86-90	88	1	**1**	100	20	20

***Equation i*:** **Frequencies**

Total Frequencies $= 100 = 2 + 10 + \text{n} + 34 + 34 + 15 + \text{t} + 6 + 1$

Simplifies to: $n + t = 32 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (i)$

***Equation ii*:** **Mean**

Mean is given by $A + \frac{\Sigma fd}{\Sigma f}$ Where A = 68, $\Sigma fd = (20 + 90 + 75 + 10t - 5n) = 55 + 10t - 5n$

$\text{Mean} = 68 + \frac{55+10t-5n}{100} = 68.45$

Simplfies to: $n - 2t = 2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (ii)$

Solving (i) and (ii) above, gives $(n, t) = (22, 10)$

(i) Median class: 66-70, $l = 65.5$

Median= $l + \left(\frac{\frac{N}{2} - n_b}{n_w}\right) i = 65.5 + \left(\frac{\frac{100}{2} - 34}{34}\right) 5$

$= 65.5 + \left(\frac{50-34}{34}\right) 5 \approx 67.85$

Answer: 67.85

(ii) Modal class: 66-70, $l = 65.5$

$= l + \left(\frac{t_1}{t_1 + t_2}\right) i$

Where, $i = 5,\ t_1 = 34 - 22 = 12,\quad t_2 = 34 - 15 = 19$

$$= 65.5 + \left(\frac{12}{12 + 19}\right) 5 = 65.5 + \frac{12}{31} \times 5$$

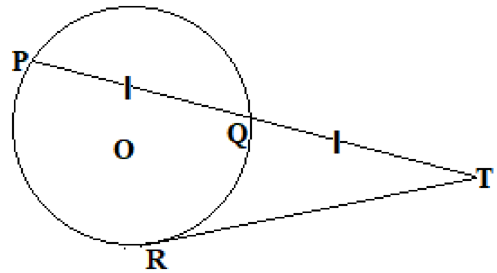
$= 65.5 + \frac{60}{31} \approx 65.5 + 1.94 = 67.44$

Answer: 67.44

11. (b) Circle Problem

Rectangular Theorem: $PT \,.\, QT = TR^2$

Given, $PQ = QT$, Therefore, $PT = 2PQ$



$2PQ \,.\, QT = TR^2$

$2PQ^2 = TR^2$

$PR = \sqrt{2PQ^2} = PQ\sqrt{2}$

Answer: Proved that $PR = PQ\sqrt{2}$

12. (a) 3D - Problem

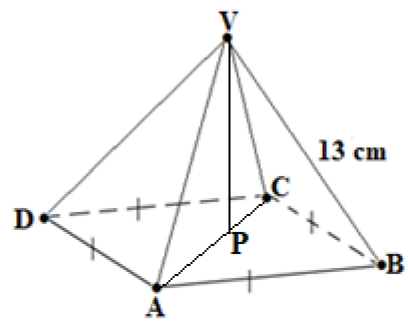
(i) The sold is the Square Pyramid as shown below.

(ii) Given: $AC = 10\sqrt{2}$, Therefore, $AP = 5\sqrt{2}$

The angle required is the angle VCP

Using $\cos \hat{c} = \frac{PC}{VC} = \frac{5\sqrt{2}}{13} = 0.5439$,

$\hat{c} = \cos^{-1}(0.5439) \approx 57°$



12. (b) The Earth as a Sphere

13. The length of a parallel of latitude (a circle around the Earth at a given latitude) is calculated as:
Length = 2πRcosθ

Where:
R = 6370 km (radius of Earth)
θ = latitude angle

First, determine the latitude:

- The angle between the ray to P and the ray to the south pole is 75°.
- The angle between the south pole and the equator is 90°.
- Therefore, the latitude is:
  θ = 75° - 90° = -15°

We take θ = 15° because cosine is an even function:
cos(-15°) = cos(15°)

Calculate the length:

Length = 2 × π × 6370 × cos(15°)
≈ 2 × 3.1416 × 6370 × 0.9659
≈ 38646.12 km

Answer: The length of the parallel of latitude through point P is approximately 38,646.12 km.

13. (a) Matrix Problem (a)

A matrix A is a 2×2

Therefore, matrix M must be of order 1×2 to match the given results $(-2 \quad 16)$

Let matrix M be the matrix with elements x, y: say $M = (x \quad y)$.

Equation

$$(x \quad y)\begin{pmatrix} 3 & 6 \\ -2 & 16 \end{pmatrix} = (-2 \quad 16)$$

$$(3x - 2y \quad 6x - 6y) = (-2 \quad 16)$$

$$3x - 2y = -2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. i)$$

$$6x - 6y = 16 \ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (ii)$$

Therefore, $(x \quad y) = \left(-\frac{22}{3} \quad -10\right)$

Answer: $M = \left(-\frac{22}{3} \quad -10\right)$

13. (b) Matrix Problem (b)

Writing in matrix form:

$$\begin{pmatrix} 3 & a \\ a-4 & 4 \end{pmatrix}\begin{pmatrix} x \\ 4 \end{pmatrix} = \begin{pmatrix} 21 \\ 14 \end{pmatrix}$$

If Faraja was trying to solve the problem, and encountered with the error message, this means the matrix, $\begin{pmatrix} 3 & a \\ a-4 & 4 \end{pmatrix}$ is a singular one. Therefore, its determinant is 0.

$$\rightarrow 12 - a(a-4) = 0$$

$$a^2 - 4a - 12 = 0$$

$$a = -2 \text{ or } 6$$

Answer: The possible values of a are -2 and 6

13. (c) Reflection of Lines

i) Image of the line y = -x under reflection in the y-axis

For reflection in the y-axis, any point (x, y) becomes (-x, y).
The equation of the line y = -x after reflection becomes:
y = -(-x) = x

Therefore, the image of the line y = -x under reflection in the y-axis is:
y = x.

ii) Image of the line 3x + 4y – 12 = 0 under reflection in the line y = -x

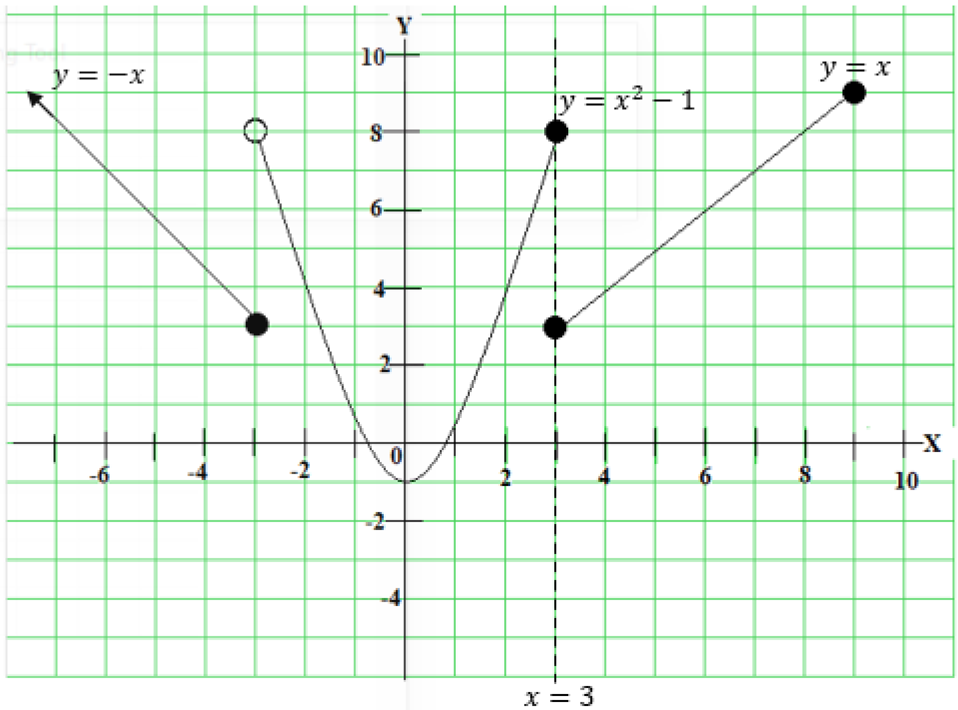
For reflection in the line y = -x, any point (x, y) becomes (-y, -x).
Replacing x with -y and y with -x in the equation 3x + 4y – 12 = 0:
3(-y) + 4(-x) - 12 = 0
-3y - 4x - 12 = 0

Or rearranging:
4x + 3y + 12 = 0

Therefore, the image of the line 3x + 4y – 12 = 0 under reflection in the line y = -x is: 4x + 3y + 12 = 0.

14. (a) Functios

(i) The sketch of the graph $f(x)$



(ii) Domain and range of $f(x)$

Domain = $\{x: x \leq 9\}$
Range = $\{y: y \leq -1\}$

(iii) $f(-2)$: It found in this range, $3 < x \leq 3$, $f(x) = x^2 - 1$
$f(-2) = (-2)^2 - 1$
$= 4 - 1 = 3$
Answer: $f(-2) = 3$

NOTE: The given problem is a Relation not a function as the line $x = 3$ has more than ONE value

14. (b) Linear Programming

Let:

x = number of scientific calculators produced daily

y = number of graphic calculators produced daily

Constraints:

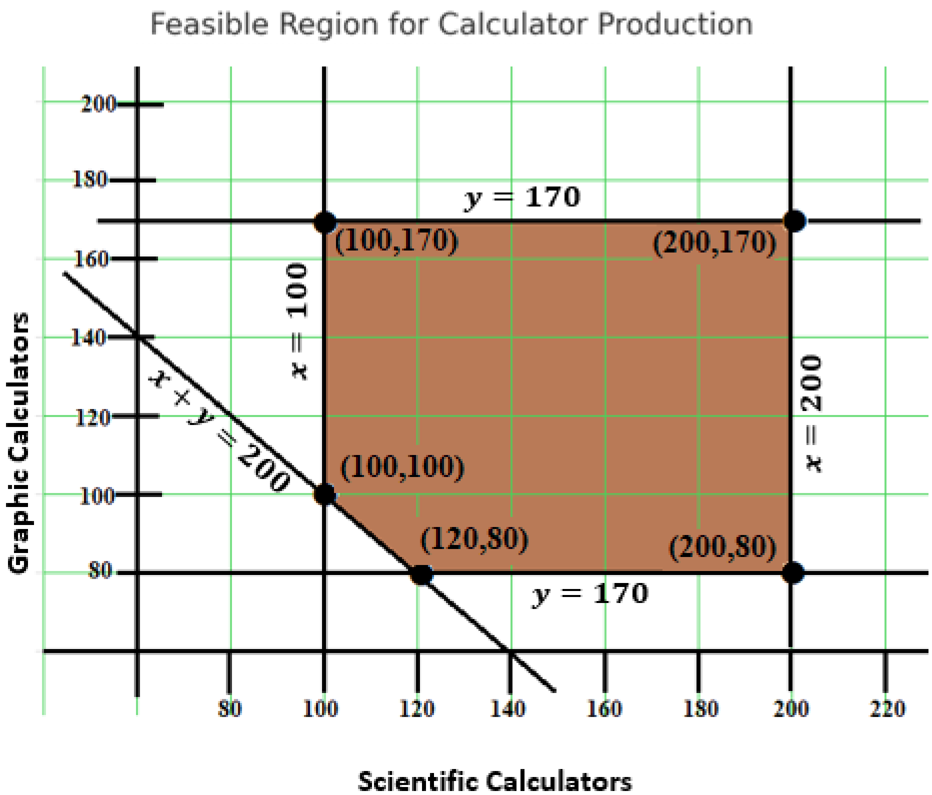
$100 \leq x \leq 200$

$80 \leq y \leq 170$

$x + y \geq 200$

Objective function (Net profit):

Profit = -2000x + 5000y



Corner points and corresponding profit:

Corner Point (x,y)	**Profit Calculation**	**Profit**
(100,100)	2000*100 + 5000*100	300,000
(100,170)	2000(100) + 5000(170)	650,000
(200,80)	2000(200) + 5000(80)	0
(200,170)	2000(200) + 5000(170)	450,000
(120,80)	2000(120) + 5000(80)	160,000

The company should produce 100 scientific calculators and 170 graphic calculators daily to maximize net profit (650,000/=).