Table of content

1
Mixed questions; paper one and two

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sets</td>
<td>12</td>
</tr>
<tr>
<td>2. Index notation</td>
<td>14</td>
</tr>
<tr>
<td>3. Approximations</td>
<td>15</td>
</tr>
<tr>
<td>4. Algebra</td>
<td>16</td>
</tr>
<tr>
<td>5. Matrices</td>
<td>17</td>
</tr>
<tr>
<td>6. Similarity and Congruency</td>
<td>18</td>
</tr>
<tr>
<td>7. Scale Drawing</td>
<td>19</td>
</tr>
<tr>
<td>8. Travel Graphs</td>
<td>20</td>
</tr>
<tr>
<td>9. Angle Properties of a Circle</td>
<td>21</td>
</tr>
<tr>
<td>10. Equations</td>
<td>25</td>
</tr>
<tr>
<td>11. Functions</td>
<td>26</td>
</tr>
<tr>
<td>12. Variations</td>
<td>26</td>
</tr>
<tr>
<td>13. Mensuration</td>
<td>27</td>
</tr>
<tr>
<td>14. Trigonometry</td>
<td>30</td>
</tr>
<tr>
<td>15. Loci</td>
<td>33</td>
</tr>
<tr>
<td>16. Probability</td>
<td>37</td>
</tr>
<tr>
<td>17. Linear programming</td>
<td>39</td>
</tr>
<tr>
<td>18. Calculus</td>
<td>44</td>
</tr>
<tr>
<td>19. Vectors</td>
<td>45</td>
</tr>
<tr>
<td>20. Transformation Geometry</td>
<td>47</td>
</tr>
<tr>
<td>21. Coordinate Geometry</td>
<td>50</td>
</tr>
<tr>
<td>22. Social And Commercial Arithmetic</td>
<td>54</td>
</tr>
</tbody>
</table>
MATERIAL PRODUCTION - QUESTIONS

1. Simplify \( \frac{2+12}{4+3x+6} \) \([1]\)

2. The first five term of a sequence are
   4, 9, 16, 25, 36, ---------
   (a) The 10\(^{th}\) term \([1]\)
   (b) The \(n\)\(^{th}\) term \([1]\)
   (c) Rearrange the quantities in the descending order
       0.00126, \(3/2500\), 0.125\% \([2]\)

3. Simplify
   (a) \(\frac{3}{4}q^8 \times \frac{2}{3}q^{12}\) \([2]\)
   (b) Solve the equation
       \(\frac{x}{4} - 8 = -12\) \([2]\)

4. Simplify \(\left( -\frac{3}{8} - \frac{1}{2} \right) \div \left( \frac{3}{8} - \frac{1}{2} \right)\) \([2]\)

5. Solve the simultaneous equations below
   \(y + \frac{x}{2} = 5\)
   \(-5 + x = 2y\) \([3]\)

6. (i) Solve the inequality \(5 - 3x < 17\) \([2]\)
   (ii) Solve the equation \(x^2 + 4x - 22 = 0\) \([4]\)

7. The point \(X(6,2)\) and \(Y(8,5)\) lie on a straight line.
   (a) Calculate the gradient of the line. \([1]\)
   (b) Find the equation of the line \([2]\)
8.

Calculate:

(i) Angle ACB [1]
(ii) Angle OAB [1]
(iii) Angle ABC [2]

9. Given that the Earth’s mass is 0.010526315 of the mass of the planet Saturn, while the mass of the Earth is $5.7 \times 10^{24}$ kg. Find the mass of the planet Saturn, giving your answer in standard form correct to 2 significant figures. [3]

10. Simplify the indices given below:

(a) $\left( x^{\frac{2}{3}} \right)^{27}$
(b) $\left( \frac{z^{-\frac{1}{2}}}{4^2} \right)^{-2}$
11. Bwalya takes 2.5 litres of water each day. A full glass holds 125 millilitres of water. How many full glasses of water does he drink each day? [2]

12. Given the function \( f(x) = \frac{x+3}{x}, x \neq 0 \) [1]
   (a) Calculate \( f\left(\frac{1}{4}\right) \)
   (b) Solve \( f(x) = \frac{1}{4} \) [2]
13. The right angled triangle in the diagram has sides of length $7y$ cm, $24y$ cm and 150 cm.

(a) Show that $y^2 = 36$ [2]
(b) Calculate the perimeter of the triangle [1]

14. Given that $f: x \rightarrow 5 - 3x$, calculate:
   (i) $f(-1)$ [1]
   (ii) $f^{-1}(x)$ [2]
   (iii) $f f^{-1}(8)$ [1]

15. (a) find the product of $\begin{pmatrix} 3 & 4 \\ 5 & 2 \end{pmatrix}$ [2]
   (b) Given $\begin{pmatrix} 7 \\ 3 \end{pmatrix}$ $(x \ y) = \begin{pmatrix} 28 & 42 \\ 12 & 18 \end{pmatrix}$ find the values of $x$ and $y$ [2]

16.

17. On the Venn diagrams given below, shade the appropriate regions
   (a) $A' \cap C'$
18. Given that \( B = \begin{pmatrix} x & 8 \\ 2 & x \end{pmatrix} \)

(a) Find \(|B|\), the determinant of \(B\), in terms of \(x\).  

\[ [1] \]

(b) Find the values of \(x\) when \(|B| = 9\)  

\[ [3] \]

19. The quantity \(y\) varies as the cube of \((x + 2)\). \(y = 32\) when \(x = 0\).

Find \(y\) when \(x = 7\).  

\[ [3] \]

20. The largest possible circle is drawn inside a semi-circle, as shown in the diagram. The distance \(AB\) is 12 cm.
21. A boy played Bonanza game 500 times and won 370 of the games. Afterwards he won the next $x$ games and lost none. He won 75% of the games he played. Find the value of $x$. [4]

22. For the numbers 8, 3, 5, 8, 7, 8 find the mean and median [2]

23. Nkumbu is cycling at 4 meters per second. After 3.5 seconds she starts to decelerate and after a faster 2.5 seconds she stops. The diagram shows the speed-time graph for Nkumbu.

Calculate:
(a) The constant deceleration [1]
(b) The total distance travelled during the 6 seconds [2]
24. \(E = \{40, 41, 42, 43, 44, 45, 46, 47, 48, 49\}\)

\(P = \{\text{prime numbers}\}\)

\(O = \{\text{odd numbers}\}\)

(i) Put the numbers correctly on the Venn diagram

(ii) What is the value of \(n(B \cap A')\) 

25. A farmer had 25 hens. 14 of the hens hatched white chicks and 11 hatched black chicks. The farmer chooses two chicks at random.

(a) Write the missing probabilities on the tree diagram below

(b) What is the probability that a farmer chooses two hens which will give

   (i) Two white chicks

   (ii) Two chicks of a different colour

26. A cyclist accelerates at a speed of 12.4 meters per second in 3 seconds. He cycles at this speed for the next 5 seconds and slows down over the last 2 seconds as shown in
the graph below. He crosses the finish line after 10 seconds. Total distance covered is 100m.

(a) Calculate the distance he runs in the first 8 seconds 
(b) Calculate his speed when he crosses the finish line

27. A certain hall was built in 1996 and cost K62, 000. It was sold in 2006 for K310, 000.
(a) Calculate the 1996 price as a percentage of 2006 price. 
(b) Calculate the percentage increase in price from 1996 to 2006.

28. The scale of a plan of a school is 1:500
(a) If the road from the kitchen to the boys dormitories is 20m on the ground. What is the distance the distance between the kitchen and boys dormitories on the map in centimetres?
(b) If the area of the school compass is 20km² on the ground. What is its area on the map in cm?

29. The graph of the equation \( y = (x - 3)(x + 2) \) is shown below. It crosses the \( x \) axis at A and C and the \( y \) axis at B as shown below.

30. Triangle ABC is a right angle. BCD is a straight line, AC=12cm and AB=8cm.
Express as a fraction
(i) \( \sin \angle ACB \)
(ii) \( \cos \angle ACD \)

---

**MATHEMATICS PAPER ONE**
PAMPHLET PRODUCTION – ANSWERS

<table>
<thead>
<tr>
<th>S/N</th>
<th>SOLUTION</th>
<th>MARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.5 or ( \frac{1}{2} )</td>
<td>[1]</td>
</tr>
</tbody>
</table>
| 2   | (a) 121  
    (b) \((n+1)^2\)  
    (c) 0.00126, 0.125, \( \frac{3}{2500} \) | [1] [1] [2] |
| 3   | (a) 49   
    (b) 31 | [2] [2] |
| 4   | 7       | [2]   |
| 5   | \( x = 5 \frac{1}{2} \) and \( y = -3 \frac{1}{2} \) | [3]   |
| 6   | (i) \( x > -4 \) or \( -4 < x \)  
    (ii) 3.10 or -7.10 | [2] [4] |
| 7   | (a) 1.5  
    (b) \( y = \frac{3}{2}x - 3 \) | [1] [2] |
| 8   | (i) 40\(^\circ\)  
    (ii) 70\(^\circ\)  
    (iii) 70\(^\circ\) | [1] [1] [2] |
| 9   | 5.7 \times 10^{26} | [3]   |
| 10  | (a) \( X^{10^9} \)  
    (b) 2p | [2] [2] |
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| 11 | (a) \( \frac{3}{5} \)  
(b) \( y = \frac{3}{5}x - 6 \) | [2]  
[2] |
| 12 | 20 | [2] |
| 13 | (a) 13  
(b) -4 | [1]  
[2] |
| 14 | (i) 30  
(ii) 22  
(iii)30  
(iv)52 | [1]  
[2]  
[1]  
[1] |
| 15 | (a)  
(b) 336m | [2]  
[1] |
| 16 | (i) 8  
(ii) \( \frac{5-x}{3} \)  
(iii)8 | [1]  
[2]  
[1] |
| 17 | (a) 23  
(b) \( X=4, y=6 \) | [2]  
[2] |
| 18 | (a) | [1] |
|      | [b] | |
| 19 | (a) \( X^2 - 16 \)  
(b) 5 or -5 | [1]  
[2] |
| 20 | 108 | [3] |
| 21 | (a) 14.1  
(b) 24.8 | [4]  
[2] |
| 22 | 20 | [4] |
| 23 | Median=7.5  
Mean=6.5 | [1]  
[1] |
| 24 | (a) 1.6  
(b) 19 | [1]  
[2] |
<table>
<thead>
<tr>
<th>25</th>
<th><img src="image" alt="Diagram" /></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(i) 2</td>
</tr>
<tr>
<td></td>
<td>(ii) 2</td>
</tr>
</tbody>
</table>

| 26 | (a) \(\frac{11}{24}, \frac{24}{24}, \frac{10}{24}\)  
    | (b) (i) 91/300  
    | (ii) 77/150    |
|----|-----------------|
|    | [3]             |
|    | [2]             |
|    | [2]             |

| 27 | (a) 20%          
    | (b) 400%         |
|----|-----------------|
|    | [2]             |
|    | [2]             |

| 28 | (a) 4cm          
    | (b) 4cm          |
|----|-----------------|
|    | [2]             |
|    | [2]             |

| 29 | (i) A(-2, 0) C(0, -6)  
    | (ii) |\(|AC| = 5\) |
|----|-----------------|
|    | [2]             |
|    | [2]             |

| 30 | (i) SinC = \(\frac{2}{3}\)  
    | (ii) CosC = \(-\frac{1}{2}\) |
|----|-----------------|
|    | [2]             |
|    | [2]             |

| 31 | (i) A(-2, 0) and C(0, -6)  
    | (ii) |\(|AC| = 5\) units |
|----|-----------------|
|    | [3]             |
|    | [3]             |

| 32 | (i) SinC = \(\frac{2}{3}\)  
    | (ii) CosC = \(-\frac{1}{2}\) |
|----|-----------------|
|    | [1]             |
|    | [1]             |
MIXED QUESTIONS: PAPER ONE AND PAPER TWO

SETS

1. A set W has 32 subsets, how many elements does it contain?
2. A set V has 6 elements how many subsets does it have?
3. Given that \( n(A) = 18 \), \( (B) = 14 \), \( n(A \cap B) = 6 \) and \( n(A \cup B)' = 2 \) Find \( n(A \cup B) \)
4. Shade the region \((A \cup B)' \cap C'\) in the space below

5. \( E = \{ x: x < 10, x \in \text{Natural numbers} \} \)
   \( P = \{ x: x \text{ is a prime number} \} \)
   \( Q = \{ x: x \text{ is an even number} \} \)
   (i) List down the elements of
      (a) \( P \)
      (b) \( Q \)
   (ii) Find \( n(P \cap Q) \)

6. A survey carried out among school leavers in a certain district of Northern Province involving three institutions showed that 118 applied to the University of Zambia (UNZA), 98 applied to the copper belt university (CBU) and 94 Applied to Nkrumah university (NU). To increase the chances of selection, 42 applied to UNZA and CBU, 24 applied to CBU and NU, 34 applied to UNZA and NU and 8 applied to all three institutions.
   (a) Show this information on a Venn diagram
   (b) Calculate the total number of school leavers who took part in the survey.

7. At one College, a group of 25 students were asked which Cell phone service providers they subscribed to. The results are shown in the Venn diagram below
(i) Calculate the value of $x$

(ii) Given that $M = \{\text{MTN}\}$, $A = \{\text{AIRTEL}\}$ and $C = \{\text{CELL Z}\}$

Find

(a) $\pi(M \cap A)$
(b) $\pi(A \cup C')$

8. A Class of 43 pupils takes History(H), Commerce (C) and Geography(G) as optional subjects. The Venn diagram below shows their choice distribution.

(i) Calculate the value of $X$

(ii) Find How many pupils take
(a) History or Geography?
(b) Commerce but not history and Geography?

(iii) Calculate the probability that a pupil
(a) take two different subjects
(b) take one subject only.

SOLUTIONS
1. $2^n = 32$, $n = 5$
   change 32 in index form and equate the powers
2. 64 subsets
3. $n(A \cup B) = 26$
4. $(A \cup B)' \cap C'$
5 (i) \( P = \{2, 3, 5, 7\} \)  
(b) \( Q = \{2, 4, 6, 8\} \)  
(ii) \( n(P \cap Q) = 2 \)

6(a) 

(b) 218 school leavers

7. (i) \( x = 10 \)

(ii) \( n(A \cap C) = 23 \)

8. (i) \( x = 5 \)

(ii) a) 31 
    b) 6

INDEX NOTATION
1. Simplify \((3x^3)^2\)

2. Evaluate
   
   \[(a) \ 3^2 \times 2^2 \]
   \[(b) \ 7^0 \times 7^4 \div 7^2 \]
   \[(c) \ 4^0 + 4^1 \]
   \[(d) \ \left( \frac{1}{4} \right)^{-2} \]

3. Evaluate the following
   
   \[(a) \ 5^3 \times 5^{-1} + 8^0 \cdot 4^{\frac{1}{3}} \]
   \[(b) \ 27^{\frac{2}{3}} \]

4. Solve the equations
   
   \[(a) \ 3^a \div 3^5 = 27 \]
   \[(b) \ 125^b = 5 \]
   \[(c) \ 10^c = 0.001 \]
   \[(d) \ 2^{-x} = 16 \]

5. Solve the equations
   
   \[(a) \ x^3 = 8 \]
   \[(b) \ K^{\frac{2}{3}} = 4 \]
   \[(c) \ (p + 5)^{\frac{2}{3}} = 27 \]

**SOLUTIONS**

1. \(3x^6\)
2. \((a) \ 13 \quad (b) \ 49 \quad (c) \ 5 \quad (d) \ 16\)
3. \((a) \ 26 \quad (b) \ 2 \quad (c) \ 9\)
4. \((a) \ a = 8 \quad \text{express} 27 \text{ in index form so that the base is 3, then equate the}
   \text{indices}
   \[(b) \ b = \frac{1}{3} \]
   \[(c) \ c = -3 \]
   \[(d) \ x = -4 \]
5. \((a) \ x = 2 \text{ change 8 so that the index is the same as that of x}
   \[(b) \ k = 64 \]
   \[(c) \ p = -2 \quad \text{introduce the cube root on each side of the equation} \]

**APPROXIMATIONS**
1. The number of orphans and vulnerable children in one province of Zambia is 599,900
   (i) Write down this number in standard form
   (ii) Express this number correct to 1 significant figure
2. Express 0.499 in scientific notation correct to 1 significant figure.
3. Express 0.00834726 in standard form, correct to 3 significant figures.

4. Given that \( m = 6 \times 10^{-7} \) and \( 3 \times 10^2 \). Expressing your answers in standard form, Find
   (a) \( m \times n \)
   (b) \( \frac{m}{n} \)

_____

**SOLUTIONS**

1. (i) \( 5.999 \times 10^5 \) (ii) \( 6 \times 10^5 \)
2. \( 5 \times 10^{-1} \)
3. \( 8.35 \times 10^{-3} \)
4. (a) \( 1.8 \times 10^{-4} \)
   (b) \( 2 \times 10^{-9} \)

_____

**ALGEBRA**

1. Simplify
   (a) \( 3t^2 - t(t - 5) \)
   (b) \( 4(3 - 2P) - 3(1 - P) \)
   (c) \( (3q - r)(q + 2r) \)
2. Given that \( x = 5 \) and \( y = -8 \), find the value of
   (a) \( 2x - y \)
   (b) \( \sqrt[3]{y} \)
3. Given that \( a = 3, b = -5 \) and \( c = 4 \), find the value of
   (a) \( a - 2b - c^2 \)
   (b) \( \frac{9a + 2c}{b} \)
4. Factorise the following completely
   (a) \( 3x + 6 \)
   (b) \( 4p^2 - 16 \)
   (c) \( ab + 12 - 4b - 3a \)
   (d) \( z^2 - 15z + 54 \)
5. Simplify
6. Express as a single fraction
   (a) \( \frac{x-1}{2x-3} \)
   (b) \( \frac{3}{2} - \frac{5}{x+2} \)
   (c) \( \frac{5}{x+3} \)

7. Simplify
   \( \frac{3y^2 - 5y - 12}{y^2 - 9} \)

8. (a) Factorise \( x^2 - y^2 \)

   (b) Hence or otherwise find the value of

   (i) \( 18^2 - 12^2 \)
   (ii) \( (0.6)^2 - (0.4)^2 \)

**SOLUTIONS**

1. (a) \( 2t^2 + 5t \)  (b) \( 9 - 5p \)
   (c) \( 3q^2 + 5qr - 2r^2 \)

2. (a) \( 18 \)  (b) \( 2 \)

3. (a) \( -3 \)  (b) \( -7 \)

4. (a) \( 3(x + 2) \)  (b) \( 4[(p-2)(p+2)] \)
   (c) \( (b-3)(a-4) \)
   (d) \( (z-9)(z-6) \)

5. (a) \( \frac{1}{4} \)  (b) \( \frac{3p}{2+r} \)

6. (a) \( \frac{4-x}{15} \)  (b) \( \frac{6-x^2}{(x+2)(x+3)} \)

7. \( \frac{3y+4}{y+3} \)

8. (a) \( (x-y)(x+y) \)  (b) i) \( 180 \)  (ii) \( 0.2 \)

---

**MATRICES**

1. Given that \( P=\begin{pmatrix} 2 & 1 \\ -3 & 4 \end{pmatrix} \) and \( Q=\begin{pmatrix} -3 & 0 \\ 1 & 2 \end{pmatrix} \)

   Find
   (a) \( 2Q \)
   (b) \( P-2Q \)
(c) Determinant of P

2. Given that \( A = \begin{pmatrix} 2 & 3 \\ -1 & 5 \end{pmatrix} \) and \( B = \begin{pmatrix} 2 \\ 3 \end{pmatrix} \), find the

   (i) Determinant of A,
   (ii) Inverse of A
   (iii) Value of AB

3. Given that matrix \( A = \begin{pmatrix} 1 & x \\ -1 & 2 \end{pmatrix} \)

   (i) Write an expression in terms of x for the determinant of A,
   (ii) Find the value of x given that the determinant of A is 5,
   (iii) Write \( A^{-1} \)

4. (a) Express as a single matrix \( 2 \begin{pmatrix} -1 & -2 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & -3 \\ 2 & 3 \end{pmatrix} \)

   (b) Given that \( \begin{pmatrix} 2 \\ x+1 \\ 4 \\ 8 \end{pmatrix} \) is a singular matrix, find the value of x.

5. \( A = \begin{pmatrix} 2 & 3 \\ -1 & 0 \end{pmatrix} \), \( B = \begin{pmatrix} 3 & 1 \\ -4 & -3 \end{pmatrix} \), \( C = \begin{pmatrix} 1 & 2 & 3 \end{pmatrix} \), \( D = \begin{pmatrix} 2 \\ -1 \end{pmatrix} \)

   Find
   (a) \( A - B \)
   (b) \( A^2 \)
   (c) \( AAD^{-1} \)
   (d) \( CD \)

6. Given that \( P = \begin{pmatrix} 3 & -1 \\ -4 & 0 \end{pmatrix} \) and \( Q = \begin{pmatrix} 3 & 4 \\ -4 & x \end{pmatrix} \), find the value of X if P and Q have equal Determinants.

SOLUTIONS

1. (a) \( \begin{pmatrix} -6 & 0 \\ 2 & 4 \end{pmatrix} \) 2 is a scalar multiply each element of Q by 2

   (b) \( \begin{pmatrix} 8 \\ -5 \end{pmatrix} \) Subtract the corresponding elements

   (c) 11

2. (i) 13 
   (ii) \( A^{-1} = \begin{pmatrix} 5 & -3 \\ 1 & 2 \end{pmatrix} \) 
   (iii) \( \begin{pmatrix} 13 \\ 13 \end{pmatrix} \)

3. (i) \( 2 + x \)
   (ii) \( x = 3 \)
   (iii) \( \begin{pmatrix} 2 \\ 1 \end{pmatrix} \begin{pmatrix} -3 \\ 1 \end{pmatrix} \)

4. (a) \( \begin{pmatrix} -3 & -1 \\ -2 & -1 \end{pmatrix} \)

   (b) \( x = 3 \) A matrix is singular when its determinant is equal to 0

5. (a) \( \begin{pmatrix} -1 & 2 \\ 3 & 3 \end{pmatrix} \) 
   (b) \( \begin{pmatrix} 1 & 6 \\ -1 & -3 \end{pmatrix} \)
SIMILARITY AND CONGRUENCE

1. Two similar triangles have corresponding sides of length 3cm and 5cm. Find the ratio their
   (a) Areas
   (b) Volumes

2. In the figure below BC is parallel to DE and that
   AD=16cm, BC=14cm and DE =20cm.
   (a) BD
   (b) If the area of ABC is 24cm², find the
   trapezium BCED.

3. The volumes of the smaller and the larger cylinders are 64cm³ and 125cm³ respectively, calculate the surface area of the smaller
   Smaller Cylinder if the larger cylinder has area of 72cm².

SOLUTION

1. (a) 9:25  square the ratio of sides
   (b) 27:125  cube the ratio of sides

2. (a) AB=11.2, BD =16 - 11.2 = 4.8
   (b) 25 cm²

3. x=46.

SCALE DRAWING

1. The scale of the map is 1:25000
   (a) If the length of rice field is represented by 40cm on the map, find its actual length in m.
(b) If the distance between two towns is 8km, how far apart are on the map in cm?
(c) Given that the area of the maize field is 20km², find its area on the map in cm².

2. The area covered by a forest on a map is in form of a rectangle. A distance of 20km of the forest is represented by 5cm on the map.
(a) Find the scale of the map.
(b) The forest is represented by an area of 12cm² on the map. Calculate the actual area of the forest in **square kilometres**.

**SOLUTIONS**

1. (a) 10 000m
   (b) 32cm
   (c) 320cm²

2. (a) 1 : 400 00

3. (b) 192 km²

**TRAVEL GRAPHS**

1. The diagram below is a speed -time graph.

   ![Speed-Time Graph]

   Calculate
   (a) Distance covered in the first 20 seconds.
   (b) Average speed for the whole journey.
   (c) Speed when time is 50 seconds.

2. The diagram shows the speed-time graph of a bus over a period of 90 seconds. The bus reaches a maximum speed of 15m/s.
(a) Given that the acceleration was 0.5m/s² in the first few seconds. Calculate the
time taken in seconds to reach its maximum speed.

(b) The total distance travelled during the 90 seconds was 750 meters. Calculate
the length of time that the bus was travelling at during its maximum speed.

(c) Calculate the deceleration in the last few seconds

3. The diagram below is a speed- time graph of a car which was uniformly started from
80m/s to 30m/s in 25 seconds. It was further uniformly retarded at 0.5m/s² until it
came to a halt.

Calculate
(i) The retardation during the first 25 seconds
(ii) The total time it took to come to rest
(iii) The total distance travelled.

SOLUTIONS

1. (a) 600m  Distance is found by finding the area under the curve
(b) S =37.5m/s
(c) 45m/s

2. (a) t=30 sec
(b) 10 sec
(c) a =0.33m/s²

3. (i) a=-2m/s²
(ii) t=60sec
(iii) 1900m

ANGLE PROPERTIES OF A CIRCLE
1. (a) In the diagram below, ABC is at a tangent to the circle centre O and BE is the
diameter. \(<ABF=68^\circ\) and \(<DFE = 35^\circ\)

(i) Explain why \(<EBC = 90^\circ\)
(ii) \(<BFD\)
(iii)\(<DBC\)
(iv)\(<FED\)
(v) \(<FDB\)

2. In the diagram below, the diagonals of a cyclic quadrilateral ABCD meet at E, O is
the centre of the circle.

Given that \(<DAB= 75^\circ\) and \(<DAC=30^\circ\), Calculate

(i) \(<BAC\)
(ii) \(<BCD\)
(iii)\(<OBD\)
(iv)\(<OBC\)
3. In the diagram, LN is the diameter of the circle KLMN, centre O. KM is the straight line. KL=LM and KOL= 70°.

\[ \text{Find} \]
(i) \( \angle KMN \)
(ii) \( \angle KLM \)
(iii) \( \angle KNM \)

4. In the diagram CE is the diameter, O is the center of the circle. A, T and B are in a straight line AB is the tangent at T, \( \angle TDE = 20^\circ \).

\[ \text{Find} \]
(i) \( \angle TCE \)
(ii) \( \angle ETC \)
(iii) \( \angle ETB \)

5. A, B and S are points on a circle, Centre O. TA and TB are tangents. \( \angle ATB = 52^\circ \).

6.
Calculate
(a) $\angle AOS$
(b) $\angle OAB$
(c) $\angle ASB$

SOLUTIONS

1. (i) The radius is perpendicular to the tangent of a circle at the point of contact.
(ii) $\angle BFE = 90^\circ$ (angle in the semicircle)

\[ BFD = 90^\circ - 35^\circ = 55^\circ \]
(iii) $\angle DBC = 55^\circ$ (angles in the alternate segment)
(iv) $\angle FED = 123^\circ$
(v) $\angle FDB = \angle FEB = 68^\circ$

2. (i) $\angle BAC = 45^\circ$
(ii) $\angle BCD = 105^\circ$
(iii) $\angle OBD = 15^\circ$
(iv) $\angle OBC = 45^\circ$ $\angle DBC = \angle DAC = 30^\circ$ angles subtended by the same arc.

\[ \angle OBC = \angle OBD + \angle DBC \]

3. (i) $55^\circ$
(ii) $\angle KLM = 110^\circ$
(iii) $\angle KNM = 70^\circ$

4. (i) $\angle TCE = 20^\circ$
(ii) $\angle ETC = 90^\circ$
(iii) $\angle ETB = 160^\circ$ Type equation here.

5. (a) $\angle AOS = 128^\circ$
(b) $\angle AOB = 32^\circ$
(c) $\angle ASB = 58^\circ$

EQUATIONS

1. Solve the equations
(a) $2x - 6 = 3(x - 5)$
(b) \(2(x - 2) = 3(2 - x)\)
(c) \(\frac{2}{3} = \frac{9}{2x}\)
(d) \(2x + \frac{3}{x} = 5\)

2. (a) Given that \(y = \frac{x + 1}{x - b}\), express \(t\) in terms of \(a\), \(b\) and \(y\).
(b) Given that \(\frac{a}{a + 2} = b\),
   (i) Express \(a\) in terms of \(b\).
   (ii) Find the value of \(a\), when \(b = 2\)

3. Solve the following systems of simultaneous equations
   (a) \(y = 2x\) and \(x - y = 10\)
   (b) \(2a + b = 5\) and \(a - b = 4\)
   (c) \(2m + n = 1\) and \(3m - 2n = -9\)
   (d) \(p = 6q - 4\) and \(3p - 2q = 20\)

4. Solve the equations rounding off your answers correct to 2 decimal places.
   (a) \(3y^2 + 5y - 15 = 0\)
   (b) \(m^2 - m = 5\)
   (c) \(x^2 - 4x - 3 = 0\)
   (d) \((x + 1)^2 = 64\)

5. Solve the following inequalities
   (a) \(3 - 4x > 11\)
   (b) \(4(1 - 2x) \geq 32\)
   (c) \(9t - 4 < 12t - 10\)
   (d) \(-5 < 2x + 3 < 1\)

   **SOLUTIONS**

1. \(X = 7\) Open brackets by distributing 3 and then correct like terms
   (b) \(x = 5\) (c) \(r = 6\frac{3}{4}\)
   (d) \(x = 1.5\) or 1 \(\text{Multiply each term by } x \text{ to remove the denominator, then use}\)
   Factorisation method
2. (a) \(T = \frac{1 + b^2}{y} \frac{y - 1}{y - 1}\)
   (b)(i) \(a = \frac{2b}{1 - b}\) \(\text{ (ii) } -4\)
3. (a) \( x = 10, \ y = 20 \)

(b) \( a = 3, \ b = -1 \)  
(c) \( m = -1, \ n = 3 \)  
(d) \( q = 2, \ p = 8 \)

4. Use either formula or completing the square method

(a) \( y = -3.22 \) or \( 1.55 \)  
(b) \( m = 2.79 \) or \( -1.79 \)  
(c) \( x = 4.65 \) or \( -0.65 \)  
(d) \( x = 7.00 \) or \( -9.00 \)

5. Inequalities are solved in exactly the same way as equations. Change the inequality sign when divided or multiplied by a negative number on each side of the equation

(a) \( x < -2 \)  
(b) \( x \leq -3.5 \)  
(c) \( t > 2 \)  
(d) \(-4 < x < -1 \)

FUNCTIONS

1. Given that \( g : x \rightarrow 2 + 15x \), where \( x \neq 0 \), find,

(a) \( g(2) \),  
(b) \( x \) when \( g(x) = 9 \),  
(c) \( g^{-1}(-3) \).

SOLUTIONS

(a) \( 32 \)  
(b) \( x = \frac{7}{15} \)  
(c) \( g^{-1}(x) = \frac{x - 2}{15}, \ g^{-1}(-3) = -\frac{1}{3} \)

VARIATIONS

1. Given that \( y \) varies directly as \( x \) and \( y = 5 \) when \( x = 2 \), find the value of \( y \) when \( x = 3 \)

2. Given that \( y \) varies inversely as \( x \).
   (i) Write an equation in \( x, \ y \) and \( k \), where \( k \) is a constant.
   (ii) If \( y = 6 \) when \( x = 2 \), find the value of \( y \) when \( x = 9 \)

3. The variables \( x \) and \( y \) are connected by the equation \( y = \frac{K}{\sqrt{x}} \), where \( k \) is the constant.

Pairs of corresponding values are given in the table below.
Calculate
(a) k
(b) p
(c) q

4. y varies directly as z and inversely as \( w^2 \) when \( y=6, z=2 \) and \( w=3 \). Find the values of

(a) k
(b) \( y \) when \( z=6 \) and \( w = 9 \)
(c) \( w \) when \( y=3 \) and \( z=4 \)

1. \( y=7.5 \) Find the constant \( k \) using the first given values of variables.

2. (I) \( y=\frac{k}{x} \) (ii) \( y=1\frac{1}{3} \)

3. (a) \( k=24 \) (b) \( p=12 \) (c) \( q=9 \)

4. (a) \( k=27 \) (b) \( y=2 \) (c) \( w=6 \)

MENSURATION

1. The diagram below shows a sector AOB in which OA=4cm and \( \angle AOB=45^\circ \). Use \( \pi=3.142 \) Type equation here.
(a) Calculate the length of arc AB
(b) Find the area of the sector OAB
(c) Differentiate between the length of the arc and the total distance around the sector

2. The shaded part of the figure is a path of a car windscreen wiper. The wiper rotates through $120^\circ$ about $O.(\pi=\frac{22}{7})$

![Diagram](image)

Calculate

(a) The perimeter of the sector OCD correct to 1 decimal place
(b) The area of the shaded region correct to 1 decimal place.

3. A triangular prism has a base of an isosceles triangle with two sides each 5cm and the third side 6cm. Given that the height of the prism is 13cm. Find the volume of the prism.

4. In this question take $\pi=3.142$. The diagram shows a metallic frame to be filled on a window of a shop. It consists of 4 semi-circular, 4 quarter circular and a circular metal sheet all of the same radius.
(i) Given that the radius is $r$, show that the shaded area reduces to $4\pi r^2$.

(ii) Express the area of the shaded part as a percentage of the area of the square, giving your answer correct to 2 decimal places.

5. The figure shows the net of a pyramid with a square base ABCD of side 8cm.
Given that each of the triangle is an equilateral triangle, calculate

(i) The perimeter of the net
(ii) The area of the figure in square centimetres correct to 3 significant figures.
(iii) The volume of the pyramid when the shape is folded along the dotted lines.

\[ \text{Volume of the pyramid} = \frac{1}{3} \text{base area} \times \text{Perpendicular height} \]

\[ \text{SOLUTIONS} \]

1. \( AB = 3.142 \text{cm} \)
   (b) \( A = 6.284 \text{cm}^2 \)
   (c) 8 cm

2. (a) 286.6 \( \text{OC + arc CD + OD} \)
   (b) 4189.3 \( \text{Area of OCD – OAD} \)

3. 156 cm³

4. (i) \( A = 4 \times \frac{\pi r^2}{4} + \frac{\pi r^2}{2} + \pi r^2 \)
   \( = 4\pi r^2 \)
   (ii) 78.55°

5. (i) 64 cm (ii) 91.7 \( \text{Area of a square + areas of 4 triangles} \)
   (iii)

\[ \text{TRIGONOMETRY} \]

1. In the diagram below, triangle ABC is right angled. Given that \( AB = 5 \text{cm}, AC = 13 \text{cm} \)
   and that BCD is a straight line, find
   (i) The area of triangle ABC
   (ii) \( \cos < ACD \)
2. In the diagram $\triangle ABC$ and $\triangle ACD$ are right angled. $\angle ABC=\angle CAD=90^\circ$.

$AC=20.2\text{cm}$, $BC=9.5\text{cm}$, and $AD=12\text{cm}$,

Calculate

(a) $AB$
(b) $\angle BAC$
(c) The area of quadrilateral $ABCD$
(d) The perimeter of quadrilateral $ABCD$.

3. In $\triangle PQR$, $PQ=10\text{cm}$, $QN=8\text{cm}$, and $NR=3\text{cm}$
4. A Girls’ high school has been built in such a way that Administration block (A) dormitories (B) and classes (C) are connected by straight corridors. A is 60m from C and 130m from B. The bearing of B from A is 110° and the bearing of A from C is 030° as shown below.

(i) Find angle BAC
(ii) Calculate the distance BC
(iii) The Administration decided to build a tack shop along BC at T, such that T is the shortest distance from A. Given the area of triangle ABC is 3840.75 m², Calculate AT.

5. A is 12km due west of 0, B is 18km from O. On the bearing 015°.
Calculate
(a) The bearing of O from B
(b) The distance AB
(c) Show that angle OAB is equal to 46°
(d) The area of triangle AOB, giving your answer correct to 1 decimal place.

**SOLUTION**
1. A = 30 cm² (ii) 157.4°
2. (a) AB = 17.8 (b) < BAC = 28.1°
   (c) 196.175 cm²
   (d) 62.8
Perimeter is the total distance around the shape
3. (a) PN = 6 cm (b) PRN = 63.4°
4. (i) BAC = 100° (ii) BC = 152 m
   (iii) AT = 50.5 m
5. (a) 195° draw a North pole at B, then add 180 + 15
   (b) 24.1 km (c) A = 46° (d) Area = 104.3 km²

**LOCI**
1. Construct a triangle PQR, in which PQ = 7 cm, QR = 5 cm and angle PQR = 123°.
   (i) Measure PR
   On the diagram construct.
   (ii) Locus of points 4 cm from P.
   (iii) Locus of points 3.5 cm from Q
(iv) Show clearly on the diagram, the locus of points which lie in the triangle PQR, and lie less than 4cm from P, and lie less than 3.5cm from Q.

2. (a) Construct ΔABC in which AB=10cm, AC=9cm and BC=7cm, measure and write down the size of <ABC.

(b) On your diagram, draw the locus of points within the triangle which are

(i) 4cm from B

(ii) Equidistant from B and C

(c) Q is a point inside ΔABC such that it is 4cm from B and equidistant from B and C, Label the point Q.

(d) Another point P within ΔABC is such that P is:

Nearer to B than C

Greater than or equal to 4cm from C. Indicate clearly by shading the region in which P must lie.

3. (a) (i) Construct Parallelogram ABCD in which AB=8cm, BC=5.3cm and <ABC=60°.

(ii) Construct a perpendicular from A to meet CD at point Q and write down the length of AQ.

(b) On your diagram, draw the locus of points within the parallelogram ABCD which are

(i) 2.5cm from AB

(ii) 3cm from C

(iii) Equidistant from BC and CD.

(c) P is the point inside parallelogram ABCD such that P is nearer to BC than CD, less than or equal to 2.5cm from AB, indicate clearly, by shading the region in which P must lie.

SOLUTIONS
1. \[ PR = 10.5 \text{ cm} \]

2. \[ QA = 9 \text{ cm} \]
   \[ QC = 7 \text{ cm} \]
   \[ QB = 10 \text{ cm} \]
\[ AQ = 4.5 \]
1. A box contains 3 green apples and 5 red apples. An apple is picked from the box and not replaced then a second apple is picked. Expressing the answer as a fraction in its simplest form, Calculate

(i) the probability that both apples picked are green.

(ii) the probability that the two apples picked are of different colours.

2. A box contains 12 identical marbles of which 5 are blue and 7 are red. Two marbles are picked from the box at random one after another. The tree diagram below shows the possible outcomes and their probabilities.

(a) Find the values of p and q.
(b) Expressing each answer as a fraction in its lowest, find the probability that
(i) Two blue marbles are chosen
(ii) Atleast one red marble is chosen.
3. A box contains, blue, green, black and red beads. Given that
\[ P(\text{green}) = \frac{2}{5} \quad P(\text{red}) = \frac{1}{4} \quad \text{and} \quad P(\text{black}) = \frac{1}{5} \]

(a) Find \( P(\text{blue}) \)

(b) Find the least number of beads that must be in the box to suit these probabilities.
A box contains $x$ yellow, six red and two blue marbles. Use the tree diagram above to answer the following questions.

(i) Find the number of yellow marbles
(ii) Two marbles are drawn at random from the box, find the probability that both are red.
(iii) Two marbles are drawn at random from the box, find the probability that at least one is blue.

**SOLUTIONS**

1. (i) $\frac{3}{28}$ (ii) $\frac{15}{28}$

2. (a) $p = \frac{5}{11}$, $q = \frac{6}{11}$
   
   (b) i) $P(\text{BB}) = \frac{5}{33}$
   
   ii) $1 - P(\text{BB})$ or $P(\text{BR}) + P(\text{RB}) + P(\text{RR})$

3. (a) $P(\text{B}) = \frac{3}{20}$ (b) 20 Beads

4. (i) $x = 4$, 4 Yellow marbles
   
   (ii) $P(\text{RR}) = \frac{5}{22}$

   (iii) $P(\text{At least one blue}) = \frac{7}{22}$

**LINEAR PROGRAMMING**

1. Illustrate the solution set of each of the following systems of inequations on a Cartesian plane by shading unwanted region.
   
   (a) $2y - 3x \leq 6$, $5y + 4x \leq 4$, $y \geq 0$
   
   (b) $y - x \geq -6$, $8y + 5x < 5$, $x \geq 0$

2. The diagram below shows the region $R$ bounded by three lines.
3. A small scale farmer wishes to keep sheep and goats. Let \( x \) represent the number of sheep and \( y \) the number of goats.

(i) Write the inequalities that represent each of the following conditions.
   (a) The number of sheep should not be more than 4.
   (b) A goat feeds on 4 kg of food while a sheep feeds on 2 kg of food per day. The total amount of food should be at least 8 kg per day.
   (c) The number of sheep should be more than the number of goats.

(ii) Using a scale of 2 cm to represent 1 unit on both axes, draw \( x \) and \( y \) axes for \( 0 \leq x \leq 5 \) and \( 0 \leq y \leq 5 \) and shade the unwanted region to indicate clearly the region where the solution of the inequalities lies.

4. Mrs. Mwape bakes two types of cakes for sale: type A and type B.

(i) To satisfy her regular customers daily, she must bake,
   (a) At least 10 cakes of type A
   (b) At least 20 cakes of type B

Taking \( x \) to represent the number of cakes of type A and \( y \) to represent cakes of type B,

Write two inequalities which satisfy the above conditions.

(ii) (a) To avoid wastage, the total number of cakes she should bake per day must not exceed 70. Write another inequality which satisfies this condition.
(b) The point \((x, y)\) represents \(x\) cakes of type A and \(y\) cakes of type B. Using a scale of 2cm to represent 10 cakes on each axis; draw \(x\) and \(y\) for \(0 \leq x \leq 80\) and \(0 \leq y \leq 80\). Present the three inequalities above on your graph and shade the unwanted region to indicate clearly the region where \((x, y)\) must lie.

(iii) If \(2x + 3y\) is the objective function.
(a) Find the maximum number of cakes she must bake
(b) Write down the number of cakes of each type

SOLUTIONS

1.

2. \(x \geq 0,\ 5y - 4x \geq 15,\ 5y + 4x \leq 20\)

3. (i) a) \(x \leq 4\)  (b) \(2x + 4y \leq 8\)  (c) \(x \geq y\)
4. (i) a) $x \geq 10$  
(b) $y \geq 20$
(ii) $x + y \leq 70$
(iii) (a) 200 cakes 
(b) 10 cakes of type A
60 cakes of type B
CALCULUS

1. Find the derivatives of the following using first principle
   (a) \( y = x^3 \)
   (b) \( y = 3x^2 + 1 \)
   (c) \( y = x - \frac{1}{x} \)

2. (a) Find the gradient function of \( f(x) = x^2 \)
   (b) Hence determine the gradient at
      (i) \( x = 4 \)
      (ii) \( x = -1 \)

3. Given that \( y = 2x^2 - 4x + 1 \)
   Find
   (i) \( \frac{dy}{dx} \)
   (ii) The coordinates of the point where the gradient is
      (a) 0
      (b) \(-8\)

4. Find the area under the curve \( y = x^2 + 5 \) and between \( x=1 \) and \( x=4 \)

5. Find the area enclosed by the curve \( x = 9 - y^2 \) and y-axis

SOLUTION

1. (a) \( 2x^2 \) \hspace{1cm} (b) \( 6x \)
2. (i) 8 \hspace{1cm} (ii) -2
3. (i) 2x-4 \hspace{1cm} (ii) (1,-1) \hspace{1cm} (-1,7)
4. 36 units. sq
5. 36 units. S
VECTORS

1. Given that \( \mathbf{a} = \begin{pmatrix} \frac{1}{2} \\ 3 \end{pmatrix}, \ \mathbf{b} = \begin{pmatrix} 3 \\ 1 \end{pmatrix} \) and \( \mathbf{c} = \begin{pmatrix} 4 \\ 0 \end{pmatrix} \) evaluate;

(i) \( \mathbf{a} + \mathbf{b} \),
(ii) \( \mathbf{a} - \mathbf{c} \),
(iii) \( \mathbf{c} - \mathbf{b} \),
(iv) \( 3\mathbf{b} - 4\mathbf{a} + 2\mathbf{b} \),
(v) \( 3\mathbf{b} + 7\mathbf{c} - 2\mathbf{a} \).

2. Given that \( \overrightarrow{OA} = \begin{pmatrix} 7 \\ -8 \end{pmatrix}, \ \overrightarrow{OB} = \begin{pmatrix} 5 \\ 0 \end{pmatrix} \) and that P is the midpoint of AB. Find

(a) \( \overrightarrow{AB} \) as a column vector.
(b) The magnitude of \( \overrightarrow{OP} \).

3. In the diagram, \( \mathbf{OA} = \mathbf{a}, \ \mathbf{OB} = 2\mathbf{b}, \ \mathbf{AC} : \mathbf{AB} = 3 : 4 \) and that D is the midpoint of OB. Express in terms \( \mathbf{a} \) and/or \( \mathbf{b} \).

\[ \text{(i) } \overrightarrow{AB} \]
\[ \text{(ii) } \overrightarrow{OD} \]
\[ \text{(iii) } \overrightarrow{CD} \]
\[ \text{(iv) } \overrightarrow{AD} \]

4. In the diagram below, M is the midpoint of BP and P is on OA produced such that OA: AP = 1:2. OA = \( \mathbf{a} \) and OB = \( \mathbf{b} \).

\[ \text{Diagram showing M as midpoint of BP, P on OA, and other vectors} \]
Express in terms of $\mathbf{a}$ and/or $\mathbf{b}$ the vectors

(a) $\overrightarrow{OP}$;  (b) $\overrightarrow{BA}$;  (c) $\overrightarrow{BP}$;  (d) $\overrightarrow{BM}$.

5. In triangle OAB, $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$. Given that M is a point on AB such that AB = 3AM and that N is the midpoint of OB.

(i) Express in terms of $\mathbf{a}$ and/or $\mathbf{b}$ the vectors,

(a) $\overrightarrow{AE}$;  (b) $\overrightarrow{OM}$;  (c) $\overrightarrow{AN}$.

(ii) Given that OM meets AN at P and that $\overrightarrow{AP} = h \overrightarrow{AN}$ show that $\overrightarrow{OP} = (1 - h)\mathbf{a} + \frac{1}{2}h\mathbf{b}$.

6. In the diagram $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$ and M and N are midpoints of OA and OB respectively. AN and BM intersect at G.

(i) Find in terms of $\mathbf{a}$ and/or $\mathbf{b}$ the vectors,
(a) OM, (b) AN

(ii) Given that \( AG = gAN \) where \( g \) is a constant, show that \( OG = (1 - g)a + \frac{g}{2}b \)

**TRANSFORMATION GEOMETRY**

1. Using a scale of 2 cm to represent 1 unit on each axis, draw \( x \)-axis and \( y \)-axis for \(-4 \leq x \leq 4 \) and \(-5 \leq y \leq 5 \).

(a) \( \Delta ABC \) with vertices \( A (-4, 1), B (-3, 1) \) and \( C (-4, 3) \) is mapped onto \( \Delta A_1B_1C_1 \) with vertices \( A_1 (1, 2), B_1 (2, 2) \) and \( C_1(1, 4) \) by translation.

   (i) Draw and label \( \Delta ABC \) and \( \Delta A_1B_1C_1 \).
   (ii) Write the column vector representing this translation.

(b) \( \Delta A_1B_1C_1 \) is mapped onto \( \Delta A_2B_2C_2 \) by reflection in the \( x \)-axis. Draw and label \( \Delta A_2B_2C_2 \).

(c) \( \Delta A_1B_1C_1 \) is mapped onto \( \Delta A_3B_3C_3 \) by enlargement. Given that \( \Delta A_3B_3C_3 \) has vertices \( A_3 (-2, -1), B_3 (-4, -1) \) and \( C_3 (-2, -5) \).

   (i) Draw and label \( \Delta A_3B_3C_3 \)
   (ii) Find the coordinates of the centre of enlargement,
   (iii) Find the scale factor.

(d) \( \Delta A_2B_2C_2 \) is mapped onto \( \Delta A_4B_4C_4 \) by rotation in the anticlockwise direction centre origin through \( 90^\circ \).

   (i) Find the vertices of \( \Delta A_4B_4C_4 \).
   (ii) Draw and label \( \Delta A_4B_4C_4 \).

(e) Describe fully a single transformation which maps \( \Delta A_1B_1C_1 \) onto \( \Delta A_4B_4C_4 \).

2. Using a scale of 1 cm to represent 1 unit on each axis, draw \( x \)-axis and \( y \)-axis for \(-8 \leq x \leq 8 \) and \(-8 \leq y \leq 8 \).

(a) \( \Delta ABC \) with vertices \( A (-5, 7), B (-5, 4) \) and \( C (-7, 4) \) is mapped onto \( \Delta A_1B_1C_1 \) by translation with column vector \( T = \begin{pmatrix} 12 \\ 0 \end{pmatrix} \).

   (i) Find the coordinates of \( \Delta A_1B_1C_1 \),
   (ii) Draw and label \( \Delta ABC \) and \( \Delta A_1B_1C_1 \).

(b) A transformation reflection in the line \( y = 0 \) maps \( \Delta A_1B_1C_1 \) onto \( \Delta A_2B_2C_2 \).

(i) Find the coordinates of \( \Delta A_2B_2C_2 \).
ii) Draw and label $\Delta A_2B_2C_2$.

c) Given that $\Delta A_1B_1C_1$ with vertices $A_3$ (-4, -1), $B_3$ (4, -4) and $C_3$ (-4, -4) is a image of $\Delta A_1B_1C_1$ under transformation.
   (i) Draw and label $\Delta A_3B_3C_3$
   (ii) Describe fully a single transformation which maps $\Delta A_1B_1C_1$ onto $\Delta A_3B_3C_3$.

(d) $\Delta ABC$ is mapped onto $\Delta A_4B_4C_4$ by shear. Given that the vertices of $\Delta A_4B_4C_4$ are $A_4$ (-5, 2), $B_4$ (-5, -1) and $C_4$ (-7, -5)
   (i) Draw and label $\Delta A_4B_4C_4$.
   (ii) Find the shear factor.

3. Using a scale of 1 cm to represent 1 unit on each axis, draw x-axis and y-axis for $-4 \leq x \leq 10$ and $-6 \leq y \leq 6$.

   (a) The vertices of $\Delta ABC$ are $A$ (2, 4), $B$ (6, 4) and $C$ (6, 2) and those of $\Delta A_1B_1C_1$ are $A_1$ (-2, 0), $B_1$ (-2, 4) and $C_1$ (0, -4).

   (i) Draw and label $\Delta ABC$ and $\Delta A_1B_1C_1$
   (ii) State the angle of anticlockwise rotation which maps $\Delta ABC$ onto $\Delta A_1B_1C_1$.
   (iii) Find the coordinates of the centre of this rotation.

   (b) $\Delta ABC$ can also be mapped onto $\Delta A_1B_1C_1$ by an anticlockwise rotation about the point (8, 2) followed by a translation.

   (i) State the angle of this rotation.
   (ii) Find the column vector of the translation that followed.

   (c) Given that $\Delta A_3B_3C_3$ has vertices $A_3$ (-1, 1), $B_3$ (-1, -3) and $C_3$ (1, -3) is a image of $\Delta ABC$ under a single transformation.

   (i) Draw and label $\Delta A_3B_3C_3$
   (ii) Describe fully a single transformation which maps $\Delta ABC$ onto $\Delta A_3B_3C_3$.

4. Using a scale of 2 cm to represent 1 unit on each axis, draw x-axis and y-axis for $-3 \leq x \leq 7$ and $-3 \leq y \leq 7$.

   (a) $\Delta ABC$ has vertices $A$ (3, 6), $B$ (3, 7) and $C$ (1, 7). $\Delta A_1B_1C_1$ has vertices $A_1$ (-1, 4), $B_1$ (-2, 4) and $C_1$ (-2, 2).

   (i) Draw and label $\Delta ABC$ and $\Delta A_1B_1C_1$.
   (ii) Describe fully a single transformation which maps $\Delta ABC$ and $\Delta A_1B_1C_1$.

   (b) The matrix $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ maps $\Delta ABC$ onto $\Delta A_2B_2C_2$.

   (i) Find the coordinates of $\Delta A_2B_2C_2$. 
(ii) Draw and label \( \Delta A_2B_2C_2 \).

(c) \( \Delta A_1B_1C_1 \) can be mapped onto \( \Delta A_3B_3C_3 \) by translation. Given that \( A_3 \) is a point (3, -1)

(i) Find the column vector representing this translation,
(ii) Draw and label \( \Delta A_3B_3C_3 \)

(d) \( \Delta A_4B_4C_4 \) has vertices \( A_4(0, 3), B_4(0, 1) \) and \( C_4(4, 1) \).

(i) Draw and label \( \Delta A_4B_4C_4 \).
(ii) Describe fully a single transformation which maps \( \Delta A_1B_1C_1 \) onto \( \Delta A_4B_4C_4 \).

SOLUTIONS

1. (a) (i) \( \Delta ABC \) and \( \Delta A_1B_1C_1 \) correctly drawn and labelled.
   (ii) Translation vector \( T = \begin{pmatrix} -2 \\ 1 \end{pmatrix} \)

   (b) \( \Delta A_2B_2C_2 \) correctly drawn and labelled.

   (c) (i) \( \Delta A_3B_3C_3 \) correctly drawn and labelled.
   (ii) Coordinates of the centre of enlargement are (0, 1).
   (iii) Scale factor -2.

   (d) (i) \( A_4(2,1), B_4(2, 2) \) and \( C_4(4, -1) \).
   (ii) \( \Delta A_4B_4C_4 \) correctly drawn and labelled.

   (e) Reflection, in the line \( y = x \)

2. (a) (i) \( A_1(7, -1), B_1(7, -4) \) and \( C_1(5, -4) \).
   (ii) \( \Delta ABC \) and \( \Delta A_1B_1C_1 \) correctly drawn and labelled.

   (b) (i) \( A_2(7, 1), B_2(7, 4) \) and \( C_2(5, 4) \).
   (ii) \( \Delta A_2B_2C_2 \) correctly drawn and labelled.

   (c) (i) \( \Delta A_3B_3C_3 \) correctly drawn and labelled.
   (ii) Stretch, with invariant line y-axis and stretch factor - 4.

   (d) (i) \( \Delta A_4B_4C_4 \) correctly drawn and labelled.
   (ii) Shear factor - 2

3. (a) (i) \( \Delta ABC \) and \( A_1B_1C_1 \) correctly drawn and labelled.
(ii) Angle of an anticlockwise rotation $90^\circ$.
(iii) Centre of rotation $(2, 0)$.

(b) (i) Angle of rotation $90^\circ$.
(ii) Translation vector $\begin{pmatrix} -8 \\ 4 \end{pmatrix}$

(c) (i) $\triangle A_3B_3C_3$ correctly drawn and labelled.
(ii) Reflection, in the line $y = -x + 3$.

---

4. (a) (i) $\triangle ABC$ and $A_1B_1C_1$ correctly drawn and labelled.
(ii) An anticlockwise rotation, through $90^\circ$, Centre of rotation $(2, 3)$.

(b) (i) $A_2(6, 3)$, $B_2(7, 3)$ and $C_2(7, 1)$.
(ii) $\triangle A_2B_2C_2$ correctly drawn and labelled.

(c) (i) Translation vector $\begin{pmatrix} 4 \\ -5 \end{pmatrix}$
(ii) $\triangle A_3B_3C_3$ correctly drawn and labelled.

(d) (i) $\triangle A_4B_4C_4$ correctly drawn and labelled.
(ii) Enlargement, with centre of enlargement $(2, 5)$ and scale factor $-2$.

---

COORDINATE GEOMETRY

1. Given that a straight line passes through the points $A(5, -9)$ and $B(3, 7)$, Find;

   (a) The coordinates of a midpoint between $A$ and $B$.
   (b) The distance between points $A$ and $B$.
   (c) The gradient of a straight line passing through $A$ and $B$.
   (d) The equation of the line passing through the points $A$ and $B$.
   (e) The value of the $y$-intercept of the line passing through the points $A$ and $B$.

2. Find the equation of a straight line passing through point $Q(5, -3)$ with gradient $-4$.

3. Find the equation of a straight line with the gradient $\frac{3}{7}$ and through y-intercept 5.
4. Given that the equation of a straight line is \(3y - 2x + 9 = 0\), find:
(a) its gradient of a straight line.
(b) the value of the y-intercept.

5. If the equation of a straight line is \(5x - 2y = 10\), find;
(a) The equation of a straight line passing through (5, -2) parallel to \(5x - 2y = 10\).
(b) The equation of a straight line passing through (-4, 7) perpendicular to \(5x - 2y = 10\).

6. The points A and B are (4, -3) and (12, 7) respectively; find
(i) (a) the coordinates of the midpoint of AB,
   (b) the gradient of a straight line passing through A and B,
   (c) the length of line AB,
   (d) the equation of the straight line AB.
(ii) Given also that C is a point (-3, -7) and that D is such that \(DC = \left(\frac{5}{5}\right)\), find the coordinates of point D.
(iii) Calculate the length of line BD.
(iv) The equation of the straight line parallel to line BD passing through point (6,4).
(v) The equation of the straight line perpendicular to line BD passing through point (-3, 5).

SOLUTIONS

1. (a) midpoint = \(\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)\)
   midpoint = \(\left(\frac{5 + 3}{2}, \frac{-9 + 7}{2}\right)\)
   midpoint = \(\left(\frac{8}{2}, \frac{-2}{2}\right)\)
   \[\therefore\text{midpoint} = (4, -1)\]

(b) \[AB = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}\]
   \[AB = \sqrt{(5 - 3)^2 + (-9 - 7)^2}\]
   \[AB = \sqrt{(2)^2 + (-16)^2}\]
   \[AB = \sqrt{4 + 256}\]
   \[AB = \sqrt{260}\]
   \[\therefore AB = 16.1\]

(c) \[m = \frac{y_1 - y_2}{x_1 - x_2}\]
   \[m = \frac{-6 - 7}{5 - 3}\]
\[ m = \frac{-16}{2} \]
\[ \therefore m = -8 \]

(d) \[ y - y_1 = m(x - x_1), \quad m = -8, \quad (3, 7) \]
\[ y - 7 = -8(x - 3) \]
\[ y - 7 = -8x + 24 \]
\[ \therefore y = -8x + 31 \]

(e) \[ y \text{-intercept} = 31 \]

2. \[ y - y_1 = m(x - x_1), \quad m = -4, \quad (5, -3) \]
\[ y - (-3) = -4(x - 5) \]
\[ y + 3 = -4x + 20 \]
\[ \therefore y = -4x + 17 \]

3. \[ y = mx + c, \quad m = \frac{3}{7}, \quad c = 5 \]
\[ y = \frac{3}{7}x + 5, \]
\[ \therefore 5y = 3x + 35. \]

4. \[ 3y - 2x + 9 = 0, \]
\[ 3y = 2x - 9, \]
\[ y = \frac{2}{3}x - 3, \]

\[ \begin{align*} 
& (i) \quad m = \frac{2}{3}; \\
& (ii) \quad c = -3. 
\end{align*} \]

5. \[ 5x - 2y = 10 \]
\[ y = \frac{5}{2}x - 5 \]
\[ \therefore m_1 = \frac{5}{2} \]

(a) For parallel lines \( m_1 = m_2 \).
\[ m_2 = \frac{5}{2}, \quad (5, -2) \]
\[ y - y_1 = m(x - x_1), \]
\[ y - (-2) = \frac{5}{2}(x - (-2)) \]
\[ \therefore 2y = 5x - 29. \]

(b) For perpendicular lines \( m_1 \times m_2 = -1 \)
\[ m_2 = -\frac{2}{5}, \quad (-4, 7) \]
\[ y - y_1 = m(x - x_1), \]
\[ y - 7 = -\frac{2}{5}(x - (-4)) \]
\[ \therefore 5y = -2x + 27. \]
6. (i) (a) midpoint = \( \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) \)
midpoint = \( \left( \frac{4 + 12}{2}, \frac{-3 + 7}{2} \right) \)
midpoint = \( \left( \frac{16}{2}, \frac{4}{2} \right) \)
\therefore \text{midpoint} = (8, 2)

(b) \( AB = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} \)
\( AB = \sqrt{(4 - 12)^2 + (-3 - 7)^2} \)
\( AB = \sqrt{(-8)^2 + (-10)^2} \)
\( AB = \sqrt{64 + 100} \)
\( AB = \sqrt{164} \)
\therefore AB = 12.8

(c) \( m = \frac{y_2 - y_1}{x_2 - x_1} \)
\( m = \frac{-3 - (-3)}{4 - 12} \)
\( m = \frac{-3}{-8} \)
\therefore m = \frac{3}{4}

(d) \( y - y_1 = m(x - x_1) \), \( m = \frac{5}{4} \), (4, -3)
\( y - (-3) = \frac{5}{4} (x - 4) \)
\( 4y + 12 = 5x - 20 \)
\therefore 4y = 5x - 32

(ii) \( \overline{OD} = \overline{OC} + \overline{CD} \)
\( = \begin{pmatrix} -3 \\ 5 \end{pmatrix} - \begin{pmatrix} 5 \\ -8 \end{pmatrix} \)
\( \overline{OD} = \begin{pmatrix} -8 \\ -12 \end{pmatrix} \)
\therefore D (-8, -12)

(iii) (b) \( AB = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} \)
\( AB = \sqrt{(4 + 8)^2 + (-3 + 12)^2} \)
\( AB = \sqrt{(12)^2 + (9)^2} \)
\( AB = \sqrt{144 + 81} \)
\( AB = \sqrt{225} \)
\therefore AB = 15

(iv) B (4, -3) and D (-8, -12)
$m = \frac{y_2 - y_1}{x_2 - x_1}$, \\
$m = \frac{-3 - (-12)}{4 - (-6)}$ \\
$m = \frac{9}{12}$ \\
$m = \frac{3}{4}$

For parallel lines $m_1 = m_2$. \\
$m_2 = \frac{3}{4}, (6, 4)$

$y - y_1 = m(x - x_1)$, \\
y - 4 = \frac{3}{4}(x - 6)$ \\
$4y - 16 = 3x - 18$ \\
$\therefore 4y = 3x - 2$

(v) For perpendicular lines $m_1 \times m_2 = -1$ \\
$m_2 = -\frac{4}{3}, (-3, 5)$

$y - y_1 = m(x - x_1)$, \\
y - 5 = -\frac{4}{3}(x - (-3))$ \\
$3y - 15 = -4x - 12$ \\
$\therefore 3y = -4x + 3$

SOCIAL AND COMMERCIAL ARITHMETICS

1. Mrs Mbewe sold a radio at K110.00. She made a loss of 20% . Calculate the cost of the radio.

2. The exchange rate between the Zambian Kwacha (K) and the British Pound (£) at one time was K11.30 to £1. Swence intends to change K350, 300.00. How many British Pounds can she receive?

3. The price of a DVD player was K 850 after an increase of 10%. What was the price of a player before the increase?

4. An aeroplane has seats for 120 passengers. Calculate the:

   (a) Number of passengers on board when $\frac{8}{15}$ of the seats is occupied.
   (b) Percentage of seats which are occupied when there are 114 passengers.

5. The electricity meter of a house is read and found to be 18 552, the previous reading was 17 044.
   (a) Find the number of units used.
(b) The first 70 units are charged at K0.25 each and the remaining units at K0.10 each. Find the cost of the electricity used.

6. The price of a Tipper Truck was increased from K500,000 to K600,000. Calculate the percentage increase in the price of the Tipper Truck.

7. Mr Banda gets a monthly salary of K3,850. Calculate his annual salary.

8. In 2006, Salifyanji went to a golf tournament. His ticket cost K700.00. In 2007 the cost of a ticket was reduced to K630.00. Calculate the percentage decrease in the cost of a ticket.

______________________________

SOLUTIONS

1. Loss percentage = \( \frac{\text{cost price} - \text{selling price}}{\text{cost price}} \times 100 \)
   \[ 20 = \left( \frac{x-110}{x} \right) \times 100 \]
   \[ 100x - 20x = 11000 \]
   \[ 80x = 11000 \]
   \[ x = 137.50 \]

2. \( £ 1 = K 11.30 \)
   \[ x = K 350,300 \]
   \[ \therefore x = £ 31,000 \]

3. Profit percentage = \( \frac{\text{selling price} - \text{cost price}}{\text{cost price}} \times 100 \)
   \[ 10 = \left( \frac{850 - x}{850} \right) \times 100 \]
   \[ 100x - 20x = 11000 \]
   \[ 80x = 11000 \]
   \[ x = 137.50 \]

4. (a) 64
   (b) 95%.

5. (a) 1508 units
   (b) K 161.30

6. 20%.

7. Annual salary = 12 x 3850
   = K 46,200

8. 10%
31. Simplify \( \frac{2+12}{4+3+8} \) \[1\]

**SOLUTIONS:**

0.5 Or \( \frac{1}{2} \)

32. The first five terms of a sequence are 4, 9, 16, 25, 36, \[\hfill\]
(d) The 10th term \[1\]
(e) The nth term \[1\]
(f) Rearrange the quantities in the descending order 0.00126, 3/2500, 0.125% \[2\]

**SOLUTIONS:**

(a) 121
(b) \((n + 1)^2\)
(c) 0.00126, 0.125, \(\frac{3}{2500}\)

33. Simplify \( \frac{3}{4} \cdot q^8 \times \frac{2}{3} \cdot q^{12} \) \[2\]

(d) Solve the equation \( \frac{x}{4} - 8 = -12 \) \[2\]

**SOLUTIONS:**

(c) 49
(d) 31
34. Simplify \( \left( -\frac{3}{8} - \frac{1}{2} \right) \div \left( \frac{3}{8} - \frac{1}{2} \right) \) \[2\]

**SOLUTIONS:**  7

35. Solve the simultaneous equations below
\[
\begin{align*}
y + \frac{x}{2} &= 5 \\
-6 + x &= 2y
\end{align*}
\] \[3\]

**SOLUTIONS:**
\[x = 5 \frac{1}{3} \text{ and } y = -\frac{1}{3}\]

36. (i) Solve the inequality \(5 - 3x < 17\) \[2\]
(ii) Solve the equation \(x^2 + 4x - 22 = 0\) \[4\]

**SOLUTIONS:**
(iii) \(x > -4 \text{ or } -4 < x\)
(iv) 3.10 or -7.10

37. The point \(X(6,2)\) and \(Y(8,5)\) lie on a straight line.

(c) Calculate the gradient of the line. \[1\]
(d) Find the equation of the line \[2\]

**SOLUTIONS:**
(c) 1.5
(d) \(y = \frac{3}{2}x - 3\)

38.

Solutions:
(iv) $40^\circ$
(v) $70^\circ$
(vi) $70^\circ$

39. Given that the Earth’s mass is 0.010526315 of the mass of the planet Saturn, while the mass of the Earth is $5.7 \times 10^{24}$ kg. Find the mass of the planet Saturn, giving your answer in standard form correct to 2 significant figures.

Solutions:
$5.7 \times 10^{26}$

40. Simplify the indices given below:
(c) $\left(x^{\frac{3}{2}}\right)^{27}$
(d) $\left(\frac{y^{\frac{1}{2}}}{4}\right)^{-2}$

Solutions:
(a) $x^{18/9}$
(b) $2p$
41. [Diagram]

(c) Calculate the gradient of the line Q

(d) Write down the equation of the line

SOLUTIONS:

(c) \( \frac{3}{5} \)

(d) \( y = \frac{3}{5} x - 6 \)

42. Bwalya takes 2.5 liters of water each day. A full glass holds 125 milliliters of water. How many full glasses of water does he drink each day?

SOLUTIONS:

20

43. Given the function \( f(x) = \frac{x+3}{x}, x \neq 0 \)

(c) Calculate \( f\left( \frac{1}{4} \right) \)

(d) Solve \( f(x) = \frac{1}{4} \)

SOLUTIONS:

(c) 13

(d) -4

44.
Given that AD is diameter, angle BAC = 22° and angle BAC = 60°

Calculate:

(iv) Angle DEC [1]
(v) Angle BEC [2]
(vi) Angle CAD [1]

**SOLUTIONS:**

(v) 30
(vi) 22
(vii) 30
(viii) 52

45. The right angled triangle in the diagram has sides of length 7y cm, 24y cm and 150cm.

(c) Show that \( y^2 = 36 \) [2]

(d) Calculate the perimeter of the triangle [1]

**SOLUTIONS:**
(a) show \[y^2 = 36\]
(b) 336m

46. Given that \(f: x \rightarrow 5 - 3x\), calculate:

(iv) \(f(-1)\)  
(v) \(f'(x)\)  
(vi) \(ff^{-1}(8)\)  

SOLUTIONS:

(iv) 8  
(v) \(\frac{5-x}{3}\)  
(vi) 8

47. The matrix \(A = \begin{pmatrix} 1 & x \\ -1 & 2 \end{pmatrix} \)

(a) Write down an expression, in terms of x, for the determinant of A.
(b) Given that the determinant of A is 5
   (i) Calculate the value of x
   (ii) Write down \(A^{-1}\)

SOLUTION:

(a) \(2 + x\)
(b) (i) 3
   (ii) \(A^{-1} = \frac{1}{5} \begin{pmatrix} 2 & -3 \\ 1 & 1 \end{pmatrix}\)

48. On the Venn diagrams given below, shade the appropriate regions
   (b) \(A' \cap C'\)
49. Given that \( B = \begin{pmatrix} x & 8 \\ 2 & x \end{pmatrix} \)
(c) Find $|B|$, the determinant of $B$, in terms of $x$. [1]
(d) Find the values of $x$ when $|B|=9$ [3]

SOLUTIONS:
(c) $X^2 - 16$
(d) 5 or -5

50. The quantity $y$ varies as the cube of $(x + 2)$. $y = 32$ when $x = 0$.
Find $y$ when $x = 7$. [3]

SOLUTIONS:

108

51. The largest possible circle is drawn in inside a semi-circle, as shown in the diagram.
The distance $AB$ is 12 cm.

(c) Find the standard area of the shaded part [4]
(d) Find the perimeter of the segment [2]

SOLUTIONS:
(c) $14.1\text{cm}^2$
(d) $24.8\text{cm}$

52. A boy played Bonanza game 500 times and won 370 of the games. Afterwards he won the next $x$ games and lost none. He won 75% of the games he played. Find the value of $x$. [4]

SOLUTIONS:
53. For the numbers 8, 3, 5, 8, 7, 8 find the mean and median

SOLUTIONS:
Median = 7.5
Mean = 6.5

54. Nkumbu is cycling at 4 meters per second. After 3.5 seconds she starts to decelerate and after a faster 2.5 seconds she stops. The diagram shows the speed-time graph for Nkumbu.

Calculate:
(c) The constant deceleration
(d) The total distance travelled during the 6 seconds

SOLUTIONS:
(c) 1.6
(d) 19

55. E={40,41,42,43,44,45,46,47,48,49}
P= {prime numbers}
O= {odd numbers}
(iii) Put the numbers correctly on the Venn diagram
56. A farmer had 25 hens. 14 of the hens hatched white chicks and 11 hatched black chicks. The farmer chooses two chicks at random.

(c) Write the missing probabilities on the tree diagram below

(d) What is the probability that a farmer chooses two hens which will give
(iii) Two white chicks
(iv) Two chicks of a different color.

**SOLUTIONS:**

(c) \( \frac{11\ 14\ 10}{24'\ 24'\ 24'} \)

(d) (i) \( \frac{91}{300} \)

(ii) \( \frac{77}{150} \)

57. A cyclist accelerates at a speed of 12.4 meters per second in 3 seconds. He cycles at this speed for the next 5 seconds and slows down over the last 2 seconds as shown in the graph below. He crosses the finish line after 10 seconds. Total distance covered is 100m.

(c) Calculate the distance he runs in the first 8 seconds
(d) Calculate his speed when he crosses the finish line

**SOLUTIONS:**

(a) 80.6s

(b) 7m/s

58. A certain hall was built in 1996 and cost K62, 000. It was sold in 2006 for K310, 000.

(c) Calculate the 1996 price as a percentage of 2006 price.
(d) Calculate the percentage increase in price from 1996 to 2006.

**SOLUTIONS:**

(c) 20%

(d) 400%
59. The scale of a plan of a school is 1:500
   (c) If the road from the kitchen to the boys dormitories is 20m on the ground. What is the distance the distance between the kitchen and boys dormitories on the map in centimeters?
   (d) If the area of the school compass is 20km$^2$ on the ground. What is its area on the map in cm?

SOLUTIONS:
   (c) 4cm
   (d) 4cm

60. The graph of the equation $y = (x - 3)(x + 2)$ is shown below. It crosses the $x$ axis at A and C the $y$ axis at B as shown below.
   (a) Find the coordinates of B and C
   (b) The length of Ac.

SOLUTIONS:
   (iii) A(-2, 0) C(0, -6)
   (iv) $|AC| = 5$

61. Triangle ABC is a right angle. BCD is a straight line, AC=12cm and AB=8cm.
Express as a fraction

(iii) \( \sin \angle ACB \)

(iv) \( \cos \angle ACD \)

**SOLUTIONS:**

(iii) \( \sin C = \frac{2}{3} \)

(iv) \( \cos C = -\frac{1}{2} \)

62. In the diagram below, EAF is a straight line and AB is parallel to CD

Find the value of:

(a) \( x \) \hspace{1cm} [1]

(b) \( y \) \hspace{1cm} [1]
SOLUTIONS:

(a) \( x = 64 \)
(b) \( y = 58 \)

63. (a) A car dealer sold his spare parts at $1000. He made a profit of 25% on the price paid for them. Calculate the price at which she bought the spare parts in local currency (kwacha) if the dollar trading at $1 = K9, 250.00. \[2\]

(b)(i) evaluate \( 5^0 + 5^2 \) \[1\]

(ii) Simplify
1. \( \left( \frac{1}{2} \right)^2 \) \[1\]
2. \( (x^6)^{1/2} \) \[1\]

SOLUTION:

(a) K6, 937.50
(b) (i) 26
(ii)(1) \( x^2 \)
(2) \( x^3 \)

64. Given that \( c = \frac{5}{9}(f - 32) \)

(a) Calculate \( c \) when \( f = -4 \)
(b) Express \( f \) in terms of \( c \)

SOLUTIONS:

(a) 20
(b) \( f = \frac{160 + 9c}{5} \)

65. On the grid in the answer space \( \overrightarrow{OP} = p \) and \( \overrightarrow{OQ} = q \)

(a) Given that \( \overrightarrow{OR} = p - q \), mark the point \( R \) clearly on the grid.

(b) The point \( S \) is shown on the grid. Given that \( \overrightarrow{OS} = q + hp \), find \( h \).

SOLUTION:

(a) Mark \( R \) two squares below \( P \)
(b) $h = -\frac{3}{4}$ or $-0.75$

66. AOB is the sector of a sector of radius $r$ cm. $A\hat{O}B = 60^\circ$

Find in its simplest terms of $r$ and $\pi$

(i) the area of the sector
(ii) the perimeter of the sector

SOLUTIONS:

(i) $\frac{1}{6} \pi r^2$

(ii) $r \left(\frac{6+\pi}{3}\right)$

67. A man who is 1.8 m tall stands on horizontal ground 50m from a vertical tree. The angle of elevation of top of the tree from his eyes is $30^\circ$. Use as much of the information given below as necessary to calculate an estimate of the height of the tree. Give your answer to a reasonable degree of accuracy. [$\sin 30^\circ = 0.5$, $\cos 30^\circ = 0.866$, $\tan = 0.577$] [4]
SOLUTION:

ABCD is a parallelogram. X is the point on BC such that BX: XC = 2:1.
\[ \overrightarrow{AB} = 2p \text{ and } \overrightarrow{AD} = 3q. \] Find, in terms of p and q,

(a) \[ \overrightarrow{AC} \]  
(b) \[ \overrightarrow{AX} \]  
(c) \[ \overrightarrow{XD} \]

SOLUTIONS:

(a) \[ 2p + 3q \]  
(b) \[ 2p + 2q \]  
(c) \[ q - 2p \]
At Ituna Secondary School, 100 pupils were picked at random, 80 were taking Ordinary Mathematics (OM) and 35 were taking Additional Mathematics (AM). Where,

X students were taking Ordinary Mathematics and Additional Mathematics

Y students study neither Ordinary nor Additional Mathematics

The Venn diagram below illustrates this information

(a) Express in set builder notation, the value of x. [1]
(b) Find, in its simplest form, an expression for y in terms of x. [2]
(c) Find:
   (i) The least value of x [1]
   (ii) The greatest possible value of y [1]

SOLUTIONS:

(a) \( y = n(S \cup F) \)
(b) \( y = x - 15 \)
(c) 
  (i) \( y = 15 \)
  (ii) \( y = 20 \)

Below is display of findings of results of the following games; Football (F), Netball (N) and Tennis (T).

---

Answer the whole of this question on a sheet of graph paper.

The variables \( x \) and \( y \) are connected by the equation

\[
y = \frac{x^2}{8} - \frac{18}{x} = -5
\]
(a) Calculate the value of q

(b) Using a scale of 2cm to 1 unit, draw a horizontal $x - \text{axis}$ for $0 \leq x \leq 8$. Using a scale of 1cm to 1 unit, draw a vertical $y - \text{axis}$ for $0 \leq y \leq 14$. On your axes, plot the points given in the table and join them with a smooth curve.

(c) Use your graph to find
   (i) The value of $x$ when $y = 8$
   (ii) The least value of $y$

(d) By drawing a tangent, find the gradient of the curve at the point where $x = 2.5$

(e) On the axes used in part (b), draw the graph of $y = 12 - x$.

SOLUTIONS:

(a) $y = 2.5$

(b) Draw a smooth graph using the values given

(c) (i) $x = 1.4$  (ii) least value = 6.5

(d) Gradient = -2

(e) The line should pass through points (1.2, 6.2) and (3.7, 0)

---

The variables $x$ and $y$ are connected by the equation

$y = 24 + 10x - x^2$

(a) Solve the equation $0 = -24 + 10x - x^2$

(b) The table shows values of $x$ and the corresponding values of $y$

<table>
<thead>
<tr>
<th>$X$</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>24</td>
<td>40</td>
<td>48</td>
<td>48</td>
<td>40</td>
<td>$p$</td>
</tr>
</tbody>
</table>

(i) Find the value of $p$

(ii) Using a scale of 1cm to represent 1metre, draw a horizontal $x - \text{axis}$ for $0 \leq x \leq 14$. Using a scale of 2cm to represent 10 meters drawn a vertical $y - \text{axis}$ for $0 \leq y \leq 50$. On your axes, plot the points from the table and join them with a smooth curve.
(iii) By drawing a tangent, find the gradient of the point $(8, 40)$ [2]

(c) Given that $y = 24 + 10x - x^2$ and $y = -(x - 5)^2$. Find the value of $y$ [3]

(d) The range of $y = 24 + 10x - x^2$ [1]

SOLUTIONS:

(a) $x = -2$ or $12$

(b) (i) value of $p = 24$  (ii) Draw a smooth graph (iii) the line should pass through $(8, 40)$ and $(4, 60)$

(c) $y = 49$

(d) $0 \leq y \leq 49$

The variables $x$ and $y$ are connected by the equation below:

$y = 22x - 4.9x^2$

And below are values of $x$ and $y$

<table>
<thead>
<tr>
<th>$X$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>2.5</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>0</td>
<td>17.1</td>
<td>24.4</td>
<td>24.4</td>
<td>21.9</td>
<td>9.6</td>
<td>-12.5</td>
<td>$p$</td>
</tr>
</tbody>
</table>

(a) Calculate the value of $p$ [1]

(b) Using a scale of 2cm to 1unit, draw a horizontal $x - \text{axis}$ for $0 \leq x \leq 6$. Using a scale of 2cm to 10 meters, draw a vertical $y - \text{axis}$ for $-50 \leq y \leq 30$. On your graph, plot the points given in the table and join them with a smooth curve. [3]

(c) Use the graph to find

(i) The maximum value of $y = 22x - 4.9x^2$ [1]

(ii) The value of $y$ when $x = 4.5$ [2]

(d) By drawing a tangent, find the gradient of the graph at $(3, 21.9)$ [2]

(e) The area bounded by the curve and the $x - \text{axis}$ [3]

SOLUTIONS:

(a) Value of $p = -44.4$

(b) Draw a smooth graph

(c) (i) maximum value of $y = 24.5$  (ii) $y=0$

(d) Gradient = - 8.9

(e) Area = 70 units$^2$
In the diagram, find:

(i) Describe position Q, W and V

(ii) The difference in longitude between P and Q; P and T

(iii) The difference in latitude between S and U; S and W

SOLUTIONS:

(i) W(40° S, 40° E) and V(10° N, 45° E)

(ii) and T is 75°

Describe position Q, W [1]

The difference in longitude between P and Q; P and T [1]

The difference in latitude between S and U; S and W [1]

Q(30° N, 10° W),

For P and Q is 20° ; P
(iii) For $S$ and $U$ is $20^\circ$ ; $S$ and $W$ is $70^\circ$

(a) Two places $P$ and $Q$ lie on the line of latitude $57^\circ$. Find the distance between them measured along the line of latitude if the difference in longitude is $42^\circ$.

(b) A plane flies north from town $A(30^\circ S, 15^\circ E)$ to town $B(30^\circ N, 15^\circ E)$ in 12 hours. Find the speed of the plane, taking the radius of the Earth to be $3437\; nm$ and $\pi$ to be $3.142$.

SOLUTION:

(a) $2,543.50 km.$

(b) $3599\; nm.$

P and $Q$ are points on the surface of the Earth situated on the same parallel of latitude $70^\circ\; N$ as shown in the diagram below. The longitudes of $P$ and $Q$ are $25^\circ\; W$ and $15^\circ\; E$ respectively. $A$ and $B$ are points on the Equator, such that $A$ is due South of $P$ and $B$ is due south of $Q$.

$[\pi = 3.142, R = 3437\; nm]$
(a) State the position of the point Q
(b) Find the distance between A and B.
(c) Calculate the radius of the small circle of latitude 70° N
(d) Find the distance along the parallel of latitude between P and Q, correct to 2 decimal places

SOLUTIONS:

(a) Q(70° N, 15° E)
(b) 2156.92nm
(c) 1175.52nm
(d) 2399nm

The diagram below shows positions of three towns A, B, and C.
(a) An Aircraft flies due south from A to B in nautical miles. Calculate the distance. [2]
(b) Calculate the average speed in knots of the aircraft in (a). [2]
(c) Given that the aircraft flies further from B to C in nm, calculate the distance travelled from B to C. [2]
(d) Another aircraft flies at an average speed of 150 knots and has fuel for three hours. Calculate the longitude to the nearest degree of the most western point the aircraft must reach before the fuel is used up completely. [3]

SOLUTIONS:

(a) 2340 nm
(b) 213 knots
(c) 472 nm
(d) 131°

X, Y and Z are points on the surface of the Earth as shown in the diagram below. X is on the parallel of latitude 55° N, Z and Y are on the same parallel of latitude 65° S, X and Y are on the same longitude 30° E and Z is on longitude 45° W. \[ \pi = 3.142, R = 6370 \, km. \]
(a) Find the difference in latitude between points X, Y

(b) Calculate the distance XY along the same longitude, giving your answer to the nearest kilometer.

(c) If the local time at Z is 06:00 hours, what is the time at Y?

(d) Find the distance ZY in kilometers, giving your answer to the nearest kilometer.

SOLUTIONS:

(a) 120°

(b) 13343km

(c) 11:00 hours

(d) 3524km