1. (a) (i) Required to calculate: \( \frac{2\frac{1}{2} + 1\frac{1}{8}}{\frac{4\frac{1}{2}}{8}} \).

**Calculation:**

\[
\begin{align*}
2\frac{1}{2} + 1\frac{1}{8} &= \frac{5}{2} + \frac{9}{8} \\
&= \frac{20 + 9}{8} \\
&= \frac{29}{8}.
\end{align*}
\]

We first work the numerator

\[
3 \times \frac{29}{8} = \frac{87}{8}
\]

Hence,

\[
\frac{\text{Numerator}}{\text{Denominator}} = \frac{87}{8} \cdot \frac{8}{2} = \frac{87}{4} = \frac{21 + 1}{2} = \frac{21 + 3}{6} = \frac{24}{6}.
\]

Converting both numerator and denominator into improper fractions. Then

inverting the denominator and multiplying to get:

\[
\begin{align*}
\frac{8}{2} &= \frac{9}{8} \\
\frac{27}{8} &= \frac{27}{8} \times \frac{2}{9} \\
&= \frac{3}{4} \text{ (in exact form)}.
\end{align*}
\]

(ii) **Required to calculate:** \(3.96 \times 0.25 - \sqrt{0.0256} \)

**Calculation:**

The arithmetic is a bit cumbersome, especially with finding the square root of 0.0256. So, we use the calculator to find 3.96 x 0.25, then \(\sqrt{0.0256} \), to get

\[
3.96 \times 0.25 - \sqrt{0.0256} = 0.99 - 0.16 = 0.83 \text{ (in exact form)}.
\]

(b) **Required to calculate:** \( W, X, Y \) and \( Z \).

**Calculation:**
The total cost, \( W \), of \( 6 \frac{1}{2} \) kg of rice @ \$2.40 per kg = \( 6\frac{1}{2} \times 2.40 \)

\[ = \$ 15.60 \]

Hence the value of \( W = \$15.60 \)

The cost of 4 bags of potatoes = \$52.80

Hence the unit price of potatoes, \( X = \frac{52.80}{4} \)

\[ = \$ 13.20 \]

Hence the value of \( X = \$13.20 \)

The cost of \( Y \) cartons of milk @ \$2.35 each = \$14.10

The value of \( Y = \frac{\text{Total cost of milk}}{\text{Cost of 1 carton}} \)

\[ = \frac{14.10}{2.35} \]

\[ = 6 \]

Hence, \( Y = 6 \)

\( Z \% \) VAT = \$9.90

Sub-total = \$82.50

\[ Z = \frac{\text{V.A.T.}}{\text{Sub-Total}} \times 100 \]

\[ = \frac{9.90}{82.50} \times 100 \]

\[ = 12 \]

The value of \( Z = 12 \)

2. (a) **Required To Write:** \( \frac{x-2}{3} + \frac{x+1}{4} \) as a fraction in its lowest terms.

**Solution:**

The LCM of 4 and 3 is 12. So,

\[ \frac{x-2}{3} + \frac{x+1}{4} = \frac{4(x-2)+3(x+1)}{12} \]

\[ = \frac{(7x-5)}{12} \quad \text{(as a fraction in its lowest terms)} \]

(b) **Data:** \( ab = (a + b)^2 - 2ab \)

**Required to calculate:** \( 3 * 4 \)
Calculation:
In the binary operation of $3 \star 4$, the value of
\[ a = 3, \quad b = 4 \]
\[ \therefore 3 \star 4 = (3 + 4)^2 - 2(3)(4) \]
\[ = (7)^2 - 24 \]
\[ = 49 - 24 \]
\[ = 25 \]

(c) (i) **Required to factorise**: $xy^3 + x^2y$

**Solution:**
We separate the common terms from each of the two terms. These are shown underlined.
\[ xy^3 + x^2y = xy \cdot y^2 + x \cdot xy \]
\[ = xy(y^2 + x) \]

(ii) **Required to factorise**: $2mh - 2nh - 3mk + 3nk$

**Solution:**
The four terms are grouped into two terms of two each. We factor out the common factor in each of the two groups to get:
\[ 2mh - 2nh - 3mk + 3nk = 2h(m - n) - 3k(m - n) \]
\[ = (m - n)(2h - 3k) \]

(d) **Data**: Table of values of the variables $x$ and $y$.
**Required to find**: the value of $a$ and of $b$

**Solution:**

<table>
<thead>
<tr>
<th>$x$</th>
<th>$y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>$a$</td>
</tr>
<tr>
<td>$b$</td>
<td>48</td>
</tr>
</tbody>
</table>

$y$ varies directly as $x$.
This may be expressed as
\[ y \propto x \]
\[ \therefore y = kx \]
(\text{where } k \text{ is the constant of proportion or constant of proportionality})

When $x = 2$ and $y = 12$
(data from the table of values)
\[ 12 = k(2) \]
\[ 12 = 2k \]
\[ \therefore k = 6 \]

Hence the equation can now be expressed as $y = 6x$
When \( x = 5, y = a \)  
\[
\therefore \ a = k(5) \\
a = (6)(5) \\
= 30
\]

When \( x = b, y = 48 \)  
\[
\therefore \ 48 = k(b) \\
48 = 6b \\
\therefore \ b = 8
\]

Hence, the value of \( a = 30 \) and the value of \( b = 8 \).

3. (a) **Data:** A given Venn diagram, \( U = \{\text{Students in a class of } 35\} \)

\[
\begin{array}{c}
\text{U} \\
M \\
x + 5 \\
4 \\
\hline \\
A \\
8 \\
x \\
\hline
\end{array}
\]

(i) **Required to find:** The number of students who do not study either Art or Music.  
**Solution:**  
The number of students who do not belong to the set \( M \) or the set \( A \) is 4 as shown in the complement region of \( M \cup A \) and is the number of students who do not study either Art or Music.  
(This number is seen on the diagram in \((M \cup A)'\).)

(ii) **Required to find:** The value of \( x \).  
**Solution:**  
The sum of all the numbers of all the subsets of the Universal set in the diagram.  
\[
= (x + 5) + 8 + (x) + 4 \\
= 2x + 17
\]

The total number of students = 35 (data)  
Hence, we may equate  
\[
\therefore \ 2x + 17 = 35 \\
2x = 35 - 17 \\
x = 9
\]
(iii) **Required to find:** The number of students studying Music only.

**Solution:**
The value of \( x = 9 \)
\[ n (M \text{ only}) = (9 + 5) \text{ as shown on the diagram} \]
\[ = 14 \text{ students} \]

(b) (i) **Data:** \( EF = 8 \text{ cm}, \angle EFG = 125^\circ, FG = 4 \text{ cm}, \angle HEF = 70^\circ, \) \( EH = 7 \text{ cm} \)

**Required:** To draw the quadrilateral with the above measurements.

**Solution:**
Draw a straight line longer than 8 cm and cut off \( EF = 8 \text{ cm} \).
At \( E \) we draw an angle of \( 70^\circ \) and at \( F \) we draw an angle of \( 125^\circ \)
Cut off \( FG = 4 \text{ cm} \)
Cut off \( GH = 8.5 \text{ cm} \)

(ii) **Required to find:** The length of \( GH \).

**Solution:**
\( GH = 8.5 \text{ cm} \) (by measurement using the ruler)

4. (a) (i) **Data:** \( 5 - 2x < 9 \)

**Required to find:** \( x \)

**Solution:**
The procedure is much the same as solving an equation
\[5 - 2x < 9\]
\[5 < 9 + 2x\]
\[5 - 9 < 2x\]
\[-4 < 2x\]
\[\therefore -\frac{4}{2} < x\]
\[-2 < x\]
\[x > -2\]

(ii) **Data:** \(x \in \mathbb{Z}\)

**Required to find:** The smallest value of \(x\)

**Solution:**
\[x \in \mathbb{Z}\]
\[\therefore x_{\text{min}} = -1\]

\[\text{(b) (i) Data:}\]

\[121 \text{ cm}^2\]

\[l\]

\(a) \quad \text{Required to calculate: } l, \text{ length of side.}

\text{\textbf{Calculation:}}

The area of a square is side \(\times\) side. So,
\[l \times l = 121\text{ cm}^2\]
\[\therefore l = \sqrt{121}\text{ cm}\]
\[= 11\text{ cm}\]

\(b) \quad \text{Required to find: Perimeter of square.}

\text{\textbf{Calculation:}}

Perimeter = \(l \times 4\)
The side, \(l\), was found to be 11 cm
So, perimeter is
\[= 11 \times 4\]
\[= 44\text{ cm}\]
(ii) a) **Data:**

![Diagram of a square and a circle](image)

**Required to find:** The radius of the circle

**Solution:**
The circumference of the circle is the same as the perimeter of the Square (data)

Since the perimeter of the square is 44 cm, then,

\[
2\pi r = 44
\]

\[
2 \times \frac{22}{7} \times r = 44
\]

\[
\therefore r = 7 \text{ cm}
\]

b) **Required to find:** Area of the circle.

**Solution:**

\[
A = \pi r^2
\]

\[
= \left( \frac{22}{7} \right) (7)^2
\]

\[
= 154 \text{ cm}^2
\]

5. a) **Data:**

![Diagram of a triangle](image)
Triangle $OMN'$ is the image of triangle $OMN$ after undergoing an enlargement, about the center $O$.

(i) **Required to Find:** Value of $k$, the scale factor.

**Solution:**

$OMN \xrightarrow{\text{Enlargement}} O'M'N'$,

The center of enlargement is $O$.

Separating the 2 triangles so we may better view them.

Scale Factor = $\frac{\text{Image Length}}{\text{Object Length}}$

Choosing $\frac{N'M'}{NM}$

$$\frac{16}{8} = 2$$

(ii) **Required to calculate:** The length of $OM$.

**Calculation:**

$$OM^2 = (6)^2 + (8)^2$$ (by using Pythagoras’ Theorem)

$$= 36 + 64$$

$$OM = \sqrt{100}$$

$$= 10 \text{ cm}$$

(iii) **Required to calculate:** The length of $OM'$.

**Calculation:**

The scale factor of the enlargement is 2

$$\frac{OM'}{OM} = 2$$

$$\frac{OM'}{10} = 2$$

$$OM' = 20 \text{ cm}$$
(b) **Data:**

\[
\begin{align*}
&\hspace{1cm} Q \hspace{1cm} 12.6 \text{ m} \hspace{1cm} 3.26 \text{ m} \hspace{1cm} 8.4 \text{ m} \\
&\hspace{1cm} 15^\circ \hspace{1cm} S \hspace{1cm} R
\end{align*}
\]

\(PQ = 12.6 \text{ cm}, \ QR = 8.4 \text{ cm} \) and \(Q\hat{P}R = 15^\circ\)

(i) **Required to find:** Length of \(QS\), to 3 significant figures.

**Solution:**

Looking separately at the right-angled triangle \(PQS\).

\[
\sin 15^\circ = \frac{QS}{12.6} \hspace{1cm} \text{(definition)}
\]

\[
QS = 12.6 \times (\sin 15^\circ)
\]

\[
= 3.26 \text{ m to 3 s.f.}
\]

(ii) **Required to find:** \(\hat{RQS}\) to 3 significant figures.

**Solution:**

Considering the right-angled triangle \(RQS\)

\[
\cos \hat{RQS} = \frac{3.261}{8.4}
\]

\[
\hat{RQS} = \cos^{-1} \left( \frac{3.261}{8.4} \right)
\]

\[
= 67.15^\circ \approx 67.2^\circ \text{ (to 3 s.f.)}
\]

(iii) **Required to find:** The area of \(\triangle PQR\)

**Solution:**

\[
P\hat{Q}S = 180^\circ - (90^\circ + 15^\circ)
\]

\[
= 75^\circ
\]

\(\therefore P\hat{Q}R = 67.2^\circ + 75^\circ = 142.21^\circ\)

(The sum of angles in a triangle = 180°)
In triangle $PRQ$ we have two sides and the included angle. So,

Area of $\Delta PQR = \frac{1}{2}(QP \times QR) \sin PQR$

$$= \frac{1}{2}(12.6 \times 8.4) \sin PQR$$

$$= \frac{1}{2}(12.6 \times 8.4) \sin 142.21^\circ$$

$$= 32.42$$

$$= 32.4 \text{ cm}^2 \text{ (to 3 s.f.)}$$

6. (a) **Data:** $f(x) = 6x + 8$ and $g(x) = \frac{x-2}{3}$.

(i) **Required to calculate:** $g\left(\frac{1}{2}\right)$.

**Calculation:**
We substitute $x = \frac{1}{2}$ in $g(x)$ to get

$$g\left(\frac{1}{2}\right) = \frac{\left(\frac{1}{2}\right)-2}{3} = -\frac{1}{2}$$

(ii) **Required to calculate:** An expression for $gf(x)$.

**Calculation:**
We could find $gf(x)$ by replacing $x$ in $g(x)$ by $f(x)$.

$$gf(x) = g(f(x)) = g(6x + 8)$$

$$= \frac{(6x + 8) - 2}{3} = \frac{6x + 6}{3}$$

$$= 2x + 2$$

(iii) **Required to calculate:** $f^{-1}(x)$

**Calculation:**
Let $f(x)$ be $y$.

$y = 6x + 8$

Interchange $x$ and $y$.

$x = 6y + 8$

$x - 8 = 6y$

$y = \frac{x - 8}{6}$

$\therefore f^{-1}(x) = \frac{x - 8}{6}$
(b) (i) **Required to find:** The coordinates of \( A \) and of \( B \).

**Solution:**

Read off from the graph
\[ A = (-2, 3) \]
\[ B = (4, 6) \]

(ii) **Required to find:** The gradient of \( AB \).

**Solution:** Using the formula for gradient, we get
\[
\text{Gradient} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6 - 3}{4 - (-2)} = \frac{1}{2}
\]

(iii) **Required to find:** The equation of the line passing through \( A \) and \( B \).

**Solution:**
Choosing \( A = (-2, 3) \)

Then using \( \frac{y - y_1}{x - x_1} = m \), where \( (x_1, y_1) \) is a point on the line and \( m \) is the gradient. We get
\[
\frac{y - 3}{x - (-2)} = \frac{1}{2}
\]
\[
2(y - 3) = x + 2
\]
\[
2y = x + 6
\]
\[
2y = x + 2 + 6
\]
\[
2y = x + 8
\]
\[
y = \frac{1}{2}x + 4
\]

If, instead, we had chosen \( B \) as the point, the equation would have been the same.
7. (a), (b) **Data:** Number of packages = 100

**Mass is a continuous variable**
L.C.B-lower class boundary
U.C.B-upper class boundary

<table>
<thead>
<tr>
<th>Mass, ( m ) (kg)</th>
<th>L.C.B</th>
<th>U.C.B.</th>
<th>No. of Packages (Frequency)</th>
<th>Cumulative Frequency</th>
<th>Points to Plot (U.C.B., C.F.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>(0.5, 0)</td>
</tr>
<tr>
<td>1 – 10</td>
<td>0.5 ( \leq m &lt; 10.5 )</td>
<td>12</td>
<td>0 + 12 = 12</td>
<td>(10.5, 12)</td>
<td></td>
</tr>
<tr>
<td>11 – 20</td>
<td>10.5 ( \leq m &lt; 20.5 )</td>
<td>28</td>
<td>12 + 28 = 40</td>
<td>(20.5, 40)</td>
<td></td>
</tr>
<tr>
<td>21 – 30</td>
<td>20.5 ( \leq m &lt; 30.5 )</td>
<td>30</td>
<td>40 + 30 = 70</td>
<td>(30.5, 70)</td>
<td></td>
</tr>
<tr>
<td>31 – 40</td>
<td>30.5 ( \leq m &lt; 40.5 )</td>
<td>22</td>
<td>70 + 22 = 92</td>
<td>(40.5, 92)</td>
<td></td>
</tr>
<tr>
<td>41 – 50</td>
<td>40.5 ( \leq m &lt; 50.5 )</td>
<td>8</td>
<td>92 + 8 = 100</td>
<td>(50.5, 100)</td>
<td></td>
</tr>
</tbody>
</table>

We plot (upper class boundary, cumulative frequency)

**Cumulative frequency**

(c) (i) **Required to find:** Median mass

**Solution:**
½ of CF is 50
The horizontal at 50 is drawn to meet the curve. At the point of meeting, a vertical is dropped to obtain the read off that is the median
Median mass = 24 kg (as shown on the diagram)

(ii) **Required To Find:** Probability that the mass of a package is less than 35 kg

**Solution:**
The vertical at 35 is drawn to meet the curve. At the point of meeting, a horizontal is drawn to obtain the read off that is the number of packages that is < 35 kg and which is 81.

\[ P(\text{Mass} < 35 \, \text{kg}) = \frac{\text{No. of packages} < 35 \, \text{kg}}{\text{Total no. of packages}} = \frac{81}{100} \]
8. Answer Sheet for Question 8

(a)

(b) (i) Number of the diagram $\times 4$
      $= 6 \times 4 = 24$ sticks

(ii) The number of the diagram is 7
     The number of sticks $= 7 \times 4 = 7(4)$
     The rule connecting $t$ and $s$ gives
     $1 + \left( \frac{3}{4} \times 7(4) \right) = 22$

Hence, the number of thumb tacks in the seventh diagram is 22

(c)

<table>
<thead>
<tr>
<th>No. of sticks $s$</th>
<th>Rule Connecting $t$ and $s$</th>
<th>No. of Thumb Tacks $t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>$1 + \left( \frac{3}{4} \times 4 \right)$</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>$1 + \left( \frac{3}{4} \times 8 \right)$</td>
<td>7</td>
</tr>
<tr>
<td>12</td>
<td>$1 + \left( \frac{3}{4} \times 12 \right)$</td>
<td>10</td>
</tr>
<tr>
<td>52</td>
<td>$1 + \left( \frac{3}{4} \times 52 \right)$</td>
<td>40</td>
</tr>
<tr>
<td>(i)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>$1 + \left( \frac{3}{4} \times x \right) = 55$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\frac{3}{4} x = 54$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$x = \frac{54 \times 4}{3}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$x = 72$</td>
<td>55</td>
</tr>
<tr>
<td>(ii)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(d) $t = 1 + \left( \frac{3}{4} \times s \right)$
9. (a) **Data:** \( y = x^2 - x + 3 \quad \text{(1)} \) and \( y = 6 - 3x \quad \text{(2)} \)

**Required to solve:** The value of \( x \) and of \( y 

**Solution:**

Solving simultaneously

Equating the equations (1) and (2) since both are equal to \( y \).

We obtain a quadratic in \( x \).

\[
\begin{align*}
  x^2 - x + 3 &= 6 - 3x \\
  x^2 - x + 3 - 6 + 3x &= 0 \\
  x^2 + 2x - 3 &= 0 \\
  (x + 3)(x - 1) &= 0 \\
  x &= 1 \text{ or } -3
\end{align*}
\]

When \( x = 1 \)

\[
y = 6 - 3(1) \\
= 6 - 3 \\
= 3
\]

When \( x = -3 \)

\[
y = 6 - 3(-3) \\
= 6 + 9 \\
= 15
\]

Hence, \( x = 1, y = 3 \) **OR** \( x = -3, y = 1 \)

(b) (i) **Data:** \( 4x^2 - 8x - 2 = a(x + h)^2 + k \), \( a, h \) and \( k \) are constants.

**Required to express:** \( 4x^2 - 8x - 2 \) in the form \( a(x + h)^2 + k \).

**Solution:**

\[
\begin{align*}
  4x^2 - 8x - 2 &= 4(x^2 - 2x) - 2 \\
  &= 4[(x - 1)^2 - 1] - 2 \\
  &= 4(x - 1)^2 - 4 - 2 \\
  &= 4(x - 1)^2 - 6
\end{align*}
\]

\[
\frac{1}{2} \text{ coefficient of } -2x = \frac{1}{2}(-2) = -1
\]

Therefore \( 4(x - 1)^2 - 6 \) is of the form \( a(x + h)^2 + k \) where \( a = 4, h = -1 \) and \( k = -6 \).

(Note that we could have also expanded the right hand side and equated coefficients to obtain the same solution)

(ii) **Required to find:** The \( x \) – coordinate of the minimum point on \( f(x) \)

**Solution:**

\[
\begin{align*}
  4(x - 1)^2 - 6 &= 0 \\
  4(x - 1)^2 &\geq 0, \quad \forall x \\
  \therefore \text{ minimum } f(x) &= 4(0) - 6 = -6
\end{align*}
\]

This occurs when \( 4(x - 1)^2 = 0 \) and \( x = 1 \)
During the first stage the car’s speed increases from 0 ms$^{-1}$ to 12 ms$^{-1}$. Acceleration = 0.6 ms$^{-2}$ is constant and shown by a straight line branch.

(i) **Required to find:** Value of $x$.
**Solution:** The gradient of the line on a velocity-time graph gives the acceleration.

\[
\frac{12 - 0}{x - 0} = 0.6
\]
\[
x = \frac{12}{0.6} = 20 \text{ s}
\]

(ii) **Required to explain:** What takes place during the second stage.
**Solution:** In the second stage of the journey, from 20 to 25 seconds, the velocity is constant as the gradient is 0. There is no acceleration or the acceleration is 0 ms$^{-2}$. The branch is a horizontal line and the car is moving at the constant speed of 12 ms$^{-1}$.

(iii) **Required to find:** The distance travelled during the third stage.
**Solution:**
The area under a speed – time graph gives distance covered. The third stage is shown as the shaded triangle.

\[
\text{Area} = \frac{(60 - 25) \times 12}{2} = 210 \text{ m}
\]

10. (a) **Data:**

\[
\begin{align*}
&\text{(i) Required to calculate: } X\hat{O}Z \\
&\text{Calculation: } \\
&X\hat{Y}Z = 180^\circ - 64^\circ = 116^\circ \\
&(\text{The opposite angles of the cyclic quadrilateral } WXYZ \text{ are supplementary}).
\end{align*}
\]

\[
\begin{align*}
&\text{(ii) Required to calculate: } Y\hat{X}Z \\
&\text{Calculation: } \\
&Y\hat{X}Z = 23^\circ \\
&(\text{The angle made by the tangent to a circle and a chord, angle } VYZ \text{ at the point of contact } = \text{ angle in the alternate segment, angle } YXZ.)
\end{align*}
\]

\[
\begin{align*}
&\text{(iii) Required to calculate: } O\hat{X}Z \\
&\text{Calculation: } \\
&OX = OZ \text{ (radii of the same circle)} \\
&\text{Triangle } OXZ \text{ is isosceles (two sides are equal) and the base angles are therefore equal.}
\end{align*}
\]
\[
O\hat{X}Z = \left(\frac{180^\circ - 128^\circ}{2}\right) \quad (\text{The sum of angles in a triangle} = 180^\circ).
\]
\[
= \frac{52^\circ}{2}
\]
\[
= 26^\circ
\]

(b) **Data:**

(i) **Required to calculate:** The value of \(x\).

**Calculation:**
\[
x^\circ = 180^\circ - (48^\circ + 56^\circ)
\]
\[
= 76^\circ \quad (\text{The angles at a point in a straight line} = 180^\circ)
\]

(ii) **Required to calculate:** The length of \(RP\).

**Calculation:**
Applying the cosine rule to triangle \(PQR\) since we have two sides and the included angle
\[
(RP)^2 = (220)^2 + (360)^2 - 2(220)(360)\cos 56^\circ
\]
\[
= 48400 + 129600 - (158400)(\cos 56^\circ)
\]
\[
RP = \sqrt{178000 - (158400)(\cos 56^\circ)}
\]
\[
= 299.0
\]
\[
= 299 \text{ km}
\]

(iii) **Required to calculate:** The bearing of \(R\) from \(P\).

**Calculation:**
Using the sine rule on triangle \(PQR\)
Bearing is the direction measured from North in a clockwise direction.

\[ \frac{RQ}{\sin R\hat{P}Q} = \frac{RP}{\sin 56^\circ} \]

\[ \frac{360}{\sin R\hat{P}Q} = \frac{299}{\sin 56^\circ} \]

\[ \sin R\hat{P}Q = \frac{360 \times \sin 56^\circ}{299} \]

\[ R\hat{P}Q = \sin^{-1} \left( \frac{360 \times \sin 56^\circ}{299} \right) = 86.5^\circ \]

\[ \therefore \text{Bearing of } R \text{ from } P: 132^\circ + 86.5^\circ = 218.5^\circ \]

11. (a) **Data:** Matrix, \( M = \begin{pmatrix} 3 & 5 \\ 2 & 4 \end{pmatrix} \)

**Required to calculate:** Inverse of the matrix

**Calculation:**

We first find the determinant of \( M \)

\( \det M = (4)(3) - (5)(2) = 12 - 10 = 2 \)

Now we find the inverse of \( M \).

\[ M^{-1} = \frac{1}{2} \begin{pmatrix} 4 & -5 \\ -2 & 3 \end{pmatrix} \]

\[ = \begin{pmatrix} 2 & \frac{5}{2} \\ -1 & \frac{3}{2} \end{pmatrix} \]

\[ = \begin{pmatrix} 2 & 2 \frac{1}{2} \\ -1 & \frac{1}{2} \end{pmatrix} \]

(b) **Data:** \( R(7, 2) \xrightarrow{M=\begin{pmatrix} 0 & a \\ b & 0 \end{pmatrix}} R'(2, -7) \)

\( T(-5, 4) \xrightarrow{M=\begin{pmatrix} 0 & a \\ b & 0 \end{pmatrix}} T'(4, 5) \)

(i) **Required to calculate:** The value of \( a \) and of \( b \).

**Calculation:**
Both are 2x1 matrices and are equal. So equating corresponding entries we obtain

\[
\begin{align*}
2a &= 2 \\
a &= 1
\end{align*}
\]

\[
\begin{align*}
7b &= -7 \\
b &= -1
\end{align*}
\]

\[
\therefore M = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}
\]

(ii) **Required to describe**: The transformation that \( M \) represents.

**Solution**:

\( M = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \) is the matrix that represents a \( 90^\circ \) clockwise rotation about the origin.

(c) **Data**: \( WXYV \) is a parallelogram.

\[
\begin{align*}
VY &= a \\
VW &= b \\
WS : SY &= 1:2
\end{align*}
\]

(i) a) **Required To Write**: An expression in terms of \( a \) and \( b \) for \( \overline{WY} \).

**Solution**:

Applying the vector triangle law

\[

WY = WV + VY
\]

\[
= a + (-b)
\]

b) **Required to write**: An expression in terms of \( a \) and \( b \) for \( \overline{WS} \).

**Solution**:
\[WS = \frac{1}{3} WY\]
\[\quad = \frac{1}{3} (a - b)\]
\[\quad = \frac{a - b}{3} \text{ or } \frac{1}{3} a - \frac{1}{3} b\]

c) **Required To Write:** An expression in terms of \(a\) and \(b\) for \(\overrightarrow{SX}\).

**Solution:**
Applying the vector triangle law
\[\overrightarrow{SX} = \overrightarrow{SW} + \overrightarrow{WX}\]
\(\overrightarrow{SW} = -\overrightarrow{WS}\)
\[\overrightarrow{SX} = -\frac{1}{3} a + \frac{1}{3} b + a\]
\[\overrightarrow{SX} = \frac{2}{3} a + \frac{1}{3} b\]

(ii) **Required To Prove:** \(R, S\) and \(X\) are collinear.

**Solution:**
Applying the vector triangle law
\[\overrightarrow{RX} = \overrightarrow{RW} + \overrightarrow{WX}\]
\(\overrightarrow{SW} = -\overrightarrow{WS}\)
\[\overrightarrow{SX} = \frac{2}{3} a + \frac{1}{3} b\]
\[\overrightarrow{SX} = \frac{2}{3} \left( \overrightarrow{RX} \right)\]

\(\overrightarrow{SX}\) is a scalar multiple of \(\overrightarrow{RX}\) and therefore these vectors are parallel. But \(X\) is a common point on both vectors. \(\therefore R, S\) and \(X\) are collinear.