(1) **Standard Form**

\[ A \times 10^n \]

1 ≤ A < 10 & n can be tve or -ve

**Example**

Express in standard form:

a) 321 000 = 3.21 × 10^5

b) 0.000 678 = 6.78 × 10^-4

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(2) **Prime Number**

Memorise all prime numbers from 2 to 71.

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71

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(3) **Upper & Lower Bound**

**Example**

Each of the length is measured correct to the nearest centimeter.

Find:

(a) the upper bound for the perimeter &

(b) the lower bound for the perimeter.

**Answer**

(a) Upper bound ⇒ round all reading up by 0.5 cm.

10 cm ⇒ 10.5 cm

5 cm ⇒ 5.5 cm

Perimeter = 10.5 + 10.5 + 5.5 + 5.5 = 32 cm

(b) Lower bound ⇒ round all reading down by 0.5 cm.

10 cm ⇒ 9.5 cm

5 cm ⇒ 4.5 cm

Perimeter = 9.5 + 9.5 + 4.5 + 4.5 = 38 cm

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(4) **Direct & Inverse Proportion**

**Example 1**

x is directly proportional to y.

When y = 10, x = 5

Find x when y = 20.

**Answer**

\[ x = ky \]

\[ 5 = k(10) \]

\[ \frac{k}{10} = \frac{1}{2} \]

\[ x = \frac{1}{2} y \]

When y = 20,

\[ x = \frac{1}{2} (20) = 10 \]

**Example 2**

x is inversely proportional to y.

When y = 10, x = 2

Find x when y = 30

**Answer**

\[ x = \frac{k}{y} \]

\[ 2 = \frac{k}{10} \]

\[ k = 2 \times 10 = 20 \]

\[ x = \frac{20}{y} \]

When y = 30

\[ x = \frac{20}{30} = \frac{2}{3} \]

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(5) **Percentage**

**Example**

Express 64 as a percentage of 80.

**Answer**

\[ \frac{64}{80} \times 100\% = 80\% \]

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9. Simple & Compound Interest

Simple Interest (I) = \( \frac{PRT}{100} \)

- \( P \) = principal, \( R \) = rate, \( T \) = time

Example 1
Calculate the interest owed if a man borrows $300 from a bank charging 2% simple interest per month for 3 months?

- \( P = 300 \), \( R = 2 \%), \( T = 3 \)
- \( I = \frac{300 \times 2 \times 3}{100} \)
- \( I = 18 \)

9. Compound Interest

\[ A = P \left(1 + \frac{R}{100}\right)^n \]

- \( A \) = total amount after time \( n \)
- \( P \) = principal
- \( R \) = rate
- \( n \) = time

Example 2
Calculate the total amount owed if a man borrows $300 from a bank charging 2% compound interest per month for 3 months?

- \( P = 300 \), \( R = 2 \%), \( n = 3 \)
- Total amount owed = \( P \left(1 + \frac{R}{100}\right)^n \)
- Total amount owed = \( 300 \left(1 + \frac{2}{100}\right)^3 \)
- Total amount owed = \$318.36

9. Gradient of a straight line

\[ \text{Gradient} = \frac{y_1 - y_2}{x_1 - x_2} \]

Example
Calculate the gradient of a line that passes through point A(2, -1) & B(4, 2)

\[ \text{Gradient} = \frac{y_1 - y_2}{x_1 - x_2} = \frac{-1 - 2}{2 - 4} = \frac{-3}{-6} = \frac{1}{2} \]

9. Equation of a line

- \( y = mx + c \)
- \( m \) = find the gradient
- \( c \) = find the y-intercept

Example
Find the equation of a line that passes through point AC(2, -1) & B(4, 2)

\[ \text{Eqn of a line} \Rightarrow y = mx + c \]

- \( m = \frac{1}{2} \) (found above)
- \( y = \frac{1}{2}x + c \)

To find \( c \), sub in point A:
- \( -1 = \frac{1}{2} \times 2 + c \)
- \( -1 = 1 + c \)
- \( c = 0 \)
- The equation is: \( y = \frac{1}{2}x + 0 \), or \( y = \frac{1}{2}x \)

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### Midpoint of 2 given points

Midpoint = \( \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) \)

**Example**
Find the midpoint of \( P(-2, 8) \) & \( Q(4, -4) \)

**Answer**
\[
\begin{align*}
 x_1 &= -2, \quad y_1 = 8 \\
 x_2 &= 4, \quad y_2 = -4
\end{align*}
\]
Midpoint = \( \left( \frac{-2 + 4}{2}, \frac{8 + (-4)}{2} \right) \)
= \( (1, 2) \)

### Length between 2 points

Length = \( \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} \)

**Example**
Find the distance between \( P(-2, 8) \) & \( Q(4, -4) \)

**Answer**
\[
\begin{align*}
 x_1 &= -2, \quad y_1 = 8 \\
 x_2 &= 4, \quad y_2 = -4
\end{align*}
\]
Distance = \( \sqrt{(-2 - 4)^2 + (8 - (-4))^2} \)
= \( \sqrt{6^2 + 12^2} \)
= \( \sqrt{180} \)
= \( 13.4 \) units

### Function

**Example**
\( f(x) = 4x + 1 \), \( g(x) = x^3 + 1 \)

### Indices

\( a^n \times a^m = a^{n+m} \)

**Example**
\( 3x^5 \times 4x^3 = 12x^{5+3} = 12x^8 \)

\( a^n \div a^m = a^{m-n} \)

**Example**
\( 24x^7 \div 6x^3 = 4x^{7-3} = 4x^4 \)

\( a^0 = 1 \)

**Example**
\( 24x^7 \div 3x^7 = 8x^{7-7} = 8x^0 = 8 \)
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- By formula
  * When question says "give your answers correct to 2 decimal places.", use formula *
  \[ x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \]

(5) Symmetry Properties of Circles

a) Equal chords are equidistant from centre
   If AB = CD \( \Rightarrow \) x = y

b) Perpendicular bisector of chord passes through centre
   c) Tangents from an external point are equal in length \( \Rightarrow \) KP = KQ \( \Rightarrow \) x = y

(4) Solving Quadratic Eqn

- By factorisation

Example: \( x^2 - x - 6 = 0 \)
\[
\begin{array}{c|c|c}
(x+3)(x-2) = 0 & x+3 = 0 & x = -3 \\
x-2 = 0 & x = 2 & 2x \\
& x = 3 & x = 2 \\
\end{array}
\]

\( \angle L + \angle 2 + \angle 4 + \angle 3 = 360^\circ \)

Solving Eqn involving Indices

\( 3^x \times 3^2 = 81 \)
\( 3^{x+2} = 81 \)
\( 3^{x+2} = 3^x \)
\( x + 2 = 4 \)
\( x = 4 - 2 \)
\( x = 2 \)

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b) Angles on a straight line = 180°
   \[ \angle x + \angle y = 180° \]

i) Irregular Polygon & their angles
   Total ext. \( \angle s = 360° \)
   Total interior \( \angle s = (n-2) \times 180° \)

j) Angle at centre = 2 \( \times \) angle at circumference
   \[ \angle x = 2 \times \angle y \]

k) Angles in the same segments are equal
   \[ \angle x = \angle y \]

l) Opp. \( \angle s \) in a cyclic quadrilateral = 180°
   \[ \angle x + \angle y = 180° \]

m) Angles in a quadrilateral = 360°
   \[ \angle x + \angle y + \angle z + \angle w = 360° \]

n) Angles in a \( \triangle \) = 180°
   \[ \angle x + \angle y + \angle z = 180° \]

o) Polygons & their angles
   For regular polygon with \( n \) sides, ext \( \angle = \frac{360°}{n} \)
   For regular polygon with \( n \) sides, int \( \angle = \frac{180° - 360°}{n} \)
   Example: For a 5-sided polygon, \( n = 5 \)
   ext \( \angle = \angle x = \frac{360°}{5} = 72° \)
   int \( \angle = \angle y = 180° - 72° = 108° \)

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### Given distance from a given line

**Example:** Construct a locus 2 cm from line PA.

<table>
<thead>
<tr>
<th>P</th>
<th>Q</th>
</tr>
</thead>
</table>

### Equidistant from 2 given point

**Example:** Construct a locus that is equidistant from point P & point Q.

| P | Q |

### Equidistant from 2 given intersecting lines

**Example:** Construct a locus equidistant from PQ & MN.

- **TOA:** \( \tan x = \frac{\text{opp}}{\text{adj}} \)
- **CAH:** \( \cos x = \frac{\text{adj}}{\text{hyp}} \)
- **SOH:** \( \sin x = \frac{\text{opp}}{\text{hyp}} \)

### Mensuration

- **a)** Circumference of circle = \( 2\pi r \)
- **b)** Area of circle = \( \pi r^2 \)
- **c)** Area of parallelogram = \( \text{Length} \times \text{Height} \)
- **d)** Area of trapezium = \( \frac{1}{2} (A_1 + A_2) \times \text{Height} \)
- **e)** Volume of a cuboid = \( l \times b \times h \)
- **f)** Volume of prism = \( \text{Surface area} \times \text{Height} \)
- **g)** Volume of cylinder = \( \pi r^2 h \)
- **h)** Surface area of cuboid = \( 2(lb) + 2(bh) + 2(lh) \)
- **i)** Surface area of cylinder = \( 2\pi r^2 + 2\pi rh \)
- **j)** Arc length = \( \frac{\theta}{360} \times 2\pi r \)
- **k)** Area of sector = \( \frac{\theta}{360} \times \pi r^2 \)

### Trigonometry

#### Right-angled triangle

- \( a^2 + b^2 = c^2 \)

#### Not a right-angled triangle

- Area of \( \Delta = \frac{1}{2} ab \sin C \)

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d) Sine Rule
\[ \frac{a}{\sin A} = \frac{b}{\sin B} \]
When to use?
1. Given 2 side & 1 angle, find last angle
2. Given 2 angle & 1 side, find last side

e) Cosine Rule
\[ c^2 = a^2 + b^2 - 2ab \cos C \]
When to use?
1. Given 2 side & 1 angle, find last side
2. Given 3 sides, find angle

b) For histogram,
Frequency density = \( \frac{\text{frequency}}{\text{width}} \)

21) Probability
If we call a particular event 'A' then the probability of 'A' happening is
\[ P(A) = \frac{\text{Number of different way A can happen}}{\text{Total number of outcomes}} \]
The 'and' rule
\[ P(A \text{ and } B) = P(A) \times P(B) \]
The 'or' rule
\[ P(A \text{ or } B) = P(A) + P(B) \]

22) Matrix
For a matrix, \( A = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \)
determinant \( A = ad - bc \)
\[ A^{-1} = \frac{1}{ad - bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix} \]
Example: Find \( A^{-1} \) of \( A = \begin{bmatrix} -6 & 7 \\ 3 & -3 \end{bmatrix} \)
\[ A^{-1} = \frac{1}{(6)(3) - (7)(3)} \begin{bmatrix} 3 & -7 \\ -3 & 6 \end{bmatrix} = \begin{bmatrix} 1 \\ 10 \end{bmatrix} \begin{bmatrix} 3 & -7 \\ 4 & -6 \end{bmatrix} \]
\[ = \begin{bmatrix} \frac{7}{10} & -\frac{7}{10} \\ \frac{7}{5} & -\frac{3}{5} \end{bmatrix} \]

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### Transformation

**a) Reflection**

Example: Describe transformation $T$ to $U$.

- Reflection \[1\text{mark}\]
- $y = x$ \[1\text{mark}\]

**b) Rotation**

Example: Describe transformation $T$ to $U$.

- Rotation \[1\text{mark}\]
- Centre $(0,0)$ \[1\text{mark}\]
- $180^\circ$ \[1\text{mark}\]

**c) Translation**

Example: Describe the transformation $T$ to $U$.

- Translation \[1\text{mark}\]
- $(-3)$ \[1\text{mark}\]

**d) Enlargement**

Example: Describe the transformation $T$ to $U$.

- Enlargement \[1\text{mark}\]
- Centre $(0,0)$ \[1\text{mark}\]
- Scale factor $= \frac{OA'}{OA}$
- $= \frac{4}{2}$
- $= 2$

### Shearing

Example: Describe the transformation $T$ to $U$.

- Shearing \[1\text{mark}\]
- Invariant line: $y$-axis \[1\text{mark}\]
- Shear factor $= -1$

**How to find invariant line?**

1. Draw 2 lines $AB$ & $A'B'$ & find interception point 1
2. Draw 2 lines $CB$ & $C'B'$ & find interception point 2.
3. Connect interception point 1 & 2 to get invariant line.

**How to find shear factor?**

$$\text{Shear factor} = \frac{\text{distance from invariant to new pt}}{\text{distance from old pt to new pt}}$$

Note:

- Dist to the left $\Rightarrow -ve$
- Dist right $\Rightarrow +ve$
- Dist up $\Rightarrow +ve$
- Dist down $\Rightarrow -ve$

### Stretching

Example: Describe the transformation $T$ to $U$.

- Stretching \[1\text{mark}\]
- Invariant \[1\text{mark}\]
- $x$-axis
- Scale factor $= \frac{OA'}{OA}$
- $= \frac{6}{3}$
- $= 2$

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(a) \( \left( \frac{l_1}{l_2} \right) = \left( \frac{b_1}{b_2} \right) = \left( \frac{h_1}{h_2} \right) \)

(b) \( \frac{A_1}{A_2} = \left( \frac{l_1}{l_2} \right)^2 \)

(c) \( \frac{V_1}{V_2} = \left( \frac{l_1}{l_2} \right)^3 \)