

Mathematics 0580 Formula Sheet Pg 1/9

① Standard Form

$A \times 10^n$
 $1 \leq A < 10$ & n can be +ve or -ve.

Example

Express in standard form:

- a) $321000 = 3.21 \times 10^5$
 b) $0.000678 = 6.78 \times 10^{-4}$

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

③ Upper & Lower Bound

Example

Each of the length is measured correct to the nearest centimetre

Find:

- (a) the upper bound for the perimeter &
 (b) the lower bound for the perimeter

Answer

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

$10\text{cm} \Rightarrow 10.5\text{cm}$

$5\text{cm} \Rightarrow 5.5\text{cm}$

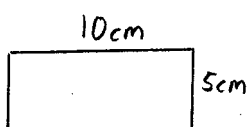
Perimeter = $10.5 + 10.5 + 5.5 + 5.5$
 = 32 cm

b) Lower bound \Rightarrow round all reading down by 0.5 cm.

$10\text{cm} \Rightarrow 9.5\text{cm}$

$5\text{cm} \Rightarrow 4.5\text{cm}$

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



④ Direct & Inverse Proportion

Example 1

x is directly proportional to y .

When $y = 10$, $x = 5$

Find x when $y = 20$.

Answer

$x = ky$

$5 = k(10)$

$k = \frac{5}{10} = \frac{1}{2}$

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

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

$xc = k$

$2 = \frac{k}{10}$

$k = 2 \times 10$

= 20

$x = \frac{20}{y}$

When $y = 30$

$x = \frac{20}{30}$

= $\frac{2}{3}$

⑤ Percentage

Example

Express 64 as a percentage of 80.

Answer

$\frac{64}{80} \times 100\% = 80\%$



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⑦ Simple & Compound Interest

$$\text{Simple interest (I)} = \frac{PRT}{100}$$

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?

$$P = 300, R = 2\%, T = 3$$

$$I = \frac{300 \times 2 \times 3}{100} \\ = \$18$$

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?

$$P = 300, R = 2, n = 3$$

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

⑧ 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)

Answer

$$A(-2, -1) \quad B(4, 2) \\ x_1, y_1 \quad x_2, y_2$$

$$\text{Gradient} = \frac{-1 - 2}{-2 - 4} \\ = \frac{-3}{-6} \\ = \frac{1}{2}$$

⑨ Equation of a line

$$y = mx + c$$

① find the gradient, m.

② find the y-intercept, c.

Example

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

Answer

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

$$m = \frac{1}{2} \text{ (found above)}$$

$$y = \frac{1}{2}x + c$$

To find c, sub in point A.

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

$$-1 = -1 + c$$

$$c = 0$$

$$y = \frac{1}{2}x + 0$$

$$\Rightarrow y = \frac{1}{2}x$$

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⑩ Midpoint of 2 given points

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

Example

Find the midpoint of $P(-2, 8)$ & $Q(4, -4)$

Answer

$$\begin{array}{cc} P(-2, 8) & Q(4, -4) \\ x_1, y_1 & x_2, y_2 \end{array}$$

$$\begin{aligned} \text{Midpoint} &= \left(\frac{-2+4}{2}, \frac{8+(-4)}{2} \right) \\ &= (1, 2) \end{aligned}$$

⑪ Length between 2 points

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

Example

Find the distance between $P(-2, 8)$ & $Q(4, -4)$

Answer

$$\begin{array}{cc} P(-2, 8) & Q(4, -4) \\ x_1, y_1 & x_2, y_2 \end{array}$$

$$\begin{aligned} \text{Distance} &= \sqrt{(-2-4)^2 + (8-(-4))^2} \\ &= \sqrt{6^2 + 12^2} \\ &= \sqrt{180} \\ &= 13.4 \text{ units} \end{aligned}$$

⑫ Function

Example

$$f(x) = 4x + 1 \quad g(x) = x^3 + 1$$

$$f(2) \Rightarrow \text{sub } x=2 \text{ \& solve for } f(x)$$

$$\begin{aligned} f(2) &= 4(2) + 1 \\ &= 8 + 1 \\ &= 9 \end{aligned}$$

$$fg(x) \Rightarrow \text{sub } x = g(x)$$

$$\begin{aligned} fg(x) &= 4(x^3 + 1) + 1 \\ &= 4x^3 + 4 + 1 \\ &= 4x^3 + 5 \end{aligned}$$

$$f^{-1}(x) \Rightarrow \text{let } y = f(x) \text{ \& make } x \text{ the subj.}$$

$$\text{Let } y = f(x) = 4x + 1$$

$$y = 4x + 1$$

$$4x = y - 1$$

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

$$f^{-1}(x) = \frac{x-1}{4}$$

⑬ Indices

$$a^m \times a^n = a^{m+n}$$

$$\begin{aligned} \text{Example: } 3x^5 \times 4x^3 &= 12x^{5+3} \\ &= 12x^8 \end{aligned}$$

$$a^m \div a^n = a^{m-n}$$

$$\begin{aligned} \text{Example: } 24x^7 \div 6x^3 &= 4x^{7-3} \\ &= 4x^4 \end{aligned}$$

$$a^0 = 1$$

$$\begin{aligned} \text{Example: } 24x^7 \div 3x^7 &= 8x^{7-7} \\ &= 8x^0 \\ &= 8(1) \\ &= 8 \end{aligned}$$

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$$(a^m)^n = a^{m \times n} = a^{mn}$$

Example: $(3x^2)^4 = 3^4 x^{2 \times 4}$
 $= 81 x^8$

$$(a \times b)^n = a^n \times b^n$$

$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$$

$$a^{-n} = \frac{1}{a^n}$$

Example: $x^2 y^5 \div x^7 y^3 = x^{2-7} y^{5-3}$
 $= x^{-5} y^2$
 $= \frac{1}{x^5} y^2$
 $= \frac{y^2}{x^5}$

$$a^{\frac{1}{n}} = \sqrt[n]{a}, n \neq 0$$

$$a^{\frac{m}{n}} = \sqrt[n]{a^m}, n \neq 0$$

Solving Eqn involving Indices

$$3^x \times 3^2 = 81$$

$$3^{x+2} = 81$$

$$3^{x+2} = 3^4$$

$$x+2 = 4$$

$$x = 4 - 2$$

$$= 2$$

(14) Solving Quadratic Eqn

- By factorisation

Example: $x^2 - x - 6 = 0$

x	-3	$-3x$
x	2	$2x$
x^2	-6	$-x$

- By formula

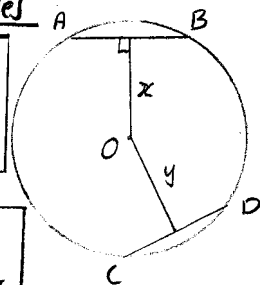
* When question says "give your answers correct to 2 decimal places.", USE FORMULA *

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

(15) Symmetry Properties of Circles

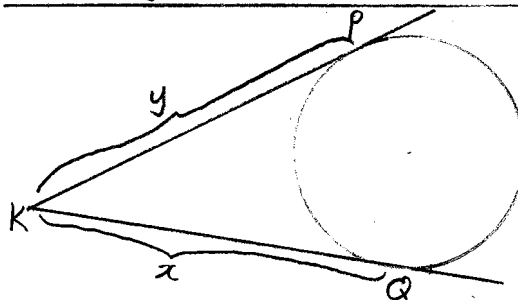
a) Equal chords are equidistant from centre

If $AB = CD \Rightarrow x = y$



b) Perpendicular bisector of chord passes through centre

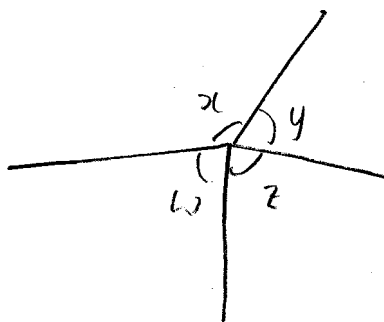
c) Tangents from an external point are equal in length. $\Rightarrow KP = KQ \Rightarrow x = y$



Paper 1 Qn

(16) Angle Properties

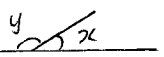
a) Angles at a point = 360°

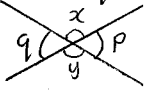


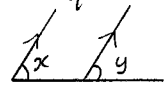
$$\angle w + \angle x + \angle y + \angle z = 360^\circ$$

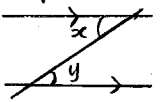


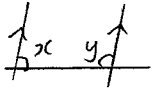
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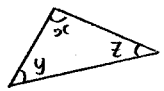

b) Angles on a straight line = 180°
 $\angle x + \angle y = 180^\circ$ 

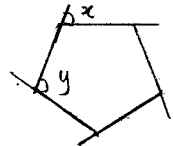
c) Vertically opp. angles are equal.
 $\angle x = \angle y$
 $\angle p = \angle q$ 

d) Corresponding angles are equal. (F)
 $\angle x = \angle y$ 

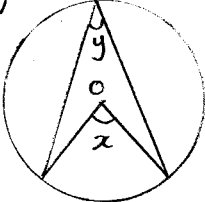
e) Alternate angles are equal (Z)
 $\angle x = \angle y$ 

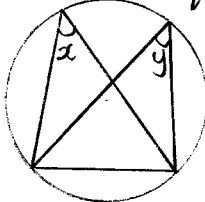
f) Interior angles = 180° (U)
 $\angle x + \angle y = 180^\circ$ 

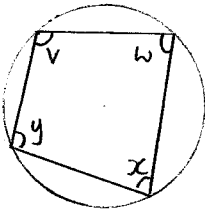
g) Angles in a $\Delta = 180^\circ$
 $\angle x + \angle y + \angle z = 180^\circ$ 
 Angles in a quadrilateral = 360°
 $\angle w + \angle v + \angle x + \angle y = 360^\circ$


h) Polygons & their angles
 For regular polygon with n sides, ext $\angle = \frac{360^\circ}{n}$
 For regular polygon with n sides, int. $\angle = 180^\circ - \frac{360^\circ}{n}$
Example For a 5-sided polygon, $n = 5$
 ext. $\angle = \angle x = \frac{360^\circ}{5} = 72^\circ$
 int. $\angle = \angle y = 180^\circ - 72^\circ = 108^\circ$


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

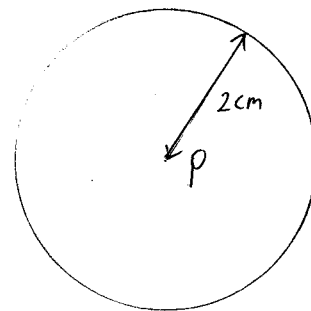
j) Angle at centre = $2 \times$ angle at circumference
 $\angle x = 2 \times \angle y$ 

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

l) Opp. $\angle s$ in a cyclic quadrilateral = 180°
 $\angle v + \angle x = 180^\circ$
 $\angle y + \angle w = 180^\circ$ 

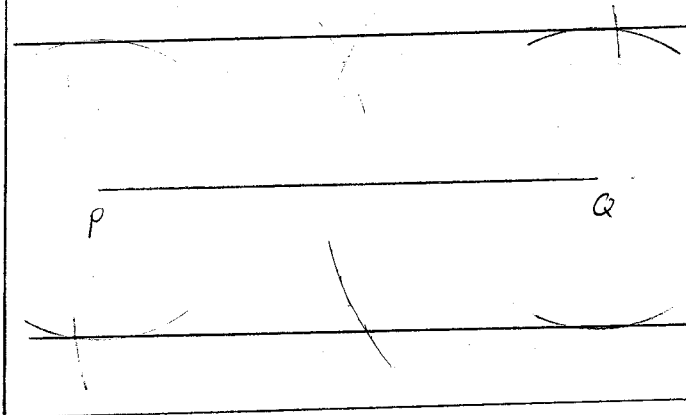
⑰ Locus

a) Given distance from a given point
 Example: Construct a locus 2cm from P.

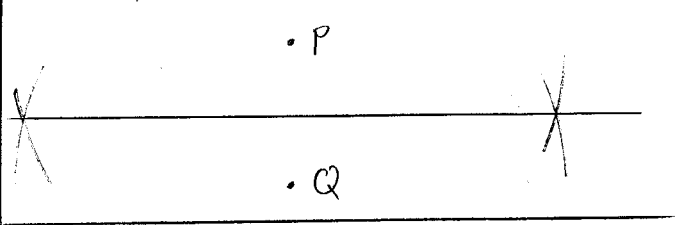


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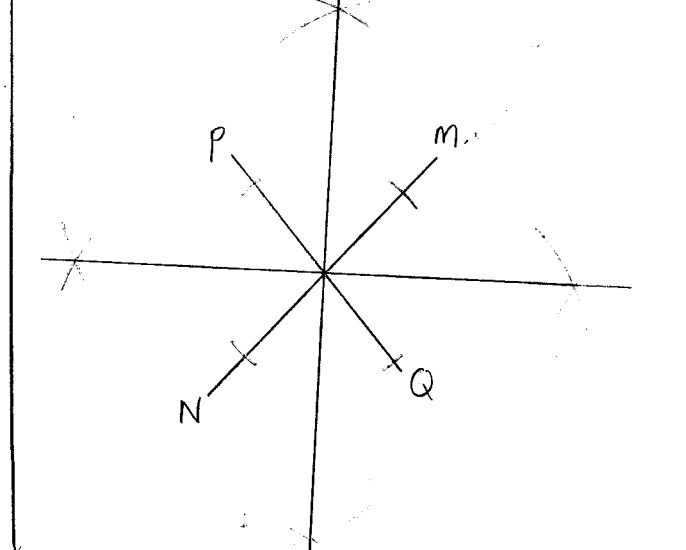
b) Given distance from a given line
 Example: construct a locus 2cm from line PQ



c) Equidistant from 2 given point
 Example: Construct a locus that is equidistant from point P & point Q



d) Equidistant from 2 given intersecting lines
 Example: Construct a locus equidistant from PQ & MN.



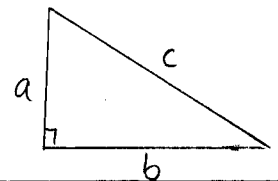
⑧ Mensuration

- a) Circumference of circle = $2\pi r$
- b) Area of circle = πr^2
- c) Area of parallelogram = Length \times height
- d) Area of trapezium = $\frac{1}{2}(l_1 + l_2) \times$ height
- e) Volume of a cuboid = $l \times b \times h$
- f) Volume of prism = surface area \times 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 = $2\pi r^2 + 2\pi r h$
- j) Arc length = $\frac{\theta}{360} \times 2\pi r$
- k) Area of sector = $\frac{\theta}{360} \times \pi r^2$

⑨ Trigonometry

Right-angled triangle

a) $a^2 + b^2 = c^2$

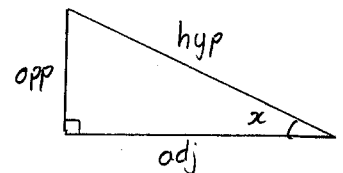


b) TOA CAH SOH

$\tan x = \frac{\text{OPP}}{\text{adj}}$

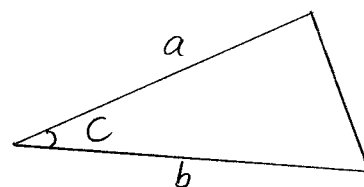
$\cos x = \frac{\text{adj}}{\text{hyp}}$

$\sin x = \frac{\text{OPP}}{\text{hyp}}$



Not a right-angled triangle

c) Area of $\Delta = \frac{1}{2} a b \sin C$



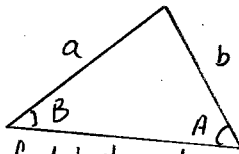
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d) Sine Rule

$$\frac{a}{\sin A} = \frac{b}{\sin B}$$

When to use?

- ① Given 2 side & 1 angle, find last angle
- ② Given 2 angle & 1 side, find last side

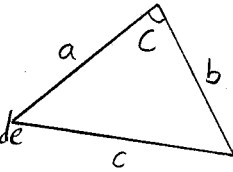


e) Cosine Rule

$$c^2 = a^2 + b^2 - 2ab \cos C$$

When to use?

- ① Given 2 sides & 1 angle, find last side
- ② Given 3 sides, find angle



b) For histogram,

$$\text{Frequency density} = \frac{\text{frequency}}{\text{width}}$$

② 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

$$P(A \text{ or } B) = P(A) + P(B)$$

② Statistics

a) Mode, median & mean

Example: normal die, numbered 1 to 6, rolled 50 times

Score	1	2	3	4	5	6
Frequency	15	10	7	5	6	7

Mode = 15 \Rightarrow score with highest frequency

Median \Rightarrow score in the middle position

$$\frac{50+1}{2} = 25.5 \Rightarrow 25^{\text{th}} \text{ \& } 26^{\text{th}} \text{ position}$$

$$\text{median} = \frac{2+3}{2} = 2.5$$

$$\text{Mean} = \frac{\text{total score}}{\text{frequency}}$$

$$= \frac{1 \times 15 + 2 \times 10 + 3 \times 7 + 4 \times 5 + 5 \times 6 + 6 \times 7}{50}$$

$$= 2.96$$

② Matrices

For a matrix, $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$

$$\text{determinant } A = ad - bc$$

$$A^{-1} = \frac{1}{ad-bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$$

Example: Find A^{-1} of $A = \begin{bmatrix} -6 & 7 \\ -4 & 3 \end{bmatrix}$

$$A^{-1} = \frac{1}{(-6)(3) - (7)(-4)} \begin{bmatrix} 3 & -7 \\ 4 & -6 \end{bmatrix}$$

$$= \frac{1}{-18 + 28} \begin{bmatrix} 3 & -7 \\ 4 & -6 \end{bmatrix}$$

$$= \frac{1}{10} \begin{bmatrix} 3 & -7 \\ 4 & -6 \end{bmatrix}$$

$$= \begin{bmatrix} \frac{3}{10} & -\frac{7}{10} \\ \frac{2}{5} & -\frac{3}{5} \end{bmatrix}$$

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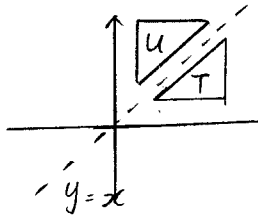
23 Transformation

a) Reflection

Example: Describe transformation T to U

Reflection [1 mark]

$y = x$ [1 mark]



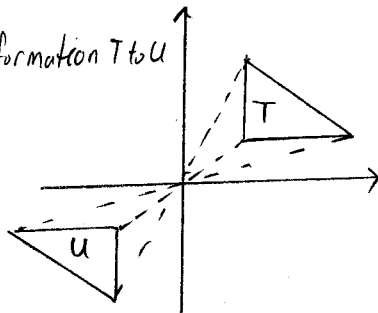
b) Rotation

Example: Describe transformation T to U

Rotation [1 mark]

Centre (0,0) [1 mark]

180° [1 mark]

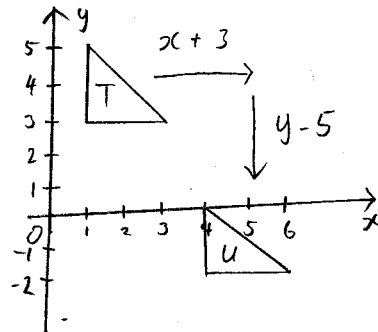


c) Translation

Example: describe the transformation T to U

Translation [1 mark]

$\begin{pmatrix} 3 \\ -5 \end{pmatrix}$ [1 mark]



d) Enlargement

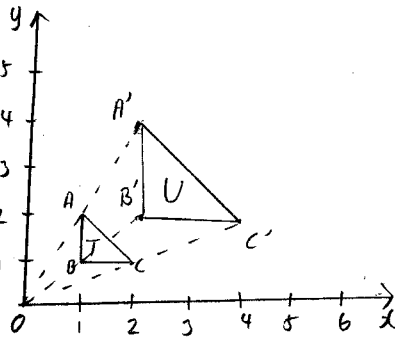
Example: describe the transformation T to U

Enlargement [1 mark]

Centre (0,0) [1 mark]

⇒ Draw 2 lines AA' & BB' intersection is the centre

scale factor = $\frac{OA'}{OA}$
 $= \frac{4}{2}$
 $= 2$



e) Shearing

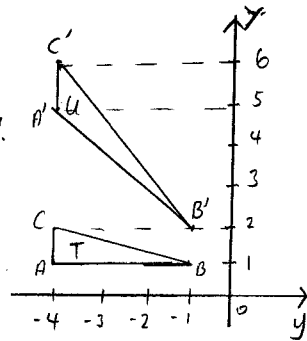
Example:

Describe the transformation T to U

Shearing [1 mark]

Invariant line, y-axis [1 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?

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

- Note: dist to the left ⇒ -ve
 " " " right ⇒ +ve
 dist upward ⇒ +ve
 dist downward ⇒ -ve

f) Stretching

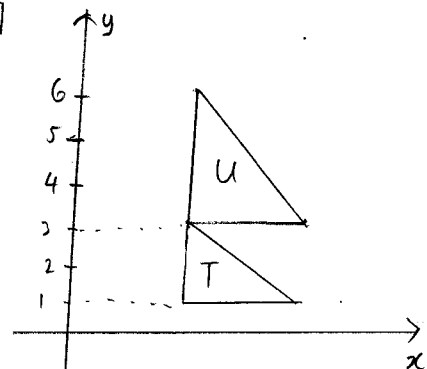
Example: Describe transformation T to U

Stretching [1 mark]

invariant [1 mark]

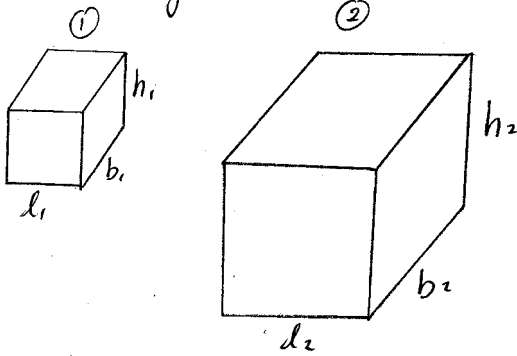
stretch factor

= $\frac{\text{invariant to new pt}}{\text{invariant to old pt}}$
 $= \frac{6}{3}$
 $= 2$



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② Similar Figures.



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

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

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

www.megalecture.com